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Can cacti and cows coexist?

Opuntia fragilis in Wisconsin

Opuntia fragilis is abundant in the upper Great Plains west of the 100th meridian, with the center of its range in western Nebraska, the Dakotas, and up into Canada. It is widely scattered across North America west of the Mississippi, from Iowa northward, although in many of those states it is uncommon.

My interest has been in the area where this prikley pear's range extends into the upper Midwest: Minnesota, Wisconsin, Ontario, and into Michigan, Iowa, and Illinois. It is on State Endangered Species lists in Michigan, Iowa, and Illinois, and on Wisconsin's Threatened Species list. You probably recall reading about my fascination with finding the Brittle Prickly Pear in the states of Michigan (one population), Illinois (one population), and Iowa (four populations). Wisconsin, fortunately, harbors many more. We have found it or have reliable evidence of its existence in 35 spots, know of two more possible sites on private property, and have eliminated or have good reason to eliminate another 25 reports, most of which are now too overgrown with woody vegetation to harbor this tiny cactus.

I'm not going to describe each Wisconsin *Opuntia fragilis* habitat in detail, although I now have more than three gigabytes of photos of them—photos which, curiously, have opuntia pads in almost every image. I also can't be too specific about locations, having signed a confidentiality agreement with the Wisconsin Department of Natural Resources. Frankly, while I completely agree with their concern, I used to think it was a bit of an overreaction. Would someone really be interested enough in a rare plant that they would go to the trouble of working through scientific documents to try to find locations where it grew, and yet be so stupid that they didn't realize it was wrong to dig them up? No way! I mean, we are talking people who know about plants. We call those people plant-lovers, or more formally, botanists. And everyone knows that botanists are smart, good-looking, hard-working, humble people with high ethical standards.

Well, I've changed my mind. Last week we tried to find a small population in a State Natural Area in Adams County. They are not there any more, and Wisconsin DNR employee Randy Hoffman told me that about 25 years ago, when he visited the site, all he found were about a dozen holes in the sand. Someone had dug up and hauled away the entire population. It's gone, and will likely

▼ *Opuntia fragilis* in spring. The plant is turgid and bright green and is covered with new buds that will become new pads. The new buds have a striped whitish appearance, because they are covered with tiny leaves, which will soon fall off. This plant is growing in sandy soil in western Wisconsin, and is successfully competing with the surrounding grasses.

▲ **TOP** Military reserves often protect habitat that is rare elsewhere, and Fort McCoy is no exception. There are at least six sites where *Opuntia fragilis* grows within Fort McCoy. This sandy hill has thousands of plants, including many large clusters that regularly bloom. Veronica Flores, an intern from Bolivia, is searching for a plant to sample, accompanied by a Fort McCoy employee. Veronica, they are farther up the hill! **BOTTOM** One of the clusters growing on the hill, this plant is covered with new buds and is so dense that the surrounding grasses are almost completely excluded. It may be one physiologically integrated clone, or it could be several different plants growing in a tangled mat.

never be found there again. Probably someone wanted to use them for personal landscaping, or planned to sell them.

If you are not my mother, you are reading this because you love cacti. Great! But don't let that love destroy these wonderful plants. Don't collect plants from the wild without permits and good reasons for what you are doing, and don't buy plants if you have any suspicion that they are illegal collections. I have obtained permits for my work, but even then we are just collecting a few

▼ **TOP** A Fort McCoy cluster in bloom in late June, 2009. Two flowers are open, and there are three more buds standing by. Although the cluster may be old, individual pads are not (note the dying pad toward the lower left). Flower petals are a clear, green-tinted yellow. The stigma, in the center of the flower, is bright green, and the stamen filaments are red. Typically, flowers are open for only one day. **BOTTOM** A cluster of *Opuntia fragilis* growing in an old quarry in central Wisconsin. As is typical for plants growing on rock outcrops, the cacti are found in narrow bands along the edge of exposed rock. Usually the only other plants growing with the prickly pears are mosses and spike mosses, but here the town has beautified the quarry by introducing a *Sedum* species (diploid *S. acre* or possibly *S. urvillei*). This is also a typical, small Midwestern population: we only found five plants at this site, growing a dozen meters from the owner's office, who had no idea his property hosted a rare species of cactus.

Tim Wilder

pads. We all need to work to take care of this sadly battered planet.

I'm a plant ecologist. My former graduate student, Barbara Anderson, and I studied the ecology of the one Illinois population of *Opuntia fragilis* a few years ago. In the more distant past

several undergraduate students joined me to investigate a cluster of small populations in central Minnesota. A few years ago I took an entire year for my first sabbatical. Interestingly, my university was not willing to give me a year so I could catch up on my reading, go for long walks in the woods, or splash in the lake with my daughters. Instead they expected me to accomplish something botanical. So I decided I would hunt for populations of *Opuntia fragilis* in its eastward extension.

We've now driven thousands of miles, burned through one small grant (thank you Western Illinois University!), clambered over rock outcrops, and ambled across sandy prairies. We've been bitten by ticks, chased by mosquitoes, impaled on prickly ash, and have seen poison ivy in luxurious abundance. We've been sunburned one day and wet from rain the next. We saw two timber rattlesnakes on a bluff high above the Mississippi River, and Brandon gamely broke my fall when I slowly toppled backwards trying to climb a rock outcrop. When we find a population, we take GPS coordinates, collect some pads for herbarium vouchers and to extract DNA, shoot pictures, and record field notes about site conditions and the population size and appearance. This year we've collected soil samples and looked for flower buds.

Now that I have found almost 100 populations in these five states, I have a much clearer picture of its distribution and ecology. While the DNA analysis is going slowly (anyone know a graduate student who wants to study prickly pear DNA?), we're hoping to find out more about possible relationships between populations. I've observed considerable variation among sites, from tiny, delicately spined pads from Lake of the Woods to large, fiercely-spiked stems on a hill above a gas station in southwestern Minnesota. I'm especially interested in flowering, since we've found that Illinois populations of this species do not produce seed.

In June we resumed our cactus hunt. Sadly, my brother's pickup truck is not firing on all cylinders, and despite his claim that he has been able to function for years with a similar condition, we borrowed my wife's car instead, while she and our daughters traveled to the Netherlands. My

ONE MAN AND A CACTUS?

Lars and Veronica were a great team last year, but Brandon and Camila have been excellent as well. Their styles are considerably different. If my nephew Lars was a left-lane driver, Brandon is a right-lane driver, and has shown a curious reluctance to stomp on the brakes or cut across three lanes of traffic when I see a possible *fragilis* site. Lars was fighting a knee injury and didn't spend much time walking, while Brandon has enthusiastically charged up every ridge and willingly clambered through brush to "have a peek over there." Camila, like Veronica, has become a great field helper, carrying our tool bag, collecting soil samples, and patiently reminding me of forgotten sunglasses and notebooks. I have a tendency to lose things, as evidenced by a pair of sunglasses forgotten in northeastern Iowa, another pair left in a motel in Black River Falls, and a glasses lens that mysteriously disappeared one afternoon. And there was that field notebook I left on the sixth floor of the Madison DNR building… I've asked Brandon and Camila to share some of their experiences (see below).

Finally, this project hasn't been just me. I've had volunteers help hunt for cactus, people have shared their knowledge, and I've received assistance from many local public servants. So, from Eric, Brandon, Camila, Lars, and Veronica: a big thank you to Tom, Randy, Julia, Craig, Michelle, Sara, Henry, David, Jennifer, Paul, another Paul, Bud, Jim, Tim, Steve, Mike, Kris, Glyn, and Scott, as well as all the people whose names I don't know or whom I have forgotten to mention. That's been the best of this experience: meeting people who also love plants. Opuntia obsessionists are great.

Although I am a microbiology major, I thought it would be interesting to see what was involved in a field biologist's research. Throughout our Wisconsin trip it was amazing to me how small these cacti were compared to the picture I had in my head. I soon discovered that they weren't going to be easy to find, and that it would take quite a bit of walking and climbing to get to them. I remember the first day we were out doing research—probably the longest, hottest day of the trip, but also the day I learned the most. Eric showed us where the plants grow—rock outcrops and sandy soil—and he gave me the opportunity to do all the hands-on work of collecting samples. At each site we collected several pads and a soil sample, used GPS to document the locality, a thermometer to measure the temperature of the soil—simple things that might help us understand things like why do some of these plants flower and others don't, and what are its preferred growing conditions. This was a great opportunity for me, getting stuck with glochids and infested with ticks notwithstanding.

—Camila Sharkey, WIU undergraduate student

Searching for Opuntia fragilis *has been an eye-opening experience. We've seen many beautiful places and met interesting and knowledgeable people along the way. One thing that really stood out to me was that these cacti reside in such few and scattered spots. Some were rocky outcrops with little soil, plants growing in the cracks of rocks. Some were in flat sandy areas, and two locations were in cemeteries. I noticed variation in pad morphology: from spine configuration, size, and color to pad sizes—small at the Lake of the Woods, larger and wider in those from Oregon County. There are things easily overlooked in nature. You could have this cactus right in front of you and not notice it—unless of course you are inclined to hike barefoot!*

—Brandon Caley, WIU graduate student

▲ Wisconsin's northernmost population of *Opuntia fragilis* is found on this rock outcrop in Burnett County. The population is sadly in decline, probably from increased shade from the surrounding trees. As is fairly common in Wisconsin, this is private property.

eyes don't let me drive anymore, so I hired Brandon Caley to be my driver and general assistant. Brandon is a graduate student at Western Illinois University. He's researching plants, but unfortunately he's chosen a colleague in my department to be his advisor instead of working with me. Our first stop was to pick up Camila Sharkey. Camila is a microbiology student who just completed her junior year at Western Illinois University. She wanted experience doing research, so she's along for the hunt, and maybe (just maybe) I can talk her into working on our DNA analysis later.

We are completing the search that I began last year. After a quick swing through Minnesota to search for a few sites we hadn't found last year, we headed east into Wisconsin. Last year we found 19 sites in Wisconsin but ran out of time and resources before we could look for the 30 more I suspect still exist. Now, after two weeks and two thousand miles of driving, we are ready to return to Illinois. We've met many helpful Wisconsin biologists, knocked on doors and talked to people both helpful and aloof, and on the way we've ridden the ducks at the Wisconsin Dells and eaten fresh cheese curds.

Geography: moving from north to south in western Wisconsin we've found *Opuntia fragilis* in Burnet, Polk, Dunn, Pepin, Buffalo, Trempeleau, and Monroe Counties. More sites can be found in central Wisconsin, including Sauk, Adams, Columbia, Marquette, Waushara, and Waupaca Counties. *Opuntia fragilis* has also been reported from Green, Green Lake, Jackson, and LaCrosse Counties, but we were unable to find the plant in those areas, and I am convinced in all but LaCrosse County *Opuntia fragilis* has disappeared.

First, let me tell you how wonderful the Wisconsin Department of Natural Resources is. They have maintained a detailed database of sightings of *Opuntia fragilis*, as well as many other rare species, and my hunt was made vastly easier with this information. (The next time you see a state biologist, give them a hug.) Such data is not infallible, though. The information the DNR has compiled is a patchwork. "1954: specimen collected from rock outcrop" and the only location information is a section (a square mile). Sometimes the information seems to be wrong, outdated, or misleading. "10,000 stems, could be one clone" sounds like one very big plant, but we found the usual scattered clusters, and sadly nowhere near 10,000 anymore. Third, they don't know every site. I also learned of three or four possible sites while searching through herbarium records, and we learned of a dozen additional sites just from talking to people.

Almost half the sites in Wisconsin, and both of two possible sites we were unable to thoroughly investigate, are on private property. We've found

▼ Fire in grassy areas does damage pads on *Opuntia fragilis*, but the plants survive and may actually benefit from the reduction in competition. The fire damage seen here was caused by a controlled burn in the Trempeleau Wildlife Refuge, and the plants have rebounded, producing lots of new pads.

populations growing in roadside ditches, in the center of cemeteries where they are regularly mowed, on the edges of cow pastures (Paul said sometimes his cows come in for milking with a pad hanging from their face), and we were unable to visit one rock outcrop that has been leased to a quarrying operation. The plants at that site have been transplanted to an area that is not scheduled to be quarried, or so I've been told.

While some of these landowners are unaware of their populations, many are proud and protective of their prickly pears. Wisconsin's biggest population is owned by a high school teacher who apparently has a conservation easement designed to protect the cacti. One landowner suspiciously worried that I was going to publish the location of his property, and that he would be deluged with visitors. A 31-year-old guy in Waupaca County told me how he had screamed when he stepped on them as a little boy, and added "We've always known they were kinda special."

I have learned that people like to talk, and that you can learn things if you listen. I guess my mom was right when she told me to stop talking and pay attention! When I asked Paul, a dairy farmer in Dunn County, if he had prickly pears on his property, he shook his head and drawled "Nope, sorry. All I got is some of them there cactus." Turned out his farm was a new site for us, and is not on the state records. Paul wouldn't let us go up to the pasture without him ("The cactus are there along the fence, but the bull is in with the cows"), but he loaded Veronica on the back of his ATV and drove her up to see the plants. Since then I've gotten several emails from him, including one with a story about a huge black bear in the area, and another reporting his discovery of several new clumps of *O. fragilis* on his property. A teenaged girl wearing a basketball shirt told me to drive down the road to talk to her grandmother. Her grandmother reminisced through the screen door about climbing the ridge with her husband to look at the flowers, and sadly admitted that they hadn't found any prickly pears when they last went up the hill six years ago. (We didn't either.)

▲ Eric (left) talking to Paul. Paul is a farmer in western Wisconsin who is proud to have *Opuntia fragilis* growing in several places on his farm. Paul and I have become friends, and he recently sent me an e-mail in which he told me that two deer shot last fall had old *O. fragilis* pads clinging to their fur (which is apparently how these plants are moved around, being that they normally fail to flower and set seed). On Paul's farm the cacti coexist with his Jersey cows, and Paul says sometimes the cows come down for milking with a pad or two stuck to their muzzles. The future of *Opuntia fragilis* in Wisconsin will depend in part on the willingness of landowners like Paul to allow the plants to grow on their property. Paul: Thanks, from all of us.

Wisconsin *Opuntia fragilis* populations occur on two types of substrates: rock outcrops and sandy soils. Most of the Brittle Prickly Pear growing in Wisconsin is on sand, and the largest populations cover dozens of acres. *Opuntia fragilis* can be found in many places along the west side of the Chippewa River in Pepin County and some nearby counties, and is quite abundant on sand prairies in Fort McCoy. Further east there are much smaller populations on sand in Adams, Waupaca, and Waushara Counties. Most of these are thin sandy soils on private land or in cemeteries.

Thirteen populations are growing on rock outcrops. All but one of these outcrops are on igneous rocks; there is one population on a sandstone outcrop in Adams County, and although there are many limestone outcrops in Wisconsin, I have never seen *O. fragilis* on limestone. These sites are usually small areas of exposed rock facing south, and the prickly pears grow in areas where enough

water and soil have accumulated to permit mosses to grow, but they are not able to compete with grasses and other vascular plants. Most of these populations are quite small, often only a dozen or so plants, and many are seriously threatened by shading and other competition from nearby woody vegetation. We have found *Opuntia fragilis* growing under scrubby oak shade, struggling against spreading prostrate juniper, and simply surrounded by large red cedars casting an increasingly dense shadow. Seven of these sites are privately owned, and one has recently been transplanted in anticipation of a planned quarrying operation.

One question we tried to answer this year was about flowering of this cactus in the Midwest. Many anecdotal reports mention that some populations rarely or never flower, and one researcher has reported an association between *Cladonia* lichens, often called Deer Moss, and flowering. The first half of June is too early for flowers themselves, but the flower buds are distinguishable. We found flower buds in some populations in Minnesota, but in Wisconsin we found only one large population in Pepin County that sporadically flowers, and the only other flower bud I found on plants among 15 populations we studied this year was on one sturdy plant growing near a tombstone, though Tim Wilder, conservation manager at Fort McCoy, says the population there can flower abundantly. We found *Cladonia* lichens in a few locations, but saw no evidence of a relationship between *O. fragilis* health and *Cladonia* proximity.

In my estimation, plants will not flower unless they have been able to accumulate enough resources—sugar from photosynthesis and soil nutrients. Typically plants that flower have 15 or more pads. We suspect that plants on rock outcrops are more likely to flower when their roots penetrate more deeply into crevices. More work needs to be done, but it is possible that deeper crevices are associated with greater resource availability. Finally, there is a genetic component to flowering; growers have informed me that plants obtained from certain populations simply don't bloom, even when provided with ideal growing conditions.

I have been wondering how *Opuntia fragilis* responds to fire. A sandy prairie in Trempeleau County may have some answers. Last year, the Trempeleau Wildlife Refuge burned the site. Apparently the burn workers who were hired overlooked instructions to avoid prickly pears. In June we saw extensive burn damage on the cacti. The tops of almost every pad in the affected clusters were killed, including some clusters almost 20" in diameter. Clearly, these plants are susceptible to fire damage. However, the pads were not killed entirely, and the plants were bristling with new growth. It is my conclusion that controlled burns will damage *Opuntia fragilis* if the fire is close enough, but at least under fire intensities typical of this sand prairie, the plants are not destroyed, and there is probably a net benefit from the reduction of competition from other vascular plants, especially woody vegetation.

In conclusion, what should Wisconsin cactus enthusiasts know? First, your state is concerned about *Opuntia fragilis*, and has over 30 known populations in existence. Second, while many of these sites are public property, almost half are on private land, so private-property owners are a vital component of future species preservation in this state. Third, leave the plants alone. Most of the populations are small and quite vulnerable to the effects of people. Site managers should especially watch the encroachment of woody vegetation, which seems to be much more of a problem in Wisconsin than in the drier and less woody Minnesota. Finally, if you think you know of an opuntia site in Wisconsin, big or small, please drop me a note!

The best remaining locations in Wisconsin for *Opuntia fragilis* are Pepin County and Fort McCoy. Undoubtedly, there are places in Pepin County where this species grows that we still don't know about. This area is a series of sand banks, and *Opuntia fragilis* was probably originally growing on almost every sandy part of this county. Agriculture has eliminated the species from much of the county but probably also encouraged its spread in areas that were grazed instead of plowed. Fort McCoy is certainly the place where *Opuntia fragilis* are the most likely to persist, and it's a toss-up whether Thorp Hill harbors the most cacti in the state or not. The site, of course, is off limits to the public, and the fort has an active cactus management program.

So, can cacti and cows coexist? Paul is proof that they can, and the future of *Opuntia fragilis* in Wisconsin will be largely dependent on whether landowners lucky enough to have this fascinating little cactus will protect them and maintain suitable habitat. Competition from woody plants is the biggest current threat to the Wisconsin populations that still exist.