Aquatic Vegetation of Lake Minnie Belle
Meeker County, Minnesota
(DOW 47-0119-00)
June 21-22, 2004

Lake Minnie Belle (47-0119-00)
Photo source: 2003 Farm Service Administration

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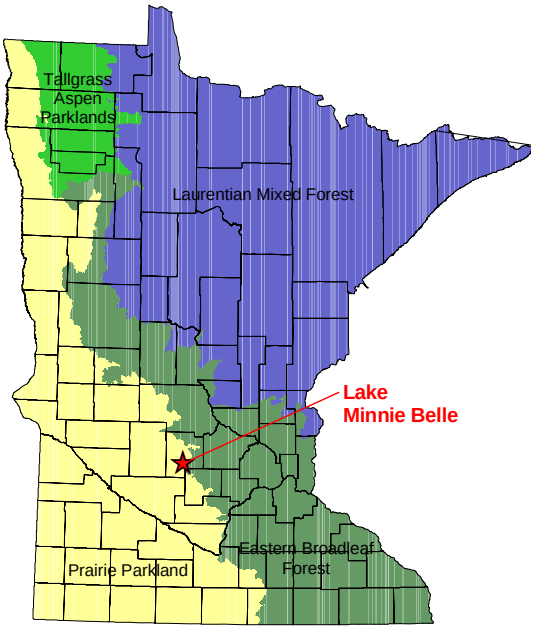
Summary

An aquatic vegetation survey of Lake Minnie Belle (47-0119-00), Meeker County, Minnesota, was conducted on June 21 and 22, 2004. Seventeen native aquatic plant species were identified, making the plant community of Lake Minnie Belle one of the richest in southern Minnesota. The lake has higher than average water clarity compared to other lakes in this region and several submerged species that require clear water occur in this lake. Plants were found distributed throughout the lake basin to a maximum depth of about six meters, although most vegetation occurred in depths less than five meters. The non-native species, curly-leaf pondweed (*Potamogeton crispus*) was present in 44 percent of the sample sites, and it usually co-occurred with native species rather than forming monotypic beds. The most commonly occurring native species were muskgrass (*Chara* sp.) (found in 47 percent of the sample sites), followed by coontail (*Ceratophyllum demersum*) (43 percent), northern watermilfoil (*Myriophyllum sibiricum*), (39 percent), flat-stem pondweed (*Potamogeton zosteriformis*) (32 percent), and narrowleaf pondweed (*Potamogeton* sp.) (23 percent). Native plant species were most common in water depths less than four meters and curly-leaf pondweed reached its highest frequency in depths from four to five meters. The diverse mix of submerged species provides an important variety of habitat structure for fish, invertebrates and other aquatic wildlife.

Introduction

Figure 1. Location of Lake Minnie Belle (47-0119-00), Meeker Co., MN



Lake Minnie Belle (DOW 47-0119-00) is located approximately six miles south of the City of Litchfield in Meeker County, Minnesota. The lake occurs within an ecological region known as the Prairie Parkland Province (Fig. 1).

Lake Minnie Belle lies in the south-central portion of the North Fork Crow River Watershed, about 20 miles south of the North Fork Crow River (Fig. 2). Flow leaves Lake Minnie Belle through Sucker Creek and then continues north through a series of lakes and creeks to the North Fork of the Crow River. The North Fork of the Crow River flows east through the watershed to the Mississippi River.

Within the minor watershed that includes Lake Minnie Belle, land use is primarily agricultural (Fig. 3). Lake Minnie Belle is at the headwaters of this minor watershed and while its shoreline is heavily developed, relatively large forest tracts remain on the south and east shores (Fig. 3). This shoreland buffer zone may contribute to the relatively good water quality reported in a 1988 study (Munson 1988). The lake is classified as mesotrophic (moderate nutrients) with good water clarity between 1986 and 2004 as indicated by a mean summer Secchi depth of 3.7 meters

Figure 2. Major lakes and rivers within North Fork Crow River Watershed

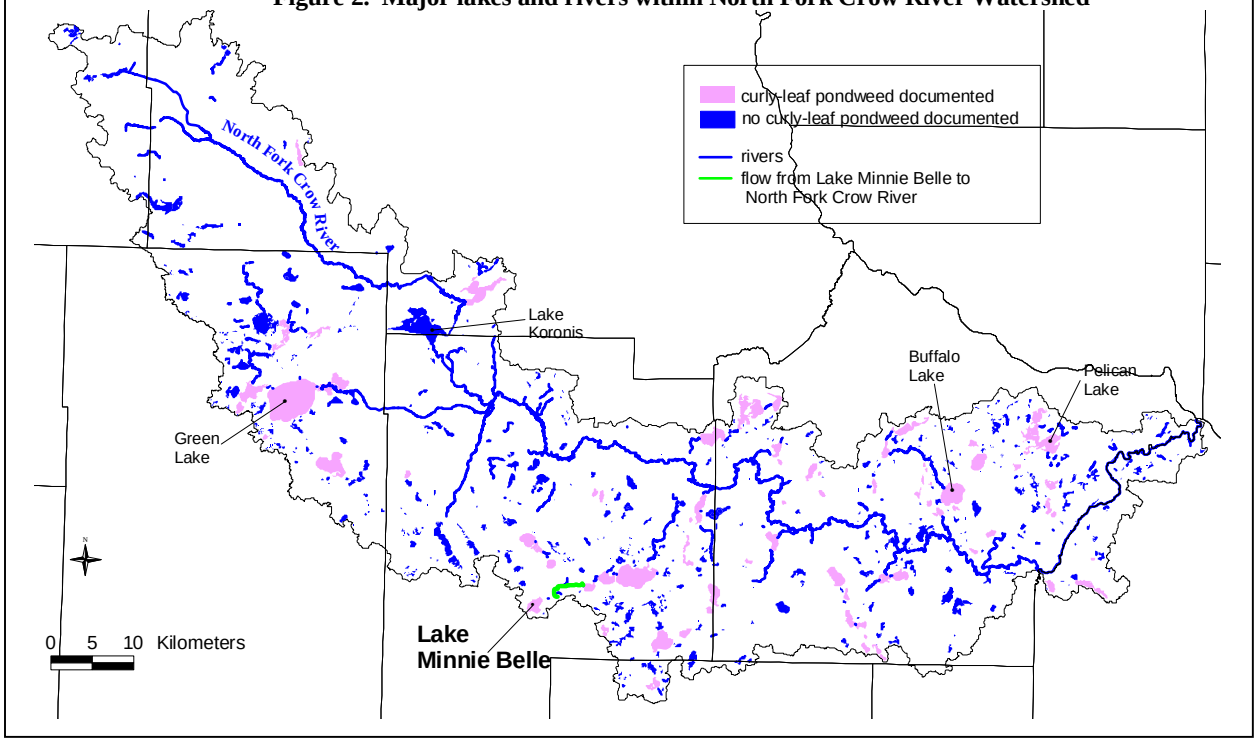
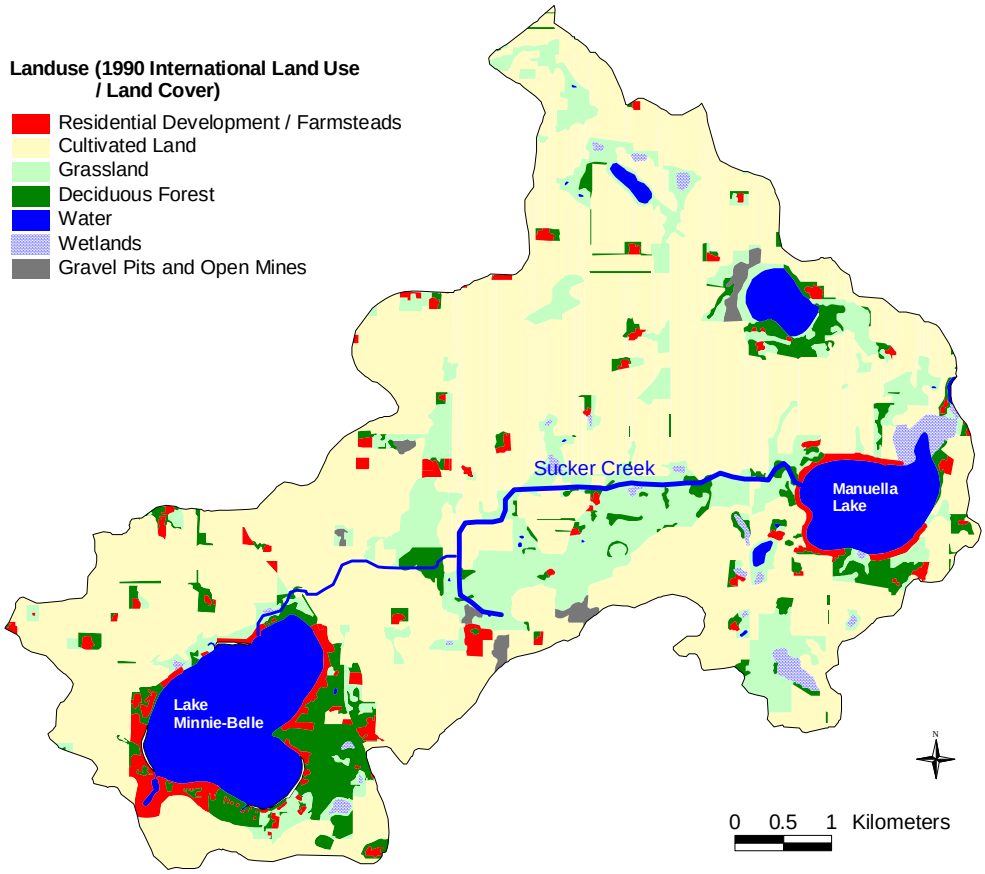


Figure 3. Landuse within the Sucker Creek Watershed that includes Lake Minnie Belle (47-0119-00). (12



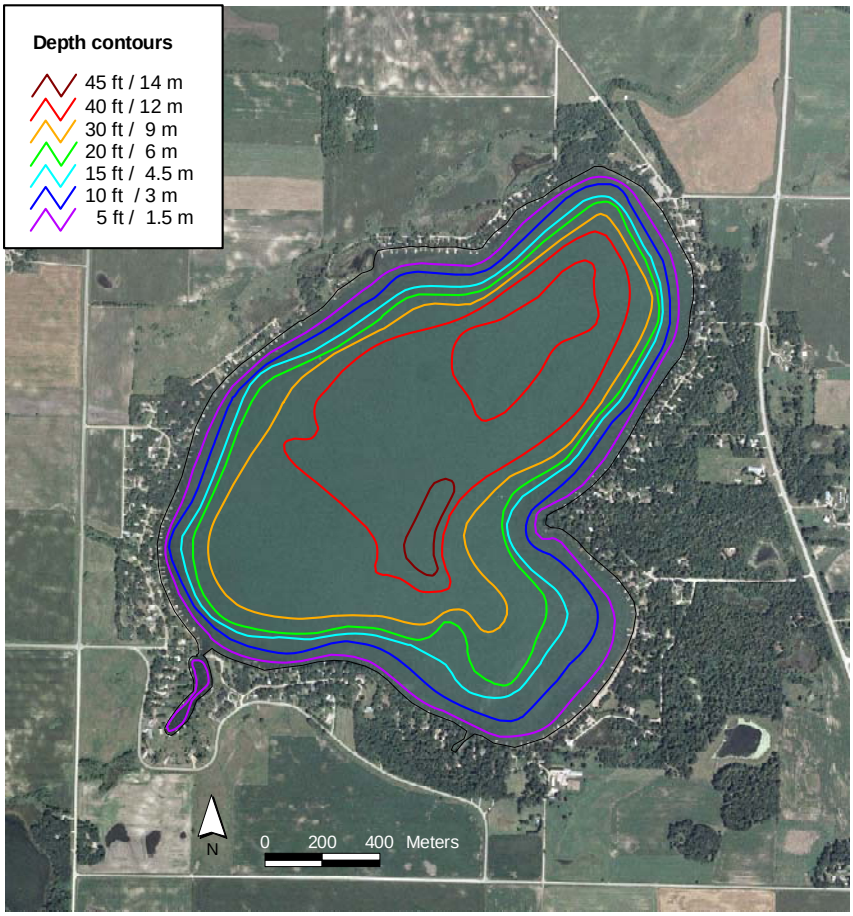
(MPCA 2006).

Lake Minnie Belle is a 220 hectare (545 acre) basin with a primarily round, or bell-shaped, perimeter. A shallow, 1.5 hectare (4 acre) lagoon occurs on the southwest end of the lake. The lake has a maximum depth of 14 meters and at least 31 percent of the lake is less than 4.5 meters in depth (Fig. 4) providing potential area for aquatic plant growth. Shoal substrates are described as primarily sand and gravel (MnDNR Fisheries Lake Files).

The shoreline of Lake Minnie Belle is completely developed with homes and cottages, with the exception of a state-owned aquatic management area located on the north side of the lake. A public boat launch is located on the northeast shore.

Previous vegetation surveys of Lake Minnie Belle were conducted by MnDNR Fisheries staff in 1957, 1974, 1983, and 1993 (MnDNR Fisheries Lake Files). In 1957, aquatic plants were reported to a depth of about 5 meters and were most abundant on the west side of the lake and in the southeast bay. Maximum depth of vegetation reported ranged from about 4 meters in 1974 to 6 meters in 1993. In total, 15 different native submerged species were identified during these surveys and common species included native watermilfoil (*Myriophyllum* sp.), coontail (*Ceratophyllum demersum*), a variety of pondweeds (*Potamogeton* spp.) and muskgrass (*Chara*

Figure 4. Depth contours of Lake Minnie-Belle (47-0119-00) source: MnDNR 1970.



sp.). No waterlilies (*Nymphaea* sp. or *Nuphar sp.*) were reported. Bulrush (*Scirpus* spp.) and cattail (*Typha* spp.) were present in isolated areas including the lagoon at the southwest corner.

Curly-leaf pondweed *(Potamogeton crispus)*, a non-native invasive species, 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). There are 166 lakes in the North Fork Crow Wing Watershed that are 100 acres or larger in size and at least 39 percent of those lakes, including Lake Minnie Belle contain curly-leaf pondweed (Fig. 2). It is likely present in additional lakes within the watershed, but has simply not been verified. The 1993 MnDNR vegetation survey of Lake Minnie Belle located curly-leaf pondweed on 27 of the 30 survey transects and reported it as common at nearly half of those sites (MnDNR Fisheries Lake Files).

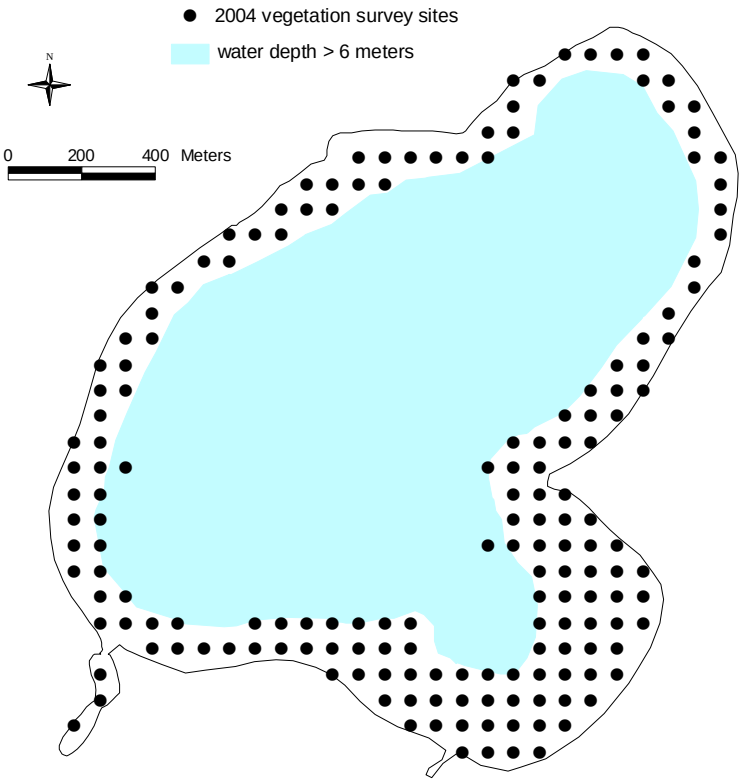
Survey Objectives

The purpose of the 2004 survey of Lake Minnie Belle was to describe the current aquatic plant community, including:

1) Estimate the maximum depth of rooted vegetation
2) Estimate the percent of the lake occupied by rooted vegetation
3) Record the aquatic plant species that occur in the lake
4) Estimate frequencies of occurrence of individual species
5) Develop maps of the distribution of the common species

Methods

Figure 5. Vegetation survey sites on Lake Minnie Belle (47-0119-00) 2004.



A Point-Intercept vegetation survey of Lake Minnie Belle was conducted on June 21 and 22, 2004 following the methodology described by Madsen (1999). A Geographic Information System (GIS) was used to generate sample points across the lake surface in a 70 meter by 70 meter grid (Fig. 5), resulting in a total of 319 potential points. In the field, surveyors decided not to sample in depths greater than six meters because they consistently were not finding vegetation beyond that depth. As a result, 171 sites were actually sampled with 165 points falling within the vegetated zone from shore to the six meter depth.

After the survey points were generated in the GIS, they were uploaded into a Global Positioning System (GPS) unit, which 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 using a measured stick in water depths less than two meters and an electronic depth finder in deeper water. The surveyors recorded all plant species found within a one meter squared sample site at the pre-designated side of the boat. A double-headed, weighted garden rake, (Fig. 6) attached to a rope was used to survey vegetation not visible from the surface. If curly-leaf pondweed (*Potamogeton crispus*) was present at a site, surveyors recorded whether or not it formed surface mats at that site.

Figure 6. Rake used to sample vegetation.

Nomenclature followed Crow and Hellquist (2000). Voucher specimens were collected for most plant species and are stored at the MnDNR in Brainerd.

Data were entered into a Microsoft Access database. Frequency of occurrence for each species was calculated as the number of sites in which a species occurred divided by the total number of sample sites. Frequency was calculated for the entire vegetated zone (0-6 meters). Sampling points were also grouped by water depth and separated into seven depth zones for analysis.

Frequency = Number of sites in which species occurred / total number of sample sites

Example: There were 165 sample sites within the shore to 6 meter depth zone.
Coontail (*Ceratophyllum demersum*) occurred in 77 of those sample sites.
Frequency of coontail = (77/165)*100 = 46%

Results / Discussion

Types of aquatic plants found

Seventeen different species of native aquatic plants were identified in Lake Minnie Belle (Table 1). Two species, muskgrass (*Chara* sp.) and stonewort (*Nitella* sp.) are actually large algae, or "macroalgae". The other species are all flowering plants that may have inconspicuous underwater flowers or small flowers that extend above the water surface. All of the aquatic plants recorded during this survey are submerged species but floating-leaf pondweed (*Potamogeton natans*), Illinois pondweed (*P. illinoensis*), and large-leaf pondweed (*P. amplifolius*), may also form floating leaves. The plant community included a mix of broad-leaf or "cabbage" plants, narrow-leaf or "grass-like" plants, and plants with finely-dissected leaves.

Table 1. Aquatic plants of Lake Minnie Belle, Meeker County (47-0119-00) June 21-22, 2004.

Frequency calculated for vegetated zone (shore to 6 meter depth)
Frequency = percent of sites in which species occurred
165 sample sites

Common Name	Scientific Name	Voucher	Frequency
Muskgrass	*Chara sp.*		47
Curly-leaf pondweed	*Potamogeton crispus*	x	44
Coontail	*Ceratophyllum demersum*	x	43
Northern watermilfoil	*Myriophyllum sibiricum*	x	39
Flatstem pondweed	*Potamogeton zosteriformis*		32
Narrow-leaf pondweed	*Potamogeton sp.*		23
Sago pondweed	*Stuckenia pectinata*		15
Clasping leaf pondweed	*Potamogeton richardsonii*	x	13
Illinois pondweed	*Potamogeton illinoensis*		12
Whitestem pondweed	*Potamogeton praelongus*		12
Canada waterweed	*Elodea canadensis*	x	7
Wild celery	*Vallisneria americana*	x	5
Stonewort	*Nitella sp.*		4
Water marigold	*Megaladonta beckii*		1
Largeleaf pondweed	*Potamogeton amplifolius*	x	1
Water stargrass	*Zosterella dubia*		1
White water buttercup	*Ranunculus sp.*	x	2
Floating-leaf pondweed	*Potamogeton natans*		present*

* present indicates plant was found during survey but did not occur within a specific sample site.

Compared to other lakes in Minnesota, Lake Minnie Belle has a relatively high number of native submerged plant species. In lakes surveyed by MnDNR Fisheries, the number of submerged species observed ranges from zero to 26 with a mean of eight species per lake. Most lakes in Minnesota have at least one floating-leaf plant species, such as white waterlily (*Nymphaea odorata*) or yellow waterlily (*Nuphar variegata*), but none were found in Lake Minnie Belle. Emergent species were not recorded during this survey, and a 2001 survey found only isolated areas of bulrush (*Scirpus* sp.) and cattail (*Typha* sp.) (DNR Fisheries Lake Files).

One non-native submerged species, curly-leaf pondweed (*Potamogeton crispus*), was observed during the survey.

Percent of vegetated sites and plant frequency by water depth

Aquatic plants were found to a maximum depth of about six meters in Lake Minnie Belle and within the zone from shore to six meters, 89 percent of the sites contained vegetation. Plants were most frequent in depths from two to four meters where 100 percent of the sites contained plants (Fig. 7). Vegetated areas occurred around the entire lakeshore and extended lakeward about 100 meters in most areas and as much as 300 meters in the southeast end of the lake (Fig. 8).

Abundance and distribution of common species

Within the vegetated zone (shore to six meters), 45 percent of the sites contained only native species, 40 percent included a mix of native and non-native species, and four percent contained only non-native vegetation. Native species were present at all depth zones and dominated in depths less than five meters.

Figure 7. Percent of sites with vegetation vs. water depth in Lake Minnie-Belle (47-0119-00), June 21-22, 2004.

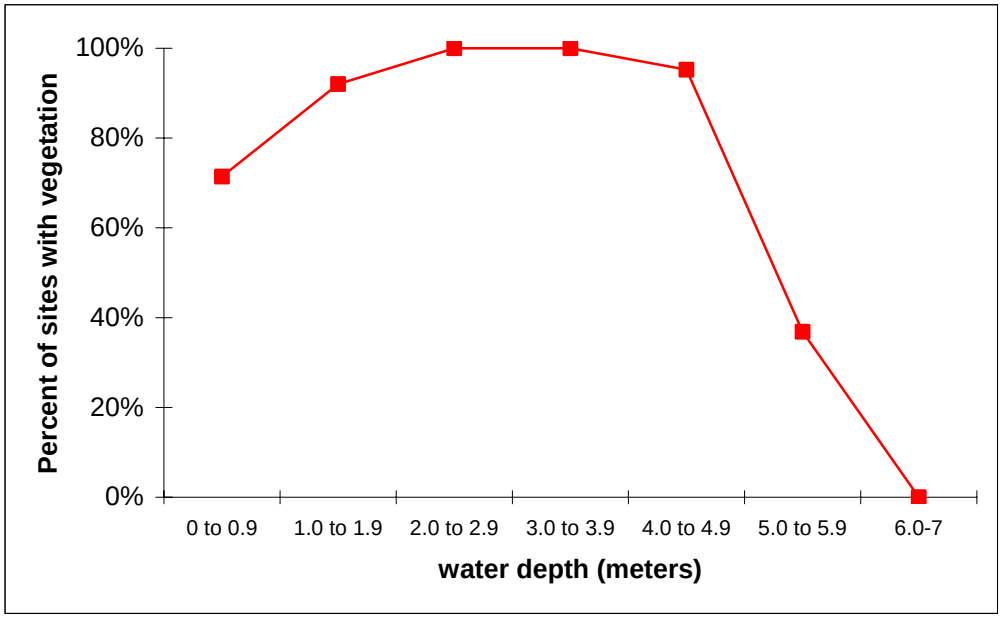
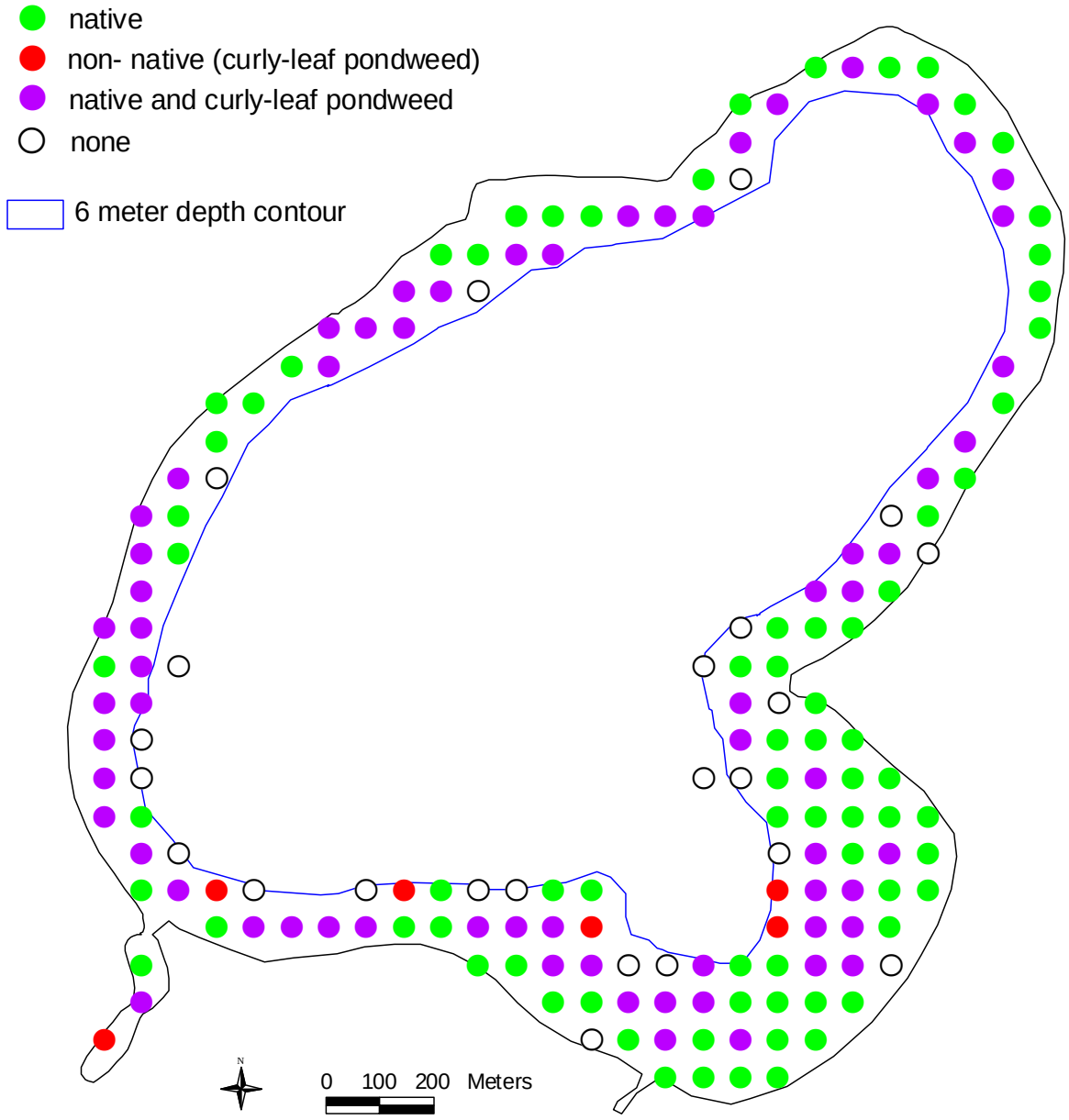


Figure 8. Distribution of native and non-native vegetation in Lake Minnie Belle (47-0119-00) June 21-22, 2004.



Native species

The most common species found were muskgrass (*Chara sp.)*, coontail (*Ceratophyllum demersum*), Northern watermilfoil (*Myriophyllum sibiricum*), flatstem pondweed (*Potamogeton zosteriformis*) and narrowleaf pondweed (*Potamogeton* sp.*).* These species occurred with similar distribution patterns around the lakeshore (Fig. 9).

Figure 9. Distribution of common species in Lake Minnie Belle (47-0119-00), June 21-22, 2004.

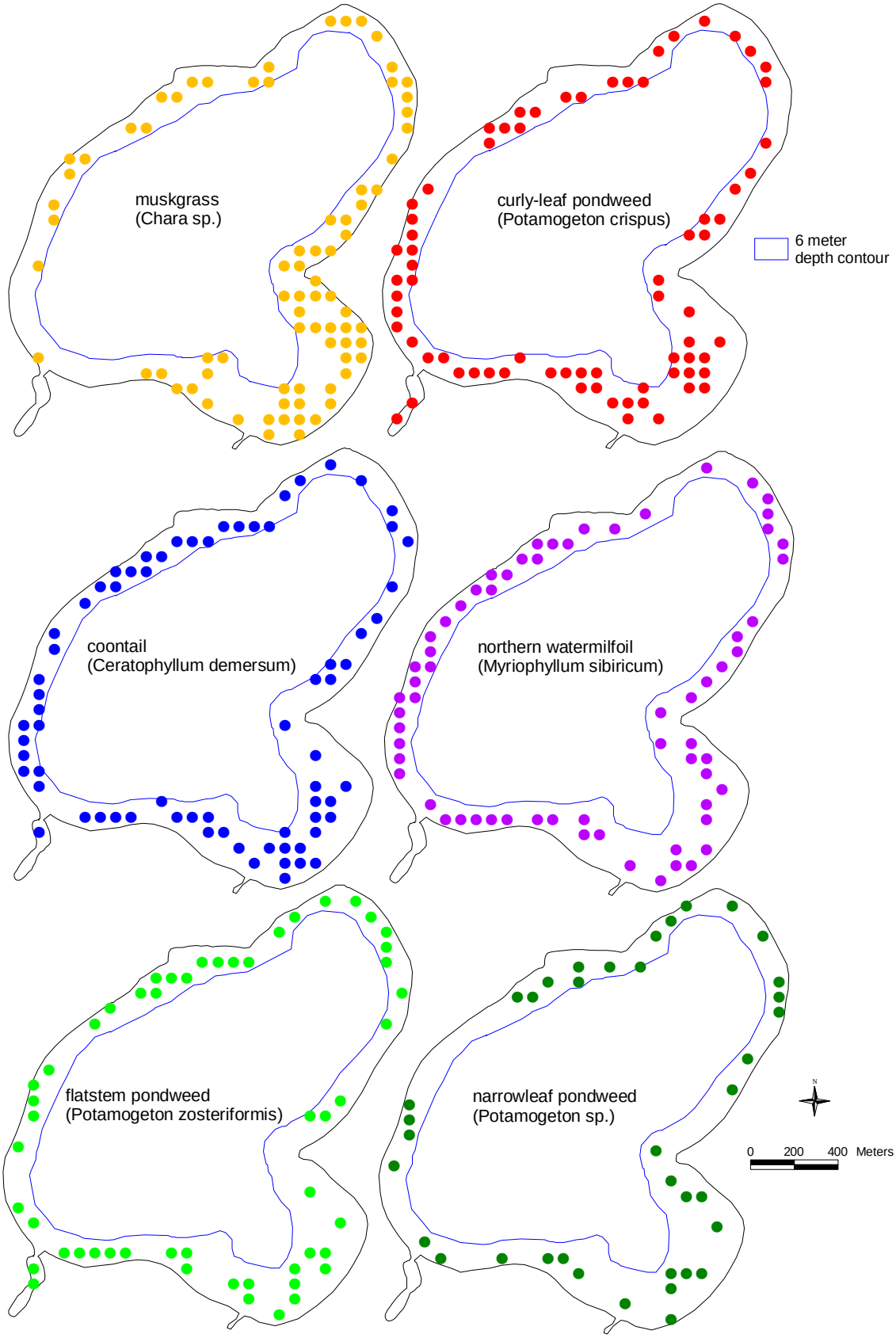
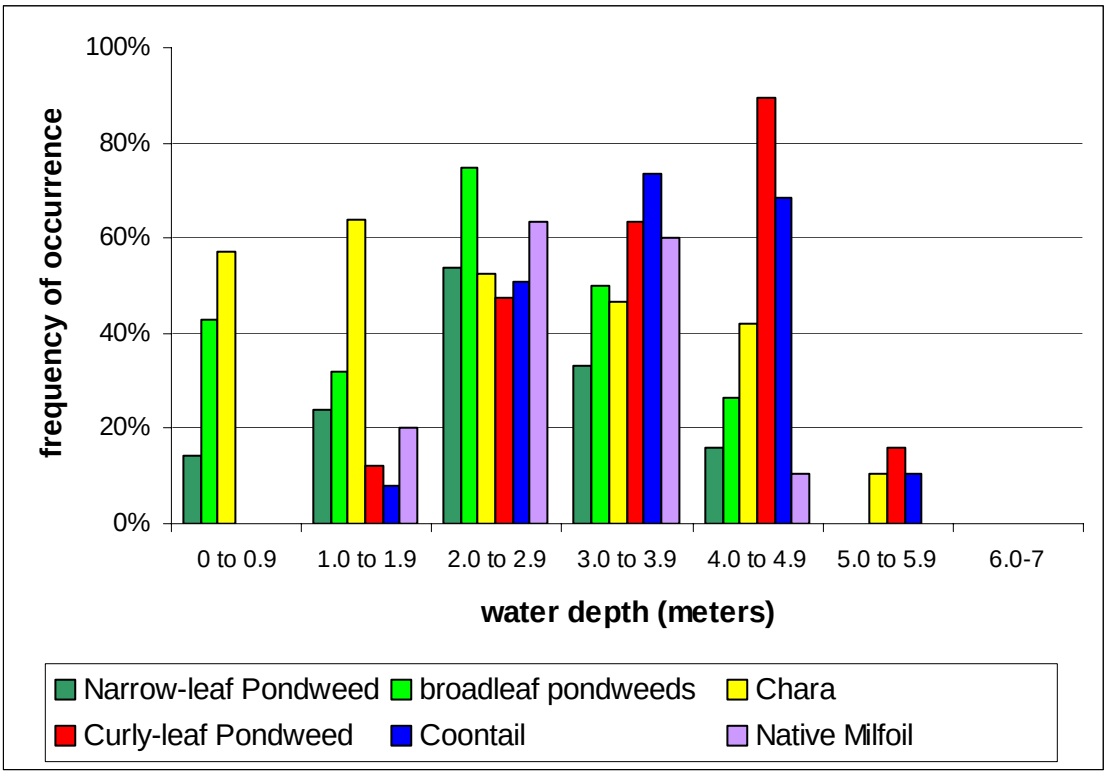


Figure 10. Bed of muskgrass (*Chara* sp.)

Muskgrass (*Chara* sp.) (Fig. 10) was the most frequently found species in Lake Minnie Belle, occurring in 47 percent of the sites (Table 1). It was found to a depth of about five meters and in at least 40 percent of the sites at all depths less than five meters (Fig. 11). It was the most frequently occurring species in depths less than two meters. Muskgrass is a submerged, macroscopic algae that is common in many hardwater Minnesota lakes. It is named for its' characteristic musky odor. This algae resembles a large moss but has a brittle texture due to mineral deposits on its' leaf-like surfaces. Because this species 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 species to occupy open areas of lake bottom where it can act as a sediment stabilizer. This algae provides beneficial cover for fish, as well as the aquatic insects that bluegills, smallmouth and largemouth bass feed upon.

Coontail (*Ceratophyllum demersum*) (Fig. 12) occurred in 43 percent of the sites (Table 1) in depths between one and six meters (Fig. 11). It was most frequent in depths from two to five

Figure 11. Frequency of common aquatic plant species vs. water depth in Lake Minnie Belle (47-0119-00), June 21-22, 2004.



meters (Fig. 11). Coontail is the most common submerged flowering plant in Minnesota lakes. It grows entirely submerged and is adapted to a broad range of lake conditions, including turbid water. Coontail is perennial and can overwinter as a green plant under the ice and then begins new growth early in the spring. Because it is only loosely rooted to the lake bottom it may drift between depth zones (Borman et al. 1997). Coontail provides important cover for young fish, including bluegill, yellow perch, largemouth bass and northern pike. It also supports aquatic insects beneficial to both fish and waterfowl.

Figure 12. Coontail (*Ceratophyllum demersum*).

Northern watermilfoil (*Myriophyllum sibiricum*) (Fig. 13) occurred in 39 percent of the survey sites (Table 1) and was most frequent in depths of two to four meters (Fig. 11). Northern watermilfoil is a perennial, rooted submerged plant with spike-like flowers that extend above the water surface. The numerous finely divided leaves of this plant provide habitat for aquatic invertebrates and fish. Northern watermilfoil is often mistaken for the non-native invasive Eurasian watermilfoil (*Myriophyllum spicatum*), which was not found in Lake Minnie Belle. Northern watermilfoil has 5-10 leaflet pairs compared to 12-21 leaflet pairs for Eurasian watermilfoil. Northern watermilfoil prefers soft sediments of clearer water lakes (Borman et al. 1997).

Figure 13. Northern watermilfoil (*Myriophyllum sibiricum*).

Native Pondweeds (*Potamogeton* spp. and *Stuckenia* spp.) were present in at least one-third of the Lake Minnie Belle survey sites and were most common in water depths less than four meters (Fig. 11). Pondweeds are a diverse and important group of submerged plants. Eight different native pondweed species were recorded and each has a different preference for water depth, substrate and turbidity. The presence of many pondweed species is indicative of higher water clarity and a diverse habitat structure for fish and invertebrates.

Figure. 14. Flatstem pondweed (*Potamogeton zosteriformis*).

Flatstem pondweed (Fig. 14) was the most frequent of native pondweeds found in Lake Minnie Belle, occurring in 32 percent of the survey sites (Table 1). Flatstem pondweed can grow in a wider variety of conditions than some of other pondweed species.

Figure 15. Large-leaf pondweed (*Potamogeton amplifolius*).

Other common pondweeds found included plants with very narrow leaves such as narrow-leaf pondweed (*Potamogeton* sp.) (23 percent frequency) and sago pondweed (*Stuckenia pectinata*), (15 percent) and broad-leaf or "cabbage" type pondweeds (Fig. 15) including Illinois (*P. illinoensis*), (13 percent), clasping-leaf (*P. richardsonii*), (12 percent), and white-stem (*P. praelongus*), (12 percent). Many of the broad-leaf pondweeds are not tolerant of turbidity and are among the first to decline when water clarity decreases.

All other species were found in less than 10 percent of the survey sites (Table 1) but their presence is important because a high number of different species usually indicates clear water conditions. In addition to northern watermilfoil and the broad-leaf pondweeds mentioned above, water marigold (*Megaladonta beckii*) is also not tolerant of turbidity (Nichols 1999) and usually restricted to northern Minnesota lakes or southern lakes with high clarity.

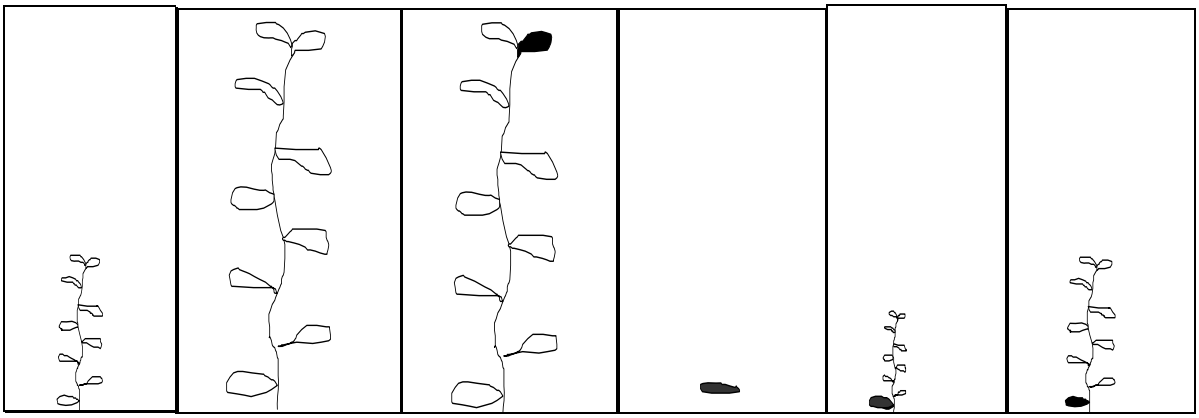
Curly-leaf pondweed in Lake Minnie Belle

Curly-leaf pondweed occurred in 44 percent of sampled sites, making it the second most frequently found plant on the 2004 survey. It occurred throughout the vegetated zone and was most frequent between depths of two and five meters, where it occurred in at least 40 percent of the survey sites (Fig. 11).

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 at least 700 Minnesota lakes (Invasive Species Program 2005). This non-native has been present in nearby Ripley and Washington Lakes (Meeker County) since at least 1974 (MnDNR Fisheries Lake Files). It is not known when it originally invaded Lake Minnie Belle but it likely has been present in the lake for many years.

Like many native submerged plants, curly-leaf pondweed is perennial but it has a unique life cycle which may provide a competitive advantage over native species. Curly-leaf pondweed is actually dormant during summer and begins new growth in late summer and early fall (Fig. 16). 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 many native plants are not fully mature. In late spring and early summer, curly-leaf plants form structures called "turions" (Fig. 17) 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). Turions may also remain in the lake sediment and germinate in later years. It is not known how long turions may remain viable (Invasive Species Program 2005). In late spring or early summer, curly-leaf pondweed may form dense mats at the water surface. The extent and locations of these mats vary with individual lakes but they usually occur in water depths less than

Figure 16. Life cycle of Curly-leaf pondweed (*Potamogeton crispus*).



Winter	**Spring**	**Late Spring**	**Summer**	**Fall**	**Winter**
Plants Continue Growing under ice	Plants reach maximum growth	Plants begin to die back and form turions	Turions remain dormant	Turions germinate	Newly sprouted plants continue growth

three meters. During the June 2004 survey of Lake Minnie Belle, curly-leaf plants were present but did not form extensive surface mats.

Figure 17. Turions forming at tips of curly-leaf pondweed (*Potamogeton crispus*) plants.

Value of aquatic vegetation

Aquatic vegetation provides critical habitat for fish, waterfowl and invertebrates, buffers the shorelines from wave action, and stabilizes sediments and utilizes nutrients that would otherwise be available for algae. A mix of emergent, floating-leaf and submerged plants can provide a variety of habitat structure for a diverse group of fish and wildlife species. In general, native vegetation provides a higher quality of habitat because native plants have coevolved in Minnesota lakes with native fish and wildlife. Non-native species, like curly-leaf pondweed, may displace native plants and/or contribute to lower clarity that in turn harms native plants. Nevertheless, non-native vegetation can provide some benefits to a lake, particularly if native vegetation has already declined. Monitoring changes in aquatic plant communities can provide information on the amount and quality available fish and wildlife habitat and may provide clues to changes in the overall water quality of the lake and watershed.

Change in Lake Minnie Belle plant community

Data from the 2004 vegetation surveys of Lake Minnie Belle can be used to monitor annual changes in the native and non-native plant species composition. In general, some factors that may lead to change in native and non-native aquatic plant communities include:

- Change in water clarity
  If water clarity increases, the maximum rooting depth of submerged vegetation is expected to increase. Similarly, if water clarity declines, the maximum depth at which vegetation grows may decline.
- Snow cover
  Curly-leaf pondweed, in particular, may fluctuate in abundance in response to snow cover. Many native submerged plants also have the ability to grow under the ice, particularly if there is little snow cover and sunlight reaches the lake bottom. In years following low snow cover, curly-leaf and some native submerged plants may increase in abundance.
- Shoreland development
  Development along shorelines can directly impact aquatic plants if they are removed or damaged. Development may indirectly impact aquatic plants if nutrient and/or sediment loadings to the lake are increased, leading to lower water clarity. Click here for more information on shoreline best management practices.
- 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.
- Natural fluctuation in plant species.
  Many submerged plants are perennial and regrow in similar locations each year. However, like terrestrial plants, aquatic plants may shift in distribution and abundance between years. These shifts may be due to natural fluctuation in the plant population and may also be influenced by lake conditions.
- Aquatic plant management activities
  Humans can impact aquatic plant communities directly by destroying vegetation with herbicide or by mechanical means. For information on the laws pertaining to aquatic plant management: MnDNR APM Program. Motorboat activity in shallow, vegetated areas can be particularly harmful for species such as wild rice, waterlilies, and bulrush. Herbicide and mechanical control of aquatic plants can directly impact the aquatic plant community. Monitoring these control activities can help insure that non-target species are not negatively impacted.

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