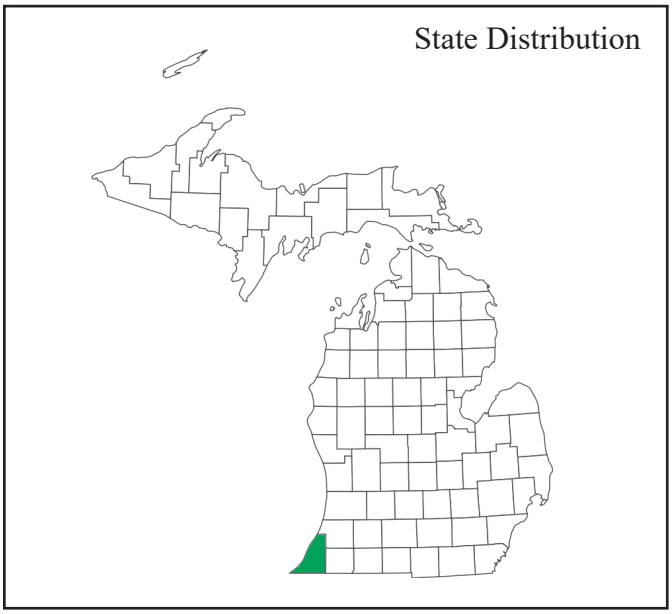
Wolffiella gladiata (Hegelm.) Hegelm. Florida mudmidget

Photograph by Paul B. Marcum, Illinois Natural History Survey



Best Survey Period

Legal status: State Threatened

Global and state rank: G4G5 (Apparently Secure to Secure) / SNR (Not ranked)

Other common name(s): sword-like bog-mat, mud-midget, bog mat, sword bogmat

Family: Araceae (Arum family)

Subfamily: Lemnoideae (Duckweed subfamily)

Synonyms: *Wolffiella floridana* (Donn. Sm.) C.H. Thomps., *Wolffia floridana* (Donn. Sm.) Donn. Sm. ex Hegelm., *Wolffia gladiata* Hegelm., *Wolffiella gladiata* var. *floridana* Donn. Sm.

Taxonomy: Florida mudmidget belongs to a larger group of plants commonly known as duckweeds that also includes the genera *Landolita*, *Lemna*, *Spirodela*, and *Wolffia*. When the duckweeds were first described, they were placed in their own family – Lemnaceae, a reasonable taxonomic decision in view of how unlike duckweeds are from any other angiosperm. Further genomic and phylogenetic analysis in the late 1990s and early 2000s, however, have placed the duckweeds within the larger family Araceae and the subfamily Lemnoideae. Recently, many taxonomists contended that Lemnaceae should be split from Araceae and once again be made its own family, although this taxonomic change would require the cleaving of other obviously araceous plants, including skunk cabbage (*Symplocarpus foetidus*) from Araceae (Stevens 2017, Tippery 2021).

Within the duckweeds, *Spirodela* and *Landolita* form the oldest clade while *Lemna*, *Wolffia*, and *Wolffiella* are more recently derived. Amongst the five genera there are an estimated 38 species, and half of these species occur only in North America. Of the North American species, Florida mudmidget is one of three species of *Wolffiella*. The name of the genus is a diminutive of another genus, *Wolffia*, which was named after German botanist and physician Johann Friederich Wolff. The specific epithet *gladiata* is derived from the Latin word for sword, gladius, and references the sword shape of the plant body.

Total Range: The core range of Florida mudmidget is centered in the mid to southeastern United States.

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In total, the species ranges from Texas east to Florida, north to Massachusetts, Ohio, Michigan, and west to the panhandle of Oklahoma There are also disjunct populations found in Washington. It is listed as Vulnerable (S3) in Illinois, Kentucky, Virginia, and North Carolina; Imperiled (S2)n Indiana and Ohio; and Critically Imperiled (S1) in Missouri, New Jersey, Oklahoma, and Texas. At the time of this abstract publication, it is unranked in Michigan.

State Distribution: This species was not known to exist in Michigan until 2017 when it was discovered in Berrien County. Its discovery was a result of survey efforts initiated after new observations were made in nearby Indiana. Given the species' diminutive and cryptic nature, it could be easily overlooked, and it is likely more populations are present in Michigan than originally thought.

Recognition: The whole body of the plant consists of a single, sword or scythe–shaped frond that lacks leaves, stems, and roots and rarely flowers. As such, traits commonly used for plant identification are highly unlikely to be observed or are entirely absent. The frond is linear or needle-like and ranges from 3–9 mm (0.1–0.4 in) long and less than 1 mm (0.04 in) wide. Fertile fronds are documented as being shorter and narrower than vegetative fronds, but this difference can be difficult to determine in the field (Godfrey and Wooten 1979). It can be found as a single frond, but often fronds are found in cohered in clumps that appear to originate from a single base. These clumps become hemispherical as they increase in size, which can resemble a mop head or jellyfish dangling below the water's surface. The clumps then cling together to form floating mats – hence its secondary common name of "bog mat."

Florida mudmidget can be distinguished from other duckweeds by its **simple, linear frond and lack of roots**. It is much **larger and longer** than species of *Wolffia*, which are the only other duckweeds that lacks roots (Reznicek et. al. 2011). Star duckweed (*Lemna trisulca*) is the most likely to be confused for Florida mudmidget as it also forms underwater, interconnected clumps, but the frond differs in shape. Florida mudmidget could also be confused for aquatic liverworts such as floating crystalwort (*Riccia fluitans*) or fringed heartwort (*Ricciocarpos natans*), which will often grow with duckweeds. Like duckweeds, the bodies of floating crystalwort and fringed heartwort consist of a simple thallus, but their thalli are larger, flat , and dichotomously fork.

Best survey time/phenology: Florida mudmidget can be observed any time during the growing season, typically between April and November, after temperatures warm enough for overwintering fronts to begin reproducing and before frost damages fronds in the late fall or early winter.

Habitat: Florida mudmidget occurs in shaded, sheltered, shallow bodies of water, or along shorelines, often with other duckweeds. The Michigan population was discovered in a mucky-bottomed seepage lake in association with swamp beggarticks (*Bidens discoidea*), buttonbush (*Cephalanthus occidentalis*), spiny hornwort (*Ceratophyllum echinatum*), whorled loosestrife (*Decodon verticillatus*), mild water-pepper (*Persicaria hydropiperoides*), pointed water meal *Wolffia brasiliensis*, and common water meal (*Wolffia columbiana*) (Namestnik and Slaughter 1559236, MICH 2018).

It also occurs in nearby northwest Indiana where populations occurred in shallow pools near the shores of lakes as well as shaded ponds. Populations located along lake shorelines often grew amongst dense patches of yellow pond-lily (*Nuphar advena*) and were also associated with spiny hornwort, coontail *(Ceratophyllum demersum*), star duckweed, common duckweed (*Lemna minor*), floating crystalwort, common water meal, pondweed (*Potamogeton strictifolius*), and sweet-scented waterlily (*Nymphaea odorata*). The populations found in ponds were associated with coontail, spiny hornwort, common duckweed, water fern (*Azolla caroliniana*), and greater duckweed (*Spirodela polyrrhiza*). (Alix and Scribailo 2001)

In the broader Chicago region, it is also noted as associating with waterthread pondweed (*Potamogeton bicupulatus*), ribbon-leaved pondweed (*Potamogeton epihydrus*), water-shield (*Brasenia schreberi*), water smartweed (*Persicaria amphibia*), humped bladderwort (*Utricularia gibba*), floating crystalwort, and fringed heartwort (Wilhelm et. al. 2017).

Biology: Compared to other vascular plants, duckweeds have undergone extreme morphological reduction (Pozzi et. al. 2015) (Smith et. al. 2024). All five genera have evolved to reduce not only their size, but their anatomical complexity to better adapt to their aquatic habitat. This is likely a form of neoteny as the lack of tissue differentiation is similar to embryonic cellular organization (Ziegler et. al. 2023). The *Wolffias* and *Wolffiellas* – completely lack roots, stems, leaves, and vasculature. Their forms have been reduced to a thallus, or an undifferentiated mass of tissue. Their overall body structure more closely resembles primitive liverworts than their fellow angiosperms.

Florida mudmidget is a perennial forb that most often reproduces asexually through budding. Daughter plants form within a small pouch located near the base of the frond and frequently remain attached to the parent. As the parent continues to produce daughters, and the daughters in turn produce offspring, the entangled clump of fronds either interlock and form dense colonies or act like aquatic tumbleweeds carried away by water currents (Thompson 1896). Due to the overall lack of anatomical complexity of duckweeds, asexual reproduction occurs at the highest rate of any known vascular plants, at least in laboratory conditions (Ziegler et. al. 2023).

Plants can produce flowers, but it is exceedingly rare, and the flowers are easily missed by observers in the field. It is unknown what factors lead to flowering, though it is thought plants only flower under stressful conditions such as crowding, high temperatures, and intense sunlight (Ziegler et. al. 2023). Flowers consist of a single stamen and a single

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pistil that sit at the bottom of a cup-like depression on the surface of the frond. Fertile fronds have been observed to contain more air within thallus tissues, allowing for increased exposure to the surface of the water where flowers barely exert into the open air (Hurz and Crowson 1949, Godfrey and Wooten, 1976. Flowers produce a single bladder-like achene called an utricle. Very little is known about pollination and seed dispersal mechanisms, although wind and water currents likely facilitate both. When colder conditions prevail in late fall and early winter, Florida mudmidget forms resting fronds that are capable of overwintering in water. Resting fronds are smaller, denser in starch, and more robust than normal fronds (Ziegler et. al. 2023).

Conservation/management: Little is known about the Michigan distribution of Florida mudmidget. More surveys are needed to understand the species' full extent and its habitat within Michigan and to develop a more comprehensive conservation plan. Michigan is likely the northernmost extent of its range, and thus Michigan populations likely possess unique genetics that are important to preserve, especially in the face of climate change (Rehm et. al. 2015). Peripheral populations usually endure less favorable conditions than the core population, and these stressors increase genetic diversity that can positively impact the resilience of the species

as a whole (Lesica and Allendorf 1995). All duckweeds, including Florida mudmidget, are hardy plants capable of withstanding a wide range of environmental conditions, although they are still susceptible to extremes. They can themselves become a nuisance, however, when nutrient-abundant runoff causes excessive growth that leads to eutrophication (Ziegler et. al. 2023).

Comments: Duckweeds are being seriously considered as a large-scale source of food for livestock or human consumption because of their relative high levels of protein and nutrients, minimal growth requirements, and ability to rapidly reproduce (Takács et. al. 2025). Numerous civilizations across the globe, including Chinese, Christian, Greek, Hebrew, Hindu, Japanese, Maya, Muslim, and Roman cultures, have historically utilized duckweeds as food, medicine, and components in rituals, likely for the same reasons they are being studied today (Edelman et. al. 2022). They are also being considered for phytoremediation of polluted water bodies due to high tolerances to heavy metals, such as Cadmium, and ability to grow in and process wastewater (Ziegler et. al. 2023, Smith et. al. 2024).

Research needs: There is little biological research on Florida mudmidget, and most of the information presented here is generalized for duckweeds. Research into floral triggers, dispersal methods, and faunal relationships are desirable for this species. Further research into the effects of climate change may have on Florida mudmidget, particularly its range expansion, is needed. Research is also needed to better understand the northern range of its distribution including Michigan populations. Surveys should also be conducted to document potential new populations in Michigan and determine its true extent.

Related abstracts: Emergent marsh, Submergent marsh

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