Aquatic Vegetation Survey of

Upper South Long Lake (ID #18-0096-00)
and
Lower South Long Lake (ID #18-0136-00)

Crow Wing County, Minnesota

2009

Great Blue Heron on Upper South Long Lake, June 2009.

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Summary

Upper and Lower South Long lakes are eutrophic waterbodies in north central Minnesota. A lakewide survey was conducted in June, 2009 to assess the distribution and abundance of the non-native plant, curly-leaf pondweed (*Potamogeton crispus*). Information on vegetation and water depth was recorded at 529 sample sites in Lower South Long Lake and 351 sample sites in Upper South Long Lake and substrate types were described at shallow water sites.

Submerged plants were found to a depth of 13 feet in Upper South Long and to 16 feet in Lower South Long, but in the lower lake only one site beyond the 15 feet depth contained plants. Within the 0 to 15 feet depth zone, 63% of the Upper South Long lake sites and 80% of Lower South Long Lake sites contained plants.

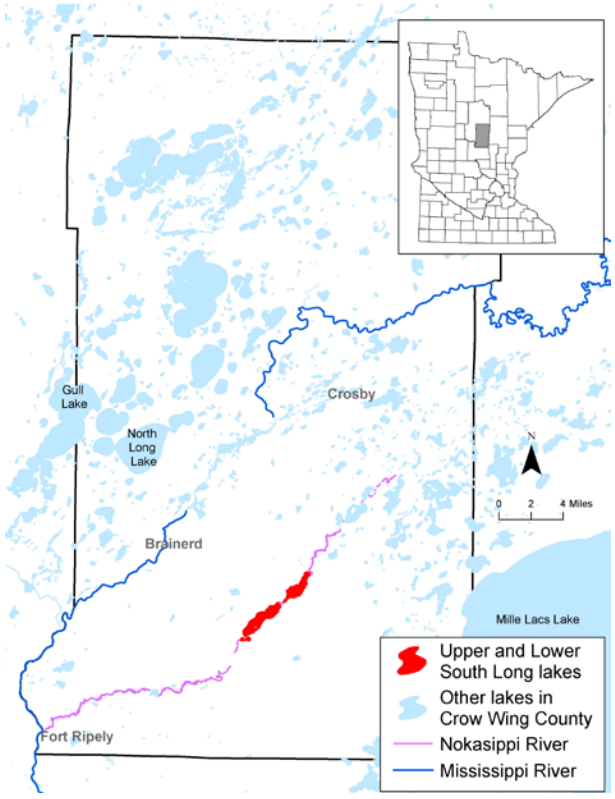
A total of 26 native plants were recorded in these lakes and included six emergent, two floating-leaf, and 18 submerged taxa. Star duckweed (*Lemna trisulca*), was the most common submerged plant in Lower South Long and occurred in 39% of the sites. Coontail (*Ceratophyllum demersum*), was the most common submerged plant in Upper South Long and occurred in 28% of the sample sites. Other common submerged taxa included northern watermilfoil (*Myriophyllum sibiricum*), muskgrass (*Chara* sp.), flat-stem pondweed (*Potamogeton zosteriformis*), white-stem pondweed (*Potamogeton praelongus*), and white-water buttercup (*Ranunculus aquatilis*).

The non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*), was documented during the survey and occurred with a frequency of 14% in Upper South Long and 17% in Lower South Long. It was found in water depths from two to 13 feet in Upper South Long and from one to 11 feet in Lower South Long. It was present at scattered locations around the lakes and often co-occurred with native plants.

Introduction

Upper and Lower South Long Lakes are located in Crow Wing County, north central Minnesota (Figure 1). These lakes lie in the center of the Mississippi River-Brainerd Watershed. They are elongated lakes with a southwest-northeast orientation. The Nokasippi River runs southwest through the lakes and after leaving Lower South Long it joins the Mississippi River at the southwest corner of the county (Figure 1).

Figure 1. Upper and Lower South Long Lakes in Crow Wing County, Minnesota.



Upper and Lower South Long Lakes are among the 20 largest lakes in Crow Wing County. Lower South Long is the larger lake with a surface area of 1,295 acres and about ten miles of shoreline. Upper South Long has a surface area of 795 acres and about six miles of shoreline. They are relatively shallow lakes with a mean depth of about 20 feet (Shelito and Heiskary 1999) and a maximum depth of 47 feet. Both lakes are described as eutrophic (high nutrients), and water clarity is considered slightly below average for northern central Minnesota lakes (Shelito and Heiskary 1999). In 2008, the average summer secchi disk reading was 7 feet for Upper South Long and 9 feet for Lower South Long (MPCA, 2008).

Previous vegetation surveys recorded a diversity of native plants in these lakes with more than 23 types of lake plants. Bulrush (*Schoenoplectus* sp.), an important emergent plant for fish and invertebrate habitat, was common in past surveys (DNR Fisheries lake files). Submerged plants, such as muskgrass (*Chara* sp.), coontail (*Ceratophyllum demersum*) and flat-stem pondweed (*Potamogeton zosteriformis*), were commonly found to a depth of 10 feet.

The non-native plant, Eurasian watermilfoil (*Myriophyllum spicatum*), has **NOT** been found in Upper or Lower South Long Lakes but has been located in three lakes in the watershed: Bay, Upper Mission and Lower Mission lakes, and in nearby Mille Lacs Lake. The non-native plant, curly-leaf pondweed (*Potamogeton crispus*), does occur in Upper and Lower South Long Lakes as well as in most lakes in the watershed. However, previous vegetation surveys have been conducted in mid to late summer, after curly-leaf pondweed has naturally senesced. Detailed, historical information on curly-leaf pondweed distribution and abundance in these lakes is not available.

Objectives
This survey provides a quantitative description of the 2009 curly-leaf pondweed population in Upper and Lower South Long Lakes. 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
Lower South Long Lake was surveyed on June 9 and 11, 2009 and Upper South Long Lake was surveyed on June 12, 15 and 17, 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 for both lakes were placed across the entire lake and spaced 65 meters (213 feet) apart, resulting in about one survey point per acre. Surveyors sampled all sites (529) within the shore to 20 feet depth zone in Lower South Long and all sites (351) within the shore to 15 feet depth zone in Upper South Long (Figure 2, Table 1).

The survey was conducted by boat and surveyors used the GPS unit to navigate 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).

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 in both lakes and sampling points were also grouped by water depth and separated into depth zones for analysis (Table 1).

Figure 2. Vegetation survey sites in Upper and Lower South Long Lakes, June 2009.

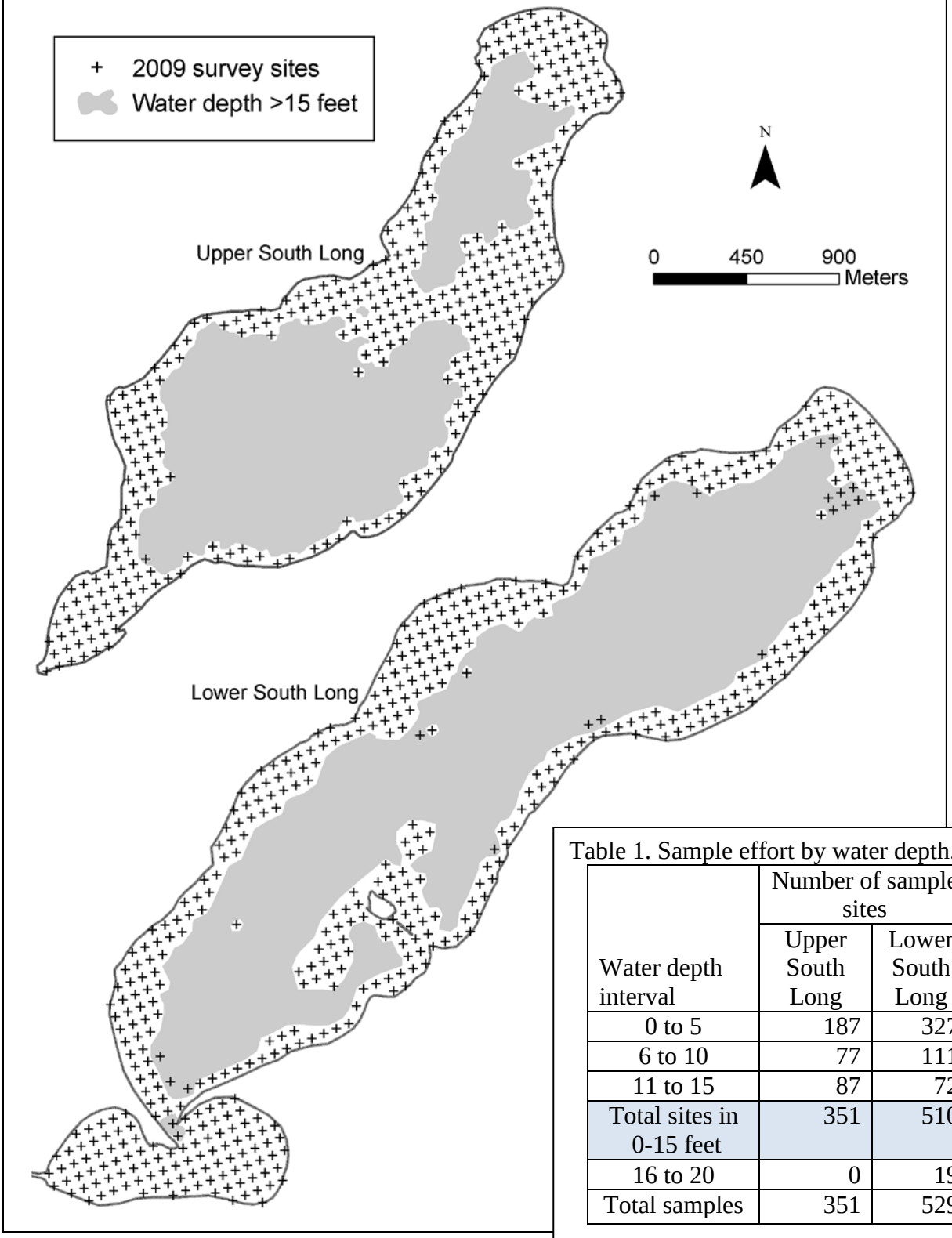


Table 1. Sample effort by water depth.

Water depth interval	Number of sample sites	
	Upper South Long	Lower South Long
0 to 5	187	327
6 to 10	77	111
11 to 15	87	72
Total sites in 0-15 feet	351	510
16 to 20	0	19
Total samples	351	529

Example calculation of frequency:
There were 510 samples sites in the 0-15 feet zone in Lower South Long Lake.

Coontail (*Ceratophyllum demersum*) occurred in 173 sites.

Coontail frequency in 0-15 feet zone = (173/510) *100 = 34%

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.

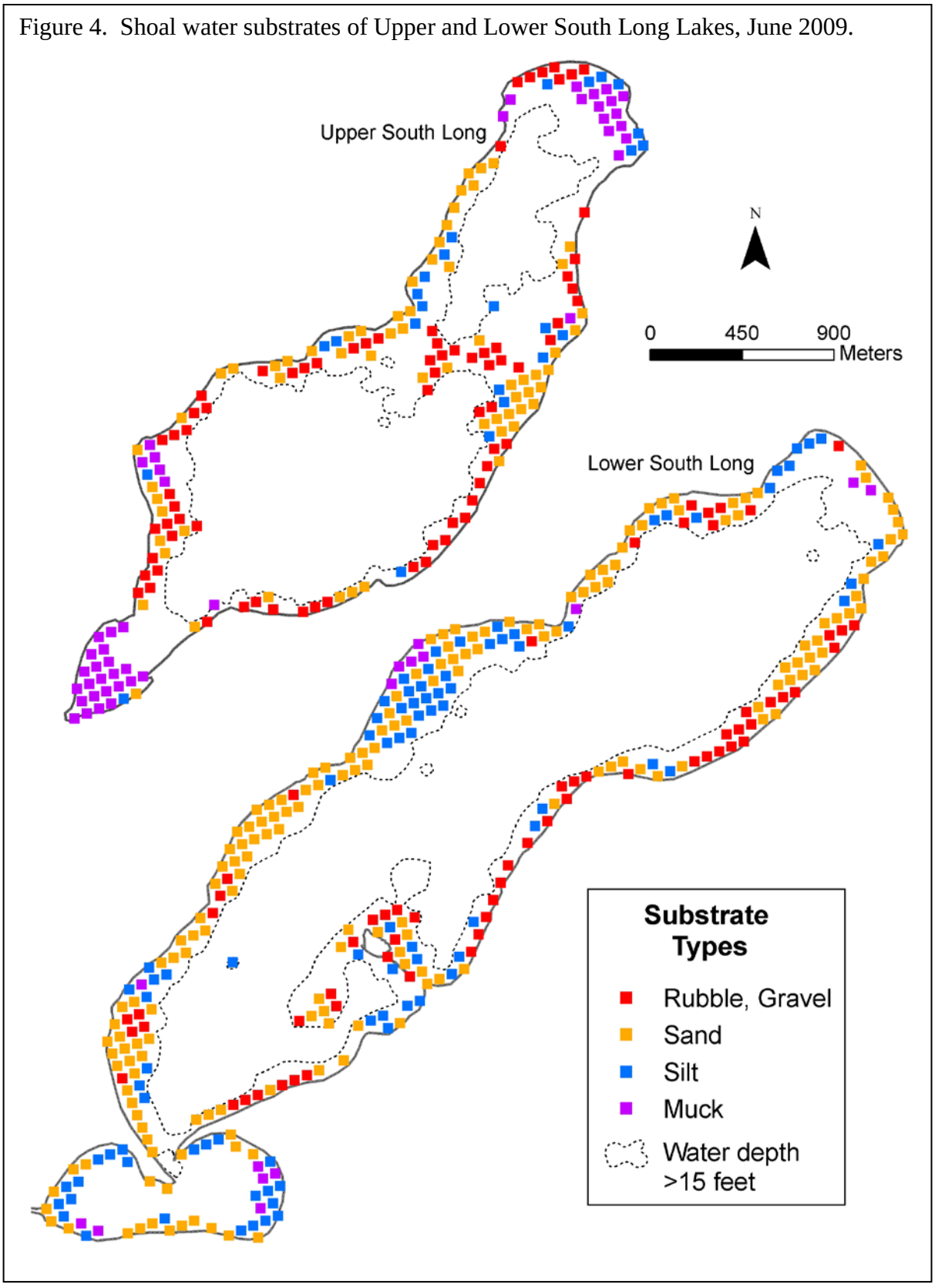
Table 2. Substrate classes

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 Upper and Lower South Long Lakes were primarily hard substrates of sand, gravel, and rubble. Softer substrates of silt and muck were found in shallow, protected bays (Figure 4).

Figure 4. Shoal water substrates of Upper and Lower South Long Lakes, June 2009.



Number of submerged plant taxa recorded
A total of 26 native plants were recorded in these lakes including six emergent, two floating-leaf, and 18 submerged taxa (Table 3).

One non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*), was documented in both lakes during the survey. The non-native Eurasian watermilfoil (*Myriophyllum spicatum*), was **NOT** found during the June 2009 survey.

Table 3. Frequency of aquatic plants in Upper and Lower South Long Lakes, June 2009.

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

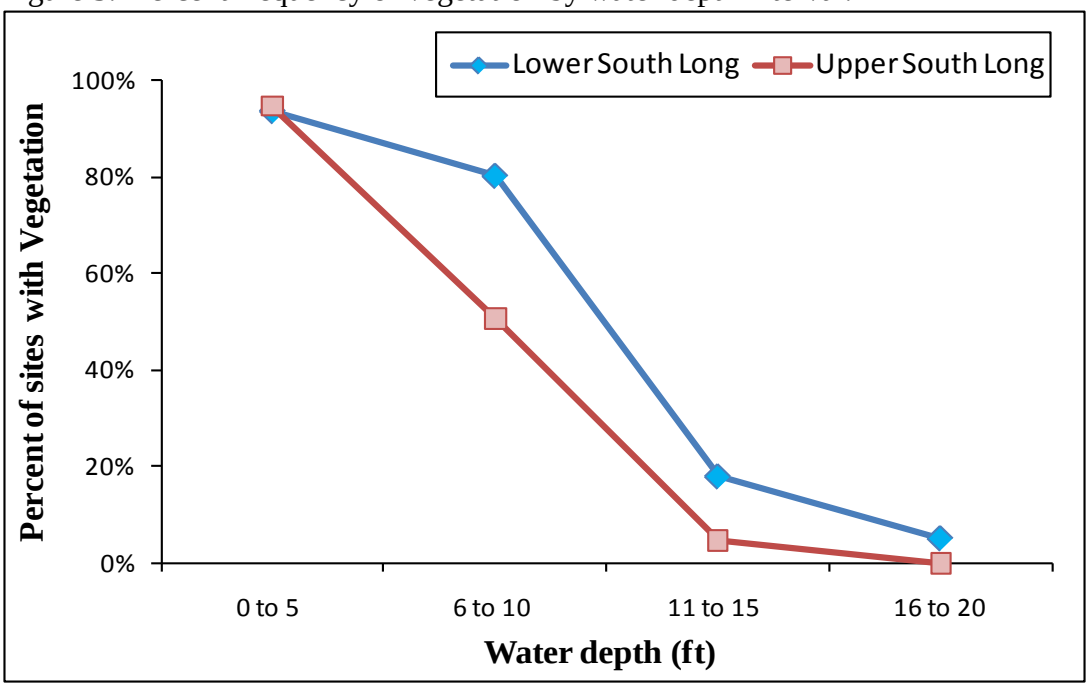
Life Form	Common Name	Scientific Name	Frequency	
			L. South Long 510 pts	U. South Long 351 pts
Native Submerged	Star duckweed	*Lemna trisulca*	39	2
	Coontail	*Ceratophyllum demersum*	34	28
	White-water buttercup	*Ranunculus aquatilis*	23	3
	Northern watermilfoil	*Myriophyllum sibiricum*	19	13
	Muskgrass	*Chara* sp.	14	20
	Canada waterweed	*Elodea canadensis*	12	3
	White-stem pondweed	*Potamogeton praelongus*	8	12
	Clasping-leaf pondweed	*Potamogeton richardsonii*	7	4
	Flat-stem pondweed	*Potamogeton zosteriformis*	4	16
	Water star-grass	*Heteranthera dubia*	4	6
	Water marigold	*Bidens beckii*	3	4
	Variable pondweed	*Potamogeton gramineus*	3	3
	Narrow-leaf pondweed	*Potamogeton* sp.	2	2
	Wild celery	*Vallisneria americana*	1	---
	Greater bladderwort	*Utricularia vulgaris*	<1	1
	Large-leaf pondweed	*Potamogeton amplifolius*	---	<1
	Illinois pondweed	*Potamogeton illinoensis*	---	2
	River pondweed	*Potamogeton nodosus*	---	<1
Non-native Submerged	Curly-leaf pondweed	*Potamogeton crispus*	17	14
Floating-leaf	Yellow waterlily	*Nuphar variegata*	4	1
	White waterlily	*Nymphaea odorata*	3	4
Emergent	Bulrush	*Scirpus* sp.	7	4
	Wild rice	*Zizania palustris*	2	1
	Needle grass	*Eleocharis acicularis*	1	---
	Swamp horsetail	*Equisetum fluviatile*	<1	<1
	Giant burreed	*Sparganium eurycarpum*	<1	---
	Cattail	*Typha* sp.	<1	---

"---"= not found in any sample sites

Distribution of aquatic plants

Submerged plants were found to a depth of 13 feet in Upper South Long and to 16 feet in Lower South Long. Within the shore to 15 feet depth zone, vegetation occurred in 63% of the Upper South Long sites and in 80% of the Lower South Long sites. In both lakes vegetation was sparse in depths greater than 10 feet (Figure 5). In the 11 to 15 feet zone, only 5% of the Upper South Long sites and 18% of the Lower South Long sites were vegetated. Beyond the 15 feet depth, only one site in Lower South Long contained plants.

Figure 5. Percent frequency of vegetation by water depth interval.



Submerged plants occurred around the entire perimeter of both lakes and the broadest beds occurred in areas of shallow water such as the southern bays and the shallow bar in the center of Lower South Long (Figure 6). Native plants dominated both lakes and in the 0 to 15 feet depth zone, 59% of the Upper South Long sites and 75% of the Lower South Long sites contained only native plants (Figure 6).

The number of plant taxa found at each one square meter sample site ranged from zero to seven. Sites with the highest number of plant taxa were found in the shallow areas around both lakes (Figure 7).

Figure 6. Native plants vs. Curly-leaf Pondweed in Upper and Lower South Long Lakes, June 2009.

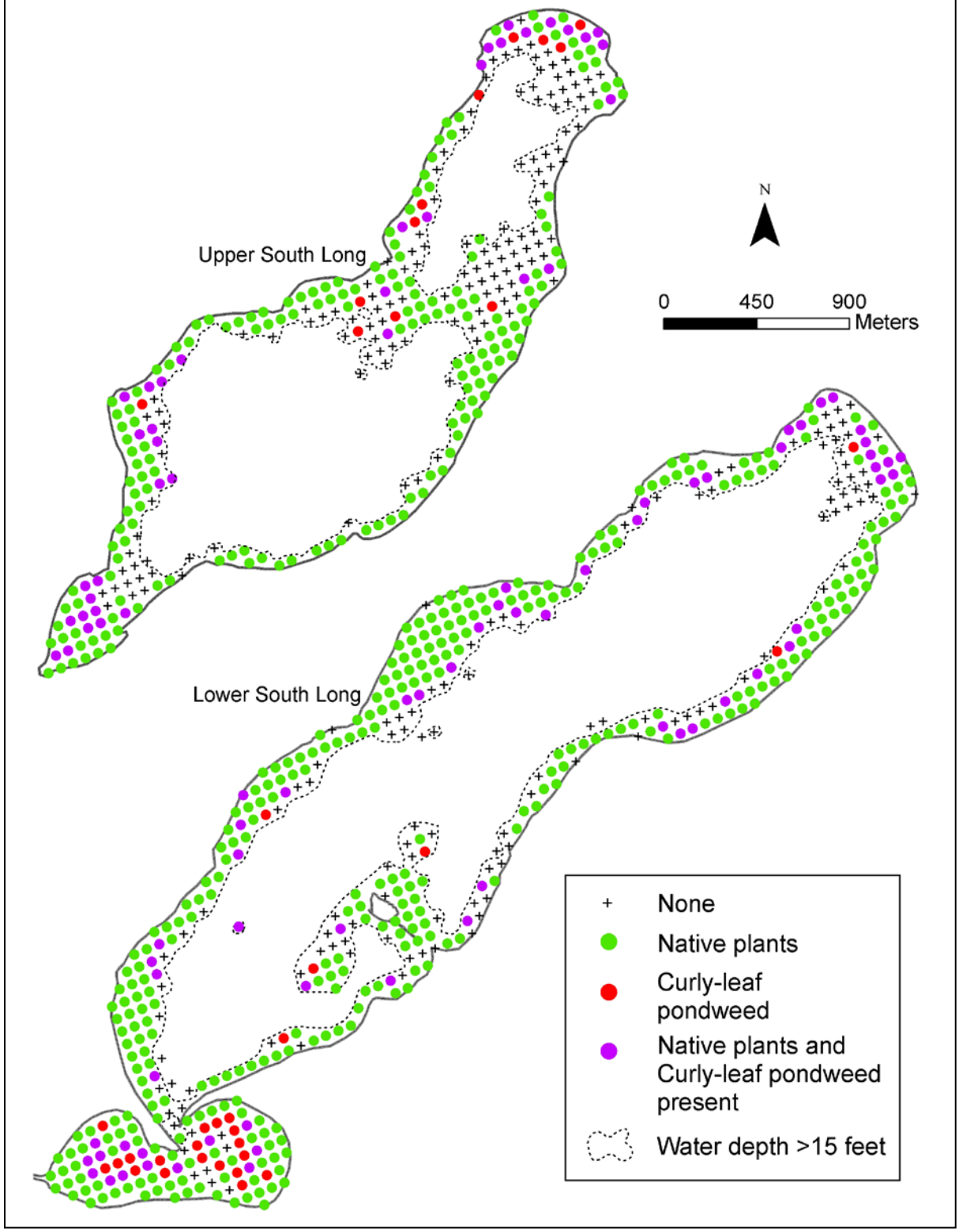
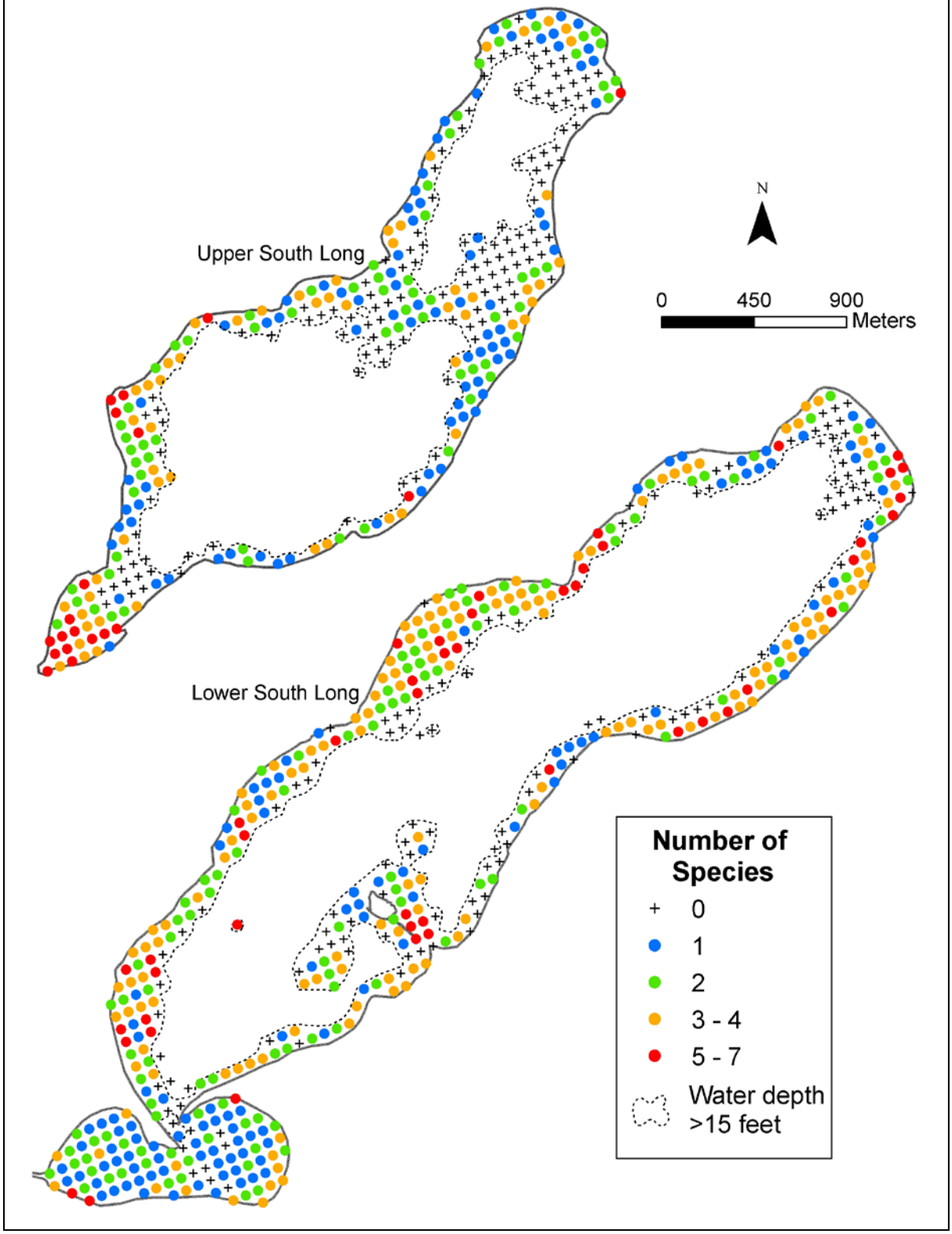


Figure 7. Number of plant species at each sample site, Upper and Lower South Long Lakes, June 2009.



Common native submerged plants

Star duckweed (*Lemna trisulca*) (Figure 8) is a native plant that often occurs submerged near the lake bottom but it does not anchor to the substrate and can float freely with the current. This plant was the most frequent plant in Lower South Long Lake and occurred in 39% of the survey sites (Table 3). It was the most frequent plant in the 0 to 5 feet depth zone and was the only plant found over 15 feet in Lower South Long (Figure 15). In Upper South Long star duckweed was only found in 2% of the survey sites (Table 3).

Figure 8. Star duckweed (*Lemna trisulca*) photo by Robert Freckman-Univ of WI – Stevens Point

Coontail (*Ceratophyllum demersum*) (Figure 9), was the most common species found in Upper South Long and occurred in 28% of the survey sites. In Lower South Long Lake, coontail occurred in 34% of the survey sites (Table 3). It was found throughout the vegetated zone but was most frequent in the 6 to 10 feet depth zone of Upper and Lower South Long Lakes. Coontail was found to a depth of 12 feet in Upper South Long and 11 feet in Lower South Long 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.

Northern watermilfoil (*Myriophyllum sibiricum*) (Figure 10) occurred in 19% of Lower South Long sites and in13% of the Upper South Long sites (Table 3). It occurred to a depth of 10 feet in both lakes but was most frequent in the 0 to 5 feet depth zone (Figure 15). This native, submerged plant 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

Figure 10. Northern watermilfoil

Muskgrass (*Chara* sp.) (Figure 11) occurred with a frequency of 20% in Upper South Long and 14% in Lower South Long (Table 3). Muskgrass was the dominant plant in the 0 to 5 feet depth zone in Upper South Long (Figure 15). 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 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 11. Muskgrass

Flat-stem pondweed (*Potamogeton zosteriformis*) (Figure 12) occurred with a frequency of 16% in Upper South Long and 4% in Lower South Long (Table 3). It was found to a depth of eight feet in Upper South Long and six feet in Lower South Long but was common in both lakes from shore to five feet depth zone (Figure 15). Flat-stem pondweed is named for its flattened, grass-like leaves. Flat-stem pondweed is a perennial plant that is anchored to the lake bottom by underground rhizomes. Depending on water clarity and depth, these plants may reach the water surface and may produce flowers that extend above the water. These pondweeds are anchored to the lake bottom by rhizomes and over winter by winter buds.

Figure 12. Flat-stem pondweed (*Potamogeton zosteriformis*)

White-stem pondweed (*Potamogeton praelongus*) (Figure 13), is one of several species that are often called "cabbage" plants by anglers. The leaves are lance to oval shaped and clasp the stem and the leaf tips are boat shaped. The fruits of pondweeds are a favorite duck food and the broad leaves provide food and shelter for fish. This plant is an indicator of good water clarity in lakes. White-stem pondweed was the most common broad-leaf pondweed in both lakes and was found in 12% of Upper South Long sites and in 8% of Lower South Long sites (Table 3). It was found most frequently in the 0 to 5 feet depth zone (Figure 15).

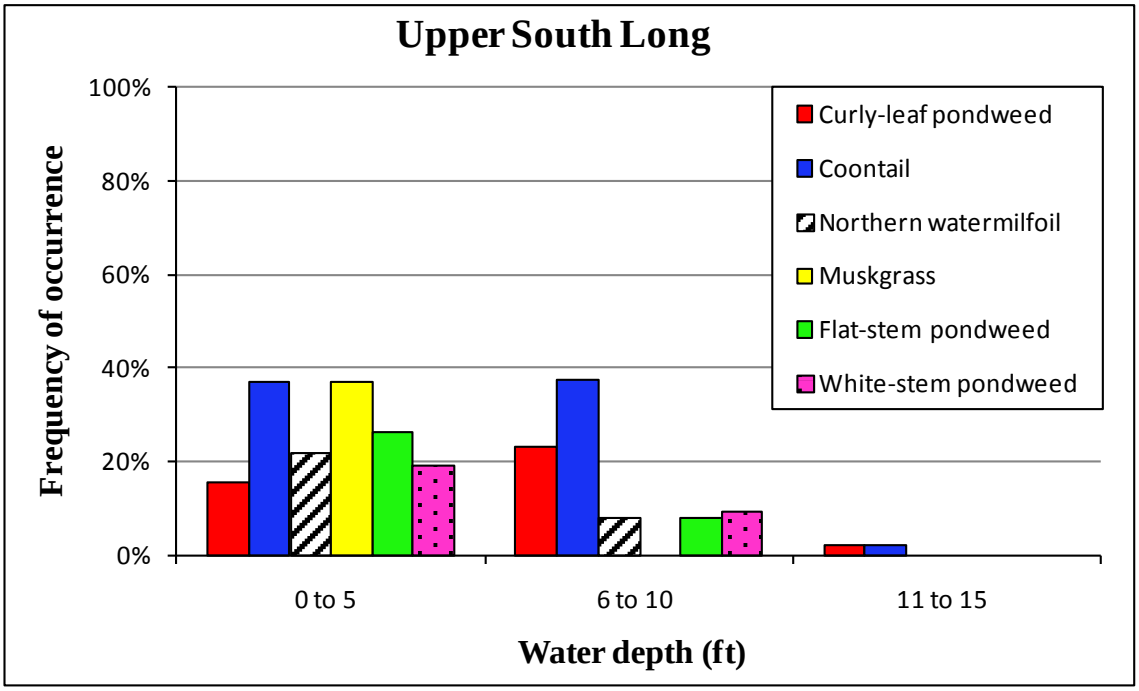
Figure 13. White-stem pondweed.

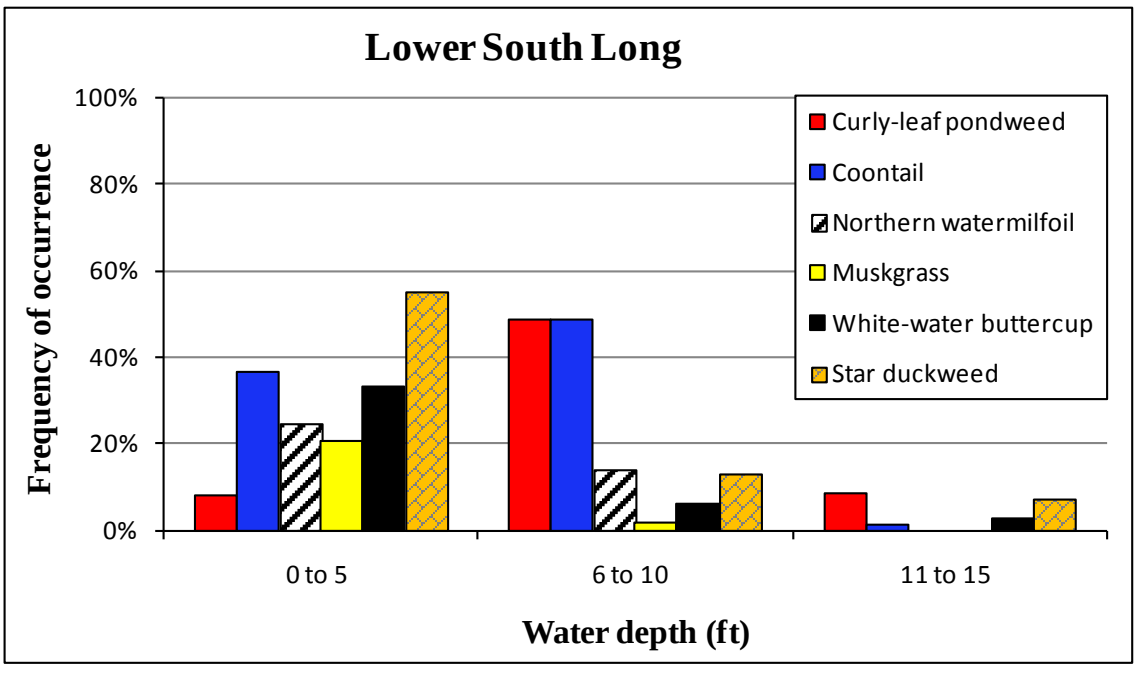
White-water buttercup (*Ranunculus aquatilis*) (Figure 14), occurred with a frequency of 23% in Lower South Long and 3% in Upper South Long (Table 3). In Lower South Long Lake it was found from one to 11 feet and was common in the 0 to 5 feet depth zone (Figure 15).

Figure 14. White-water buttercup

White-water buttercup is a perennial plant that has alternate leaves, and grows from both trailing runners and buried rhizomes (Borman et al. 2001). The flowers start blooming early in the summer and extend above the water surface. The fruit and foliage of white-water buttercup are a favorite waterfowl food. This plant is good cover for fish and invertebrates and is a producer of food for trout (Borman et al. 2001).

Figure 15. Frequency of common plants by water depth interval, June 2009.





Curly-leaf pondweed

Curly-leaf pondweed (*Potamogeton crispus*) (Figure 16) was found in 14% of the Upper South Long sites and 17% of the Lower South Long sites (Table 3). In Upper South Long Lake it was found throughout the lake, but was more commonly found in the north and south bay's (Figure 6). In Lower South Long Lake it was found primarily throughout the shallow southern bay, but also occurred at different depths throughout the lake. In both lakes it was most frequent in the 6 to 10 feet depth (Figure 15).

Figure 16. Curly-leaf pondweed.

Curly-leaf pondweed 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 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.

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 Upper and Lower South Long Lakes provide critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants).

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