A BOTANICAL SURVEY OF THE GOODNEWS BAY REGION, ALASKA

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June Mcatee of Calista Corporation provided valuable background information on the geology of the region. All errors of geological interpretation in this report, however, are entirely my own.

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OBJECTIVES

The objective of this survey was to assist the Bureau of Land Management (BLM) Anchorage District Office in obtaining baseline information about the flora of the Goodnews Bay region of western Alaska (Figure 1). Knowledge of the flora of an area is fundamental to any management efforts aimed at maintaining the biodiversity of that area. The Goodnews Bay region contains a diverse array of habitats from coastal wetlands to alpine tundra, yet it has seen virtually no botanical study.

The 1993 field survey concentrated on habitats thought likely to contain rare or unusual plant species (calcareous and ultramafic barrens, alpine tundra, and aquatic sites) but attempted to collect as much of the flora as was possible within the limited time available.

STUDY AREA

The study area centered on BLM lands north of the village of Goodnews Bay in western Alaska, between longitudes 161_05_ and 162_ W, and latitudes 59_08_ and 59_28_ N, approximately 150 km south of the city of Bethel. The area actually sampled by the survey included approximately 900 km_ (Figure 1). The Ahklun Mountains reach the coast in this area, forming the first of a series of mountain ranges stretching north and east from the Bering Sea through the Kilbuck and Kuskokwim Mountains into Interior Alaska. The Ahklun Mountains have a complex geology and contain a wide range of rock types of various origins and pH's, ranging from acidic granites to ultramafics and limestones. (Recrystallized limestones of the Kilbuck terrane are some of the oldest rocks known in Alaska.) Various plant species have marked preferences for rock type (especially as it relates to pH), and the complex and varied geology of the area suggested a similarly rich flora. Their geography and geology thus suggest the Ahklun Mountains and the surrounding region could have served as a corridor for migrations of plants from other regions in Alaska, Canada and Cordilleran North America, as well as from Northeast Asia. The other areas of western Alaska where alpine habitats reach the Bering Sea (the Seward Peninsula and adjacent Northwest Alaska, and the Aleutian Islands) are known for their endemic species and for species that are disjunct from Asia (Kelso 1990).
The Ahklun Mountains were covered by alpine glaciers during glacial maxima, but remained close to the edge of the unglaciated interior of Beringia which extended north to the Seward Peninsula and west to Chukotka. In addition to the rich alpine habitats, the coastal portion of the study area contains extensive brackish and freshwater wetlands that had not yet been explored.

METHODS

We selected potential survey sites prior to the field season using 1:60,000 scale color infrared (CIR) aerial photography as well as existing geologic maps of the area (Hoare and Coonrad 1978). Rare plants and rare or unusual communities were the focus of the survey and we concentrated on those areas most likely to contain them: limestone or calcareous barrens and outcrops; ultramafic slopes; and alpine screes, outcrops and tundra. Although few collections had been made in this area prior to our survey, several unusual finds had been made. In 1965 Eric Hulten (1966) had visited Cape Newenham (south of Goodnews Bay), several sites in the Kilbuck Mountains (northeast of Goodnews Bay), Aniak, and Nelson Island. Among his collections were several sheets of *Artemisia* from Cape Newenham and Kagati Lake which he described as a new variety, *Artemisia glomerata* var. *subglabra*. No other collections were ever made of this taxon and it had been listed by the U.S. Fish and Wildlife Service as a Category 2 Candidate species. While at Cape Newenham, Hulten also collected *Cerastium regelii* Ostenf., a plant of the Canadian and Eurasian high arctic. In Alaska, this species is known from only one other site (Heritage Program rank G4 S1). In 1976 Maxcine Williams visited Platinum, on the south side of Goodnews Bay. Among her collections was a sheet of the poppy *Papaver walpolei* A. Pors., a Beringian endemic (Heritage Program rank G3 S3) whose nearest location was on calcareous gravels of the Seward Peninsula. These collections provided an initial list of rare taxa to look for and suggested that other disjunct species from northwestern or northern Alaska might also be found.

Field work was conducted from 6 - 12 July 1993 from a base camp at Canyon Lake. This site provided easy access to alpine habitat on Kisogle Mountain, and is one of the few lakes in the study area large enough for a float plane to land. We used a helicopter to travel to all other sites.

Crews of two to three botanists each were shuttled between sites so as to maximize the number of sites we could visit in the time available. At each site we compiled species lists and briefly described the vegetation. We did not make voucher collections of every taxon at each site. We did, however, attempt to document the flora of the study area as a whole by making at least one collection of each taxon seen. Critical taxa received extra attention.

Collections and field notes were reviewed each evening to evaluate the adequacy of coverage of the various landforms and habitats and to set priorities for the following day.

Study Sites:

Plants were collected at 25 sites in the Goodnews Bay region (Figures 1 - 7). These sites are listed below with their latitudes, longitudes, elevations (in meters above sea level), and a brief description of their vegetation and landforms.

Site 1: Kisogle Mountain, 59_25_01_ N, 161_09_32_ W, 275-325m. Granite. Acidic, alpine tundra and rocky seeps.

Site 2: Kisogle Mountain, 59_24_48_ N, 161_09_32_ W, 325m.
Granite. Acidic, alpine tundra and rocky seeps.

Site 3: Kisogle Mountain, 59_25_04_ N, 161_10_29_ W, 325-600m.
Granite. Acidic ridge with alpine tundra, rock outcrops and talus slope.

Site 4: Slate Creek Pass, Kisogle Mountain, 59_24_12_ N, 161_11_54_ W, 472m. Subalpine meadow, talus slope, and solifluction soil.

Site 5: Nautilus Creek Ridge, 59_17_36_ N, 161_40_00_ W, 183m. Limestone screes, outcrops, and gravelly deflation scars.

Site 6: Tatlignagpeke Mountain saddle, 59_22_21_ N, 161_24_28_ W, 533m. Sparsely vegetated ultramafic screes and outcrops.

Site 7: Tatlignagpeke Mountain ridge crest, 59_22_37_ N, 161_24_09_ W, 533-760m. Sparsely vegetated ultramafic screes and outcrops.

Site 8: Peak southeast of Tatlignagpeke Mountain, 59_21_22_ N, 161_23_40_ W, 503m. Rocky alpine tundra and screes; not ultramafic.

Site 9: Tatlignagpeke Mountain seeps, 59_22_38_ N, 161_25_40_ W, 260-320m. Moist to wet rocky seeps and pond margin.

Site 10: Ridge south of Tatlignagpek Mountain, 59_20_22_ N, 161_23_09_ W, 450m. Rocky seeps, alpine tundra and scree; not ultramafic.

Site 11: Eagle Bluff, 59_24_46_ N, 161_42_48_ W, 152m. Limestone outcrops, screes, sorted stone nets and calcareous schists.

Site 12: Mitlak Mountain (limestone), 59_24_36_ N, 161_32_51_ W, 400m. Xeric, recrystallized limestone barrens, outcrops and screes.

Site 13: Cripple Creek wetlands, 59_24_37_ N, 161_50_18_ W, 7m. Freshwater pond and pond margins.

Site 14: Lagoon edge southwest of Cripple Creek, 59_24_12_ N, 161_52_15_ W, 7m. Brackish ponds and sandy beach ridge.

Site 15: Coastal pond southwest of Cripple Creek, 59_24_18_ N, 161_51_39_ W, 7m. Filled-in pond with wet sedge herbaceous meadow.

Site 16: USGS Second- spit, 59_22_29_ N, 161_56_24_ W, 7m.
Tidal pool and beach ridge.

Site 17: Coastal pond west of Cripple Creek, 59_22_06_ N, 161_50_50_ W, 15m. Freshwater pond with aquatic vegetation.

Site 18: Mitlak Mountain (ultramafic), 59_24_57_ N, 161_32_53_ W, 370-540m. Sparsely vegetated barrens of orange-weathering serpentinite.

Site 19: Eagle Bluff, 59_24_29_ N, 161_42_57_ W, 180m. Limestone outcrops, screes, sorted stone nets and calcareous schists.

Site 20: Sphinx Mountain, 59_12_21_ N, 161_37_52_ W, 290m. Rocky non-calcareous ridge crest with alpine heath.

Site 21: Limestone Ridge, 59_11_55_ N, 161_40_53_ W, 244m. Sparsely vegetated ridge (limestone and ultramafic substrate) with moist swales .

Site 22: Kiglapak Mountains, 59_09_48_ N, 161_39_27_ W, 213m. Sparsely vegetated screes.

Site 23: Kiugtlugtulit Mountain, 59_19_21_ N, 161_34_42_ W, 457m. Acidic alpine tundra and chert outcrops near ridge crest.

Site 24: Arolik Creek, 59_26_41_ N, 161_20_30_ W, 131m. Sparsely vegetated gravel bar and sandy cut bank.

Site 25: Canyon Lake, 59_25_30_ N, 161_09_34_ W, 152m. Moist subalpine meadows.

RESULTS

Flora and Phytogeography

A total of 446 collections were made representing approximately 288 taxa. This number does not represent the complete flora of the area since we did not collect extensively across all habitats. I believe it does represent the vast majority of taxa found on the habitats we emphasized (alpine, limestone, and ultramafic sites), as well as providing a good representation of the coastal wetland flora. The flora was dominated by taxa having a circumpolar distribution (43% of the total). Asiatic-North American taxa (widely distributed on both continents) accounted for 29% of the flora and Berinigian taxa (ranging between the Kolyma and Mackenzie Rivers) represented another 13% of the flora. These numbers agree well with Kelso's (1989) analysis of the flora at Cape Prince of Wales on the Seward Peninsula. In both cases the floras show a strong Asiatic connection, although the Goodnews Bay flora has a larger North American component (13%) than does the flora at Wales (5%) probably reflecting a greater representation of boreal and interior taxa at Goodnews Bay. Situated on the southern Bering Sea coast as well as at the western end of the Kuskokwim Mountains, the flora of Goodnews Bay shows elements of several broad floristic areas. These include: Southcoastal Alaska and the Aleutians; Interior Alaska; and the Seward Peninsula and western Brooks Range.

The collections made during 1993 added greatly to our knowledge of the flora of this poorly explored area. Although we were only able to spend six days exploring selected alpine and aquatic sites, at least 50 of the 288 taxa collected represent significant extensions of the previously known range of these plants. For this report, we considered a significant range extension to be any new locality that is at least 150 km from the nearest previously reported collection for that taxon. Our collections extend the previously known range for 38 of these taxa by more than 400 km, and some extensions exceed 600 km (e.g. *Primula tschuktshorum*). Our principal sources for previously known ranges of the taxa were: Hulten (1968), Argus (1973), Porsild and Cody (1980), Aiken and Darbyshire (1990), and Morin et al. (1994).

As could be expected for any area that has received scant botanical attention, many of the remaining collections filled in small gaps in the known range of taxa or were peripheral to their previously known range, extending it by less than 150 km. Several taxa (e.g. *Potentilla biflora*, *Papaver walpolei*, *Astragalus harringtonii*) were previously known from the general area of Goodnews Bay, but are otherwise disjunct by more than 600 km from their main ranges.

Listed below are all significant range extensions and rare taxa collected during this survey. Collection and sites numbers can be found in the species list appended to this report.

*Aphragmus eschscholtzianu*s Andrz.
Acomastylis rossii (R. Br.) E. Greene
Aconitum delphinifolium DC. ssp. *paradoxum* (Reichb.) Maguire & Hulten
Arenaria chamissonis Maguire
Astragalus harringtonii (Rydb.) Hulten
Astragalus polaris Benth.
Atriplex gmelinii C. Meyer
Campanula uniflora L.
Carex eleusinoides Turcz.
Carex glacialis Mackenzie
Carex glareosa Wahlenb. ssp. *glareosa*
Carex media R. Br.
Carex membranacea Hook.
Carex micropoda C. Meyer
Carex misandra R. Br.
Carex ramenskii V. Komarov
Carex rupestris All.
Carex scirpoidea Michaux
Chrysosplenium wrightii Franchet & P. A. L. Savat.

Claytonia acutifolia Pallas ssp. *graminifolia* Hulten
Claytonia scammaniana Hulten
Cryptogramma stelleri (S. Gmelin) Prantl
Cryptogramma sitchensis (Ruprecht) T. Moore
Equisetum variegatum Schleigh ssp. *variegatum*
Eriophorum triste (Th. Fries) Hadac & A. Loeve
Festuca brevissima Yurtsev
Festuca vivipara (L.) Smith ssp. *glabra* Frederiksen
Galium brandegei A. Gray
Gentiana prostrata Haenke
Listera cordata (L.) R. Br.
Minuartia elegans (Cham. & Schldl.) Schischkin
Novosieversia glacialis (J. Adams) F. Bolle
Oxygraphis glacialis (Fischer) Bunge
Oxytropis mertensiana Turcz.
Papaver alaskanum Hulten
Papaver macounii E. Greene
Papaver walpolei A. Pors.
Platanthera dilatata (Pursh) Lindley var. *dilatata*
Poa pseudoabbreviata Rosch.
Podistera macounii (J. Coulter & Rose) Mathias & Constance
Potamogeton filiformis Pers.
Potamogeton subsibericus Hagstr.
Potentilla biflora Willd. ex Schldl.
Primula egaliksensis Wormsk.
Primula tschuktschorum Kjellman
Puccinellia nutkaensis (Presl) Fern. & Weath.
Ranunculus trichophyllus ssp. *eradicatus* (Laest.) Cook
Salix rotundifolia Trautv. ssp. *dodgeana* Rydb.
Saxifraga caespitosa L.
Senecio kjellmanii A. Pors.
Sibbaldia procumbens L.
Silene acaulis L. ssp. *acaulis*
Taraxacum hyparcticum Dahlst.
Woodsia glabella R. Br.
Zannichellia palustris L.

Rare Taxa

Before the field season we noted several rare taxa that had been reported for the Goodnews Bay area or that might be expected to occur there. Of the two taxa collected by Hulten at Cape Newenham, (*Artemisia glomerata* var. *subglabra* and *Cerastium regellii*) we found neither. Based on the experience of this survey as well as subsequent trips to Cape Newenham and Kagati Lake, it is now clear that the plants Hulten described as *A. glomerata* var. *subglabra* are well within the range of variation for *A. globularia* (see Lipkin 1994). Several new locations were found for *Papaver walpolei*, previously collected at Platinum (on the south side of Goodnews Bay). This species is now known from the Ogilvie Mountains in the Yukon Territory, the eastern Brooks Range (Arctic National Wildlife Refuge), as well as the Seward Peninsula, Northwestern Alaska, and eastern Chukotka. On the Seward Peninsula it is common on calcareous sites and sometimes abundant. Although we found this endemic poppy at four sites, it was localized and usually quite rare. We did not visit the Red Mountain site as part of this survey, but it is reported to be more common there. All sites were on gravels and outcrops of limestone or ultramafic substrate, matching its habitat in other parts of its range. The Goodnews Bay populations are widely disjunct from the main range of this species and efforts should be made to ensure they are not extirpated.

Several additional rare taxa were found in the course of the survey:
Primula tschuktschorum (G2G3 S2S3). This rare primrose was thought to be a narrow Beringian endemic, found only on the western Seward Peninsula, St. Lawrence Island, and easternmost Chukotka (Kelso 1987). It was listed as a Category 2 Candidate species and thought to be rare at all known sites. It was collected at several sites as part of this survey though it was rare at all of them. It is typically found on wet gravels, seeps, and snowbeds, often with disturbed soils, and is usually on acidic or non-calcareous substrate. At Goodnews Bay it was found on wet rocky seeps with granitic substrate. It is now known to be more common on the Seward Peninsula, occaisionally in large populations (Kelso 1996), and has also been reported from additional sites in Wood Tikchik State Park and Cape Newenham in southwestern Alaska.

Aphragmus eschscholtzianus Andrz. (G3 S3). A distinctive endemic of saturated solifluction soil and mossy rocks along alpine streams, this rare mustard was only known from 15 - 20 sites in Alaska. It is usually reported as extremely rare. The rock seep site on Kisogle Mountain fits this description. The last 2 years have seen 15 - 18 additional sites reported in the Chugach and Wrangell Mountains as well the Togiak Refuge. This easily overlooked species may prove to be more common as additional areas are explored.

Oxygraphis glacialis (G4G5 S2S3). This predominantly Asian member of the Buttercup family is only known in Alaska from the Aleutian Islands, the westernmost Seward Peninsula and Cape Lisburne. Its occurence on limestone barrens in the Goodnews Bay area is a sizable though not unexpected disunction.

Cryptogramma stelleri (G5 S2S3). This rare parsley fern is found at scattered sites across Interior Alaska, west to the Seward Peninsula. It is found on calcareous rocks and seeps and is almost always rare whever it occurrs.

Zannichellia palustris (G5 S3). This aquatic horned pondweed was previously thought to be rare in Alaska and was known from only a handful of sites. It is becoming increasingly more likely that its rarity is an artifact of limited collecting in its habitat (shallow brackish or fresh water), and that future efforts will uncover additional sites. The Goodnews Bay site was a coastal brackish pond, and several additional sites have now been found in Southcentral Alaska near Cook Inlet and Prince William Sound.

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APPENDIX A

The following list of collections is arranged phylogenetically by family following Hulten 1968. 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.) Collection sites and collection numbers are noted next to taxon. The location of each site is shown in Figures 1 - 7 and described in the text.

This list is not a complete flora of the area and additional species will, no doubt, be added to this list when further exploration is done.

All collections are archived at the herbarium of the University of Alaska Museum, Fairbanks.

Captions for Study Site Photographs, Figures 8 - 31.

Figure 8. Canyon Lake and camp site, looking northwest from shoulder of Kisogle Mountain.

Figure 9. Site 3, Kisogle Mountain. Rocky seeps and moist acidic tundra on granitic substrate.

Figure 10. Site 3, Kisogle Mountain, looking south.

Figure 11. Site 4, moist to wet meadow west of Slate Creek Pass with granitic talus slope in background.

Figure 12. Main ridge of Tatlignagpeke Mountain showing contact zone of acidic tundra with ultramafic rocks (site 6) in middle foreground of photo. The slopes and ridge of site 7 are seen in the background (to the northeast).

Figure 13. Barren screes of site 8, looking northwest to sites 6 and 7 on Tatlignagpeke Mountain.

Figure 14. *Claytonia scammaniana* on ultramafic (peridotite) scree and talus of Tatlignagpeke Mountain (site 6). This is the westernmost location for this endemic Alaskan spring beauty.

Figure 15. *Papaver walpolei* in ultramafic talus of Tatlignagpeke Mountain (site 6).

Figure 16. Site 20, Sphinx Mountain, looking south across non-calcareous alpine tundra towards the Kiglapak Mountains (site 22) and Goodnews Bay.

Figure 17. Site 21, Limestone Ridge, looking northwest from Sphinx Mountain.

Figure 18. Site 21, Limestone Ridge.

Figure 19. Site 22, Kiglapak Mountain, showing with xeric carbonate screes with sparse plant cover.

Figure 20. *Arenaria chamissonis*, on carbonate scree of Kiglapak Mountains (site 22). This endemic Beringian sandwort is characteristic of carbonate or calcareous screes and outcrops.

Figure 21. *Eritrichium aretioides*, on carbonate scree of Kiglapak Mountains (site 22). This arctic forget-me-not was common on calcareous and ultramafic screes and outcrops throughout the study area.

Captions for Study Site Photographs, Figures 8 - 31 (continued).

Figure 22. Mitlak Mountain, looking south from Site 18 across serpentinite barrens (foreground) to well vegetated chloritic schists (middle ground) and recrystallized limestone barrens (background).

Figure 23. Mitlak Mountain, showing orange weathering serpentinite of Site 18 with Alaska poppy (*Papaver alaskanum*).

Figure 24. Calcareous outcrops and gravels on ridge above Nautilus Creek (site 5).

Figure 25. Sites 11 and 19 ("Eagle Bluff") showing Precambrian recrystallized limestone of Kilbuck terrane. Rocks of this formation are considered to be some of the oldest in Alaska.

Figure 26. Limestone outcrops on "Eagle Bluff".

Figure 27. Limestone slopes below "Eagle Bluff" showing frost sorted patterned ground. *Papaver walpolei* was found at the edge of the patterned ground in the background.

Figure 28. South Fork of the Arolik River showing tussock tundra covering level to rolling surfaces; sand and gravel bars are common along the river. Site 24 is located at the base of the cutbank in the background.

Figure 29. Site 24 along the South Fork of the Arolik River.

Figure 30. Coastal wetlands between Jacksmith Bay and Carter Bay.

Figure 31. Brackish pond near coast dominated by mare's tail (*Hippuris*).