Aquatic vegetation of Little Rock Lake

May-June, 2005

ID# 05-0013-00

Benton County, Minnesota

Canada waterweed (*Elodea canadensis*), a common native species found in Little Rock Lake

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Summary

Little Rock Lake is a shallow, nutrient rich lake in central Minnesota. Historically, this lake contained a relatively diverse, native aquatic plant community. Water clarity has declined over the decades and the lake experiences frequent summer algal blooms. An aquatic vegetation survey was conducted in May and June 2005 to assess the Spring plant community. This survey focused on assessing curly-leaf pondweed, a non-native submerged plant that is most common in late Spring and early Summer.

This survey included a lakewide assessment of vegetation and water depths at 311 sample stations. Plants were found to a depth of 13 feet but were most frequent in the 4 to 6 feet depth zone, where 87% of the sites contained plants. Lakewide, about 50% of the sites contained plants.

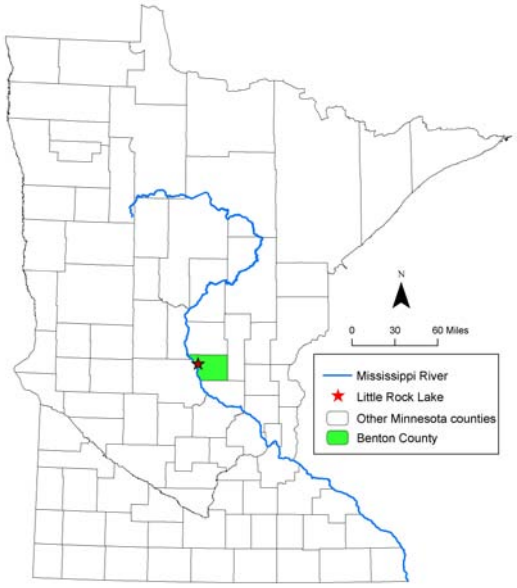
The non-native submerged species, curly-leaf pondweed (*Potamogeton crispus*), was the most commonly occurring plant and was found in 44% of the sites. At most of the sites (34%) where curly-leaf was found, it was the only plant observed. Only 8% of the sites contained a mix of curly-leaf and native plants and only 6% of the sites contained only natives.

Six native submerged plant species were found in the lake but only 14% of the sites contained native plants. The most common native plants were Canada waterweed (*Elodea canadensis*), narrow-leaf pondweed (*Potamogeton* sp.), sago pondweed (*Stuckenia pectinata*), and coontail (*Ceratophyllum demersum*). These are native species that are adapted to low water clarity. Native plants that require clear water are no longer found in the lake, or occur infrequently.

Introduction

Little Rock Lake is located about two miles southeast of the city of Rice in Benton County, central Minnesota (Figure 1). The lake receives inflow from Little Rock Creek, Zuleger Creek and Sucker Creek and outlets to Little Rock Creek, which flows south to the Mississippi River. There is a dam on the Mississippi River at Sartell that controls the lake level. Water level data available from 1985 -2005 indicate that Little Rock Lake water levels may fluctuate as much as five feet in some years (Anon. 2006).

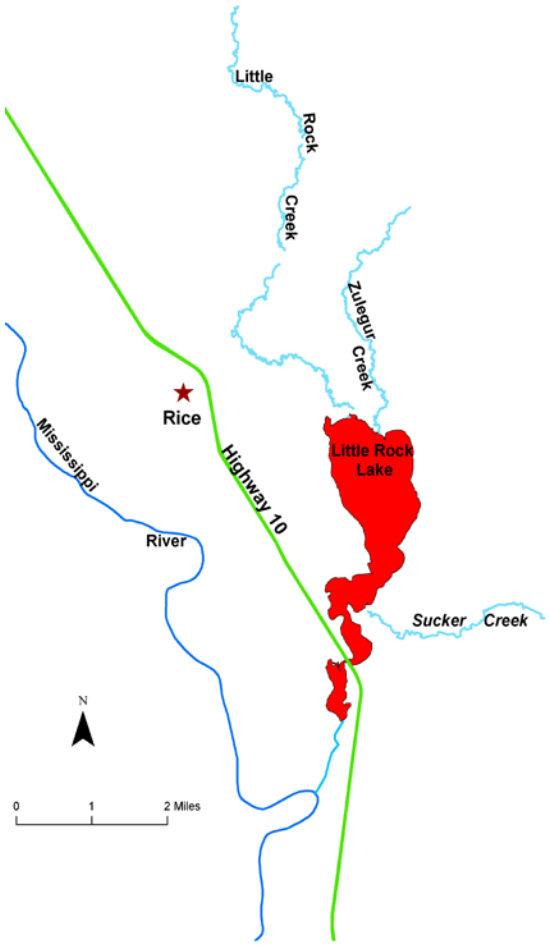
Figure 1. Location of Little Rock Lake on Mississippi River.



Lake Characteristics

Little Rock Lake is the largest lake in the county and the second largest in the Mississippi River-Sartell Watershed with a surface area of 1450 acres and about 16 miles of shoreline. The maximum depth of the lake is 23 feet but most of the lake is shallow (15 feet deep or less) (Figure 3). This lake is a very fertile, hard water lake with a large rough fish population. It is characterized as hypereutrophic (very high nutrients) (Heiskary 1991) and summer algal blooms are common and summer water clarity is low. 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. In 2005, mean summer (July through September) water clarity, as measured by Secchi disc readings, was two feet in Little Rock Lake (MPCA, 2009). 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 half times the Secchi depth. Based on Secchi disk measurements alone, aquatic plants are expected to be restricted to depths of three feet and less in this lake.

Figure 2. Flow from Little Rock Lake to Mississippi River.



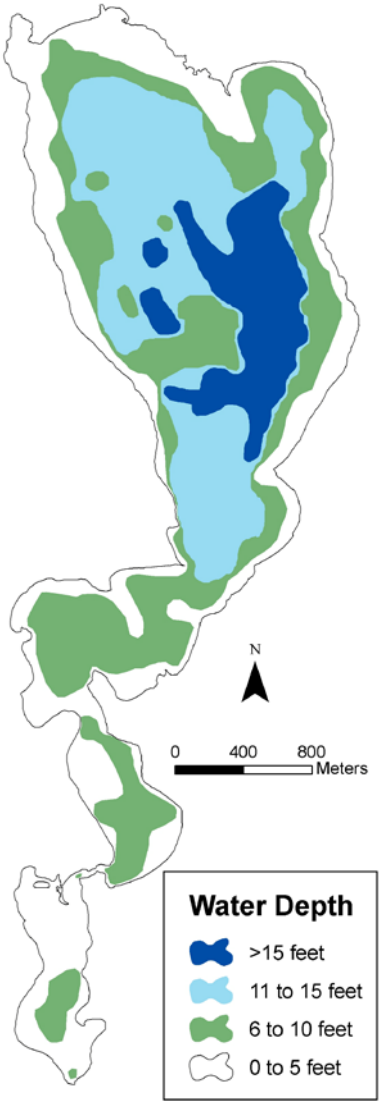
Historic aquatic plant community

In the 1940's, Little Rock Lake supported a relatively diverse and abundant aquatic plant community. Emergent plants included broadleaf cattail (*Typha latifolia*), giant cane (*Phragmites* sp.), and hard-stem bulrush (*Schoenoplectus acutus*), with numerous other marsh plants interspersed (DNR Lake Files 1945 survey). Both white waterlily (*Nymphaea odorata*) and yellow waterlily (*Nuphar variegata*) were reported to be common in the lake. Submerged plants were described as abundant in 1941 and included wild celery (*Vallisneria americana*), six different native pondweeds (*Potamogeton* spp.), coontail (*Ceratophyllum demersum*), bushy pondweed (*Najas flexilis*), mud plantain (*Zosterella dubia*) and northern watermilfoil (*Myriophyllum* sp). Many of the submerged plants that were present in 1941 grow well in clear water lakes and are not tolerant of turbidity.

An August 1945 survey still reported abundant submerged plant growth but noted an apparent decline of wild celery and sago pondweed and an increase in leafy pondweed (*Potamogeton foliosus*). These changes were associated with fluctuations in water levels and lower clarity.

By 1974, emergent bulrush plants were restricted to only the point on the east shore and waterlilies were found only occasionally. Submerged plants were found to a depth of only three feet and only three native species were reported. This trend continues today, with submerged plants restricted to very shallow water and only a few types of native plants present. Most of the native submerged plants that require clear water are no longer found in the lake.

Figure 3. Little Rock Lake depth contours (Based on 2005 data).



Curly-leaf pondweed

The non-native plant, curly-leaf pondweed (*Potamogeton crispus*) (Figure 4) has been present in Little Rock Lake since at least 1974, when it was reported as abundant (MnDNR Lake Survey Files). This submerged plant is closely related to native pondweeds but it is not native to Minnesota. It has been present in Minnesota since at least 1910 (Moyle and Hotchkiss 1945) and is now found in at least 700 Minnesota lakes (MnDNR Invasive Species Program 2008). 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).

Figure 4. Curly-leaf pondweed

Curly-leaf pondweed foliage does provide some fish and wildlife habitat, but it may also create problems. 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. If extensive areas of curly-leaf occur in a lake, when these plants die, they release nutrients into the water column that may contribute to algal blooms.

Objectives

This survey provides a quantitative description of the 2005 curly-leaf pondweed population in Little Rock Lake. Information on native plants was also collected but may be incomplete because many native plants do not reach peak growth until mid to late summer. Objectives included:

1. Estimate the maximum depth of rooted vegetation
2. Estimate the percent of the lake occupied by rooted vegetation
3. Record the aquatic plant species that occur in the lake
4. Estimate the abundance of curly-leaf pondweed and common native plant species
5. Develop distribution maps for curly-leaf pondweed and native plants

Methods

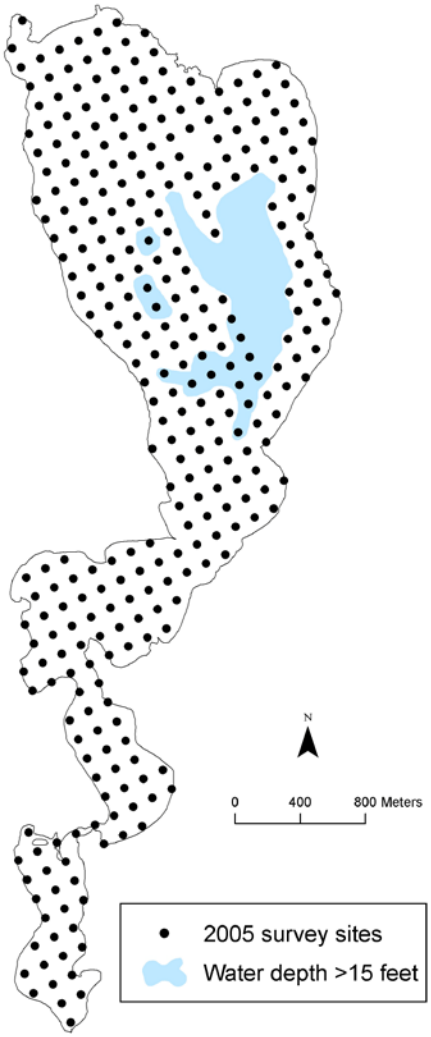
Little Rock Lake was surveyed on May 26, 31 and June 1, 2005. A point-intercept survey method was used and followed the methods described by Madsen (1999). Survey waypoints were created using a Geographic Information System (GIS) computer program and downloaded into a handheld Global Positioning System (GPS) unit. Survey points were placed across the entire lake and spaced 100 meters (328 feet) apart resulting in 311 survey sites from shore to 15 feet (Table 1, Figure 5).

Table 1. Sampling effort by water depth.

Water depth interval (feet)	Number of sample sites
0 to 3	55
4 to 6	97
7 to 9	64
10 to 12	46
13 to 15	49
Total (0 to15)	311
16 to 17	11
total	322

The survey was conducted by boat and a GPS unit was used to navigate the boat to each sample point. One side of the boat was designated as the sampling area. At each site, water depth was recorded in one-foot increments using a

Figure 5. 2005 vegetation survey sites on Little Rock Lake.



measured stick in water depths less than eight feet and an electronic depth finder in depths greater than eight feet.

Surveyors recorded all plant taxa found within a one square meter sample site at the pre- designated side of the boat. A double-headed, weighted garden rake, attached to a rope is used to survey vegetation not visible from the water surface (Figure 6). Plant identification followed Hellquist and Crow (2000) and nomenclature followed MnTaxa (2009).

Data were entered into a Microsoft Access database and frequency of occurrence was calculated for each taxon as the number of sites in which taxa occurred divided by the total number of sample sites. Frequency was calculated for the entire area from shore to 15 feet and sampling points were also grouped by water depth and separated into five depth zones for analysis (Table 1). Frequency was also calculated for the entire lake area sampled (to 17 feet) and these estimates are the values used in the Little Rock Lake Aquatic Vegetation Management Plan (Anon. 2006).

Figure 6. Sampling rake.

Results and Discussion

Number of plant taxa recorded

A total of seven native aquatic plant taxa (types) were recorded in Little Rock Lake including one floating-leaved, and six submerged taxa (Table 2). The non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*), was found.

Table 2. Frequency of aquatic plants in Little Rock Lake, May -June 2005.

[Frequency is the percent of sample sites in which a plant taxon occurred within the shore to 15 ft water depth. It is also calculated for the entire depth zone sampled (to 17 feet)].

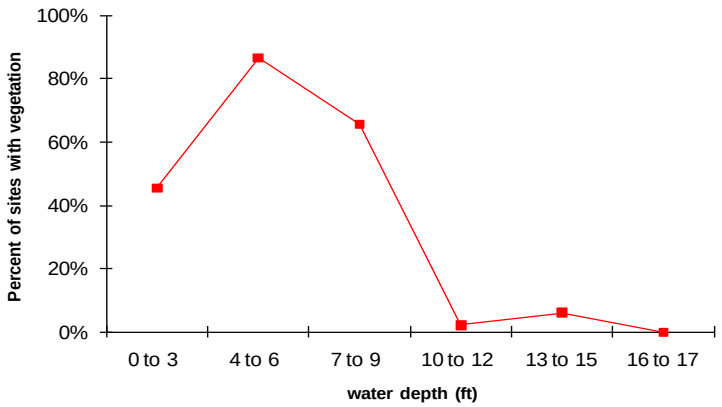
Life Form	Common Name	Scientific Name	Frequency	
			0-15 ft (311 sites)	0 to 17 ft (322 sites)
SUBMERGED	Curly-leaf pondweed	*Potamogeton crispus*	44	42
	Canada waterweed	*Elodea canadensis*	9	9
	Narrow-leaf pondweed	*Potamogeton* sp.	5	4
	Sago pondweed	*Stuckenia pectinata*	2	2
	Coontail	*Ceratophyllum demersum*	1	1
	Clasping-leaf pondweed	*Potamogeton richardsonii*	<1	<1
	Northern water milfoil	*Myriophyllum sibiricum*	<1	<1
FLOATING	White waterlily	*Nymphaea odorata*	2	2

Example: In Little Rock Lake there were 311 samples sites in the 0-15 feet depth zone. Canada waterweed occurred in 37 sites.
Frequency of Canada waterweed in 0 to 15 feet zone = (37 / 311)*100 = 9%

Distribution of aquatic plants

Plants were found in about 50% of the sites and occurred to a depth of 13 feet. Vegetation was most common in the 4 to 6 feet depth zone, where 87% of sites contained plants (Figure 7). In water depths greater than 10 feet, only 4 sites contained plants.

Figure 7. Aquatic plant frequency vs. water depth.



Plant diversity

The number of plant taxa found at each one square meter sample site ranged from zero to three with a mean of 0.6 taxa per site. The greatest number of plants was found in sites south of the Highway 10 bridge. Most sites in the main lake contained only one plant species or no vegetation (Figure 8).

Curly-leaf pondweed

The non-native submerged species, curly-leaf pondweed, was the most frequently occurring plant, occurring in 44% of all survey sites. It was found scattered around the entire lake in depths of 2 to 13 feet. At most of the sites (34%) where curly-leaf was found, it was the only plant observed (Figure 9). Only 8% of the sites contained curly-leaf and native plants and only 6% of the sites contained only natives. Curly-leaf pondweed was the dominant plant at all water depths and was most frequent in depths of 4 to 9 feet (Figure10).

Figure 8. Number of plant species at each sample site, Little Rock Lake, 2005.

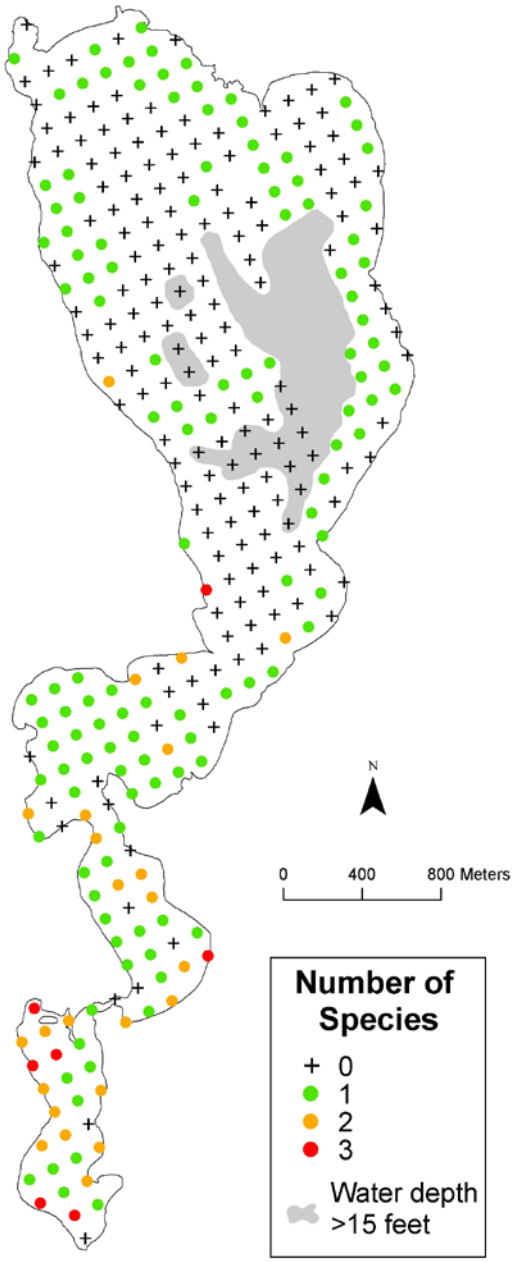


Figure 9. Distribution of Curly-leaf pondweed vs. native species, 2005.

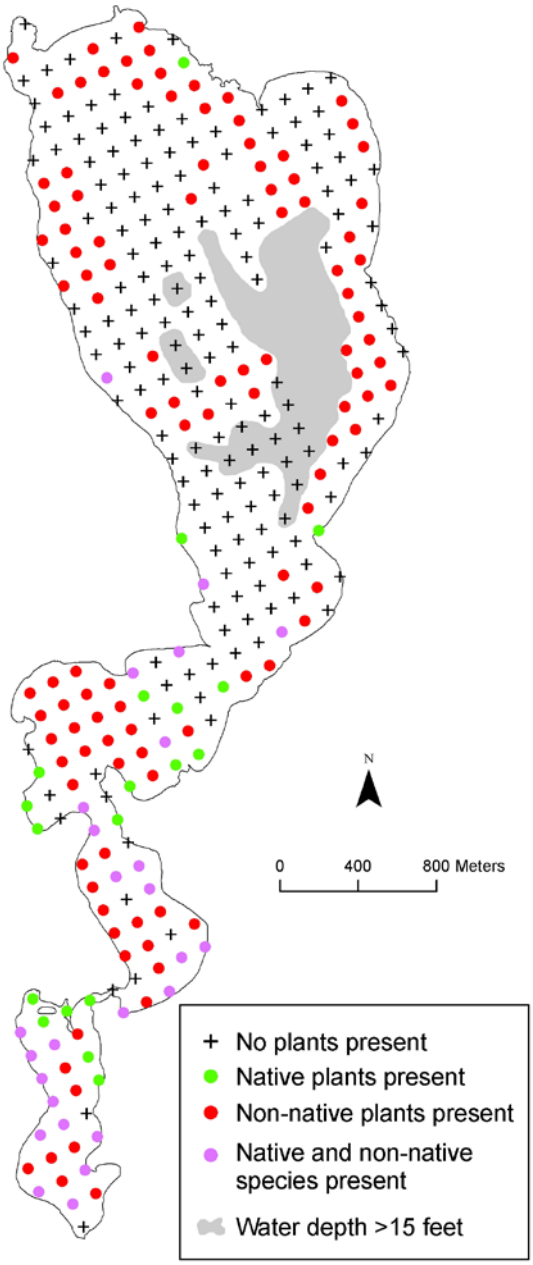
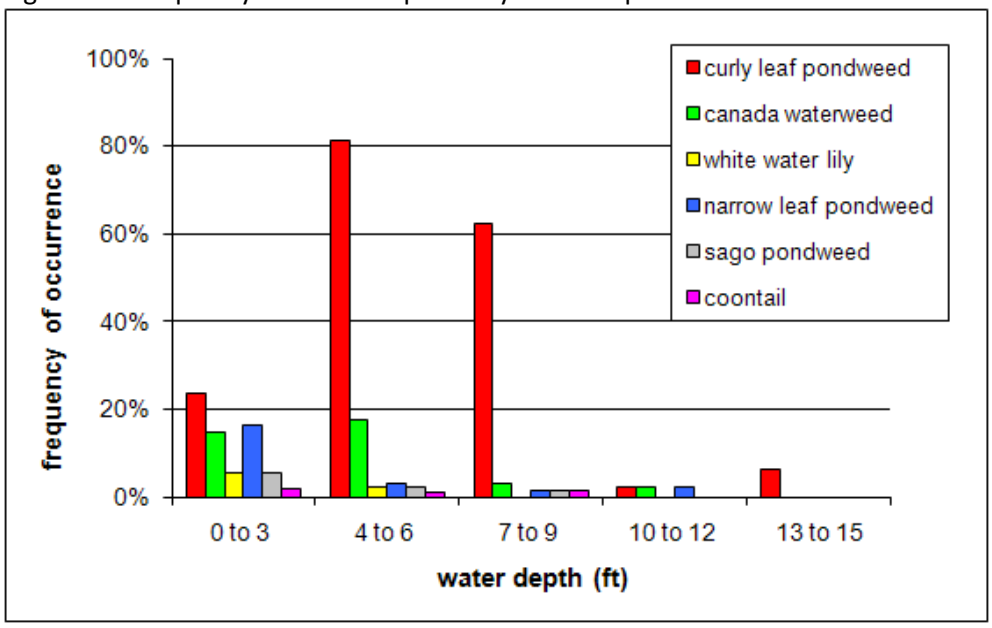


Figure 10. Frequency of common plants by water depth interval.

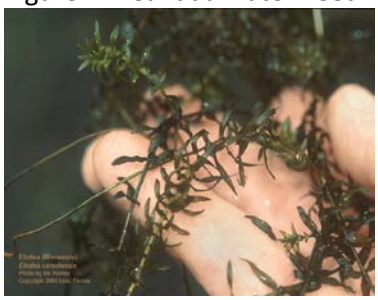


Native aquatic plants

This survey was conducted in Spring, before many native aquatic plants reach maturity. Nevertheless, the results still provide a general assessment of the types of native plants that are found in the lake. Emergent plants were not recorded, indicating their relative low occurrence in the lake. White waterlily was found in only 2% of the sites. Only six native submerged taxa were recorded and most are plants that can tolerate turbid water.

Canada waterweed (Figure 11) is a perennial submerged species that is widespread throughout Minnesota. It is adapted to a variety of conditions and is tolerant of low light and prefers soft substrates. Canada waterweed can overwinter as an evergreen plant and spreads primarily by fragments. Canada waterweed was the most common native plant found in Little Rock Lake but occurred in only 9% of the survey sites (Table 2). It was one of the few submerged plants that were found in depths greater than 9 feet but was uncommon in depths greater than 6 feet (Figure 10).

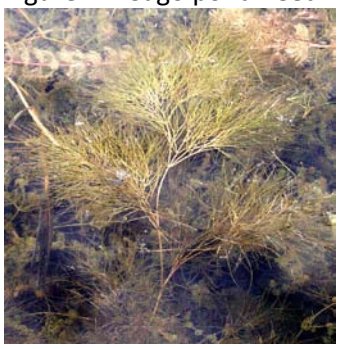
Figure 11. Canada waterweed



Other native species were found very uncommon in Little Rock Lake and were most often found in depths of 3 feet or less. They included three species of native pondweeds: narrow-leaf pondweed (*Potamogeton* sp.), sago pondweed (*Stuckenia pectinata*), clasping-leaf pondweed *(Potamogeton richardsonii)*, Coontail (*Ceratophyllum demersum*), and northern watermilfoil (*Myriophyllum sibiricum*).

Native Pondweeds. In addition to the non-native, curly-leaf pondweed, there are over 20 native species of pondweed in Minnesota and three were found in Little Rock Lake: Narrow-leaf pondweed, Sago pondweed (Figure 12) and clasping-leaf pondweed (Figure 13). Seeds and tubers of pondweeds 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 12. Sago pondweed



Coontail (Figure 14) 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. 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 13. Clasping-leaf pondweed

Northern watermilfoil (Figure 15) is a native, submerged plant. It is a rooted perennial with finely dissected leaves. Particularly in depths less than ten feet, this plant may reach the water surface and its flower stalk will extend above the water surface. It spreads primarily by stem fragments and over-winters by hardy rootstalks and winter buds. Northern watermilfoil is not tolerant of turbidity and grows best in clear water lakes. For information on how to distinguish the native northern watermilfoil from the non-native, Eurasian watermilfoil, click here: identification.

Figure 14. Coontail

Figure 15. Northern watermilfoil

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 can be used to monitor finer-scale changes that may occur, such as an increase in a particular taxa or a change in the depths at which individual taxa occur. In general, factors that may lead to change in native and non-native aquatic plant communities include:

- Change in water clarity
  If water clarity in Little Rock Lake increases, submerged vegetation may be more common at depths greater than 3 feet.

- Snow and ice cover
  Curly-leaf pondweed, in particular, may fluctuate in abundance in response to snow 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, curly-leaf and some native submerged plants may increase in abundance.

- 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 abundant and diverse aquatic plant communities found in Little Rock Lake provide critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants).

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