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Grasslands of the Aishihik-Sekulmun Lakes Area, Yukon Territory, Canada

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ABSTRACT. Grassland communities found on dry, steep, south-facing slopes in the Aishihik-Sekulmun Lakes area, southwest Yukon Territory, are dominated by *Artemisia frigida* and *Carex filifolia*, with *Calamagrostis purpurascens, Poa glauca, Penstemon gormanii, Phlox hoodii,* and *Potentilla nivea* subdominant. The grasslands are similar in terms of dominants and subdominants to other grasslands in southwest Yukon, but twelve species that have not been recorded at other sites were found in the Aishihik-Sekulmun area. The composite species list from southwest Yukon grasslands was compared to those from grasslands found in Alaska and in the boreal forest on the northern Great Plains. These three regions share a number of species; however, at least 25% of the species in each region are restricted to that region alone and absent from the other two. The southwest Yukon grasslands flora contains the following groups: species restricted to southwest Yukon, species found in both southwest Yukon and Great Plains grasslands, species found in both southwest Yukon and Alaska grasslands, and species found in grasslands in all three regions. Further work is needed to more fully characterize the floristic components of southwest Yukon grasslands and variations among them.

Key words: Aishihik Lake, grasslands, steppe, Yukon Territory

RÉSUMÉ. Les communautés herbeuses qui se trouvent sur les versants secs, abrupts et exposés du sud de la région des lacs Aishihik-Sekulmun, au sud-ouest du Yukon, sont dominées par *Artemisia frigida* et *Carex filifolia,* avec comme espèces sous-dominantes, *Calamagrostis purpurascens, Poa glauca, Penstemon gormanii, Phlox hoodii* et *Potentilla nivea.* Ces prairies sont semblables en termes d'espèces dominantes et sous-dominantes à d'autres prairies du sud-ouest du Yukon, mais, dans la région d'Aishihik-Sekulmun, on a trouvé douze espèces qui n'ont pas été relevées ailleurs. On a comparé la liste combinée des espèces présentes dans les prairies du sud-ouest du Yukon aux listes établies pour des prairies se trouvant en Alaska et dans la forêt boréale des grandes plaines septentrionales. Ces trois régions ont un certain nombre d'espèces en commun, même si dans chaque région, au moins 25 p. cent des espèces présentes ne se retrouvent absolument pas dans les deux autres régions. La flore des prairies du sud-ouest du Yukon contient les groupes suivants: les espèces qui se limitent au sud-ouest du Yukon, les espèces présentes à la fois dans les prairies du sud-ouest du Yukon et des grandes plaines, les espèces présentes à la fois dans les prairies du sud-ouest du Yukon et de l'Alaska, et les espèces présentes dans les prairies de ces trois régions. De plus amples travaux sont nécessaires pour mieux établir les caractéristiques des composantes floristiques des prairies du sud-ouest du Yukon ainsi que des variations qui y existent.

Mots clés: lac Aishihik, prairies, steppe, Territoire du Yukon

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INTRODUCTION

Grasslands are a small, but widely distributed and persistent, component of boreal forests throughout western and northwestern North America. They occur locally on well-drained, generally south-facing slopes near the more arid margins of boreal forest distribution, and thus their distribution appears to be under strong topographic (i.e., soil moisture) controls. They have been described from Manitoba (Blood, 1966), Saskatchewan (Carbyn, 1971; Cameron, 1975; Elchuk, 1998), Alberta (Moss and Campbell, 1947; Moss, 1952), southwest Yukon (Douglas, 1974; Hoefs et al., 1975; Orloci and Stanek, 1979; Johansen et al., 1989; Lausi and Nimis, 1991; Laxton et al., 1996), and Alaska (Hanson, 1951; Edwards and Armbruster, 1989; Wesser and Armbruster, 1991; Lloyd et al., 1994). Floristically these boreal grasslands are similar at the generic (e.g., *Festuca, Poa*) and even specific (e.g., *Artemisia frigida, Bromus pumpellianus, Calamagrostis purpurascens, Carex filifolia*) levels. In addition, they share some floristic elements with grasslands on south-facing slopes in northeast Asia (Yurtsev, 1982) and other arctic and subarctic regions on both sides of the Bering Strait (Yurtsev, 1982; Murray et al., 1983; Ritchie, 1984; Walker et al., 1991).

Grasslands in Alaska and Yukon have attracted interest as possible modern analogues of Late Pleistocene Beringian steppe communities (Lausi and Nimis, 1991; Walker et al., 1991; Laxton et al., 1996; Schweger, 1997). Their locations and floristic similarities suggest they might be relicts

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of steppe communities within a landscape now dominated by other vegetation types. Although these grasslands differ somewhat in their component species, their similarities might indicate a group of species widely distributed in glacial Beringia.

The controversy over the nature of glacial Beringian vegetation was summarized in the "production paradox" formulated by Schweger et al. (1982), who also emphasized the need to look for modern analogues as one component of the reconstruction process for this vegetation type. Although many pollen records suggest the vegetation was relatively unproductive compared to present-day steppe, faunal remains indicate it was productive enough to support a variety of large grazers (Schweger, 1997). It has been proposed that the Beringian landscape was a mosaic of vegetation types (Elias et al., 1996), in which moisture and loess deposition gradients were probably important determinants of vegetation gradients (Schweger, 1997). The findings of Laxton et al. (1996), that biomass and floristic richness in grasslands in the Kluane area of southwest Yukon increased with the amount of silt in the soil, support Schweger's (1992) hypothesis that areas locally in receipt of loess may have been highly productive sites capable of supporting the Beringian grazers, perhaps set within a matrix of less productive vegetation communities.

Boreal grasslands such as those studied by Laxton et al. (1996) are common on south-facing slopes in southwest Yukon, a region arid by virtue of its location in the rain shadow of the St. Elias Mountains (Keenan and Cwynar, 1992). But grasslands are not limited to areas that receive loess. They also occur east of the Kluane grasslands, around Aishihik and Sekulmun Lakes, on dry slopes that have thin, poorly developed soils and less productive vegetation (Johansen et al., 1989). This paper describes Aishihik-Sekulmun grasslands and compares them with grasslands in other areas of southwest Yukon.

In their investigation of the ecological phytogeography of southern Yukon, Lausi and Nimis (1991) put the grassland species into five groups based on present and inferred past distributions. They concluded that southwest Yukon grasslands developed largely in isolation from the xerophytic flora of the Siberian steppes and with substantial species inputs from, and exchanges with, Cordilleran and west and central North American grasslands via the ice-free corridor during the Late Pleistocene. This paper compares present floristic similarities between southwest Yukon grasslands and those in Alaska and the northern Great Plains.

STUDY AREA AND METHODS

Aishihik-Sekulmun Grasslands

Aishihik and Sekulmun Lakes extend northward from 50 to 100 km north of the Alaska Highway and are approximately midway between Whitehorse and Kluane National Park, Yukon (Fig. 1). The study area is bounded roughly on the west by the Nisling and Ruby Ranges, to the north by Stevens Lake, to the east by Hopkins and Giltana Lakes, and to the south by the confluence of the West Aishihik and Aishihik Rivers.

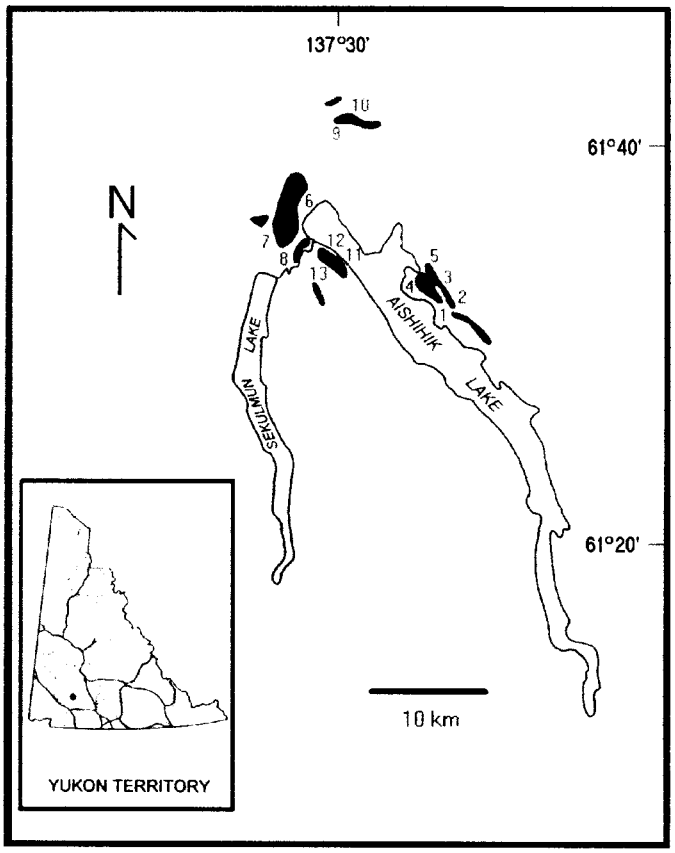

FIG. 1. Map of the study area in the Aishihik-Sekulmun Lakes region. Shaded zones indicate clusters of grasslands on south-facing slopes in which the study sites, indicated by number, were located. The inset shows the location of the study area in the Yukon Territory. On the inset map, the solid lines are major roads and the dotted lines are rivers.

Interpretations of black-and-white aerial photography (1979; 1:60 000) identified possible xeric grassland areas on the basis of topographic and reflectance characteristics. Thirteen grasslands around the north ends of Aishihik and Sekulmun Lakes, accessible by boat and foot travel, were surveyed in July 1981 (Fig. 1). In each grassland, the topographic and edaphic conditions were noted, although quantitative soil analyses were not done. Ecological processes (grazing, browsing, aspen forest invasion) that appeared to be affecting the stability and species compositions of the grasslands were described. On each slope, a sampling area (approximately 10 m × 10 m) judged to be representative of the vegetation community on the main part of the slope was selected, and cover was estimated for all vascular plant species occurring in each sampling area. In some of the grasslands, a minor community at the crest of the slope could be recognized and was described separately. Additional species that occurred outside the sampling area were noted.

FIG. 2. Grasslands near the north end of Aishihik Lake.

Species identifications were determined according to Hultén (1968) and Scoggan (1978–79), with nomenclature revised as necessary for this paper to conform to Cody (1996). Voucher specimens are stored in the Herbarium of the Biology Department, University of Waterloo, Ontario; some duplicates are in the Vascular Plant Herbarium, Research Branch, Agriculture and Agri-Food Canada, Ottawa.

Grassland Comparisons

Species lists (phanerogams only) from the Aishihik-Sekulmun grasslands were compared with lists from grasslands in other parts of southwest Yukon (Douglas, 1974; Hoefs et al., 1975; Lausi and Nimis, 1991; Laxton et al., 1996). A southwest Yukon grasslands species list was then compiled and compared to species lists from grasslands in Alaska (Hanson, 1951; Edwards and Armbruster, 1989; Walker et al., 1991; Wesser and Armbruster, 1991; Lloyd et al., 1994), Alberta (Clarke et al., 1942; Moss and Campbell, 1947; Moss, 1952; Schwarz and Wein, 1997), and Saskatchewan (Coupland and Brayshaw, 1953; Saskatchewan Conservation Data Centre, 1997; Elchuk, 1998). Because the different studies reported abundances in various ways, only presence-absence data were used; subspecies or varieties were compared whenever that information was available. Sørenson indices of similarity (SPSS 7.5 for Windows) were calculated comparing Aishihik-Sekulmun to southwest Yukon grasslands, and southwest Yukon grasslands to those in Alaska and to those on the northern Great Plains (Alberta and Saskatchewan).

RESULTS

Aishihik-Sekulmun Grasslands

The importance of topographic and edaphic controls on the distribution of these grasslands was recognized in both aerial photo and field surveys. The grasslands occurred only on well-drained substrates and on south-facing slopes. The slopes ranged from 20˚ to 30˚, averaging 26˚; aspects ranged from 140˚ to 275˚, but were mostly between 155˚ and 195˚. The substrates, whether till, glaciofluvial, or residual in origin, were characteristically sandy or silty. All of the grasslands occur on low hills, in hummocky or ridged topography (Fig. 2). Boreal forest covered north-facing slopes and valley bottoms.

The vegetation communities covering the main part of the grassland slopes were dominated by two species: *Artemisia frigida* and *Carex filifolia* (Table 1). Subdominant species included *Calamagrostis purpurascens*, *Poa glauca*, *Penstemon gormanii*, *Phlox hoodii*, and *Potentilla nivea*. *Calamagrostis purpurascens*, *Pulsatilla ludoviciana*, *Bromus pumpellianus*, and *Poa glauca* were especially common along the peripheries of the slopes.

Populus tremuloides-Rosa acicularis-Arctostaphylos uva-ursi communities usually defined the lower and lateral edges of the grasslands, and occasionally they also occurred, along with *Salix glauca* thickets, as "islands" of shrubby vegetation on the slopes. A commonly associated species was *Shepherdia canadensis*. *Populus tremuloides* suckers along the edges of grasslands often showed signs of heavy browsing, especially by snowshoe hare (*Lepus americanus macfarlani* Merriam), judging by the profusion of fecal pellets (J. Theberge, pers. comm. 1981). Extensive damage to *Betula glandulosa* and *Picea glauca* seedlings and saplings along the forested margins, due to browsing by hares, was also noted.

Most of the slopes showed signs of active erosion and terracette formation. Often arctic ground squirrel (*Spermophilus parryii plesius* Osgood) activity (burrowing and travelling across the slope) enhanced this erosion. Where ground squirrels were present in high densities (judging by the number of burrow holes), their selective grazing of graminoids reduced dramatically the coverage by *Carex filifolia* and *Poa glauca*, leaving *Artemisia frigida* and *Penstemon gormanii* as the dominant species around their burrows. Almost all of the grasslands had an abundance of horse droppings; there were feral horses in the area, and outfitters passing through had been grazing their horses in the grasslands in the recent past (as indicated by the outfitters).

Several forb species are more common on the crest than on the main part of grassland slopes. These include *Bupleurum americanum* (*B. triradiatum*), *Erigeron caespitosus*, and *Oxytropis splendens*. On the crests, *Artemisia frigida* and *Carex filifolia* were less dominant than on the slopes (Table 1).

Grassland Comparisons

The list of species compiled from studies of southwest Yukon grasslands (Table 2) totals 109 taxa. Sixty-four of these were recorded by one study only, but of these some (e.g., *Amelanchier alnifolia, Bromus ciliatus,* and *Potentilla fruticosa*) are ecotone species and may not have been

TABLE 1. Species, frequencies, and average covers in the Aishihik-Sekulmun grasslands. (Authorities are given in Table 2.)

Species	Frequency (%) (slope communities) n = 13	Average Cover[1] (slope communities)	Frequency (%) (crest communities) n = 5	Average Cover[1] (crest communities)
Graminoids				
Bromus pumpellianus var. *pumpellianus*	39	1	80	1
Calamagrostis purpurascens	77	1	100	1
Carex filifolia	92	2	80	1
Danthonia intermedia	0	—	20	+
Elymus calderi	15	1	20	+
E. trachycaulus ssp. *andinus*	15	+	0	—
E. trachycaulus ssp. *subsecundus*	8	+	20	+
Festuca brachyphylla	0	—	20	1
F. saximontana	15	+	60	1
Koeleria asiatica	15	1	20	1
Poa glauca	85	1	80	1
Shrubs and Forbs				
Achillea millefolium ssp. *borealis*	15	+	0	—
Androsace septentrionalis	62	+	40	+
Arenaria capillaris	15	1	40	1
Artemisia frigida	100	2	80	1
Aster alpinus spp. *vierhapperi*	8	1	0	—
Braya humilis	8	+	0	—
Bupleurum americanum	31	+	80	1
Castilleja hyperborea	8	+	0	—
Cerastium arvense	0	—	20	1
Chamaerhodos erecta ssp. *nuttallii*	23	+	0	—
Epilobium angustifolium	8	+	20	+
Erigeron caespitosus	31	+	60	1
Eriogonum flavum var. *aquilinum*	8	1	0	—
Erysimum angustatum	8	+	0	—
Linum lewisii	0	—	20	+
Oxytropis splendens	31	+	80	1
O. viscida	8	+	20	1
Penstemon gormanii	77	1	0	—
Phlox hoodii	62	1	100	1
Plantago canescens	0	—	20	+
Potentilla litoralis	46	1	80	1
P. pensylvanica	77	+	60	1
Pulsatilla ludoviciana	69	+	100	1
Saxifraga tricuspidata	23	1	20	+
Silene repens	0	—	20	+
Solidago simplex	15	+	40	1
Stellaria longipes	0	—	20	+
Zygadenus elegans	0	—	20	1
Bare ground	100	3	100	3

[1] Average cover expressed on Braun-Blanquet (1932) cover scale (+ = less than 1%, 1 = 1–5%, 2 = 6–25%, 3 = 26–50%); average cover includes only those grasslands in which the species was found.

consistently noted. Twelve species found in the Aishihik-Sekulmun grasslands were not reported from other southwest Yukon grasslands.

In total, 264 species have been reported from Alaska, southwest Yukon, and northern Great Plains (Alberta and Saskatchewan) grasslands, although many are found in only one of the regions. The largest group (about 44% of the total) comprised species restricted to the Great Plains, floristically the richest of the three regions. About 10% of the total species were restricted to southwest Yukon grasslands, and another 10% to Alaska grasslands. Thirty-seven species (14%) were found in all three regions. Alaska and southwest Yukon share 21 species not found in Great Plains grasslands. Southwest Yukon and the Great Plains have 25 species not found in Alaska, and Alaska and Great Plains grasslands share 11 species not found in southwest Yukon. The Sørenson indices of similarity (Table 3) indicate that Alaska and southwest Yukon grasslands are more similar to each other than either is to the Great Plains grasslands.

DISCUSSION

Southwest Yukon Grasslands

Of the twelve species reported only from Aishihik-Sekulmun grasslands, some are of particular interest. For example, *Eriogonum flavum* var. *aquilinum* is reported in Yukon only from this location, though it occurs also in Alaska (Cody, 1996). It is recognized as distinct from *Eriogonum flavum* var. *flavum* which is found in fescue

TABLE 2. Species found in southwest Yukon grasslands, listed by study. Grassland regions reported from include Yukon (Y), Alaska (A), and Great Plains (GP).

Species	Grassland Regions Reported From	Aishihik-Sekulmun	Douglas (1974) Af/Pg	Hoefs et al. (1975) Alliances 8 and 10	Lausi and Nimis (1991) G2 G3 G4	Laxton et al. (1996)
Graminoids						
Agropyron sibiricum (Willd.) PB.	Y					X
Bromus ciliatus L.	Y GP					X
B. pumpellianus Scribn. var. *pumpellianus*	A Y GP	X		X		X
Calamagrostis canadensis (Michx.) Beauv.	A Y GP					X
C. purpurascens R.Br.	A Y GP	X	X	X	X	X
Carex filifolia Nutt.	A Y GP	X		X	X	
C. obtusata Liljeb	A Y GP				X	
C. rupestris All.	A Y			X		
C. scirpoidea Michx.	A Y GP			X		
C. supina Wahl.	A Y		X			
Danthonia intermedia Vasey	A Y GP	X		X		
Elymus calderi Barkworth	Y	X	X	X	X	
E. trachycaulus (Link) Gould ex Shinners	A Y GP					X
E. trachycaulus(Link) Gould ex Shinners ssp. *andinus* (Scribn. & Smith) A. & D. Löve	A Y	X		X		
E. trachycaulus (Link) Gould ex Shinners ssp. *subsecundus* (Link) Gould	Y GP	X		X		
E. trachycaulus (Link) Gould ex Shinners ssp. v*iolaceus* (Hornem.) A. & D. Löve	A Y					X
Festuca altaica Trin.	A Y GP				X	
F. brachyphylla Schultes & Schultes fil.	Y	X	X		X	
F. ovina L. ssp. *alaskana* Holmen[1]	Y					X
F. saximontana Rydb.	Y GP	X				
Hierochlöe odorata (L.) Beauv.[1]	Y GP		X			
Koeleria asiatica Domin	Y	X				
Poa glauca Vahl	A Y	X	X	X	X	
Stipa comata Trin. & Rupr.	Y GP				X	
Shrubs						
Amelanchier alnifolia (Nutt.) Nutt.	A Y GP				X	
Arctostaphylos uva-ursi (L.) Spreng. s.l.	A Y GP	X		X	X	X
Juniperus communis L. s.l.	A Y GP	X	X	X	X	
Juniperus horizontalis Moench	A Y GP			X	X	
Potentilla fruticosa L.	Y GP					X
Rosa acicularis Lindl. s.l.	A Y GP	X	X	X	X	X
Salix glauca L. s.l.	A Y	X		X		
Shepherdia canadensis (L.) Nutt.	A Y GP	X	X	X	X	X
Forbs						
Achillea millefolium L.	Y GP		X			
A. millefolium L ssp. *borealis* (Bong.) Breitung	A Y	X		X	X	
Androsace septentrionalis L.	A Y GP	X				
Anemone multifida Poir. s.l.	A Y GP		X	X	X	X
A. narcissiflora L. s.l.	A Y					X
A. parviflora Michx.	A Y					X
Antennaria alpina (L.) Gaertn.	Y			X		
A. media Greene	Y			X		
A. microphylla Rydb.	Y GP				X	
A. rosea Greene	A Y GP		X	X		X
Arabis holboellii Hornem.	A Y GP			X	X	
A. holboellii Hornem. var. *retrofracta* (Grah.) Rydb.	Y GP		X			X
Arenaria capillaris Poir.	A Y	X				
Arnica angustifolia Vahl in Hornem.	A Y					X
Artemisia alaskana Rydb.	Y		X		X	
A. dracunculus L.	A Y GP			X		
A. frigida L.	A Y GP	X	X	X	X	X
A. furcata Bieb.	Y			X		
A. rupestris L. ssp. *woodii* Neilson	Y			X		
Aster alpinus L. ssp. *vierhapperi* Onno	Y	X		X		
Astragalus australis (L.) Lam.	Y GP			X		
A. williamsii Rydb.	Y			X		
Braya humilis (C.A. Mey.) Robins.	A Y	X				
Bupleurum americanum Coult. & Rose	A Y GP	X				

[1] Nomenclature as reported by original author(s).

TABLE 2. Species found in southwest Yukon grasslands, listed by study. Grassland regions reported from include Yukon (Y), Alaska (A), and Great Plains (GP) – *continued:*

Species	Grassland Regions Reported From	Aishihik-Sekulmun	Douglas (1974) Af/Pg	Hoefs et al. (1975) Alliances 8 and 10	Lausi and Nimis (1991) G2 G3 G4	Laxton et al. (1996)
Forbs – *continued:*						
Castilleja hyperborea Pennell	Y	X		X		
Cerastium arvense L.	Y GP	X				
Chamaerhodos erecta (L.) Bge. ssp. *nuttallii* (Pickering ex Rydb.) Hultén	A Y GP	X	X	X	X	
Draba aurea M. Vahl	Y			X		
Epilobium angustifolium L. s.l.	A Y GP	X			X	X
E. latifolium L.	Y		X			
Erigeron caespitosus Nutt.	Y GP	X	X	X	X	
E. compositus Pursh	A Y GP		X		X	
Eriogonum flavum Nutt. var. *aquilinum* Reveal	Y	X				
Erysimum angustatum Rydb.	Y	X		X		
Eurotia lanata (Pursh) Moq.	Y GP			X		
Fragaria virginana Duchesne	Y GP				X	
Galium boreale L.	A Y GP			X	X	X
Geocaulon lividum (Richards.) Fern.	Y					X
Gentianella propinqua (Richards.) J.M. Gillett	A Y				X	
Geum macrophyllum Willd. ssp. *perincisum* (Rydb.) Hultén	Y GP				X	
Hedysarum alpinum L.	A Y GP			X		
H. boreale Nutt. ssp. *mackenzii* (Richards.) Welsh	A Y		X	X		X
Lappula squarrosa (Retz.) Dumont	Y GP			X		
Linum lewisii Pursh	A Y GP	X	X	X	X	X
Maianthemum stellatum (L.) Link	A Y GP			X		
Melandrium apetalum (L.) Fenzl[1]	Y				X	
Mertensia paniculata (Ait.) G. Don var. *paniculata*	Y			X		
Minuartia rossii (R. Br.) Graebn.	Y			X		
Orobanche fasciculata Nutt.	Y GP			X		
Oxytropis campestris (L.) DC.	A Y GP				X	
O. campestris (L.) DC. ssp. *varians* (Rydb.) Cody	Y		X			X
O. huddelsonii A.E. Porsild	Y			X		
O. splendens Dougl.	Y GP	X		X		X
O. viscida Nutt. s.l.	A Y GP	X		X	X	
Penstemon gormanii Greene	A Y	X		X	X	X
P. procerus Dougl.	Y GP				X	
Phlox hoodii Richards.	Y GP	X				
Plantago canescens Adams	A Y GP	X		X	X	
Polemonium pulcherrimum Hook.	A Y				X	
Potentilla anserina L. s.l.	Y GP		X			
P. litoralis Rydb.	Y	X		X		
P. nivea L.	A Y	X		X	X	
P. norvegica L.	Y GP				X	
P. pensylvanica L.	A Y GP		X		X	
Pulsatilla ludoviciana (Nutt.) Heller	A Y GP	X	X	X	X	X
Saxifraga tricuspidata Rottb.	A Y	X	X		X	
Sedum lanceolatum Torr.	Y GP				X	
Senecio conterminus Greene[1]	Y			X		
Silene repens Patrin	A Y	X				
Solidago canadensis L var. *salebrosa* (Piper) Jones	Y					X
S. decumbens Greene[1]	A Y GP				X	
S. multiradiata Ait.	A Y				X	
S. simplex Kunth	Y	X	X	X		
Stellaria longipes Goldies. s.l.	A Y GP	X				
Townsendia hookeri Beaman	Y GP			X		
Vicia americana Muhl.	Y GP					X
Zygadenus elegans Pursh	A Y GP	X				

[1] Nomenclature as reported by original author(s).

and mixed grasslands of the Great Plains, indicating a specific floristic similarity between the Yukon and Alaska grasslands. On the other hand, *Phlox hoodii* was a subdominant on some slopes in the Aishihik-Sekulmun area, but was not reported from other Yukon grasslands; it is an important plant in dry grasslands in the northern Great Plains. Given their broad distributions in southwest Yukon, both *Festuca saximontana* and *Cerastium arvense* would be expected in, but are not reported from, other southwest Yukon grasslands. *Koeleria asiatica* is disjunct

TABLE 3. Sorenson similarity indices for pairs of grassland regions. Maximum value = 1; minimum value = 0.

	Aishihik-Sekulmun	Kluane	Southwest Yukon	Alaska	Great Plains
Aishihik-Sekulmun	1.00				
Kluane	0.39	1.00			
Southwest Yukon[1]			1.00		
Alaska	0.38	0.56	0.66	1.00	
Great Plains	0.18	0.34	0.43	0.40	1.00

[1] Southwest Yukon includes Aishihik-Sekulmun and Kluane.

in mountains of southwest Yukon from its Amphi-Beringian distribution, and its occurrence in the Aishihik-Sekulmun grasslands is of interest; it was not reported from Alaska grasslands. Of the other seven species, four are reported from Alaska grasslands (*Arenaria capillaris, Bupleurum americanum, Braya humilis, Silene repens*) and three from both Alaska and Great Plains grasslands (*Androsace septentrionalis, Stellaria longipes,* and *Zygadenus elegans*). Another species of interest is *Eurotia lanata* as it is disjunct in southwest Yukon, with its main distribution in mixed prairie, westward in Canada, and south. This species was found in the Aishihik-Sekulmun area by Pearse Bowden Consultants Ltd. (1972) and in the Kluane area by Hoefs et al. (1975), but I did not find it in this study.

Fifteen species were found by at least four of the five studies of southwest Yukon grasslands: these form the core group of grassland species. All but one of these (*Anemone multifida*) was found in the Aishihik-Sekulmun area. Only six species were recorded in all southwest Yukon grassland studies. In fact, nearly two-thirds of the total southwest Yukon grassland species were recorded by only one study, indicating the variations among the grasslands. The dominant and subdominant species occur consistently, but with variations in their relative importance. There are many differences among grasslands in the occurrences of the more minor species. Whether the floristic differences among southwest Yukon grasslands are real or an artifact of limited investigation needs to be addressed by further research.

Laxton et al. (1996) found that in grasslands around the southern end of Kluane Lake, productivity and species diversity increase with the amount of silt in the soil, which presumably indicates a greater amount of Neoglacial loess deposition. The Aishihik-Sekulmun grasslands do not receive loess deposition and would be expected to fit into the less productive and diverse end of the spectrum. Productivity was not measured at the Aishihik-Sekulmun grasslands in this study, but Johansen et al. (1989) found forage productions of 450 kg/ha in grasslands that receive windblown loess (e.g., those close to the Donjek River) and 275 kg/ha in those on shallow soils in the Aishihik Lake area. The number of species I recorded from individual communities in the Aishihik-Sekulmun area ranged from 6 to 21, a range very similar to the range of 2–20 species that Laxton et al. (1996) reported for individual 10 m × 10 m plots in Kluane grasslands.

Lausi and Nimis (1991:85) suggested that the Kluane Lake grassland community type "behaves as a long-lasting stage of a succession leading, through an intermediate stage with *Populus tremuloides* and *Arctostaphylos uva-ursi*, to a xerophytic *Picea glauca* forest." Hoefs et al. (1975:157) described a *Populus tremuloides-Rosa acicularis-Shepherdia canadensis* association that is "a successional stage between white spruce climax forest and grasslands." In the Aishihik-Sekulmun area, the boundary at the crests of slopes between north-facing white spruce forest and south-facing grassland appeared to be very stable (Fig. 2), with no establishment of spruce seedlings in the grassland. Along the lower and lateral edges of grassland slopes, however, the *Populus tremuloides-Rosa acicularis-Arctophylos uva-ursi* community appeared to be invading, apparently held in check by browsing. The extent of damage indicated that the snowshoe hare population was probably near a population cycle peak that year and that snowshoe hares are a very important factor in the maintenance of the grasslands. Hares can browse up to about 0.5 m above ground level when there is no snow cover and higher as snow accumulates (Banfield, 1974:82–83). Extensive damage to dwarf birch and white spruce seedlings and saplings was also noted throughout the Aishihik-Sekulmun area. Spruce is not a preferred food species of hares, but they will eat it when food is scarce. Spruce seedlings were found invading the grassland slopes only rarely, which supports the conclusion of Lausi and Nimis (1991) that the Yukon grasslands are a long-lasting successional stage; under present climate conditions, it seems likely that they are a stable disclimax on these south-facing slopes. In the Aishihik-Sekulmun area, browsing by snowshoe hare, some slope destabilization by arctic ground squirrel grazing and burrowing, and the localized aridity of the south-facing slopes limit the loss of grasslands to aspen or spruce forest invasion.

In summary, the Aishihik-Sekulmun grasslands are representative of those found elsewhere in southwest Yukon, containing 14 of the 15 most widespread grassland species. However, the grasslands found in southwest Yukon seem to be quite variable because many of the other species recorded from grasslands were found by only one of the studies reported in this paper. The Aishihik-Sekulmun grasslands also have a floristic richness similar to that reported for Kluane grasslands (Laxton et al., 1996), in spite of the substantial differences in productivity (Johansen et al., 1989).

Boreal Grassland Comparisons

The floristic comparisons of the three regions (Alaska, Yukon, and northern Great Plains) attempted here have a number of limitations. First, data from a range of grassland community variations were used to compile the species list for each region, ignoring individual species' distributions within the regions. Second, comparisons of presence-absence, rather than abundance, give equal weight to all species in assessments of floristic similarity: regional differences in the relative importance of species in the grasslands are not considered. Third, the analysis relies entirely on taxa reported, and it is likely that other species occur but have not been seen. However, when these limitations of the analysis are kept in mind, the results can be cautiously interpreted as indicating relative floristic similarities and providing a list of species that can be searched for in future grassland surveys, especially in less well known areas.

In each of the three regions, a substantial portion of the flora is restricted to that region and absent from the other two: 28% in Alaska, 25% in southwestern Yukon, and 61% in the northern Great Plains grasslands. This is, in all cases, less than the 70% reported for Siberian boreal grasslands by Yurtsev (1982), and these figures support the conclusion of Lausi and Nimis (1991) that species exchanges were important in producing floristic similarities among extant North American grasslands. Many of the species restricted to one of the grassland regions occur in other nearby communities, e.g., arctic/alpine species in the case of Alaska grasslands or mixed prairie in the case of Great Plains fescue grasslands.

The Yukon and Alaska grasslands are more similar to each other than either is to the Great Plains grasslands, in part because so many Great Plains grassland species are restricted to that region. There are some important differences between southwest Yukon and Alaska grasslands, however. For example, some steppe indicator species, such as *Carex obtusata* and *Festuca lenensis* (Yurtsev, 1982), are largely or completely missing in southwest Yukon grasslands. *Carex filifolia*, mainly a more southern species, is very important in southwest Yukon, but it is much less important in Alaska grasslands.

The 21 species found in both southwest Yukon and Alaska grasslands represent a significant portion of their floras, about 25% for each. The floristic similarity between these two regions suggests that the grasslands developed their present form either in part from a species group widely distributed in glacial times or via species exchanges between the two regions.

CONCLUSIONS

The grasslands found in the Aishihik-Sekulmun area are similar to grasslands found elsewhere in southwest Yukon, but contain several species not reported from the others. Further studies are needed to more completely characterize southwest Yukon grasslands. A floristic comparison of boreal grasslands shows that grasslands in Alaska, Yukon, and the northern Great Plains have many species unique to each area (as compared to the other two), but also many species in common. The number of species shared among Alaska, southwest Yukon, and Great Plains grasslands suggests that either relict communities, or species exchanges, or both were important in producing the modern grasslands.

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