

Fall 2008 survey for rare bryophytes at proposed management sites, Pigeon Lake Provincial Park, Alberta¹

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Project contact

Ksenija Vujnovic, Heritage Protection Specialist, East Central Areas
Parks Division

Alberta Tourism, Parks and Recreation

3rd Floor, 9820 106 St.

Edmonton, AB T5K 2J6

Tel: 780-644-7688

Email: Ksenija.Vujnovic@gov.ab.ca

Contractor

Richard Caners, Ph.D. Candidate

10425 143 St. NW

Edmonton, AB T5N 2S5

Tel: 780-435-7021

Email: rcaners@ualberta.ca

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<i>Brachythecium rutabulum</i> , a moss	(S2?; 4 occurrences)
<i>Cephaloziella rubella</i> , a liverwort	(SNR; 1 occurrence)
<i>Chiloscyphus pallescens</i> , a liverwort	(S1; 4 occurrences)
<i>Hypnum pallescens</i> , a moss	(S2; 2 occurrences)
<i>Leskea polycarpa</i> , a moss	(S1; 1 occurrence)
<i>Lophozia ascendens</i> , a liverwort	(S1; 1 occurrence)
<i>Ricciocarpos natans</i> , a liverwort	(S2; 2 occurrences)
<i>Scapania glaucocephala</i> , a liverwort	(S2; 2 occurrences)

¹ This report should be cited as follows: Caners, R. T. 2008. Fall 2008 survey for rare bryophytes at proposed management sites, Pigeon Lake Provincial Park, Alberta. Final report to Alberta Tourism, Parks and Recreation, Edmonton, Alberta.

1.0 Survey objectives and methods

The objective of this survey was to document the occurrence of rare bryophytes (mosses, liverworts, and hornworts) at Pigeon Lake Provincial Park, Alberta. Several sites at Pigeon Lake and Zeiner campgrounds within the Park were surveyed as they may be cleared or upgraded for the development of new facilities, including camp stalls, access and internal roads, trails, and buildings (see Section 1.1, below, for details). All sites were surveyed on September 13, 14, and 20, 2008, during which time a total of 30 hours of survey effort was performed. Rare bryophytes are defined as those currently found on the ANHIC (Alberta Natural Heritage Information Centre) plant tracking and watch lists (Gould 2006), available at the following website: <http://www.tpr.alberta.ca/parks/heritageinfocentre/plants/vascularbryophytes/default.aspx>.

Prior to the commencement of the survey, aerial photographs, maps, and other documentation outlining the location of proposed upgrades in the Park were obtained from Ksenija Vujnovic (Heritage Protection Specialist, East Central Areas; Parks Division, Alberta Tourism, Parks and Recreation) and reviewed. ANHIC had no records of rare bryophytes occurring within the Park boundary or in the general vicinity of the Park at the time of the survey (ANHIC 2008).

Bryophyte surveys were conducted with reference to Doubt and Belland (2000). At each site, surveying was conducted using a Floristic Habitat Sampling (Newmaster et al. 2005) approach, whereby all important microhabitats were systematically sampled for the presence of rare species. Collections of rare species were made when their population sizes and numbers were large enough to warrant collection (cf. Doubt and Belland 2000). Collections of common species were also made to provide an introductory list of bryophytes for the Park. Locations of all bryophyte collections were marked in the field using GPS (Garmin 60CSx) and have been presented in **Appendix 1** using Park imagery (Google Earth Plus 4.3.7284.3916 [beta]). Please note that the collection locations depicted in Appendix 1 do not represent the full extent of areas surveyed. A complete list of species encountered at the survey sites is presented in **Appendix 3**.

Taxonomic keys used for species identification include Lawton (1971), Crum and Anderson (1981), and BFNA (2007) for mosses, and Smith (1991), Schuster (1966-1992), and Damsholt (2002) for liverworts. Specimens are to be deposited at the Devonian Botanic Garden, University of Alberta. Photographs presented in **Appendix 2** have been deposited on Compact Disc with Alberta Tourism, Parks and Recreation.

Nomenclature for all bryophytes in the report follows Anderson et al. (1990) for mosses and Stotler and Crandal-Stotler (1991) for liverworts.

1.1 Survey locations in the Park

All sites that required surveying (as outlined in the Memorandum of Agreement for this contract) were visited during the three-day sampling period. The following is a list of the survey sites and the actions undertaken at each location:

Pigeon Lake campground (Appendix 1a)

1) Campground loops G, H, I, and J

I surveyed all areas that may be upgraded at proposed campground loops G, H, I, and J, which correspond to existing loops B/C, D, E, and F/G, respectively. Proposed upgrades include modifications to approximately 225 existing camp stalls, reconfiguration of the existing road network, relocation of utilities as necessary, replacement of furnishings, and the addition of new access roads, parking lots, access trails, and shower buildings.

2) New shower building

I surveyed the proposed location of a new shower facility at the north end of new loop G.

3) Newly designed loops A, B, C, D, and E

I surveyed the proposed location for the construction of new campground loops A, B, C, D, and E. Potential upgrades to this location include the addition of approximately 202 camp stalls, access and internal roads, furnishings, trails, washroom and shower buildings, playgrounds, and the naturalization of existing open areas.

4) Existing day use area

I surveyed the proposed locations for the development of a new boat launch and parking area, expansion of the existing boat launch, clearing of the day use beach area, and expansion of the existing day use area parking lot.

Zeiner campground (Appendix 1b)

1) Expansion of existing camp stalls in loop A

I surveyed the camp stalls and adjacent forests in existing loop A, which is to be upgraded or expanded to accommodate larger camping units.

2) Expansion of existing beach campground

I surveyed the existing beach campground, which is to be upgraded or expanded by re-shaping existing camp stalls and by landscaping.

3) Clearing of area in the vicinity of the old shower building

I surveyed the forest adjacent to the old shower building, which is to be expanded to accommodate a larger shower facility.

2.0 Survey results

A total of eight species of rare bryophytes was documented at the proposed sites for upgrading. These include three mosses (*Brachythecium rutabulum*, S2?; *Hypnum pallescens*, S2; *Leskea polycarpa*, S1) and five liverworts (*Cephaloziella rubella*, SNR; *Chiloscyphus pallescens*, S1; *Lophozia ascendens*, S1; *Ricciocarpos natans*, S2; *Scapania glaucocephala*, S2). The ranks associated with each species define their conservation status in Alberta (state/provincial rank, S) and are based on criteria developed by The Nature Conservancy (NatureServe 2008). Species ranks in Alberta are based primarily on the number of occurrences of a species in the province, although information on population size and trends, life history and reproductive strategies, range, and current threats is used when available (see Gould 2006 for further information). The provincial status ranks referred to in this report are defined as follows (Gould 2006):

- S1: <5 occurrences or only a few remaining individuals;
- S2: 6-20 occurrences or with many individuals and fewer occurrences;
- S3: 21-100 occurrences;
- SNR: Unranked or under review;
- _?: Rank is questionable

Each of the survey sites at Pigeon Lake and Zeiner campgrounds are described below in terms of the rare species encountered and habitat features that are important for bryophytes. Waypoints ('wpts.') of bryophyte collections referred to in the body of this report are presented in **Appendix 1**.

2.1 Pigeon Lake campground (waypoints 214-248 and 265-266)

2.1.1 Campground loops G, H, I, and J (waypoints 214-239)

The forests of proposed campground loops G, H, I, and J are dominated by trembling aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*), with the occasional paper birch (*Betula papyrifera*) (**photos 1a-c, Appendix 2**). Localized wet depressions are frequent throughout the area and are dominated by willow (*Salix* spp.) and to a lesser extent by alder (*Alnus* spp.) (**photos 2a-b, Appendix 2**). White spruce (*Picea glauca*) is infrequent but occurs as scattered individuals in the canopy and understory. The forest floor is dominated by a high cover of forbs, graminoids, and shrubs (**photos 1a, 3a-b, Appendix 2**). Dominant forbs and graminoids include (in no particular order) wild sarsaparilla (*Aralia nudicaulis*), common yarrow (*Achillea millefolium*), common fireweed (*Epilobium angustifolium*), wild lily-of-the-valley (*Maianthemum canadense*), dewberry (*Rubus pubescens*), and wild vetch (*Vicia americana*); at wetter sites bluejoint (*Calamagrostis canadensis*), cow parsnip (*Heracleum lanatum*), and palmate-leaved coltsfoot (*Petasites frigidus* var. *palmatus*) are abundant. Dominant shrubs include (in no particular order) saskatoon (*Amelanchier alnifolia*), trembling aspen, wild red currant (*Ribes triste*), prickly rose (*Rosa acicularis*), wild red raspberry (*Rubus idaeus*), snowberry (*Symphoricarpos albus*), and low-bush cranberry (*Viburnum edule*).

The forests at Pigeon Lake campground are floristically depauperate in terms of bryophytes, likely because 1) the forests are relatively open and dry; 2) there are few microhabitats important for (especially rare) bryophytes; and 3) the understory is dominated by herbaceous plants, whose leaf litter can smother bryophytes on the forest floor. Important microhabitats such as patches of exposed mineral soil, large boulders, intermittent streams, and large, well-decayed logs and stumps are lacking or uncommon. The most important microhabitats in these forests are the bases of trees and partly-decayed logs on the forest floor. Furthermore, wet forest depressions that are dominated by willow tend to contain unique assemblages of bryophytes because of their higher moisture availability as compared to adjacent forests.

The moss *Leskea polycarpa* (currently ranked S1 in Alberta by ANHIC) was found at a single location at Pigeon Lake Provincial Park, growing at the margin of a small wetland along the main campground road (**wpt. 215, Appendix 1a; sample PL-54**) (**photos 4a-b, Appendix 2**). The centre of the wetland was dominated by emergent macrophytes (mostly sedges, *Carex* spp.), while willow and balsam poplar dominate at the periphery. The bowl of the wetland was dominated by the mosses *Drepanocladus aduncus* and *Leptodictyum riparium*. *Leskea polycarpa* was found growing at the base of willow stems and rotting wood just above the level of the water line. *Identification.* – *Leskea polycarpa* is recognized by its pale green or brownish mats, and stem leaves that are 0.8-1.2 mm in length, longer than broad, and somewhat curved to one side (secund) at the tips (Crum and Anderson 1981). Branch leaves are smaller and usually sub-secund, smooth or slightly pleated, and often with recurved margins near the base. Capsules (sporangia) are brown or yellow-brown, noticeably elongate at 2-3 mm in length, subcylindric, and often curved (**photo 5, Appendix 2**). Specimens of *Leskea polycarpa* encountered at this site had an abundance of mature sporophytes.

The liverwort *Chiloscyphus pallescens* (currently ranked S1 in Alberta by ANHIC) was found in a wet forest depression on a decaying willow bole on the ground (**wpt. 230, Appendix 1a; sample PL-25**) (**photo 2b, Appendix 2**). *Identification.* – *Chiloscyphus pallescens* is recognized, in part, by sporophytes that are borne on a short branch that arises along the main stem (as opposed to being terminal at the end of the stem, as found in some species such as *Lophocolea heterophylla*) (**photo 6, Appendix 2**). As well, the species has leaf cells that contain several (usually 4-6) large oil bodies (Schuster 1966-1992) (**photo 7, Appendix 2**). The trilobed perianths (tubular sheath that surrounds the developing sporophyte) with dentate margins, several large oil bodies, and preference for decaying logs are characters that serve to distinguish the species from the closely-related *Chiloscyphus polyanthos*. *Chiloscyphus pallescens* was also encountered at the

Pigeon Lake campground at **wpts. 241** (see Section 2.1.3, below) and **266** (see Section 2.1.5, below), and at Zeiner campground at **wpt. 255** (see Section 2.2.3, below).

The liverwort *Scapania glaucocephala* (currently ranked S2 in Alberta by ANHIC) was found growing on a decaying aspen log on the forest floor of an aspen-dominated forest (**wpt. 233, Appendix 1a; sample PL-28**) (**photos 8a-c, 9, Appendix 2**). The species was growing in admixture with other liverworts, including the rare species *Lophozia ascendens*, described below. *Identification.* – *Scapania glaucocephala* is recognized, in part, by its complicate-bilobed leaves, with a keel that is 0.4-0.5 the size of the ventral lobe, minute size (3-6 mm in height), pure-green colour, and reddish-brown vegetative propagules (gemmae). Moreover, leaves are bordered by 1-several rows of equally thick-walled cells, whereas the inner cells are thin walled (Schuster 1966-1992). The species was also encountered at Zeiner campground at **wpt. 250** (see Section 2.2.1, below).

The liverwort *Lophozia ascendens* (currently ranked S1 in Alberta by ANHIC) was found at a single location at Pigeon Lake Provincial Park, interspersed with *Scapania glaucocephala* on a decaying aspen log in an aspen-dominated forest (**wpt. 233, Appendix 1a; sample PL-28**) (**photo 9, Appendix 2**). *Identification.* – *Lophozia ascendens* is recognized, in part, by its small size, being only 0.7-1.1 mm wide and 2.0-3.5 (rarely 8-10) mm high, with greenish-yellow gemmae (Schuster 1966-1992). Plants form yellow-green patches, with reddish- to purplish-brown secondary pigmentation (Damsholt 2002). The plants have a strongly ascending growth form, with leaves that are noticeably narrower in width than in length, and that are inserted nearly perpendicular (transverse) to the main axis of the stem (**photo 10, Appendix 2**). The stems of mature plants are merely 7-11 cells in diameter in cross section. Oil bodies are 6-10 per cell, spherical to ovoid, 4-5 x 8-9 µm, and formed of numerous barely protruding spherules (Damsholt 2002) (**photo 11, Appendix 2**). The perianth mouth is divided into lobes that are each 3-5(7) cells wide at the base and with an apex of 2-5 superimposed cells (Damsholt 2002). The species is described as being ‘highly restricted’ in occurrence to the early stages of decomposition of logs and stumps (Schuster 1966-1992). [*Lophozia ascendens* is not mistakable with the much larger *Lophozia ventricosa*. *L. ventricosa* is characterized by mostly prostrate shoots that are 0.8-3.0(4.0) mm wide and 1.0-5.0 cm long, 16-22 cells in diameter in cross-section, and greenish above and brownish or purplish ventrally. The leaves of prostrate shoots are typically contiguous and subhorizontal. *Lophozia ventricosa* has cells that contain 9-25 subspherical to ellipsoidal oil bodies, 5-7 x 5-9 µm in dimension (Damsholt 2002). Moreover, the perianth mouth is lobulate, with lobes having teeth only 1-2 cells long (Damsholt 2002).]

2.1.2 New shower building (waypoint 246)

The proposed location for the new shower building contains few microhabitats that are important for bryophytes (**wpt. 246, Appendix 1a; photo 3b, Appendix 2**). The most abundant species at the site were *Pylaisiella polyantha* and *Amblystegium serpens*, which were found at the base of broadleaf trees. No rare bryophytes were encountered.

2.1.3 Newly designed loops A, B, C, D, and E (waypoints 240-245)

The forested area at the north end of this site contains the most suitable habitat for bryophytes (**photos 12a-b, Appendix 2**). These forests are dominated by trembling aspen and balsam poplar and, like the proposed loops G, H, I, and J, above, contain wet depressions that are dominated by willow. In comparison, the southern portion of this site is currently being used for agricultural purposes, including forage production and pasture (**photo 13, Appendix 2**), and is largely devoid of bryophytes.

The liverwort *Chiloscyphus pallescens* (**wpt. 241, Appendix 1a; sample PL-34**) (**photo 14, Appendix 2**) was found on a decaying willow bole in a small, forested, non-permanent stream channel. The species *Brachythecium rutabulum* was also found nearby (described below). *Chiloscyphus pallescens* was also encountered at Pigeon Lake campground at **wpts. 230** (see Section 2.1.1, above) and **266** (see Section 2.1.5, below), and at Zeiner campground at **wpt. 255** (see Section 2.2.3, below).

The moss *Brachythecium rutabulum* (currently ranked S2? in Alberta by ANHIC) was found at two locations at Pigeon Lake campground (**wpts. 241 and 243, Appendix 1a; samples PL-36 and PL-42, respectively**) (**photo 15, Appendix 2**). At both locations, the species was found on decaying wood in a moist forest depression dominated by willow (**wpt. 241** was a small, willow-dominated stream channel; **photo 14**). The liverwort *Chiloscyphus pallescens* was also present at **wpt. 241** (see details above). *Identification.* – *Brachythecium rutabulum* is recognized, in part, by being autoicous, and by its relatively large size as compared to other members of the genus. The species is robust and forms glossy, green or yellow mats with ascending branches, and is known to grow in wet forest habitats (Crum and Anderson 1981). Stem leaves are large at 2-3 mm in length with numerous oblong cells in the basal corners. Branch leaves are slightly smaller at 2.0-2.5 mm in length, nearly smooth (rarely pleated), with apices only occasionally twisted. Margins of branch leaves have slight but distinct serrations in the upper half. The species was also encountered as an incidental observation at Pigeon Lake campground at **wpt. 265** (see Section 2.1.5, below), and at Zeiner campground at **wpt. 261** (see Section 2.2.2, below).

The species *Brachythecium rivulare* (S3; an uncommon species, not tracked by ANHIC) was encountered at Pigeon Lake campground in a large, wet forest depression at **wpt. 230** (**photo 16, Appendix 2**) and at Zeiner campground on soil in a stream channel at **wpt. 262**. The liverwort *Chiloscyphus pallescens* was also encountered at **wpt. 230** (see Section 2.1.1, above). *Brachythecium rivulare* can be distinguished from *Brachythecium rutabulum* in being dioicous (although is sometimes autoicous) and growing in extensive and loose, pale, whitish- to yellow-green or yellow-brown, somewhat shiny mats or tufts (Crum and Anderson 1981). Stem leaves are 1.8-2.5 mm in length, broadly oblong-ovate, and often abruptly acuminate at the tips, with obviously inflated alar cells in broad decurrencies (Crum and Anderson 1981) (**photo 17, Appendix 2**). The species is described as growing on shaded soil and humus in wet seeps around springs and in the overflow of streams in woods.

The liverwort *Cephaloziella rubella* (currently ranked SNR in Alberta by ANHIC) was found growing on a decaying balsam poplar log (approximately 15 cm in diameter) in a forest dominated by balsam poplar (**wpt. 245, Appendix 1a; sample PL-44**) (**photos 18a-b, Appendix 2**). *Identification.* – *Cephaloziella rubella* is recognized, in part, by the following characters: typically paroicous (Schuster 1966-1992), shoots have numerous, long, and colourless rhizoids; leaves on sterile stems are distant and transversely inserted, and have entire margins that are bilobed to 0.5-0.7 (Smith 1991) of their length. Leaf lobes are (2)3-5(6) cells wide at the base and cells are 8-12(14) μm wide, thick-walled, and typically have a smooth cuticle. Moreover, the species is a distinct xerophyte and is ‘abundantly fertile’, commonly developing a red pigmentation (Schuster 1966-1992). All of these characters are present in collections of the species made from Pigeon Lake Provincial Park, although plants are mostly green and lacked a strong pigmentation, possibly because of its shaded habitat.

2.1.4 Existing day use area (waypoints 246-248)

The expansion of the existing day use area parking lot into the adjacent forest will not have an impact on rare bryophytes. The forest contains few microhabitats that are important for bryophytes and is infilled with shrubs, including (in no particular order) saskatoon, red-osier dogwood (*Cornus stolonifera*), choke cherry (*Prunus virginiana*), prickly rose, wild red raspberry, and snowberry, as well as regenerating aspen (**photo 19, Appendix 2**). No rare bryophytes were encountered at this site.

The proposed location for the site of the new boat launch and parking area is presently comprised of mature balsam poplar forest, with an understory dominated by the following shrubs (in no particular order): red-osier dogwood, prickly rose, wild red currant, and low-bush cranberry, as well as regenerating aspen and balsam poplar (**photo 20, Appendix 2**). This site contains few microhabitats that are important for bryophytes; a few small logs on the forest floor are dry and host few species. No rare bryophytes were encountered at this site.

Likewise, the site of the existing boat launch that is to be expanded into the adjacent young aspen forest (**photos 21a-b, Appendix 2**) contains few microhabitats for bryophytes. No rare species were encountered at this site.

2.1.5 Incidental observations (waypoints 265-266)

A small, forested, non-permanent stream near the day use area was surveyed for the potential occurrence of the moss *Leskea polycarpa*. The site appeared to have many features in common with another occurrence of the species at Lois Hole Provincial Park, Alberta, including flowing water during a portion of the year, decaying wood near the water line, and an abundance of willow, balsam poplar, and ostrich fern, *Matteuccia struthiopteris* (**photo 22, Appendix 2**). *Leskea polycarpa* was not encountered at this site; however, the moss *Brachythecium rutabulum* (**wpt. 265, Appendix 1a; sample PL-83**) and the liverwort *Chiloscyphus pallescens* (**wpt. 266, Appendix 1a; sample PL-86**) were encountered. *Brachythecium rutabulum* was found on a decaying willow log just above the water line and *Chiloscyphus pallescens* was found close by, also on a decaying willow log.

2.2 Zeiner campground (waypoints 249-264)

2.2.1 Expansion of existing camp stalls in loop A (waypoints 249-252)

As compared to Pigeon Lake campground (Section 2.1, above), the forests at Zeiner campground have a greater abundance of white spruce in the canopy and a reduced cover of understory shrubs (**photos 23a-b, Appendix 2**) as compared to forests at Pigeon Lake campground (Section 2.1, above). Dominant shrubs include (in no particular order) red-osier dogwood, common Labrador tea (*Ledum groenlandicum*), prickly rose, willow, and low-bush cranberry.

The liverwort *Scapania glaucocephala* was encountered on a large, decaying aspen log at loop A (**wpt. 250, Appendix 1b; sample PL-61**) (**photo 24, Appendix 2**) beneath a mixed canopy of trembling aspen and white spruce, in association with the common liverworts *Jamesoniella autumnalis* and *Lophocolea heterophylla*. The species was also encountered at Pigeon Lake campground at **wpt. 233** (see Section 2.1.1, above).

2.2.2 Expansion of existing beach campground (waypoints 256-264)

The forest immediately to the west of the existing beach campground (**Appendix 1b**) is dominated by trembling aspen, paper birch, and white spruce (**photo 25, Appendix 2**). The understory is dominated by the shrubs (in no particular order) prickly rose, northern gooseberry (*Ribes oxycanthoides*), wild red currant, and willow, whereas common Labrador tea and wild red raspberry are more occasional. The forest appears to contain a greater diversity of microhabitats for bryophytes as compared to forests at Pigeon Lake campground (Section 2.1, above). Important microhabitats include large, decaying logs and stumps of

conifer and broadleaf trees, large tree bases, and wet forest depressions (with a predominance of willow) and non-permanent stream channels.

The moss *Brachythecium rutabulum* (currently ranked S2 in Alberta by ANHIC) was encountered in a wet forest depression dominated by willow, growing on a fallen willow bole and on patches of forest floor (**wpt. 261, Appendix 1b; sample PL-76**). Please refer to Section 2.1.3, above, for the diagnostic characters of this species.

The moss *Hypnum pallescens* (currently ranked S2 in Alberta by ANHIC) is locally abundant in the forests adjacent to the beach campground (**wpts. 256-261, Appendix 1b; sample PL-71**) (**photo 26, Appendix 2**). The species was encountered with sporophytes at these waypoints, growing as small mats at the base of birch trees. *Identification.* – *Hypnum pallescens* is recognized, in part, by dark yellowish-, or brownish-green, slightly shiny mats (Crum and Anderson 1981). Leaves are 0.6-1.0 mm in length, and gradually or abruptly acuminate from a broader base; upper cells are linear-rhomboidal (6-8:1) with fairly thick walls; alar cells are small, subquadrate, thick-walled, and occur in several rows. Moreover, pseudoparaphyllia found mostly along the stems are small and lanceolate. *Hypnum pallescens* was also encountered near the entrance of Zeiner campground, at the base of a large spruce tree at **wpt. 253** (see Section 2.2.4, below).

The liverwort *Ricciocarpos natans* (currently ranked S2 in Alberta by ANHIC) was encountered on wet mineral soil at the mouth of a stream that flows into Pigeon Lake during certain times of the year (**wpt. 264, Appendix 1b; sample PL-81**) (**photos 27a-b, Appendix 2**). *Identification.* – *Ricciocarpos natans* is a small aquatic, thalloid liverwort. The species is typically found floating in still water along the margins of ponds, small lakes, ditches, or backwaters of streams, or is sometimes found stranded on soil exposed by receding water levels (Schuster 1966-1992, personal observation). When floating, plants can be recognized by their green to reddish-tinged gametophytes, with segments measuring 5-10 mm in length, and an obvious fringe of dark-coloured scales that spread outwards from beneath the lobes. The upper surface of the plant has distinct grooves and inconspicuous air pores (appearing as mere dots). When growing on soil, plants are often larger in size, darker in colour, and have much smaller scales (Schuster 1966-1992). Approximately 150 m of lakeshore to the north of the mouth of the stream was examined (especially among stands of emergent macrophytes) for the occurrence of this and other aquatic liverworts, but none were encountered. However, *Ricciocarpos natans* was documented near the entrance to Zeiner campground, floating in water and growing on soil along the banks of a forested water channel at **wpt. 254** (see incidental observations, below).

2.2.3 Clearing of area in the vicinity of the old shower building (waypoint 255)

The forest in the vicinity of the old shower building is a mixture of trembling aspen, balsam poplar, and white spruce. The forest floor is dominated by an abundance of red-osier dogwood, wild red raspberry, and a high cover of the graminoid Kentucky bluegrass (*Poa pratensis*).

The liverwort *Chiloscyphus pallescens* was encountered on a small, partly-decayed aspen log close to the old shower building (**wpt. 255, Appendix 1b; sample PL-68**) (**photos 28a-b, Appendix 2**). Please refer to Section 2.1.1, above, for the diagnostic characters of this species. *Chiloscyphus pallescens* was also encountered at Pigeon Lake campground at **wpts. 230** (Section 2.1.1, above), **241** (Section 2.1.3, above), and **266** (Section 2.1.5, above).

2.2.4 Incidental observations (waypoints 253-254)

A stream and adjacent forest near the entrance of Zeiner campground were surveyed for the presence of rare bryophytes because of the high probability of occurrence of unique or uncommon species.

The moss *Hypnum pallescens* was encountered at the base of a large white spruce tree (**wpt. 253, Appendix 1b; sample PL-64 (photo 29, Appendix 2)**) and the liverwort *Ricciocarpos natans* was found nearby, floating in water and growing on soil along the banks of a forest stream (**wpt. 254, Appendix 1b; sample PL-65 (photos 30a-b, Appendix 2)**). The occurrence of *Ricciocarpos natans* at **wpt. 254** was approximately 0.5 km upstream of **wpt. 264** (see Section 2.2.2, above).

3.0 Mitigation of potential damage to rare species

Summary of findings – A total of eight rare bryophyte species (representing 17 collections) was encountered during the fall 2008 survey at Pigeon Lake Provincial Park. These species were observed at a limited number of sites within the Park where proposed development or upgrading activities are expected to occur. These species do not represent the total numbers of occurrences likely to be found in the Park if targeted surveys were to be conducted over larger areas of higher quality habitat. However, some of the encountered species may occur infrequently in the Park and be at greater risk of local extirpation as a result of the planned developments.

Important microhabitats for rare bryophytes at Pigeon Lake Provincial Park – The most important microhabitats for bryophytes at the surveyed sites include the bases of large broadleaf and conifer trees, and decaying logs and stumps on the forest floor. Decaying logs and stumps that are protected from moisture loss by a high forest canopy cover, concave topographic features (e.g., riparian channels), and wet forest depressions, provide an especially important habitat for many bryophytes and are capable of hosting large numbers of species. Several liverworts encountered during the survey are obligately epixylic (growing exclusively on decaying wood) (e.g., *Cephaloziella rubella*, *Chiloscyphus pallescens*, *Lophozia ascendens*, *Scapania glaucocephala*), and are therefore dependent on decaying logs for their continued survival.

Wet forest depressions and riparian channels are important habitats for some rare species (e.g., *Leskea polycarpa*, *Brachythecium rutabulum*), and often contain unique assemblages of bryophytes because of their comparatively high moisture levels. The mosses *Leskea polycarpa* and *Brachythecium rutabulum* are dependent on habitats with high moisture levels for their survival. *Leskea polycarpa* is described as growing in wet places that are often subject to flooding, particularly on wood substrates situated immediately adjacent to streams (Crum and Anderson 1981). The species was found at a single location at Pigeon Lake Provincial Park (see Section 2.1.1, above), at a forested wetland just above the waterline (indicated by an abrupt reduction in the abundance of the wet-adapted species *Leptodictyum riparium* and *Drepanocladus aduncus*), presumably where moisture levels are highest. *Brachythecium rutabulum* is described as growing in wet forest habitats (Crum and Anderson 1981) and was found almost exclusively in wet, willow-dominated forest depressions at Pigeon Lake Provincial Park. Moreover, many liverwort species in the boreal forest are sensitive to desiccation (e.g., Fenton and Frego 2005, Hylander et al. 2005), and are therefore reliant on mesic substrates such as decaying logs for their survival. Decaying logs found in wet forest depressions are more protected from desiccation and able to retain moisture for longer periods of time.

Considerations when upgrading – Any development or upgrading activities at Pigeon Lake Provincial Park should avoid the removal of or damage to habitats that are important for rare bryophytes. At Pigeon Lake campground (Appendix 1a) there were relatively few large, well-decayed logs and stumps at the surveyed sites; those that do exist should be protected to ensure the survival of species they host (e.g., *Cephaloziella rubella*, *Chiloscyphus pallescens*, *Lophozia ascendens*, *Scapania glaucocephala*) and to preserve habitat for

those species they are capable of hosting. Moreover, decaying logs and stumps should preferably be sheltered from moisture loss resulting from the creation of nearby forest edges (especially those that are south- or west-facing) or the removal of canopy trees during development activities. In comparison, the forests at Zeiner campground (**Appendix 1b**) contained a greater diversity of habitats for bryophytes, including a greater abundance and larger size of white spruce and paper birch trees, increased abundances of decaying logs and stumps (both conifer and broadleaf types), and riparian channels. As suggested for Pigeon Lake campground, decaying logs and stumps should be left intact and sheltered from moisture loss. Furthermore, large canopy trees should be left standing as they provide important habitat for numerous species (**photos 26 and 29**), including the rare moss, *Hypnum pallescens*. Development in the vicinity of wet forest depressions (**photo 2b, Appendix 2**), forested streams (**photo 31, Appendix 2**), and forested wetlands (**photo 4a, Appendix 2**) should be strictly avoided, as these provide important habitat for distinct assemblages of bryophytes and several rare species (e.g., *Brachythecium rutabulum*, *Chiloscyphus pallescens*, *Leskea polycarpa*, *Ricciocarpos natans*). Any development or upgrading activities in the areas surrounding these types of wetlands need to ensure that the local hydrology is not affected. Therefore, it is strongly recommended that the advice of professional hydrologists be obtained prior to any major upgrading or development activities in the Park.

None of the rare bryophyte occurrences at Pigeon Lake Provincial Park was relocated for the following reasons:

- 1) Many epixylic species (e.g., *Cephaloziella rubella*, *Chiloscyphus pallescens*, *Scapania glaucocephala*) could not be moved without the accompanying relocation of their entire microhabitat (e.g., large decaying log);
- 2) Some species were firmly affixed their substrate and their removal would have resulted in damage to the population (e.g., *Hypnum pallescens* at the base of trees);
- 3) There were no suitable habitats (e.g., wet forest depressions) available in the vicinity for transplanting;
- 4) There is no research evidence to suggest that transplants are an effective mitigation tool for these species.

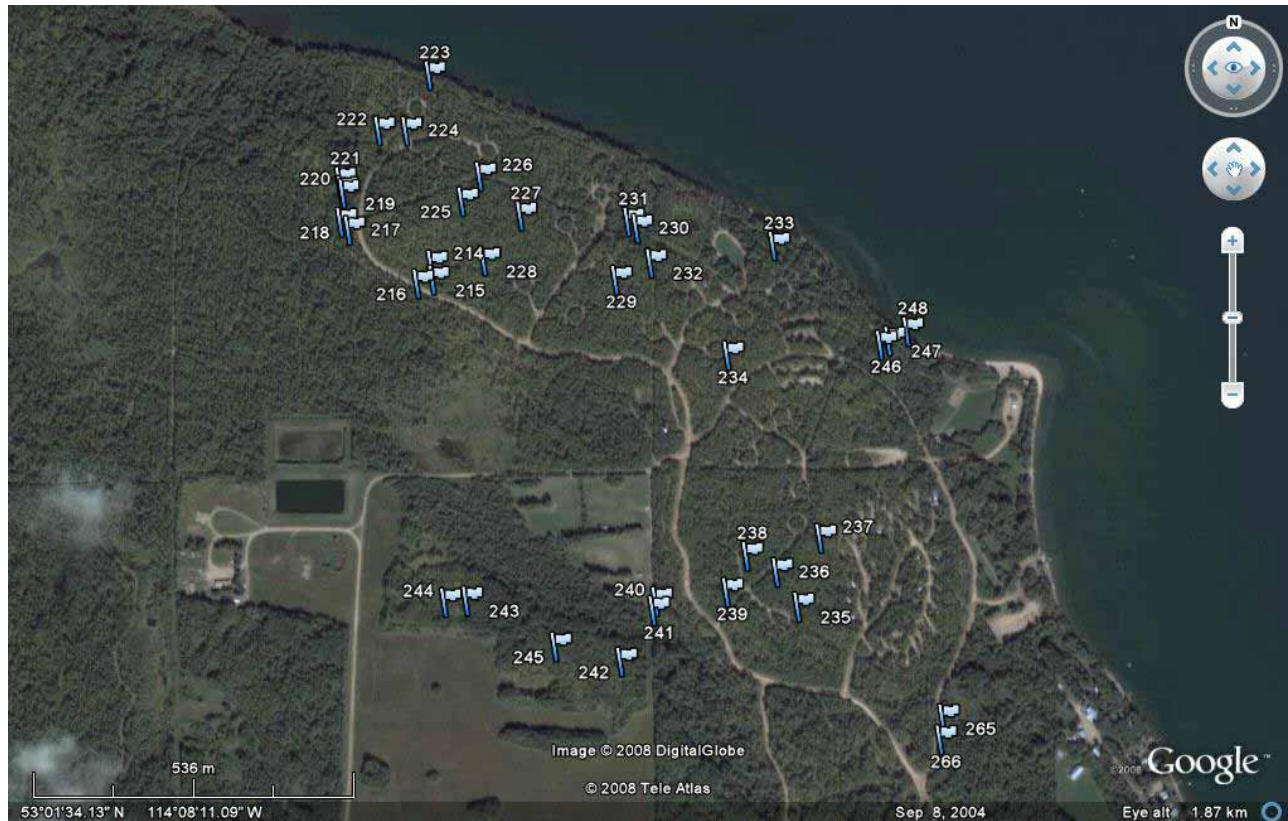
Instead of relocating rare bryophytes, the populations were marked in the field with orange flagging tape and their locations were recorded using GPS. Rare plant locations have been superimposed over Google Earth imagery of the Park (**Appendix 1**) to clearly indicate where they occur and to help limit disturbance to these areas.

Some rare species were encountered more frequently than others at Pigeon Lake Provincial Park and may be at a reduced risk of extirpation as a result of the proposed management activities. The moss *Brachythecium rutabulum* was encountered at four locations during the surveys, always in wet, willow-dominated forest depressions, and likely occurs frequently in similar habitats throughout the Park. The liverwort *Chiloscyphus pallescens* was encountered at four locations, always epixylic on decaying boles of broadleaf trees and shrubs, and likely occurs throughout the Park where these microhabitats are found. Moreover, the moss *Hypnum pallescens*, although only documented twice during the surveys, was locally abundant at the base of trees at Zeiner campground, and may occur over larger areas in the Park. However, extended searches for these and other rare bryophyte species should be conducted to provide more detailed information about their local abundance, and the potential effects of management activities on their long-term maintenance in the Park.

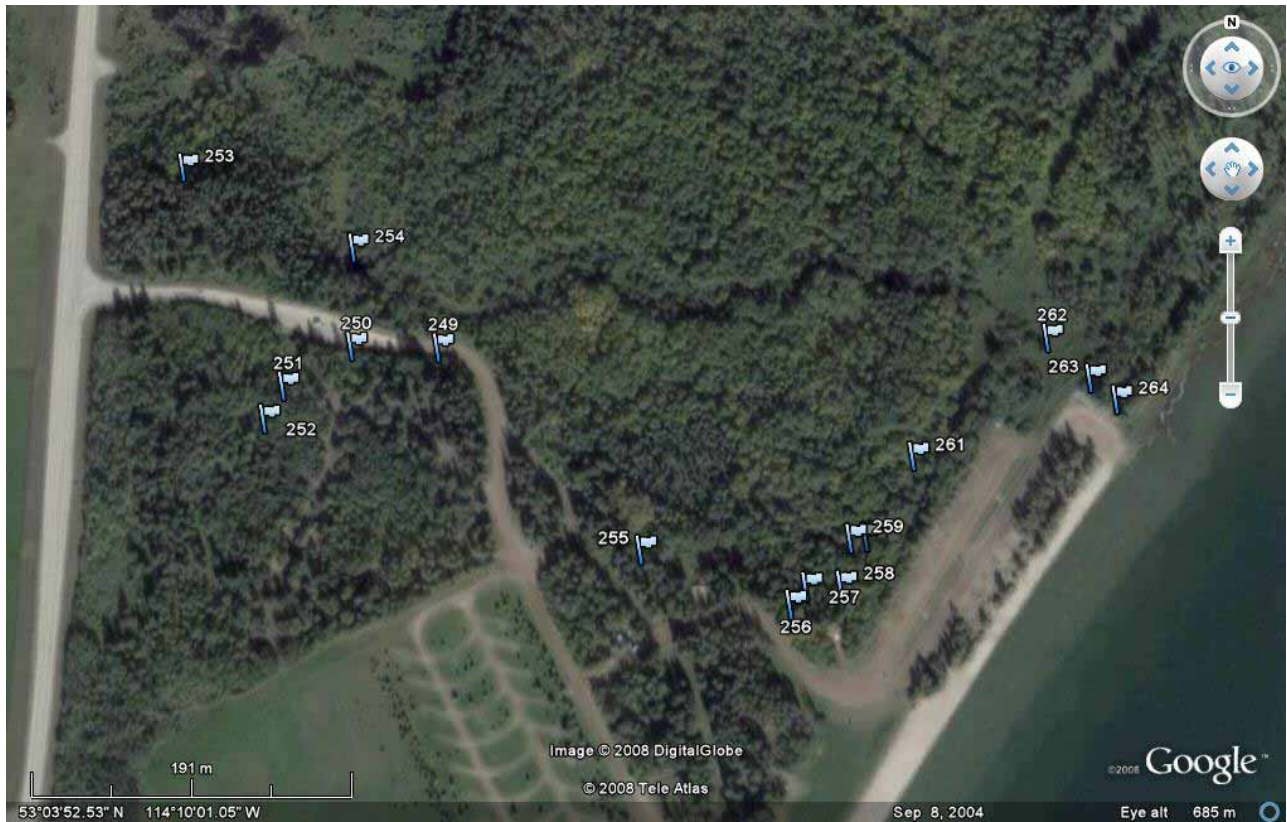
4.0. References cited

- Anderson, L. E., H. A. Crum, and W. R. Buck. 1990. List of the mosses of North America north of Mexico. *Bryologist* 93:448-449.
- Alberta Natural Heritage Information Centre (ANHIC). 2008. Database query. Accessed August 2008.
- Bryophyte Flora of North America (BFNA). 2007. The treatments: descriptions, keys, illustrations, and maps. Available at: <<http://www.mobot.org/plantscience/bfna/TREATments.htm>>. Bryophyte Flora of North America. Accessed September 2008.
- Crum, H. A., and L. E. Anderson. 1981. Mosses of eastern North America. 2 vols. Columbia University Press, New York, USA.
- Damsholt, K. 2002. Illustrated flora of Nordic liverworts and hornworts. Nordic Bryological Society, Lund, Norway.
- Doubt, J., and R. Belland. 2000. Monitoring protocols for elements of non-vascular plant diversity in Alberta's forested zones. Devonian Botanic Garden, Edmonton, Canada.
- Fenton, N. J., and K. A. Frego. 2005. Bryophyte (moss and liverwort) conservation under remnant canopy in managed forests. *Biological Conservation* 122:417-430.
- Gould, J. 2006. Alberta Natural Heritage Information Centre tracking and watch lists – vascular plants, mosses, liverworts and hornworts. Alberta Community Development, Parks and Protected Areas Division, Edmonton, Canada.
- Hylander K., M. Dynesius, B. G. Jonsson, and C. Nilsson. 2005. Substrate form determines the fate of bryophytes in riparian buffer strips. *Ecological Applications* 15:674-688.
- Lawton, E. 1971. Moss Flora of the Pacific Northwest. Hattori Botanical Laboratory, Nichinan, Japan.
- NatureServe. 2008. NatureServe conservation status. NatureServe Central Databases. Available at: <<http://www.natureserve.org/explorer/ranking.htm#natsub>>. Accessed September 2008.
- Newmaster, S. G., R. J. Belland, A. Arsenault, D. H. Vitt, and T. R. Stephens. 2005. The ones we left behind: Comparing plot sampling and floristic habitat sampling for estimating bryophyte diversity. *Diversity and Distributions* 11:57-72.
- Schuster, R. M. 1966-1992. The Hepaticae and Anthocerotae of North America east of the hundredth meridian. 6 vols. New York, London, and Chicago, USA.
- Smith, A. J. E. 1991. The liverworts of Britain and Ireland. Cambridge University Press, Cambridge, UK.
- Stotler, R., and B. A. Crandall-Stotler. 1977. Checklist of the liverworts and hornworts of North America. *Bryologist* 80:407-428.

Appendix 1 – Location of bryophyte collections at Pigeon Lake Provincial Park



Appendix 1a. Location of rare and common bryophyte collections made at Pigeon Lake campground (Section 2.1, this report) during the September, 2008 survey at Pigeon Lake Provincial Park, Alberta. Numbers in the images are the waypoints ('wpts.') referred to in the body of this report. Please note that these locations do not represent the full extent of areas surveyed. Imagery was obtained from Google Earth Plus (4.3.7284.3916 [beta]). The above image has a different scale than the image in Appendix 1b, below.



Appendix 1b. Location of rare and common bryophyte collections made at Zeiner campground (Section 2.2, this report) during the September, 2008 survey at Pigeon Lake Provincial Park, Alberta. Numbers in the images are the waypoints ('wpts.') referred to in the body of this report. The text for wpt. 260 in the image is obscured by wpt. 259. Please note that these locations do not represent the full extent of areas surveyed. Imagery was obtained from Google Earth Plus (4.3.7284.3916 [beta]). The above image has a different scale than the image in Appendix 1a, above.

Appendix 2 – Photos of surveyed sites and bryophytes²



Photo 1a (photo no. IMG_3472). Aspen-dominated forest at Pigeon Lake campground near **wpt. 216**. Note the high abundance of forbs and shrubs in the understory. This site contains relatively few microhabitats for bryophytes; the most important ones include the bases of trees and decayed wood on the forest floor.



Photo 1b (photo no. IMG_3487). Aspen-dominated forest at Pigeon Lake campground close to **wpt. 230**. Note the high abundance of forbs and shrubs in the understory. This site contains relatively few microhabitats for bryophytes; the most important ones include the bases of trees and decayed wood on the forest floor.

² Photo numbers in Appendix 2 refer to the file name of images deposited with Alberta Tourism, Parks and Recreation.



Photo 1c (photo no. IMG_3515). Balsam poplar-dominated forest at Pigeon Lake campground near **wpt. 235**. Note the high abundance of forbs and graminoids in the understory. This site contains relatively few microhabitats for bryophytes; the most important ones include the bases of trees and decayed wood on the forest floor.



Photo 2a (photo no. IMG_3483). A wet forest depression at Pigeon Lake campground dominated by large willow. Mesic forest habitats such as this typically contain different assemblages of bryophytes as compared to adjacent forest, and are important for some rare species, including the moss *Brachythecium rutabulum* and the epixylic liverwort *Chiloscyphus pallescens*. Compare with **photo 2b**.



Photo 2b (photo no. IMG_3490). A wet forest depression at Pigeon Lake campground dominated by large willow at **wpt. 230**. Mesic forest habitats such as this typically contain different assemblages of bryophytes as compared to adjacent forest, and are important for some rare species, including the moss *Brachythecium rutabulum* and the epixylic liverwort *Chiloscyphus pallescens*. Compare with **photo 2a**.



Photo 3a (photo no. IMG_3486). An aspen-dominated forest at Pigeon Lake campground with a high abundance of forbs and graminoids in the understory.



Photo 3b (photo no. IMG_3507). An aspen-dominated forest at **wpt. 246** at Pigeon Lake campground with a high abundance of forbs, graminoids, and shrubs in the understory.



Photo 4a (photo no. IMG_3468). A small forest wetland at **wpt. 215** along the main gravel road at Pigeon Lake campground. The moss *Leskea polycarpa* (S1) was found at the wetland margin, growing just above the waterline at the bases of large willows and on decayed wood.



Photo 4b (photo no. IMG_3545). The moss *Leskea polycarpa* (S1) was found growing at the base of this large willow at the margin of a small forest wetland. The wetland was situated at **wpt. 215** along the main gravel road at Pigeon Lake campground.



Photo 5 (photo no. IMG_3771). The moss *Leskea polycarpa* (S1) growing at the base of a large willow at the margin of a small forest wetland. Note the curved stem and branch leaves of the gametophytes in the background, and the noticeably elongate, sub-cylindric, and slightly curved sporangium in the foreground.



Photo 6 (photo no. IMG_3837). The liverwort *Chiloscyphus pallescens* (S1). Note that the developing sporophyte (visible through the perianth) is borne on a short branch that arises along the main stem.

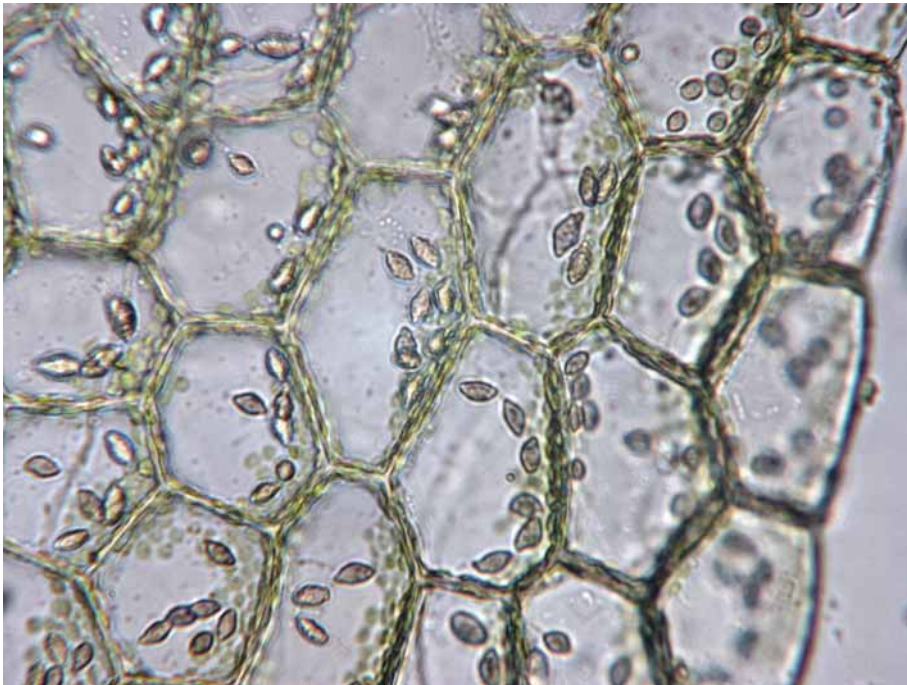


Photo 7 (photo no. IMG_3665). Oil bodies in the leaf cells of the liverwort *Chiloscyphus pallescens* (S1), from a plant found in the Park (approximately 1000x magnification).



Photo 8a (photo no. IMG_3505). A decaying aspen log in an aspen-dominated forest. This microhabitat is host to the liverworts *Scapania glaucocephala* (S2), *Lophozia ascendens* (S1), and several additional epixylic species.



Photo 8b (photo no. IMG_3500). The liverwort *Scapania glaucocephala* (S2) growing on a decaying aspen log in an aspen-dominated forest. The liverwort *Lophozia ascendens* (S1) and several additional epixylic species were found growing on the same log.



Photo 8c (photo no. IMG_3859). The liverwort *Scapania glaucocephala* (S2) growing on a decaying aspen log in an aspen-dominated forest.



Photo 9 (photo no. IMG_3851). The liverworts *Scapania glaucocephala* (S2; with reddish-brown vegetative propagules) and *Lophozia ascendens* (S1; with greenish-yellow vegetative propagules) growing on a decaying aspen log in an aspen-dominated forest.



Photo 10 (photo no. IMG_3652). Close-up of the liverwort *Lophozia ascendens* (S1), from a collection made in the Park. Note that the leaves are inserted quite transversely along the stem and are longer than wide.

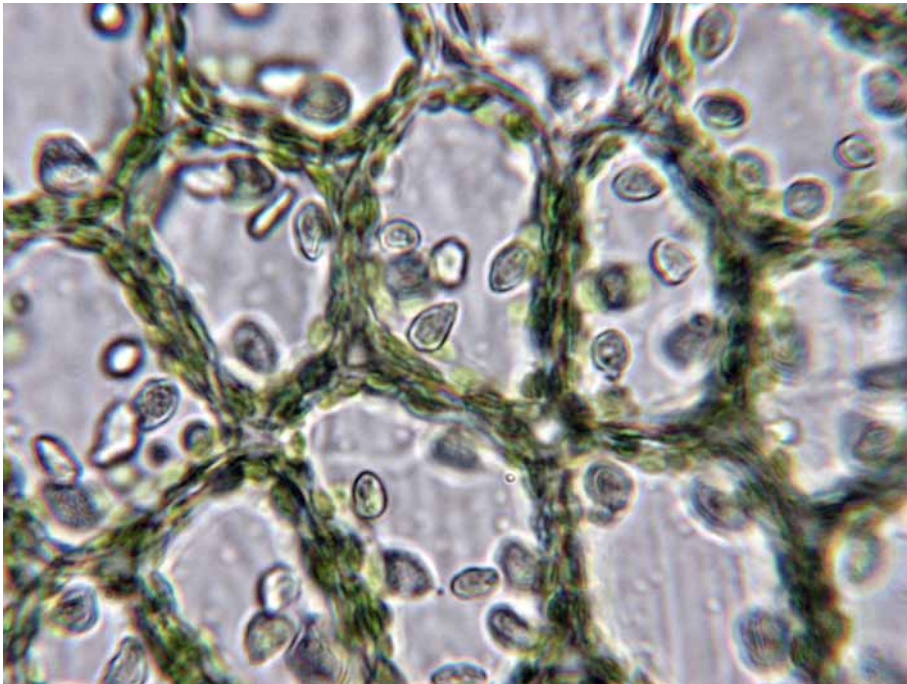


Photo 11 (photo no. IMG_3655). Oil bodies within the leaf cells of the liverwort *Lophozia ascendens* (S1), from a plant found in the Park. Oil bodies are 6-10 per cell, spherical to ovoid, 4-5 x 8-9 μm in dimension, and formed of numerous barely protruding spherules (Damsholt 2002) (approximately 1000x magnification).



Photo 12a (photo no. IMG_3521). Forested area at the north end of the proposed site for new campground loops A, B, C, D, and E. These forests are dominated by trembling aspen and balsam poplar, and contain several wet, willow-dominated depressions. Compare with **photo 12b**.



Photo 12b (photo no. IMG_3529). Forested area at the north end of the proposed site for new campground loops A, B, C, D, and E. These forests are dominated by trembling aspen and balsam poplar, and contain several wet, willow-dominated depressions. Compare with **photo 12a**.



Photo 13 (photo no. IMG_3533). Non-forested area at the south end of the proposed site for new campground loops A, B, C, D, and E. This area is currently being used for agricultural purposes, including forage production and grazing, and contains few bryophytes.



Photo 14 (photo no. IMG_3517). The liverwort *Chiloscyphus pallescens* (S1) was found at **wpt. 241** on a decaying bole of willow on the ground in this small, forested, non-permanent stream channel.



Photo 15 (photo no. IMG_3479). The moss *Brachythecium rutabulum* (S2?) was found growing on a decaying bole of willow on the ground at **wpt. 241** in a small, forested, non-permanent stream channel. The liverwort *Chiloscyphus pallescens* (S1) was found nearby (also on a decaying willow bole) in the same stream channel (see **photo 14**).



Photo 16 (photo no. IMG_3492). The moss *Brachythecium rivulare* (S3) growing on the forest floor in a large, wet forest depression at **wpt. 230**.



Photo 17 (photo no. IMG_3765). A single stem leaf of the moss *Brachythecium rivulare* (S3). Note the inflated alar cells at the base of the leaf.



Photo 18a (photo no. IMG_3755). The liverwort *Cephaloziella rubella* (SNR) growing on a decaying log at wpt. 245. Note the abundance of developing sporophytes.



Photo 18b (photo no. IMG_3757). A fertile shoot of the liverwort *Cephaloziella rubella* (SNR). Note the perianth that contains the developing sporophyte and the colourless rhizoids.



Photo 19 (photo no. IMG_3538). A narrow band of aspen forest adjacent to the existing parking lot at the Pigeon Lake campground day use area. This site contains few microhabitats that are important for bryophytes.



Photo 20 (photo no. IMG_3543). The proposed site of a new boat launch and parking area at the Pigeon Lake campground day use area, comprised of mature balsam poplar. This site contains few microhabitats that are important for bryophytes.



Photo 21a (photo no. IMG_3644). Forested area adjacent to the existing boat launch at the Pigeon Lake campground day use area.



Photo 21b (photo no. IMG_3645). Forested area adjacent to the existing boat launch at the Pigeon Lake campground day use area. This site is to be developed for the expansion of the boat launch. Apart from the bases of small trees, the site contains few microhabitats that are important for bryophytes.



Photo 22 (photo no. IMG_3647). A small, forested, non-permanent stream near the Pigeon Lake campground day use area at **wpts. 265 and 266**. *Brachythecium rutabulum* and *Chiloscyphus pallescens* were found on decaying willow logs on the banks. The surrounding forest was dominated by balsam poplar and had an abundance of ostrich fern, *Matteuccia struthiopteris*, in the understory.



Photo 23a (photo no. IMG_3579). A forested area at loop A of Zeiner campground.



Photo 23b (photo no. IMG_3585). Forested area at loop A of Zeiner campground. Dominant shrubs in the vicinity include red-osier dogwood, common Labrador tea, prickly rose, willow, and low-bush cranberry.



Photo 24 (photo no. IMG_3582). The liverwort *Scapania glaucocephala* (S2) was encountered on a decaying aspen log at loop A of Zeiner campground at **wpt. 250**, beneath a mixed canopy of trembling aspen and white spruce.



Photo 25 (photo no. IMG_3622). The forest immediately to the west of the existing Zeiner beach campground is dominated by trembling aspen, paper birch, and white spruce.



Photo 26 (photo no. IMG_3621). The moss *Hypnum pallescens* (S2) was locally abundant in the forests adjacent to the Zeiner beach campground, growing as small mats at the base of birch trees, commonly in association with the mosses *Brachythecium erythrorrhizon*, *Brachythecium starkei*, and *Plagiothecium denticulatum*. This photo was taken at **wpt. 256**.



Photo 27a (photo no. IMG_3641). A small stream channel that drains into Pigeon Lake at **wpt. 264**. The aquatic liverwort *Ricciocarpos natans* (S2) was found growing on mineral soil exposed by receding water levels.



Photo 27b (photo no. IMG_3638). The small, aquatic liverwort *Ricciocarpos natans* (S2) growing on mineral soil in a small stream channel that drains into Pigeon Lake at **wpt. 264**.



Photo 28a (photo no. IMG_3610). The liverwort *Chiloscyphus pallescens* (S1) was encountered on this partly decayed aspen log close to the old shower building at Zeiner campground at **wpt. 255**.



Photo 28b (photo no. IMG_3612). The forested area adjacent to the old shower (visible in the background on the left) building at Zeiner campground where the liverwort *Chiloscyphus pallescens* (S1) was encountered.



Photo 29 (photo no. IMG_3596). The moss *Hypnum pallescens* (S2) was encountered as an incidental observation at the base of a large white spruce tree near the entrance to Zeiner campground.



Photo 30a (photo no. IMG_3604). The aquatic liverwort *Ricciocarpos natans* (S2) was encountered as an incidental observation in this stream channel, floating in water and growing on soil along the banks. This occurrence of *Ricciocarpos natans* at **wpt. 254** was approximately 0.5 km upstream of another occurrence of the species at **wpt. 264**.



Photo 30b (photo no. IMG_3606). The aquatic liverwort *Ricciocarpos natans* (S2) growing on soil along the banks of a stream channel at **wpt. 254**. This occurrence of *Ricciocarpos natans* was approximately 0.5 km upstream of another occurrence of the species at **wpt. 264**.



Photo 31 (photo no. IMG_3637). A stream channel that drains into Pigeon Lake near **wpt. 264**. The aquatic liverwort *Ricciocarpos natans* (S2) was found both upstream (**wpt. 254**) and immediately downstream (**wpt. 264**) of this site.

Appendix 3 – List of rare and common bryophytes encountered during the survey³

Taxonomic name⁴

Abietinella abietina
Amblystegium serpens
Aulacomnium palustre
Barbula convoluta
Barbula unguiculata
*Blepharostoma trichophyllum**
Brachythecium erythrorrhizon
Brachythecium rivulare
Brachythecium rutabulum (currently ranked S2? in Alberta by ANHIC)
Brachythecium salebrosum
Brachythecium starkei
Bryohaplocladium microphyllum
Bryum argenteum
Bryum lisae var. *cuspidatum*
Bryum pseudotriquetrum
Campylium chrysophyllum
Campylium hispidulum
Campylium stellatum
*Cephaloziella rubella** (currently ranked SNR in Alberta by ANHIC)
Ceratodon purpureus
*Chiloscyphus pallescens** (currently ranked S1 in Alberta by ANHIC)
Climacium dendroides
Cratoneuron filicinum
Dicranum flagellare
Dicranum fuscescens
Dicranum polysetum
Dicranum scoparium
Drepanocladus aduncus
Eurhynchium pulchellum
Helodium blandowii
Herzogiella turfacea
Hylocomium splendens
Hypnum pallescens (currently ranked S2 in Alberta by ANHIC)
Isopterygiopsis pulchella
*Jamesoniella autumnalis**
*Lepidozia reptans**
Leptobryum pyriforme
Leptodictyum riparium
Leskea polycarpa (currently ranked S1 in Alberta by ANHIC)
Lophocolea heterophylla

³ This list includes only those species encountered at a limited number of sites during the survey and is not intended to represent the full complement of species in the Park.

⁴ This list includes both mosses and liverworts (liverworts indicated with an asterisk,*). Underlined species are those currently found on the ANHIC plant tracking and watch lists.

Appendix 3, *continued*

*Lophocolea minor**

*Lophozia ascendens** (currently ranked S1 in Alberta by ANHIC)

*Marchantia polymorpha**

Mnium spinulosum

Oncophorus wahlenbergii

Orthotrichum obtusifolium

Orthotrichum speciosum

Plagiomnium ellipticum

Plagiomnium cuspidatum

Plagiomnium drummondii

Plagiomnium medium

Plagiothecium denticulatum

Platygyrium repens

Pleurozium schreberi

Pohlia nutans

Polytrichum commune

Polytrichum juniperinum

*Ptilidium pulcherrimum**

Ptilium crista-castrensis

Pylaisiella polyantha

Rhytidium rugosum

*Ricciocarpos natans** (currently ranked S2 in Alberta by ANHIC)

Sanionia uncinata

*Scapania glaucocephala** (currently ranked S2 in Alberta by ANHIC)

Tetraphis pellucida

Thuidium recognitum

Tortula ruralis

Appendix 4 – ANHIC rare plant survey forms⁵



<i>Brachythecium rutabulum</i> , a moss	(S2?; 4 occurrences)
<i>Cephaloziella rubella</i> , a liverwort	(SNR; 1 occurrence)
<i>Chiloscyphus pallescens</i> , a liverwort	(S1; 4 occurrences)
<i>Hypnum pallescens</i> , a moss	(S2; 2 occurrences)
<i>Leskea polycarpa</i> , a moss	(S1; 1 occurrence)
<i>Lophozia ascendens</i> , a liverwort	(S1; 1 occurrence)
<i>Ricciocarpos natans</i> , a liverwort	(S2; 2 occurrences)
<i>Scapania glaucocephala</i> , a liverwort	(S2; 2 occurrences)

Information from these rare plant survey forms is available by request from:

Todd Kemper, ANHIC Senior Botanist

Email: Todd.Kemper@gov.ab.ca

Tel: 780-644-2747

⁵ These forms were submitted to ANHIC on December 08, 2008, as part of this report.