

Gastony's Cliffbrake (*Pellaea gastonyi*) in Manitoba: New Records and Assessment of Conservation Status

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Gastony's Cliffbrake (*Pellaea gastonyi* Windham) is a globally rare fern (Pteridaceae) that grows on limestone cliffs and ledges, including those associated with alvars. Until now, the only record in Manitoba was from a location just north of Fisher Branch. We report additional records and locations, one of which is over 250 km north of the initial collection. We also provide a conservation status assessment of this species in Manitoba that indicates that this species is rare in the province and is threatened in a least a portion of its range by habitat loss and degradation.

Key Words: Gastony's Cliffbrake; *Pellaea gastonyi*; Manitoba; limestone; alvar; rare species; fern; habitat loss

Gastony's Cliffbrake (*Pellaea gastonyi* Windham) is a fern (Pteridaceae) of calcareous outcrops and cliffs (Windham 1993a). Its distribution consists of scattered occurrences in central and western North America (Windham 1993b), including South Dakota, Wyoming, Missouri, and Washington in the United States (Windham 1993b; Rocky Mountain Herbarium 2008). Aside from Manitoba, its Canadian range includes the cordilleran regions of British Columbia and Alberta and a disjunct population in northern Saskatchewan (Rigby and Britton 1970; Windham 1993a). The global conservation status of Gastony's Cliffbrake is G2G3 – Imperilled–Vulnerable (NatureServe 2013), although it may be locally abundant (Brunton 1979).

The species arose through hybridization of apogamous triploid Purple-stemmed Cliffbrake (*Pellaea atropurpurea* [L.] Link) and diploid Western Dwarf Cliffbrake (*Pellaea glabella* ssp. *occidentalis* [E. E. Nelson] Windham), except for Missouri material, which has the diploid *Pellaea glabella* ssp. *missouriensis* (Gastony) Windham as a parent (Gastony 1988; Windham 1993a). Because the hybrid is apogamous and, thus, able to reproduce autonomously from the parent taxa, it was described as a new species by Windham (1993a). Of the parent taxa, only Western Dwarf Cliffbrake occurs in Manitoba, where scattered populations are known from the southern half of the province, and plants are often locally abundant where suitable habitat, i.e., calcareous outcrops, exists (Manitoba Conservation Data Centre, unpublished data). The sparsely villous rachis and purple-brown petiole of Gastony's Cliffbrake reliably distinguish it in the field from Western Dwarf Cliffbrake which has a hairless rachis and a light-brown to straw-coloured petiole (Windham 1993a; Harms and Leighton 2011). It is distinguished from Purple-stemmed Cliffbrake by the presence of long, divergent (versus more abundant short, curly) hairs along the rachis, smaller

ultimate leaf segments, and large spores (Windham 1993a).

The first Manitoba collection of Gastony's Cliffbrake (MANITOBA: South side of Marble Ridge Road, 1.6 km west of its junction with Highway 17, about 12 km north of Fisher Branch, 51.18361°N, 97.62556°W, dolomite cliff face, 26 July 2001, *B. A. Ford 0140*, *M. Piercey-Normore* & *D. Punter*, WIN 67479; D. F. Brunton herbarium) has not been previously reported in the literature. It was initially identified as Smooth Cliffbrake (*Pellaea glabella* Mettenius ex Kuhn), then annotated to Gastony's Cliffbrake by D. F. Brunton in 2005. Western Dwarf Cliffbrake is also present at this location (Manitoba Conservation Data Centre, unpublished data). The specimen was collected at the north end of a limestone outcrop, locally known as Marble Ridge, which extends approximately 20 km to the southeast. The north end of Marble Ridge has been of ecological interest for some time because of its near-surface limestone bedrock and limestone cliffs, and it is now recognized as an alvar ecosystem (Neufeld *et al.* 2012). Until the surveys reported here, the population at this location was the only one known in Manitoba.

Study Area and Methods

Near-surface limestone bedrock occurs in large areas of Manitoba's Interlake region, and alvars are known to occur in several of these areas (Manitoba Conservation Data Centre, unpublished data). In 2012, the Manitoba Conservation Data Centre (MBCDC) partnered with the Nature Conservancy of Canada to conduct surveys in the southern portion of the Interlake to determine the extent and quality of alvar ecosystems and limestone cliffs in this region and record observations of rare plant taxa, including *Pellaea* Link species (Neufeld *et al.* 2012). Additional surveys of limestone-

dominated areas near Grand Rapids in the northern portion of the Interlake were conducted in 2012 and 2013 by MBCDC staff. Because Scoggan (1957) reported Western Dwarf Cliffbrake at Grand Rapids, the MBCDC surveys focused on limestone cliffs and ledges in an effort to refine the known distribution of this species in the area and search for Gastony's Cliffbrake.

For the Manitoba Alvar Initiative, 67 candidate survey sites were identified using aerial imagery and GIS shapefiles of geological data available through the Manitoba Land Initiative (<http://mli2.gov.mb.ca/>) and 61 of these sites were surveyed in 2012 (Neufeld *et al.* 2012). For surveys at Grand Rapids, reports from the Manitoba Geological Survey (Bezys and Kobylecki 2003;

Kobylecki and Bogdan 2004) were also used to identify potential survey sites. Additional sites were identified in the field while conducting surveys. At Grand Rapids, seven sites were surveyed in 2012. In 2013, five new sites were surveyed and additional surveys were carried out at one 2012 site. The locations of *Pellaea* species were recorded with a Global Positioning System (GPS) unit and specimens were collected when necessary for confirmation of identification or to document new locations. All specimens were deposited at the University of Manitoba Herbarium (WIN). Habitat type and condition were noted, and a coarse visual estimate of the number of plants was made. All known Manitoba occurrences of Gastony's Cliffbrake are shown in Figure 1.

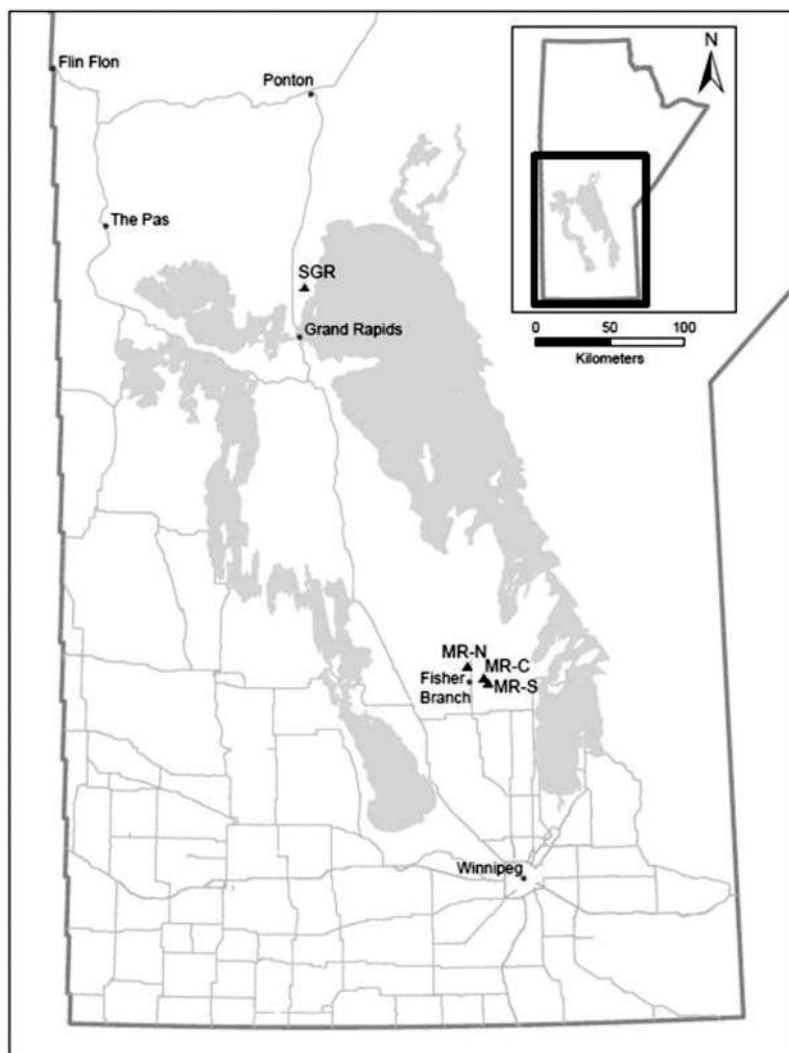


FIGURE 1. *Pellaea gastonyi* (Windham) locations (black triangles) in Manitoba. Note: MR-N, C, S = Marble Ridge North, Centre, and South, respectively; SGR = Sturgeon Gill Road.

Results

Marble Ridge North

This site corresponds to the location of the first Manitoba collection of Gastony's Cliffbrake (see Introduction); thus, no additional specimens were collected during the surveys reported here. In 2012, surveys expanded the areal extent of the known population of Gastony's Cliffbrake at the north end of Marble Ridge from approximately 1.3 ha to 148 ha. The population size was estimated to be 300-500 plants. The actual extent of this occurrence and number of plants may be somewhat larger as additional suitable habitat in the area remains to be surveyed. Most of the northern portion of Marble Ridge is alvar, with limestone bedrock at or within several centimetres of the surface. There are numerous limestone outcrops and plateaus up to 2 m high on the alvar, and it was at the edges of these outcrops, in the cracks in the limestone, that Gastony's Cliffbrake was most often observed (Figure 2). The limestone at the edges of the outcrops tended to be more fractured and less consolidated than limestone elsewhere in the alvar. Gastony's Cliffbrake was also observed growing at the base of limestone boulders sit-

ting on the alvar (Figure 3). It was only observed in areas of full or part sun. Western Dwarf Cliffbrake was also frequently observed in the area, although it was most often found growing in horizontal cracks in vertical faces of limestone cliffs and boulders, sometimes in very shaded areas.

Marble Ridge Centre

In 2012, a new location of Gastony's Cliffbrake was discovered in the central portion of Marble Ridge (MANITOBA: NW25-24-01W1, 51°06'30"N, 97°28'53"W, small cliff limestone ledge, 6 July 2012, *Chris Friesen MBCDC9*, WIN 76794), approximately 12 km southeast of Marble Ridge North. The areal extent of occurrence was approximately 3.3 ha with an estimated population size of fewer than 100 plants. This area is also alvar and, as at Marble Ridge North, Gastony's Cliffbrake was found growing in open areas at the edges of limestone outcrops in cracks in the rock. This portion of Marble Ridge contains additional unsurveyed habitat that likely supports Gastony's Cliffbrake. Western Dwarf Cliffbrake was also found in the area, but only on shaded cliff faces.



FIGURE 2. Limestone ridge on Marble Ridge alvar similar to those that support Gastony's Cliffbrake (*Pellaea gastonyi* Windham). Photo courtesy of the Nature Conservancy of Canada, 2012.



FIGURE 3. Limestone boulders on Marble Ridge alvar, some of which support Gastony's Cliffbrake (*Pellaea gastonyi* Windham). Photo courtesy of the Manitoba Conservation Data Centre, 2012.

Marble Ridge South

Approximately 4.5 km southeast of Marble Ridge Centre, another population of Gastony's Cliffbrake was discovered in 2012 (no specimen collected). This population was divided between two limestone outcrops separated by a 200-m wide wooded gully. The population consisted of fewer than 100 plants in a very small area (approximately 0.04 ha) on the west side of the gully, with one additional plant found on the opposite side of the gully. The outcrops on either side of the gully were open alvars. The plants on the west side were growing in habitat similar to those found at Marble Ridge North and Marble Ridge Centre. The one plant found on the east side of the gully was growing in deep shade on the edge of the outcrop. This was the only location where Gastony's Cliffbrake was found growing in shade.

Vegetative cover at the Marble Ridge sites was dominated by lichens and mosses growing on limestone bedrock and low-growing vascular plants including Creeping Juniper (*Juniperus horizontalis* Moench), Common Bearberry (*Arctostaphylos uva-ursi* [L.] Sprengel), and Poverty Oatgrass (*Danthonia spicata* [L.] P. Beauvois ex Roemer & Schultes).

Grand Rapids, Sturgeon Gill Road

Many of the 12 Grand Rapids sites surveyed had apparently suitable habitat for Gastony's Cliffbrake, but it was found at just one (MANITOBA: 53°28'49"N, 99°13'15"W, upper edge of limestone cliff, 21 September 2012, C. Friesen MBCDC72, WIN 76797). This site, which is just north of Sturgeon Gill Road, approximately 32 km north of Grand Rapids, was first surveyed in 2012 with additional surveys in 2013. Over the 2 years, up to 100 plants were found growing at the top of a limestone cliff in cracks in the limestone bedrock (Figure 4). Near-surface limestone bedrock was commonly observed near Grand Rapids, and such areas were usually dominated by Jack Pine (*Pinus banksiana* Lambert) and Paper Birch (*Betula papyrifera* Marshall). The Gastony's Cliffbrake site was a Jack Pine–Paper Birch stand with sparse to discontinuous tree cover (Figure 5). The limited tree cover was likely because of the lack of soil and the fire history of the site; the most recent burn was in 1979 (Manitoba 2013). Western Dwarf Cliffbrake was observed at this and a number of other sites near Grand Rapids, typically growing in the horizontal cracks of limestone cliffs.



FIGURE 4. Limestone ledge habitat of Gastony’s Cliffbrake (*Pellaea gastonyi* Windham) north of Grand Rapids, Manitoba. Photo courtesy of the Manitoba Conservation Data Centre, 2012.



FIGURE 5. Jack Pine–Paper Birch habitat on near-surface limestone bedrock near Grand Rapids, Manitoba. Photo courtesy of the Manitoba Conservation Data Centre, 2012.

Discussion

Brunton (1979) noted that in Alberta there was a clear association between site orientation and the *Pellaea* taxa present. Sites supporting Gastony's Cliffbrake in Manitoba are level or have only slight directional orientation and are in full to part sun; only one plant (at Marble Ridge South) was found growing in the shade of adjacent vegetation. Plants in Missouri are also found in full sun (G. Yatskievych, curator, Missouri Botanical Garden, 10 January 2014, personal communication). Western Dwarf Cliffbrake was found in both open areas and those shaded by adjacent vegetation (e.g., trees growing immediately adjacent to cliff face at Marble Ridge North).

Many sites surveyed included apparently suitable habitat (exposed fractured limestone), yet supported few, if any, Gastony's Cliffbrake. The paucity of Gastony's Cliffbrake at such sites may indicate that microhabitat or microclimatic characteristics are not suitable (Richard *et al.* 2000). Alternatively, factors related to dispersal and establishment could be limiting the small- to medium-scale distribution (Wild and Gagnon 2005).

At a broader scale, Gastony's Cliffbrake occurs in three ecozones in Canada: montane-cordillera (British Columbia and Alberta sites), boreal shield (northern Saskatchewan site), and boreal plains (Manitoba sites) (Ecological Stratification Working Group 1995). Its North American distribution ranges from the Great Plains (Missouri, South Dakota) in the south to the boreal forest near Lake Athabasca in northern Saskatchewan. These data suggest that, as a species, it is tolerant of considerable climatic variation at a broad scale.

The typical habitat for this species throughout its range is calcareous rock, often limestone or dolomite (Brunton 1979; Windham 1993a), and the discontinuous distribution of this substrate in North America likely accounts for the similarly discontinuous distribution of Gastony's Cliffbrake. Hastings (2002) linked the distribution of *Grimmia Dry Rock Moss* (*Grimmia teretineris* Limpricht), a moss of calcareous rock that occurs at Marble Ridge and near Grand Rapids (Caners 2011; Manitoba Conservation Data Centre, unpublished data), to the margins of ancient epicontinental seaways, with occurrences in central and western North America associated with the margin of the Cretaceous epicontinental seaway. The known Canadian occurrences of Gastony's Cliffbrake occur near the margins of this seaway, suggesting that a more detailed review of the North American occurrences of this species and ancient seaway margins is warranted.

Distribution and search effort

Including the records reported here, the distribution of Gastony's Cliffbrake in Manitoba extends discontinuously from near Fisher Branch in the southern Interlake region to the Grand Rapids area in the northern Interlake (Figure 1). The total extent of occurrence in Manitoba, as calculated with a minimum convex poly-

gon encompassing all known occurrences, is 1282 km², although much of this area is not suitable habitat. The indexed area of occupancy, using 1 km × 1 km and 2 km × 2 km grids, is 11 km² and 20 km², respectively (IUCN Standards and Petitions Subcommittee 2013). There are likely additional occurrences in Manitoba that remain to be discovered, especially in the northern Interlake. As noted above, many areas of near-surface limestone bedrock in the southern Interlake have been the subject of at least cursory surveys, and, given the apparently narrow habitat preference of Gastony's Cliffbrake, it seems unlikely that its known distribution in the southern Interlake will change significantly. Large areas of near-surface limestone bedrock, with associated cliffs and outcrops, remain unsurveyed in the northern Interlake. However, of 12 sites searched in 2012 and 2013 by the MBCDC, only one supported Gastony's Cliffbrake. Also, it has not been found during surveys in 2008 and 2013 of ferns associated with limestone north and west of the Interlake near Ponton, Flin Flon, and The Pas (R. Staniforth, professor (retired), University of Winnipeg, 11 January 2014, personal communication). These observations suggest that although apparently suitable habitat is common in the northern Interlake, the distribution of Gastony's Cliffbrake is likely limited. Thus, the overall known distribution of Gastony's Cliffbrake in Manitoba is unlikely to change dramatically with the discovery of additional populations.

Population size and trends

Detailed counts have not been conducted, but the coarse estimates reported here suggest that three of the four Manitoba occurrences consist of up to 100 plants. The largest occurrence, at the northern end of Marble Ridge, likely has up to 500 plants. Thus, in total, there are likely no more than 1000 plants known in Manitoba. Given the amount of potential habitat in Manitoba that remains to be surveyed, additional search effort may result in a moderate increase in the number of known plants.

Because the species was only recently discovered in Manitoba and surveys to date have focused on determining distribution rather than population size, it is not possible to determine trends in population size. The extent and condition of habitat appear relatively stable, which suggests a similar trend in population size. Some plants may have been destroyed by quarrying at the north end of Marble Ridge (Manitoba Conservation Data Centre, unpublished data).

Limiting factors and threats

Mining and forestry activities north of Grand Rapids may threaten this species. However, there is currently no mining or forestry activity within several kilometres of the Gastony's Cliffbrake site (Manitoba 2014; T. Werstroh, regional forester, Manitoba Conservation and Water Stewardship, 19 February 2014, personal communication).

Areas supporting Gastony's Cliffbrake have near-surface limestone and are, therefore, of interest to quarry operators, particularly at Marble Ridge. Several quarry leases at the north end of Marble Ridge include areas that support Gastony's Cliffbrake. Such areas would require protection if lease holders develop this land. Several existing quarries are in areas that likely supported alvar, and possibly cliffbrakes, before quarry development (Neufeld *et al.* 2012).

The portions of Marble Ridge that support this species are leased for cattle grazing. However, grazing and trampling are unlikely threats to Gastony's Cliffbrake as those areas produce little forage (Neufeld *et al.* 2012). Surveys in 2012 did not reveal any apparent damage to this species by cattle (Neufeld *et al.* 2012).

Current protection and status

Gastony's Cliffbrake is not protected under Manitoba's *Endangered Species and Ecosystems Act* or Canada's *Species At Risk Act*, nor has it been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). All known occurrences in Manitoba are on provincial crown land where certain uses and activities are regulated. As such, they may be protected from certain activities, although there are other resource claims, such as quarry leases, on some of this land (Neufeld *et al.* 2012).

The NatureServe global and Canadian national conservation status ranks for Gastony's Cliffbrake are both Imperilled–Vulnerable (G2G3 and N2N3, respectively); the species has not been ranked nationally in the United States (NatureServe 2013). In Canadian provinces, the status ranks are S1 in Alberta, Saskatchewan, and Manitoba and S2S3 in British Columbia (NatureServe 2013). Despite the additional populations and increased extent of occurrence reported here, the S1 rank for Gastony's Cliffbrake in Manitoba remains appropriate as the number of populations is small and the number of individuals is limited.

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