Alaska Natural Heritage Program
Field Report:

Botanical Survey of the Salmon Fork of the Black River, 1991

By

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The objective of this survey was to assist the Bureau of Land Management (BLM) Fairbanks Area Office, in a resource inventory of BLM lands along the Salmon Fork of the Black River. Particular attention was directed towards the identification and description of rare, unique or unusual plants and plant communities.

Alaska Natural Heritage Program (AKNHP) staff, together with University of Alaska Museum staff, provided botanical and plant ecological expertise to the expedition for the stretch of river from the Alaska/Yukon border to Pink Bluff (north of Big Mountain) and neighboring alpine areas of the Keele Range (Figure 1). Specific objectives included:

A. Opportunistically collecting and documenting the vascular and non-vascular plants of these areas.

B. Opportunistically sampling and describing the plant communities of accessible alpine sites and open, south-facing river bluffs.

JUSTIFICATION

The Porcupine Plateau and Ogilvie Mountains Physiograghic Sections between the Porcupine and Yukon Rivers are largely unexplored parts of Alaska. No vegetation descriptions or plant collections had been previously made in the study area. The nearest synecological work comes from studies in the Porcupine River valley 85 mi N-NW (Yarie 1983, Farjon and Bogaers 1985, Howenstein 1993). To the south, the nearest botanical work comes from studies at Kathul Mountain approximately 60 mi S-SW of the Salmon Fork (Edwards and Armbruster 1989). The nearest work in the Yukon Territory is from the Old Crow Flats 85 mi N (Ovenden and Brassard 1989), and from the Nahoni Range of the Ogilvie Mountains 130 mi SE (See and Bliss 1980).

This inventory focused on river bluffs and limestone alpine

sites. The flora of similar sites in this general region contain rare and potentially threatened species, including several taxa endemic to Alaska and the Yukon (Batten et al. 1979). Steep, south-facing bluffs in interior Alaska often support a steppe-like vegetation of Artemisia, grasses and xerophytic herbs. The arid bluffs are prominent features of major rivers in this region that contrast sharply with the surrounding taiga. So-called steppe tundra vegetation is thought to have been predominant across much of Beringia during the cooler and more arid climate of the full glacial period. Bluff communities today may represent isolated remnants, or analogs of this previously widespread vegetation type.

COOPERATORS

Funded by and conducted in cooperation with:	Fairbanks Area Office Bureau of Land Mgmt. Fairbanks, AK 99755 (Winston Hobgood, Project Coordinator)
Bryophyte and lichen collections and identifications:	Dr. Barbara Murray Herbarium, Univ. of Alaska Museum 907 Yukon Dr. Fairbanks, AK 99775

PROCEDURES

Vascular Plant Collections

Representative collections of vascular plants were made from the defined vegetation units. Special attention was paid to extensive surveys of xeric bluff and alpine sites likely to contain rare taxa. All collections are archived at the University of Alaska Herbarium and include descriptions of precise location, habitat, associates and abundance.

A listing of non-vascular plant collections is being prepared separately by Dr. B. Murray.

Ecological Characterization of Plant Communities and Habitats

This inventory focused on locating and describing plant communities occupying unusual habitats or habitats that were of limited extent. Color infra-red (CIR) photography and ground-site observations were used to locate homogeneous vegetation units. For each identified unit, visual estimates of dominant growth

forms and percentage cover for all dominant plants were made, associated species noted, and physical site characteristics described (Appendix A). All vegetation descriptions were completed using releve techniques (Mueller-Dombois and Ellenberg 1974). A series of rapid survey visual prompts was used to aid in the assessment of physical site characteristics. Examples of these prompts are found on the 1991 data sheet in Appendix A. Photographic records were completed for all sites.

Releves (plots) of vegetation data were sorted into plant community types based on site moisture, elevation, physiognomy and location on the landscape, and within these groupings into plant associations using a modified releve sort (Mueller-Dombois and Ellenberg 1974). COENOS, an IBM-PC program for vegetation classification (Ceska and Roemer 1979), was used to create stand association tables as needed for descriptive purposes.

RESULTS

Alpine Habitats

Field work was conducted between June 8 - 20, 1991. A base camp was established in the Keele Mountains on June 8, at 2700 ft ASL (treeline = 2600 ft ASL) on the west side of a saddle 6 miles south of White VABM (Black River USGS 1:250,000 quad). The limited range of the helicopter left our camp approximately 5 miles south of the primary alpine limestone habitat area (Figures 1, 2).

A reconnaissance was conducted to the north on June 9 to access the primary alpine limestone area and assess the variability of habitats we might anticipate within range of camp. Survey sites are documented in Figures 1, 2 and 3. A late spring snow storm limited field work during the following two days, but various alpine habitats were sampled during the last three days prior to moving to the Salmon Fork.

General Description of Alpine Habitats

No rare, unique or unusual Alaskan plant communities were found in the study area. A list of major habitats and commonly associated vegetation types are found in Table 1. Species composition and photos are provided in Appendix B.

Rounded peaks in the immediate vicinity of camp consisted of boulder piles with a dense cover of lichens, principally black, foliose Umbilicaria and green, crustose Rhizocarpon species (Plates 1, 2). These slopes appeared dark-gray to black on the CIR imagery. Moist pockets and solifluction stripes provided

stability and moisture to support a mix of non-calciphilous alpine and subalpine shrubs and herbs, primarily Betula glandulosa, Spiraea stevenii and Dryopteris fragrans. Other common species included Salix phlebophylla, Anemone narcissiflora, Saxifraga tricuspidata, Epilobium angustifolium, Douglasia ochotensis, Hierochloe alpina and Festuca altaica.

Nonvegetated, exposed, rubble summit ridges and talus slopes graded into vegetated mountain benches and saddles that appeared white and speckled pink on the CIR imagery. The dominant vegetation type in these areas was a hummocky, Wet, Betula occidentale-Salix spp.-Eriophorum vaginatum-Carex bigelowii Mixed Low-Shrub Tussock Tundra (Appendix B, S4; Plate 4). A Moist, Betula occidentale Low Shrub Tundra community occupied long, narrow, shallow depressions running parallel to the lower mountain slopes. These radiated out from the saddles and extended to Moist and Wet Salix spp. Tall Shrub communities at treeline.

Well-defined stone stripes occupied the saddle in the immediate vicinity of base camp and were common in other parts of the study area. Vegetated ridges within these complexes were covered by a species-rich Mixed, Dwarf Shrub Tundra type (Appendix B, S3A).

A well-developed, bouldery stone net occurred on the plateau immediately south of camp. The dwarfed, vegetated portion between the frost-rived ridges was a Moist, Dwarf Shrub, Fruticose/Foliose Lichen Tundra (Appendix B, S2A; Plate 3).

Alpine Limestone Substrates

Most of the vegetation types identified in Table 1 occurred on circumneutral to acidic substrates. Two rather dramatic geological contacts - one at 1600 ft ASL to the west below camp (Plate 9) and a second approximately 4 miles north of camp (Plates 5, 6) - separated these circumneutral to acidic sites from strikingly pure-white carbonate substrates.

Of particular interest to the AKNHP were these limestone habitats that characterize the Ogilvie Mountain extension into Alaska from the Yukon Territory. The abrupt limestone contact 4 miles north of camp and just south of White VABM was briefly visited late on the first day's reconnaissance. It was a very blocky, bouldery area and difficult to traverse (Plates 5, 6). Numerous rock outcrops occurred along the ridgeline within the saddle; the sparse vegetation cover was characterized by numerous calciphiles (Appendix B, S1).

With increasing elevation, the blocky nature of the limestone substrate saddles gave way to rubbly scree slopes and fellfields variously barren of vegetation or characterized by stone stripes. Vegetated portions of the stone stripes were dominated by a Dryas

octopetala-Carex rupestris-Carex glacialis, Dwarf Shrub Sedge Tundra (Appendix B, S5; Plates 7, 8).

Because of the early snowstorms and distance to the White Mountain VABM sites, more time was devoted to characterizing these typic, carbonate habitats closer to base camp. Below camp, a narrow, exposed ridge consisting of finely fragmented limestone rubble extended from treeline downslope into the surrounding boreal forest (Figure 2; Plates 9-11). Numerous outcrops were found along the ridgeline. Seventeen releves were completed and a stand association table was constructed to characterize this limestone habitat (Table 2).

The ridge site was variously barren of vegetation or covered by an Open, Dry, Dwarf Shrub, Sedge, Lichen Tundra (Plates 10-12). Dominant species included: Dryas octopetala, Carex rupestris, Carex glacialis, Carex scirpoidea, Cetraria nivalis, C. cucullata, various crustose lichen species, Dicranum spp., Rhytidium rugosum, and Hypnum spp. Different species groups associated with differences in aspect and elevation are noted in Table 2. Lesquerella calderi, a species new to Alaska, was prevalent throughout the limestone habitats.

River Bluff Habitats

One of the reasons for our interest in surveying the flora and vegetation of the Salmon Fork of the Black River is the existence of many large, steep, south-facing bluffs along the river. Similar sites (as noted in the Justification) in other portions of the unglaciated Yukon, Tanana and Porcupine drainages support rare or unusual vascular and non-vascular plant species on xeric slopes, often as part of a steppe or steppe-like community. Many of these taxa are endemic to the area, or widely disjunct in their distribution, and may represent remnants of a once more widespread flora and vegetation. Vegetation on these steppic slopes varies from site to site, but constant signature species usually include Artemisia frigida and various dry-site grasses and sedges such as Pseudoroegneria spicata, and Calamagrostis purpurascens.

Along the Salmon Fork, bluffs are concentrated in the upper section, down as far as Pink Bluff, just past the mouth of Runt Creek (Figure 3). We were able to float this section of the river (from the Canadian border to Pink Bluff) between 14 and 20 June 1991. Unfortunately, due to changes in helicopter schedules, the plant ecologist was unable to accompany us on this section of the trip. With the limited time available we concentrated on extensive collecting and floristic investigations, conducting only limited, descriptive, plant community work, as represented in the following brief notes.

General Description

Bluffs along the Salmon Fork, from the Canadian border to Pink Bluff, may be divided into three main types: 1) steep, south- and east-facing rubble slopes, of shale-like, circumneutral to slightly carbonitic rock; 2) steep, south- to southeast-facing calcareous slopes with rock outcrops and silty or sandy soils; and 3) steep, north- to northeast-facing calcareous slopes. Site numbers in the following descriptions refer to the numbered collection sites on Figures 3 and 4.

Type 1: Rubble Slope bluffs (Sites 16-20, Plates 13, 14)

Rubble Slope bluffs predominate along the upper section of the river, and were the only type of south-facing bluff seen until we reached the bluffs across from the John Roberts Cabin site (as marked on the USGS topographic quadrangle). The steep (30-45‘), excessively well-drained slopes consisted of fractured, shale-like rubble. Vegetation cover was sparse (usually less than 15%, often less than 5% cover) and consisted of dry, open low-shrub and dry, graminoid herbaceous communities. Visually, the most prominent species were Artemisia alaskana, Dryopteris fragrans, various xeric grasses, and (locally) Papaver nudicaule ssp. americanum. Artemisia frigida was notable in its absence from all of these sites. Few, if any, of the taxa on these sites could be called strong calciphytes, and most of the flora consisted of a combination of xeric- and lithic-site species derived from the surrounding alpine and boreal flora, as well as several species apparently restricted to bluff slopes (at least in this region). Several of the taxa, e.g. Dryopteris fragrans, Saxifraga tricuspidata, Selaginella sibirica, were prominent species on non-calcareous blockfields and talus slopes on the alpine ridges just north of the river. Typical stands were characterized by:

Artemisia alaskana
Dryopteris fragrans
Woodsia ilvensis
Papaver nudicaule ssp. americanum
Pseudoroegneria spicata
Calamagrostis purpurascens
Poa glauca
Saxifraga tricuspidata
Selaginella sibirica

Selaginella sibirica had the highest constancy of all the species and was common to abundant in nearly all stands at every site. Other common species included:

Juniperus communis
Campanula aurita
Solidago multiradiata
Epilobium angustifolium
Senecio ogotorukensis
Arnica angustifolia

Smaller bluffs, or bluffs with more fines, contained little or no Dryopteris. Interspersed with the above listed steep, xeric stands were stabilized, lower angle, mesic stands containing an open woodland of Betula papyrifera, Populus tremuloides, Viburnum edule, and Rosa acicularis.

Although the communities of these Type 1 bluffs represent an unusual vegetation complex (apparently undescribed) they are probably not uncommon at similar sites in the interior, especially where rubble slopes are located near the alpine. The unusual floristic elements of interior steppic bluffs would not be expected at these sites.

Type 2: Calcareous bluffs with silty or sandy soils (sites 22 - 25, 27, Plates 15-19)

Type 2 Calcareous bluffs were found across the river from the John Roberts Cabin site (as marked on the USGS topographic quadrangle). Due to a lack of time, only the easternmost of these bluffs were examined. There is a far larger exposure of Type 2 bluffs just down river from the mouth of Drifting Snow Creek that should be investigated in the future.

Type 2 Calcareous bluffs are characterized by steep (32-35‘), south-facing dry slopes with fine, silty to sandy, calcareous soils and numerous rock outcrops. Vegetation cover was sparse, usually less than 15%. In contrast to Rubble Slope bluffs, Calcareous bluffs were notable for their complete lack of Selaginella sibirica and Dryopteris fragrans (or any other ferns); Papaver nudicaule ssp. americanum was rare or absent.

The most exposed, xeric portions of these bluffs (south- or southeast-facing; Plates 16, 17) contained a dry, open grassland with a graminoid herbaceous community of:

Pseudoroegneria spicata
Calamagrostis purpurascens
Artemisia alaskana
Juniperus communis
Lesquerella arctica
Zygadenus elegans
Bupleurum americanum

Other common species included:

Carex glacialis
C. filifolia
Potentilla arenosa
Dryas crenulata
Solidago multiradiata
Senecio ogotorukensis
Campanula aurita
Penstemon gormanii
Saxifraga tricuspidata
S. reflexa
Torularia humilis
Gastrolychnis ostenfeldii

These xeric, calcareous sites lacked Artemisia frigida, but did share other elements of steppe bluff sites along the Yukon, Tanana, and Porcupine Rivers. Although none of the rare species associated with those steppe bluffs were found here, the larger exposures of bluffs found just downriver (near Drifting Snow Creek; Plate 18) still need to be investigated, and are the most likely of any of the bluffs along the Salmon Fork to contain these rare taxa. It is interesting that although Lesquerella calderi was the only Lesquerella found on the calcareous alpine sites of the Keele Range, it is apparently replaced by the more common L. arctica on the bluff sites.

One site (#27, on the southeast-facing exposure of Pink Bluff above Runt Creek; Plate 19) was noteworthy in that it was the only bluff site investigated that had Artemisia frigida, rather than A. alaskana. This site was on a very dry, moderately steep slope (30-33°) just below the crest of a rocky ridge. The community was a dry, graminoid herbaceous grassland characterized by:

Artemisia frigida
Dryas crenulata
Juniperus communis
Saxifraga tricuspidata
Potentilla arenosa
Pseudoroegneria spicata
Calamagrostis purpurascens
Pulsatilla patens

Southwest exposures of Type 2 bluff slopes were better vegetated and not as dry, often consisting of open grassland and low-shrub herbaceous communities on old burns of spruce woodland (Plate 15). Prominent species included:

Carex glacialis
C. scirpoidea
Calamagrostis purpurascens
Festuca altaica

Arctostaphylos uva-ursi
Arctous alpina
Salix glauca
Pentaphylloides floribunda
Shepherdia canadensis
Pulsatilla patens
Anemone parviflora
Mertensia paniculata
Bupleurum americanum

Type 3: North-facing Slopes (sites 26, 29, Plates 20, 21)

Steep, northwest- to northeast-facing slopes were sampled on the east end of the Pink Bluff exposure (above Runt Creek) as well as at the westernmost end of this bluff. The slopes were slightly moister and less steep (~25-30‘) than the south-facing bluff slopes. Surface material consisted of rock outcrops and stabilized, calcareous talus with more than 15% cover of vegetation. Type 3 North-facing Slopes, in contrast to the other bluff types, often had substantial cover of fruticose lichen species. Vegetation consisted of dry, graminoid herbaceous communities characterized by:

Festuca altaica
Calamagrostis purpurascens
Carex scirpoidea
C. glacialis
Dryas crenulata
Saxifraga tricuspidata
S. reflexa
Papaver nudicaule ssp. americanum

Other common species included:

Woodsia glabella
Anemone parviflora
Torularia humilis
Senecio ogotorukensis
Campanula aurita
Parrya nudicaulis ssp.septentrionalis
Cypripedium guttatum ssp. guttatum

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APPENDIX B. List and description of the common alpine tundra plant communities of the Salmon Fork of Black River.

Cover Classes:

1 1 individual
2 <5 (few, seldom individuals)
3 <5 (many individuals)
4 6-25%
5 26-50%
6 51-75%
7 76-100%

* = Dominant species where cover classes were not determined.

S1

Plate No: 5

Physiognomic Type: Dwarf Shrub Sedge Tundra

Dominant Species: Dryas octopetala-Carex spp.

Habitat: Dry, blocky, bouldery saddle with numerous rock outcrops; limestone substrate.

Plant Growth Form (% Cover): not noted

Dwarf Shrub		Moss	
Sedge		Fruticose/Foliose Lichen	
Grass		Crustose Lichen	
Graminoid		Bare Soil/Rock	
Forb			

Vascular Plants, Bouldery Saddle:

Silene acaulis		Salix reticulata	
Androsace chamaejasme		Papaver spp.	
Toffieldia coccinea		Saxifraga oppositifolia	
Minuartia arctica		Eritrichium aretioides	
Carex rupestris		Carex scirpoidea	
Dryas octopetala		Oxytropis jordalii	
Potentilla biflora		Saussurea angustifolia	
Cardamine pratensis		Campanula lasiocarpa	
Anemone parviflora			

Vascular Plants on Rock Outcrops:

Dryas octopetala	Anemone drummondii
Carex rupestris	Thalictrum alpinum
Carex scirpoidea	Torularia humils
Carex glacialis	Erigeron spp.
Lesquerella calderi	Potentilla biflora
Phlox alaskensis	

Dominant Lichens and Mosses: not recorded.

S2A

Plate No: 3

Physiognomic Type: Moist, Dwarf Shrub, Fruticose/Foliose Lichen Tundra

Dominant Species: Betula occidentale-Anemone narcissiflora-Hierochloe alpina-Cetraria cucullata-Alectoria ochroleuca-Asahinea chrysantha

Habitat: Vegetated portion of stone nets; circumneutral-acidic substrates.

Plant Growth Form (% Cover):

Dwarf Shrub	46%	Moss	15%
Sedge	2%	Fruticose/Foliose Lichen	2%
Grass	2%	Crustose Lichen	10%
Graminoid	1%	Bare Soil/Rock	16%
Forb	4%		

Vascular Plants:

Betula occidentale	5	Pedicularis labradorica	1
Dryas octopetala	2	Arctostaphylos alpina	1
Anemone narcissiflora	2	Vaccinium uliginosum	1
Hierochloe alpina	2	Pedicularis lanata	1
Salix phlebophylla	2	Minuartia arctica	1
Lupinus arcticus	1	Douglasia ochotensis	1
Ledum decumbens	1	Luzula confusa	1
Carex microchaeta	1	Vaccinium vitis-idaea	1
Campanula lasiocarpa	1		

Dominant Lichens:

Cetraria nivalis	Asahinea chrysantha*
C. cucullata*	Stereocaulon spp.
Alectoria ochroleuca*	Cladonia spp.
Cladina spp.	Alectoria spp.
Thamnolia spp.	

Dominant Mosses:

Rhytidium rugosum*	Polytrichum juniperinum
Dicranum spp.	Bryum spp.

S2B

Plate No: 3

Physiognomic Type: Rocky, Barren Tundra

Dominant Species: Various crustose and foliose/fruticose lichens

Habitat: Frost-rived portion of stone nets; boulders 6-20 inches in diameter; circumneutral-acidic substrate.

Plant Growth Form (% Cover):

Dwarf Shrub		Moss	
Sedge		Fruticose/Foliose Lichen	40%
Grass		Crustose Lichen	40%
Graminoid		Bare Soil/Rock	20%
Forb			

Vascular Plants:

Campanula lasiocarpa*		Luzula confusa	
Douglasia ochotensis*		Vaccinium vitis-idaea	
Minuartia arctica*		Artemisia arctica	
Selaginella sibirica*		Arctostaphylos alpina	
Antennaria friesiana*		Carex microchaeta	
Dryas octopetala		Pedicularis oederi	
Hierochloe odorata		Anemone narcissiflora	

Dominant Lichens:

Umbilicaria spp.*	Cladonia spp.
Rhizocarpon spp.*	Thamnolia spp.
Parmelia spp.	Cornicularia spp.
Alectoria spp.	Cetraria laevigata
Asahinea chrysantha	Cladina spp.
Cetraria nivalis	

Dominant Mosses:

Rhacomitrium lanuginosum	

S3A

Plate No: none

Physiognomic Type: Moist, Dwarf Shrub, Moss Tundra

Dominant Species: Salix planifolia ssp. pulchra-Salix reticulata-Salix arctica-Betula occidentale-Dryas octopetala-Aulacomnium turgidum-Rhytidium rugosum-Hylocomium splendens

Habitat: Vegetated stone stripe troughs in mountain saddles; circumneutral-acidic substrates; very species-rich site.

Plant Growth Form (% Cover):

Dwarf Shrub	40%	Moss	80%
Sedge	10%	Fruticose/Foliose Lichen	20%
Grass	3%	Crustose Lichen	5%
Graminoid	5%	Bare Soil/Rock	
Forb	15%		

Vascular Plants:

Salix planifolia ssp. pulchra	5	Arctostaphylos alpina	3
Betula occidentale	5	Anemone narcissiflora	3
Salix reticulata	4	Senecio atropurpureus	3
Dryas octopetala	4	Empetrum nigrum	3
Salix arctica	4	Oxytropis maydelliana	3
Ledum decumbens	4	Rhododendron lapponicum	3
Salix glauca	4	Oxytropis nigrescens	3
Carex bigelowii	3	Saxifraga punctata	2
Vaccinium uliginosum	3	Bistorta vivipara	2
Lagotis glauca	3	Eriophorum triste	2
Pedicularis langsdorffii	3	Pyrola spp.	2

Pedicularis oederi	3	Minuartia arctica	2
Pedicularis lapponicus	3	Antennaria compacta	2
Pedicularis capitata	3	Saxifraga hieracifolia	2
Lupinus arcticus	3	Stellaria spp.	2
Equisetum varigatum	3	Carex spp.	1
Hierochloe odorata	3	Picea glauca	1

Dominant Lichens:

Cetraria cucullata	C. richardsoni
C. nivalis	Cladonia spp.

Dominant Mosses:

Aulacomnium turgidum*	Dicranum spp.
Rhytidium rugosum*	Tomenthypnum nitens
Hylocomium splendens*	

S3B

Plate No: none

Physiognomic Type: Barren Tundra

Dominant Species:none

Habitat: Largely unvegetated, frost-rived, stone stripes in mountain saddles; circumneutral-acidic substrates.

Plant Growth Form (% Cover):

Dwarf Shrub	15%	Moss	5%
Sedge	5%	Fruticose/Foliose Lichen	15%
Grass		Crustose Lichen	10%
Graminoid		Bare Soil/Rock	75%
Forb	10%		

Vascular Plants:

Salix reticulata	1	Saussurea angustifolia	1
Salix phlebophylla	1	Vaccinium vitis-idaea	1
Dryas octopetala	1	Anemone narcissiflora	1
Lloydia serotina	1	Carex bigelowii	1
Toffieldia coccinea	1	Pedicularis langsdorffii	1
Petasites frigidus	1	Lupinus arcticus	1
Eriophorum vaginatum	1	Luzula spp.	1

Dominant Lichens: none recorded

Dominant Mosses: none recorded

S4

Plate No: 4

Physiognomic Type: Hummocky, Wet, Mixed Low Shrub, Tussock Sedge Tundra

Dominant Species: Betula occidentale-Salix reticulata-Salix planifolia ssp. pulchra-Eriophorum vaginatum-Carex bigelowii

Habitat: Mountain foot slopes and benches above treeline; circumneutral-acidic substrate.

Plant Growth Form (% Cover):

Dwarf Shrub	30%	Moss	40%
Sedge	10%	Fruticose/Foliose Lichen	5%
Grass	5%	Crustose Lichen	
Graminoid		Bare Soil/Rock	
Forb	10%		

Vascular Plants:

Eriophorum vaginatum	7	Carex bigelowii	3
Betula occidentale	5	Dryas crenulata	2
Vaccinium vitis-idaea	4	Rhododendron lapponicum	2
Salix reticulata	4	Eriophorum triste	2
Salix planifolia ssp. pulchra	4	Saxifraga hieracifolia	2
Ledum decumbens	3	Senecio atropurpureus	2
Anemone narcissiflora	3	Poa arctica	2
Arctostaphylos rubra	3	Pedicularis spp.	2
Lupinus arcticus	3	Picea glauca	1
Bistorta vivipara	3	Carex spp.	1
Cassiope tetragona	3	Pyrola asarifolia	1

Pedicularis oederi	3	Luzula kjellmaniana	1
Empetrum nigrum	3	Oxytropis borealis	1

Dominant Lichens:

Cetraria cucullata*	Peltigera aphthosa*
Cladina spp.*	

Dominant Mosses:

Hylocomium splendens*	Tomenthypnum nitens
Aulacomium turgidum*	Sphagnum spp.
Dicranum spp.	

S5

Plate No: 7, 8

Physiognomic Type: Dry Dwarf Shrub, Sedge Tundra

Dominant Species: Dryas octopetala-Carex rupestris-Carex glacialis

Habitat: Vegetated portion of stone stripes; bouldery and rubbly foot slopes, benches and summit plateaus; limestone substrate south of White VADM.

Plant Growth Form (% Cover):

Dwarf Shrub	45%	Moss	10%
Sedge	10%	Fruticose/Foliose Lichen	10%
Grass		Crustose Lichen	
Graminoid		Bare Soil/Rock	
Forb	3%		

Vascular Plants:

Dryas octopetala	5	Senecio resedifolius	1
Carex rupestris	3	Minuartia spp.	1
Carex glacialis	3	Pedicularis capitata	1
Thalictrum alpinum	3	Pinguicula vulgaris	1
Androsace chamaejasme	3	Lloydia serotina	1
Lesquerella calderi	3	Arctogrostis latifolia	1
Carex scirpoidea	3	Antennaria compacta	1
Pedicularis lanata	3	Torularia humils	1
Anemone drummondii	3	Papaver spp.	1
Lupinus arcticus	2	Draba porsildii	1
Silene acaulis	2	Carex misandra	1
Minuartia arctica	2	Antennaria friesiana	1
Anemone narcissiflora	2	Chrysanthemum integrifolium	1

Saxifraga oppositifolia	2	Festuca altaica	1
Rhododendron lapponicum	2	Poa alpina	1
		Phlox alaskensis	1
Eritrichium aretioides	1		

Dominant Lichens:

Cetraria tilesii*	Cetraria cucullata
Cetraria nivalis	

Dominant Mosses: Species not recorded

APPENDIX C. Vascular plant collections, Black River 1991.

The following list of collections is arranged alphabetically by family, genus, and species within the broad phylogenetic groups of pteridophytes (ferns and fern allies), gymnosperms (conifers), monocotyledons (including grasses, sedges, rushes, orchids and lillies), and dicotyledons (including the remaining flowering plants). Nomenclature generally follows that used by the Northern Plant Documentation Center, University of Alaska Herbarium, Fairbanks. Where this differs from Hultén 1968, I have included Hultén's name for the taxon in square brackets []. (The = sign, as used here, refers only to Hulten's use of the name, and does not imply accepted synonymy.) Common names largely follow Welsh 1974, and are not complete.

Please note that this list does not represent the complete flora of the area, but only those taxa that were collected during our investigations. Many of the more common species such as white and black spruce, cotton grass, and fireweed were not collected and are not listed. Our collections concentrated on the steep, south-facing bluffs along the Salmon Fork of the Black River and the alpine fellfields and calcareous outcrops and screes of the Keel Mountains. Range extensions are marked with **, the most significant of these being Lesquerella calderi (first record for Alaska) and Draba porsildii. Additional species will, no doubt, be added to this list when further exploration is done.

Collection sites and collection numbers are noted below each name in the format: **Site ## (collection ##-##)**. Collection numbers run from 91-1 through 91-236 (the prefix '91' indicating the year of collection), with multiple collections from the same site separated by commas. The location of each site is shown on the maps in Figures 3 and 4.

All collections are archived at the herbarium of the University of Alaska Museum, Fairbanks. Specimens of the genera Draba and Lesquerella were determined or verified by G. A. Mulligan, Canada Department of Agriculture, Ottawa.

EQUISETACEAE
(Horsetail Family)

EQUISETUM ARVENSE L. — Meadow Horsetail

Site 12 (91-111). Abundant in moist non-calcareous alpine tundra, and other moist sites.

SELAGINELLACEAE
(Spikemoss Family)

SELAGINELLLA SIBIRICA (Milde) Hieron. — Northern Selaginella

Site 9 (91-95, 91-136). Abundant in rocky alpine tundra, and on south-facing rubble slopes along the Salmon Fork of the Black River; apparently not calciphilous.

ASPLENIACEAE
(Spleenwort Family)

**ASPLENIUM VIRIDE Hudson — Green Spleenwort

Site 26 (91-213b). Rare on west-facing calcareous slope. Range extension.

CYSTOPTERIS FRAGILIS (L.) Bernh. — Fragile Fern

Sites 5 (91-44, 91-49b); 28 (91-224). Occasional in crevices of calcareous rock outcrops and cliffs.

DRYOPTERIS FRAGRANS (L.) Schott — Fragrant Shield-fern

Sites 11 (91-106); 17 (91-148). Common to dominant on talus and rubble slopes, usually on acidic or non-calcareous slopes.

WOODSIA GLABELLA R. Br. — Smooth Woodsia

Sites 5 (91-43, 91-49); 6 (91-134); 24 (91-196). Rare to scattered on dry calcareous ridges and bluff slopes.

**WOODSIA ILVENSIS (L.) R. Br. — Rusty Woodsia

Site 17 (91-150). Locally common on one dry, south-facing bluff and rubble slope. Range extension.

CUPRESSACEAE
(Cypress Family)

JUNIPERUS COMMUNIS L. — Common Juniper

Site 6 (91-65). Occasional on dry, open, south-facing slopes.

POACEAE
(Grass Family)

CALAMAGROSTIS PURPURASCENS R. Br. ssp. PURPURASCENS — Purple Reedgrass

Site 6 (91-68, 91-71). Common to abundant on dry, south-facing slopes below the alpine. In open low-shrub graminoid, and graminoid forb meadows on nearly all bluffs.

FESTUCA ALTAICA Trin.

Site 22 (91-200). Common in moist pockets of rocky mountain slopes and on blocky talus slopes. Occasionally on dry calcareous fellfields and in open grasslands of dry calcareous bluffs, especially in old burns.

POA ALPINA L. — Alpine Bluegrass

Site 6 (91-74). Occasional in dry, grass forb meadows.

POA GLAUCA M. Vahl — Glaucous Bluegrass

Site 6 (91-75); 14 (1-127); 17 (91-144); 18 (91-158, 91-160). Common on most dry, calcareous, south-facing slopes, especially in grasslands.

PSEUDOROEGNERIA SPICATA (Pursh) LÖVE — Bluebunch Wheatgrass
[= Agropyron spicatum (Pursh) Scribn. & Sm.] (also as Elytrigia spicata (Pursh) D. R. Dewey)

Site 18 (91-159); 24 (91-198); 27 (91-222). Common to abundant on all xeric, calcareous, south-facing bluffs. A typical species of these grassland or steppic sites.

CYPERACEAE
(Sedge Family)

CAREX FILIFOLIA Nutt. — Thread-leaf Sedge

Site 23 (91-189b). Rare on dry, south-facing bluff.

CAREX GLACIALIS Mackenzie — Glacier Sedge

Site 2 (91-10); 4 (91-15); 5 (91-128); 22 (91-188); 23 (91-189a); 24 (91-197); 26 (91-216). Common to abundant on dry, calcareous scree slopes, outcrops, and bluffs.

CAREX MICROCHAETA Holm

Site 13 (91-118). Tentative identification of an immature specimen; rare on moist turf of calcareous rock stripes.

CAREX MISANDRA R. Br. — Short-leaf Sedge

Site 13 (91-126). Uncommon on dry, calcareous, alpine screes and rock stripes.

CAREX NARDINA Fries

Site 5 (91-90). Rare on dry, calcareous alpine screes.

CAREX PETRICOSA Dewey

Sites 6 (91-72; 91-73); 8 (91-23). Locally common on dry solifluction slopes, sandy grasslands, and turfy patches of calcareous ridges. This species is closely related to C. franklinii Boot, from which our specimens are tentatively distinguished.

CAREX RUPESTRIS All. — Rock Sedge

Site 2 (91-9). Uncommon on calcareous outcrops.

CAREX SCIRPOIDEA Michaux

Site 5 (91-17); 8 (91-28); 22 (91-187). Common on calcareous slopes and outcrops.

CAREX VAGINATA Tausch — Sheathed Sedge

Site 12 (91-115). Rare in moist, non-calcareous alpine tundra.

JUNCACEAE
(Rush Family)

LUZULA CONFUSA Lindeb. — Northern Woodrush

Site 9 (91-101). Occasional in moist, non-calcareous, stony alpine tundra, and rocky, exposed areas.

LUZULA KJELLMANIANA Miyabe & Kudo
[= L. tundricola Gorodk.]

Site 12 (91-116). Common in moist to wet, mixed low-shrub, tussock sedge tundra on alpine benches.

LILIACEAE
(Lily Family)

LLOYDIA SEROTINA (L.) Reichb. Alp Lily

Site 5 (91-50). Rare in stony alpine tundra.

TOFIELDIA COCCINEA Richardson Northern Asphodel

Site 8 (91-25, 91-32). Occasional on open screes of calcareous ridges and in open woodlands just below treeline with calcareous soil.

ZYGADENUS ELEGANS Pursh Elegant Death Camas

Sites 4 (91-16); 6 (91-76); 22 (91-178). Common on south- facing bluffs and slopes with xeric grasslands; also occasional on carbonate screes.

ORCHIDACEAE
(Orchid Family)

AMERORCHIS ROTUNDIFOLIA (Banks) Hultén Round-leaf Orchis

Site 29 (91-229). Rare (only seen once); in moist to wet calcareous soils of open white spruce woodland atop a bluff.

CYPRIPEDIUM CALCEOLUS L. ssp. PARVIFLORA (Salisb.) Hultén
Yellow Lady's-slipper

Site 6 (91-66). Locally common (but only seen at one site), in sandy, well drained, calcareous soils of south facing slopes with open spruce-aspen woodland, just below treeline.

CYPRIPEDIUM GUTTATUM Sw. ssp. GUTTATUM Spotted Lady's-slipper

Site 26 (91-214); 29 (91-236). Only seen at two sites, but locally common there in moist, well-drained, rocky, calcareous soils. In open spruce woodlands or dry meadows on bluff slopes.

APIACEAE
(Carrot Family)

BUPLEURUM AMERICANUM Coult. & Rose — Thorough-wort
[=B. triradiatum J. Adams ssp. arcticum (Regel) Hultén]

Site 22 (91-177). Common on south-facing bluff slopes along river.

ASTERACEAE
(Aster Family)

ANTENNARIA COMPACTA Malte [= A. friesiana (Trautv.) Ekman ssp. compacta (Malte) Hult.]

Site 6 (91-80). Locally common on solifluction soil of south-facing xeric slope.

**ANTENNARIA DENSIFOLIA Porsild
[= A. friesiana (Trautv.) Ekman ssp. compacta (Malte) Hult.]

Site 8 (91-34). Common; forming mats on open soil of calcareous ridge. Range extension.

ANTENNARIA FRIESIANA (Trautv.) Ekman

Site 9 (91-98). Common in dry to moist alpine tundra.

ARNICA ANGUSTIFOLIA M. Vahl
[= A. alpina (L.) Olin ssp. angustifolia (M. Vahl) Maguire]

Site 6 (91-70); 18 (91-155, 91-165). Common on dry south-facing rubble slopes and subalpine meadows; often calcareous.

ARNICA GRISCOMII Fern. ssp. FRIGIDA (C. Meyer ex Iljin) S. J. Wolf

Site 17 (91-143). Locally common on dry south-facing rubble slope.

ARTEMISIA ALASKANA Rydb. — Alaskan Wormwood

Sites 17 (91-147); 18 (91-163); 22 (91-204). Common to dominant on xeric, steep, south-facing rubble slopes and bluffs along the Salmon Fork.

ARTEMISIA ARCTICA Less. ssp. ARCTICA

Site 9 (91-100). Common in moist to dry alpine tundra.

ARTEMISIA FRIGIDA Willd. — Prairie Sagewort

Site 27 (91-220). This signature species of steppic vegetation was almost entirely absent from the south-facing bluffs that were investigated along the Salmon Fork. It was seen at only one small, rocky, site near the top of the east shoulder of Pink Bluff.

CHRYSANTHEMUM INTEGRIFOLIUM Richardson

Site 13 (91-121). Very rare on calcareous rock stripes.

CREPIS ELEGANS Hook. Elegant Hawk's-beard

Site 25 (91-210). Uncommon, in sand depressions on gravel bars along Salmon Fork.

ERIGERON HYPERBOREUS E. Greene

Sites 2 (91-7); 5 (91-88, 91-129); 7 (91-56); 8 (91-26). Common on calcareous alpine screes and outcrops.

SAUSSUREA ANGUSTIFOLIA (Willd.) DC.

Site 29 (91-233). Occasional in open understory of moist spruce woodland on top of bluff.

SENECIO ATROPURPUREUS B. Fedtsch. ssp. FRIGIDUS (Richardson) Hultén

Site 12 (91-108). Common in moist alpine tundra.

SENECIO LUGENS Richardson

Site 29 (91-232). Occasional in open understory of spruce woodlands.

SENECIO OGOTORUKENSIS Packer
[= S. conterminus Greenm.]

Sites 6 (91-78); 17 (91-145, 91-151); 18 (91-167); 20 (91-169); 22 (91-182, 91-183, 91-202); 24 (91-195); 26 (91-219). Common on xeric bluffs and rubble slopes.

SENECIO RESEDIFOLIUS Less.

Sites 5 (91-84); 7 (91-55). Scattered on dry calcareous screes and outcrops.

SOLIDAGO MULTIRADIATA Aiton Northern Goldenrod

Site 22 (91-180). Scattered to common on dry bluffs.

BETULACEAE

BETULA OCCIDENTALIS Hook. Water Birch

Site 9 (91-93). Occasional in moist non-calcareous alpine sites.

BORAGINACEAE
(Borage Family)

ERITRICHIUM ARETIOIDES (Cham.) DC.

Sites 3 (91-11); 5 (91-52, 91-87). Common to abundant on dry calcareous screes and outcrops.

ERITRICHIUM SPLENDENS Kearney Showy Forget-me-not

Sites 5 (91-82); 8 (91-19). Common to abundant on dry calcareous screes and outcrops. An interesting Alaskan endemic and one of the typical species of these sites.

MERTENSIA PANICULATA (Aiton) G. Don var. PANICULATA

Site 6 (91-60). Common in spruce woodlands.

MERTENSIA PANICULATA (Aiton) G. Don var. ALASKANA (Britton) L.O. Williams

Sites 16 (91-156); 21 (91-171). Common in spruce woods and riparian meadows; endemic to Alaska and the Yukon.

BRASSICACEAE
(Mustard Family)

ARABIS HIRSUTA (L.) Scop. Hairy Rockcress

Site 24 (91-192). Rare, on bare, disturbed soil of dry bluff. A minor range extension; also known from the Porcupine R. to the north.

CARDAMINE PRATENSIS L. Cuckoo Flower

Site 28 (91-224). Rare to occasional in moist to wet sites along the river.

DESCURAINIA SOPHIA (L.) Prantl Tansy Mustard

Site 28 (91-225) Rare, seen at one site, at base of cliff along

the Salmon Fork.

**DRABA PORSILDII G. A. Mulligan

Sites 5 (91-46); 9 (91-96); 13 (91-123); 17 (91-141, 91-153); 18 (91-166). Occasional to common on calcareous outcrops, alpine screes, and river bluffs. Previously known in Alaska from only two locations, this endemic of western Canada was the only draba found at our sites.

ERYSIMUM CHEIRANTHOIDES L. Wormseed

Site 16 (91-154a). Common on the lower slopes and meadows of some bluffs along the Salmon fork.

ERYSIMUM PALLASII (Pursh) Fern. Pallas Wallflower

Sites 17 (91-140, 910152). Occasional on steep xeric rubble slopes and bluffs.

EUTREMA EDWARDSII R. Br.

Site 1 (91-1). Rare. Seen only once in wet frost scar of alpine shrub heath.

LESQUERELLA ARCTICA (Wormsk.) S. Watson

Site 22 (91-179). Common on dry bluff slopes. This is the common bladderwort found on dry slopes and alpine screes over the rest of Alaska. Here it is apparently restricted to the dry bluffs along the rivers, and is absent from the calcareous screes in the alpine, where it is replaced by the closely related L. calderi.

**LESQUERELLA CALDERI G.Mulligan & A. Pors.

Sites 2 (91-4); 4 (91-39) 5 (91-89); 8 (91-37). First record for Alaska; this species was previously known only from the Yukon and the westernmost portion of the Northwest Territories. In our area, L. calderi apparently replaces L. arctica on the calcareous outcrops of the Keele Range (Ogilvie Mts.), but has apparently not extended its range to include the bluffs along the rivers. These two closely related species can be difficult to distinguish.

PARRYA NUDICAULIS (L.) Regel ssp. SEPTENTRIONALIS Hultén

Site 26 (91-217). Locally common on northwest or west slopes of bluffs.

TORULARIA HUMILIS (C. Meyer) O. Schulz
[= Braya humilis (C. A. Mey.) Robins.]

Site 2 (91-6); 13 (91-119); 22 (91-176); 26 (91-212); 28 (91-226). Common on dry, calcareous alpine outcrops, screes, and river bluffs.

CAMPANULACEAE
(Bellflower Family)

CAMPANULA AURITA E. Greene — Yukon Bellflower

Site 6 (91-62); 17 (91-149); 22 (91-175); 24 (91-194). Common on dry calcareous bluffs and outcrops along the river; rare to infrequent in the alpine.

CAMPANULA LASIOCARPA Cham. — Mountain Harebell

Site 1 (91-2). Occasional in moist alpine tundra and fellfield.

CARYOPHYLLACEAE
(Pink Family)

GASTROLYCHNIS OSTENFELDII (A. Pors.) Petrovski
[= Melandrium taimyrense Tolm.]

Sites 23 (91-190); 22 (91-208). Dry, calcareous, bluff slopes along the Salmon Fork.

GASTROLYCHNIS TAYLORAE (Robinson) D. Murray
[= M. taylorae (Robins.) Tolm.]

Site 28 (91-223). Occasional on calcareous terraces and cliffs along the Salmon Fork.

MINUARTIA ARCTICA (Steven) Asch. & Graebner — Arctic Sandwort

Sites 5 (91-41, 91-85, 91-86); 6 (91-77); 9 (91-99, 91-137, 91-138); 12(91-110). Common to abundant on dry, alpine slopes and fellfields.

MINUARTIA ELEGANS (Cham. & Schldl.) Schischkin
[= M. rossii (R. Br.) Graebn.]

Sites 5 (91-48); 7 (91-57); 13 (91-125); 22 (91-181). Rare, on calcareous outcrops and screes.

MINUARTIA RUBELLA (Wahlenb.) Graebner Reddish Sandwort

Site 28 (91-225). Rock ledges on calcareous cliffs along river.

SILENE ACAULIS L. Moss Campion

Site 5 (91-92). Occasional on calcareous alpine screes and outcrops.

SILENE REPENS Patrin Pink Campion

Sites 16 (91-154b); 18 (91-161); 29 (91-231). Occasional on dry, calcareous bluffs.

WILHELMSIA PHYSODES (Fischer) McNeill Merckia

Site 21 (91-170). Occasional on gravel bars along the river.

CORNACEAE
(Dogwood Family)

SWIDA STOLONIFERA (Michx.) Rydb. Red-osier Dogwood
[= Cornus stolonifera Michx.]

Sites 21 (91-173); 25 (91-209). Common to abundant in shrub thickets and spruce woods along the Salmon Fork.

FABACEAE
(Pea Family)

ASTRAGALUS ABORIGINUM Richardson

Site 5 (91-42); 10 (91-102). Locally common, but only seen at two sites, both alpine, on disturbed sandy soil of frost scars and calcareous outcrops.

HEDYSARUM ALPINUM L. ssp. AMERICANUM (Michaux) B. Fedtsch.

Site 8 (91-33). Occasional on wooded subalpine slopes with white spruce and aspen, and also in the transition zone to from wooded slopes to xeric calcareous fellfield.

OXYTROPIS BRYOPHILA (E. Greene) Yurtsev Blackish Oxytrope
[= O. nigrescens (Pall.) Fisch. ssp. bryophila (Greene) Hult.]

Site 4 (91-13); 12 (91-113). Uncommon, in open alpine fellfields on calcareous substrate.

OXYTROPIS JORDALII A. Porsild
[= O. campestris (L.) DC. ssp. jordalii (Pors.) Hult.]

Site 4 (91-12); 8 (91-22, 91-35); 5 (91-132). Common in fellfields on calcareous screes and exposed ridges. See O. varians, below.

OXYTROPIS VARIANS (Rydb.) Schumann Field Oxytrope
[= O. campestris ssp. gracilis (Nels.) Hult.]

Site 8 (91-27, 91-36); 6 (91-67, 91-81); 8 (91-130, 91-131). Common on lower slopes of calcareous ridges and in the transition zone to woodland below these slopes. This species is closely related to O. jordalii (see above). When they were found at the same general site, O. varians was always in more protected, sheltered sites and generally lower on the slope or ridge, while O. jordalii occupied the exposed portions of ridges and upper slopes.

FUMARIACEAE
(Earth Smoke Family)

CORYDALIS PAUCIFLORA (Stephan) Pers. Few-flowered Corydalis

Site 11 (91-105). Rare; seen once in moist rock depressions at the base of a talus slope.

GENTIANACEAE
(Gentian Family)

GENTIANELLA PROPINQUA (Richardson) J. M. Gillett
[= Gentiana propinqua Richards.]

Site 6 (91-63). Rare, in open, spruce woodland below limestone ridge. Tentative identification based on immature specimen.

LENTIBULARIACEAE
(Bladderwort Family)

PINGUICULA VULGARIS L. ssp. VULGARIS Common Butterwort

Site 13 (91-120); 29 (91-230). Rare, in moist to wet calcareous soil of solifluction stripes and other seepy areas with calcareous soils.

PAPAVERACEAE
(Poppy Family)

PAPAVER NUDICAULE L. ssp. AMERICANUM Randel ex Murray

Site 17 (91-146); 18 (91-162); 26 (91-215); 29 (91-234). Common to abundant on xeric rubble slopes of steep, south-facing bluffs along the Salmon Fork. Together with Artemisia alaskana and Dryopteris fragrans, this poppy was an aspect dominant of these slopes. It was noticeably absent from calcareous bluffs with more fines rather than coarse rubble.

POLEMONIACEAE
(Phlox Family)

PHLOX ALASKENSIS Jordal — Alaskan Phlox
[= P. sibirica L.]

Site 2 (91-3); 4 (91-18); 6 (91-064). Common to abundant on dry, calcareous screes and ridges; one of the typical species of these sites.

POLEMONIUM PULCHERRIMUM Hook. ssp. LINDLEYI (Wherry) V. Grant

Site 21 (91-172); 27 (91-222b) Rare, on gravel bars and in meadows on rocky slopes.

PRIMULACEAE
(Primrose Family)

ANDROSACE CHAMAEJASME Host ssp. LEHMANNIANA (Sprengel) Hultén

Site 8 (91-31). Common to abundant on dry, calcareous screes and ridges; one of the typical species of these sites.

DODECATHEON PULCHELLUM (Raf.) Merr. ssp. PAUCIFLORUM (E.Greene) Hultén

Site 23 (91-191). Rare (solitary plant seen at one site); dry ridge crest of calcareous bluff, open, steppic vegetation. (Tentative identification based on old scape, past flowering.)

**DOUGLASIA OCHOTENSIS (Willd.) Hultén

Site 5 (91-54); 4 (91-135) Common to abundant on non-calcareous

alpine talus, screes, and fellfields. Seen on one calcareous rock outcrop (in a snow gully), otherwise conspicuous in its consistent absence from all calcareous screes and fellfields, where it was seemingly replaced by Silene acaulis. Range extension.

PYROLACEAE
(Wintergreen Family)

PYROLA ASARIFOLIA Michaux — Liverleaf Wintergreen

Site 12 (91-112). Rare, in moist tussock sedge tundra on alpine benches.

RANUNCULACEAE
(Buttercup Family)

ANEMONE DRUMMONDII S. Wats. — Drummond Anemone

Site 5 (91-45); 15 (91-124). Occasional in sheltered pockets of dry calcareous alpine outcrops. (91-124 approaches the closely related A. multiceps.)

ANEMONE NARCISSIFLORA L.

Site 19 (91-168). Locally common to abundant in non-calcareous, moist alpine tundra, and in moist meadows and snow beds on north-facing bluff slopes.

PULSATILLA PATENS (L.) Miller

Sites 22 (91-184); 23 (91-199). Locally common on less exposed portions of calcareous, south-facing bluffs (not on rubble slopes).

THALICTRUM ALPINUM L. — Arctic Meadowrue

Sites 2 (91-5); 8 (91-21); 5 (91-83). Rare, on calcareous alpine outcrops, screes and fellfields.

THALICTRUM SPARSIFLORUM Turcz. — Few-flower Meadowrue

Site 16 (91-139). Occasional along riverbanks in moist willow and alder scrub.

ROSACEAE
(Rose Family)

DRYAS ALASKENSIS A. Pors. Alaska Mountain Avens
[= Dryas octopetala L. ssp. alaskensis (Pors.) Hult.]

Site 8 (91-29); 6 (91-79); 29 (91-253a). Common on calcareous soils in snowbeds, protected areas, and open spruce woodlands. Often found near D. octopetala, but in less exposed sites.

DRYAS CRENULATA Juz.

Site 12 (91-114); 22 (91-185, 91-206); 24 (91-193); 26 (91-218). Common on open, dry, bluff slopes with silty or sandy calcareous soil.

DRYAS OCTOPETALA L. Mountain Avens

Site 5 (91-40, 91-53, 91-91); 9 (91-94). Common to abundant on exposed alpine tundra and fellfields, especially on calcareous substrate. Often found near D. alaskensis, but in more exposed sites.

DRYAS SYLVATICA (Hultén) A. Pors.
[= D. integrifolia M. Vahl ssp. sylvatica (Hult.) Hult.]

Site 29 (91-235b). Open spruce forests on calcareous soils.

PENTAPHYLLOIDES FLORIBUNDA (Pursh) Kuntze Shrubby Cinquefoil
Yellow Rose, Tundra Rose
[= Potentilla fruiticosa L.]

Site 8 (91-38). Occasional in open spruce woodland; common on woodland sites that have burned, especially dry, bluff slopes.

POTENTILLA ARENOSA (Turcz.) Juz.
[= P. hookeriana Lehm.]

Site 22 (91-205); 27 (91-221). Common on open, dry, bluff slopes with calcareous outcrops and silty or sandy calcareous soil.

POTENTILLA NIVEA L. Snow Cinquefoil

Site 22 (91-186). Rare, on open, dry, bluff slopes with

calcareous outcrops and silty or sandy calcareous soil.

POTENTILLA UNIFLORA Ledeb. One-flower Cinquefoil

Site 2 (91-8). Rare, seen once on a calcareous alpine outcrop.

ROSA ACICULARIS Lindley Prickly Rose

Site 6 (91-69). Common along rivers in willow scrub, on gravel bars, and in spruce forests up to treeline.

RUBIACEAE
(Madder Family)

GALIUM BOREALE L. Northern Bedstraw

Site 6 (91-61); 16 (91-157). Occasional to common at base of rubble slopes along rivers, and in open spruce-woodland up to treeline.

SALICACEAE
(Willow Family)

SALIX PHLEBOPHYLLA Andersson

Site 9 (91-97). Common to abundant in non-calcareous alpine tundra and fellfield.

SANTALACEAE
(Sandalwood Family)

GEOCAULON LIVIDUM (Richardson) Fern.

Site 8 (91-30); 6 (91-59). Common in spruce forests up to treeline, rare above.

SAXIFRAGACEAE
(Saxifrage Family)

SAXIFRAGA HIERACIFOLIA Waldst. & Kit. Hawkweed-leaf Saxifrage

Site 10 (91-103). Occasional in moist disturbed soil of frost scars.

SAXIFRAGA HIRCULUS L. Yellow Marsh Saxifrage

Site 12 (91-117). Rare, in moist to wet tussock-sedge tundra on alpine benches.

SAXIFRAGA OPPOSITIFOLIA L. Purple Mountain Saxifrage

Site 5 (91-47). Common to abundant on calcareous alpine screes, fellfields and outcrops.

SAXIFRAGA REFLEXA Hook. Yukon Saxifrage

Site 5 (91-51);6 (91-58); 18 (91-164); 22 (91-207). Common to abundant on dry, calcareous slopes and outcrops.

SAXIFRAGA TRICUSPIDATA Rottb. Three-tooth Saxifrage

Site 5 (91-14); 17 (91-142); 22 (91-203). Common to abundant on dry rocky slopes and outcrops; generally on calcareous substrate.

SCROPHULARIACEAE
(Figwort Family)

CASTILLEJA HYPERBOREA Pennell Northern Indian Paintbrush

Site 8 (91-24); 6 (91-133). Rare, in sheltered sites on dry, calcareous alpine slopes.

LAGOTIS GLAUCA P. Gaertna ssp. MINOR (Willd.)

Site 10 (91-104). Common in moist, stony alpine tundra.

PEDICULARIS LANGSDORFFII Fischer ex Steven ssp. ARCTICA (R. Br.) Pennell

Site 12 (91-109). Common in moist alpine tundra.

PEDICULARIS OEDERI M. Vahl Oeder Lousewort

Site 12 (91-107). Common in moist alpine tundra.

PENSTEMON GORMANII E. Greene Gorman Beardtongue

Site 22 (91-174, 91-201). Locally common to abundant on dry, calcareous river bluffs with silty-sandy soil and rock outcrops.

LIST OF PLATES

background to the left.

Plate 14. Collection site 17, south-facing rubble slope on Salmon Fork of the Black River.

Plate 15. Southwest-facing slope of calcareous bluff (Salmon Fork of the Black River) showing open grassland and low-shrub herbaceous communities on old burn of spruce woodland. Collection site 24 is on the open ridge line at top of photograph.

Plate 16. Type 2 bluff (south-facing calcareous bluff with silty soil and rock outcrops); general vicinity of collection site 23.

Plate 17. Collection site 23, showing xeric, open grassland.

Plate 18. Large exposure of south-facing bluffs downriver from Drifting Snow Creek. These bluffs were not visited during this study.

Plate 19. Collection site 27 on the southeast-facing exposure of Pink Bluff above Runt Creek, just below the crest of a rocky ridge. This was the only bluff site investigated that had Artemisia frigida rather than A. alaskana.

Plate 20. Type 3 bluff (north-facing slope) above Runt Creek at east end of Pink Bluff; collection site 26.

Plate 21. Type 3 bluff (north-facing slope) at westernmost end of Pink Bluff; general vicinity of collection site 29.

Plate 22. View to northeast (upriver) from westernmost end of Pink Bluff, showing the valley of the Salmon Fork of the Black River, with Keele Range to the north.