

Opuntia fragilis in Illinois

The record for the northernmost-growing cactus goes to the diminutive Brittle Prickly Pear, *Opuntia fragilis*, found nearly to the Arctic Circle in British Columbia and Alberta. While most common in the upper Great Plains region (Nebraska, the Dakotas, and on into Canada) populations are also sparsely scattered throughout the Midwest, including Ontario, Michigan, Wisconsin, Illinois, Minnesota, and Iowa. In Illinois, Iowa, and Michigan it is on State Endangered or Threatened Species Lists.

Within Illinois there are three species of prickly pear: *Opuntia humifusa* (often called *O. compressa*), *O. macrorhiza*, and *O. fragilis*. *O. humifusa* is scattered along the Illinois River system, where it grows in sandy outwashes. *O. macrorhiza* is found in similar sandy outwashes along the Mississippi River. And *Opuntia fragilis* is known from only one Illinois locality: the new Lost Mound Unit (managed by the Fish and Wildlife Service), a large sandy outwash plain along the Mississippi River, in the northwestern corner of the state.

O. humifusa and *O. macrorhiza* can be difficult to distinguish from each other. Each has large pads (about the size of your hand) that are substantially flattened and sparsely spined. In larger plants the terminal pads are held in the air during the growing season. *O. fragilis* is unique. It has much smaller, more rounded pads (about the size of a thumb-joint), it's more densely spined, and rarely are the pads held substantially above the ground. Furthermore, *O. fragilis* joints are much easier to detach from the plant; the very name *fragilis* refers to this tendency, which is undoubtedly the main method of reproduction in this species.

The famous early-1900s plant ecologist Henry Gleason was the first to report *Opuntia fragilis* from Illinois. He studied a large bunchgrass prairie on a sandy outwash in southern Jo Daviess County and described in great detail a number of different plant

associations and subcommunities found at the site. *Opuntia fragilis* is mentioned in passing¹ as growing on sandy plains in reversional blowouts and adjoining bunchgrass-dominated plant communities.

Opuntia fragilis at Lost Mound, Illinois, where it tends to be covered in "black spot" damage, likely due to warm, wet winters that prevent pad desiccation.



Gleason took “the presence of *Opuntia fragilis* in Illinois as evidence of a formerly more widespread occurrence of western elements in the Midwest as a result of a period of comparatively greater aridity.”^{2,3} Although Dr Gleason was a meticulous researcher, his herbarium specimen of *Opuntia fragilis* became lost for many years. In 1918 the 5000 acre site harboring *O. fragilis* in Illinois became part of a new US Army Munitions Depot, established along with a sizable amount of Mississippi River bottomland. The site became closed to the public, and in the intervening years Illinois botanists argued whether there was enough evidence to include *Opuntia fragilis* on the state list of plants^{4,5}.

The missing herbarium specimen turned up³ at the Gray Herbarium in Massachusetts, and in 1984 botanists obtained permission to search within Depot grounds. There they found a large population of *Opuntia fragilis* growing on heavily grazed sand prairie in the east-central part of the Savanna Army Depot. By the early 1990s it had been decided to decommission the facility, and a concomitant biodiversity assessment of the land turned up over 40 rare plant and animal taxa, including several *Opuntia fragilis* populations, in which most specimens, it was reported, appeared to have some sort of a blackish discoloration^{6,7}.

I joined the Biology Department at Western Illinois University in 2001. Having investigated *Opuntia fragilis* in Minnesota, I was excited to learn of a funding opportunity through the Illinois Endangered Species Board and received a grant to begin a multi-year investigation into the ecology of our state’s only *Opuntia fragilis* population.

My first impressions were that this population was wildly different from the ones I knew in Minnesota. The often minuscule Minnesota populations⁸ grow on small granite outcrops in mossy crevices on exposed rock. The Illinois population is scattered over a large region (at least 150 acres, it turns out) and occurs on almost pure sand. Where the Minnesota plants seem unable to tolerate competition, disappearing whenever grasses and wildflowers move into their area, the Illinois plants grow in bunchgrass prairie surrounded by Junegrass, Bluegrass, *Tephrosia virginiana*, and other wildflowers and grasses (although the cover is sparse enough that bare sand can usually be seen). The pads of the Minnesota cacti are usually a glossy dark green, whereas in Illinois the plants often look yellowish or reddish, and many pads have discolored and damaged black areas. Overall, the Illinois plants look less healthy.

There are also important similarities between these populations. For instance, both sites har-

LEFT *Opuntia fragilis* in bloom near a tagged brick used to mark plants under study. The flowers have a green stigma, red stamen filaments, and yellow petals. **RIGHT** *Opuntia humifusa*, also found in Illinois, is shown here in western Indiana.



bor an abundance of non-vascular plants. In Minnesota, *Opuntia fragilis* grows with lichens and mosses; in Illinois it is found with *Cladonia* (reindeer lichen), a spikemoss (*Selaginella rupestris*), and small mats of bluegreen algae.

The Illinois site has had a chaotic history over the past century. While the Mississippi River bottomlands received the most damaging impact (and is now a Superfund cleanup site) due to factories built there to assemble and disassemble bombs, on the uplands area more than 200 km of gravel roads were built, an equal length of railroad lines were laid, and more than 1000 buildings to store munitions components were erected. Many of the buildings were covered with sand scraped away from adjacent surfaces, and additional areas were scraped and flattened for outdoor storage sites. And, fearing wildfires, the army introduced cattle, which heavily grazed the entire uplands area.

Despite its various insults, much of the land remains intact and is almost unique in Illinois for having never been plowed. If the land had been privately owned, the uplands would undoubtedly have become potato fields. Today it manages to harbor one of Illinois' largest number of rare and endangered species. And in a state where we have become accustomed to protecting prairies only an acre or two in size; a contiguous piece of bunchgrass prairie spanning 5000 acres is a rare biological treasure trove. The land has been deeded to the National Fish and Wildlife Foundation, and while some of it has been turned over to private commercial uses, much of the area is protected and remains behind locked fences.

Our goals when we began our investigations were to assess and survey the existing population and then to monitor its yearly cycles. Led by Barbara Anderson (who has since completed a master's thesis on *Opuntia fragilis* in Illinois), we systematically searched one site, labeled "C" by the army, and marked every plant we found. A second area, "F", had a much larger and more scattered population of prickly pears, from which we randomly selected 100 plants small enough for Barbara to monitor, and marked those as well.

Because of the danger of unexploded ordnance, we were (and are) unable to place anything in the soil; we placed pieces of bricks marked with numbered metal tags near the surveyed plants and recorded GPS coordinates to re-locate them. Then each plant was sketched so that we knew the position and appearance of each pad. Barb and her helpers returned in 2003, 2004, and 2005 to track each plant and observe the fate of each stem. She also searched the C site for additional plants, and while a few more were found each year, most were probably not new but rather had simply been overlooked in previous surveys.

We've found that the *O. fragilis* population covers an area of about 150 acres, and in some regions it is actually one of the dominant plant species. Interestingly, plant sizes are quite small. At the C site, where we tracked every plant we could find, the plants grew by about 50% over three years, from an average of fewer than four pads per plant, to an average of six or seven.

We also observed a substantial number of flowers in the Illinois population—exciting news because *O. fragilis* flowers in Minnesota are rare.

Opuntia macrorhiza in Lost Mound Site, Illinois.



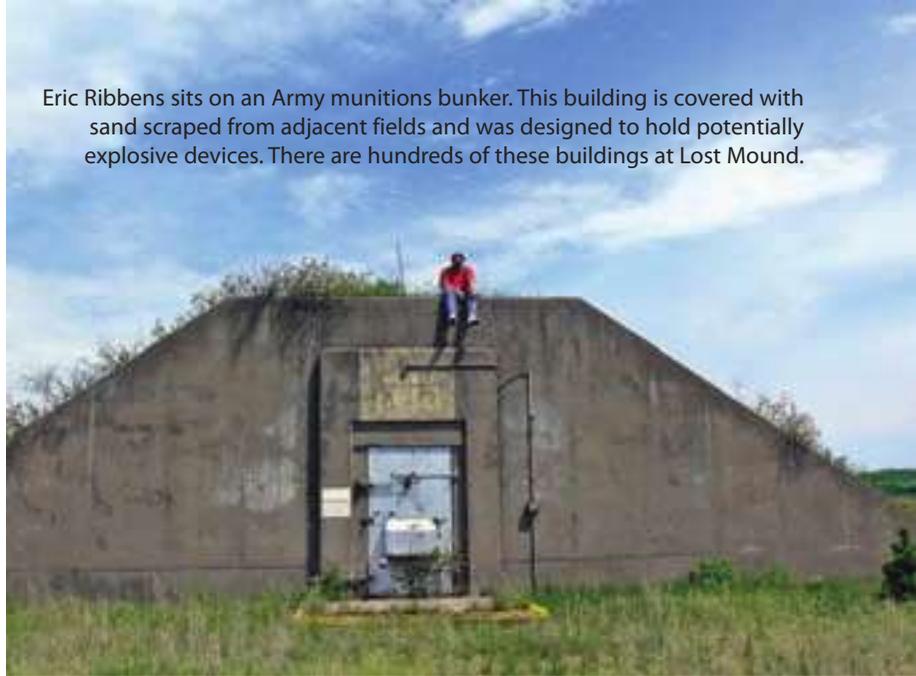
We marked and tracked a number of flowers and were surprised to discover that none of the flowers produced seed. Open pollination, controlled pollination... no seeds. Barbara conducted some germination experiments and showed that pollen tube growth is inhibited in the stamen—apparently some kind of self-incompatibility mechanism is at work. In other words, the stigma of the flower is chemically deterring pollen from growing, probably because it recognizes the

pollen as having the same genetic profile. We have done some preliminary DNA work, which shows that the genetic diversity within the population is moderate, and a study in progress now will help us know if only a single clone grows at this site.

The population of *Opuntia fragilis* is undoubtedly native to the site and has probably been aided and expanded by the activities of the depot, especially by grazing and cattle movement. Since the depot was closed, cattle have been removed, and the other grasses and flowers are becoming more dense. It is unclear how the prickly pears will respond. I suspect controlled burns or some other management technique to reduce the growth of the competitors will become important for continued *Opuntia fragilis* survival.

Asexual reproduction is undoubtedly responsible for the success and spread of this population on the edge of the range of the species, where it is probably on the edge of its physiological capabilities as well. Because *Opuntia fragilis* sur-

Eric Ribbens sits on an Army munitions bunker. This building is covered with sand scraped from adjacent fields and was designed to hold potentially explosive devices. There are hundreds of these buildings at Lost Mound.



vives winters by desiccating its pads, the plants here are stressed. Their lack of vigor and damaged stems are probably due to warm wet winters, where repeatedly melting snow prevents adequate drying of the tissue.

Opuntia fragilis, while at the very edge of its range, is a fascinating member of the Illinois flora. I encourage you to try to visit Lost Mound. We continue to investigate the ecology of this interesting species, in particular the possibility that the Brittle Prickly Pear may reproduce sexually in some parts of its range, but only via fragmentation in other areas. This line of study poses interesting questions about the long-term survival prospects of the different populations, and probably hints at why hobbyists have noticed that some clones are much more apt to flower than others. 🍷

ACKNOWLEDGEMENTS

This research has been partially funded by the Illinois Endangered Species Protection Board and by a grant from the US Fish and Wildlife Service.

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Visiting *Opuntia fragilis* in Illinois

Currently, research into environmental contaminants restricts public access. When access is no longer restricted you will see a habitat and a set of species that are exceptional in Illinois. Feel free to contact the Refuge for more information.

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