Aquatic Vegetation of Snelling Lake

Surveyed June 2005
ID #27-0001-00
Hennepin County, Minnesota

Kayaker on Snelling Lake, 2005.

Minnesota
DEPARTMENT OF NATURAL RESOURCES

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Summary

Snelling Lake is a 103 acre, shallow lake in the St. Paul-Minneapolis metropolitan area of Minnesota. It is located within Fort Snelling State Park. An aquatic vegetation survey, conducted in June 2005, included a lakewide assessment of vegetation and water depths at 160 sample stations.

Aquatic plants occurred around the entire perimeter of the lake and extended to a depth of 10 feet, the maximum depth of the lake. Vegetation was present in 100% of the sample sites.

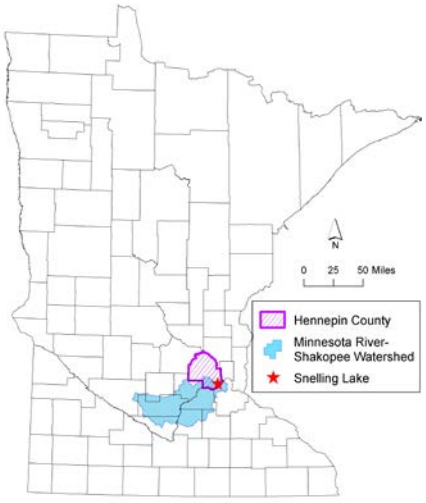
A total of 15 native aquatic plant species were recorded in Snelling Lake including three emergent, two floating-leaved, and 10 submerged species (Table 2). Coontail (*Ceratophyllum demersum*) was the most common submerged plant and was found in 91% of the sample sites. Other native submerged species included white-water buttercup (*Ranunculus aquatilis*), Canada waterweed (*Elodea canadensis*), and northern watermilfoil (*Myriophyllum sibiricum*).

Two non-native submerged plants were present in the lake. Curly-leaf pondweed (*Potamogeton crispus*) was found in 71% of the sample sites and was most frequent in depths of six to 10 feet. Eurasian watermilfoil (*Myriophyllum spicatum*) was located at two areas of the lake but did not occur within any of the survey sites.

Introduction

Snelling Lake is located five miles southwest of downtown St. Paul, in Hennepin County, Minnesota (Figure 1). It is located adjacent to the Minneapolis / St. Paul International Airport and occurs completely within the boundaries of Fort Snelling State Park (Figure 2).

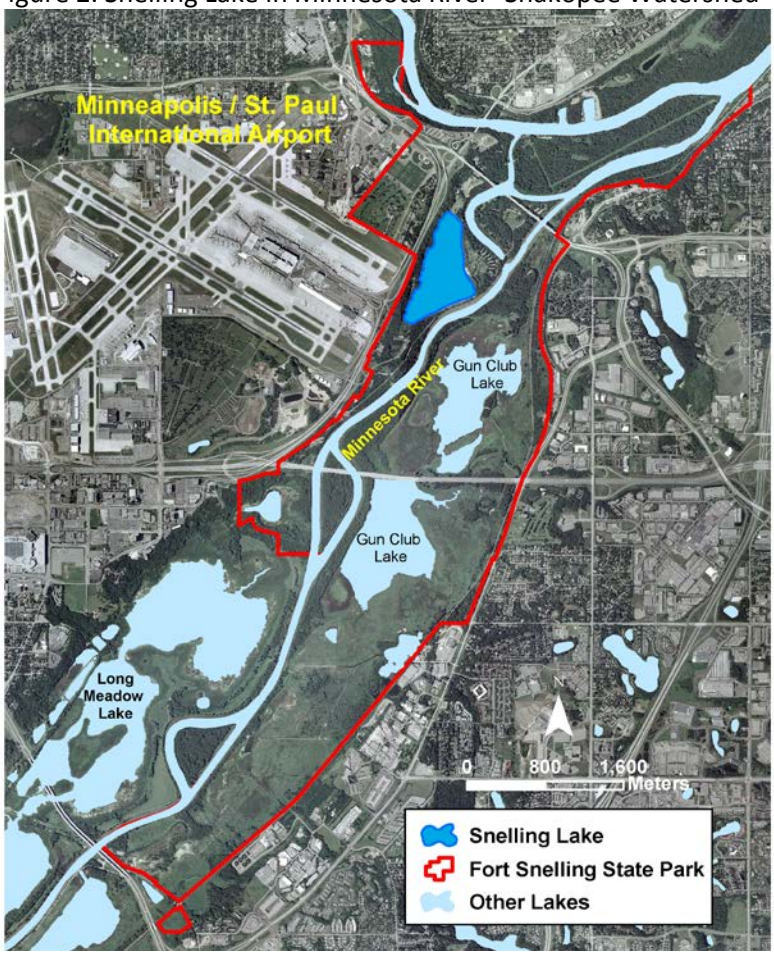
Figure 1. Location of Snelling Lake in Minnesota.



Snelling Lake is in the Minnesota River- Shakopee Watershed (Figure 1). The Minnesota River flows northeast to southwest along the southeast side of Snelling Lake but is not directly connected to the lake (Figure 2). Snelling Lake receives inflow from a spring on the west shore and a stream on the southwest shore of the lake.

There are about 125 lakes in this watershed and about 89 lakes in Hennepin County that are at least 50 acres in size. Snelling Lake is one of the smallest lakes in the watershed and the county, with a surface area of 103 acres and about two miles of shoreline. There is a public boat access on the south end of the lake. The access is for electric motor propelled and motor-less boats only.

Figure 2. Snelling Lake in Minnesota River- Shakopee Watershed



Snelling Lake is triangular shaped and has a maximum depth of 10 feet. This shallow water is referred to as the littoral zone. Rooted submerged plants are often common in the littoral zone if adequate sunlight reaches the lake bottom.

According to MNDNR Fisheries Lake Files Secchi disk

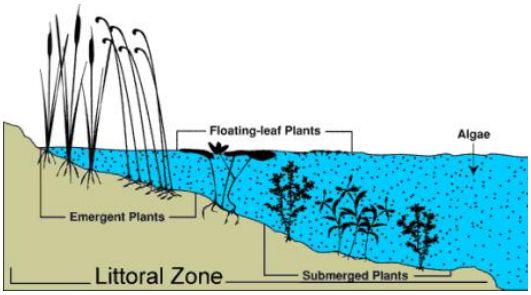
readings[1] averaged seven feet from 1960 to 1989. Based on Secchi disk measurements alone, aquatic plants are expected to grow to about 10 feet in Snelling Lake[2]. Other factors that may influence the depth of plant growth include substrate type, wind fetch, and plant species composition.

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 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

[1] 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.

[2] 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.

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[3]. 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, 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.

Historical Surveys

Previous vegetation surveys of Snelling Lake found plants growing to depths of nine feet with abundant plant growth described throughout the lake in 1960, 1974, 1975, 1984, and 1989 (MnDNR Fisheries Lake Files). Twenty-five different aquatic plant species have previously been recorded in the lake including submerged plants like coontail (*Ceratophyllum demersum*), Canada waterweed, flat-stem pondweed (*Potamogeton zosteriformis*), and sago pondweed (*Stuckenia pectinata*). Floating-leaf plants like white waterlily (*Nymphaea odorata*), yellow waterlily (*Nuphar variegata*) and the uncommon American lotus (*Nelumbo lutea*) and emergent plants such as bulrush (*Schoenoplectus* spp.) and cattails (*Typha* spp.) have also been recorded in previous surveys. The non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*), has been present in the lake since the early 1950's but was not documented in a survey until 1989.

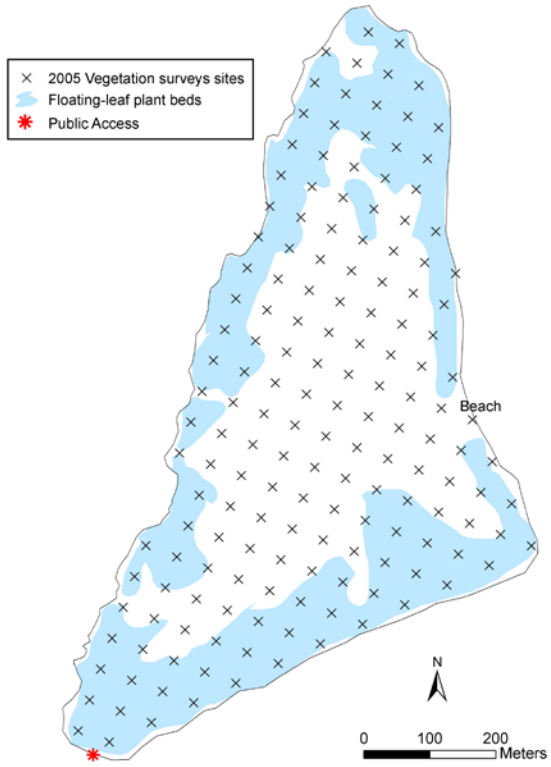
Objectives

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

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

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

Figure 4. Vegetation survey sites.



Methods

Lakewide vegetation survey

A lakewide vegetation survey was conducted on June 8, 2005 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.

Table 1. Sampling effort by water depth.

Water depth interval (feet)	2005
0 to 5	53
6 to 10	107
Total sample points	160

Figure 5. Survey rake.

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).

A total of 160 sites were surveyed in Snelling Lake. Frequency was calculated for the entire lake and data were also separated into five feet increment depth zones for analysis (Table 1). Frequency estimates were also calculated for individual species and selected groups of species (see Appendix 2).

Results and Discussion

Distribution of aquatic plants

Plants were found to a depth of 10 feet (the maximum depth sampled) and 100% of the sites were vegetated.

Types of plants recorded

A total of 15 native aquatic plant species were recorded including three emergent, two floating-leaved, and 10 submerged species (Table 2). Two non-native submerged plants, curly-leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*) were documented. Two non-native emergent plants were present in the lake, purple loosestrife (*Lythrum salicaria*) and reed canary grass (*Phalaris arundinaceae*). Two floating-leaf plants that were documented in previous surveys, yellow waterlily (*Nuphar variegata*) and American lotus *(Nelumbo lutea*), were not detected during the 2005 survey. These plants may still occur in the lake but in low abundance.

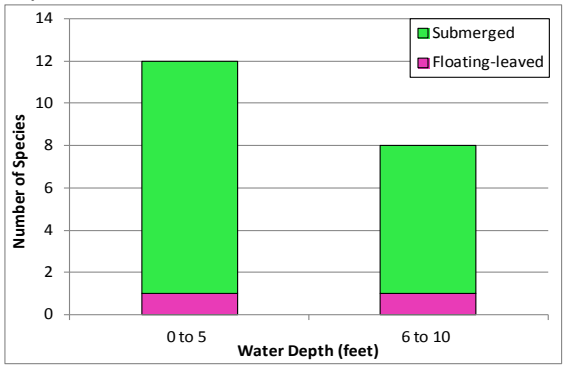
Table 2. Frequency of aquatic plants in Snelling Lake Point-intercept survey, June 2005.

(Frequency is the percent of sample sites in which a plant species occurred within the shore to 10 ft water depth.)

Life Form	Common Name	Scientific Name	Frequency (n=160)
NATIVE SUBMERGED	Coontail	*Ceratophyllum demersum*	91
	White-water buttercup	*Ranunculus aquatilis*	33
	Canada waterweed	*Elodea canadensis*	24
	Northern watermilfoil	*Myriophyllum sibiricum*	10
	Sago pondweed	*Stuckenia pectinata*	5
	Flat-stem pondweed	*Potamogeton zosteriformis*	4
	River pondweed	*Potamogeton nodosus*	2
	Narrow-leaved pondweed	*Potamogeton* sp.*	2
	Muskgrass	*Chara* sp.	2
	Bushy pondweed	*Najas flexilis*	1
NON-NATIVE SUBMERGED	Curly-leaf pondweed	*Potamogeton crispus*	71
	Eurasian watermilfoil	*Myriophyllum spicatum*	Present
FLOATING	White waterlily	*Nymphaea odorata*	21
	Floating-leaf water smartweed	*Persicaria amphibia*	Present
EMERGENT These plants extend well above the water surface and are usually found in shallow water, near shore.	Purple loosestrife	*Lythrum salicaria***	Present
	Reed Canary Grass	*Phalaris arundinacea***	Present
	Narrow-leaf cattail	*Typha angustifolia*	Present
	Blue Flag Iris	*Iris versicolor*	Present
	Spikerush	*Eleocharis sp.*	Present

*Specimens of "narrow-leaved pondweeds" were not identified to species.
Present = Found in lake but not within sample sites.
**Non-native emergents escaped from cultivation

Figure 6. Number of plant species vs. water depth.



The zone from shore to a depth of 10 feet contained the greatest number of plant species (Figure 6). Emergent and floating-leaf plants were generally restricted to water depths of five feet and less.

The number of plant species found at each one square meter sample site ranged from zero to six, with a mean of three (Figure 7). Sites with the highest number of plant species were found mixed in with waterlily beds.

Emergent and floating-leaf plants

Emergent plants, like cattail, were present along the shoreline but were not found in any sample sites. The most common floating-leaf plant was white waterlily (*Nymphaea odorata*; Figure 8). It was present in 21% of all sites and in shallow water (less than six feet, it occurred in 49% of the sites. Waterlily beds covered about 48 acres (Figure 9).

Figure 8. White waterlily

Figure 7. Number of species per sample site, Snelling Lake.

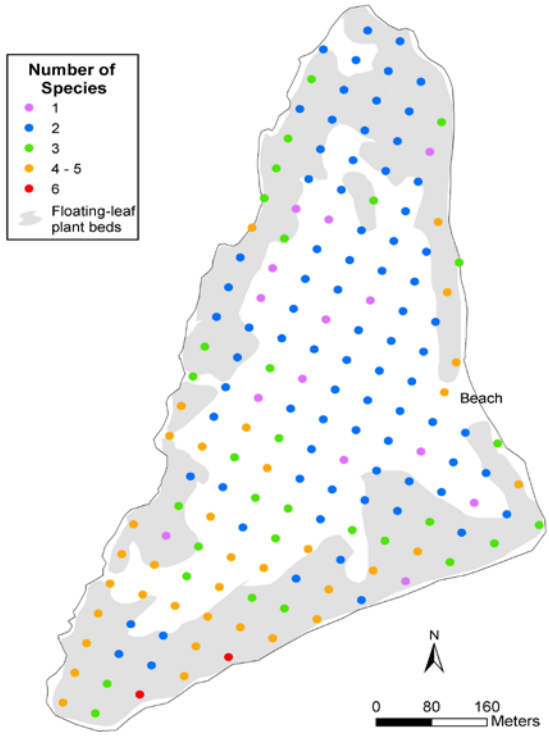
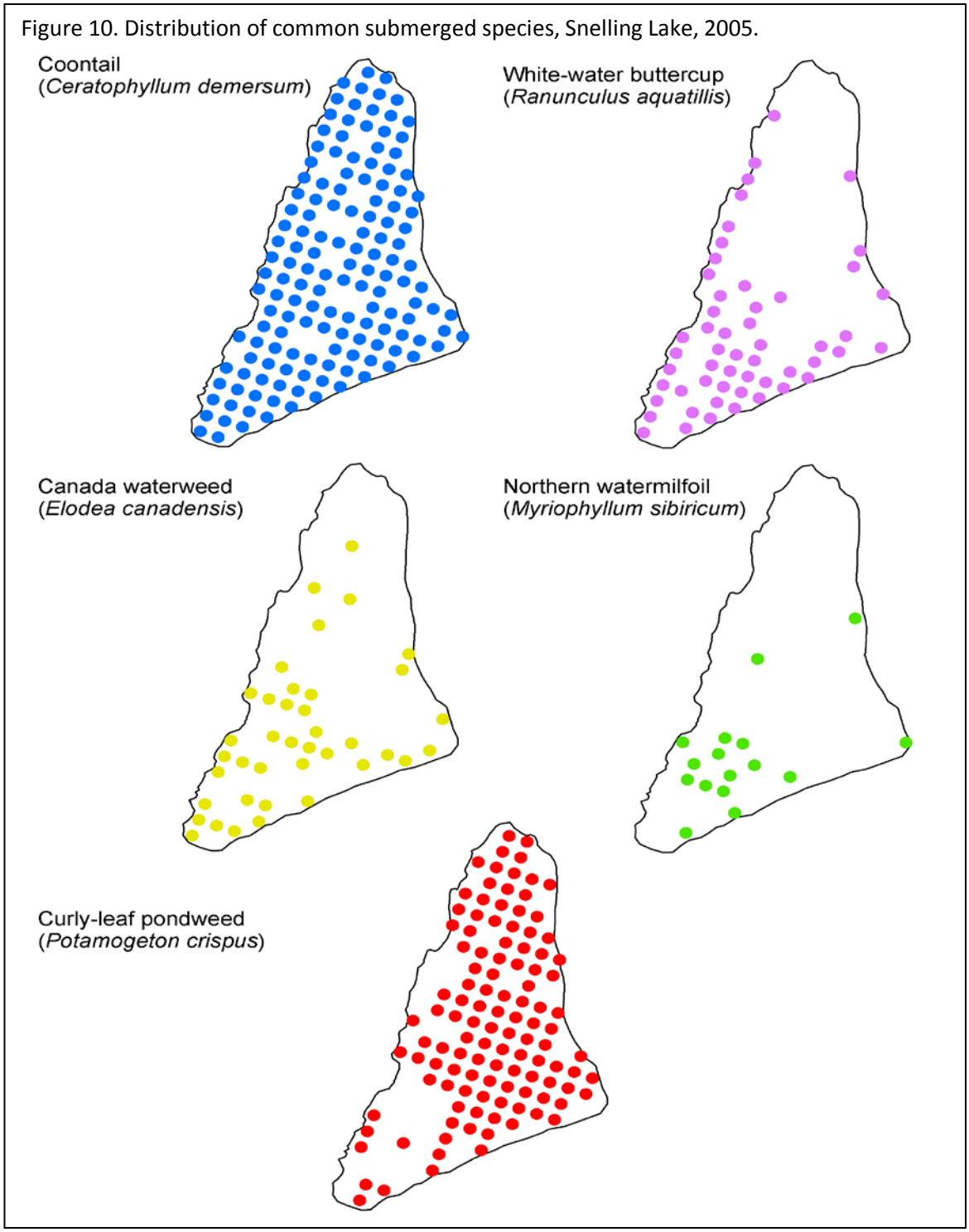


Figure 9. Major floating-leaf plant beds, Snelling Lake.

Submerged plants

Submerged plants occurred in 100% of the Snelling Lake sites and included a mix of native and non-native species. The most common native species were coontail, white water-buttercup, Canada waterweed, and northern watermilfoil; the most frequent non-native plant was curly-leaf pondweed (Figure 10).

Figure 10. Distribution of common submerged species, Snelling Lake, 2005.

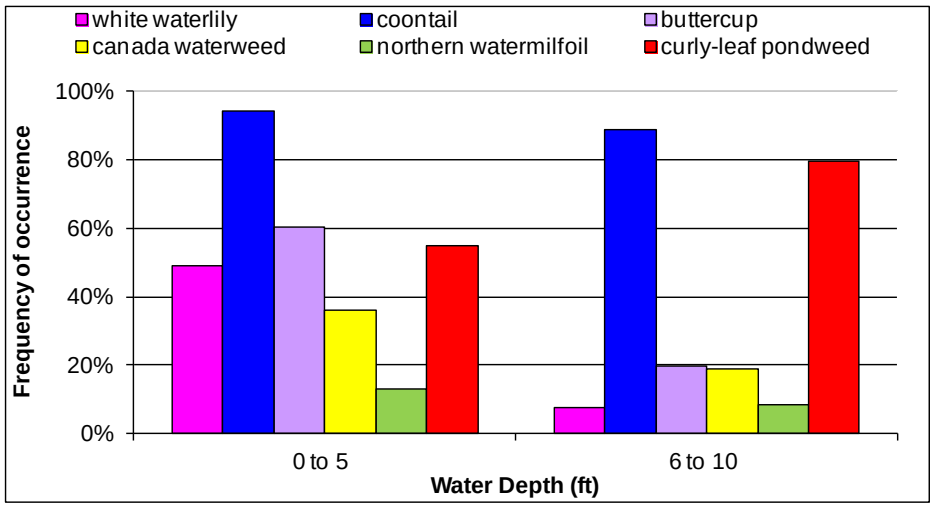


Coontail (*Ceratophyllum demersum*; Figure 11) is the most common submerged plant in Minnesota and was also the most frequently occurring plant in Snelling Lake. It was found in 91% of the sample sites (Table 2) and was the dominant plant in shallow and deep water (Figure 12).

Figure 11. 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 (Nichols 1999). Coontail is a native 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. Frequency of common plants by water depth interval.



Curly-leaf pondweed (*Potamogeton crispus*; Figure 13) was found in 71% of the survey sites (Table 2) and occurred to a depth of 10 feet (Figure 12). This 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 2010).

Figure 13. Curly-leaf pondweed.

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

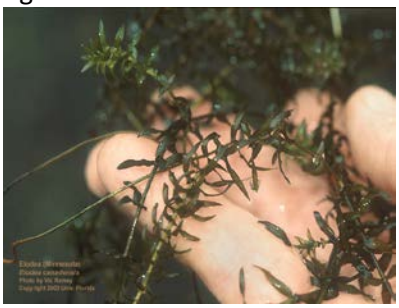
called “turions” which are hardened stem tips that break off and fall to the substrate. Turions remain dormant through the summer and germinate into new plants in early fall (Catling and Dobson 1985). The foliage of curly-leaf pondweed does provide some fish and wildlife habitat, but it may also create 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.

White water buttercup (*Ranunculus aquatilis*) was found in 33% of the Snelling Lake survey sites and was common in depths from shore to five feet (Figure 12). It was concentrated in the southern half of the lake (Figure 10). White water buttercup (Figure 14) is a rooted, perennial native submerged plant with finely divided alternate leaves. The leaves have a stalk between the stem and divided portion of the leaf. The flowers have five petals, are white, and grow above the water. The flowers bloom in late spring, whereas the fruits develop in early summer. The stems emerge from rhizomes in early spring. White-water buttercup is found in streams and lakes with higher alkalinity (Borman et al. 2001).

Figure 14. White water buttercup.

Canada waterweed (*Elodea canadensis*) was found in 24% of the sites (Table 2) and was most frequent in shallow water (Figure 12). This perennial submerged species is native and 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 (Figure 15) can overwinter as an evergreen plant and spreads primarily by fragments.

Figure 15. Canada waterweed.



Northern watermilfoil (*Myriophyllum sibiricum*) was found in 10% of the Snelling Lake survey sites and was found in the southern part of the lake (Figure 10). This plant is native to Minnesota. It is a rooted, perennial submerged plant with finely dissected leaves (Figure 16). It may reach the water surface, particularly in depths less than ten feet and its flower stalk extends 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 16. Northern watermilfoil.

Eurasian watermilfoil (*Myriophyllum spicatum)* (Figure 17) resembles and is closely related to northern watermilfoil but is not native to Minnesota. Click here for information on how to distinguish this non-native from native species: identification. Eurasian watermilfoil was located at two sites during the survey but did not occur within any of the sample sites. In some areas of some lakes, Eurasian watermilfoil can form thick beds and crowd out native plants.

Figure 17. Eurasian watermilfoil

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 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 Snelling Lake increases, submerged vegetation may be more common at depths greater than 5 feet. Declines in water clarity may lead to fewer plants and fewer 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 Snelling 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: Historical and current aquatic plants of Snelling Lake

Submerged plants

Common Name	Scientific Name	1960	1974	1975	1984	1989	2005
Coontail	*Ceratophyllum demersum*	X	X	X	X	X	X
Muskgrass	*Chara* sp.			X			X
Needlegrass	*Eleocharis acicularis*					X	
Canada waterweed	*Elodea canadensis*	X	X	X	X	X	X
Water star-grass	*Heteranthera dubia*			X			
Northern watermilfoil	*Myriophyllum sibiricum*			X	X	X	X
Eurasian watermilfoil (I)	*Myriophyllum spicatum*						X
Bushy pondweed	*Najas flexilis*					X	X
Curly-leaf pondweed (I)	*Potamogeton crispus*					X	X
Variable pondweed	*Potamogeton gramineus*				X	X	
River pondweed	*Potamogeton nodosus*						X
Clasping-leaf pondweed	*Potamogeton richardsonii*					X	
Narrow-leaf pondweed	*Potamogeton* spp.					X	X
Straight-leaved pondweed	*Potamogeton strictifolius*			X			
Flat-stem pondweed	*Potamogeton zosteriformis*		X	X	X	X	X
White water buttercup	*Ranunculus aquatilis*						X
Sago pondweed	*Stuckenia pectinata*	X		X		X	X
	Total	3	3	8	5	11	12

Free-floating plants

Common Name	Scientific Name	1960	1974	1975	1984	1989	2005
Lesser duckweed	*Lemna minor*		X	X			
Greater duckweed	*Spirodela polyhriza*				X	X	
Watermeal	*Wolffia* sp.					X	
	Total	0	1	1	1	2	0

Floating-leaved plants

Common Name	Scientific Name	1960	1974	1975	1984	1989	2005
Floating-leaf smartweed	*Persicaria amphibia*		X	X		X	X
White waterlily	*Nymphaea odorata*	X			X	X	X
Yellow waterlily	*Nuphar variegata*	X					
American lotus	*Nelumbo lutea*			X	X	X	
	Total	2	1	2	2	3	2

Emergent plants

Common Name	Scientific Name	1960	1974	1975	1984	1989	2005
Spikerush	*Eleocharis* sp.						X
Arrowhead	*Sagittaria rigida*					X	
Bulrush[2]	*Schoenoplectus* sp.			X	X	X	
Broad-leaved cattail	*Typha latifolia*	[a]X	X	X	X		
Narrow-leaved cattail	*Typha angustifolius*				X	X	X
Total		1	1	2	3	3	2

Wetland emergent plants

Common Name	Scientific Name	1960	1974	1975	1984	1989	2005
Blue-flag iris	*Iris versicolor*					X	X
Purple loosestrife (I)	*Lythrum salicaria*					X	X
Reed canary grass (I)	*Phalaris arundinaceae*					X	X
Greater water dock	*Rumex* sp.					X	
Total		0	0	0	0	4	3

I = introduced

[a]X = Identified only to genus

[1]a species of bulrush (*Schoenoplectus* sp.) was used to record bulrush plant that was hard-stem bulrush (*Schoenoplectus acutus*), soft-stem bulrush (*S. tabernaemontani*) or the hybrid.

Sources:
1960 (July 6-7): Earl Huber, Terry Boldingh, DNR Fisheries Survey
1974 (June 27-29): Roger Hugill, DNR Fisheries Survey
1975 (July 3): Leroy Dalke, Larry Gatea, DNR Fisheries Survey
1984 (June 27-28): Mark Ebbers (Crew Leader); DNR Fisheries Survey
1989 (June 28): Jodell Jahr, Craig Bell, MnDNR Fisheries Survey
2005 (June 8): Perleberg, Peterson, Point-Intercept survey, MnDNR Division of Ecological and Water Resources

Appendix 2: 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 10 feet depth zone.

Example:
In Snelling Lake there were 160 sample sites in the 0 to 10 feet depth zone.
Coontail occurred in 146 sites.
Frequency of Coontail in 0 to 10 feet zone = (146/160)*100 = 91%