STATUS AND TRENDS SURVEY OF CATEGORY 2 PLANTS IN THE YUKON-CHARLEY RIVERS NATIONAL PRESERVE, ALASKA

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ACKNOWLEDGEMENTS

Field work in remote areas of Alaska is impossible without the help and support of others. Yukon-Charley Rivers National Preserve provided logistics within the Preserve and field assistance for the entire survey. Critical support offered daily by Penny Knuckles, Resource Management Specialist, made the survey possible within the time allotted. The help and companionship of Preserve staff Kevin Fox, Zoe Leonard, and Andrew Knight was greatly appreciated. Anne Leggett, volunteer from HDR Engineering, Anchorage, and Alan Batten, University of Alaska Museum Herbarium, were invaluable field assistants. David Murray, University of Alaska Museum Herbarium, provided early guidance and essential editing.

Preface

The upper Yukon River region was explored early, and outlines of its botany were shaped gradually by activities that began with the gold rushes, first to Circle City and the Birch Creek and Forty Mile River diggings, and some years later to the Klondike. The Yukon River and its tributaries were the early "highways" for gold rush stampeders, trappers, and other travelers by riverboat in summer and dog teams in winter, so the target taxa of this report---restricted to cliffs, ledges, rubble slopes and steppe bluffs along the rivers---must have been passed countless times unnoticed. Knowledge of these rare plants is relatively recent: *Podistera yukonensis* was recognized first by Mathias and Constance (1950); *Cryptantha shackletteana*, collected by Shacklette in 1960 was not named as a new species by Higgins until 1969; *Eriogonum flavum* var. *aquilinum* was named by Reveal in 1967 and *Draba murrayi* was named by Mulligan in 1979.

One by one, with each discovery, it has become increasingly clear that this area is one of special botanical interest. From distribution maps (dot-maps based on specimens) we understood that here was an unusual floristic element, comprised of several taxa very restricted in range (endemic) or disjunct from other distant populations. It was not until Steven B. Young drew our attention to the importance of the steppe plants as a community on steep, south-facing bluffs of the Charley River and at Kathul Mountain in the upper Yukon River region (Young 1976a) that we connected the rare plants to a landscape and an explanation for their occurrence. He had noticed the floristic similarity of the modern bluff vegetation to the floristic profile of pollen spectra of late-glacial age vegetation (ca 18,000 years ago), thought to be a type of steppe from which the trees and shrubs dominant in today's taiga were absent. This observation fit with the hypothesis of Yurtsev (1972) who took this apparent floristic similarity between the present day bluff vegetation and what was postulated for late-glacial time to mean that the bluffs support remnant, relict communities of that ancient steppe, with which Young (1976a and b) tended to agree.

The first intensive study of the bluff system along the Yukon River was the report of Batten et al. (1979), and this in turn was enlarged upon by projects initiated by staff of the Yukon-Charley Rivers National Preserve. In 1981 we took a team of Russians (botanists and a soil scientist) on a brief trip to Eagle and worked downstream on the Yukon River only as far as Calico Bluff. Boris Yurtsev gained his first look at the Alaskan version of the steppe phenomenon he had written about from his experience in Chukotka and on Wrangel Island in Russia. His Alaskan observations have been published (1972, 1984a and b). Randal Howenstein completed two field seasons (1982 and 1983) along the Porcupine and Yukon rivers before his tragic death on the Copper River in 1985. Some of his results were incorporated in the report of Murray et al. (1983).

Edwards and Armbruster (1989) highlighted the conditions at Kathul Mountain, which became expanded by Lloyd et al. (1994). Carl Roland is completing an important analysis of steppe bluff community structure with comparisons to counterparts along the upper Kolyma River of the Russian Far East (Roland, unpub. manuscript).

Although much has been written about the Asian elements in our flora generally and on the steppe bluffs specifically, it is clear that the rarest of the rare species are unique to Alaska and more probably North American in origin, having their closest relatives in the Rocky Mountains and Intermountain West. In addition to the taxa treated in this report, the endemics *Papaver nudicaule* subsp. *americanum, Penstemon gormanii, Phacelia mollis, Erysimum asperum* var. *angustatum* and the interesting disjunct, *Phacelia sericea*, emphasize this point.

The principal research questions have been directed at determining the origin of these taxa and how they got to their present positions, which means assessing the relative importance of history on one hand and recent events and contemporary conditions on the other. Scott Armbruster and his students have been looking at ecological factors to explain the composition of the vegetation of steppe bluffs (Edwards and Armbuster 1989, Wesser 1991, Wesser and Armbruster 1991, Lloyd et al. 1994). The bluffs and their plants are clearly important natural laboratories where basic questions of plant ecology and geography can be addressed both descriptively and experimentally.

To focus management plans on landforms and habitats---on the bluffs---fits well with the current shift in rare plant protection from an emphasis on each taxon, taken separately, one at a time, to a search for opportunities to conserve several species at the same time by protecting certain habitats. The steppe bluffs provide that opportunity. But having said that, no management plan can be developed if the distribution, ecology, and reproductive biology of each taxon is not known. Since each is different from the others in one or more aspects, we must still understand how they differ. The steppe bluffs can be managed as a unit as long as there is a clear and critical understanding of the component species. This report by Carolyn Parker is an example of precisely the sort of work that must be continued. The fact remains that these rare plants are not always found wherever there is suitable habitat. Either we do not completely understand what constitutes suitable habitat or there are factors other than ecological ones affecting their distribution and abundance. Occurrence of the rare plants can be predicted from what we already know, but proof that our predictions are correct requires field work and physical documentation.

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STATUS AND TRENDS SURVEY OF CATEGORY 2 PLANTS IN THE YUKON-CHARLEY RIVERS NATIONAL PRESERVE, ALASKA

Introduction

National Park Service is mandated to protect rare plants that occur on their land from needless extinction. Sound management decisions can only be based on reliable information concerning plant population localities, population size, habitat needs, and potential threats. Four Category 2 species occur in the Yukon-Charley Rivers National Preserve, Alaska: *Cryptantha shackletteana, Draba murrayi, Eriogonum flavum* var. *aquilinum,* and *Podistera yukonensis*. Plants listed Category 2 by the United States Fish and Wildlife Service are those considered possible candidates for threatened or endangered status under the Endangered Species Act, but for which sufficient information is currently lacking. The objectives of this survey included locating and describing known and new localities for these four taxa, assessing population size, describing habitat(s), identifying possible threats, and making recommendations for future population monitering and preservation. Recommendations for multiple species conservation are offered for Kathul Mountain, which supports a large subarctic steppe community and three of the Category 2 taxa listed above.

Description of Survey Area

The central upper Yukon River valley of eastern interior Alaska cuts through a region dominated by ancient uplands and mountains (Fig. 1). This landscape was part of Eastern Beringia, that portion of Alaska and northwestern Canada that remained unglaciated during the Quaternary glacial advances, and which was contiguous with unglaciated areas of the Russian Far East. The modern zonal vegetation throughout this region is the northern boreal forest, an extensive mosaic of willow, cottonwood, aspen, birch, white spruce, black spruce, and mixed-species forest stands. Alpine tundra is found on isolated high elevation sites.

Steep, S-facing bluffs along major river drainages often support an azonal, treeless, sparse vegetation dominated by tufted grasses, sedges, and forbs. This subarctic steppe, and its floristic relationships with similar vegetation in eastern Asia, has been described by several workers (Yurtsev 1972, Young 1976a and b, 1982, Murray et al. 1983). The unique occurrence on these bluffs of highly disjunct taxa, known otherwise only from western North American montane regions far to the south, has also been noted (Murray et al. 1983, Batten et al. 1979, Shacklette 1966).

Several plant species growing on these subarctic steppe bluffs are restricted to these and similar sites, and are rare in our Alaska flora. Included are the four Category 2 taxa, *Cryptantha shackletteana, Draba murrayi, Eriogonum flavum* var. *aquilinum,* and *Podistera yukonensis,* which are the focus of this survey.

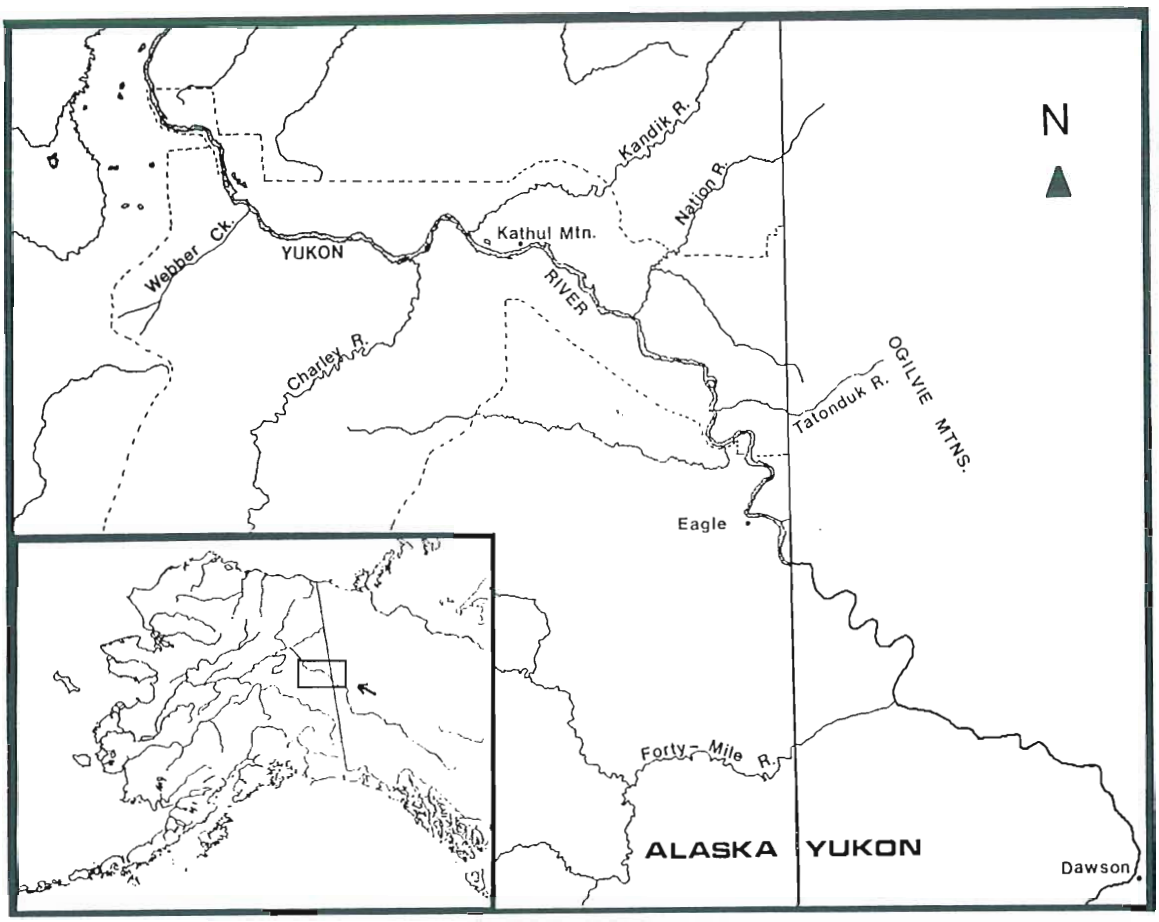

Figure 1. Survey area for Category 2 plants study in the Yukon-Charley Rivers National Preserve, Alaska. Insert shows location of enlarged portion of map. Regions visited include lower Tatonduk and Kandik rivers and Yukon River from Webber Creek to Eagle. Dotted line shows approximate National Preserve boundary.

Field Methods

Field work was carried out in the summer of 1995. The lower Tatonduk and Kandik rivers, Montauk Bluff on the Yukon River, and Hillard Peak were visited between May 27 and June 9. Travel on the Tatonduk River was by jet boat. Two workers were transported by helicopter to the entrance of Johnson Gorge on the Kandik River and rafted through the gorge to a helicopter pickup site several miles downstream. Hillard Peak was reached by helicopter from Eagle and Montauk Bluff was reached by riverboat on the Yukon River.

The remaining Yukon River sites were visited from August 9 to 21. A late summer date was preferred for these sites in order to minimize disturbance to Peregrine Falcon nesting activity which is high in the vicinity of S-facing bluffs and cliffs along the river. Eagle (Mission) Bluff is accessible by foot from the town of Eagle, and the remaining sites were reached by riverboat.

Previous field work by others (Batten et al. 1979, Roland 1990, Ambrose 1992) guided us to many known populations of the Category 2 taxa considered in this survey. When a population was located, the following field observations were taken: location on topographical maps (1:63,360) and on enlarged images of aerial photographs, habitat description, associated species, count or estimate of population size and structure, evidence of herbivory and/or disease, flowering or fruiting condition, and insect visitors to flowers. Photographs and slides were taken to record habitat and general area for most populations. Immature fruits were available and sampled for, *Draba murrayi* and *Podistera yukonensis* in an effort to quantify seed set. Herbarium collections were made to document new populations located.

Scientific Name: *Cryptantha shackletteana* L.C. Higgins,
Great Basin Nat. 29(1):28. 1969

Family: Boraginaceae (Borage Family)

Common Name: none

Synonymy: *Cryptantha spiculifera* (Piper) Payson (*in* Hultén 1968)
Incorrectly reported as *C. sobolifera* Payson (= *C. nubigena* (Payson) Greene) by Shacklette (1966) who made the first collection at Eagle Bluff.

Present legal status: USFWS; listed Category 2
Alaska Natural Heritage Program; listed S1

Type specimen: Eagle Bluff, ca. 1 mile NW of Eagle
S.L. Welsh and G. Moore 8629, 26 July 1968 (BRY)

Taxonomic treatments:

Cryptantha shackletteana was recognized as taxonomically distinct from *C. spiculifera* (Piper) Payson (=*C. interrupta* (Greene) Payson; *Oreocarya spiculifera* Piper) by Higgins (1969) based on its longer and narrower leaves, less conspicuous pustulate leaf hairs, more capitate inflorescence, longer and narrower nutlets with less apparent markings, and weaker stems. Hultén (1973) questioned this treatment and argued that the population at Eagle, the only one known at the time, may represent an isolated biotype of *C. spiculifera*.

Batten et al.(1979), looking at specimens from both Eagle and Calico Bluffs, suggest the Alaskan plants fall within *C. spiculifera* as described in Hitchcock et al. (1955-1969) with the exception of leaf pubesence; our material having conspicuous pustules only on the dorsal leaf surfaces, not on both as noted in Hitchcock et al. Five herbarium specimens added to ALA since that report show inconspicuous pustules throughout and conspicuous pustules on the dorsal side and margins of ventral sides of the leaves only. This appears to be a variable trait, and any review of this taxon should involve a survey of several individuals from both Alaska populations and a comparison between these and *C. spiculifera* specimens from throughout its southern range.

Geographical range:

Accepting Higgin's treatment, *Cryptantha shackletteana* is a narrowly restricted endemic of eastern Interior Alaska. It is known only from Eagle and Calico bluffs. There is one specimen with a suspect locality from the Porcupine River discussed below.

Should this taxon become synonomized with *C. spiculifera* it will remain biogeographically unique, as the Alaskan populations are highly disjunct, over 2000 km from the northern edge of its intermontane distribution.

Previous studies:

Cryptantha shackletteana was first collected, but misidentified as *C. sobolifera*, at Eagle Bluff by Shacklette (1966). Batten et al. (1979) reported a "large" population at Eagle Bluff, and a second population of "unknown size" at Calico Bluff. In their report, they recommended threatened status for this species.

Current study:

Calico Bluff, Yukon River

Cryptantha shackletteana is abundant on 1) the scree that spans the upriver end of Calico Bluff, 2) the vertical rock face in most places where it is visible, and 3) along the river margin on the talus originating from the rock face (Figs. 2,3, 4 and A.9). Several thousand plants are estimated growing here. The upper portion of the scree, which is soft due to the high proportion and depth of fines, supports at least 1-2,000 plants including many small-sized rosettes. *Cryptantha* is a co-dominant with *Eriogonum flavum* var. *aquilinum* on the rock faces that are visible from the top of this scree. A concentration of plants is found along the river bank at the base of the bluff, often growing right down to high water levels. Small, non-flowering individuals dominate in this zone, especially directly along the river edge. High recruitment ablility for this population is suggested by the high proportion of small, immature individuals found here. Curiously, no plants were seen along the short sections of bank backed by forested slopes. It was not clear what the controlling factor(s) might be unless the forest acts a barrier to dispersal.

A late May 1995 visit noted most of the plants at the lower end of the scree (the only area reached) were flowering (Fig. 2). In mid-August, a low percentage (< 15%) of plants had conspicuous flowering stems, but no attached fruits. It's uncertain whether fruits had matured and dispersed, or fruit production had been aborted, as it appeared had happened for other taxa this summer possibly due to a hard frost in the late spring (P. Knuckles, pers. comm.).

Associated species include *Artemisia alaskana, A. frigida, Erysimum asperum* var. *angustatum, Eriogonum flavum* var. *aquilinum, Oxytropis borealis, Solidago multiradiata, Galium boreale,* and *Rosa acicularis.*

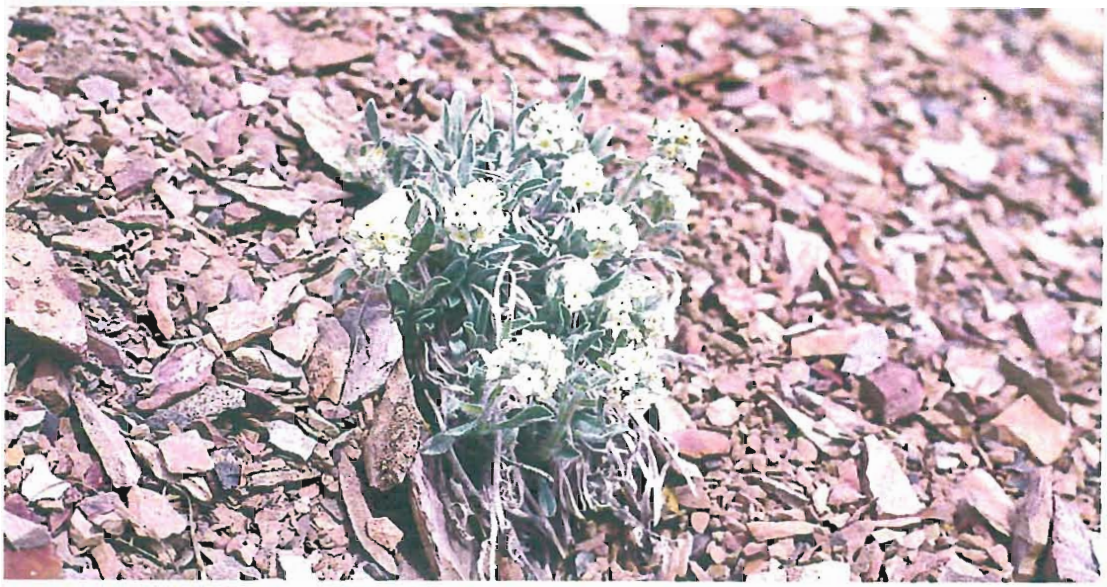

Figure 2. *Cryptantha shackletteana* growing on unstable scree at the base of Calico Bluff, Yukon River. This population was in full flower on May 27, 1995.

Figure 3. *Cryptantha shackletteana* is a dominant species on the upper portion of the sparsely vegetated, unstable scree at Calico Bluff. No evidence of the current season's flowering or fruit remained in late August. Large cushion at center right is *Eriogonum flavum* var. *aquilinum*. (Photos by C.L. Parker)

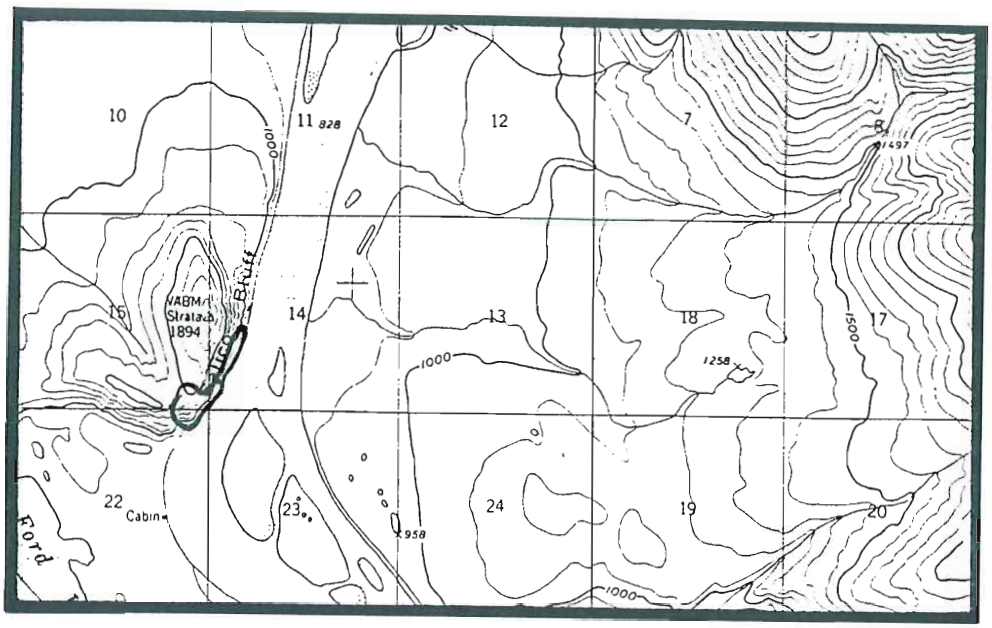

Figure 4. USGS Eagle Quadrangle (D-1). Yukon River, Alaska. Calico Bluff at center left of map. *Cryptantha shackletteana* was found in the area indicated. (Scale 1:63,360, 1 in. = 1 mile).

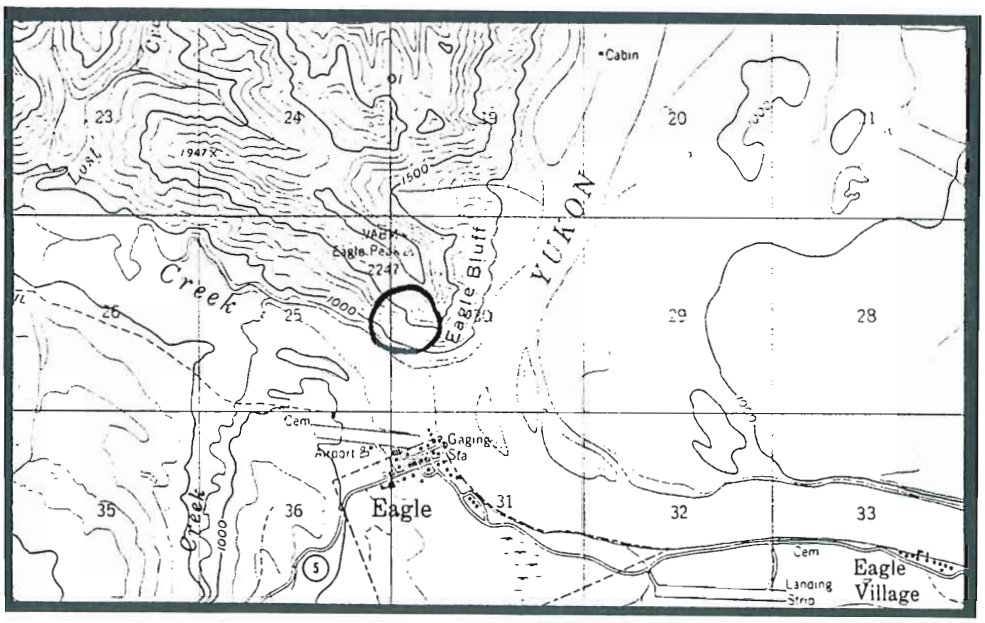

Figure 5. USGS Eagle Quadrangle (D-1). Yukon River, Alaska. Eagle (Mission) Bluff at center of map. *Cryptantha shackletteana* was found in the area indicated. (Scale 1:63,360, 1 in. = 1 mile).

Eagle (Mission) Bluff, Yukon River

A few thousand *Cryptantha* plants are estimated to be growing on the eastern end of Eagle Bluff (Fig. 5 and A.10). They were primarily restricted to the rock-dominated habitats at all elevations and essentially absent from adjacent tufted graminoid steppe slopes that have little or no rock cover. A strong inverse relationship was noted between the occurrence of *Cryptantha* and areas where tufted *Calamagrostis purpurascens* and *Artemisia frigida* were dominant.

Less than 10% of the plants had flowering stems attached in mid-August. Batten (pers. comm.) noted, however, that a majority of plants had maturing flowering stems during a mid-July visit in 1978.

Associated species include *Artemisia frigida, A. alaskana, Solidago multiradiata, Agropyron spicatum, Minuartia yukonensis, Phacelia sericea,* and *Eriogonum flavum* var. *aquilinum.*

Summary discussion:

Localities

Eagle (Mission) and Calico bluffs are the only localities of *Cryptantha shackletteana* known to date. No localities are yet recorded from similiar habitats in the Yukon Territory, Canada (Cody, pers. comm.).

Population size and structure

Populations at both localities consist of an estimated few thousand individuals. Totals may be greater, as a large portion of the suitable habitat at both sites is either not easily reached, or even visible. A wide range of rosette sizes, suggesting several age classes, was observed at both localities.

Reproduction

Reproductive effort was difficult to assess from our late season visits. *Cryptantha* flowers in late May to early and mid June and flowering stems normally stay attached, often into a second season, though they lose most inflorescence parts after the first year. Several healthy-looking flowering specimens were seen in late May at the base of Calico Bluff. The lack of flowering stems in mid August was curious. The 1995 growing season in this region included a late spring frost and an unusually wet summer, factors that may explain the poor flowering and fruit set noted by local residents for some more common taxa, such as *Rosa acicularis*. This may have also affected reproductive success for *Cryptantha* in a way that included flowering stem loss or lack of development.

Vigorous recruitment in this population is evident from the high density and abundance of very small, non-flowering rosettes, among a few medium sized flowering plants along the river margin at the base of Calico Bluff.

Habitat

At both localities *Cryptantha shackletteana* was growing on rock faces, screes, and on other rock-dominated slopes having no or minimal soil development. On Eagle Bluff, it was conspicuously absent from the tufted graminoid steppe vegetation, although it was abundant on adjoining rocky slopes and outcrops. In addition, it was found in abundance, as discussed above, along the gently sloped gravel and rubbly river margin at the base of Calico Bluff.

Concerns:

Although both known populations of *Cryptantha shackletteana* appear to be robust and recruiting, there are reasons we should maintain a high level of concern. The depletion or loss of either population will put the taxon at an increased risk of extinction and will certainly demand a change to threatened or endangered status.

Both Eagle and Calico Bluff are accessible and often visited. Although a portion of the populations at both sites grows on essentially inaccessable rock faces, a large portion grow on screes and rocky slopes which offer hiking routes. These substrates are unstable enough to be greatly disturbed by foot traffic. The soft, deep scree at Calico Bluff is inviting to hikers and is also, understandably, the preferred route to the top of the bluff, as alternatives would involve climbing a vertical, loosely-fractured rock face or a long walk up through brushy forest understory. Footprints were observed everywhere on this large scree and any route up it may be taken. Hikers up Eagle Bluff usually follow one of a few popular routes which are known to local residents and to which visitors are directed, hence disturbance here is more restricted. Plants growing on the screes and vegetated rock slopes at both sites are easily broken off or excavated by foot traffic, especially during a rapid descent. An increase in the numbers of visitors could definitly reduce both populations.

Recommendations:

1) Field workers should continue to watch for additional localities of *Cryptantha shackletteana* throughout this region and document them on maps and, if reasonable, with herbarium collections.

2) An increase in visitation at either site should be considered as potentially threatening. Limiting visitors at both localities is both impractical and undesirable. Neither locality is currently managed by National Park Service (*see* Appendix C). If visitation levels increase in the future, the construction and maintainance of trails that avoid the most sensitive areas may be a partial solution, bearing in mind that such development often encourages yet higher numbers of visitors.

3) Any future study that involves frequent monitoring of either populations must be designed to minimize disturbance to the unstable habitats preferred by *Cryptantha shackletteana*.

4) A reassessment of the taxonomic status of *Cryptantha shackletteana* is in order to determine its relationship with *C. spiculifera*. A change in taxonomic treatment should not alter protection at the state level.

5) Considering there are only two known populations, both at readily accessable localities and lacking any protective federal management, *Cryptantha shackletteana* should retain its Category 2 listing.

Collections held at University of Alaska Herbarium, Fairbanks (ALA):

Format: USGS Quadrangle
Locality and habitat
Collector and number, date, ALA accession number
Co-ordinates, elevation

EAGLE QUAD.:

Eagle Bluff, S-facing bluff, 35-40° slope
Batten and Dawe 78-206, 11 July 1978, ALA V77936
64°48'N, 141°13'W, 580 msm
Chromosome Voucher, 2n=24, Dawe and Murray, 1981

Eagle Bluff, rubble slope
Wesser 87-8, 7 June 1987, ALA V102929
64°49'N, 141°10'W

Eagle Bluff, SE-facing slope, open, fine scree, sandy soil
Lipkin 80-24, 11 June 1980, ALA V75472
64°50'N, 141°11'W

Calico Bluff, E-SE-facing outcrop, ca. 40° slope, in shattered, black, shaly bedrock
Batten and Dawe 78-258, 15 July 1978, ALA V90733
64°55'N, 141°11'W, 240 msm

Calico Bluff, dry slopes of unstable limestone and shale rubble
Moldenhauer Y118, 30 June 1982, ALA V96375
64°55'N, 141°12'W, 400 msm

Calico Bluff, steep, S-facing scree slopes
Lipkin 80-27, 12 June 1980, ALA V75468
64°54'N, 141°10'W

There is also a specimen collected by R. Howenstein (deceased) labeled from the Porcupine River area. Until his field notes are carefully looked at, this locality is suspect. He does not mention its occurrence on the Porcupine River in his unpublished thesis, yet he certainly would have recognized the significance of such a record to his study. He duplicated his site numbers along each river, and this specimen could have come from the Yukon River at a site (Eagle or Calico Bluff?) having the same number (#13) as listed for the Porcupine River locality.

Scientific Name: *Draba murrayi* G.A.Mulligan
Can. J. Bot. 57(18): 1873-1875. 1979

Family: Brassicaceae (Cruciferae) (Mustard Family)

Common Name: none

Synonymy: none
Draba sp. in Batten et al. 1979

Present Legal Status: USFWS; listed Catergory 2
Alaska Natural Heritage Program; listed S2
Canada; rare

Type Specimen: Kathul Mountain, Yukon River, Alaska
Batten and Dawe 78-291 (ALA)

Taxomonic treatment:

The original description of *Draba murrayi* was based on two specimens from Kathul Mountain (Mulligan 1979). Material collected during this survey displayed a greater range in style length, degree of branching, distribution of pubesence, and habitat preference than was described in the original treatment. Mulligan has reviewed these recent collections and has confirmed them as *Draba murrayi*. Our conception of this taxon has now been broadened considerably, relative to the original description.

Geographical range:

Until recently, *Draba murrayi* was only known from Eagle Bluff, the Ogilvie Mountains, Yukon, Canada, just east of the Alaska-Canada boundary, and from the type locality, Kathul Mountain. In the course of this study it was documented at several sites along the lower Tatonduk River valley, in Johnson Gorge on the lower Kandik River, and along the Yukon River between Webber Creek and the town of Eagle.

Previous studies:

Draba murrayi was first collected at Kathul Mountain by Batten and Dawe in 1978 (Batten et al. 1979). They recognized it as an unnamed taxon and sent collections to G.A. Mulligan who published the current name (Mulligan 1979). Batten et al. reported *Draba murrayi* growing on steep, S- and SE-facing treeless slopes and on rock faces at Kathul Mountain. They recommended a threatened status for the taxon. Recently, several populations were reported by Roland (1990) along the lower Tatonduk and Kandik Rivers.

Current study:

Tatonduk River

Draba murrayi was found at several localities along the lower Tatonduk River downstream from the Alaska-Canada boundary. The species was abundant and widespread on the steep, forested slopes and rocky habitats in the vicinity of Funnel Creek, on the forested, S-facing slopes just west of Pass Creek, and on an alluvial-capped terrace and adjacent slopes north of the Tatonduk River mouth (Figs. 6,7,8,9, A.1 and A.2).

Steep, rugged, limestone mountains characterize the Funnel Creek area. The region has experienced frequent forest fires, and S-facing slopes along the north bank of the river support various stages of forest regeneration, primarily birch, aspen, and white spruce. These immature forest stands are highly fragmented by large rock outcrops, taluses, and open, steppe-like slopes. *Draba murrayi* was found throughout this area in dry, open habitats. It was found most consistantly and abundantly in the herbaceous, dry, understory of immature, open birch, aspen, and mixed forest stands, and on rock faces, taluses and rocky ridge tops. Estimates of a few hundred to several thousand plants at separate localities were common. *Draba* was also found, but not as abundant, on a few small steppe-like slopes. Most sites visited were S-facing, but an E-facing, open birch stand also supported a large population.

Associated species in the Funnel Creek area included *Calamagrostis purpurascens, Festuca altaica, Saxifraga tricuspidata, Artemisia alaskana, A. frigida, Galium boreale,* and *Rosa acicularis.*

Two areas just 1 km downstream from Pass Creek were visited (Fig. 9 and A.2). A S-facing, mature aspen woodland supported a few dozen *Draba* plants, but these were restricted to small limestone outcrops in the understory. Near by, a very steep, S-facing steppe within a mixed birch-white spruce forest supported an estimated 300 plants, most of which were restricted to the steppe margin or were growing conspicuously adjacent to large *Juniperus communis* clumps or *Calamagrostis purpurascens* tufts. This small steppe had a definite layer of loess and was, in some respects, more similar to the larger Yukon River bluffs than the steppe-like sites visited upstream on the Tatonduk River.

An alluvium-capped terrace and the adjacent SE-facing slope northeast of the Tatonduk River mouth both supported large populations of *Draba murrayi* (Fig. 9 and A.2). The S-facing bluff of the terrace was mantled in loess, and *Artemisia frigida* dominated the species-poor vegetation. Approximately 1000 *Draba* plants were growing under, and restricted to, a small patch of aspen, which was invading from the upper margin of the bluff. A definite vegetation boundary was associated with this aspen patch as *Calamagrostis purpurascens* replaced *Artemisia frigida* as the dominant herb growing with *Draba* in the aspen understory.

An estimated 1200 *Draba murrayi* plants were growing in one large open area within the understory of a mature aspen stand on the SE-facing slopes just upriver from this bluff.

Figure 6. *Draba murrayi* growing on small rock outcrop in understory of immature paper birch stand, Funnel Creek area, Tatonduk River. Plants here were in late flower to early fruit in late May. (Photos by C.L. Parker)

Figure 7. Young, post-fire paper birch-willow stand on dry, S-facing slope above Tatonduk River. *Draba murrayi* was often found in the immature, open, herbaceous understory dominated by *Calamagrostis purpurascens*, *Festuca altaica*, and forbs.

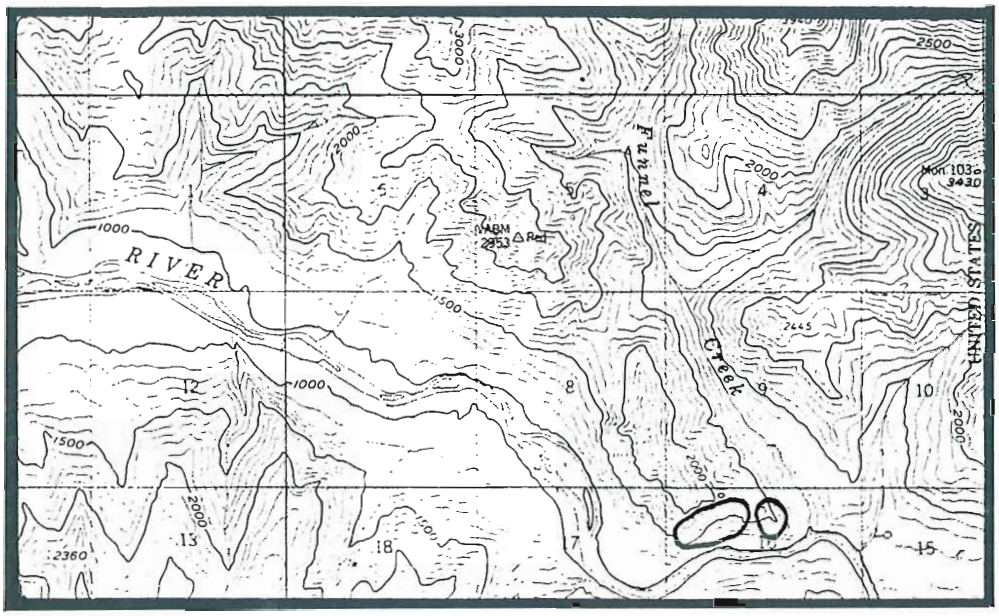

Figure 8. USGS Charley River Quadrangle (A-1). Funnel Creek, lower Tatonduk River. Alaska-Canada boundary along right margin of map. *Draba murrayi* was common and abundant in the areas indicated. (Scale 1:63,360, 1 in. = 1 mile).

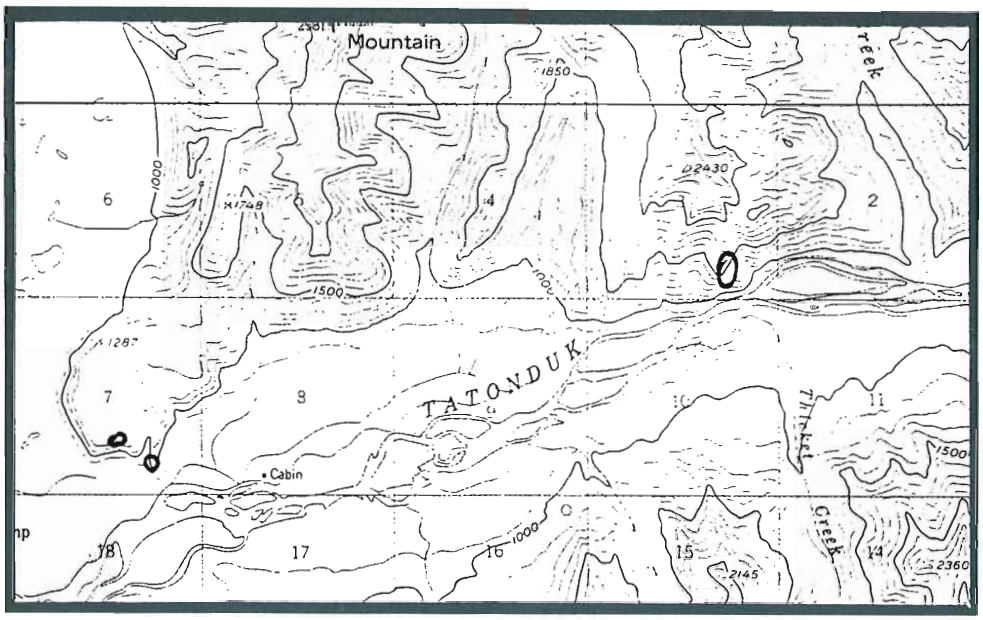

Figure 9. USGS Charley River Quadrangle (A-1). Lower Tatonduk River. Confluence with Yukon River is just beyond lower left margin of map. *Draba murrayi* was found on a slope downstream from Pass Creek (right center on map) and just NE of the mouth of the river, as indicated. (Scale 1:63,360, 1 in. = 1 mile).

Calamagrostis purpurascens and *Rosa acicularis* were the dominant species associated with *Draba* at this site. Within the same understory, *Draba* was conspicuously scarce in patches dominated by *Saxifraga tricuspidata* and *Juniperus communis*.

Throughout the Tatonduk River area, *Draba murrayi* was abundant and appeared to prefer sites that were open, but partially shaded such as woodlands, forest openings, and rock outcrops adjacent to, or within, forests. Evidence of herbivory was noted; entire flowering stems were missing on some plants, and curiously, it was common to see stigmas missing from maturing siliques, as if they had been bitten off by insects. An estimated 70-90% of the plants counted bore flowering stems. Generally, plants growing in more sunny, exposed sites were smaller, more cespitose, and phenologically advanced relative to those growing in partially shaded areas.

Johnson Gorge, Kandik River

Several sites in Johnson Gorge on the lower Kandik River were visited (Fig. 10 and A.3). The northern rim of this gorge is steep, rocky, and covered with birch, aspen and mixed white spruce-deciduous forest. Evidence of forest fire is prevalent. *Draba murrayi* was found scattered and abundant throughout the area and seemed to prefer the more open woodlands, clearings, and rock outcrops within the forest (as was noted for populations along the Tatonduk River). Several hundred plants were found growing on a wet, shady, N-facing rock face along the river at the lower end of the gorge. Estimates of a few dozen to over one thousand plants were made for most populations, with ca. 80 - 85% bearing flowering stems. Plants appeared healthy, though a few withered (possibly frost-nipped) flowering stems were found at one exposed site.

Associated species throughout the gorge include *Phacelia mollis, Rosa acicularis, Saxifraga tricuspidata, Agropyron spicatum, Calamagrostis purpurascens, Festuca altiaca,* and lichens.

Webber Creek, Yukon River

Draba murrayi was found growing on the volcanic bluffs directly across from the mouth of Webber Creek, on the north bank of the Yukon River (Fig. 11 and A.5). It was found on both unstable talus on the lower portion of this slope and on the steppe-like knolls along the ridge crest. Distribution was patchy, plants were widely scattered, and only a few dozen individuals were found at any one site. Associated species include *Calamagrostis purpurascens, Solidago multiradiata, Saxifraga tricuspidata,* and *Artemisia frigida*.

Woodchopper Creek,Yukon River

A prominent steppe knoll and adjacent open forested slopes downstream and across the Yukon River from the mouth of Woodchopper Creek support a few hundred scattered *Draba* plants (Fig. 12 and A.6). The species was scattered throughout this area and was most closely associated with small rock outcrops

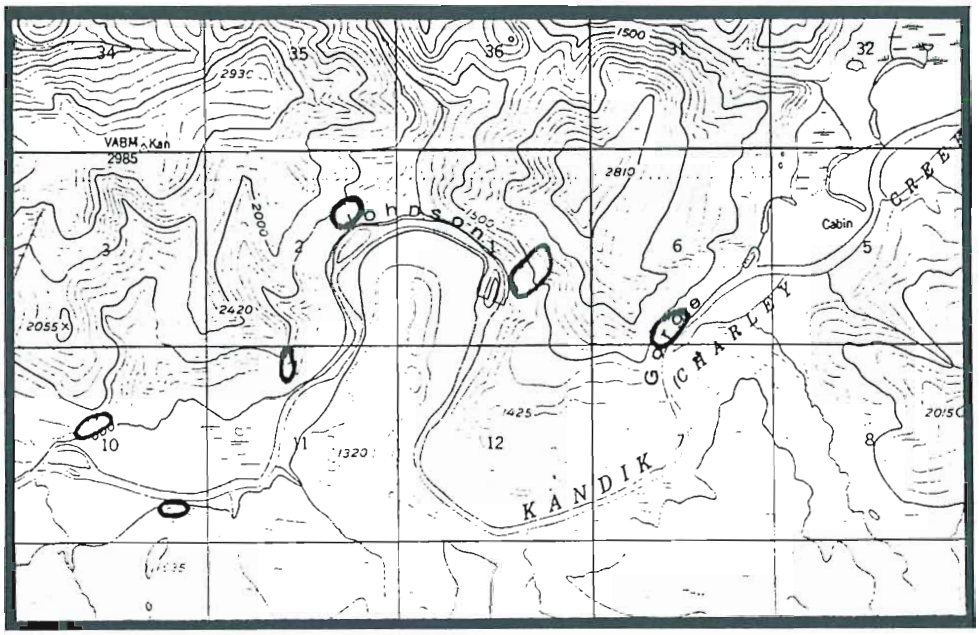

Figure 10. USGS Charley River Quadrangle (B-2). Johnson Gorge, lower Kandik River. *Draba murrayi* was located at all the sites indicated. Most sites are immature, open forest stands. The lowermost site at left is a N-facing outcrop. (Scale 1:63,360, 1 in. = 1 mile).

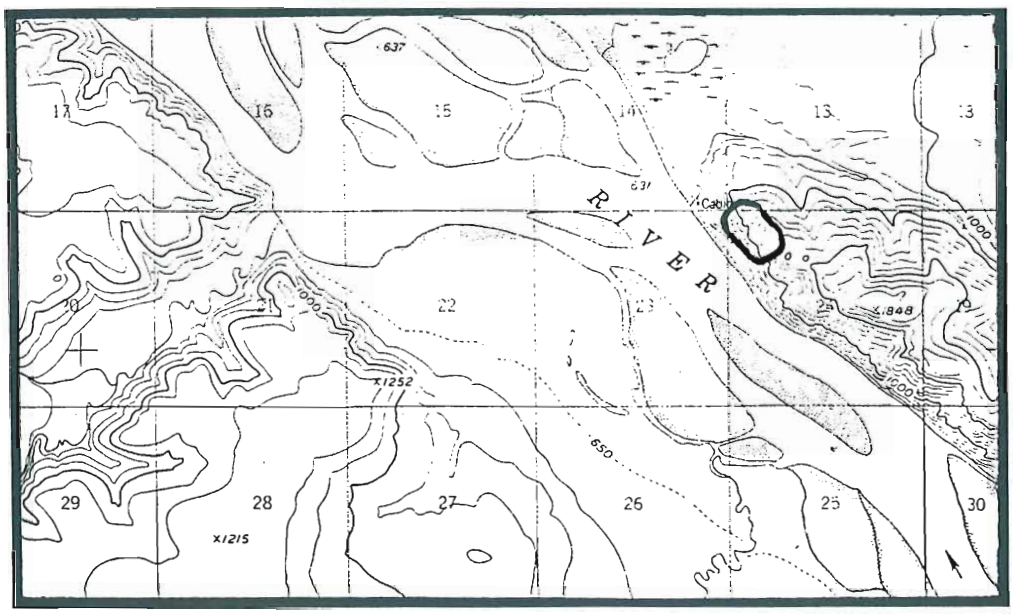

Figure 11. USGS Charley River Quadrangle (B-6). Yukon River. Bluffs across from mouth of Webber Creek are at right margin of map. *Draba murrayi* was found scattered within the area indicated. (Scale 1:63,360, 1 in. = 1 mile).

and patches of bare soil in both the forested and steppe habitats.

Biederman Bluff, Yukon River

The downriver end of Biederman Bluff directly adjacent to the river, supports a dispersed population of *Draba murrayi* (Fig. A.7). Individuals were widely scattered and strongly associated with aspen woodlands where the understory was dominated by *Artemisia frigida* and *Calamagrostis purpurascens*, although it did not consistantly appear in this habitat. A few plants were observed on the soft, platy talus that covered a large portion of this slope, but *Draba* was conspicuously absent in association with patches of *Juniperus* and on coarse rubble. There was evidence of herbivory on flowering stems of several plants. No attempt was made to estimate population size, however this extensive bluff probably supports over one thousand plants.

Kathul Mountain, Yukon River

At Kathul Mountain, the type locality, *Draba murrayi* is widespread and found in all the major habitats: aspen forest and woodland, rock outcrops and scree, and steppe (Fig. A.8). Plants are widely scattered but are most strongly associated with steppe vegetation dominated by *Artemisia frigida*, *Calamagrostis purpurascens*, and *Agropyron spicatum*. Most plants were in late fruit by mid August, and most seeds had been dispersed. No effort was made to estimate population size for the entire area, though counts at two separate sites where plants were concentrated within a small, defined area (< 0.25 acre), were ca. 70 and 100 plants, respectively. Considering the large area involved and the distribution of *Draba* throughout, the population size at Kathul Mountain must certainly be a few thousand plants.

Nation River mouth, Yukon River

A small population of *Draba murrayi* was found on a massive limestone hogback 1 km SE of the Yukon - Nation river confluence (Fig. 13). Approximately one hundred plants were growing both in the partial shade of an aspen woodland and on an adjacent exposed, unshaded, coarse rubble slope near the top of the ridge.

Eagle (Mission) Bluff, Yukon River

Draba murrayi was not observed at Eagle Bluff during our brief visit, but it has been collected by previous workers (ALA collections, see below). Information from various herbarium specimens describe the habitat as "ridgetop, rubble", "rock crevice", and "in aspen". One collector noted that the species was "scattered but common" on the "summit ridge".

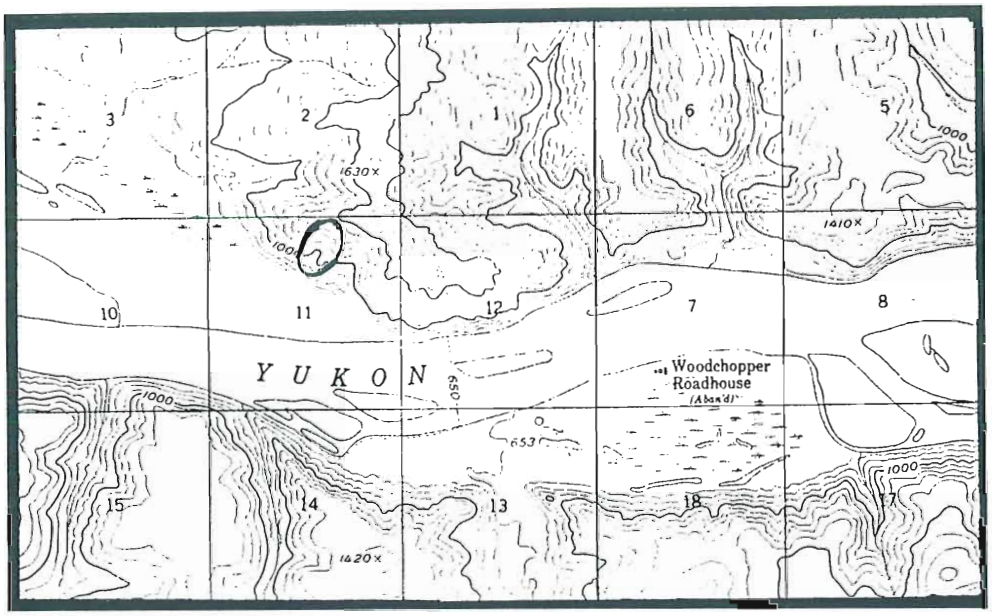

Figure 12. USGS Charley River Quadrangle (B-5). Yukon River. Bluffs across from mouth of Woodchopper Creek are center left. *Draba murrayi* was found on the steppe knoll and adjacent rocky, forested slopes downriver from the bluffs as indicated. (Scale 1:63,360, 1 in. = 1 mile).

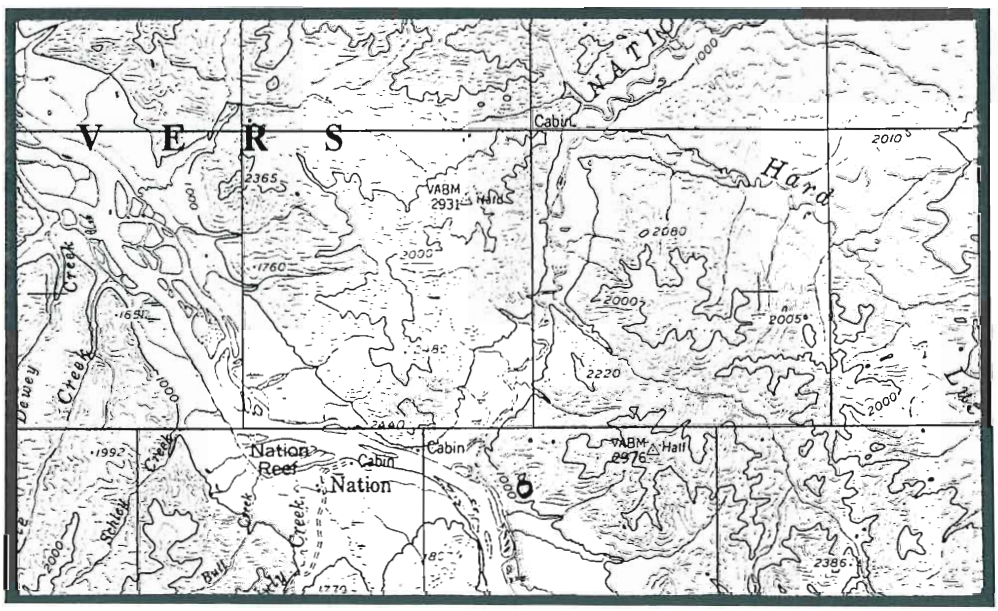

Figure 13. USGS Charley River Quadrangle. Confluence Yukon and Nation Rivers. A small population of *Draba murrayi* was located on the limestone hogback exposed ca. 1 km SE of the mouth of Nation River. (Scale 1:250,000, 1 in. = 4 miles).

Summary discussion:

Localities

Draba murrayi was found at several localities along the lower Tatonduk River between the Alaska-Canada boundary and its confluence with the Yukon River. It was also found throughout the Johnson Gorge area of the lower Kandik River. In addition, several populations were located along the Yukon River between Webber Creek and Eagle, Alaska. A single Canadian locality, labeled "Ogilvie Mtns. at the Yukon-Alaska Border" (Douglas et al. 1981) may have come from just east of the Funnel Creek, Tatonduk River site visited in this survey.

Population size and structure

Draba murrayi was usually widespread wherever found and therefore it was difficult to define discreet populations. This was especially true for the Tatonduk River and Johnson Gorge areas where it was very abundant and found throughout the open, immature mixed forest stands that dominated S-facing slopes along these river valleys. Counts or estimates made for a given small area, such as a forest clearing or small steppe, ranged from one to several hundred plants, and an estimate for an entire slope, or area covered in one day, could be from over one to several thousand. Even at sites, such as those along the Yukon River, where *Draba* was less abundant and individual plants widely scattered, it was noted frequently in several habitats within the area covered, and overall population size was estimated to be large.

Determining relative age using plant size may be less reliable for *Draba murrayi* than it is for the other taxa surveyed. Clusters of basal leaf rosettes arise from single and branched caudices of each individual. They range from ca. 1 to 10 cm. in diameter. There is considerable range in both leaf and rosette size, in degree of caudex branching, and in compactness displayed by individual leaf rosettes and the entire rosette cluster. Rosette diameter, considered as a size class, seems less comparable among individuals as an indicator of relative age. All size classes bore flowering stems and all populations visited included individuals displaying a wide range of basal diameters including some very small plants.

Reproduction

Draba murrayi was in full flower to mid fruit in late May and early June and was in full fruit, with seeds mostly dispersed, by mid August. Typical for the genus, a range of flowering to fruiting stages coexisted on single flowering stems in early summer. Plants in exposed, sunny, and/or drier sites were usually further developed phenologically. Insect visitors included small bees and bee flies.

Plants commonly showed evidence of herbivory affecting reproduction. Along the Tatonduk River, entire flowering stems were missing, possibly eaten by Dall sheep which are common in the area. At all localities, developing fruits often had only a

portion of the style attached - the stigma was missing and appeared to have been bitten off. Many fruits had been pierced; one or two ovules damaged while the rest of them appeared normal. This strongly suggests insect ovipositing and larval feeding is occurring on maturing fruits.

Developing fruits were collected from two populations along the Tatonduk River to assess reproductive effort. It has been suggested (Wiens 1984) that the seed to ovule ratio (S/O) in individual fruits correlates more closely to a genetically-controlled plant dispersal strategy than to the environmental conditions of the current growing season that control total number of fruits or seeds. Using methods described by Wiens, the S/O for these populations were determined:

-Funnel Creek area	mean S/O =	0.81 (n=27)
-mouth of Tatonduk R.	"	0.67 (n=24)

These ratios are higher than the mean S/O of ca.0.50 found for most perennials and suggest, following Wiens' discussion, that *Draba murrayi* displays a strategy for high dispersal ability shown by annuals and "weedy" species. This is consistant with its abundance in open, sparsely vegetated sites.

Habitat

We now appreciate that the ecological amplitude for *Draba murrayi* is broader than had been first thought. Along the Tatonduk and Kandik rivers, it was most commonly found in open birch, aspen, and mixed deciduous-white spruce stands that are reforesting S-facing slopes following fire. *Draba* was most abundant in the more open areas within these stands and on adjacent rock outcrops and screes within the forest zone (Fig. 7). It was also found in the patches of graminoid steppe-like vegetation found on the unforested sites, but it was not as abundant there as in partially shaded areas.

Along the Yukon River, *Draba murrayi* is found on S-facing bluffs, but these populations generally consist of more widely scattered individuals. *Draba* is consistantly part of the steppe vegetation there and is also found on adjacent rocky outcrops, screes, and in open, forest understories.

In all habitats, *Draba* was almost always growing on bare soil, seldom in lichen, moss, or in dense ground cover of any form. In a few disturbed microsites, where vegetation had been recently disturbed, *Draba* was invading newly exposed soil. Plants were often immediately adjacent to a tussock or another, larger plant, but were not otherwise growing in a crowded situation.

Several hundred *Draba murrayi* plants were found growing on a sparsely vegetated, moist, shady, N-facing rock face along the Kandik River near the mouth of Johnson Gorge. The single Canadian specimen from the Ogilvie Mountains was collected from "among rocks" (!DAO photcopy).

These combined observations suggest we should view this taxon as an early successional invader of open space. It is even possible that *Draba* would actually flourish under

intermediate levels of disturbance such as after fires or trail building, given its preference for open sites and bare soil. Clearly it is not restricted to the steppe vegetation from where it was first described, but can trive in a variey of habitats.

Concerns:

Most of the many sites visited supported large, healthy populations of *Draba murrayi*. *Draba* was frequently found and very abundant along the lower Tatonduk and Kandik Rivers, and though less abundant elsewhere, it was found at many sites along the central Yukon River between Webber Creek and Eagle.

Draba murrayi is obviously not restricted to a specific type of habitat, but is found in association with a diversity of vegetation types as described above. However, it appears to be endemic to a restricted area within eastern interior Alaska and western Yukon, Canada.

Our primary concern for this taxon should focus on the smaller populations on steppe bluffs along the Yukon River where it is commonly found, but far less abundant than in the Tatonduk and Kandik river valleys. If these unique sites are given protection from development and disturbance, these populations should remain secure.

Recommendations:

1) Field workers should continue to watch for new localities of *Draba murrayi* in interior eastern Alaska and document them on maps and with herbarium collections whenever possible. Open, early successional stands, woodlands, and rock-dominated habitats, in addition to steppe slopes, should be considered as likely habitats.

2) An effort should be made to relocate and describe the *Draba murrayi* population at Eagle Bluff which was missed in this survey but has been documented by herbarium collections. Calico and Montauk bluffs should also be revisited and a more careful search for *Draba* made at both sites.

3) Future development or disturbance to steppe bluffs along the Yukon River should be avoided if possible. Plans for development should make every effort to divert disturbance away from areas having the greatest concentrations of *Draba murrayi* and other sensitive taxa associated with these sites.

4) Given the number and sizes of populations now documented for *Draba murrayi,* it is recommended that it be considered for listing as Category 3.

Collections held at University of Alaska Herbarium, Fairbanks (ALA)

Format: USGS Quadrangle
Locality and habitat
Collector and number, date, ALA accession number
Coordinates, elevation
Notes (! G.A. Mulligan, specimen seen by GAM)

CHARLEY RIVER QUAD.:

Kathul Mountain, steep soil slope, azimuth 160°
Batten and Dawe 78-291, 17 July 1978, ALA 77150
65°20'N, 142°15'W, 360 msm
PARATYPE, ! G.A. Mulligan
Chromosome Voucher, 2n=48, Dawe and Murray, 1981

Kathul Mountain, SE-facing cliff, ca. 35° slope
Batten and Dawe 78-272, 17 July 1978, ALA 77144
65°20'N, 142°15'W, 305 msm
HOLOTYPE, ! G.A. Mulligan

Kathul Mountain, lower, dry grassy slopes
Moldenhauer Y40, 24 June 1982, ALA V96319
65°20'N, 142°15'W, 610 msm

Tatonduk R., W of Funnel Cr., S-facing limestone slope
Parker 5553, 31 May 1995, ALA V119487
65°00'N, 141°03'W, 600 msm

Tatonduk R., 3 km above mouth, S-facing, xeric steppe slope
Parker 5563, 2 June 1995, ALA V119498
65°00'41"N, 141°18'57"W, 360 msm
! G.A. Mulligan

Tatonduk R., W of Funnel Cr., S-facing limestone slope
Parker 5517, 28 May 1995, ALA V119451
65°00'N, 141°03'W, 580 msm

Nation R. mouth at Yukon R., coarse-grained limestone ridge
Parker 6252, 19 August 1995, ALA V119583
65°11'N, 141°40', 500 msm

Biedermann Bluff, S-facing, dry open aspen understory
Parker and Batten 6233, 12 August 1995, ALA V119567
65°23'N, 142°40'W, 425 msm
! G.A. Mulligan

Kathul Mountain, S-facing, xeric graminoid steppe slope
Parker and Batten 6234, 13 August 1995, ALA V119568
65°20'N, 142°19'W, 400 msm

Kandik R., Johnson Gorge, moist, N-facing rock face along river
Parker 5595, 8 June 1995, ALA V119530
65°28'N, 141°54'W, 330 msm
! G.A. Mulligan

Kandik R., Johnson Gorge, steep, S-facing slope, dry birch forest
Parker 5591, 7 June 1995, ALA V119525
65°28'N, 141°52'W, 470 msm

Kathul Mountain, aspen understory on S-facing slope
Parker and Batten 6238, 13 August 1995, ALA V119572
65°20'N, 142°19'W, 400 msm
! G.A. Mulligan

Webber Cr. vic., N bank of Yukon R., steep S-facing outcrops
Parker and Batten 6214, 9 August 1995, ALA V119552
65°25'N, 143°33'W, 600 msm

Tatonduk R., W of Funnel Cr., S-facing limestone slope
Parker 5544, 30 May 1995, ALA V119478
65°00'22"N, 141°02'42"W, 520 msm

Tatonduk R., W of Funnel Cr., S-facing limestone slope
Parker 5543, 30 May 1995, ALA V119477
65°00'22"N, 141°02'42"W, 520 msm

Kandik R., Johnson Gorge, steep, dry SE-facing slope
Parker 5598, 8 June 1995, ALA V119533
65°28'N, 141°54'W, 420 msm
! G.A. Mulligan

Tatonduk R., W of Pass Cr., steep, S-facing limestone outcrops
Parker 5561, 1 June 1995, ALA V119496
65°01'14"N, 141°12'35"W, 310 msm

Kandik R., Johnson Gorge, SE-facing graywacke rubble slope
Parker 5582, 6 June 1995, ALA V119517
65°28'N, 141°51'W, 320 msm
! G.A. Mulligan

Tatonduk R., W of Pass Cr., steep, xeric steppe slope
Parker 5558, 1 June 1995, ALA V119493
65°01'14"N, 141°12'35"W, 310 msm
! G.A. Mulligan

Nation R. mouth at Yukon R., coarse-grained limestone ridge
Parker 6251, 19 August 1995, ALA V119582
65°11'N, 141°40', 500 msm
! G.A. Mulligan

EAGLE QUAD.:

Eagle Bluff, path along ridge crest, azimuth 209°
Dawe 79-45, 9 July 1979, ALA V99219
64°48'N, 141°13'W, 515-530 msm

Eagle Bluff, path along ridge crest, azimuth 209°
Dawe 79-40, 9 July 1979, ALA V99222
64°48'N, 141°13'W, 515-530 msm

Eagle Bluff, path along ridge crest, azimuth 209°
Dawe 79-35, 9 July 1979, ALA V99221
64°48'N, 141°13'W, 515-530 msm

Eagle Bluff, path along ridge crest, azimuth 209°
Dawe 79-41, 9 July 1979, ALA V99223
64°48'N, 141°13'W, 515-530 msm

Eagle Bluff, ridgetop rubble
Wesser 87-29, 27 June 1987, ALA V102956
64°49'N, 141°10'W

Eagle Bluff, summit ridge, growing with *Juniperus*
Lipkin 80-23, 11 June 1980, ALA V75663
64°50'N, 141°11'W

Eagle Bluff, ridge crest near summit, in rock crevice
Batten and Dawe 78-244, 14 July 1978, ALA 77142
64°48'N, 141°12'W
Annotated by G.A. Mulligan, 1979, as
Draba murrayi X another *Draba* spp.

Tatonduk R., 3 km above Funnel Cr., E-facing slope
Parker 5534, 29 May 1995, ALA V119468
64°59'N, 141°00'W, 600 msm
! G.A. Mulligan

Scientific Name: *Eriogonum flavum* Nuttall var. *aquilinum* J. Reveal, Ark. Bot. 7(1):46. 1968

Family: Polygonaceae (Buckwheat Family)

Common Names: Yellow eriogonum, Umbrella plant

Synonymy: none

Present legal status: USFWS; listed Category 2
Alaska Natural Heritage Program; listed S2
Canada, recommended to be listed rare
(Cody, 1994)

Type specimen: Eagle (Mission) Bluff, 0.5 miles N of Eagle
H.T. Schacklette 6202, 26 June 1960 (US)

Taxonomic treatments:

Eriogonum flavum is a highly variable taxon, and several varieties and subspecies have been described within its western North American distribution. Alaska material has been given taxonomic recognition as var. *aquilinum* based on its distinctive 4-lobed involucre (and its highly disjunct location, over 2000 kilometers to the north) (Reveal, *in* Hultén 1967). All collections held at ALA, including those from populations located since the type material was described, display this 4-lobed involucre.

Geographical range:

The species as a whole is widespread in dry grassland and rocky alpine habitats throughout the central Rocky Mountains and Great Basin region northward to southern Alberta, Canada.

Our northern variety, var. *aquilinum*, is highly disjunct from this southerly distribution. Populations are known from S-facing bluffs and rock cliffs along the upper and middle Yukon and middle Porcupine river valleys in Alaska, and from Aishihik Lake, southern Yukon, Canada (Cody 1994).

Previous studies:

Eriogonum flavum var. *aquilinum* was first collected at Eagle (Mission) Bluff in 1960 by H.T. Shacklette. Batten et al. (1979) later recorded it from both Eagle Bluff and Kathul Mountain. They reported finding several thousand plants on Eagle Bluff which were restricted to steep, S-facing grasslands and sparsely vegetated rubble slopes. The population was described as healthy and restricted to, but common at, the eastern end of the bluff. They noted that most plants were

flowering and appeared to be setting seed during their mid to late July visit.

At Kathul Mountain, a single small population of about 100 individuals was located by Batten and Dawe (Batten et al. 1979) on alluvium that caps a small knoll W of the main massif. This population was described as setting seed and appearing to maintain itself.

Batten et al. (1979) recommended listing the taxon as threatened at both the state and federal level.

In the last 15 years, several additional populations have been located along the Yukon River between Eagle and Circle, and along the middle Porcupine River valley west of the Alaska-Canada border, and in southern Yukon, Canada (*see* Roland 1990, Ambrose, unpub. USFWS memo, 1992, Cody 1994, ALA collections).

Current study:

Webber Creek, Yukon River

A few hundred plants were observed growing on the large Woodchopper volcanic outcrops on the north bank of the river just upstream from the mouth of Webber Creek (Figs. 15, 16 and A.5). Observations were made only from along the bank, as where plants were seen, the face of the bluff was too steep or unstable to gain any elevation. A few to 15-20 plants could be spotted from any one point along the shore while looking at least 10-15 m up onto the rock face. This population included many very large individuals (30+ cm diameter) with numerous flowering stems, though only peduncles and pedicels remained at the time of our visit in mid August.

Plants at this location showed a definite preference for the firmer, fine-grained pillow basalt and similar solid rock surfaces. Individuals were growing on narrow ledges and in crevices and did not appear on the looser, more rubbley,fractured rock faces or screes along the river bank at the base of the outcrop, nor on the open forested slopes that bordered this face to the northwest. This portion of the outcrop rises 300 m above the river, and it is likely the population here is much larger than can be estimated by observations made only from along the river bank.

The predominant associated species at this site include *Artemisia frigida, A. alaskana, Potentilla hookeriana, Dryas drummondii,* and *Agropyron spicatum.*

Woodchopper Creek, Yukon River

The Woodchopper volcanics are exposed opposite the mouth of Woodchopper Creek and form another large, steep rocky bluff (Fig. 17 and A.6). Fewer plants were seen here than at Webber Creek, and the distribution, as observed by walking along the river bank and looking overhead, was patchy. The greatest density of individuals was noted in the central portion of the area surveyed. Approximately 200 plants, including many large individuals, were counted.

As at Webber Creek, plants showed a strong preference for the firmer, more vertical rock surfaces, and one individual,

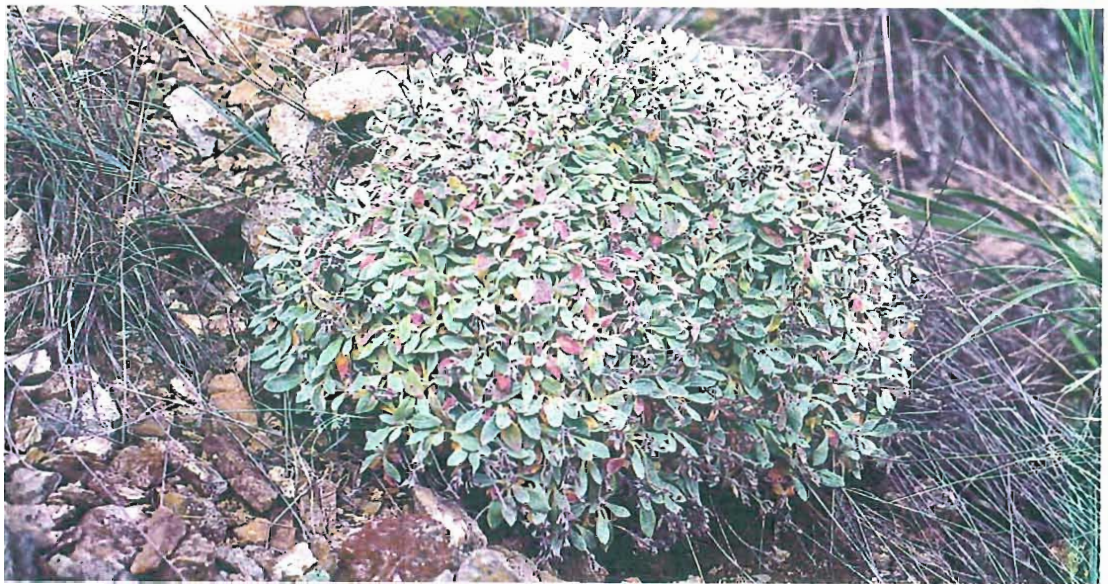

Figure 14. *Eriogonum flavum* var. *aquilinum* growing at the type locality for this taxon, Eagle (Mission) Bluff on the Yukon River, Alaska. This cushion is approximately 25 - 30 cm in diameter and is growing on a sparsely vegetated rubble slope. (Photos by C.L. Parker)

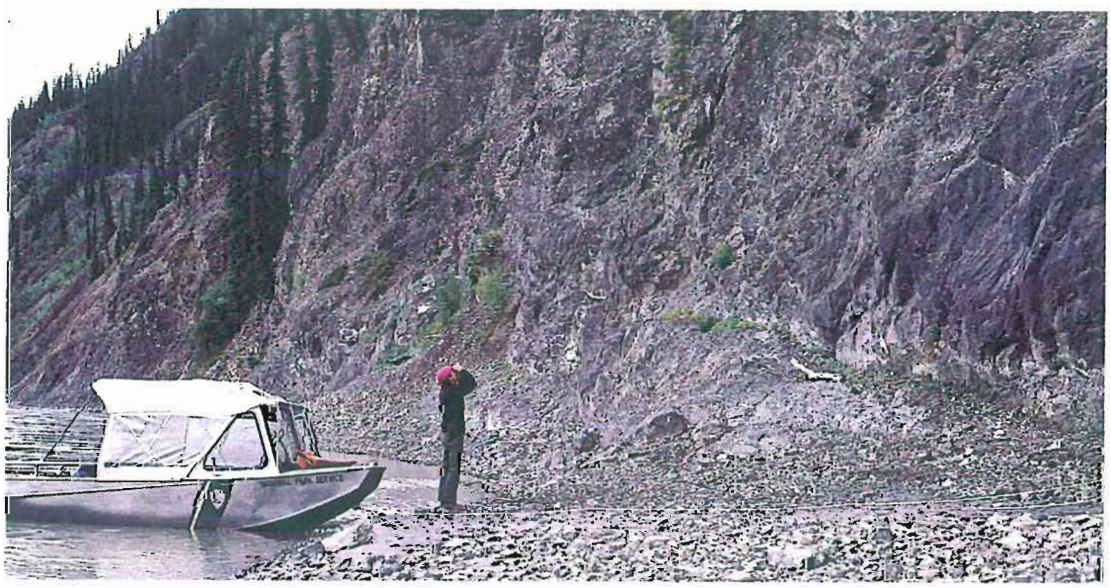

Figure 15. Yukon River, Alaska. Rock outcrops on north bank of the river across from the mouth of Webber Creek. *Eriogonum flavum* var. *aquilinum* is growing on the vertical, volcanic cliffs above the river.

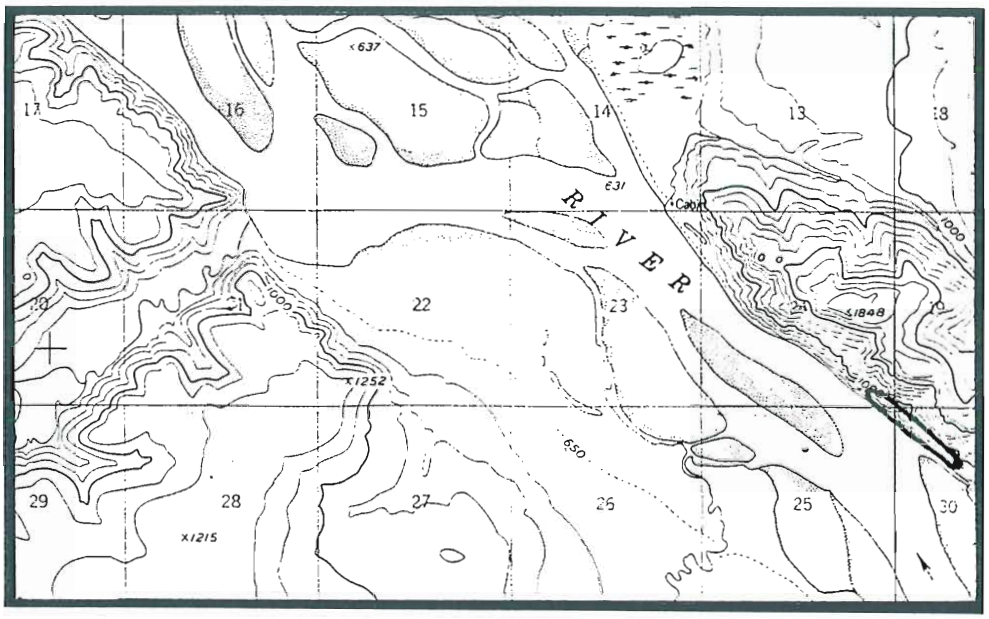

Figure 16. USGS Charley River Quadrangle (B-6). Yukon River. Bluffs across from mouth of Webber Creek are at right edge of map. *Eriogonum flavum* var. *aquilinum* was observed from along river bank and was abundant on section of bluff indicated. (Scale 1:63,360, 1 in. = 1 mile).

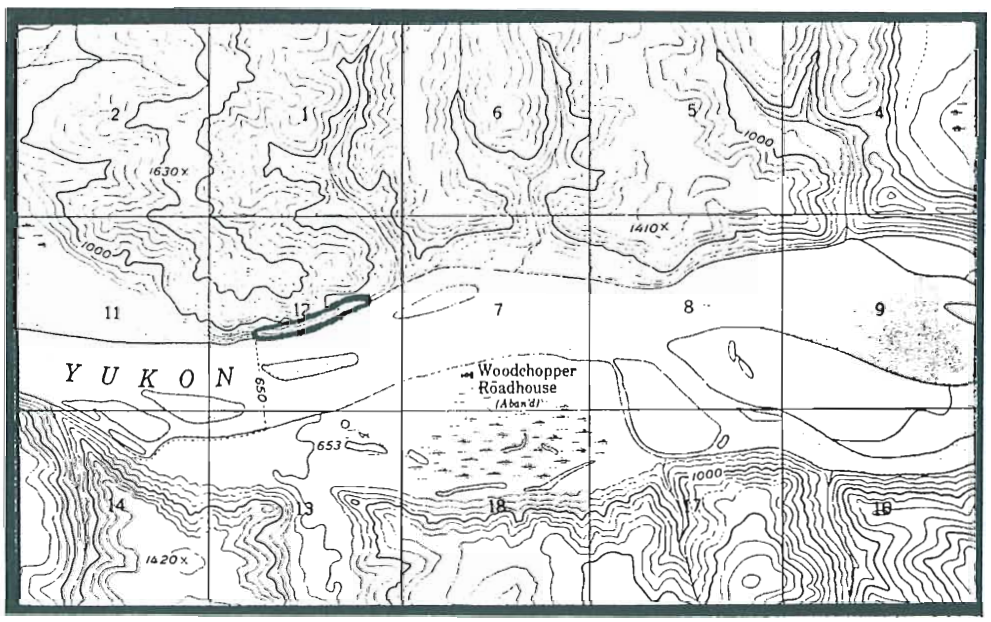

Figure 17. USGS Charley River Quadrangle (B-5). Yukon River. Bluffs across from mouth of Woodchopper Creek are center left on map. *Eriogonum* was observed from along the river bank in the area indicated. (Scale 1:63,360, 1 in. = 1 mile).

collected for herbarium records, proved to be very deeply rooted in a crevice. *Eriogonum* was not growing in any of the small patches of loess or soil deposits scattered along this face, nor was it found on a large, open graminoid steppe knoll just downstream from the rock outcrops.

Associated species include *Artemisia frigida, A. alaskana, Potentilla hookeriana, Oxytropis splendens, Erigeron caespitosus*, and *Agropyron spicatum*.

Kathul Mountain, Yukon River

The small population located and described by Batten and Dawe (Batten et al. 1979) was revisited during this survey. The 155 plants are restricted to a narrow area (ca. 5 X 100 m) of Quaternary-aged alluvium that is exposed near the top of a small rocky, knoll situated 1.5 kilometer SW of the summit of Kathul Mountain (Fig. 18 and A.8). Restriction of the plants to this gravely substrate is pronounced, but difficult to understand. The aspen forest above this exposure may be unsuitable habitat, but the extensive shaley rock slope and outcrops below it are similar in aspect, steepness, and texture to slopes on Calico and Eagle Bluffs where *Eriogonum flavum* var. *aquilinum* is also found. Bedrock differences may play a role here, although lithology did not have a notable effect on any of the associated species at this site.

Approximately one half of the plants here (46%) had flowering stems, but only the peduncles and pedicels remained in mid August. This population did not contain the very large diameter (25-30 cm) plants seen elsewhere. Diameter size categories recorded were: 26% plants under 10 cm; 45% at 10-15 cm, and 29% greater than 15 cm diameter.

Excavation of one small specimen suggests previous below-ground attachment to a larger neighboring plant. Limited vegetative recruitment of individuals may occur through the spreading of below-ground stems, possibly under the influence of downslope creep.

Associated species include *Galium boreale, Bupleurum triradiatum,* and *Epilobium angustifolium*. In addition, there is a 50-65% fruticose lichen cover on much of the upper portion of this site.

Kathul Mountain has been visited by several botanists during the last 15 years, and this is the only population of *Eriogonum* found to date.

Calico Bluff, Yukon River

At Calico Bluff the greatest abundance of *Eriogonum* appeared to be at the upriver end of the rock face where the bluff face turns away from the river (Fig. 19 and A.9). A few dozen plants were found on the lower portion of this rock face and on the large scree that extends from the river bank to near the summit. A few hundred plants were also observed from near the top of this scree, the majority growing on the highly fractured rock outcrop that faces the river. A patch of about 30 small individuals, ca. 4-8 cm diameter each, was found in a

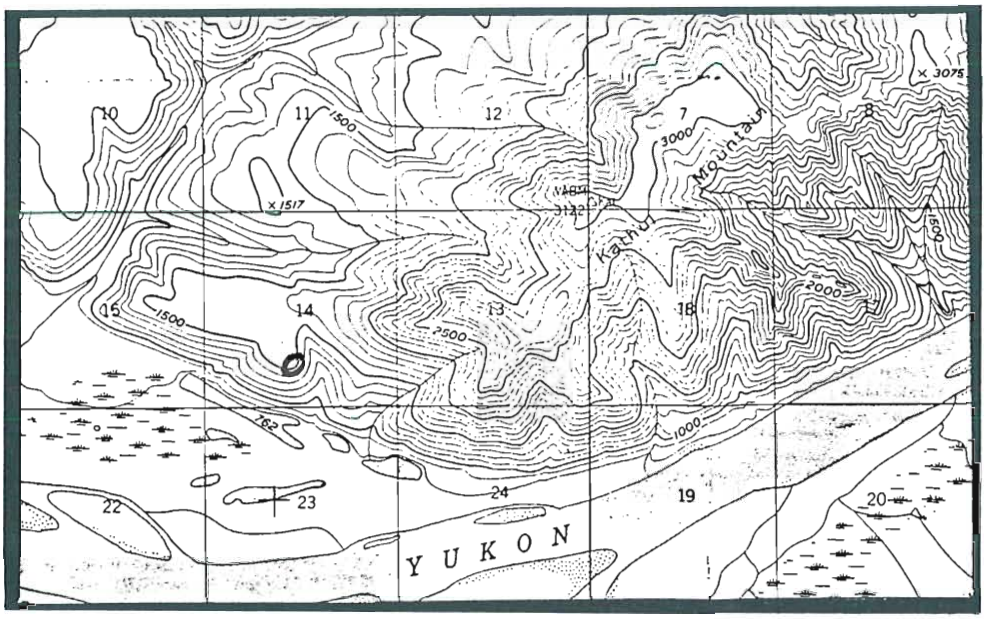

Figure 18. USGS Charley River Quadrangle (B-3). Yukon River, Kathul Mountain. Location of small population of *Eriogonum flavum* var. *aquilinum* on western flank of Kathul Mountain is indicated. (Scale 1:63,360, 1 in. = 1 mile).

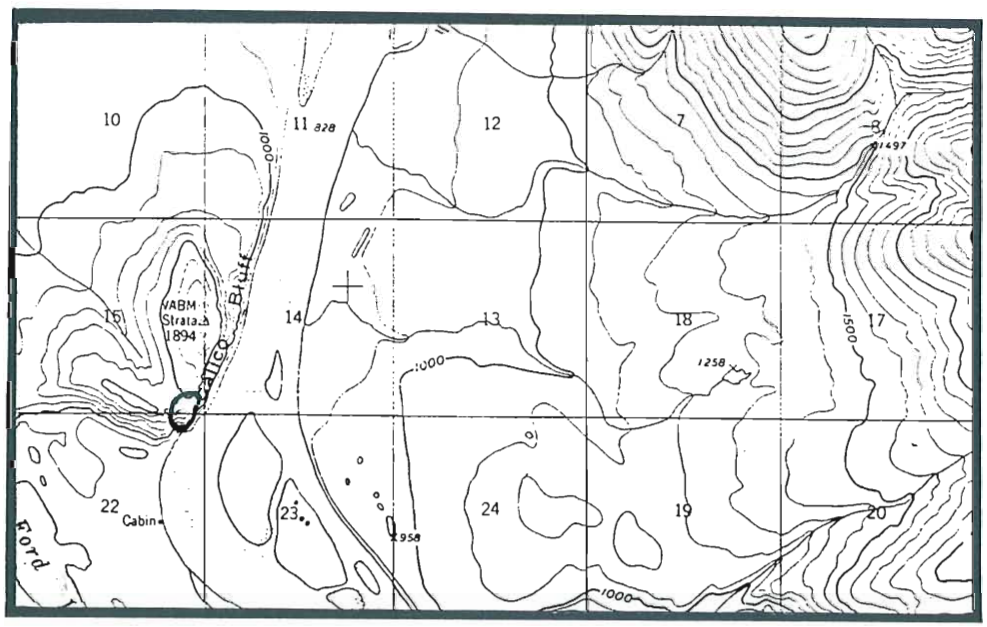

Figure 19. USGS Eagle Quadrangle (D-1). Yukon River. Calico Bluff is at center left of map. *Eriogonum* was observed as abundant in the area indicated. (Scale 1:63,360, 1 in. = 1 mile).

relatively flat pocket of fines near the top of the scree and adjacent to the white spruce forest.

Knuckles (pers. comm.) reports that during full flowering, plants are very conspicuous even from a distance, on that portion of the vertical rock face that fronts the river.

The leaves on many of the plants at this site had several minute holes on their upper surface, as if made by a small herbivorous or burrowing insect. The leaves were still firm and green and the individuals so affected looked healthy.

Associated species include *Cryptantha shackletteana, Artemisia alaskana, A. frigida, Oxytropis borealis, Penstemon gormanii, Erysimum asperum* var. *angustifolium*, and *Epilobium angustifolium*.

Eagle (Mission) Bluff, Yukon River

Only the eastern portion of Eagle Bluff was visited (Figs. 14, 20 and A.10). An estimated 2000+ plants were growing on a steep, S-facing, unforested area of the bluff just west of the peak where the town flagpole is located, ca. 300 m above Mission Cr. This area included graminoid steppe-like vegetation dominated by tufted *Calamagrostis purpurascens*, rocky scree, small rock outcrops mantled in coarse debris, and pockets of deep, mineral fines. In each of these adjoining habitats, *Eriogonum* was abundant, and the population showed a broad range of cushion sizes from small to very large (30-35 cm diameter) individuals. Most had flowering stems, but with only peduncles and pedicels remaining in mid-August.

Associated species on this portion of the slope include *Artemisia alaskana, A. frigida, Oxytropis splendens, Minuartia yukonensis, Cryptantha shackletteana, Bupleurum triradiatum, Senecio ogotorukensis,* and *Calamagrostis purpurascens*.

On the lower-elevation rock outcrops and graminoid steppe slope looking down onto Fort Egbert, only ca. 8-10 plants were seen, and these were restricted to highly fractured rock outcrops. Here *Eriogonum* was associated with *Cryptantha shackletteana, Phacelia sericea, Artemisia alaskana* and *A. frigida*.

Summary Discussion:

Localities

Five populations of *Eriogonum flavum* var. *aquilinum* along the Yukon River were visited during this survey as described above. Two additional Yukon River populations have been reported by Ambrose (unpub. USFWS memo, 1992): one on the bluffs across from Eagle Village, upstream from Eagle (USGS Eagle Quadrangle (D-1) 64°47'N, 141°06'W), and one on the bluffs down river from Webber Creek, ca. 19-23 miles upriver from Circle (vic. USGS Circle Quadrangle (C-1) 65°43'N, 144°02'W). Ambrose noted that the species was "abundant" at both sites.

Four separate, but relatively close, localities are known from herbarium specimens collected along the Porcupine River

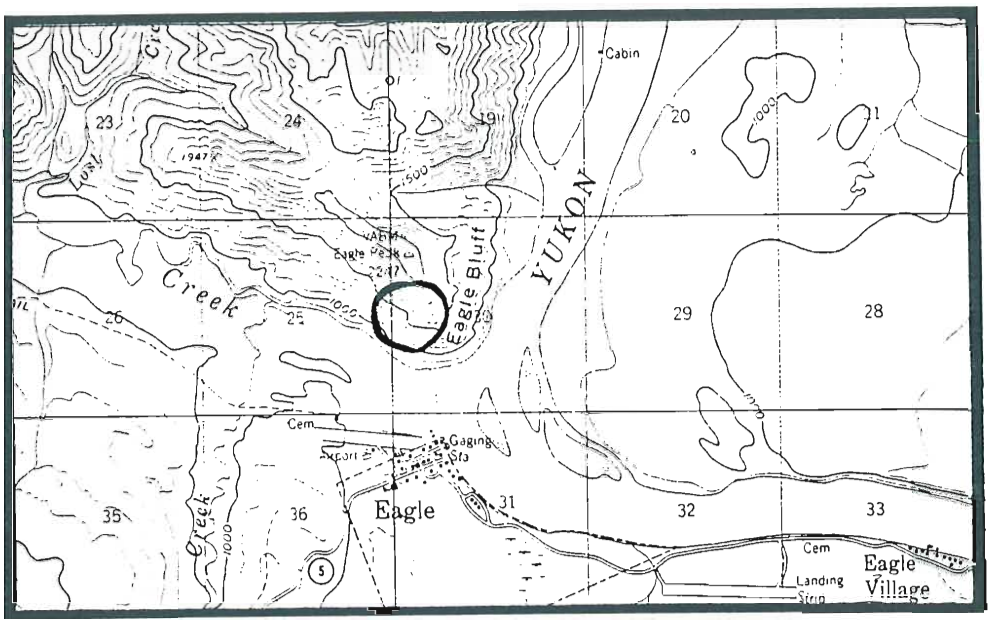

Figure 20. USGS Eagle Quadrangle (D-1). Yukon River, Eagle (Mission) Bluff. *Eriogonum flavum* var. *aquilinum* was observed and abundant in the area indicated. (Scale 1:63,360, 1 in. = 1 mile).

downriver from Burnt Paw (vic. USGS Black River Quadrangle: 66°59'N, 142°44-54'W). All of these specimens were collected on steep, dry, S- or SE-facing rocky bluffs supporting only a sparse vegetation. These localities are all within an extended, and more or less contiguous, bluff system and a recent visitor to the site estimates the population on the entire bluff system is at least a few thousand plants (M. Emers, pers. comm.).

One Canadian locality is recorded from the Aishihik Lake area in southwestern Yukon Territory (Cody 1994).

Population size and structure

The population counts of a few hundred plants at Webber and Woodchopper Creeks are probably under-estimates, as these sites were surveyed from the river bank. Stable, solid, near vertical rock faces, the habitat favored at these sites, extend to higher elevations beyond our veiw.

Calico and Eagle bluffs both support large populations of at least 1000-2000 individuals, and these counts are probably also under-estimates due to the brief time spent at each and the difficulty in reaching the steeper, unstable areas.

Lacking their showy yellow flowers in August, the dull gray-green *Eriogonum* cushions become more difficult to spot, especially when looking from a distance against a background of rock or bare soil. This factor certainly contributed toward under-estimating the size of all populations visited.

The populations at each of these sites displayed a broad range in cushion sizes. Cushion size has been used as a rough indicator of relative age for the long lived perennials that display this growth form, the assumption being that a strong correlation exists between increasing age and increasing cushion diameter. Although no true seedlings were found, several small cushions consisting of only 1-4 stems and leaf rosettes were seen in each population, and sizes ranged upward to some real "grandmother" cushions up to 40 cm in diameter, built up from a few dozen stems. This range in cushion diameters suggests all of these populations are currently recruiting new individuals, though possibly at a very slow rate.

The small population at Kathul was counted directly, and the 155 plants are restricted to the narrow zone described above. Although a range of cushion sizes was observed here, there were no really large individuals, which may indicate this is a younger population.

Reproduction

The only indication of reproductive effort evident in mid-August was the number of flowering stems that remained attached to the cushion. The presence of at least two "color categories" of stems suggest that they may persist for more than one year. Though there was no way to determine if successful seed set had occurred this season, approximately 50% of the plants had a few to several flowering stems (up to 25-35 stems on large plants). Within the entire population, the actual proportion of flowering individuals may be somewhat

lower, as smaller cushions with very few or no flowering stems might be overlooked in the field and their numbers under estimated.

Habitat

Habitat preference varied at different sites. At Webber and Woodchopper creeks, *Eriogonum* was observed only on the rock faces above the river and was not seen on the nearby steppe-like slopes. At Kathul Mountain, *Eriogonum* was found only on a narrow exposure of alluvium and was not seen on rock faces, rubble, or steppe, all common habitats at this locality. At Calico and Eagle bluffs, this species was seen on rock faces, rubble slopes, and on graminoid steppe. At the latter two sites, large, healthy plants were noted on each habitat, and a strong habitat preference was not clearly apparent. Although these varied observations may be an artifact, in part, of the relatively brief time spent visiting each locality, they do indicate that the ecological amplitude of this taxon includes a range of habitats all common to the unforested, dry, S-facing bluffs characteristic of the middle Yukon and Porcupine River valleys.

Concerns:

The small population of *Eriogonum flavum* var. *aquilinum* described at Kathul Mountain merits our greatest concern. It is restricted to a very narrow area and could very easily be lost due to disturbance. Currently, there is little, if any serious adverse impact at the site. The main massif of Kathul Mountain is impressive and certainly attracts a few of the visitors traveling along the Yukon River, the primary access to the area. However the *Eriogonum* locality is distant from the most obvious and easiest hiking routes that might be considered, and it is probably rarely reached except by a few curious botanists. Any future development that involves the construction of trails or roads in the area is of serious concern though, as the gravely knoll site might be considered both as a suitable route or as a materials source. This tiny population could be eliminated entirely under such development.

Calico and Eagle bluffs are occasionally visited, and during this survey, evidence of recent hikers was noted at both. Some of this hiking can be destructive, as the commonly used routes are steep and unstable. A lot of material is unavoidably loosened underfoot, even when care is taken to minimize disturbance. At both sites, a large portion of the populations of *Eriogonum* is growing on near-vertical rock faces and unlikely to be disturbed, but plants growing on the slopes, and the plant community(s) as a whole, are definitely affected by this activity. This effect is now more or less limited to the margins of the few popular routes up these slopes, and this current level of use probably will not threaten these populations. Any development that increases visitation at these areas, such as a foot bridge across Mission Creek at the base of Eagle Bluff, or a boat landing at the base of Calico Bluff, should merit serious concern.

Considering their habitat preference, the populations of *Eriogonum* growing on the rock bluffs at Webber and Woodchopper Creeks are probably relatively secure at this time.

Recommendations:

1) Field workers should continue to watch for new localities of *Eriogonum flavum* var. *aquilinum* in interior eastern Alaska and document them on maps, and if reasonable, with herbarium collections.

2) With the exception of Kathul Mountain, the sites visited in this survey supported large, healthy populations. The first level of concern for the protection of this taxon is the protection of its habitat. This should include monitoring for a) any significant increase in visitation or b) any plans for future development at any of these areas.

If the potential for increased impact by hikers should arise, the construction and maintenance of a definable, stabilized trail that avoids the most sensitive areas may be the best strategy. To limit visitors seems both impractical and undesirable.

Future development such as road construction, that required a source of rock fill or crushed rock, could threaten the populations growing on rock faces and rubble. Areas supporting *Eriogonum* populations should be avoided.

3) Given the unstable habitats preferred by *Eriogonum*, any monitoring of the size and/or age structure of a population should be carefully designed not to contribute to the degradation of the site.

4) A assessment of the taxonomic status of this taxon is in order now that herbarium specimens from several Alaskan localities are available. This should not affect any protection status at the state level.

5) Given the number and size of populations now documented, *Eriogonum flavum* var. *aquilinum* should be considered for listing as Category 3.

Collections held at University of Alaska Herbarium, Fairbanks (ALA):

Format: USGS Quadrangle
Locality and habitat
Collector and number, date, ALA accession number
Co-ordinates, elevation

EAGLE QUAD.:

Calico Bluff, dry rubble slope, loose limestone and shale
Moldenhauer Y115, 30 June 1982, ALA V96306
64°55'N,141°12'W, 400 msm

Calico Bluff, steep, S-facing scree slopes
Lipkin 80-29, 13 June 1980, ALA V75467
64°54'N, 141°10'W

Eagle Bluff, rubble slope, lower area of bluff
Wesser 87-19, 15 June 1987, ALA V102954
64°49'N, 141°10'W

Eagle Bluff, SE-facing slope, open, fine scree with sandy soil
Lipkin 80-25, 11 June 1980, ALA V75639
64°50'N, 141°11'W

Eagle Bluff, deep brown soil, SW-facing, 33° slope
Batten and Dawe 78-251, 14 July 1978, ALA 82814
This specimen annotated by James L. Reveal, (US)

CHARLEY RIVER QUAD.:

Kathul Mountain, transition from lower black, loose shaley rubble to slope cap of coarse alluvium, 30-35° slope, azimuth 140-190°
Batten and Dawe 78-354, 23 July 1978, ALA 82816
65°21'N, 142°20'W, 455-460 msm
This specimen annotated by James L. Reveal, (US)

Woodchopper, 15 km downriver from, Site 33, SW-facing, steep bluff with blocky scree and fines, mostly exposed bedrock
Howenstein s.n., 21 July 1983, ALA V103490
65°24'N, 143°36'W

Woodchopper Cr., across Yukon River from mouth of creek, volcanic rock outcrops
Parker 6247, 17 August 1995, ALA V119578
65°22'N, 143°21'W, 240 msm

Webber Cr., across Yukon River from mouth of creek, S-facing, volcanic rock outcrops
Parker 6244, 16 August 1995, ALA V119576
65°25'N, 143°33'W, 240 msm

BLACK RIVER QUAD.:

Porcupine River, Site 15, SE-facing bluff, 30° slope, xeric, silty-loam with thick carbonate crust on loose rocks, unstable, with some exposed bedrock
Howenstein and Borron 215, 10 July 1982, ALA V76258
66°59'N, 142°51'W, ca. 200 msm

Porcupine River, Site 21, S-facing bluff with 15-28° slope, xeric, sandy-silt loam covered by small gravel with thick carbonate crust, exposed bedrock
Howenstein and Borron 266, 14 July 1982, ALA V76168
66°59'N, 142°54'W, 350 msm

Porcupine River, Site 16, SE-facing bluff, 26° slope, xeric, silty loam with thick carbonate crust on loose rocks, unstable, some exposed bedrock
Howenstein and Borron 230, 10 July 1982, ALA V76243
66°59'N, 142°50'W, ca. 200 msm

Porcupine River, Site 15, SE-facing bluff with 30° slope, xeric, silty loam with thick carbonate crust on loose rocks, unstable, with some exposed bedrock
Howenstein and Borron 223, 27 July 1982, ALA V76266
66°59'N, 142°51'W, ca. 200 msm

Porcupine River, S-facing bluff, rocky, calcareous slope
Emers 9361, 19 July 1993, ALA V116681
66°59'N, 142°50'W, 244 msm

Porcupine River, S-facing bluff, on rocky, calcareous slope
Emers 9373, 20 July 1993, ALA V116682
66°59'N, 142°44'W, 305 msm

Scientific Name: *Podistera yukonensis* Mathias & Constance
Bull. Torrey Bot. Club 77(2): 133-39. 1950

Family: Apiaceae (Umbelliferae) (Parsley Family)

Common Name: none

Synonymy: none

Present legal status: USFWS; listed Category 2
Alaska Natural Heritage Program; listed S1
Canada; rare

Type specimen: Little Klondike R., Yukon, Canada
Campbell 692 (CAN)

Taxonomic treatment: None, a distinct species, and its taxonomy has not been questioned.

Geographical range:

Podistera yukonensis is a narrowly restricted endemic found, in Alaska, only in the upper Yukon River valley. It is known from Kathul Mountain, Hillard Peak, and from "near Eagle", an early collection seen by Hultén, but which was incorrectly included by him under *Ligusticum mutellinoides* ssp.*alpinum* in Flora of Alaska and Yukon (Hultén 1941-1950, but see Hultén 1967). Sites in Yukon, Canada include Mile 58 on the 60-Mile Road (Dawson-Jack Wade Junction Road); Tombstone Range, Ogilvie Mts; Moosehide Hills, Yukon River, 25 km downstream from Dawson (Roland, pers. comm.); and the type locality on the Little Klondike R. (Cody 1994). Populations are known from both low elevations (360 msm on Kathul Mountain) and high alpine (2280 msm in Ogilvie Mts.).

Previous studies:

Batten et al. (1979) recorded *Podistera yukonensis* as abundant on S-facing rubble slopes and grasslands at low elevations on Kathul Mountain. They recommended a threatened status for the taxon.

Current study:

Kathul Mountain, Yukon River

Several thousand *Podistera yukonensis* plants are estimated growing on Kathul Mountain. Their occurrence is concentrated on 1) the centrally-located rubble slopes and rock faces of the main massif above the river, 2) the black, platy scree at the lower, downriver end of this massif, and 3) the screes and rocky open areas of the lower-elevation slopes immediately west of this area (Figs. 21,22,23 and A.8). The largest concentration of individuals was located on a broad saddle of deeply-weathered black platy rock that is part of the large northwest ridge descending from the peak. No plants were found on the tufted graminoid steppe; they appeared to be restricted, instead, to rock-dominated habitats. Although the largest concentration of plants were found at low to mid elevations on the slope, several hundred plants were seen on the upper slopes to 880 msm (2900 ft. elevation).

Where *Podistera* was very abundant, plants were often aligned in rows. On the broad, gently sloping saddle west of the main slope of Kathul Mountain, the alignment of plants clearly followed the linear patterns where bedrock was exposed at, or just under, the surface On the steeper scree slopes this pattern was more subtle where observed and it was unclear exactly what may have been responsible. Generally, *Podistera* was less abundant, or absent, wherever bedrock was deeply buried by scree.

Few, if any, fruits remained attached in mid August, although approximately one third of the plants had numerous flowering stems still projecting above the foliage. These stems may have represented two (or more) growing seasons, as suggested by the variation in color and degree of stiffness.

Associated species varied at each population and habitat on Kathul Mountain. On the rubble slopes directly above the river were *Calamagrostis purpurascens*, *Phalcelia sericea*, *Galium boreale*, *Rubus idaeus*, and *Artemisia frigida*. On the finer, black scree located at the lower western end of the main face were *Phacelia sericea*, *Smilacina stellata*, *Rosa acicularis*, and *Epilobium angustifolium*. *Podistera yukonensis* was co-dominant with *Oxytropis splendens* in the large population found at the saddle; additional species here included *Erigeron caespitosus*, *Douglasia arctica*, *Potentilla* cf. *nivea*, and *Festuca lenensis*.

Hillard Peak

Over one thousand plants of *Podistera yukonensis* were counted on a steep, S to SE-facing alpine scree slope on the southeast flank of Hillard Peak (Fig. 24 and A.11). Most individuals were growing within narrow strips of vegetation which were oriented downslope on an unstable scree, but some were rooted in the loose scree between these stripes and on the adjacent solid rock faces. *Posistera* did not extend onto the more stable area of steppe vegetation directly below this site.

Figure 21. *Podistera yukonensis* growing in platy scree on a broad saddle on the southwest flank of Kathul Mountain. Only a few fruits remained attached in mid August. (Photos by C.L. Parker)

Figure 22. S-facing rubble on lower slopes of Kathul Mountain. *Podistera* is one of the dominate plants on this sparsely vegetated, unstable scree.

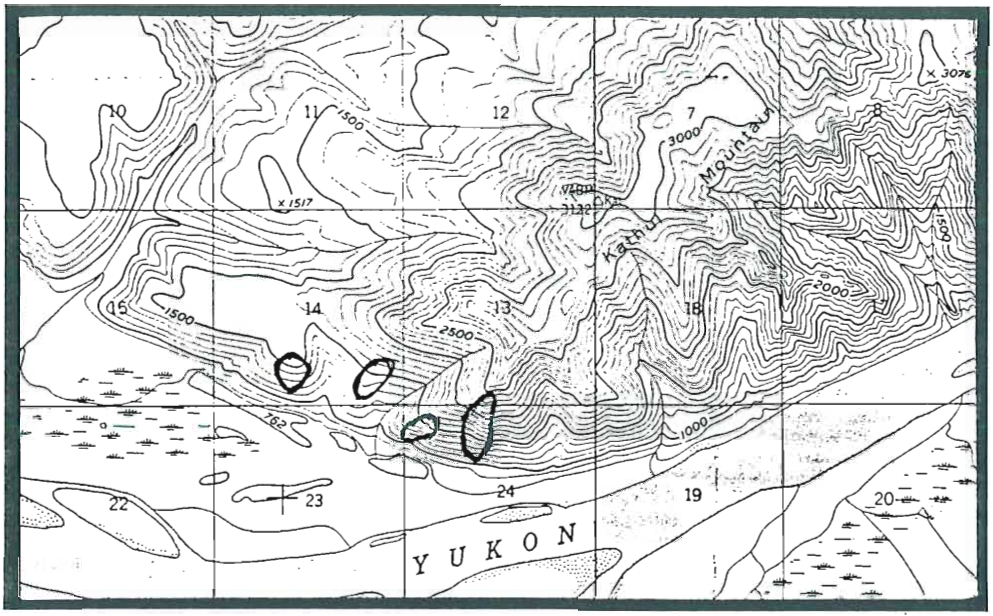

Figure 23. USGS Charley River Quadrangle (B-3). Yukon River, Kathul Mountain. Areas where *Podistera yukonensis* was observed and abundant are indicated. (Scale 1:63,360, 1 in. = 1 mile).

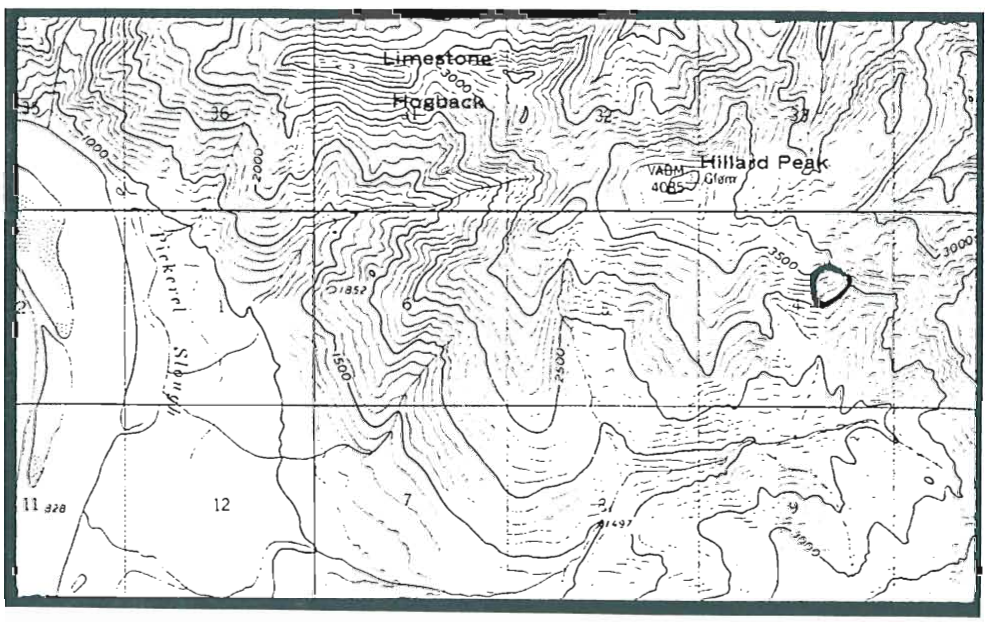

Figure 24. USGS Eagle Quadrangle (D-1). Yukon River is along left margin of map. Hillard Peak at upper right. Location of population of *Podistera* on southeast flank of Hillard Peak is indicated. (Scale 1:63,360, 1 in. = 1 mile).

A range of plant sizes was recorded and approximately one half of the plants had flowering stems bearing immature fruits on 6 June. An estimated 25% of this population bore both healthy-looking umbels with maturing fruits in addition to withered umbells that appeared to have been aborted shortly after flowering.

Associated taxa included *Calamagrostis purpurascens, Minuartia arctica, Saxifraga tricuspidata, Bupleurum triradiatum, Hierochloe alpina,* mosses and lichens.

Summary discussion:

Localities

In Alaska, *Postistera yukonensis* is well documented only from Kathul Mountain and Hillard Peak. Four additional localities are known from Yukon, Canada. The exact locality of the "near Eagle" collection dated 1910 and seen by Hultén (1967) is uncertain. It may even be one of the known Alaskan sites, as early collectors often noted locality very broadly on herbarium specimens. This distinct taxon is clearly a narrowly restricted upper Yukon River valley endemic.

Population size and structure

Kathul Mountain supports several thousand plants. Three areas, as described above, have the greatest concentration, but a few, to a few hundred plants were seen elsewhere at this locality. Wherever observed, *Podistera* displayed a range of size classes from small (a few leaves, clumps 5 - 10 cm diameter) to large (20 - 30 cm diameter). A predominance of medium to large plants was observed on the low-elevation, black, platy scree at the west end of Kathul Mountain. Plants were often crowded together, and it is possible that some plants, considered as separate individuals, may have actually been attached by below-ground stems that had been spread by downslope movement.

The population on Hillard Peak occupies a smaller area and a direct count of ca. 1000 individuals was made. An additional estimated 100 plants were scattered adjacent to this slope. This smaller population also showed a range in sizes, however the proportion of smaller plants appeared to be greater within the vegetated strips relative to the scree as determined by counting size classes in one small area. Mortality, especially of smaller individuals, is presumedly higher on the very unstable portion of this site.

Reproduction

Few, if any, fruits remained on plants at Kathul Mountain in mid August, though approximately 25 -50% of the large plants had flowering stems. Most had several (10-25) stems which may have represented two or more years reproductive effort. Examination of four herbarium specimens from Kathul Mountain that bear developing fruits suggest that only a small portion (10 - 25%) of the flowers in each umbel may produce mature fruits.

Approximately one half of the plants at Hillard Peak had flowering stems supporting at least some maturing fruits. A sample of these umbels was collected and preserved in alcohol. Each sampled umbel had both flowers and fruits at various developmental stages from almost fully-sized fruit to withered, aborted flowers. A count of the total number of flowers per umbel, the proportion of full-sized fruits per umbel, and proportion of all maturing, medium-sized to larger, healthly looking fruits per umbel gave the following results:

Average number of flowers/umbel	87.33
(n = 15, s.d. = 22.88)	
Average percent of large fruits/flowers/umbel	10.03
(n = 15, s.d. = 0.086)	
Average percent of large and medium fruits/flowers/umbel	31.58
(n = 15, s.d. = 0.158)	

Fruit development may be staggered in *Podistera* and a sample taken during a single visit, as sampled here, cannot accurately reflect reproductive effort by seed. The numerous small fruits and full flowers not included in these statistics may have continued to develop during a favorable summer. These results do show, however, that 10 to 30% of the flowers were definitely forming some mature fruits by our early June visit.

Habitat

At Kathul Mountain, *Podistera yukonensis* was found most abundantly on rock-dominated habitats and was absent from the graminoid steppe and open forested slopes. *Podistera* was found on the ledges and crevices of rock faces, in coarse rubble, and in fine scree where it was often one of the dominant taxa. On screes composed of fine to medium sized fragments, it was observed that plants were more abundant where bedrock was close to the surface, and less abundant or absent on the lower sections of the same slope where the scree deposit was deeper. As noted above, the plants growing in the saddle below and southwest of the peak were aligned with the exposed bedrock into distinct linear patterns. Most plants on Kathul Mountain were found at lower (360 msm) to mid elevations, but several plants were growing near the top (850 msm).

The population on Hillard Peak was on an alpine (1000 - 1070 msm) scree slope, but the majority of plants were rooted on rock faces or within the well-defined vegetation stripes that had developed on this slope, and not in the unstable scree. A few plants were found on a stable E-facing heath slope adjacent to the this site, but no *Podistera* was found on the steppe slope located below this site.

In Yukon, Canada, *Podistera* has been found on S-facing rocky alpine sites and on rock faces to 2280 msm (Cody 1994).

These combined observations suggest *Podistera* prefers open, rocky habitats over a wide range of elevation, but requires some degree of substrate stability as might be provided by vegetation or bedrock. Although it is found at

Kathul Mountain adjacent to steppe vegetation, it probably should not be considered a strict steppe taxon, but possibly an alpine species that reaches lower elevations in exposed rocky habitats.

Concerns:

Both *Podistera yukonensis* populations visited were large and appeared to be healthy, but as there are only two known populations in the state, our concern for this taxon should remain high. Any serious disturbance that threatens either population could result in the need to change the legal status of this taxon, as least at the state level.

The Hillard Peak locality is remote, readily accessible only by helicopter, and unlikely to be visited.

Although it is infrequently visited, Kathul Mountain is easily reached by the river. Given the broad distribution and large number of plants here, current levels of visitation are not likely to adversely impact this population. However, any road construction or similar development that required a route across, or rockfill source on the western flank of Kathul Mountain might impact the two large population concentrations found there.

Recommendations:

1) Field workers should continue to look for and document additional populations of *Podistera yukonensis*, especially in rocky alpine areas of eastern interior Alaska.

2) Development on the south face of Kathul Mountain that involves roadbuilding or mining for rockfill should be avoided, as the largest population of *Podistera yukonensis* is well established here and could be seriously impacted by such activity.

3) Considering there are only two known localities for *Podistera* in Alaska, and three in Yukon, Canada, this taxon should retain its Category 2 listing.

Collections held at University of Alaska Herbarium, Fairbanks (ALA)

Format: USGS Quadrangle
Locality and habitat
Collector and number, date, ALA accession number
Coordinates, elevation

CHARLEY RIVER QUAD.:
Kathul Mountain, rubble slope
Lloyd s.n., 4 May 1991, ALA V109855
65°21'N, 142°17'W, 150 msm

Kathul Mountain, W end to summit, S-facing, dry bluff with bedrock outcrops, Site 27
Howenstein s.n., 13 July 1983, ALA V103499
65°20'N, 142°15'W

Kathul Mountain, dry herb meadow
Batten and Dawe 78-316, 19 July 1978, ALA V94905
65°20'N, 142°19'W, 430 msm

Kathul Mountain, black, shale rubble slope
Batten and Dawe 78-309, 18 July 1978, ALA V94904
65°20'N, 142°18'W, 300 msm

Kathul Mountain, dry, open edges of aspen forest and dry slopes of unstable shale rubble
Moldenhauer Y18, June 1982, ALA V96362
65°20'N, 142°15'W, 610 msm

Kathul Mountain, summit of W-facing ridge, rocky outcrops
Batten and Dawe 78-343, 22 July 1978, ALA V94903
65°21'N, 142°18'W, 885 msm

RECOMMENDATIONS FOR MULTIPLE SPECIES CONSERVATION AT KATHUL MOUNTAIN

Rising over 700 m above the Yukon River, Kathul Mountain is one of the most impressive natural landmarks within Yukon-Charley Rivers National Preserve. The steep, S-facing bluff facing the river supports the largest subarctic steppe community in the Preserve; a complex mosaic of tufted grasslands, aspen-birch woodlands, screes, and rock outcrops that extends from the Yukon River flood plain to alpine tundra at the summit. Recognized as unique, Kathul Mountain has been the focus of several recent botanical studies. Floristic affinities that may link subarctic steppe in Alaska with both Asian steppes and the Quaternary vegetation of unglaciated Beringia are of biogeographic and paleoecologic interest (Young 1976a, Murray et al. 1983, Yurtsev 1984a and b, Edwards and Armbruster 1989). Environmental control of the distribution of both species and vegetation classes has been investigated (Lloyd et al. 1994). The vegetation has been described by several workers (Batten et al. 1979, Roland 1990, and references cited above). Floristic diversity at Kathul was the highest of all steppe sites visited in the Preserve in a recent study (Roland unpub. manuscript) which suggests that species richness on subarctic steppe is correlated with increased topographic relief.

Three Category 2 taxa are found at Kathul Mountain, more than are found together at any other locality within the Preserve. As described in this report, the lower western flank supports a small population of *Eriogonum flavum* var. *aquilinum*. *Podistera yukonensis* is abundant on some rock outcrops and screes and scattered throughout from mid-elevations upward on rocky sites. *Draba murrayi* is widespread at all elevations and is most closely associated with tufted grasses and open, aspen woodlands. In addition, several East Beringian endemics, uncommon elsewhere within the Preserve and in Alaska's flora, are concentrated here, including *Penstemon gormannii*, *Erysimum asperum* var. *angustatum*, *Minuartia yukonensis*, and *Douglasia arctica*. Floristic links with Asian steppe include *Festuca lenensis* and *Artemisia laciniata*. The botanical richness of Kathul Mountain must be recognized and protected. The following comments and recommendations are offered:

1) An initial and primary protective strategy for Kathul Mountain would be to not develop the immediate area in any way that may attract additional visitors. Such development might include construction of campgrounds, public use cabins, boat landings, signs, road, or trails. The current level of visitation at Kathul Mountain is low and does not seriously threatened plant populations. There are no suitable camp sites at the base of Kathul Mountain to attract people traveling on the river. A shallow sand bar/island extends for some length parallel to the river bank, and a band of forest with a brushy understory lies between the bank and the base of the bluff, both contributing to making access to the bluff inconvenient. Most hikers drawn to the upper slopes or summit will likely choose the most open, direct route, following the contiguous unforested steppe area on the eastern edge of the face, hence missing more sensitive areas discussed below. The popular adage, "keeping a good thing quiet", may be an adequate and appropriate policy under the current level of use.

2) Researchers doing field work on Kathul Mountain over a period of several days or weeks could be a greater potential source of disturbance to the more fragile and sensitive areas. Research should not be discouraged, but guidelines for a "steppe etiquette" should include:

- Extreme care to minimize dislodging soil and/or plants while walking on the bluff, especially when descending, as the substrate over most of the bluff is poorly consolidated and easily moved underfoot.

- A research party should include only the minimum number of workers required to undertake the study. Disturbance is greatly increased when a few to several people are actively concentrated onto a very small area or following each other's path.

- The establishment of permanent plots or markers should be discouraged. When such markers are critical to a study, they should be minimized and made relatively inconspicuous. Markers visible from a distance often draw attention and may attract the curious. Temporary markers should be removed as soon as they are no longer necessary.

3) *Draba murrayi* is widely scattered in the grassland and open woodland areas of the steppe. Although these habitats are more stable than other steppe habitats, the small rosettes are easily dislodged from the fine loess. A project focusing on this taxon will probably be covering a lot of area, as plants are widespread, and workers should heed the first two suggestions listed above for "steppe etiquette".

4) *Podistera yukonensis* is abundant on the rock outcrops and some of the screes on the central area of the south face of Kathul. It is also abundant, as described previously in this report, on the mid-elevation black shale saddle on the western flank of the peak. In addition, plants are scattered throughout on rocky sites. Individual plants are firmly rooted, but these areas are very unstable, and any study involving this taxon must take special care to minimize disturbance of the substrate. Intensive or long term studies could be focused on the population located on the western flank (Fig. 23, lower right of Section 14), which is large and growing on a site which is relatively stable compared to those of other populations.

5) The small population of *Eriogonum flavum* var. *aquilinum* found at Kathul is definitely at risk. It consists of only ca. 150 plants, is restricted to a very small area, and is growing on a cap of loose alluvial gravels. Random local extinctions of once more widespread plants is suggested as an explanation for the erratic distribution pattern of rare plants on subarctic steppes in eastern interior Alaska today (Roland, unpub. manuscript). This process may be occurring now in this tiny population. *Eriogonum* individuals are long-lived and slow growing. A monitoring program designed for this population should be very long term and involve very infrequent

visitation. Photographic monitoring methods may be the least intrusive and therefore more appropriate for this population. Development that involves trails or roads should be routed as distant as possible from this site. A study focusing on this taxon should consider an alternative population consisting of more individuals, where our concern need not be so acute.

6) Kathul Mountain is a valuable natural laboratory. Research here should not be discouraged, but should be restricted to only those investigations that specifically require this unique setting to address their questions. Educational tours, and similar interested groups, should be deflected to alternative subarctic steppe sites.

7) Strong consideration should be given for the designation of Kathul Mountain as a Research Natural Area (RNA). It is hoped that with this special status the preservation of this unique area can be assured without drawing unwanted attention and increased visitation.

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APPENDIX A

AERIAL PHOTOGRAPHS OF REGIONS COVERED IN STATUS AND TRENDS SURVEY OF CATEGORY 2 PLANTS IN THE YUKON-CHARLEY RIVERS NATIONAL PRESERVE, ALASKA

Aerial photographs are presented for the regions visited during this survey. Black lines indicate routes taken and are described in the corresponding caption. Populations of Category 2 species are either marked on the photographs, if they appeared to be restricted, or their distribution is described in the caption. North is at the top of the page. Scale is roughly 1 inch - 1 mile for most images. Original color aerial photographs were acquired from the GeoData Center, Geophysical Institute, University of Alaska, Fairbanks.

CONTENTS

Figure A.1. USGS Charley River Quadrangle (A-1). Funnel Creek, lower Tatonduk River. Alaska-Canada border is just off right margin of image. Funnel Creek drains from the north, reaching Tatonduk R. near right margin. This figure corresponds with Figure 8. Areas covered include the S-facing slopes of the SSE-trending limestone ridge that parallels Funnel Creek. Vegetation was predominantly open, mixed birch-aspen-white spruce forest dissected by rock outcrops and scree. *Draba murrayi* was widespread within the area indicated.

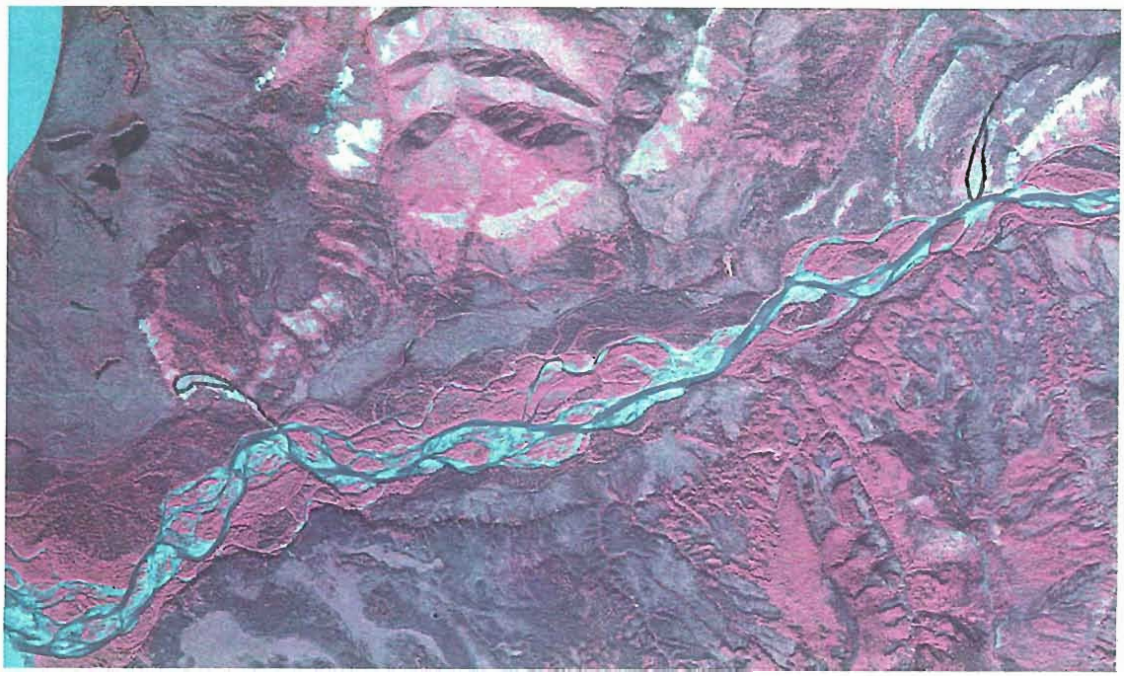

Figure A.2. USGS Charley River Quadrangle (A-1). Lower Tatonduk River, near confluence with Yukon River. Yukon River visable at upper left corner of image. This figure corresponds with Figure 9. Areas visited include the limestone hogback slope indicated in upper right corner and the S-facing slopes at the tip of the uplands on north bank of river. *Draba murrayi* was found associated with upland mixed birch-aspen-white spruce forest and steppe vegetation at both sites. However, on the open steppe slope just upriver from the Tatonduk River mouth, *Draba* was restricted to the understory of a small aspen clone that was invading the middle upper portion of the slope.

Figure A.3. USGS Charley River Quadrangle (B-2). Johnson Gorge, lower Kandik River. This figure corresponds to Figure 10. Most sites visited are on the north bank of the river. These areas were dominated by open, mixed birch-white spruce forest stands dissected by rock outcrops, scree, and patches of steppe vegetation. *Draba murrayi* was widespread throughout these areas. One N-facing rock face, indicated by arrow in the lower left half of image, supported a large population of *Draba*.

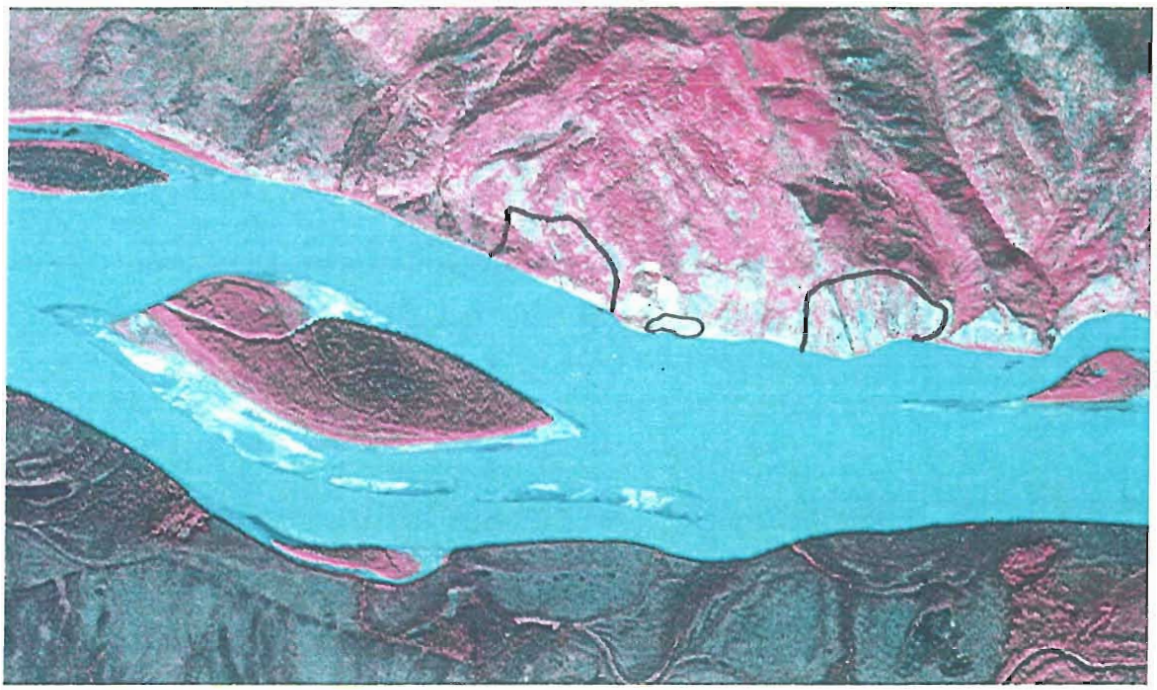

Figure A.4. USGS Charley River Quadrangle (A-1,2). Montauk Bluff, Yukon River. Routes taken are indicated. Predominant vegetation was open aspen-birch forest and herbaceous steppe dissected by rock outcrops. No Category 2 taxa were recorded here during our visit.

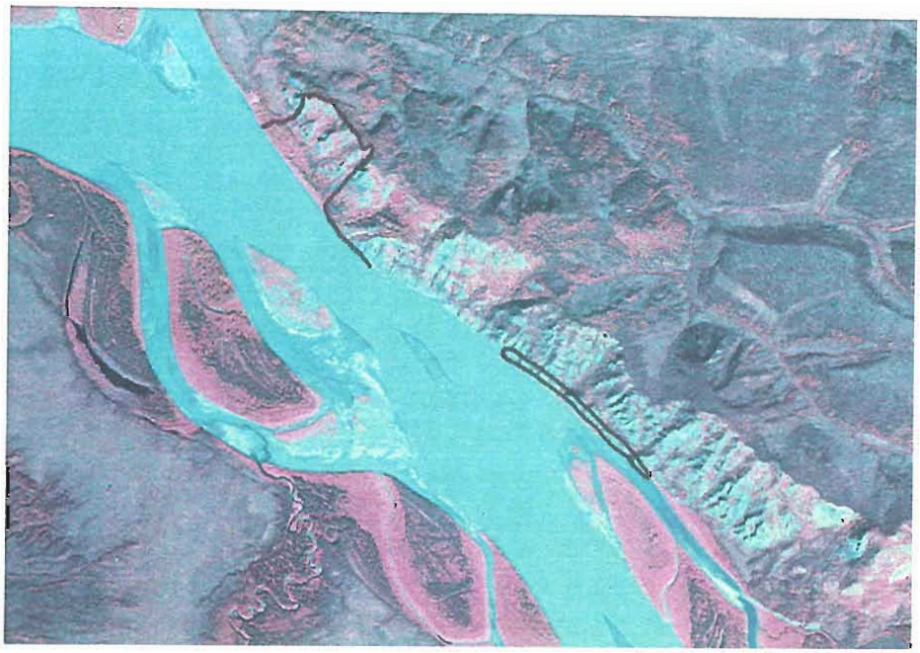

Figure A.5. USGS Charley River Quadrangle (B-6). Yukon River, bluffs across from Webber Creek. Mouth of Webber Creek visible toward lower left of center. This figure corresponds with Figures 11 and 16. Routes taken are indicated. Area was dominated by rock faces and scree with patches of mixed birch-white spruce forest and steppe vegetation. *Draba murrayi* was scattered on the slopes of the downriver area visited (upper left of image). *Eriogonum flavum* var. *aquilinum* was growing on the rock faces along the upriver area indicated.

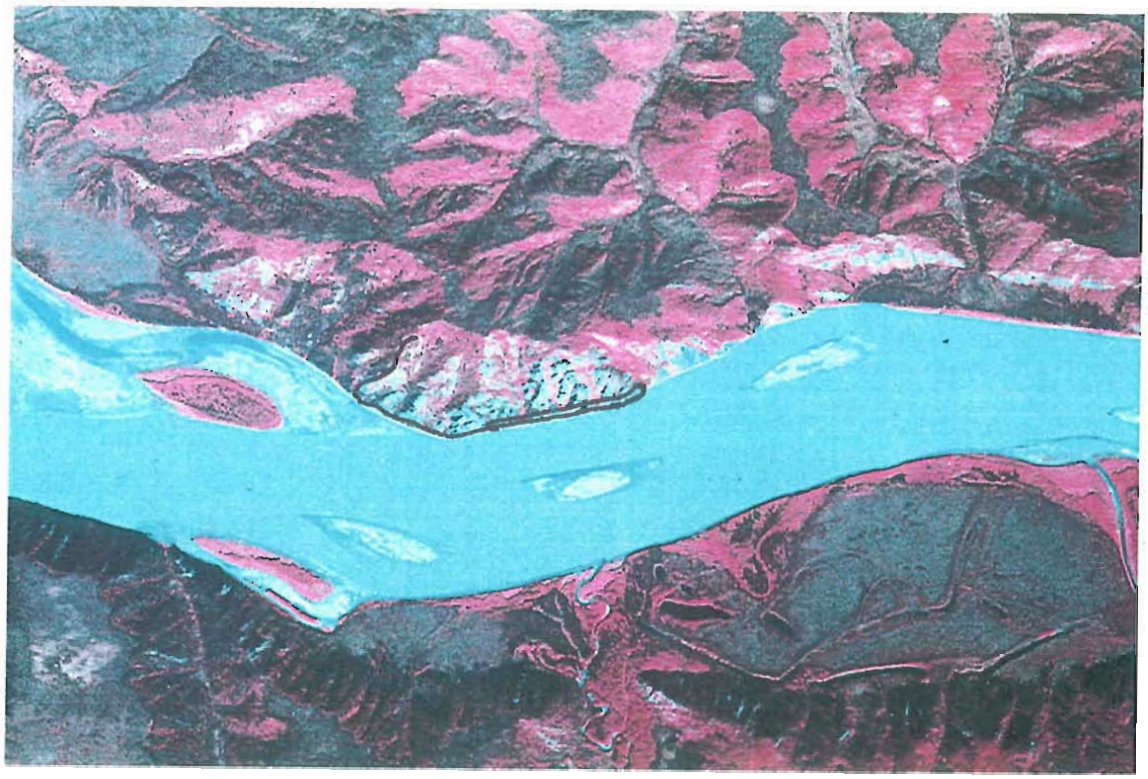

Figure A.6. USGS Charley River Quadrangle (B-5). Yukon River across from mouth of Woodchopper Creek. Woodchopper Creek and roadhouse site at lower center of image. This figure corresponds to Figures 12 and 17. *Draba murrayi* was found scattered in the open mixed aspen-birch-white spruce forest and steppe on upper slopes at the downriver end of area visited. *Eriogonum flavum* var. *aquilinum* was growing on the rock faces directly across from the mouth of Woodchopper Creek as indicated.

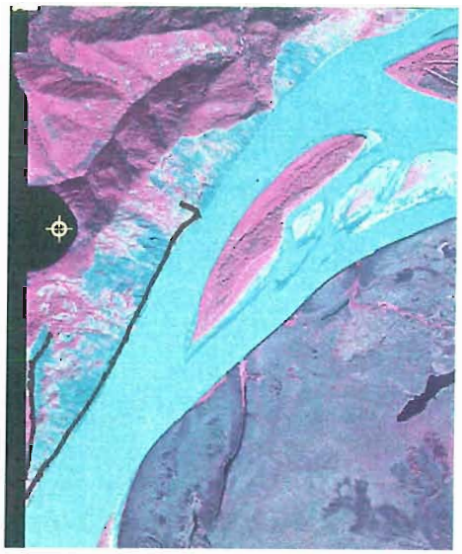

Figure A.7. USGS Charley River Quadrangle (B-4). Yukon River, Biederman Bluff. The rock outcrops and scree that dominate this site support only widely scattered shrubs and herbs. Patches of mixed birch-aspen-white spruce forest and steppe cover the more stable areas. *Draba murrayi* was scattered here, but most strongly associated with open aspen stands.

Figure A.8. USGS Charley River Quadrangle (B-3). Kathul Mountain, Yukon River. Steppe and open, mixed forest dominate the vegetation. This figure corresponds to Figures 18 and 23. Black lines show areas covered in survey. A small population of *Eriogonum flavum* var. *aquilinum* is indicated by the westernmost (upper left) enclosed circle. The largest concentrations of *Podistera yukonensis* are indicated by the three remaining enclosed circles, although *Podistera* was scattered in many additional areas dominated by rock faces or scree. *Draba murrayi* was widely scattered throughout the area, although it was most strongly associated with steppe and open aspen woodland.

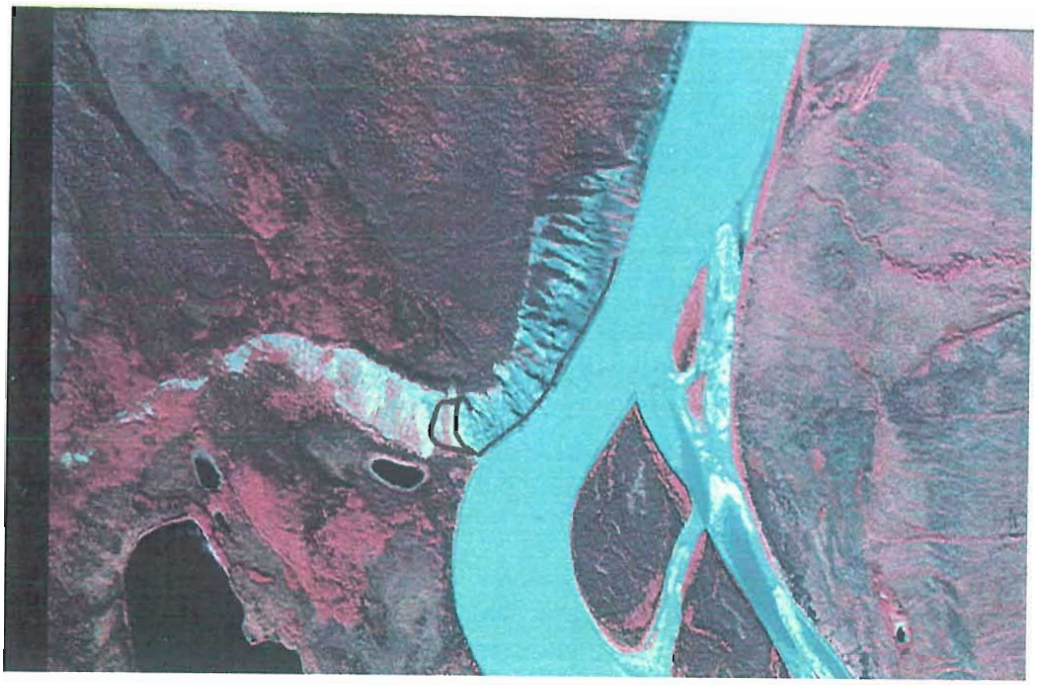

Figure A.9. USGS Eagle Quadrangle (D-1). Calico Bluff, Yukon River. This figure corresponds to Figures 4 and 19. Rock outcrops and scree dominate this site, with patches of aspen and mixed forest covering more stable areas. *Eriogonum flavum* var. *aquilinum* is abundant near the top of the large, S-facing scree that spans the height of the bluff where it turns away from the river and on the rock face above the river. *Cryptantha shackletteana* is common on the large scree, especially toward the top, and is also very abundant along the base of the downriver end of the bluff.

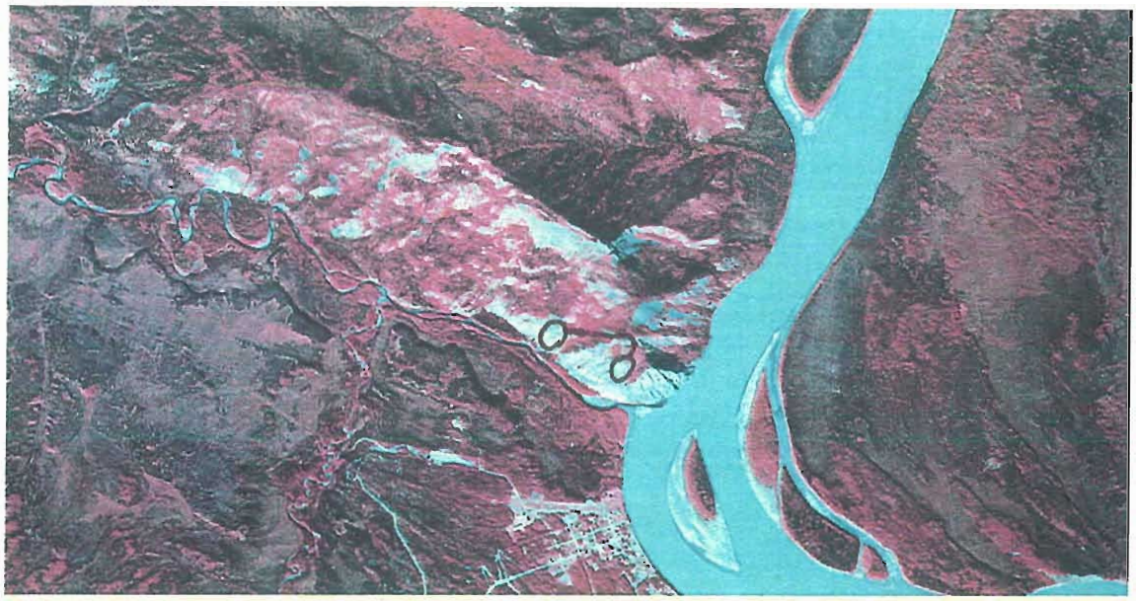

Figure A.10. USGS Eagle Quadrangle (D-1). Eagle (Mission) Bluff, Yukon River. Town of Eagle at lower center of image. This figure corresponds to Figures 5 and 20. Rock outcrops and scree dominate the eastern end of the bluff. Steppe and mixed aspen-birch-white spruce forest are found on more stable areas. *Eriogonum flavum* var. *aquilinum* and *Cryptantha shackletteana* were scattered in most rocky or steppe sites and abundant in the areas indicated by enclosed circles. *Draba murrayi* has been documented from the ridgecrest by other workers, but was not seen in this survey.

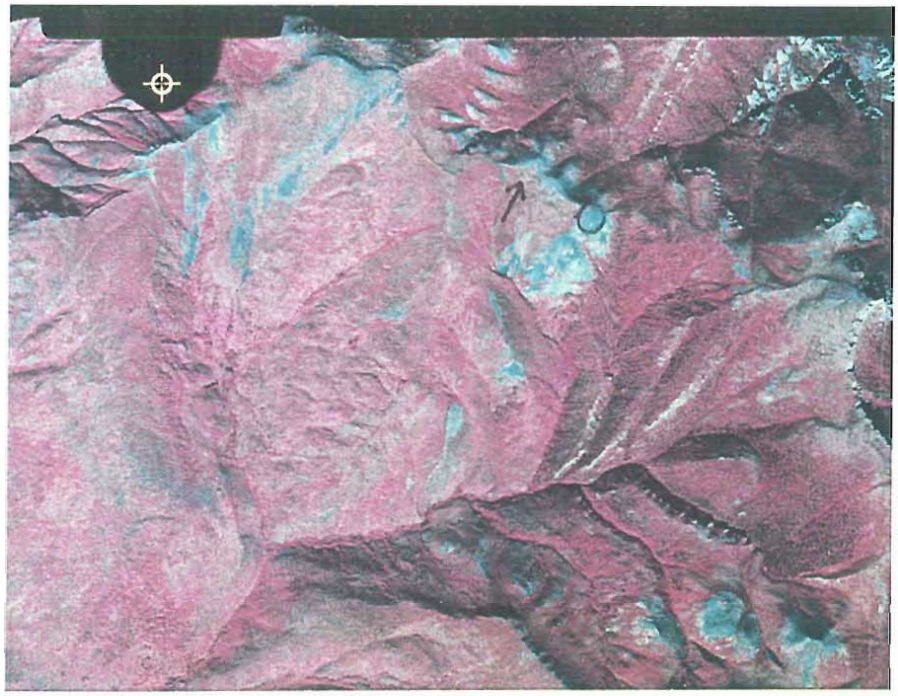

Figure A.11. USGS Eagle Quadrangle (D-1). Hillard Peak. Peak is indicated by small arrow. Drainage south of peak flows into Yukon River 2.5 miles west of lower left margin of photo. This figure corresponds to Figure 24. Population of *Podistera yukonensis* is located on scree knoll as shown by enclosed circle.

APPENDEX B

ANNOTATED LIST OF VASCULAR PLANT COLLECTIONS
STATUS AND TRENDS SURVEY OF CATEGORY 2 PLANT SPECIES
YUKON-CHARLEY RIVERS NATIONAL PRESERVE
SUMMER 1995

FORMAT:

Family Name

SCIENTIFIC NAME
Locality
ALA Accession Number Collector Number Habitat

Accessioned collections are held at the University of Alaska Museum, Herbarium, Fairbanks (ALA). An incomplete duplicate set, including those collections listed here lacking an ALA accession number, is held at Yukon-Charley Rivers National Preserve herbarium. Collection numbers are those of the author.

This is not a complete list of taxa for the area, but only a list of collections made in the course of this survey. Previous workers have documented the flora of this area more thoroughly (see Batten et al. 1979, Young 1976, ALA collections) and our collecting efforts were directed toward documenting new taxa for the area and new populations of rare or uncommon species.

Adiantaceae

CRYPTOGRAMMA STELLERI (S. Gmelin) Prantl
Kandik River, Johnson Gorge, N bank, entrance to gorge.
V0119520 5585 SE-facing graywacke rock face, in seepage.

Tatonduk River, S bank of river, ca. 3 km above Funnel Cr.
V0119463 5529 Wet crevices on NE-facing rock face.

Adoxaceae

ADOXA MOSCHATELLINA L.
Tatonduk River, N bank, ca. 3 km above mouth of river.
V0119506 5571 Moist aspen forest floor, growing in litter.

Aspleniaceae

CYSTOPTERIS FRAGILIS (L.) Bernh.
Tatonduk River, N bank of river, W of Funnel Cr.
V0119452 5518 S-facing limestone slope, rock outcrops in open, dry, birch-white spruce stand.

CYSTOPTERIS MONTANA (Lam.) Bernh.
Yukon River, vic. mouth of Webber Cr., across river from mouth.
V0119577 6245 Moist, riparian shrub understory.

WOODSIA GLABELLA R. BR.
Tatonduk River, S bank of river, ca. 3 km above Funnel Cr.
V0119458 5524 Steep, moist, E-facing rock faces.

WOODSIA ILVENSIS (L.) R. Br.
Kandik River, NW bank below mouth of Johnson Gorge.
V0119538 5603 Moist dirt crevices of boulder slope.

Asteraceae

ARTEMISIA BOREALIS Pallas
Tatonduk River, N bank of river, W of Funnel Cr.
V0119471 5537 S-facing limestone slopes, rock outcrop.

ARTEMISIA CANADENSIS Michaux
Yukon River, vic. mouth of Webber Cr.
V0119545 6205 Sand-gravel bar, herbaceous understory of *Salix*.

ARTEMISIA LACINIATA Willd.
Kathul Mtn.
V0119575 6242 S-facing, dry, open, aspen understory.

ASTER COMMUTATUS (Torr. & A. Gray) A. Gray
Yukon River, vic. mouth of Webber Cr., N bank of river.
V0119553 6212 Sandy river bank.

ERIGERON CAESPITOSUS Nutt.
Yukon River, Woodchopper Cr., N bank of river.
V0119558 6219 Silt-sandy river banks at base of outcrops.

Kandik River, Johnson Gorge, N bank of river.
V0119528 5589 Steep, S-facing slope, growing on outcrops.

SENECIO OGOTORUKENSIS Packer
Kandik River, Johnson Gorge, N bank, near mouth of gorge.
V0119531 5596 Rocky outcrops in white spruce forest.

Kandik River, Johnson Gorge, N bank, at entrance to gorge.
V0119519 5584 SE-facing graywacke rock face, in crevices.

SOLIDAGO CANADENSIS L.
Yukon River, Woodchopper Cr., N bank of river.
V0119555 6216 Silt-sandy river bank at base of outcrops.

Betulaceae

BETULA hybrid
Tatonduk River, N bank, ca. 3 km above Funnel Cr.
V0119449 5514 Tussock-heath on old terrace, open shrub-woodland, growing to 2.5 m tall, gray bark, shrub growth form, growing with *B. glandulosa* and *B. papyrifera*.

Boraginaceae

CRYPTANTHA SHACKLETTEANA L. C. Higgins
Calico Bluff, Yukon R., 12.5 km N of Eagle.
6255 S-facing, soft, fine scree slope.

ARABIS DIVARICARPA Nelson

Tatonduk River, N bank, ca. 3 km above mouth.
V0119502 5568 Steep S-facing slope, open aspen-paper birch forest, herbaceous understory.

ARABIS HIRSUTA (L.) Scop.

Tatonduk River, N bank, ca. 3 km above mouth.
V0119503 5569 Steep S-facing slope, open aspen-paper birch forest, herbaceous understory.

ARABIS HOLBOELLII Hornem.

Tatonduk River N bank, ca. 3 km above mouth.
V0119501 5567 Steep S-facing slope, open aspen-paper birch forest, herbaceous understory.

DRABA MURRAYI G. Mulligan

A selection of these *D. murrayi* specimens have been reviewed, and the determinations confirmed, by G.A. Mulligan (DAO). These collections display a wider range of variation for some diagnostic morphological characters than was noted in the original description for the species (Mulligan 1979).

Yukon River, Biederman Bluff, upriver end of bluff.
6230 S-facing, open, dry aspen stand, herbaceous-shrub understory.

Yukon River, Biederman Bluff, downriver end of bluff.
6229 S-facing slope, soft shaley siltstone-sandstone scree, rich in fines.

Yukon River, vic. Woodchopper Cr., N bank of river.
6223 S-facing, xeric, graminoid steppe.

Yukon River, vic. Webber Cr., across from creek mouth.
6213 S-facing volcanic rubble slope.

Yukon River, vic. mouth Nation River, hogback ridge upriver from Nation R. mouth.
V0119583 6252 Coarse-grained limestone ridge, dry, SE-facing, open slope.

Yukon River, vic. mouth Nation River, hogback ridge upriver from Nation R. mouth.
V0119582 6251 Coarse-grained limestone ridge, dry, SW-facing slope, under open aspen.

Kathul Mtn.
V0119572 6238 Aspen understory on S-facing slope.

Kathul Mtn.
V0119568 6234 S-facing, xeric, graminoid steppe.

Yukon River, Biederman Bluff, downriver end of bluff.
V0119567 6233 S-facing, dry, open, aspen understory.

Yukon River, vic. mouth of Webber Cr., N bank of river.
V0119552 6214 Steep S-facing volcanic rock outcrops and bluffs, *Calamagrostis-Artemisia fridiga* steppe near summit.

Kandik River, Johnson Gorge, N bank, near mouth of gorge.
V0119533 5598 Steep, dry SE-facing slope, graminoid steppe.

Kandik River, Johnson Gorge, N bank, near mouth of gorge.
V0119530 5595 Moist, N-facing rock face along river.

Kandik River, Johnson Gorge, N bank.
V0119525 5591 Steep, S-facing slope, dry birch forest understory.

Kandik River, Johnson Gorge, N bank, at entrance to gorge.
V0119517 5582 SE-facing graywacke rubble slope dominated by *Saxifraga tricuspidata*, lichens and mosses.

Tatonduk River, N bank, ca. 3 km above mouth.
V0119498 5563 S-facing xeric steppe slope dominated by *Artemisia frigida*, shale capped by alluvial gravels.

Tatonduk River, N bank, W of Pass Cr.
V0119496 5561 Steep, S-facing limestone outcrops in aspen-white spruce forest.

Tatonduk River, N bank, W of Pass Cr.
V0119493 5558 Steep, xeric steppe dominated by *Calamagrostis purpurascens* and bare soil.

Tatonduk River, N bank, W of Funnel Cr.
V0119487 5553 S-facing limestone slope, xeric sedge-dominated steppe.

Tatonduk River, N bank, W of Funnel Cr.
V0119478 5544 S-facing limestone slope, open, sunny rock outcrops.

Tatonduk River, N bank, W of Funnel Cr.
V0119477 5543 S-facing limestone slope, partially-shaded rock outcrops within cottonwood stand.

Tatonduk River, N bank, W of Funnel Cr.
V0119451 5517 S-facing limestone slope, rock outcrops in open, dry birch-white spruce stand.

Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119469 5535 E-facing slope, mesic to dry open herbaceous slopes.

Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119468 5534 E-facing slope, mesic understory of birch spruce forest.

DRABA NEMOROSA L.
Yukon River, Montauk Bluff.
V0119510 5573 Steep S-facing slope, growing in mossy depression in rock outcrop.

DRABA PRAEALTA E. Greene
Tatonduk River, N bank, W of Pass Cr.
V0119489 5554 Moist mud of river bank.

Tatonduk River, N bank, ca. 3 km above Funnel Cr.
V0119447 5513 Steep bank, moist, shady alder-spruce understory.

ERYSIMUM ASPERUM (Nutt.) DC. var. ANGUSTATUM (Rydb.) J. Boivin
Yukon River, Biederman Bluff.
V0119566 6231 S-facing slope, under dry, open aspen stand.

Yukon River, Biederman Bluff, downriver end of bluff.
V0119565 6228 Platey, soft and sandstone scree at base of bluff.

Yukon River, Biederman Bluff, downriver end of bluff.
V0119564 6227 Platey, soft and sandstone scree at base of bluff.

Yukon River, vic. mouth of Webber Cr., N bank of river.
V0119547 6207 Steep S-facing volcanic rock outcrops and bluffs, rubble below rock face.

Kandik River, Johnson Gorge, N bank.
V0119523 5588 Steep, S-facing slope, dry birch forest, growing in open, grassy site within forest.

Kandik River, NW bank below mouth of Johnson Gorge.
V0119537 5602 Base of SE-facing herbaceous slope.

ERYSIMUM INCONSPICUUM (S. Watson) Macmillan

Yukon River, Montauk Bluff.
V0119512 5577 S-facing, xeric steppe dominated by *Artemisia frigida*.

Tatonduk River, N bank, ca. 3 km above mouth.
V0119500 5565 Steep S-facing slope, open aspen-paper birch forest, herbaceous understory.

LESQUERELLA ARCTICA (Wormsk.) S. Watson
Yukon River, vic. mouth Nation River, hogback ridge upriver from Nation R. mouth.
V0119580 6249 Coarse-grained limestone ridge, dry, SE-facing slope.

TORULARIA HUMILIS (C. Meyer) O. Schulz
Tatonduk River, N bank, W of Pass Cr.
V0119490 5555 Steep, xeric steppe dominated by *Calamagrostis purpurascens* and bare soil.

Caryophyllaceae

CERASTIUM ARVENSE L.
Kandik River, Johnson Gorge, N bank, at entrance to gorge.
V0119521 5586 Moist graywacke rock face.

CERASTIUM MAXIMUM L.
Kandik River, Johnson Gorge, N bank.
V0119526 5592 Steep, S-facing slope, dry birch forest understory.

GASTROLYCHNIS TAYLORAE (Robinson) D. Murray
Kandik River, Johnson Gorge, N bank, near mouth of gorge.
V0119532 5597 Moist herbaceous bank along river edge.

Tatonduk River, N bank, ca. 3 km above Funnel Cr.
V0119446 5512 Steep bank, moist, shady alder-spruce understory.

MINUARTIA RUBELLA (Wahlenb.) Graebner
Tatonduk River, N bank, W of Funnel Cr.
V0119476 5542 S-facing limestone slope, rock outcrops.

MINUARTIA YUKONENSIS Hultén
Yukon River, vic. Woodchopper Cr., N bank of river.
V0119560 6221 S-facing, xeric *Calamagrostis-Artemisia frigida*-dominated steppe.

SILENE WILLIAMSII Britton
Yukon River, vic. Woodchopper Cr., N bank of river.
V0119561 6222 S-facing, xeric *Calamagrostis-Artemisia frigida*-dominated steppe.

Chenopodiaceae

CHENOPODIUM CAPITATUM (L.) Asch.
Yukon River, vic. mouth of Webber Cr., N bank of river.
V0119550 6210 Steep, S-facing volcanic rock outcrops and bluffs, growing under aspen.

CORISPERMUM HYSSOPIFOLIUM L.
Yukon River, vic. mouth of Webber Cr.
V0119544 6204 Sand-gravel bar, growing with *Salix* and *Equisetum* on moist, more frequently disturbed area.

Cornaceae

SWIDA STOLONIFERA (Michx.) Rydb.
Yukon River, vic. mouth of Webber Cr., N bank, bluff across from creek mouth.
V0119546 6206 Steep S-facing volcanic rock outcrops and bluffs, rubble below rock face.

Cyperaceae

CAREX CONCINNA R. Br.
Tatonduk River, N bank, ca. 3 km above Funnel Cr.
V0119448 5515 Steep bank, moist, shady alder-spruce understory.

CAREX CRAWFORDII Fern.
Kathul Mtn.
6241 S-facing, steep, xeric graminoid steppe.

Yukon River, Montauk Bluff.
V0119508 5574 Steep, S-facing xeric steppe dominated by *Artemisia frigida*.

CAREX FILIFOLIA Nutt.
Tatonduk River, N bank, W of Funnel Cr.
V0119483 5549 S-facing limestone slope, at base of cliff.

CAREX NARDINA Fries
Tatonduk River, N bank, W of Funnel Cr.
V0119482 5548 S-facing limestone slope, xeric, sedge-dominated steppe.

CAREX OBTUSATA Lilj.
Kandik River, Johnson Gorge, N bank, near mouth of gorge.
V0119534 5599 Steep, dry SE-facing slope, graminoid steppe.

Tatonduk River, N bank, W of Funnel Cr.
V0119472 5538 S-facing shale slope, dry open slope dominated by *Selaginella sibirica*.

CAREX ROSSII Boott
Kandik River, Johnson Gorge, N bank, near mouth of gorge.
V0119535 5600 Steep, dry SE-facing slope, graminoid steppe.

Tatonduk River, N bank, W of Pass Cr.
V0119492 5557 Steep, xeric steppe dominated by *Calamagrostis purpurascens* and bare soil.

CAREX SUPINA Willd. ssp. SPANIOCARPA (Steudel) Hultén
Yukon River, Montauk Bluff.
V0119511 5576 S-facing, xeric steppe, dominated by *Artemisia frigida*.

Yukon River, Montauk Bluff.
V0119509 5575 Steep, S-facing xeric steppe, dominated by *Artemisia frigida*.

Ericaceae

ARCTOSTAPHYLOS UVA-URSI (L.) Sprengel
Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119467 5533 E-facing slope, dry to mesic open slopes and openings in birch-spruce forest.

Fabaceae

OXYTROPIS SPLENDENS Douglas
Yukon River, vic. Woodchopper Cr., N bank of river.
V0119557 6218 Silt-sandy river banks and rock outcrops.

OXYTROPIS VISCIDA Nutt.
Yukon River, vic. mouth Nation River, hogback ridge up-river from Nation R. mouth.
V0119585 6254 Coarse-grained limestone ridge, dry, SE-facing, open slope.

Tatonduk River, N bank, ca. 3 km above mouth.
V0119504 5566 Mesic gravel bars, open shrubland, dominated by *Dryas*.

Fumeriaceae

CORYDALIS PAUCIFLORA (Stephan) Pers.
Kandik River, NW bank, below mouth of Johnson Gorge.
V0119542 5607 Wet, mossy understory of willow-white spruce stand.

Grossulariaceae

RIBES HUDSONIANUM Richardson
Tatonduk River, S bank , ca. 3 km above Funnel Cr.
V0119456 5522 Understory of willow and cottonwood, old river terrace.

Hydrophyllaceae

PHACELIA MOLLIS J. F. Macbr.
Kandik River, NW bank below mouth of Johnson Gorge.
V0119536 5601 Base of SE-facing herbaceous slope, partially shaded, birch-white spruce forest margin.

Kandik River, Johnson Gorge, N bank, at entrance to gorge.
V0119516 5581 SE-facing graywacke rubble slope dominated by *Saxifraga tricuspidata*, lichens and mosses.

PHACELIA SERICEA (Graham) A. Gray
Eagle (Mission) Bluff, 1 km N of Eagle, above Mission Cr.
V0119587 6257 SE-facing rubble slopes.

Kathul Mtn.
V0119571 6237 Cottonwood understory at base of S-facing slope.

Yukon River, Biederman Bluff, downriver end of bluff.
V0119563 6226 Platey, soft and sandstone scree at base of bluff.

Liliaceae

LLOYDIA SEROTINA (L.) Reichb.
Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119464 5530 NW-facing rock faces.

SMILACINA STELLATA (L.) Desf.
Yukon River, Montauk Bluff.
V0119513 5578 S-facing, xeric steppe, dominated by *Artemisia frigida*.

Ophioglossaceae

BOTRYCHIUM LUNARIA (L.) Sw.
Yukon River, vic. Woodchopper Cr., N bank of river.
6224 Mixed white spruce-birch forest understory, moist and shady.

Orchidaceae

LISTERA BOREALIS Morong
Tatonduk River, N bank, ca. 3 km above mouth.
V0119505 5570 Moist white spruce forest floor, in moss.

Papaveraceae

PAPAVER NUDICAULE L. ssp. AMERICANUM Randel ex Murray
Kandik River, Johnson Gorge, N bank, at entrance to gorge.
V0119518 5583 SE-facing graywacke rubble slope dominated by *Saxifraga tricuspidata*, lichens and mosses.

Tatonduk River, N bank, W of Funnel Cr.
V0119484 5550 S-facing limestone slope, xeric, sedge-dominated steppe, larger flower has dark pink petals, yellow only at base.

Tatonduk River, N bank, W of Funnel Cr.
V0119473 5539 S-facing shale slope, dry open slope dominated by *Selaginella sibirica*.

Tatonduk River, N bank, W of Funnel Cr.
V0119450 5516 S-facing limestone slope, open, dry birch-white spruce stand, herbaceous understory.

Plantaginaceae

PLANTAGO CANESCENS J. Adams
Yukon River, vic. Woodchopper Cr., N bank of river.
V0119556 6217 Silt-sandy river bank at base of outcrops.

Tatonduk River, N bank, W of Funnel Cr.
V0119479 5545 S-facing limestone slope, xeric, sedge-dominated steppe.

Poaceae

FESTUCA ALTAICA Trin.
Kandik River, Johnson Gorge, N bank.
V0119524 5590 Steep, S-facing slope, dry birch forest, growing in open, grassy site within forest.

FESTUCA LENENSIS Drobov
Tatonduk River, N bank of river, W of Funnel Cr.
V0119481 5547 S-facing limestone slope, xeric, sedge-dominated steppe.

HIEROCHLOE ODORATA (L.) P. Beauv.
Kandik River, Johnson Gorge, N bank, at entrance to gorge.
V0119514 5579 Wet mud-silt along river edge.

POA GLAUCA M. Vahl
Kandik River, Johnson Gorge, N bank.
V0119527 5593 Steep, S-facing slope, dry birch forest understory.

Tatonduk River, N bank, W of Pass Cr.
V0119491 5556 Steep, xeric steppe dominated by *Calamagrostis purpurascens* and bare soil.

Tatonduk River, N bank, W of Funnel Cr.
V0119480 5546 S-facing limestone slope, xeric, sedge-dominated steppe.

Polemoniaceae

PHLOX ALASKENSIS Jordal
Tatonduk River, N bank, W of Funnel Cr.
V0119485 5551 S-facing limestone slope, xeric, sedge-dominated steppe.

PHLOX HOODII Richardson
Yukon River, vic. mouth Nation River, hogback ridge upriver from Nation R. mouth.
V0119581 6250 Coarse-grained limestone ridge, dry, SE-facing slope.

Tatonduk River, N bank, W of Funnel Cr.
V0119475 5541 S-facing limestone slope, rock outcrops.

POLEMONIUM ACUTIFLORUM Willd.
Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119455 5521 Steep, E-facing mesic slope, under paper birch and alder.

POLEMONIUM PULCHERRIMUM Hook.
Kandik River, Johnson Gorge, N bank, at entrance to gorge.
V0119522 5587 SE-facing graywacke rubble slope, herbaceous understory of open birch forest.

Polygonaceae

ERIOGONUM FLAVUM Nutt. var. AQUILINUM Rev.

Kathul Mtn., downstream end of west flank of Kathul.
6243 SSE-facing, dry, alluvial gravel bench at top of bluff and outcrops.

Yukon River, vic. mouth Woodchopper Cr., N bank of river.
V0119578 6247 Volcanic rock outcrops along river.

Yukon River, vic. mouth of Webber Cr., N bank of river.
V0119576 6244 S-facing, volcanic rock (pillow basalts) outcrops along river.

Primulaceae

ANDROSACE CHAMAEJASME Host

Tatonduk River, N bank, W of Funnel Cr.
V0119486 5552 S-facing limestone slope, at base of cliff.

DODECATHEON PULCHELLUM (Raf.) Merr.

Tatonduk River, N bank, W of Funnel Cr.
V0119470 5536 Wet sandy river shore, herbaceous vegetation.

DOUGLASIA ARCTICA Hook.

Kathul Mtn.
V0119570 6236 S-facing, xeric, graminoid steppe and rock outcrops.

Yukon River, vic. mouth of Webber Cr., N bank of river.
V0119549 6209 Steep S-facing volcanic rock outcrops and bluffs, growing on rock face.

PRIMULA MISTASSINICA Michaux

Tatonduk River, N bank, W of Funnel Cr.
V0119453 5519 Along edge of wet, sandy river bank.

Tatonduk River, N bank, ca. 3 km above Funnel Cr.
V0119445 5511 Steep bank, moist, shady alder-spruce understory.

Ranunculaceae

ACONITUM DELPHINIFOLIUM DC.

Eagle (Mission) Bluff, 1 km N of Eagle above Mission Cr.
V0119586 6256 SE-facing rubble slopes.

ACTAEA RUBRA (Aiton) Willd.

Kandik River, Johnson Gorge, N bank, near mouth of gorge.
V0119529 5594 Mature white spruce forest understory.

ANEMONE MULTICEPS (E. Greene) Standley

Yukon River, vic. mouth Nation River, hogback ridge upriver from Nation R. mouth.
V0119579 6248 Coarse-grained limestone ridge, SE-facing slope.

Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119461 5527 NW-facing rock faces.

ANEMONE PARVIFLORA Michaux
Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119460 5526 Steep, mesic, E-facing slope.

ANEMONE RICHARDSONII Hook.
Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119454 5520 Damp, shady alder draw in spruce stand, growing in leaf litter.

PULSATILLA PATENS (L.) Miller
Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119462 5528 Steep, mesic E-facing slope.

RANUNCULUS LAPPONICUS L.
Kandik River, NW bank below mouth of Johnson Gorge.
V0119540 5605 Wet, mossy understory of willow-white spruce stand.

Rosaceae

AMELANCHIER ALNIFOLIA (Nutt.) Nutt.
Tatonduk River, N bank, ca. 3 km above mouth.
V0119499 5564 Margins of S-facing xeric steppe slope dominated by *Artemisia frigida*, shale capped by alluvial gravels.

CHAMAERHODOS ERECTA (L.) Bunge
Kathul Mtn.
V0119569 6235 S-facing rock outcrops.

DRYAS ALASKENSIS A. Pors.
Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119459 5525 Steep, mesic, E-facing slope.

DRYAS DRUMMONDII Richardson
Yukon River, vic. mouth of Webber Cr., N bank of river.
V0119551 6211 Steep, S-facing volcanic rock outcrops.

POTENTILLA cf HOOKERIANA
Kathul Mtn.
V0119574 6240 S-facing, xeric, graminoid-dominated steppe.

POTENTILLA FURCATA A.E. Porsild
Tatonduk River, N bank, W of Pass Cr.
V0119495 5560 Steep, S-facing limestone outcrops in aspen-white spruce forest.

POTENTILLA HOOKERIANA Lehm.
Yukon River, Woodchopper Cr., across from creek mouth.
V0119562 6225 S-facing, xeric *Calamagrostis-Artemisia frigida*-dominated steppe slope.

Yukon River, Woodchopper Cr., across from creek mouth.
V0119554 6215 Volcanic rock outcrops along river.

Tatonduk River, N bank, W of Pass Cr.
V0119494 5559 Steep, xeric steppe slope dominated by *Calamagrostis purpurascens* and bare soil.

POTENTILLA NIVEA L.
Yukon River, vic. mouth Nation River, hogback ridge upriver from Nation R. mouth.
V0119584 6253 Coarse-grained limestone ridge, dry, SE-facing, open slope.

Kathul Mtn.
V0119573 6239 S-facing rock outcrops.

POTENTILLA PENSYLVANICA L.
Yukon River, Woodchopper Cr., across from creek mouth.
V0119559 6220 S-facing, xeric *Calamagrostis-Artemisia frigida*-dominated steppe slope.

POTENTILLA UNIFLORA Led, b.
Tatonduk River, N bank, W of Funnel Cr.
V0119474 5540 S-facing limestone slope, rock outcrops.

ROSA WOODSII Lindley
Yukon River, Montauk Bluff.
V0119507 5572 Steep, S-facing xeric steppe dominated by *Artemisia frigida*.

Saxifragaceae

CHRYSOSPLENIUM TETRANDRUM (N. Lund) T. C. E. Fries
Kandik River, Johnson Gorge, N bank, at entrance to gorge.
V0119515 5580 River bank, moist herbaceous understory of alder.

SAXIFRAGA EXILIS Stephan
Kandik River, NW bank below mouth of Johnson Gorge.
V0119543 5608 Wet, mossy understory of willow-white spruce stand.

SAXIFRAGA NELSONIANA D. Don
Kandik River, NW bank below mouth of Johnson Gorge.
V0119541 5606 Wet, mossy understory of willow-white spruce stand.

SAXIFRAGA OPPOSITIFOLIA L.
Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119465 5531 NW-facing rock faces.

SAXIFRAGA REFLEXA Hook.
Kandik River, NW bank below mouth of Johnson Gorge.
V0119539 5604 Moist dirt crevices of boulder slope.

Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119457 5523 Steep E-facing slope, moist micro-sites on rock faces and in birch forest openings.

Scrophulariaceae

PENTSTEMON GORMANII E. Greene
Yukon River, vic. mouth of Webber Cr., N bank of river. across from creek mouth.
V0119548 6208 Steep S-facing volcanic rock outcrops and bluffs, rubble below rock face.

Selaginellaceae

SELAGINELLA SIBIRICA (Milde) Hieron.
Tatonduk River, S bank, ca. 3 km above Funnel Cr.
V0119466 5532 E-facing slope, moist thin soil on rock.

Violaceae

VIOLA BIFLORA L.
Tatonduk River, N bank, vic. of Pass Cr.
V0119497 5562 Steep, moist bank above river bar, in litter under aspen and white spruce.

APPENDIX C

LAND MANAGEMENT AGENCIES AND PRIVATE OWNERS OF AREAS COVERED IN SURVEY OF CATEGORY 2 PLANTS

Sites noted in this report which are within Yukon-Charley Rivers National Preserve and managed by the National Park service include:

Webber Creek area
Woodchopper Creek area
Biederman Bluff
Kathul Mountain
Montauk Bluff
Johnson Gorge, Kandik River
Calico Bluff, summit of bluff

Site managed by Alaska State Division of Natural Resources:

Eagle Bluff

Area owned and managed by Hungwitchin Village Corporation, a member of Doyon, Ltd. include:

Tatonduk River, Funnel Creek
bluffs across from Eagle Village

Area owned and managed jointly by Hungwitchin Village Corporation and Doyon, Ltd. include:

Tatonduk River, Pass Creek area
Tatonduk River, near mouth

Site owned and managed by Doyon, Ltd.:

Hillard Peak

Site owned by private land owner Max Beck:

Calico Bluff (summit area is in Preserve)

NOTE: Private ownership must be respected and those wishing to visit private property should first receive permission from the respective owner(s).