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Opuntia fragilis *in Michigan*

We left Marquette driving north to Big Bay. This is the Michigamme Highland, a region of granite and sandstone knobs, glacial moraines, sparkling clear lakes, and outwash plains. Paul Bunyan may have driven Babe the Blue Ox along this road a century ago. Northern forest covers this land—a complex mixture of deciduous trees and conifers. Sturdy white pines with their delicate needles. Sugar maples. Balsam fir. White birches along forest edges, and yellow birches in the interior. Spruce. Several kinds of aspen. I catch glimpses of other species, too, as we drive. Cottages abound, especially when we are near the

beaches along Lake Superior. But we are hunting prickly pears.

North of Big Bay the road diminishes, and soon we reach the gatehouse of the Huron Mountain Club. The club members cherish their privacy, and the gatekeeper thoroughly inspects my research permit from the Huron Mountain Wildlife Foundation before giving me the gate keys I'll need later. We have left paved roads, but we drive smoothly through woods that have never been logged, past several lakes, through a stand of jack pine, past several of Michigan's Big Trees, eventually to reach Mountain Lake.

Mountain Lake is aptly named because it nestles against the Huron Mountain. From a simple boathouse we see the bulk of the mountain looming over the lake's far side, a huge piece of granite with rocky outcrops clearly visible on its steep slopes. One of those outcrops is our destination.

We walk through beautiful old-growth forest. The land is flat here, and in typical north woods fashion we repeatedly skirt or gingerly step through wet spots run through with ferns. After we reach the shore of the lake we hike the slope of the mountain. The trail is faint, marked with occasional stone cairns, and it winds up and down over sections of exposed granite that are slippery when wet. The outcrops remind me of places in Minnesota where I have seen the prickly pear we are after, but it is not until the seventh outcrop that we reach the only location in Michigan where *Opuntia fragilis* grows. By now I'm tired and sweaty, and glad to sit and just look.

We are maybe 25 meters above Mountain Lake, and to the south Norway Bay is visible through the treetops. Granite shoulders to the surface here, tumbling down towards the lake. It is seamed and gnarled. There are trees growing on and around the

► **TOP** Pieces of paper mark surveyed plants of *Opuntia fragilis* at the Huron Mountain Study Site, a rocky outcrop with steep slope, light shading, and areas of litter accumulation. **BOTTOM** The rock surrounding this single *Opuntia fragilis* plant is covered with foliose lichens and old pine needles. ◄ **OPPOSITE** The view of Huron Mountain from the Mountain Lake boathouse. *Opuntia fragilis* grows on a rocky outcrop near the left side of the image.

◄▲ A cluster of *Opuntia fragilis* in beds of moss sitting directly on bedrock. *O. fragilis* pads are tiny!

outcrop, including red oak, white pine, and sugar maple, although many are small and maybe somewhat stunted. Much of the rock is exposed, but in seams and depressions mosses and lichens (especially *Cladium*) have moved in, and wherever soil has been able to accumulate shrubs are abundant: Common juniper (*Juniperus communis)*, Leatherwood (*Dirca palustris*), Black Cherry (*Prunus virginiana*), and blueberries (*Vaccinium*). We are sitting on a flat ridge, but at our feet the rock slopes sharply. Every step is cautious to avoid stepping on the cacti or falling down the hill.

Wherever water can be trapped, mosses and lichens grow in a litter of shed pine needles. The prickly pears grow on and around these mossy beds, but none are found in nearby areas with enough accumulated soil for other vascular plants to grow. The prickly pears look fantastic. Lushly green, turgid, and fiercely bristling with spines, the population looks healthy. The plants tend to be larger here than in Illinois (on average more pads), and we find clusters with over 200 cladodes.

Prickly pears in Michigan?

Opuntia fragilis is a small, northern species of cactus, growing almost as far north as the Arctic Circle. Although it is widely distributed across North America, in the upper Midwest it is rarer, and in Michigan it is a state endangered species. In 1976 *Opuntia fragilis* was added to the list of Michigan's rare and endangered plant species[1], and it is found within Michigan only at one locality in the Huron Mountains. It was last confirmed[2] at the site in 1985, where it was "thriving on Huron Mountain in Marquette County on sunny rock surfaces," and a second location in Ogemaw County was deemed "of uncertain status on a hill east of St Helen (collected in 1967)."

I have been studying this species since 1995, but about the Michigan populations little is known, aside from its "thriving," and another note[3] indicating that it is restricted to a few acres. How did *Opuntia fragilis* colonize Michigan? Illinois is on the edge of its range. Rarity in Iowa can be

explained by intense agriculture. But the Huron Mountain plants are over 100 miles away from the nearest-known Wisconsin population. I'm particularly curious about the Ogemaw County site in Michigan's lower peninsula, a red oak-jack pine forest with a dry sandy soil that would be atypical *O. fragilis* habitat. After some telephone tag I reach Ryan O'Connor from the Michigan Department of Natural Resources, who tells me that there have been repeated searches in the area but that *Opuntia fragilis* has not been seen in Ogemaw County since 1967. He adds that even if it was there it should not be listed as native, because it is believed that the population was the result of a recent introduction by a local landowner.

The Huron Mountain site is privately owned by the Huron Mountain Club, and prior permission is required for entrance. Access for approved research projects is arranged through the Huron Mountain Wildlife Foundation, and through them we obtained access to the site and funding for this work. The site has been protected since at least 1880, and has undoubtedly experienced little disturbance. The only sign of human impact that we found is a rather dim walking trail at the top of the outcrop. The forest on and around Huron Mountain has been protected by the Huron Mountain Club from logging, although some disturbance, including a fire[3], has occurred. But much of the land around the site is dominated by old-growth White Pine–Sugar Maple forest, with hemlocks and other subdominant northern-forest trees.

The climate of Michigan's Upper Peninsula is cold continental. Temperatures can range from –40° to 35°C, with a mean annual temperature of 23°C. Annual precipitation averages 760 mm, of which 460 mm falls as snow. However, since the prickly pears are growing on a southerly-facing rock outcrop with a moderate to steep slope, the actual microclimate at the site may differ considerably. Nonetheless, *Opuntia fragilis* in upper Michigan must tolerate fairly intense freezing and being regularly covered with snow.

We searched the entire outcrop for *Opuntia fragilis* to determine the relationship between the population and its substrate, census the entire site, and determine sizes, presence of flowers, and overall plant health. We had heard anecdotal reports of a second "bathtub-sized" location east of the main site, but when we set out to find it we found a second rather large inhabited spot. Hence the prickly pears occupy two areas. The first is about 28 × 23 m. Within this area the plants are not uniformly distributed but are instead strongly affected by soil depth (in the photos here you can see plants marked by pieces of paper). On one extreme is bare rock, and on the other is enough soil to support small trees and the associated woodland community, especially Bigleaf Aster. *Opuntia fragilis* occupies a fairly narrow band of "soil"; if there is enough debris to support a moss and lichen community, *Opuntia fragilis* is also present. But by the time enough material has accumulated to enable grasses and other vascular plants to grow, *Opuntia fragilis* disappears. Even the deeper areas of soil are still significantly dry: in early July the asters growing in the deeper soil pockets on the outcrop were slightly wilted by midday, whereas they looked good in the adjacent forest understory. The second area, about 100 m to the south, is 23 × 14 m, and is similar to the first site in all respects.

Both outcrops are shaded for a few hours of daylight, but the shade is produced by a thin canopy. However, there does appear to be a weak relationship between *Opuntia fragilis* locations and light levels: it usually grows in lightly shaded areas, avoiding full sunlight and the shading of denser foliage. However, soil dynamics are undoubtedly more important than light exposure.

One of the issues we struggle with is determining what is a single plant. Many of the plants are clearly distinct, but in some areas the chains of pads overlap to the point that it is difficult to determine if they are separate plants or not. Given the tendency of *Opuntia fragilis* to break apart, probably each cluster consists of many independent physiological units, even if they have a common genetic origin and location. We assumed that a large cluster represents one plant; while this may not be realistic physiologically, it is probably true genetically and certainly true for the purposes of managing and tracking the fate of those pads and calculating microenvironmental effects.

We found 1121 plants in the larger site, and 875 in the smaller site. Size is here defined as the number of pads, but for plants over 20 pads the number of pads gets progressively more difficult to precisely determine. We attempted to count every pad in every cluster, but pad-size numbers for the larger cluster could well be off by at least 10%. 50% of the population consists of plants with five pads or fewer, and only 15% of the plants in the population have more than 20. This size distribution usually means that the population has

Visiting *Opuntia fragilis* in Michigan

The Huron Mountain population is on private property owned by the Huron Mountain Club. Access to the site is not usually permitted, and the club discourages inquiries.

a stable distribution (many younger and a few older individuals).

The pads (cladodes) look substantially healthier than those we've studied in northwestern Illinois, where pad coloration ranges from a bronzed red to light green and are often slightly wrinkled; the Michigan most pads were a rather uniform bright deep green and turgid (old pads often lose their chlorophyll). Some of the pads in Illinois have been damaged and have necrotic black spots, which is perhaps frost damage due to a wet winter, but we found no black spots on the Michigan plants, and we observed only one plant that appeared to be on the verge of death. *Fragilis* spines in Michigan appeared to be stouter than those in Illinois, based on the difficulty of removing them from fingers. Michigan also had a higher frequency of large clusters than many other sites, which may be due to the site's isolation and protection.

▲ The green stigma and red filaments of this *Opuntia fragilis flower* are just visible; the petals themselves are a pure yellow. Although rare, occasionally we found multiple flower buds and spent flowers on one plant. Despite producing flowers, fruits failed to develop, and no seeds were formed during our first season of studying this site.

We also recorded the presence of flower buds. Flower buds are quite large on *Opuntia fragilis*—often larger than the pad that they grow from—and they are quite recognizable, so even though we only found a few flowers in bloom, we were easily able to determine which plants were going to flower. *Opuntia fragilis* does not appear to flower unless it has ample resources, so flowering appears to be rather uncommon. We found 15 flowers (some on the same plant) in the first site, 27 in the second. Five of those plants had multiple flower buds (up to nine), including one pad with three. Interestingly, flowers were only produced by plants with at least 20 pads. This may indicate that chains of pads within a larger cluster are still connected to other chains in the cluster, and are thus sharing resources instead of competing for them.

We marked the 15 flowers in the first site and revisited the them in August to determine their fates. We were able to relocate all 15 flowers, but none of them were setting seed. The base of the flower was flaccid, turning red, and several that we dissected contained no seeds. Given the relatively low number of flowers, the short duration of blooming for each individual flower, and the possibility that opuntia may not be able to self-pollinate, the probability of seeds being produced in the entire population is quite low. Lichens have been found to be associated with the production of *Opuntia fragilis* flowers[4], but while lichens occur scattered throughout the Michigan site, the relationship between flower production and environmental parameters appears to be mostly driven by access to resources (nutrients and sun) and plant size.

In conclusion, there is one population of *Opuntia fragilis* in Michigan, with two distinct sub-sites. This population, while restricted to a small area, appears to be surviving quite well, and is receiving ample protection. Given that the description of

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In the US *E. texensis* occurs from the southernmost tip of Texas all the way through southeastern New Mexico. I first saw plants in cactus gardens around Albuquerque when I lived there many years ago, but only recently did I attempt to find them in the wild. My wife and I set off to locate a well-known population of *E. texensis* along the El Paso River south of Carlsbad, NM. The long drive toward Carlsbad took us through rolling grasslands, with an occasional herd of cattle and smaller groups of antelope usually close by. Periodically the landscape would be interrupted by taller, ungrazed vegetation and an occasional patch of scrub brush. We were watching a herd of antelope when my wife noticed some curious mounds in one of these vegetated areas. Pulling to the side of the freeway and backing up (in eastern New Mexico you can drive for miles and not see another car on the four-lane), we parked near a mound within a few yards of the fence alongside the freeway. I hopped the fence to take a closer look and discovered what I thought must be the largest Horse Crippler ever seen. The single, outward-pointing central spine, flanked by six or seven slightly shorter radials, was unmistakable.

We investigated several other mounds 20–30 yards away, and surprise!—more colossal Horse Cripplers. There were more than a dozen within sight, scattered 20–50 yards apart across the scrubby terrain. None were of a more modest size, and we found no seedlings.

Although fairly inconspicuous from the vantage point of a moving car, these specimens were anything but low and flat. At 91 cm (3 feet) across from spine tip to spine tip, no New Mexico range animal was going to accidently step on one! Their globose bodies were 56–61 cm (22–24″) in diameter and 30–38 cm (12–15″) tall, nearly twice the width and height reported for this species in the literature[1–3]. And although it is known that populations in the western part the species' range sport longer spines than ones farther east, these plants had spines more than twice as long as previously reported: about 15 cm (6″) in length. Given how slow this species grows in cultivation, these colossal plants must be ancient.

Could these giant *E. texensis* be hybrids? Aside from their size, the plants looked for all the world like their smaller cousins, and no other barrel cactus was observed in the area for many miles. The only other cactus we found growing in the immediate vicinity was a large clump of *Coryphantha macromeris*. Whatever the case, this find really made our trip and proved that new discoveries can still be made right here in our own backyard.

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➤ **Opuntia fragilis** continued from **page 224**

the second site was that it was "about the size of a bathtub" but that we found the second site was 23 × 14 m in area, it is probable that the populations have been expanding, probably by pad fragmentation, since sexual reproduction appears to be uncommon, and possibly absent.

So what's in the future? We have marked and sketched a sample of plants, and will be tracking these plants over several years to try to determine pad turnover and production rates. We will be monitoring the outcomes of flowering as well. From a management perspective this population seems to be doing well. Its small size, both spatially and in terms of the number of plants, means that it could quite easily be eliminated; fortunately, its remote and protected location should minimize the likelihood of vandalism or removal of pads by enthusiasts. Many rock outcrop populations have difficulty moving pads uphill or are suffering from excessive shade. While neither of these processes seem to be a concern at this point, the population should be monitored, especially for shade-related issues if trees become larger or more abundant.

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