Aquatic Vegetation of
Ten Mile Lake (DOW 11-0413-00)
Cass County, Minnesota

June 2006

Ten Mile Lake, Cass County, MN. June 19, 2006

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Report Review: Calub Shavlik, DNR Fisheries, Walker

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Summary

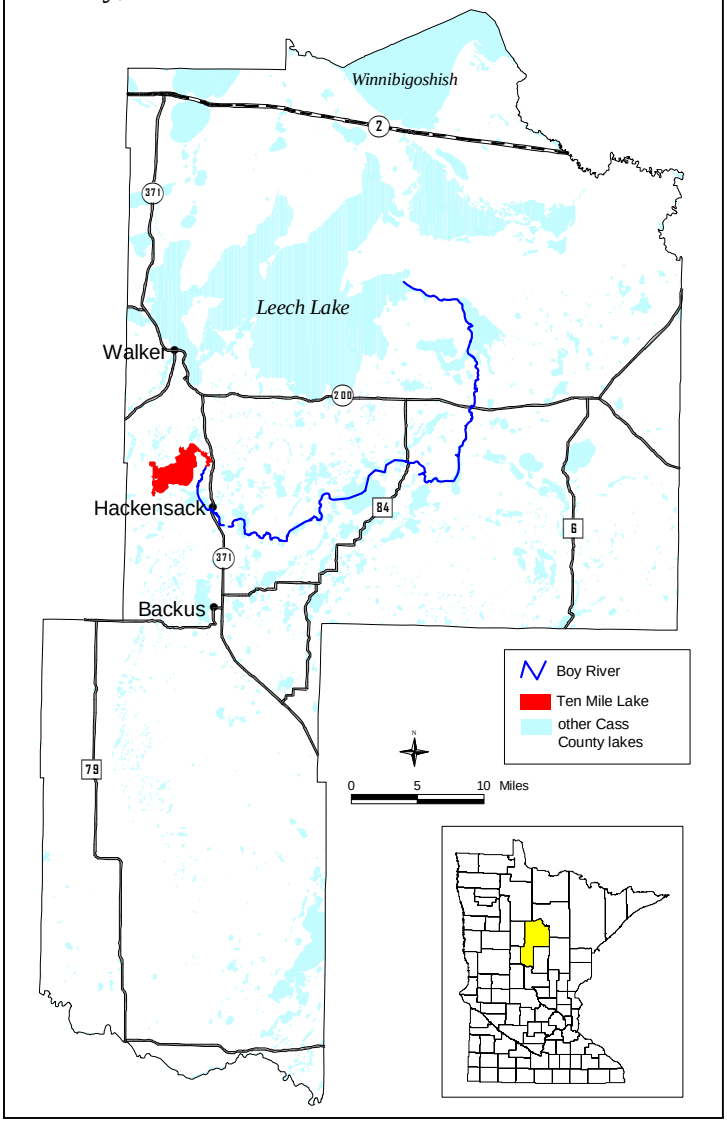
An aquatic vegetation survey of Ten Mile Lake (11-0413-00), Cass County, Minnesota, was conducted between June 12 and June 22, 2006. The results of this survey were combined with emergent plant bed maps that were delineated in 2003 by DNR Fisheries staff.

A total of 37 native aquatic plant taxa were recorded, making Ten Mile Lake among the richest lake plant communities in the state. Plants occurred around the entire perimeter of Ten Mile Lake but were more concentrated within the bays where 84 percent of the survey sites contained vegetation compared to 54 percent of the sites in the main basin. Approximately 90 acres of bulrush and 50 acres of waterlilies occurred within the bays and along protected shorelines. Submerged plants occurred to a depth of 29 feet and included rooted flowering plants and large algae.

Rooted plants were most common in depths less than six feet while large algae were common to a depth of 25 feet. Muskgrass (*Chara* sp.) is a large algae that can form low-growing beds along the lake bottom. It was the most common submersed plant in Ten Mile Lake and was found in 45 percent of the survey sites. The most common flowering submerged plants included flat-stem pondweed (*Potamogeton zosteriformis*), Canada waterweed (*Elodea canadensis*), bushy pondweed (*Najas flexilis*), northern watermilfoil (*Myriophyllum sibiricum*), Robbin's pondweed (*Potamogeton robbinsii*), white-stem pondweed (*Potamogeton praelongus*) and a narrow-leaf pondweed (*Potamogeton* sp.) and their lakewide frequency of occurrence ranged from four to seven percent.

Introduction

Figure 1. Location of Ten Mile Lake in Cass County, Minnesota.



Ten Mile Lake (DOW 11-0413-00) is located between the cities of Hackensack and Walker, in Cass County, north-central Minnesota (Fig. 1). The lake is named "Ten Mile" because it is located ten miles south of a historical trading post on Leech Lake.

Ten Mile Lake is the headwaters of the Boy River which flows south from Ten Mile and then east and north through a chain of 15 or 16 lakes before emptying into the east side of Leech Lake (Fig. 1).

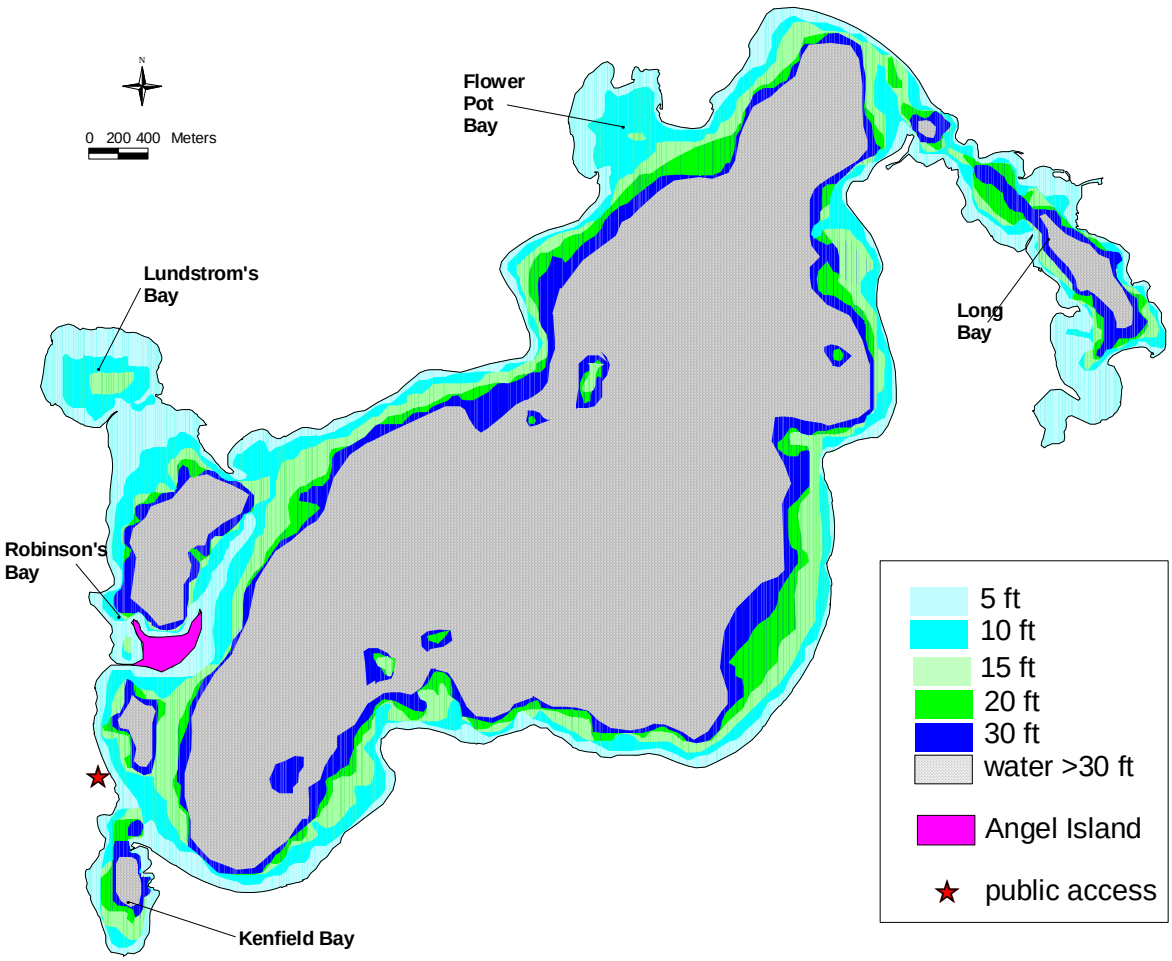
Ten Mile Lake has a surface area of 4,669 acres making it one of the largest lakes in the state and the seventh largest in Cass County. It is also one of the deepest lakes in Minnesota, with a maximum depth of 208 feet and a mean depth of 53 feet (Hodgson and Heiskary 1991). About 30 percent of the lake is less than 15 feet in depth and shallow areas include the bays and nearshore sites (Fig. 2).

The shoreline of Ten Mile Lake is primarily forested but also heavily developed with residential homes. There is a public boat launch on the southwest shore (Fig. 2).

A 1991 study described the water quality of the lake as excellent with a mean phosphorus concentration lower than other lakes in Minnesota's northern forest region (Hodgson and Heiskary 1991). Between 1974 and 2006, mean summer water clarity, as measured by Secchi disc readings, ranged from 13 feet to 21 feet, with a mean of 18 feet (MPCA 2007).

Previous vegetation surveys of Ten Mile Lake were conducted in 1948, 1958, 1971, 1983, 1997 and 2003 (MnDNR Fisheries Lake Files) and provide a general description of the aquatic plant communities. A total of 37 different plant taxa were recorded during these surveys including 19 submerged, five floating, five emergent and eight wetland plant taxa. Plants that were commonly found include muskgrass (*Chara* sp.), Canada waterweed (*Elodea canadensis*), northern watermilfoil (*Myriophyllum sibiricum*), a variety of pondweeds (*Potamogeton* spp.),

Figure 2. Depth contours of Ten Mile Lake, Cass County.



bushy pondweed (*Najas flexilis*), coontail (*Ceratophyllum demersum*), white waterlily (*Nymphaea odorata*), yellow waterlily (*Nuphar variegata*), and hardstem bulrush (*Scirpus acutus*). These historical surveys describe sparse aquatic plants in the main basin but abundant vegetation in all of the bays and wind-protected areas of the lake. Plant growth was recorded to a maximum depth of 27 feet in 2003.

Objectives

The purpose of this vegetation survey was to provide a quantitative description of the 2006 plant population of Ten Mile Lake using a method that can be repeated in future years. 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

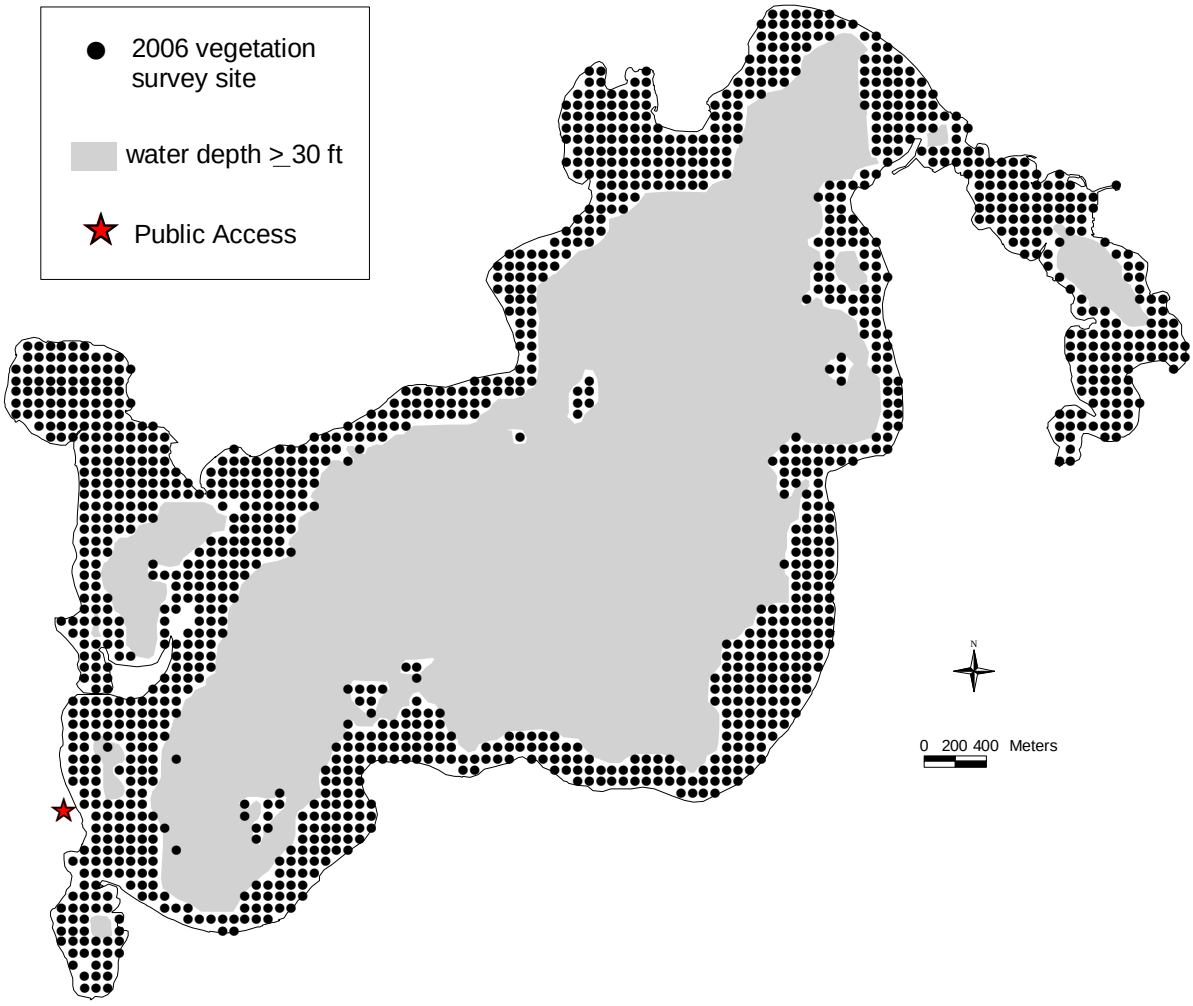
Floating-leaf and emergent vegetation

Shallow protected areas of Ten Mile Lake contain extensive beds of floating-leaf and emergent vegetation. To avoid damage to these plant beds, surveyors did not motor into these sites. To estimate the extent of the floating-leaf plant beds, surveyors used aerial photography to delineate the plant bed boundaries. Emergent plants, such as bulrush, can be difficult to locate on aerial photographs. DNR Fisheries staff mapped major beds of emergent vegetation in 2003 by boating around the edge of each emergent plant bed and recorded the boundary using a Global Positioning System (GPS) receiver.

Submerged vegetation survey

A vegetation survey of Ten Mile Lake was conducted on June 12, 13, 14, 19, 20 and 22, 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 GPS receiver. Survey points were spaced 75 meters apart, resulting in

Figure 3. Vegetation survey sites in Ten Mile Lake (11-0413-00) Cass Co, 2006.



about one survey point per 1.5 acres. Two field crews, each consisting of one boat and two surveyors, conducted the survey. In the field, surveyors sampled all survey points between shore and 30 feet for a total of 1465 sample sites (Fig. 3). About 70 percent of the sample sites occurred in the main basin and 30 percent were within the bays.

Figure 4. Sampling rake.

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 water depths greater than eight feet. 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, attached to a rope was used to survey vegetation not visible from the surface (Fig. 4). At each sample site where water depths was six feet and less, surveyors described the bottom substrate using standard substrate classes (Table 1).

Table 1. Substrate classes

muck
marl
silt
sand
gravel
rubble (3-10”)
bolder (>10”)

Plant identification and 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 and frequency of occurrence was calculated for each species as the number of sites in which a species occurred divided by the total number of sample sites.

Frequency was calculated for the entire area from shore to 30 feet and sampling points were also grouped by water depth and separated into six depth zones for analysis (Table 2).

In July and August, surveyors re-visited shorelines of Ten Mile Lake to search for additional plant taxa that may have been overlooked during the Point-Intercept survey. Any additional plant taxa found were recorded.

Example:

In Ten Mile Lake there were 1465 samples sites in the zone from shore to the 30 feet depth.

Muskgrass (*Chara* sp.) occurred in 664 of those sites.

Frequency of muskgrass in the shore to 30 feet depth zone = 664/1465 (*100) =45 %

Table 2. Sampling effort by water depth
Ten Mile Lake, 2006.

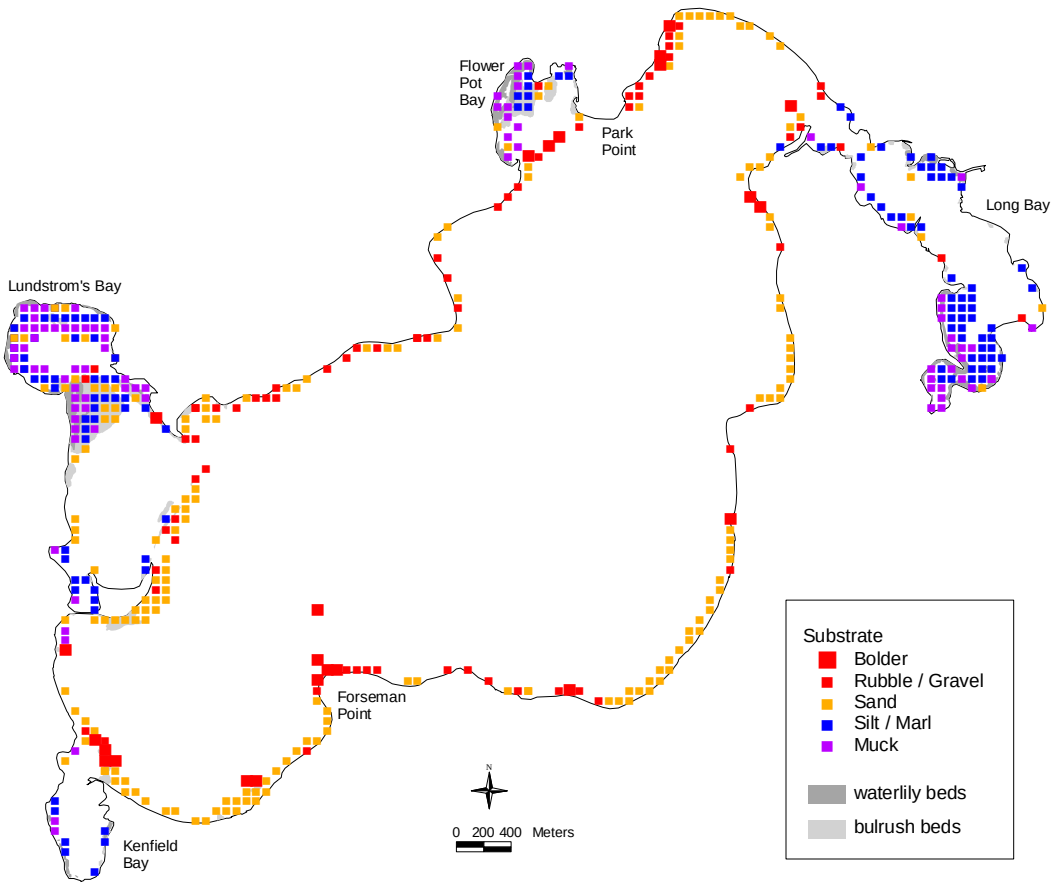
Depth interval in feet	Number of sample points
0 to 5	412
6 to 10	331
11 to 15	294
16 to 20	187
21 to 25	135
26 to 30	106
Total number of sample points	1465

Results

Shoal sediments

Sediment type in shallow water sites (0 to 6 feet of water) of the main basin include sand, gravel, rubble and bolder (Fig. 5). A sand-gravel reef occurs on the south side of Angel Island and extends north from the island. Bolders occur across the entrances to Flower Pot Bay and Kenfield Bay and are also found along Forseman Point and the shoreline north of Park Point. Sediments within the bays were mostly muck, silt and marl (Fig. 5) and natural sand beaches occur along shores of the main basin (Fig. 6).

Figure 5. Shoal sediments of Ten Mile Lake, 2006.



Number and types of plants recorded

A total of 37 native aquatic plant taxa were recorded in Ten Mile Lake including five emergent, five floating-leaved, one free-floating and 26 submerged plants (Table 2). Submerged plants included two types of large algae, an aquatic moss, an aquatic fern, and numerous flowering plants.

Fig. 6. Natural sand beach on Ten Mile Lake.

Table 2. Frequency of aquatic plants in Ten Mile Lake Point-intercept survey, June 2006.

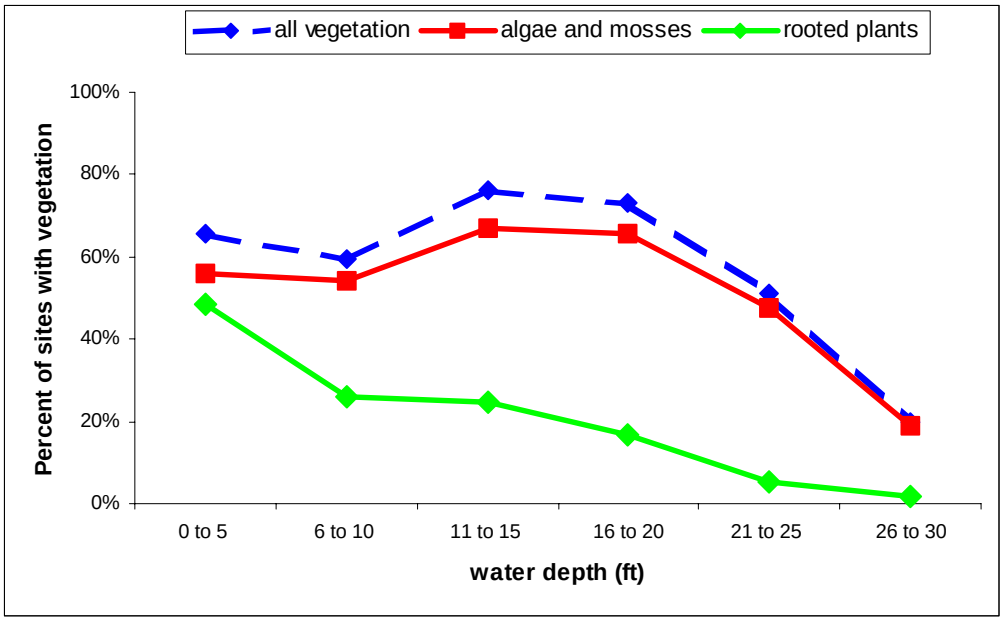
* Frequency is the percent of sample sites in which a plant taxa occurred.

Life Form				Common name	Scientific name	Frequency of occurrence		
						Bays	Main basin	Lakewide
Submerged	Non-flowering plants	Algae		Muskgrass	*Chara sp.*	67	37	45
				Stonewort	*Nitella*	2	14	11
		Watermoss			*Not identified to genus*	2	<1	1
		Quillwort			*Isoetes sp.*	0	<1	<1
	Flowering plants	Perennial		Canada waterweed	*Elodea canadensis*	15	3	7
				Northern watermilfoil	*Myriophyllum sibiricum*	12	3	6
			Pondweeds	Flat-stem pondweed	*Potamogeton zosteriformis*	15	3	6
				Robbins Pondweed	*Potamogeton robbinsii*	10	1	4
				White-stem pondweed	*Potamogeton praelongus*	9	2	4
				Narrow-leaf pondweed	*Potamogeton sp.*	9	2	4
				Large-leaf pondweed	*Potamogeton amplifolius*	4	<1	1
				Illinois pondweed	*Potamogeton illinoensis*	4	1	1
				Clasping-leaf pondweed	*Potamogeton richardsonii*	2	0	<1
				Variable pondweed	*Potamogeton gramineus*	1	<1	2
				Fries pondweed	*Potamogeton freisii*	1	<1	<1
				Sago pondweed	*Stuckenia pectinata*	1	<1	<1
				Coontail	*Ceratophyllum demersum*	6	2	3
				Water marigold	*Megaladonta beckii*	1	<1	<1
				White Water Buttercup	*Ranunculus spp.*	1	0	<1
				Greater Bladderwort	*Utricularia vulgaris*	2	0	<1
				Flat-leaved bladderwort	*Utricularia intermedia*	1	0	<1
				Bladderwort	*Utricularia sp.*	<1	0	<1
				Wild Celery	*Vallisneria americana*	<1	<1	<1
				Water stargrass	*Heteranthera dubia*	1	<1	<1
				Water bulrush	*Scirpus subterminalis*	1	0	<1
		Annual		Bushy pondweed	*Najas flexilis*	14	<1	4
Free-floating				Greater Duckweed	*Spirodela polyrhiza*	<1	0	<1
Floating				Floating-leaf pondweed	*Potamogeton natans*	10	0	3
				White water lily	*Nymphaea odorata*	7	0	2
				Yellow water lily	*Nuphar variegata*	6	0	2
				Watershield	*Brasenia schreberi*	2	0	1
				Floating-leaf burreed	*Sparganium fluctuans*	<1	<1	<1
Emergent				Bulrush	*Scirpus sp.*	7	1	3
				Wild rice	*Zizania palustris*	3	0	1
				Spikerush	*Eleocharis sp.*	<1	0	<1
				Arrowhead	*Sagittaria sp.*	<1	0	<1
				Burreed	*Sparganium sp.*	<1	0	<1
Percent of sites with vegetation						84	54	63

Distribution of plants by water depth

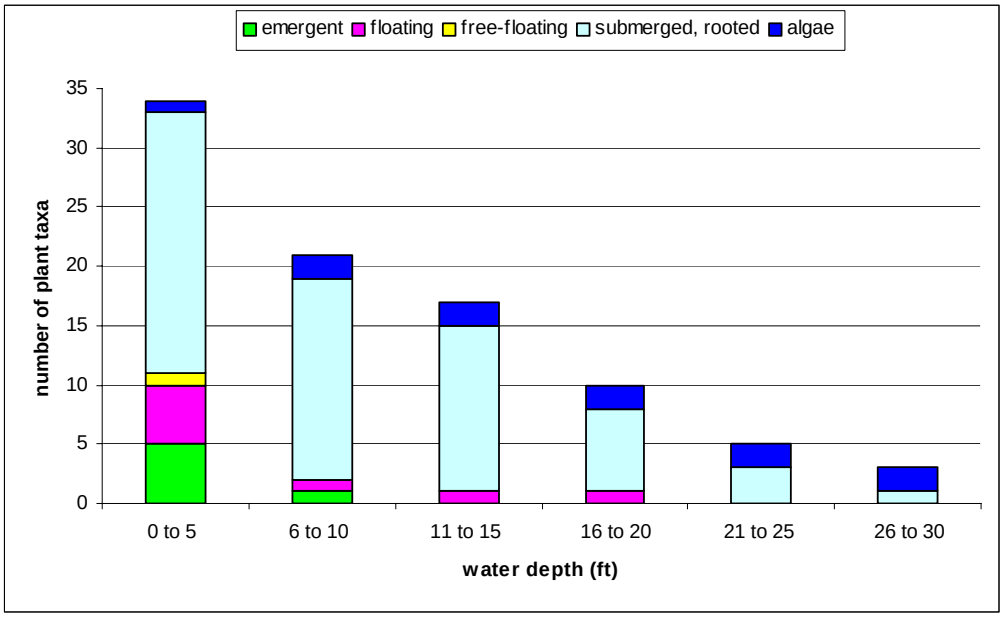
Plants were found to a maximum depth of 29 feet in Ten Mile Lake and 63 percent of all sample sites contained vegetation. Plant occurrence was greatest in depths of 11 to 20 feet, where vegetation was found in 75 percent of the sample sites (Fig. 7). Rooted plants occurred at all depths to 29 feet but were most common in depths less than six feet where they were found in 48 percent of the sample sites. Large algae were also present at all depths to 29 feet and were more frequent than rooted plants. In water depths from shore to 25 feet, large algae occurred in nearly half of all sample sites.

Figure 7. Plant abundance vs. water depth. Ten Mile Lake, June 2006.



The highest number of plant taxa was found in shallow water, from shore to a depth of five feet (Fig. 8). Emergent plants were restricted to water depths of seven feet and less and floating-leaved plants were most common to a depth of five feet . Free-floating duckweeds were only found in protected bays and occurred in depths less than six feet. Submerged rooted plants were found to a maximum depth of 29 feet but only three taxa occurred in depths greater than 20 feet. Non-rooted submerged plants (primarily large algae) were found at all depths to 29 feet.

Figure 8. Number of plant taxa vs. water depth. Ten Mile Lake, June 2006.



Distribution of plants in main basin versus bays

Plants occurred around the entire perimeter of Ten Mile Lake but were concentrated within the bays (Fig. 9). Of the 37 plant taxa found, 36 occurred in the bays and only 22 were found in the main basin (Table 3). Within the main basin, plants were found in 54 percent of the sample sites but most of these sites contained only non-rooted plants (large algae or watermoss) and rooted plants occurred in only 11 percent of the sites. Areas of the main basin that did contain rooted plants were relatively protected shorelines such as the shore north of the public access, the shore north of Batcheller Point, and the shore south of Foresman Point (Fig. 9). Emergent plant beds within the main basin were not common but included bulrush beds at the entrance to Kenfield Bay and along the south side of Angel Island.

Aquatic plants were abundant within all bays and 84 percent of sample sites in the bays were vegetated. Extensive bulrush and waterlily beds were present in Lundstrom's Bay and Flower Pot Bay and a diverse mix of submerged plants occurred in all bays (Fig. 10).

The number of different plant taxa found at each survey site ranged from zero to 10. In the main basin, the mean number of plant taxa per site was less than one. The bays contained the greatest number of taxa and several areas contained between six and ten species per square meter (Fig. 10).

Figure 9. Distribution of aquatic plants in Ten Mile Lake, June 2006.

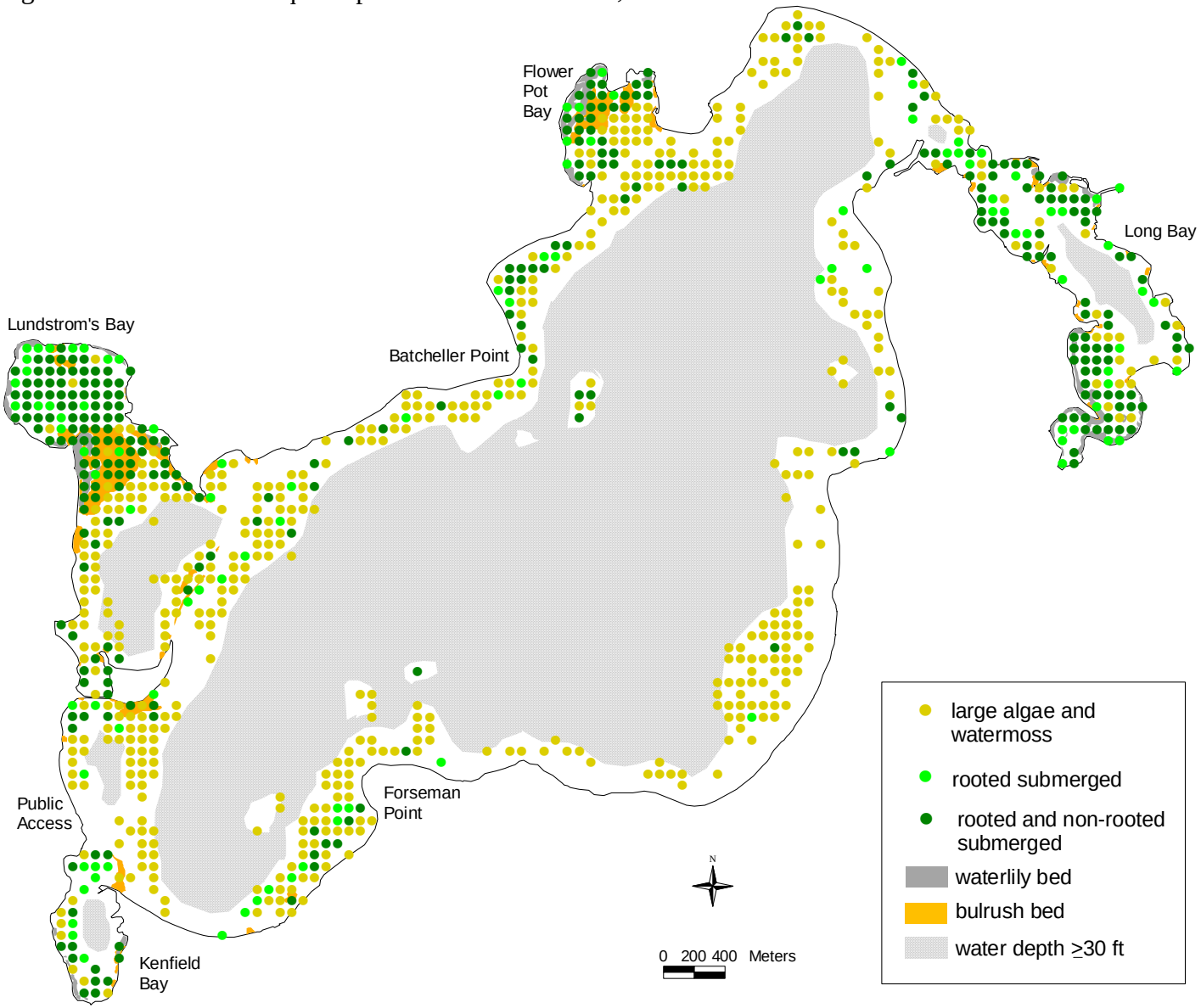
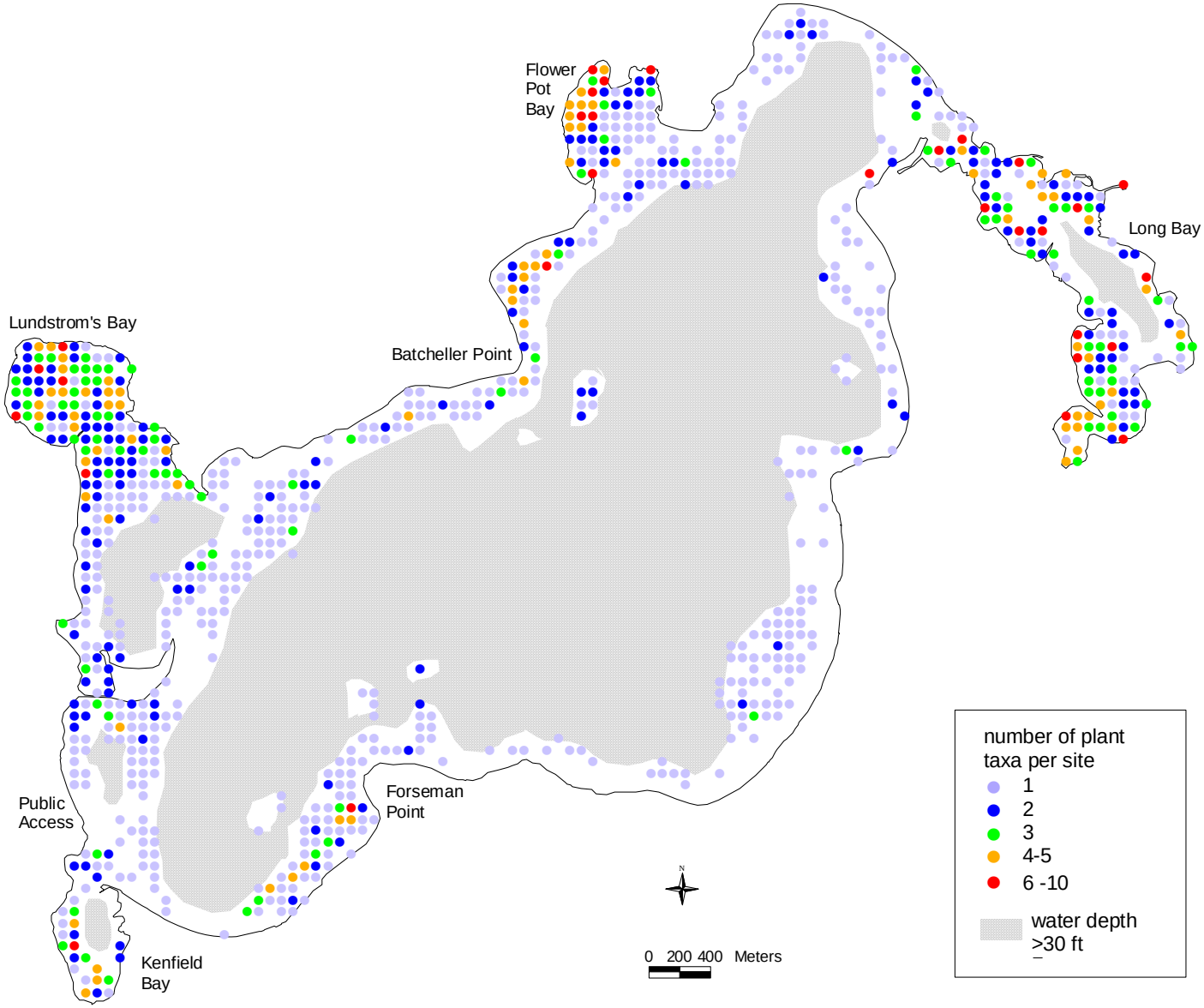


Figure 10. Number of plant taxa found at each sample site. Ten Mile Lake, June 2006.



Emergent and floating-leaf plants

The most common emergent plant in Ten Mile Lake was bulrush (Fig. 11) and approximately 90 acres of bulrush were mapped (Fig. 9). The largest bulrush beds occurred at the south end of Lundstrom's Bay and in Flower Pot Bay. Submerged vegetation was often found within these bulrush beds. Bulrush was usually found in sand and silt sediments and occurred to a maximum depth of seven feet. Other emergent plants found included arrowhead (*Sagittaria* sp.), burreed (*Sparganium* sp.) spikerush (*Eleocharis* sp.) and wild rice (*Zizania palustris*). Wild rice was found in Lundstrom's Bay, Flower Pot Bay and Long Bay.

About 50 acres of water lily beds were mapped (Fig. 9) and floating-leaf pondweed (*Potamogeton natans*), white water lily (*Nymphaea odorata*) (Fig. 12) and yellow water lily (*Nuphar variegata*) (Fig. 13) were the most common species. Waterlily beds often contained scattered bulrush plants as well as submerged plants. Waterlily beds were often associated with muck sediments.

Bulrush and other emergent aquatic plants offer shelter for insects and young fish as well as food, cover and nesting material for waterfowl, marsh birds and muskrats. Water lily beds provide similar benefits and also provide shade for fish and frogs. The root systems of emergent and floating-leaf plants act to stabilize the lake bottom and beds of these plants help buffer the shoreline from wave action.

Figure 11. Bulrush (*Scirpus*) bed on Ten Mile Lake, 2006.

Figure 12. White water lily (*Nymphaea odorata*)

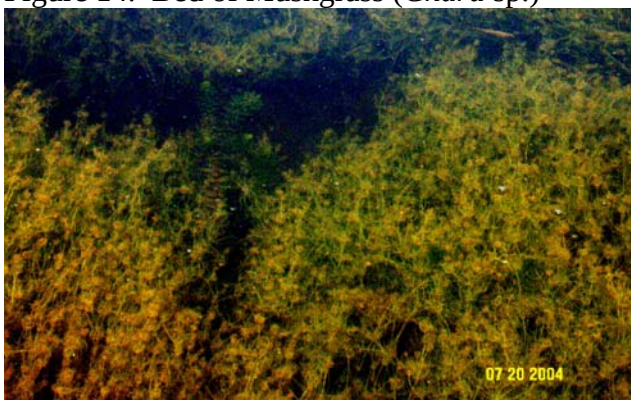
Figure 13. Yellow water lily (*Nuphar variegata*)

Submerged plants - algae

Submerged plants occurred in 63 percent of Ten Mile sample sites and included a wide variety of forms including large algae, grass-leaved plants, broad-leaved plants, and plants with finely dissected leaves.

The most common submerged plant taxa were large algae: muskgrass (*Chara* sp.) (Fig. 14) and stonewort (*Nitella* sp.) (Fig. 15).

Figure 14. Bed of Muskgrass (*Chara* sp.)



Muskgrass (*Chara* sp.) (Fig. 14) is a macroscopic, or large, algae that is common in many hard water Minnesota lakes. It has a brittle texture and a characteristic "musky" odor. 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 colonize open areas of lake bottom where it can act as a sediment stabilizer. Beds of muskgrass can provide important habitat for fish spawning and nesting.

In Ten Mile Lake, muskgrass was the most frequent submerged plant found and occurred in 45 percent of all survey sites (Table 3) and was found around the entire lake (Fig. 16). Within the bays, muskgrass was found in 67 percent of the survey sites, compared to 37 percent of the sites in the main basin. Muskgrass occurred to a maximum depth of 28 feet but was most common in depths from shore to 15 feet where it occurred in 56 percent of the sites (Fig. 17). In depths greater than 20 feet, muskgrass was found in only five percent of the sample sites.

Figure 15. close-up of Stonewort (*Nitella* sp.)

Stonewort (*Nitella* sp.) (Fig. 15) is also a large algae but lacks the brittle texture and musky odor of muskgrass. It is often found in deeper water than muskgrass. In Ten Mile Lake it occurred in 11 percent of the sample sites and was found on the deep edge of muskgrass beds (Fig. 16). Stonewort was the only plant that was more abundant in the main basin (where it occurred in14 percent of the sample sites) than in the bays (where it occurred in only two percent of the sample sites (Table 2). Stonewort was found in depths of seven to 30 feet and was the only plant found beyond the 28 feet depth. Stonewort was most common in depths of 20 to 30 feet where it was present in 31 percent of the sample sites (Fig. 17).

Figure 16. Distribution of large algae in Ten Mile Lake, June 2006.

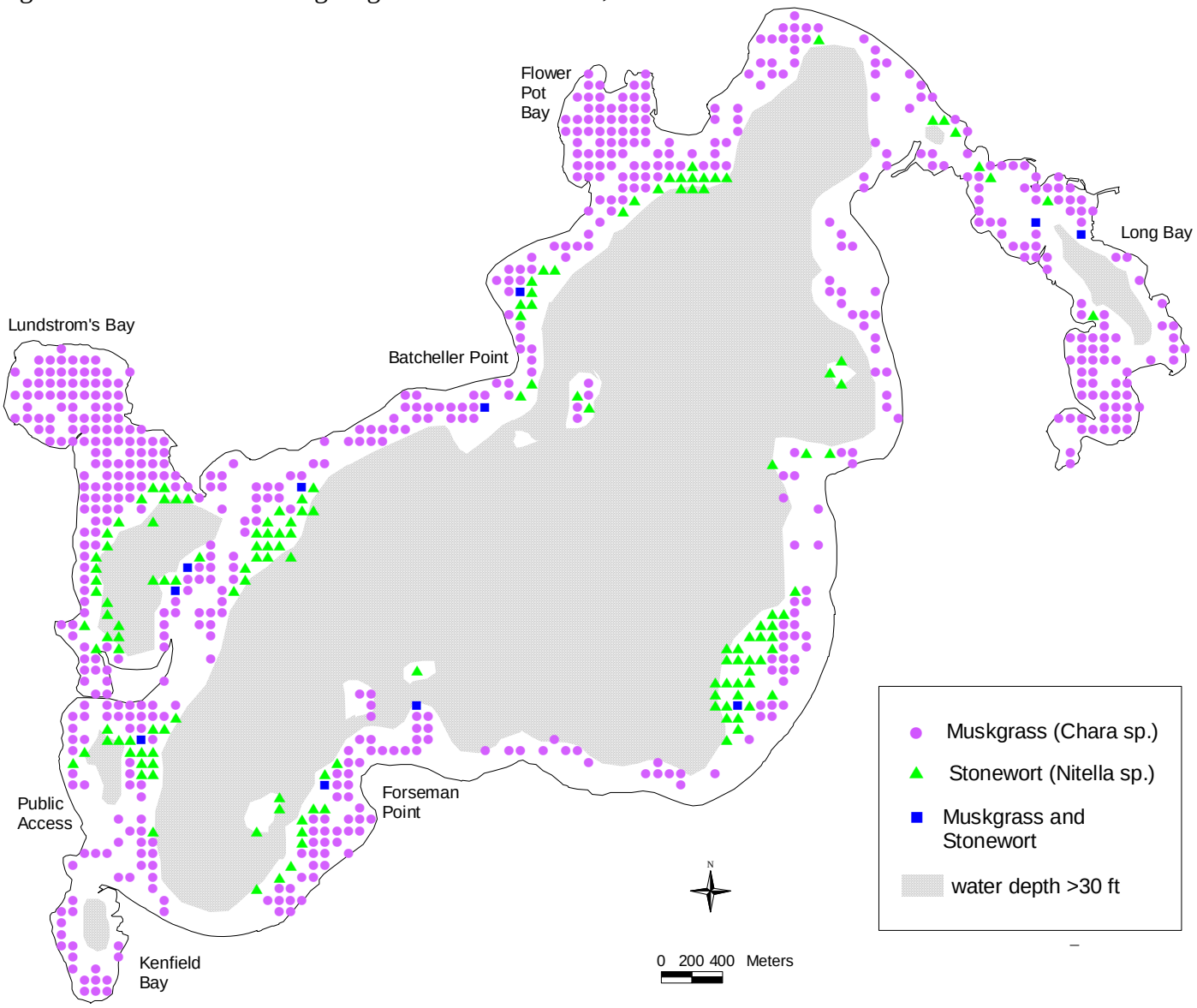
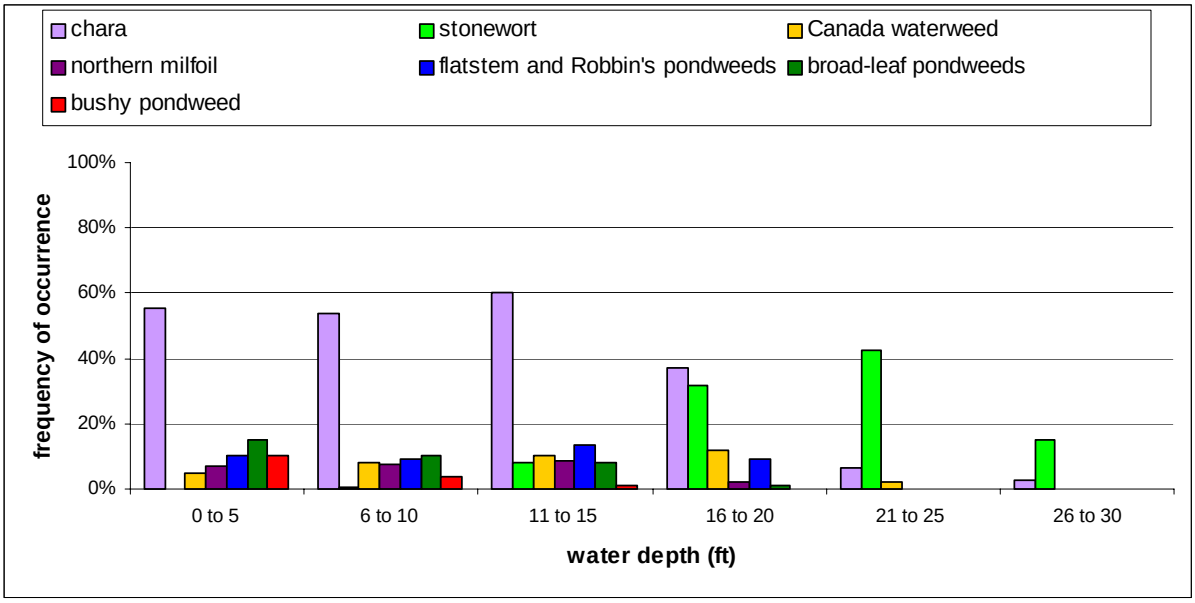


Figure 17. Distribution of common submerged species by water depth, Ten Mile Lake, June 2006.



Submerged plants – flowering plants

The most common flowering submerged plants were Canada waterweed (*Elodea canadensis*), northern watermilfoil (*Myriophyllum sibiricum*), several pondweed species (*Potamogeton spp.)* and bushy pondweed (*Najas flexilis*) (Table 3).

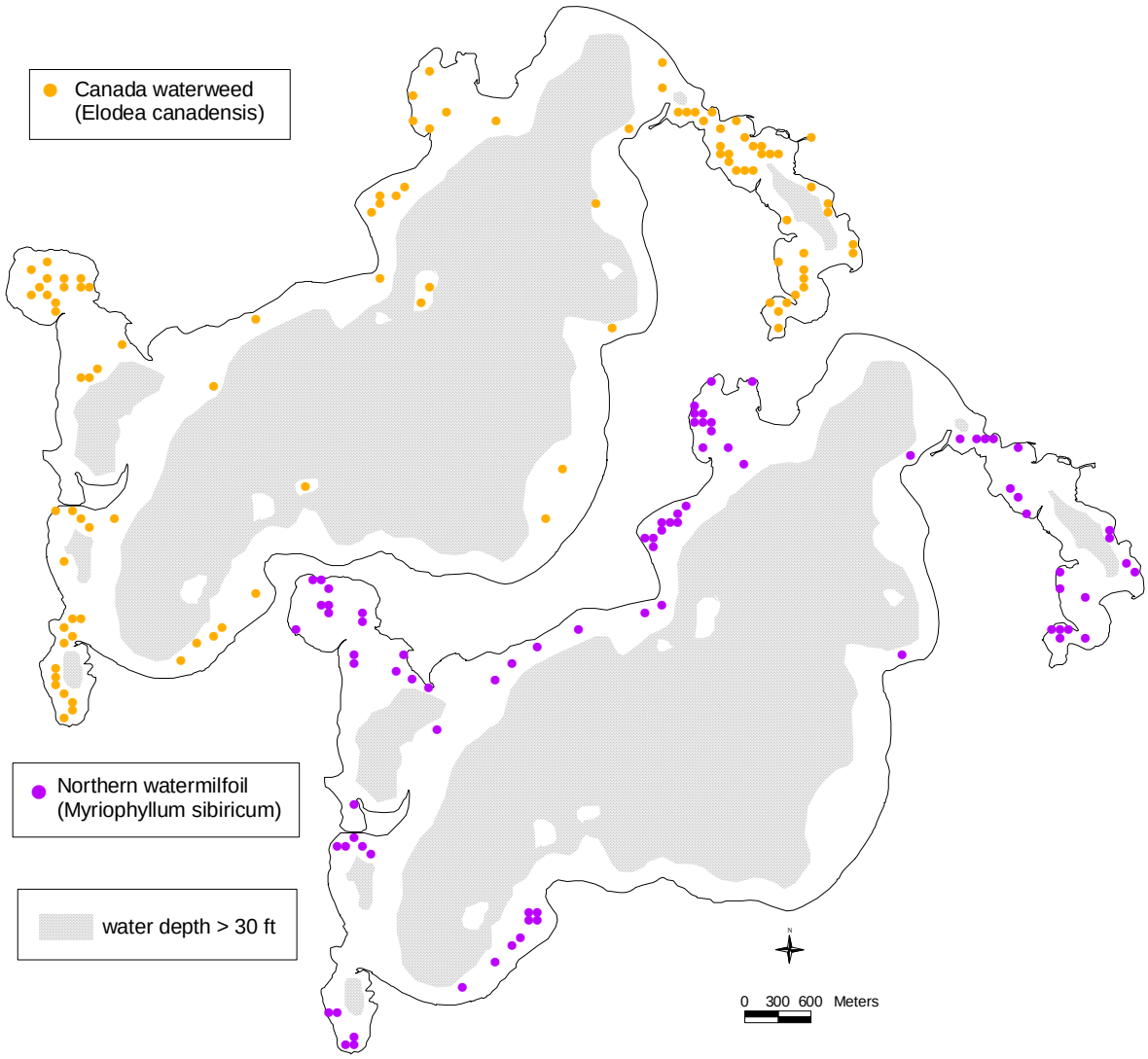
Figure 18. Canada waterweed (*Elodea canadensis*) (photo by Vic Ramey, U of Florida)

Canada waterweed (*Elodea canadensis*) (Fig. 18) is a rooted, perennial submerged species that is widespread throughout Minnesota and is adapted to a variety of conditions. It is tolerant of low light and prefers soft substrates. This species can over winter as an evergreen plant and spreads primarily by fragments. The branching stems of this plant can form thick underwater plant beds that are valuable habitat for a variety of fish and invertebrates.

In Ten Mile Lake, it occurred from shore to a depth of 22 feet (Fig. 17). It was found in seven percent of all sample sites and was most common within the bays where it occurred in 15 percent of the sites (Table 3, Fig 19). Canada waterweed was one of the few flowering plants found at offshore sites in the main basin of Ten Mile Lake.

Northern watermilfoil (*Myriophyllum sibiricum)* (Fig. 20) 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

Figure 19. Distribution of common flowering plants in Ten Mile Lake, June 2006.



turbidity and grows best in clear water lakes. This native plant provides fish shelter and insect habitat and the extensive root systems help stabilize near-shore sediments.

Northern watermilfoil was found in six percent of all the Ten Mile Lake sample sites, 12 percent of the bay sites and in three percent of the main basin sites (Table 3, Fig. 19). It occurred to a depth of 20 feet but was more common in depths of 15 feet and less (Fig. 17).

Figure 20. Northern watermilfoil. (*Myriophyllum sibiricum*)

Nine different native submerged "pondweed" (*Potamogeton spp.*) taxa occur in Ten Mile Lake and most are named for their unique leave structure. The fruits of pondweeds are a favorite duck food and the leaves provide food and shelter for fish.

Narrow-leaved pondweeds found in Ten Mile Lake include Flat-stem pondweed (*Potamogeton zosteriformis*) (Fig. 21) and Robbin's pondweed (*Potamogeton robbinsii*). These plants have 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. These pondweeds are anchored to the lake bottom by rhizomes and overwinter by winter buds.

Figure 21. Flat-stem pondweed (*Potamogeton zosteriformis*)

In Ten Mile Lake, flat-stem pondweed was found in six percent of the sites surveyed and Robbin's pondweed occurred in four percent. Both species were most common within the bays were they was found in 15 percent and 10 percent of the sample sites, respectively (Table 3). They were found to a depth of 20 feet (Fig. 17) and often co-occurred with Canada waterweed, northern watermilfoil and other pondweeds (Fig. 19, 24).

Broadleaf pondweeds in Ten Mile Lake include large-leaf pondweed (*Potamogeton amplifolius*), variable pondweed (*P. gramineus*), Illinois pondweed (*P. illinoensis)*, white-stem pondweed (*P. praelongus*), and clasping-leaf pondweed (*P. richardsonii*). These rooted, perennial plants with wide leaves are often called "cabbage" plants by anglers. These plants are primarily submerged but many will form floating leaves in shallower water (Fig. 22).

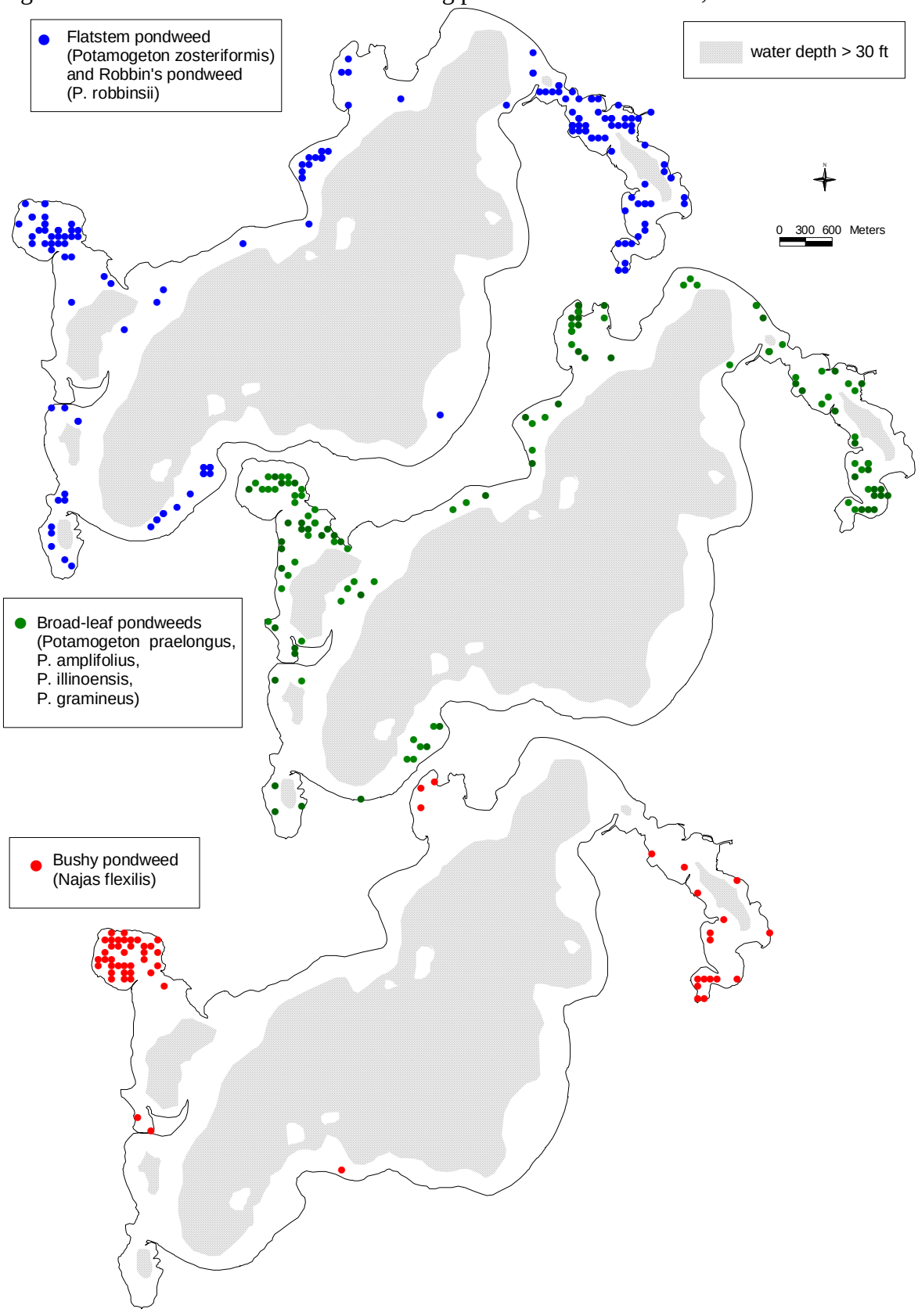
Figure 22. A broad-leaf pondweed or "cabbage" (*Potamogeton amplifolius*)

White-stem pondweed was the most abundant broadleaf pondweed in Ten Mile Lake and was found in four percent of all sample sites (Table 3). Broad-leaf pondweeds were more common in depths of 15 feet and less (Fig. 17) and were generally found within sheltered bays (Fig. 24).

Figure 23. Bushy pondweed (*Najas flexilis*)

Bushy pondweed (*Najas flexilis*) (Fig. 23) is unique because it is one of the few annual submerged

Figure 24. Distribution of common flowering plants in Ten Mile Lake, June 2006.



species in Minnesota and must re-establishes every year from seed. The seeds and foliage of this plant are an important duck food and beds of this plant provide good fish cover. In Ten Mile Lake, bushy pondweed was found to a depth of 12 feet (Fig. 17) and was mostly restricted to the bays where it occurred in 14 percent of the sites; in the main lake, it was found in less then one percent of the sites (Table 3, Fig. 24). The seedlings of this plant are unlikely to colonize heavily wave swept sites of the main bay.

Unique Plants

In addition to the commonly occurring plants in Ten Mile Lake, there were several unique plants located during the survey.

Quillwort (*Isoetes* sp.) (Fig. 25) is a submerged plant that is associated with low alkalinity, clear lakes of northern Minnesota. It is specially adapted to live in very low carbon environments (Bolton and Adams 1986). This is not a flowering plant but reproduces and spreads by megaspores that are produced late in the summer. Quillwort was found in only a few sites during the Ten Mile survey but it may have been missed at some survey sites because it can be difficult to collect this small plant on a rake.

Figure 25. Quillwort (*Isoetes* sp.)
Photo: C. Taylor USDA-NRCS PLANTS Database

Other unique plants found in Ten Mile Lake include floating-leaf burreed (*Sparganium fluctuans*), water bulrush (*Scirpus subterminalis*), and species of bladderwort (*Utricularia intermedia and Utricularia sp.*). These species are not widespread in Minnesota but are usually associated with low alkalinity lakes of northern Minnesota. Although they were found infrequently during the survey, their presence is indicative of the high clarity of Ten Mile Lake.

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 and wave activity. Much of Ten Mile lake is too deep or wind-swept for aquatic plant growth. The sheltered shallow areas do support an abundant and diverse native aquatic plant community that in turn, provides critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants).

The high number of plant species found in Ten Mile Lake is a reflection of the excellent water clarity. Many of the plants found require clear water and are not found in lakes with higher turbidity. Another reason for the high diversity of plant types is that Ten Mile Lake has a variety of sediment types and a mix of protected bays and open water sites. Plant species with different habitat requirements can exist within this system.

A review of past vegetation surveys indicates that, over the past 50 years, the general aquatic plant community has not likely changed greatly in Ten Mile Lake. In all survey years, a relatively high number of native plants have been recorded and rooted plants remain well distributed throughout the bays. Data collected in 2006 can be used to monitor finer-scale changes that may occur, such as an increase in a particular species or a change in the depths at which individual species 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 in Ten Mile Lake 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 species have **not** been documented in Ten Mile Lake but if they invade the lake, they may directly or indirectly impact the native plant community. Non-native plant species, such as Eurasian watermilfoil (*Myriophyllum spicatum*) or curly-leaf pondweed (*Potamogeton crispus*) may form dense surface mats that may shade out native plants. The impact of these 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
  Many submerged plants are perennial and regrow in similar locations each year. However, a few species such as bushy pondweed (*Najas flexilis*) and wild rice (*Zizania palustris*) are annuals and are dependant on the previous years seed set for regeneration.
- 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, click here: MnDNR APM Program or contact your local DNR office. 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. Limiting these types of activities can help protect native aquatic plant species.

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Canada waterweed (pg. 17) Vic Ramey, U of Florida. Copyright Univ. of Florida 1993. At Univ. of Florida Center for Aquatic Plants: http://aquat1.ifas.ufl.edu/welcome.html

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