Aquatic Vegetation Survey of

Round Lake (DOW #18-0373-00)

Crow Wing County, Minnesota

2006

Round Lake. 2006

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Summary

Round Lake is a 1,650 acre, mesotrophic lake in north central Minnesota. The lake has historically supported an abundant and diverse native aquatic plant community. The aquatic vegetation survey, conducted in June 2006, included a lakewide assessment of vegetation and water depths at 315 sample stations and a characterization of near shore substrate types

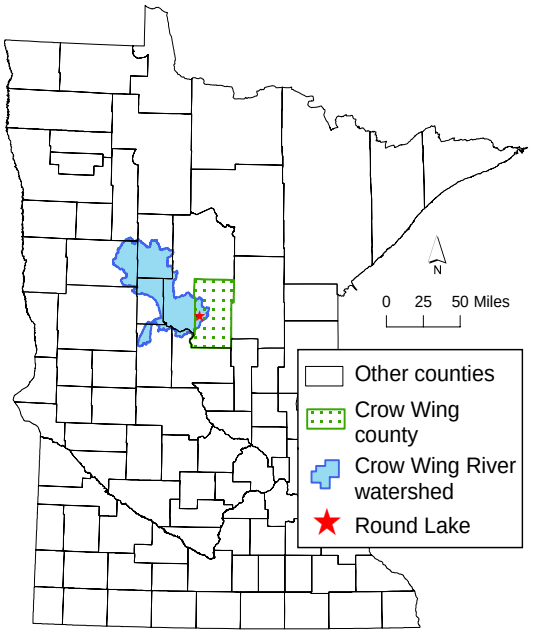
A total of 25 native aquatic plant species were recorded including four emergent, two floating-leaved, and 19 submerged plants. Aquatic plants occurred around the entire perimeter of the lake and vegetation was present in 75 percent of the sample sites. Plants were found to 20 feet, the maximum depth sampled. Vegetation was most frequent in the shore to 15 feet depth zone, where 82 percent of the sites contained plants.

Native submerged plants occurred in 70 percent of the sample sites. Muskgrass (*Chara* sp.) was the most common submerged plant and was found in 49 percent of the sample sites. Other native submerged taxa included northern watermilfoil (*Myriophyllum sibiricum*), coontail (*Ceratophyllum demersum*), broad-leaf pondweeds (*Potamogeton* spp.) and flat-stem pondweed (*Potamogeton zosteriformis*). The non-native plant curly-leaf pondweed (*Potamogeton crispus*) was found in 15 percent of the sample sites and was most frequent in depths of six to 15 feet.

Introduction

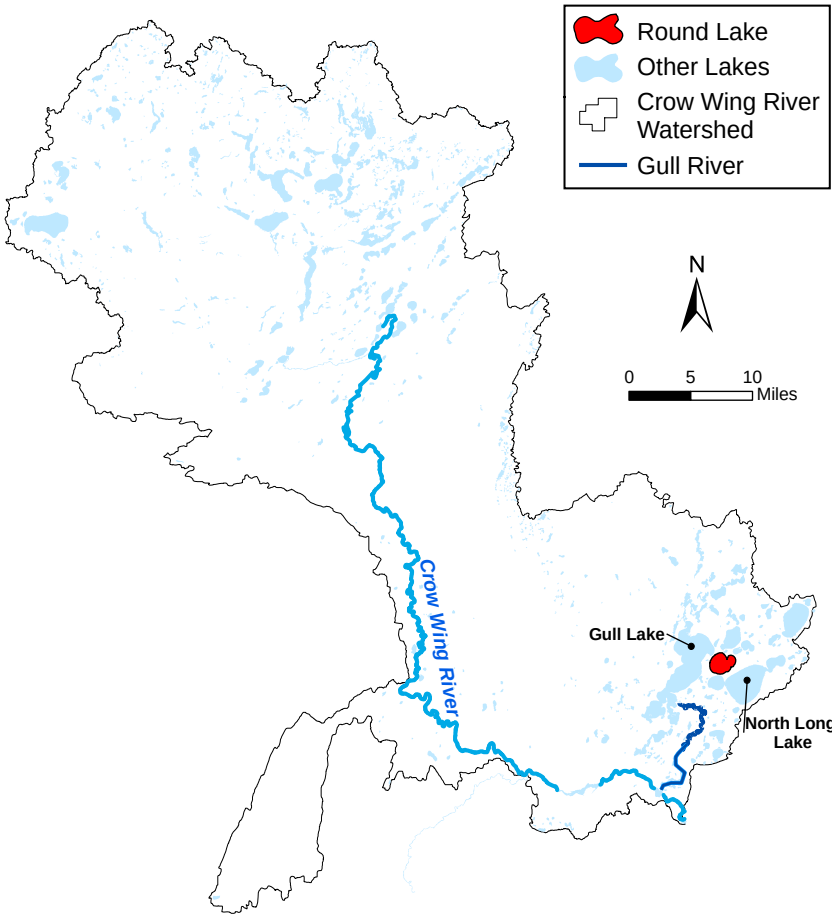
Round Lake is located in Crow Wing County, north central Minnesota, in the Crow Wing River Watershed (Figure 1). There are about 225 lakes in this watershed and about 260 lakes in Crow Wing County that are at least 50 acres in size. Round Lake is the eighth largest lake in the watershed and the 12th largest lake in the county, with a surface area of 1,650 acres and about seven miles of shoreline.

Figure 1. Location of Round Lake in Minnesota.



Round Lake is in the southeastern end of the watershed and lies between Gull and North Long lakes (Figure 2). Bishop Creek flows west from North Long Lake into Round Lake and outflows to the northwest into Gull Lake. The Gull River flows south from Gull Lake about 11 miles until it meets the Crow Wing River. The Crow Wing River drains the watershed to the southeast and empties into the Mississippi River.

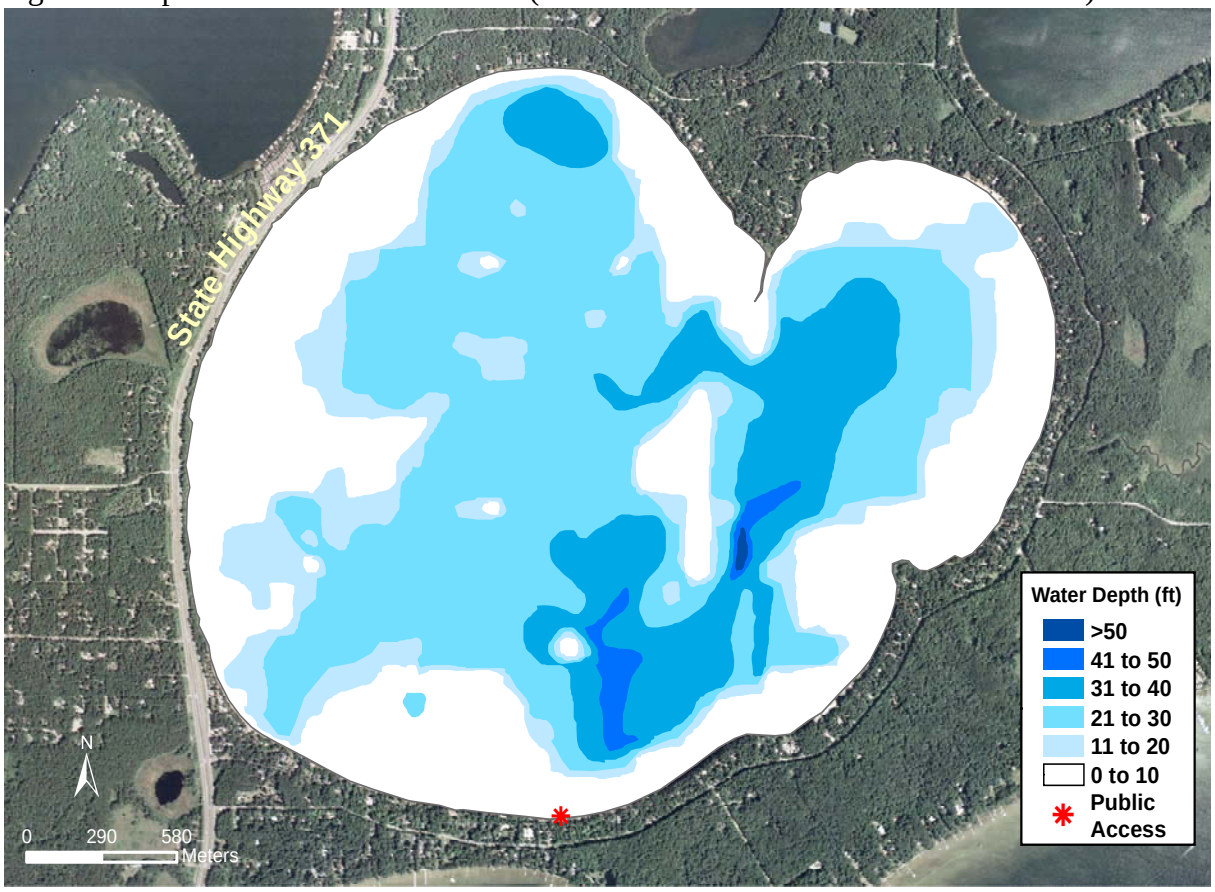
Figure 2. Round Lake in Crow Wing River Watershed



The uplands surrounding Round Lake remain mostly forested but heavily developed with residential homes. State Highway 371 runs along the west side of the lake and a public access is located on the south shore (Figure 3).

As its name implies, Round Lake is circular in outline. It has maximum depth of 51 feet and 38 percent of the lake basin is less than 15 feet in depth (Figure 3). A broad shallow area rings the lake shoreline and there are a few shallow bars, the largest of which

Figure 3. Depth contours of Round Lake (10 and 20 foot contour based on 2006 data).



occurs in the center of the lake (Figure 3). 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.

Figure 4. Measuring Secchi Disc transparency

The Secchi disc (Figure 4) 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. Between 1993 and 2007, mean summer water clarity, as measured by Secchi disc readings, ranged from nine feet to 11 feet in Round Lake (MPCA, 2008). 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 grow to about 14 to 17 feet in Round Lake. Other factors that may influence the depth of plant growth include substrate type, wind fetch, and plant species composition.

Previous vegetation surveys of Round Lake found plants growing to depths of 15 feet with abundant plant growth described throughout the lake in 1968, 1981, 1986, and 1991 (MnDNR Fisheries Lake Files). More than 31 different aquatic plant taxa have previously been recorded in Round Lake including muskgrass (*Chara* sp.), flat-stem pondweed (*Potamogeton*

zosteriformis), Canada waterweed (*Elodea canadensis*), coontail (*Ceratophyllum demersum*), wild rice (*Zizania palustris*), and hard-stem bulrush (*Scirpus acutus*).

Objectives
The purpose of this vegetation survey was to provide a quantitative description of the 2006 plant population of Round Lake. Specific 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 common species
6. Develop distribution maps for the common species

Methods

Mapping emergent vegetation beds
Emergent plant beds were mapped in 2004 by Minnesota Department of Natural Resources Brainerd Area Fisheries biologists.

Lakewide vegetation survey
Round Lake was surveyed on June 21, 2006. 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 100 meters (328 feet) apart. Three field crews, each consisting of two surveyors and one boat, conducted the survey. A total of 315 sites were surveyed (Figure 5, Table 1).

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

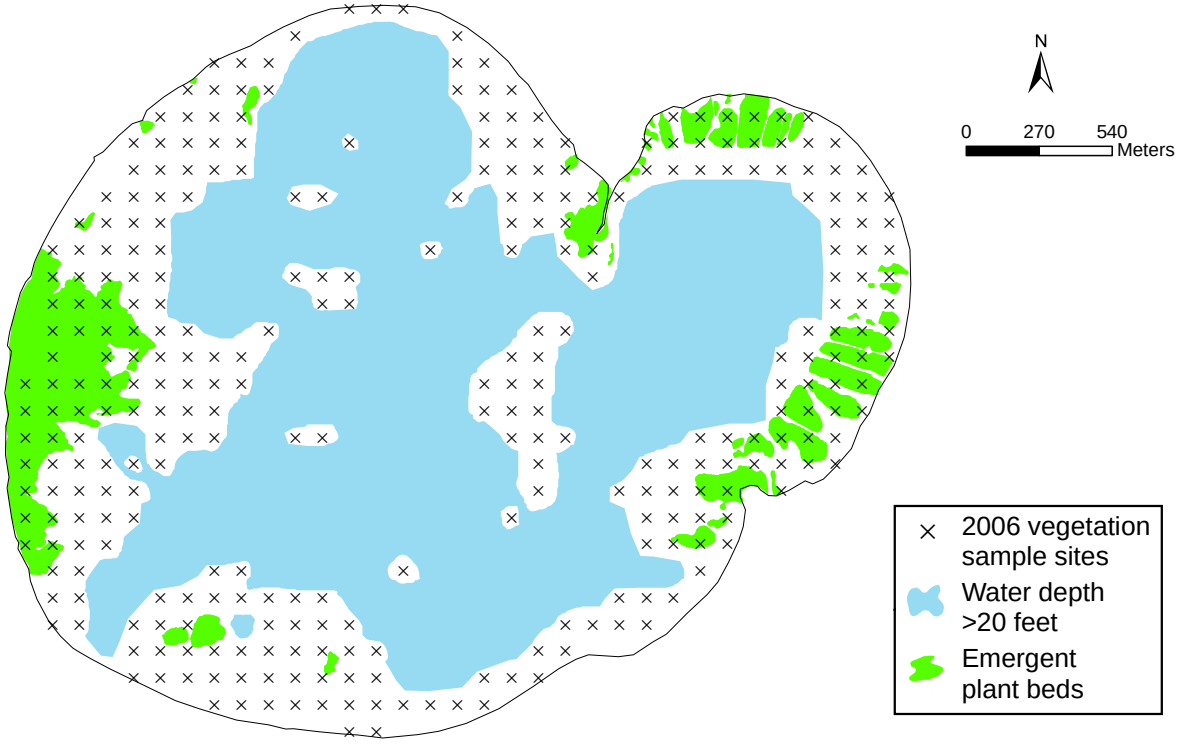
Surveyors recorded all plant taxa found within a one square meter sample site at the pre-designated side of the boat. A double-headed, weighted garden rake, attached to a rope was used to survey vegetation not visible from the surface (Figure 6). Plant identification and nomenclature followed Crow and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

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 four depth zones for analysis (Table 1).

Table 1. Sampling effort by water depth.

Water depth interval	Number of sites
0 to 5	204
6 to 10	44
11 to 15	16
16 to 20	51
Total sample points	315

Figure 5. 2006 vegetation survey sites



Example: In Round Lake there were 315 samples sites.

Muskgrass (*Chara* sp.) occurred in 154 sites.

Frequency of muskgrass in shore to 20 feet zone of Round Lake = 154/315 (*100) = 49 %

Figure 6. Sampling rake.

At each sample site where water depth was seven feet and less, surveyors described the bottom substrate using standard substrate classes (Table 2). If several substrate types occurred at a site, surveyors recorded the most common type.

Table 2. Substrate classes

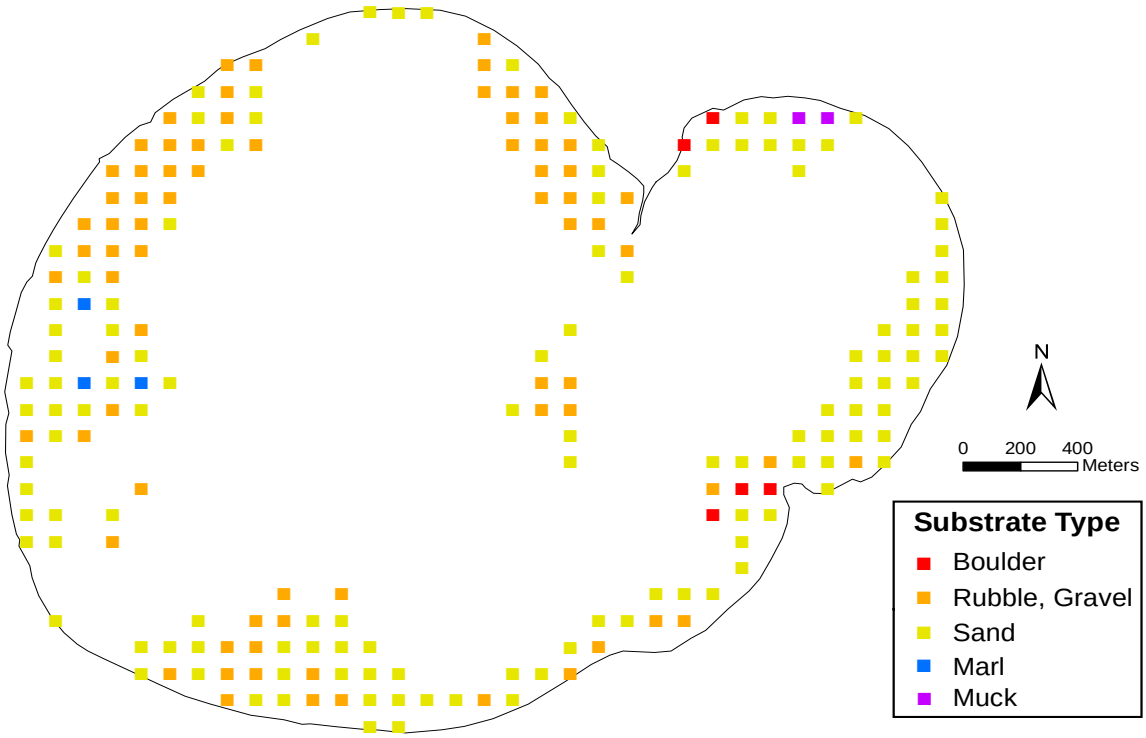
muck	decomposed organic material
marl	calcareous material
silt	fine material with little grittiness
sand	diameter less than 1/8 inch
gravel	diameter 1/8 to 3 inches
rubble	diameter 3 to 10 inches
boulder	diameter over 10 inches

Results

Shoal substrates

The shoal substrates of Round Lake were primarily hard substrates of sand, boulder, gravel and rubble. Boulders were found at scattered locations. Softer substrates of marl and muck were found at five points in Round Lake (Figure 7). Muck was located in the northeast bay and marl was located on the west side of Round Lake, in depths greater than three feet.

Figure 7. Shoal water sediments of Round Lake, 2006.



Distribution of aquatic plants

Aquatic plants occurred around the entire perimeter of Round Lake and on most off-shore shallow bars (Figure 8). The broadest bands of vegetation were on the west and southwest shores where plants extended lakeward about 900 meters (3,000 feet). In areas along the north shore, vegetation was restricted to a narrow band of about 200 meters (600 feet).

Plant occurrence by water depth

Plants were found to a depth of 20 feet (the maximum depth sampled) and 75 percent of the sites were vegetated. Vegetation was most common in the shore to 15 feet zone where 82 percent of the sites contained plants (Figure 9). In the 16 to 20 feet zone, only 35 percent of the sites were vegetated. Scattered plants likely occurred beyond the 20 feet depth.

Figure 8. Distribution of aquatic plants in Round Lake, 2006.

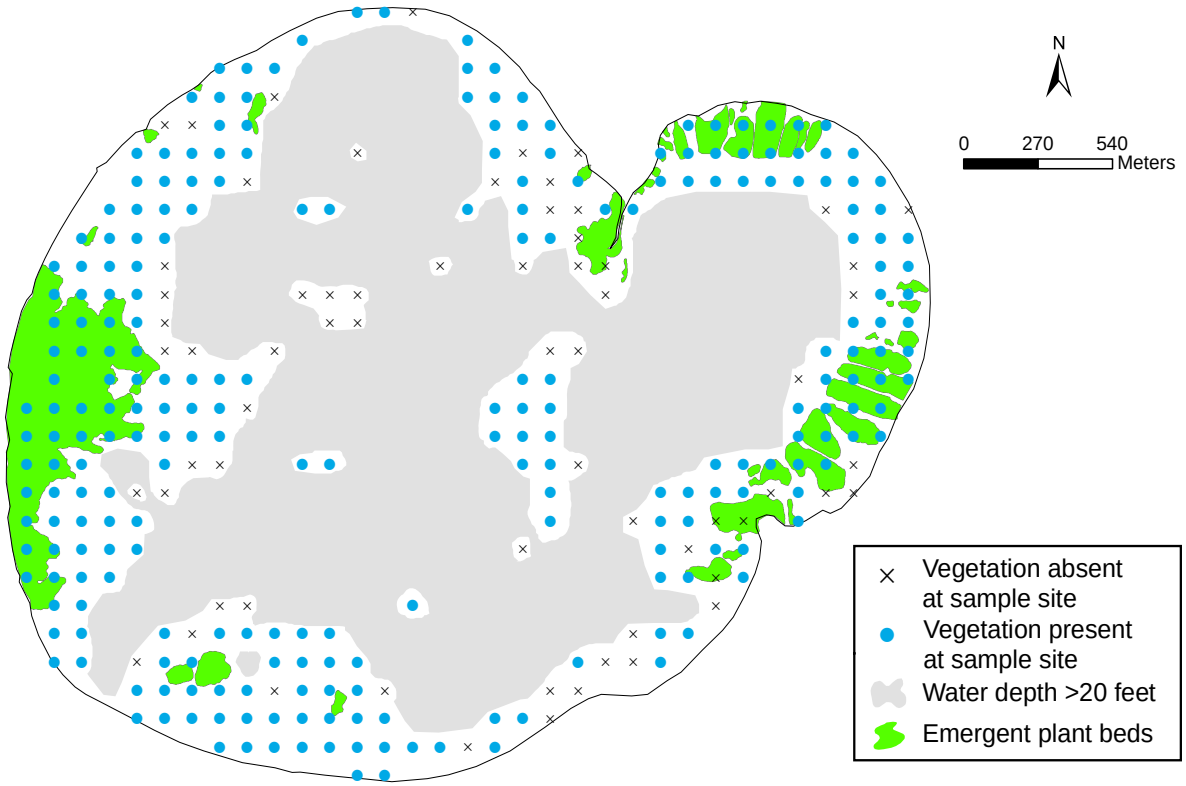
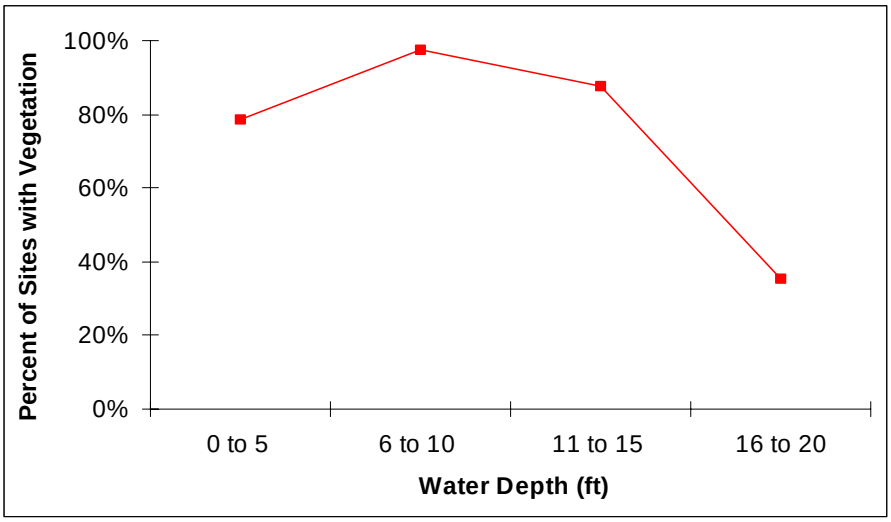


Figure 9. Percent frequency of vegetation by water depth interval.



Number of plant species recorded and distribution by water depth

A total of 25 native aquatic plant taxa were recorded in Round Lake including four emergent, two floating-leaved, and 19 submerged taxa (Table 3). One non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*), was documented.

Table 3. Frequency of aquatic plants in Round Lake Point-intercept survey, June 2006.

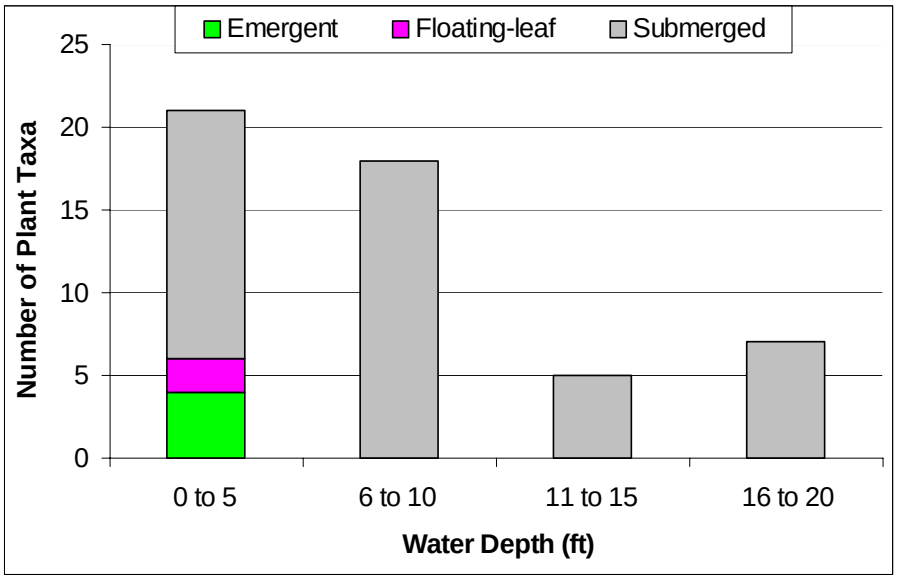
(Frequency is the percent of sample sites in which a plant taxon occurred within the shore to 20 ft water depth.)
315 sample sites

Life Form		Common Name	Scientific Name	Frequency
NATIVE SUBMERGED These plants grow primarily under the water surface. Upper leaves may float near the surface and flowers may extend above the surface. Some species may also form floating leaves. Plants may or may not be anchored to the lake bottom.	Large Algae and moss	Muskgrass	*Chara* sp.	49
		Stonewort	*Nitella* sp.	<1
		Watermoss	*Not identified to genus*	<1
	Dissected-leaf rooted plants	Northern water milfoil	*Myriophyllum sibiricum*	14
		Coontail	*Ceratophyllum demersum*	9
		Bladderwort	*Utricularia vulgaris*	1
		White water buttercup	*Ranunculus aquatilis*	1
		Water marigold	*Megaladonta beckii*	1
	Broad-leaf rooted plants ("cabbage")	Variable pondweed	*Potamogeton gramineus*	9
		White-stem pondweed	*Potamogeton praelongus*	8
		Illinois pondweed	*Potamogeton illinoensis*	6
		Clasping-leaf pondweed	*Potamogeton richardsonii*	2
		Large-leaf pondweed	*Potamogeton amplifolius*	<1
	Grass-leaf rooted plants	Flat-stem pondweed	*Potamogeton zosteriformis*	8
		Wild celery	*Vallisneria americana*	3
	Small-leaf rooted plants	Bushy pondweed	*Najas flexilis*	3
		Narrow-leaf pondweed	*Potamogeton sp.**	3
		Fries pondweed	*Potamogeton friesii*	1
		Sago pondweed	*Stuckenia pectinata*	1
		Canada waterweed	*Elodea canadensis*	1
NON-NATIVE SUBMERGED		Curly-leaf pondweed	*Potamogeton crispus*	15
FLOATING These plants are rooted in the lake bottom with leaves that float on the water surface.		Yellow waterlily	*Nuphar variegata*	1
		White waterlily	*Nymphaea odorata*	<1
EMERGENT These plants extend well above the water surface and are usually found in shallow water, near shore.		Hardstem bulrush	*Scirpus acutus*	16
		Wild Rice	*Zizania palustris*	3
		Three-square bulrush	*Scirpus pungens*	1
		Spikerush	*Eleocharis sp.*	1

*Some specimens of "narrow-leaved pondweeds" were positively identified as *Potamogeton freisii* (Fries pondweed). However, it is not known whether other "look-a-like" narrow-leaf pondweed species occurred in the lake. Therefore, a separate group of "unidentified narrow-leaf pondweeds" (*Potamogeton* sp.) are reported here but not counted in species tally.

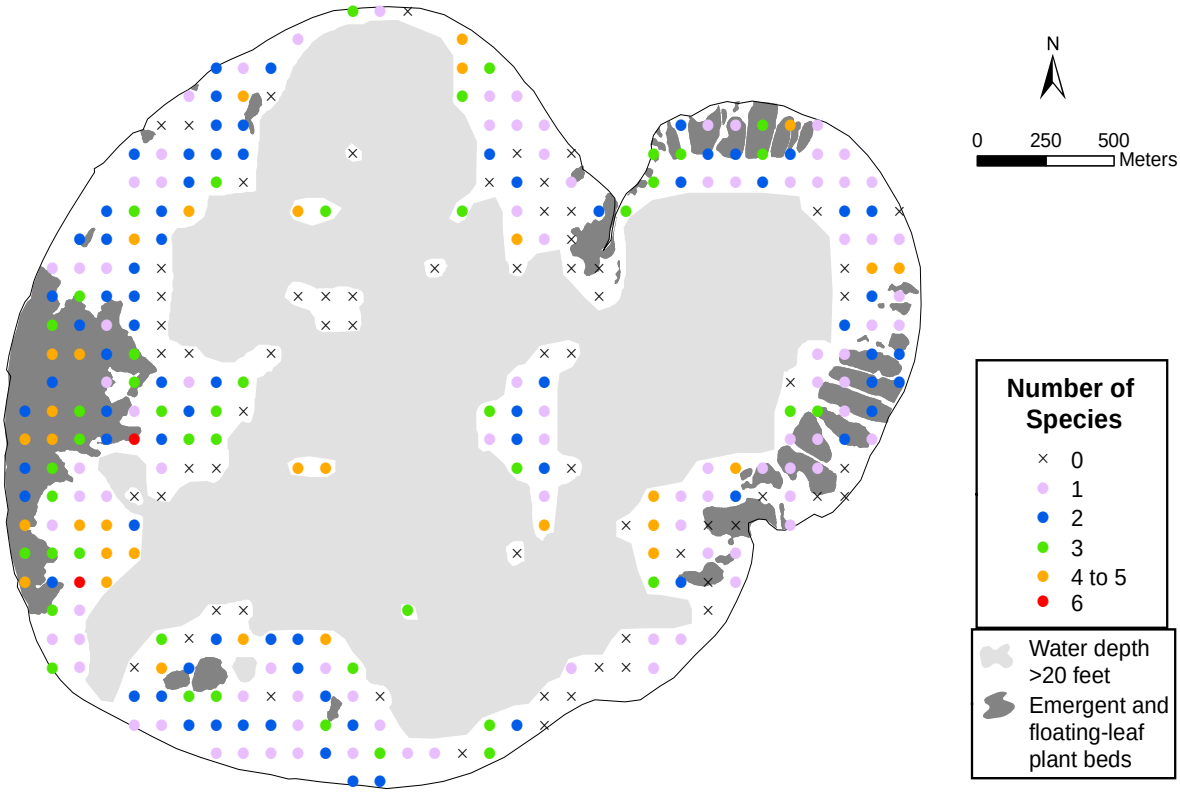
The zone from shore to a depth of five feet contained the greatest number of plant taxa and all three life forms (emergent, floating-leaf and submerged) occurred at this depth interval (Figure 10). Emergent and floating-leaf plants were generally restricted to water depths of five feet and less. Only eight plant taxa occurred in depths greater than 10 feet.

Figure 10. Number of taxa found at each water depth interval



The number of plant taxa found at each one square meter sample site ranged from zero to six, with a mean of two. Sites with the highest number of plant taxa were found near shore as well as off-shore on shallow bars (Figure 11).

Figure 11. Number of plant species at each sample site, Round Lake, 2006.

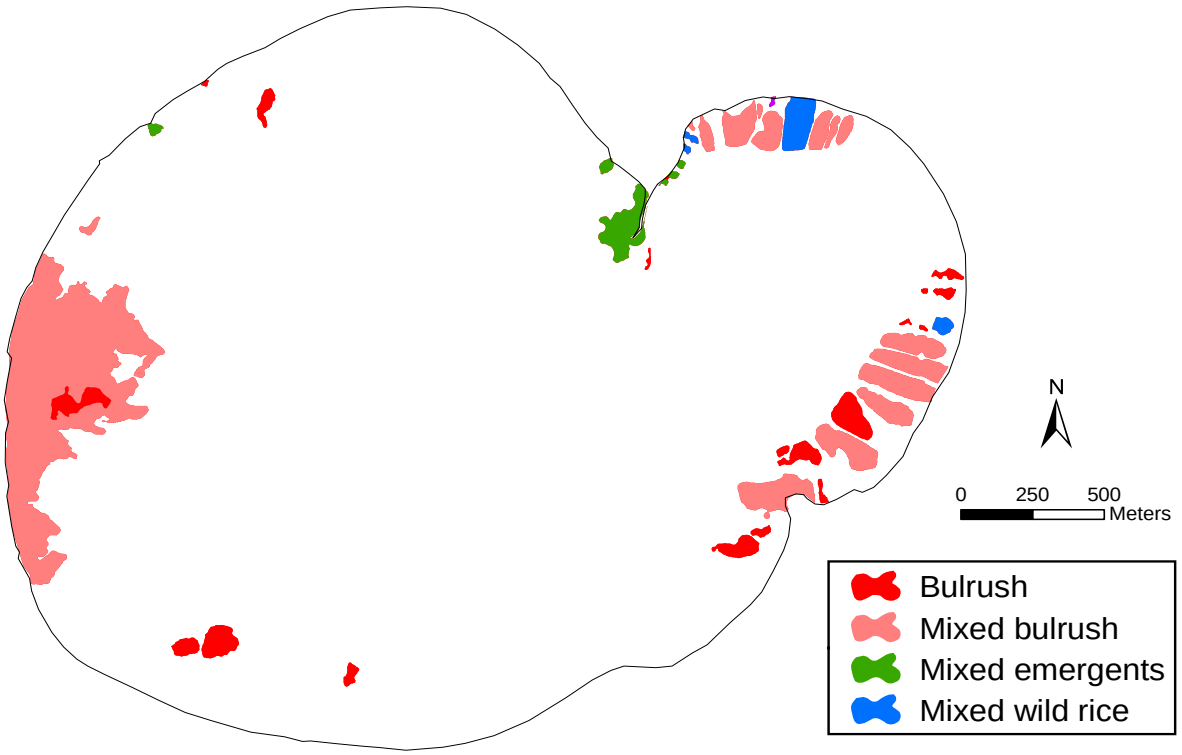


Emergent and floating-leaf plants

Emergent and floating-leaf aquatic plants offer food, cover and nesting material for waterfowl, marsh birds and muskrats, and provide shelter and shade for insects, young fish, and amphibians. The root systems of emergent and floating-leaf plants protect shorelines against erosion by buffering the wave action and by holding soil in place.

In 2004, MnDNR Brainerd Area Fisheries staff mapped about 143 acres of emergent plant beds in Round Lake. The largest beds occurred on the western and eastern shores (Figure 12). The major plant bed types were bulrush, wild rice, and mixed stands (Figure 12). In 2006, 17 percent of the survey sites contained at least one emergent or floating-leaf plant. Within the 0 to 5 feet depth range, 26 percent of the sites contained emergent and/or floating-leaf plants.

Figure 12. Major emergent plant beds 2004.



Hard-stem bulrush (*Scirpus acutus*) (Figure 13) was the most common emergent in Round Lake. It is an emergent, perennial plant that occurs in lakes and wetlands throughout Minnesota (Ownbey and Morley 1991). Bulrush stems are round in cross section and lack showy leaves. Clusters of small flowers form near the tips of long, narrow stalks. This emergent may occur from shore to water depths of about six feet and its stems may extend several feet above the water surface. Bulrush stands are particularly susceptible to

Figure 13. Bulrush mixed with waterlilies in Round Lake, 2006.

destruction by excess herbivory and direct removal by humans. Beds of bulrush, or bulrush mixed with other species, covered about 126 acres. Bulrush was found in 16 percent of all sites (Table 3) and between shore and the five feet depth, bulrush was found in 24 percent of the sample sites. Bulrush was usually found in sand or gravel.

Wild rice (*Zizania palustris*) (Figure 14) is an annual plant that germinates each year from seed that fell to the lake bottom in the previous fall. It prefers soft substrates (Lee 1986, Nichols 1999) and generally requires moving water for growth (MnDNR 2008). The plant begins growth underwater and then forms a floating-leaf stage (Figure 12) before becoming fully emergent. Wild rice is susceptible to disturbance from storms and motorboats because it is weakly rooted to the lake bottom.

Figure 14. Floating-leaf stage of wild rice, Round Lake, 2006.

About six acres of wild rice was mapped, included some stands that were mixed with bulrush, other emergent vegetation, and/or waterlilies. Wild rice occurred in three percent of all sites (Table 3) and in three percent of sites in depths less than six feet.

Floating-leaf plants included yellow waterlily (*Nuphar variegata*), and white waterlily (*Nymphaea odorata*). Waterlily beds, or mixed beds of waterlilies and emergents covered about one acre in Round Lake Waterlily beds often contained scattered wild rice plants, bulrush plants, and submerged plants. Waterlilies and wild rice were often associated with soft substrates.

Native submerged plants

Native submerged plants occurred in 70 percent of the Round Lake sites. The most frequently sampled native submerged taxa were muskgrass (*Chara* sp.), northern watermilfoil (*Myriophyllum sibiricum*), coontail (*Ceratophyllum demersum*), broad-leaf pondweeds (*Potamogeton spp.*) and flat-stem pondweed (*Potamogeton zosteriformis*).

Muskgrass (*Chara* sp.) (Figure 15) is a macroscopic, or large, algae that is common in many hard water lakes in Minnesota. 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 15. Muskgrass

Muskgrass was the most common submerged plant in Round Lake, occurring in 49 percent of the sites (Table 3). It was found throughout Round Lake (Figure 16) but was mostly restricted to depths of 10 feet and less (Figures 17). Muskgrass could be found growing in thick beds with no other

vegetation and in other areas it co-occurred within mixed beds of pondweeds and other submerged plants.

Figure 16. Distribution of common native submerged species in Round Lake, 2006.

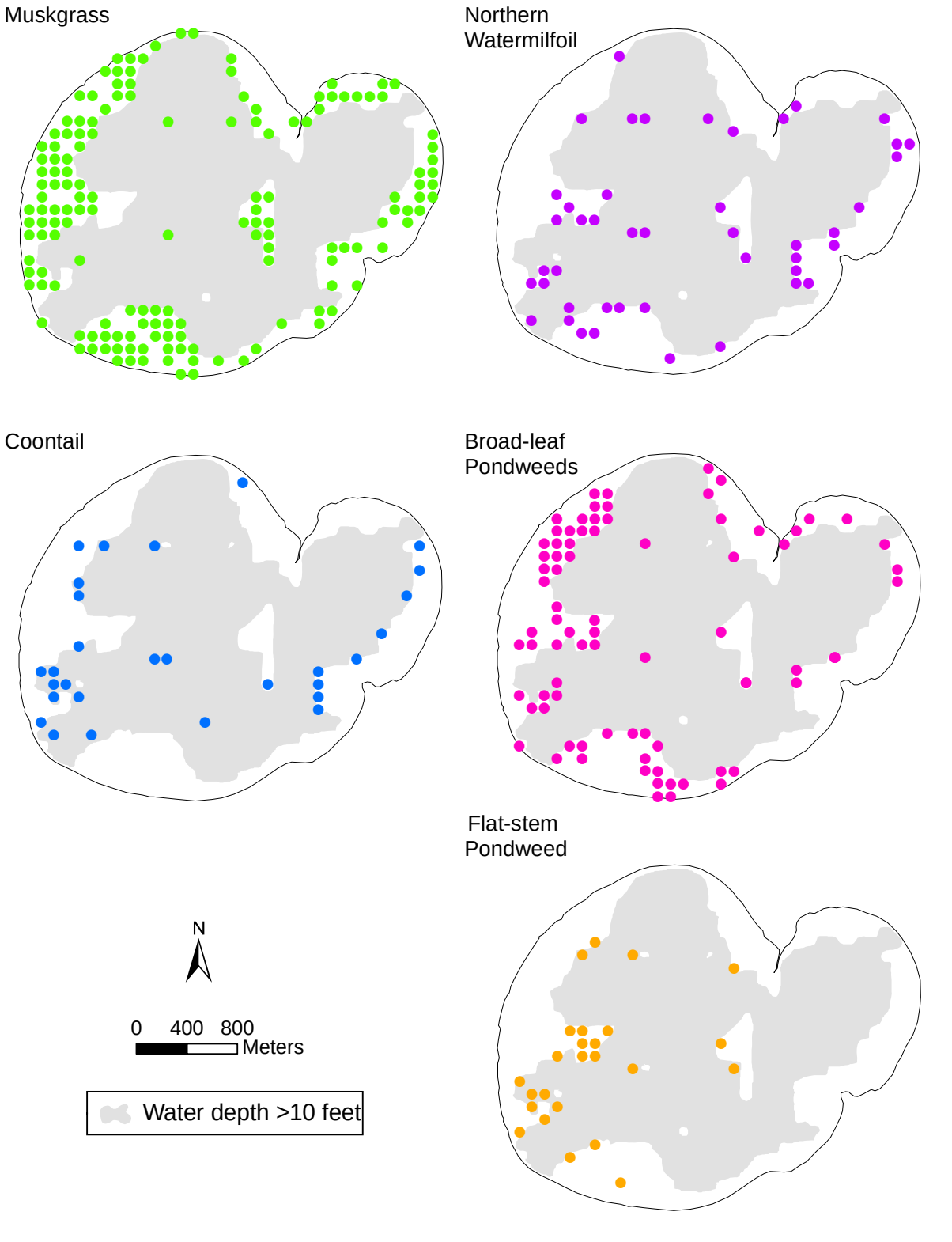
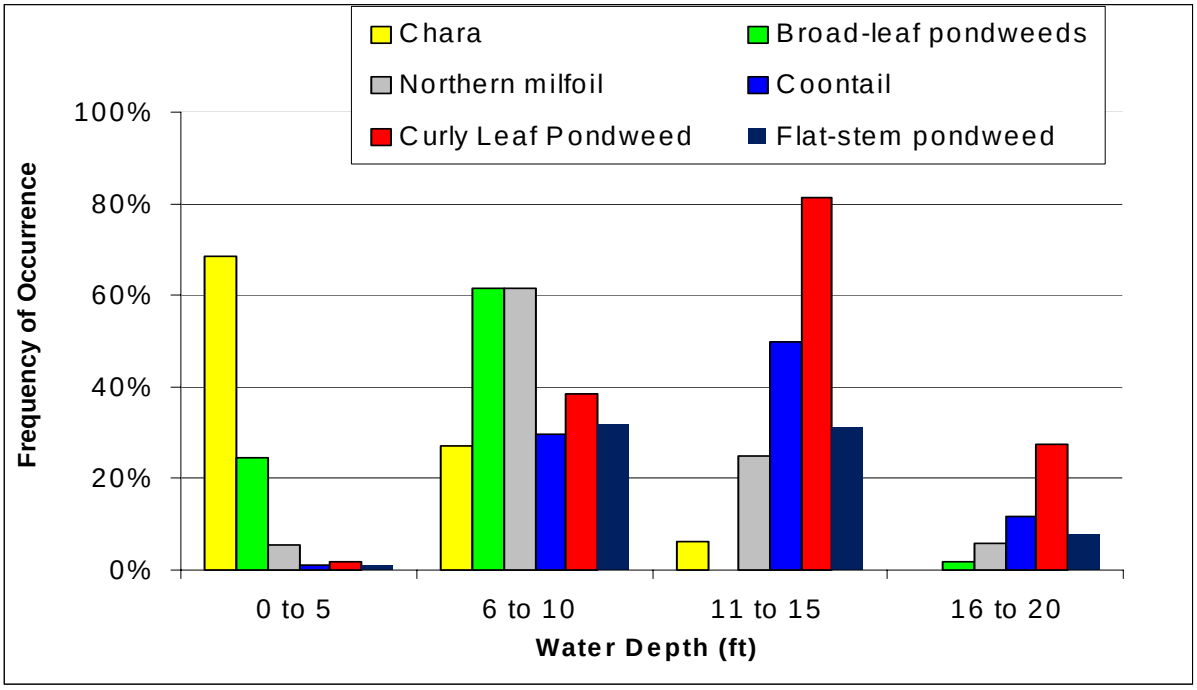


Figure 17. Frequency of common plants by water depth interval. Round Lake, June 2006.



Northern watermilfoil (*Myriophyllum sibiricum*) (Figure 18) is a rooted, perennial submerged plant with finely dissected leaves. 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. For information on how to distinguish this native plant from the non-native, Eurasian watermilfoil: identification.

Figure 18. Northern watermilfoil

Northern watermilfoil was found in 14 percent of Round Lake survey sites. It occurred around the lake (Figure 16) and was common in water depths of six to 15 feet (Figure 17). It occurred on the deep edge of muskgrass beds and occasionally co-occurred with muskgrass.

Coontail (*Ceratophyllum demersum*) (Figure 19) 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. Coontail occurred in nine percent of the survey sites (Table 3). It occurred at all depth zones sampled and was common

Figure 19. Coontail

in six to 15 feet water depth where it was the most frequent native plant (Figure 18).

Pondweeds (*Potamogeton* spp.) are one of the largest groups of submerged plants in Minnesota lakes. These plants are rooted perennials and their rhizomes may form mats on the lake bottom that help consolidate soil (Arber 1920). Pondweeds have opposite, entire leaves and form "cigar-shaped" flowers that emerge above the water surface. Many pondweed species over-winter as hardy rhizomes while other species produce tubers, specialized winter buds, or remain "evergreen" under the ice. 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). Pondweeds inhabit a wide range of aquatic sites and species vary in their water chemistry and substrate preferences and tolerance to turbidity. There are over 35 species of pondweeds in Minnesota and they vary in leaf shapes and sizes.

Figure 20. White stem pondweed (a type of broad-leaf pondweed)

Broad-leaf pondweeds are a group of wide-leaved submerged plants that are often called "cabbage" by anglers. Broad-leaf pondweeds found in Round Lake include large-leaf pondweed (*Potamogeton amplifolius*), Illinois pondweed (*P. illinoensis*), variable pondweed (*P. gramineus*), white-stem pondweed (*P. praelongus*), and clasping-leaf pondweed (*P. richardsonii*). These perennial plants produce tubers and fruits that are a favorite duck food and their broad leaves provide food and shelter for fish. Twenty-five percent of sites contained at least one broad-leaf species. Most common broad-leaf pondweeds in Round Lake were variable pondweed and white-stem pondweed (Figure 20). Broad-leaf pondweeds were found throughout Round Lake, but were most abundant on the northwest shoreline and were common in depths of ten feet and less (Figures 16, 17).

Figure 21. Flat- stem pondweed

Flat-stem pondweed (*Potamogeton zosteriformis*) (Figure 21) is a perennial plant that 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, these plants may reach the water surface and may produce flowers that extend above the water. Flat-stem pondweed was distributed around the west half of Round Lake (Figure 16) and it occurred in eight percent of the Round lake survey sites (Table 3). In Round Lake, it was common to depths from six to 15 feet (Figure 17).

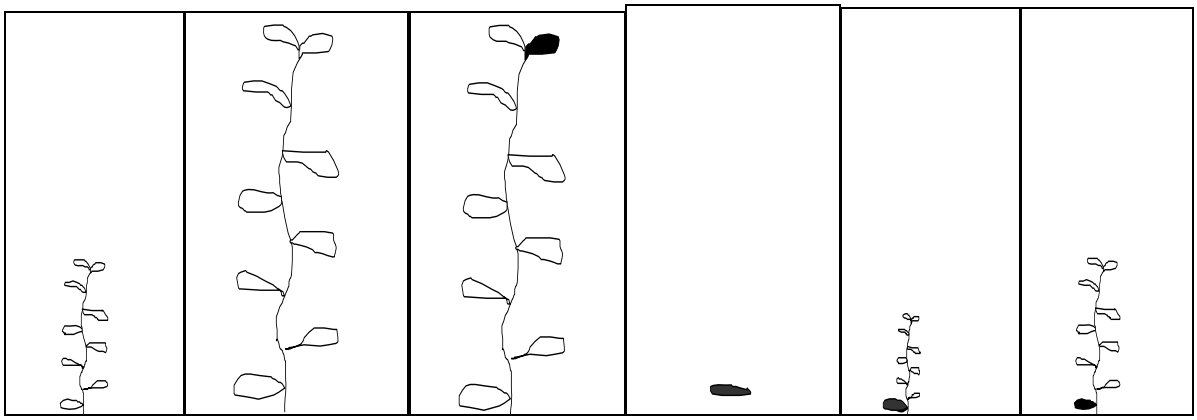
Figure 22. Curly-leaf pondweed

Curly-leaf pondweed (*Potamogeton crispus*) (Figure 22) is closely related to the native pondweeds found in

Round Lake but it is not native to Minnesota. This submerged plant that has been present in Minnesota since at least 1910 (Moyle and Hotchkiss 1945) and is now found in at least 700 Minnesota lakes (Invasive Species Program 2005). 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 (Figure 23). 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.

Figure 23. Life cycle of Curly-leaf pondweed (*Potamogeton crispus*).



Curly-leaf pondweed was present in 15 percent of the sample sites in Round Lake (Table 3) and was the most common in the 11 to 20 feet water depth zone (Figure 17). It was most frequent in the northwest bay, but it was also found scattered at other locations around the lake (Figure 24). Despite its presence in the lake, it was not the dominant plant. In most sites where curly-leaf occurred, it was found with native plant species; in five percent of the sites, curly-leaf pondweed was the only plant found (Figure 25).

Figure 24. Distribution of Curly-leaf pondweed (*Potamogeton crispus*).

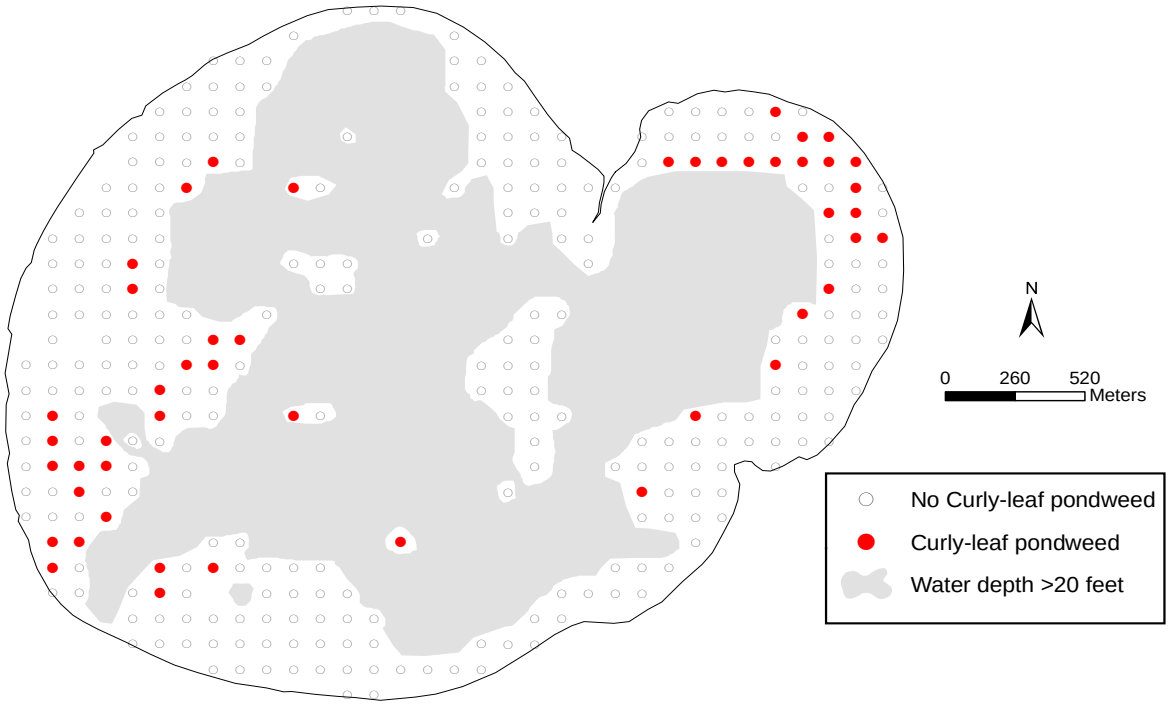
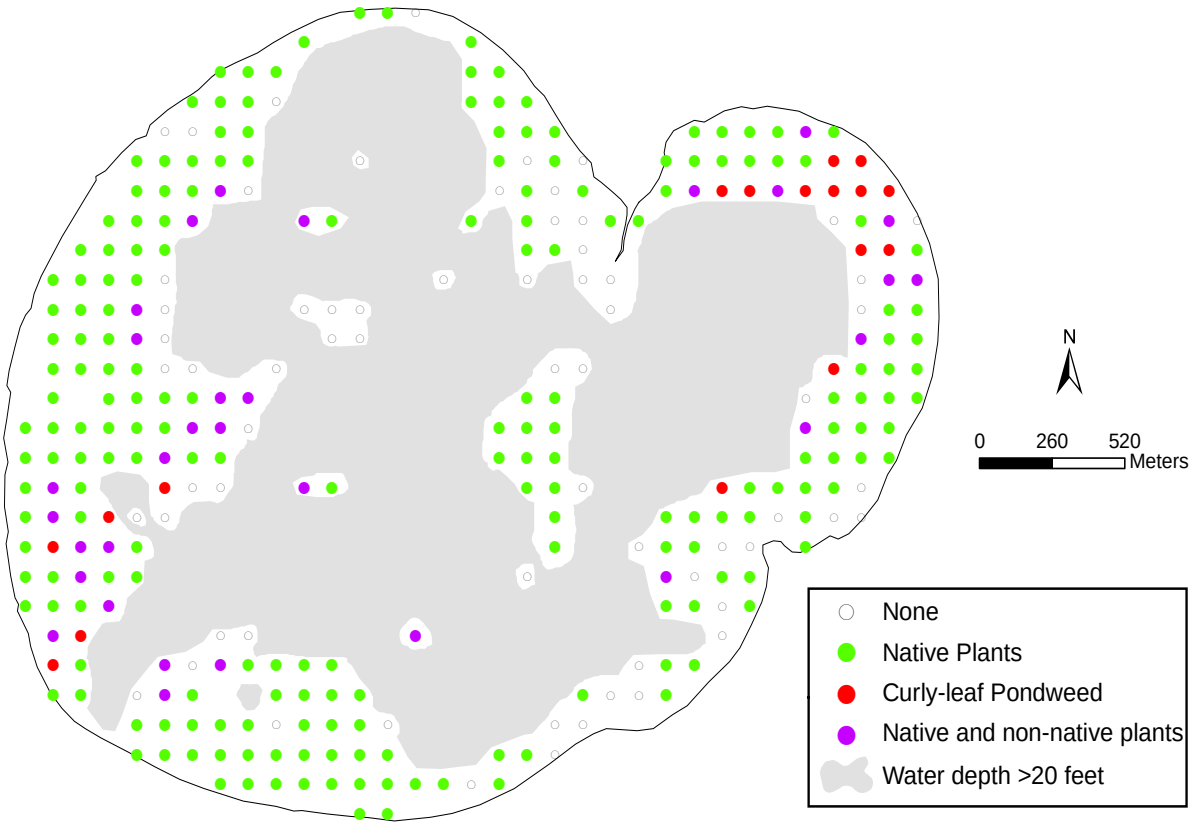


Figure 25. Native plants vs. Non-native plants in Round Lake, 2006.



Discussion

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 water clarity of Round Lake is sufficiently high to allow aquatic plant growth to a depth of at least 20 feet and scattered vegetation likely occurs beyond that depth. The predominance of hard substrates in the near-shore area may limit the types of aquatic plants within that zone. Plants like muskgrass and bulrush are more typically found along these types of sandy shores. The abundant and diverse native aquatic plant communities found in these lakes provides critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants).

A review of past vegetation surveys of Round Lake indicates that the general aquatic plant community has not likely changed greatly in these lakes. In all survey years, a relatively high number of native plants have been recorded and rooted plants remain well distributed throughout the lake. Data collected in 2006 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. 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.

In general, factors that may lead to change in the aquatic plant communities include:

- Change in water clarity
  If water clarity decreases, submerged vegetation may be restricted to shallower water.
- Change in water level
  Many aquatic plants are adaptable to water level fluctuations and in low water years, aquatic plants may expand in distribution. The extent and duration of these distribution changes can be difficult to predict.
- Snow and ice cover
  Many submerged plants 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, some 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.
- Invasive species
  Non-native plant species, such as curly-leaf pondweed (*Potamogeton crispus*) may form dense surface mats that may shade out native plants. The impact of invasive species varies among lakes but the presence of a healthy native plant community may help mitigate the harmful effects of these exotics.
- Natural fluctuation in plant species abundance
  Many submerged plants are perennial and regrow in similar locations each year. However, a few species such as wild rice (*Zizania palustris*) and bushy pondweed (*Najas flexilis*) are annuals and are dependant on the previous years seed set for regeneration.
- Aquatic plant management activities

Humans can impact aquatic plant communities directly in a variety of ways. Motorboat activity in vegetated areas can be particularly harmful for species such as bulrush and 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. Herbicide and mechanical control of aquatic plants can directly impact the aquatic plant community. For information on the laws pertaining to aquatic plant management, click here: MnDNR APM Program or contact your local DNR office. Limiting these types of activities can help protect healthy aquatic ecosystems.

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