Reintroducing Pitcher's Thistle

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Pitcher's thistlle was listed as threatened in 1988 because of population decline due to destruction of shoreline sand dune habitat. This species is being restored to the Illinois shoreline of Lake Michigan by planting propagules grown from seeds collected in the wild.
Photos by Marlin Bowles

Opposite page (from top): Restoration planting began in 1991, but flowering and reproduction from natural recruitment did not occur until 1998.

All plants in the restored populations are monitored annually to determine their growth and reproduction.

Although reintroduction has been used as an effective conservation tool for many endangered and threatened animals, most recovery efforts for plant species have focused on population protection and habitat management as the primary recovery objectives. One reason is that, since habitat destruction is one of the leading threats to plants, appropriate habitat for reintroduction is often scarce. Another reason is that the reintroduction of rare plant species is an emerging science that remains in its infancy, and little information is available to guide restoration design or the quantitative analysis of restoration success. Research on the reintroduction of Pitcher's thistle *(Cirsium pitcheri)*, a threatened plant, is helping us define and measure success.

Pitcher's thistle is restricted in distribution to the western Great Lakes shoreline, where it inhabits open sand dunes. Individuals of this species reproduce only once, reaching a threshold flowering size after three to eight years, then disperse their seeds and die. As a result, viable populations require frequent recruitment of new seedling cohorts, and population structures are highly variable, depending upon cohort demographic histories and successional stages of vegetation. Because dynamic shoreline processes may cause the elimination of entire populations, this species also appears to depend on gene flow among populations or colonization of new habitats.

Pitcher's thistle was extirpated from the Illinois shoreline of Lake Michigan in the early 1900s. Reintroduction began in former habitat at Illinois Beach State Park in 1991. This park is located 43 miles (70 kilometers) north of Chicago along the west shoreline of Lake Michigan. It has a 0.9-mile (1.5-km) wide sand deposit with low dunes that extends for more than 12.4 miles (20 km). Secondary dunes were found to replicate appropriate habitat for this species and were free from shoreline erosion and recreational impacts. Two localities separated by less than 0.6 miles (1 km) were used to establish populations north and south of the Dead River, which drains into Lake Michigan. Our goals include creating two viable populations that would be stable or increasing in size and unlikely to go extinct in the next 100 years.

Cirsium pitcheri propagules used for reintroduction were grown from seeds collected from natural thistle populations in Indiana, southern Wisconsin, and southern Michigan. Thistle cohorts were usually propagated for one season, overwintered, and then transplanted at the restoration site. More than 100 plants were established south of the Dead River by 1993, and the first two of these plants flowered in 1994. The first flowering of naturally recruited plants occurred in 1998, and seedlings from these flowering plants are now replacing artificial cohorts. More than 140 naturally recruited seedlings have been observed but, to date, only eight have flowered. The total number of plants shared between both populations has been maintained between 100 and 200 plants, but the population established north of the Dead River is younger and does not yet have naturally recruited seedlings.

The restoration has successfully reached a number of short-term goals. Plants have completed their life cycles and proportions of seed, seedling, juvenile, and flowering plant stages are comparable to a natural population at

the Indiana Dunes National Lakeshore at West Beach (Bell et al. 2003).

To assess the growth rate of the population south of the Dead River, we developed demographic models from monitoring data. For populations that are increasing in size, the rate of population growth (λ) is greater than 1, for stable populations $\lambda = 1$, and for decreasing populations λ is less than 1. The older Illinois Beach restoration has an overall stable population growth rate ($\lambda = 1.03$) that varies from year to year, ranging from 0.66 to 1.21. These are similar to the values of λ calculated for the natural Indiana Dunes population, which ranged from 0.87 to 1.21. Both the restoration and natural populations have high variation in stage class numbers compared to natural populations of 11 other plant species reviewed by Eric Menges (1998). The high variation indicates that a relatively high population size is required to reduce extinction probability. Encouragingly, the restored population had a year with a very low population growth rate that was followed by a relatively high growth rate the next year, indicating that it has sufficient size to recover from some fluctuations in population size.

Our long-term goal is to create two populations, each with an extinction probability less than 5 percent for the next 100 years. Using the demographic models, we estimated minimum viable population size (MVP) with this extinction probability for *Cirsium pitcheri* to be approximately 500 plants for the Illinois Beach population south of the Dead River. Using this projection for populations north and south of the Dead River, both need to be increased to a viable level of 500 individuals. Matrix models for the Illinois Beach restoration also indicate that at least 150 times as many seeds as seedlings need to be planted to reach the same establishment goal. Using seeds to establish a population of *Cirsium pitcheri* is the least efficient method of restoration, presumably due to high seed mortality. Therefore, we plan to introduce additional plants over the next several years. We also hope to see natural population expansion into nearby available habitat.

Although some measures of viability indicate that the *Cirsium pitcheri* restoration has been successful, others indicate that long-term persistence of the population is still in doubt. Many additional plants need to be reintroduced to bring the population numbers up to the estimated MVP and to test our models. An estimation of the genetic variability of these populations will also be useful to evaluate the evolutionary potential of this restoration.

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