

Aquatic Macrophyte Survey of Mirror Lake and Shadow Lake in Waupaca Wisconsin

Summer 2011



Prepared By
Center for Watershed Science and Education
University of Wisconsin-Stevens Point



Center for Watershed Science and Education
College of Natural Resources
University of Wisconsin - Stevens Point

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ACKNOWLEDGEMENTS

We would like to acknowledge

- ❖ The Friends of Waupaca Mirror and Shadow Lakes and the City of Waupaca for their dedication to protect and improve Mirror and Shadow Lakes now, and for future generations.
- ❖ The Wisconsin Department of Natural Resources for staff support and funding.
- ❖ Special thanks to Carol Elvery for her tireless dedication to the betterment of Mirror and Shadow Lakes.

INTRODUCTION

Two surveys of aquatic plants were conducted for Mirror and Shadow Lakes in June and August 2011. In June, a survey was conducted to identify the extent of the non-native and potentially invasive aquatic plant curly-leaf pondweed (*Potamogetan crispus*), and in August a second survey evaluated the health of the entire aquatic plant community.

Mirror and Shadow Lakes are located within the City of Waupaca in Waupaca County, Wisconsin. The surface watershed for Mirror Lake covers 34 acres of land that drains water into the lake. Shadow Lake receives much of the water that drains from Mirror Lake, thus making the two water bodies closely interconnected. This interconnectedness is important when trying to understand the biological relationships within a lake. Aquatic plants, algae, fish, and wildlife can travel from one lake to another when lakes are connected as they are in the case of Mirror and Shadow Lakes. This can be of special concern when considering the transport of aquatic invasive species.

Aquatic plants play a significant role in a lake's ecosystem (Figure 1). They provide habitat for the fishery and other aquatic organisms, stabilize the sediment, reduce erosion, provide cool temperatures during hot summer days, buffer the effects of waves, infuse oxygen into the water, and utilize nutrients that may otherwise be used by algae. The species of aquatic plants that comprise an aquatic plant community can provide insight into the health of the aquatic ecosystem. Some species are present only in specific conditions and may not be tolerant of disturbance, whereas other species are very tolerant of disturbance or are less particular about the type of conditions they grow in. Abundant growth of invasive aquatic plant species (such as Eurasian water milfoil and curly-leaf pondweed) can significantly alter the aquatic plant and fish communities in a lake. In Wisconsin, the spread of these invasive species is occurring at an alarming rate as they are transported from lake to lake by boats, trailers, fishing equipment, and bait.

The results of these surveys were used in the development of a lake management plan for Mirror and Shadow Lakes.

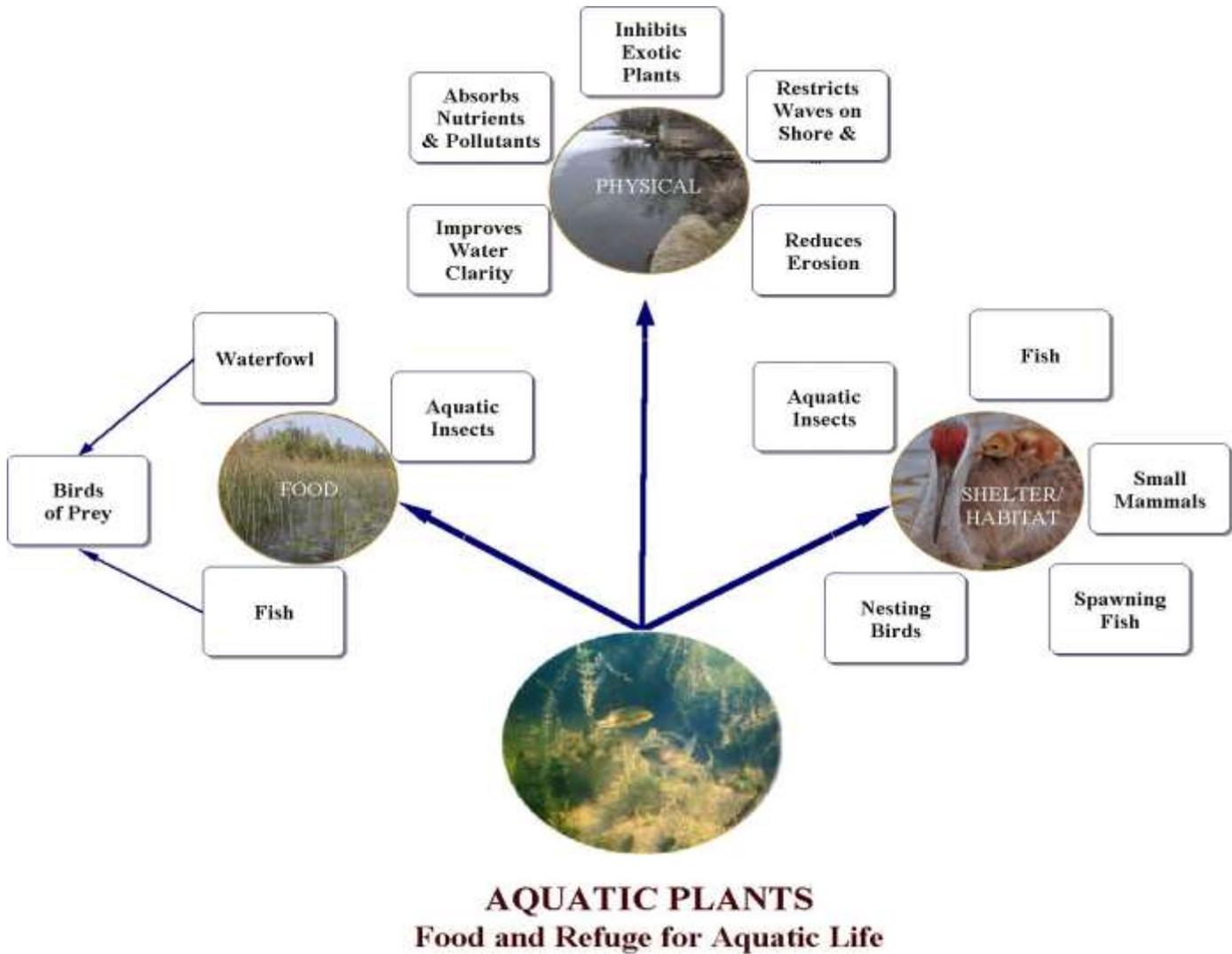


Figure 1. A healthy aquatic plant community is an important asset of any aquatic ecosystem. The functions and benefits of plants to lakes are wide ranging—from food, shelter, and habitat for wildlife to the improvement of water quality, plants are part of a healthy natural system.

METHODS

Two aquatic plant surveys were conducted by UW-Stevens Point in 2011. The first survey evaluated non-native curly leaf pondweed (*Potamogeton crispus*) for both lakes on June 17, 2011. The second aquatic plant survey for Mirror Lake and Shadow Lake was completed August 18 and 19, 2011. The surveys were accomplished using the Wisconsin Department of Natural Resources (WDNR) point intercept sampling protocol (Hauxwell et al., 2010). The GPS coordinates for the grid were provided by the WDNR (Figure 2 and 3). The 30 m grid was laid out with equal spacing between all points to ensure future replication and thorough coverage of each individual grid. Mirror Lake had 244 sampling points and Shadow Lake had a total of 186 sampling points. GPS points were uploaded to a Garmin GPS map 78s handheld unit which was used to locate sampling sites while in the field.

A pole mounted rake was used to sample aquatic plants at each grid point. The 13.8 inch rake had a double rake head with fourteen teeth on each side. After the rake was brought up each species present was assigned a fullness rating. Ratings ranged from 0 (plants not present) to 3 (plants overflowing the rake tines). Depth and dominant sediment type were also recorded at each site.

Multiple crews of staff members assisted by local volunteers, used a variety of watercrafts to travel between sample points. Volunteers sampled from kayaks and a canoe with the UWSP Center for Watershed Science and Education (CWSE) staff in some circumstances; other days, kayaking volunteers accompanied staff in canoes.

Numerous sites were inaccessible by boat. Every effort was made to try and access these points using the more maneuverable canoes. If the water was too shallow for a canoe or was on land, the point was listed as inaccessible and if possible, visuals were identified. Mirror and Shadow Lakes had a total of 170 points and 110 points, respectively that were either inaccessible or deeper than the maximum rooting depth for aquatic plants. Several additional points were added near shore using the GPS when a habitat not covered by the WDNR points was visibly identified between or around points.



Figure 2. Sample sites used in the 2011 aquatic macrophyte survey of Mirror Lake, Waupaca WI.



Figure 3. Sample sites used in the 2011 aquatic macrophyte survey of Shadow Lake, Waupaca WI.

RESULTS

The aquatic plant community was surveyed during August 2011 in Mirror and Shadow Lakes. Because of the steep sides and dark colored water, aquatic vegetation was present in Mirror Lake at only 30% of the sampled sites (74 of 244 sites, Figure 6). The average number of aquatic plant species per vegetated site was 2.3; a total of eleven species were encountered during sampling using the pole-mounted rake (Table 1). The major sediment types in Mirror Lake and Shadow Lake were determined to be brown fibrous peat and marl and deeper depths were composed of a thin muck layer.

Aquatic vegetation was present in Shadow Lake, 40.3% of the sample sites (75 of 186 sites, Figure 7). The average number of plant species per vegetated site was 2.7. Shadow Lake had 20 aquatic plant species. The increase compared with Mirror Lake is due to the greater variability of habitat types around the lake which include areas with groundwater inflow, small bays, and more shallows in general (Table 2). The most common aquatic plant found in both Mirror Lake and Shadow Lake was muskgrass (*Chara*) (Figure 12 and Figure 11), which occurred at 78% and 68% of vegetated sites, respectively. Muskgrass is actually a macrophytic algae which is adapted to disturbance. It is a beneficial plant that provides habitat for small fish and macroinvertebrates and improves the water clarity. Other aquatic plants that frequently occurred in the lakes included: Coontail (*Ceratophyllum demersum*), Illinois Pondweed (*Potamogeton illinoensis*), and Northern Water Milfoil (*Miriophyllum sibiricum*).

A Floristic Quality Index (FQI) value was calculated for both lakes. An FQI gives insight into the quality of the plant community. Native aquatic plants are ranked on a scale of 1-10 (termed a "Coefficient of Conservatism", or "C Value"); those that are sensitive to disturbance are given a ranking of 10, whereas plants that are tolerant of disturbance are placed at the lower end of the scale. Non-native aquatic plants are given a rating of 0. Plants that were found on shore do not have values assigned are identified as N/A. Calculations are computed based on C-values, resulting in an FQI for the entire lake. The aquatic plant with the highest C-value within the two lakes was the yellow pond lily, with a C-value of 8. The FQI for Mirror Lake was 18.9, and 23.4 in Shadow Lake (Table 1 and Table 2). These values are within an expected range for developed lakes in central Wisconsin with hard water.

Table 1. Aquatic plant species identified in Mirror Lake and associated coefficients of conservation (C-Value). August 2011

Genus/species	Common Name	C-Value
<i>Ceratophyllum demersum</i>	Coontail	3
<i>Chara</i>	Muskgrasses	7
<i>Myriophyllum sibiricum</i>	Northern water-milfoil	6
<i>Najas flexilis</i>	Slender naiad	6
<i>Nuphar advena</i>	Yellow pond lily	8
<i>Nuphar variegata</i>	Spatterdock	6
<i>Nymphaea odorata</i>	White water lily	6
<i>Potamogeton illinoensis</i>	Illinois pondweed	6
<i>Potamogeton crispus</i>	Curly leaf pondweed	0
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	6
<i>Vallisneria americana</i>	Wild celery	6

Table 2. Aquatic plant species identified in Shadow Lake and associated coefficients of conservation (C-Value). August 2011

Genus/species	Common Name	C-value
<i>Ceratophyllum demersum</i>	Coontail	3
<i>Chara</i>	Muskgrasses	7
<i>Cicuta bulbifera</i>	Bulb-bearing water hemlock	N/A
<i>Elodea canadensis</i>	Common waterweed	3
<i>Elodea nuttallii</i>	Slender waterweed	7
<i>Heteranthera dubia</i>	Water star-grass	6
<i>Lemna trisulca</i>	Forked duckweed	6
<i>Myriophyllum sibiricum</i>	Northern water-milfoil	6
<i>Najas flexilis</i>	Slender naiad	6
<i>Nitella</i>	Nitella	7
<i>Nuphar variegata</i>	Spatterdock	6
<i>Nymphaea odorata</i>	White water lily	6
<i>Polygonum amphibium</i>	Water smartweed	5
<i>Potamogeton illinoensis</i>	Illinois pondweed	6
<i>Potamogeton crispus</i>	Curly leaf pondweed	0
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	6
<i>Stuckenia pectinata</i>	Sago pondweed	3
<i>Utricularia vulgaris</i>	Common bladderwort	7
<i>Vallisneria americana</i>	Water celery	6
	Filamentous algae	0

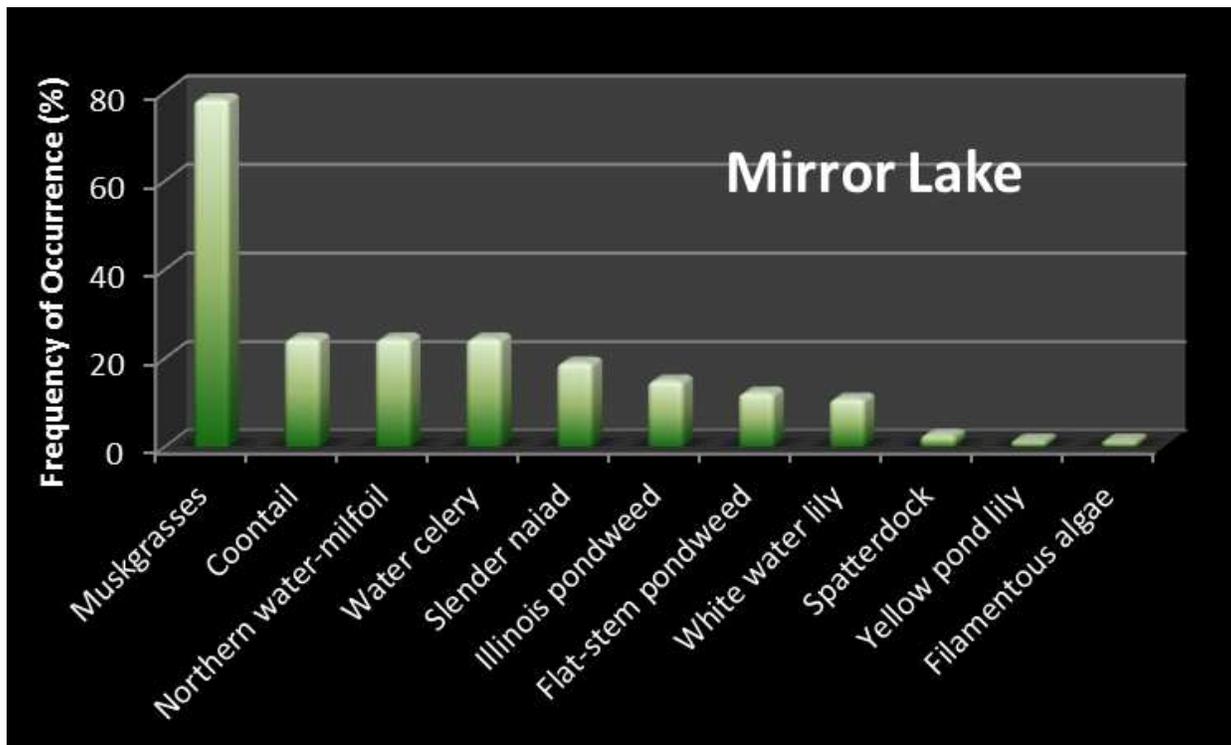


Figure 4. Percent frequency of aquatic plants species in Mirror Lake, Waupaca WI. August 2011

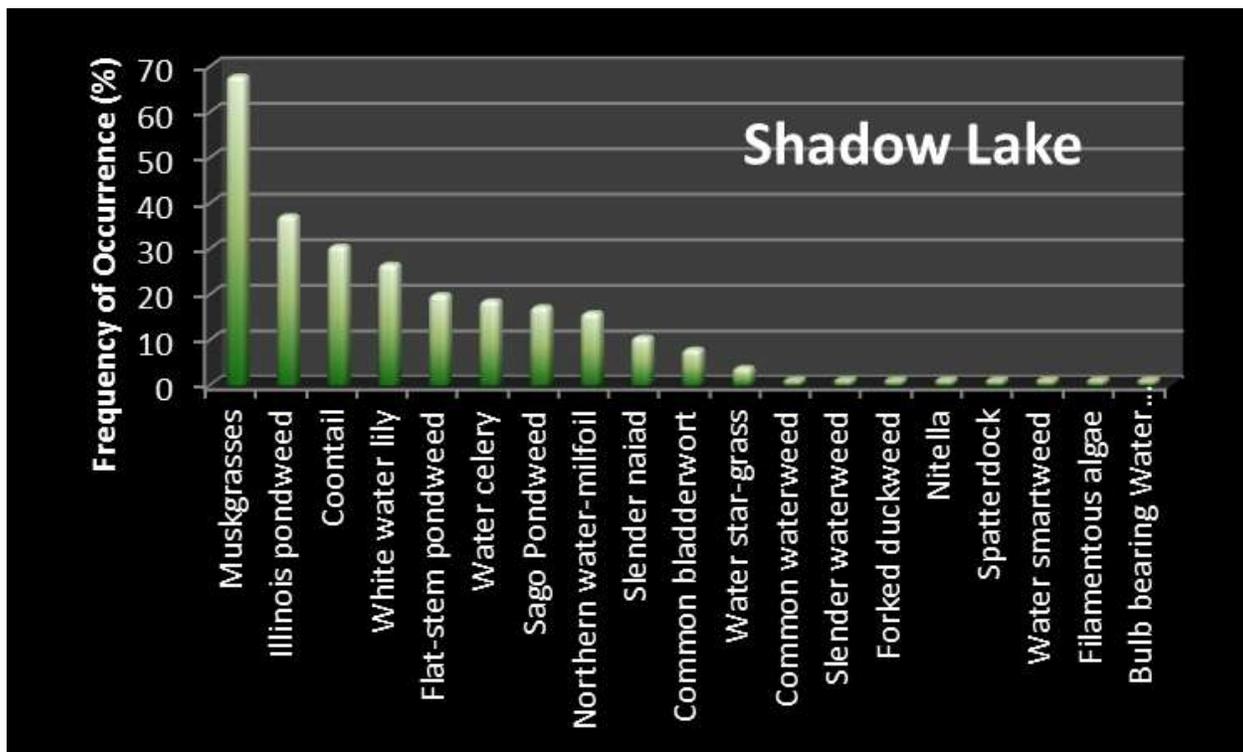


Figure 5. Percent frequency of aquatic plant species found in Shadow Lake, Waupaca WI. August 2011

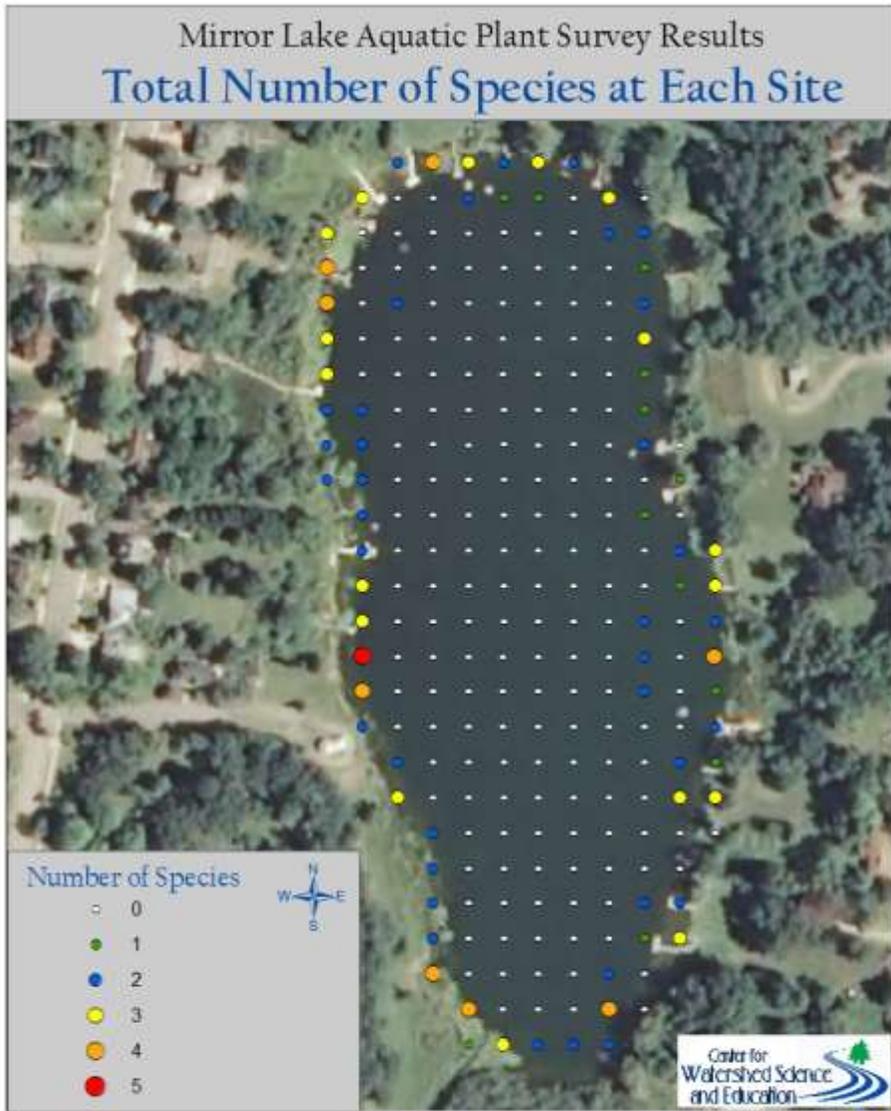


Figure 6. Number of aquatic plant species identified at each site in Mirror Lake, Waupaca WI. August 2011

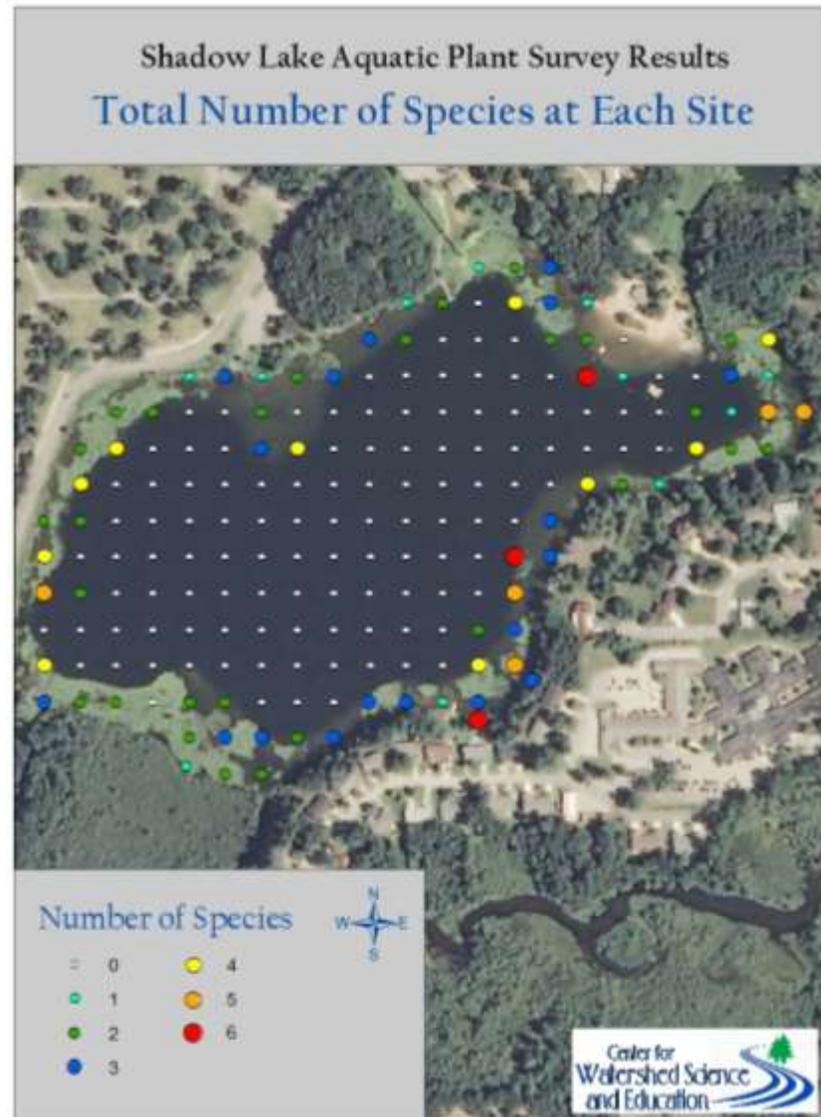


Figure 7. Number of aquatic plant species identified at each site in Shadow Lake, Waupaca WI. August 2011

Curly Leaf Pondweed (CLP) is a non-native aquatic plant found in Mirror Lake and Shadow Lakes. CLP should be tracked over time because in some circumstances it can out-compete native plants and become problematic. In low abundance, it provides shade and cover for fish. In most cases in Wisconsin, CLP dies off in early summer, releasing nutrients into the water that can cause algal blooms throughout the summer. In recent years volunteers with the Friends of Mirror and Shadow Lakes have been removing CLP by hand to prevent the spread of turions (seeds) in the lakes.



Figure 8. Location and density of curly-leaf pondweed in Mirror Lake. June 2011

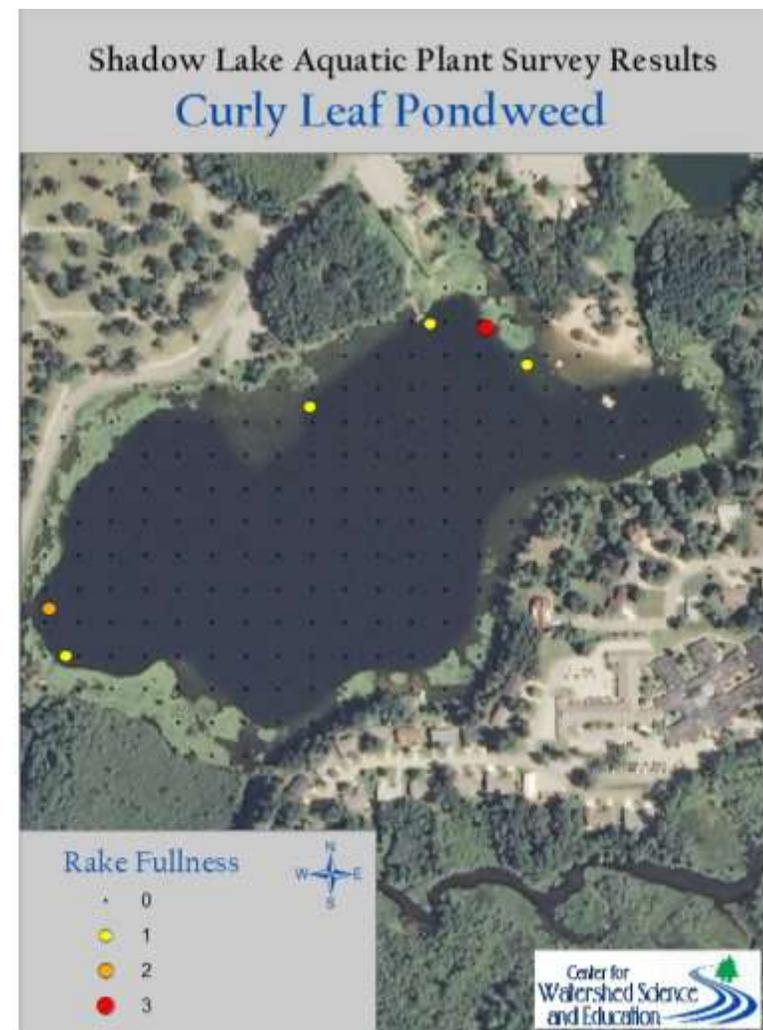


Figure 9. Location and density of curly-leaf pondweed in Shadow Lake. June 2011

Filamentous Algae are present in Mirror Lake. In moderate presence, filamentous algae can be somewhat beneficial to the lake. It can out-compete other types of algae and provide habitat for invertebrates and shelter and food for small fish. Filamentous algae are fueled by nutrient rich water.

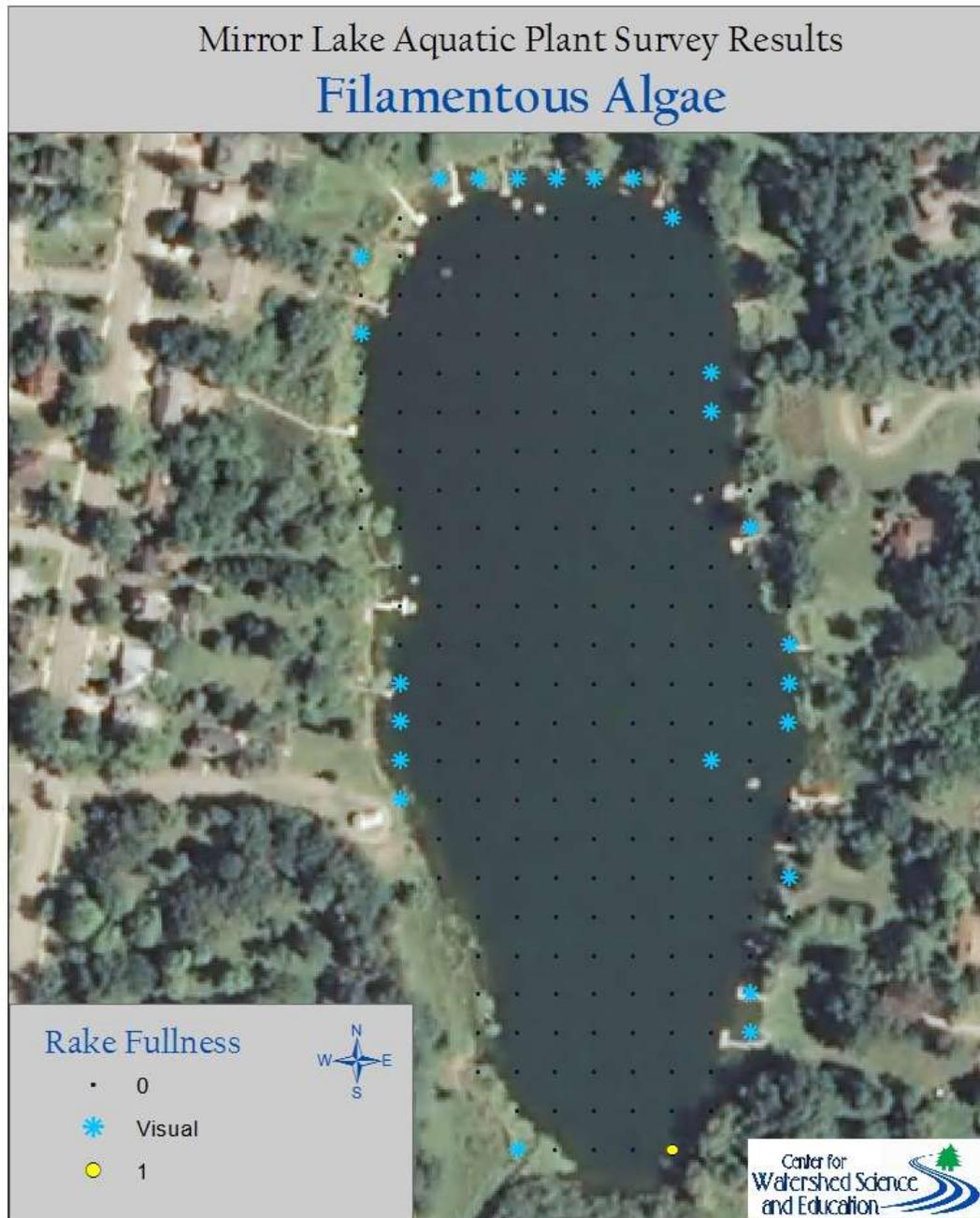


Figure 10. Location and density of filamentous algae in Mirror Lake, Waupaca WI. August 2011

Chara (Muskgrass) is the most prevalent aquatic plant in both Mirror Lake and Shadow Lakes. It is valuable to the ecosystem as food for waterfowl and habitat for aquatic insects and small fish and it uses nutrients that would otherwise be used by other forms of algae. These distinctive-smelling macrophytic (large leaf) algae don't have roots so they can be found at sites deeper than other aquatic plants and in areas that are disturbed. Chara prefers the hard water found in both Mirror and Shadow Lakes.

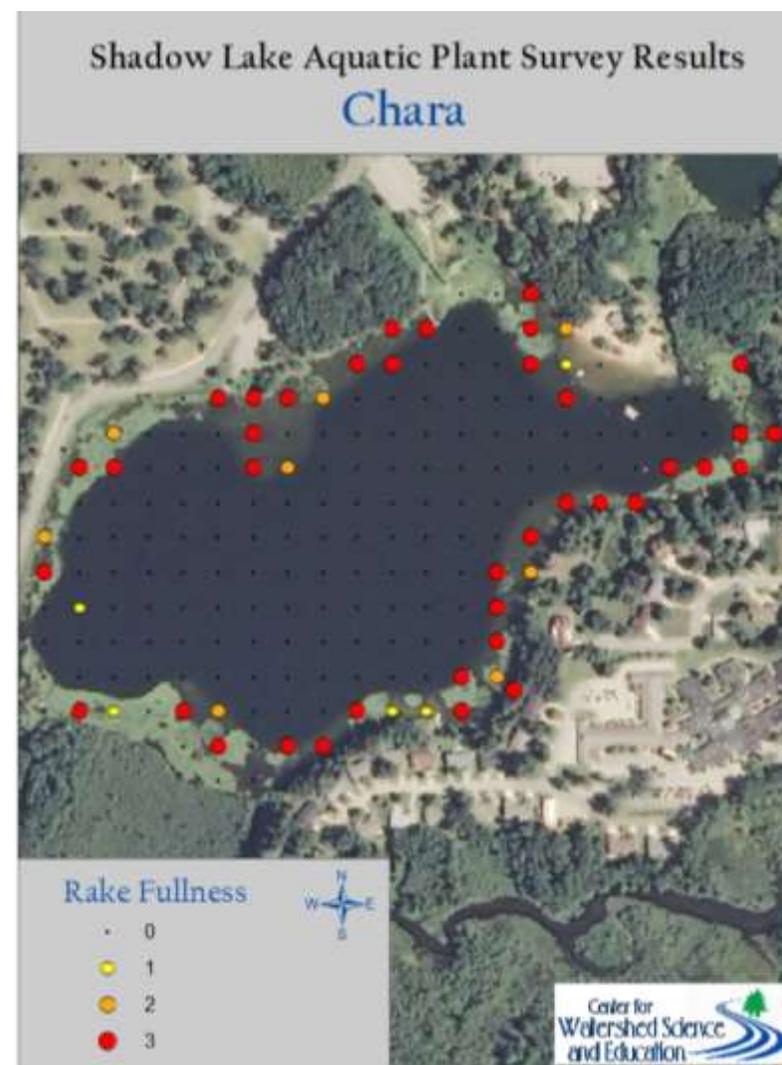
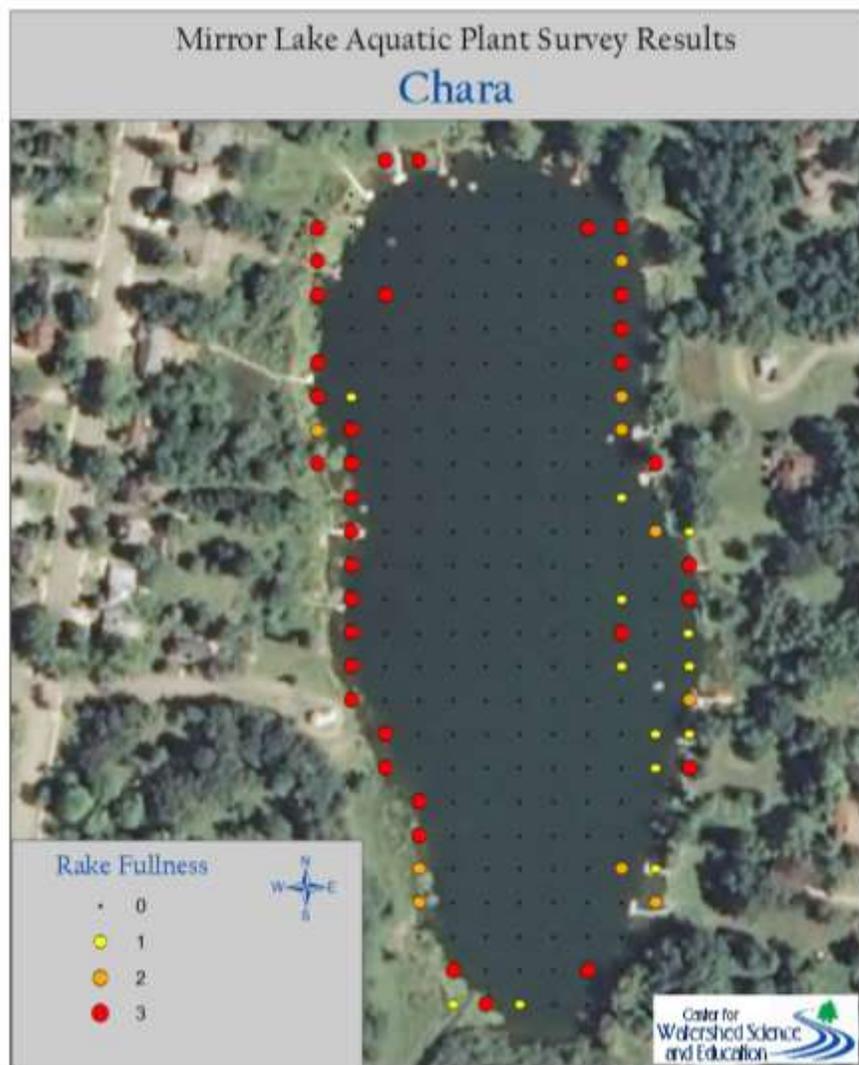


Figure 11. Location and density of chara in Mirror Lake. August 2011

Figure 12. Location and density of chara in Shadow Lake. August 2011

Coontail is a native free-floating aquatic plant that is present through the winter which provides shelter for aquatic insects during the cold season. It is consumed by waterfowl, and fish eat insects from its foliage.

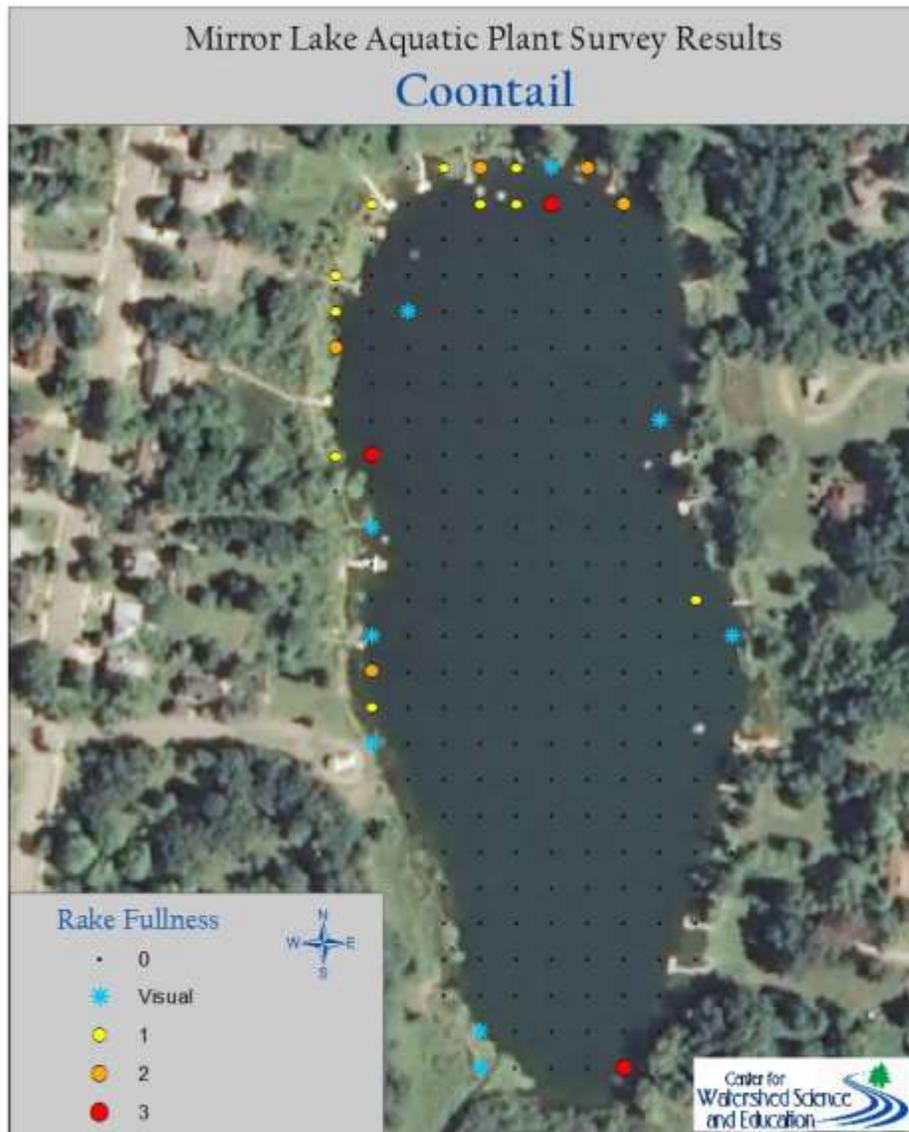


Figure 13. Location and density of coontail in Mirror Lake. August 2011

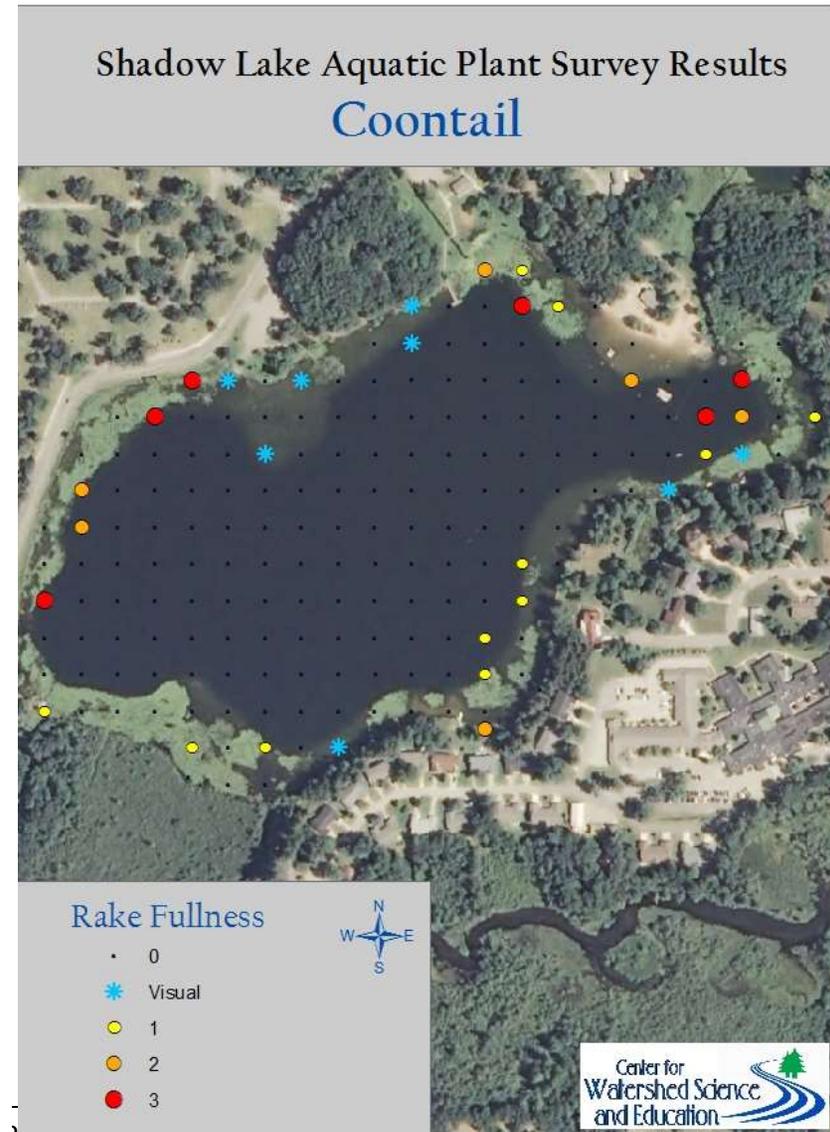


Figure 14. Location and density of coontail in Shadow Lake. August 2011

Illinois Pondweed is the second most abundant aquatic plant in Shadow Lake. It provides food for grazing animals such as deer, beaver, and muskrats, and shade and cover for fish. Waterfowl eat the fruits of this pondweed, which are produced on a stalk.

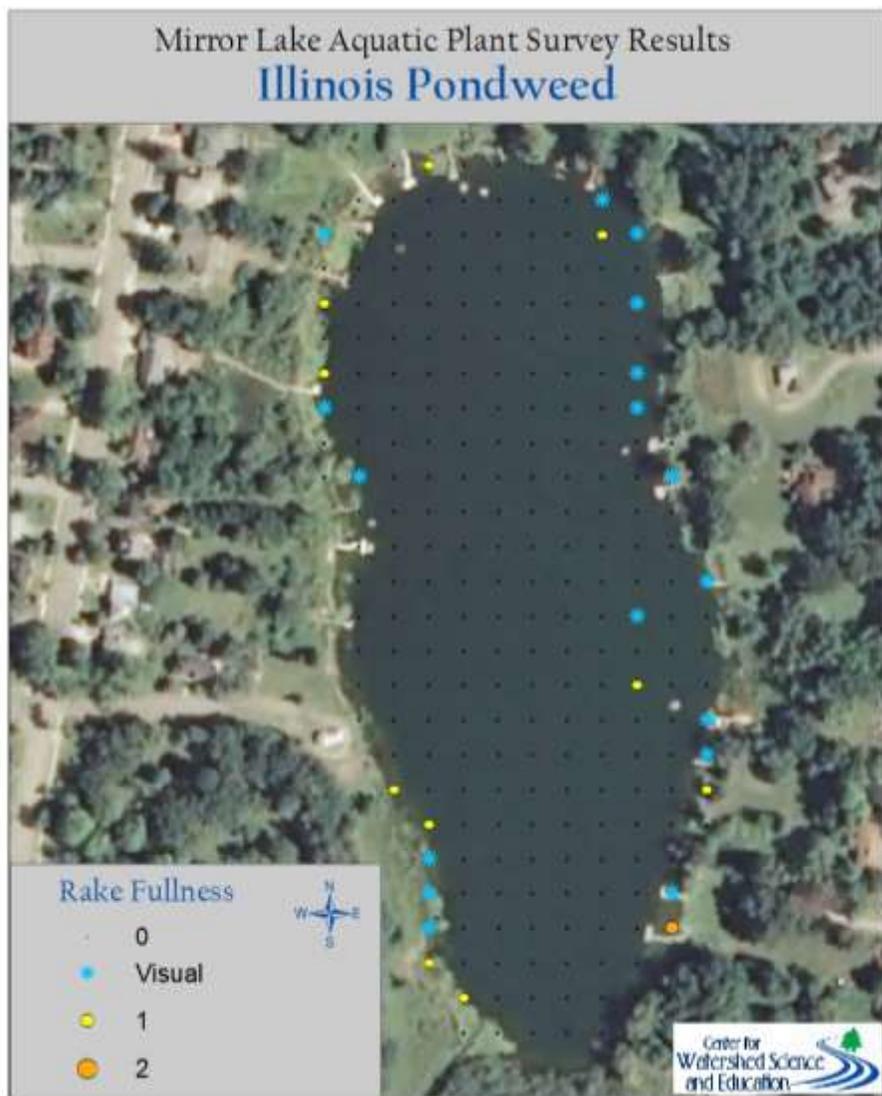


Figure 15. Location and density of Illinois Pondweed in Mirror Lake. August 2011

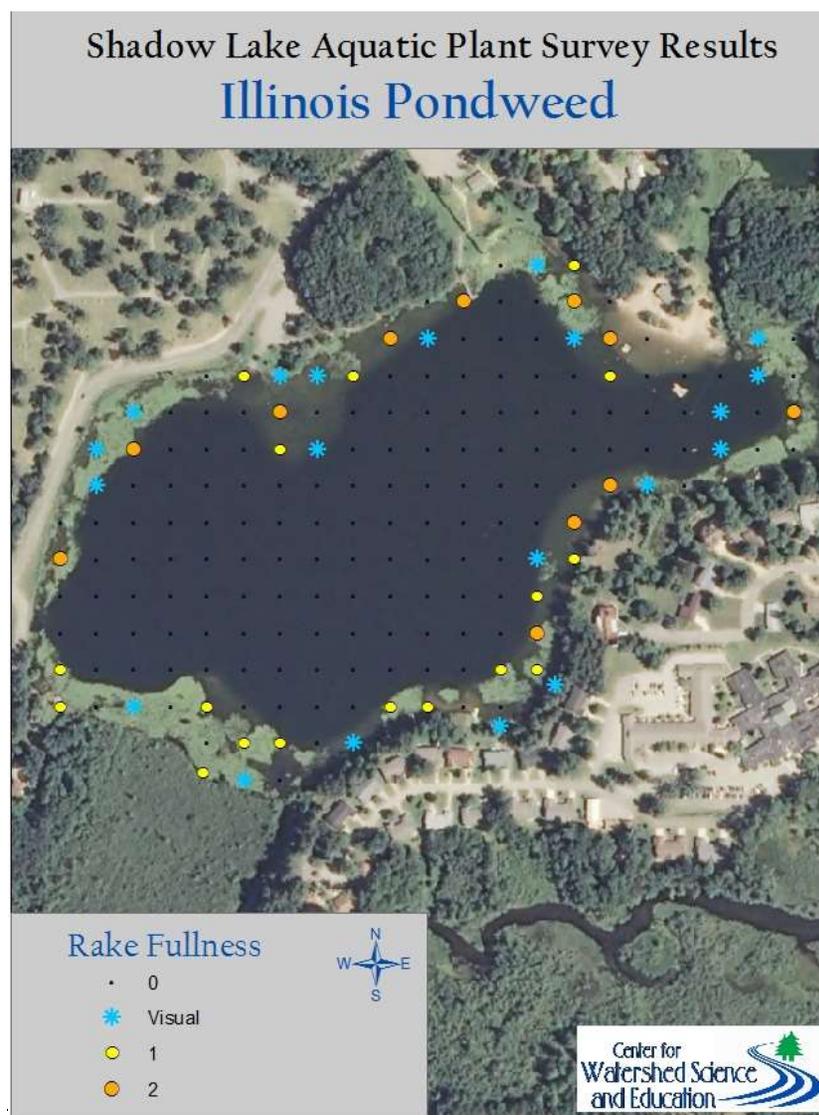


Figure 16. Location and density of Illinois pondweed in Shadow Lake. August 2011

Water Lilies are prevalent in both Shadow and Mirror Lakes. These native plants provide seeds for animals to eat and shade for life within the lake. These plants are ideal for breaking up the action of waves, reducing shoreland erosion.

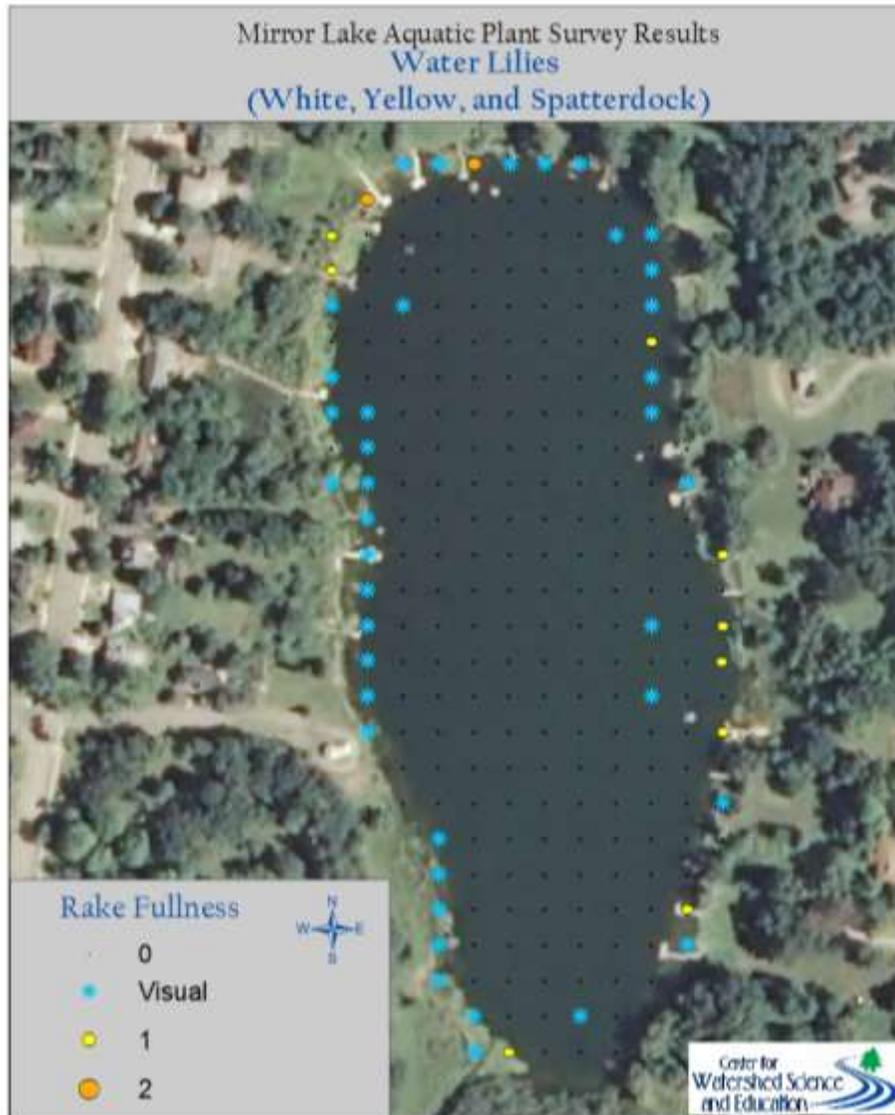


Figure 17. Location and density of water lilies in Mirror Lake. August 2011

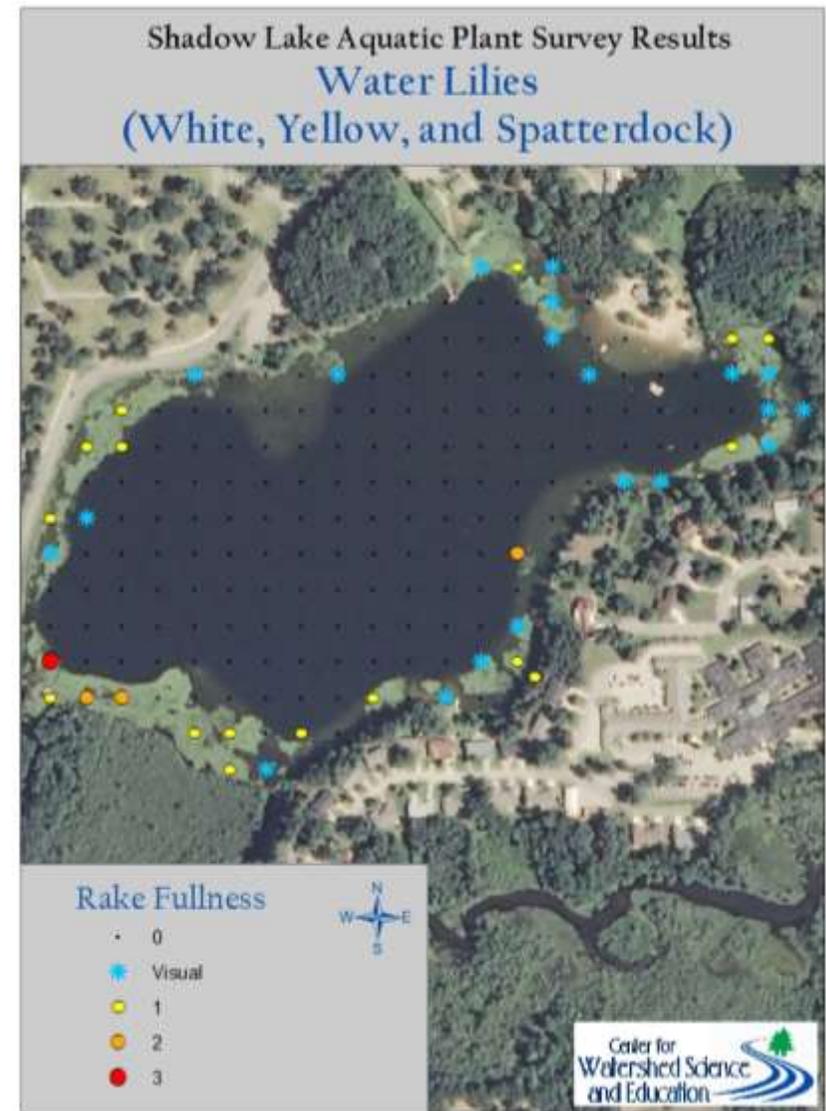


Figure 18. Location and density of water lilies in Shadow Lake. August 2011

Northern Water Milfoil is a native aquatic plant. This milfoil is easy to confuse with the non-native and invasive Eurasian water milfoil, which *has* been found and treated in Shadow Lake. Northern milfoil plant is beneficial to the lakes' ecosystems. It filters the water with its feathery leaves and provides hiding places for fish and insects.

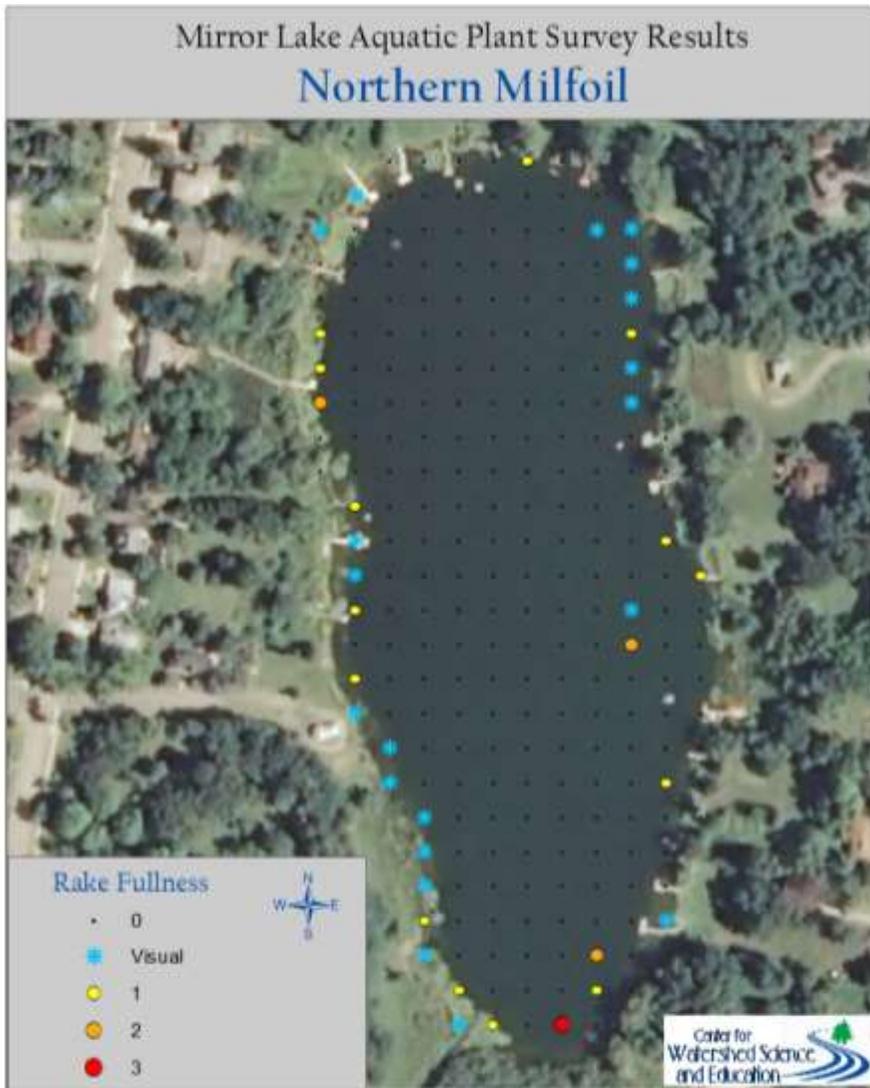


Figure 19. Location and density of northern milfoil in Mirror Lake. August 2011



Figure 20. Location and density of northern milfoil in Shadow Lake. August 2011

Native and Invasive Milfoils: A Comparison

It can be easy to confuse Northern Water Milfoil with the invasive Eurasian Water Milfoil. Here is a side-by-side comparison of the two species.

Northern Water-Milfoil

(*Myriophyllum sibiricum*)

One of the seven native milfoils found in Wisconsin. A valuable plant that offers shade, shelter and foraging opportunities for fish.

- Rigid feather-like leaves forming a Christmas tree shape. The lower leaflets are usually quite long.
- Leaves usually stiff when out of water.
- Leaves arranged in whorls (circles) of 4 to 6 around stem.

- Usually 7 to 10 leaflet pairs per leaf.
- Stem is usually whitish or whitish green in color.

Eurasian Water-Milfoil

(*Myriophyllum spicatum*)

Non-native

Highly invasive plant, able to form dense mats near the surface that entangle motor boat propellers and interfere with swimming. Spread by watercraft and trailers.

- Delicate feather-like leaves. Leaflets are mostly the same length.
- Leaves are usually limp when out of water.
- Leaves arranged in whorls (circles) of 3 to 5 around stem.

- Usually 12 to 21 leaflet pairs per leaf.
- Long spaghetti-like stems.

If you suspect a new infestation, report it to your local DNR service center.

Appendix

Flatstem Pondweed is present in both Mirror and Shadow Lakes. This grass-like pondweed is grazed by beaver, deer, muskrats, and other animals, and provides cover for lake inhabitants.



Figure 21. Location and density of flatstem pondweed in Mirror Lake. August 2011

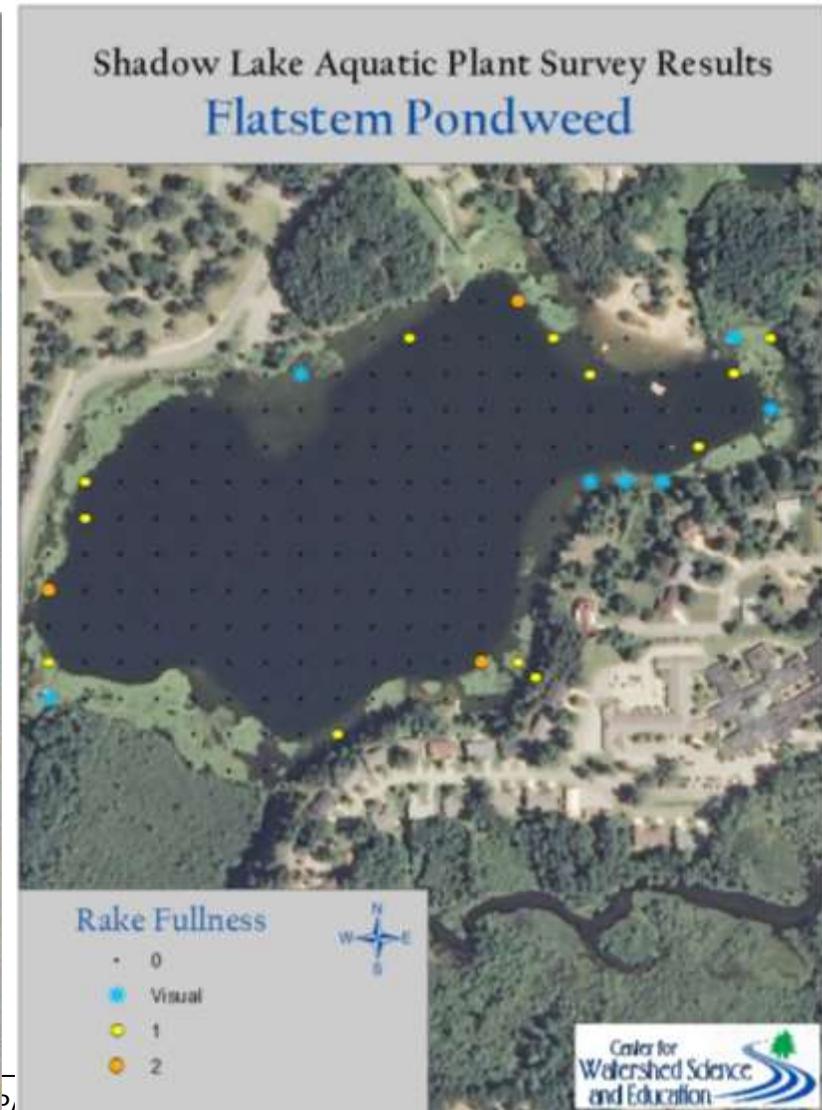


Figure 22. Location and density of flatstem pondweed in Shadow Lake. August 2011

Sago Pondweed is an aquatic plant that, in moderate presence, provides excellent habitat for invertebrates and fish. It is beneficial as a favorite food source for waterfowl, which consume the tubers and reproductive parts of the plant.

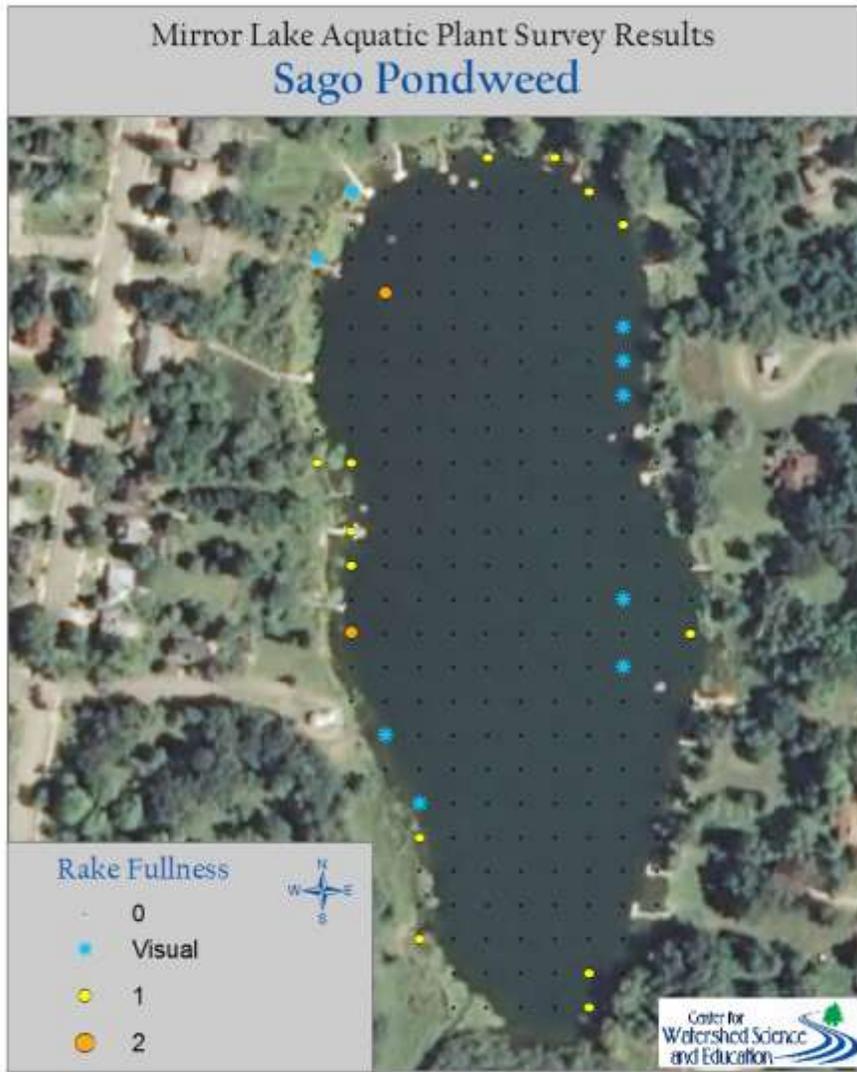


Figure23. Location and density of sago pondweed in Mirror Lake. August 2011

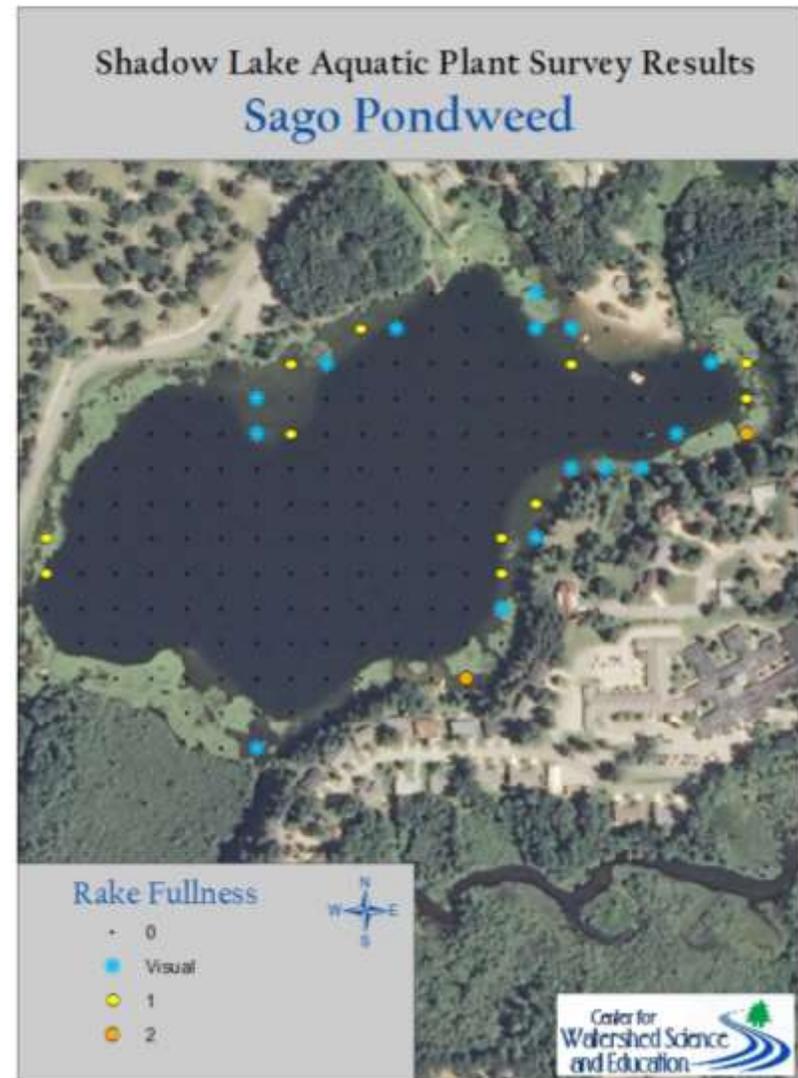


Figure24. Location and density of sago pondweed in Shadow Lake. August 2011

Slender Naiad is found in both Mirror and Shadow Lakes. The entire plant provides an extremely valuable food source for a wide range of waterfowl including ducks, teals, shovelers, pintails, and many others.



Figure25. Location and density of slender naiad in Mirror Lake. August 2011

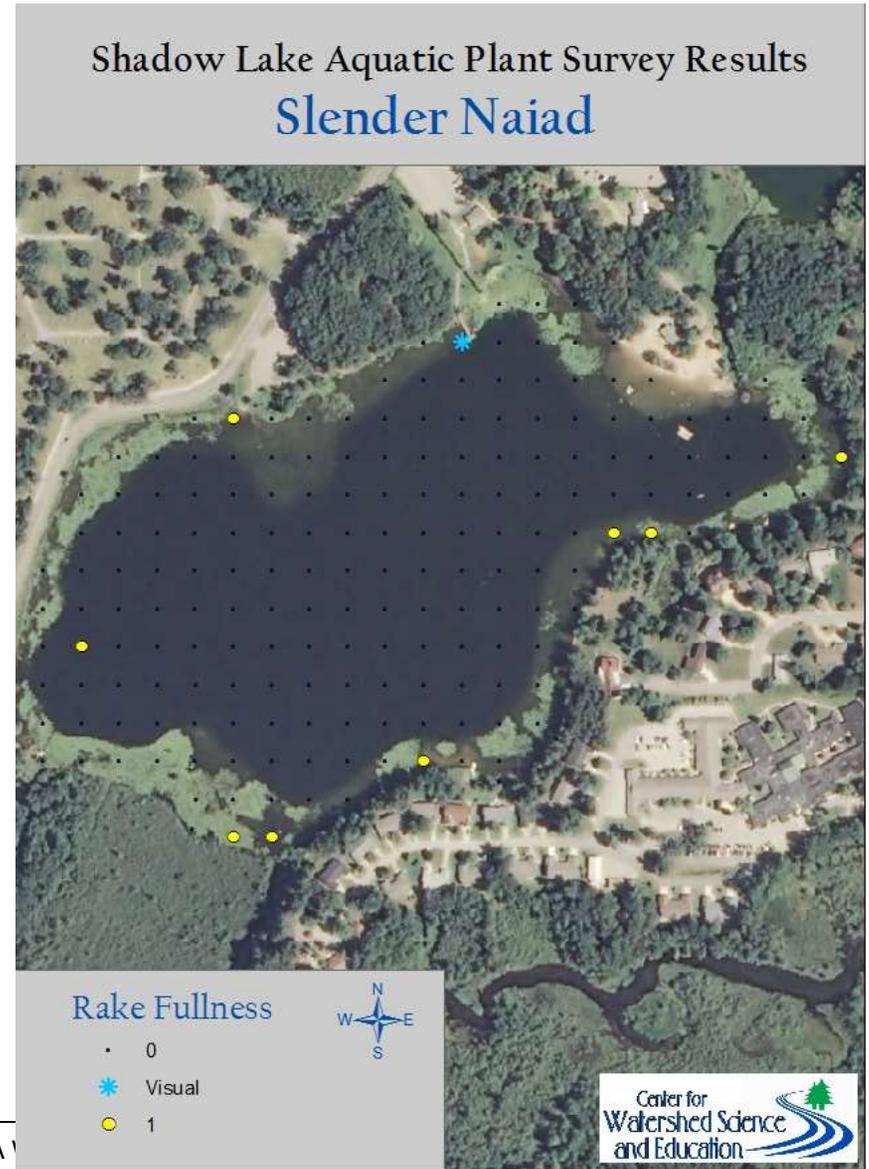


Figure26. Location and density of slender naiad in Shadow Lake. August 2011

Water Celery is a grass-like aquatic plant that is found in both Mirror and Shadow Lakes. The entire plant is edible to waterfowl, including rhizomes, leaves, tubers, and fruits. It is of special importance to the canvasback duck, which shows a particular fondness for the plant and prefers it over other aquatic plants.

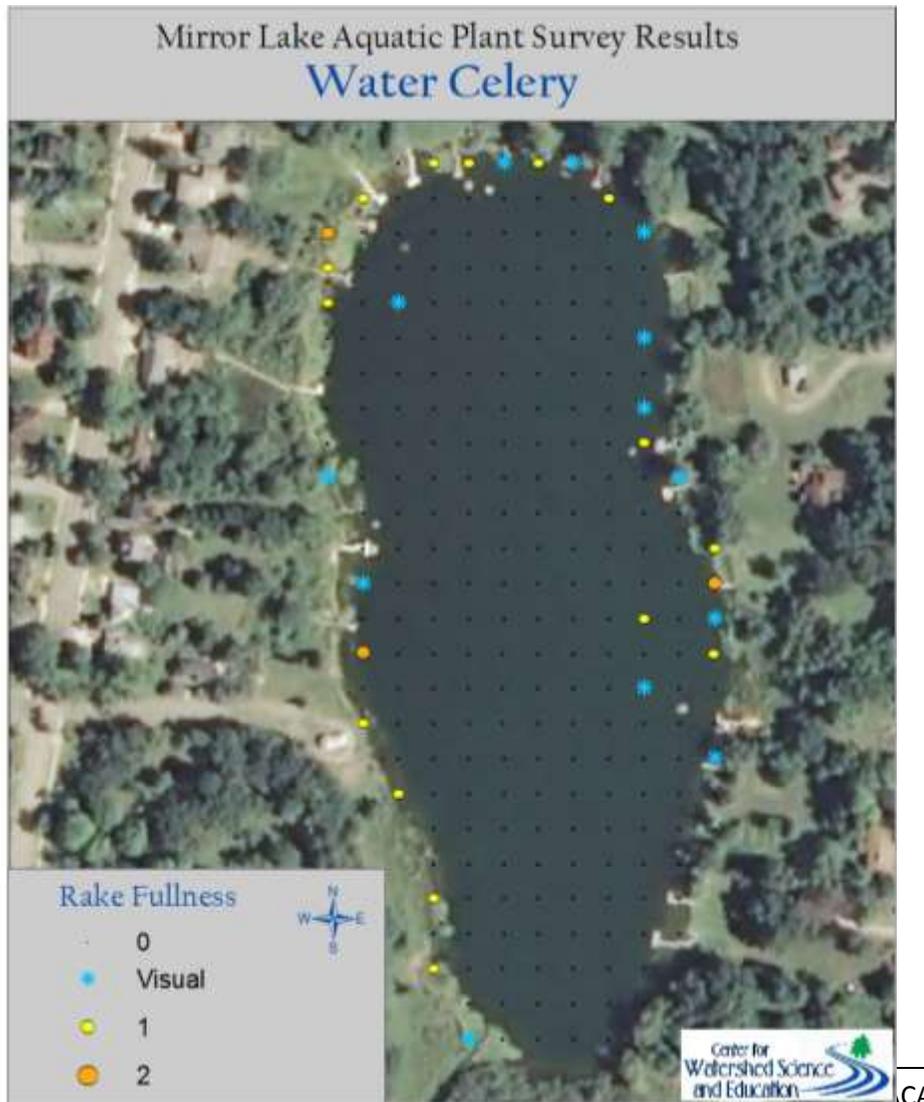


Figure 27. Location and density of water celery in Mirror Lake. August 2011

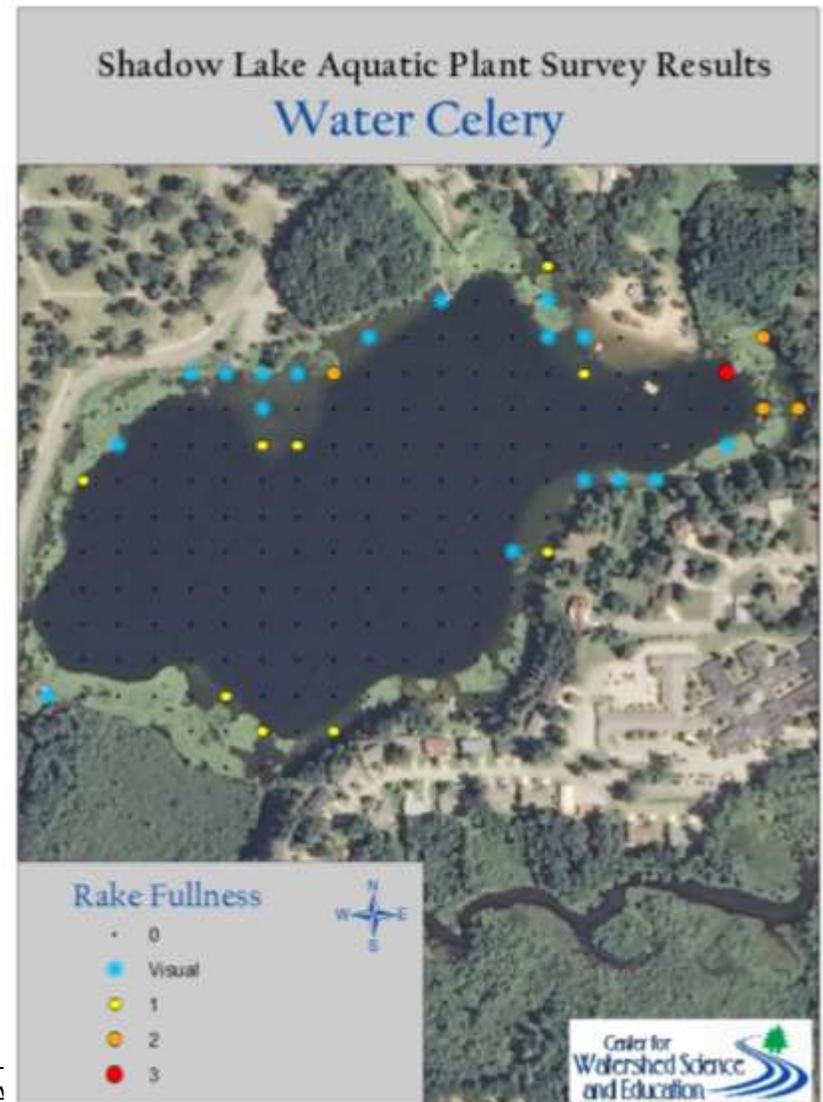


Figure 28. Location and density of water celery in Shadow Lake. August 2011

Common Bladderwort was found in Shadow Lake. This plant is unique in that it possesses tiny “bladders” that trap insects that are then used for food by the plant. Because bladderworts lack roots, the plants can grow in areas where the sediment/depth is not ideal for rooted plant, providing habitat where other plants cannot.

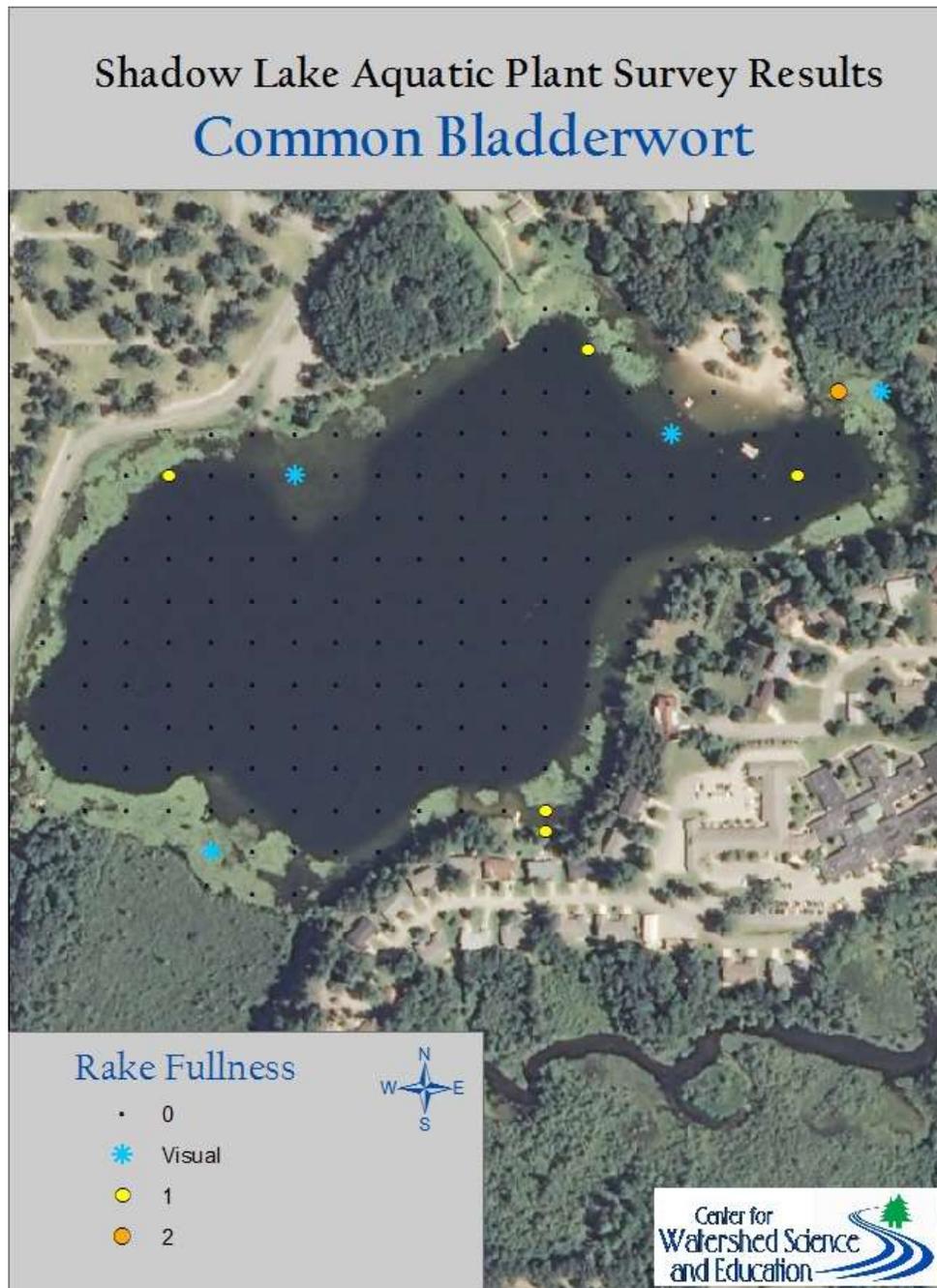


Figure 29. Location and density of common bladderwort in Shadow Lake. August 2011

Duckweed is a small free-floating plant found in still waters. It is fairly common and is often located close to shore. It is an abundant and important food source for ducks, provides shade for fish, and if in dense enough growth, can discourage the development of mosquito larvae.



Figure 30. Location and density of duckweed in Shadow Lake. August 2011

Softstem Bullrush was found only in Shadow Lake. Fruits are eaten by a variety of birds, and the stems and other parts of the plants are often used as nesting materials for shorebirds.

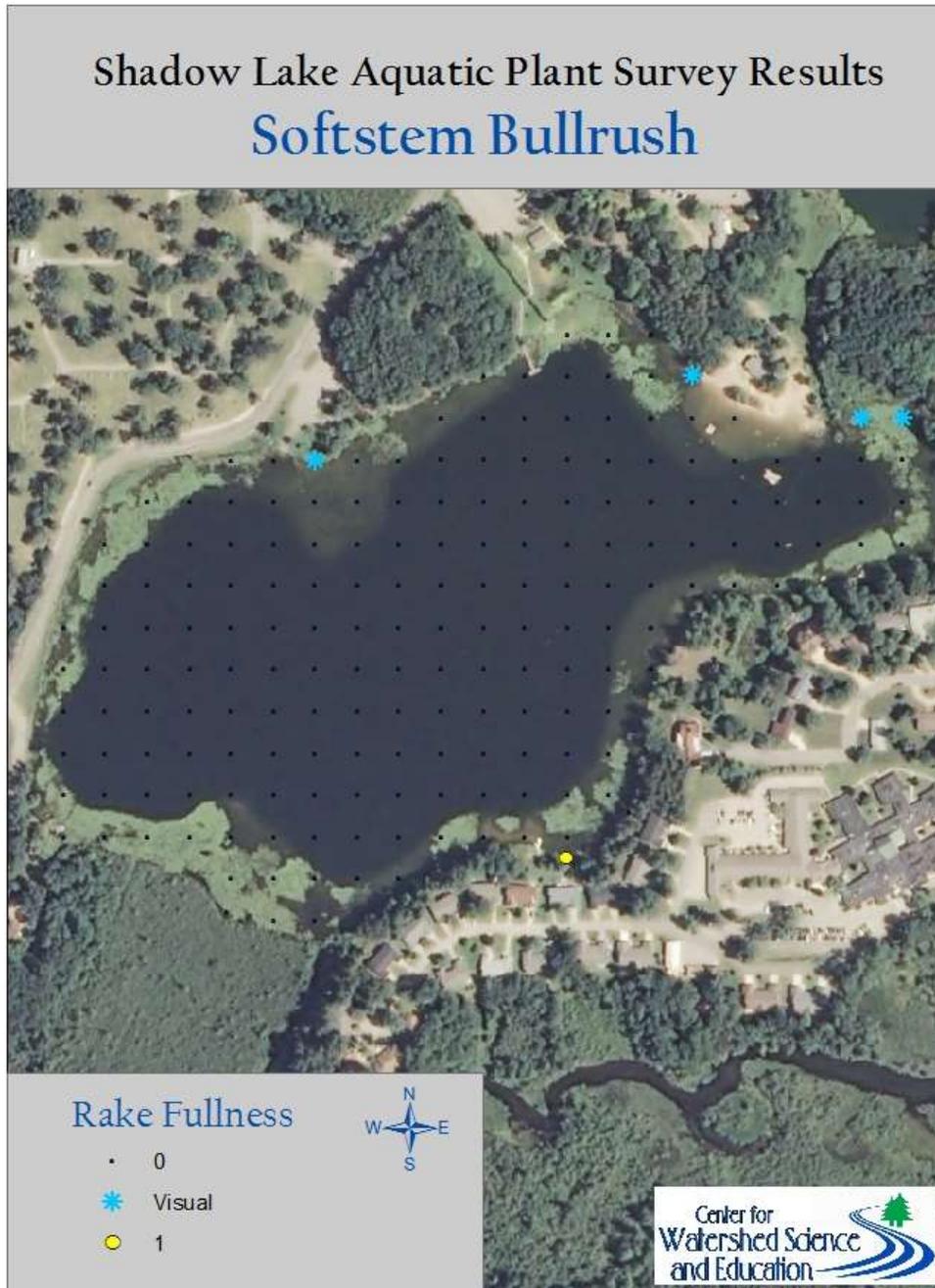


Figure 31. Location and density of softstem bullrush in Shadow Lake. August 2011

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