REDISCOVERY OF WOLFFIELLA GLADIATA (LEMNACEAE) IN INDIANA

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Wolffiella gladiata (Hegelm.) Hegelm. (synonyms: Wolffiella gladiata var. floridana Donn. Sm., Wolffiella floridana (Donn. Sm.) C. H. Thomps.), commonly referred to as the sword bogmat or mud-midget, is a warm-temperate species in the Lemnaceae. It has more of a southern to southeastern distribution in the United States where it is found in areas having humid growing seasons and mild winters (Gleason & Cronquist 1991; Landolt 1986; Landolt 2000). Throughout its range, the sword bogmat is found partially submersed and free-floating in sheltered stagnant waters of ponds, lakes, marshes, and sloughs. In the Great Lakes region, W. gladiata is quite rare (Landolt 1986) and it is the only one of three Wolffiella species found in the United States (Landolt 2000). In Indiana, it is known from only two historical populations (Deam 1940; Hicks 1937). Because of the age of the records for this species and the lack of confirmation on the continued persistence of these populations of W. gladiata, it is currently considered as being extirpated from the state (Indiana Natural Heritage Data Center 2000).

As one of the world’s smallest flowering aquatic angiosperms (Fassett 1940; Hicks 1937; Sculthorpe 1967), plants of W. gladiata have no true roots, leaves, or stems, and like all other species in the Lemnaceae, the plant body is reduced to a simple thallus (frond). The thin, tongue-shaped thallus is approximately 3–9 mm in length and 0.3–0.8 mm wide and is often attached to other thalli, forming a small colony of plants, which in turn may become interwoven with additional colonies or with other free-floating species resulting in a mat (Landolt 1986; Landolt 2000). Although W. gladiata occasionally flowers, it rarely produces fruits (Landolt 1986; Landolt 2000). Reproduction most often occurs by means of vegetative budding (Gleason & Cronquist 1991; Hicks 1937).

During the first stage of our effort to document the aquatic flora of Indiana and map its many state-listed species, floristic surveys of over 110 lakes and ponds have been conducted in the northern and central part of the state from 1995 to 2000. In many cases, visits were made to sites having documented historical occurrences of imperiled species to determine if these populations still persist. During the course of this fieldwork, we have discovered five new locations for W. gladiata and rediscovered this species at one of the two sites of its historical occurrence (Fig. 1). Below is a chronological account of the events leading to the rediscovery and documentation of additional populations of W. gladiata in Indiana.

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FIGURE 1. Distribution of *Wolffiella gladiata* in Indiana. Numbers represent the location and chronological order in which populations were discovered. The star represents an extant population at a site of historical occurrence.
On 20 June 1998, the first new location for *W. gladiata* in Indiana was recorded. While we were wading the shallows of Hog Lake, LaPorte County, we discovered a relatively large mat of *W. gladiata* 5 m east of the boat ramp at the lake’s public access site. At this location, the sword bogmat was growing in a small isolated pool near the shoreline behind an extensive stand of *Nuphar advena* (Aiton) W. T. Aiton (spatterdock). The plants appeared to be exceptionally vigorous, covering 90% (9 m²) of the pool’s surface. Further investigation of the nearshore habitat revealed small colonies of the sword bogmat within pockets of the dense *Nuphar* stand, which extended along most of the northern shore. The stand of *Nuphar* likely provided a barrier against wave action, preventing the small plants from being washed ashore. Other associated plant species included *Ceratophyllum demersum* L., *Ceratophyllum echinatum* A. Gray, *Lemna minor* L., *Lemna trisulca* L., *Riccia fluitans* L., (an aquatic liverwort) and *Wolffiella columbiana* H. Karst.

Two months later an additional population of the sword bogmat was located in LaPorte County approximately 13 km southeast of Hog Lake. The plants were found in the southern bend of Horseshoe Lake, a highly eutrophic body of water on the northeast side of the city of LaPorte. *Wolffiella gladiata* formed colonies occurring as large clumps in and among the patches of spatterdock and *Nymphaea odorata* Aiton subsp. *tuberosa* (Paine) Wiersema & Hellq. (white water-lily). Throughout the shallow waters of the southern end of the lake, the sword bogmat was relatively common and found in association with *Ceratophyllum demersum*, *Ceratophyllum echinatum*, *Potamogeton strictifolius* A. Benn., and *Spirodela polyrrhiza* (L.) Schleid. A search of the unsheltered, developed portions of the lake yielded no additional plants of *W. gladiata*.

On 4 September 1998, a visit was made to Kates Pond in Warren County, a historical occurrence site for *W. gladiata*, where it was collected in 1937 by R. C. Friesner (his number 11112, deposited in BUT). Consistent with previous observations on habitats where the sword bogmat occurs, Kates Pond is located in an area where trees provide shade and shelter for much of the western portion of the pond. *Wolffiella gladiata* was flourishing at Kates Pond where it was growing in large clumps and forming large floating mats in association with *Azolla caroliniana* Willd. These two species were the most dominant free-floating species in the pond. Other associated species included *Ceratophyllum demersum*, *Ceratophyllum echinatum*, and *Lemna minor* L.

One year later, our investigations led us to Lake Maxinkuckee in Marshall County, which is the location of the first documented report of *W. gladiata* in Indiana (Coulter 1901). Coulter (1901) reported on the specimens collected by H. W. Clark (his number 618453 in US), which were growing near the Norris Inlet. Although we visited and extensively searched potential habitats on three different occasions throughout the growing season, no plants of *W. gladiata* were located. Most of the area around the lake has been extensively developed over the past hundred years, leaving only a small number of undisturbed strips of shoreline and a few sheltered bays.

On 8 July 1999, a third population of *W. gladiata* was discovered in LaPorte County at Prairie Pond located in Rolling Prairie approximately 2.5 km southeast of Hog Lake and 4.0 km northeast of Horseshoe Lake. A few submerged
colonies of the sword bogmat were located along the north shore, and a large floating mat was seen directly out from the dock along the nature trail. Although the pond is small, shallow, and perhaps ephemeral, having a total surface area of approximately 900 m² and a maximum depth of 2.5 m, it is nestled in a wooded area that provides shade and shelter for many free-floating aquatic plant species. The population of sword bogmat at this site was the smallest of those previously mentioned, contributing only a small percent to the total surface area of the floating mat, which was comprised of *Lemna minor*, *Lemna trisulca*, *Riccia fluitans*, *Spirodela polyrrhiza*, and *Wolffia columbiana*. Other associated species included *Ceratophyllum demersum*, *Ceratophyllum echinatum*, *Najas flexilis L.*, *Nuphar advena*, *Nymphaea odorata* subsp. *tuberosa*, and *Potamogeton epihydrus* Raf.

The last two additional populations of sword bogmat were discovered during the field season of 2000. In May, *W. gladiata* was found in Redwing Lake, Lake County. Small colonies of these plants were growing in shallow water directly off both banks of the northern tip of the lake, which is bisected by 173RD Ave. These colonies were tucked away in small pockets along the shoreline. A search of the open waters yielded no additional plants. Plants growing in association with *W. gladiata* at Redwing Lake included *Ceratophyllum demersum*, *Ceratophyllum echinatum*, *Lemna minor*, and *Wolffia columbiana*. The second population was discovered at Silver Lake, LaPorte County. Silver Lake is located on the property of the Le Mans Academy in Rolling Prairie. This site currently represents the furthest east collection of *W. gladiata* in Indiana. Small mats were found along the east shore of the lake; however, plants occurred in colonies around much of the shoreline.

It is noteworthy to point out that at all locations we have visited and found *W. gladiata*, the plants appeared pale green and grew luxuriantly in relatively shaded and protected areas, but as bleached patches in open water. In addition, the most common free-floating, submerged associate of *W. gladiata* we have seen is *Ceratophyllum echinatum*. *Ceratophyllum echinatum* is an aquatic plant species new to the state of Indiana (Scribailo & Alix 2002), and like *W. gladiata*, it has a strong habitat preference for shaded and protected shorelines. This shade can take the form of overhanging trees or floating leaves of *Nuphar advena*. Unfortunately, *Nuphar advena* is one of the most commonly sprayed nuisance aquatic plant species in Indiana due to its prevalence and abundance in shallow eutrophic waters. Conservation initiatives should dictate that we develop a more intensive effort to identify as yet unknown populations of *W. gladiata* and other rare aquatic plant species from these types of locations prior to the approval of herbicide application permits. We have no doubts that additional effort will result in the discovery of other populations of this species. Our surveys of over 110 lakes and ponds in Indiana over the last five years have yielded well over 100 new records for state-listed aquatic plant species and the discovery of several species new to the state.

**LaPorte Co.**: Hog Lake, 41°42′20″N, 86°37′46″W, ca. 4 km north of Rolling Prairie, 20 Jun 1998, *M. S. Alix s.n.* (BUT); Horseshoe Lake, 41°38′38″N, 86°43′52″W, ca. 3 km north of LaPorte, 21 Aug 1998, *M. S. Alix s.n.* (BUT); Prairie Pond, Rolling Prairie, 41°40′57″N, 86°36′34″W, pond is located directly
behind Rolling Prairie Elementary School, 8 Jul 1999, *M. S. Alix s.n. (BUT)*; Silver Lake, 41°41′32″N, 86°35′38″W, ca. 3 km northeast of Rolling Prairie, 7 Aug 2000, *M. S. Alix s.n. (BUT)*.

**Lake Co.**: Redwing Lake, 41°18′9″N, 87°23′22″W, ca. 3 km northeast of Lowell, 20 May 2000, *M. S. Alix s.n. (BUT)*.

**Warren Co.**: Kates Pond, 40°20′59″N, 87°11′54″W, ca. 2 km northwest of Independence, dense, 4 Sep 1998, *M. S. Alix s.n. (personal collection)*.

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**LITERATURE CITED**


