

Description of a relict aspen parkland-associated grassland in the Peace River region of British Columbia, Canada

NICHOLAS P. HAMILTON

British Columbia Ministry of Forests, Prince George, British Columbia V2N 4W5 Canada; email: nick.hamilton@gov.bc.ca

Hamilton, N.P. 2023. Description of a relict aspen parkland-associated grassland in the Peace River region of British Columbia, Canada. *Canadian Field-Naturalist* 137(4): 327–333. <https://doi.org/10.22621/cfn.v137i4.3057>

Abstract

The aspen parkland-associated grasslands of the Peace River region, British Columbia (BC), have been severely reduced in area, primarily because of agricultural and urban development. In this region, the species composition of plant communities is similar to that of prairie grasslands and is topographically influenced, occurring primarily on warm-aspect slopes along the Peace River and some of its tributaries. Historical records show that non-forested grass- and sedge-dominated plant communities occurred on flat and gently rolling terrain in a parkland ecosystem near what are now the communities of Dawson Creek and Fort St. John. The Peace grasslands are not represented in BC's biogeoclimatic ecosystem classification, perhaps leading to their neglect in regional natural resource management and conservation planning. Here, I describe the vascular plant community of a level-terrain relict aspen parkland-associated grassland in the Peace River region. Its species composition differs from nearby warm-aspect grasslands and includes provincially listed plant species. Increased awareness of grassland communities may support conservation, ecosystem restoration, and climate change adaptation in the southern boreal region of BC.

Key words: Aspen parkland; grasslands; Peace River; relict

Introduction

Across the Great Plains of North America, the aspen parkland ecosystem is broadly transitional—in climate and plant species composition—from grasslands to boreal forests (Rowe and Coupland 1984). Aspen parkland extends from Manitoba to western Alberta, with some descriptions including areas in the Peace River region of northeastern British Columbia (BC; Moss 1932, 1952). The biogeoclimatic ecosystem classification system of BC excludes aspen parkland. Plains on the eastern side of the Rocky Mountains are included in its Boreal White and Black Spruce zone (Meidinger and Pojar 1991). Further, although climate and disturbance regimes drive parkland vegetation to the south (Hogg 1994), various soil properties that limit tree growth are an additional factor in maintaining parkland conditions in the Peace River region's boreal climate (Wilkinson and Johnson 1983). Parklands include a mosaic of forested, grassland, and shrubby vegetation. In this study, I focus on the grassland component, and hereafter "grasslands" refers to grassland parts of the parkland mosaic/ecosystem.

In BC's Boreal White and Black Spruce zone, grasslands are limited to steep, warm-aspect slopes of some major river valleys, especially along the

Peace River (Pojar 1982; DeLong *et al.* 2011). These topographically influenced grasslands are floristically similar to prairie grasslands, as Coupland (1961) described. Common species include Northern Wheatgrass (*Elymus lanceolatus* (Scribner & J.G. Smith) Gould), Western Wheatgrass (*Pascopyrum smithii* (Rydberg) Barkworth & D.R. Dewey), Western Porcupine Grass (*Hesperostipa curtiseta* (Hitchcock) Barkworth), and Junegrass (*Koeleria macrantha* (Ledebour) Schultes; Moss 1952; Pojar 1982). Considering current landscape patterns, the biogeoclimatic ecosystem classification treatment of grasslands as "non-zonal" because of topographic influences is accurate; grasslands are generally limited to steep, warm-aspect slopes of some major river valleys. However, an early soil survey (Farstad *et al.* 1965), early pre-agricultural descriptions (Dawson 1881; Macoun 1904), and an early account by Raup (1934) of BC's Peace region suggest an aspen parkland ecosystem existed that included level and gently rolling terrain in areas surrounding what are now the communities of Dawson Creek and Fort St. John. The grassland plant communities on the level and gently sloping terrain of this ecosystem have been considered lost to agricultural cultivation and urban development (Wikeem and Wikeem 2004). Native

grassland plant communities in the region remain primarily on slopes too steep for cultivation.

In spring 2022, the Province of BC invited me to comment on a resource extraction permit process for the expansion of a gravel quarry in a grassland. The notification included the location of the grassland area in the Peace region, at the confluence of the Pine and Peace rivers, where vegetation is predominantly native grasses. The area is flat, indicating that it may be a relict aspen parkland-associated grassland and perhaps representative of formerly more extensive plant communities in the southern part of BC's Peace region. The grassland area is the site of a large, expanding gravel quarry that is reducing its extent. I surveyed this grassland to characterize its vascular plant biodiversity and inform conservation and management.

Methods

The grassland covers ~200 ha at the confluence of the Pine and Peace rivers in northeastern BC (56.152823°N, 120.766177°W), near the community of Taylor. The area is in the moist warm Boreal White and Black Spruce subzone (DeLong *et al.* 2011); mean annual temperature is 2.3°C and mean annual precipitation is 392 mm, with average temperatures of -14.5°C in January and 16.4°C in July for the 1981–2010 climate normal period (Wang *et al.* 2016). Soils are classified as the Clayhurst type, which consists of Eluviated Eutric Brunisols that have a sandy loam veneer over gravelly and sandy glaciofluvial deposits (Lord and Green 1986). The grassland is in Treaty 8 territory and on the traditional territory of the Dane-Zaa people. The area is mostly provincial Crown land with provincial grazing tenure allocation, and part of the area is private land.

Field sampling was carried out on 27 July 2022. I placed a single 10 m × 10 m plot on a location judged to represent average plant cover conditions. Considering the flat terrain (no ridges or swales), the plot location was representative of the grassland, excluding shrubbier areas bordering forest edges. Within the plot, I estimated vascular plant species cover

according to modified Daubenmire (1959) cover classes with the cover-class categories, range (mid-point) for each category as follows: “trace” <1%, 1 = 1–<5% (2.5%), 2 = 5–<25% (15%), 3 = 25–<50% (37.5%), 4 = 50–<75% (62.5%), 5 = 75–<95% (85%), and 6 = 95–100% (97.5%). The sole modification to the Daubenmire cover classes was adding the trace category to better represent the abundance of sparse species (cover class categories and mid-points are described in Mueller-Dombois and Ellenberg [2003]). I also walked through the grassland for ~2 h recording all observed additional species; however, considering the reconnaissance nature of this project, I likely missed some species, especially those not visible in summer, such as spring-flowering forbs. No vouchers were collected because of time limitations and my 20 years of experience in plant ecology work in grasslands. At two locations near the plot, I sampled soil to a depth of 20 cm, recording soil colour and assessing the proportion of soil particle size according to the soil texturing key (Province of British Columbia 2010: 38).

Results

I recorded a total of 48 plant species in the grassland (Table 1): 30 occurring in the plot and an additional 18 found in my survey across the grassland (Figure 1). The plot location was a good representation of average cover values of frequent species throughout the grassland, while additional infrequently occurring species were recorded outside the plot. Richardson's Needlegrass (*Eriocoma richardsonii* (Link) Romaschenko) was the most abundant grass species throughout the grassland, while Slender Wheatgrass (*Elymus trachycaulus* (Link) Gould ex Shinners), Western Porcupine Grass, Junegrass, Vasey's Oatgrass (*Danthonia intermedia* Vasey), and Spike Oat (*Helictochloa hookeri* (Scribner) Romero Zarco) had lower cover values but were highly frequent. The grassland had high forb cover, with Northern Bedstraw (*Galium boreale* L.) and Prairie Smoke (*Geum triflorum* Pursh) present across the grassland and an additional 28 forb species

TABLE 1. Species composition of the grassland according to modified Daubenmire (1959) coverage classes. The cover class ranges were determined by ocular estimation of a single plot. As the plot was judged to be representative of the average condition of the grassland, the cover values are also an approximation for average cover across the grassland area.

Species	Cover class*	Status†
Grasses and sedges		
Richardson's Needlegrass, <i>Eriocoma richardsonii</i> (Link) Romaschenko	25–50	n
Western Porcupine Grass, <i>Hesperostipa curtisetata</i> (Hitchcock) Barkworth	1–5	n
Junegrass, <i>Koeleria macrantha</i> (Ledebour) Schultes	1–5	n
Vasey's Oatgrass, <i>Danthonia intermedia</i> Vasey	<1	n
Spike Oat, <i>Helictochloa hookeri</i> (Scribner) Romero Zarco	<1	n
White-scaled Sedge, <i>Carex xerantica</i> L.H. Bailey	<1	n

TABLE 1. Continued.

Species	Cover class*	Status†
Rough Bentgrass, <i>Agrostis scabra</i> Willdenow	t	n
Smooth Brome, <i>Bromus inermis</i> Leysser	t	e
Rocky Mountain Fescue, <i>Festuca saximontana</i> Rydberg	t	n
Green Needlegrass, <i>Nassella viridula</i> (Trinius) Barkworth	t	n
Canada Ricegrass, <i>Piptatheropsis canadensis</i> (Poirot) Romaschenko, P.M. Peterson & Soreng	t	n
Kentucky Bluegrass, <i>Poa pratensis</i> L.	t	e
Purple Oatgrass, <i>Schizachne purpurascens</i> (Torrey) Swallen	t	n
Forbs		
Northern Bedstraw, <i>Galium boreale</i> L.	5–25	n
Prairie Smoke, <i>Geum triflorum</i> Pursh	5–25	n
Wild Onion, <i>Allium cernuum</i> Roth	1–5	n
Common Harebell, <i>Campanula rotundifolia</i> L.	1–5	n
Bastard Toadflax, <i>Comandra umbellata</i> (L.) Nuttall	1–5	n
Creamy Peavine, <i>Lathyrus ochroleucus</i> Hooker	1–5	n
Western Goldenrod, <i>Solidago lepida</i> de Candolle	1–5	n
Common Yarrow, <i>Achillea millefolium</i> L.	<1	n
Cut-leaved Anemone, <i>Anemone multifida</i> Poiret	<1	n
Field Chickweed, <i>Cerastium arvense</i> L.	<1	n
Richardson's Alumroot, <i>Heuchera richardsonii</i> R. Brown	<1	n
Virginia Strawberry, <i>Fragaria virginiana</i> Miller	<1	n
American Vetch, <i>Vicia americana</i> Muhlenberg ex Willdenow	<1	n
Rock Cress, <i>Arabis</i> sp.	t	n
Frog Orchid, <i>Coeloglossum viride</i> (L.) Hartman	t	n
Philadelphia Fleabane, <i>Erigeron philadelphicus</i> L.	t	n
Umbellate Hawkweed, <i>Hieracium umbellatum</i> L.	t	n
Mint-leaved Bergamot, <i>Monarda fistulosa</i> var. <i>menthifolia</i> (Graham) Fernald	t	n
Silky Locoweed, <i>Oxytropis sericea</i> Nuttall	t	n
Showy Locoweed, <i>Oxytropis splendens</i> Douglas ex Hooker	t	n
Sticky Cinquefoil, <i>Drymocallis glandulosa</i> (Lindley) Rydberg var. <i>glandulosa</i>	t	n
Woolly Cinquefoil, <i>Potentilla hippiana</i> Lehmann	t	n
Prairie Cinquefoil, <i>Potentilla pensylvanica</i> L.	t	n
White-leaved Cinquefoil, <i>Potentilla pulcherrima</i> Lehmann	t	n
Strict Blue-eyed Grass, <i>Sisyrinchium montanum</i> Greene	t	n
Starry False Solomon's Seal, <i>Maianthemum stellatum</i> (L.) Link	t	n
Lindley's Aster, <i>Symphyotrichum ciliolatum</i> (Lindley) Á. Löve & D. Löve	t	n
Smooth Blue Aster, <i>Symphyotrichum laeve</i> (L.) Á. Löve & D. Löve	t	n
Veiny Meadow-rue, <i>Thalictrum venulosum</i> Trelease	t	n
Yellow Salsify, <i>Tragopogon dubius</i> Scopoli	t	e
Shrubs		
Common Bearberry, <i>Arctostaphylos uva-ursi</i> (L.) Sprengel	5–25	n
Wild Prickly Rose, <i>Rosa acicularis</i> Lindley	5–25	n
Saskatoon, <i>Amelanchier alnifolia</i> (Nuttall) Nuttall ex M. Roemer	1–5	n
Western Snowberry, <i>Symphoricarpos occidentalis</i> Hooker	1–5	n
Trembling Aspen, <i>Populus tremuloides</i> Michaux	t	n

*<1 indicates low abundance inside the plot; t (trace) indicates additional species found in the grassland area outside the plot. Species in the <1 cover class inside the plot tended to have greater frequency across the grassland than trace species that were found only outside the plot.

†n = native, e = exotic.



FIGURE 1. a. The plot used as an approximation of cover values for the grassland. b. An overview of the area with the grasslands on warm aspect slopes along the Peace River in the background. c. A patch of Mint-leaved Bergamot (*Monarda fistulosa* var. *menthifolia*) in the foreground with inflorescences of native grasses in the background. Orange markers in b are part of the gravel quarry operation. Photos: Nicholas Hamilton.

with low cover values and various levels of frequency. Low-growing shrubs occurred across the grassland, mainly Bearberry (*Arctostaphylos uva-ursi* L.) and Wild Rose (*Rosa acicularis* Lindley), with more Sas-

katoon (*Amelanchier alnifolia* Nuttall ex M. Roemer) and Western Snowberry (*Symphoricarpos occidentalis* Hooker) near grassland-forest edges. There were several occurrences of Canada Ricegrass (*Piptattheropsis canadensis* (Poirlet) Romaschenko, P.M. Peterson & Soreng); White-scaled Sedge (*Carex xerantica* L.H. Bailey) was low-cover but common. These two species are provincially red- and blue-listed, respectively (BCCDC 2022). Occasional patches of Mint-leaved Bergamot (*Monarda fistulosa* var. *menthifolia* (Graham) Fernald), which is at its BC northern limit in the Peace River valley, tended to be closer to forest edges. Near the grassland-forest boundary, there were shrubby areas, where Green Needlegrass (*Nassella viridula* (Trinius) Barworth) was more abundant than elsewhere in the grassland. The exotic grass Smooth Brome (*Bromus inermis* Leysser) was invading the grassland from the edges and was likely the most abundant grass species in shrubby forest-grassland edge areas.

Surface humus layers were absent, with substrates consisting of vegetation and grass/forb leaf litter on mineral soil. There was low cover of mosses and lichens, which were not identified to species. Soil texture above 20 cm depth was a loam with some sandy feel—indicating it is close to the boundary between classification as a loam and sandy loam. The colour of the surface mineral soil was very dark brown for the first 5 cm, indicating abundant incorporated organic matter, and dark greyish brown from 5 to 15 cm depth. Cobble content was high near the soil surface (top 5 cm), with fewer at greater (5–15 cm) depths. I did not reach the layer of gravelly deposits with higher coarse fragment content that reportedly occur beneath the loam veneer at >25 cm depth (Lord and Green 1986).

Discussion

This grassland site is an example of the biological diversity of an aspen parkland ecosystem that has been nearly extirpated in BC. Although the soils are well drained (Lord and Green 1986), the plant community reflects conditions that are less xeric than warm-aspect slopes along the river valleys. Notably, the indicators of topographically driven grasslands of the boreal climate—Northern Wheatgrass and Western Wheatgrass—are absent. Instead, the presence of numerous species indicates a strong similarity to the “Semi-open Prairies” (Raup 1934) and the “Agropyron-Stipa” plant communities Moss (1952) described for flat and gently rolling terrain in the parkland areas of the Peace regions of Alberta and BC. The diversity and abundance of native needlegrasses are similar to the higher elevation (cooler climate) grasslands of BC’s Cariboo–Chilcotin region (Hamilton *et al.* 2022). However, compared with the

Cariboo–Chilcotin grasslands, the Peace grassland has more forbs, higher shrub cover, less exotic Bluegrass (*Poa pratensis* L.), and a greater abundance of Slender Wheatgrass. Also, the plant community has several species that are specific to the Great Plains (do not occur in the intermountain regions of BC), such as Spike Oat, Richardson’s Alumroot (*Heuchera richardsonii* R. Brown), and Showy Locoweed (*Oxytropis splendens* Douglas ex Hooker). All the species I observed have been found by others in the Peace region (Moss 1952). The presence of cobbles near the soil surface and glaciofluvial gravels at greater depths likely contribute to limiting growth of trees on this site. However, it seems that the near-surface loam veneer has sufficient water-holding capacity to support a mesic grassland plant community. Although there is grazing tenure over the Crown land parts of the grassland, it appears that grazing has not occurred for a long time, given the absence of manure. The excessive accumulation of grass litter appears to suppress grass growth. A low-severity disturbance, such as light grazing or prescribed fire, may increase site productivity.

Grassland and parkland conditions are reported as the native vegetation for Black and Dark Gray Solod and Solonetzic Chernozem (Farstad *et al.* 1965; Lord and Green 1986)—soil types that are now entirely under cultivation and other development. Similarly in Alberta, <0.5% of upland Peace parkland grasslands remain in native condition, with losses attributed primarily to agricultural cultivation (Baker 2005). Despite the well-drained soil conditions at this level-terrain relict aspen parkland grassland, there is a strong similarity in species composition to the gentle-terrain Peace parkland grasslands described by Raup (1934), Moss (1952), and Baker (2005). Notably, Raup provides a detailed account of Peace grasslands at a time when more extensive uncultivated sites were likely still present. Raup creates two groups of grassland plant species: one more commonly occurring on steep warm-aspect slopes along river valleys, and a second occurring more commonly on mesic gentle terrain (i.e., not steep-flat or slightly sloping or gently rolling), noting there were various intermediate conditions containing plants of both groups. The relict grassland of my study contains multiple species of both groups, but is lacking indicators of the wettest and driest conditions, suggesting an edaphic condition intermediate to dry and mesic grasslands. Therefore, I suggest that instead of viewing this relict grassland as a phenomenon of well-drained soils in a predominantly forested landscape, it may be considered as representing one of the possible grassland conditions in the context of a parkland landscape that was once extensive through the Alberta and BC Peace

region. A final comment on Raup’s description is that some of the species and plant associations described are not present in modern accounts (e.g., Baker 2005; Willoughby *et al.* 2021), likely reflecting the loss of Peace grasslands plant communities.

Relicts are important for ecosystem management and conservation, serving as reference conditions for ecological restoration in similar areas. Remnant native grasslands are also culturally significant and can provide a source of local propagules for native plant cultivation. Peace parkland grasslands support populations of butterflies and moths that are disjunct from their main ranges in the prairie regions further south (Schmidt *et al.* 2014). According to the earliest Euro-Canadian accounts, populations of bison (likely Wood Bison [*Bison bison* var. *athabascae*]) and Elk (*Cervus canadensis*) were present along the Upper Peace River (Bowes 1963). Historically, Peace grasslands were important bison habitat and Indigenous peoples used prescribed fire to manage vegetation and bison populations (Ridington *et al.* 2013). A fur trading post, established in 1794 on a shore of the Peace River near Fort St. John, was the site of early interactions among Euro-Canadians (French and English speaking), Métis people from Central Canada and the Eastern Great Plains, and Indigenous peoples from Northern Cordillera and the Northwestern Great Plains (Burley *et al.* 1996). Initially, hunting bison along the upper Peace was an important economic activity in supplying food to fur traders, but populations were severely depleted by the early 1800s (Burley *et al.* 1996) and extirpation occurred in the late 1800s or early 1900s (Bowes 1963; South Peace Historical Society 2023).

Quarry development of this site will remove ~50 ha of grasslands, which will leave 150 ha of grassland in native condition across Crown and private land. Under climate warming scenarios and increased fire frequencies, parkland and grassy conditions are projected to expand across parts of the southern boreal forest (Hogg and Hurdle 1995; Stralberg *et al.* 2018), including southern parts of the BC Peace region (MacKenzie and Mahony 2021). Therefore, conservation of ecological relicts in the Peace region may support climate change adaptation activities, such as restoration to native non-forested and parkland vegetation conditions. Future research on Peace parklands is required to improve conservation and management efforts, especially considering the dearth of research since the work of Moss (1952).

Acknowledgements

I thank Richard Kabzems for providing preliminary information on this grassland and Christopher Lewis for field assistance. I thank the reviewers

Dwayne Lepitzki, Jeff Saarela, and Sybille Haeussler for their feedback, which helped to improve this manuscript.

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Received 21 September 2022

Accepted 20 February 2024

Associate Editor: J.M. Saarela