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Distribution and Habitats of Forked Aster (*Aster furcatus*), a Threatened Wisconsin Plant

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Abstract

We describe the locations and habitat characteristics of 10 of the 14 known populations of *Aster furcatus* in Wisconsin. We were unable to identify any particularly unusual features of *A. furcatus* habitats which could be related to its rarity. The rarity of forked aster is probably not related to specialized habitats, but is most likely the result of requirements for moderate disturbance, inability to withstand competition, poor reproduction from seed, and low genetic variance.

Introduction

Forked Aster (*Aster furcatus*, Asteraceae) is presently listed as threatened in Wisconsin (Wisconsin DNR, 1989), and is a Category 2 proposed addition to the Federal List of Threatened and Endangered Species. Not only does forked aster have a limited distribution, but it is rare in every state in which it has been recorded (Michigan, Wisconsin, northwestern Illinois, Indiana, eastern Iowa, and southeastern Missouri) (Figure 1, specimen data provided by W. Lamboy). In Missouri, *Aster furcatus* is found almost exclusively in cool, damp microhabitats of north-facing, dolomite limestone bluffs and talus slopes along rivers. While there are 37 sites listed for *Aster*

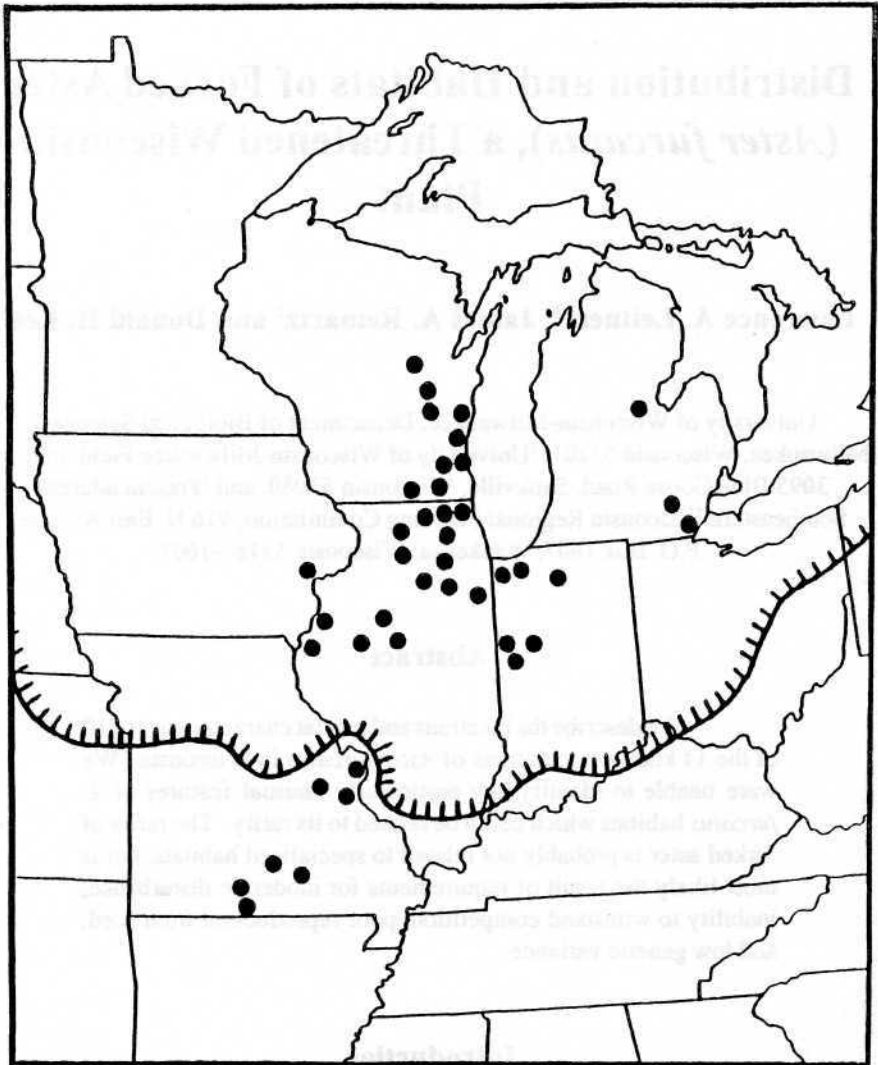


Figure 1. Historical distribution of *Aster furcatus* based on specimen data provided by W. Lamboy. Hatched line represents the maximum extent of Pleistocene glaciation.

furcatus in Missouri, 30 of these are along a 75 km stretch of the Jacks Fork River in one county (Missouri Dept. of Conservation, 1989). The Missouri locations are confined to 6 counties and 85% are within two adjacent counties; therefore, the large number of sites provides a somewhat exaggerated picture

of its abundance. In Wisconsin, Illinois and Indiana, forked aster grows in a wider variety of habitats, but is most often associated with river flood plains. These include rich floodplain woods, woodland edges, disturbed woodlots, railroad rights-of-way, and dry oak-hickory forests (Tans and Read, 1975).

Aster furcatus is a long-lived perennial herb that spreads clonally with shallow rhizomes, capable of producing large clones over time. Rhizomes up to 50 cm long are formed late in the growing season and produce a shoot (either vegetative or flowering) at their tip in the following season (Reinartz and Les, in prep.). Flowering and seed set are much more abundant in more sunny microhabitats. Reproduction by seed is a rare event because the seedlings grow very slowly, require low competition, exposed, relatively fertile soils, and will not tolerate dense shade (Reinartz and Les, in prep.). In many populations, lack of a sufficient number of self-incompatibility alleles causes extremely low seed set (Reinartz and Les, in prep.).

As a result of persistent, long-lived clones, *Aster furcatus* populations appear to be very stable on some sites for long periods of time. There are 6 known populations of *Aster furcatus* in Wisconsin. Three of these were first collected at their present locations in 1874, 1904, and 1908, two between 1910 and 1930. Three more populations have been known for at least 40 years. A number of populations once located in Milwaukee County have been destroyed by development. *Aster furcatus* has extremely low levels of genetic variance throughout its range. Les, et. al (1991) examined variation at 22 electrophoretic loci in 23 populations of *A. furcatus* across its range in Wisconsin, Illinois, Indiana, and Missouri. Except for two rare alleles found in single individuals in three populations, all but one of the loci examined were fixed for single alleles. We hypothesize that *Aster furcatus* may be a relatively recently evolved species that has been lacking in genetic variation since its inception.

In 1988, we were contacted by the Wisconsin Department of Transportation to study the population biology of *A. furcatus* in conjunction with transplanting a population in Sheboygan Co. which was to be destroyed by road construction. As part of that project, we examined the habitats of Wisconsin populations to gain insight into the habitat requirements of forked aster. In this paper we report on the habitat descriptions of 10 Wisconsin populations. The population genetic structure of *A. furcatus* is described in Les et al. (1991) and its demography and breeding system will be described elsewhere.

Methods

We chose 10 of the 14 known Wisconsin populations for study. The dominant species in the tree, shrub, and herb strata of the communities were recorded. We described soil type and moisture status and recorded soil temperatures at 30cm below the surface. We obtained 5 soil samples from each site and had them analyzed at the University of Wisconsin-Milwaukee Soils Lab for: percent sand, silt and clay; pH; percent organic matter; total soluble salts; available potassium, phosphorus, calcium, and magnesium; water soluble nitrate; and cation exchange capacity. We tested for significant differences among the soil factors of the populations using one-way Analysis of Variance. The data were then converted to a matrix presenting normalized euclidean distances and input into an average linkage cluster analysis to assess site correspondences. We also estimated the total size of the *A. furcatus* population in terms of the number of stems in each population.

Results

A general summary of site locations and characteristics of the 10 populations studied is presented in Table 1. Results of soils analyses are presented in Table 2. No soil samples were obtained from the Honey Creek population. One-way Analysis of Variance on each factor, showed highly significant differences among populations ($P < 0.01$) for all measured soil characteristics except cation exchange capacity ($P = 0.41$).

A cluster analysis of the nine sites using soil variables depicted populations as two groups (Figure 2), with Sheboygan Falls, Lauderdale Lakes, Kletzsch Park and Whitnall Park clustered together, and the other five populations forming another group. Soil variables contributing most to the cluster analysis were % organic matter, available calcium concentration, and magnesium concentration. Sheboygan Falls, Lauderdale Lakes, Kletzsch Park and Whitnall Park all tended to be relatively high in organic matter, calcium, and magnesium.

Table 1. Locations and general site characteristics of 10 Wisconsin populations of *Aster furcatus*. Soil information is mostly derived from Soil Conservation Service Manuals for the counties.

Sheboygan Falls

Location: Sheboygan Co., T14N R22E, S1. West bank of Onion River.

General Habitat Notes:

Soils - Bellevue Fine Sandy Loam, sandy subsoil on nearly level floodplain. Moderately well-drained, subject to flooding. High water capacity and high native fertility with a mildly alkaline A horizon.

Vegetation - The site has a canopy of *Acer saccharum*, *Tilia americana*, *Quercus rubra*, *Pinus strobus*, *Fagus grandifolia*, *Salix* sp. and *Crataegus* sp.

Aster Population - An *A. furcatus* population of about 2000 stems grew throughout the relatively level floodplain, both within the closed-canopy, mature forest and in an adjacent, woods-edge field. Flower production was much higher in the more open microhabitats. In October 1988 in preparation for highway construction which would have caused its extirpation, almost the entire population was removed for transplanting.

Greendale Cemetery

Location: Sheboygan Co., T15N R23E, S28 and S29. Narrow floodplain of a tributary to the Sheboygan River.

General Habitat Notes:

Soils - Poorly-drained alluvial land, wet, layered loamy, sandy, and gravelly material, the result of deposition by flood waters.

Vegetation - Disturbed semi-open woodlot dominated by small *Acer negundo* and *Fraxinus pennsylvanica*.

Aster Population - Large (at least 4,000 stems) and spreading through about 0.4 km of floodplain. *A. furcatus* grows from the edge of the stream to dry areas up the embankment from the river.

Cambridge Avenue

Location: Milwaukee Co., T7N R22E, S9. In woods east of the Milwaukee River.

General Habitat Notes:

Soils - Kewaunee-Manawa Association. Well-drained to somewhat poorly drained. Clay and silty-clay subsoil formed in this loess and silty - clay glacial till.

Vegetation - Relatively open, disturbed canopy of *Quercus alba*, *Quercus rubra* and *Tilia americana*

Aster Population - About 400 stems. The site is disturbed by trail bike and informal walking paths in addition to silting from a sewer project.

Perkins Property

Location: Waukesha Co., T6N R17E, S5. North of Bark River.

General Habitat Notes:

Soils - Fox Sandy Loam. Slightly coarser than loam, well-drained over calcareous sand and gravel outwash. Relatively low available water capacity, slow runoff, neutral A. horizon and moderate natural fertility.

Vegetation - Disturbed, semi-open, young, shrubby woods with a canopy of *Ulmus americana*, *Fraxinus pennsylvanica*, *Quercus alba*, *Quercus velutina*, *Prunus serotina* and *Rhamnus cathartica*.

Aster Population - At least 2,000 stems scattered through open woods and especially dense along a small farm lane which bisects the woods. Most flower production occurred in sunny areas along the roadway.

Lauderdale Lakes

Location: Walworth Co., T4N R16E, S35. Woods west of Lauderdale Lakes.

General Habitat Notes:

Soils - This population is scattered over a large, hilly, very diverse area of approximately 50 ha. *A. furcatus* is found from very wet, poorly-drained soils near the lake edge to very dry oak woods at the top of steep hills. The general soil types in the area are the Casco Series and Casco-Rodman Complex. Well-drained loamy soils over deep sand and gravel with a low moisture capacity and a neutral A horizon.

Vegetation - Mostly relatively open, dry, mature woods with a canopy of *Quercus alba*, *Quercus rubra* and *Carya ovata*.

Aster Population - This population is scattered over such a large area and is distributed so unevenly that size estimates are difficult. There are probably at least 2,000 stems. An especially large, dense patch occurs in an exposed area adjacent to a narrow residential road that divides the woods.

Kletzsch Park

Location: Milwaukee Co., T8N R22E, S19. West bank of Milwaukee River.

General Habitat Notes:

Soils - Fox-Casco Association. Well-drained with a subsoil of clay loam. This population consists of a single large patch in a damp area along the river bank which may be a seepage area.

Vegetation - The floodplain where the *A. furcatus* is growing is open. The bank immediately above it has a canopy of *Quercus alba*, *Quercus rubra* and *Acer saccharum*.

Aster Population - About 2,900 stems are located within one 20m² patch. Electrophoretic data suggested that this patch was a single clone of *A. furcatus* (Les et al., 1991). Since *A. furcatus* is mostly self-incompatible seed set in the population is < 1%.

Jacobus Park

Location: Milwaukee Co., T7N R21E, S27. Two sites, one at the top of the bluff over the Honey Creek floodplain, the other at the south bank of Honey Creek.

General Habitat Notes:

Soils - Ozaukee-Morley-Mequon Association. Well-drained to somewhat poorly-drained with a subsoil of silty-clay loam and silty-clay. The site at the creek bank has a more sandy soil.

Vegetation - Open, dry-mesic woods with a canopy of *Quercus rubra*.

Aster Population - At the top of the bluff there are about 500 stems which were partially buried by construction fill, through which the asters are growing. The creek bank site has just a few individuals.

Honey Creek

Location: Milwaukee Co., T7N R21E, S28. In Milwaukee Psychiatric Institute Woods and south of Honey Creek Parkway.

General Habitat Notes:

Soils - No soil information was obtained.

Vegetation - Open oak woods of *Quercus alba*, *Q. rubra*, and *Q. macrocarpa*, with a dense *Lonicera* understory. The individuals south of Honey Creek Parkway and along the mowing line for the roadway are in full sun.

Aster Population - Small population with only a few scattered *A. furcatus* stems.

Roehl Co. Park

Location: Rock Co., T2N R14E, S27. Along Spring Brook in Roehl Co. Park.

General Habitat Notes:

Soils - Edmund-Rockton-Whalan Association. Well-drained, mainly clay and clay loam subsoil over dolomite bedrock.

Vegetation - Semi-open woodland with a canopy of *Juglans nigra*, *Quercus alba*, *Q. rubra* and *Acer negundo*.

Aster Population - Consists of two patches separated by 0.2 to 0.3 km. Each patch has fewer than 100 stems.

Whitnall Park

Location: Milwaukee Co., T6N R21E, S32. North bank of tributary of Root River in Whitnall Park.

General Habitat Notes:

Soils - Sebewa Silt Loam. Poorly-drained silt loam with a loamy subsoil. Underlain by calcareous sand and gravel outwash. Subject to flooding in spring with a moderate water capacity, an alkaline A horizon, and moderate natural fertility.

Vegetation - Relatively open second-growth canopy of *Fraxinus nigra*, *Acer negundo*, *Tilia americana*, *Quercus bicolor*, *Q. macrocarpa*, and *Rhamnus cathartica*.

Aster Population - A single patch of about 300 stems about 1m above the water level.

Table 2. Results of soils analyses of five samples collected from each Means (1SD). Analyses of Variance were highly significant ($P < 0.01$) followed by the same lower case letter do not differ significantly.

Char.	SF	GC	CA	PP	LL
% Sand	44 (9)b	50 (21)bc	45 (6)b	71 (2)d	26 (5)a
% Silt	45 (9)c	41 (16)bc	44 (8)c	24 (2)a	45 (14)c
% Clay	11 (1)ab	9 (5)a	10 (5)ab	5 (1)a	28 (9)d
pH	7.3 (0.2)de	7.2 (0.2)bcd	7.4 (0.1)e	7.1 (0.2)abc	7.0 (0.2)a
% Org.*	9.3 (4.9)bc	5.1 (0.8)a	4.8 (1.1)a	5.2 (.8)a	7.7 (3)ab
Sol. Salt*	17 (4)a	20 (2)ab	23 (3)ab	19 (3)a	51 (33)c
P* (ppm)	12 (4)abc	9 (5)a	13 (1)abc	28 (5)d	10 (4)ab
K* (ppm)	118 (40)b	121 (44)b	176 (32)c	109 (22)ab	62 (31)a
Ca*(ppm)	1940 (890)b	1285 (246)a	1330 (145)a	1200 (197)a	1565 (268)ab
Mg* (ppm)	485 (79)cd	445 (10)bc	400 (16)ab	418 (28)ab	529 (48)de
N* (ppm)	66 (17)bc	66 (7)bc	99 (8)e	73 (12)cde	42 (41)ab
CEC*	29.8 (14.2)	22.4(3.7)	24.4 (1.5)	28.2 (3.2)	49.2 (38.4)

¹, based on a single sample.

Site abbreviations: SF, Sheboygan Falls; GC, Greendale Cemetery; KP, Kletzsch Park; JP, Jacobus Park; RP, Roehl Co. Park; WP, Whitnall Park.

*Soil Character Abbreviations: % Org., % Organic matter; Available Potassium; Ca, Available Calcium; Mg, Available Magnesium;

of 9 Wisconsin populations of *Aster furcatus*. Figures presented are for every factor except cation exchange capacity. Population means

KP	JP	RP	WP	Mean
69 (5)d	61 (15)cd	24 (4)a	26 (3)a	46 (20)
23 (3)a	28 (11)ab	55 (6)c	51 (17)c	40 (15)
9 (5)a	11 (4)ab	21 (8)c	16 (3)bc	13 (8)
7.3 (0.1)cde	7.1 (0.1)abc	7.1 (0.2)ab	7.2 (0.1)bcd	7.2 (0.2)
7.2 (1.1)ab	4.4 (1.5)a	4.6 (1.3)a	12.7 (5.2)c	6.8 (3.6)
34 (5)b	27 (5)ab	19 (7)ab	23 (8)ab	26 (15)
15 (1)c	14 (3)bc	13 (2)abc	14 (2)bc	14 (6)
133 (60)bc	247 (53)d	89 (10)ab	258 (24)d	146 (73)
2050 (592)b	1265 (325)a	1305 (99)a	1705 (165)ab	1516 (474)
469 (16)c	383 (37)a	449 (38)bc	538 (27)e	457 (62)
72 (12)cde	68 (23)bcd	31 (4)a	95 (34)de	68 (28)
37.1 ¹	8.1 ¹	28.8 (2.7)	---	30.0 (17.8)

CA, Cambridge Avenue; PP, Perkins Property; LL, Lauderdale Lakes;

Sol. Salt, Soluble Salts (mols x 10⁻⁵); P, Available Phosphorus; K, N, Water Soluble Nitrate; CEC, Cation exchange capacity (meg/100g).

Dendrogram of Average Linkage Distance Between Groups

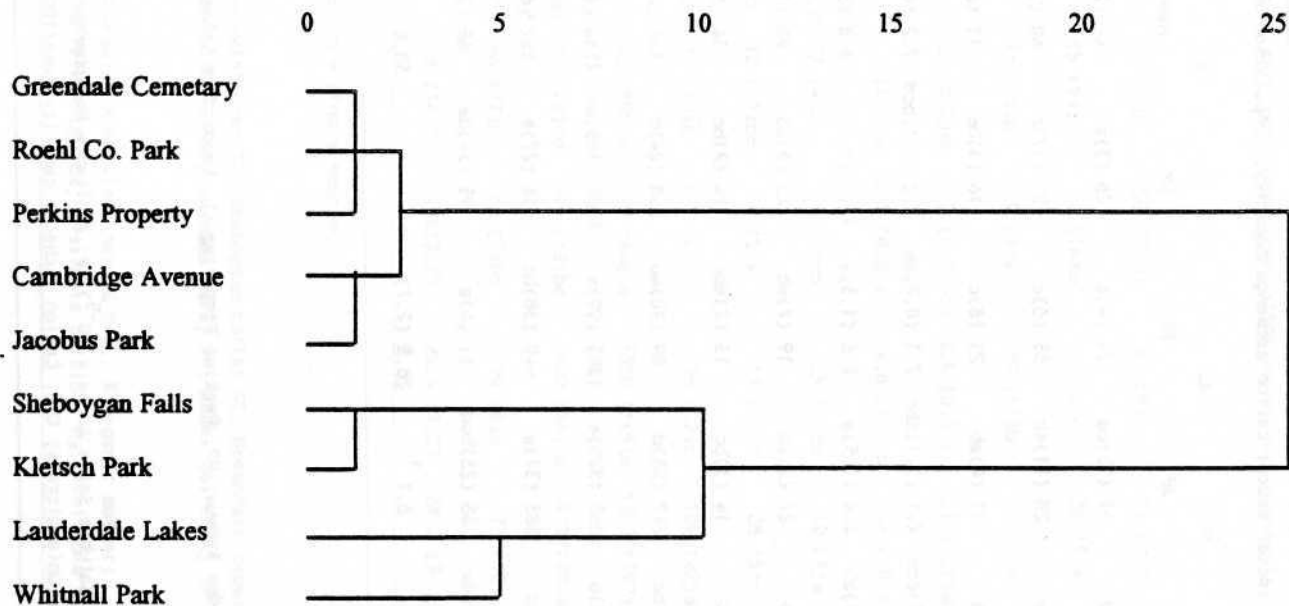


Figure 2. Hierarchical Cluster Analysis of 9 Wisconsin populations of *Aster furcatus* based on 11 measured soil characteristics.

Discussion

Aster furcatus populations in Wisconsin are frequently found along river or stream floodplain terraces, however, they are also located in a much wider variety of habitats. Tans and Read (1975) state that, "This diversity in the quality of habitats from which the few collections of *A. furcatus* have been taken ... is somewhat disconcerting to the botanist who would like to think (or hope) that all rare plants should be found in the most pristine habitats." Growth of *A. furcatus* seems to respond positively to light and moderate levels of disturbance, but negatively to competition. Although often found in woodlands, beneath a mesic or dry-mesic forest canopy, the highest density of *A. furcatus* stems is usually in semi-open areas - frequently a forest edge (eg. along a stream, field or road). Since habitats having relatively high light levels but low levels of competition from other herbaceous species are infrequent, these requirements undoubtedly contribute to the rarity of forked aster.

The canopy dominants in *A. furcatus* habitats include *Quercus alba*, *Q. rubra*, *Q. macrocarpa*, *Tilia americana*, *Acer saccharum*, *A. negundo*, and *Fraxinus* spp. The typical soil texture varies from silt loams to sandy loams. No *A. furcatus* populations were found in heavy clay soils. The parent material underlying the soils is usually limestone or calcareous glacial till, so soil pH's are generally slightly alkaline. Apparently, forked aster never grows in acidic soil. With the exception of cation exchange capacity, there were no measured soil characteristics which were so constant in the 9 populations studied that they did not show significant differences among populations. Cation exchange capacity measurements were, however, based on a much smaller sample than the other variables and an unequal number of samples per population, so the lack of significant differences may have been an artifact of the sampling.

We analyzed soil from three locations which did not have *A. furcatus* populations in order to evaluate them as potential transplant sites. The sites chosen appeared similar to known *A. furcatus* population sites in their topography and general vegetation characteristics. Cluster analysis of these three sites with the 9 forked aster sites (based on soil characteristics) grouped all three sites with the "Sheboygan Falls, Lauderdale Lakes, Kletzsch Park, Whitnall Park" group. All three of these sites differed from the 9 *Aster* populations in having slightly acidic (mean pH 6.8) soils, higher mean available potassium, and lower mean water soluble nitrogen than the forked aster population sites.

This study did not identify any particular soil factor as a specific requirement of forked aster population sites which could offer at least a partial explanation for its rarity. Similarly, its plant community associates were not either particularly unusual or constant. The most specialized habitat characteristic of forked aster may be a requirement for moderate levels of disturbance to periodically increase light intensity, which enhances its vegetative and reproductive vigor. The frequent occurrence of *A. furcatus* near streams and rivers may result from the historically advantageous disturbance regime associated with flooding events. The rarity of *A. furcatus* is most closely tied to its poor reproduction from seed and its low genetic variance (Les et al. 1991).

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Literature Cited

- Les, D.H., J.A. Reinartz, and E.J. Esselman. 1991. Genetic consequences of rarity in *Aster furcatus* (Asteraceae), a threatened, self-incompatible plant. *Evolution* 45: 1641-1650.
- Missouri Department of Conservation. 1989. *Aster furcatus* Element Occurrence Records.
- Reinartz, J.A. and D.H. Les. Bottleneck-associated dissolution of self-incompatibility and breeding system consequences in *Aster furcatus* (Asteraceae). In preparation.
- Tans, W.E. and R.H. Read. 1975. Recent Wisconsin records for some interesting vascular plants in the Western Great Lakes Region. *Michigan Botanist* 14(3):131-143.
- Wisconsin Department of Natural Resources. 1989. Endangered and threatened species list. Wisconsin Bureau of Endangered Resources.