Aquatic Vegetation of Lake Maria (Little Mary Lake)

Surveyed June 2005 and June 2006
ID #86-0139-00
Wright County, Minnesota

Cattails and waterlily bed on shore of Lake Maria. 2005

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Summary

Little Mary Lake is a 125 acre, shallow, nutrient-rich lake in central Minnesota. Aquatic vegetation surveys were conducted in June 2005 and 2006.

Aquatic plants were scattered around the entire perimeter of the lake but vegetation growth was limited by low water clarity. Plants were found to a depth of 11 feet but were most frequent in the shore to three feet depth zone, where 63% of the sites in 2005 and 57% of the sites in 2006 contained plants. Lakewide, plants were present in 27% of the sample sites in 2005 and 43% of the sample sites in 2006.

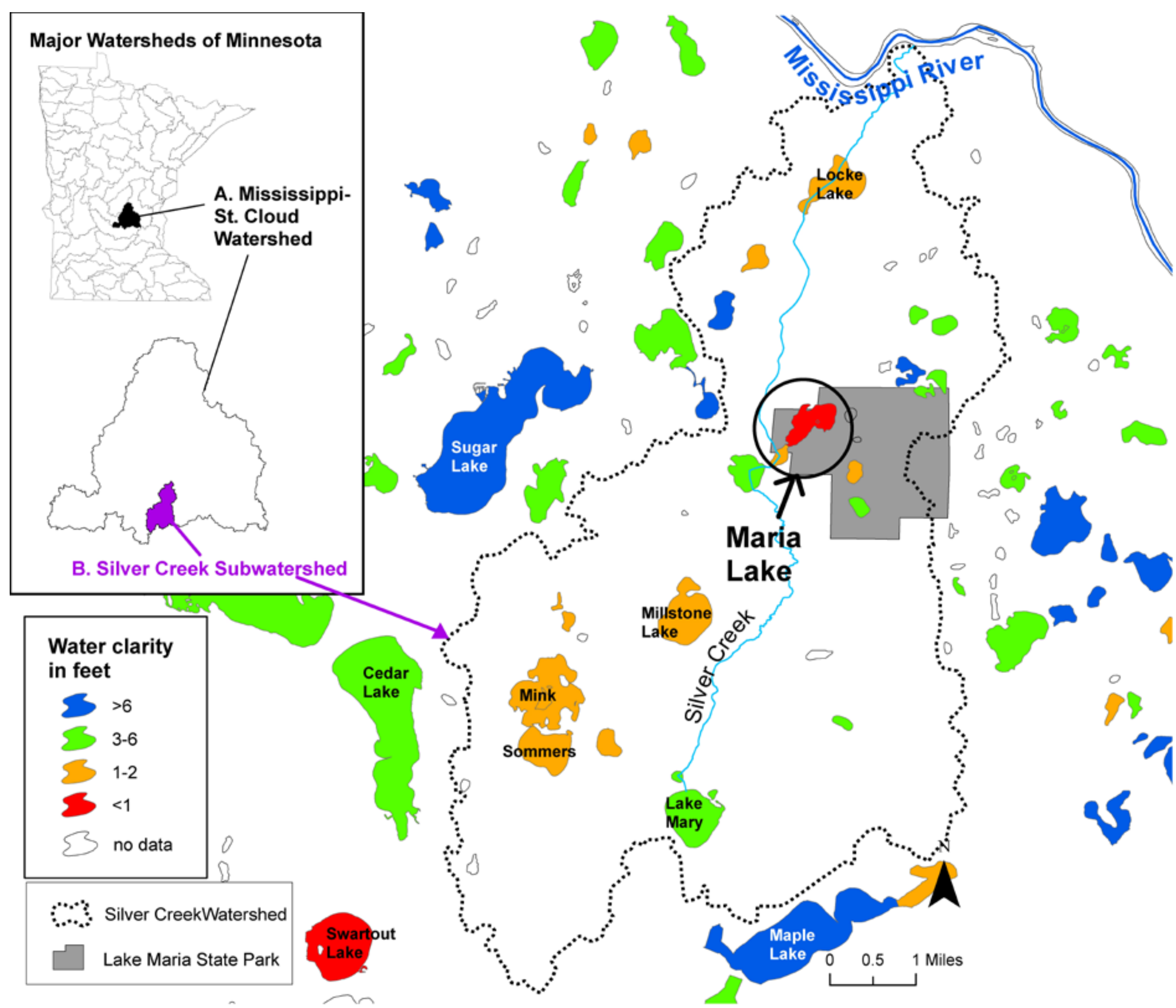
A total of nine aquatic plant species were recorded in the lake and included one emergent, two floating-leaved, and six submerged plants. The submerged plant community was dominated by species that are tolerant of turbidity. The most frequently occurring submerged species were coontail (*Ceratophyllum demersum*) and Canada waterweed (*Elodea canadensis*). Coontail increased in frequency from 2005 to 2006 but other species remained stable. The non-native plant curly-leaf pondweed (*Potamogeton crispus*) was found in eight percent of the sample sites in 2005 and six percent in 2006. It was most frequent in depths from shore to three feet. Eurasian watermilfoil was first detected in the lake in 2006 and was found in three sample sites.

Introduction

Lake Maria (or Little Mary Lake) is located in Wright County, central Minnesota in the St. Cloud-Mississippi River Watershed (Figure 1 inset). It occurs about five miles south of the Mississippi River within the Silver Creek sub-watershed (Figure 1). Silver Creek flows north from Lake Mary through the west end of Lake Maria and into Locke Lake but a downstream barrier on the creek isolates Locke Lake from the Mississippi River.

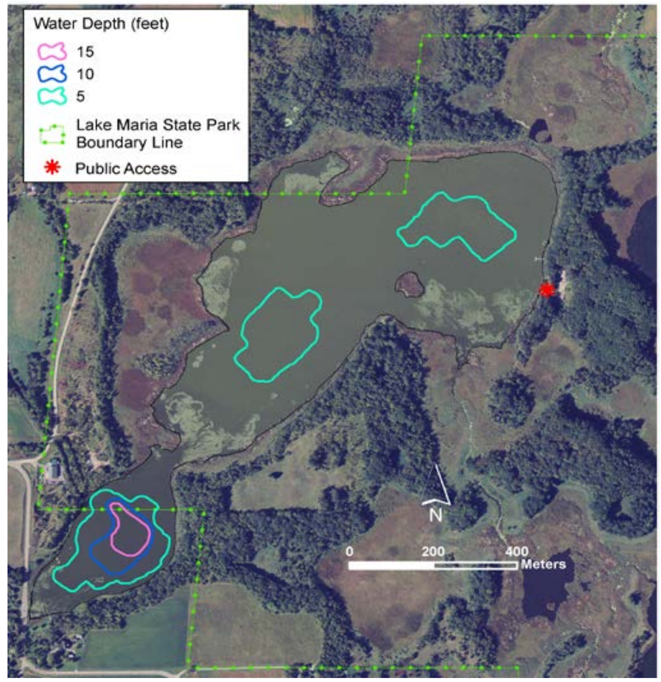
Land use in the watershed is primarily agricultural which contributes to low clarity (less than 2 feet) in many of the lakes. Lake Maria is one of three lakes contained primarily within Lake Maria State Park. High quality hardwood forests still remain within the Park and provide an important shoreline buffer for Lake Maria.

Figure 1. Water clarity of Lake Maria and other lakes within Silver Creek Watershed. (water clarity data from U of MN satellite imagery project: http://lakes.gis.umn.edu)



Lake Maria has an elongated outline with a north and a south basin. The lake covers about 125 acres and has a total shoreline length of about three miles. It is a shallow lake with a maximum depth of 15 feet in the south basin and five feet in the north basin (Figure 2). Lake Maria is characterized as hypereutrophic (very high nutrients). Water quality data are limited but compared to other lakes in the area, Lake Maria is among the lowest in clarity (Figure 2). In 2009, the mean summer[1] water clarity, as measured by Secchi disc readings[2], was 0.5 feet in the north basin and 0.8 feet in the south basin. Based on Secchi disk measurements alone, aquatic plants have the potential to reach depths of only one to two feet in the lake[3].

Figure 2. Lake Maria depth contours (contours based on 2005-2006 data).



Motorized boats are not permitted on the lake but canoe access is available on the east shore. Privately owned shoreline lots on the south basin have been developed with residential homes.

Amounts and types of aquatic plants in Minnesota lakes

Within a lake, types and amounts of aquatic plants are influenced by a variety of factors including water clarity, water chemistry, water depth, substrate, and wave activity. Deep or wind-swept areas may lack aquatic plant growth, whereas sheltered shallow areas may support an abundant and diverse native aquatic plant community. The annual abundance, distribution and composition of aquatic plant communities may change due to environmental factors, predation, the specific phenology of each plant species, introductions of non-native plant or animal species and human activities in and around the lake.

Aquatic plants can be divided into four groups or "life forms" based on whether the main portion of the plant occurs above, on, or below the water surface. These life forms: emergent, floating-leaved, free-floating and submerged plants (Figure 3), often favor certain water depth

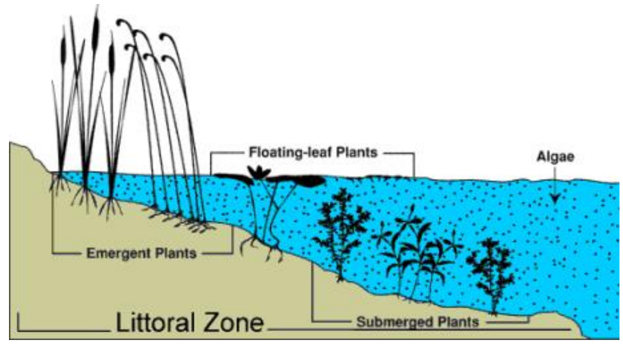
[1] June through September

[2] The Secchi disc transparency measures the depth to which a person can see into the lake and provides a rough estimate of the light penetration into the water column. Water clarity is influenced by the amount of particles in the water column and can fluctuate seasonally and annually.

[3] As a general rule, sunlight can penetrate to a depth of two times the Secchi depth and aquatic plants can grow to a depth of one and a half times the Secchi depth.

zones around the lake but overlap occurs with one life form grading into another. Each life form group has unique functions and values.

Figure 3. Forms of aquatic plants found in Minnesota lakes.



Emergent plants, like cattails and bulrush, are rooted in the lake bottom with most of their leaves and stems extending above the water surface. Floating-leaf plants, such as waterlilies, are also anchored in the lake bottom with leaves and flowers that float on the water surface. Root systems of these plants form extensive networks that take up nutrients and help consolidate and stabilize bottom substrate. Beds of floating-leaf and emergent plants also help buffer the shoreline from wave action, offer shelter for insects and young fish, and provide shade for fish and frogs. These beds also provide food, cover and nesting material for waterfowl, marsh birds and muskrat. Floating-leaf and emergent plants are most often found in shallow water to depths of about six feet and may extend lake-ward onto mudflats and into adjacent wetlands.

Submerged plants have stems and leaves that primarily grow underwater but they may also form flowers, fruits and some leaves that emerge above or float on the water surface. Submerged plants are typically anchored to the lake bottom but some species do drift freely with the currents. This group includes non-flowering plants such as large algae, mosses, and fern-like plants, and flowering plants that may produce flowers above or below the water surface. Submerged plants may form low-growing mats or may grow several feet in the water column with leaf shapes that include broad ovals, long and grass-like, or finely dissected. Submerged plants release oxygen into the water column, compete for nutrients with microscopic algae, and provide food and shelter for a variety of invertebrates, fish, amphibians and other wildlife.

Free-floating plants are the smallest of Minnesota's lake plants and include small flowering plants that are commonly known as "duckweeds" as well as microscopic algae. Different survey methods are required to assess microscopic algae and they are not included in this report. Duckweeds are present in many Minnesota lakes and if present in sufficient amounts, they can accumulate into mats and create a shade barrier along protected shorelines. As their name implies, they are also an important food source for waterfowl.

Plant species richness is a term used to describe the total number of plant species present in a lake and it can be used to help describe the general health of the waterbody. In Minnesota, plant species richness can range from zero (un-vegetated lakes) to more than 40 species in a lake[4]. Species richness is generally higher in high clarity lakes than in turbid lakes and more species are usually found in moderately fertile lakes than in nutrient poor lakes. Therefore,

[4] These values are from a review of MNDNR lake vegetation surveys.

lakes of north central Minnesota are often among the "richest" in terms of numbers of plant species. Water quality changes that result in lower clarity may also result in the loss of some plant species, or lower species richness.

Objectives

The purpose of this vegetation survey was to provide a quantitative description of the plant population of Lake Maria. Specific objectives included:

1. Describe the general distribution of plants in the lake including the depths at which plants occur.
2. Record the aquatic plant species that occur in the lake
3. Estimate the abundance of each species
4. Develop distribution maps for the commonly occurring species
5. Compare the 2005 and 2006 plant communities

Methods

Lakewide vegetation survey

A lakewide vegetation survey was conducted on June 26, 2005 and June 6, 2006 using a point-intercept survey method (Madsen 1999, MnDNR 2009). Survey waypoints were created using a GIS computer program and downloaded into a handheld GPS unit. Survey points were placed across the entire lake and spaced 50 meters (164 feet) apart, resulting in about one survey point per acre (Figure 4, Table 1). The survey was conducted by boat and a GPS unit was used to navigate to each sample point. One side of the boat was designated as the sampling area.

Figure 4. Vegetation survey sites.

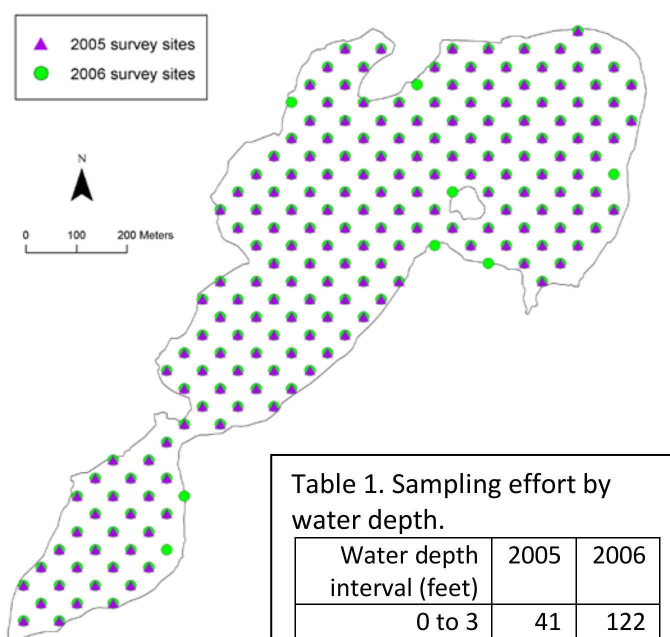
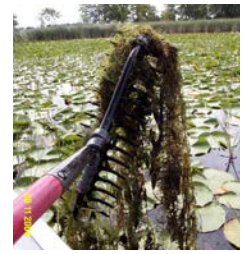


Table 1. Sampling effort by water depth.

Water depth interval (feet)	2005	2006
0 to 3	41	122
4 to 6	137	67
7 to 15	15	12
Total sample points	193	201

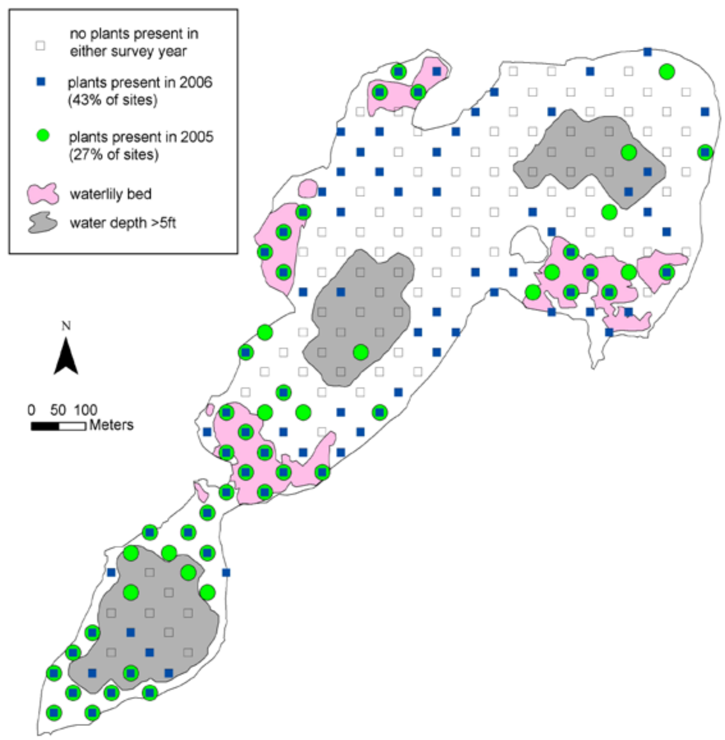
Surveyors recorded all plant species found at each sample site (approximately a one square meter sample site at the pre-designated side of the boat). A double-headed, weighted garden rake, attached to a rope was used to survey vegetation not visible from the water surface (Figure 5). Any additional plant species found outside of sample sites were recorded as "present" in the lake but these data were not used in frequency calculations. Plant identification followed Crow and Hellquist (2000) and Flora of North America (1993+) and nomenclature followed MnTaxa (2011).

Figure 5. Survey rake.



A total of 193 sites were surveyed in 2005 and 201 sites were surveyed in 2006. Only sites that were surveyed in both years were used to calculate frequency data. Frequency was calculated for the entire lake and data were also separated into 3 feet increment depth zones for analysis (Table 1). Frequency estimates were also calculated for individual species and selected groups of species (Appendix 1).

Figure 6. Aquatic Plant Distribution, 2005 and 2006.



Results and Discussion

Distribution of aquatic plants

Plants were scattered around the entire lake in both survey years and the percent of vegetated sites ranged from 27% in 2005 to 43% in 2006 (Figure 6). Plant growth was found to 10 feet in 2005 and to 11 feet in 2006 but in both years, plant frequency was highest (about 60%) in depths of 0 to 3 feet; in deeper water about 20% of sites contained plants (Figure 7).

Types of plants recorded

A total of nine aquatic plant species (types) were recorded in Lake Maria (Table 2) including one emergent, two floating-leaved and six submerged plants. Two of the submerged plants, curly-leaf pondweed and Eurasian watermilfoil, are not native to Minnesota.

The highest number of plant species was found in shallow water, from shore to a depth of three feet (Figure 8).

Figure 7. Plant occurrence by water depth.

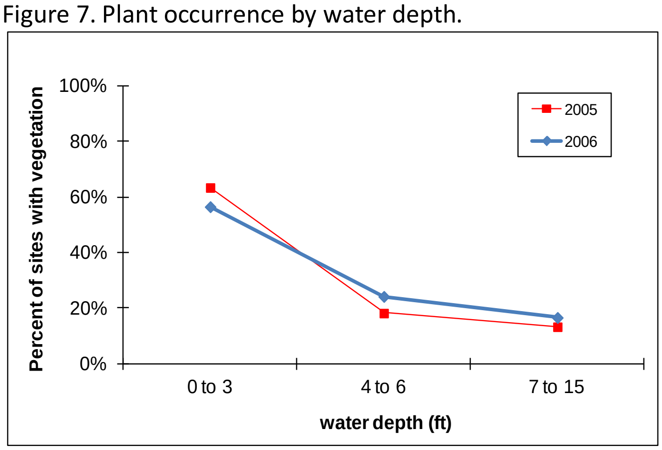


Table 2. Frequency of aquatic plants in Little Mary Lake Point-intercept survey, June 2005 and 2006.

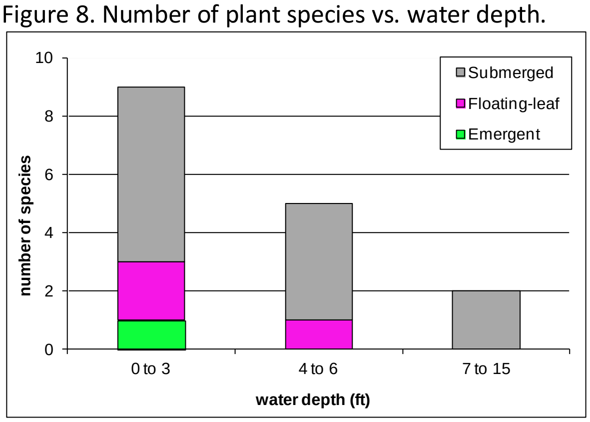
(Frequency is the percent of sample sites in which a plant species occurred within the shore to 15 ft water depth.)

Life Form	Common Name	Scientific Name	Frequency 2005 (n=193)	Frequency 2006 (n=193)
NATIVE SUBMERGED	Coontail	*Ceratophyllum demersum*	9	36
	Canada waterweed	*Elodea canadensis*	10	10
	Sago pondweed	*Stuckenia pectinata*	1	1
	Narrow-leaved pondweed	*Potamogeton* sp.*	--	2
NON-NATIVE SUBMERGED	Curly-leaf pondweed	*Potamogeton crispus*	8	6
	Eurasian watermilfoil	*Myriophyllum spicatum*	--	1
FLOATING	White waterlily	*Nymphaea odorata*	10	9
	Yellow waterlily	*Nuphar variegata*	1	--
EMERGENT	Narrow-leaf cattail	*Typha angustifolia*	Present	Present

*Specimens of "narrow-leaved pondweeds" were not identified to species.
Present = Found in lake but not within sample sites.

Only two submerged species (coontail and Canada waterweed) occurred in depths greater than six feet (Figure 8). Most sites contained no plants or only one species.

Figure 8. Number of plant species vs. water depth.



Floating-leaved and emergent plants

No in-lake beds of emergent plants were detected but cattails (*Typha* sp.) were common along shorelines. Twenty-two acres of waterlily beds were mapped (Figure 6). White waterlily (*Nymphaea odorata*; Figure 9) was the most common floating-leaf plant and was found in about 10% of the sites in both years. Yellow waterlily (*Nuphar variegata*; Figure 10) was also present. Waterlilies occurred in depths less than six feet and often included submerged plants.

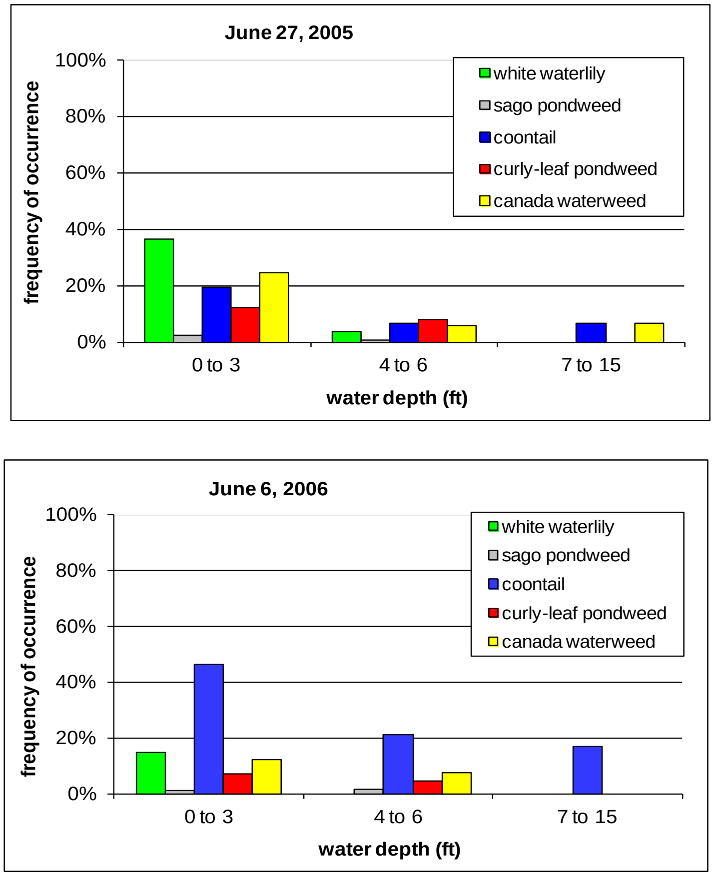
Figure 9. White waterlily

Figure 10. Yellow waterlily

Submerged plants

The submerged plant community was comprised of species that are tolerant of lower clarity including four native species (coontail, Canada waterweed, sago pondweed and narrow-leaf pondweed) and two non-native species (curly-leaf pondweed and Eurasian watermilfoil).

Figure 11. Frequency of common plant by water depth interval 2005 and 2006.



Coontail (*Ceratophyllum demersum*) was the deepest growing plant in both years and was found to 10 feet in 2005 and to 11 feet in 2006. It was the most common submerged species in 2006, occurring in 36% of the sample sites. It increased in frequency from 9% in 2005 (Table 2). In both years it was most frequent in the 0 to 3 feet depth zone and in 2006 it was the only plant found in depths greater than six feet (Figure 11).

Coontail (Figure 12) grows entirely submerged and its roots are only loosely anchored to the lake bottom. It is adapted to a broad range of lake conditions and is tolerant of higher turbidity and can grow in muck substrates (Nichols 1999). Coontail is perennial and can over winter as a green plant under the ice and then begins new growth early in the spring, spreading primarily by stem fragmentation. The finely divided leaves of this plant provide a home for insects valuable as fish food.

Figure 12. Coontail

Canada waterweed (*Elodea canadensis*) was found in 10% of the sites in 2005 and 2006 (Table 2). It was found to a depth of 7 feet in 2005 and 6 feet in 2006 but in both years was most frequent in depths of three feet and less (Figure 11). This perennial submerged species (Figure 13) is widespread throughout Minnesota. It is adapted to a variety of conditions and is tolerant of low light and prefers soft substrates (Nichols 1999). Canada waterweed can overwinter as an evergreen plant and spreads primarily by fragments.

Figure 13. Canada waterweed.

Sago pondweed (*Stuckenia pectinata*) and narrow-leaf pondweed (*Potamogeton* sp.) are related species that look very similar. Both occurred infrequently in Little Mary Lake in both survey years, occurring in two percent or less of the survey sites. These submerged plants

(Figure 14) have very narrow-leaves and produce seeds and tubers that are an important source of waterfowl food (Fassett 1957). The foliage of pondweeds is food for a variety of marsh birds, shore birds and wildlife and provides shelter, shade and spawning sites for a range of fish species (Borman et al. 2001).

Figure 14. Sago pondweed

Curly-leaf pondweed (*Potamogeton crispus*) is related to the native Sago pondweed and narrow-leaf pondweed but has broader leaves (Figure 15) and is not native to Minnesota. This plant was found in eight percent of the survey sites in 2005 and six percent of the sites in 2006 (Table 2). It occurred to a depth of 6 feet in both years.

Figure 15. Curly-leaf pondweed.

Curly-leaf pondweed is a submerged plant that has been present in Minnesota since at least 1910 (Moyle and Hotchkiss 1945) and is now found in more than 700 Minnesota lakes (Invasive Species Program 2010). Like many native submerged plants, it is perennial but has a unique life cycle that may provide a competitive advantage over native species. Curly-leaf pondweed is actually dormant during late summer and begins new growth in early fall. Winter foliage is produced and continues to grow under ice (Wehrmeister and Stuckey 1978). Curly-leaf reaches its maximum growth in May and June, when water temperatures are still too low for most native plant growth. In late spring and early summer, curly-leaf plants form structures called “turions” which are hardened stem tips that break off and fall to the substrate. Turions remain dormant through the summer and germinate into new plants in early fall (Catling and Dobson 1985). The foliage of curly-leaf pondweed does provide some fish and wildlife habitat, but it may also create problems in some lakes, or in areas of some lakes. During its peak growth in spring, curly-leaf may reach the water surface at certain depths and create dense mats. These dense growths may compete with native vegetation and can also cause problems for recreational lake users. Protecting existing native plant beds may help reduce possible negative impacts of non-native species like curly-leaf pondweed.

Eurasian watermilfoil (*Myriophyllum spicatum*; Figure 16) was first documented in Little Mary Lake during the 2006 point-intercept survey. It was found in only three survey sites and was found to a depth of three feet.

Figure 16. Eurasian watermilfoil

This non-native plant has feather-shaped leaflets and roots in the lake bottom. In clearer lakes it may grow to depths of 20 feet and may reach the water surface in shallower water. It is closely related to a native plant, northern watermilfoil which was not found in Little Mary Lake. For information on how to distinguish the non-native, Eurasian watermilfoil from the native northern watermilfoil, click here: identification.

Factors influencing aquatic plant communities

The types and amounts of aquatic vegetation that occur within a lake are influenced by a variety of factors including water clarity, water chemistry, depth, substrate type, and wave activity. Monitoring change in the aquatic plant community can be helpful in determining whether changes in the lake water quality are occurring and for estimating the quality of vegetation habitat available for fish and wildlife communities. Data collected in 2005 and 2006 can be used to monitor finer-scale changes that may occur, such as an increase in a particular species, loss of species, or changes in the depths at which individual species occur. In general, factors that may lead to change in aquatic plant communities include:

- Change in water clarity

  If water clarity in Little Mary Lake increases, submerged vegetation may be more common at depths greater than 5 feet. Increases in water clarity may lead to more rooted plants and more types of plants in the deep end of the current vegetated zone.

- Snow and ice cover

  Many native submerged plants also have the ability to grow under the ice, especially if there is little snow cover and sunlight reaches the lake bottom. In years following low snow cover, and/or a reduced ice-over period, submerged plants may increase in abundance or there may be a shift in species dominance.

- Water temperatures / length of growing season

  In years with cool spring temperatures, submerged plants may be less abundant than in years with early springs and prolonged warm summer days.

- Aquatic plant management activities

  Humans can impact aquatic plant communities directly by destroying vegetation with herbicide or by mechanical means. The results of these control activities can be difficult to predict and should be conducted with caution to reduce potential negative impacts to non-target species. Motorboat activity in vegetated areas can be particularly harmful for species such as wild rice. Shoreline and watershed development can also indirectly influence aquatic plant growth if it results in changes to the overall water quality and clarity. For information on the laws pertaining to aquatic plant management: MnDNR APM Program.

The abundance and assortment of aquatic plants found in Little Mary Lake provides a habitat complexity that can be utilized by a variety of fish and wildlife and also provides a variety of other lake benefits. Protecting existing native aquatic plant beds will help maintain critical fish and wildlife habitat and the general water quality of the lake.
(Click here for more information on: value of aquatic plants).

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Appendix 1: Calculation of plant abundance

Frequency of occurrence was calculated as the percent of sites, within a specific depth zone, where a plant species was detected. Unless otherwise noted, frequency values were calculated for the 0 to 15 feet depth zone.

Example:

In Little Mary Lake there were 193 sample sites in the 0 to 15 feet depth zone.
Coontail occurred in 69 sites in 2006.
Frequency of Coontail in 0 to 15 feet zone = (69/193)*100 = 36%