Aquatic Vegetation Survey of

Serpent Lake (DOW #18-0090-00)

Crow Wing County, Minnesota

2009

Loons on Serpent Lake, May 2009.

Report by: Donna Perleberg, Aquatic Plant Ecologist
Stephanie Loso, Aquatic Biologist
Minnesota Department of Natural Resources
Division of Ecological Resources
1601 Minnesota Dr., Brainerd, MN 56401

Lakewide sampling (2009):
MnDNR Ecological Resources Division Staff:
Dan Swanson, Invasive Species Specialist
Rich Rezanka, Invasive Species Specialist
Stephanie Loso, Aquatic Biologist
Ben Burggraff, Student Worker
Adam Rollins, Intern
Luke Pelosa, Intern

Report review:
Kevin Mott, Aquatic Plant Management Specialist, MnDNR Fisheries, Brainerd

A note to readers:
Text that appears in blue underline is a hypertext link to a web page where additional information is provided. If you are connected to the Internet, you can click on the blue underlined text to link to those web pages.

This report is also available online at:
http://www.dnr.state.mn.us/eco/pubs_aquatics/veg_reports.html

This report should be cited as:
Perleberg, D. and S. Loso. 2009. Aquatic vegetation of Serpent Lake, Crow Wing County, Minnesota, 2009. Minnesota Department of Natural Resources, Ecological Resources Division, 1601 Minnesota Dr., Brainerd, MN 56401. 13 pp.

Summary

Serpent Lake is a 1,103 acre lake in north central Minnesota. A lakewide survey was conducted in late May, 2009 to assess the distribution and abundance of the non-native plant, curly-leaf pondweed (*Potamogeton crispus*). Information on vegetation and water depths were recorded at over 450 sample sites and substrate type was described at shallow water sites.

Submerged plants were found to a depth of 22 feet. Within the 0 to 15 feet depth zone, 72% of sites contained plants. Plant growth was scattered in depths greater than 15 feet; in the 16 to 25 feet depth zone, only 10% of sites were vegetated.

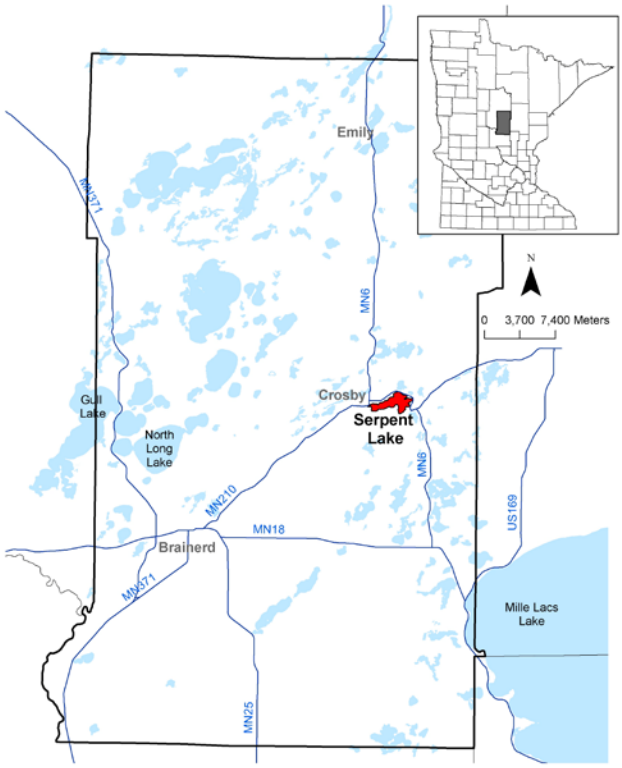
Native plants dominated the plant community and 59% of the sample sites (0 to 20 feet) contained at least one native plant. In Serpent Lake, 14 native, submerged aquatic plant taxa were recorded. Coontail (*Ceratophyllum demersum*), was the most common submerged plant, occurring in 35% of the sample sites (0 to 20 feet). Other common submerged taxa included northern watermilfoil (*Myriophyllum sibiricum*), muskgrass (*Chara* sp.), flat-stem pondweed (*Potamogeton zosteriformis*), and Canada waterweed (*Elodea canadensis*).

The non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*), was documented during the survey but was found in only 8% of all survey sites. It was found in water depths from one to 22 feet but did not dominate at any depth. It was present at scattered locations around the lake and often co-occurred with native plants.

Introduction

Serpent Lake is located in Crow Wing County, north central Minnesota (Figure 1). The lake is the 12th largest in the county with a surface area of 1,103 acres. Serpent Lake lies in the Mississippi River-Brainerd Watershed. Serpent Creek flows from the west side of the lake and flows north through several small lakes before emptying into the Mississippi River.

Figure 1. Location of Serpent Lake, Crow Wing County, Minnesota.



Serpent Lake shoreline is about nine miles in length and is nearly all developed with residential homes. The maximum water depth is 65 feet and 32% of the lake basin is less than 15 feet in depth. The lake is described as mesotrophic, with relatively high water clarity. The average summer secchi disk reading for Serpent Lake in 2008 was 15 feet (MPCA, 2008).

The lake has historically supported a diverse plant community with more than 30 different native plant types recorded. The non-native plant, curly-leaf pondweed (*Potamogeton crispus*), occurs in Serpent Lake as well as in most lakes in the watershed. The non-native plant, Eurasian watermilfoil (*Myriophyllum spicatum*), has **NOT** been found in Serpent Lake but has been located in three lakes in the watershed: Bay, Upper Mission and Lower Mission lakes, and in nearby Mille Lacs Lake.

Objectives

This survey provides a quantitative description of the 2009 curly-leaf pondweed population in Serpent 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. Describe the shoal sediments of the lake
2. Estimate the maximum depth of rooted vegetation
3. Estimate the percent of the lake occupied by rooted vegetation
4. Record the aquatic plant species that occur in the lake
5. Estimate the abundance of curly-leaf pondweed and common native plant species
6. Develop distribution maps for curly-leaf pondweed and native plants

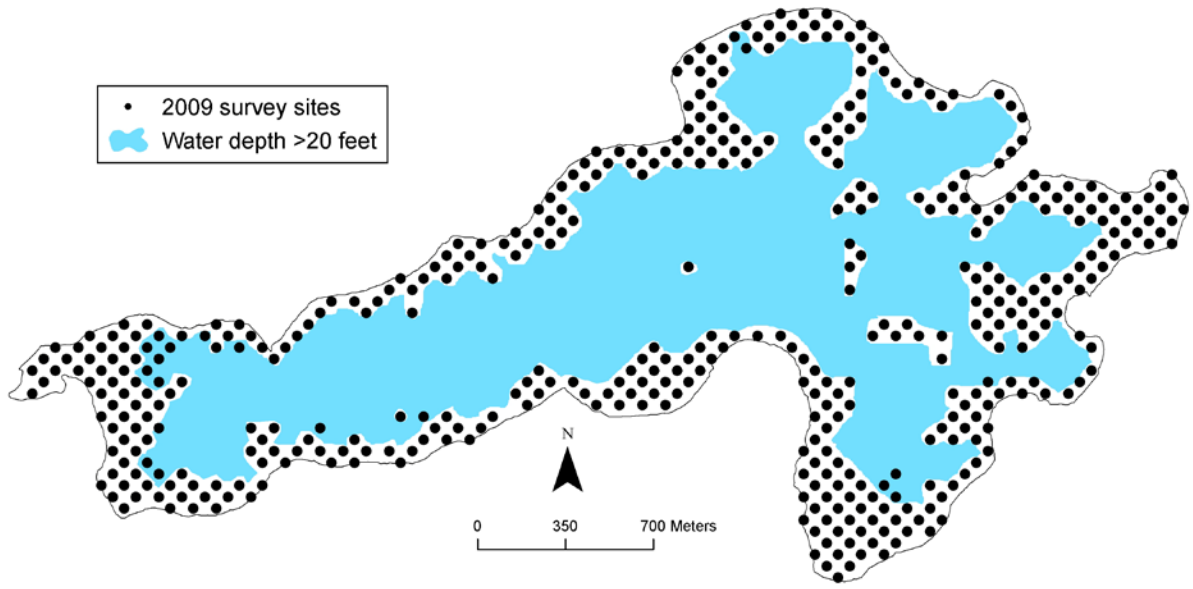
Methods

Lakewide vegetation survey

Serpent Lake was surveyed on May 19 and 21, 2009. 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) receiver. Survey points were placed across the entire lake and spaced 65 meters (213 feet) apart, resulting in about one survey point per acre.

The survey was conducted by boat and surveyors sampled all sites within the shore to 20 feet depth zone which included 433 sites (Figure 2, Table 1). Surveyors sampled some sites in the 21 to 25 feet depth zone but in depths greater than 17 feet, only two sites contained plants.

Figure 2. 2009 vegetation survey sites in Serpent Lake.



The 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 measured stick or electronic depth finder.

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 was used to survey vegetation not visible from the surface (Figure 3). Plant identification and nomenclature followed MnTaxa (2009).

Table 1. Sampling effort by water depth.

Water depth interval	Number of sample sites
0 to 5	147
6 to 10	146
11 to 15	63
16 to 20	77
Total sample points in 0 to 20 feet depth	433
21 to 25	19

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 20 feet and sampling points were also grouped by water depth and separated into five depth zones for analysis (Table 1).

Surveyors described bottom substrate at each sample site where water depth was seven feet and less. Standard substrate classes were used (Table 2) and if several substrate types occurred at a site, surveyors recorded the most common type.

Figure 3. Sampling rake.

Table 2. Substrate classes.

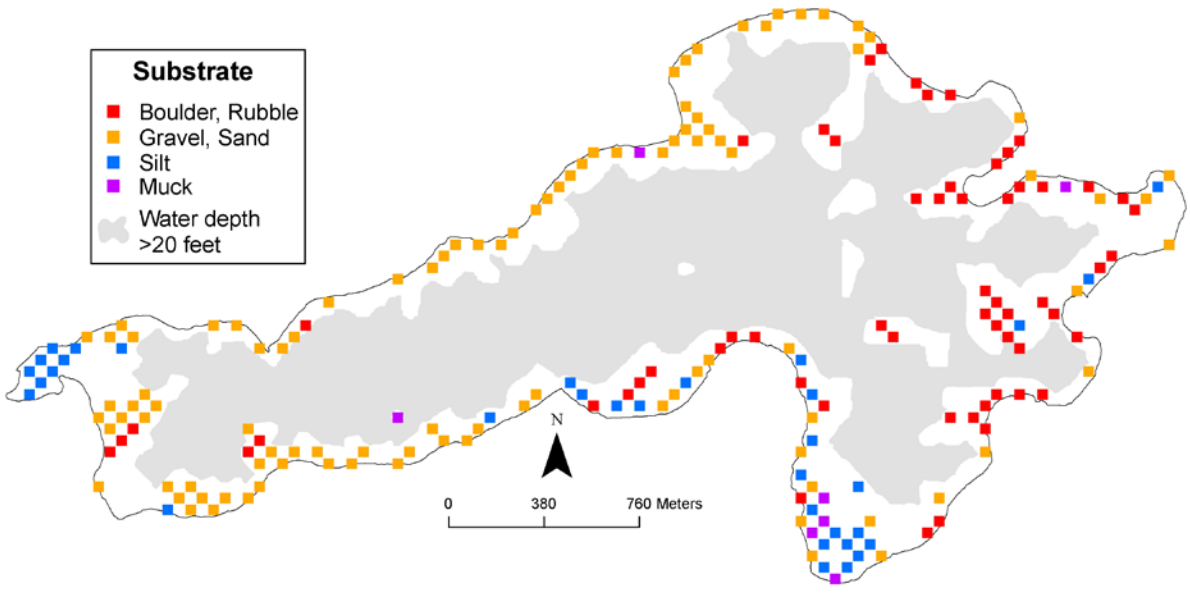
muck	decomposed organic material
marl	calcareous material
silt	fine material with little grittiness
sand	diameter less than 1/8 inch
gravel	diameter 1/8 to 3 inches
rubble	diameter 3 to 10 inches
boulder	diameter over 10 inches

Results

Shoal substrates

The shoal substrates of Serpent Lake were primarily hard substrates of sand, gravel, boulder and rubble. Softer substrates of silt and muck were found in south and west bays (Figure 4).

Figure 4. Shoal water substrates of Serpent Lake, May 2009.



Distribution of aquatic plants

Within the shore to 20 feet depth zone, vegetation occurred in 61% of the sites. Plants occurred around the perimeter of the lake and were also scattered at off-shore shallow sandbars (Figure 5). Plants were found to a depth of 22 feet but were most common in depths less than 16 feet, where 72% of sites contained plants (Figure 6). In the 16 to 25 feet zone, only 10% of the sites were vegetated.

Figure 5. Distribution of aquatic plants in Serpent Lake, May 2009.

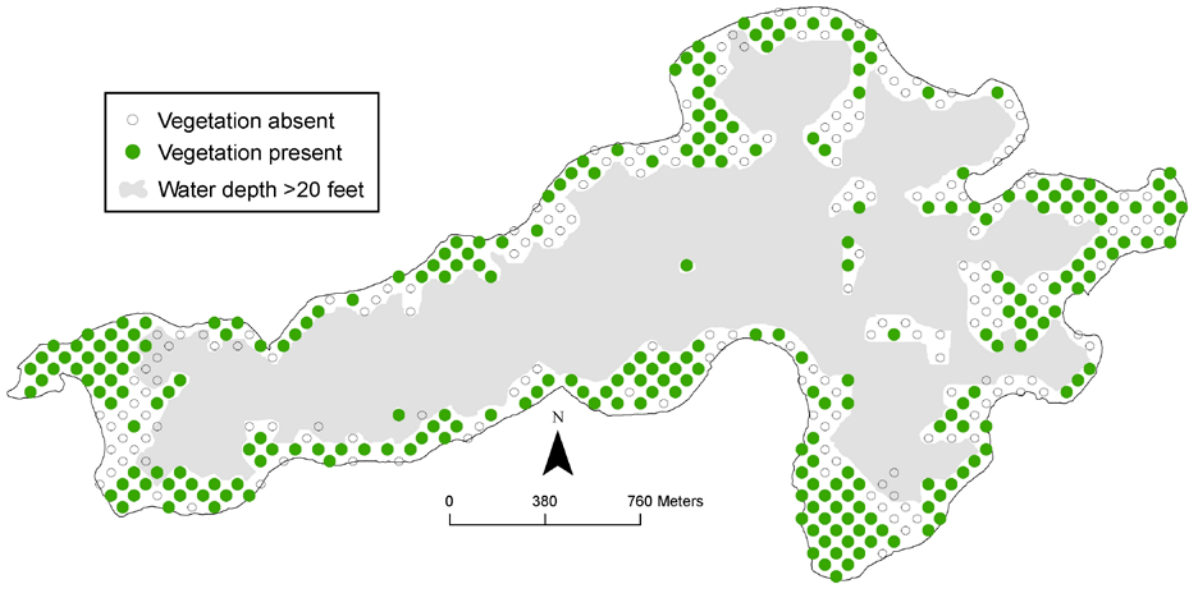
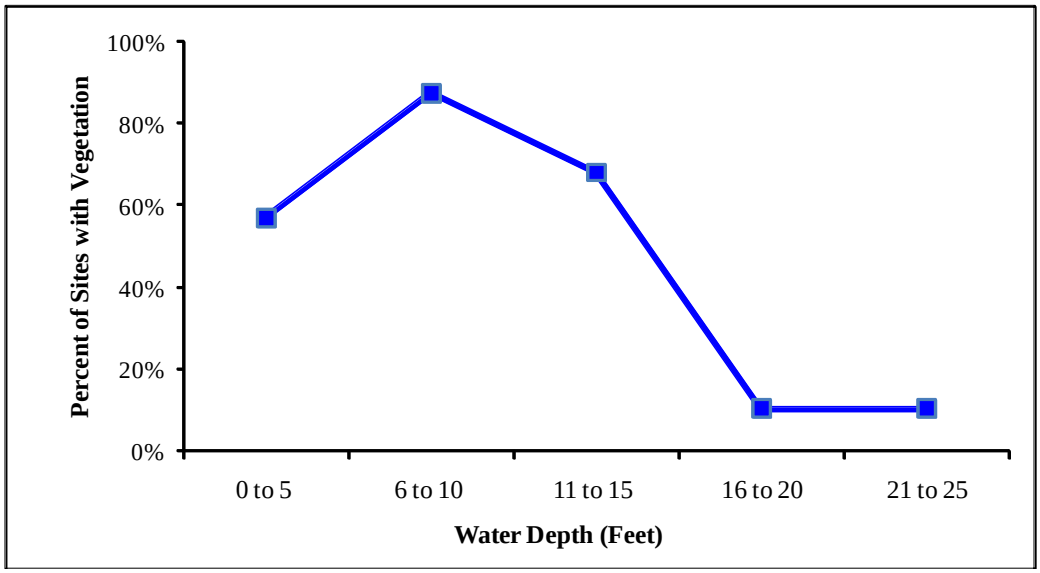


Figure 6. Percent frequency of vegetation by water depth interval.



Number of submerged plant taxa recorded

In Serpent Lake, 14 native submerged plant taxa were recorded (Table 3). These plants grow primarily under the water surface and most are anchored to the lake bottom by roots. Some have leaves that may float near or on the water surface. One non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*), was documented during the survey. Eurasian watermilfoil (*Myriophyllum spicatum*) was **NOT** found during the 2009 spring survey.

Table 3. Frequency of aquatic plants in Serpent Lake Point-intercept survey, May 2009.

(Frequency is the percent of sample sites in which a plant taxon occurred within the shore to 20 ft water depth.)

Life Form	Common Name	Scientific Name	Frequency 433 pts
NATIVE SUBMERGED	Coontail	*Ceratophyllum demersum*	35
	Northern watermilfoil	*Myriophyllum sibiricum*	21
	Muskgrass	*Chara* sp.	17
	Flat-stem pondweed	*Potamogeton zosteriformis*	13
	Canada waterweed	*Elodea canadensis*	9
	White-stem pondweed	*Potamogeton praelongus*	3
	White water buttercup	*Ranunculus aquatilis*	2
	Water star-grass	*Zosterella dubia*	2
	Water marigold	*Megaladonta beckii*	1
	Clasping-leaf pondweed	*Potamogeton richardsonii*	1
	Stonewort	*Nitella* sp.	<1
	Wild celery	*Vallisneria americana*	<1
	Bushy Pondweed	*Najas flexilis*	<1
	Star duckweed	*Lemna trisulca*	<1
NON-NATIVE SUBMERGED	Curly-leaf pondweed	*Potamogeton crispus*	8

Example calculation of frequency:
There were 433 samples sites in the 0-20 feet zone.
Coontail (*Ceratophyllum demersum*) occurred in 152 sites.
Coontail frequency in 0-20 feet zone = (152/433) *100 = 35%

Native plants dominated the lake and in the 0 to 20 feet depth zone, 54% of the sites contained only native plants (Figure 7). The number of plant taxa found at each one square meter sample site ranged from zero to six. Sites with the highest number of plant taxa were found in the shallow eastern bays (Figure 8).

Figure 7. Native plants vs. Curly-leaf Pondweed in Serpent Lake, May 2009.

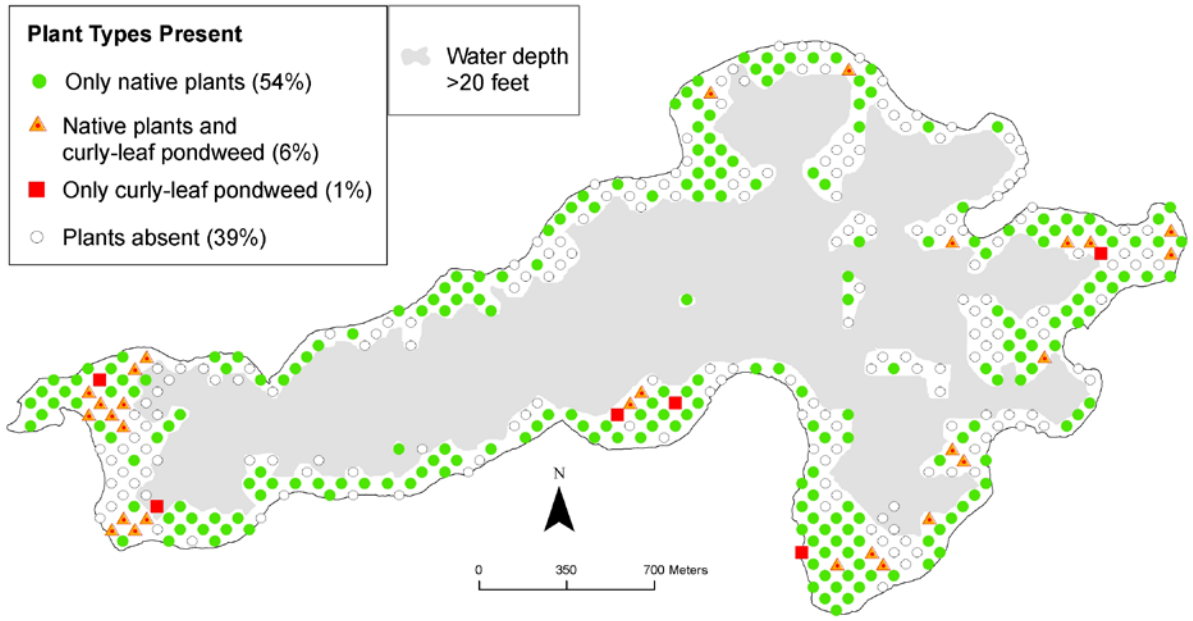
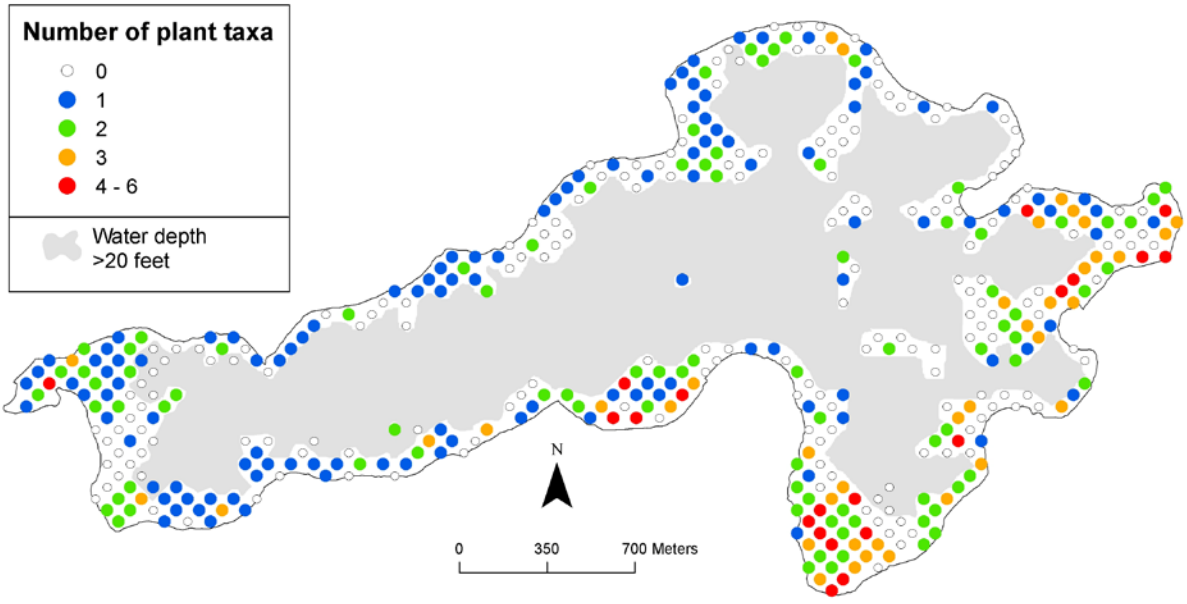


Figure 8. Number of plant species at each sample site, Serpent Lake, May 2009.



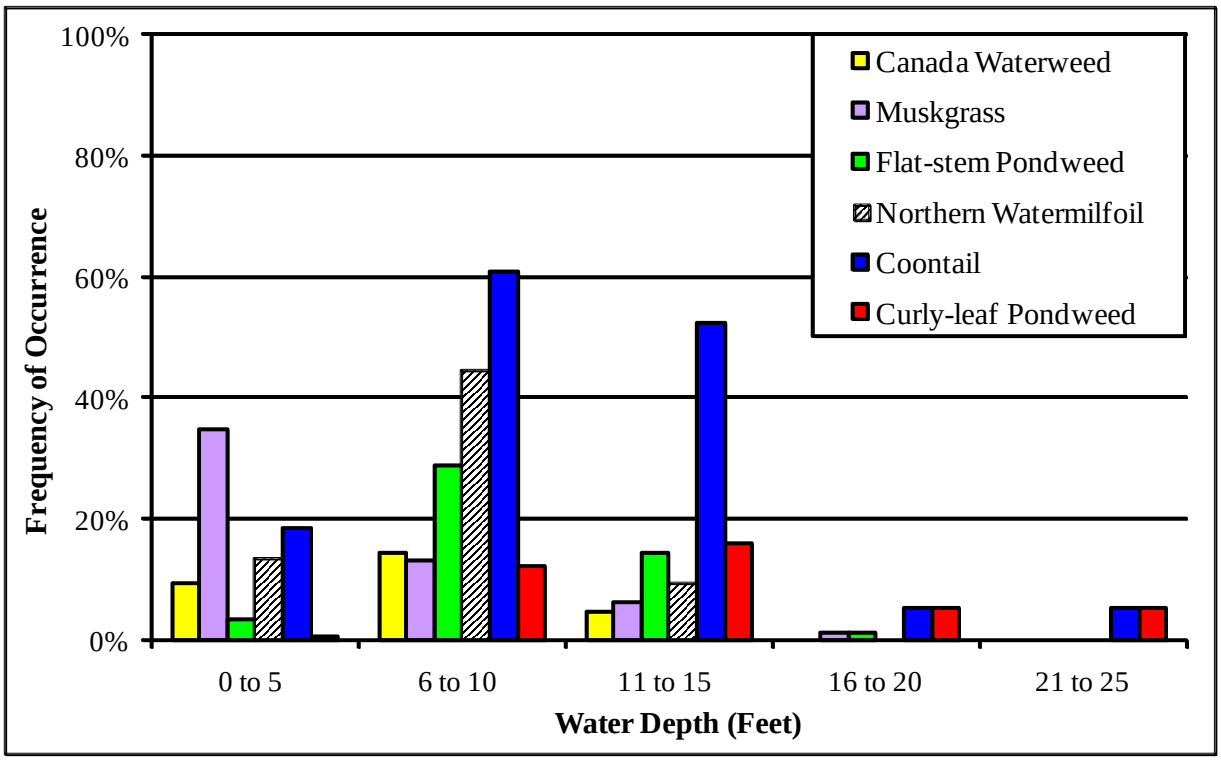
Common native submerged plants

Coontail (*Ceratophyllum demersum*) (Figure 9), was the most common species found and occurred in 35% of the survey sites (Table 3). It was found throughout the vegetated zone of Serpent Lake to a depth of 21 feet. It was most frequent in the 6 to 15 feet depth zone (Figure 10) and was often found in mixed beds with flat-stem pondweed and northern watermilfoil.

Figure 9. Coontail.

Coontail 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 10. Frequency of common plants by water depth interval. Serpent Lake, May 2009.



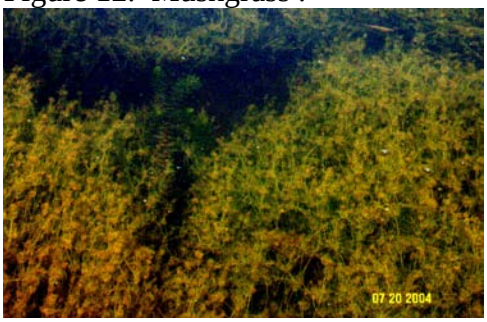
Northern watermilfoil (*Myriophyllum sibiricum*) (Figure 11) was found in 21% of the survey sites (Table 3). It occurred to a depth of 15 feet but was most frequent in the 6 to 10 feet depth zone (Figure 10). This native, submerged plant is a rooted perennial with finely dissected leaves.

This plant may reach the water surface and its flower stalk will extend above the water surface, particularly in depths less than ten feet. 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

Figure 11. Northern watermilfoil.

Muskgrass (*Chara* sp.) (Figure 12) occurred in 17% of the sample sites (Table 3) and was the dominant plant in the 0 to 5 feet depth zone (Figure 10). Muskgrass is a macroscopic, or large, algae and is common in many hard water Minnesota lakes. It has a brittle texture and a characteristic "musky" odor. Because muskgrass does not form true stems, it is a low-growing plant, often found entirely beneath the water surface where it may form low "carpets" on the lake bottom. Muskgrass is adapted to a variety of substrates and is often the first taxa to colonize open areas of lake bottom where it can act as a sediment stabilizer. Beds of muskgrass can provide important fish spawning and nesting habitat.

Figure 12. Muskgrass .



Flat-stem pondweed (*Potamogeton zosteriformis*) (Figure 13) occurred in 13% of the survey sites (Table 3) and was most common in the 6 to 10 feet depth zone (Figure 10). This plant is anchored to the lake bottom by underground rhizomes and over-winters by winter buds. It is named for its flattened, grass-like leaves. Depending on water clarity and depth, flat-stem pondweed may reach the water surface and may produce flowers that extend above the water. Fruits of pondweeds are an important food source for waterfowl and the leaves provide habitat structure for fish and invertebrates.

Figure 13. Flat- stem pondweed .

Canada waterweed (*Elodea canadensis*) (Figure 14) was found in 9% of the Serpent Lake survey sites (Table 3). It was most frequent in depths of ten feet and less (Figure 10). This perennial submerged species 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.

Figure 14. Canada waterweed.

Curly-leaf pondweed

Curly-leaf pondweed (*Potamogeton crispus*) (Figure 15) was found in 8% of the survey sites (Table 3). It was scattered around the shoreline and often occurred in mixed beds with native plants (Figure 7). It was found in water depths from one to 22 feet and was most frequent in the 6 to 15 feet depth zone, where it occurred in 13% of the sites (Figure 10).

Figure 15. Curly-leaf pondweed.

This is a non-native, 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 2008). Like many native submerged plants it is perennial, but its unique life cycle 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 shade out native vegetation and can also cause navigation problems for recreational lake users.

Numerous native plants that were found in previous summer surveys of Serpent Lake were not located during the early spring 2009 survey. These plants likely still occur in the lake but were not observed in 2009 because they had not yet germinated and/or reached maturity.

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

Literature Cited

Catling, P. M. and I. Dobson. 1985. The biology of Canadian weeds. 69. *Potamogeton crispus* L. Canadian Journal of Plant Science 65:655-668.

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

MnTaxa. 2009. Minnesota State checklist of vascular plants. Minnesota Department of Natural Resources, Division of Ecological Resources, St. Paul.

MPCA. 2008. Minnesota Pollution Control Agency. St. Paul, MN. Lake Water Quality Assessment Program. Lake Water Quality Data Search website: http://www.pca.state.mn.us/water/lkwqSearch.cfm (accessed September 2009)

MnDNR Invasive Species Program. 2008. Invasive Species of Aquatic Plants and Wild Animals in Minnesota: Annual Report for 2004. Minnesota Department of Natural Resources, St. Paul, MN. http://www.dnr.state.mn.us/eco/pubs_invasives.html

Moyle, J. B. and N. Hotchkiss. 1945. The aquatic and marsh vegetation of Minnesota and its value to waterfowl. Minnesota Department of Conservation. Technical Bulletin 3. 122 pp.

Wehrmeister and Stuckey. 1978. The life history of *Potamogeton crispus* with emphasis on its reproductive biology. Ohio Journal of Science. 78 (April program and abstract) supplement: 16.

Shoreline of Serpent Lake, May 2009