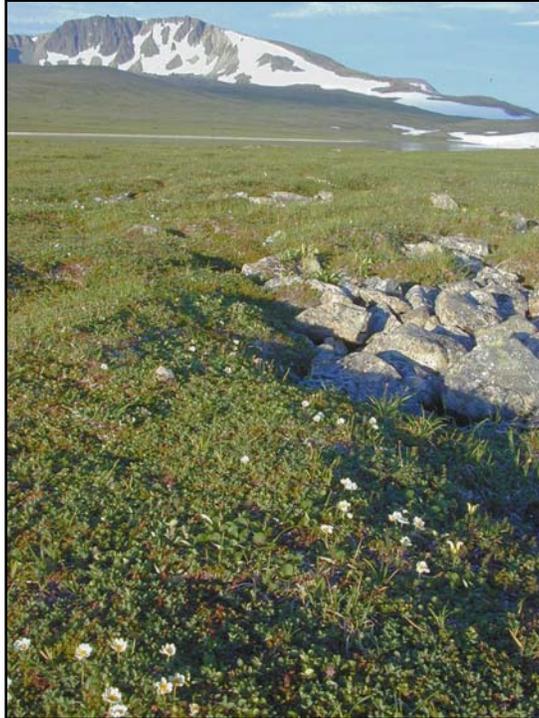


**ALAGNAK WILD RIVER & KATMAI NATIONAL PARK
VASCULAR PLANT INVENTORY
ANNUAL TECHNICAL REPORT**



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ABSTRACT

In 2002, the Alaska Natural Heritage Program (AKNHP), conducted vascular plant field inventories in the Alagnak Wild River and Katmai National Park units in accordance with a cooperative agreement with the National Park Service. The primary goal was to document $\geq 90\%$ of the vascular plant species expected to occur within the parks and significantly improve our understanding of current species distributions. The inventory targeted diverse habitat types and poorly-sampled areas. The AKNHP visited four diverse eco-geographic regions and sampled intensively within these regions from late June to mid-August, 2002. A total of 530 specimens were collected, recorded, pressed, and curated. For Katmai Park, 317 individual taxa are represented, 146 are new records for the park, and an additional 41 represent verifications of previously unvouchered reports. Of the 133 specimens collected from the Alagnak Wild River, 120 are new records for that unit. A number of finds were significant range extensions or taxa of conservation concern. *Dupontia fisheri* is a tundra grass of northern and western Alaska. We located a population at Swikshak Lagoon, over 300 km east of the other outlying stations, and this site is the first recording from a woodland marsh in Alaska. Additionally, AKNHP collected a number of sedges that were notable range extensions. Last, we located a population of the rare *Primula tschuktschorum* (G3 - S2S3 rank), and *Aphragmus eschscholtzianus* (G3 - S3 rank), near Mirror Lake.

EXECUTIVE SUMMARY

The National Park Service is conducting a vascular plant inventory to document the occurrence, distribution, and relative abundance of plants occurring in the Southwest Alaska Network. The inventory was developed to provide baseline information for future monitoring and management of natural resources within the Park Network. In 2002, the University of Alaska Anchorage, Alaska Natural Heritage Program, conducted field inventories in the Alagnak Wild River and Katmai National Park units in accordance with the Cooperative Agreement No. 1443CA991000013, Modification No. 17. The primary goal is to document $\geq 90\%$ of the vascular plant species expected to occur within the parks and significantly improve our understanding of current species distributions. The inventory targeted diverse habitat types and poorly-sampled areas. Following an analysis of previous floristic surveys, we noted that most collections were from the corridor between Brooks Camp and the Valley of 10,000 Smokes and a few coastal locations. However, the majority of Katmai Park had not been inventoried, and no collecting had occurred along the Alagnak River. Geological maps, aerial photos, and Park personnel were consulted to locate areas of concentrated inventory work. We chose one sampling region (Swikshak Lagoon) on the east coast of Katmai that had a high diversity of habitats, geology, topology, and moisture gradients, and therefore was likely to have high corresponding vascular plant diversity. To capture a large number of alpine taxa and species whose range is more interior, we surveyed the Mirror Lake area of the northeastern portion of Katmai Park. Contact Creek was chosen as a sampling region due to a nearby calcareous outcrop (a determinant of a large group of vascular plants associated with basic soils) and its southwesterly location in the Bristol Bay Lowland eco-region. Last, additional opportunistic collection occurred in the Brooks Camp area, Nonvianuk River, and Dakavak Lake. The Alagnak Wild River was floated and surveys were completed from the confluence of the Nonvianuk Branch to the westerly end of the Wild River boundary.

While at the remote collection regions, techniques of inventory involved hiking to as many habitat types and geographic areas as possible, and collecting specimens that were known to be new records or considered significant. Upon collection of specimens, data were gathered on collection-site characteristics: from latitude and longitude to associated species and soil conditions. Plants were then pressed and dried and catalogued with the Alaska Natural Heritage Program. Last, final taxonomic determinations and herbarium mounting was conducted by the University of Alaska Fairbanks Museum.

A total of 530 specimens were collected, recorded, pressed, and curated. Duplicate or triplicate sheets are present for many of the specimens. 317 separate taxa are represented, and 146 are new records (an additional 41 are taxa that were previously reported but unvouchered) for Katmai Park. All 120 taxa collected from the Alagnak Wild River represent new records. A number of finds were significant range extensions or of taxa of conservation concern. *Dupontia fisheri* is a tundra grass of northern and western Alaska, with outlying stations at Hazen Bay and Cold Bay. We located a population at Swikshak Lagoon, over 320 km east of the other outlying stations. This population is the first recording of *Dupontia* from a woodland marsh in Alaska. *Carex nardina*, *C. rupestris*,

Kobresia myosurioides, and *Ranunculus nivalis* are alpine species that were collected in Katmai Park 160 - 300 km south of their previously known distributions. These four species are more common in the Alaska and Brooks Ranges (*Ranunculus nivalis* is also known from Goodnews Bay to the west and the Lime Hills to the north). A few new exotic species were collected in anthropogenically disturbed sites. Last, we located a population of the rare *Primula tschuktschorum* (G3 - S2S3 rank), and *Aphragmus eschscholtzianus* (G3 - S3 rank), near Mirror Lake.

Key Words

Alagnak Wild River, Katmai National Park, inventory, vascular plants

INTRODUCTION

An Inventory and Monitoring (I & M) Program for the National Park Service (NPS) was established by the US Congress in 1992. The goal of NPS and the I & M program is to establish baseline information and long-term trends of natural resources in the parks. Currently, biological inventories are being conducted to establish data to be used in future monitoring programs, make management decisions, conduct research, and educate the public. To meet these objectives, NPS established three program goals:

- Document at least 90 percent of the species of vertebrates and vascular plants expected to occur in the park
- Describe the distribution and abundance of species of special concern (e.g., rare species or exotics)
- Provide information necessary to establish a monitoring strategy, with special reference to special threats and resource issues within each park.

The Alaska Natural Heritage Program (AKNHP) was contracted to conduct the vascular plant inventory component of the I & M program of the Southwest Alaska Network. In 2002, three AKNHP botanists inventoried the vascular flora of Alagnak Wild River and Katmai National Park. The following report outlines pertinent information on the regions inventoried, methods employed, the flora encountered, and a discussion of the importance of those finds.

Alagnak Wild River (ALAG) is the smallest management area in the SWAN at 12,440 hectares. The Wild River status was established in 1980 to protect the river's remarkable scenery, rich wildlife and cultural history, and "free-flowing characteristics." The river flows from Kukaklek Lake to Bristol Bay, a distance of approximately 90 km. The ALAG encompasses a broad range of habitat types, from aquatic and wet-sedge tundra, to boreal forest and dry bluffs. The Alagnak River is renowned for its sport fishing and continues to be essential for subsistence uses as well.

Bordering the Alagnak River to the east, Katmai National Park and Preserve (KATM) is the largest and oldest park in the SWAN. Katmai National Park is 1,655,816 hectares and was established in 1918. The park was created to preserve the geologic features associated with the eruption of Novarupta in 1912. The towering Mount Katmai collapsed in the eruption, leaving a wide crater and an ash-filled valley extending to the

west, known as the Valley of Ten Thousand Smokes. Several active vents remain. Katmai has a great diversity of plant associations and habitats, spanning Shelikof coastal communities in the east, across high mountains and rolling tundra, to extensive wet-sedge tundra of the Bristol Bay Lowlands on the western edge of the park (Boggs et al. 2003). Additionally, the park contains diverse aquatic habitats (including the largest freshwater lake in the National Park System) and the largest population of protected brown bears in North America.

Management Efforts and Issues

Resource managers of SWAN units have had little opportunity to obtain baseline information due to the large size, ruggedness, and remoteness of the units. In addition, earlier scientific research has been stymied by the unavailability of land cover and habitat maps. Clear data gaps exist for vascular plants as well as other taxa. Thus, the I & M Program represents the first step to gather resource information on plant and animal species. The data will assist land managers in developing and improving their management activities and programs.

In addition to documenting greater than 90% of vascular plants, the I & M Program attempts to obtain greater baseline information on the presence, absence, and distribution of species of special concern. For plants, the species of concern relate to threatened, endangered, rare, and exotic species.

To determine the status of previously collected inventory data in SWAN units, the AKNHP was contracted to compile and verify historical and predicted species occurrences for each park. This project involved synthesizing information from a broad range of sources. Ultimately, a list of species verified to be in the units and a list of species, not verified, but expected to occur was compiled.

Overview of Inventory

In an attempt to document 90% or more of the vascular plant diversity in ALAG and KATM, the AKNHP first developed a list of taxa expected to occur in the units (Lenz et al. 2001). Determinations for expected taxa were based on known distributions and collections, and expert opinion of botanists. Second, field sites were chosen prior to arrival that would cover the greatest habitat diversity, and therefore encompass the greatest possible number of species. Third, teams of AKNHP botanists visited the field sites. They collected, identified, and pressed over 500 plant specimens. Identifications were verified and curated at the University of Alaska Museum (ALA) and the collection data was entered into ALA and AKNHP databases.

The compilation of historic collections indicated that for ALAG, virtually no vascular plant taxa were reliably documented prior to AKNHP collections in 2002. The paucity of previous collections is partially an artifact of the small unit size and recent wilderness designation. We estimated that approximately 390 vascular plant taxa ("taxa" in this context refers to classification end units; i.e., either species, subspecies, or varieties) are

possibly present along the corridor. A total of 133 specimens were collected by AKNHP on a float trip during a week-long float trip in late July, 2002. 120 of these represent new records for the unit. No major range extensions or species of special concern were encountered; however, one collection of a grass could not be properly identified and is being reviewed.

Previous plant collections were more thorough from KATM, with over 300 plant taxa documented. Floristic work was initiated soon after the 1912 eruption and continued intermittently to the present. A total of 623 taxa (confirmed + unconfirmed + probably present) were estimated to occur in the unit. Intensive collection by the AKNHP occurred in three main areas with additional collections made sporadically throughout the park. Over 500 specimens, representing 146 new records for the park, were collected by AKNHP botanists. An additional 41 represent confirmations of taxa that were "unconfirmed" from the park - for example, cited in literature but without voucher collections. Therefore, the percentage of documented, confirmed taxa, relative to expected vascular plant taxa rose from 54% to 84% in 2002. Two taxa of special conservation concern were collected, plus three exotic weeds.

The two species of conservation concern are rare both globally and within Alaska (AKNHP Rare Plant Tracking List, see http://www.uaa.alaska.edu/enri/aknhp_web/biodiversity/botanical/vascular_species_concern/species_table/images/AKNHP_Plt_Trking_List_2003%20.pdf). One of the rare species collected in Katmai (*Primula tschuktschorum*) represents a major range extension to the southeast (Fig. 54). This species has a restricted range, occurring only on the tip of the Chukotka Peninsula in Russia, east to Alaska on the Seward Peninsula, and in isolated populations south to Bristol Bay. Population sizes of *P. tschuktschorum* are generally small, but a few are large and threats do not appear imminent (Kelso 1995). We do, however, recommend further survey and monitoring studies on this and the other rare taxon in Katmai.

Methodological details, site descriptions, and discussion of the relevance of 2002 collections and recommendations for future research are outlined below.

METHODS AND MATERIALS

The AKNHP's vascular plant inventory in the Alagnak Wild River and Katmai National Park occurred from late June to mid-August, 2002. Determination of expected taxa, site selection, and sampling design preceded field work and was initiated in January of 2002.

Expected and Known Taxa

To gauge progress toward achieving 90% documentation of the expected flora, an informed list of known and probable taxa was first required. Plant collections from the Herbarium of the University of Alaska Museum (ALA) and from the herbaria of the various park units (ANCS+) were databased along with selected collections from other herbaria, observations, and floristic lists from published and unpublished literature.

Collections from ALA were verified for both taxonomic identification and geographic location. Collections from ANCS+ were largely unverified for both taxon and geographic location. The records were used by AKNHP to develop lists of taxa known from or expected to occur in the park units. Taxa that were only known from unverified collections or from observations or literature citations were recorded as "Unconfirmed".

Determining the expected species in areas that are poorly known is replete with difficulties. Our method included documented taxa occurring within 50 km of the park units. This is a very rough approximation at best. Even after revisions were made (based on likely habitats and geography) the list undoubtedly omits taxa in the units and includes taxa that are not present. Taxa known from within 50 km of the park boundary, or that were otherwise felt likely to occur in the park, were recorded as "Probably Present".

Using these definitions, we determined that the percentage of the total expected flora known to be present in each park was 0% for ALAG and 54% for KATM.

Floristic History

Alagnak Wild River (ALAG)

Virtually no floristic information exists for this narrow river corridor. We had no records of any collections and only a few unverified observations by park rangers. This park unit is adjacent to KATM and although it is unlikely to contain plant taxa not found in that park, there are very few collections in KATM that were within 50 km of ALAG.

We estimated that approximately 390 vascular plant taxa are possibly present along the corridor. This number was calculated by removing the alpine and coastal species from the list compiled for KATM (discussed below). This estimated number is likely an overestimate since the unit is quite narrow and does not include a wide diversity of habitats, moisture gradients, etc.

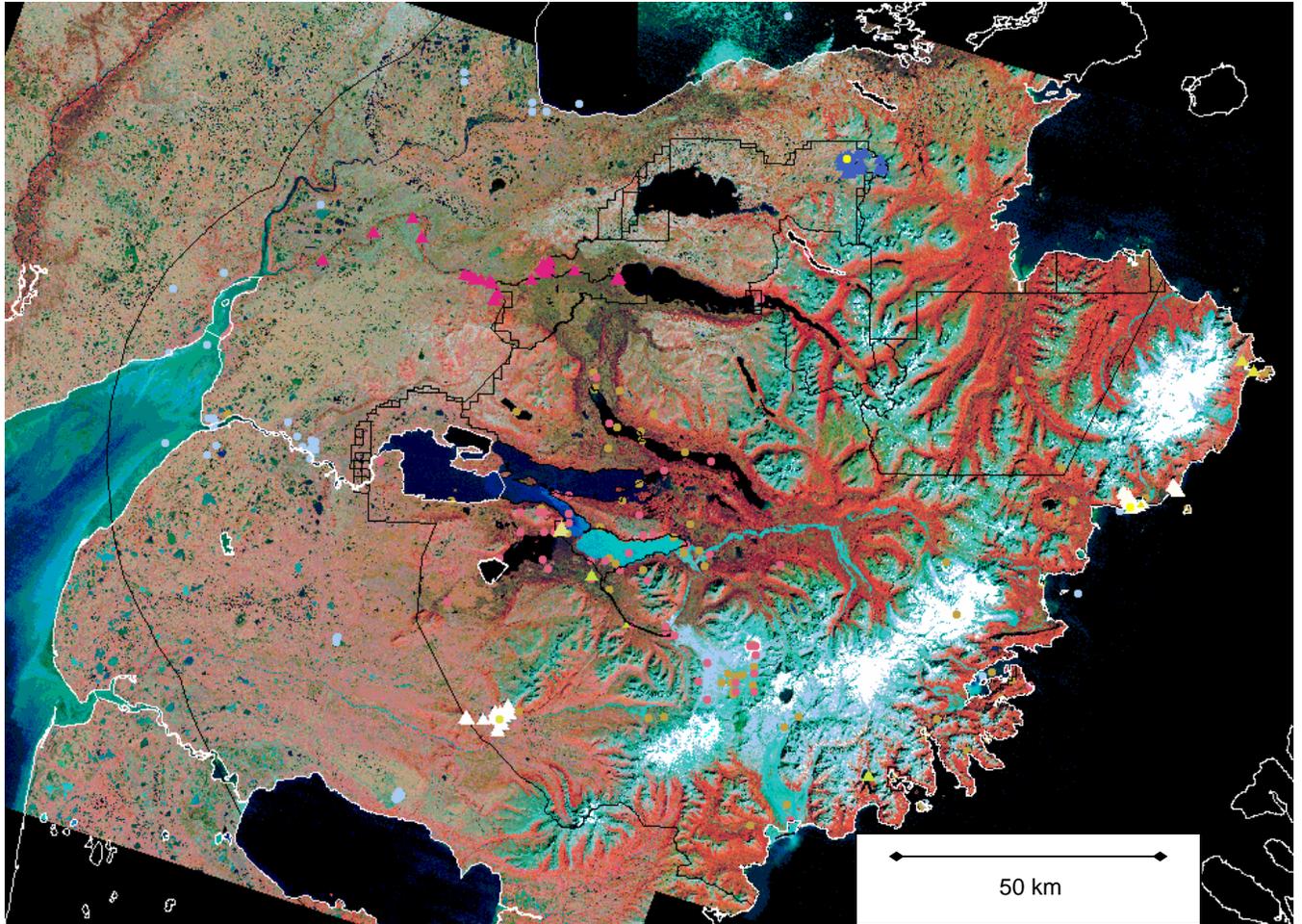
Katmai National Park and Preserve (KATM)

Over 330 vascular plant taxa were reliably documented by collections from KATM. Additional taxa are known from unverified collections and observations in literature and field notes. The earliest botanical collections were made from 1915-1930 (Griggs 1918, 1936; Fig. 1), following the 1912 eruption. Cahalane (1954) made collections in 1953-54 as part of a biological survey, though clearly the main focus was not botanical. Collections were made in the 1970's by John Dennis in preparation for a vegetation map (project was unfinished) and by Young and Racine (1976) examining at a proposed park extension. Other significant park collections have been made by NPS personnel (e.g., Rice, Moore) and during studies on bear habitat by Tom Smith. Most recently, collections were made by Boggs et al. (2003) as part of a landcover mapping project for the park. The vast majority of collections are within the corridor between Brooks Camp and the Valley of Ten Thousand Smokes and a few coastal locations (e.g., Hallo Bay). Large areas of the park have had no botanical collecting. Figure 2 shows the collections within the park and surrounding areas.



Figure 1. Robert F. Griggs collecting plants along a *Leymus mollis* beach strand community (above) and a scree slope of 400 m elevation, below (from Griggs 1936).

Figure 2. Katmai National Park and 50 km buffer area, showing areas where plants have been collected. Collections by AKNHP botanists in 2002 are shown as triangles; previous collections are shown as circles.



Sampling Design

In order to attain the goal of documenting 90% of the expected flora, we adopted a reconnaissance method of floristic survey. This method was recommended as the best approach for plant inventories in all Alaska parks by the wide group of botanists at the Alaska Plant Inventory Working Group September 2000 meeting. 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 park collections
- under-represented plant communities in existing inventories
- logistical feasibility (e.g., access means, cost)
- potential of certain types of sites to maximize species and communities encountered (e.g., ecotones, high gradient areas)

To maximize species diversity we targeted sampling in ecologically different areas and distributed sampling throughout both units. Targeted sampling has been incorporated into the plant study design to ensure that sampling occurs in unique sites or habitats where species that are expected, but not yet documented, may exist. Logistical feasibility (e.g., access means, cost) and the potential of certain types of sites to maximize species and plant associations encountered (e.g., ecotones, high gradient areas) were incorporated into the study design. The final site selection process for this study required detailed examination of aerial photographs, geology, and landcover maps.

This targeted, judgement-based approach is essential to identify species of special concern and attempt to locate additional populations based on known habitat preferences and patterns of distribution. As surveys progress the lists of species of special concern will be refined as will our knowledge of their habitat and geography.

Site Descriptions

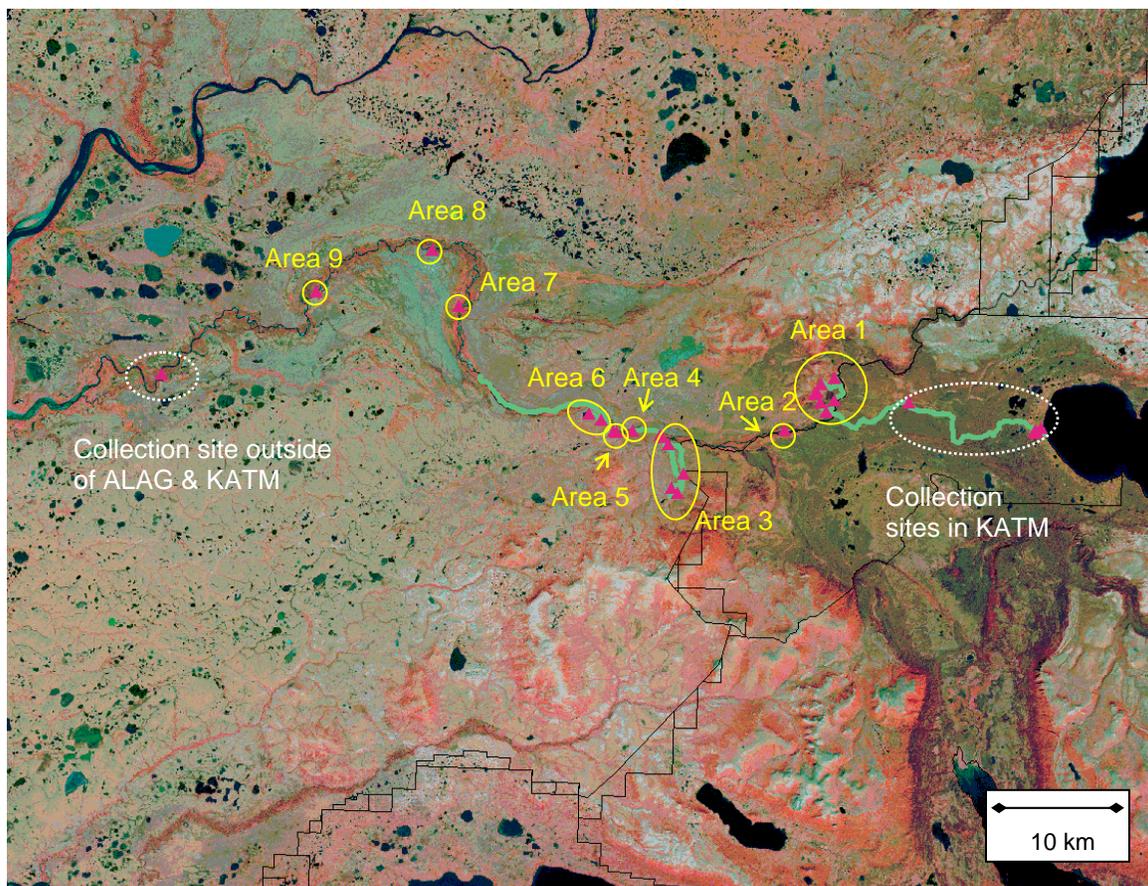
The two units AKNHP inventoried were surveyed differently due to variation in unit size, logistics, and diversity of habitat-types. We therefore present methods, results and discussions of each unit in a somewhat different manner. Sampling in ALAG was conducted on single float trip through a long, narrow corridor of similar wetland habitats. A number of discrete sampling areas were located along this unit and we present findings for each of these areas. In KATM, we visited three distinct eco-geographic regions and sampled a number of different habitat-types within the regions. The total number of collection-sites within regions was 20-30. It is impractical to discuss each of the nearly 100 collection-sites in KATM, and we therefore discuss collections associated with particular habitat-types for each of the three KATM collection regions.

Preferred species names are given based on the Synthesis of North American Flora (BONAP). Names based on Hultén (1968) are given parenthetically when divergent from BONAP

Alagnak Wild River (ALAG)

The ALAG unit was surveyed by a single drift trip from the confluence of the Nonvianuk and Alagnak Rivers to 10 km downstream from Middle River Camp, a distance of roughly 42 km (Fig. 3). Surveys were conducted from 25 July to 29 July 2002 by AKNHP staff and were accompanied by an NPS back-country ranger. Due to dangerous rapids along the upper Alagnak, the field crew was dropped at the upper reaches of Nonvianuk River and rafted down to the Alagnak. Nine major collecting areas, which included from one to eight specific collection-sites, were established along the river. Seven of the nine collection areas were wet-sedge tundra or willow thickets. Additional collecting occurred sporadically. Figure 3 shows the overall area inventoried. The geographic location, topography, and habitats of the areas are discussed below.

Figure 3. Primary collection areas along the Alagnak River. Areas traversed are indicated as the green line and collection-sites are shown as red triangles. Collection-sites outside of the ALAG boundary are also indicated.



ALAG Area 1 -

On 25 July 2002, at the Alagnak-Nonvianuk confluence, the crew hiked up the Alagnak River as far as possible (roughly 3.5 km) and surveyed the riparian and higher elevation, bluff habitats. The location was 59.03° N and 155.88° W and ranged from 170 to 210 m (Fig. 3). Habitats within the survey area were diverse. Wet tussock meadow bordered with birch and alder, low shrub-graminoid meadows, and low-shrub tundra were common habitats sampled (Fig. 4). Additionally, the field crew encountered boreal communities with an overstory of Kenai birch and white spruce. Soils ranged from saturated to moist and generally had a well-developed acidic peat component. The major associated species at this site were *Calamagrostis canadensis*, *Ledum palustre*, *Salix barclayi*, *Betula nana*, *B. kenaica*, *Alnus viridis* ssp. *fruticosa* (*crispa* ssp. *sinuata*), and *Picea glauca*.



Figure 4. AKNHP botanist collecting in a wet graminoid meadow at ALAG Area-1. *Mimulus guttatus* is the yellow flower in the foreground. The dominant graminoids are *Calamagrostis canadensis*, *Carex aquatalis*, *Carex canescens*, and *Carex pluriflora*.

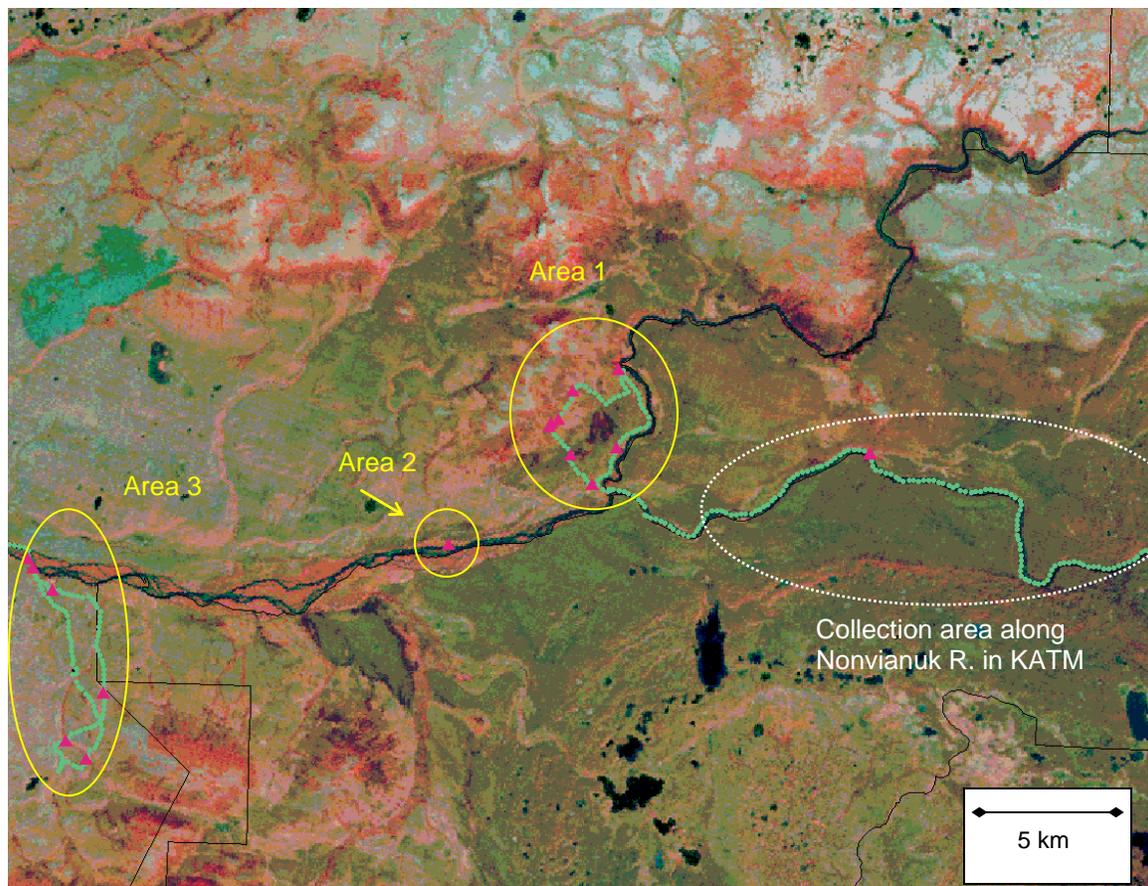
ALAG Area 2 -

Collections on 26 July 2002 were confined to a compact area approximately 3 km downstream from confluence of Alagnak and Nonvianuk rivers on the north side of the river (59.01° N, 155.90° W; Fig. 5). This was a moist, low shrub-graminoid meadow at the edge of a small bay with slow moving water. The major associated species of the 11 specimens collected included: *Calamagrostis canadensis*, *Salix barclayi*, and *Comarum (Potentilla) palustre*.

ALAG Area 3 -

This area was just downstream from Charlie Summerville's lodge where the Katmai National Preserve's northwestern boundary abuts Alagnak Wild River (59.01°N, 156.05°W, Fig. 5); collections occurred on 28 July 2002. The elevation was ca. 75 m. The plant habitat was a closed-willow woodland with small graminoid openings. Soils were moist with a large organic component. Dominant associated species were *Salix alaxensis*, *Calamagrostis canadensis*, and *Equisetum arvense*.

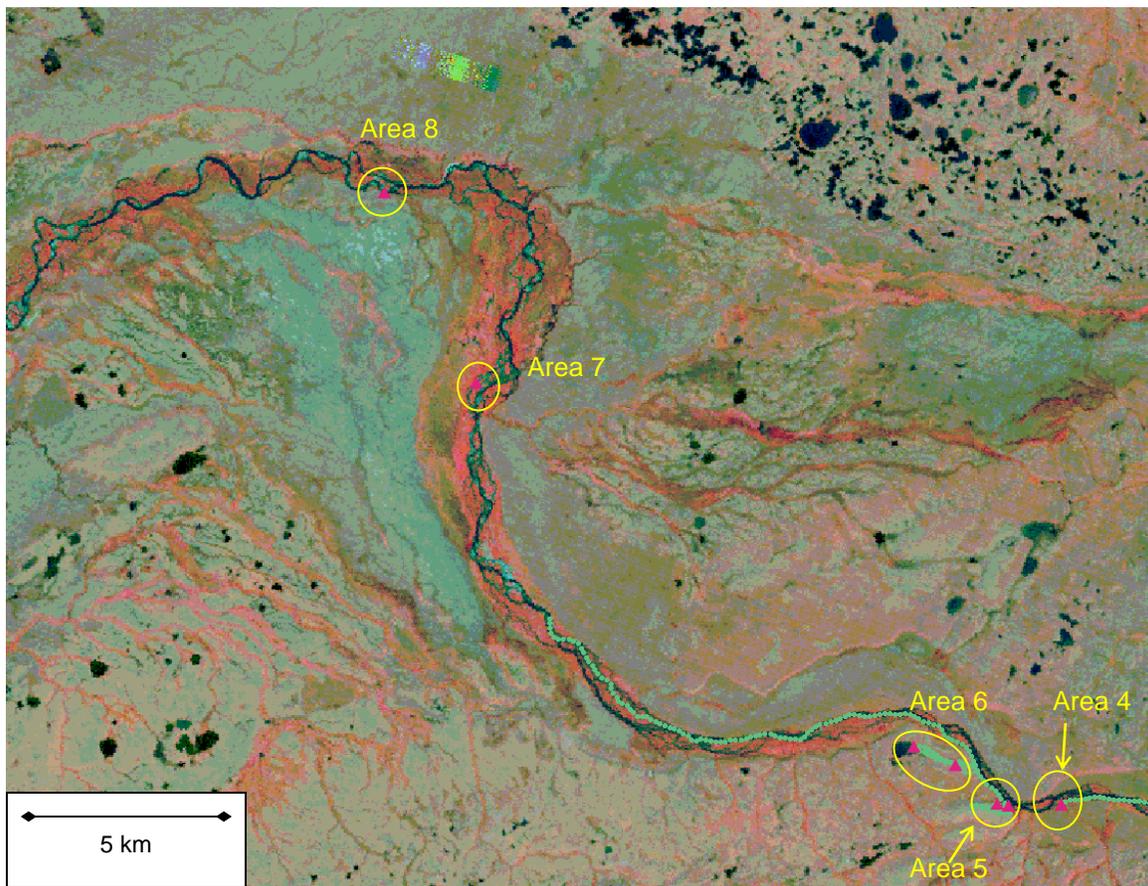
Figure 5. Collection areas along the upper Alagnak River. Specific collection-sites are shown as triangles. Areas traversed are in green.



ALAG Area 4 -

Sampling-Area 4 was a low shrub-graminoid meadow that along the south side of the river at 59.01°N, 156.09°W (Fig. 6), which was inventoried on 28 July 2002. The area was just along the riverbank, 1 m above the water level. The associated dominants were *Salix barclayi*, *Vaccinium uliginosum*, *Dasiphora (Potentilla) fruticosa*. Substrates were moist to saturated mud and peat.

Figure 6. Collection areas of the lower Alagnak River. Specific collection-sites are shown as triangles. Areas traversed are in green.



ALAG Area 5 -

Area 5 was a bluff on south side of the river, including rocky outcrops near the river's edge to a 177 m peak, 1 km to the west. The location was 59.01°N, 156.11°W with elevation ranging from 160 to over 170 m (Fig. 6). The collection area was inventoried 28 July 2002. The habitat encompassed near vertical rocky outcrops with little vegetative cover (Fig. 7A) to ericaceous low-shrub tundra at the top of the peak (Fig. 7B). The substrates ranged from moist peaty soil to bare mineral outcrops. Major species of the shrub tundra were *Empetrum nigrum*, *Vaccinium uliginosum*, *Ledum palustre*, and lichens (e.g., *Cladina*, *Cladonia*, *Cetraria*, and *Nephroma* spp.).



Figure 7A. Rocky bluff, tall shrub thickets, and ericaceous low-shrub tundra of ALAG Area-5.



Figure 7B. Ericaceous low-shrub tundra of ALAG Area-5. The Alagnak River is visible on the left.

ALAG Area 6 -

Area 6 was a large pond and a smaller pond, 1.5 km northwest of Area 5, which were also inventoried on 28 July 2002. The location of Area 6 was 59.02°N, 156.14°W, with an elevation of 110 m (Fig. 6). Five aquatic species were collected in muddy sand under 0.5 m water. Associated species were *Sparganium angustifolium* and *Arctophila fulva* (Fig. 8). Wet-sedge and ericaceous-shrub communities surrounded the ponds.



Figure 8. Wet-sedge and ericaceous-shrub habitat bordering shallow pond of ALAG Area-6.

ALAG Area 7 -

A few collections were made along a sandy gravel bar at 59.08°N, 156.3°W along the river at 30 m elevation (Fig. 5). Dominant plant species at this site included *Rorippa palustris*, *Mimulus guttatus*, and *Chamerion (Epilobium) latifolium*, all species tolerant of soil disturbance (Fig. 9). Substrates were primarily moist mineral soils of small- to medium-sized river cobbles.



Figure 9. ALAG Area-7, a gravel bar along the Alagnak River, bordered by thickets of willows, alders, and bluejoint grass.

ALAG Area 8 -

This collection area was a low-shrub tundra community in an open white spruce forest along the river's edge at the temporary NPS "Middle River Camp" (Fig. 10). The location of the site was 59.12°N and 156.33°W, and elevation of 22 m (see Fig. 6). Collections at this site occurred on 29 July 2002. Soils were moist and peaty. The dominant associated species were *Ledum palustre*, *Betula nana*, *Vaccinium uliginosum*, and *Vaccinium vitis-idaea*.



Figure 10. White spruce - low shrub community of ALAG Area-8.

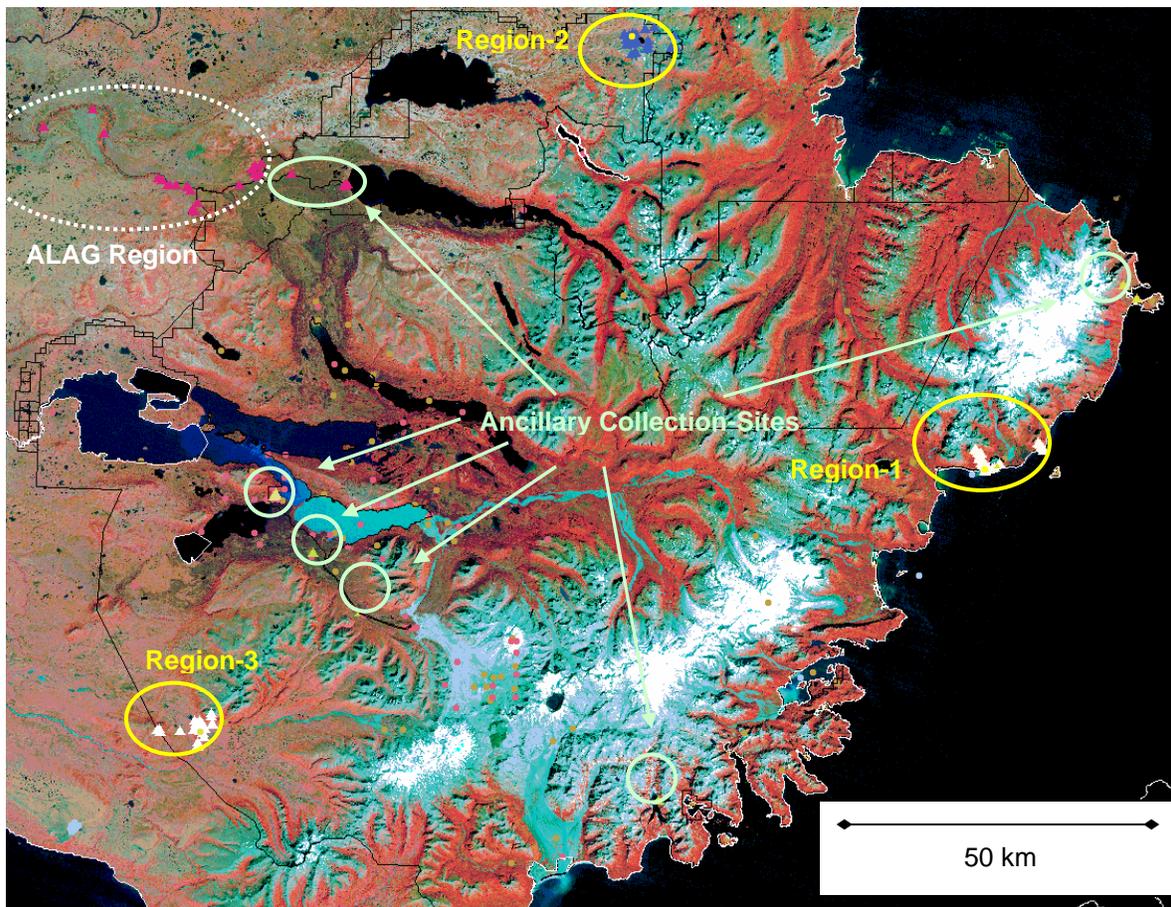
ALAG Area 9 -

The final area was just downstream from Tony Sarp's Katmai Lodge (59.09°N and 156.47°W) along a sand bar island. The location of this site in relation to others is shown in Figure 3. This site was sampled on 29 July 2002. The community type was a wet, low shrub-graminoid meadow, recently under spring water flow. The major associates included *Salix barclayi* and *Calmagrostis canadensis*. Substrates were moist to saturated peat.

Katmai National Park and Preserve (KATM)

Based on the sampling design criteria, we concentrated our inventory in three diverse eco-geographic regions of the unit, incorporating very divergent habitat types (Fig. 11). Multiple collection-sites were located within each region. Region-1 was the Swikshak Lagoon area on the east coast of the Alaska Peninsula. This region had salt-marsh, graminoid-umbel meadows, and alpine habitats. Region-2 was an alpine site, located in the northeastern portion of KATM. This region had both tundra, fell field, and aquatic habitats. The third region, largely wet-sedge tundra and higher elevation tundra, was located in the extreme southwestern border of the park. All three regions had a range of bedrock types and topographies. Additional collections occurred near Brooks Camp, Valley of Ten Thousand Smokes, Cape Douglas, and Dakavak Lake. Access to all regions was by fixed-wing aircraft.

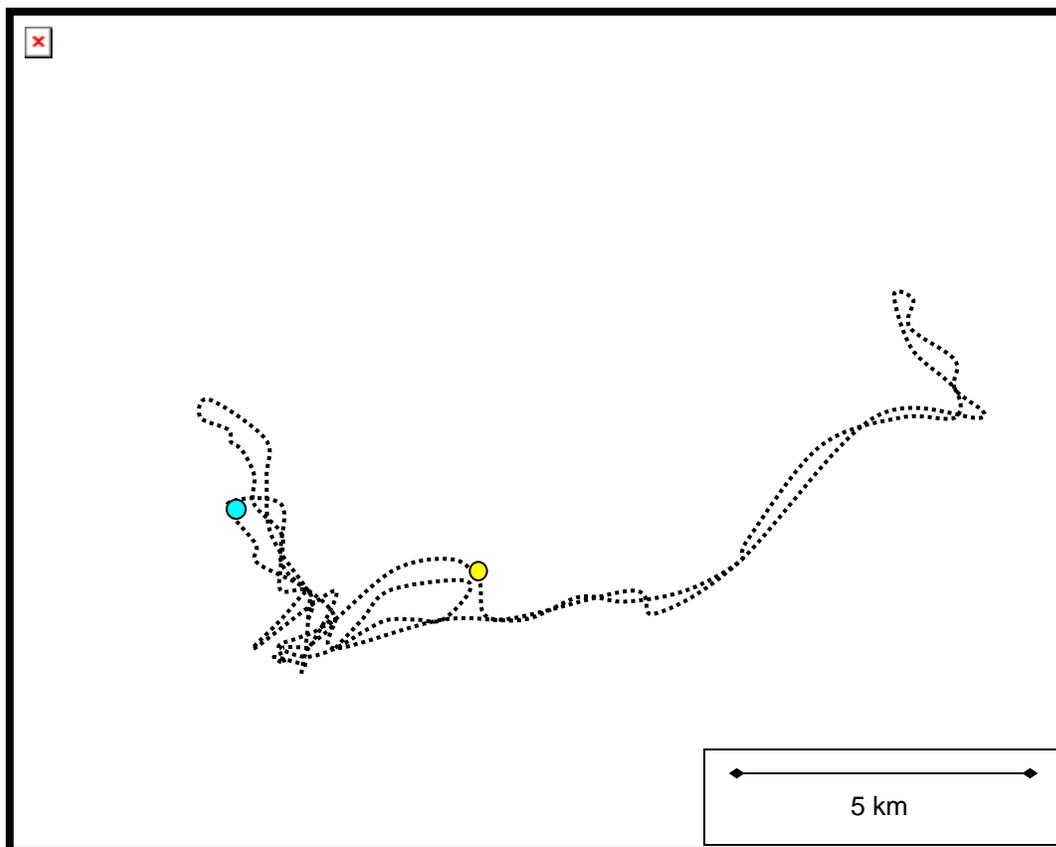
Figure 11. Landsat image of Katmai Park, showing primary and ancillary regions (open ellipses) and specific collection-sites by AKNHP (triangles). Previous collections are shown as small closed circles.



KATM Region 1 -

Areas around Swikshak Lagoon were thoroughly inventoried from 2 - 8 July 2002 and the region was revisited 15 August 2002. A camp was established at the NPS cabin on the end of Swikshak spit (58.61°N, 153.76°W). Daily plant-collecting trips by three AKNHP botanists and a Student Conservation Association (SCA) intern radiated from this location. Figure 12 shows the region covered and specific locations of all collection-sites. The primary habitat types encountered at low elevation were intertidal beach and halophytic-sedge habitats, forb-graminoid meadows, freshwater ponds and marshes, and alder and willow thickets. Forb-graminoid meadows and alder/willow thickets extended into higher elevations along with wet, low shrub-sedge meadows and fens. At the highest elevations (450 - 900 m), herbaceous-dwarf shrub tundra, and exposed deflation and scree slopes were dominant. Each of these primary communities is discussed below.

Figure 12. Collection-sites at KATM-1 (Swikshak Lagoon). Areas traversed are shown as the black dashed lines and specific locations where plants were collected are shown as light triangles. Areas revisited 15 August 2002 are shown as yellow triangles. (The collection locality of significant finds are indicated as circles: *Dupontia fisheri* site = yellow circle; *Carex nardina*, *C. rupestris*, and *Kobresia myosurioides* = bright blue circle. These finds are shown and discussed in Results and Discussion sections.)



The topography at KATM Region-1 included extensive sand and gravel beaches and a series of older beach ridges (Fig. 13A) as well as marshes and ponds. Steep headlands were also common as were high mountain peaks and glaciers (Fig 13B). Elevation ranged from sea-level to over 900 m.



Figure 13A. View of Swikshak Lagoon, looking south from a steep headland. Older beach ridges are visible as alder and driftwood bands.



Figure 13B. View of Swikshak Lagoon and Fourpeaked Mountain, looking northeast.

The geology of the region was quite diverse. Marine and riverine deposits were extensive at lower elevations. Schist and shale were common at low and mid-elevations, while more volcanic-derived parent material was present at higher elevations. In one alpine area, we located a small calcareous outcrop.

Intertidal Communities -

In the intertidal-zone, we concentrated collections on salt-marsh ponds and bordering halophytic wet-sedge meadows (Fig. 14). The saturated soil was silty and vegetative cover was nearly 100%. The dominant species were *Carex lyngbyei*, *C. ramenskii*, *Poa eminens*, *Festuca rubra*, *Argentina egedii*, *Plantago maritima*, *Stellaria humifusa*, and *Dendratherum (Chrysanthemum) arcticum*. A few additional collections were made on the sandy/gravelly upper beach zone. However, this habitat type had previously been well botanized and we encountered few taxa new to the park. The dominants of this community were *Leymus mollis*, *Honkenya peploides*, and *Senecio pseudoarnica*.



Figure 14. Intertidal salt-marsh community at KATM Region-1 (a bear is present the background).



Figure 15. Forb-graminoid meadow at KATM Region-1.

Forb-Graminoid Meadows -

The intertidal communities transitioned to extensive forb-graminoid meadows of older beach ridges (Fig. 15). The soil in this habitat was generally moist and sandy over coarser gravels. The dominant species were *Calamagrostis canadensis*, *Leymus mollis*, *Chamerion (Epilobium) angustifolium*, *Lupinus nootkatensis*, *Angelica lucida*, *Conioselinum gmelinii*, *Carex podocarpa*, and *C. gmelinii*. This community-type also extended up the slopes on a number of headlands in the Swikshak area. However, the soil of headland forb-graminoid meadows had a much greater organic component and slopes were as steep as 40°. In these communities the dominant plants were *Calamagrostis canadensis*, *Carex macrochaeta*, *Heracleum lanatum*, *Angelica lucida*, *Geranium erianthum*, *Petasites frigida*, *Sanguisorba canadensis (stipulata)*, *Equisetum arvense*, and *Athyrium filix-femina*.

Freshwater Marsh -

East of Swikshak Lagoon a series of freshwater ponds and marshes were encountered that had a number of species new to the park. All the collections occurred in saturated soil: wet mud, or in standing water. The dominant plant species were *Carex lyngbyei*, *C. canescens*, *Comarum (Potentilla) palustre*, *Nuphar polysepalum*, and *Eriophorum russeolum* (Fig. 16).



Figure 16. Freshwater marsh at KATM Region-1.



Figure 17. Wet, low shrub-sedge meadow.

Alder and Willow Thickets -

Occasional stands of cottonwood (*Populus balsamifera* ssp. *trichocarpa*), birch (*Betula kenaica*), alder (*Alnus viridis* ssp. *fruticosa*), and willows (*Salix* spp.) were present at low elevations. The primary species of willows were *Salix alaxensis*, *S. barclayi*, *S. bebbiana*, and *S. pulchra*. These shrub communities often abutted the forb-graminoid meadows and many of the herbaceous species were in common between the two community types. These communities were generally low in diversity and were not heavily sampled.

Wet, Low Shrub - Sedge Meadows and Fens -

Low shrub-sedge meadows and fens were encountered at lower and mid-elevations. These habitats were characterized by poorly drained, subhygric peaty soil with a thick sphagnum layer. *Myrica gale*, *Salix pulchra*, *Deschampsia caespitosa*, *Calamagrostis canadensis*, *Equisetum arvense*, and a number of sedges (*Carex pluriflora*, *C. media*, and *C. loliaceae*) were common in this community (Fig. 17).

Herbaceous - Dwarf Shrub Tundra -

At higher elevations (360 - 900 m) the community transitioned to tundra vegetation with an increasing degree of exposed soil (Fig. 18). Low-ericaceous tundra was common in low-alpine areas with greater organic soil development. *Vaccinium uliginosum*, *V. vitis-idaea*, *Rhododendron camtschaticum*, *Arctostaphylos alpina*, and *Carex podocarpa* were the common constituents of the low-ericaceous tundra. In more moist, high-elevation snow beds we encountered dense carpets of *Harimanella (Cassiope) stelleriana* and *Luetkea pectinata*.

In areas with more rocky, well-drained substrates, the components of the herbaceous-dwarf shrub tundra shifted to include *Dryas alaskensis*, *Oxytropis nigrescens*, *Artemisia arctica*, *Potentilla villosa*, *Saxifraga oppositifolia*, *Saxifraga bronchialis*, *Minuartia obtusiloba*, *Rhodiola integrifolia (Sedum roseum)*, *Festuca rubra*, *Hierochloa alpina*, *Carex microchaeta*, and *Luzula* spp. Within the herbaceous-dwarf shrub community a number of exposed deflation areas and scree slopes were also sampled. Soils were extremely well-drained and stony and vegetative cover was minimal. Associated species of these exposed sites were *Lagotis glauca*, *Equisetum arvense*, *Oxytropis varians (campestris ssp. gracilis)*, *O. jordalii (campestris ssp. jordalii)*, *Festuca brachyphylla*, *Achillea borealis*, and *Polemonium boreale* (Fig. 17). A small calcareous knob was located just north of the Swikshak cabin at around 670 m, which had a high diversity of species despite low vegetative cover.

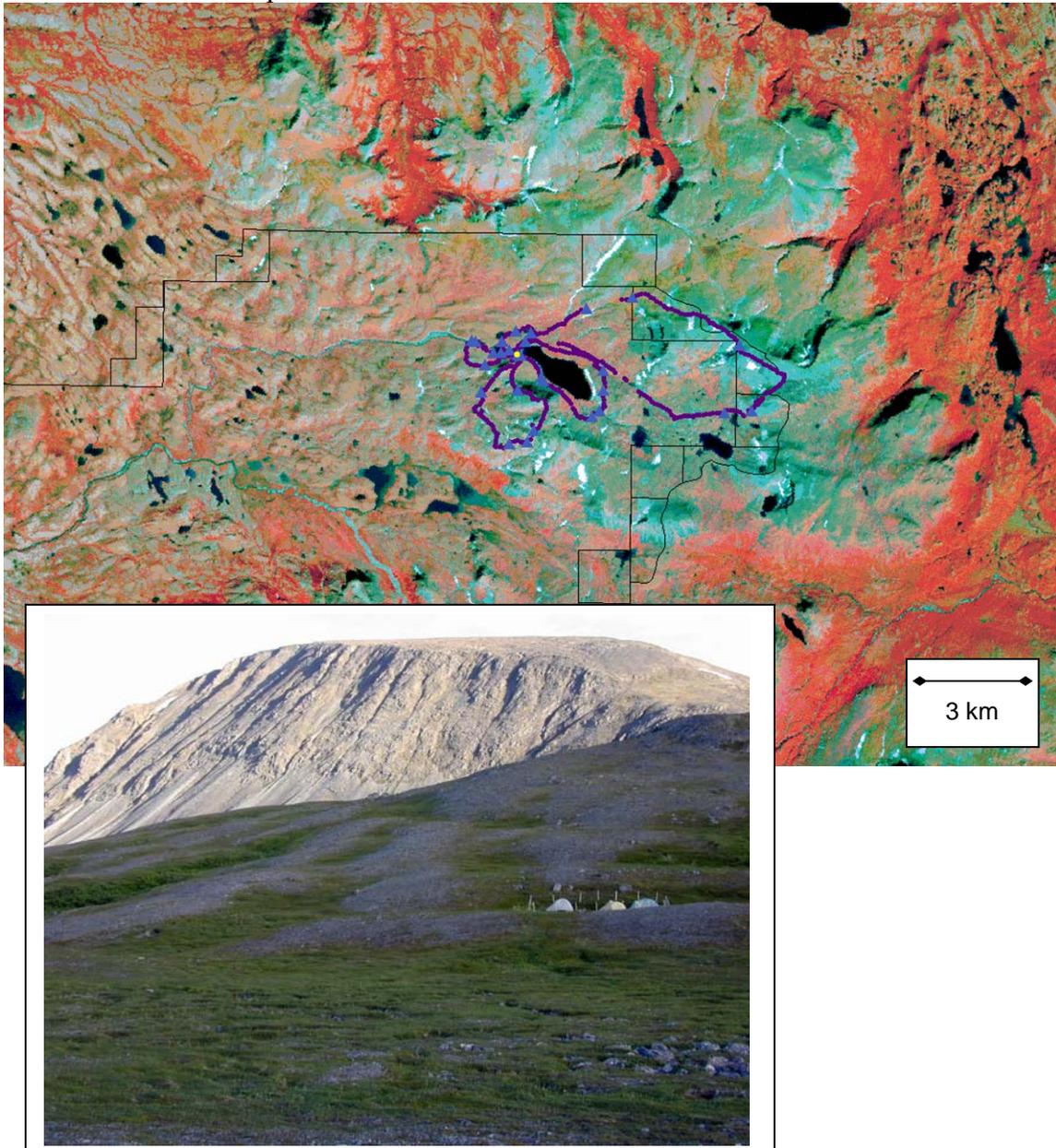


Figure 18. Herbaceous-dwarf shrub tundra. *Rhododendron camtschaticum* is the lavender flower in the foreground. *Arnica frigida* is the yellow flower.

KATM Region 2 -

Areas surrounding Mirror Lake in the northeastern portion of KATM were inventoried from 13 - 18 July 2002 by two AKNHP botanists and an SCA intern. The snow had only recently melted from most of the area and many of the plants had not reached full flower. We were able to seek out more phenologically advanced microsites to capture the more slowly developing taxa. This area was chosen as a collecting locality largely due to its access to higher elevations and northern geographic location within the park. A camp was established on the western end of the lake (59.24°N, 154.78°W; 450 m; Fig. 19), and daily plant-collecting trips radiated in all directions from this location. Figure 19 shows the region covered and collection-sites for all plants in the region.

Figure 19. Collection-sites at KATM-2, Mirror Lake. Collection-sites are shown as blue triangles and the area traversed is shown as a purple line. The camp location is shown as a small yellow circle at the west end of the lake. The inset shows the physiognomy of the area and ANKNP camp.



The topography of this region included lakeshores, and ponds, steep-eroded stream banks, rolling low hills, and mountain peaks. Elevations ranged from 400 to 900 m. The geology of the region is largely volcanic, with large basalt slopes, occasional ash and serpentine outcrops, and lesser amounts of lacustrine and riverine deposits.

Primary plant communities were aquatic, associated with shallow ponds and streams; wet-sedge tundra; low shrub - herbaceous tundra; and high alpine fell fields. Each of these primary communities is discussed below.

Aquatic/Semi-Aquatic -

Shallow ponds were numerous to the west of Mirror Lake (see Fig. 20A) and smaller snow-melt ponds were common throughout the region (Fig. 20B). Additionally, we inventoried vegetation along the Mirror Lake outlet, Funnel Creek. In these habitats the saturated soils were stony or silty. Associated dominant plant species of shallow ponds were *Equisetum arvense*, *Eleocharis* spp., *Geum calthifolia*, and *Primula tschuktschorum*. Along the fast-running creek, the primary plant species were *Equisetum arvense*, *Saxifraga nelsoniana*, *Diapensia lapponica*, *Vaccinium uliginosum*, *Carex microchaeta*, *Salix arctica*, *Calamagrostis canadensis*. In the saturated snow-beds *Calamagrostis canadensis*, *Equisetum arvense*, *Polemonium acutifolium*, *Rhodiola integrifolia*, *Saxifraga nelsoniana*, *Salix arctica*, and *Ranunculus nivalis* were common.



Figure 20A. Shallow pond margins in the Mirror Lake area. *Primula tschuktschorum* is present in the foreground.



Figure 20B. Snow-melt pond. Sedges, rushes, and buttercups were the dominants.

Wet-Sedge Tundra -

Poorly drained, wet-sedge tundra were encountered west of Mirror Lake and sporadically throughout the area (Fig. 21). Soils were saturated with a thick peat layer. Low willow shrubs and dwarf birch were also common adjacent to this habitat. Associates include *Sphagnum* spp., *Carex* spp., *Eriophorum* spp., *Betula nana*, *Salix glauca*, and *S. ovalifolium*.

Low Shrub - Herbaceous Tundra -

The most common type of habitat encountered at KATM Region-2 was low shrub-herbaceous tundra, which covered the rolling hills north of the lake and along the lower slopes of the larger peaks (Fig. 22). This habitat was characterized by stony and well-drained substrates, generally with a thick layer of lichens (*Cladonia* spp., *Cladina* spp., *Cetraria* spp., and *Nephroma* spp.) or graminoid turf. The soil was moist in all cases. Graminoid/herbaceous associates included *Festuca altaica*, *Carex microchaeta*, *C. podocarpa*, *Geranium erianthum*, *Geum calthifolium*. The low-shrub component contained *Empetrum nigrum*, *Salix glauca*, and *S. reticulata* at lower elevations. *Leutkea pectinata*, *Harimanella (Cassiope) stelleriana*, and *Dryas alaskensis* were more common at higher elevations.



Figure 21. Wet-sedge tundra of KATM Region-2. *Carex* spp. and *Eriophorum* spp. were dominants.



Figure 22. Low shrub-herbaceous tundra, common in the Mirror Lake area. *Harimellina stelleriana* and *Geum calthifolium* are the dominants shown here.

Alpine Fellfields -

High alpine peaks at elevations of 700 to 1000 m and with little vegetative cover, surrounded Mirror Lake. We sampled vegetation from all of the nearby peaks. Slopes ranged from flat to nearly vertical. The substrates were very rocky, coarse, and well-drained. Most of the parent material was large basalt cobbles; however, we also investigated an ultramafic outcrop 6-8 km east of Mirror Lake and a more basic ash deposit immediately southwest of the lake. Vegetative cover was generally under 10%. The dominant species of alpine fell fields were *Dryas alaskensis*, *Salix arctica*, *Rhododendron camtschaticum*, *Oxytropis nigrescens*, *Festuca richardsonii*, *Trisetum spicatum*, *Luzula multiflora*, *Saxifraga nelsoniana*, and *Minuartia arctica*. Figures 23A and 23B show the habitat and surrounding area.



Figure 23A. Alpine fellfields. A low-density mixture of dwarf shrubs and herbs were present at these sites. Mirror Lake is on the right side and Funnel Creek is visible in the middle of the photograph.

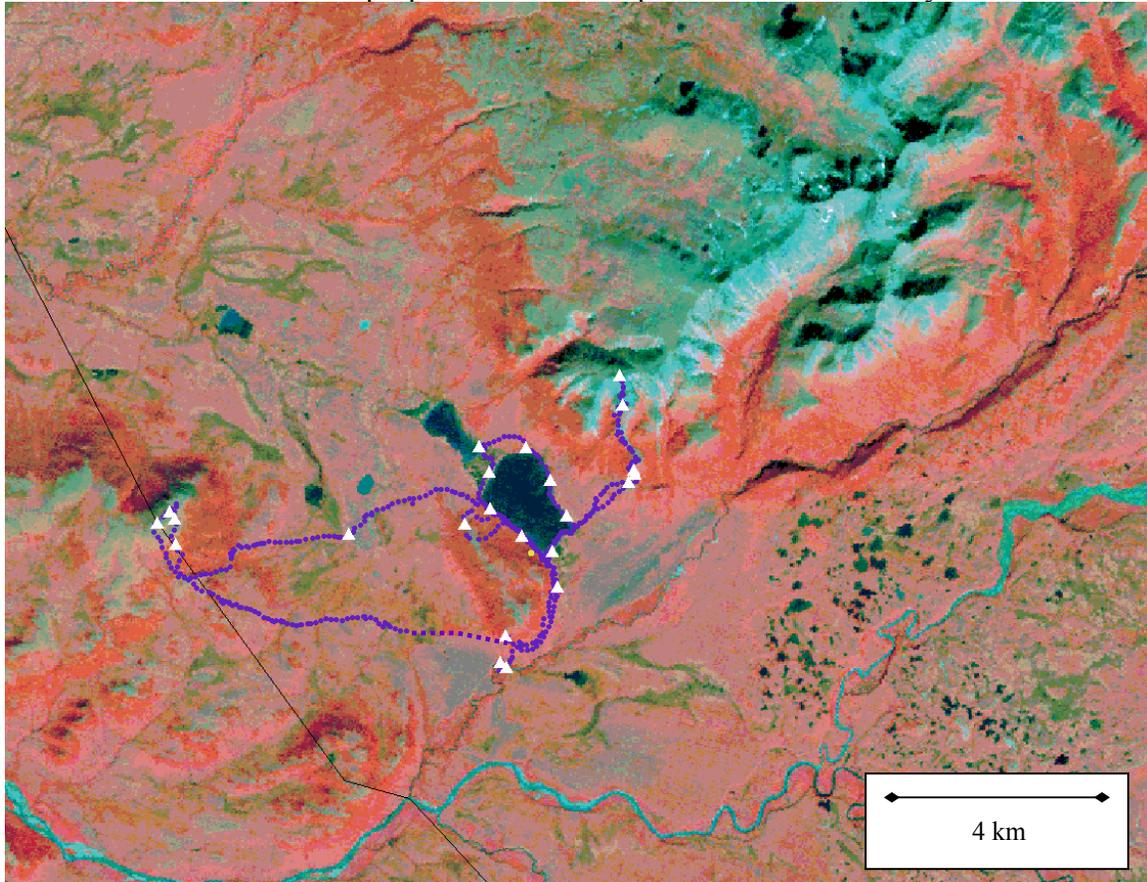


Figure 23B. AKNHP crew members on a talus slope above Mirror Lake.

KATM Region 3 -

A region on the southwest border of Katmai Park was inventoried from 5 - 10 August 2002. This area, Contact Creek, was chosen as a study site because little or no collecting had occurred in the Bristol Bay Lowlands eco-region, and the area had a high topographic and geologic diversity. In particular, a large calcareous outcrop was indicated on geologic survey maps at a small peak on the Park and Becharof National Wildlife Refuge boundary. Calcareous substrates often house a very different flora, potentially containing rare taxa, and are uncommon within KATM. A camp was established on the southern end of the unnamed lake north of Contact Creek (58.21°N, 155.97°W; 180 m; Fig. 24). Plant-collecting trips radiated from this location westward to the Park boundary, south along Contact Creek, north and east to the nearby peak. Figure 24 shows the region covered and specific locations of all collection sub-sites.

Figure 24. Collection-sites at KATM-3 (Contact Creek), shown as light triangles. Area traversed is indicated as the purple line. The camp location is the small yellow circle.



The topography of this region included lakeshores, streams banks, river-bars, low rolling hills, wetlands, and alpine mountain peaks. Elevations ranged from 180 m to nearly 900 m. Visibility was poor with dense fog, affording limited collecting opportunities at high elevations. The geology of the region is largely volcanic, with large basalt and granite

slopes. Lesser amounts of lacustrine and riverine deposits were also observed. The calcareous deposits on the park boundary were not located.

Primary plant-community types were similar to those encountered at KATM Region-2. However, the dominant species were largely dissimilar. The community types included: aquatic/semi-aquatic, associated with lake margins, shallow ponds, and streams; wet-sedge tundra; low shrub-herbaceous tundra; alder/willow thicket; and alpine fellfields. Each of these primary communities is discussed below.

Aquatic/Semi-Aquatic -

We collected along the lakeshore, in shallow ponds to the north and west of the lake, and along a number of streams (Fig. 25). Soils were saturated and muddy, or peaty in some cases. The lake margin was stony in some areas and thick with mud in others. Along the lake, dominant plants were *Potamogeton* spp., *Arctophila fulva*, and *Hippuris vulgaris*. In the nearby shallow muskeg ponds, *Eriophorum angustifolium*, *E. russeolum*, *E. vaginatum*, *Eleocharis* spp., *Comarum (Potentilla) palustre*, *Carex aquatilis*, and *Betula nana* were common. Small muddy back-waters and exposed gravel bars (Fig. 25) of medium-sized cobbles were sampled along Contact Creek. These contained *Ranunculus hyperboreus* and *Alopecurus aequalis* and were surrounded by *Chamerion (Epilobium) latifolium* and thick *Calamagrostis canadensis* swards.



Figure 25. Gravel bar along Contact Creek.



Figure 26. Wet-sedge tundra and surrounding willow thickets along the lake margin.

Wet-Sedge Tundra -

Wet-sedge tundra was the most common vegetation type in this region. Soils were completely saturated and peaty, generally with a large *Sphagnum* moss component. The primary sedge species in this habitat were *Carex aquatilis*, *C. membranacea*, *Eriophorum angustifolium*, and *E. russeolum*. The low or dwarf shrubs, *Betula nana*, *Salix reticulata*, *S. glauca*, *Dasiphora (Potentilla) fruticosa*, were often present. Figure 26 shows this habitat type at Contact Creek.

Low Shrub - Herbaceous Tundra -

At higher elevations (300 - 450 m) that were well drained, the wet-sedge tundra gave way to low shrub-herbaceous tundra. Under a normally thick layer of lichens, the soils were very shallow and rocky. The dominant species of low shrub-herbaceous tundra were *Rhododendron camtschaticum*, *Salix arctica*, *Diapensia lapponica*, *Empetrum nigrum*, and *Carex microchaeta*.

Alder/Willow Thickets and Bluejoint Meadows -

Alder and willow thickets as well as bluejoint meadows were common on most slopes rising from lower wet-sedge tundra. Diversity in these habitats was very low and only modest sampling occurred there. The alder thickets were restricted to moderately well-drained areas with some organic soil development. The dominant species of the alder thickets were *Alnus viridis* ssp. *fruticosa (crispa)*, *Calmagrostis canadensis*, and *Dryopteris expansa* (see Fig. 27). Willow thickets were common lower on the hill-slopes and where often found in saturated peaty soils (see Fig. 26). The primary willow species were *Salix pulchra* and *S. barclayi*.

Alpine Fellfields -

We encountered fellfields at elevations of 450 - 520 m, 6.5 km west of camp on the KATM Park boundary, and 450 - 820 m, 4 km northwest of camp. Slopes were moderate to nearly vertical. The substrates were very rocky, coarse, and well-drained, with poorly developed soil and often a thick layer of lichens. Most of the parent material was large basalt cobbles. We were unable to locate a calcareous outcrop 6-8 km west of camp, as indicated on geology maps. The parent material at this hill appeared to be neutral to moderately acidic, judging from the species composition and lack of effervescence when dipped in acid. Vegetative cover was generally under 10%. The dominant species of this habitat were *Carex microchaeta*,



Figure 27. SCA intern-botanist collecting in an alder thicket.

Empetrum nigrum, *Rhododendron camtschaticum*, *Salix arctica*, and *Diapensia lapponica*. Figure 28 shows the habitat and surrounding area.

We also collected specimens along a steep rocky outcrop at relatively low elevation (300 m). This location had a similar rocky, well-drained substrate, but largely dissimilar dominant species than the alpine fellfields (Fig. 29). The dominants included: *Bupleurum triradiatum*, *Potentilla villosa*, *Saxifraga bronchialis*, *Salix arctica*, and *Poa glauca*.



Figure 28. Alpine fellfield north of Contact Creek at 670 m. Note alder thickets and *Calamagrostis canadensis* meadows below.

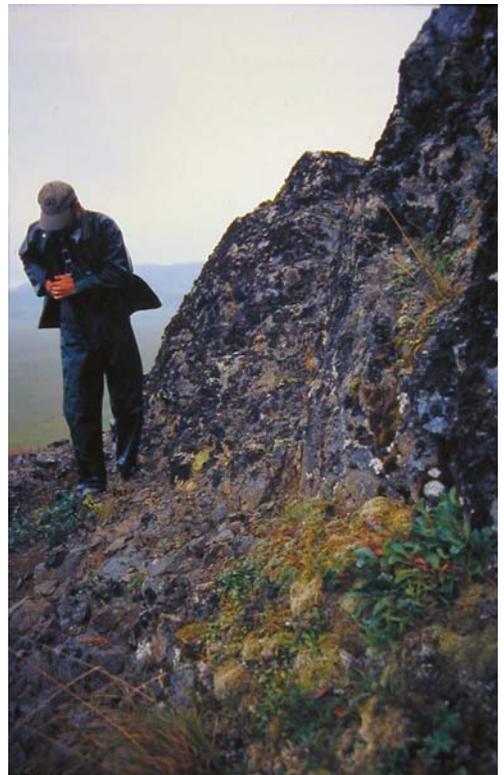
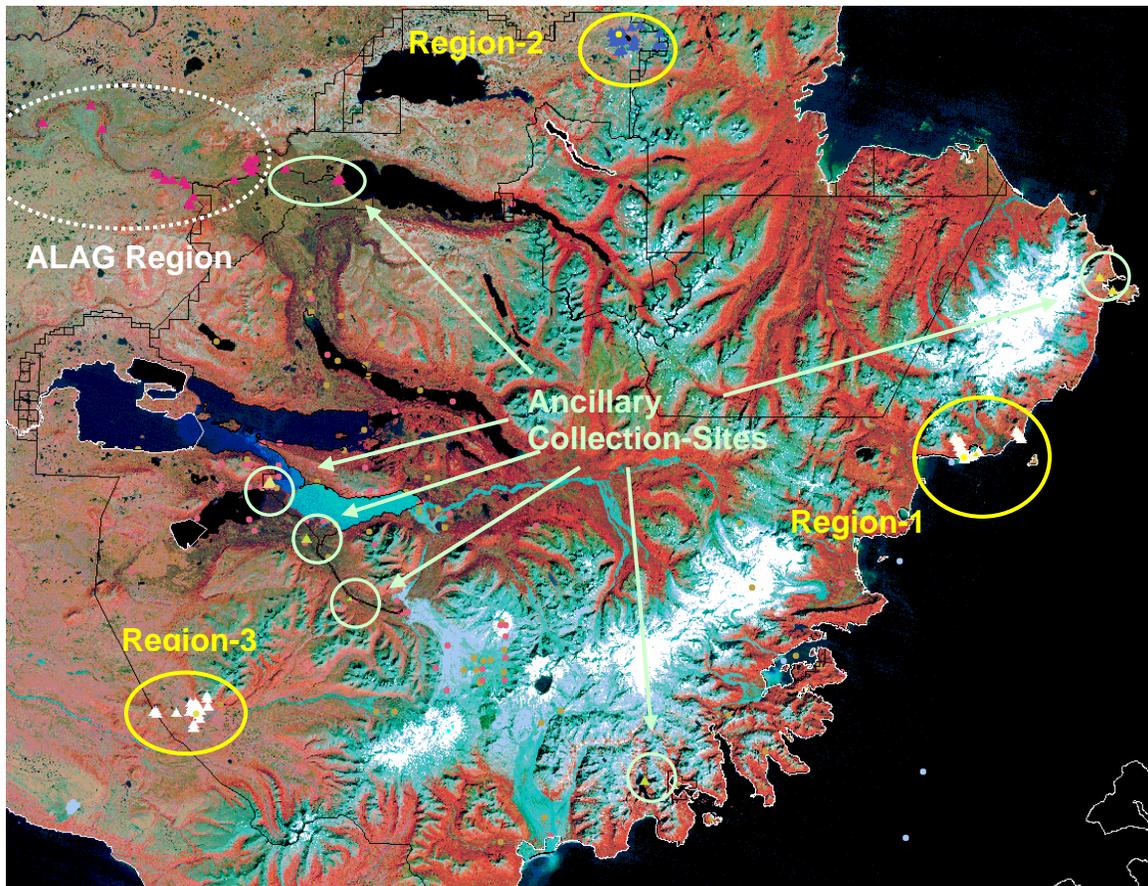


Figure 29. Rocky outcrop at 300 m, rising above bluejoint meadows and alder thickets.

Ancillary Sites -

The upper Nonvianuk River in KATM was briefly sampled on 23 and 24 July, 2002, by AKNHP. Habitats encountered along the upper Nonvianuk River were largely open white spruce forests and wet-sedge tundra. In mid-August, we briefly visited a number of additional sites. Two botanist sampled in the Brooks Camp area, specifically targeting introduced species around developed areas, such as campgrounds, roads, and buildings. Areas around Dakavak Lake and Sukoi Bay along Shelikof Straights were sampled on the 13 and 14 August, 2002. We returned to Swikshak Lagoon (KATM Region-1) on 15 August and collected a number of additional taxa. Figure 30 shows the location of ancillary sites.

Figure 30. Ancillary vascular plant collection-sites in Katmai Park, highlighted in light green.



Field Methods

Fieldwork was conducted by one or two teams of botanists at each region. At KATM Region-1, three AKNHP botanists and an SCA intern were present. At KATM Regions-2 and 3, two AKNHP botanists and an SCA intern comprised the field-crew. Fieldwork along the Alagnak River was conducted by one AKNHP botanist, an SCA intern, and an NPS ranger. Two AKNHP botanists and an SCA intern conducted the fieldwork at the ancillary sites.

Access to regions was by fixed-wing aircraft and by raft for the ALAG portion. At each region we made a complete floristic inventory using the following methods:

- Each region was mapped on an aerial photo or USGS topographic map and a georeference point was recorded using GPS. The routes surveyed were also mapped. Representative photos were taken of each region including communities, unusual landforms, and notable plants. (However, photographs taken along the upper Alagnak River were destroyed by wet conditions in the field.)
- A description of each region was recorded and significant landforms and plant associations described.
- As new communities were encountered, the following data were recorded: vegetation type, slope, aspect, elevation, topographic position, moisture, soil types, parent material, cover classes of growth forms and bare ground, and dominant species by growth form.
- A complete species list was made for each region.
- Additional data were gathered specific to the location, habitat, etc. in which plants were collected (these collection localities are referred to as "collection-sites"). The nature of data collected is discussed in the following section.
- An aerial-oblique photo of the region and significant plant associations was taken on departure.
- Vouchers were collected and curated as discussed below.

Vouchers and Curation

Voucher specimens were collected for those species that are new to the park or eco-region, species of concern (rare, endemic, exotic), geographic or ecological range extensions and specimens not identifiable in the field. For species of grapefern (*Botrychium*), above-ground portions of the fern were collected for isozyme analysis at the University of Iowa. Unused portions of the plant will serve as voucher specimens. The following data were collected for each vouchered specimen: date, unique collection number, latitude and longitude (NAD27, decimal degrees); slope, aspect, elevation, topographic position, associated landforms, associated species, vegetation class, substrate, soil moisture, soil type, drainage, parent material, cover class and frequency class, notes on characters not preserved well, associated photo number, phenology and ecological observations. A "collection-site" is a location in which plants with the same specific latitude, longitude, habitat type, and collection date are collected. Collection-sites can include from just a single vouchered specimen to over 20, and is confined to an area of less than 400 m² of similar habitat attributes.

The size of the population and area surveyed was included for species of concern.

Collections were made only if the population was large enough to support removal of individuals and followed the collecting protocol of Murray and Parker (1990). Duplicate or triplicate collections were made when possible, allowing the first set to be archived at the Herbarium of the University of Alaska Museum (ALA) and the second set to be sent to the park.

Specimens were sorted, examined and identified by AKNHP botanists who collected them and the collections were then sent to ALA where notable finds and difficult taxa were reviewed by the Museum staff. As needed, specimens were sent out to authorities by ALA for determination.

A cooperative agreement was initiated with ALA for curation. Specimens to be archived at ALA and those to go to park herbaria were prepared at ALA.

At the park level, specimens will be curated through the import of data into ANCS+. Specimens returned to parks from ALA will be filed and accessioned. In addition, catalog ledgers will be updated and loan forms completed. Rare plant sighting forms (with maps) were completed for taxa with an AKNHP rank of S3 or less.

Products

The AKNHP has agreed to supply the NPS with this Final Technical Report that also includes:

1. An annotated species list describing all taxa and the basic geographic and habitat attributes of each park unit (Appendix 1).
2. Preparation of rare plant species lists for each unit, with notes on conservation status, biogeographic affinities, habitat preferences and related data (Appendix 2).
3. Publication-quality maps for selected species such as species of special concern or major range extensions that result from this project (Discussion).

In addition, the AKNHP has supplied/will supply the following to NPS:

4. A complete set of mounted and curated voucher specimens, to be housed at the Herbarium of the University of Alaska (ALA), with a set of duplicates supplied to the park.
5. Work with NPS to create a fully populated NPSpecies, and ANCS+ databases for each park unit
6. Annual reports describing the results of the inventory in each park unit
7. GIS data layers with links to plant databases (GIS attributes discussed in Appendix 3)

RESULTS

Significant increases in numbers of vascular plant species verified for KATM and ALAG were made in 2002. We collected, recorded, and curated 530 specimens from KATM and 133 from ALAG. 317 separate taxa were represented, and 187 were new records or verifications of unconfirmed taxa for Katmai Park. All 120 taxa collected from ALAG were new records. A number of finds were significant range extensions or of taxa of conservation concern. Significant results from collections are described for each of the primary regions. An annotated species list describing all taxa and the basic topographic and habitat attributes for ALAG and KATM is presented in Appendix 1. Appendix 2 give a list of rare species encountered.

Alagnak Wild River (ALAG)

Prior to this survey, virtually no plants had been collected in the ALAG unit. In a single drift trip from the confluence of the Nonvianuk and Alagnak Rivers to Middle River Camp, a distance of roughly 42 km we collected 133 specimens. Of these, 120 were new records for the unit. Nearly all of the species collected are common in the Bristol Bay Lowlands and are distributed throughout the holarctic region. No species of conservation concern or major range extensions were encountered. However, an unusual grass specimen was collected, and is currently being reviewed.

ALAG Area 1 -

At the Alagnak-Nonvianuk confluence, 66 specimens were collected from riparian and higher elevation, bluff habitats. The location was 59.03° N and 155.88° W and ranged from 170 to 210 m in elevation (see Figs. 3 & 4). Habitats within the survey area were more diverse than most of the other areas along the ALAG. Common habitats were wet tussock meadows bordered by shrub birch and alder, low shrub-graminoid meadows, and low-shrub tundra; additionally, a limited amount of dry-boreal community with an overstory of Kenai birch and white spruce were encountered (Fig. 4).

In the wet tussock meadows many widespread wetland *Carex* species were collected, such as *C. canescens*, *C. loliacea*, *C. pluriflora*, *C. saxatilis*, and *C. utriculata*. Other common wetland species collect included: *Rumex aquaticus*, *Spiranthes romanzoffiana*, and *Drosera rotundifolia*. Kenai birch (*Betula kenaica*) and *Alnus viridis* ssp. *fruticosa* were the small trees and shrubs collected from this site. *Ribes laxiflorum* (trailing black current) is a dry-mesic forest species that is uncommon in western Alaska. This species is more common in dry boreal forest in the Cook Inlet area, and ranges southeast along the Pacific coast and Rocky Mountains. This taxon was also found in Lake Clark in 2001, and these collections represent some of the most westerly known populations of this species. A specimen temporarily referred to as "*Bromus viviparus*" was collected in a small birch and alder stand. This grass looks superficially like the genus *Bromus*, but the awns appear distinctly more subapical, than is characteristic for the genus - in some cases the awns are actually dorsal. This collection is being reviewed. No other taxa from this area are significant range extensions or species of conservation concern.

ALAG Area 2 -

In a low shrub-graminoid community, approximately 3 km downstream from confluence of Alagnak and Nonvianuk rivers, on the north side of the river, 11 specimens were collected (59.01° N, 155.90° W; see Fig. 5). This included the aquatic and semi-aquatic species, *Hippuris vulgaris*, *Juncus filiformis*, and *Iris setosa*. *Agrostis scabra*, *Rhinanthus minor*, *Viola epipsala* were some of the mesic-wet meadow species collected at this site.

ALAG Area 3 -

This moist, closed willow thicket had a low diversity of vascular plants (location: 59.01°N, 156.05°W; see Fig. 5). Five taxa, each from separate families were collected. These were *Populus tremuloides*, *Rorippa palustris* var. *palustris*, *Rubus arcticus* ssp. *stellatus*, *Galium trifidum* ssp. *trifidum*, *Cicuta virosa* (*mackenzieana*). All of these are common throughout Alaska. *Populus tremuloides*, which is a dry-boreal species, reaches its southwesterly range limit in this Alagnak River area.

ALAG Area 4 -

Ranunculus trichophyllus, *Petasites frigidus*, *Betula nana*, *Festuca richardsonii*, and *Chrysosplenium tetrandrum* were collected from a low shrub-graminoid location just downstream from Area 3 (59.01°N, 156.09°W; see Fig. 6). These five of these species have circumpolar distributions and were expected to occur in the ALAG unit.

ALAG Area 5 -

At this rocky outcrop and bluff on the south side of the river, we collected 17 taxa (location: 59.01°N, 156.11°W; see Fig. 6). This was one of the few non-wetland and higher elevation sites encountered, and the species collected reflect the dwarf shrub - herbaceous tundra character. The grass species were *Festuca brachyphylla*, *F. altaica*, and *Hierochloe odorata*. Mesic-tundra herbaceous species collected were *Anemone narcissiflora* (Fig. 31A), *Antennaria monocephala*, *Arnica frigida*, *Carex podocarpa*, *Chamerion* (*Epilobium*) *latifolium*, *Pedicularis lanata* (*kanei*) (Fig. 31B), *Pinguicula villosa*, and *Tofieldia coccinea* (Fig. 31C). The woody species were all dwarf shrubs (*Diapensia lapponica*, *Loiseleuria procumbens*, *Salix arctica*, *S. phlebophylla*). All of these species are circumboreal except *Antennaria monocephala*, *Arnica frigida*, *Carex podocarpa*, and *Salix*



Figure 31A. *Anemone narcissiflora* - a common species encountered throughout ALAG & KATM in open mesic sites.



Figure 31B. *Pedicularis lanata* - a species of mesic tundra.

phlebophylla, which are common throughout Beringia.

ALAG Area 6 -

This was a wetland site, of small ponds and adjacent wet-sedge meadows (location: 59.02°N, 156.14°W; see Fig. 6). Eleven voucher species were collected including *Eriophorum russeolum*, *E. vaginatum*, *Carex kelloggii*, *C. rotundata*, *C. utriculata*, *Arctophila fulva*, *Sparganium angustifolium*, and *Subularia aquatica*. All of these species are common over much of Alaska and have a holarctic distribution.

ALAG Area 7 -

In sandy, mesic soil on a gravel bar along the river, *Alopecurus aequalis*, was collected (location: 59.08°N, 156.3°W; see Fig. 6). This grass was scattered throughout the site and was also encountered along Contact Creek in southwestern KATM. This species is widespread throughout interior and south coastal Alaska and neighboring regions.

ALAG Area 8 -

The ericaceous shrubs *Vaccinium uliginosum* (Fig. 31D), *V. vitis-idaea*, *Empetrum nigrum* and arctic/subarctic grasses *Calamagrostis canadensis*, *Arctagrostis latifolia* were collected from the white spruce-low shrub community of this site (location: 59.12°N and 156.33°W; see Fig. 6).

ALAG Area 9 -

A total of 12 specimens were collected and pressed from the wet, sandbar community of Area 9 (59.09°N and 156.47°W; see Fig. 3). The graminoid species were *Juncus arcticus*, *Carex lyngbyei*, *Agrostis scabra*, *Deschampsia caespitosa*, and *Glyceria maxima*. Additional species collected were aquatic or semi-aquatic, including: *Callitriche palustris*, *Caltha natans*, *Ranunculus gmelinii*, and *Limosella aquatica*. *Limosella aquatica* is a widespread species, but has only infrequently been collected in Alaska, probably due to its small stature and aquatic nature.



Figure 31C. Close-up photo of *Tofteldia pusilla* a close relative of *T. coccinea*, found in open rocky tundra.



Figure 31D. *Vaccinium uliginosum*.

Katmai National Park and Preserve (KATM)

Fieldwork at three primary regions and some brief collecting at additional stations resulted in 530 specimens; 146 are new records for the park. New records were obtained from all primary sites and from all major habitat types. Most of the new records were of common species widespread throughout Alaska and/or the holarctic region; however, a number of taxa of conservation significance were also collected. These are discussed below.

KATM Region 1 -

In a targeted search for unknown and under-collected taxa, we collected 153 specimens from around Swikshak Lagoon in early July and again briefly in mid-August. Collecting occurred in all six primary habitat types encountered (i.e., intertidal communities; forb-graminoid meadows; freshwater ponds and marshes; alder and willow thickets; wet, low shrub-sedge meadows and fens; and herbaceous-dwarf shrub tundra, and exposed alpine slopes). A summary of results for each habitat type follows.

Intertidal Communities -

A total of 15 taxa were collected from salt marsh and upper beach strand habitats. In general this habitat was moderately low in diversity. The biomass was dominated by *Honkeya peploides*, *Leymus mollis*, *Poa eminens*, and *Carex macrocephala* in sandy, beach strand areas, and by *Plantago maritima*, *Carex lyngbei*, *C. ramenskii*, and *Argentina (Potentilla) egedii* in salt-marsh communities. Most of these dominants had been collected before in the park; however, ten of the specimens had not been confirmed in KATM. These include the common and widespread species: *Carex ramenskii*, *Argentina (Potentilla) egedii*, and *Stellaria humifusa*. We collected *Cakile edentula* from a sandy site, which is a species restricted to scattered coastal, sandy beaches in Alaska. *Cakile edentula* is quite common along the coastal sand dunes from California to British Columbia, but becomes increasingly rare in the Gulf of Alaska coast. Isolated populations are known from exposed beach sites in southeast Alaska, remote islands in Prince William Sound, on southern Kodiak Island, and at Aniakchak. This population is one of the farthest west collections known from the mainland.

Forb-Graminoid Meadows -

We collected 33 taxa from forb-graminoid meadows. Of these, 26 were new verified records for the park. Many were common species such as *Lupinus nootkatensis*, *Heracleum lanatum*, *Carex gmelinii*, and *Achillea borealis*. The composition of species in this community was typical of the eastern Aleutians and Alaska Peninsula coast, with many umbels (Apiaceae), lupines, geraniums, and large orchids. This included the striking orchids *Dactylorhiza aristata* and *Cypripedium guttatum* (Figs. 32A-B).



Figure 32A.
Dactylorhiza aristata.



Figure 32B.
Cypripedium guttatum.

Freshwater Marsh -

Twenty-one taxa were collected from freshwater communities in the Swikshak Lagoon area. Many of the collections were of aquatic species such as *Hippuris vulgaris*, *Sparganium angustifolium*, *Potamogeton sp.*, *Menyanthes trifoliata*, and *Utricularia vulgaris*. These habitats tended to be moderately diverse, yet only ten of the taxa were new to the park. The new taxa included two widespread wetland sedges (*Carex chordorrhiza*, and *C. rostrata*) and a number of the new records are often found in wet places, but are not obligate wetland species (e.g., *Prenanthes alata*, *Campanula rotundifolia*, and *Galium trifidum*)

Alder and Willow Thickets -

Vascular plant diversity was low in this habitat-type. Only five specimens were collected in this community; two represent new collections for the park. *Boschniakia rossica* was a new record for KATM. This species is an obligate parasite on *Alnus* and is common throughout Alaska and northeastern Asia. *Oplopanax (Echinopanax) horridum* was another new collection that was previously unconfirmed record for the park. This collection represents the approximate western limit of this species, whose distribution is centered along the northwestern Pacific Coast Mountains.

Wet, Low Shrub - Sedge Meadows and Fens -

Many taxa new to the park were found in this habitat-type. Thirteen of 23 collections were new to KATM. A collection of the previously unverified, *Picea sitchensis* was made from a small grove on the headland 10.5 km northeast of the Swikshak cabin. According to park rangers, stands of this species are more common from Hallo Bay south to Katmai Bay, but are unknown north of Swikshak Lagoon. Additional collections from wet-sedge meadow that were new or confirmations to the park were three widespread sedges *Carex norvegica (media)*, *C. pluriflora*, and *C. rotundata*. Collections of *C. rotundata* are generally absent from the Bristol Bay Lowlands; most collections are concentrated in wet places in northern, western, and southcentral Alaska. The collection of *C. rotundata* at Swikshak is the one of the more southerly collections of this sedge;

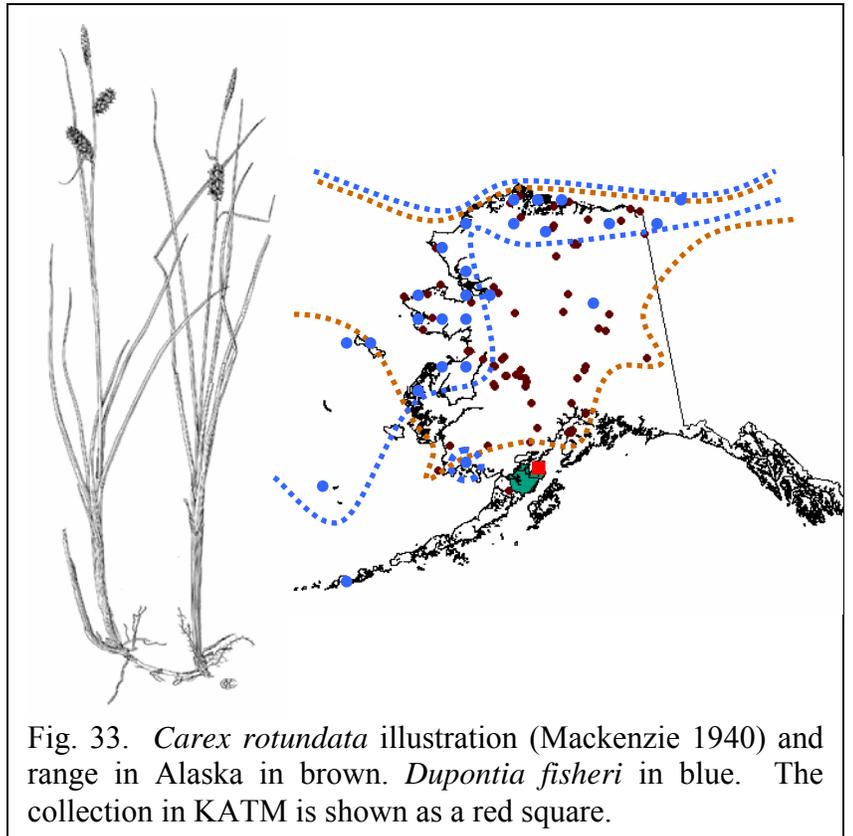


Fig. 33. *Carex rotundata* illustration (Mackenzie 1940) and range in Alaska in brown. *Dupontia fisheri* in blue. The collection in KATM is shown as a red square.

however, it has been collected recently by S. Talbot further south in Becharof NWR (Fig. 33). A more striking range extension and addition to the park is the collection of *Dupontia fisheri* (Fig. 34A-B). The population was found along the edge of a pond in a wet sedge meadow, bordered with alder and willow, cottonwood and birch. This common circumpolar grass is typically found in wet coastal tundra of arctic and western Alaska, and similar regions of Northern Canada, Greenland, and Russia. In Alaska, isolated outlying populations have been found at Cold Bay on the Alaska Peninsula and Cape Pierce in southwest Alaska. This collection of *Dupontia fisheri* at Swikshak is the furthest east location, and the first from a woodland habitat in Alaska. This site is over 320 km from the Cape Pierce location. Individuals of *D. fisheri* were scattered or patchy to numerous; total population size is likely > 5,000. The primary associated species were *Carex lyngbyei*, *Calamagrostis canadensis*, *Eriophorum russeolum*, *Comarum (Potentilla) palustre*, and *Sphagnum* spp.

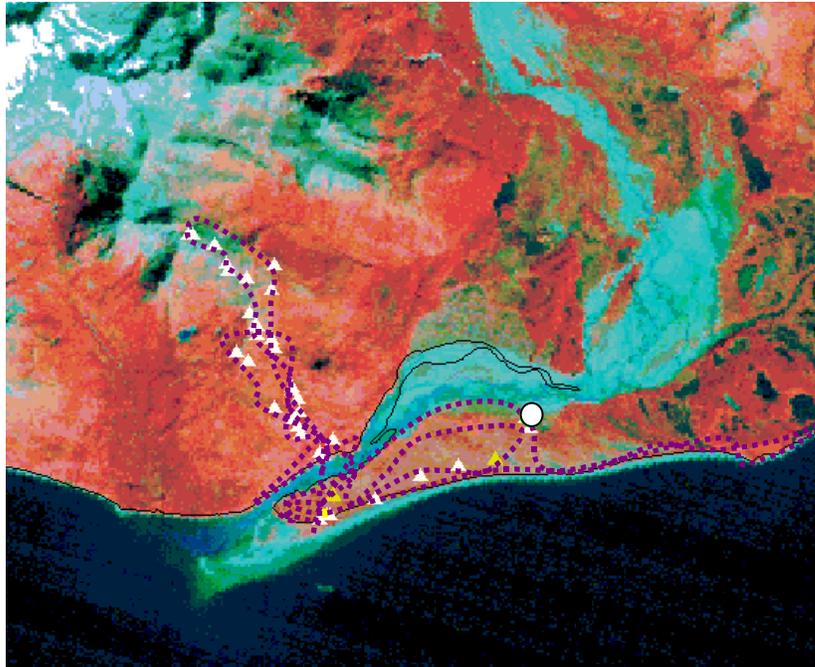


Figure 34A. Collection locality of *Dupontia fisheri* at Swikshak Lagoon, shown as a white circle.



Figure 34B. Photo of *Dupontia fisheri* taken at Swikshak Lagoon.

Herbaceous - Dwarf Shrub Tundra -

Few previous collections were from this habitat-type. Therefore, we spent a large portion of our time surveying tundra communities. A total of 155 specimens were collected, pressed, and catalogued from alpine meadows and tundra habitats around Swikshak. Of the total, 30 taxa were new to the park (or confirmations of "unconfirmed" taxa). Five of the new records were the sedges: *Carex anthoxanthea*, *C. nardina*, *C. podocarpa*, *C. rupestris*, *C. scirpoidea*, and *Kobresia myosuroides*. *Carex anthoxanthea* is an alpine species common on grassy slopes in coastal-southern Alaska. *Carex nardina*, *C. rupestris*, *C. scirpoidea* and *Kobresia myosuroides* are species that had not been collected on the Alaska Peninsula. The *Kobresia myosuroides*, *Carex nardina*, and *C. rupestris* represent range extensions to the southwest approximately 350-500 km (see Figs. 39-41). *Carex scirpoidea* has been widely collected in the Alaska Range and on Kodiak Island, but no records are present for the Alaska Peninsula. The other new records included a variety of widespread species, ranging from the ferns *Botrychium lunaria* and *B. lanceolatum* to more "advanced" (i.e., recently derived) angiosperm families such as Scrophulariaceae s. l. (*Pedicularis lanata*) and Asteraceae (*Arnica lessingii*).

KATM Region 2 -

At this high elevation area (400 - 900 m) in the vicinity of Mirror Lake, we recorded nearly 40 new records for the park, including a number of substantial range extensions and two globally and state, rare taxa (Alaska Natural Heritage Program - Rare Plant Tracking List).

Aquatic/Semi-Aquatic -

Fifteen specimens were collected from aquatic to semi-aquatic habitats. These include six species that are new to the park: *Andromeda polifolia*, *Carex anthoxanthia*, *C. membranacea*, *Juncus biglumis*, *J. drummondii*, and *Primula eximia* (sensu Kelso 1987). Most of these new records are of widespread taxa (e.g., *Andromeda polifolia*, *Carex membranaceae*, *Juncus biglumis*).

We collected *Primula tschuktschorum* (sensu stricto) in saturated wet tundra along upper Funnel Creek and again in a population mixed with *P. eximia* along a wet pond margin in saturated soil near Mirror Lake. This is not only a significant range extension from known-verified collections, but is a globally rare taxon (Fig. 35). This species may have been collected in KATM in 1978; however, prior taxonomic confusion relating to this species makes the identity of this early collection dubious. The taxon was outlined as *Primula tschuktschorum* var. *tschuktschorum* by Hultén (1968), who loosely distinguished it from



Figure 35. *Primula tschuktschorum* growing along saturated pond margins at KATM Region-2.

P. tschuktschorum var. *arctica* on the basis of plant size. The two varieties were later raised to species status by Kelso (1987), who described a number of clear and consistent traits to separate the rare, *P. tschuktschorum* (s.s.) from the larger and more widespread *P. eximia*. Bud Rice with NPS made a collection of "*P. tschuktschorum* var. *arctica*" at Murray Lake, Katmai in 1978. He would not have been using the currently accepted treatment of these two taxa, and since they are poorly delineated in Hultén (1968), it is difficult to say with certainty which taxon was collected in the park in 1978. A careful examination of his collection is clearly warranted along with the recent *Primula* collections by AKNHP botanists. AKNHP assumed they had collected *P. tschuktschorum* (s.s.) from two populations; however, determinations by ALA indicated that both *P. tschuktschorum* and *P. eximia* had been collected. Duplicate sheets from the "*P. eximia*" site suggest *P. tschuktschorum* is also present. The morphology of *Primula* at Mirror Lake appears to be intermediate in many traits and a closer evaluation is needed.

The specific collection locality of *P. tschuktschorum* (s.s.) by AKNHP is shown in Fig. 36. This species is restricted to the Bering Strait Region with an outlying populations south to the northern coast of Bristol Bay. The KATM Region-2 population is located nearly 320 km to the east of the northern Bristol Bay populations (see Fig. 54). At KATM Region-2, *P. tschuktschorum*, was relatively common along the banks of shallow ponds and snowmelt areas at around 400 to 450 m and into wet-sedge tundra communities with noticeable water flow (see Fig. 35). Many patches of 50 - 200 plants were encountered, with a total population size estimated at 5,000 individuals. This

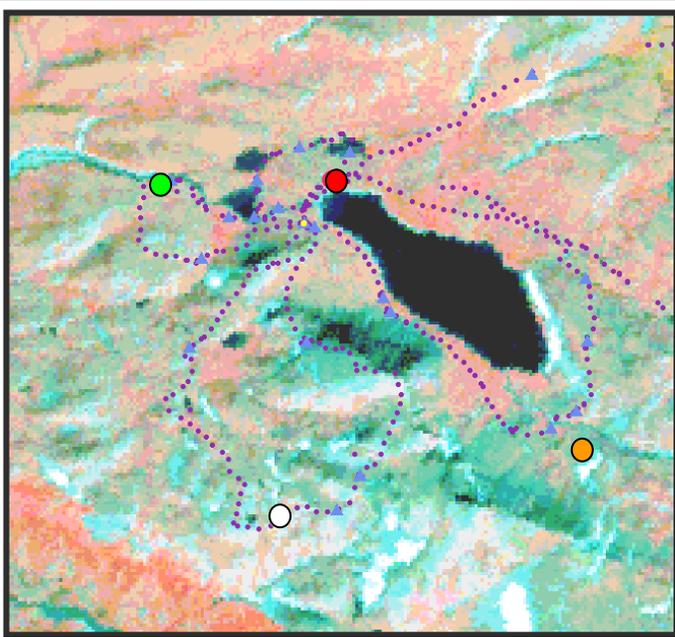


Figure 36. Collection-sites of KATM Region-2, as blue triangles. *Primula tschuktschorum* site is highlighted in green and the potentially mixed *P. tschuktschorum*-*P. eximia* site in red. *Aphragmus eschscholtzianus* site is shown in white, and *Ranunculus nivalis* in orange.

species was always associated with heavy saturated soils, generally with a shallow layer of peat. The associated species of the rare primrose were: *Calamagrostis canadensis*, *Carex podocarpa*, *Sanguisorba sitchensis*, *Salix glauca*, *Rumex* spp., *Eriophorum* spp., *Salix reticulata*, *Vaccinium uliginosum*, *Festuca altaica*.

Wet-Sedge Tundra -

Poorly drained, wet-sedge tundra was encountered west of Mirror Lake and 18 specimens were collected from this habitat. Of the 18 specimens, ten were new to the park: *Anemone narcissiflora* ssp. *monantha* (*alaskana*), *Carex bigelowii*, *C. rariflora*, *Eriophorum angustifolium* ssp. *scabriusculum*, *E. russeolum*,

Lagotis glauca, *Ranunculus nivalis*, *Rumex arcticus*, *Salix fuscescens*, and *Saxifraga hirculus*. The new records included a range extension of the sedge, *Carex rariflora*, which is more common in wet peaty soils in southcentral and central Alaska but was not known from the Alaska Peninsula. *Ranunculus nivalis* was collected on the southern end of Mirror Lake (Fig. 36). This taxon, which is a circumpolar species of wet meadows in mountains or tundra, was previously unrecorded from southwestern Alaska. The nearest collections are ca. 160 km north in the Chigmit Mountains of Lake Clark National Park and Lime Hills, and ca. 500 km northwest at Hooper Bay on the Bering Sea.

Low Shrub - Herbaceous Tundra -

The most common type of habitat encountered at KATM Region-2 was low shrub-herbaceous tundra and 38 specimens were collected. Of these, 15 were new park records: *Agrostis mertensii*, *Arnica latifolia* (Fig. 37), *Campanula uniflora*, *Carex bigelowii*, *Carex lachenalii*, *Draba stenoloba*, *Equisetum scirpoides*, *Lupinus nootkatensis*, *Pedicularis albolabiata* (*sudetica* ssp. *albolabiata*), *Pedicularis labradorica*, *Saxifraga lyallii*, *Thalictrum alpinum*, *Tofieldia pusilla*, *Vaccinium ovalifolium*, *Veronica wormskjoldii*. The new record, *Arnica latifolia*, is well known from Kodiak Island and Kenai Peninsula-Susitna Valley and to the southeast; however, no records are known from the Alaska Peninsula. *Equisetum scirpoides* is a new park record and a moderate range extension south (the species is generally collected much farther to the north). *Campanula uniflora* is a widespread circumboreal alpine species with populations from Norway to the Rocky and Sierra Mountains. This taxon is found on arctic and alpine tundra in northern Alaska, through the Alaska Ranges and in the Aleutians. No records were known from the northern portion of the Alaska Peninsula.

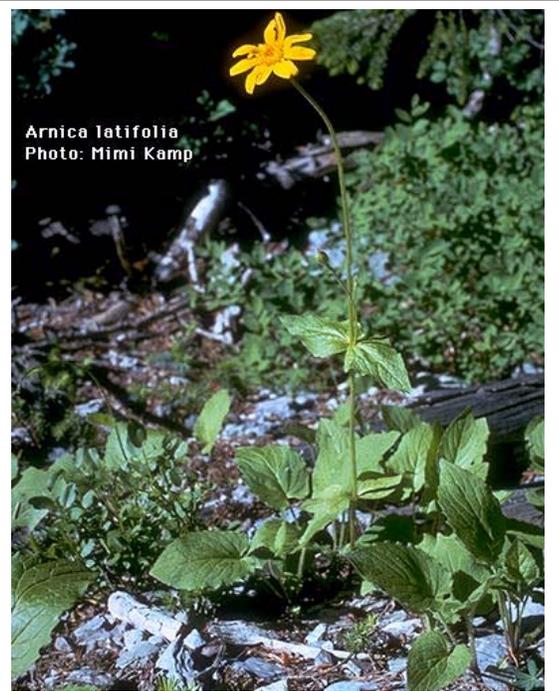


Figure 37. Photo of *Arnica latifolia* (http://www.swsbm.com/Images/A/Arnica_latifolia-3.jpg)



Figure 38. Photo of *Eritrichium chamissonis* from KATM Region-2 (Mirror Lake).

Alpine Fellfields -

Eight of 19 collections in the alpine communities, surrounding Mirror Lake, were newly verified park records *Aphragmus eschscholtzianus*, *Carex micropoda*, *Cryptogramma sitchensis*, *Draba fladnizensis*, *Festuca brevissima*, *Ranunculus nivalis*, *Saxifraga flagellaris*, *Saxifraga serpyllifolia*. Nearly all of these collections were of very widespread species. Two collections were of more

restricted species. We collected *Eritrichium chamissonis* (see Fig. 38) that is a species restricted to rocky or sandy soil in the Bering Sea area, from the upper Colville River in the western Brooks Range to the Chukotka Peninsula in Russia and south to the Pribilof Islands, Alaska Peninsula, and east to Kodiak Island. Despite a narrow geographic range, this species is relatively common and has been collected in a number of areas near Katmai Park and was listed by Young et al. (1978) as present in the park, although not vouchered until recent collections by T. Smith. *Aphragmus eschscholtzianus* (Fig 39A) on the other hand, is listed as a G3, S3 (rare or uncommon globally and within the state) and is known from scattered alpine sites in the Aleutians, east across the Alaska Range, Chugach and Wrangell Mountains to Northern B.C., with disjunct populations on the Seward Peninsula and Central Brooks Range (see Fig. 53). This rare mustard is restricted to solifluction soil and rocky melt-ponds at high elevations. We located the *Aphragmus eschscholtzianus* population on a rocky, sparsely vegetated, former melt-pond along an alpine bench just south of Mirror Lake (Fig. 39B). The population size was between 100 and 200 individuals. Nearby associated species included *Carex microchaeta*, *Ranunculus eschscholtzii*, and *Lagotis glauca*.



Figure 39A. *Aphragmus eschscholtzianus* photographed from a different site in southcentral Alaska.



Figure 39B. Collection locality of *Aphragmus eschscholtzianus* at KATM Region-2 (Mirror Lake).

KATM Region 3 -

Aquatic/Semi-Aquatic -

We collected 24 specimens along the lakeshore, in shallow ponds to the north and west of the lake, and along a number of streams in the vicinity of Contact Creek. This included obligate aquatic species such as four *Potamogeton* species (*P. filiformis*, *P. gramineus*, *P. praelongus*, *P. pusillus*) *Sparganium angustifolia*, and *Subularia aquatica*, and wetland species such as *Carex lyngbyei*, *C. chordorrhiza*, and *Comarum palustre*. Additionally, we collected a number of taxa from wet sand and gravel bars such as *Rorippa palustris* ssp. *palustris*, *Barbarea orthoceras*, and even an isolated *Papaver radicum* ssp. *alaskanum* that likely was washed down from higher elevations. Nine taxa from aquatic/semi-aquatic habitats were new records for KATM. This included: *Aster sibericus*, *Callitriche heterophylla*, *Poa glauca*, *Poa pratensis*, *Polygonum fowleri*, *Potamogeton gramineus*, *Sagina saginoides*, *Sparganium angustifolium*, *Utricularia vulgaris*. *Polygonum fowleri* has been collected along the Gulf Coast from British Columbia through Alaska as far as Kodiak Island, but no collections are known from the mainland west of Homer.

Wet-Sedge Tundra -

Twenty specimens were collected from wet-sedge tundra. *Carex bigelowii*, *Carex media*, *Carex membranacea*, *Carex sitchensis*, *Epilobium palustre*, *Eriophorum russeolum*, *Eriophorum vaginatum* (Fig. 40), *Juncus triglumis*, *Pedicularis parviflora* ssp. *parviflora*, and *Saxifraga hirculus* were new park records. These species are widespread in wet areas of southwestern Alaska.

Low Shrub - Herbaceous Tundra -

At mid elevations, low shrub-herbaceous tundra was commonly encountered. We recorded 26 taxa; nine are new park records. The new taxa were *Betula glandulosa*, *Isoetes echinospora*, *Lycopodium alpinum*, *Poa glauca*, *Draba nivalis*, *Prenanthes alata*, *Carex bigelowii*, *Arnica chamissonis*. Two species, *Artemisia globularia* and *Stellaria laeta*, were found on more open, rocky microsites within the to low shrub-herbaceous tundra.

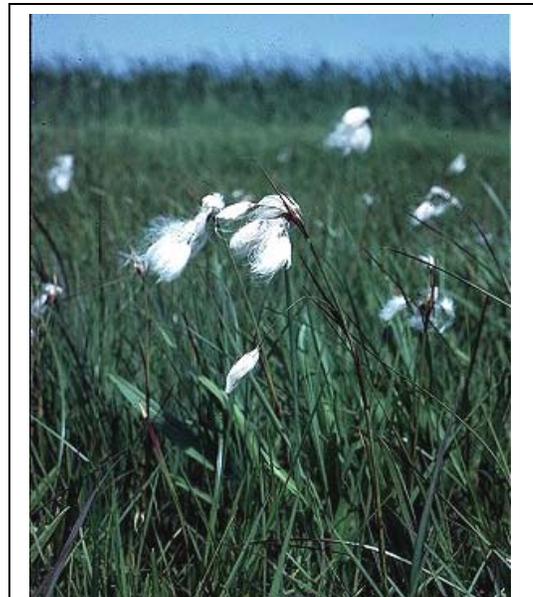


Figure 40. *Eriophorum vaginatum*. Photo from Robert W. Freckmann, Wisconsin State Herbarium.

Alder and Willow Thickets and Bluejoint Meadows -

Alder and willow thickets and adjacent bluejoint meadows were very low in diversity, and we collected just six taxa in this habitat. *Cicuta douglasii*, widespread in southern Alaska and western North America, was the only taxa new for the park.

Alpine Fellfields -

Five specimens were collected from higher elevation, fellfield sites. None of the collections are new to the park. However, *Claytonia scammaniana* (see Fig. 40) is endemic to Alaska and western Yukon Territory, with most populations clustered in the Alaska Range, Tanana Uplands, and scattered locations southwest to Goodnews Bay. One population has been recorded just south of Katmai Park on the Alaska Peninsula and recently Tom Smith has collected the taxon in the park.



Figure 40. *Claytonia sarmentosa*, a close relative of *C. scammaniana*, which is found in moist, mossy microsites. *Claytonia scammaniana* is generally found on talus slopes in the mountains.

Ancillary Sites -

A total of 66 taxa were collected and recorded from additional sites scattered throughout the park. The majority of collections were from the upper Nonvianuk River in the northwestern region of KATM. This included 34 mostly wetland specimens, 14 of which were new park records: *Aster sibericus*, *Carex brunnescens* (Fig. 41A) *Carex pluriflora*, *Carex rotundata*, *Carex tenuiflora*, *Carex williamsii*, *Epilobium palustre*, *Eriophorum vaginatum*, *Isoetes echinospora*, *Poa pratensis*, *Ranunculus lapponicus*, *Rumex arcticus*, *Salix fuscescens*, and *Trichophorum caespitosum*. *Carex williamsii* is a new park record, whose distribution is generally confined to the northern half of Alaska. However, within the last ten years populations have been located at Ugashik on the Alaska Peninsula, just south of KATM, and on Kodiak Island.

Fourteen specimens were collected from areas around Brooks camp. *Carex media*, *Juncus arcticus* ssp. *sitchensis*, *Juncus alpinus*, *Matricaria matricarioides*, and *Taraxacum trigonolobum* were new to the park. Our collections included three introduced species: *Capsella rubella* and *Plantago major* var. *major*, along with the previously

unknown, *Matricaria matricarioides*. All of these collections of exotics were around developed areas such as buildings, roads, and campgrounds.

Seven species were collected from Dakavak Lake the southeastern part of KATM. *Aruncus dioicus* (*sylvester*), *Poa pratensis*, and *Romanzoffia sitchensis* were new records for the park and *Salix sitchensis* was formerly unconfirmed.

At Sukoi Bay, on Cape Douglas, 11 voucher specimens were collected. This site, visited in mid-August, had all new or previously unconfirmed park records. The taxa new to the park at this location were: *Arnica amplexicaulis*, *Campanula rotundifolia* (41B), *Dendranthemum arcticum* ssp. *arcticum*, *Gentiana douglasiana*, *Gentiana platypetala*, *Juncus supiniformis*, *Plantago macrocarpa*, *Prenanthes alata*, and *Vaccinium ovalifolium*.



Figure 41A. *Carex brunnescens*, photo from Emmet J. Judziewicz, Wisconsin State Herbarium.



Figure 41B. *Campanula rotundifolia*, photo from Robert R. Kowal, Wisconsin State Herbarium.

DISCUSSION

A vascular plant inventory was conducted by the Alaska Natural Heritage Program in agreement with NPS to provide baseline information for future monitoring and management of natural resources for Katmai National Park and Alagnak Wild River Units. The AKNHP documented the occurrence, distribution, and relative abundance of plants occurring in these units with the primary goal of documenting $\geq 90\%$ vascular plant taxa expected to occur within the parks and improve our understanding of current species distributions.

Significant increases in the number of vascular plant species verified for KATM and ALAG were made in 2002. Prior to 2002, no plants were reliably known from the ALAG and 54% of the 623 expected taxa were known from KATM. Following the 2002 field season, 120 new taxa were recorded for ALAG. An estimated total of 390 taxa are possible within ALAG, based on an analysis of the distribution and habitat requirements of southwestern Alaskan plants. However, this is likely a severe overestimate, since the ALAG unit is quite small and narrow, excluding a broad range of substrate and habitat types. Based on this broad interpretation of expected taxa, we collected 31% of the potential vascular plant species. Additional, targeted collecting would likely add 60 -100 taxa to the 120 collected in 2002.

The percent of documented and vouchered taxa in KATM jumped from 54% prior to 2002 to 84% after the field season. This included documenting previously unconfirmed taxa, collecting many well-known and widely distributed taxa, but also a number of conservation significance. It is likely that an additional 20-40 taxa can be added to the 523 now verified in the park with a single field season of future collecting in novel habitat types and geographic regions. This would closely approximate the goal of NPS in documenting $\geq 90\%$ vascular plant taxa expected to occur within the park (ca. 40 new taxa are required to achieve 90%).

A number of important finds were made in KATM in 2002. AKNHP collected six species that are major range extensions, three species that are exotic weeds, and two species that are globally and regionally rare. The relevance and importance of the finds are discussed below.

Major Range Extensions -

Dupontia fisheri R. Br. ssp. *psilosantha* (Rupr.) Hult.:

Tundra grass (*Dupontia fisheri* ssp. *psilosantha*, Fig. 42) is a circumpolar grass of wet meadows in coastal tundra. In Alaska it is found across the North Slope and extending south across the coastal tundra of the Seward Peninsula to the Yukon-Kuskokwim Delta, with outlying, disjunct populations at Cape Pierce and Cold Bay (Fig. 33).

The population at Swikshak (KATM Region-1) is a range extension to the east of 320 km from the Cape Pierce population and is unusual in being surrounded by open deciduous woodland. (Typically, this tundra species is not found near wooded habitats). Figure 43 (top) shows the more typical habitat of the species relative to the habitat it was found in at Swikshak (Fig. 43: bottom). The total population size was likely $\geq 5,000$ individuals.

As with nearly all populations of *Dupontia* in western and southwestern Alaska, this population was quite uniform in morphology and typical of subspecies *psilosantha*. No individuals were suggestive of, or intermediate to, subspecies *fisheri*. This supports the maintenance of the two forms as distinct taxa (see discussion in Aiken et al. in prep).

The two disjunct populations in south-western Alaska are likely the result of long-distance dispersal by waterfowl. The grass is an important food source for migrating ducks and geese (Gauthier et al. 1995) and the locations of these southerly, disjunct populations are along migration routes. It is unlikely that is a relictual population as the region was heavily glaciated during the Pleistocene.

While the KATM population is relatively large and secure, it is still a conservation concern. Disjunct populations are not genetically linked to other populations and are often under divergent natural selection. This creates an opportunity for the population to develop novel genetic-morphological-ecological attributes, via genetic drift and selection, not found in other, more contiguous populations. We therefore stress the importance of this population (and of the other range extensions discussed below) and suggest that modest population monitoring occurs in the future. This is discussed further in the "Recommendations" section below.



Figure 42. Photo of *Dupontia fisheri* from Swikshak Lagoon.



Figure 43: Top. Typical coastal north-slope habitat of *Dupontia fisheri*. Photo is from A. T. L. A. S. (Arctic Transitions in the Land-Atmosphere System: http://www.geobotany.uaf.edu/atlas/atlas_sites.html)

"Barrow, Arctic Coastal Plain (coastal acidic tundra)
 The site is located in Subzone 3 (N 71 19 17.6, W 156 36 29.3) on a fairly homogenous flat residual surface (unaffected by thaw-lake processes). Most of the surface is either featureless or has flat-centered ice-wedge polygons. The primary plant community is *Saxifraga cernua*–*Carex aquatilis*. This type commonly occurs on moderately drained, zonal sites near the coast and is dominated by graminoids (*Alopecurus alpinus*, *Carex aquatilis*, *Dupontia fisheri*, *Eriophorum angustifolium*, *Poa arctica*), forbs (*Cardamine pratensis*, *Cerastium jenisejense*, *Chrysosplenium tetrandrum*, *Petasites frigidus*, *Saxifraga cernua*, *S. hirculis*, *S. hieracifolia*, *S. nelsoniana*, *Stellaria laeta* and mosses (*Oncophorus wahlenbergii*, *Polytrichastrum alpinum*, *Polytrichum strictum*, and *Sarmentypnum sarmentosum*). Prostrate and semi-erect willows (*Salix rotundifolia*, *S. planifolia* ssp. *pulchra*) are common in some areas." - A .T .L .A. S. (2002)

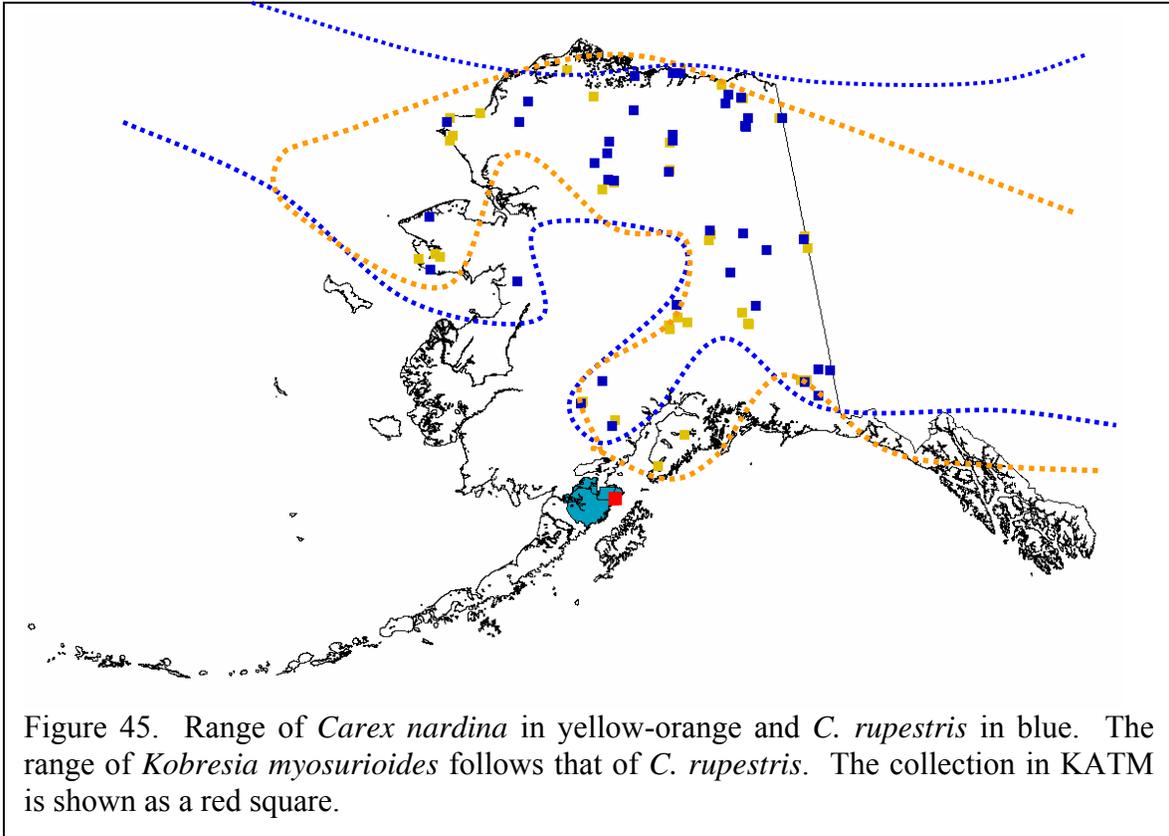
Figure 43: Bottom. Woodland marsh at Swikshak Lagoon, where *Dupontia fisheri* was found.

Carex nardina Fries:

On an exposed alpine knob at 450 m, just north of Swikshak Lagoon (KATM Region-1; Fig. 44) three significant range extensions of sedge species were noted. The substrate was dry and rocky and likely moderately calcareous. However, the material did not effervesce when acid was applied, so it was likely only modestly basic. The associated species were *Saxifraga oppositifolia*, *Saxifraga bronchialis*, *Minuartia obtusiloba*, *Rhodiola integrifolia* (*Sedum rosea*), *Festuca rubra*, *Artemisia arctica*, and *Silene acaulis*. Although, none of these species are obligate calciphiles, *Saxifraga oppositifolia*, and *Silene acaulis* are tolerant of high pH substrates and are common on calcareous sites; these two species were not found elsewhere in the area. The densely tufted, terminally spiked sedge, *Carex nardina* (Figs. 45, 46) was found in very limited numbers; perhaps less than 20 individuals were located. In general, this taxon is found on exposed, rocky arctic and alpine tundra, usually on calcareous parent material (Murray 2002). *Carex nardina* is common throughout mountainous and northern regions of the state but has not been observed on the Alaska Peninsula. However, a population was collected in 1996 by P. Caswell in the mountains of Lake Clark National Park, approximately 160 km to the north. Additionally, a collection is known about 160 km to the northeast, from a scree slope in Kachemak Bay on the southern tip of the Kenai Peninsula. The collection in KATM represents a moderate range extension to the southwest; however, it is not surprising since mountainous habitat is continuous from the Alaskan Range to the Aleutian Range.



Figure 44. Exposed alpine knob at Swikshak where *Carex nardina* and *C. rupestris* were collected. *Kobresia myosuroides* was collected from a site nearby.



Carex rupestris Allion:

We located another single-spiked, androgynous sedge, *Carex rupestris* (Figs. 44, 45, 47) that was growing together with *C. nardina* near Swikshak Lagoon (KATM Region-1). Thus, the substrate and associated species are identical to those described above. *Carex rupestris* is found on dry to mesic heaths and rocky outcrops; it has a very widespread holarctic distribution with populations in the Alps, Scandinavia, Siberia, East Asia, and throughout northern North America, including disjunct populations in the Rocky Mountains (Ball 2002a). In Alaska, this taxon is confined to the Alaska Range, Wrangell Mountains, Tanana Uplands, and Brooks Range (Fig. 45). A number of populations are also known from the Lime Hills. In 1997, P. Caswell located a population at Falls Mountain in Lake Clark National Park, roughly 160 km to the north of the population found at Swikshak. This range extension farther south along the Aleutian Range is not surprising. Only a narrow, 15-30 km low elevation "barrier", separates the high elevation sites of the Chigmit Mountains (Lake Clark and Lime Hills) with the continuous mountains of Katmai National Park. More extensive survey work would likely reveal more *C. rupestris* sites along the Walakta Mountains in KATM.



Figure 46. *Carex nardina*. Photo is from Nilsson 1995.



Figure 47. *Carex rupestris*. Photo is from Nilsson 1995.

Kobresia myosuroides (Villars) Fiori et al.:

At 450 m, in moist rocky soil at KATM Region-1, we collected *Kobresia myosuroides*. This voucher was made from a patch of ca. 100 individuals within ericaceous low-shrub tundra with a thick *Cladina* spp. and *Cladonia* spp. lichen component. The associated species were *Empetrum nigrum*, *Artemisia arctica*, *Carex podocarpa*, *Gymnocarpium dryopteris*, *Rubus arcticus*, *Vaccinium uliginosum*, and *Salix arctica*. The global and Alaskan distribution of this species is almost identical to that of *C. rupestris* (Fig. 45) and this collection near Swikshak Lagoon represents a 160-300 km range extension to the southwest. According to Hultén (1968), this species is associated with calcareous slopes and gravel bars. However, Ball (2002b) describes the habitat more broadly: "tundra, grasslands, heaths, bare rocky, dry to wet ground." The Swikshak population did not appear to be on a calcareous substrate with such a large ericaceous shrub component. However, this site is not far from the weakly calcareous site of *C. nardina* and *C. rupestris* and may, in fact, have a more basic pH.

Ranunculus nivalis L.:

At Mirror Lake (KATM Region-2), in a saturated snow bed we found a population of 500 to 1000 individuals of snow buttercup, *Ranunculus nivalis* (see Fig. 48). The snow buttercup is found in wet meadows and along brooks in the mountains and in snow beds, and blooms quickly after the snow has melted (Nilsson 1995). This is a common holarctic species found throughout the mountains of Alaska and near sea level in the Arctic (Fig. 49; Benson 1948), but according to Hultén (1968) has not been collected from the southwestern portion of the state. However, in 2001 the AKNHP collected the taxon near a mountain lake in Lake Clark National Park. The collection in KATM is a ca. 160 km range extension to the southwest.



Figure 48. *Ranunculus nivalis*. This photo was taken in Satteviera, Artfjället, Sweden. (www.quark.lu.se/~jum/hiking/vindelfjallen/1991/frame3.htm)

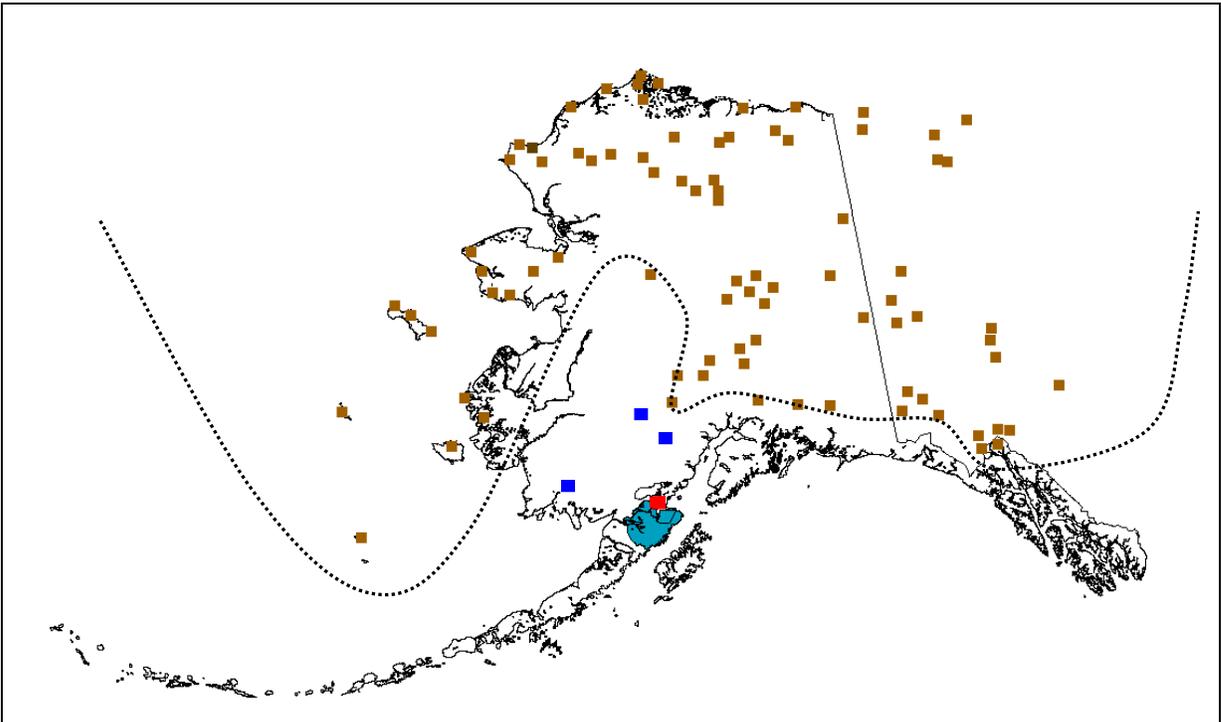


Figure 49. Distribution of *Ranunculus nivalis*, based on Hultén (1968). Individual collections are shown as brown squares and general distribution indicated above the dashed line. The recent collections in LACL, Lime Hills, and Goodnews Bay are shown in blue, and KATM is shown as a red square.

Exotic Species -

At Brooks Camp three introduced species were found. The camp receives thousands of visitors each year and it is surprising that only three exotic species were collected. However, AKNHP sampling intensity was restricted to a single collecting day. The species were restricted to highly disturbed sites and did not appear to be establishing in more native habitats.



Figure 50A. *Capsella rubella*. Photo is from: [http://www.inra.fr/hyppa/hyppa-a/capru_ah.htm#Adult plant](http://www.inra.fr/hyppa/hyppa-a/capru_ah.htm#Adult%20plant)



Figure 50B. *Matricaria matricarioides*. Photo is from: http://www.missouriplants.com/Greenalt/Matricaria_matricarioides_page.html

Capsella rubella Reut.:

The introduced weed, *Capsella rubella* (Fig 50A) was rare (fewer than 200 individuals) and confined to disturbed ground near buildings at Brooks Camp. Associated species were *Equisetum arvense*, *Achillea millefolium*, and *Calamagrostis canadensis*. This weed is capable of establishing in areas with disturbed substrates, but is not considered a serious threat to native communities. However, destruction of this population and further monitoring is recommended (see below).

Matricaria matricarioides (Less.) Porter:

At the same collection site as *Capsella rubella*, the small composite, *Matricaria matricarioides* (Fig. 50B) was collected. Few individuals were found scattered around buildings and roads. This species is believed to be native to northwestern North America (as well as Asia), but is not native to Alaska (Hultén 1968, McClintock 1996). Like *C.*

rubella, this species is restricted to waste places and does not appear to successfully compete with intact communities.

Plantago major var. *major*:

Another introduced species was located at the Brooks Camp campground. *Plantago major* var. *major* (Fig. 51) was more common than *Capsella rubella*, but was also restricted to disturbed sites. The community associates included *Calamagrostis canadensis*, *Betula papyrifera*, *Chamerion (Epilobium) angustifolium*, and the weed *Matricaria matricarioides*. This species is not a particularly aggressive invader and is not cause for serious concern. Although it can become dense under high nutrient and disturbance conditions, it is a weak competitor in moderately intact plant communities.



Figure 51. *Plantago major*. Photo is from: <http://www.wsu.edu:8080/~wsherb/images/Plantaginaceae/plantago.html>

Species of Conservation Concern -

Aphragmus eschscholtzianus Andr.:

We identified a small population of the rare species, *Aphragmus eschscholtzianus* (Fig. 52) at an alpine site just south of Mirror Lake (KATM Region-2). This species is listed by the AKNHP as a G3 - S3 (rare globally and within the state). It is known primarily from scattered alpine sites from the Aleutians, east across the Alaska Range, Chugach and Wrangell Mountains to Northern B.C., with disjunct populations on the Seward Peninsula and Central Brooks Range (Fig. 53). We found a population of between 100 and 200 individuals in a former melt-pond along an alpine bench at approximately 600 m. Many of the high elevation areas around Mirror Lake were inventoried, but only this isolated patch of plants was located. Further, the habitat-type of where it was found (drying melt-ponds with large cobbles at high elevations) was not observed elsewhere. Because of its rarity, small population sizes, and narrow habitat specificity, we recommend more targeted inventory for this taxon and demographic monitoring of the Mirror Lake population.



Figure 52. *Aphragmus eschscholtzianus*.

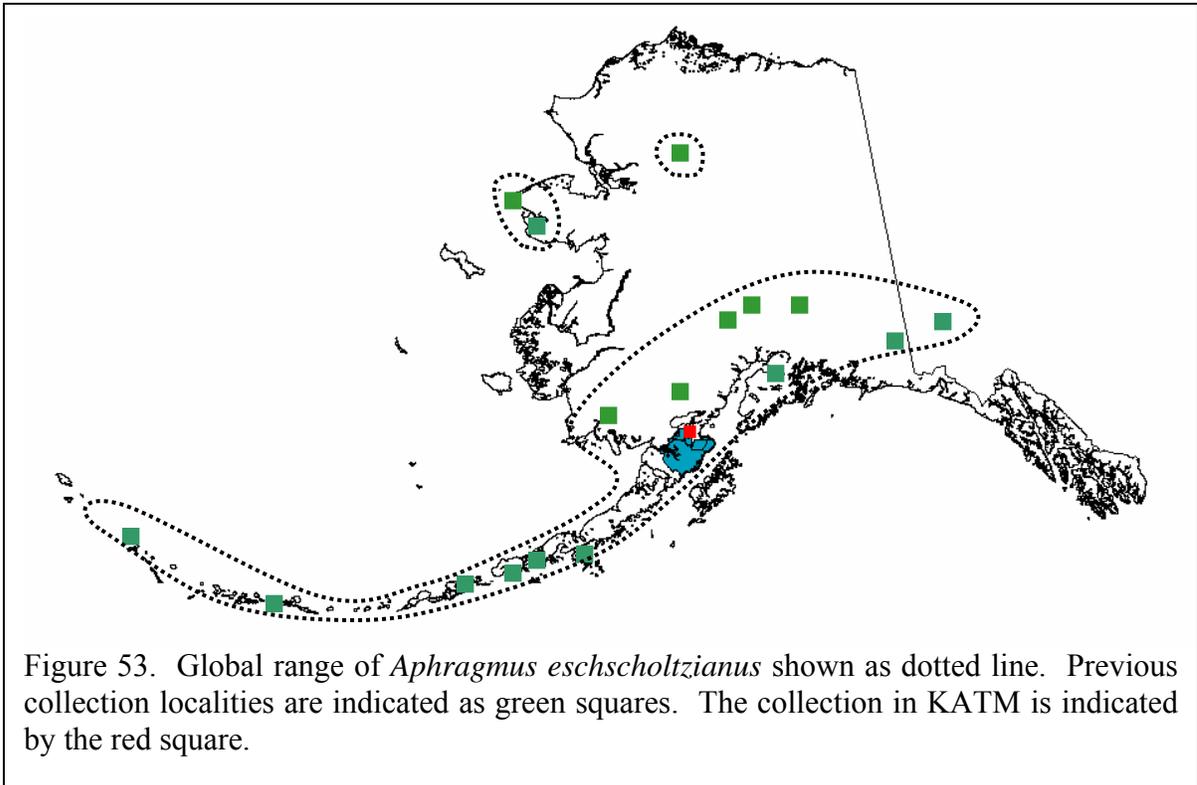
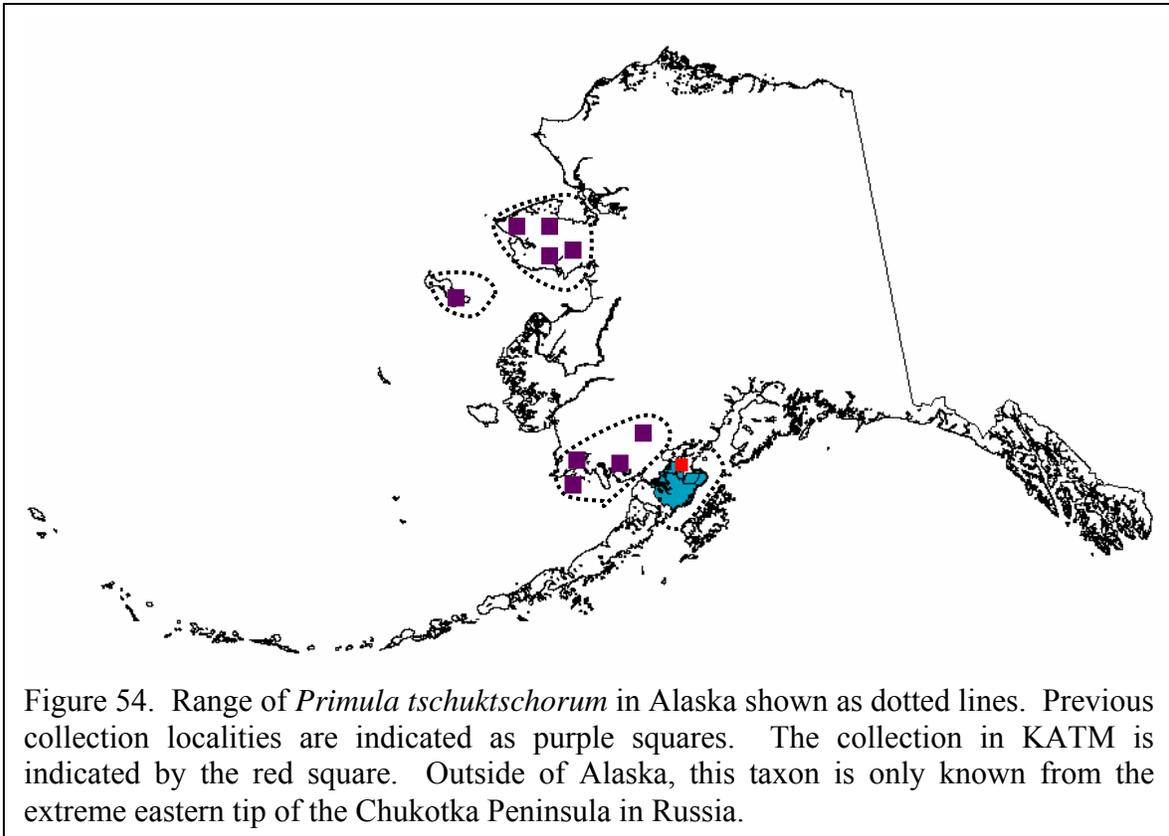


Figure 53. Global range of *Aphragmus eschscholtzianus* shown as dotted line. Previous collection localities are indicated as green squares. The collection in KATM is indicated by the red square.

Primula tschuktschorum Kjellm.:

An additional species, which is not only a significant range extension, but globally rare was also collected near Mirror Lake (KATM Region-2). *Primula tschuktschorum* is a taxon restricted to the Bering Strait Region with a few outlying populations south in the Akhlun and Kilbuck Mountains near Bristol Bay (Kelso 1995; Fig. 54). The species is considered a G3 - S2S3 (i.e., uncommon to rare globally and within Alaska). The KATM population is located nearly 320 km to the east of the Bristol Bay populations, which are concentrated around alpine lakes and seeps near Tikchik Lake and Goodnews Bay. At the KATM site, plants were relatively common along the banks of shallow ponds and snowmelt areas at around 400 to 450 m and into wet-sedge tundra communities. Many patches of 50 - 200 plants were encountered, with a total population size estimated at 5,000 individuals.



Kelso, in her 1995 USFWS status report, indicated that the taxon is not in eminent danger of extirpation, since more populations of large size had been located on the Seward Peninsula and south, near Goodnews Bay. However, Kelso (1995) noted a number of concerns and potential threats to the species. At some populations on the Seward Peninsula grazing by geese and reindeer is quite severe, with almost all fruits and flowers removed from a population numbering in the thousands. If grazing of this intensity is consistent across years as the geese migrate through, reproduction by this rare plant could

be severely curtailed or eliminated. Thus, the viability of individual populations and the species as a whole could be threatened.

Additionally, this species has an unusual reproductive system, distyly, which may limit its ability to reproduce by seed. Distyly is a genetic polymorphism in which populations are composed of two morphs: one with long styles and short stamens and another with short styles and long stamens (Fig. 55). The style/stamen dimorphism is normally accompanied with a self- and intra-morph physiological incompatibility, such that only pollinations between *different* morphological types results in seed set. Under conditions in which pollinators are common, this reproductive system may function well. However, when pollinators become rare, seed production can become nearly non-existent. Distylous species should produce less than half the seeds as species with normal self-incompatibilities as pollinators become limiting, because only half the members of the distylous population/species are available as compatible mates.



Figure 55. Closeup photograph of both morphological forms of *Primula tschuktschorum*. Notice the stigma is obvious in the upper flower ("pin" morph) and the stigma is below the anther-level in the lower flower ("thrum" morph).

More often than is generally acknowledged, distylous systems are not as complete as suggested (Carlson and Meinke, in prep.). Often, the intra-morph physiological incompatibility is only weak, allowing moderate seed set even when pollinators are rare. Further, it has been suggested that distyly functions only with a very limited suite of pollinators, such that pollen from each morph-type is deposited on specific locations on the bodies of the pollinators (Ganders, 1979). However, this may not always be true (Carlson and Meinke, in prep.).

The reproductive status and health of the KATM *P. tschuktschorum* population is unknown. During the six days we were at this site the weather was poor, no pollinators were observed visiting the flowers. This species flowers very early when conditions for pollinators are meager, even for bumblebees, which can function at nearly freezing temperatures (Heinrich 1979). We did observe fruits with apparently viable seeds were maturing. We therefore suggest, that more ecological information is needed to determine the status of this rare and disjunct species in the park.

Additionally, we collected the very closely related species, *P. eximia* that was co-occurring and flowering with *P. tschuktschorum*. Kelso (1987) considers *P. eximia* a homostylous (just a single morph with a consistent style length) derivative of the distylous *P. tschuktschorum*, and she noted that presence/absence of farina (powdery or mealy wax exudate) and plant size are additional characters that are useful in separating the two taxa. It is very curious to have two such closely related species flowering together in the same location. This raises further questions and concerns for the security of the rare species. If pollinators move freely between the two, then a loss of fitness of both taxa will likely occur via a number of mechanisms, including pollen wastage, hybrid inviability or sterility, or genetic swamping (see Waser 1978, Armbruster et al. 1994). It is also interesting that specimens identified as *P. eximia* by UAF Herbarium lacked the characteristic white farina, and some of the *P. tschuktschorum* individuals were of a size more typical of *P. eximia*. The apparent mosaic of traits in this mixed population may be evidence of past or present hybridization (see Harrison and Rand 1989, Young 1996). AKNHP is currently reviewing the material and conducting a preliminary morphological analysis. However, revisiting the site may be necessary to resolve the systematic and ecological questions.

Suggestions for further research are outlined in the Recommendations section below.

PLANS FOR COMING YEAR

The AKNHP will be concentrating floristic inventories for the Southwest Alaska Network Parks in Kenai Fjords National Park in 2003. Targeted sampling in KATM and ALAG will likely occur in 2004 or 2005.

Recommendations

To achieve a more complete list of species in ALAG and KATM, we recommend the following locations and habitats be inventoried (also shown in Fig. 58):

- Old Savonoski Village Site. This location is one of only two known in Alaska for the grass *Catabrosa aquatica* (Fig. 56, listed as "Critically Imperiled" within Alaska, although not rare globally: AKNHP Vascular Plant Tracking List). This grass has a broad distribution (Eurasia and in North America from New Brunswick to New Mexico), but populations are often small and isolated (e.g., State listed as "Endangered" in Wisconsin). The populations in Alaska are disjunct from the other North American and Asian populations by thousands of kilometers. Additionally, the village site was a location of early European influence and it is possible that introductions of exotic species have become established. Further, wetland and white spruce woodland habitats would likely result in additional new taxa to the park as these habitat types were not exhaustively surveyed in 2002.



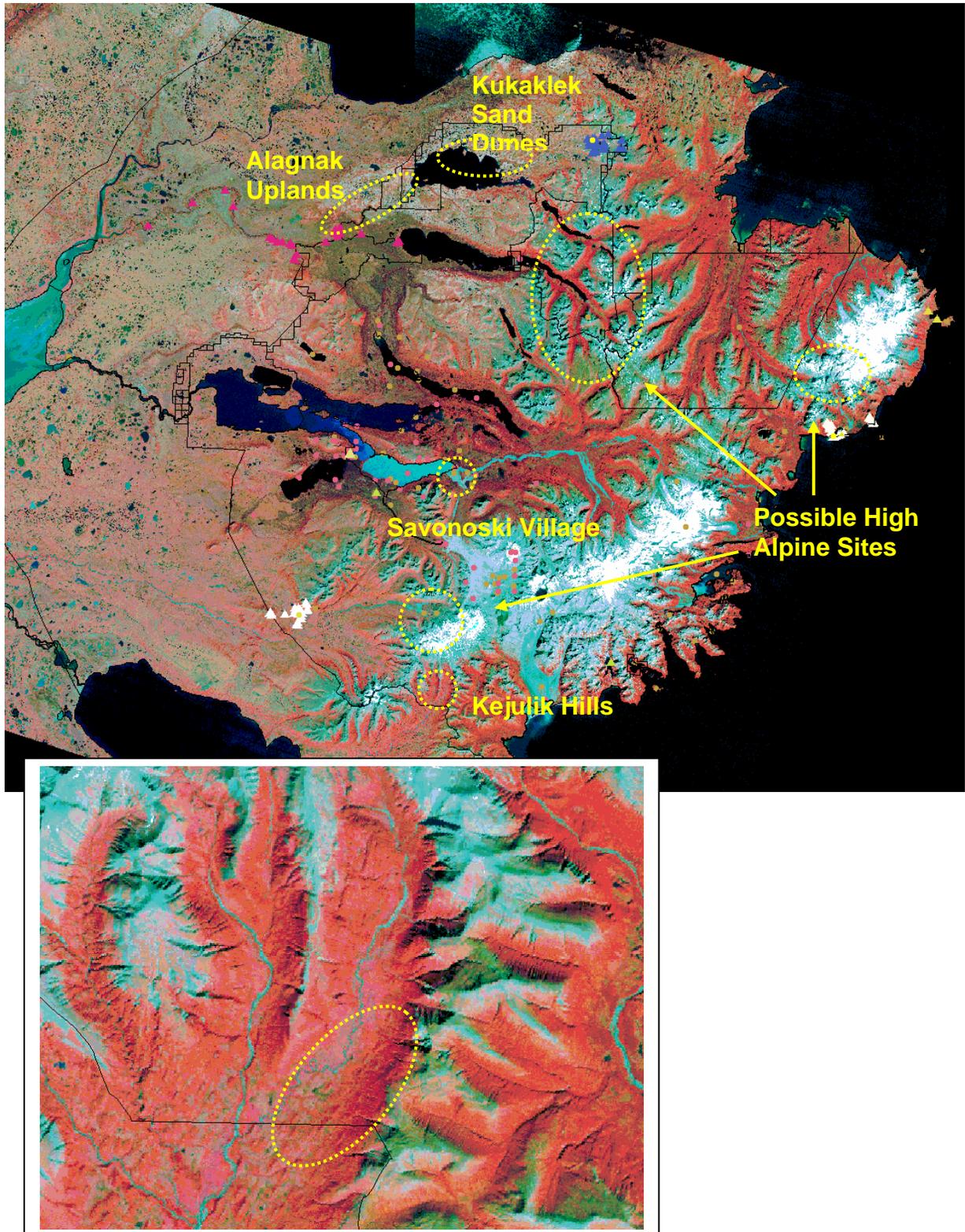
- Sand dunes along the northern edge of Kukaklek Lake and outlet of Moraine Creek into Kukaklek Lake (Fig. 57). We did not encounter any inland sand dunes in the 2002 field season and it is likely that a small number of taxa new to the park would be located in such habitats.



Figure 57. Oblique view of sand dunes at the confluence of Moraine Creek and Kukaklek Lake. Extensive dunes are also located along the northern portion of Kukaklek Lake.

- Elevations above 1000 m. No inventories were conducted at the highest elevations, which often have unique, high-alpine habitat specialists. Suggested locations include: Kejulik Mountains, Walatka Mountains, and ice-free peaks near Fourpeaked Mountain. These areas appear to be only helicopter accessible.
- Areas with calcareous outcrops. We were only able to access one site with merely moderately basic soils. A large component of the KATM taxa listed as probably present are widespread calciphiles and would likely be added as confirmed if an appropriate substrate was identified and visited.
- Hills along upper Kejulik River. No collections are known from this southerly border of KATM and there are a series of drumlins (streamlined glacial depositions) that may harbor unique taxa.
- Upper Alagnak River. The upper portion of this unit was not sampled due to rapids and this portion includes higher elevation sites, with apparently dry and stony tundra that was not sampled along ALAG in 2002.

Figure 58. Suggested future sampling sites in ALAG and KATM units, shown as labeled yellow circles. The inset is a close-up of the Kejulik Hills. Known plant collection sites are shown as triangles (AKNHP 2002) or circles (previous collections).



Recommendations for monitoring or other action include the following:

- *Dupontia fisheri* - We recommend casual monitoring of this major range (and habitat) extension at Swikshak Lagoon to observe any changes in abundance. Further, botanists working in the park should pay special attention for this species in other locations, especially at coastal marshes, meadows, and lake shores. This taxon is very abundant in the high arctic and is not of conservation concern, but because of the nature of the range extension, opportunistic observations are recommended.
- Exotic species - We suggest that efforts be made to eliminate the introduced plants at Brooks Camp. This includes three species: *Capsella rubella*, *Matricaria matricarioides*, and *Plantago major* var. *major*. None of these species are known to be aggressive in undisturbed sites; however, weeds that were not problems have been known to become particularly invasive after many years as benign species in novel communities (Cronk and Fuller 2001). Because the weeds seem to be isolated and not of large population sizes, control by spot-applied herbicide over a couple of years seems manageable.
- *Aphragmus eschscholtzianus* - This rare species would benefit from a better understanding of its distribution within KATM and knowledge of its population dynamics. We only located one site of relatively few individuals, but it is possible that that this taxon is more common in the park. More extensive surveys in the mountains to the south may reveal additional populations and of larger sizes. Second, most management decisions of rare plants are made without a good understanding of the biological status of the species (Schemske et al. 1994), and we therefore recommend that explicit stage-specific matrix population modeling be employed. Matrix population models are a powerful tool to identify population growth parameters and the particular stages (or age-classes) most important to population growth (see discussion in Schemske et al. 1994). Additionally, ancillary data on ecology and reproductive ecology can be taken while collecting population data.
- *Primula tschuktschorum* - We recommend the same monitoring procedures for this species, also located at Mirror Lake. A careful survey and estimation of population sizes in KATM is necessary, as well as documenting the biological status of populations within the park. Additionally, because of the unusual reproductive system and potential limitations imposed by it, we suggested that a study be conducted on its reproductive biology. Last, we believe it is essential to determine what are the evolutionary (thus, taxonomic) differences between the more widespread, homostylous entity, *P. eximia*, and rare, *P. tschuktschorum*, both of which co-occur at Mirror Lake in KATM. This investigation would involve isozyme or DNA-based methods in addition to a morphological analysis and examination of reproductive interactions between the two entities.

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APPENDIX 1

Plant Collections of Alagnak Wild River -

Annotated species list describing all taxa and the basic geographic and habitat attributes.

Fam	Species	General Locality	Specific locality	Lat (dec degree)	Long (dec degree)	Habitat	Collection #
Asteraceae	<i>Achillea borealis</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-278
Ranunculaceae	<i>Aconitum delphinifolium</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-314
Poaceae	<i>Agrostis scabra</i>	Alagnak River	3 km downstream from confluence of Alagnak and Nonvianuk rivers on N side of river	59.012553	-155.903338	low shrub graminoid meadow	02-335
Poaceae	<i>Agrostis scabra</i>	Alagnak River	bluff on S side of Alagnak from rock outcrops to peak 583	59.008732	-156.109924	ericaceous low shrub tundra	02-369
Poaceae	<i>Agrostis scabra</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-393
Betulaceae	<i>Alnus viridis</i> ssp. <i>fruticosa</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035217	-155.867722	small closed birch alder stand understory	02-297
Poaceae	<i>Alopecurus aequalis</i>	Alagnak River	3 km S of major W turning bend of Alagnak River	59.082216	-156.299666		02-377
Ericaceae	<i>Andromeda polifolia</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035813	-155.865555	low shrub tundra	02-305
Ranunculaceae	<i>Anemone narcissiflora</i>	Alagnak River	rock outcrops along S side of Alagnak near peak 583	59.008421	-156.105638	low shrub tundra	02-359
Asteraceae	<i>Antennaria monocephala</i>	Alagnak River	bluff on S side of Alagnak from rock outcrops to peak 583	59.008732	-156.109924	ericaceous low shrub tundra	02-370b
Poaceae	<i>Arctagrostis latifolia</i> var. <i>latifolia</i>	Alagnak River	"middle river camp" 2 km W of major W turning bend of Alagnak River	59.116167	-156.334994	low shrub tundra in open spruce forest	02-382
Poaceae	<i>Arctophila fulva</i>	Alagnak River	large pond NW of peak 583	59.018603	-156.139974		02-374
Ericaceae	<i>Arctostaphylos alpina</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035813	-155.865555	low shrub tundra	02-304
Asteraceae	<i>Arnica frigida</i>	Alagnak River	bluff on S side of Alagnak from rock outcrops to peak 583	59.008732	-156.109924	ericaceous low shrub tundra	02-370
Asteraceae	<i>Artemisia tilesii</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-324
Betulaceae	<i>Betula glandulosa</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-268
Betulaceae	<i>Betula kenaica</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-279
Betulaceae	<i>Betula nana</i>	Alagnak River	along S side of Alagnak between Summerville's Lodge and peak 583	59.009005	-156.086975	low shrub graminoid forb meadow	02-353
Polygonaceae	<i>Bistorta viviparum</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-328
Orobanchaceae	<i>Boschniakia rossica</i>	Alagnak River	W side of Alagnak River 3 km N of confluence of Nonvianuk and Alagnak rivers	59.045034	-155.844666	closed birch alder stand	02-312
Poaceae	<i>Bromus "viviparus"</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035217	-155.867722	small closed birch alder stand understory	02-295
Poaceae	<i>Calamagrostis canadensis</i>	Alagnak River	"middle river camp" 2 km W of major W turning bend of Alagnak River	59.116167	-156.334994	low shrub tundra in open spruce forest	02-381
Callitricheaceae	<i>Callitriche palustris</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-390
Ranunculaceae	<i>Caltha natans</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-384
Ranunculaceae	<i>Caltha palustris</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-275
Campanulaceae	<i>Campanula lasiocarpa</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-316
Cyperaceae	<i>Carex aquatilis</i>	Alagnak River	between small and large pond NW of peak 583	59.015497	-156.125051	low shrub and tussock tundra	02-372c
Cyperaceae	<i>Carex bigelowii</i> ssp. <i>lugens</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.034552	-155.868479	low shrub tundra	02-290b
Cyperaceae	<i>Carex brunnescens</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.029558	-155.860931	low shrub graminoid meadow	02-286
Cyperaceae	<i>Carex canescens</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-273
Cyperaceae	<i>Carex canescens</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035813	-155.865555	subhygric sedge sink hole within low shrub tundra	02-301
Cyperaceae	<i>Carex lyngbei</i>	Alagnak River	3 km downstream from confluence of Alagnak and Nonvianuk rivers on N side of river	59.012553	-155.903338	low shrub graminoid meadow	02-341
Cyperaceae	<i>Carex lyngbei</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-392
Cyperaceae	<i>Carex media</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-325
Cyperaceae	<i>Carex media</i>	Alagnak River	3 km downstream from confluence of Alagnak and Nonvianuk rivers on N side of river	59.012553	-155.903338	low shrub graminoid meadow	02-334
Cyperaceae	<i>Carex nesophila</i>	Alagnak River	rock outcrops along S side of Alagnak near peak 583	59.008421	-156.105638	low shrub tundra	02-361
Cyperaceae	<i>Carex pluriflora</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-274
Cyperaceae	<i>Carex rotundata</i>	Alagnak River	between small and large pond NW of peak 583	59.015497	-156.125051	low shrub and tussock tundra	02-372
Cyperaceae	<i>Carex saxatilis</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.029558	-155.860931	low shrub graminoid meadow	02-285
Cyperaceae	<i>Carex utriculata</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.040946	-155.861027	subhygric open salix fen	02-311
Cyperaceae	<i>Carex utriculata</i>	Alagnak River	small pond N of peak 583	59.015497	-156.125051	wet sedge meadow	02-371b
Onagraceae	<i>Chamerion (Epiobium) latifolium</i>	Alagnak River	rock outcrops along S side of Alagnak near peak 583	59.008421	-156.105638	low shrub tundra	02-360
Saxifragaceae	<i>Chrysosplenium tetrandrum</i>	Alagnak River	rock outcrops along S side of Alagnak near peak 583	59.008421	-156.105638	wet mossy puddle in closed populus woods	02-355
Apiaceae	<i>Cicuta virosa</i>	Alagnak River	just down stream from Charlie Summerville's lodge where Katmai National Preserve's E boundary abuts Alagnak Wild River	59.007615	-156.052649	closed salix woods with small graminoid openings	02-350

Plant Collections of Alagnak Wild River (cont.) -

Fam	Species	General Locality	Specific locality	Lat (dec degree)	Long (dec degree)	Habitat	Collection #
Portulacaceae	<i>Claytonia chamissoi</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-272
Rosaceae	<i>Comarum (Potentilla) palustre</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-271
Rosaceae	<i>Dasiphora (Pentaphylloides) fruticosa</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-329
Poaceae	<i>Deschampsia caespitosa</i> var. <i>caespitosa</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-388
Poaceae	<i>Deschampsia caespitosa</i> var. <i>caespitosa</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-394
Diapensiaceae	<i>Diapensia lapponica</i>	Alagnak River	bluff on S side of Alagnak from rock outcrops to peak 583	59.008732	-156.109924	ericaceous low shrub tundra	02-366
Droseraceae	<i>Drosera rotundifolia</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035813	-155.865555	low shrub tundra	02-303
Dryopteridaceae	<i>Dryopteris expansa</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035217	-155.867722	small closed birch alder stand understory	02-294
Empetraceae	<i>Empetrum nigrum</i> ssp. <i>Hermaphroditum</i>	Alagnak River	"middle river camp" 2 km W of major W turning bend of Alagnak River	59.116167	-156.334994	low shrub tundra in open spruce forest	02-379
Onagraceae	<i>Epilobium ciliatum</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-266
Equisetaceae	<i>Equisetum arvense</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.03522	-155.868	small closed birch alder stand understory	02-291b
Equisetaceae	<i>Equisetum arvense</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035217	-155.867722	small closed birch alder stand understory	02-292
Equisetaceae	<i>Equisetum fluviatile</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-269
Equisetaceae	<i>Equisetum scirpoides</i>	Alagnak River	3 km downstream from confluence of Alagnak and Nonvianuk rivers on N side of river	59.012553	-155.903338	low shrub graminoid meadow	02-332
Equisetaceae	<i>Equisetum sylvaticum</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035217	-155.867722	small closed birch alder stand understory	02-291
Cyperaceae	<i>Eriophorum angustifolium</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035813	-155.865555	subhygric sedge sink hole within low shrub tundra	02-299
Cyperaceae	<i>Eriophorum russeolum</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-277
Cyperaceae	<i>Eriophorum russeolum</i>	Alagnak River	small pond N of peak 583	59.015497	-156.125051	wet sedge meadow	02-371
Cyperaceae	<i>Eriophorum vaginatum</i>	Alagnak River	between small and large pond NW of peak 583	59.015497	-156.125051	low shrub and tussock tundra	02-372b
Poaceae	<i>Festuca altaica</i>	Alagnak River	rock outcrops along S side of Alagnak near peak 583	59.008421	-156.105638	low shrub tundra	02-357
Poaceae	<i>Festuca baffinensis</i>	Alagnak River	rock outcrops along S side of Alagnak near peak 583	59.008421	-156.105638		02-356
Poaceae	<i>Festuca richardsonii</i>	Alagnak River	along S side of Alagnak between Summerville's Lodge and peak 583	59.009005	-156.086975	low shrub graminoid forb meadow	02-354
Rubiaceae	<i>Galium boreale</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-322
Rubiaceae	<i>Galium trifidum</i>	Alagnak River	just down stream from Charlie Summerville's lodge where Katmai National Preserve's E boundary abuts Alagnak Wild River	59.007615	-156.052649	closed salix woods with small graminoid openings	02-349
Geraniaceae	<i>Geranium erianthum</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-280
Poaceae	<i>Glyceria maxima</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-395
Dryopteridaceae	<i>Gymnocarpium dryopteris</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035217	-155.867722	small closed birch alder stand understory	02-293
Poaceae	<i>Hierochloa alpina</i>	Alagnak River	rock outcrops along S side of Alagnak near peak 583	59.008421	-156.105638	low shrub tundra	02-358
Hippuridaceae	<i>Hippuris vulgaris</i>	Alagnak River	3 km downstream from confluence of Alagnak and Nonvianuk rivers on N side of river	59.012553	-155.903338	low shrub graminoid meadow	02-336
Hippuridaceae	<i>Hippuris vulgaris</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-383
Iridaceae	<i>Iris setosa</i>	Alagnak River	3 km downstream from confluence of Alagnak and Nonvianuk rivers on N side of river	59.012553	-155.903338	low shrub graminoid meadow	02-331
Juncaceae	<i>Juncus arcticus</i> ssp. <i>sitchensis</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-391
Juncaceae	<i>Juncus filiformis</i>	Alagnak River	3 km downstream from confluence of Alagnak and Nonvianuk rivers on N side of river	59.012553	-155.903338	low shrub graminoid meadow	02-333
Ericaceae	<i>Ledum palustre</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035813	-155.865555	low shrub tundra	02-302
Schrophulariaceae	<i>Limosella aquatica</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-385
Caprifoliaceae	<i>Linnaea borealis</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-315
Ericaceae	<i>Loiseleuria procumbens</i>	Alagnak River	bluff on S side of Alagnak from rock outcrops to peak 583	59.008732	-156.109924	ericaceous low shrub tundra	02-365
Fabaceae	<i>Lupinus nootkatensis</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.034552	-155.868479	low shrub tundra	02-289
Juncaceae	<i>Luzula multiflora</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-283
Juncaceae	<i>Luzula multiflora</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-326
Juncaceae	<i>Luzula parviflora</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.0243	-155.845	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-283b
Schrophulariaceae	<i>Mimulus guttatus</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-265
Pyrolaceae	<i>Moneses uniflora</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-282

Plant Collections of Alagnak Wild River (cont.) -

Fam	Species	General Locality	Specific locality	Lat (dec degree)	Long (dec degree)	Habitat	Collection #
Salicaceae	<i>Populus tremuloides</i>	Alagnak River	just down stream from Charlie Summerville's lodge where Katmai National Preserve's E boundary abuts Alagnak Wild River	59.002026	-156.043305	aspen stand	02-346
Pyrolaceae	<i>Pyrola asarifolia</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-327
Pyrolaceae	<i>Pyrola secunda</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-318
Ranunculaceae	<i>Ranunculus gmelinii</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-387
Ranunculaceae	<i>Ranunculus hyperboreus</i> ssp. <i>hyperboreus</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-284
Ranunculaceae	<i>Ranunculus trichophyllus</i> ssp. <i>trichophyllus</i>	Alagnak River	along S side of Alagnak between Summerville's Lodge and peak 583	59.009005	-156.086975	low shrub graminoid forb meadow	02-351
Schrophulariaceae	<i>Rhinanthus minor</i>	Alagnak River	3 km downstream from confluence of Alagnak and Nonvianuk rivers on N side of river	59.012553	-155.903338	low shrub graminoid meadow	02-338
Crassulaceae	<i>Rhodiola integrifolia</i>	Alagnak River	3 km downstream from confluence of Alagnak and Nonvianuk rivers on N side of river	59.012553	-155.903338	low shrub graminoid meadow	02-340
Grossulariaceae	<i>Ribes laxiflorum</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035217	-155.867722	small closed birch alder stand understory	02-296
Brassicaceae	<i>Rorippa palustris</i> var. <i>palustris</i>	Alagnak River	just down stream from Charlie Summerville's lodge where Katmai National Preserve's E boundary abuts Alagnak Wild River	59.007615	-156.052649	closed salix woods with small graminoid openings	02-347
Brassicaceae	<i>Rorippa palustris</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-386
Rosaceae	<i>Rubus arcticus</i>	Alagnak River	just down stream from Charlie Summerville's lodge where Katmai National Preserve's E boundary abuts Alagnak Wild River	59.007615	-156.052649	closed salix woods with small graminoid openings	02-348
Rosaceae	<i>Rubus chamaemorus</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035813	-155.865555	low shrub tundra	02-298
Polygonaceae	<i>Rumex arcticus</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-267
Salicaceae	<i>Salix arctica</i>	Alagnak River	bluff on S side of Alagnak from rock outcrops to peak 583	59.008732	-156.109924	ericaceous low shrub tundra	02-364
Salicaceae	<i>Salix barclayi</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.040946	-155.861027	subhygric open salix fen	02-308
Salicaceae	<i>Salix fuscescens</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.035813	-155.865555	subhygric sedge sink hole within low shrub tundra	02-300
Salicaceae	<i>Salix glauca</i> var. <i>acutifolia</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.034552	-155.868479	low shrub tundra	02-290
Salicaceae	<i>Salix phlebophylla</i>	Alagnak River	bluff on S side of Alagnak from rock outcrops to peak 583	59.008732	-156.109924	ericaceous low shrub tundra	02-368
Salicaceae	<i>Salix reticulata</i>	Alagnak River	3 km downstream from confluence of Alagnak and Nonvianuk rivers on N side of river	59.012553	-155.903338	low shrub graminoid meadow	02-339
Rosaceae	<i>Sanguisorba canadensis</i> (stipulata)	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-281
Saxifragaceae	<i>Saxifraga nelsoniana</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-319
Asteraceae	<i>Senecio lugens</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-321
Asteraceae	<i>Solidago multiradiata</i> ssp. <i>multiradiata</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-317
Sparganiaceae	<i>Sparganium angustifolium</i>	Alagnak River	large pond NW of peak 583	59.018603	-156.139974		02-373
Rosaceae	<i>Spiraea stevenii</i> (beauverdiana)	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.029558	-155.860931	closed shaded birch spruce forest	02-288
Orchidaceae	<i>Spiranthes romanoffiana</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.040946	-155.861027	subhygric open salix fen	02-310
Caryophyllaceae	<i>Stellaria calycantha</i>	Alagnak River	just downstream from Tony Sarp's Katmai Lodge	59.087862	-156.473192	low shrub graminoid meadow	02-389
Brassicaceae	<i>Subularia aquatica</i>	Alagnak River	large pond NW of peak 583	59.018603	-156.139974		02-375
Gentianaceae	<i>Swertia perennis</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-330
Liliaceae	<i>Tofieldia coccinea</i>	Alagnak River	bluff on S side of Alagnak from rock outcrops to peak 583	59.008732	-156.109924	ericaceous low shrub tundra	02-363
Primulaceae	<i>Trientalis europaea</i>	Alagnak River	W side of Alagnak River 3 km N of confluence of Nonvianuk and Alagnak rivers	59.045034	-155.844666	closed birch alder stand	02-313
Poaceae	<i>Trisetum spicatum</i> ssp. <i>spicatum</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-323
Ericaceae	<i>Vaccinium uliginosum</i>	Alagnak River	"middle river camp" 2 km W of major W turning bend of Alagnak River	59.116167	-156.334994	low shrub tundra in open spruce forest	02-378
Ericaceae	<i>Vaccinium vitis-idea</i>	Alagnak River	"middle river camp" 2 km W of major W turning bend of Alagnak River	59.116167	-156.334994	low shrub tundra in open spruce forest	02-380
Ericaceae	<i>Vaccinium oxycoccus</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.040946	-155.861027	subhygric open salix fen	02-307
Valerianaceae	<i>Valeriana capitata</i>	Alagnak River	W side of Alagnak River 1 km N of confluence of Nonvianuk and Alagnak rivers	59.030984	-155.844833	white spruce stand (40 ft tall)	02-320
Schrophulariaceae	<i>Veronica americana</i>	Alagnak River	W side of confluence of Alagnak and Nonvianuk rivers	59.024301	-155.853288	subhygric edge of small herbaceous streamlet between tussock meadow and birch alder woods	02-270
Caprifoliaceae	<i>Viburnum edule</i>	Alagnak River	hill NW of confluence of Alagnak and Nonvianuk rivers	59.029558	-155.860931	closed shaded birch spruce forest	02-287
Violaceae	<i>Viola epipsila</i>	Alagnak River	3 km downstream from confluence of Alagnak and Nonvianuk rivers on N side of river	59.012553	-155.903338	low shrub graminoid meadow	02-337
Bryophyte		Alagnak River	large pond NW of peak 583	59.018603	-156.139974		02-376

Plant Collections of Katmai National Park and Preserve -

Annotated species list describing all taxa and the basic geographic and habitat attributes.

Family	Species	General Locality	Specific locality	Lat (dec degree)	Long (dec degree)	Habitat	Collection #
Asteraceae	<i>Achillea borealis</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-055
Ranunculaceae	<i>Aconitum delphinifolium</i>	Contact Creek	N ridge of Contact Lake margin (large lake near Contact Creek)	58.217565	-155.963553		02-460
Ranunculaceae	<i>Aconitum delphinifolium</i>	Mirror Lake	road from Brook's camp stream crossing at km 28	59.253993	-154.743704	dwarf shrub tundra	02-196
Ranunculaceae	<i>Actaea rubra</i>	Mirror Lake	road from Brook's camp stream crossing at km 28 to 3 Fork's Overlook	58.386964	-155.511624	tall (15m) cottonwood stand	02-489
Poaceae	<i>Agrostis alaskana</i>	Dakavak Bay	W edge of Dakavak Lake	58.102854	-154.688447		02-492
Poaceae	<i>Agrostis alaskana</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-101
Poaceae	<i>Agrostis alaskana</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-106
Poaceae	<i>Agrostis alaskana</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-107
Poaceae	<i>Agrostis alaskana</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-111
Poaceae	<i>Agrostis mertensii</i>	Mirror Lake	hills N of lake	59.253993	-154.743704	dwarf shrub tundra	02-195
Poaceae	<i>Agrostis scabra</i>	Mirror Lake	road from Brook's camp stream crossing at km 28 to 3 Fork's Overlook	58.393465	-155.510808		02-485
Poaceae	<i>Agrostis scabra</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.186098	-155.977566		02-439
Poaceae	<i>Agrostis scabra</i>	Contact Creek	lowlands between Red Mt and Contact Lake (large lake just W of Contact Creek)	58.207208	-156.027969	tussock tundra	02-418
Poaceae	<i>Agrostis scabra</i>	Contact Creek	stream from Contact Lake (large lake E of Contact Creek) that flows S into Contact Creek	58.199337	-155.96003	wet graminoid meadow	02-426
Poaceae	<i>Alopecurus aequalis</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.186098	-155.977566		02-442
Ericaceae	<i>Andromeda polifolia</i>	Mirror Lake	pond W of lake	59.247755	-154.781887		02-213
Ranunculaceae	<i>Anemone narcissiflora</i> ssp. <i>monantha</i>	Mirror Lake	edge of pond just NW of lake	59.247396	-154.773444	wet low shrub sedge meadow	02-209
Asteraceae	<i>Antennaria alpina</i>	Mirror Lake	ponds on NW side of lake 100 m N of GPS point	59.245116	-154.77662	ericaceous low shrub tundra	02-201
Asteraceae	<i>Antennaria alpina</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.624076	-153.781994		02-141
Brassicaceae	<i>Aphragmus eschscholtzianus</i>	Mirror Lake	hills SW of lake	59.216825	-154.784464		02-231
Brassicaceae	<i>Arabis hirsuta</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-050
Brassicaceae	<i>Arabis lyrata</i>	Contact Creek	S slope of peak S of Contact Lake (large lake E of Contact Creek)	58.190685	-155.975989		02-432
Poaceae	<i>Arctagrostis latifolia</i> var. <i>latifolia</i>	Dakavak Bay	W edge of Dakavak Lake	58.102854	-154.688447		02-491
Poaceae	<i>Arctagrostis latifolia</i> var. <i>latifolia</i>	Contact Creek	NW shore of Contact Lake (large lake E of Contact Creek)	58.218536	-155.983079		02-469
Poaceae	<i>Arctophila fulva</i>	Contact Creek	stream from Contact Lake (large lake E of Contact Creek) that flows S into Contact Creek	58.199337	-155.96003	wet graminoid meadow	02-424
Poaceae	<i>Arctophila fulva</i>	Contact Creek	N ridge of Contact Lake margin (large lake near Contact Creek)	58.217565	-155.963553		02-465
Rosaceae	<i>Argentina egedii</i>	Swikshak Lagoon	salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	halophytic wet sedge meadow	02-512
Asteraceae	<i>Arnica amplexicaulis</i>	Sukoi Bay	ridge NW of bay	58.872905	-153.367568	wet mossy meadow	02-503
Asteraceae	<i>Arnica chamissonis</i>	Contact Creek	along Contact Creek just S of large lake (Contact Lake)	58.1884	155.9653	meadow with scattered tall shrubs	02-474
Asteraceae	<i>Arnica latifolia</i>	Mirror Lake	SW edge of lake	59.241098	-154.779216	low shrub meadow	02-175
Asteraceae	<i>Arnica lessingii</i> ssp. <i>lessingii</i>	Mirror Lake	edge of pond just NW of lake	59.247396	-154.773444	wet low shrub sedge meadow	02-210
Asteraceae	<i>Arnica lessingii</i> ssp. <i>lessingii</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.630915	-153.774494		02-145
Asteraceae	<i>Arnica chamissonis</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.613202	-153.764485		02-147
Asteraceae	<i>Artemisia globularia</i>	Contact Creek	Red Mt (peak 1721) NW of confluence of Contact Creek and King Salmon River	58.210122	-156.086676	dwarf shrub tundra and stony slopes	02-406
Asteraceae	<i>Artemisia tilisii</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.186098	-155.977566		02-444
Asteraceae	<i>Artemisia tilisii</i> ssp. <i>gormanii</i>	Contact Creek	N ridge of Contact Lake margin (large lake near Contact Creek)	58.217565	-155.963553		02-463
Rosaceae	<i>Aruncus dioicus</i> (sylvester)	Dakavak Bay	W edge of Dakavak Lake	58.116309	-154.710321	alder shrub thicket	02-494
Rosaceae	<i>Aruncus dioicus</i> (sylvester)	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.639066	-153.598629	forb graminoid meadow	02-074
Asteraceae	<i>Aster sibericus</i>	Nonvianuk Lake outlet	beach on S side of outlet	59.018031	-155.59426	forb graminoid meadow with tall shrubs	02-262
Asteraceae	<i>Aster sibericus</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.186098	-155.977566		02-440
Asteraceae	<i>Aster sibericus</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.647258	-153.61374		02-086
Fabaceae	<i>Astragalus umbellatus</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.648395	-153.613665		02-092
Dryopteridaceae	<i>Athyrium felix-femina</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.637004	-153.791826		02-044
Brassicaceae	<i>Barbarea orthoceras</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.186098	-155.977566		02-436
Betulaceae	<i>Betula glandulosa</i>	Contact Creek	N ridge of Contact Lake margin (large lake near Contact Creek)	58.217565	-155.963553		02-461
Betulaceae	<i>Betula kenaica</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	bank of pond in graminoid meadow	02-105
Betulaceae	<i>Betula nana</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.635993	-153.597106	low shrub graminoid forb meadow and fen	02-057
Orobanchaceae	<i>Boschniakia rossica</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.648395	-153.613665	alder patch	02-093
Ophioglossaceae	<i>Botrychium lanceolatum</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.648888	-153.610972	herbaceous meadow	02-079
Ophioglossaceae	<i>Botrychium lunaria</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.648888	-153.610972	herbaceous meadow	02-080
Ophioglossaceae	<i>Botrychium</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-008
Poaceae	<i>Bromus ciliatus</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.613202	-153.764485	herbaceous meadow with scattered alder	02-116
Apiaceae	<i>Bupleurum triadiatum</i>	Contact Creek	S slope of peak S of Contact Lake (large lake E of Contact Creek)	58.190685	-155.975989		02-428
Brassicaceae	<i>Cakile edentula</i>	Swikshak Lagoon	S side of spit near W end	58.607	153.7705		02-094
Poaceae	<i>Calamagrostis deschampsoides</i>	Swikshak Lagoon	brackish pond and salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	halophytic wet sedge meadow	02-013
Callitricheae	<i>Callitriche heterophylla</i>	Contact Creek	W edge of Contact Lake (large lake E of Contact Creek)	58.212249	-155.982425		02-472
Ranunculaceae	<i>Caltha leptosepala</i>	Mirror Lake	headwaters of Funnell Creek, 250 m from Mirror Lake	59.242643	-154.785122	low shrub tundra with herbaceous sedge stream margin	02-150

Plant Collections of Katmai National Park and Preserve (cont.) -

Family	Species	General Locality	Specific locality	Lat (dec degree)	Long (dec degree)	Habitat	Collection #
Campanulaceae	<i>Campanula rotundifolia</i>	Sukoi Bay	ridge NW of bay	58.872905	-153.367568	herbaceous meadow	02-506
Campanulaceae	<i>Campanula rotundifolia</i>	Swikshak Lagoon	E end of spit	58.61866	-153.69077		02-115
Campanulaceae	<i>Campanula uniflora</i>	Mirror Lake	S edge of lake	59.234167	-154.766632	dwarf shrub tundra	02-183
Brassicaceae	<i>Capsella rubella</i>	Brook's Camp	around buildings and roads	58.557441	-155.776676		02-477
Brassicaceae	<i>Cardamine umbellata</i>	Mirror Lake	along upper Funnel Creek	59.241871	-154.793158	ericaceous shrub graminoid meadow	02-166
Brassicaceae	<i>Cardamine umbellata</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.616818	-153.770155	meadow near small stream with scattered alder	02-121
Cyperaceae	<i>Carex anthoxanthia</i>	Mirror Lake	SW edge of lake, 100 m E of GPS point	59.244988	-154.805196		02-178
Cyperaceae	<i>Carex aquatilis</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-241
Cyperaceae	<i>Carex bigelowii</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.207738	-155.971874	wet low shrub sedge fen	02-399
Cyperaceae	<i>Carex bigelowii</i>	Contact Creek	NE side of Contact Lake (large lake near Contact Creek)	58.21145	-155.957658		02-458
Cyperaceae	<i>Carex bigelowii</i>	Mirror Lake	hills SW of lake 50 m S of GPS point	59.231024	-154.799344	wet sedge meadow	02-230
Cyperaceae	<i>Carex bigelowii</i>	Mirror Lake	pond W of lake	59.244987	-154.788593	low shrub graminoid meadow	02-217
Cyperaceae	<i>Carex brunescens</i>	Nonvianuk Lake outlet	N end of pond S of ranger cabin	59.015338	-155.598557	wet sedge sphagnum fen	02-255
Cyperaceae	<i>Carex canescens</i>	Nonvianuk Lake outlet	N end of pond S of ranger cabin	59.015338	-155.598557	wet sedge sphagnum fen	02-254
Cyperaceae	<i>Carex chordorrhiza</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-248
Cyperaceae	<i>Carex chordorrhiza</i>	Contact Creek	SE border of Contact Lake (large lake E of Contact Creek)	58.205351	-155.962019		02-448
Cyperaceae	<i>Carex chordorrhiza</i>	Swikshak Lagoon	E end of spit	58.61293	-153.68831	nuphar pond and marsh	02-100
Cyperaceae	<i>Carex circinata</i>	Swikshak Lagoon	talus knob below peak 2750 N of Swikshak Lagoon	58.626898	-153.777804	herbaceous dwarf shrub tundra patches with open scree rubble	02-030
Cyperaceae	<i>Carex disperma</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.637951	-153.596221	shrub patch	02-069
Cyperaceae	<i>Carex gmelinii</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-003
Cyperaceae	<i>Carex gmelinii</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-054
Cyperaceae	<i>Carex lachenalii</i>	Mirror Lake	along upper Funnel Creek	59.241897	-154.788899	herbaceous dwarf shrub tundra	02-160
Cyperaceae	<i>Carex limosa</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-249
Cyperaceae	<i>Carex livida</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-242
Cyperaceae	<i>Carex lugens</i>	Contact Creek	lowlands between Red Mt and Contact Lake (large lake just W of Contact Creek)	58.2104	156.0143	tussock tundra	02-419
Cyperaceae	<i>Carex lyngbyei</i>	Nonvianuk Lake outlet	N end of pond S of ranger cabin	59.015338	-155.598557	wet sedge sphagnum fen	02-253
Cyperaceae	<i>Carex lyngbyei</i>	Contact Creek	stream from Contact Lake (large lake E of Contact Creek) that flows S into Contact Creek	58.199337	-155.96003	wet graminoid meadow	02-427
Cyperaceae	<i>Carex macrochaeta</i>	Mirror Lake	E side of lake	59.226034	-154.735938		02-185
Cyperaceae	<i>Carex mackenziei</i>	Swikshak Lagoon	brackish pond and salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	halophytic wet sedge meadow	02-018
Cyperaceae	<i>Carex macrochaeta</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.618025	-153.774087	ericaceous low shrub tundra	02-125
Cyperaceae	<i>Carex media</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.207738	-155.971874	wet low shrub sedge fen	02-398
Cyperaceae	<i>Carex media</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.637951	-153.596221	subhygic low shrub forb meadow	02-067
Cyperaceae	<i>Carex membranacea</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.207738	-155.971874	wet low shrub sedge fen	02-400
Cyperaceae	<i>Carex membranacea</i>	Mirror Lake	SW edge of lake, 100 m E of GPS point	59.244988	-154.805196		02-179
Cyperaceae	<i>Carex mertensii</i>	Dakavak Bay	W edge of Dakavak Lake	58.116309	-154.710321	alder shrub thicket	02-495
Cyperaceae	<i>Carex microchaeta</i>	Contact Creek	S slope of peak S of Contact Lake (large lake E of Contact Creek)	58.190685	-155.975989		02-431
Cyperaceae	<i>Carex micropoda</i>	Mirror Lake	E side of lake	59.226034	-154.735938		02-187
Cyperaceae	<i>Carex nardina</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.624076	-153.781994		02-138
Cyperaceae	<i>Carex nesophila</i>	Contact Creek	Red Mt (peak 1721) NW of confluence of Contact Creek and King Salmon River	58.210122	-156.086676	dwarf shrub tundra and stony slopes	02-407
Cyperaceae	<i>Carex nigricans</i>	Mirror Lake	E side of lake	59.226034	-154.735938		02-186
Cyperaceae	<i>Carex pachystachya</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.613202	-153.764485	herbaceous meadow with scattered alder	02-118
Cyperaceae	<i>Carex pluriflora</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-238
Cyperaceae	<i>Carex pluriflora</i>	Swikshak Lagoon	brackish pond and salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	halophytic wet sedge meadow	02-020
Cyperaceae	<i>Carex pluriflora</i>	Swikshak Lagoon	3 km E of cabin	58.611646	-153.73607	wet sedge meadow	02-012
Cyperaceae	<i>Carex pluriflora</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.635993	-153.597106	low shrub graminoid forb meadow and fen	02-059
Cyperaceae	<i>Carex ramenskii</i>	Swikshak Lagoon	brackish pond and salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	halophytic wet sedge meadow	02-019
Cyperaceae	<i>Carex rariflora</i>	Mirror Lake	edge of pond just NW of lake	59.247396	-154.773444	wet low shrub sedge meadow	02-203
Cyperaceae	<i>Carex rariflora</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.635993	-153.597106	low shrub graminoid forb meadow and fen	02-060
Cyperaceae	<i>Carex rotundata</i>	Nonvianuk Lake outlet	N end of pond S of ranger cabin	59.015338	-155.598557	wet sedge sphagnum fen	02-256
Cyperaceae	<i>Carex rotundata</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.633512	-153.773866	wet sedge meadow	02-143
Cyperaceae	<i>Carex rupestris</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.624076	-153.781994		02-137
Cyperaceae	<i>Carex saxatilis</i>	Mirror Lake	pond W of lake	59.247755	-154.781887		02-212
Cyperaceae	<i>Carex saxatilis</i>	Swikshak Lagoon	3 km E of cabin	58.611646	-153.73607	wet sedge meadow	02-011
Cyperaceae	<i>Carex scirpoidea</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.624076	-153.781994	ericaceous low shrub tundra adjacent to talus slope	02-136
Cyperaceae	<i>Carex scirpoidea</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.648395	-153.613665		02-090

Plant Collections of Katmai National Park and Preserve (cont.) -

Family	Species	General Locality	Specific locality	Lat (dec degree)	Long (dec degree)	Habitat	Collection #
Cyperaceae	<i>Carex utriculata</i>	Mirror Lake	edge of pond just NW of lake	59.247396	-154.773444	wet low shrub sedge meadow	02-204
Cyperaceae	<i>Carex utriculata</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-102
Cyperaceae	<i>Carex williamsii</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-243
Cyperaceae	<i>Carex williamsii</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-249b
Cyperaceae	<i>Carex canescens</i>	road from Brook's camp to 3 Fork's Overlook	opening in woods at km 15.5 pullout 1 km W of road	58.454315	-155.650717	wet low shrub sedge meadow in opening of mixed spruce forest	02-480
Cyperaceae	<i>Carex lugens</i>	road from Brook's camp to 3 Fork's Overlook	opening in woods at km 15.5 pullout 1 km W of road	58.454315	-155.650717	wet low shrub sedge meadow in opening of mixed spruce forest	02-482
Cyperaceae	<i>Carex media</i>	road from Brook's camp to 3 Fork's Overlook	opening in woods at km 15.5 pullout 1 km W of road	58.454315	-155.650717	wet low shrub sedge meadow in opening of mixed spruce forest	02-481
Caryophyllaceae	<i>Cerastium beeringianum</i>	Nonvianuk Lake outlet	beach on S side of outlet	59.018031	-155.59426	forb graminoid meadow with tall shrubs	02-261
Caryophyllaceae	<i>Cerastium beeringianum</i>	Contact Creek	S ridge up peak 2640	58.230557	-155.940657		02-452
Caryophyllaceae	<i>Cerastium beeringianum</i>	Mirror Lake	along upper Funnel Creek	59.241871	-154.793158	ericaceous shrub graminoid meadow	02-163
Caryophyllaceae	<i>Cerastium beeringianum</i>	Mirror Lake	hills SW of lake	59.231024	-154.799344		02-225
Saxifragaceae	<i>Chrysosplenium wrightii</i>	Mirror Lake	hills SW of lake	59.231024	-154.799344		02-224
Apiaceae	<i>Cicuta douglasii</i>	Contact Creek	Red Mt (peak 1721) NW of confluence of Contact Creek and King Salmon River	58.204596	-156.084107	meadow within alder thicket	02-416
Apiaceae	<i>Cicuta douglasii</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.639066	-153.598629	forb graminoid meadow	02-072
Apiaceae	<i>Cicuta virosa</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-251
Apiaceae	<i>Cicuta virosa</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-099
Portulacaceae	<i>Claytonia chamissoi</i>	Alagnak River	hills SW of Charlie Summerville's lodge where Katmai National Preserve's E boundary abuts Alagnak Wild River	58.974678	-156.037137	wet low shrub meadow	02-343
Portulacaceae	<i>Claytonia scammaniana</i>	Contact Creek	S ridge up peak 2640	58.230557	-155.940657		02-451
Orchidaceae	<i>Coeloglossum viride</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-006
Rosaceae	<i>Comarum (Potentilla) palustre</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-247
Rosaceae	<i>Comarum (Potentilla) palustre</i>	Contact Creek	stream from Contact Lake (large lake E of Contact Creek) that flows S into Contact Creek	58.199337	-155.96003	wet graminoid meadow	02-425
Rosaceae	<i>Comarum (Potentilla) palustre</i>	Mirror Lake	edge of pond just NW of lake	59.247396	-154.773444	wet low shrub sedge meadow	02-207
Apiaceae	<i>Conioselinum chinense</i>	Contact Creek	Red Mt (peak 1721) NW of confluence of Contact Creek and King Salmon River	58.204596	-156.084107	meadow within alder thicket	02-417
Pteridaceae	<i>Cryptogramma acrostichoides</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.637004	-153.791826		02-042
Pteridaceae	<i>Cryptogramma sitchensis</i>	Mirror Lake	hills 4 mi. E of lake	59.226484	-154.654325		02-191
Orchidaceae	<i>Cypripedium guttatum</i>	Swikshak Lagoon	200 m NE of cabin	58.605971	-153.764593	forb graminoid meadow	02-001
Dryopteridaceae	<i>Cystopteris fragilis</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.624076	-153.781994		02-132
Orchidaceae	<i>Dactylorhiza aristata</i>	Swikshak Lagoon	slope above N side of W side of lagoon	58.615981	-153.769077	forb graminoid meadow	02-023
Asteraceae	<i>Dendranthemum arcticum</i> ssp. <i>arcticum</i>	Sukoi Bay	hill on S edge of bay	58.859	153.3642	ericaceous dwarf shrub tundra	02-498
Asteraceae	<i>Dendranthemum arcticum</i> ssp. <i>arcticum</i>	Swikshak Lagoon	brackish pond and salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	halophytic wet sedge meadow	02-017
Poaceae	<i>Deschampsia caespitosa</i> var. <i>caespitosa</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.186098	-155.977566		02-441
Poaceae	<i>Deschampsia caespitosa</i> var. <i>caespitosa</i>	Contact Creek	Red Mt (peak 1721) NW of confluence of Contact Creek and King Salmon River	58.210122	-156.086676	dwarf shrub tundra and stony slopes	02-411
Poaceae	<i>Deschampsia caespitosa</i> var. <i>caespitosa</i>	Mirror Lake	ponds on NW side of lake	59.245116	-154.77662		02-200
Poaceae	<i>Deschampsia caespitosa</i> var. <i>caespitosa</i>	Mirror Lake	hills SW of lake	59.231024	-154.799344		02-223
Poaceae	<i>Deschampsia caespitosa</i> var. <i>caespitosa</i>	Swikshak Lagoon	3 km E of cabin	58.611646	-153.73607	wet sedge meadow	02-010
Poaceae	<i>Deschampsia caespitosa</i> var. <i>caespitosa</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.646888	-153.610972		02-078
Brassicaceae	<i>Draba borealis</i>	Swikshak Lagoon	bank of lagoon near trail to cabin	58.6084	153.769		02-056
Brassicaceae	<i>Draba fladhiznesis</i>	Mirror Lake	hills SW of lake	59.231523	-154.780252		02-237
Brassicaceae	<i>Draba lactea</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.624076	-153.781994		02-134
Brassicaceae	<i>Draba lonchocarpa</i> ssp. <i>Vestita</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.647258	-153.61374		02-085
Brassicaceae	<i>Draba lonchocarpa</i> ssp. <i>Vestita</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.624076	-153.781994		02-135
Brassicaceae	<i>Draba nivalis</i>	Contact Creek	S slope of peak S of Contact Lake (large lake E of Contact Creek)	58.190685	-155.975989		02-433
Brassicaceae	<i>Draba stenoloba</i>	Mirror Lake	along upper Funnel Creek	59.244816	-154.802728		02-168
Droseraceae	<i>Drosera rotundifolia</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-239
Rosaceae	<i>Dryas alaskensis</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.633732	-153.784064	dwarf shrub tundra	02-037
Rosaceae	<i>Dryas integrifolia</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.644399	-153.607813	herbaceous dwarf shrub tundra	02-075
Dryopteridaceae	<i>Dryopteris expansa</i>	Contact Creek	Red Mt (peak 1721) NW of confluence of Contact Creek and King Salmon River	58.210122	-156.086676	dwarf shrub tundra and stony slopes	02-408
Dryopteridaceae	<i>Dryopteris expansa</i>	Contact Creek	hill on SW shore of Contact Lake (large lake just W of Contact Creek)	58.209562	-155.990622	closed alder thicket	02-405
Dryopteridaceae	<i>Dryopteris expansa</i>	Mirror Lake	along upper Funnel Creek	59.241897	-154.78899	herbaceous dwarf shrub tundra	02-155
Dryopteridaceae	<i>Dryopteris expansa</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.637004	-153.791826		02-043
Poaceae	<i>Dupontia fisheri</i> ssp. <i>psilosantha</i>	Swikshak Lagoon	E end of spit	58.61866	153.69077	wet sedge meadow	02-113
Cyperaceae	<i>Eleocharis acicularis</i>	Swikshak Lagoon	E end of spit	58.61866	153.69077		02-112
Cyperaceae	<i>Eleocharis kamschatca</i>	Swikshak Lagoon	salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	halophytic wet sedge meadow	02-513
Cyperaceae	<i>Eleocharis kamschatca</i>	Swikshak Lagoon	ponds near alder patch S of salt marsh on Swikshak spit	58.618002	-153.706775	sedge meadow	02-515

Plant Collections of Katmai National Park and Preserve (cont.) -

Family	Species	General Locality	Specific locality	Lat (dec degree)	Long (dec degree)	Habitat	Collection #
Onagraceae	<i>Epilobium palustre</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-245
Onagraceae	<i>Epilobium palustre</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.207738	-155.971874	wet low shrub sedge fen	02-404
Equisetaceae	<i>Equisetum arvense</i>	Contact Creek	NE side of Contact Lake (large lake near Contact Creek)	58.21145	-155.957658		02-459
Equisetaceae	<i>Equisetum fluviatile</i>	Mirror Lake	pond W of lake	59.247755	-154.781887		02-214
Equisetaceae	<i>Equisetum fluviatile</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-110
Equisetaceae	<i>Equisetum scirpoides</i>	Mirror Lake	along upper Funnel Creek	59.241897	-154.78899	herbaceous dwarf shrub tundra	02-159
Equisetaceae	<i>Equisetum sylvaticum</i>	Contact Creek	trail between lake E of Contact Creek (Contact Lake) and Contact Creek	58.1923	155.9626	low shrub tundra	02-475
Equisetaceae	<i>Equisetum variegatum</i>	road from Brook's camp to 3 Fork's Overlook	downstream from stream crossing at km 28	58.393465	-155.510808		02-486
Equisetaceae	<i>Equisetum variegatum</i>	Mirror Lake	pond W of lake	59.244987	-154.788593	low shrub graminoid meadow	02-218
Cyperaceae	<i>Eriophorum angustifolium</i> ssp. <i>subarcticum</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.207738	-155.971874	wet low shrub sedge fen	02-396
Cyperaceae	<i>Eriophorum angustifolium</i> ssp. <i>scabrisculur</i>	Mirror Lake	N side of hills NE of lake	59.257174	-154.661024	forb graminoid meadow	02-193
Cyperaceae	<i>Eriophorum angustifolium</i> ssp. <i>subarcticum</i>	Mirror Lake	hills SW of lake 50 m S of GPS point	59.231024	-154.799344	wet sedge meadow	02-229
Cyperaceae	<i>Eriophorum russeolum</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.207738	-155.971874	wet low shrub sedge fen	02-401
Cyperaceae	<i>Eriophorum russeolum</i>	Mirror Lake	edge of pond just NW of lake	59.247396	-154.773444	wet low shrub sedge meadow	02-202
Cyperaceae	<i>Eriophorum scheuchzeri</i>	Mirror Lake	ponds on NW side of lake	59.245116	-154.77662		02-197
Cyperaceae	<i>Eriophorum vaginatum</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-237b
Cyperaceae	<i>Eriophorum vaginatum</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.207738	-155.971874	wet low shrub sedge fen	02-402
Boraginaceae	<i>Eritrichium chamissonis</i>	Mirror Lake	hills SW of lake	59.231024	-154.799344		02-221
Schrophulariaceae	<i>Euphrasia mollis</i>	Swikshak Lagoon	trail between cabin and lagoon	58.606363	-153.763295	herbaceous meadow	02-510
Poaceae	<i>Festuca brachyphylla</i>	Swikshak Lagoon	talus knob below peak 2750 N of Swikshak Lagoon	58.626898	-153.777804	herbaceous dwarf shrub tundra patches with open scree rubble	02-031
Poaceae	<i>Festuca brachyphylla</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.23102	-153.611		02-077b
Poaceae	<i>Festuca brevisissima</i>	Mirror Lake	hills SW of lake	59.231024	-154.799344		02-222
Poaceae	<i>Festuca brevisissima</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.648888	-153.610972		02-077
Poaceae	<i>Festuca richardsonii</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.648395	-153.613665		02-089
Poaceae	<i>Festuca rubra</i> var. <i>rubra</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.6484	-153.613665		02-089b
Rubiaceae	<i>Galium boreale</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.635993	-153.597106	low shrub graminoid forb meadow and fen	02-061
Rubiaceae	<i>Galium trifidum</i> ssp. <i>trifidum</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.620278	-153.770401		02-146
Gentianaceae	<i>Gentiana algida</i>	Mirror Lake	hills SW of lake	59.217511	-154.775028		02-232
Gentianaceae	<i>Gentiana amarella</i> var. <i>acuta</i>	Sukoi Bay	S spit	58.860496	-153.32702	herbaceous meadow	02-497
Gentianaceae	<i>Gentiana amarella</i> var. <i>acuta</i>	Swikshak Lagoon	trail between cabin and lagoon	58.606363	-153.763295	herbaceous meadow	02-509
Gentianaceae	<i>Gentiana douglasiana</i>	Sukoi Bay	bench on W end of bay	58.861999	-153.356148	graminoid meadow	02-500
Gentianaceae	<i>Gentiana platypetala</i>	Sukoi Bay	ridge NW of bay	58.872905	-153.367568	herbaceous meadow	02-505
Rosaceae	<i>Geum calthifolium</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.625546	-153.774483	forb graminoid meadow	02-027
Rosaceae	<i>Geum rosii</i>	Swikshak Lagoon	top of talus knob on peak 2750 N of Swikshak Lagoon	58.636961	-153.791123		02-048
Dryopteridaceae	<i>Gymnocarpium dryopteris</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.635993	-153.597106	forb graminoid meadow	02-064
Apiaceae	<i>Heracleum lanatum</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-053
Saxifragaceae	<i>Heuchera glabra</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.637004	-153.791826		02-045
Asteraceae	<i>Hieracium triste</i>	Mirror Lake	N side of lake	59.231871	-154.73421	ericaceous heath	02-189
Asteraceae	<i>Hieracium triste</i>	Mirror Lake	edge of pond just NW of lake	59.247755	-154.781887	ericaceous low shrub tundra	02-211
Poaceae	<i>Hierochloa odorata</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-002
Hippuridaceae	<i>Hippuris vulgaris</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-096
Isoetaceae	<i>Isoetes echinospora</i>	Nonvianuk Lake outlet	N end of pond S of ranger cabin	59.015338	-155.598557	pond with round cobble bottom	02-258
Isoetaceae	<i>Isoetes echinospora</i>	Contact Creek	N shore of Contact Lake margin (large lake near Contact Creek)	58.217565	-155.963553		02-462
Juncaceae	<i>Juncus alpinus</i>	road from Brook's camp to 3 Fork's Overlook	downstream from stream crossing at km 28	58.393465	-155.510808		02-488
Juncaceae	<i>Juncus alpinus</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-103
Juncaceae	<i>Juncus alpinus</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.635993	-153.597106	low shrub graminoid forb meadow and fen	02-062
Juncaceae	<i>Juncus alpinus</i> ssp. <i>sitchensis</i>	road from Brook's camp to 3 Fork's Overlook	downstream from stream crossing at km 28	58.393465	-155.510808		02-487
Juncaceae	<i>Juncus biglumis</i>	Mirror Lake	pond 1 mi. W of lake	59.244987	-154.788593		02-220
Juncaceae	<i>Juncus drummondii</i>	Mirror Lake	E side of lake	59.226034	-154.735938		02-188
Juncaceae	<i>Juncus filliformis</i>	Alagnak River	hills SW of Charlie Summerville's lodge where Katmai National Preserve's E boundary abuts Alagnak Wild River	58.971572	-156.029729	wet low shrub meadow	02-342
Juncaceae	<i>Juncus mertensianus</i>	Sukoi Bay	ridge NW of bay	58.872905	-153.367568	wet mossy meadow	02-504
Juncaceae	<i>Juncus mertensianus</i>	Mirror Lake	headwaters of Funnel Creek, 250 m from Mirror Lake	59.242643	-154.785122	low shrub tundra with herbaceous sedge stream margin	02-152
Juncaceae	<i>Juncus supiniformis</i>	Sukoi Bay	bench on W end of bay	58.861999	-153.356148	graminoid meadow	02-501
Juncaceae	<i>Juncus triglumis</i>	Contact Creek	lowlands between Red Mt and Contact Lake (large lake just W of Contact Creek)	58.2126	156.0058	open pothole in low shrub tundra	02-420
Cyperaceae	<i>Kobresia myosuroides</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.618025	-153.774087	ericaceous low shrub tundra	02-126
Schrophulariaceae	<i>Lagotis glauca</i>	Mirror Lake	edge of pond just NW of lake	59.247396	-154.773444	wet low shrub sedge meadow	02-208
Schrophulariaceae	<i>Lagotis glauca</i>	Swikshak Lagoon	talus knob below peak 2750 N of Swikshak Lagoon	58.626898	-153.777804	herbaceous dwarf shrub tundra patches with open scree rubble	02-029

Plant Collections of Katmai National Park and Preserve (cont.) -

Family	Species	General Locality	Specific locality	Lat (dec degree)	Long (dec degree)	Habitat	Collection #
Scrophulariaceae	<i>Limosella? aquatica?</i>	Swikshak Lagoon	brackish pond and salt marsh S of Swikshak R. on Swikshak Spit along upper Funnel Creek	58.616822	-153.721999	halophytic wet sedge meadow	02-014
Orchidaceae	<i>Listera cordata</i>	Mirror Lake	pond W of lake	59.244816	-154.802728	Luetkea meadow	02-167
Fabaceae	<i>Lupinus nootkatensis</i>	Mirror Lake	.5 km E of cabin	59.247755	-154.781887	ericaceous low shrub tundra	02-215
Fabaceae	<i>Lupinus nootkatensis</i>	Swikshak Lagoon	Red Mt (peak 1721) NW of confluence of Contact Creek and King Salmon River	58.606363	-153.763295	forb graminoid meadow	02-052
Juncaceae	<i>Luzula arcuata</i> ssp. <i>unalaschcensis</i>	Contact Creek	S ridge up peak 2640	58.210122	-156.086676	dwarf shrub tundra and stony slopes	02-412
Juncaceae	<i>Luzula arcuata</i> ssp. <i>arcuata</i>	Contact Creek	along upper Funnel Creek	58.230557	-155.940657	herbaceous dwarf shrub tundra	02-453
Juncaceae	<i>Luzula arcuata</i> ssp. <i>arcuata</i>	Mirror Lake	along upper Funnel Creek	59.241897	-154.788899	herbaceous dwarf shrub tundra	02-161
Juncaceae	<i>Luzula spicata</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.647258	-153.61374		02-084
Juncaceae	<i>Luzula wahlenbergii</i> ssp. <i>piper</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.207738	-155.971874	wet low shrub sedge fen	02-403
Juncaceae	<i>Luzula wahlenbergii</i> ssp. <i>piper</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.635803	-153.786327		02-040
Lycopodiaceae	<i>Lycopodium alpinum</i>	Contact Creek	Red Mt (peak 1721) NW of confluence of Contact Creek and King Salmon River	58.210122	-156.086676	dwarf shrub tundra and stony slopes	02-413
Lycopodiaceae	<i>Lycopodium alpinum</i>	Swikshak Lagoon	top of talus knob on peak 2750 N of Swikshak Lagoon	58.636961	-153.791123		02-047
Asteraceae	<i>Matricaria matricarioides</i>	Brook's Camp	around buildings and roads	58.557441	-155.776676		02-476
Menyanthaceae	<i>Menyanthes trifoliata</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-098
Caryophyllaceae	<i>Minuartia rubella</i>	Mirror Lake	hills SW of lake	59.231024	-154.799344		02-227
Caryophyllaceae	<i>mystery aquatic</i>	Contact Creek	W edge of Contact Lake (large lake E of Contact Creek)	58.212249	-155.982425		02-473
Araliaceae	<i>Oplopanax horridum</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.616818	-153.770155	along stream bank in thick alder	02-124
Fabaceae	<i>Oxytropis jordalii</i>	Swikshak Lagoon	talus knob below peak 2750 N of Swikshak Lagoon	58.626898	-153.777804	herbaceous dwarf shrub tundra patches with open scree rubble	02-035
Fabaceae	<i>Oxytropis maydelliana</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.624076	-153.781994		02-131
Fabaceae	<i>Oxytropis nigricans</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.618025	-153.774087	ericaceous low shrub tundra	02-127
Fabaceae	<i>Oxytropis varians</i>	Swikshak Lagoon	talus knob below peak 2750 N of Swikshak Lagoon	58.626898	-153.777804	herbaceous dwarf shrub tundra patches with open scree rubble	02-028
Papaveraceae	<i>Papaver radicum</i> ssp. <i>alaskanum</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.185277	-155.975635		02-445
Papaveraceae	<i>Papaver radicum</i> ssp. <i>alaskanum</i>	Contact Creek	S ridge up peak 2640	58.230557	-155.940657		02-450
Papaveraceae	<i>Papaver radicum</i> ssp. <i>alaskanum</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.624076	-153.781994		02-140
Saxifragaceae	<i>Parnassia palustris</i>	Nonvianuk Lake outlet	N end of pond S of ranger cabin	59.015338	-155.598557	wet sedge sphagnum fen	02-252
Schrophulariaceae	<i>Pedicularis albolabiata</i>	Mirror Lake	along upper Funnel Creek	59.241897	-154.788899	herbaceous dwarf shrub tundra	02-158
Schrophulariaceae	<i>Pedicularis labradorica</i>	Mirror Lake	hills N of lake	59.253993	-154.743704	dwarf shrub tundra	02-194
Schrophulariaceae	<i>Pedicularis lanata</i>	Swikshak Lagoon	talus knob below peak 2750 N of Swikshak Lagoon	58.626898	-153.777804	herbaceous dwarf shrub tundra patches with open scree rubble	02-034
Schrophulariaceae	<i>Pedicularis lanata</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.632133	-153.779654		02-142
Schrophulariaceae	<i>Pedicularis parviflora</i> ssp. <i>parviflora</i>	Contact Creek	ponds on N side of Contact Lake margin (large lake E of Contact Creek)	58.222914	-155.986491		02-468
Asteraceae	<i>Petasites frigidus</i>	Mirror Lake	along upper Funnel Creek	59.244988	-154.805196		02-170
Thelypteridaceae	<i>Phegopteris (Thelypteris) connectilis</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.639066	-153.598629	forb graminoid meadow	02-073
Poaceae	<i>Phleum alpinum</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.647258	-153.61374		02-087
Ericaceae	<i>Phyllodoce aleutica</i> ssp. <i>aleutica</i>	Mirror Lake	SW edge of lake	59.241098	-154.779216	low shrub meadow	02-174
Pinaceae	<i>Picea sitchensis</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.635993	-153.597106	forb graminoid meadow	02-065
Lentibulariaceae	<i>Pinguicula vulgaris</i>	Swikshak Lagoon	talus knob below peak 2750 N of Swikshak Lagoon	58.626898	-153.777804	herbaceous dwarf shrub tundra patches with open scree rubble	02-033
Plantaginaceae	<i>Plantago macrocarpa</i>	Sukoi Bay	hill on S edge of bay	58.859	153.3642	ericaceous dwarf shrub tundra	02-499
Plantaginaceae	<i>Plantago major</i> var. <i>major</i>	Brook's Camp	campground	58.560971	-155.775872		02-479
Orchidaceae	<i>Platanthera dilatata</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.637951	-153.596221	shrub patch	02-071
Poaceae	<i>Poa arctica</i>	Mirror Lake	along upper Funnel Creek	59.241871	-154.793158	ericaceous shrub graminoid meadow	02-165
Poaceae	<i>Poa arctica</i>	Swikshak Lagoon	top of talus knob on peak 2750 N of Swikshak Lagoon	58.636961	-153.791123	turf	02-049
Poaceae	<i>Poa glauca</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.186098	-155.977566		02-437
Poaceae	<i>Poa glauca</i>	Contact Creek	S slope of peak S of Contact Lake (large lake E of Contact Creek)	58.190685	-155.975989		02-429
Poaceae	<i>Poa glauca</i>	Contact Creek	S slope of peak S of Contact Lake (large lake E of Contact Creek)	58.190685	-155.975989		02-430
Poaceae	<i>Poa glauca</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.624076	-153.781994		02-133
Poaceae	<i>Poa glauca</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.624076	-153.781994		02-139
Poaceae	<i>Poa palustris</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.613202	-153.764485	herbaceous meadow with scattered alder	02-117
Poaceae	<i>Poa paucispicula</i>	Mirror Lake	pond 1 mi. W of lake	59.244987	-154.788593		02-219
Poaceae	<i>Poa pratensis</i> ssp. <i>pratensis</i>	Nonvianuk Lake outlet	beach on S side of outlet	59.018031	-155.59426	forb graminoid meadow with tall shrubs	02-260
Poaceae	<i>Poa pratensis</i> ssp. <i>pratensis</i>	Dakavak Bay	W edge of Dakavak Lake	58.116309	-154.710321	alder shrub thicket	02-496
Poaceae	<i>Poa pratensis</i> ssp. <i>pratensis</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.186098	-155.977566		02-438
Poaceae	<i>Poa</i> sp.	Mirror Lake	hills SW of lake	59.231523	-154.780252		02-236
Poaceae	<i>Poa</i> sp.	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.647258	-153.61374		02-082
Poaceae	<i>Poa stenantha</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.647258	-153.61374		02-083
Poaceae	<i>Poa</i> sp.	Swikshak Lagoon	trail between cabin and lagoon	58.606363	-153.763295	herbaceous meadow	02-508

Plant Collections of Katmai National Park and Preserve (cont.) -

Family	Species	General Locality	Specific locality	Lat (dec degree)	Long (dec degree)	Habitat	Collection #
Polemoniaceae	<i>Polemonium acutiflorum</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.616818	-153.770155	open graminoid meadow	02-123
Polygonaceae	<i>Polygonum aviculare</i>	road from Brook's camp to 3 Fork's Overlook	downstream from stream crossing at km 28	58.393465	-155.510808		02-484
Polygonaceae	<i>Polygonum aviculare</i>	Contact Creek	SE side of Contact Lake (large lake near Contact Creek)	58.217624	-155.937836		02-454
Polygonaceae	<i>Polygonum fowleri</i>	Contact Creek	NW shore of Contact Lake (large lake E of Contact Creek)	58.218536	-155.983079		02-470
Salicaceae	<i>Populus balsamifera</i> ssp. <i>trichocarpa</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-007
Potamogetonaceae	<i>Potamogeton alpinus</i>	Contact Creek	ponds on N side of Contact Lake margin (large lake E of Contact Creek)	58.222914	-155.986491		02-467
Potamogetonaceae	<i>Potamogeton epiphydrus</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-097
Potamogetonaceae	<i>Potamogeton filiformis</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.212249	-155.982425		02-422
Potamogetonaceae	<i>Potamogeton gramineus</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.212249	-155.982425		02-423
Potamogetonaceae	<i>Potamogeton praelongus</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.212249	-155.982425		02-423A
Potamogetonaceae	<i>Potamogeton pusillus</i>	Nonvianuk Lake outlet	N end of pond S of ranger cabin	59.015338	-155.598557	pond with round cobble bottom	02-257
Potamogetonaceae	<i>Potamogeton pusillus</i>	Nonvianuk Lake outlet	N end of pond S of ranger cabin	59.015338	-155.598557	pond with round cobble bottom	02-259
Potamogetonaceae	<i>Potamogeton pusillus</i>	Contact Creek	NE side of Contact Lake (large lake near Contact Creek)	58.21145	-155.957658		02-456
Rosaceae	<i>Potentilla hyparctica</i>	Mirror Lake	hills SW of lake	59.231024	-154.799344		02-228
Rosaceae	<i>Potentilla hyparctica</i>	Mirror Lake	hills SW of lake	59.231523	-154.780252		02-235
Rosaceae	<i>Potentilla uniflora</i>	Contact Creek	Red Mt (peak 1721) NW of confluence of Contact Creek and King Salmon River	58.210122	-156.086676	dwarf shrub tundra and stony slopes	02-409
Rosaceae	<i>Potentilla villosa</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.647258	-153.61374		02-081
Asteraceae	<i>Prenanthes alata</i>	Sukoi Bay	ridge NW of bay	58.872905	-153.367568	herbaceous meadow	02-507
Asteraceae	<i>Prenanthes alata</i>	Contact Creek	S ridge up peak 2640	58.219716	-155.936356	herbaceous meadow	02-449
Asteraceae	<i>Prenanthes alata</i>	Swikshak Lagoon	E end of spit	58.618666	153.69077		02-114
Primulaceae	<i>Primula eximia</i>	Mirror Lake	ponds on NW side of lake	59.245116	-154.77662		02-198
Primulaceae	<i>Primula tschuktschorum</i>	Mirror Lake	along upper Funnel Creek	59.244988	-154.805196		02-172
Poaceae	<i>Puccinellia nutkaensis</i>	Swikshak Lagoon	salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	halophytic wet sedge meadow	02-516
Pyrolaceae	<i>Pyrola asarifolia</i> ssp. <i>pupurea</i>	Mirror Lake	.5 mi. SW of SW corner of lake	59.2384	154.7977	low shrub meadow	02-173
Pyrolaceae	<i>Pyrola minor</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.623089	-153.779553	margin of sphagnum fen	02-130
Ranunculaceae	<i>Ranunculus arborvitus</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.617601	-153.768969	herbaceous meadow	02-024
Ranunculaceae	<i>Ranunculus hyperboreus</i> ssp. <i>hyperboreus</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.186098	-155.977566		02-443
Ranunculaceae	<i>Ranunculus lapponicus</i>	Alagnak River	hills SW of Charlie Summerville's lodge where Katmai National Preserve's E boundary abuts Alagnak Wild River	58.983561	-156.024064	low shrub tussock meadow	02-345
Ranunculaceae	<i>Ranunculus nivalis</i>	Mirror Lake	SE edge of lake	59.224591	-154.74002	snowbed meadow	02-184
Ranunculaceae	<i>Ranunculus nivalis</i>	Mirror Lake	hills SW of lake	59.220483	-154.7713		02-233
Ranunculaceae	<i>Ranunculus reptans</i>	Swikshak Lagoon	ponds near alder patch S of salt marsh on Swikshak spit	58.618002	-153.706775	sedge meadow	02-514
Crassulaceae	<i>Rhodiola integrifolia</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.633732	-153.784064	dwarf shrub tundra	02-038
Ericaceae	<i>Rhododendron camtschaticum</i>	Mirror Lake	S edge of lake	59.234167	-154.766632	dwarf shrub tundra	02-182
Ericaceae	<i>Rhododendron camtschaticum</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.644399	-153.607813	herbaceous dwarf shrub tundra	02-076
Hydrophyllaceae	<i>Romanzoffia sitchensis</i>	Dakavak Bay	W edge of Dakavak Lake	58.102854	-154.688447		02-493
Brassicaceae	<i>Rorippa palustris</i> var. <i>palustris</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.186098	-155.977566		02-435
Rosaceae	<i>Rubus spectabilis</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.613202	-153.764485	herbaceous meadow with scattered alder	02-119
Polygonaceae	<i>Rumex aquaticus</i> var. <i>fenestratus</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.615316	-153.76861	small herbaceous fen	02-120
Polygonaceae	<i>Rumex arcticus</i>	Nonvianuk River	6 mi. downstream from outlet on N side of river	59.03123	-155.754712	wet low shrub graminoid forb meadow and fen	02-263
Polygonaceae	<i>Rumex arcticus</i>	Mirror Lake	along upper Funnel Creek	59.244988	-154.805196		02-171
Potamogetonaceae	<i>Ruppia maritima</i>	Swikshak Lagoon	brackish pond and salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	halophytic wet sedge meadow	02-022
Potamogetonaceae	<i>Ruppia maritima</i>	Swikshak Lagoon	salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	brackish channel of salt marsh	02-511
Caryophyllaceae	<i>Sagina saginoides</i>	Contact Creek	Contact Creek S of 2 large lakes (Contact Lake)	58.185277	-155.975635		02-446
Salicaceae	<i>Salix arbusculoides</i>	road from Brook's camp to 3 Fork's Overlook	opening in woods at km 15.5 pullout 1 km W of road	58.454315	-155.650717	wet low shrub sedge meadow in opening of mixed spruce forest	02-483
Salicaceae	<i>Salix barclayi</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.637951	-153.596221	shrub patch	02-070
Salicaceae	<i>Salix bebbiana</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-005
Salicaceae	<i>Salix fuscescens</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-244
Salicaceae	<i>Salix fuscescens</i>	Mirror Lake	edge of pond just NW of lake	59.247396	-154.773444	wet low shrub sedge meadow	02-206
Salicaceae	<i>Salix fuscescens</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-108
Salicaceae	<i>Salix glauca</i> var. <i>acutifolia</i>	Alagnak River	hills SW of Charlie Summerville's lodge where Katmai National Preserve's E boundary abuts Alagnak Wild River	58.974678	-156.037137	wet low shrub meadow	02-344
Salicaceae	<i>Salix glauca</i> var. <i>acutifolia</i>	Contact Creek	W edge of Contact Lake (large lake E of Contact Creek)	58.212249	-155.982425	alder thicket	02-471
Salicaceae	<i>Salix ovalifolia</i> ssp. <i>cyclophylla</i>	Mirror Lake	along upper Funnel Creek	59.241897	-154.78899	herbaceous dwarf shrub tundra	02-156
Salicaceae	<i>Salix pulchra</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-004
Salicaceae	<i>Salix rotundifolia</i>	Mirror Lake	hills SW of lake	59.220483	-154.7713		02-234
Salicaceae	<i>Salix rotundifolia</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.635803	-153.786327		02-039
Salicaceae	<i>Salix sitchensis</i>	Dakavak Bay	W edge of Dakavak Lake	58.102854	-154.688447		02-490
Asteraceae	<i>Saussurea angustifolia</i>	Mirror Lake	along upper Funnel Creek	59.241871	-154.793158	ericaceous shrub graminoid meadow	02-162
Saxifragaceae	<i>Saxifraga flagellaris</i>	Mirror Lake	hills SW of lake	59.231024	-154.799344		02-226

Plant Collections of Katmai National Park and Preserve (cont.) -

Family	Species	General Locality	Specific locality	Lat (dec degree)	Long (dec degree)	Habitat	Collection #
Saxifragaceae	<i>Saxifraga hieraciifolia</i>	Contact Creek	Red Mt (peak 1721) NW of confluence of Contact Creek and King Salmon River	58.209016	-156.084696	wet sedge herbaceous meadow	02-414
Saxifragaceae	<i>Saxifraga hirculus</i>	Contact Creek	N ridge of Contact Lake margin (large lake near Contact Creek)	58.222994	-155.971234	muskeg	02-466
Saxifragaceae	<i>Saxifraga hirculus</i>	Mirror Lake	S edge of lake	59.235353	-154.767775	graminoid sedge meadow	02-180
Saxifragaceae	<i>Saxifraga lyallii</i>	Mirror Lake	along upper Funnel Creek	59.244816	-154.802728		02-169
Saxifragaceae	<i>Saxifraga nelsoniana</i>	Swikshak Lagoon	top of talus knob on peak 2750 N of Swikshak Lagoon	58.636961	-153.791123		02-046
Saxifragaceae	<i>Saxifraga oppositifolia</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.648395	-153.613665		02-091
Saxifragaceae	<i>Saxifraga rivularis</i>	Mirror Lake	along upper Funnel Creek	59.241897	-154.788899	herbaceous dwarf shrub tundra	02-157
Saxifragaceae	<i>Saxifraga serpyllifolia</i>	Mirror Lake	hills 4 mi. E of lake	59.244631	-154.661024		02-192
Asteraceae	<i>Senecio triangularis</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.623089	-153.779553	margin of sphagnum fen	02-129
Asteraceae	<i>Solidago lepida</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.613202	-153.764485		02-148
Asteraceae	<i>Solidago lepida</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.635993	-153.597106	forb graminoid meadow	02-066
Asteraceae	<i>Solidago multiradiata</i> ssp. <i>arctica</i>	Mirror Lake	S edge of lake	59.235353	-154.767775	graminoid sedge meadow	02-181
Asteraceae	<i>Solidago multiradiata</i>	Swikshak Lagoon	talus knob below peak 2750 N of Swikshak Lagoon	58.626898	-153.777804	herbaceous dwarf shrub tundra patches with open scree rubble	02-032
Sparganiaceae	<i>Sparganium angustifolium</i>	Contact Creek	NE side of Contact Lake (large lake near Contact Creek)	58.21145	-155.957658		02-457
Sparganiaceae	<i>Sparganium angustifolium</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-095
Orchidaceae	<i>Spiranthes romanzoffiana</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-246
Caryophyllaceae	<i>Stellaria calycantha</i>	Mirror Lake	headwaters of Funnel Creek, 250 m from Mirror Lake	59.242643	-154.785122	low shrub tundra with herbaceous sedge stream marain	02-151
Caryophyllaceae	<i>Stellaria humifusa</i>	Swikshak Lagoon	brackish pond and salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	halophytic wet sedge meadow	02-016
Caryophyllaceae	<i>Stellaria laeta</i>	Contact Creek	N ridge of Contact Lake margin (large lake near Contact Creek)	58.217565	-155.963553		02-464
Caryophyllaceae	<i>Stellaria longipes</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-051
Brassicaceae	<i>Subularia aquatica</i>	Contact Creek	SW shore of Contact Lake (large lake just W of Contact Creek)	58.212249	-155.982425		02-421
Asteraceae	<i>Taraxacum kamschaticum</i>	Mirror Lake	3-4 mi. E of lake	59.225985	-154.668868	forb graminoid meadow	02-190
Asteraceae	<i>Taraxacum lacerum</i>	Swikshak Lagoon	.5 km E of cabin	58.606363	-153.763295	forb graminoid meadow	02-009
Asteraceae	<i>Taraxacum trigonolobum</i>	Brook's Camp	Historic Cabin Re-creation	58.55668	-155.781376		02-478
Saxifragaceae	<i>Tellima grandiflora</i>	Swikshak Lagoon	hill N of Swikshak Lagoon	58.623089	-153.779553	margin of sphagnum fen	02-128
Ranunculaceae	<i>Thalictrum alpinum</i>	Mirror Lake	pond W of lake	59.244987	-154.788593	low shrub graminoid meadow	02-216
Ranunculaceae	<i>Thalictrum alpinum</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.630915	-153.774494		02-144
Liliaceae	<i>Tofieldia pusilla</i>	Mirror Lake	along upper Funnel Creek	59.241871	-154.793158	ericaceous shrub graminoid meadow	02-164
Cyperaceae	<i>Trichophorum caespitosum</i>	Nonvianuk Lake outlet	fen S of ranger cabin	59.01596	-155.601856	wet sedge sphagnum fen	02-240
Cyperaceae	<i>Trichophorum caespitosum</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.636961	-153.791123		02-036
Cyperaceae	<i>Trichophorum caespitosum</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.635993	-153.597106	low shrub graminoid forb meadow and fen	02-063
Juncaginaceae	<i>Triglochin palustris</i>	Swikshak Lagoon	brackish pond and salt marsh S of Swikshak R. on Swikshak Spit	58.616822	-153.721999	halophytic wet sedge meadow	02-021
Lentibulariaceae	<i>Utricularia minor</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-104
Lentibulariaceae	<i>Utricularia vulgaris</i>	Contact Creek	NE side of Contact Lake (large lake near Contact Creek)	58.21145	-155.957658		02-455
Lentibulariaceae	<i>Utricularia</i>	Swikshak Lagoon	E end of spit	58.61293	153.68831	nuphar pond and marsh	02-109
Ericaceae	<i>Vaccinium ovalifolium</i>	Sukoi Bay	ridge NW of bay	58.869407	-153.364301	open alder stand	02-502
Ericaceae	<i>Vaccinium ovalifolium</i>	Mirror Lake	SW edge of lake	59.241098	-154.779216	low shrub meadow	02-176
Schrophulariaceae	<i>Veronica wormskjoldii</i>	Mirror Lake	headwaters of Funnel Creek, 250 m from Mirror Lake	59.242643	-154.785122	low shrub tundra with herbaceous sedge stream marain	02-153
Caprifoliaceae	<i>Viburnum edule</i>	Contact Creek	just SE of Contact Lake (large lake E of Contact Creek)	58.199337	-155.96003	alder thicket	02-447
Violaceae	<i>Viola epipsila</i>	Mirror Lake	headwaters of Funnel Creek, 250 m from Mirror Lake	59.242643	-154.785122	low shrub tundra with herbaceous sedge stream marain	02-154
Violaceae	<i>Viola langsdorfii</i>	Swikshak Lagoon	peak 2750 N of Swikshak Lagoon	58.625546	-153.774483	forb graminoid meadow	02-026
Dryopteridaceae	<i>Woodsia ilvensis</i>	Contact Creek	S slope of peak S of Contact Lake (large lake E of Contact Creek)	58.190685	-155.975989		02-434
Dryopteridaceae	<i>Woodsia ilvensis</i>	Swikshak Lagoon	cape and headland N of Swikshak Lagoon	58.648395	-153.613665		02-088

APPENDIX 2

Rare Plant Species List for Alagnak Wild River -

No rare species were collected in this unit.

Rare Plant Species List for Katmai National Park and Preserve -

Aphragmus eschscholtzianus Andr.:

This species is listed as rare to uncommon globally and within the state of Alaska (G3-S3, Alaska Natural Heritage Program Rare Plant List). There are fewer than 30 known locations of this rare mustard globally and within Alaska. The distribution is generally restricted to mountains in the Aleutians, Alaska Range, and isolated stations on the Seward Peninsula and Brooks Range. Only a single population is known outside of Alaska (Wrangell Mountains in Yukon Territory). This species appears to be a habitat specialist of moist, yet well drained alpine sites. Population sizes can range from a few individuals to a few thousand and do not appear to have any immediate threats.

At Mirror Lake (KATM Region-2) along a mountainous ridge (600 m elev.) south west of the lake we located a population of *Aphragmus eschscholtzianus* in a well-drained former snowmelt pond with large cobbles (59.127°N 154.784°W). Approximately 100-200 individuals were present.

Primula tschuktschorum Kjellm.:

This rare primrose is only known from the Bering Strait Region and areas around Bristol Bay. It is rare to uncommon globally and within the state (G3 - S2S3). This species is found in wet tundra and pond margins, often shallowly submerged. More recent surveys on the Seward Peninsula and mountains surrounding Bristol Bay have revealed a number of new populations, which can often be of large sizes ($\geq 5,000$). This taxon faces severe herbivory by geese, and possibly reindeer, in some locations (Kelso 1995), but is generally not impacted by anthropogenic factors.

A few specimens of *Primula tschuktschorum* were collected from a total population of ca. 5,000. We collected a few specimens from a small, dispersed population (50 -200 individuals) a wet-sedge tundra site along upper Funnel Creek in the vicinity of Mirror Lake (59.245°N 154.804°W; KATM Region-2). In another, nearby location (59.245°N 154.776°W; KATM Region-2) we collected *P. eximia* as well as what appears to be *P. tschuktschorum*. This mixed-population was composed of a many small patches of 50 - 200 plants, surrounding a number of small ponds with a total population size estimated at ca. 5,000. We are currently reviewing the *Primula* specimens collected from Mirror Lake to verify the species determinations and range of morphological variation.

APPENDIX 3

User's Guide for GIS Attributes and Data Layers with Links to Plant Data Bases -



The National Park Service
Inventory and Monitoring



USER'S GUIDE

FOR

**Floristic Survey of Katmai NP and Alagnak Wild River
GIS Database**

Prepared for Southwest Alaska Area Network – National Park Service

By

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INTRODUCTION

In 2002, the Alaska Natural Heritage Program (AKNHP) entered into a Cooperative agreement with the National Park Service (NPS) Inventorying and Monitoring program to provide a floristic survey for Katmai National Park and Preserve and Alagnak Wild River Corridor. As a result of this study, a Geographic Information System (GIS) based data-system was developed to store the results of this floristic survey and integrate these data with historical plant collections. This simple GIS application was developed by the Alaska Natural Heritage Program and allows users to view and query plant collections in a spatial context while providing all associated site data. The global positioning data collected at each 2002 collection site serves as the basis for the spatial depiction of survey data. Spatial data for historical collections is limited to location coordinates obtained from the collection records and herbarium labels. The spatial accuracy and depiction of the historical records have a wider variation of accuracy than that of the 2002 survey which was collected in a more precise and standardized format. This GIS database is a self contained ArcView interface that allows easy access to botanical data and thus integrates floristic collections for both Katmai NP&P and Alagnak Wild River corridor. The associated project report provides background for the 2002 project and explains data collection methodology.

Database, information for the 2002 survey has been separated into three formats:

- 1) **Collection spreadsheets** for each 2002 collection site. These contain site information, species collected, the habits in which they occurred, and associated species information.
- 2) **GIS Data Layers** that depict collection site locations and provide background coverages for collection regions. Historical collections include those from the University of Fairbanks Herbarium and the 1953-54 Cahalane Katmai NP collection.
- 3) **Digital field photos** that were taken at the collection sites and provide an overview of the specimen collection area.

The Katmai NP&P and Alagnak Wild River database summarizes all botanical collections for the area and provides access to the products generated from the 2002 survey. This survey was aimed at collecting specimens that would document the occurrence of additional taxa for the Park and Preserve as well as the Wild River Corridor. These collections were made after a review of existing vouchered specimens and survey locations were chosen to expand data collection into areas not previously surveyed. It is our intent that this CD database application be made available to a wide audience and is intended to provide land resource managers with a data tool to better assess the floristic data of these areas, that contribute to a better understanding of the botanical character of land units managed by the National Park Service.

This User's Guide describes the structure, usage, and navigation of the ArcView GIS database application developed for this floristic inventory. This document will accompany the database application as it is distributed to assist the users in understanding the technical and organizational aspects and component data layers of the CD application.

An additional CD contains the raw data layers used to construct this application and has been delivered as a separate product to the Southwest Alaska Area Network of the Alaska National Park System.

SOFTWARE REQUIREMENTS AND INSTALLATION

Software required for successful use of this product includes ArcView 3.1 or higher, Powerlink Extension for ArcView, and Microsoft Excel. Collection spreadsheets are accessible using Microsoft Excel alone. However, no spatial data can be accessed without ArcView 3.1 or higher and Powerlink extension is needed to access the connection of excel files and field photos within the ArcView application.

This CD-ROM was designed to operate from a C: drive of any computer with required software. It is recommended to increase viewing speed, that you copy the entire project (file: "swan_nps") to a C: drive. It is very important to **copy the entire file**.

**** Please note:** To operate properly, the file **MUST be placed directly on the selected drive**, not as a subfolder of any other directory.

CD-ROM CONTENTS

The Species of Concern database contains spatial and spreadsheet information regarding historical botanical collections, and 2002 floristic study for Katmai NP&P and Alagnak Wild River Corridor. The 2002 survey data has been organized into five regional survey areas that include, Alagnak River Corridor, Contact Creek, Mirror Lake, Swikshak Lagoon, and Ancillary Collection sites. Within these five units, sub-units have been established to aid in viewing the site locations. A sixth division summarizes all historical plant collection data. See Table 1 for complete list of regional Survey units and sub-units. The database is completely accessible through the ArcView GIS application. Spreadsheet information may also be accessed directly using Microsoft Excel. Within the ArcView database ('katm_alag_floristic02.apr') there are a total of 14 **Views** (pages): an individual **View** for each regional survey area or regional survey sub-unit, and a separate summary **View** for all historical plant collections. In each **View** the user is able to link to spreadsheet information for a specific collection site and to a field photograph taken from each location. Each collection site spreadsheet contains a listing of each species collected at that location, habitat information, associated species at that site, a variety of locational data as well as basic collection information (Collector name, date, number, etc.).

This CD-ROM contains a User's Guide for the Floristic Survey for Katmai National Park and Preserve and Alagnak Wild River Database (user_guide.doc). Additionally, a separate CD containing all products including, field photos, site locations, and collection information has been provided for those users of the data that may not wish to access the data by way of the ArcView application .

Table A1. Katmai National Park and Preserve and Alagnak Wild River Corridor Regional Survey Units and Sub-units. Regional survey units that were large and dispersed are divided into sub-units, shown in the right column.

Regional Survey Unit Name	Regional Survey Sub-unit Name
All Survey Sites	N/A
Alagnak River	Alagnak River - West Alagnak River - Central Alagnak River - East
Ancillary Sites	Ancillary Sites - Brooks Ancillary Sites - Dakavak Ancillary Sites - Margot Ancillary Sites - Nonvianuk Ancillary Sites - Sukoi Bay
Contact Creek	N/A
Mirror Lake	N/A
Swikshak Lagoon	Swikshak Lagoon - East Swikshak Lagoon - West

USER GUIDELINES

A. Data Sources

The Collection Spreadsheets and GIS distribution layers reflect a compilation of existing collection summary provided by the University of Alaska Fairbanks Herbarium (ALA) obtained in 2001, a historical park collection obtained in 1953-54 by Cahalane et al. from Katmai National Park and Preserve Headquarters, and recently acquired data from the Alaska Natural Heritage Program from the NPS sponsored floristic survey conducted in summer 2002. Carolyn Parker, botanist with University of Alaska Herbarium, provided verification for specimens collected in the 2002 survey.

B. Collection Site Spreadsheets and Field Photos

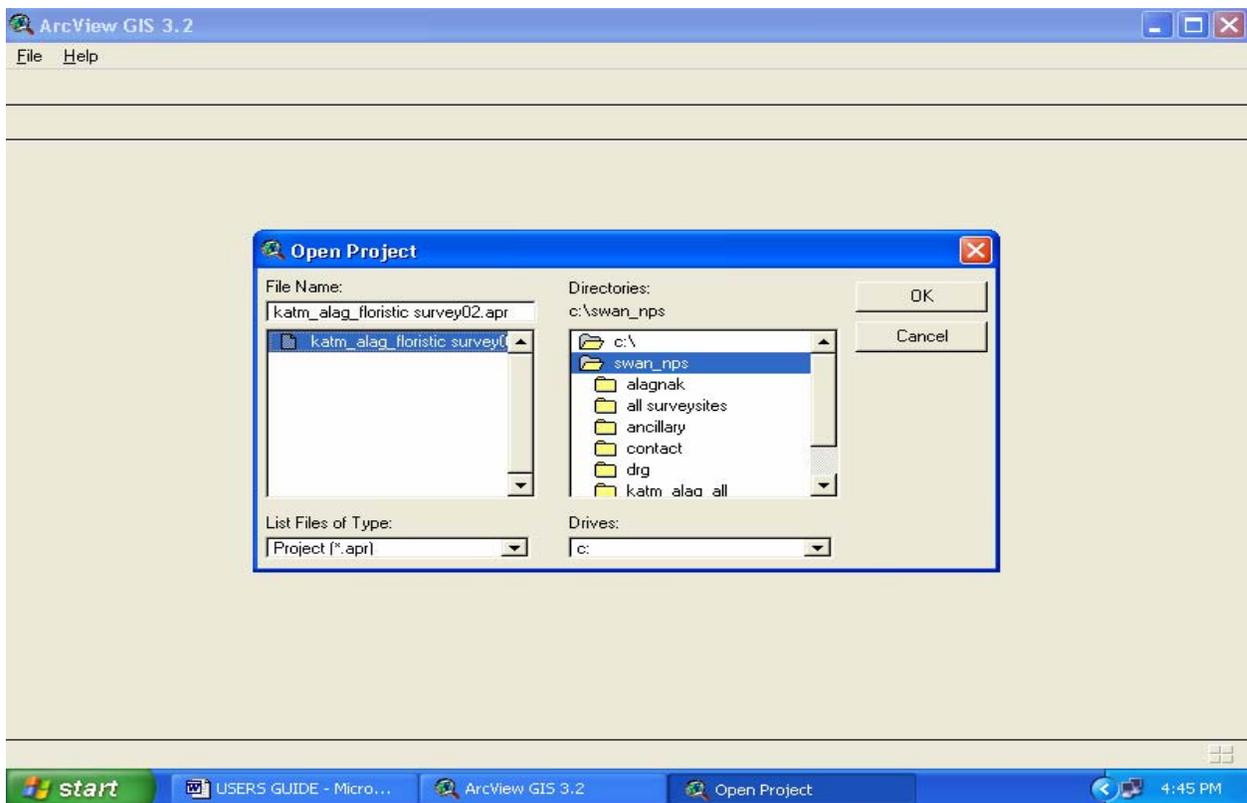
Spreadsheets have been provided both individually for each 2002 collection site, as well as a spreadsheet summary of all collections. These are accessible in Excel format and in the ArcView application. Historical collections from ALA and the 1953-54 Cahalane collection are presented as spreadsheets (*.xls) and spatially through ArcView application. No attempts were made to standardize attribute information between 2002

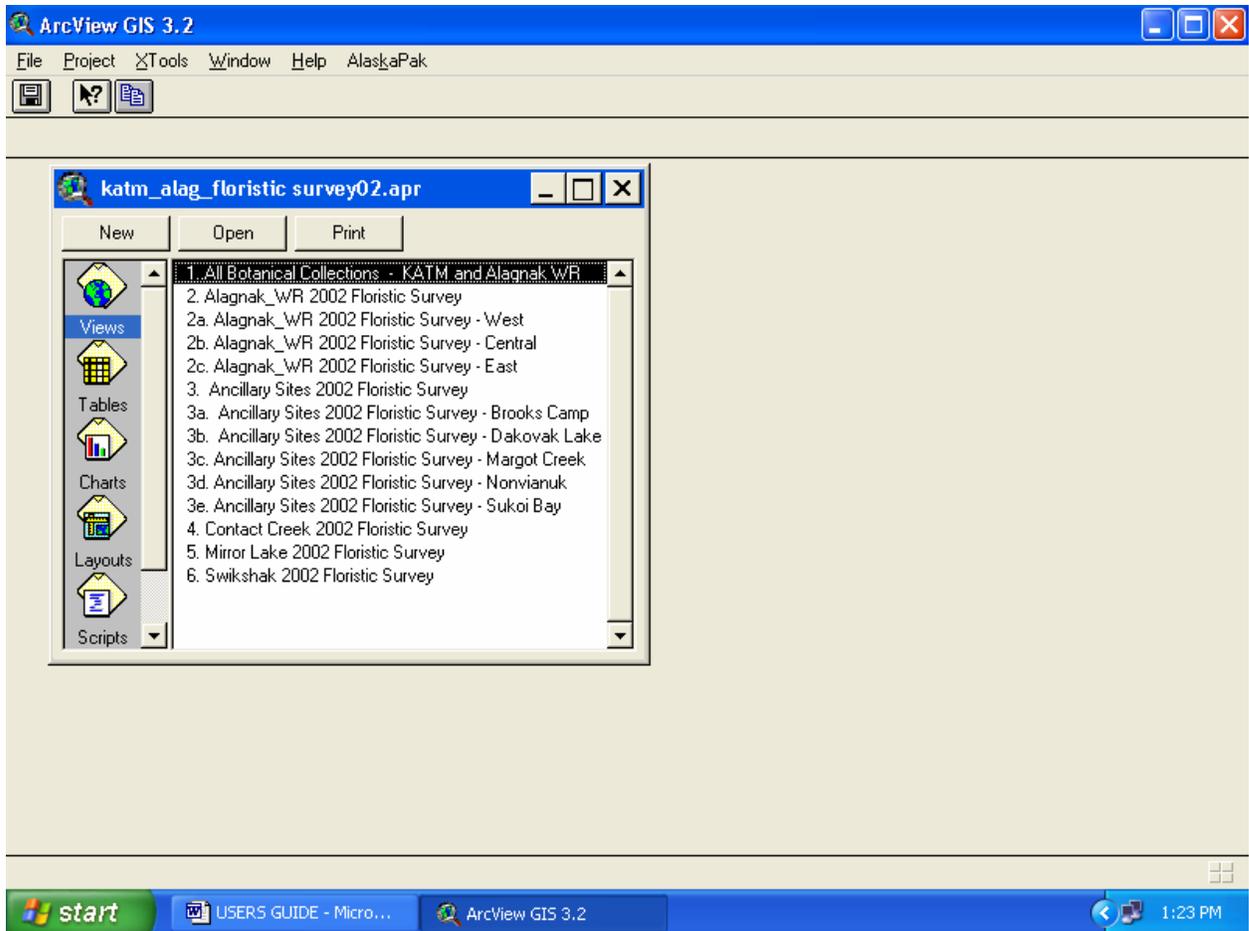
and historic data sets. **C. ARCVIEW GIS Database:**
'Katm_alag_floristicsurvey02.apr'

How to Open the Project

The database was designed for use by those with a basic level of ArcView proficiency. Very basic instructions for opening the program and use of the Powerlink feature are included in this User's Guide. In addition to the built-in help files in ArcView, more detailed information and support can be found on-line at <http://support.esri.com/>; to purchase an on-line course in using ArcView, visit ESRI's virtual campus at <http://campus.esri.com/>. Powerlink is an extension for Arcview provided online through <http://www.benchmarkgis.com>. This extension is provided for a free 15 day download at this site or purchase for \$69. This extension must be activated for the application to operate correctly. Before accessing the database, Powerlink extension must be loaded in the ArcView extension folder.

Load Swan_nps folder to your C; drive. This CD-ROM is designed to operate in C:\ disk drive, and the contents may also be copied to a hard-drive to increase viewing speed (see **SOFTWARE REQUIREMENTS AND INSTALLATION**). To open the project activate ArcView Files open project, choose c:\Swan_nps and click on 'Katm_alag_floristicsurvey02.apr' as shown in the example below.





Once the ArcView project opens, the first page should appear as in the example above. Note that the icon for “Views” is highlighted in the blue bar on the left side of the screen; this icon must be active to access views.

How to Open a View

To open the desired **View**, click on the name of **View** (it should appear highlighted in black, as in the All Botanical Collections KATM and Alagnak WR example above). Then click the “Open” button or simply double-click the desired **View**, and the **View** will appear on your screen. There are 14 separate views for this project.

How to Open an Attribute Table

Each **View** consists of several data layers or **Themes**. To view the attribute table for a **Theme**, the **Theme** must first be made active. To activate a **Theme**, simply click once on the **Theme** name.

Once the **Theme** is active, click the “Table” icon on the toolbar at the top of the **View**, or use the “Theme” pull-down menu and select “Table”:

Refer to Section **E. Database Contents** for an explanation of data and field names presented in these tables.

How to Use Powerlinks

To access the spreadsheets and field photos via ArcView, use the regional area polygon shape file available for each regional area unit and sub-unit. Click on the **Theme** labeled *_poly.shp to activate it (Step 1), then click on the Hotlink button (black lightning bolt) (Step 2). With the Hotlink button active, click anywhere in the polygon (Step 3). This will automatically start Excel and bring up the appropriate spreadsheet for that collection point and activate the image viewer and display the field photos associated with that collection site.

D. Database Structure

The project ‘Species_of_Concern.apr’ consists of 6 separate **Views** (pages). In addition to one **View** per regional survey site, there is also one **View** containing all historical plant collections from Katmai NP&P and Alagnak Wild River corridor. Each species’ **View** contains the **Themes** (data layers) developed for that regional survey area. (see table #2 for a complete list of the 55 data layers or themes for each survey area).

Basemap Descriptions

The basemap for the database was the U.S. Geological Survey Digital Raster graphics (digital depiction of the USGS 1:63360 quad series). These .tif formatted files were converted into Alaska Albers projection and provided by the Alaska Regional Office GIS Division for use in the botanical survey. All shape files were georeferenced using the Alaska Albers projection (unit class = meters). All spatial point features representing collection sites were converted from their original projections for display on this layer. These DRG’s and the boundary of Katmai NP&P and the Alagnak WR coverages provided by the NP GIS division was used to georeference original polygon and point features. Original decimal degree locations for each site are included in all spreadsheets. All collection site locations

were buffered to create a polygon coverage from which links to associated spreadsheets and field photos could be established.

Map Projection

All shape files were created and displayed using an Alaska Albers Equal Area map projection. Projection parameters include:

Projection: Albers

Spheroid: Clarke 1866

Central Meridian: -154 00 00

Reference Latitude: 50 00 00

Standard Parallel 1: 55 00 00

Standard Parallel 2: 65 00 00

False Easting: 0

False Northing: 0

Data Formats

Shape files in the regional survey site folders are located under the folder labeled shapefiles and are in ArcView file format. Each shapefile has 3-5 associated files in an ArcView format (extensions include *.shp, *.dbf, *.shx, *.sbn, and *.sbx) that can be used by all versions of ArcView. There is a point feature file showing collection-site locations within each regional survey area, as well as a polygon coverage built around these points to allow linking to the other data components. Shape files are stored both as point features and polygon features. For each collection site there is a point or *_sites shape file showing the exact location of the location and a (*_poly) file that is a buffered coverage of these sites created to link to associated data within the ArcView application. Other base maps to include the park boundary is also stored as a polygon coverage in the ArcView folder under the associated regional survey unit.

Spreadsheet files in the Regional Survey folders are organized under Spreadsheets and are in MS Excel format (.xls extension).

Field Photo Image Files are located in fieldphoto folder under each regional survey area. These files have a .tif extension and are easily open using any image viewer and a variety of other software applications.

DRG Base maps are stored together in the DRG folder by way of the c:\swan_nps\DRG path.

E. Database Contents and Development of GIS Data Layers

A total of 29 data layers (**Themes**) were developed for this database. For a complete list of **Themes** included for each species, please see table 2. There are an additional 26

baselayers used to display these layers. Database tables for historical collections (NPDC and Cahalane Collections and the 2002 survey were used to develop these themes.)

University of Alaska Fairbanks NPDC: (*Npdc uaf collections.shp*)

This theme was developed as an event theme using ArcView software. The original electronic data received from the University of Alaska herbarium was imported into Excel and adjusted to fit the desired format. These data were transferred from Excel to ArcView via a comma delimited text file. All associated information is stored in the point feature attribute table and is accessible through the '**Identity**' function of ArcView.

The core set of attributes used for this layer includes, taxonomic name, location, habitat and collection information. A complete list of attribute field definitions is available in Table 3.

Cahalane Park Data Layer 1953-54 (*Cahalane53-54.shp*)

This theme was developed as an event theme using Arcview software. The original electronic data received from NPS and was imported into Excel and adjusted to fit the desired format. These data were transferred from Excel to ArcView via a comma delimited text file and a point feature theme was produced. All associated survey information is stored in the attribute table and viewable through the '**Identity**' function of ARCVIEW.

The core set of attributes used for this includes the following: specimen name, collectors, location, and elevation. A complete list of attribute field definitions is available in Table 4.

2002 Floristic Survey Data Layer: (*2002nps_survey.shp*)

This theme was developed as an event theme using Arcview software. The original electronic data was compiled from survey data collected by AKNHP staff and put in Excel spreadsheet format, afterspecimen verification by Carolyn Parker and Alan Batten at the UAF herbarium.

On the summary spreadsheet, each collection site was assigned a unique number and name. This summary spreadsheet was edited and transferred from Excel to ArcView via a comma delimited text file. This summary table was used to create a point feature theme for the entire survey to include all collection sites. All data were edited and regional units and sub-units were divided to create themes for each. These layers were assembled with their base layers into separate views and a polygon shape file was created for each regional survey unit and sub-unit. The polygon shape file was used to store site identification and pathways necessary to establish links. The original summary spreadsheet was then divided into separated

Excel sheets on each for a collection site and these were grouped according to regional survey units and sub-units.

The point feature file for each site contains attributes for the following general areas; location, taxonomic names, habitat, site characteristics, and collection notes. See Table 3 for a full listing of attributes and their definitions.

The polygon coverages for each regional survey unit and sub-unit were attributed with those features that allowed linkage to appropriate spreadsheets and field photos. See table 3 for a full listing of these attributes.

F. Database Assemblage

All theme layers as described above, were then assembled and organized in ArcView for each of the five regional survey areas. Field photos were scanned, formatted as .tif files, and named according to the associated collection site survey name and number. The Powerlink ArcView extension was used to assemble pathways which were automatically inserted into the regional survey unit and sub-unit a polygon attribute tables. Field photos were connected to appropriate field collection sites. A final edit was made of all data and application function tested.

CONTACTS

Any comments that would help enhance the quality of this project or aid in the use of these data should be directed to:

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Table A2. Database Content for the Katmai NP&P and Alagnak WR Corridor Floristic Survey.

View	Shape File Name	Feature Class
1. All Botanical Collections - KATM and Alagnak WR	Alagnak_wr.shp Npdc_uaf_collections.shp 2002nps_survey.shp Cahalane53-54.shp Katmnp_boundary.shp	line point point point polygon
2a. Alagnak_WR 2002 Floristic Survey - West	Alagnak_west_poly.shp Alagnak_wr.shp Alag_west_sites.shp	polygon line point
2b. Alagnak_WR 2002 Floristic Survey - Central	Alagnak_central_poly.shp Naknek-d1.tif Alag_central_sites.shp	polygon image point
2c. Alagnak_WR 2002 Floristic Survey - East	Alag_east_sites.shp Alagnak_east_poly.shp Iliamna-a8.tif	point polygon image
3. Ancillary Sites 2002 Floristic Survey	Ancillary_sites.shp Katmnp_boundary.shp Iliamna-c6.tif Iliamna-b5.tif Iliamna-a3.tif Iliamna-a8.tif Iliamna-a7.tif Afognak-d4.tif Afognak-d5.tif	point polygon image image image image image image
3a. Ancillary Sites 2002 Floristic Survey - Brooks Camp	Brooks_sites.shp Brooks_poly.shp MtKatmi-c6.tif	point polygon image
3b. Ancillary Sites 2002 Floristic Survey - Dakovak Lake	Dakovak_poly.shp Dakovak_sites.shp MtKatmi-a3.tif	polygon point image
3c. Ancillary Sites 2002 Floristic Survey - Margot Creek	Margot_sites.shp Margot_poly.shp	point polygon

	MtKatmi-b5.tif	image
3d. Ancillary Sites 2002 Floristic Survey - Nonvianuk	Nonvianuk_sites.shp Nonvianuk_poly.shp Iliamna-a8.tif Iliamna-a7.tif	point polygon image image
3e. Ancillary Sites 2002 Floristic Survey - Sukoi Bay	Sukoi_sites.shp Sukoi_bay_poly.shp Afognak-d5.tif Afognak-d4.tif	point polygon image image
4. Contact Creek 2002 Floristic Survey	Contact_poly.shp Contact_sites Naknek-a1.tif MtKatmi-a6.tif	polygon point image image
5. Mirror Lake 2002 Floristic Survey	Mirror_sites.shp Mirror_poly.shp Iliamna-b5.tif Iliamna-a5.tif	point polygon image image
6a. Swikshak 2002 Floristic Survey - West	Swik_west_sites.shp Swik_west_poly.shp Afognak-c6.tif	point polygon image
6b. Swikshak 2002 Floristic Survey - East	Swik_east_sites.shp Swik_east_poly.shp Afognak-c5.tif	point polygon image

Table A3. Field Definitions for Theme Attribute Tables.

Theme: 2002 Floristic Survey Site Point feature themes and excel spreadsheets

Example all *_site.shp files for project

Field Name	Description
Collection	Collection Number
Link_no	Link Number
Lat_dd	Latitude decimal degrees
Long_dd	Longitude decimal degrees
Waypt_no	Way Point number
Family	Taxonomic Family
Scientific	Scientific Name
Quadname	1:62 USGS Quadrangle name
Park_unit	Park Unit Symbol
Survey_reg	Survey Region Name
General_lo	General Location
Location	Location description
Loc_type	Type of location GPS/Map
Min_elev	Minimum Elevation with units
Precision	Precision of Location
Max_elev	Maximum Elevation
Topography	Topography
Aspect	Aspect
Slope	Slope
Habitat	Habitat Description
Z_vegcover	Percent Vegetation Cover
Substrate	Substrate
Abundance	Abundance
Coll_notes	Collection Notes
Assoc_spp_	Associated Species
Collector	Collector's Name(s)
Comm_	Community
Day_month_	Collection Date
Photo_no	Field Photo Number
Survey_no	Survey Number

Theme: Cahalane KATM 1953-54 Collection

Field Name	Description
Collecting	Survey site, General location of

	collection
Lat	Latitude in decimal degrees
Long	Longitude in decimal degrees
Elev__ft_	Elevation in feet
Dates	Month day and year of collection
Collectors	Collectors name
Station_ra	Complete or Incomplete

Theme: UAF Herbarium ALA Collection

Field Name	Description
Famcode	ALA Family Code
Sci_name	Scientific Name
Genus	Genus Name
Species	Species Name
Infrank	Infra rank code
Infraspeci	Infra species Name
Lmu	Land Management Unit
Quad	USGS Quadrangle 1:63360
Locality	General locality
Lat_dd	Latitude in Decimal Degrees
Long_dd	Longitude in Decimal Degrees
Elev	Elevation and units of measure
Habitat	General habitat comments
Collector	Collectors Name
Col_date	Collection Date
Col_num	Collection Number
Ala_acc	ALA Accession Number
Citation	Source
Long_alb	Longitude in meters AK Albers
Lat_alb	Latitude in meters AK Albers

Theme: Regional Survey_polygon coverage
All *_poly.shp layers in project

Field Name	Description
Survey_no	Unique Survey Number
SS_name	Regional Survey Name
Link_photo	Pathway to field photo (s)
Link_sheet	Pathway to field spreadsheet

