

Small Patch Communities of Colin-Cornwall Lakes Wildland Provincial Park
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Front page: Hay sedge (*Carex siccata*) graminoid slopes on north shore of Colin Lake.
Photo by L. Allen

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Introduction

In July 2002 Colin-Cornwall Lakes Wildland Provincial Park (CC) was surveyed to document small patch plant communities. Small patch plant communities add considerably to the diversity of a site, harbouring flora and potentially fauna dependent on these specialized habitats¹. They are, however, often overlooked in vegetation studies because they are neither extensive nor common enough to be considered representative. The focus of this study was to look within the matrix of the representative plant communities to find and document the small patch communities that may be significant in a provincial context.

CC is a remote site located in the northeast corner of Alberta, situated along the Saskatchewan boundary, about 50 km south of the Northwest Territories border (Figure 1). Two previous biophysical investigations of the site have been carried out. In 1978, a team from the Biogeoclimatic Ecosystem Classification of Alberta project spent three days on the west end of Colin Lake and sampled four sites². In 1983 several sites around Colin and Woodman lakes were investigated as part of a project to collect background information for an overview report on the Canadian Shield Natural Region of Alberta³. The 2002 field program was centred in the Colin and Woodman lakes area.

CC is situated within the Kazan Upland Subregion of the Canadian Shield Natural Region. Bedrock makes up an average of 60% of the landscape of the subregion⁴ and plays a dominant role in defining the character of the site. The portion of the Canadian Shield that occurs in Alberta is made up of three major north – south trending bands of bedrock (Numbers 1, 2a and 3 in Figure 2), with small inclusions of two other rock types (2b and 4 in Figure 2). CC includes examples of all three of these major bands (Figure 2). Colin Lake is within the easternmost band, predominantly made up of granitoids (No. 1 in Figure 2). There is also a portion of the granitoid band that is found directly north of Woodman Lake. Generally, the area from west of Colin Lake to Cornwall Lake and including Woodman Lake is within the central band of rocks, which are predominantly granitic gneisses (No. 3, Figure 2). The area south of and west of Cornwall Lake is part of the westernmost band of shield rocks, which are also predominantly granitoids (No. 2a, Figure 2). Potentially, these differences in bedrock may be reflected in differences in vegetation.

During glaciation, the rocks were scraped clean, leaving large areas of essentially bare rock. There are, however, some areas where glacial debris was left behind – including an area of glaciofluvial and glaciolacustrine sands north of Colin Lake. There is also a series of ridges along the north shores of Colin Lake and the unnamed lake to the west of Colin Lake (called Camp Lake in this report). The ridges have been reported as either sections of an esker or more likely of a moraine³. Wetlands and lakes have formed in basins and faults between rock knobs. The landscape then is essentially extensive areas of rock outcrop interspersed with lakes, creeks and other wetlands, with sand plains in some areas.

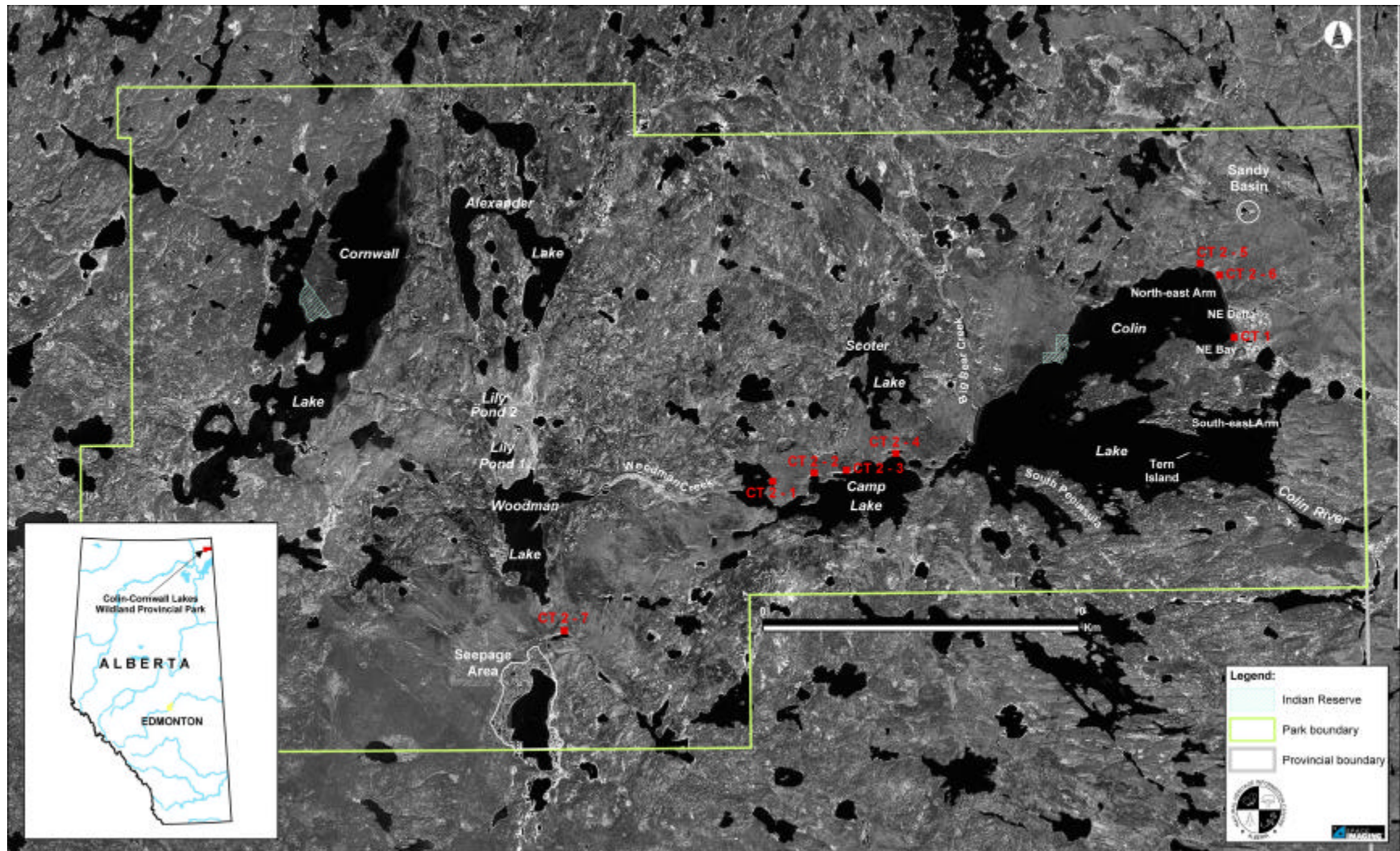


Figure 1. Colin-Cornwall Lakes Wildland Provincial Park: Location and Community Type (CT) Locations

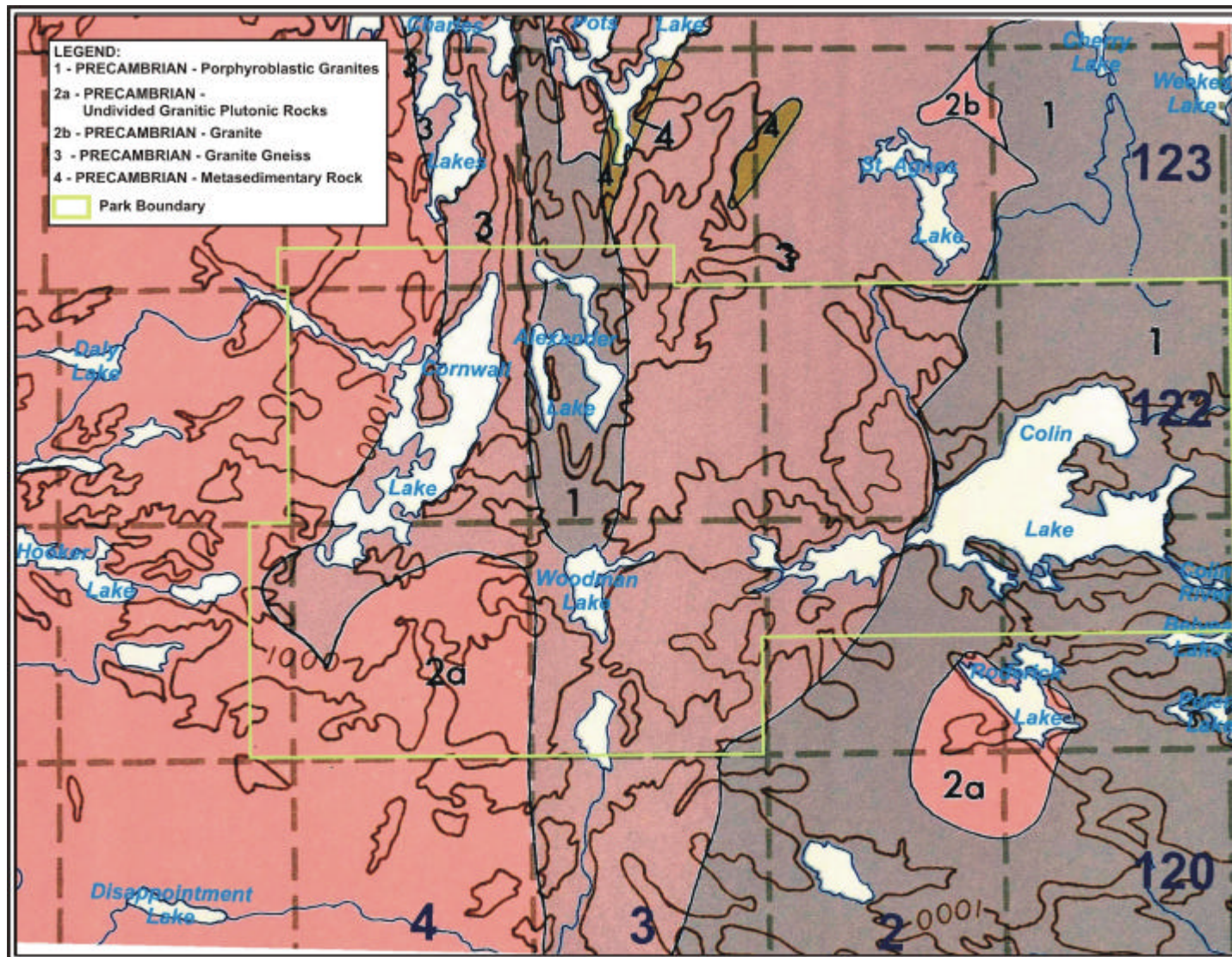


Figure 2. Bedrock geology of the Colin-Cornwall Lakes area (adapted from Green *et al.* 1970⁴)

Fire is another important factor defining the character of the area. Frequent fires have burned much of the area investigated. A large one in 1998 covered the majority of the landscape from the north shore of Colin Lake through to Woodman Lake. As a result, successional vegetation predominates and there are few mature stands. Any found tended to be on islands and peninsulas, surrounded by the protecting influence of water.

In their overview of the Kazan Upland Natural Subregion, Wallis and Wershler³ concluded that there are relatively few plant communities in the subregion. They broke them down into:

- Rock outcrop mosaics
- Jack pine (*Pinus banksiana*) woodlands on sandy plains and rocky hills
- Deciduous woodlands
- Black spruce bogs
- Sedge marshes in wet depressions
- Swamps of willow, larch and black spruce

The vegetation of CC follows this pattern. The rock outcrops that dominate the landscape are usually lichen covered, with vascular plant species largely restricted to cracks and pockets in the rocks where some soil and moisture collect. Stunted, open jack pine stands occur, usually with a well-developed understory of lichens, dominated by *Cladina mitis*. The sand plains also have open jack pine woodlands with a well-developed lichen understory. These jack pine stands on sand are very similar to the extensive stands that characterize the Athabasca Plains Natural Subregion. Wallis and Wershler³ detail the species expected to occur on these rocky sites and Raup and Argus⁵ discuss the similarities and differences between the sandy and rocky pine woods. Deciduous woodlands occur on moist sites, and are much less common than pine woods. Wallis and Wershler³ note, however, that the most extensive deciduous woodlands in the Kazan Upland Natural Subregion are around Woodman Lake.

Small creeks occasionally cut through the outcrops and wetlands have formed beside them and in pockets between rocky knobs. The wetlands are primarily poor fens or bogs, although sedge marshes have formed along some of the creeks. Lake-filled depressions with rocky shores are common. Wallis and Wershler³ note that although the shorelines of lakes are generally rocky and steep, the larger lakes often have a sloping east shoreline with sandy shoals and a sandy shore.

Methods

The focus of this work was to collect information on small patch communities in Colin-Cornwall Lakes Wildland Provincial Park. Although the information presented here will supplement the information on representative vegetation, emphasis was placed on documenting communities that may be significant in a provincial context.

A literature review was done for sites with similarities to the Wildland Provincial Park, including sites in northern Alberta, northwestern Saskatchewan and the nearby Northwest Territories. Several generalized plant communities such as “open pine stands” are mentioned as potentially of interest. In addition, some references mention habitats such as “grassy slopes” or “sandy shores” as being restricted in extent. Plant communities or habitats that have been documented as unusual in any way were noted

as types of interest that potentially occur within the Wildland Provincial Park. Wherever possible these types of interest were linked to habitats that could be picked out on aerial photographs. The types of interest and target habitats are listed in Appendix 1.

The Alberta Natural Heritage Information Centre Preliminary Plant Community Tracking List⁶ (TL) is a compilation of plant communities thought to be of restricted distribution in the province. Types known to occur in the Canadian Shield or Boreal Forest natural regions were linked to a habitat, and are listed in Appendix 2.

In total, 41 unusual communities or sites were identified through the literature and tracking list review and linked to target habitats (Appendices 1 and 2). In all, 22 different habitats were recognized as having potential to include one or more of the 41 unusual communities or sites. Appendix 3 summarizes the 22 target habitats. Aerial photographs for the Wildland Provincial Park were then reviewed and all locations of target habitats were marked. Also included in Appendix 3 is a note as to whether or not the target habitat is likely to occur in CC.

In addition, “special habitats” around Colin and Woodman lakes³, were added to the list of target areas. Wallis and Wershler³ identify grassy slopes at Colin and Woodman lakes as the only known location for these grasslands in the Kazan Upland Natural Subregion. This habitat was already on the target list. Following are the other special habitats noted by Wallis and Wershler that were added to the target list:

- rocky islands, for their mature woodlands and the presence of species rare in the region;
- a wetland north of Colin Lake in a sandy basin with unusual species and plant communities; and
- a seepage area around the unnamed lake south of Woodman Lake with plant species not encountered elsewhere during their study.

As many target areas as possible were visited during the field program (July 6 - 10, 2002). Sites were reached on foot or by boat. Unfortunately, the summer of 2002 was hot and very dry in northeastern Alberta. Wildfires flared up and the field crew was evacuated well before the fieldwork was finished.

Considerable reconnaissance work was accomplished, but detailed studies that were planned for some of the target sites, like the grassland communities, were not completed. Only one of the grassland occurrences was documented, using a 5 X 5 m vegetation plot, subjectively placed in a homogeneous location. Site data and floristic composition were documented and the percent cover of each species visually estimated. Other grassland sites were noted and some general descriptive notes made, but documentation through plots, although planned, was not completed.

Specimens of difficult taxonomic groups or of unknown species were collected and identified in the camp or pressed for later identification. Scientific names for the most part follow Moss⁷, but have been updated to be consistent with the taxonomy used by the Alberta Natural Heritage Information Centre. When taxonomy other than Moss is used, the name found in Moss is included in parenthesis in the discussion of the community type (CT). Common names follow Ealey⁸. The methods outlined here are discussed in more detail in ANHIC 2002⁹.

Results

Table 1 summarizes the targeted habitats that might reasonably be expected to occur in CC, determined by an overview of the aerial photographs. Of the 22 target habitats listed in Appendix 3, fourteen had potential to occur in CC. If a community type (CT) was located that was considered potentially significant, it is noted in the observations column and documented in further detail in the following section.

Table 1. Target Habitats	
Target Habitats	Observations
Uplands	
Deciduous stands	Stands visited, no unusual types noted
Graminoid openings in forests	No sites located on aerial photographs or noted during field study
North-facing cliffs	Sites visited, rare moss species noted but more work needed to determine CT
Open graminoid slopes	Sites visited and documented (CT2. <i>Carex siccata</i> [hay sedge] graminoid slopes)
Open pine stands	Stands visited, no unusual types noted
Shrubby forest openings	Sites visited, no unusual types noted
Riparian	
Shrublands	Sites visited, no unusual types noted
Wetlands	
Beaver ponds, ponds with open water	Sites visited, no unusual types noted
Fens	Sites visited, no unusual types noted
Larix fen	One small stand visited, no unusual types noted
Protected bays in lakes	Sites visited, one CT documented (CT1. <i>Isoetes echinospora</i> [northern quillwort] submergent aquatic community)
Sandy shoreline	Sites visited, no unusual types noted
Shrubby fen	Sites visited, no unusual types noted
Slow moving streams	Sites visited, no unusual types noted
Additional Targets (from Wallis and Wershler ³)	
Rocky islands with mature woodlands	Sites visited, no unusual types noted
Sandy wetland north of Colin Lake	Site not visited due to insufficient time
Seepage area south of Woodman Lake	Site not visited due to insufficient time

Plant Communities Documented

Most landscape types visited did not support plant communities that were considered unusual. In these cases, plant communities present were simply noted. A short description of these types is included in Appendix 4, with photographs of selected types provided in Appendix 5. Two plant community types (CT) of potential significance are documented in more detail in the following section. These are:

CT1. *Isoetes echinospora* submergent aquatic community
Northern quillwort submergent aquatic community

CT2. *Carex siccata* graminoid slopes
Hay sedge graminoid slopes

The general locations of the sites documented for each CT are given in Figure 1. Detailed information for each community is presented below, followed by a discussion, an evaluation of the community's significance, and brief recommendations.

Detailed Plant Community Information

CT1. *Isoetes echinospora* submergent aquatic community
Northern quillwort submergent aquatic community

Location (Figure 3)

Colin Cornwall Wildland Provincial Park

UTM 12V 552005.94 Easting 6605981.78 Northing (NAD 83)

Site description

The northern quillwort submergent aquatic community occurs in Colin Lake at the east end of the north arm. The community is found in from about 20 cm to 1 m deep water near the shore, rooted in a sandy bottom.

Comments

Northern quillwort is mixed in with seedlings of arum-leaved arrowhead (*Sagittaria cuneata*). Seedlings are difficult to identify, so there may also be other species of aquatic plants present in the community. There were thousands of plants in the community, with northern quillwort appearing to be the dominant, although is difficult to verify.

Discussion

The northern quillwort submergent aquatic community has also been found in Fidler-Greywillow Wildland Provincial Park (FGW), growing along the east shore of the largest lagoon on Bustard Island¹⁰. It was found in a band close to the shoreline, on a sandy substrate in water up to 30 cm deep. Northern quillwort was by far the dominant species. Seedlings of other aquatic species, primarily arum-leaved arrowhead, strands of water milfoil (*Myriophyllum* sp.), pondweeds (*Potamogeton* spp.), and some white water crowfoot (*Ranunculus aquatilis*) were the only other species noted.

The northern quillwort CT is in much deeper water in CC than in FGW on Bustard Island. The primary reason for the difference may be wave action and ice scour.

Raup and Argus⁵ noted that the Lake Athabasca region is poor in aquatic plants, probably because of wave and ice action. The shoreline at Colin Lake is more subject to both than is the lake on Bustard Island, so the plants may have to be in deeper water to avoid getting ripped out. There were more species associated with the northern quillwort on Bustard Island, possibly because of the shallower water and reduced wave and ice action.

Significance

The northern quillwort submergent aquatic community is currently on the preliminary plant community tracking list⁶, ranked S1. The dominant species of the community, northern quillwort, is also considered rare in Alberta (ranked S1)¹¹.

Recommendation

The northern quillwort submergent aquatic community is recognized as a community of provincial significance. It should be recognized as a sensitive element of provincial significance in CC Wildland Provincial Park. Although only one location for this CT was found in CC, there appear to be other areas of suitable habitat that should be inspected such as at the east end of the south arm of Colin Lake and along the east shore of Cornwall Lake.

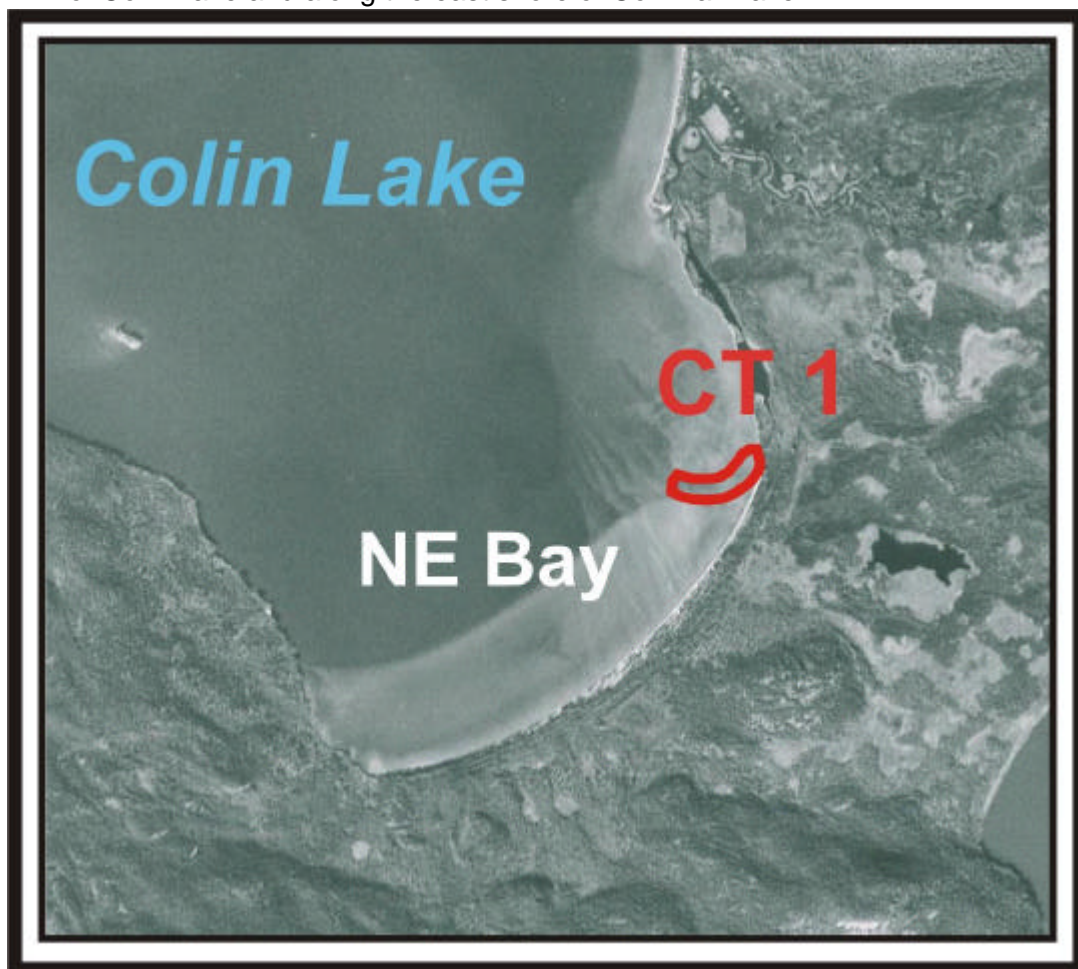


Figure 3. CT1 Occurrence Location

CT 2. *Carex siccata* graminoid slopes
Hay sedge graminoid slopes

Location (Figures 4, 5 and 6)

Colin-Cornwall Lakes Wildland Provincial Park

1. UTM	12V	537407.5 Easting	6601462.5 Northing (NAD 83)
2. UTM	12V	538752.5 Easting	6601672.5 Northing (NAD 83)
3. UTM	12V	539532.5 Easting	6601752.5 Northing (NAD 83)
4. UTM	12V	541232.5 Easting	6602287.5 Northing (NAD 83)
5. UTM	12V	550927.5 Easting	6608322.5 Northing (NAD 83)
6. UTM	12V	551527.5 Easting	6607882.5 Northing (NAD 83)
7. UTM	12V	530717.5 Easting	6596652.5 Northing (NAD 83)

Site Description

Wallis and Wershler first documented the graminoid slopes of CC³. They occur along the north shore of Camp Lake (Sites 1 through 4, Figure 4) and in two more locations along the north shore of Colin Lake (Sites 5 and 6, Figure 5). These slopes are part of a landform that has been reported as either an esker or more likely a moraine³. A seventh location is found at the edge of a small lake south of Woodman Lake (Site 7, Figure 6). This may be on a different landform, but it is still likely glaciofluvial in origin.

The graminoid communities occur on upper to mid-slope positions, sometimes interspersed with shrub communities. Shrublands or woodlands often develop at the toe of the slope. These communities have developed on steep south- to southwest-facing slopes of sandy and gravelly glacial deposits. The slopes are xeric, rapidly drained, and usually with considerable exposed mineral soil. Sandy areas are subject to blowouts.



Site 6

Photo by K. Vujnovic

Graminoid slopes interspersed with juniper communities, deciduous woodlands at toe of slope

Comments

A reconnaissance review of the grassland slopes was initiated to choose the best sites for transects. Detailed plots however were not done due to the sudden termination of the fieldwork. All sites were at least viewed from the boat and confirmed to be graminoid slopes except Site 7. This is reported in Wallis and Wershler³ as a graminoid slope, but was not inspected during the 2002 fieldwork. Some percent cover information was noted for Site 5 (CC5 in Table 2), and notes on present (P) or dominant (D) species were made on Sites 4 and 6 (CC4, CC4a and CC6, Table 2). Some observations were made for Site 1 and are included in the discussion below.

Comparable communities were found in Maybelle River Wildland Provincial Park (MR)¹². Plot data from the MR sites are also provided in Table 2. One small graminoid slope was documented outside of FGW¹³. Information from this location is also included in Table 2 (FGW1).

Ten lichen species, mostly *Cladonia* spp. and *Cladina* spp. were documented in the MR plots¹², but only total lichen cover is reported in Table 2 since no comparable details were collected for the CC sites. Species that had less than 1% cover and were found in only one plot (19 in total), are not included in Table 2, but a full list of species from all plots is provided in Appendix 5.

Discussion

The graminoid slopes are composed of patchy vegetation. Wallis and Wershler³ looked at graminoid slopes in the Colin and Woodman lakes area and concluded that a pasture sagewort (*Artemisia frigida*) dominated community was the most widespread type, but no such communities were noted during the 2002 study. They also found western porcupine grass (*Stipa curtisetia*) and Canby bluegrass (*Poa canbyi*) with low to moderate cover, but again neither species was documented at the grassland sites looked at in 2002. They may have concentrated their work in sites not inspected in 2002 (Sites 2 and 3, Figure 4 or Site 7, Figure 6).

Of the sites that were looked at in 2002, Site 1 is a west-southwest facing, steep unstable graminoid slope on sandy soils, with considerable unvegetated sand. In spots, slender wheat grass (*Elymus trachycaulus*) is the dominant species, but hay sedge (*Carex siccata*) is still prominent. There are patches of spreading dogbane (*Apocynum androsaemifolium*) and weak sedge (*Carex supina*). Other species noted include plains wormwood (*Artemisia campestris*), and harebell (*Campanula rotundifolia*). Small aspen (*Populus tremuloides*) are scattered along the slope.



Site 1 – graminoid slope
Photo by D. Vuinovic

Table 2. *Carex siccata* graminoid slopes

	MC*	P%**	CC4	CC4a	CC5	FGW1	MR4	MR5	MR5a
Tall shrubs									
<i>Populus tremuloides</i>	–	42	P	P	.5				
<i>Pinus banksiana</i>	.1	28					.5		.5
<i>Prunus pensylvanica</i>	.1	28					.5	.5	
Low shrubs									
<i>Amelanchier alnifolia</i>	.2	42			.5	.5	.5		
<i>Juniperus communis</i>	–	14		D	.5	.5	.5		
Dwarf shrubs									
<i>Arctostaphylos uva-ursi</i>	.5	42					1	.5	2
Forbs									
<i>Artemisia campestris</i>	–	71	P	P	3		.5	.5	
<i>Apocynum androsaemifolium</i>	–	57		P			.5	.5	.5
<i>Campanula rotundifolia</i>	–	57	P		.5	.5			.5
<i>Achillea millefolium</i>	.2	42				.5	.5	.5	
<i>Arabis lyrata</i>	.2	42					.5	.5	.5
<i>Selaginella rupestris</i>	–	42	P					1	.5
<i>Saxifraga tricuspidata</i>	–	28	P	P					
<i>Solidago spathulata</i>	.3	28					.5		2
Graminoids									
<i>Carex siccata</i>	–	100	D	D	25	10	8	4	8
<i>Festuca saximontana</i>	1	85		D	3	.5	4	.5	.5
<i>Elymus trachycaulus</i> (<i>Agropyron trachycaulum</i>)	–	57	P	D	2	.5			
<i>Agrostis scabra</i>	.2	42					.5	.5	.5
<i>Carex tonsa</i>	.4	42					1	1	1
<i>Carex supina</i>	–	28		P	.5				
<i>Oryzopsis pungens</i>	.1	28					.5		.5
<i>Poa glauca</i>	–	28		P		3			
Mosses									
<i>Ceratodon purpureus</i>	.2	42					.5	.5	.5
<i>Polytrichum piliferum</i>	1	42					5	3	3
Lichens									
<i>Cladina</i> / <i>Cladonia</i> spp.	–	100	D	D	1	50	2	2	5

*MC is average (mean) cover value (%) for all plots (not provided for species when some plots have only P or D)

**P% is percent (%) presence for all plots listed.

Species (rows) sorted by strata, then descending presence within strata

Site 4 (CC4 Table 2) is a steep, sandy, south-facing slope. The vegetation cover is sparse, but hay sedge is dominant, often with a well-developed mat of green reindeer lichen (*Cladina mitis*). There are patches dominated by slender wheat grass, weak sedge, or Rocky Mountain fescue (*Festuca saximontana*). Continuing west along the ridge, common juniper (*Juniperus communis*) becomes prominent (Site CC4a Table 2). Further west still, creeping juniper (*Juniperus horizontalis*) dominates.



Site 4 – graminoid slope looking west toward juniper area.
Photo by D. Vujnovic

Site 5 is on a steep slope with about 20% bare ground (sand) and about 20% litter. Hay sedge is clearly dominant in spots at 25% cover. There are spots where slender wheat grass dominates, and others with significant Rocky Mountain fescue or weak sedge cover. A sand blowout on this slope has started to develop a lichen crust community (L1 in Appendix 4) similar to those documented in FGW¹⁰ and Richardson River Dunes¹² (RR) wildland provincial parks. Scattered shrubs occur along the slope, including small aspen and clumps of pin cherry (*Prunus pensylvanica*). A narrow band of northern rice grass (*Oryzopsis pungens*) grassland near the top of the slope leads into a jack pine (*Pinus banksiana*) stand behind.



Site 5 – slope with hay sedge dominant.
Photo by L. Allen

Site 6 is just east of Site 5, and is separated from it by a fen that cuts between the two ridges. It is a very steep slope with unstable areas with little vegetation. There are spots dominated by hay sedge with clumps of shrubs mid-slope of Alaska birch (*Betula neoalaskana*) and green alder (*Alnus crispa*). Patches of

spreading dogbane were noted. There is an area with slender wheat grass as the dominant species, but hay sedge is still prominent. There are also areas of bare sand and others with small (3 dm tall) aspen suckers.



Site 6 – view of slopes from lake.
Photo by L. Allen

The FGW1 site is a small (~ 3m X 10m), S-SW facing slope situated right above the shore of Lake Athabasca and surrounded on three sides by rock outcrops. Hay sedge dominated the sparse herbaceous strata, while *Cladonia* and *Cladina* species covered up to 50 percent of the ground. Species such as timberline bluegrass (*Poa glauca*), common blue-eyed grass (*Sisyrinchium montanum*), Richardson's alumroot (*Heuchera richardsonii*), sweet grass (*Hierochloa odorata*) and harebell occurred sporadically. Patches of common juniper grew at the base of outcrops.

In the sand-dominated Athabasca Plains Natural Subregion, south of Lake Athabasca, a graminoid community dominated by hay sedge was documented in Maybelle River Wildland Provincial Park¹² (MR) on mid-slope sites on southeast- (MR4 and MR5) to southwest- (MR5a) facing hillsides (Table 2). Slopes tended to be moderately steep (about 20°) and the sites xeric and rapidly drained. Plot 5 was quite stony. Scattered whitebirch (plot 4) or green alder (plot 5) occur at the edge of the stands. The hay sedge graminoid CT was documented in three locations in MR, but was noted in many others in MR and RR¹².

Significance

The hay sedge graminoid CT documented in MR was considered to be a fairly common successional type following disturbance on the sand-dominated areas in the Athabasca Plains Natural Subregion¹². It was noted in areas from slopes such as those documented in Table 2 to roadsides and along old airstrips. At least some of the patches on the graminoid slopes of CC appear to have similarities to the ones documented in MR, however, more detailed work is needed to allow comparison.

Current information is insufficient to determine if there are any plant communities unique to the graminoid slopes at CC that would be considered provincially significant. They are, however, a restricted habitat in the Kazan Upland Natural Subregion, known only from here and from the small patch near FGW. There is much evidence of use by wildlife and several plant species were noted only on these slopes, including rare species such as weak sedge¹¹.

Recommendation

The graminoid slopes should be recognized as a regionally significant habitat, being important to both wildlife and to rare plant species. Further study is needed to document the plant communities that are associated with this habitat to determine if there are any that should be considered significant in the provincial context.



Figure 4. Graminoid slopes along the north shore of Camp Lake (Sites 1 through 4)

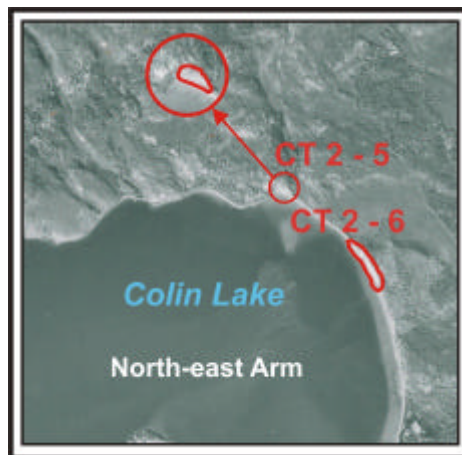


Figure 5. Graminoid slopes along the north shore of Colin Lake (Sites 5 and 6)

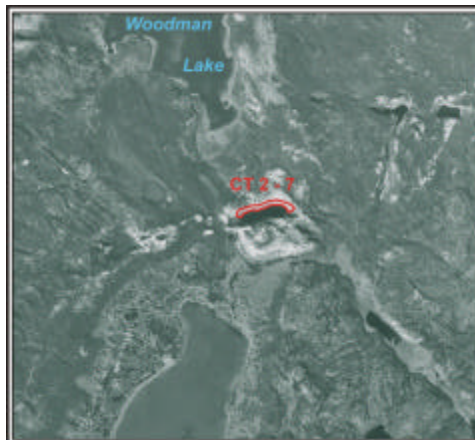


Figure 6. Graminoid slopes at the edge of a small lake south of Woodman Lake (Site 7)

Discussion

In their overview of the Kazan Upland Natural Subregion, Wallis and Wershler³ concluded that there are relatively few plant communities in the subregion. Given the simplicity of the regional vegetation, it is not surprising that few small patch communities of significance were noted. More work however is needed to document the complex mosaic of plant communities on rock outcrops. It is likely that some small patch communities, particularly those on north-facing cliff faces, may be significant in the provincial context. Also, deciduous woodlands are generally not extensive in the subregion. It is possible that some of the deciduous community types may be restricted in distribution, but more work is needed to define types and to determine their significance. Other groups that may include significant types are aquatic communities and sweet gale (*Myrica gale*) communities, but further work is needed to document these.

Wallis and Wershler³ noted some graminoid wetlands on sand in CC that they considered a special habitat and Raup and Argus⁵ noted that these habitats are quite localized in the region. These plus some of the graminoid slope locations and the seepage areas south of Woodman Lake were not looked at during the 2002 field program due to the evacuation of the field crew. They are known to be significant habitats and further work is needed to document the associated plant communities.

Recommendations

One plant community type documented in this study is on the TL⁶ and is considered rare in Alberta, the northern quillwort submergent aquatic community (CT1). This is recognized as a community of provincial significance and should be considered a sensitive element of provincial significance in CC Lakes Wildland Provincial Park. Although only one location for this CT was found in CC, there appear to be other areas of suitable habitat that should be inspected, such as at the east end of the south arm of Colin Lake and along the east shore of Cornwall Lake.

The other community type documented in detail in this report, the hay sedge graminoid slopes (CT2), is part of a regionally significant habitat, being important to both wildlife and to rare plant species. Further study is needed to document the plant communities that are associated with this habitat and to determine their significance in the provincial context. These are all small patch communities that add to the diversity of the park, and should be considered special features within CC.

Further work is recommended for several community types or groupings of communities noted during the course of this study. These are listed below, followed by the number of the corresponding type(s) as discussed in Appendix 4:

- Aquatic communities in Alberta generally need better documentation (types A1 through A6).
- The community types that make up the extensive marshes along Woodman Channel are not well documented and further work is needed to both characterize these significant wetlands and to determine if they include any provincially significant CTs (types H4, H6, H7, H10, S3 and S5).

- More work is needed to document and classify shield outcrop CTs in Alberta (type H9).
- More work is needed to document the lichen crust CTs that seem to be an early colonizer of open sand (type L1).
- Successional community types are generally not well documented (types S1, W15).
- More work is needed to characterize the shrublands found along the creeks and shorelines of lakes (types S3, S4, S6, S9 and S10). Although most are likely widespread CTs, there may be some significant sweet gale CTs.
- Birch stands are not well documented in the province and further work is needed to determine if there are some provincially significant CTs (type W1).
- Aspen woodlands are generally not extensive in the area, but more work is needed to define types and determine their significance (types W18, W19 and W20).

Conclusion

This study concentrated on documenting small patch communities of Colin-Cornwall Lakes Wildland Provincial Park. One provincially significant plant community was documented and other significant and sensitive communities noted. Significant information gaps still remain on this aspect of the biodiversity of the wildland provincial park, and further work is recommended.

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Appendices

Appendix 1. Unusual communities or habitats that potentially occur in northeastern Alberta as determined from the literature review

Community or Habitat	Reason	Habitat Targets*
Shallow water lake communities	Not well documented, may be some restricted types ¹⁰	Protected bays in lakes
Shallow water steam communities	Not well documented, may be some restricted types ¹⁰	Slow moving steams
Shallow water wetland communities	Not well documented, may be some restricted types ¹⁰	Small ponds, other open water bodies
Birch and aspen stands	May be some restricted types ¹⁰	Deciduous stands
Grasslands	Restricted in extent ⁵	Graminoid openings
Grassy, south/southwest-facing slopes	Restricted habitat ⁵	Open, south/southwest-facing slopes
North-face of rock outcrops	May be some restricted types ¹⁰	North-facing cliffs
Open pine stands	May be some restricted types	Open pine
Rich fens	May be some restricted types ¹⁰	Fens
Riparian shrublands	May be some restricted types ¹⁰	Riparian** shrublands
Rocky shore	Minor habitat ⁵	Rocky shore
Salt meadow	Restricted to a few sites ¹⁴	Saline seepages
Sandy shore	Few vegetated sandy shores ⁵ , may have communities of interest	Sandy shorelines

* "Habitat Targets" are habitats that can potentially be distinguished on aerial photographs and may include the community or habitat of interest

** Riparian is defined here as the terrestrial area where the vegetation is a product of the influence of high water tables associated with adjacent aquatic ecosystems

Appendix 2. Communities on the Preliminary Plant Community Tracking List⁶ that occur in the Canadian Shield and Boreal Forest Natural Regions

Community		Srank	Habitat
Scientific name	Common name		
Upland Communities			
<i>Amelanchier alnifolia</i> / <i>Arctostaphylos uva-ursi</i> / <i>Oryzopsis pungens</i>	saskatoon / common bearberry / northern rice grass	S2S3	Shrubby forest openings
<i>Populus tremuloides</i> / <i>Rosa acicularis</i> / <i>Apocynum androsaemifolium</i>	aspen / prickly rose / spreading dogbane	SU	Deciduous stands
<i>Populus tremuloides</i> / <i>Rubus parviflorus</i> / <i>Aralia nudicaulis</i>	aspen / thimbleberry / wild sarsaparilla	S2S3	Deciduous stands
Sand Dune Communities			
<i>Leymus mollis</i> - <i>Tanacetum bipinnatum</i> ssp. <i>huronense</i> shoreline dune	American dune grass - Indian tansy shoreline dune	S1	Extensive sandy beaches
<i>Picea glauca</i> / <i>Cetraria islandica</i>	white spruce / lichen	S1	Open spruce stands, sandy knolls
Riparian Communities			
<i>Picea glauca</i> / <i>Alnus tenuifolia</i> – <i>Betula neoalaskana</i> / <i>Equisetum pratense</i> / <i>Hylocomium splendens</i>	white spruce / river alder - Alaska birch / meadow horsetail / stair-step moss	S3	Spruce stands, river terraces
<i>Populus balsamifera</i> / <i>Alnus tenuifolia</i> / <i>Cornus stolonifera</i> / <i>Equisetum pratense</i>	balsam poplar / river alder / red-osier dogwood / meadow horsetail	S3	Deciduous stands, river terraces
<i>Populus balsamifera</i> / <i>Rhamnus alnifolia</i> / <i>Equisetum arvense</i>	balsam poplar / alder-leaved buckthorn/common horsetail	S1	Riparian deciduous stands
<i>Populus balsamifera</i> / <i>Viburnum opulus</i> / <i>Matteuccia struthiopteris</i>	balsam poplar / high-bush cranberry / ostrich fern	S1S2	Deciduous stands, river terraces
<i>Populus tremuloides</i> / <i>Salix bebbiana</i> - <i>Corylus cornuta</i> / <i>Calamagrostis canadensis</i> – <i>Matteuccia struthiopteris</i>	aspen / Bebb's willow - beaked hazelnut / bluejoint - ostrich fern	S1	Riparian deciduous stands
<i>Salix drummondiana</i> / <i>Scirpus microcarpus</i> – <i>Calamagrostis canadensis</i>	Drummond's willow / small-fruited bulrush - bluejoint	S1	Riparian shrubland

Appendix 2. Continued

Community		SRank	Habitat
Scientific name	Common name		
Wetland communities			
<i>Andromeda polifolia</i> / <i>Sarracenia purpurea</i> / <i>Sphagnum angustifolium</i>	bog rosemary / pitcher-plant / peat moss	S1S2	Shrubby fen around small pools
<i>Atriplex subspicata</i> - <i>Puccinellia nuttalliana</i> - <i>Triglochin palustris</i> string fen	spearscale saltbrush - Nuttall's salt-meadow grass - slender arrow grass string fen	S1S3	Patterned fen
<i>Calamagrostis stricta</i> - <i>Triglochin maritima</i> string fen	narrow reed grass - seaside arrowgrass string fen	S1S3	Patterned fen
<i>Carex limosa</i> - <i>Scheuchzeria palustris</i> / <i>Sphagnum teres</i> - <i>S. subsecundum</i>	mud sedge - scheuchzeria / thin-leaved peat moss	S2?	Patterned fen
<i>Carex oligosperma</i> / <i>Sphagnum subsecundum</i>	few-fruited sedge / twisted bog moss	S1S2	Channel fen on sand
<i>Carex pseudocyperus</i> - <i>Calla palustris</i>	cypress-like sedge - water arum	S1S2	Beaver ponds, ponds with open water
<i>Chamaedaphne calyculata</i> - <i>Kalmia polifolia</i> / <i>Cladina mitis</i>	leatherleaf - northern laurel / green reindeer lichen	S1S2	Channel fen on sand
<i>Cymbella pusilla</i> - <i>Mastogloia smithii</i> - <i>Nitzschia palea</i>	diatom ponds	S1S3	Ponds with open water
<i>Elymus trachycaulus</i> - <i>Distichlis stricta</i>	slender wheat grass - salt grass	S1	Saline seepage
<i>Elymus trachycaulus</i> - <i>Hierochloa odorata</i>	slender wheat grass - sweet grass	SU	Saline seepage
<i>Elymus trachycaulus</i> - <i>Koeleria macrantha</i>	slender wheat grass - June grass	SU	Saline seepage
<i>Glyceria borealis</i> - <i>Sium suave</i> - <i>Sparganium angustifolium</i>	northern manna grass - water parsnip - narrow leaved bur-reed	S1?	Slow moving streams
<i>Isoetes echinospora</i>	northern quillwort	S1	Sandy shorelines
<i>Larix laricina</i> / <i>Carex prairea</i>	tamarack / prairie sedge	S1	Larix fen
<i>Puccinellia nuttalliana</i> – <i>Suaeda calceoliformis</i> – <i>Spergularia marina</i> barren	Nuttall's salt-meadow grass - western sea-blite - salt-marsh sand spurry barren	S2	Saline seepage
<i>Salicornia europaea</i>	samphire	S2	Saline seepage
<i>Salix athabascensis</i> string shrubland	Athabasca willow string shrubland	SP	Patterned fen

Appendix 3. Target Habitats and the likelihood that they occur within Colin-Cornwall Lakes Wildland Provincial Park

Target Habitats	Number of Associated Communities	Likelihood Habitat is present in CC
Upland Habitats		
Deciduous stands	3	H, documented ³ on Woodman Lake
Graminoid openings	1	H, hard to spot on photos, but could occur
North-facing cliffs	1	H
Open, graminoid slopes	1	H, documented ³ on Colin Lake
Open pine	1	H
Shrubby forest openings	1	H, hard to spot on photos, but could occur
Sand Dune Habitats		
Extensive sandy beaches	1	L, no extensive sandy beaches
Open spruce stands, sandy knolls	1	L, no dune formations
Riparian Habitats		
Deciduous stands, large river terraces	4	L, no large river terraces
Riparian shrubland	2	H, may develop on smaller riparian systems like along streams
Spruce stands, large river terraces	1	L, no large river terraces
Wetland Habitats		
Beaver ponds, ponds with open water	3	H
Channel fen on sand	2	L, no deep sands with channel drainage
Fens	1	H
Larix fen	1	H
Patterned fen	4	L, neither landform nor hydrology is conducive to the formation of patterned fens
Protected bays in lakes	1	H
Rocky shore	1	L, requires extensive beaches to develop
Saline seepage	6	L, no saline seepages likely given geology
Sandy shorelines	2	H, sandy shores occur on east end of some larger lakes
Shrubby fen around small pools	1	H
Slow moving streams	2	H

Appendix 4. Additional plant communities noted in Colin-Cornwall Lakes Wildland Provincial Park
(from 2002 field observations and plots from Krumlik *et al.*²⁾)

No.	Community	Description and Location	Community Distribution and Significance*
Aquatic communities			
A1	<i>Hippuris vulgaris</i>	Small patch noted at mouth of Woodman Channel, Camp L. end.	Widespread species, may be a fairly common community. Similar emergent communities with <i>Hippuris vulgaris</i> as dominant reported in WBNP ¹⁵ and a <i>Hippuris vulgaris</i> / <i>Ranunculus gmelinii</i> CT was noted at LaB ¹⁶ . A "Great Plains" type occurs in Manitoba and Saskatchewan ¹⁷ . More work needed to confirm types.
A2	<i>Nuphar lutea</i> (<i>variegatum</i>)	Found in sheltered bays on Colin L. and forming extensive mats in the first two ponds north of Woodman L. Likely found in appropriate ponds and bays throughout CC. Also forms patches along creeks.	A related type dominated by <i>Nuphar lutea</i> and <i>Sparganium angustifolium</i> was found in WBNP ¹⁵ and LaB ¹⁶ in slow-moving water along streams. Similar communities with <i>Nuphar lutea</i> as dominant are found in ponds in FGW ¹⁰ and WBNP ¹⁵ . Likely a common boreal and shield floating-leaved aquatic community, but not well documented.
A3	<i>Potamogeton natans</i>	Small patch noted at the mouth of Woodman Channel, Camp L. end. Dense <i>Myriophyllum verticillatum</i> , <i>Sparganium</i> sp., <i>Potamogeton pusillus</i> and <i>Utricularia vulgaris</i> in aquatic mat. <i>Potamogeton natans</i> was also found in the SE arm of Colin L., in the shallow bay ³ .	Various communities with <i>Potamogeton natans</i> as a dominant are reported for North America ¹⁷ . More work is needed to determine if an identifiable community type occurs in AB.
A4	<i>Potamogeton obtusifolius</i>	Small patch noted at the mouth Woodman Channel, Woodman L. end.	More work is needed to determine if an identifiable community type occurs in AB.
A5	<i>Potamogeton pusillus</i>	Dense patch of submerged aquatics, dominated by <i>Potamogeton pusillus</i> noted in the second "lily pond" north of Woodman L.	More work is needed to determine if an identifiable community type occurs in AB.
A6	<i>Potamogeton richardsonii</i>	An aquatic community dominated by <i>Potamogeton richardsonii</i> was noted at the west end of Colin L., in a quiet bay just south of the channel connecting Colin and Camp lakes.	A <i>Potamogeton richardsonii</i> community was documented in La Butte Creek ¹⁶ , and Raup ¹⁵ noted a <i>Potamogeton richardsonii</i> - <i>P. gramineus</i> aquatic community in a slow moving creek in WBNP. <i>Potamogeton richardsonii</i> is a widespread species, and often dominant where it occurs. Likely a common submergent aquatic community, but not well documented.
Herbaceous Communities			
H1	<i>Calamagrostis canadensis</i>	A moist meadow in the southeast corner of a protected inlet on the south shore of Colin L. Formed behind a levee and dominated by <i>Calamagrostis canadensis</i> interspersed with depressions dominated by <i>Carex aquatilis</i> or drying pools with <i>Ranunculus gmelinii</i> . Small patches also noted along the shore of Camp L., where the generally steeply sloping shore results in only a narrow zone of suitable habitat.	Extensive <i>Calamagrostis canadensis</i> meadows have been documented in WBNP ¹⁵ . This appears to be a widespread community type, usually found as small patches in locations such as drying beaver meadows and moist forest openings ¹⁷ .

H2	<i>Carex aquatilis</i>	A moist meadow in the southeast corner of a protected inlet on the south shore of Colin L. Formed behind a levee. Depressions dominated by <i>Carex aquatilis</i> or drying pools with <i>Ranunculus gmelinii</i> . Interspersed with patches dominated by <i>Calamagrostis canadensis</i> . Small patches of <i>Carex aquatilis</i> also noted along the shore of Camp L., where the generally steeply sloping shore results in only a narrow zone of suitable habitat.	Also noted at Shelter Point ¹⁸ and other CS parks in Alberta ^{10, 12, 16} . Considered the most extensive marsh type in the Shield ³ . A well recognized, widespread type ¹⁷ .
H3	<i>Carex aquatilis</i> - <i>Calamagrostis canadensis</i>	Alternates with dense stands of <i>Myrica gale</i> along the shore of Big Bear Creek, N of Colin L.	Similar types have been reported in WBNP ¹⁵ , but likely a transition zone between a wet H2 CT and the slightly dryer conditions that favour the H1 CT ¹⁶ .
H4	<i>Carex aquatilis</i> - <i>C. lasiocarpa</i> - <i>C. diandra</i>	Woodman Channel flows through a floating mat of vegetation. <i>Calla palustris</i> generally lines the edge of the open water channel although <i>Menyanthes trifoliata</i> is also present, becoming prevalent at both ends of the channel. Moving back into the vegetation, the sedges become prominent, in varying mixtures of dominance. Other species present include <i>Carex limosa</i> , <i>C. rostrata</i> , <i>Cicuta bulbifera</i> , <i>Lysimachia thyrsiflora</i> , <i>Nuphar lutea</i> , <i>Glyceria</i> sp., <i>Rumex</i> sp. and scattered <i>Salix planifolia</i> . Relatively pure patches of <i>Calamagrostis canadensis</i> and <i>Typha latifolia</i> interrupt the sedge marsh.	The Woodman and Alexander L. areas are considered to have the best-developed marshes in Alberta's Kazan Upland ³ . The marsh lines the channel between Woodman and Camp L. for about 4km and is up to 200 m wide in areas. More work is needed to document the diversity of community types that may be represented here before their significance can be evaluated.
H5	<i>Carex lasiocarpa</i> – <i>Equisetum fluviatile</i>	NE delta, Colin L., centre of some of the ponds formed behind the ice-push ridge and the creek. With <i>Potentilla palustris</i> , <i>Carex curta</i> , <i>C. rostrata</i> , <i>C. aquatilis</i> and <i>C. utriculata</i> . Water depth about 50 cm.	This CT has many similarities to other sedge meadows found in CC. More work is needed to document the diversity of community types that may be represented here before their significance can be evaluated.
H6	<i>Carex rostrata</i>	<i>Carex rostrata</i> forms mono-specific stands in some areas. A dominant CT in sheltered bays and also forming small patch communities along the edge of Woodman Channel.	<i>Carex rostrata</i> is rare in Alberta ¹¹ , but it is unclear if this is a distinctive CT. Other CTs dominated by <i>Carex rostrata</i> have been documented in FGW ¹⁰ and LaB ¹⁶ .
H7	<i>Carex rostrata</i> – <i>Equisetum fluviatile</i>	Patches were noted along the shore of Camp L. and along Woodman Channel. Sometimes associated with <i>Nuphar lutea</i> (<i>variegatum</i>).	<i>Carex rostrata</i> is rare in Alberta ¹¹ , but it is unclear if this is a distinctive CT. Possibly represents an ecotone between <i>Carex rostrata</i> and <i>Equisetum fluviatile</i> dominated communities.
H8	<i>Equisetum fluviatile</i>	NE arm Colin L., centre of some of the ponds formed behind the ice-push ridge in the NE delta area.	Widespread CT ¹⁷ , associated with quiet waters and muddy substrate ¹⁵ . Noted at other CS parks in Alberta ^{10, 12, 16} , although not commonly encountered at CC.

H9	Rock outcrop mosaic	Three unburned rock outcrops were looked at (one on Woodman, two on Colin L.). <i>Umbilicaria muehlenbergii</i> and <i>Arctoparmelia centrifuga</i> were common, with patches of <i>Cladina</i> spp. and other lichens. Vascular plants were patchy but usually included <i>Arctostaphylos uva-ursi</i> , <i>Campanula rotundifolia</i> , <i>Carex aenea</i> , <i>C. rossii</i> , <i>C. umbellata</i> , <i>Corydalis sempervirens</i> , <i>Cryptogramma acrostichoides</i> , <i>Festuca saximontana</i> , <i>Juniperus communis</i> , <i>Oryzopsis pungens</i> , <i>Poa glauca</i> , <i>Polypodium sibiricum</i> , <i>Potentilla tridentata</i> , <i>Saxifraga tricuspidata</i> and <i>Woodsia ilvensis</i> .	Due to the extensive burns in most of the areas inspected at CC, the rock mosaic communities cannot be well described. Observed rock communities had similar vascular plant species to those noted in other CS parks, however, they did not seem to have as extensive a lichen cover as noted at LaB ¹⁶ or FGW ¹⁰ . More work is needed to characterize the rock outcrop communities of CC and of the Shield in general.
H10	<i>Typha latifolia</i>	<i>Typha latifolia</i> tends to occur in dense, mono-specific stands. It was found as small patches, usually along creeks (noted along Woodman Channel and the channel connecting Camp and Colin lakes, as well as on the channel between Woodman L. and the lily ponds).	A widespread CT ¹⁷ , encountered infrequently in the study area.
Lichen Communities			
L1	Lichen crust	Small patches on SW facing slope with grasslands on NE arm of Colin L. Lichen crust species not documented.	An early successional community found in small patches. It was noted in several areas in FGW ¹⁰ , usually adjacent to blowouts on stabilized dunes. Often associated with old burns. <i>Placynthiella uliginosa</i> was the dominant lichen crust species. A similar area of lichen crust was noted in RRD ¹² , where along with <i>Placynthiella uliginosa</i> , <i>Diploschistes muscorum</i> was a significant component of the crust. The significance and distribution of this CT is unknown.
Shrub Communities			
S1	<i>Alnus crispa</i> / <i>Ledum groenlandicum</i>	Burn area on sand north of Colin L. Dense 1m tall <i>A. crispa</i> with occasional <i>Populus tremuloides</i> suckers.	An early successional community on sand. Likely widespread, but successional CTs in general are not well documented.
S2	<i>Alnus tenuifolia</i>	Forms a narrow, discontinuous band along the north shore of Camp L. Small patches were also noted at the edge of the ice push ridge in the NE arm of Colin L.	Widespread CT ¹⁷ , noted at other CS parks in Alberta ^{12, 16} although forming only very narrow bands in CC.
S3	<i>Alnus tenuifolia</i> / <i>Myrica gale</i>	Patches along Woodman Channel.	Probably a widespread type, but not well documented.
S4	<i>Betula pumila</i> – <i>Salix pedicellaris</i> / <i>Chamaedaphne calyculata</i>	NE arm of Colin L., edge of some of the ponds formed at the mouth of the creek, behind the ice-push ridge at the edge of the lake.	Probably a widespread type, but not well documented.
S5	<i>Betula pumila</i> / <i>Calamagrostis canadensis</i>	Edge of Big Bear Creek and in the floating mat along Woodman Channel. <i>Salix planifolia</i> prominent component.	Shrub birch and willow communities along watercourses in the region usually have <i>Carex</i> as the dominant or co-dominant graminoid. More study is needed to determine the significance of <i>Calamagrostis</i> in these shrub wetlands.

S6	<i>Chamaedaphne calyculata</i>	NE arm Colin L., edge of some of the ponds formed behind the ice-push ridge in the delta area.	Wet shrublands dominated by <i>Chamaedaphne calyculata</i> are common in the Kazan Upland ³ , but are not adequately documented to sort out types. A similar CT was documented at MGT ¹² and FGW ¹⁰ .
S7	<i>Juniperus communis</i> / <i>Carex siccata</i>	South facing slope of glaciofluvial landform (CT2-Site 4a).	Part of the graminoid slope complex (CT2). More study needed to determine plant communities and significance.
S8	<i>Juniperus horizontalis</i>	South facing slope of glaciofluvial landform. Associated species include <i>Artemisia campestris</i> , <i>Carex siccata</i> , <i>Cladina mitis</i> , <i>Elymus trachycaulus</i> (<i>Agropyron trachycaulum</i>), <i>Poa glauca</i> , <i>Populus tremuloides</i> seedlings and <i>Saxifraga tricuspidata</i> .	Part of the graminoid slope complex (CT2). More study needed to determine plant communities and significance.
S9	<i>Ledum groenlandicum</i>	Small shrubland in depressions between sand hills in sand plain area north of Colin L. No additional information noted.	<i>Ledum groenlandicum</i> dominated shrublands are likely widespread, although not well documented.
S10	<i>Myrica gale</i>	Dense <i>Myrica</i> stands were noted at numerous locations along Big Bear Creek. Small patches were also noted at the edge of the ice push ridge in the NE arm of Colin L. Additional details not noted.	<i>Myrica gale</i> CTs are common along lakeshores and banks of sluggish creeks across northern Alberta ¹⁰ . Dense stands are common on both sandy and rocky shores in the Kazan Upland ³ but are not adequately documented to sort out types. Similar communities documented elsewhere include a <i>Chamaedaphne calyculata</i> - <i>Myrica gale</i> / <i>Carex lasiocarpa</i> floating mats on the edges of lakes and streams in the Great Lakes region of the United States and Canada ¹⁷ and a <i>Myrica gale</i> dominated shrub fen community. Co-dominants may include <i>Chamaedaphne calyculata</i> in more nutrient-poor examples ¹⁷ .
Woodland Communities			
W1	<i>Betula "papyrifera"</i> - <i>Pinus banksiana</i> / <i>Alnus crispa</i> / <i>Vaccinium vitis-idaea</i>	Documented in 1978 study (Plot A8028) ² on sandy lacustrine deposits over glacial till on the north shore of Colin L. A young mixed stand with <i>Betula "papyrifera"</i> the dominant tree (40% cover) but <i>Pinus banksiana</i> also prominent (30%) and <i>A. crispa</i> up to 50% cover in the shrub layer. Large fire-scarred pine present. Diverse herbs with species varying depending on canopy closure. <i>Vaccinium vitis-idaea</i> , <i>Arctostaphylos uva-ursi</i> and <i>Linnaea borealis</i> most common.	Some similarities to W13, below, but with a much higher birch component. Birch dominated communities tend to be small in area and scattered in occurrence. They are not well studied, so more inventory is needed to define types and to determine their significance.
W2	<i>Picea glauca</i> / <i>Pleurozium schreberi</i> – <i>Hylocomium splendens</i>	A disturbed stand on the large island in Woodman Lake. Occasional <i>Betula neoalaskana</i> , patches of <i>Cornus canadensis</i> in understory.	Although <i>Picea glauca</i> stands were not common in CC, <i>Picea glauca</i> / feathermoss CTs are a widespread boreal CT ¹⁹ .
W3	<i>Picea mariana</i> - <i>Betula neoalaskana</i> / <i>Pleurozium schreberi</i>	A mature stand found on an unburnt area on top of the glaciofluvial ridge N of Camp L. This stand has up to 10% <i>Alnus crispa</i> , some <i>Juniperus communis</i> , and spots where <i>Ptilium crista-castrensis</i> is dominant. Overall, mosses cover 50% and leaf litter 30%.	Very similar to the widespread <i>Picea mariana</i> / <i>Pleurozium schreberi</i> CT (W9).

W4	<i>Picea mariana</i> / <i>Betula pumila</i> / <i>Carex aquatilis</i> / mosses	NE arm of Colin L. Poor fen behind the beach ridges, low central area south of delta area. An open stand of stunted <i>Picea mariana</i> with hummocks of <i>Sphagnum fuscum</i> and <i>Carex aquatilis</i> in the hollows. W5 is found at the edge of the same fen complex.	Similar to a common boreal CT, treed poor fen ¹⁹ , usually with a prominent component of <i>Larix laricina</i> . Also found at MGT ¹² .
W5	<i>Picea mariana</i> / <i>Chamaedaphne calyculata</i> - <i>Ledum groenlandicum</i> / <i>Sphagnum fuscum</i>	Small poor fen behind ice push ridge, NE arm Colin L. Hummocky with some wet pools and channels. <i>Picea mariana</i> 15% cover, <i>Chamaedaphne calyculata</i> and <i>Ledum groenlandicum</i> main shrubs. <i>Sphagnum fuscum</i> on hummocks, <i>S. angustifolium</i> in pools. Occasional <i>Larix laricina</i> . <i>Eriophorum chamissonis</i> prominent. Edge of the fen complex, W4 is CT in wetter central area.	Likely a widespread poor fen CT, very similar to the <i>Picea mariana</i> / <i>Ledum groenlandicum</i> / <i>Sphagnum fuscum</i> bog CT considered the most common bog vegetation in the subregion ³ . Wallis and Wershler ³ note that <i>Chamaedaphne calyculata</i> is prevalent in wetter, transitional spots within the bog CT.
W6	<i>Picea mariana</i> / <i>Ledum groenlandicum</i> - <i>Rubus chamaemorus</i> / <i>Sphagnum</i> spp.	A treed bog documented in 1978 (Plot A8027) ² . A stand of stunted <i>Picea mariana</i> over permafrost near Big Bear Creek. Ground cover well developed, but species-poor. Similar stand also noted in 2002 study in the NE arm of Colin L. on a peat plateau behind the poor fen complex discussed in types W4 and W5 above.	A CT widespread boreal bog type ¹⁹ , common in the subregion ³ .
W7	<i>Picea mariana</i> / <i>Ledum groenlandicum</i> / <i>Cladina mitis</i>	NE arm of Colin L. With W6 on the peat plateau behind the poor fen. 5 m trees, up to 20% cover	<i>Picea mariana</i> stands with a significant shrub and lichen component are widespread ^{19, 20} . A similar CT was noted at FGW ¹⁰ .
W8	<i>Picea mariana</i> / <i>Ledum groenlandicum</i> / <i>Pleurozium schreberi</i>	Narrow wetland between outcrops on the S. peninsula, Colin L. 30% <i>Picea mariana</i> , 20% <i>Ledum groenlandicum</i> cover. Slightly hummocky, occasional <i>Sphagnum fuscum</i> hummock. A second stand was noted in pockets between rocks. This stand has dense 5 cm dbh, 5m tall <i>Picea mariana</i> with areas of thick <i>Vaccinium vitis-idaea</i> and <i>Ledum groenlandicum</i> . It is found on the south shore of the NE arm, Colin L.	A widespread CT. Similar CTs were documented at MGT ²¹ , MR ²² and FGW ¹⁰ .
W9	<i>Picea mariana</i> / <i>Pleurozium schreberi</i>	Mature forest, found in several places, often between rock outcrops. One stand with 10 – 15 m tall trees at about 35% cover occurs on a north-facing slope near the south peninsula on Colin L, in a pocket between rocks. Another stand is found in the middle of the larger of the Tern Islands in Colin L. It has scattered <i>Betula</i> and areas with high leaf litter. In other areas there is good <i>Cladina mitis</i> cover or <i>Hylocomium splendens</i> patches. One stand on the east end of Camp L. has a significant <i>Picea glauca</i> component.	This appears to be a CT found across the Alberta shield on unburned sites ^{3, 5, 23} and into the NWT ²³ . Also noted at MR ²² and FGW ¹⁰ .
W10	<i>Picea mariana</i> / <i>Sphagnum fuscum</i>	Small basin bog north of Colin L. Open stunted <i>Picea mariana</i> (maximum height 4m) on permafrost. Sparse shrub layer of <i>Ledum groenlandicum</i> and <i>Kalmia polifolia</i> . Also present are <i>Smilacina trifolia</i> and <i>Rubus chamaemorus</i> . <i>Carex aquatilis</i> and scattered <i>Larix laricina</i> present at the edge.	Basin bogs are a common boreal wetland type ²⁴ . This CT is very similar to the widespread boreal treed bog CT from Alberta and Saskatchewan ^{19, 20} .

W11	<i>Picea mariana</i> / <i>Tomenthypnum nitens</i>	An open, treed wetland just east of Big Bear Creek.	Likely a common boreal CT, but not well documented.
W12	<i>Pinus banksiana</i> / <i>Alnus crispa</i> / <i>Linnaea borealis</i>	Found in the sand plain area N of Colin L.; sometimes with at sparse cover of <i>Vaccinium myrtilloides</i> (max 5%).	A widespread pine community of sand-dominated landscapes, similar to the boreal CT <i>Pinus banksiana</i> / <i>A. crispa</i> / lichen ¹⁹ . A similar community was documented in RRD ²⁵ .
W13	<i>Pinus banksiana</i> / <i>Arctostaphylos uva-ursi</i> - <i>Vaccinium vitis-idaea</i> / <i>Cladina</i> spp.	Documented in 1978 study (Plot A8026) ² , a maturing stand on sandy lacustrine deposits over glacial till on the north shore of Colin L.. Trees were 15 to 19m tall, dominated by <i>Pinus banksiana</i> (30% cover) with the occasional <i>Betula</i> "papyrifera". Some <i>Alnus crispa</i> (5%) is present in the shrub layer. The ground cover was well developed with herbs and dwarf shrubs (60%), lichen (40%) and little exposed soil. A second stand was noted in the 2002 study on a sand terrace behind the ice push ridge on the NE arm of Colin L. This was a mature, open stand of 7 m tall pines and scattered <i>Betula neoalaskana</i> with about 10% tree cover (some areas with a more closed canopy). <i>Geocaulon lividum</i> and <i>Oryzopsis pungens</i> present.	A widespread pine community of sand-dominated landscapes ⁵ .
W14	<i>Pinus banksiana</i> / <i>Juniperus communis</i> / <i>Arctostaphylos uva-ursi</i> / <i>Cladina mitis</i>	Open pine on SSE facing, slightly sloping rock near the tip of the large peninsula on the south shore of Colin L. <i>Juniperus communis</i> 5% cover, 10% <i>Arctostaphylos uva-ursi</i> . Well-developed lichen mat, dominated by <i>Cladina mitis</i> , <i>C. rangiferina</i> , <i>Cladonia amaurocraea</i> and <i>Stereocaulon tomentosum</i> . Some areas with <i>Umbilicaria</i> spp., <i>Arctoparmelia centrifuga</i> , <i>Rhizocarpon geminatum</i> and <i>Polytrichum piliferum</i> . Other species noted: <i>Ribes oxycanthoides</i> , <i>Hieracium umbellatum</i> , <i>Festuca saximontana</i> , <i>Oryzopsis pungens</i> , <i>Rosa acicularis</i> , <i>Betula</i> seedlings, <i>Picea</i> seedlings, <i>Cryptogramma acrostichoides</i> , <i>Poa glauca</i> , <i>Carex rossii</i> and <i>Carex aenea</i> .	Similar to widespread Boreal and Shield jack pine / lichen communities. Very similar to the <i>Pinus banksiana</i> / <i>A. uva-ursi</i> – <i>Vaccinium vitis-idaea</i> / <i>Cladonia</i> spp. CT considered the most extensive type in the Andrew Lake area ²³ . A similar CT but without a significant <i>Juniperus communis</i> component was found in small pockets on flatter spots on rock outcrops at LaB ¹⁶ .
W15	<i>Pinus banksiana</i> / <i>Linnaea borealis</i> – <i>Arctostaphylos uva-ursi</i>	Successional stand on sandy glaciolacustrine in 1998 burn area N of Colin L. Dense patches of regenerating pine to 20 cm tall. Species commonly encountered include <i>Anemone patens</i> , <i>Campanula rotundifolia</i> , <i>Carex siccata</i> , <i>Carex aenea</i> , <i>Cornus canadensis</i> , <i>Geocaulon lividum</i> , <i>Viburnum edule</i> , with patches of <i>Calamagrostis purpurascens</i> and areas where <i>Oryzopsis pungens</i> prominent.	An early successional community on sand. Likely widespread, but successional CTs in general are not well documented. Raup and Argus ⁵ noted <i>Agrostis scabra</i> , <i>Hudsonia tomentosa</i> , <i>Carex tonsa</i> and pine seedlings as the primary species in a regenerating pine stand, on the sand plains south of Lake Athabasca.
W16	<i>Pinus banksiana</i> / <i>Vaccinium vitis-idaea</i>	In a pocket on a rock outcrop N of Colin L. along Big Bear Creek. Considerable <i>Geocaulon lividum</i> present and high needle cover	Similar to a typical community type of the Kazan Upland ³ . Also found at LaB ¹⁶ growing as small pockets in rock outcrops.

W17	<i>Pinus banksiana</i> / <i>Vaccinium vitis-idaea</i> / <i>Pleurozium schreberi</i> - <i>Cladina</i> spp.	Young pine with scattered birch on sandy lacustrine parent material. A few larger fire-scarred pine and scattered remnants of burned logs. Bryophytes somewhat more abundant than lichens (plot A8029) ²	Appears to be a young phase of the jack pine / lichen type that is widespread on stabilized dunes and sandy plains ⁵ . A similar stand was noted in FGW ¹⁰ .
W18	<i>Populus tremuloides</i> / <i>Oryzopsis pungens</i>	Found in a slight depression in the sand plain area north of Colin L.	Not documented elsewhere, but further work needed to determine if this is a valid community type. It was only noted in one slight depression in an area of Pine / <i>Oryzopsis</i> .
W19	<i>Populus tremuloides</i> / <i>Rosa acicularis</i> / <i>Leymus innovatus</i> (<i>Elymus innovatus</i>)	A disturbed area on the site of an old cabin. Mature aspen with an open understory and good grass cover.	Aspen (<i>Populus tremuloides</i>) woodlands are generally not extensive in the Kazan Upland ³ but further work is needed to define types and determine their significance.
W20	<i>Populus tremuloides</i> / <i>Viburnum edule</i> / <i>Aralia nudicaulis</i>	Aspen stand on 15° W facing slope on bedrock; high <i>Ledum groenlandicum</i> cover in some areas, <i>Alnus crispa</i> clumps in others. The stand is made up of small trees, averaging about 6 cm dbh (biggest tree with about 15 cm dbh) with high leaf litter. Other species noted: <i>Vaccinium vitis-idaea</i> , <i>Epilobium angustifolium</i> , <i>Linnaea borealis</i> , <i>Salix bebbiana</i> , <i>Rosa acicularis</i> , <i>Betula neoalaskana</i> .	Noted by Wallis and Wershler ³ as being fairly restricted in the Shield, but occurring extensively in the Woodman Lake area. They considered this a transitional type, between wetter birch woodlands and dry aspen and pine upland types. Although there may be some aspen CTs restricted to the subregion, further work is needed to define types and determine their significance.

* The following abbreviations are used in the comments:

CC = Colin-Cornwall Lakes Wildland Provincial Park

CS = Canadian Shield Natural Region

LaB = La Butte Creek Wildland Provincial Park

MR = Maybelle River Wildland Provincial Park

MGT = Margeurite River Wildland Provincial Park

NWT = Northwest Territories

RRD = Richardson River Dunes Wildland Provincial Park

WBNP = Wood Buffalo National Park

Appendix 5. Gallery of Communities (photo S7 by K. Vujnovic; W6, W13 and W19 by D. Vujnovic; others by L. Allen)



H4. *Carex aquatilis* - *C. lasiocarpa* - *C. diandra*



Calla palustris (at edge of H4. *Carex aquatilis* - *C. lasiocarpa* - *C. diandra*)



H6. *Carex rostrata*



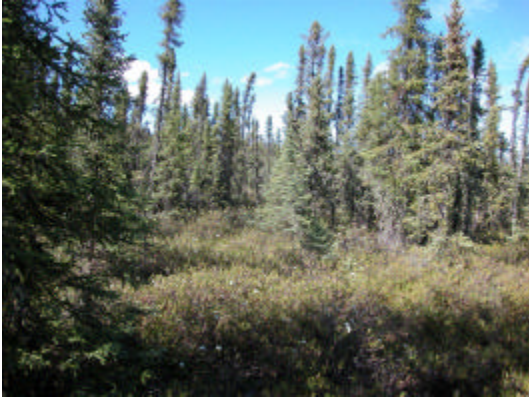
H9. Rock outcrop mosaic



S5. *Betula pumila* / *Calamagrostis canadensis*



S7. *Juniperus communis* / *Carex siccata*



W6. *Picea mariana* / *Ledum groenlandicum* – *Rubus chamaemorus* / *Sphagnum* spp.



W9. *Picea mariana* / *Pleurozium schreberi*



W13. *Pinus banksiana* / *Arctostaphylos uva-ursi* – *Vaccinium vitis-idaea* / *Cladina* spp.



W19. *Populus tremuloides* / *Rosa acicularis* / *Leymus innovatus*

Appendix 6. CT2 *Carex siccata* graminoid slopes – full species list from all plots

	MC*	P%**	CC4	CC4a	CC5	FGW1	MR4	MR5	MR5a
<hr/>									
Tall Shrubs									
<i>Populus tremuloides</i>	–	42	P	P	.5+				
<i>Pinus banksiana</i>	.1	28					.5		.5
<i>Prunus pensylvanica</i>	.1	28					.5	.5	
Low shrubs									
<i>Amelanchier alnifolia</i>	.2	42			.5	.5	.5		
<i>Juniperus communis</i>	–	14		D	.5	.5	.5		
<i>Vaccinium myrtilloides</i>	.07	14					.5		
Dwarf shrubs									
<i>Arctostaphylos uva-ursi</i>	.5	42					1	.5	2
<i>Hudsonia tomentosa</i>	.07	14							.5
Forbs									
<i>Artemisia campestris</i>	–	71	P	P	3		.5	.5	
<i>Apocynum androsaemifolium</i>	–	57		P			.5	.5	.5
<i>Campanula rotundifolia</i>	–	57	P		.5	.5			.5
<i>Achillea millefolium</i>	.2	42				.5	.5	.5	
<i>Arabis lyrata</i>	.2	42					.5	.5	.5
<i>Selaginella rupestris</i>	–	42	P					1	.5
<i>Saxifraga tricuspidata</i>	–	28	P	P					
<i>Solidago spathulata</i>	.3	28					.5		2
<i>Anemone patens</i>	.07	14							.5
<i>Antennaria rosea</i>	.07	14				.5			
<i>Arabis holboellii</i>	.07	14			.5				
<i>Draba nemorosa</i>	–	14		P					
<i>Equisetum hyemale</i>	–	14	P						
<i>Equisetum</i> sp.	.07	14			.5				
<i>Heuchera richardsonii</i>	.07	14				.5			
<i>Potentilla arguta</i>	.07	14				.5			
<i>Potentilla tridentata</i>	–	14		P					
<i>Sisyrinchium montanum</i>	.07	14				.5			
<i>Woodsia ilvensis</i>	.07	14				.5			
Graminoids									
<i>Carex siccata</i>	–	100	D	D	25	10	8	4	8
<i>Festuca saximontana</i>	1	85		D	3	.5	4	.5	.5
<i>Elymus trachycaulus</i> (<i>Agropyron trachycaulum</i>)	–	57	P	D	2	.5			
<i>Agrostis scabra</i>	.2	42					.5	.5	.5
<i>Carex tonsa</i>	.4	42					1	1	1
<i>Carex supina</i>	–	28		P	.5				
<i>Oryzopsis pungens</i>	.1	28					.5		.5
<i>Poa glauca</i>	–	28		P		3			
<i>Dichanthelium acuminatum</i>	.07	14							.5
<i>Hierochloe odorata</i>	.07	14				.5			
<i>Poa interior</i>	–	14	P						
Mosses									
<i>Ceratodon purpureus</i>	.2	42					.5	.5	.5
<i>Polytrichum piliferum</i>	1	42					5	3	3
<i>Tortula ruralis</i>	–	14	P						

Lichens

<i>Cladonia / Cladina</i>	-	100	D	D	1	50	2	2	5	
<i>Peltigera rufescens</i>	.07	14						.5		

*MC is average (mean) cover value (% cover) for all plots (not provided for species when some plots have only P or D)

**P% is percent (%) presence for all plots listed.

Species (rows) sorted by strata, then descending presence within strata

Percent(%)Cover used for cover values