RMB Environmental Laboratories, Inc.

Clearwater Lake 18-0038-00 CROW WING COUNTY

Aquatic Vegetation Point-intercept Survey

Survey Date	30 August 2018
Observers	Phillip Oswald, Tina Pierce
Date of Report	14 September 2018
Report Author	Phillip Oswald, Moriya Rufer

Lake Summary

Clearwater Lake (DOW 18-0038-00) is a medium 905-acre lake located south of Deerwood, MN in Crow Wing County. Clearwater Lake has a maximum depth of 54 feet and mean depth of 24 feet. Approximately 252 acres, or 28% of Clearwater is considered littoral zone, area less than 15 feet, which permits light penetration and allows plant growth.

Clearwater Lake is classified as a mesotrophic lake as measured from 2008-2017 by a mean secchi depth of approximately 12 feet. Continual annual monitoring can help track trends in water quality in the lake. Total phosphorous and chlorophyll-a (values that provide a measure of the amount of algae in the water) have mean values of 14 and 5 µg/L, respectively.

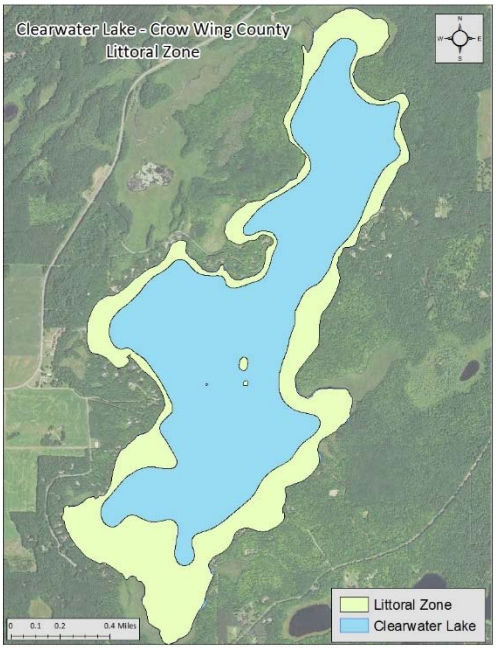
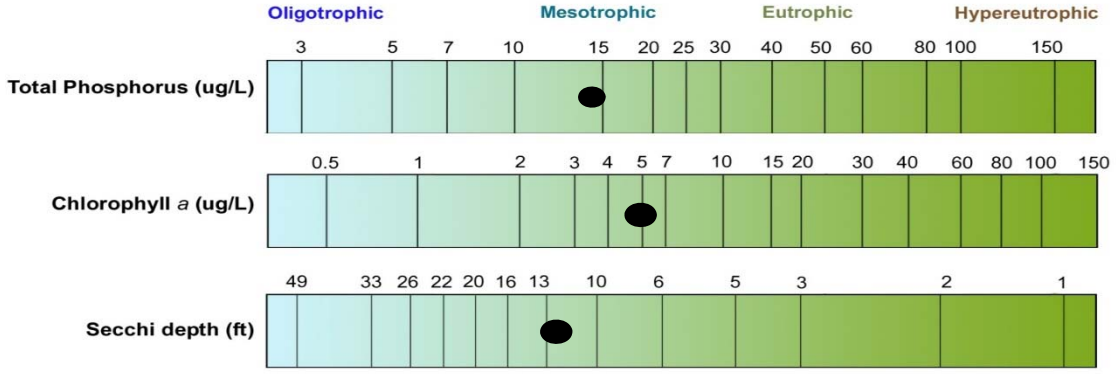


Figure 1: Clearwater Lake littoral zone, Crow Wing County, MN.

WATER QUALITY STATISTICS
Over the past 10 years

MPCA primary site	Years with Data	Mean Secchi depth (feet)	Mean Phosphorous (µg/L)	Mean Chlorophyll-a (µg/L)	Mean TSI	Trophic State
202	2008-2017	12.3	14	5	43	Mesotrophic



Objectives of the Survey

This survey describes the aquatic plant community of Clearwater Lake including:

1. Plant taxa observed and the estimated abundance of each taxon
2. Identification of taxa to the level of species when possible
3. Frequency of occurrence of each taxon found, stating the number of points used as the denominator for the calculations
4. Frequency of all aquatic plants found
5. Estimation of abundance of species sampled using MN DNR ranking system
6. Distribution map for common species
7. Determination of any invasive aquatic plants

Methods

The aquatic plant survey followed our RMBEL Standard Operating Procedure and the methodology described by Madsen (1999). Geographic Information Systems (GIS) software was used to generate sample points across the littoral zone surface in a 80-meter by 80-meter grid on Clearwater Lake, resulting in a total of 223 potential survey points. In the field, all points were sampled, and vegetation was not found beyond 14 feet in depth. A Global Positioning System (GPS) unit was used to navigate the boat to each sample point. Water depths at each site were recorded in 1-foot increments using an electronic depth finder.

A double-headed, weighted garden rake attached to a rope (Figure 2 and 3) was used to survey vegetation. Vegetation that was found under the surface by use of the double-headed garden rake was assigned a number between 0 and 4; 0 being absent, 1 being rare (≤ 1/3 of the rake head covered), 2 being scattered (>1/3 but ≤ 2/3 of the rake head covered), 3 being common (>2/3 of the rake head covered), and 4 being abundant (plants over top of rake head). Plant identification followed Blickenderfer (2007).

Figure 2 and 3: Double-headed, weighted garden rake, attached to a rope used to survey aquatic vegetation.

Frequency of occurrence was calculated for each species as the number of sites in which a species occurred divided by the total number of sample sites. The average number of plants per rake sample was calculated as the total number of plants sampled divided by the number of sample locations.

Sampling points were also grouped by water depth and separated into seven depth zones for analysis. Depth zones included less than 4 feet, 4-6 feet, 7-9 feet, 10-12 feet, 13-15 feet, 16-18 feet, and over 18 feet.

Survey Results

On 30 August 2018, 223 points were observed and sampled for aquatic vegetation. Sampling occurred to a maximum depth of 41 feet; however, no plants were found to be growing beyond 18 feet of water. Plant abundance was greatest between two and fifteen feet of water. As depths increased beyond that range, the presence of vegetation decreased and became less dense (Figure 4). The weather was conducive for the survey with sunny skies, temperatures reaching 75 degrees and little wind. Water temperatures were well in the 70s.

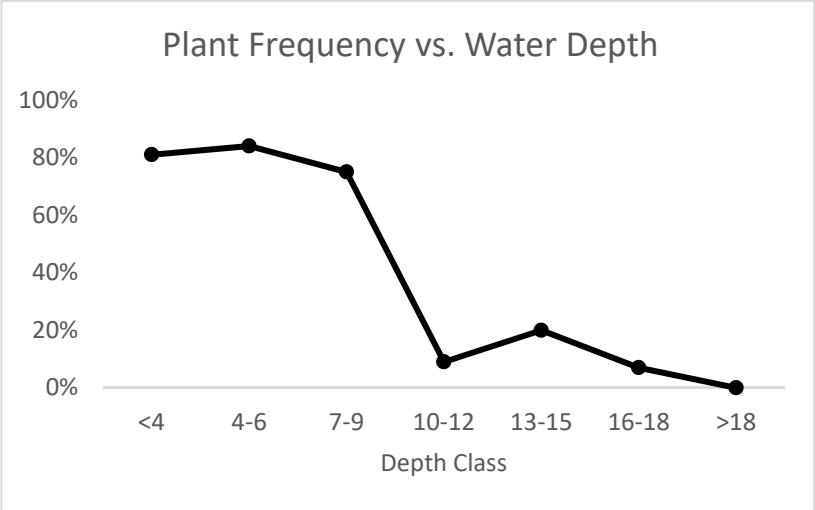


Figure 4: Plant frequency for each depth zone in Clearwater Lake, 30 August 2018.

Sixteen different types of native plants were found across the sampling area, as well as the Eurasian watermilfoil (Figures 5 & 6). Four was the maximum number of species found.

Of the 223 sampled locations in Clearwater Lake, 82 sites had no vegetation present. Eurasian watermilfoil (*Myriophyllum spicatum*) was sampled at 5 sites, which is about 2% of sites (Figure 7). The most abundant native plant species were chara (*Chara sp.*) and water celery (*Vallisneria americana),* (Figures 8 & 9).

The average number of plants per rake sample on Clearwater Lake was 1.19 for all sampled depths and 1.33 for points with depth less than 18 feet.

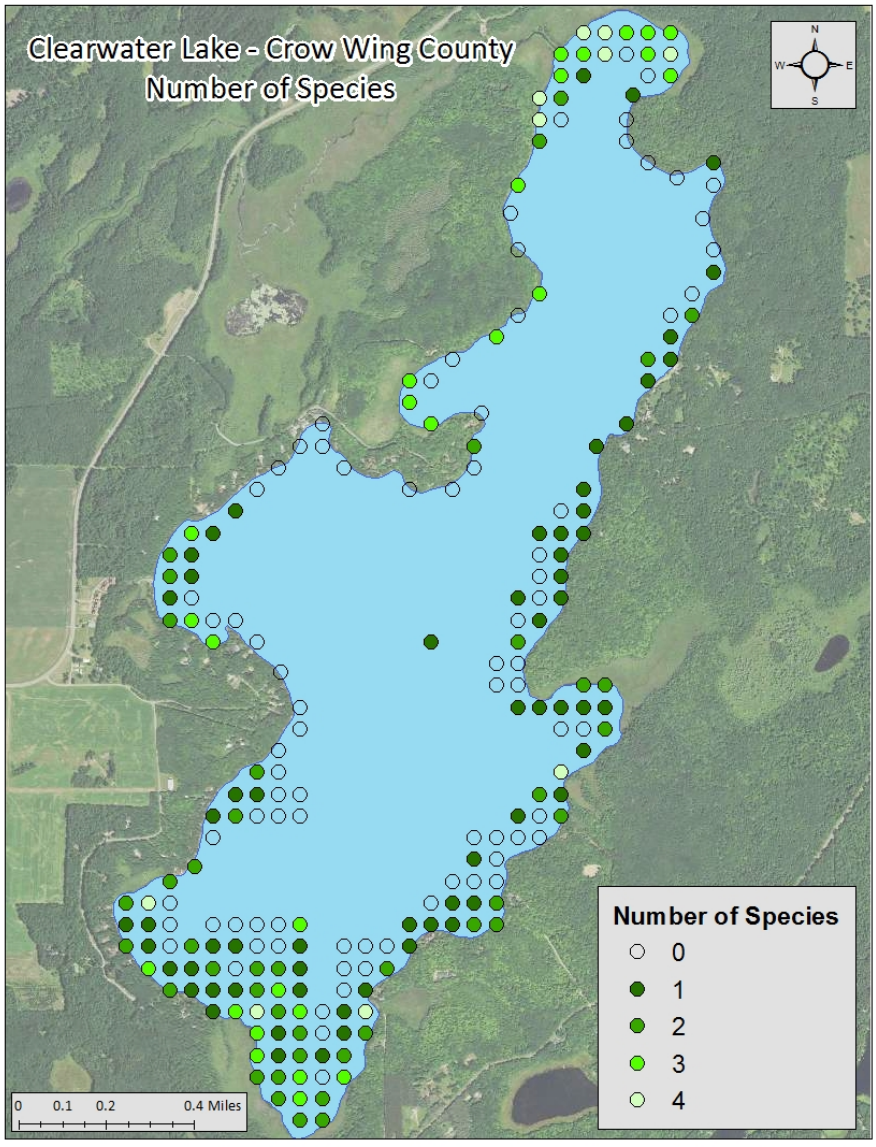


Figure 5: Number of plant species found at Clearwater Lake sample points, Crow Wing County, MN, 30 August 2018.

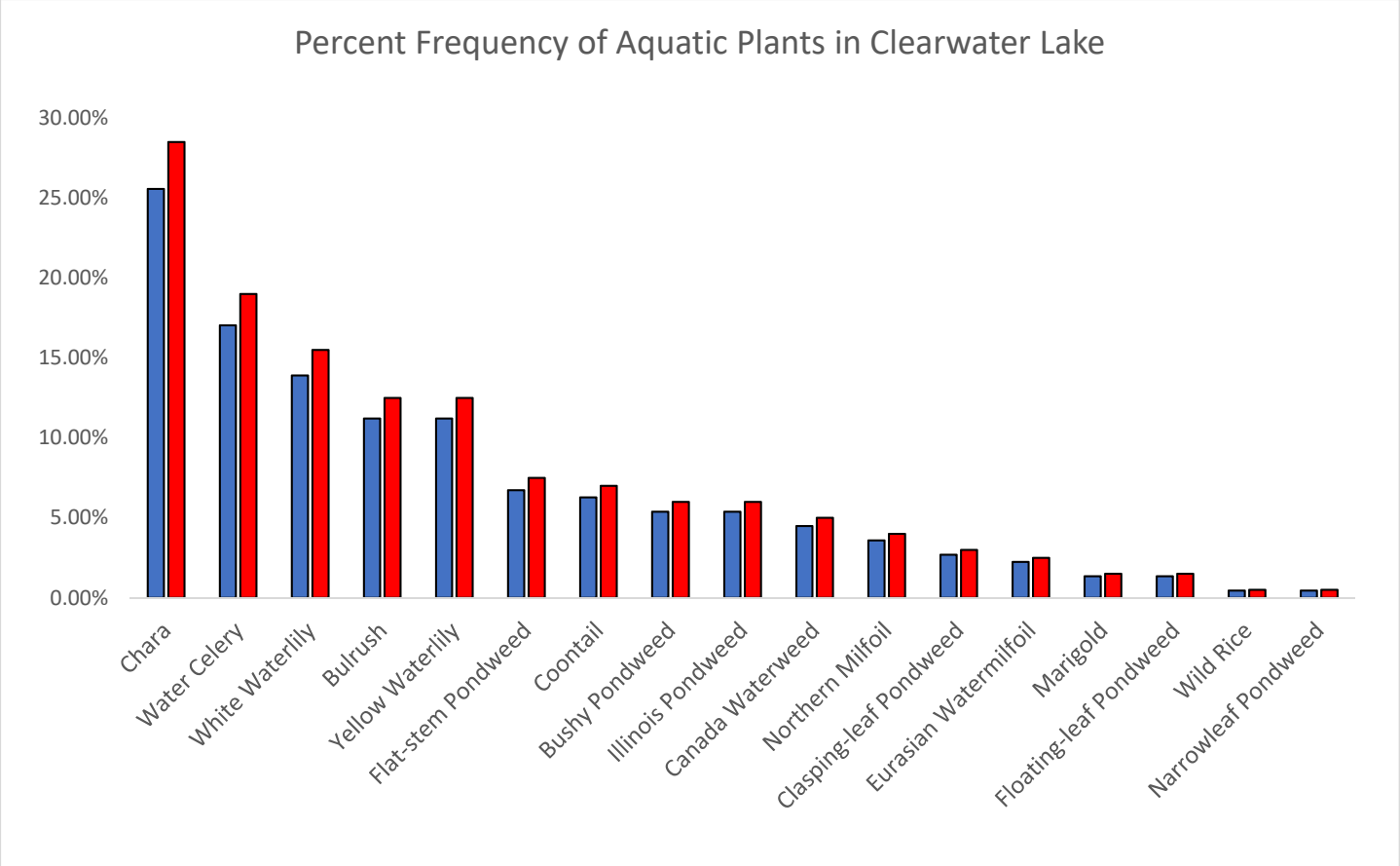


Figure 6: Frequency of aquatic plant species in Clearwater Lake, 30 August 2018.

Table 2. Aquatic plants surveyed from Clearwater Lake, Crow Wing County, MN: 30 August 2018.

Clearwater Lake				All sampled sites	Sites <18 feet
Life Form	**Common Name**	**Scientific Name**	**Count**	**Frequency (%)**	**Frequency (%)**
SUBMERGED – ANCHORED – These plants grow primarily under the water surface. Upper leaves may float near the surface and flowers may extend above the surface. Plants are often rooted or anchored to the lake bottom.	Chara	*Chara sp.*	57	25%	28%
	Water celery	*Vallisneria americana*	38	17%	19%
	Flat-stem pondweed	*Potamogeton zosteriformis*	15	6%	8%
	Coontail	*Ceratophyllum demersum*	14	6%	7%
	Bushy pondweed	*Najas flexilis*	12	5%	6%
	Illinois pondweed	*Potamogeton illinoensis*	12	5%	6%
	Canada waterweed	*Elodea canadensis*	10	4%	5%
	Northern watermilfoil	*Myriophyllum sibiricum*	8	3%	4%
	Clasping-leaf pondweed	*Potamogeton richardsonii*	6	2%	3%
	Eurasian milfoil (invasive)	***Myriophyllum spicatum***	**5**	**2%**	**3%**
	Marigold	*Bidens beckii*	3	1%	2%
	Narrowleaf pondweed	*Potamogeon sp.*	1	<1%	<1%
FLOATING – LEAF – These plant leaves float on water and are anchored to the bottom of the lake.	White waterlily	*Nymphaea odorata*	31	13%	15%
	Yellow waterlily	*Nuphar variegata*	25	11%	12%
	Floating-leaf pondweed	*Potamogeton natans*	3	1%	2%
EMERGENT – These plants extend above the water surface and are found in shallow water.	Bulrush	*Scirpus acutus*	25	11%	12%
	Wild rice	*Zizania palustrus*	1	<1%	<1
Total number of plants (species diversity for the lake)			17		
Total number of plant occurrences			266		
Total number of sites			223		
Total number of sites <18			200		

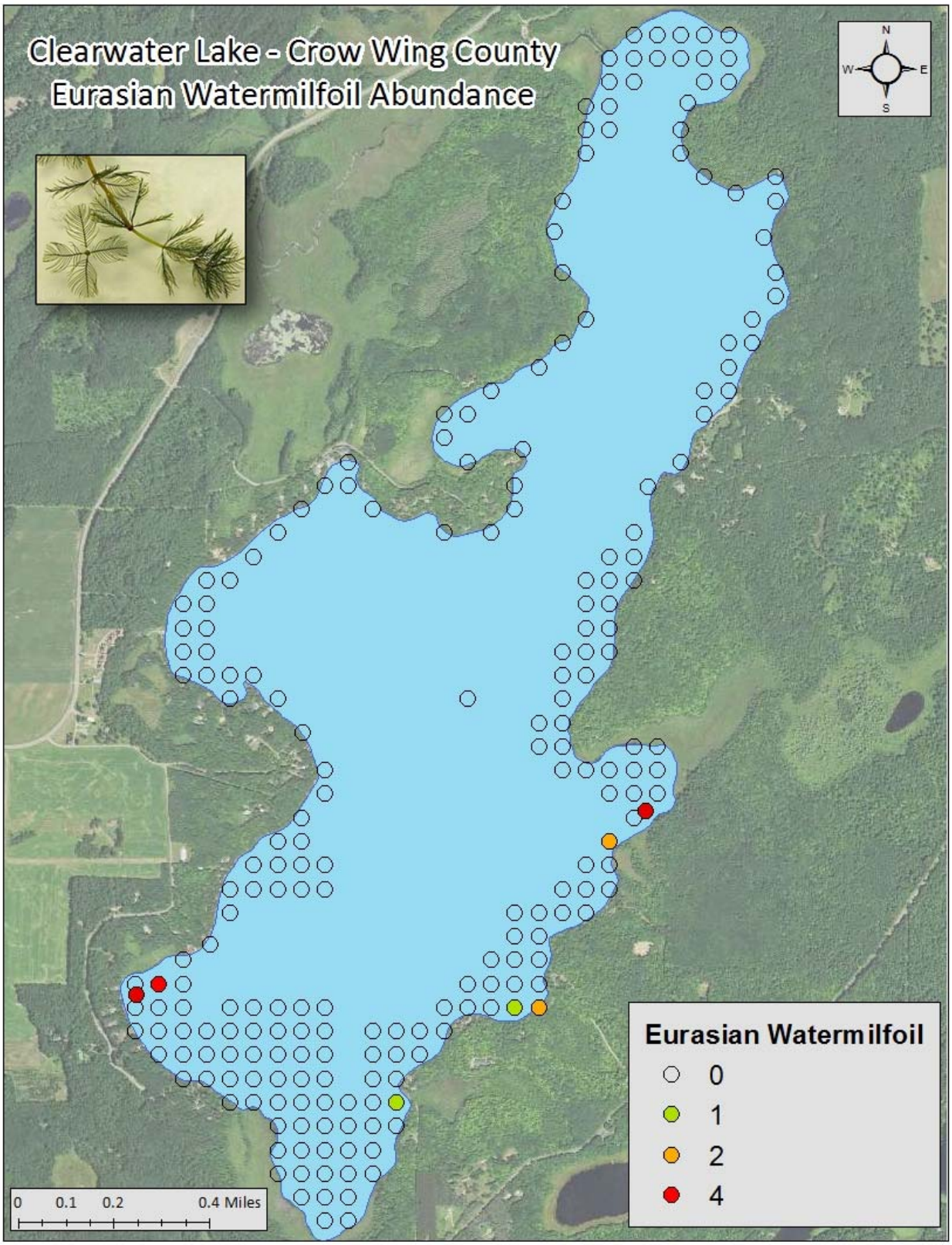


Figure 7: Density of Eurasian watermilfoil (Myriophyllum spicatum) at sample points in Clearwater Lake, Crow Wing County, MN, 30 August 2018.

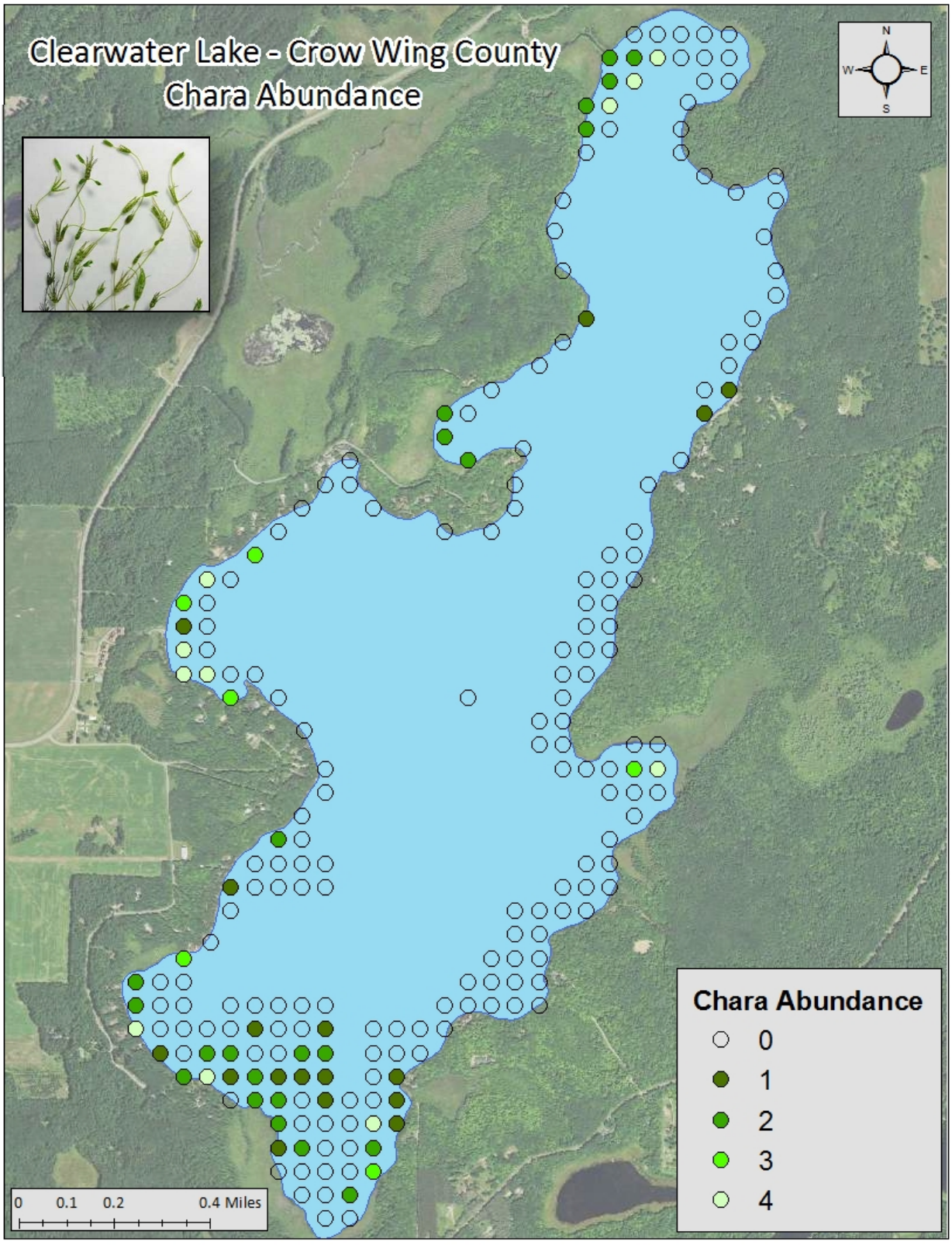


Figure 8: Density of chara (Chara sp.) at sample points in Clearwater Lake, Crow Wing County, MN, 30 August 2018.

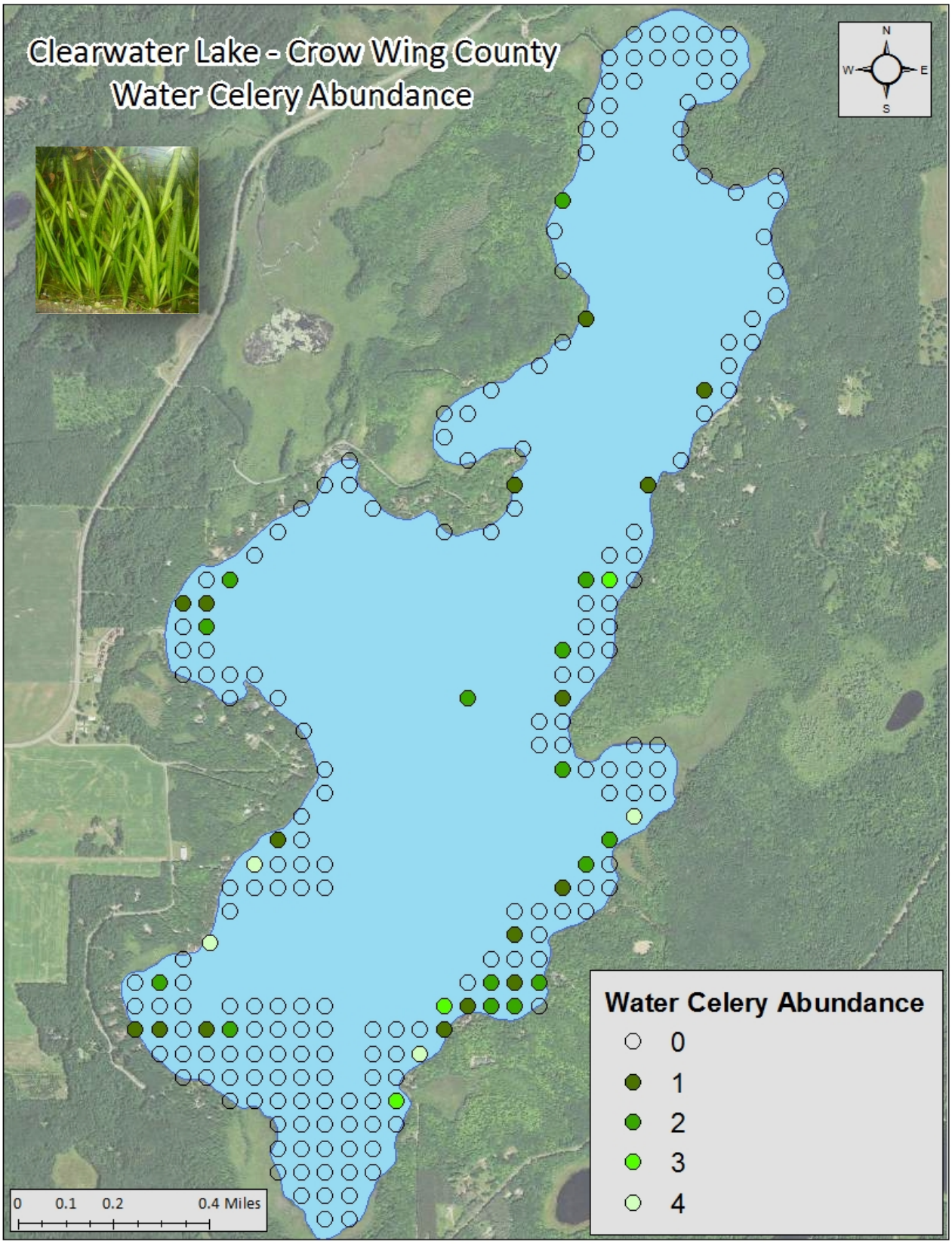


Figure 9: Density of water celery (Vallisneria americana sp.) at sample points in Clearwater Lake, Crow Wing County, MN, 30 August 2018.

Discussion

Clearwater Lake is a moderately deep lake for central Minnesota. The presence of plants and the depth at which one finds them is related to the water clarity. In areas where the sunlight does not reach the lake's bottom, there won't be plants present. Clearwater Lake has an average clarity of 12 feet, and plant abundance was greatest between two and 15 feet of water. After eleven feet, plant abundance dropped off quickly.

The Minnesota DNR lists the littoral area of Clearwater Lake to be approximately 28% of the total surface area, and the findings of this plant survey support these findings. In general, the littoral area is approximated as the area of the lake that is 20 feet deep or less; in this plant survey, no plants were found deeper than 18 feet.

Eurasian watermilfoil was the only invasive species found on Clearwater Lake; however, it did not appear to be wide-spread. Eurasian watermilfoil (EWM) was only found at <1% of sampling points, but some dense beds were found in a few locations (Figure 7).

The most abundant plants found were beneficial native plants, including Chara, Water Celery, and Bulrush (Table 2). These plants indicate good water quality and provide excellent fish and waterfowl habitat. More details about the benefits of plants can be found in the article on the next page.

Aquatic plant communities are important to a body of water because of their ability to maintain water clarity and good fish habitat. Plants in all lakes lock up nutrients in their tissues which limit algae growth keeping lakes clear and healthy. Aquatic plants produce oxygen throughout the water column as a byproduct of photosynthesis, which oxygenates the water column. Plants also help to keep the sediments stable at the bottom of the lake and prevent it from mixing into the water column. Tiny invertebrates called zooplankton eat algae and use plants as a hiding place from predators such as perch, sunfish, and crappies.

Lake Learning

Aquatic Plants – Good or Bad?

If you've spent any length of time at your favorite Minnesota lake, chances are you're no stranger to aquatic plants. Maybe you've cast into lily pads looking for bass, watched minnows dart to safety in plant beds, pulled in an anchor covered with green vegetation, or waded through a few plants while swimming.

Figure 3. Native beneficial aquatic plants.

Unfortunately, most people see aquatic plants as problems. They perceive lakes or lakeshores with lots of so-called "weeds" as messy and in need of cleaning. But what a cabin owner sees as a weedy mess is an essential part of a lake's or river's ecosystem (MN DNR).

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The presence of plants and the depth at which one finds them is related to the water clarity. In areas where the sunlight does not reach the lake's bottom (usually deep areas), there won't be plants present.

Minnesota is home to about 150 species of aquatic plants, most of which are native species. Certain native plants can be water quality indicators. Muskgrass (*Chara*) is found more often in lakes with good water clarity. Though it gives off a 'musky' odor when brought to the surface, it is a great bottom stabilizer and slows the suspension of sediments; therefore, large communities of it can greatly benefit water quality and clarity. This plant is also wonderful habitat for fish and is a favorite food for waterfowl.

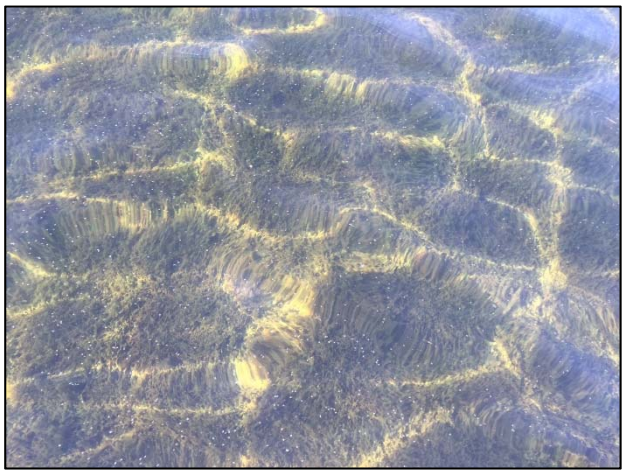

Figure 4. A Muskgrass (Chara) meadow in clear water.

Bladderwort is a very interesting native aquatic plant. It is carnivorous and captures small invertebrates with its bladder-like traps. Despite their small size, the traps are extremely sophisticated. The prey brush against trigger hairs connected to the trapdoor. The bladder, when "set", is under negative pressure in relation to its environment so that when the trapdoor is mechanically triggered, the prey, along with the water surrounding it, is sucked into the bladder. Once the bladder is full of water, the door closes again, the whole process taking only ten to fifteen milliseconds

Bulrush is very important to a lake for many reasons. It provides spawning habitat for crappies, filters the water, and helps to prevent shoreline erosion by acting as a wave break. It is imperative to protect bulrush beds in lakes for these reasons. Larger leave plants, such as the pondweeds, are important spawning and hiding areas for panfish.

Figure 5. Bladderwort, a carnivorous aquatic plant that is common in Minnesota lakes.

Homeowners should be careful not to cut or remove large areas of native plants in the lake. When aquatic plants are uprooted, the lake bottom is disturbed, and the phosphorus in the water column gets used by algae instead of plants. This contributes to "greener" water and more algae blooms. Protecting native aquatic plant beds will ensure a healthy lake and healthy fishery. If a swimming area is necessary in front of people's docks, clear only a small area of plants. Clearing a whole 100 foot frontage is not necessary and can contribute to additional algae blooms. The natural, healthy state of shallow lakes and bays is to have clear water and abundant native plant growth.

Some aquatic plants in Minnesota are not native and they may cause problems. Control of these species may be done to reduce interference with boating or swimming, to reduce the risk of spread of invasive species to un-infested water-bodies, or in some situations to attempt to produce ecological benefits such as increases in native plant communities. A DNR permit is needed for removal of aquatic plants including aquatic invasive species, and also for plant control devices such as weed rollers.

Resources
DNR Guide to Aquatic Plants: https://www.dnr.state.mn.us/shorelandmgmt/apg/index.html
Permits to control aquatic plants: https://www.dnr.state.mn.us/shorelandmgmt/apg/permits.html
DNR AIS Specialists: https://www.dnr.state.mn.us/invasives/ais/contacts.html
AIS permits: https://www.dnr.state.mn.us/invasives/training_permits.html

Enjoy the lakes! This article was written and shared by Moriya Rufer at RMB Environmental Laboratories as part of continuing education for their Lakes Monitoring Program (218-846-1465, lakes@rmbel.info). To learn more, visit www.rmbel.info.

Survey Photos

Figure 6. Eurasian watermilfoil in Clearwater Lake, Crow Wing County, 30 August 2018.

Figure 7. Eurasian watermifoil in Clearwater Lake, Crow Wing County, 30 August 2018.

Figure 8. Matted Eurasian watermilfoil in Clearwater Lake, Crow Wing County, 30 August 2018.

Literature Cited

Blickenderfer, Mary. 2007. A Field Guide to Identification of Minnesota Aquatic Plants. University of Minnesota Extension.

Borman, Susan et. al. 1997. Through the Looking Glass…a Field Guide to Aquatic Plants. University of Wisconsin Extension.

Madsen, J. D. 1999. Point intercept and line intercept methods for aquatic plant management. *APCRP Technical Notes Collection* (TN APCRP-M1-02). U.S. Army Engineer Research and Development Center, Vicksburg, MS. www.wes.army.mil/el/aqua

Aquatic Plants In Minnesota Lakes

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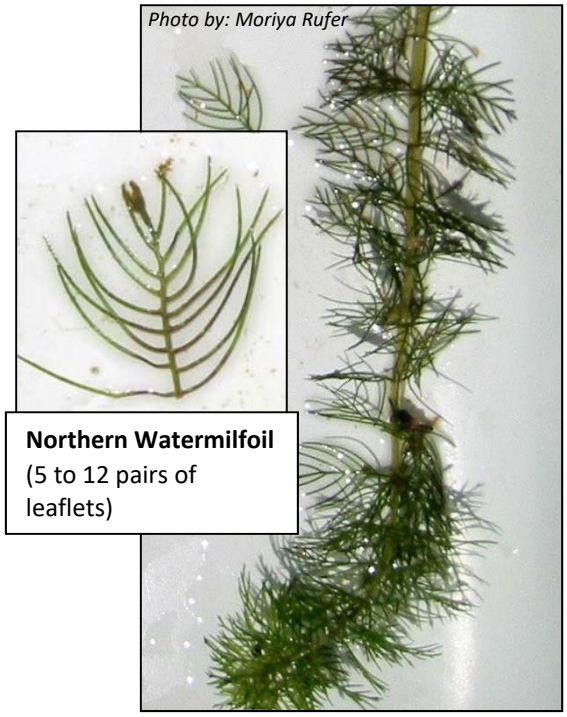
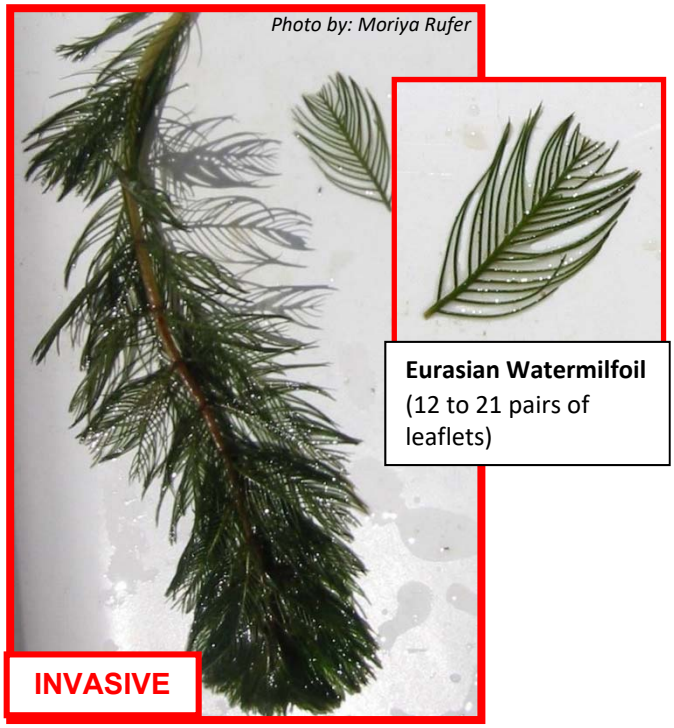
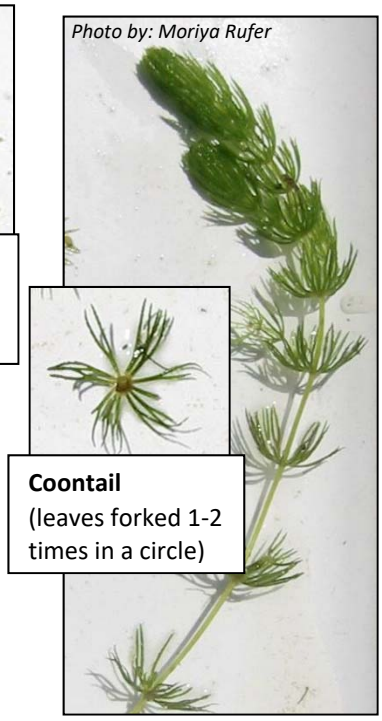


Northern Watermilfoil
(*Myriophyllum sibiricum)*

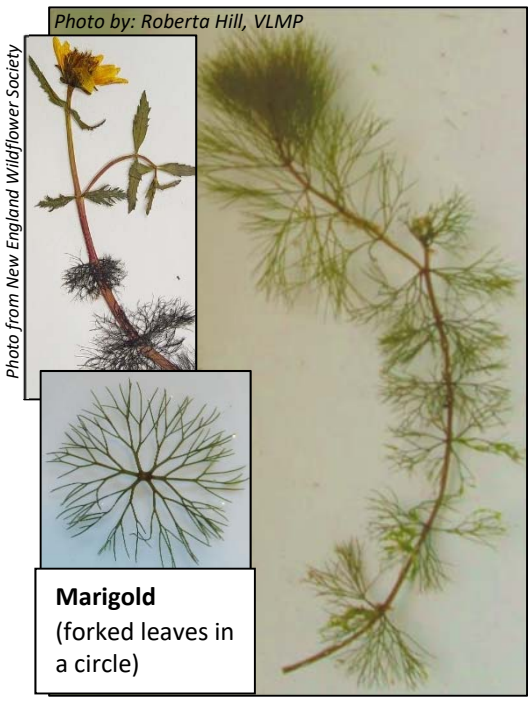


Eurasian Watermilfoil
(*Myriophyllum spicatum)*

Bladderwort
(*Utricularia vulgaris*)



Coontail
(Ceratophyllum demersum)



Water Marigold
(Bidens beckii)

Aquatic Plants In Minnesota Lakes

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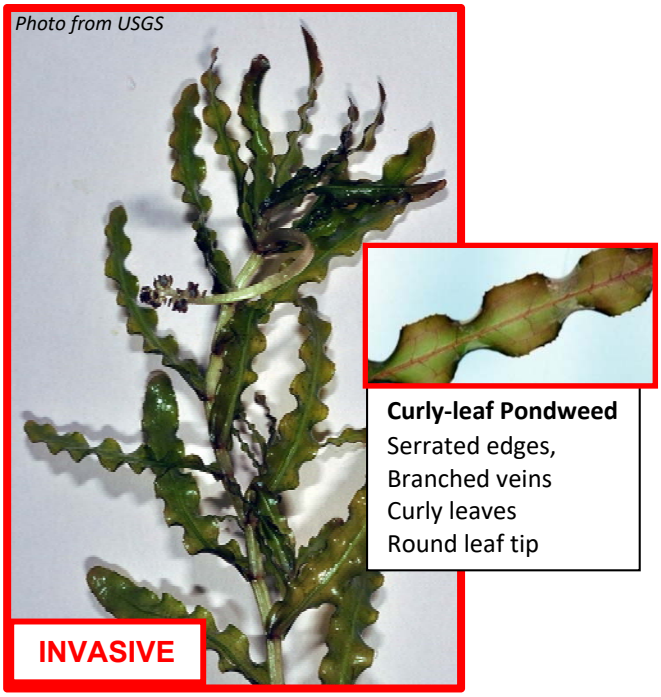

Curly-leaf Pondweed
Serrated edges,
Branched veins
Curly leaves
Round leaf tip

Curly-leaf Pondweed
(*Potamogeton crispus*)

Whitestem Pondweed
Leaf 'clasps' the stem,
Straight edges,
Parallel veins
'Bowled' leaf tip

Whitestem Pondweed
(*Potamogeton praelongus*)

Claspingleaf Pondweed
Leaf 'clasps' the stem,
Straight edges,
Parallel veins
Pointed leaf tip

Claspingleaf Pondweed
(*Potamogeton richardsonii*)

Robbin's Pondweed
Finely serrated edges,
Pointed leaf tip,
Leaf 'clasps' the stem

Robbin's Pondweed
(*Potamogeton robinsii)*

Aquatic Plants In Minnesota Lakes

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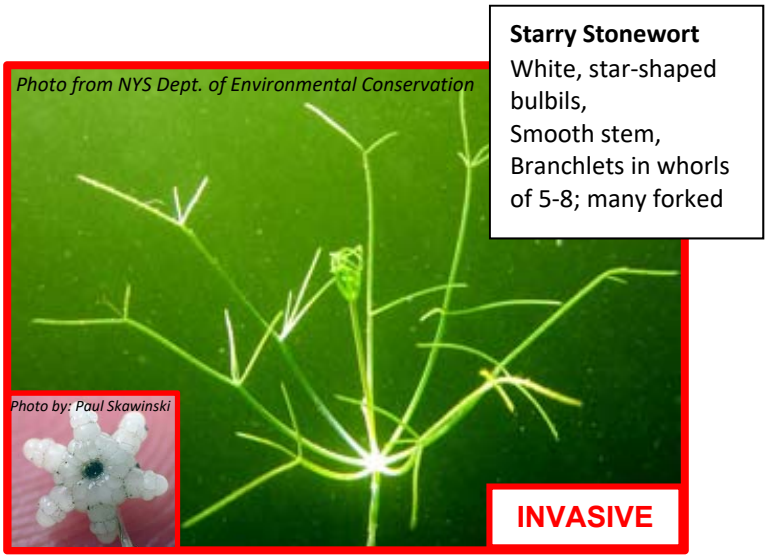
Chara
(*Chara spp.*)



Starry Stonewort
(*Nitellopsis obtuse)*

Sago Pondweed
(*Potamogeton pectinatus)*

Brittle Naiad
(*Najas minor)*

Aquatic Plants In Minnesota Lakes

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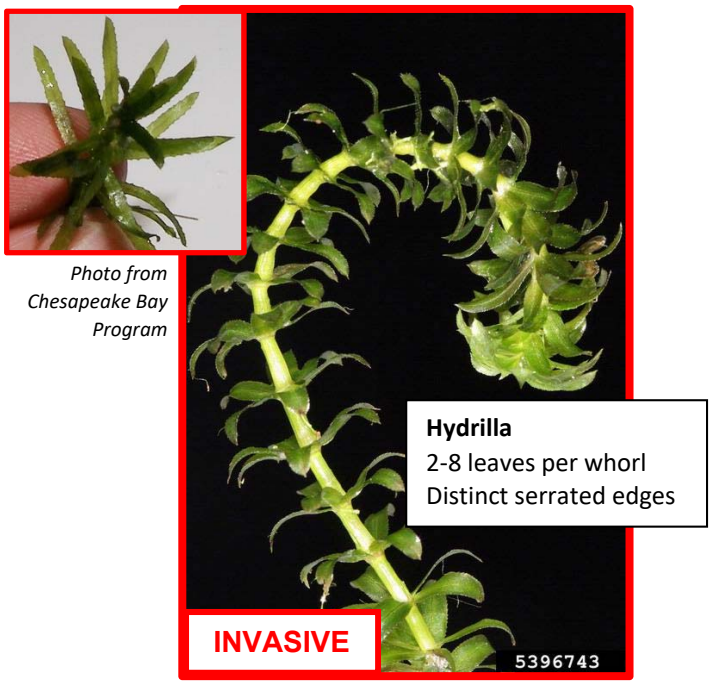
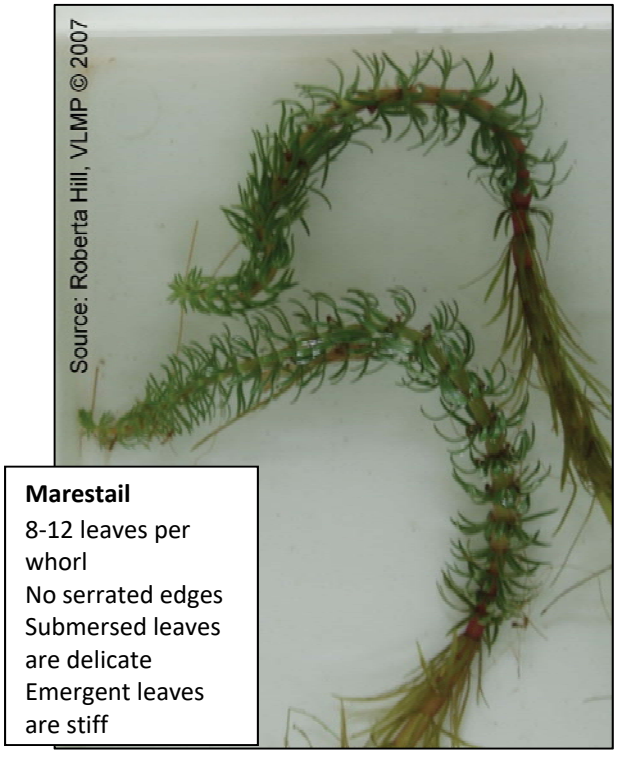
Brazilian Elodea
(Egeria densa)



Hydrilla
(*Hydrilla verticillata*)

Canada Waterweed
(Elodea canadensis)



Marestail
(*Hippuris vulgaris)*