Aquatic Vegetation of Birch Lake (DOW 11-0412-00) Cass County, Minnesota

July 13, 17, 18 and 20, 2006

Birch Lake, Cass County, MN. August 30, 2006

Report by: Donna Perleberg
Minnesota Department of Natural Resources
Division of Ecological Services
1601 Minnesota Dr., Brainerd, MN 56401
Phone: 218.833.8727
Fax: 218.828.6043
Email: donna.perleberg@dnr.state.mn.us

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Lake sampling: Donna Perleberg, Josh Knopik, Stephanie Loso, and Lucas Wandrie MnDNR Division of Ecological Services, Brainerd

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Birch Lake 2006 vegetation survey crew (J. Knopik, D. Perleberg, L. Wandrie, S. Loso)

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Summary

An aquatic vegetation survey of Birch Lake (11-0412-00), Cass County, Minnesota, was conducted on July 13, 17, 18 and 20, 2006. Thirty-seven native aquatic plant species were identified including five emergent, five floating-leaved, two free-floating and 25 submerged plants. Plants were found distributed throughout the lake basin to a maximum depth of twenty-nine feet, although most vegetation occurred in depths less than 16 feet. The zone from shore to five feet water depth contained the highest number of species. Beds of bulrush (*Scirpus* spp.) and waterlilies (*Nuphar variegata, Nymphaea odorata* and *Brasenia schreberi*) occurred along shorelines to a depth of about six feet. Water depths up to 30 feet were sampled and submerged plants were found in 77 percent of the Lower Birch sample sites and in 55 percent of the Upper Birch sample sites. The most frequently occurring submerged plants were muskgrass (*Chara* sp.) (found in 29 % of the sample sites), flat-stem pondweed (*Potamogeton zosteriformis*) (27 %), bushy pondweed (*Najas flexilis*) (26%), Canada waterweed (*Elodea canadensis*) (25%), coontail (*Ceratophyllum demersum*) (17%), northern watermilfoil (*Myriophyllum sibiricum*) (16%), Robbin's pondweed (*Potamogeton robbinsii*) (15%) and narrow-leaf pondweed (*Potamogeton* sp.) (15%). This diverse mix of plant types provides valuable fish and wildlife habitat within the lake.

Introduction

Birch Lake (DOW 11-0412-00) is located by the city of Hackensack, in Cass County, north-central Minnesota. The lake occurs within the ecological region called the Laurentian Mixed Forest, which is the true forested region of the state (Fig. 1).

Birch Lake is part of the Boy River Watershed and the Boy River flows into Birch Lake from Ten Mile Lake and outlets to Poquet Lake (Fig. 2). The majority of land within this watershed remains forested with extensive wetland areas. The shoreline of Birch Lake is primarily forested but also heavily developed with residential homes. There is a public boat launch and fishing pier on the southeast shore.

Figure 1. Location of Birch Lake in Minnesota.

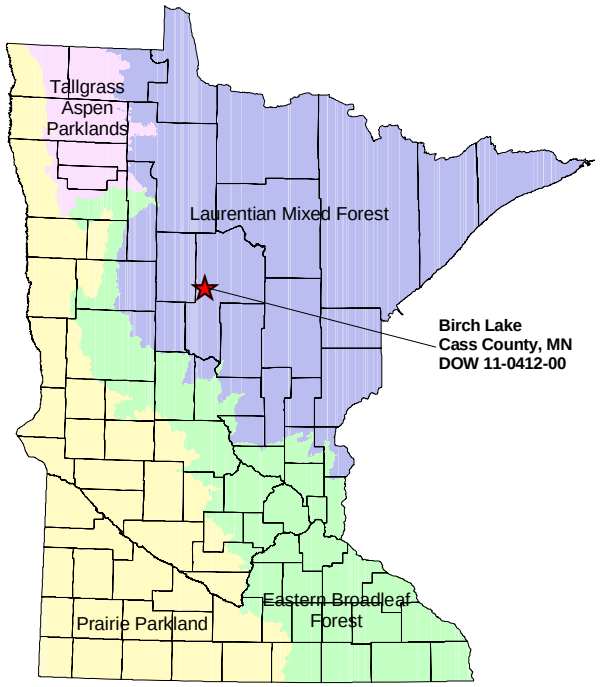
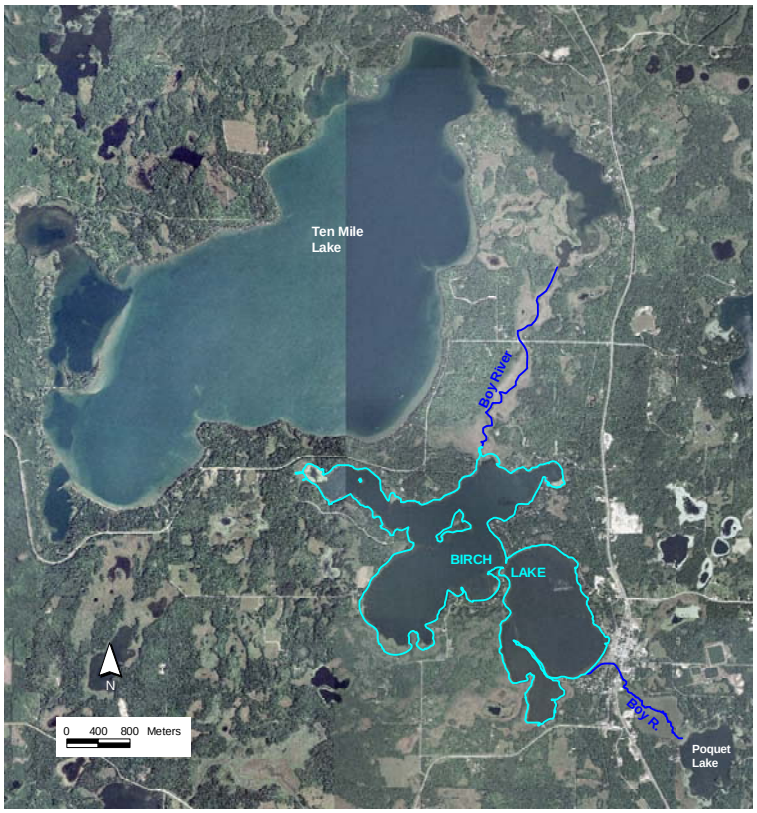


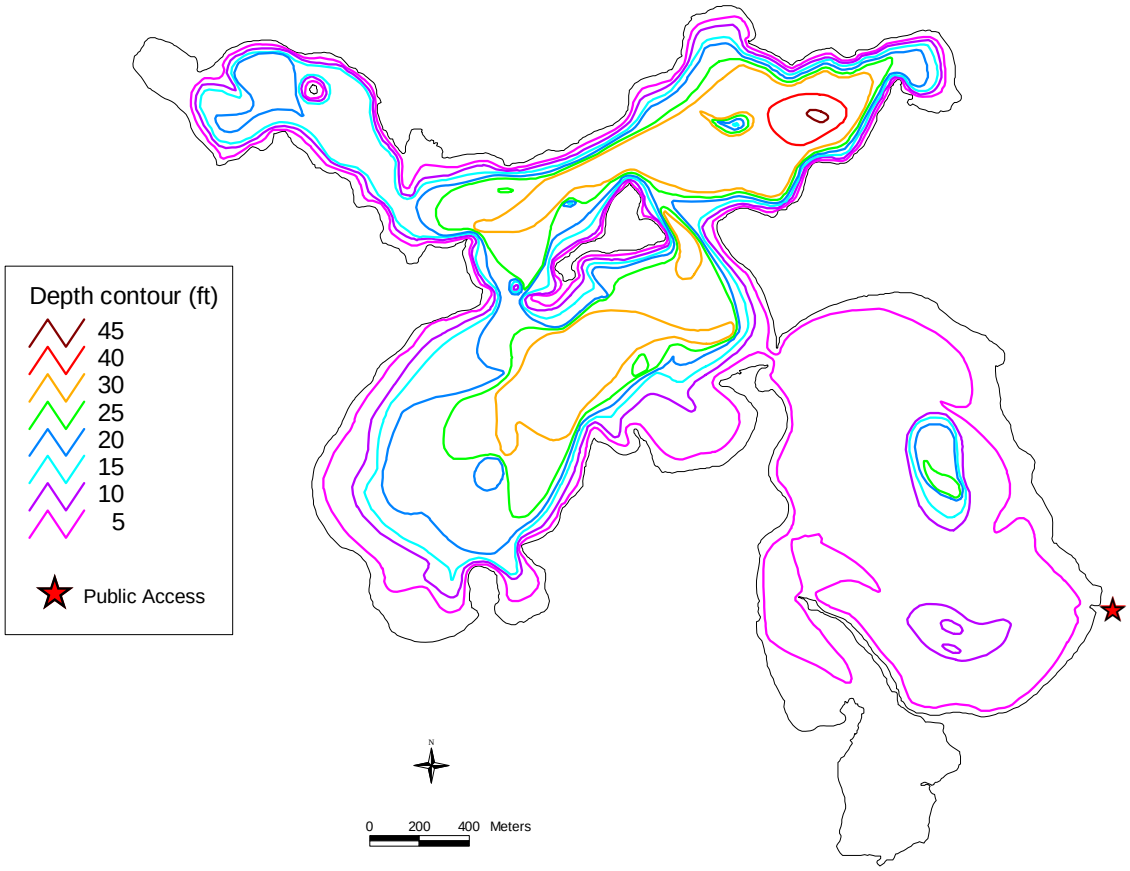
Figure 2. Boy River inlet and outlet of Birch Lake.



Birch Lake has a surface area of 1284 acres and consists of two basins. The east basin (Lower Birch) is shallow with a maximum depth of 25 feet and a mean depth of about seven feet (Fig. 3). The west basin (Upper Birch) has a maximum depth of 45 feet and a mean depth of about 20 feet (Heiskary 1990). A 13 acre island occurs in the west basin. In 1940, a dredge was used to deepen a man-made channel between the east and west basins (Heiskary 1990).

A 1989 water quality study described Birch Lake as a hard water lake with good water clarity; values for total phosphorus, chlorophyll a and Secchi disc transparency fell

Figure 3. Depth contours of Birch Lake, Cass County, MN (11-0412-00) source:MDNR 1957.



within a range typical for representative, minimally impacted lakes of the Minnesota's northern forest region (Heiskary 1990). Between 1990 and 2004, mean summer water clarity, as measured by Secchi disc reading, ranged from 12 feet to 15 feet, with a mean of 13 feet (MPCA 2006).

Previous vegetation surveys of Birch Lake were conducted in 1958, 1975, and 1983 (MnDNR Fisheries Lake Files). Different methods were used for each survey and the results are not directly comparable. Plant growth was recorded to a depth of 12 feet in 1975 and to 19 feet in 1983. In all survey years, surveyors described abundant submerged plant growth throughout the Lower Birch and in shallow bays of Upper Birch. A total of 27 different native aquatic plant species were recorded during these surveys. Plants that were reported in all previous surveys include bulrush (*Scirpus* sp.), cattail (*Typha* sp.), white water lily (*Nymphaea odorata*), yellow water lily (*Nuphar variegata*), a variety of pondweeds (*Potamogeton* spp.), muskgrass (*Chara* sp.), and northern watermilfoil (*Myriophyllum sibiricum*).

Objectives

The purpose of this vegetation survey was to provide a quantitative description of the 2006 plant population of Birch 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

Areas of Birch Lake contain extensive beds of floating-leaf and emergent vegetation in shallow water. 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. Therefore, surveyors mapped emergent plant beds in the field on August 8 and 9, 2006. Surveyors boated around the edge of each emergent plant bed and recorded the boundary using a GPS unit.

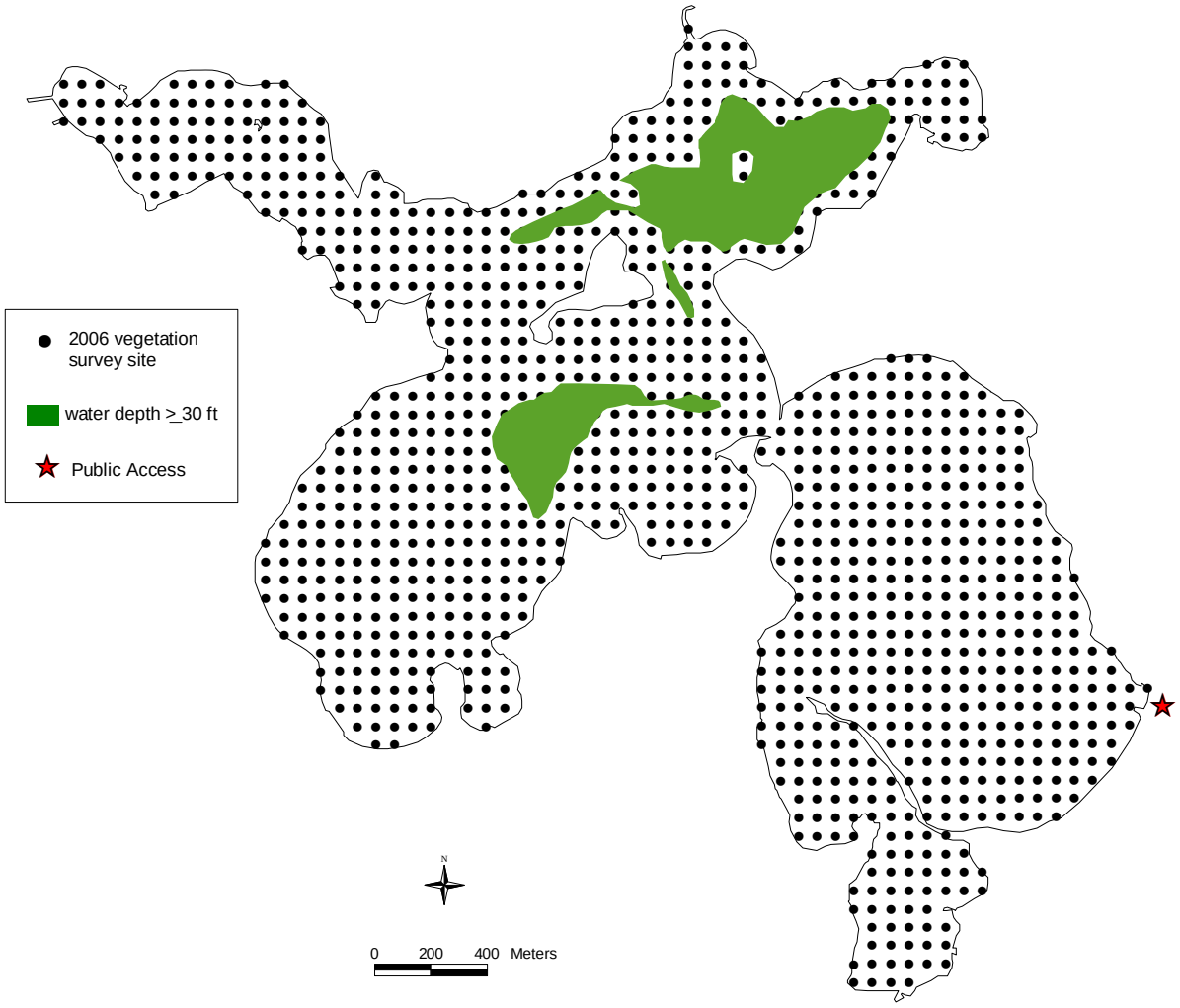
Submerged vegetation survey

A vegetation survey of Birch Lake was conducted on July 13, 17, 18 and 20, 2006. A Point-intercept survey method was used and followed the methods described by Madsen (1999). Surveys included two survey crews, each consisting of one boat and two surveyors. Survey waypoints were created using a Geographic Information System (GIS) computer program and downloaded into a Global Positioning System (GPS) receiver. Survey points were spaced 65 meters apart on Birch Lake. In the field, surveyors sampled all survey points between shore and 30 feet for a total of 1046 sample sites (Fig. 4).

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 feet 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. At each sample site where water depths was six feet and less, surveyors described the bottom substrate.

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.

Figure 4. Vegetation survey sites in Birch Lake (11-0412-00) Cass Co, 2006.



Example:
In Birch Lake there were 1046 samples sites in the zone from shore to the 30 feet depth. Muskgrass occurred in 300 of those sites. Frequency of muskgrass in the shore to 30 feet depth zone of Birch Lake
= 300/1046 (*100) =29 %

Frequency was calculated for the entire area from shore to 30 feet and sampling points were also grouped by water depth and separated into seven depth zones for analysis (Table 1).

Table 1. Sampling effort by water depth Birch Lake (11-0412-00), 2006.

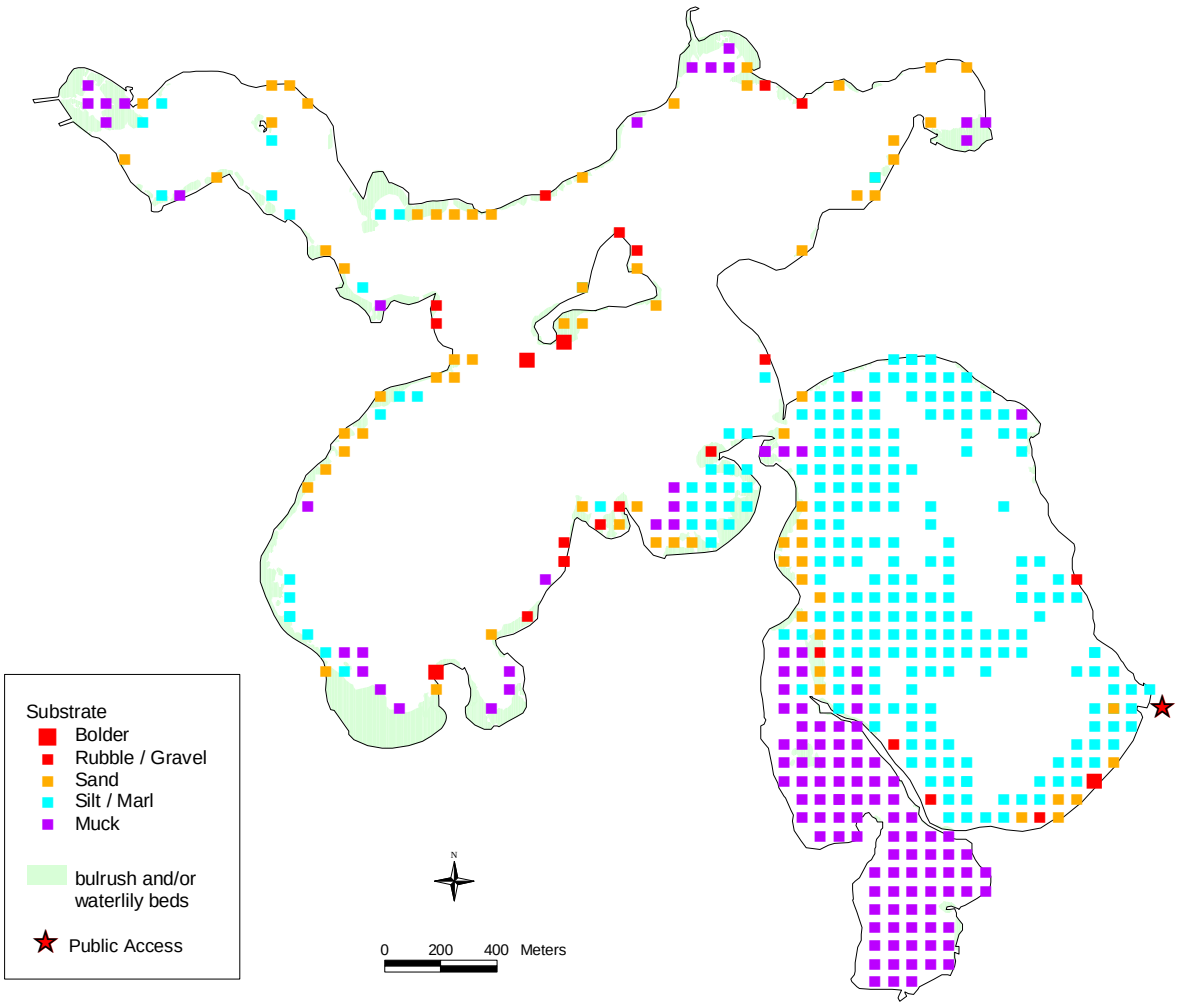
Depth interval in feet	Number of sample points
0 to 5	339
6 to 10	301
11 to 15	73
16 to 20	122
21 to 25	109
26 to 30	102
Total number of sample points	1046

Results

Shoal sediments

At most shallow water sites (0 to 6 feet of water) sediment type was described as silt/marl or muck with occasional areas of sand, gravel, rubble or bolder. The south bay of Lower Birch was uniformly comprised of muck sediments and the main basin of Lower Birch was primarily silt/marl with sand, gravel/rubble and bolder along the southeast and west shores(Fig. 5). Muck dominated the protected bays of Upper Birch and harder substrates occurred along straight shorelines and around the island (Fig. 5).

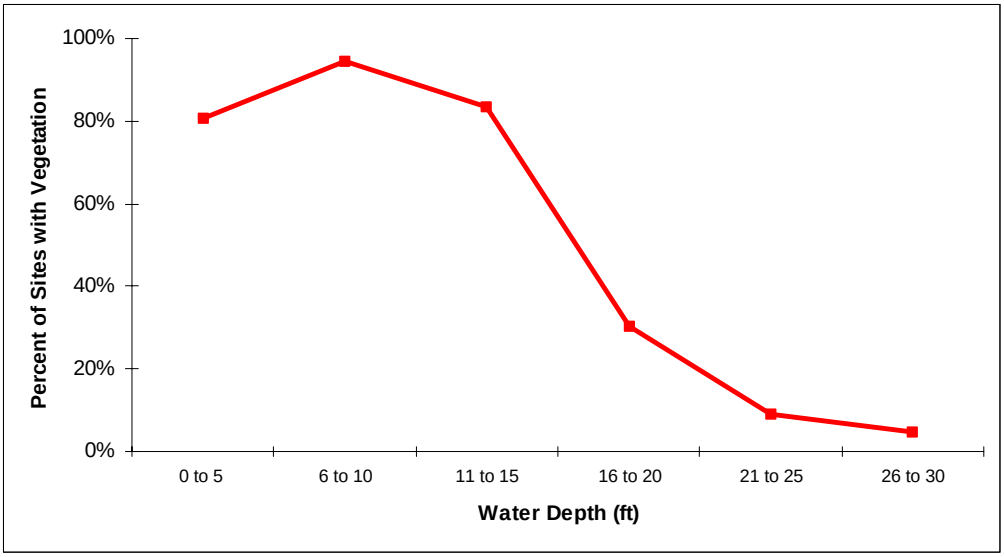
Figure 5. Shoal sediments of Birch Lake, 2006.



Distribution and maximum depth of plant growth

Plants were found to a maximum depth of 29 feet in Birch Lake but plant occurrence was greatest from shore to a water depth of 15 feet, where vegetation was found in 87 percent of the sample sites (Fig. 6). In depths greater than 15 feet, only 16 percent of sites were vegetated.

Figure 6. Plant abundance vs. water depth. Birch Lake, 2006.



Number and types of plant species recorded

A total of 37 native aquatic plant species were recorded in Birch Lake including five emergent, five floating-leaved, two free-floating and 25 submerged plants (Table 2). The highest number of plant species was found in shallow water, less than six feet in depth (Fig. 7). Only submerged plant species were found beyond the six feet depth the majority of submerged species were

Figure 7. Distribution of plant types by water depth. Birch Lake, 2006.

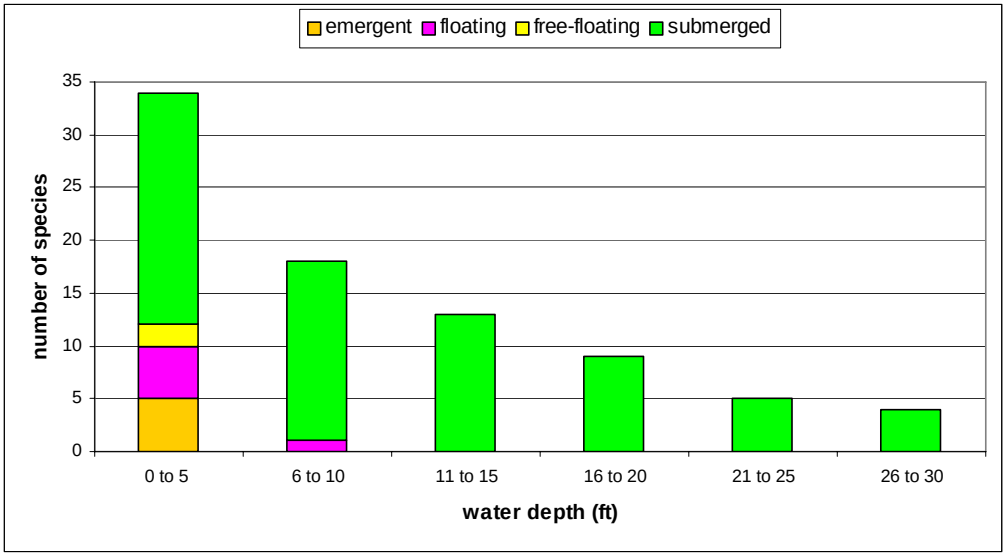


Table 2. Percent occurrence of aquatic plants in Birch Lake Point-intercept survey, July 2006.

		Common name	Scientific name	2006 (percent of sample site in which species occurred)
Submerged	Large Algae	Muskgrass	Chara sp.	29
		Stonewort	Nitella	1
	Grass-leaved plants	Flatstem pondweed	Potamogeton zosteriformis	27
		Wild Celery	Vallisneria americana	6
		Water stargrass	Heteranthera dubia	1
	Small-leaved plants	Bushy pondweed	Najas flexilis	26
		Canada waterweed	Elodea canadensis	25
	Disected or fine-leaved plants	Coontail	Ceratophyllum demersum	17
		Northern watermilfoil	Myriophyllum sibiricum	16
		Water marigold	Megaladonta beckii	2
		White Water Buttercup	Ranunculus spp.	<1
		Greater Bladderwort	Utricularia vulgaris	<1
		Flat-leaved bladderwort	Utricularia intermedia	<1
		Bladderwort	Utricularia sp.	<1
		Watermoss	Not identified to genus	<1
	Broad-leaved plants "Cabbage"	Robbins Pondweed	Potamogeton robbinsii	15
		Clasping-leaf pondweed	Potamogeton richardsonii	9
		Large-leaf pondweed	Potamogeton amplifolius	6
		Illinois pondweed	Potamogeton illinoensis	6
		Variable pondweed	Potamogeton gramineus	2
		White-stem pondweed	Potamogeton praelongus	6
	Narrow-leaved plants	Fries pondweed	Potamogeton freisii	15
		Narrow-leaf pondweed	Potamogeton sp.	10
		Sago pondweed	Stuckenia pectinata	1
		Quillwort	Isoetes sp.	<1
Free-floating		Star Duckweed	Lemna trisulca	<1
		Greater Duckweed	Spirodela polyrhiza	<1
Floating		Watershield	Brasenia schreberi	<1
		White water lily	Nymphaea odorata	2
		Yellow water lily	Nuphar variegata	1
		Floating-leaf Burreed	Sparganium fluctuans	<1
		Floating-leaf pondweed	Potamogeton natans	1
Emergent		Bulrush	Scirpus sp.	3
		Spikerush	Eleocharis sp.	1
		Needlerush	Eleocharis acicularis	<1
		Arrowhead	Sagittaria sp.	<1
		Wild rice	Zizania aquatica	present

Present = present in lake but not found in survey sites.

restricted to depths less than eleven feet; only five submerged species were found in depths greater than 20 feet (Fig. 7).

Emergent and floating-leaf plants

Approximately 50 acres of emergent plants were mapped (Fig 8) and the most common emergent species was bulrush (*Scirpus* sp.) (Fig. 9). Bulrush beds were common along most shore of Upper Birch Lake and the western shore of Lower Birch (Fig. 8). About 50 acres of water lily beds were mapped (Fig. 8) and white water lily (*Nymphaea odorata*) (Fig. 10) and yellow water lily (*Nuphar variegata*) (Fig. 11) were the most common species. 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 8. Distribution of aquatic plants in Birch Lake, 2006.

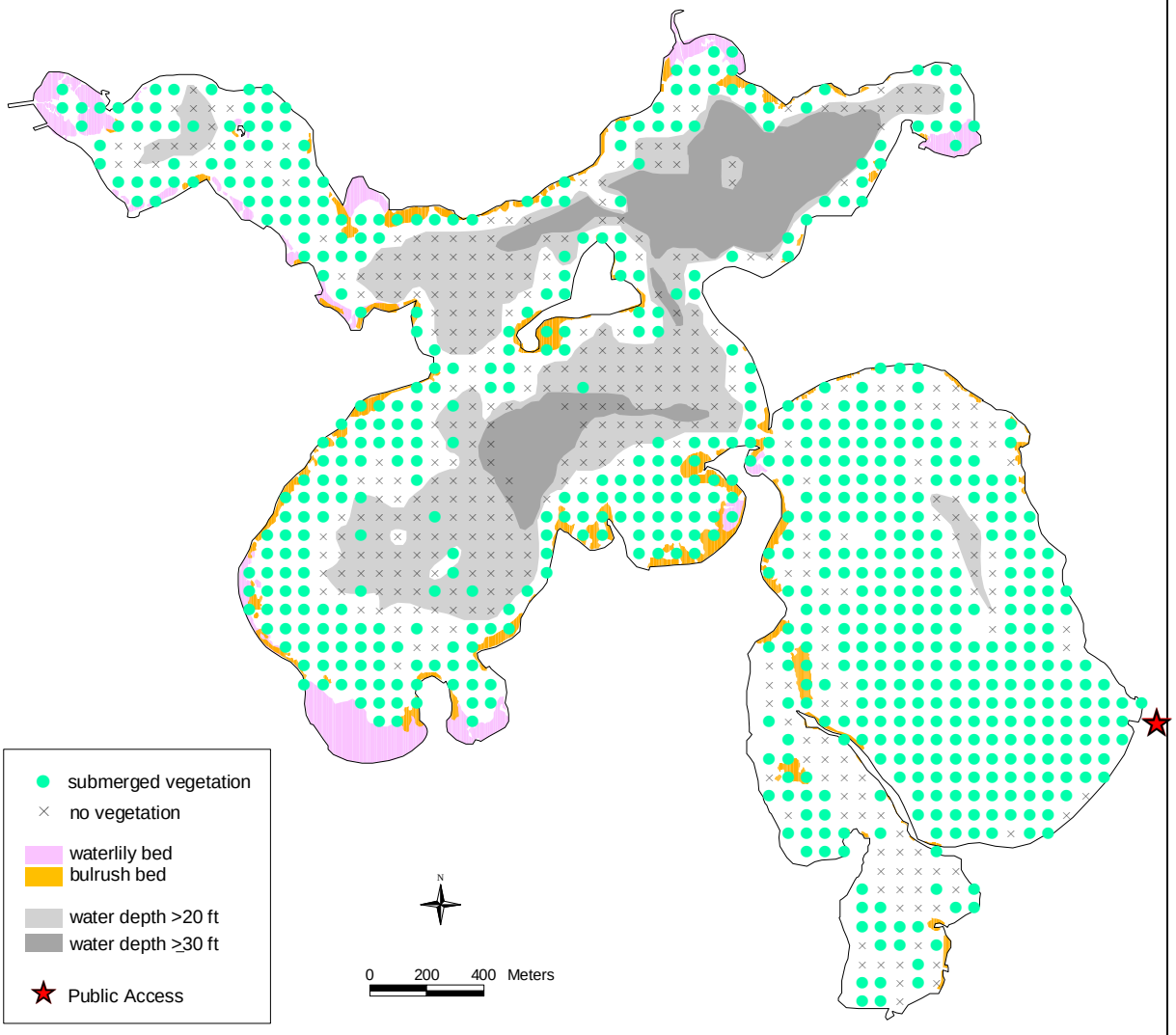


Figure 9. Bulrush (*Scirpus*) bed on Birch Lake, 2006.

Figure 10. White water lily (*Nymphaea odorata*)

Figure 11. Yellow water lily (*Nuphar variegata*)

Submerged plants

Submerged plants were common in both basins and 64 percent of all survey sites contain submerged vegetation (Fig. 8). Submerged plants occurred in 77 percent of the Lower Birch survey sites and in 55 percent of the sites in Upper Birch.

Submerged plants included a wide variety of forms including large algae, grass-leaved plants, plants with finely dissected leaves, broad-leaved plants and narrow leaved plants. The number of different submerged species found at each survey site ranged from zero to 12 and the mean number of species found per site was two. The main portion of the east basin and the shallower areas of the west basin contain the greatest number of submerged species (Fig. 12). The southwest bay of the east basin contained the fewest types of submerged species and most sample sites in that bay contained less than two plant species.

The most common submerged species, or groups of species, were muskgrass (*Chara* sp.), flat-stem pondweed (*Potamogeton zosteriformis*), bushy pondweed (*Najas flexilis*), Canada waterweed (*Elodea canadensis*), coontail (Ceratophyllum demersum), northern watermilfoil (*Myriophyllum sibiricum*), broad-leaf pondweeds (*Potamogeton* spp.), and narrow-leaf pondweeds (*Potamogeton* spp.), each of which were widespread in distribution (Figures 13 and 14) and occurred in at least 15 percent of the survey sites (Table 2).

Fig. 12. Number of submerged species found at each sample site. Birch Lake 2006.

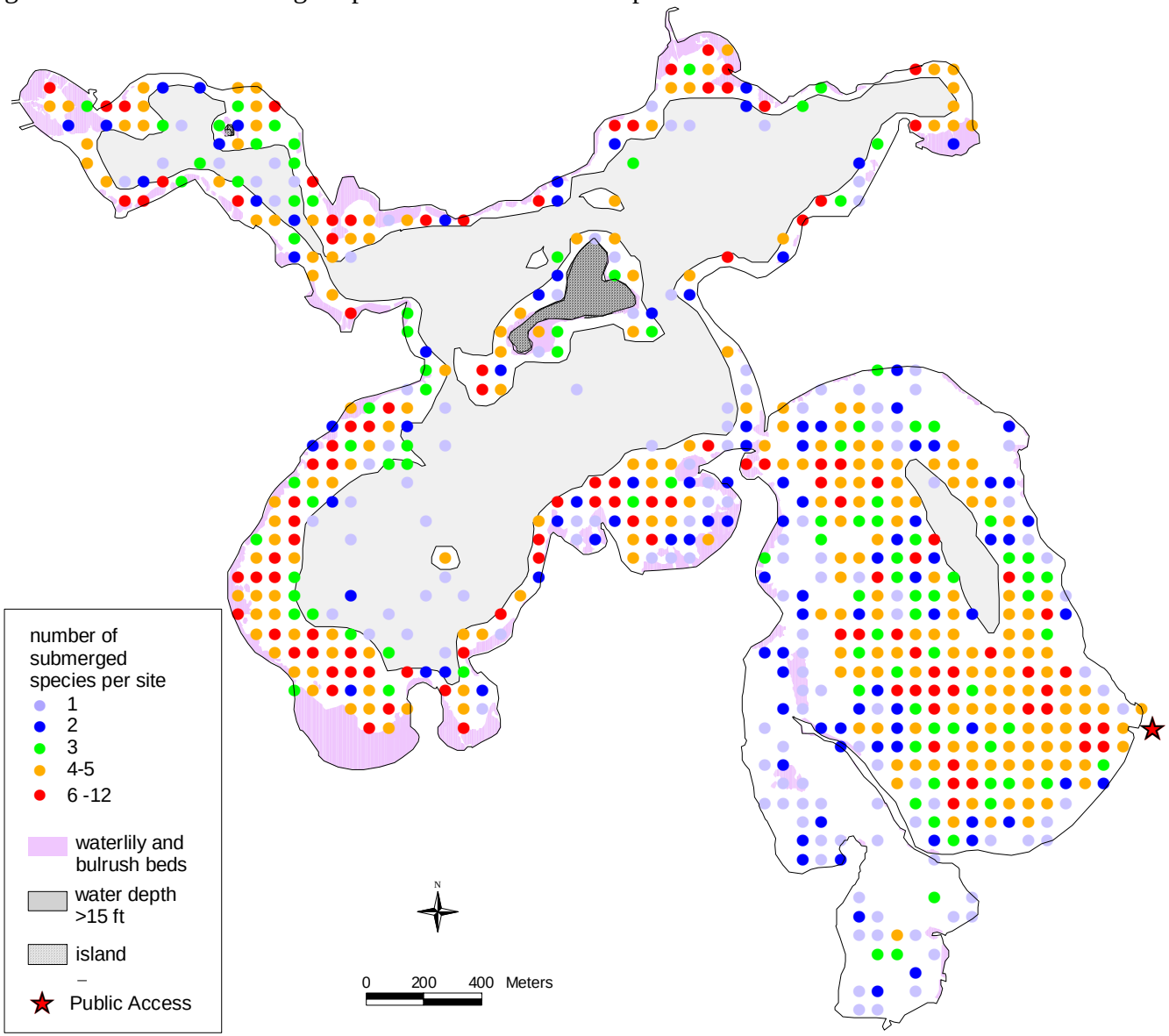


Figure 13. Distribution of common submerged species in Birch Lake, 2006.

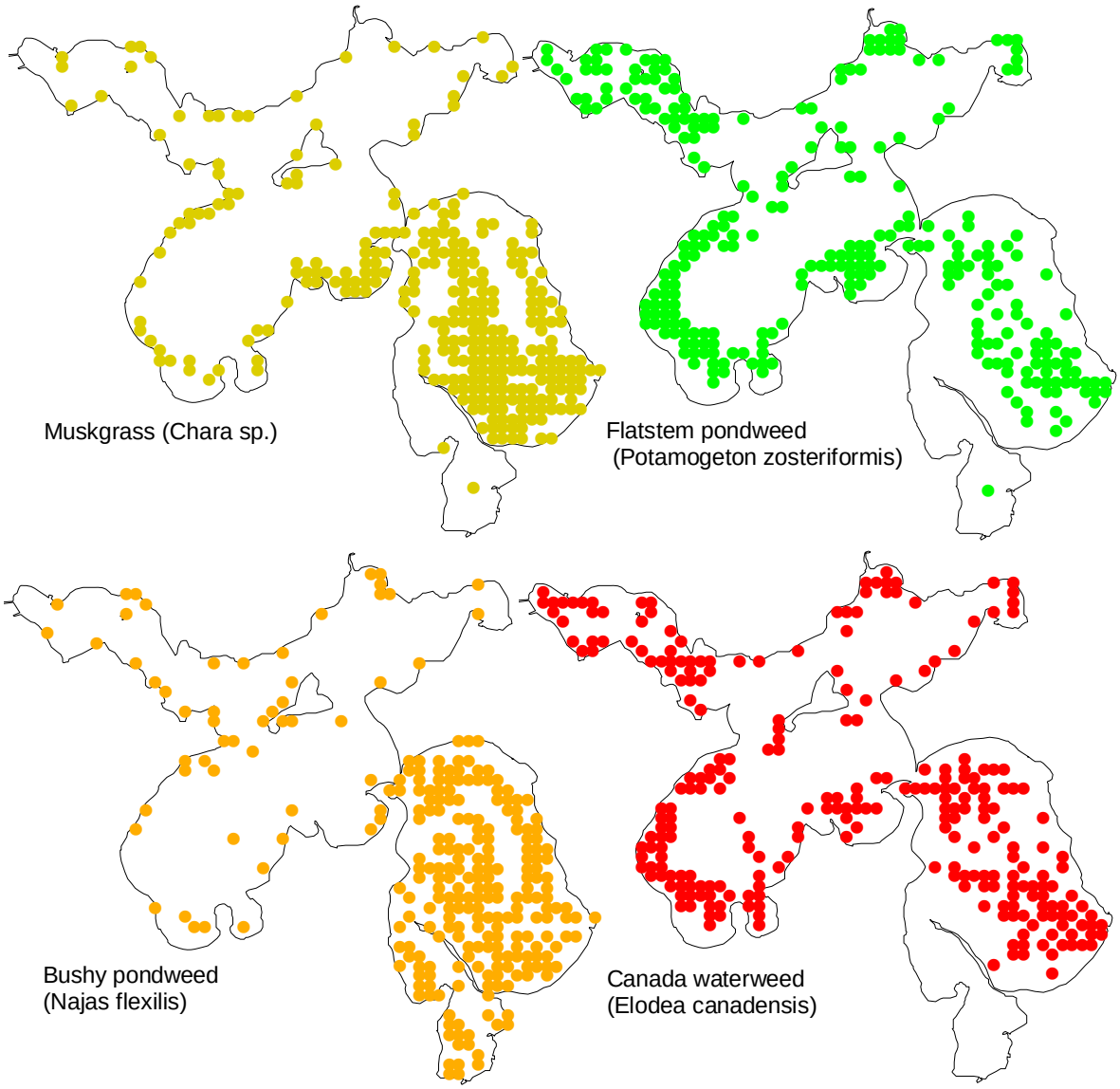


Figure 14. Distribution of common submerged species in Birch Lake, 2006.

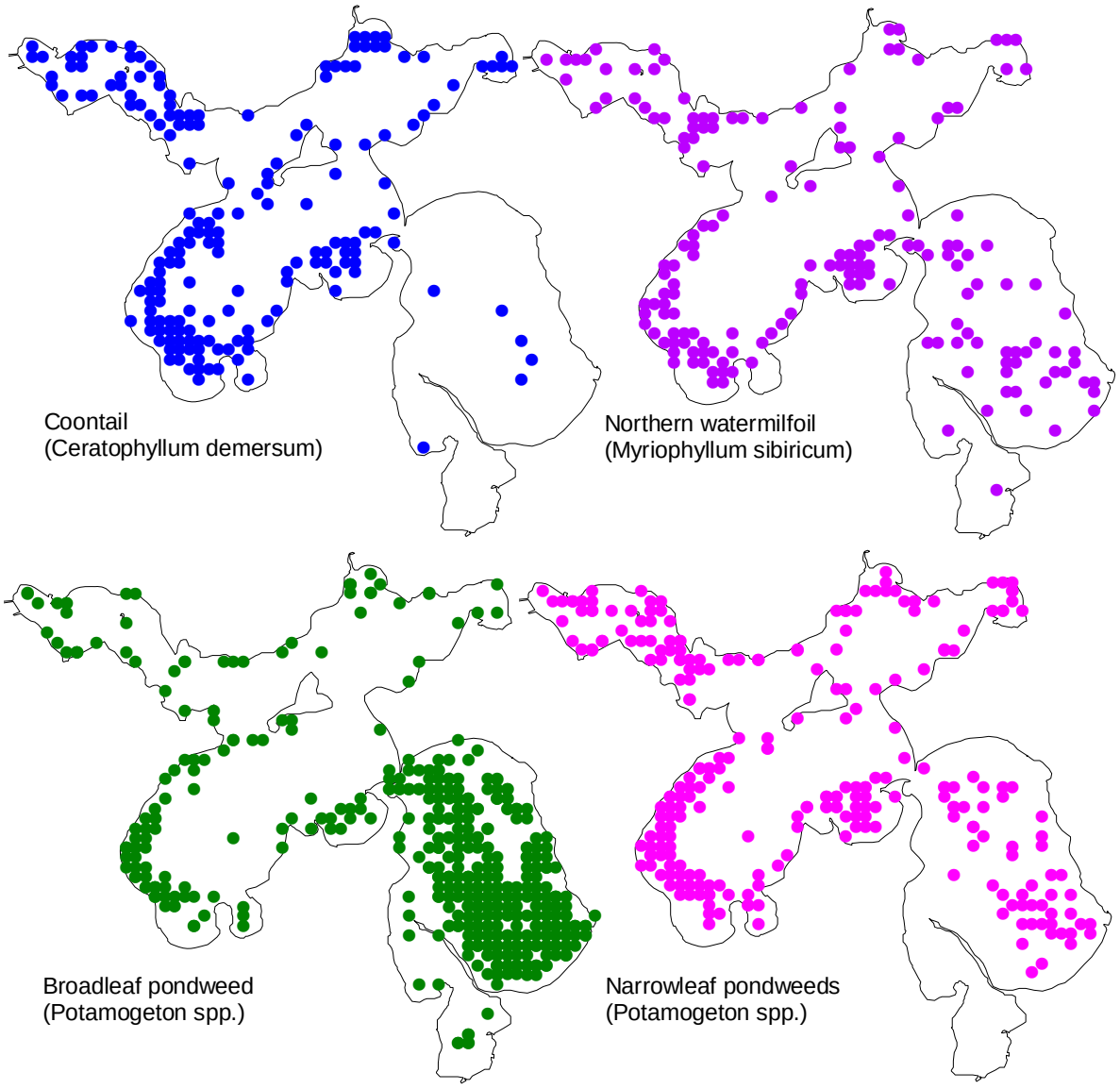
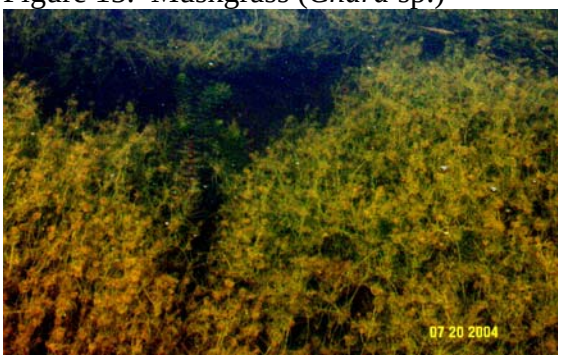
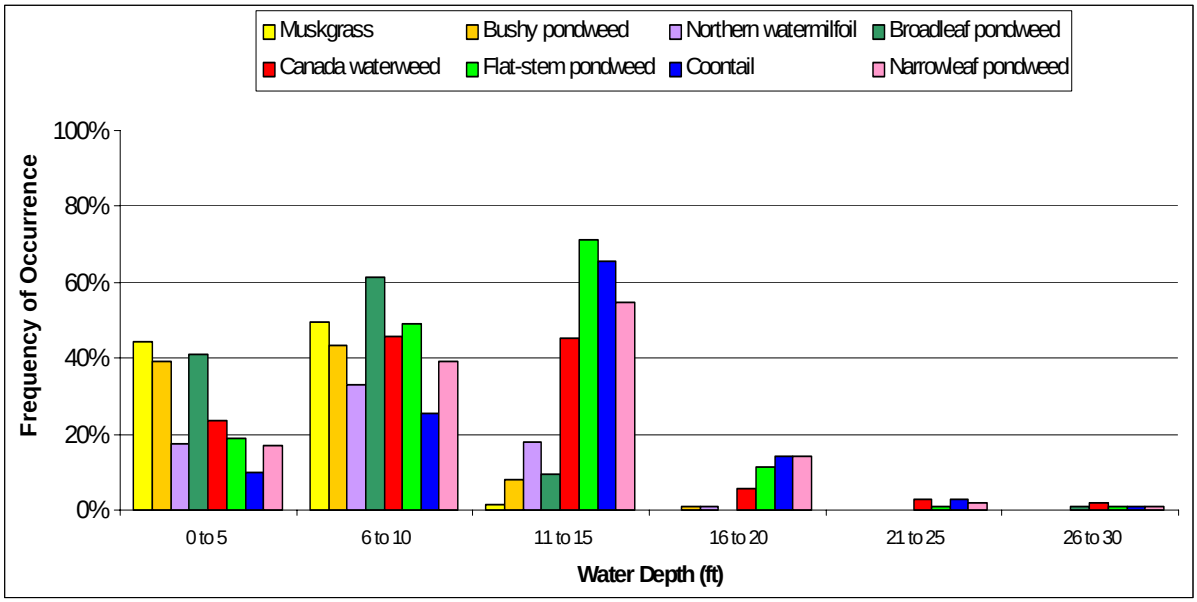


Figure 15. Muskgrass (*Chara* sp.)



Muskgrass (*Chara* sp.) (Fig. 15) 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 Birch Lake, muskgrass was the most frequent submerged plant found and occurred in 29 percent of all survey sites (Table 2). It was found around the entire lake, excluding the southwest bay of Lower Birch Lake (Fig. 13). Muskgrass occurred to a maximum depth of 15 feet but was most common in depths from shore to ten feet where it occurred in 87 percent of the sites (Fig. 16).

Figure 16. Distribution of common submerged species by water depth, Birch Lake, 2006.



Flat-stem pondweed (*Potamogeton zosteriformis*) (Fig. 17) is one of the nine different pondweed species found in Birch Lake. Pondweeds are rooted, perennial submerged plants that can be important for waterfowl food as well as fish habitat. Different pondweeds are named for their unique leave structure and "flat-stem pondweed" has flattened, grass-like leaves. Depending on water clarity and depth, flat-stem pondweed leaves may reach the water surface and it may produce flowers that extend above the water. It over winters by rhizome and winter buds and does not grow well in turbid lakes. In Birch Lake, it was found in 27 percent of the sites

surveyed (Table 2), occurring most frequently in the water depths up to fifteen feet (Fig 16). Flat-stem pondweed was well distributed around the lakeshore (Fig. 13) and often co-occurred with Canada waterweed, northern watermilfoil, and other pondweed species.

Figure 17. Flat-stem pondweed (*Potamogeton zosteriformis*)

Bushy pondweed (*Najas flexilis*) (Fig. 18) is unique because it is one of the few annual submerged 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 Birch Lake, bushy pondweed occurred in 26 percent of the sample sites (Table 2) and was most common in depths of ten feet and less (Fig. 16). It was one of the only species found in the south bay of Lower Birch Lake (Fig. 13). It likely occurred there because it does not strongly root to the lake bottom and was able to survive in the flocculent sediments of that bay.

Figure 18. Bushy pondweed (*Najas flexilis*)

Canada waterweed (Elodea canadensis) (Fig. 19) is perennial submerged species that is widespread throughout Minnesota because it 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. In Birch Lake, it occurred in both basins (Fig. 13) and was found in 25 percent of the sample sites (Table 2). It was one of the few species found at all water depths (Fig. 16).

Figure 19. Canada waterweed (*Elodea canadensis*)
(photo by Vic Ramey, Univ of Florida)

Coontail (*Ceratophyllum demersum*) (Fig. 20) grows entirely submerged and is adapted to a broad range of lake conditions, including turbid water. Coontail is perennial and can over winter as a green plant under the ice and then begins new growth early in the spring. It is loosely rooted to the lake bottom and spreads primarily by stem fragmentation. The finely divided

Figure 20. Coontail (*Ceratophyllum demersum*)

leaves of this plant provide a home for insects valuable as fish food. In Birch Lake coontail occurred in 17 percent of the sites (Table 2) and was most common in depths of six to 15 feet (Fig.

16). Coontail was mostly restricted to Upper Birch Lake (Fig. 14).

Figure 21. Northern watermilfoil. (*Myriophyllum sibiricum*)

Northern watermilfoil (*Myriophyllum sibiricum)* (Fig. 21) 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. This native plant provides fish shelter and insect habitat. Northern watermilfoil was found in 16 percent of the Birch Lake sample sites (Table 2). It was found throughout Birch Lake (Fig. 14) but was most often found in water depths less than 15 feet (Fig. 16).

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

Broadleaf pondweeds, (Fig. 22) often called "cabbage" plants by anglers, are rooted, submerged perennial plants with wide leaves. The fruits of pondweeds are a favorite duck food and the broad leaves provide food and shelter for fish. In Birch Lake, this group includes large-leaf pondweed (Potamogeton amplifolius), variable pondweed (P. gramineus), Illinois pondweed (P. illinoensis), white-stem pondweed (*P. praelongus*), clasping-leaf pondweed (*P. richardsonii*) and Robbin's pondweed (*P. robbinssi*), and clasping-leaf (*P. richardsonii*). Robbin's pondweed was the most abundant broadleaf pondweed and was found in 15 percent of the sample sites (Table 2). Broad-leaf pondweeds were well distributed around the lake and were most common in the Lower Birch (Fig. 14). These plants were most often found in depths of ten feet and less (Fig. 16).

Figure 23. A narrow-leaf pondweed (*Stuckenia pectinata*)

Narrow leaf pondweeds (Fig. 23) are rooted, perennial submerged plant with small, thin leaves. Leaves grow entirely below the water surface but flowers extend above the water. This plant also over winters as rhizomes and winter buds. There are several different types of pondweeds that are included in this general group and without fruit or flowers they are difficult to distinguish. In Birch Lake, at least two different species were identified: Fries pondweed (*Potamogeton freisii*) and

sago pondweed (*Stuckenia pectinata*). Narrow-leaf pondweeds were found in Upper and Lower Birch (Fig. 14), occurred in all water depths sampled, and were most common in depths of 6 to 15 feet (Fig. 16).

Discussion

The types and amounts of aquatic vegetation that occur within a lake are influenced by a variety of factors including water clarity and water chemistry. Birch Lake supports 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 is a reflection of the relatively good water clarity in the lake. Many of the plants that grow in Birch Lake require clear water and are not found in lakes with higher turbidity. Another reason for the high diversity of plant types is that Birch 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 Birch Lake. In all survey years, a relatively high number of native plants have been recorded and plants remain well distributed throughout the shallow portions of the lake. 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 Birch Lake increases, submerged vegetation is expected to expand in distribution and grow at greater water depths. Similarly, a decrease in water clarity may restrict at least some species 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 Birch 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 aquatica*) 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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