**A rock pink growing in a small basin in Aux Vases Sandstone in Monroe County.**

# Status of *Phemeranthus calycinus* (Holz.) Kiger in Illinois

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Prepared for the Illinois Department of Natural Resources under Wildlife Preservation Fund Contract # RC09L11W, Status of Two Rare Plant: Stickleaf (*Mentzelia oligosperma*, Loasaceae) and Rock Pink (*Talinum calycinum*) in Western and Southwestern Illinois

**23 December 2009**

## Introduction

The plant genus *Phemeranthus* is a member of the Portulacaceae or Purslane family, a plant group containing approximately 450 species placed within 12 genera. The greatest concentrations of species are in western North America, the Andes of South America, and South Africa. Nearly all species are perennial herbs having succulent leaves and stems, except for a few species that are shrubs.

Members of this plant family are found in Illinois. Perhaps the best known species is the common wildflower spring beauty (*Claytonia virginica*) whose distribution is statewide. A few weedy species are garden pests, such as purslane (Portulaca olearaca). Perhaps the least known members of this plant family are the rock pinks or fameflowers. These are small, succulent plants found in specialized habitats in Illinois and other states.

**Illinois Distribution**: The name "rock pink" is derived from their rock outcrop habitat and their flower color. There are three rock pink species native to Illinois and they have pink to rose-colored flowers. Two of these species are known to inhabit rock outcrops (Winterringer & Vestal 1956). A third species is more commonly found in the sand prairies in the northern half of Illinois.

All three species are perennial herbs having conspicuous flowers held erect by long stalks up to 30 centimeters in length. The fleshy terete (rounded) are crowded on a short stem that is often rhizomatous. Rock Pinks are also known for their unusual blooming times. The small-flowered rock pink blooms in the early morning. The large-flowered rock pink blooms in the early afternoon while the sand rock pink blooms in the late evening. Their flowers are open for short time, approximately two hours or less for only one day, causing these plants to be called flowers-of-an-hour.

The rock pinks have been the subject of recent taxonomic studies that resulted in a separation of species into two genera: *Phemeranthus* and *Talinum*. It was leaf characters, along with other features, that were used to separate species into two genera, *Phemeranthus* (rounded leaves) and *Talinum* (flattened leaves) in a relatively recent study (Kiger 2001). The three rock pink species found in Illinois all have rounded leaves, placing them in the genus *Phemeranthus*. These are *P. parviflor*us Nutt. *P. rugospermum* Holz. and *P calycinus* Engelm. They are all rare plants, but the most common species in Illinois is *P. rugospermus*, a species known from sand prairies along the Green, Illinois and Mississippi rivers and Lake Michigan. Both *P. parviflorus* and *P. calycinus* are restricted to exposed sandstone outcrops in southern Illinois where they are considered to be very rare. Both species are currently endangered in Illinois with *P. parviflorus* known from four counties and *P. calycinus* from just one.

*The Phemeranthus* species of the Midwest develop a short taproot that branches with age, producing numerous shoots from a single crown. Most Plants are found growing in thin soil or in mosses or lichens, making it difficult or impossible to distinguish a mature plant

with multiple shoots from a group of young plants with single shoots without uprooting the plants.

The large-flowered rock pink (*P. calycinus)* was first discovered in Illinois in Randolph County in 1954 near Leanderville at a site known locally as Castle Rock. The distribution of this plant includes barrens and rock ledges from southern Illinois and southern Missouri west to Kansas and south to Texas. It differs morphologically from other species in Illinois by having up to 45 stamens per flower (others have 25 or less), petals that measure 12-16 millimeters in length (the petals are shorter on other species), and sepals ranging from 4 to six mm in length. Peak flowering is from May through July, but limited flowering usually persists into August and September.

The large-flowered rock pink was first located on an outcrop of Aux Vases Sandstone known locally as Castle Rock in September of 1954 by R. H. Mohlenbrock. Although botanists likely made visits, no records are known for the site from the period 1955 to 1980. A 1981 report documents the presence of two populations and suggests the possibly of a third at Castle Rock. This report describes a small population, located near the road, that had 12 to 24 plants and a large population, apparently the one at the "rock" that had hundreds. Plants were still present on the "rock" in 1996, but the small roadside population had disappeared. A count of the population on the rock in 1999 yielded 35 plants. The population remains at the "rock", but concern remains about its long term existence. The site now experiences dense shade from adjacent eastern red cedar and winged elm trees.

A second *Phemeranthus* population was discovered in Monroe County in 2001. It was keyed out to P. calycinus using Mohlenbrock (2002). This discovery certainly indicated the potential for other populations on suitable exposures of sandstone within Monroe and Randolph counties. The purpose of this study was to search for new populations of *T. calycinum*, assess the existing populations, and to locate potential reintroduction sites.

## Description of the Study Area

The study area within Monroe and Randolph counties lies within the Central Section of the Ozark Natural Division of Illinois (Schwegman et al 1973). This is mostly covered by and is characterized by steep hills, deep ravines, and numerous exposures of sandstone bedrock, especially along stream valleys. Sandstone bedrock serves as habitat for the large-flowered rock pink (*P. calycinus*) at Castle Rock, a plant regarded to be a distinctive component of the flora of the region which has affinities with the flora of the Ozarks of Missouri.

One of the common bedrock types in the region is Aux Vases sandstone. The type section for this sandstone is an outcrop located at the mouth of the Aux Vases River in eastern St. Genevieve County, Missouri. This formation extends from Missouri across southern Illinois to Knox County, Indiana. It is usually less than eight meters (25 feet) thick and contains inclusions of dolomite and calcareous shale. Outcrops of Aux Vases sandstone are very common along stream valleys in Monroe and Randolph counties.

## Methods

The two known *Phemeranthus* populations in Monroe and Randolph counties were visited during July to assess the populations. Population levels were determined by counting the number of plants (Castle Rock), or by estimating the population size based upon counts made in several one meter square quadrates (Horse Creek). A shoot or stem was considered a separate plant in this study because of the inability to distinguish single shoot plants from those with multiple shoots when they are growing with mosses and lichens.

The ground-layer vegetation at the Horse Creek site in Monroe County was analyzed in August of 2009 using $m^2$ plots located at 1 m intervals along a 40 m transect oriented east/west in the study area. Odd-numbered plots were placed to the right, even-numbered to the left. Percent cover for each species along with bare rock and moss and lichen cover were determined using the Daubenmire (1959) cover class system as modified by Bailey and Poulton (1968). The midpoint of each cover class was used to calculate mean cover, relative cover, frequency (%), relative frequency, and importance value (I.V.) were determined for each species. As used here, IV is the sum of the relative frequency and relative cover. Nomenclature follows Mohlenbrock (2002).

Searches were made within Monroe and Randolph counties for sandstone outcrops containing the large-flowered rock pink. Outcrops were located using online aerial photography (www.Bing.com/maps), surficial geology maps of the area (Grimley and Shofner 2008), and by talking to local landowners. On ground searches were made of potential sites once once they were located and landowner permission was obtained.

Records for *Phemeranthus calycinus* in herbaria within Illinois were also examined. The data obtained included the date of collection, county, township, range, and section, global positioning coordinates (if available), the collector's name, and any notes on the population or area.

Weather data were obtained for Mayestown in Monroe County, the closest location that had long term weather data (www.Bing.com/weatherbase).This datatbase provides information on temperature and precipitation for a thirty year period.

## Results

**Herbarium searches**: Only two specimens of the plant presently considered to be *Phemeranthus calycinus* were located, one at the University of Illinois herbarium (ILL) and the other at Eastern Illinois University (EIU). The University of Illinois specimen is the basis for including this species in the flora of Illinois as well as various regional floras that have been prepared during the last 50 years. The other specimen was collected from this site in 2000, nearly 50 years after the initial collection. These two specimens contain the following data:

"Edge of dry sandstone bluffs near Leanderville at Castle Rock, Monroe County, 25 September 1954. R. H. Mohlenbrock 4911 (ILL).

"Top of sandstone cliff in shallow soil just behind cliff top, Leanderville, Monroe County, SE1/4 SW1/4 S17 T7S, R5W, 22 May 2000 J. E. Ebinger 28454 (EIU)

**Field Studies**

**Castle Rock and Randolph County:** A census taken of the Castle Rock site in 2009 yielded 28 plants, including 7 flowering individuals. The red cedar and winged elm trees were still present, and a *Panicum* or *Dicanthelium* species was growing over *Phemeranthus* plants located along the border of the sandstone rock. The grass had almost obscured the rock pinks.

Several days were also spent looking for sandstone outcrops near the Leanderville site. Some promising outcrops were located, but the rock pink was not present on any of them. These sandstone outcrops varied considerably in size, as did other features of the site. Most locations were considered unsuitable.

A large, very promising outcrop was located on private property across from the Leanderville Road. The outcrop was flat and in a very sunny location. There were no invasive exotic species present on the outcrop which was estimated to be over ten meters wide and approximately 40 meters long. Another high quality outcrop was found nearby that was large and sunny.

**Horse Creek and Monroe County:** Knowledge of the *Phemeranthus* population at Horse Creek in Monroe County dates to 2001, the year the year of its discovery. This population has always been large, numbering in the hundreds at each census. Over 1,000 plants were counted in 2001 compared to 1800 in June of 2002. In June of 2006 the population was estimated to be 2,430 plants. The population was estimated to be 2,743 plants in July of 2009.

Other locations were searched in Monroe County, but no other populations of the large-flowered rock pink were discovered. None of the sites examined appeared to be suitable for the growth of this plant. Many outcrops in Monroe and Randolph counties were considered unsuitable for the following reasons:

1. The sandstone was covered with too much soil.
2. The site had too much woody plant growth, creating dense shade.
3. The outcrop was small with an irregular surface
4. The outcrop was in an area of rapid and erosive runoff during rains.

**Quantitative Survey**

Japanese honeysuckle (*Lonicera japonica*) was the dominant plant on the sandstone outcrop (Table 1.). The vegetation of the site is naturally very sparse, making it suitable for the growth of *Phemeranthus.* The most common plants were buttonweed (*Diodia teres),* broomsedge (*Andropogon virginicus*), and panic grass (*Dichantheliumm oligosanthes*).

Several small trees have become established on the outcrop, especially at the west end. The greatest cover of Japanese honeysuckle is at the east end of the outcrop, an area where no *Phemeranthus* plants are present. Bare rock, mosses, and lichens accounted for nearly 50 percent of the cover. This percentage would have been nearly 80 percent without the presence of the Japanese Honeysuckle. This is likely the amount of bare rock, mosses, and lichens in sites where the honeysuckle is absent. It is here that the *Phemeranthus* is prospering.

## Discussion

Although the large-flowered rock pink was collected at Castle Rock in1954, no records of population sizes are available until 1981. In 1981 at least two populations of this plant were present at Castle Rock. One contained 12-24 plants while the other had hundreds of plants. The roadside population disappeared by 1996, but the population on the rock outcrop has remained.

Based upon field studies in 2009, the large-flowered rock pink does not compete well with other vegetation. The number of plants at the Castle Rock site has continued to decline as eastern red cedar, winged elm, and panic grass have encroached upon the plants. The habitat at Horse Creek in Monroe County is large, but it is not free of adverse competition. The site has a serious problem with Japanese honeysuckle which is currently threatening to overrun the entire site.

Ideal habitat for this species appears to be large, flat, sunny expanses of sandstone characterized by sparse vegetation, except mosses and lichen that appear to be important in the survival of the plants. The outcrop at the Horse Creek site in Monroe County is characterized by nearly circular, shallow depressions or basins that hold water for short periods following rains. These depressions often contain mosses and lichens and small amounts of soil. Numerous rock pink plants are present in these sites.

**An Identity Problem:** Measurements taken from several flowers from the Horse Creek, Monroe County population during the field studies did not match measurements given in the literature for the large-flowered rock pink. Consequently, a specimen was sent to the North American expert for the genera *Phemeranthus* and *Talinum*. He determined the plant to be *Phemeranthus rugospermus,* the sand prairie rock pink.

It is noteworthy to state that *Phemeranthus rugospermus* has never been reported or knowingly observed farther south in Illinois than Mason County. It is typically a sand prairie species that is sometimes associated with rock outcrops, like those found in the Nachussa grasslands in northern Illinois. Other states do report its habitat as igneous and

sedimentary rock outcrops, so its presence on sandstone outcrops should not be completely unexpected.

There are several questions yet to be answered regarding the Horse Creek *Phemeranthus* population. *Phemeranthus rugospermus* flowers are characterized by 25 to 30 stamens and three widely separated stigmas. However, the 15 to 20 flowers examined on plants at Horse Creek had 45 to 50 stamens and a prominent three-lobed stigma. The style of *P rugospermus* is about the same length as the stamens. However, the styles on the flowers examined on flowers at the Horse Creek population were well exserted beyond the stamens. It will be important to revisit this site next year to collect flowers, fruits, and seeds. All are needed to properly identify *Phemeranthus* species.

The plants key out to *Phemeranthus calycinus* using the Flora of Illinois (Mohlenbrock 2002). This key uses stamen number as a key character to separate species. The key in Volume Four of The Flora of North America uses a combination of characters, including the texture of the seed surface, to separate species. Seeds were not examined during the present study. One thing has emerged regarding the Phemeranthus plants at Horse Creek. They are not the large-flowered rock pink, *Phemeranthus calycinus.* This discovery causes uncertainty regarding the plants at Castle Rock in Randolph County. Superficially, they appear to be identical to those at Horse Creek in Monroe County. If the plants at Horse Creek are *Phemeranthus rugospermus*, it would be a significant range extension and the first time this species has been reported from southern Illinois. Although the plants may not be *P. calycinus*, this should not diminish preservation and management efforts. The Flora of North America states that *P. rugospermus* is not common anywhere within its range. The study of Cochrane (1993) describes its abundance and distribution within the United States. Illinois and Wisconsin appear to have the largest number of populations.

The future of these two rock pink sites in southern Illinois is not secure. The population at Castle Rock appears to be on the brink of extirpation. It is likely to disappear within the next five years under current conditions. Although the Horse Creek population is large, it is threatened by the invasive exotic Japanese honeysuckle. There were no rock pink plants in areas where honeysuckle was prevalent. Unlike other invasive species, Japanese honeysuckle has the potential to completely overrun the sandstone glade. This would greatly reduce or possibly eliminate the rock pink population.

## Management Recommendations

**Castle Rock:** Removal of the encroaching vegetation would allow more sunlight to reach the plants. This would be of benefit to the plants. However, it is not certain that the removal of cedars and winged elm will prevent the continued decline of this population. The population has dipped to such low levels that recovery may not be possible. However, the remaining plants may respond to increased sunlight, but this work must be accomplished soon.

Small, isolated plant populations often decline due to genetic depression. The decline of the rock pink is not unlike the decline of other rare plants like the twisted milk vetch, the old plainsman, or the Lakeside daisy (McClain and Ebinger 2002, 2003, 2008). However, the remaining plants may respond to increased sunlight, but this work must be accomplished soon before the last plants die.

**Horse Creek:** The Phemeranthus population at this site is large due to the size of the outcrop. Population counts have consistently yielded 2,000 or more plants. However, the population is threatened by Japanese honeysuckle (*Lonicera japonica*). The *Phemeranthus* is not tolerant of the competition with honeysuckle or other plants, causing a reduction or elimination of plants in areas of dense honeysuckle growth. Japanese honeysuckle has the ability to completely overgrow this outcrop. This would effectively eliminate the *Phemeranthus* population at this site. Careful removal of Japanese honeysuckle from the outcrop and the area around it would benefit the *Phemeranthus*

## Acknowledgements

Special thanks is extended to Paula McClain for help with the field work and to Debbie Newman for contacting landowners and for help with the census of plants.

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Table 1. Frequency and percent cover for vascular plants at Horse Creek Glade, Monroe County, Illinois. Based upon 40 1 $m^2$ quadrates.

| Species | % Frequency | % Cover |
|---|---|---|
| *Lonicera japonica* | 47 | 29.9 |
| *Carex sp* | 15 | 1.5 |
| *Diodia teres* | 37 | 2.0 |
| *Phemeranthus rugospermus* | 35 | 0.6 |
| *Andropogon virginicus* | 27 | 1.2 |
| *Panicum oligosanthes* | 25 | 1.8 |
| *Sporobolus sp* | 10 | 3.5 |
| Others (29 species) | | 9.9 |
| | | |
| | | |
| Mosses, bare ground | | 49.6 |
| Total | | 100.0 |

Table 2. Weather data from Maeystown, Monroe County, Illinois giving temperatures ($^0$F) and precipitation and snowfall in inches.

| Data category | Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aver. Temp. $^0$F | 55 | 28.8 | 33.1 | 44.4 | 55.9 | 65.1 | 73.8 | 78 | 76 | 68.9 | 57.5 | 45.4 | 33.5 |
| Aver. Hi. Temp. | 65.5 | 38.3 | 43 | 54.9 | 66.9 | 76 | 84.7 | 88.9 | 87 | 80.3 | 69 | 55.2 | 42.3 |
| Aver Lo Temp. | 44.5 | 19.2 | 23.1 | 33.9 | 44.9 | 54.1 | 63 | 67 | 65 | 57.5 | 46 | 35.6 | 24.7 |
| Highest Temp. | 107 | 75 | 83 | 88 | 93 | 95 | 103 | 106 | 107 | 102 | 94 | 89 | 75 |
| Lowest Temp. | -18 | -16 | -12 | - | 21 | 30 | 42 | 47 | 45 | 34 | 22 | 3 | -18 |
| Aver Precip. | 40.3 | 2 | 2.4 | 3.7 | 3.6 | 4.1 | 3.8 | 4 | 3 | 3.6 | 3 | 3.8 | 3.4 |
| Aver Snowfall | 15.9 | 4.7 | 3.9 | 2.6 | - | - | - | - | - | - | - | 1.1 | 3.3 |
| Aver days 90 + | 30 | - | - | - | 0.2 | 1.1 | 6 | 11 | 8.8 | 2.9 | 0.3 | - | - |
| Days below 32$^0$ | 72 | 19 | 15 | 10 | 1.9 | 0.1 | - | - | - | - | 1.8 | 8.4 | 17 |

Figure 1. The “Rock” at Castle Rock near Leanderville in Monroe County. This is the historic site for *Phemeranthus calycinus* in Illinois, and has been known since 1954. Note the dense lichen and moss cover on the rock, and the dense shade created by adjacent woody vegetation.

Figure 2. *Phemeranthus calycinus* plants at Castle Rock near Leanderville in Monroe County, Illinois. The quarter gives a scale to judge the size of the succulent *Phemeranthus* plants immediately to the right and top of the quarter. These plants did not bloom this year. Note the abundant litter from eastern red cedar (*Juniperus virginiana*), and the *Phemeranthus* plants growing in clumps of moss.

Figure 3. Encroaching vegetation at the Castle Rock site near Leanderville in Monroe County. The plants in the photograph are dewberry (*Rubus*) and a species of panic grass (*Dicanthelium*).

Figure 4. View of the large, nearly flat outcrop of Aux Vases Sandstone along an unnamed tributary of Horse Creek in Monroe County. Note the dense moss and lichen cover.

Figure 5. A “basin” at the *Phemeranthus* site along Horse Creek, Monroe County. These basins retain water for short periods following rains, enabling the mosses, lichens, and rock pinks to adsorb moisture. The mosses and lichens appear to provide ideal germination sites for *Phemeranthus* seeds. The mosses also serve as ideal growing sites for mature plants.

Figure 6. A *Phemeranthus* plant in bloom in the afternoon at Horse Creek in Monroe County. The plant is growing in a small basin with sedges and *Diodia teres*.

Figure 7. The west end of the Aux Vases sandstone outcrop at Horse Creek in Monroe County. The grasses are primarily broomsedge (*Andropogon virginicus*) and the small trees are post oaks (*Quercus stellata*) and the shrub aromatic sumac (*Rhus aromatica*). This vegetation threatens to make the habitat less suitable for *Phemeranthus*.

***Mentzelia oligosperma* (stickleaf) growing in gravel and loess on a hill prairie slope.**

# Status of *Mentzelia oligosperma* Nutt. (Loasaceae) in Illinois

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**23 December 2009**

## INTRODUCTION

*Mentzelia oligosperma* Nutt. is a plant species found on exposed, xeric outcrops of bedrock from Missouri north to South Dakota, west to Colorado, and south to Texas. Although this plant is relatively common in some western states, it becomes increasingly less abundant in states at the eastern edge of its range. Its distribution is limited in Illinois to the extreme western edges of a few counties that border the Mississippi River.

*Mentzelia oligosperma*, commonly known in Illinois as stickleaf, is a member of the Loasaceae, a mostly tropical plant family consisting of 20 genera and up to 260 species native to the Americas, Africa, and Arabia. Included in the 260 species are a variety of annual, biennial, and perennial herbaceous plants and a few shrubs and small trees. The genus *Mentzelia* contains 60 to 70 species, but only *M. oligosperma* is native to Illinois.

Also known as beggar's patches, chickenthief, few-flowered stickleaf, yellow stickleaf, or chickthief, this plant is an herbaceous perennial having semi-woody qualities. It sometimes grows to nearly one meter in height in parts of its range, but it seldom exceeds 50 cm in Illinois. Individuals of this species are easily recognized by their white, brittle, profusely branched stems, alternate, short-petioled, toothed leaves, and yellow to orange flowers. However, the most distinctive features of this plant may be the small, curved fruits that resemble miniature horns. These fruits plus other plant parts are covered with hooked hairs that enable them to cling to the fur of animals or to the clothing of man. It is this character that gives rise to its most frequently used common name of stickleaf.

Flowers are produced in leaf axils from June through August, resulting in small, (1 cm) fruits that contain two or more, flattened, elongate seeds. Fruits, when mature, are easily dislodged from the plant and may be transported considerable distances. However, most seeds fail to produce viable plants due to their very specific habitat requirements.

Stickleaf is restricted to the bluff edges of the Mississippi River in Adams, Calhoun, Monroe, Monroe, Pike and Randolph counties where it found growing in cracks in bedrock or in thin loess often within one meter or less of the cliff face. These locations, combined with steep topography and loose gravel or talus make data collection and close observations of plants dangerous or impossible.

Stickleaf has always been considered to be a rare plant in Illinois (Mohlenbrock 2002). Although the species is considered rare, no assessment was made to determine its population status or current distribution within Illinois until the survey of Jones (2008). Concern increased for this plant in recent years due to the loss of hill prairies to woody plant invasion and limestone cliffs to development and limestone mining. The purpose of this study was to survey populations of stickleaf not examined by Jones (2008) and to assess its habitats and potential for long term survival in the state.

## DESCRIPTION OF THE STUDY AREA

Populations of *Mentzelia oligosperma* are known from the Middle Mississippi Border Division of Illinois, a narrow band of river bluffs and rugged terrain adjacent to the Mississippi River floodplain beginning in Rock Island County and extending south to St. Clair County. *Mentzelia oligosperma* populations within Monroe and Randolph counties lie within the Central Section of the Ozark Natural Division (Schwegman et al 1973). Plants are restricted to high bluffs within both of these natural divisions which also provide habitat for several plant species more characteristic of western states.

Exposures of limestone bedrock are often present at the base of these hill prairies, especially at the interface of the cliff and the hill prairie community. These exposed ledges have a west or southwest aspect, are located in full sunlight, and are characterized by sparse vegetation. These xeric conditions and the absence of competition are habitat factors that favor the growth of stickleaf.

The climate of this area, based upon data from Griggsville in Pike County in west-central Illinois is continental, characterized by hot summers and cold winters. July is the warmest month with 14 days over $90^0$ F, and January is generally the coldest with 27 days with temperatures below $32^0$ F. The highest recorded temperature in Griggsville was $115^0$ F and the lowest was 25 degrees below zero F. Approximately 38 days will have a maximum temperature greater than 90 degrees F. The average annual precipitation, including snowfall, is 38.6 inches (Table 1).

## METHODS

Data were obtained from herbaria (EIU, ISM, ILL, ILLS, SIU) from specimens of *Mentzelia oligosperma* collected in Illinois. Selected populations, as recorded on herbarium labels, were visited and searches were made for plants. Emphasis was given to sites not visited by Jones (2008). When plants were located, the number of plants and habitat type were recorded. An assessment was also made of the quality of the habitat of each population.

Searches were made for plants in Adams, Pike, Calhoun, and Monroe counties to examine known populations and to locate new sites. Although some searches were conducted on state-owned land, the majority of the searches were made on private lands on habitat considered suitable for the growth of *Mentzelia oligosperma*. Specimens were collected from all colonies when possible and deposited in the Stover-Ebinger-Herbarium of Eastern Illinois University (EIU), The Illinois State Museum (ISM), and the Illinois Natural History Survey (ILLS). The nomenclature for vascular plants follows Mohlenbrock (2002).

Global positioning (GPS) and elevation readings were taken at each location where *Mentzelia oligosperma* was found. These data were recorded to ensure a record of the location of these rare plants.

## RESULTS

### Herbarium Records

A total of 101 herbarium specimens from Adams, Calhoun, Pike, Monroe, St. Clair, and Randolph counties were examined, including 22 from Adams, 10 from Calhoun, 30 from Pike, 36 from Monroe, and 2 from Randolph County (Table 3). The earliest known collection of this plant in Illinois was in 1844 in Pike County. Seventy-four of the specimens are those of Dr. R. A. Evers that were collected from 1948 to 1973, a time when he was conducting research on hill prairies. The most recent specimen was collected in 1987 from Swarnes Hill Prairie in Calhoun County by R. W. Nyboer.

The habitats for this plant, as described on herbarium label annotations, were rock ledges, hill prairie, rocky bluff, or rock wall of an abandoned quarry. A few annotations describe the habitat as cracks in limestone bedrock or thin loess over limestone bedrock. Limestone bedrock is not specifically mentioned on labels that give the general habitat as hill prairie, but it is likely that these specimens were also found on the bedrock near the cliff edge.

### Field Studies

Adams County

Fall Creek: The abandoned stone quarry at this site just north of the Pike County line supports one of the largest colonies of *Mentzelia oligosperma* in Illinois. The vertical walls have small ledges where *Mentzelia oligosperma* can become established and prosper. Even in this optimum habitat for *Mentzelia oligosperma*, the plants were always scattered. A total of 62 plants were located at this site, mostly as scattered individuals on the west-facing vertical walls of the old quarry (Table 2).

A considerable amount of woody vegetation is present on the floor of the quarry. These trees, once mature, will shade the *Mentzelia oligosperma* plants during the afternoon. No invasive exotic plant problems were observed.

Calhoun County

Swarnes Hill Prairie: This is one of the historic sites for *Mentzelia oligosperma* in Illinois. The habitat here is a limestone rock ledge at the base of the hill prairie where it was collected by Dr. Robert A. Evers. However, no plants could be located at this site during the field studies.

The site has experienced considerable change in the last 20 years. A portion of the hill prairie is now mowed on a regular basis throughout the growing season. Woody invasion is occurring throughout the site, and trees have grown from the talus slope and have overtopped the limestone ledge, creating afternoon shade.

Monroe County

Buettner Hill Prairie: This site was discovered by Debbie Newman during the summer of 2009. Rock ledge habitat is abundant here, affording suitable growing sites for *Mentzelia oligosperma*. The topography is very steep and great caution was exercised in looking at the site. The rock ledges were regarded as extremely dangerous due to their steepness and proximity to the cliff face.

A total of 37 plants was observed here by Debbie Newman (Table 2). Conservations with family members indicate that considerable woody vegetation has grown on the site, creating dense shade for the *Mentzelia oligosperma* plants during the morning hours.

Fults Hill Prairie: This is also one of the historic sites for *Mentzelia oligosperma* in Illinois. Rock ledges or thin loess or limestone are the habitats for Mentzelia oligosperma at this site. A total of twelve plants were located during the survey (Table 2). The sites that were surveyed were in the southernmost parts of the preserve. Populations north of these sites were not surveyed in this study.

The rock ledge habitat at Fults Hill Prairie is threatened by woody invasion that is advancing downhill toward the rock ledges. Coarse vegetation, like fall boneset, appear to be unnaturally abundant. These plants are also growing in close proximity to the rock ledges, thus creating shade and competition for the *Mentzelia oligosperma* plants.

Pike County

Housen Hill Prairie: A total of eight colonies were located at this site, either on a shale talus slope or a rock ledge. A total of 52 plants were observed growing in these habitats. The first colony, containing 21 plants was located on a steep slope characterized by loose, reddish, pea to walnut-sized gravel. The second colony was present at the south end of the prairie on a limestone ledge. Three plants were found here, but they were threatened by competition by many large, coarse plants that were growing close to the cliff edge.

The third colony of only two plants was growing in the shade of two elm trees. These plants were not as robust as those in full sunlight. The fourth colony of two plants was growing at the edge of a sinkhole. Pokeweed and boneset were dense here, creating considerable competition for the *Mentzelia oligosperma* plants. Colony five was on a west facing rock ledge. Nine plants were found here in sparse prairie vegetation.

Colony six with two plants was also on a rock ledge with prairie vegetation. Colony seven with six plants was present on a rock ledge with thin loess. Colony eight with seven plants is present on a rock ledge. It receives afternoon shade due to the growth of honeysuckle, elm and ash trees.

North New Canton Hill Prairie: A total of four colonies of Mentzelia oligosperma were located at this site. The first colony containing 17 plants was located on a gravel and thin loess slope in sparse prairie vegetation. The second colony with only one plant was located at the cliff edge. The third colony of five plants was also at the cliff edge. These plants were shaded by afternoon sun due to trees growing from the talus slope that had overtopped the cliff. The fourth colony of four plants was also present at the cliff edge. Trees were also shading this area in the afternoon. These colonies contained a total of 35 plants that were growing on rock ledges or on thin loess over limestone bedrock (Table 2).

This site is threatened by a dense growth of eastern red cedar. These trees will continue to produce shade and they have the potential to become established directly on the rock ledges where the *Mentzelia oligosperma* is growing.

Walnut Grove Hill Prairie: A total of 55 plants were located at this site, primarily on rock ledge habitat. The first colony of 11 plants was present on a steep, eroding shale slope having a southwest aspect that was wet from seepage. The second colony of 44 plans was located on a steep, eroding slope of loose shale and sandstone. The lower part of this slope was sparsely vegetated, by the upper part was characterized by little bluestem and sideoats grama.

**Field Observations and Habitat Types**

No dense colonies of the plant were observed at any locality. The greatest number of populations was in Pike County, a county also known for an abundance of hill prairies having rock ledge habitat. Rock ledge habitat was the most common type of habitat for stickleaf, but plants were also found on loose shale and talus.

A total of 245 plants were identified at sites within all counties. This compares with 246 plants identified by Jones (2008). Using this information, the total known population of *Mentzelia oligosperma* in Illinois is estimated to be approximately 300 individuals based upon these two studies.

*Mentzelia oligosperma* could not be relocated at Swarnes Hill Prairie in Calhoun County. Jones (2008) could not relocate *Mentzelia oligosperma* at seven of the 15 historic sites for this species. The plants may still persist at some of these sites, but intensive surveys will be needed to verify their presence or absence. This is the trend of rare plant species in Illinois that require specialized habitat (McClain and Ebinger 2004).

Observations made during this study plus those of Jones (2008) suggest that *Mentzelia oligosperma* is intolerant of competition. Plants growing in the shade, like those at Housen Hill Prairie, were small, (less than 5 cm in diameter) with very little branching. This contrasts with the robust, profusely branched plants growing in full sunlight.

## DISCUSSION

Something as simple as a land purchase might seem like the only action necessary to ensure the continued survival of *Mentzelia oligosperma* in Illinois. Its habitat is rock ledges atop high bluffs along the Mississippi River. It is a simple preservation plant for this plant, but one that will not ensure the long term survival of this plant. The landscape of Illinois is changing and no portion remains free of detrimental impacts of modern man upon natural vegetation. Even plants like *Mentzelia oligosperma*, whose habitat is narrow rock ledges on high, practically inaccessible bluffs, have been affected. Woody plant invasion, a process that has eliminated or reduced the size of many hill prairies, also threatens the seemingly secure, rock ledge habitat of *Mentzelia oligosperma.* Talus slopes once characterized by sparse woody growth are now completely covered by a dense growth of trees and shrubs. Among these are aggressive invasive exotic trees such as tree-of-heaven (*Ailanthus altissima*). These trees often grow to heights that exceed the height of the cliff edge, creating dense afternoon shade for the rock ledge habitat. This shade alters the microclimate and may make it less suitable for sun-lowing plants such as *Mentzelia oligosperma*. Hot, dry winds that would normally sweep across the cliff face are deflected over them.

Woody vegetation is also advancing downhill toward the cliff face on many hill prairies, creating morning shade and promoting the growth of coarse herbaceous species that compete with *Mentzelia oligosperma* for the very narrow and limited space on the rock ledges. Such changes in the vegetation are likely due to the effects of woody plant invasion.

Currently there are eight known populations of *Mentzelia oligosperma.* However, there has been *a* dramatic loss of populations over the last 60 years, an alarming trend. Jones (2008) reported the loss of *Mentzelia oligosperma* from seven sites where it was collected by Dr. Robert A. Evers (Evers 1952). Searches made during the present survey failed to reveal its presence at Swarnes Hill Prairie in Calhoun County, raising the total number of likely population extirpations to eight. This represents a 53.3 percent loss of populations from 1949 to 2009. Population loss is expected to continue into the future until the plant is reduced to a few populations.

Despite the myriad threats to *Mentzelia oligosperma*, this plant does not face imminent extirpation from Illinois. Its rock ledge habitat along high bluffs is likely to continue to diminish, but it is not likely to completely disappear. In addition, one site, Fults Hill Prairie in Monroe County, is an Illinois Nature Preserve where management activities should curtail woody invasion. However, the number of populations is expected to continue to decline because most populations are privately owned and without the benefit of management and protection activities.

No information was located on the life span of *Mentzelia oligosperma* plants, or its reproductive potential. Observations indicate that it produces a large number of fruits for a plant of its size. However, the seeds within these fruits must fall within the rock ledges

where conditions are most suitable for the growth of *Mentzelia oligosperma*. Those that germinate in dense hill prairie vegetation are not likely to survive.

The loss of *Mentzelia oligosperma* populations coincides with the loss of hill prairies in Illinois. Though there is no evidence to support the claim, the decline of *Mentzelia oligosperma* may be related to the loss of hill prairie. This taxon appears to be another member of a list of rare plant species that are being crowded out of natural habitats by woody succession. *Mentzelia oligosperma* will likely survive, but populations will diminish in size or become extirpated due to changes on hill prairies.

The total known population of *Mentzelia oligosperma* in Illinois is estimated to be approximately 300 plants present on eight sites, including seven natural sites (rock ledges associated with hill prairies), and one artificial site, a former rock quarry in Adams County. This quarry has between 62 to 85 individuals, or nearly one third of the population for the entire state. The other seven sites contain approximately 200 to 210 plants. However, none of these populations are as large as the one at Fall Creek. The population at Shewhart Hollow Hill Prairie has fewer than ten plants.

These small, isolated populations of *Mentzelia oligosperma* may be or likely will experience genetic depression problems in the future. Small and widely scattered plant populations in Illinois have a demonstrated history of decline over time (McClain and Ebinger) Populations of Mentzelia oligosperma are already disappearing within Illinois (Jones 2008 and this study).

It is likely no coincidence that *Mentzelia oligosperma* populations are being lost at the same time hill prairies are declining. Illinois has lost many hill prairies since the state-wide study of Dr. Robert Evers (1952). Fragmentation my prevent pollinators from reaching *Mentzelia oligosperma* populations due to zones of woody vegetation (Robertson et al 1995, Schwartz 1997). Others appear to have been permanently converted to forest.

Threats like mining and development of hill prairie communities are likely to continue, perhaps further reducing the number of *Mentzelia oligosperma* populations. The only site currently free of these types of threats is Fults Hill Prairie Nature Preserve in Monroe County. All others face an uncertain future as our population increases and land ownership changes.

## Acknowledgements

Special appreciation is extended to the Illinois Department of Natural Resources for funding for this study under contract # RC09L11W. Thanks is also extended to Paula McClain assistance with the field studies. Much appreciation is extended to Angella Moorehouse for assistance with landowner contacts, field studies, and the use of aerial photography.

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www.Bing.com/weatherbase

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Table1. Weather data for Griggsville, Pike County, Illinois based on a 30 year average. Temperatures are in $^0$F and precipitation and snowfall are in inches.

| Data type | Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aver. Temp. $^0$F | 51.9 | 23.9 | 28.2 | 40.2 | 53.2 | 63 | 71.8 | 76.1 | 73.7 | 66.2 | 55.1 | 41.9 | 29 |
| Aver. Hi. Temp. | 62.3 | 33.5 | 38.4 | 50.6 | 63.9 | 73.7 | 82.3 | 86.7 | 84.6 | 77.8 | 66.6 | 51.9 | 37.9 |
| Aver Lo Temp. | 41.4 | 14.3 | 18.1 | 29.7 | 42.4 | 52.2 | 61.3 | 65.5 | 62.7 | 54.6 | 43.5 | 31.8 | 20.2 |
| Highest Temp. | 115 | 76 | 81 | 92 | 94 | 102 | 104 | 115 | 113 | 103 | 96 | 84 | 73 |
| Lowest Temp. | -25 | -22 | -25 | -9 | 12 | 28 | 39 | 46 | 41 | 26 | 10 | -5 | -19 |
| Aver Precip. | 38.6 | 1.5 | 1.6 | 3.2 | 3.7 | 4.3 | 3.7 | 4.4 | 3.4 | 3.9 | 3.2 | 3 | 2.6 |
| Aver Snowfall | 24.6 | 6.6 | 6.4 | 3.9 | .8 | - | - | - | - | - | - | 1.9 | 5.4 |
| Aver days 90 + | 38 | - | - | - | 0.1 | 1.2 | 7 | 14 | 11 | 4.8 | 0.3 | - | - |
| Days below 32$^0$ | 113 | 27 | 23 | 17 | 4.2 | 0.1 | - | - | - | 0.1 | 2.9 | 14 | 25 |

Table 2. Location of *Mentzelia oligosperma* Colonies during 2009 Survey

| **County** | **Site** | **Location** | **Elevation (m)** | **Plants** |
|---|---|---|---|---|
| Adams | Fall Creek Quarry | N39.76277 W91.26767 | 169.68 | 62 |
| Calhoun | Swarnes Hill Pr. | N39.23506 W90.71766 | 211.38 | 0 |
| Monroe | Buettner Hill Pr. | N38.17312 W90.21806 | 207.37 | 37 |
| | (1) Fults Hill Pr. | N38.15333 W90.18418 | 181.45 | 1 |
| | (2)Fults Hill Pr | N38.15341 W90.18420 | 187.70 | 1 |
| | (3)Fults Hill Pr. | N38.75368 W90.18449 | 195.33 | 10 |
| Pike | (1)Housen Hill Pr. | N39.55534 W91.02387 | 227.44 | 21 |
| | (2)Housen Hill Pr. | N39.55513 W91.02382 | 226.17 | 3 |
| | (3)Housen Hill Pr. | N39.55513 W91.02373 | 229.05 | 2 |
| | (4)Housen Hill Pr. | N39.55467 W91.55467 | 225.86 | 2 |
| | | | | Subtotal 139 |

| County | Site | Location | Elevation (m) | Plants |
|---|---|---|---|---|
| Pike | (5)Housen Hill Pr | N39.55431 W91.02319 | 214.46 | 9 |
| | (6)Housen Hill Pr | N39.55419 W91.02303 | 211.26 | 2 |
| | (7)Housen Hill Pr. | N39.55406 W91.02292 | 211.96 | 6 |
| | (8)Housen Hill Pr. | N39.55392 W91.02275 | 203.79 | 7 |
| | (1) North New Canton H.P. | N39.66580 W91.12807 | 214.89 | 5 |
| | (2)North New Canton H. P. | N39.66563 W91.12781 | 203.40 | 4 |
| | (3)North New Canton H.P. | N39.66597 W91.12819 | 214.64 | 17 |
| | (4)North New Canton H.P. | N39.66592 W91.12812 | 211.08 | 1 |
| | Walnut Grove H. P. | N39.48452 W90.92955 | 193.85 | 55 |
| | | | | Total 245 |

Table 3. Specimens of *Mentzelia oligosperma* in herbaria in Illinois by county, site, collector, date, and herbarium.

| County | Locality | Collector | Date | Herbarium |
|---|---|---|---|---|
| Adams | Payson Township | R. A. Evers | 9 Sept. 1950 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 9 Sept. 1950 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 9 Sept. 1950 | ILLS |
| Adams | Payson Township | R. A. Evers | 2 July 1950 | ILLS |
| Adams | Payson Township | R. A. Evers | 2 July 1950 | ILLS |
| Adams | Payson Township | R. A. Evers | 28 May 1950 | ILLS |
| Adams | East of Bluff Hall | R. A. Evers | 5 June 1952 | LLS |
| Adams | East of Bluff Hall | R. A. Evers | 23 June1953 | ILLS |
| Adams | East of Bluff Hall | R. A. Evers | 23 June1953 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 20 July 1970 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 20 July 1970 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 20 July 1970 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 20 July1970 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 20 July 1970 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 20 July1970 | ILLS |
| Adams | Fall Creek Township | R. A. Evers | 9 June 1970 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 9 June 1970 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 9 June 1970 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 19 Aug.1971 | ILLS |
| Adams | 2.5 miles SE of Fall Creek | R. A. Evers | 20 May 1971 | ILLS |
| Adams | Abandoned quarry | K. Robertson | 3 June 1987 | ILLS |
| Adams | NE of Bluff Hall | R. A. Evers | 5 June 1952 | ILLS |
| Calhoun | North of Hamburg | R. A. Evers | 12 Aug 1950 | ILLS |
| Calhoun | North of Hamburg | R. A. Evers | 1 July 1950 | ILLS |
| Calhoun | North of Hamburg | R. A. Evers | 1 July 1950 | ILLS |
| Calhoun | North of Hamburg | R. A. Evers | 1 July 1950 | ILLS |
| Calhoun | North of Hamburg | R. A. Evers | 1 July 1950 | ILLS |
| Calhoun | North of Hamburg | R. A. Evers | 27 May 1950 | ILLS |
| Calhoun | At Hamburg | R. A. Evers | 28 May 1968 | ILLS |
| Calhoun | At Hamburg | R. A. Evers | 11 June 1970 | ILLS |
| Calhoun | North of Hamburg | R. A. Evers | 12 Aug 1950 | SIU |
| Calhoun | Swarnes Hill Prairie | R. W. Nyboer | 14 June 1977 | EIU |
| Monroe | SE of Valmeyer | R. A. Evers | 30 Aug 1950 | ILLS |
| Monroe | S of Valmeyer | R. A. Evers | 2 Sept 1949 | ILLS |
| Monroe | ? | J. O. Neil | 2 Sept 1949 | ILLS |
| Monroe | SE of Fults | R. A. Evers | 30 Aug 1950 | ILLS |
| Monroe | SE of Valmeyer | R. A. Evers | 30 Aug 1950 | ILLS |
| Monroe | Below Valmeyer | J. O. Neil | 29 Aug 1950 | ILLS |
| Monroe | ? | J. O. Neil | 29 Aug 1950 | ILLS |

| County | Locality | Collector | Date | Herbarium |
|---|---|---|---|---|
| Monroe | 3 miles S of Valmeyer | R. A. Evers | 9 July 1950 | ILLS |
| Monroe | 3 miles S of Valmeyer | R. A. Evers | 9 July 1950 | ILLS |
| Monroe | 3 miles S of Valmeyer | R. A. Evers | 9 July 1950 | ILLS |
| Monroe | 3 miles S of Valmeyer | R. A. Evers | 9 July 1950 | ILLS |
| Monroe | 3 miles S of Valmeyer | R. A. Evers | 9 July 1950 | ILLS |
| Monroe | 3 miles S of Valmeyer | J. O. Neil | 8 July 1950 | ILLS |
| Monroe | SE of Fults | R. A. Evers | 16 June 1950 | ILLS |
| Monroe | SE of Fults | R. A. Evers | 16 June 1950 | ILLS |
| Monroe | SE of Fults | R. A. Evers | 16 June 1950 | ILLS |
| Monroe | 3 miles S of Valmeyer | R. A. Evers | 24 May 1950 | ILLS |
| Monroe | S of Fults | W. Bailey | 14 July 1952 | ILLS |
| Monroe | 3 miles S of Valmeyer | R. A. Evers | 21 Oct 1955 | ILLS |
| Monroe | 3 miles S of Valmeyer | R. A. Evers | 27 June 1956 | ILLS |
| Monroe | SE of Fults | R. A. Evers | 9 July 1958 | ILLS |
| Monroe | SE of Fults | R. A. Evers | 2 June 1966 | ILLS |
| Monroe | 1.5 miles SW of Renault | P. Shildneck | 18 Aug 1977 | ISM |
| Monroe | 0.75 mile E of Fults | P. Shildneck | 19 Aug 1977 | ISM |
| Monroe | Fults Hill Prairie N.P. | A. C. Koelling | 6 Sept 1979 | ISM |
| Monroe | S of Fults | W. Bailey | 14 July 1952 | ISM |
| Monroe | 3 miles S of Valmeyer | J. Ozment | 14 July 1962 | SIU |
| Monroe | Fults Prairie | W. Bailey | 25 July 1968 | SIU |
| Monroe | Fults Prairie | R. W. Nyboer | 5 Aug 1976 | EIU |
| Monroe | 1 mile S of Fults | J. W. Thieret | 22 May 1957 | F |
| Monroe | S of Fults | D. Ladd | 16 Aug 1979 | MOR |
| Monroe | Fults Hill Prairie N.P. | G. Sampson | 25 July 1968 | BUR |
| Monroe | 3 miles S of Valmeyer | G. Winterringer | 17 Sept 1951 | ILL |
| Monroe | N of Fults | R. A. Evers | 7 Sept 1949 | ILLS |
| Monroe | Fults Prairie | R. A. Evers | 7 Sept 1949 | ILLS |
| Pike | 1 mile S of New Canton | R. A. Evers | 8 Sept 1950 | ILLS |
| Pike | S of Kinderhook | R. A. Evers | 8 Sept 1950 | ILLS |
| Pike | S of Kinderhook | R. A. Evers | 7 Sept 1950 | ILLS |
| Pike | 1 mile S of New Canton | R. A. Evers | 7 Sept 1950 | ILLS |
| Pike | 3 miles S of Kinderhook | R. A. Evers | 8 Sept 1950 | ILLS |
| Pike | 3 miles S of Kinderhook | R. A. Evers | 2 July 1950 | ILLS |
| Pike | 3 miles S of Kinderhook | R. A. Evers | 2 July 1950 | ILLS |
| Pike | 3 miles S of Kinderhook | R. A. Evers | 2 July 1950 | ILLS |
| Pike | 1 mile S of New Canton | R. A. Evers | 2 July 1950 | ILLS |
| Pike | 1 mile S of New Canton | R. A. Evers | 1 July 1950 | ILLS |
| Pike | 1 mile S of New Canton | R. A. Evers | 1 July 1950 | ILLS |
| Pike | 1 mile S of New Canton | R. A. Evers | 1 July 1950 | ILLS |
| Pike | E of Seehorn | R. A. Evers | 1 July 1950 | ILLS |
| Pike | 3 miles S of Kinderhook | R. A. Evers | 28 May 1950 | ILLS |
| Pike | 1 mile S of New Canton | R. A. Evers | 28 May 1950 | ILLS |

| County | Locality | Collector | Date | Herbarium |
|---|---|---|---|---|
| Pike | 1 mile S of New Canton | R. A. Evers | 27 May 1950 | ILLS |
| Pike | 1 mile NW of Rockport | R. A. Evers | 27 May 1950 | ILLS |
| Pike | 1 mile NW of Rockport | R. A. Evers | 19 Sept 1953 | ILLS |
| Pike | S of New Canton | R. A. Evers | 19 Sept 1953 | ILLS |
| Pike | SE of Kinderhook | R. A. Evers | 12 Sept 1968 | ILLS |
| Pike | NW of Rockport | R. A. Evers | 15 May 1969 | ILLS |
| Pike | NW of Rockport | R. A. Evers | 7 Oct 1970 | ILLS |
| Pike | NW of Rockport | R. A. Evers | 20 July 1970 | ILLS |
| Pike | SE of Kinderhook | R. A. Evers | 10 June 1970 | ILLS |
| Pike | NW of Rockport | R. A. Evers | 10 June 1970 | ILLS |
| Pike | S of New Canton | R. A. Evers | 20 May 1971 | ILLS |
| Pike | 1.3 miles S of New Canton | R. A. Evers | 11 Oct 1972 | ILLS |
| Pike | S of New Canton | S. Tyson | 19 July 1984 | ISM |
| Pike | S of New Canton | G. Winterringer | 17 Sept 1951 | ISM |
| Pike | abandoned quarry | G. Winterringer | 17 Sept 1951 | SIU |
| Pike | 3 miles S of Valmeyer | K. Robertson | 3 June 1987 | MOR |
| Randolph | N of Prairie du Rocher | R. A. Evers | 19 Sept 1950 | ILLS |
| Randolph | N of Prairie du Rocher | R. A. Evers | 26 June 1956 | F |

Figure 1. The narrow *Mentzelia oligosperma* habitat, usually not more than one meter wide, just above the cliff face. This photograph shows loose, large flakes of bedrock combined with loess in this zone. The loess hill prairie begins with the goldenrods and grasses near the center of the photograph.

Figure 2. A plant of *Mentzelia oligosperma* (white stems) growing in loose gravel, talus, and loess on the slopes of Housen Hill Prairie in Pike County. This habitat is several meters in length and width, and is very steep.

Figure 3. Woody vegetation beginning to overtop the cliff face and the habitat of *Mentzelia oligosperma*.

Figure 4. Woody vegetation that has completely overtopped the cliff face and the habitat of *Mentzelia oligosperma*, creating dense afternoon shade and altering the microclimate. Woody vegetation like this deflects the hot, dry summer winds upward, making the rock ledge habitat less xeric.

Figure 5. Woody vegetation that is advancing downhill toward the cliff face, creating morning shade and altering the microclimate of the cliff face.

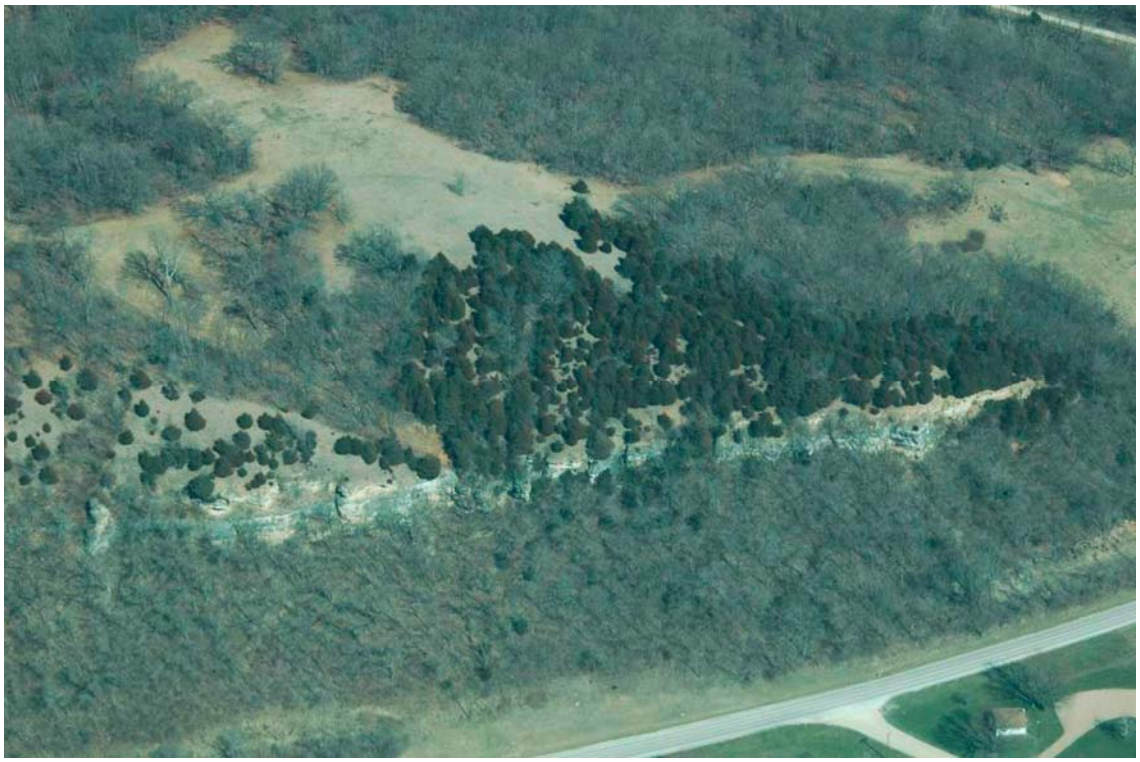

Figure 6. Aerial view of Shewhart Hill Prairie in Pike County showing the encroachment of eastern red cedar (*Juniperus virginiana*) on the hill prairie proper and other woody vegetation growing on the talus slope below the hill prairie. The narrow zone of bedrock outcrop habitat for *Mentzelia oligosperma* can be seen on the right and center of the photograph at the interface of the cliff and hill prairie. Photograph by Angella Moorehouse.