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Article in Haseltonia · February 2015

DOI: 10.2985/026.020.0105

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## IMPERFECT FLOWERS OF OPUNTIA FRAGILIS IN KALADAR, ONTARIO

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**Abstract:** The easternmost population of *Opuntia fragilis* occurs on a remote rock outcrop in Eastern Ontario. The Kaladar population is located almost 1,000 km away from its nearest neighbor and has recovered from previous vandalism. Recent visits to this site have discovered a plant producing flowers with viable pollen, but without carpels.

Keywords: Opuntia fragilis, Cactaceae, Opuntioideae, imperfect flower

## **INTRODUCTION**

The brittle prickly pear, *Opuntia fragilis* (Nuttall) Haworth, is a small decumbent cactus that is widely distributed across much of central and western North America (Benson 1982, Ribbens 2007). In the eastern reaches of its natural range, this cold-hardy cactus is typically found clinging to exposed bedrock outcrops amongst lichen, mosses and low-growing herbaceous plants (Frego and Staniforth 1985, Ribbens and Fieldseth 2012). Elsewhere it grows in dry sandy alluvial soils of prairie grasslands where it has, at times, been considered an agricultural pest subject to sanctioned eradication efforts (Maw and Molloy 1980). Across much of its range it is a threatened or vulnerable species and this is particularly evident for the most outlying populations.

*Opuntia fragilis* is one of only five Cactaceae that are native to Canada (Cota-Sánchez 2002, Hancock 2013). It has one of the largest natural ranges of any cactus in the world and it can tolerate a wide array of habitats (Benson 1982, Ribbens 2007). From the alkaline prairie soils of the Great Plains to the thin acidic duff that accumulates in cracks on bald granite rock outcrops, this species will grow in a remarkably diverse set of soil conditions. It extends as far north as the Peace River region of Northern British Columbia and Alberta and as far south as Northern Arizona and New Mexico (Benson 1982). The plants at Pike Lake, Saskatchewan tolerate temperature extremes from -50 °C to +50 °C (Ishikawa and Gusta 1996). This species has been found from elevations as high as 3,000 m in the Rocky Mountains of Colorado to coastal sites on several of the San Juan Islands and Gulf Islands in the Pacific Northwest of Washington and British Columbia (Benson 1982, Loik and Nobel 1993).

The Kaladar Hills of eastern Ontario is the location of the easternmost population (Figure 1). This site has been known to host Opuntia fragilis since at least 1934 and possibly as early as 1905 (Staniforth et al. 2002). While collections at this site have been made over the years (notably by MacClement in 1934 and Dore and Senn in 1947), the precise location of this population has repeatedly eluded researchers and the site was evidently "rediscovered" numerous times (Beschel 1967, Staniforth et al. 2002). The Kaladar population is located 10 km south of the village of Kaladar, Ontario at Little Mellon Lake (44° 34' N, 77° 07' W, Figure 1). The population spreads on both sides of Highway 41. It especially is found on a south-facing granite outcrop that is a part of the Frontenac Axis extension of the Canadian Shield (Figure 2). The outcrop is north of Mellon Creek, which flows under the nearby highway. Low-growing shrubs, including Juniperus communis, Chamaedaphne calyculata and Vaccinium sp. inhabit the lower portion of the rock face near the creek while Pinus strobus, Quercus rubra and Quercus alba trees surround the upper edge of the outcrop, which is bounded by Rhus aromatica, Arctostaphylos

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Figure 1. Range of *Opuntia fragilis*. If even a single specimen was found in a given state/province, the entire state/province is usually shaded in this map. *O. fragilis* has probably been extirpated from several states, e.g. Oklahoma and Texas.

*uva-ursi* and *Helianthus divaricatus*. *O. fragilis* grows in patches scattered across the rock face (Figure 3) with the lichen *Cladonia rangiferina* and the moss-*Polytrichum sp.* and many other plants described previously (Staniforth and Frego 2000).

The site has sustained some damage in the past. In 1985, many of the plants were evidently dug up by vandals, and one analysis suggests that the site may have been reduced to as few as six plants (Klinkenberg 1987, Staniforth and Frego 2000). In 2001, a swath of the rock face was apparently disturbed by foraging animals or snowmobiles, but recent reports of the site suggest that the population has rebounded and is evidently stable in the absence of further disturbances (Hancock et al. 2005a, b). We visited the Kaladar site in mid-June 2013 and report that the plants are healthy and numerous. We estimated that the rock face population had between 1,500-2,000 cladodes belonging to perhaps 200 plants. Past estimates include 300 plants (Beschel 1967), 396 plants with 1,683 cladodes (Staniforth and Frego in 1995) and more than 200 small colonies including single pads (Hancock et al. in 2005).

As was reported previously (Hancock et al. 2005a, b), we observed many detached cladodes dispersed across the rock face mid-section along with lichens and mosses (Figure 3). We also searched several of the rock outcrops in the forest east of the highway for signs of the previously reported satellite populations (Hancock 2013) and found one location with *O. fragilis*; the cacti are largely hidden under the lichens. For better or worse, the best way to find the plants east of the highway is to walk barefoot! (Root Gorelick, personal communication). The plants are fairly numerous there, but incredibly cryptic.

The plants look very healthy (Figure 4), and closely resemble pads from Wisconsin and some other midwestern sites. The pads do not show any of the flattening or bumpier surfaces characteristic of *Opuntia fragilis* pads from Utah. Paul Chafe first visited this site in 2012. He observed a single flower bud (Figure 5) and discovered that when the bud opened it was missing the carpels. In 2013 we found two flower buds on the same plant, and in 2014 at least four flower buds were observed on two different plants.



Figure 2. The site of the Kaladar population west of highway 41.



Figure 3. A large *Opuntia fragilis* plant. Note the *Cladonia* lichens and mosses. [Photo: Root Gorelick]

In all three years, the mature flowers were imperfect, with missing or severely deformed or missing carpels (Figure 6). In 2013 the carpels were completely missing (Figure 7), while in 2014 they were severely deformed (Figure 8). Interestingly, the flower produced in 2014 on another plant was normal (Figure 9). We used the stainability test to assess the viability of pollen. The deformed flower had 11 fertile grains and 89 non-fertile grains, while the normal flower produced 157 fertile grains and 43 nonfertile grains.

Dioecy is rather uncommon in the Cactaceae family (Rebman and Pinkava 2001). Imperfect flowers have been rarely reported for any *Opuntia*, and certainly not for any *O. fragilis*. While it is likely that this defect represents a mutation in this specific



Figure 4. Close-up of another Opuntia fragilis cluster.



Figure 5. One flower bud, early June 2013. Flower buds are typically more bronzed, with a less rounded and more chiseled appearance.



Figure 6. An open flower. Note there are no carpels.

plant, it certainly is an additional obstacle to sexual reproduction, and adds to the mystery surrounding the Kaladar population.

Acknowledgements: This manuscript has been considerably strengthened by the thoughtful comments of reviewers Ken Hancock and Kate Frego and the editor Root Gorelick.

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Figure 7. Side view of an open imperfect flower, with some petals removed.



Figure 8. A partially dissected flower (2014). Note the deformed style and stigma lobes in the left half of the flower.



Figure 9. A normal *Opuntia fragilis* flower, with green stigma lobes visible.

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