Aquatic Vegetation Survey of
Ada Lake (DOW 11-0250-00)
Cass County, Minnesota

2007

Ada Lake, Cass County, MN. 2007

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Summary

Aquatic vegetation surveys of Ada Lake (11-0250-00), Cass County, Minnesota, were conducted in July and August, 2007. Surveys included a lakewide assessment of the aquatic plant communities, mapping of emergent and floating-leaf plant beds, and detailed shoreline surveys at selected locations.

Plants occurred around the entire perimeter of Ada Lake but were more concentrated within the protected shallow bays. Approximately 10 acres of bulrush and 40 acres of waterlilies were mapped. Submerged plants were found to a depth of 24 feet but were most common from shore to the 15 feet depth where 95 percent of the sample sites contained vegetation. Beyond the 20 feet depth, only one survey site contained vegetation.

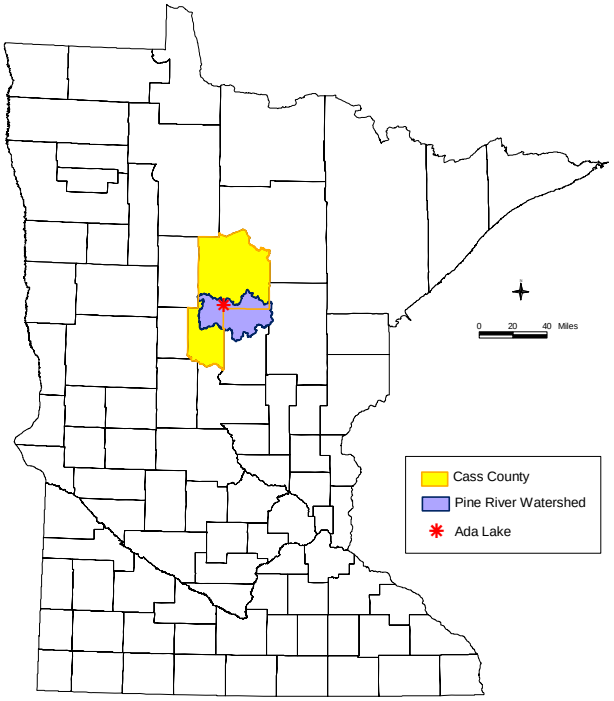
Forty native aquatic plant taxa were found in the lake and an additional 14 native wetland plant taxa were recorded along shore. The two most common submerged plant taxa were low-growing plants: bushy pondweed (*Najas flexilis*) (53% occurrence) and muskgrass (*Chara* sp.) (39% occurrence). Other submerged plants included coontail (*Ceratophyllum demersum*), northern watermilfoil (*Myriophyllum sibiricum*) and several broad-leaf pondweeds (*Potamogeton* spp.).

No non-native submerged plants were found in Ada Lake. Two non-native wetland emergent plants, purple loosestrife (*Lythrum salicaria*) and reed canary grass (*Phalaris arundinaceae*) occurred at scattered locations along the shoreline.

Introduction

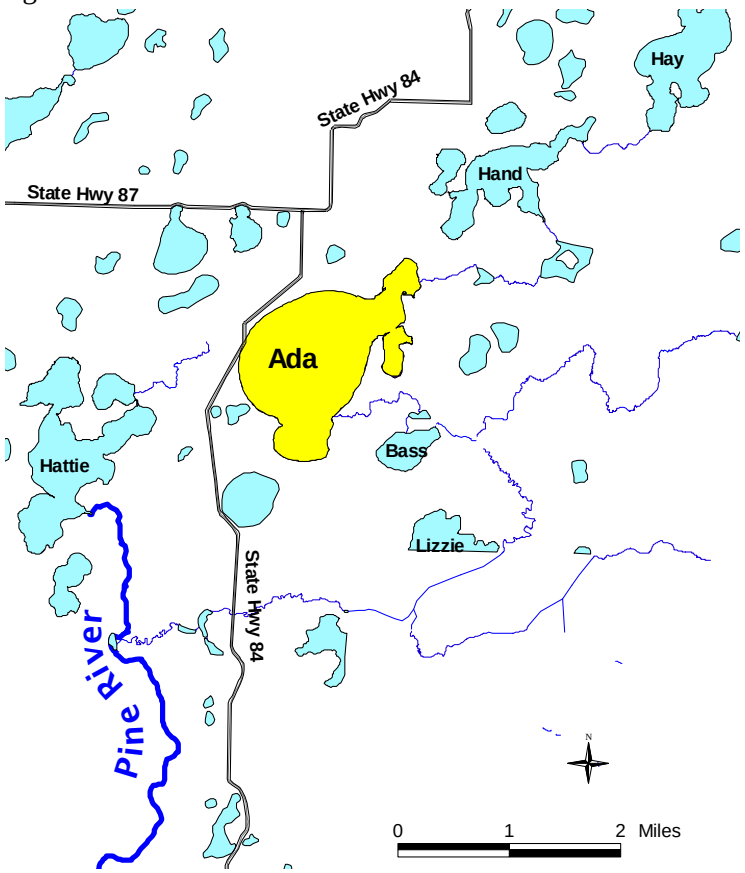
Ada Lake (DOW 11-0250-00) is located about seven miles east of the city of Backus, in Cass County, north-central Minnesota. The lake occurs within the Pine River Watershed (Figure 1).

Figure 1. Ada Lake, Cass County, MN



Ada Lake is an ice-block lake (Heiskary 1987) formed by the retreat of glaciers about 12,000 years ago. It receives drainage from a number of lakes including Rush, Hay and Hand Lakes (Heiskary 1987). A state owned concrete dam at the southeast of Ada Lake controls outflow. The dam was constructed in 1936 in an attempt to control erosion and fluctuating water levels (Hanson 2002). Ada Brook flows east over the Lake Ada dam to Bass Lake, then southeast to Lizzie Lake, and finally westward under State Highway 84 into the north fork of the Pine River which flows south to Mississippi River (Figure 2).

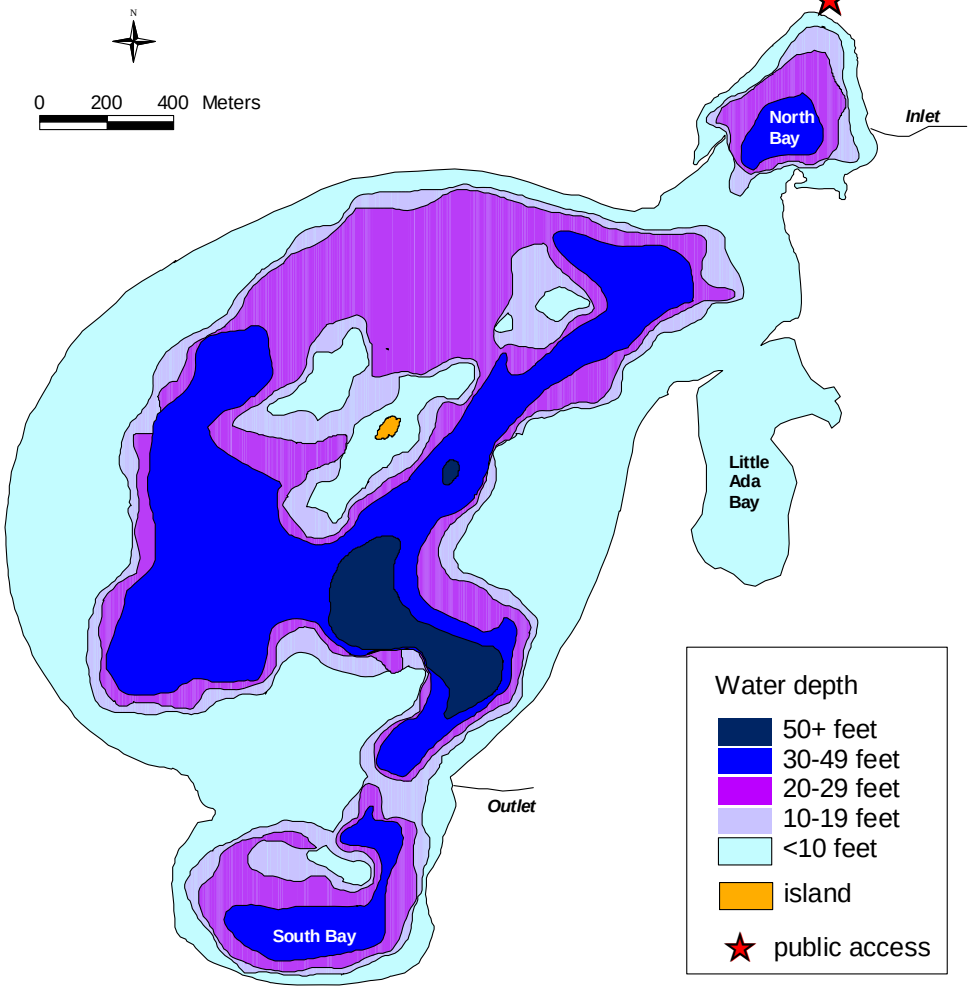
Figure 2. Ada Lake inlets and outlets.



There are about 250 Cass County lakes that are at least 50 acres in size and Ada Lake ranks 25th in size with a surface area of 974 acres and seven miles of shoreline.

The main basin of Ada Lake has a regular, circular outline and a maximum depth of 60 feet with broad stretches of shallow water (Figure 3). A one acre island occurs in the center of the lake and is surrounded by a shallow sandbar. The south bay and the northeast bay have steeper sloping shores with maximum depths of 30 feet. Little Ada

Figure 3. Depth contours of Ada Lake, Cass County.



Bay, located on the south side of the east shore, is entirely shallow with water depths less than ten feet. Lakewide, 43 percent of Lake Ada is less than 15 feet in depth.

Much of the Ada Lake shoreline remains forested but is heavily developed with residential homes and several resorts. There is a public boat launch at the north end of the lake.

Ada Lake is a hardwater, moderately nutrient enriched lake, with relatively high water clarity. The Secchi disc transparency measures the depth to which a person can see into the lake and provides a rough estimate of the light penetration into the water column. 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. In Ada Lake, between 1984 and 2007 water clarity, as measured by Secchi disc readings, ranged from 12 feet to 18 feet, with a mean of 14 feet (MPCA 2007). Based on these Secchi disk measurements alone, aquatic plants are expected to grow to a maximum depth of about 21 feet in Ada Lake. Other factors that may influence the depth of plant growth include substrate types, wind fetch, and the plant community composition.

Previous vegetation surveys of Ada Lake were conducted in 1958, 1975 and 1995 (MnDNR Fisheries Lake Files). These surveys varied in methodology and types of data collected but they provide a general description of Ada Lake's aquatic plant communities. At least 25 different native aquatic plant taxa have previously been recorded in the lake and maximum depth of vegetation growth was reported to be about 20 feet. The densest plant growth was reported in Little Ada Bay where submerged and floating-leaf plants were abundant. Dense stands of bulrush historically occurred in shallow areas around the lake.

Objectives

The purpose of this vegetation survey was to provide a quantitative description of the 2007 plant population of Ada 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 taxa that occur in the lake
5) Estimate the abundance of common taxa
6) Develop distribution maps for the common taxa

Methods

Floating-leaf and emergent vegetation beds

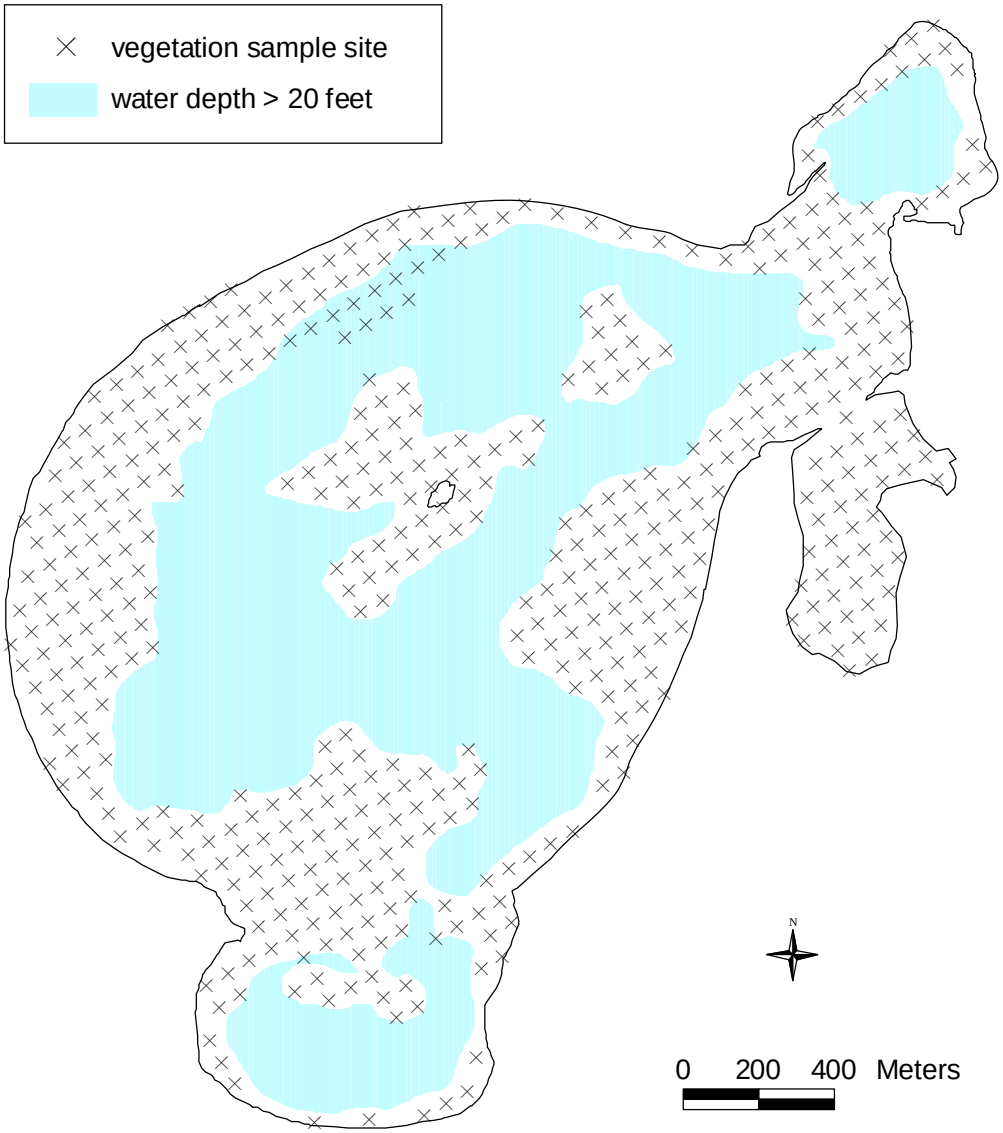
Farm Service Administration (FSA) true color aerial photographs, 2003-2004, were used to delineate beds of floating-leaf vegetation. Ground truthing was conducted in August 2007 to verify plant community composition within major beds. Bulrush (*Scirpus* spp.) beds are difficult to detect on aerial photographs and therefore, surveyors mapped bulrush beds in the field in August 2007. Surveyors motored around the lakeside perimeter of major bulrush beds and recorded locations with a Global Positioning System (GPS) receiver. To avoid damage to these plant beds, surveyors did not motor into these sites.

Lakewide vegetation survey

A lakewide vegetation survey of Ada Lake was conducted on July 11, 12, 17 and 18, 2007. 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 65 meters (213 feet) apart, resulting in about one survey point per acre. Two field crews, each consisting of one boat and two surveyors, conducted the survey. In the field, surveyors infrequently found vegetation beyond a depth of 20 feet and therefore sampled all survey points between shore and 20 feet and only a selected number of points in deeper water. A total of 491 points were surveyed and 479 points occurred within the vegetated zone from shore to a water depth of 20 feet. (Figure 4, Table 1).

A 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

Figure 4. 2007 vegetation survey sites on Ada Lake.



using a measuring stick in water depths less than eight feet and an electronic depth finder in depths greater than eight feet. The surveyors recorded all plant taxa found within a one meter square 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 5). At each sample site where water depths were seven feet and less, surveyors described the bottom substrate using standard substrate classes (Table 2).

Plant identification and nomenclature followed Crow and Hellquist (2000). Voucher specimens were

Table 1. Sampling effort by water depth, Ada Lake, 2007.

Depth interval in feet	Number of sample points
0 to 5	224
6 to 10	180
11 to 15	41
16 to 20	34
21 to 25	9
26 to 30	3
Total number of sample points	491

collected for most plant taxa and are stored at the MnDNR in Brainerd. Data were entered into a Microsoft Access database and frequency of occurrence was calculated for each taxa as the number of sites in which a 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 five depth zones for analysis (0-5, 6-10, 11-15, 16-20, 20-25 feet).

Figure 5. Surveying submerged vegetation in Ada Lake

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

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

Example:

In Ada Lake there were 479 samples sites in the zone from shore to the 20 feet depth.

Muskgrass (*Chara* sp.) occurred in 185 of those sites.

Frequency of muskgrass in the shore to 20 feet depth zone = 185/479 (*100) = 39 %

Results

Shoal substrates

Sand was the most common substrate in shallow water (shore to a water depth of four feet) and silt was more common in depths of five to seven feet (Figures 6 and 7). Muck substrates were found in Little Ada Bay and broad sand shoals occurred along the east and west shores (Figure 7). Sites of boulders included the south end of the island, and the openings to the northeast and the south bays.

Figure 6. Shoal sediment type at each water depth.

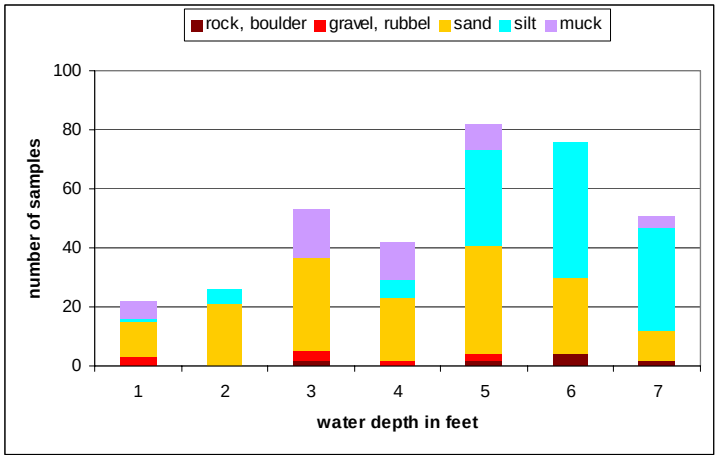
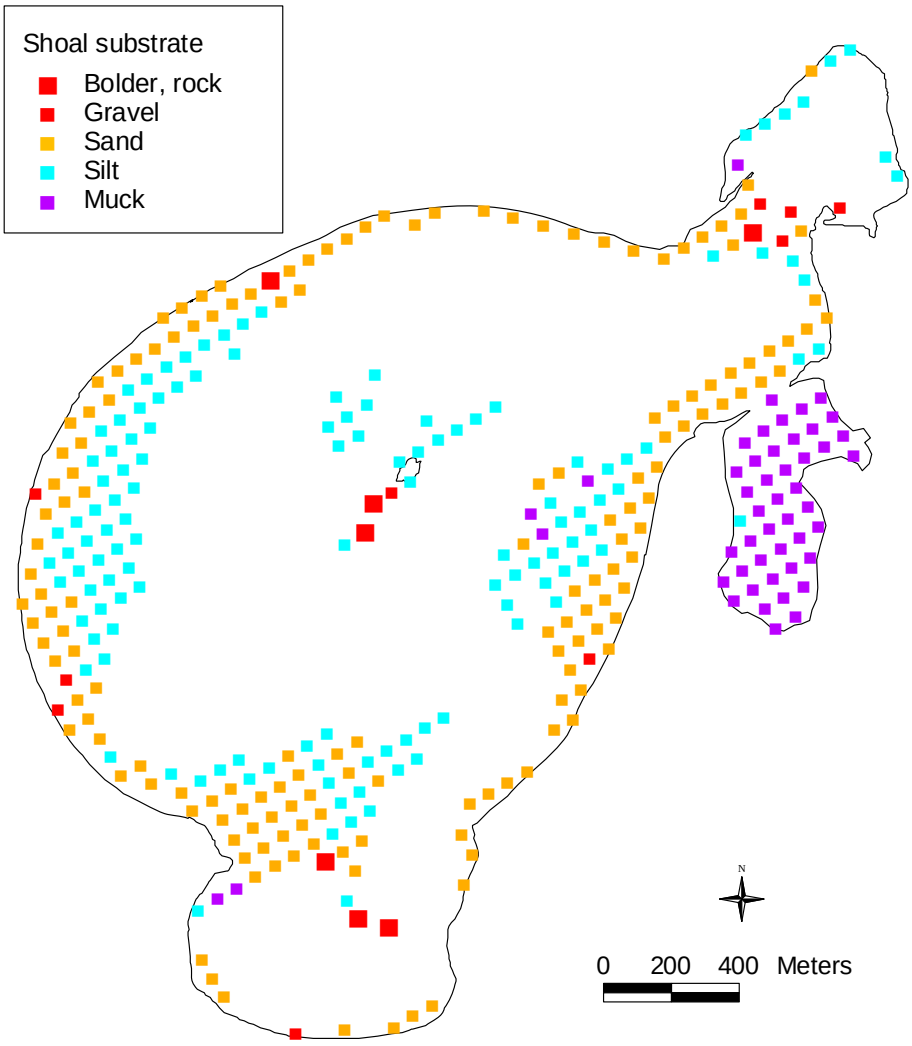


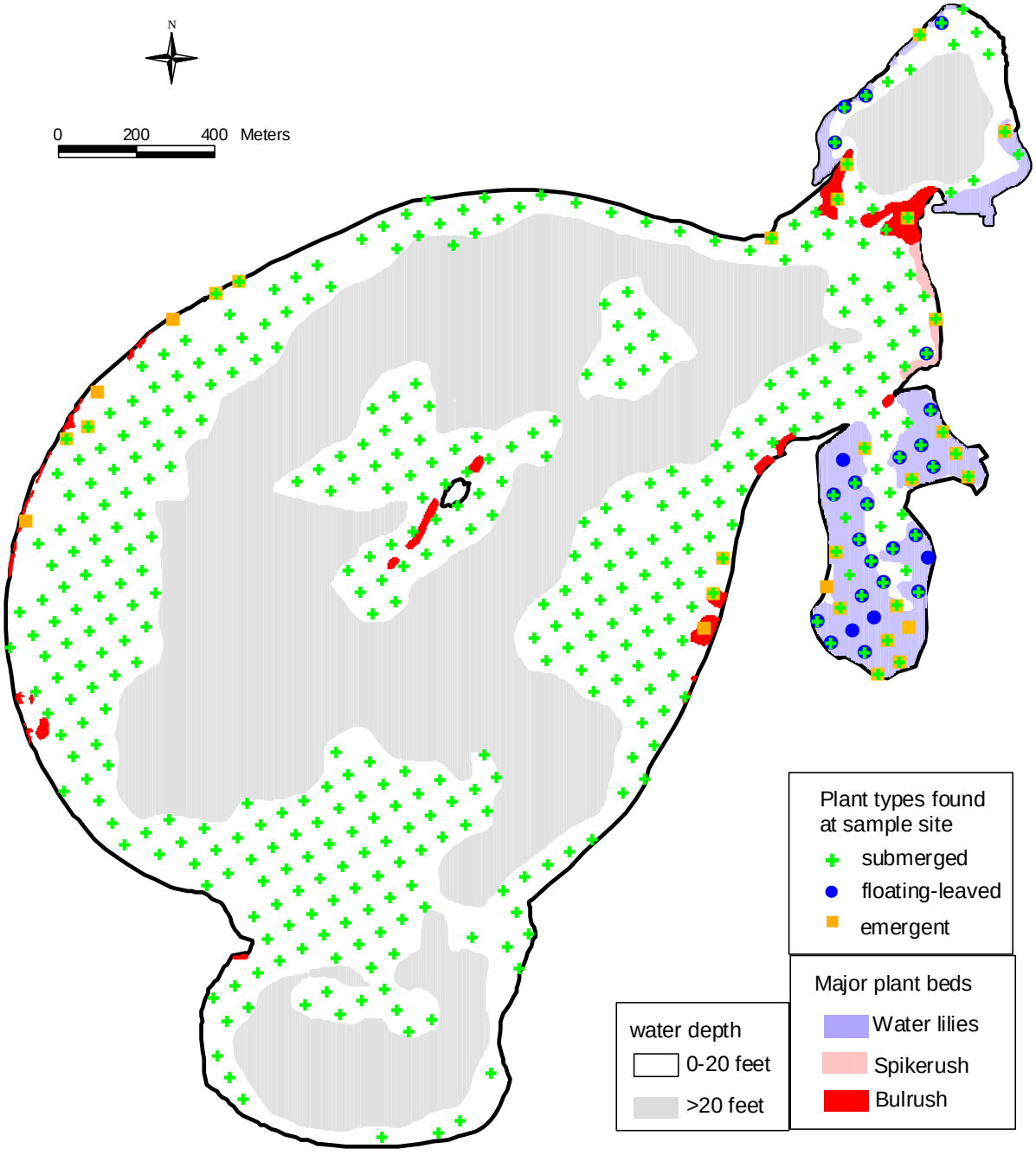
Figure 7. Shoal sediments of Ada Lake, 2007.



Distribution of aquatic plants

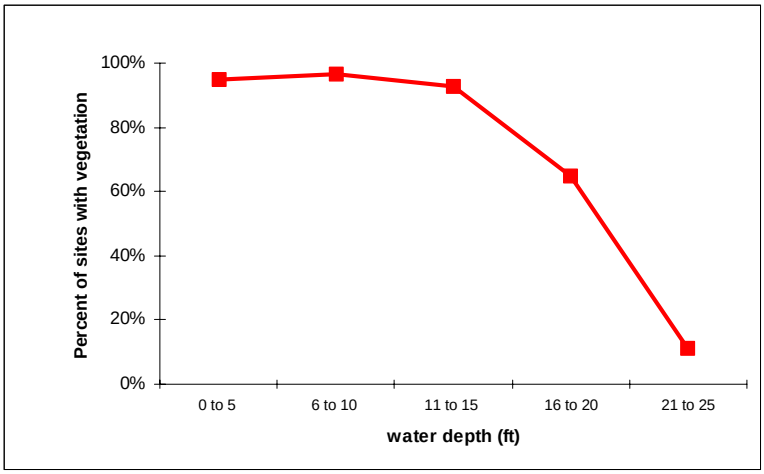
Aquatic plants were found around the entire perimeter of Ada Lake as well as the shallow off-shore areas. Areas of sparse vegetation were shorelines with steep depth contours, such as the south and north shores. Approximately 53 acres of emergent and floating-leaf beds were mapped with the largest beds occurring in Little Ada Bay (Figure 8).

Figure 8. Distribution of aquatic plants in Ada Lake, 2007.



Within the depth zone from shore to 15 feet, plants were found in 95 percent of the survey sites. Beyond the 20 feet depth, only one survey site contained vegetation (Figure 9).

Figure 9. Plant occurrence at each water depth interval.



Number and types of plants recorded

A total of 40 native aquatic plant taxa were recorded in Ada Lake including nine emergent, four floating-leaved, six free-floating and 21 submerged plants (Table 3). An additional 15 native emergent wetland plants and shrubs were recorded during July and August surveys of Ada Lake and two non-native shoreline emergent plant taxa were observed (Table 4).

Distribution of plant types by water depth and lake area

The highest number of plant taxa was found in shallow water, from shore to a depth of five feet (Figure 10). Emergent, floating-leaved and free-floating plants were restricted to water depths of five feet and less. Submerged plants were found to a maximum depth of 24 feet but only one taxon occurred at that depth.

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

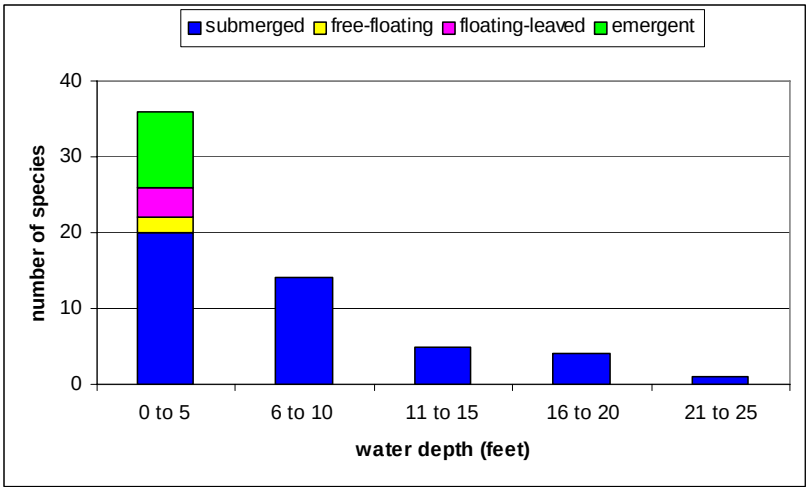


Table 3. Frequency of aquatic plants in Ada Lake Point-intercept survey, July, 2007.
(Frequency is the percent of sample sites in which a plant taxon occurred within the shore to 20 ft water depth.)
479 sample sites

Life Forms	Common Name	Scientific Name	Frequency
SUBMERGED These plants grow primarily under the water surface. Upper leaves may float near the surface and flowers may extend above the surface. Plants may or may not be anchored to the lake bottom.	Bushy pondweed	*Najas flexilis*	53
	Muskgrass	*Chara sp.*	39
	Coontail	*Ceratophyllum demersum*	17
	Northern water milfoil	*Myriophyllum sibiricum*	7
	Variable pondweed	*Potamogeton gramineus*	9
	Illinois pondweed	*Potamogeton illinoensis*	8
	White-stem pondweed	*Potamogeton praelongus*	6
	Large-leaf pondweed	*Potamogeton amplifolius*	4
	Flat-stem pondweed	*Potamogeton zosteriformis*	4
	Fries pondweed	*Potamogeton freisii*	1
	Robbin's pondweed	*Potamogeton robbinsii*	1
	Narrow-leaf pondweed	*Potamogeton sp.*	1
	Wild celery	*Vallisneria americana*	4
	Canada waterweed	*Elodea canadensis*	3
	Creeping water buttercup	*Ranunculus flammula*	1
	Water bulrush	*Scirpus subterminalis*	1
	Water stargrass	*Zosterella dubia*	<1
	White water buttercup	*Ranunculus aquatilis*	<1
	Sago pondweed	*Stuckenia pectinata*	<1
	Water moss	*Not identified to genus*	<1
	Water marigold	*Megaladonta beckii*	present
FREE-FLOATING These plants drift freely with the water current and are often found floating near or on the water surface.	Greater bladderwort	*Utricularia vulgaris*	1
	Lesser bladderwort	*Utricularia minor*	1
	Humped bladderwort	*Utricularia gibba*	present
	Flat-leaved bladderwort	*Utricularia intermedia*	present
	Star duckweed	*Lemna trisulca*	present
	Greater duckweed	*Spirodela polyhriza*	present
FLOATING These plants are rooted in the lake bottom and have leaves that float on the water surface.	Watershield	*Brasenia schreberi*	4
	Yellow waterlily	*Nuphar variegata*	4
	White waterlily	*Nymphaea odorata*	2
	Floating leaf pondweed	*Potamogeton natans*	3
EMERGENT These plants extend well above the water surface and are usually found in shallow water, near shore.	Wild Rice	*Zizania palustris*	<1
	Bulrush	*Scirpus sp.*	2
	Spikerush	*Eleocharis sp.*	1
	Needlegrass	*Eleocharis sp.*	<1
	Burreed	*Sparganium americanum*	<1
	Giant Burreed	*Sparganium eurycarpum*	<1
	Three-way sedge	*Dulichium arundinaceum*	<1
	Broadleaf arrowhead	*Sagittaria latifolia*	1
	Narrow-leaf Cattail	*Typha sp.*	<1

"present" indicates plant was observed in the lake but did not occur within any of the sample sites

Table 4. Shoreline plants identified in Ada Lake, July- August, 2007.

Life Forms	Common Name	Scientific Name
Native Wetland Emergents These plants are usually found at the lake/shore interface and in adjacent wetlands.	Swamp milkweed	*Asclepias incarnata*
	Water arum	*Calla palustris*
	Canada bluejoint grass	*Calamagrostis canadensis*
	Marsh bellflower	*Campanula aparinoides*
	Bottlebrush sedge	*Carex psuedocyperus**
	Lake sedge	*Carex lacustris**
	Wire grass	*Carex lasiocarpa**
	Blue flag iris	*Iris versicolor*
	Northern bugleweed	*Lycopus uniflora*
	Tufted loosestrife	*Lysimachia thyrsiflora*
	Swamp candles	*Lysimachia terrestris*
	Common skullcap	*Scutellaria galericulata*
	Water parsnip	*Cicuta bulbifera*
	Alder	*Alnus incana*
	Red osier dogwood	*Cornus stolonifera*
Non-native Wetland Emergents	Purple loosestrife*	*Lythrum salicaria*
	Reed canary grass	*Phalaris arundinaceae*

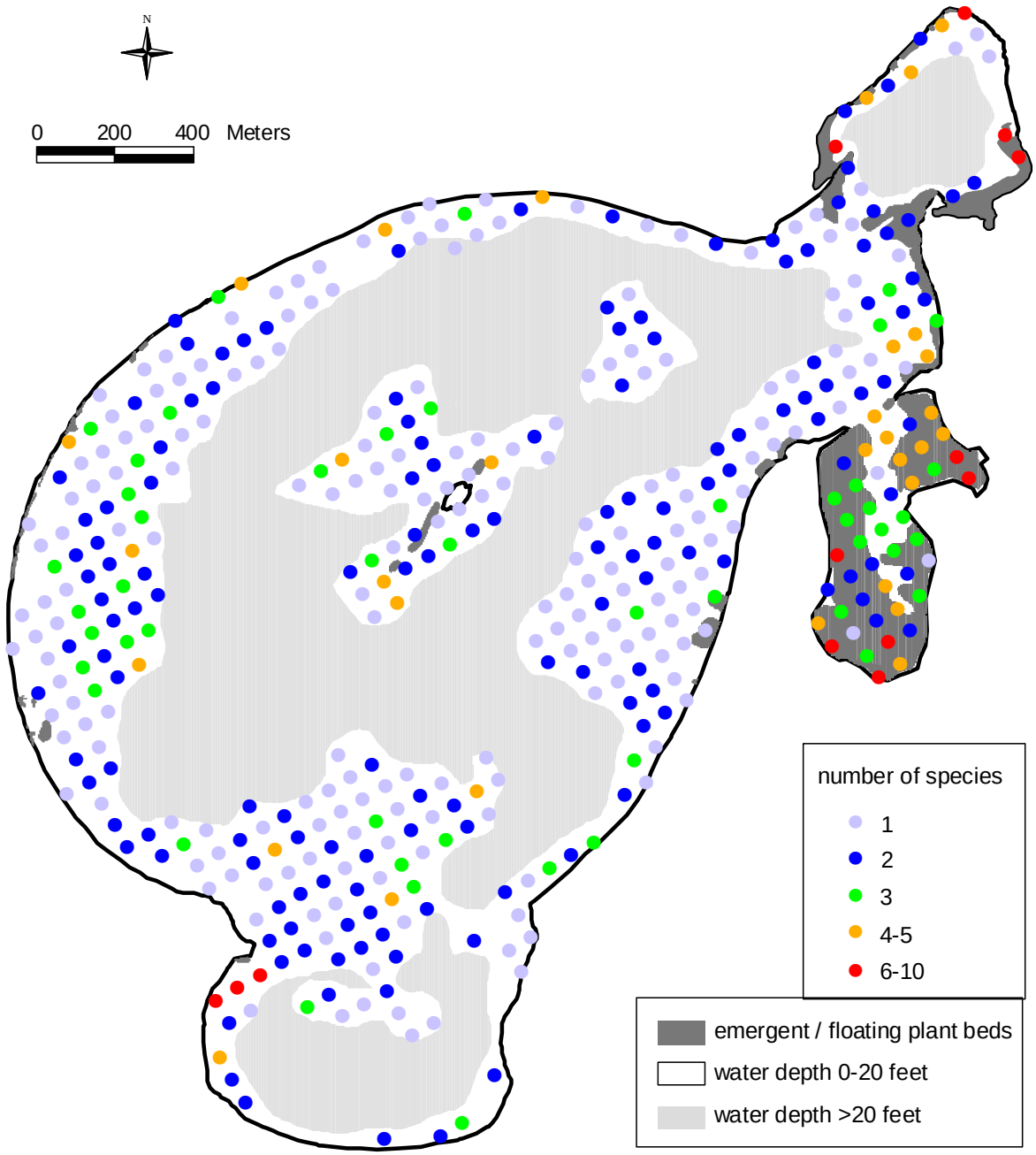
*tentative identification

The number of plant taxa found at each one meter square site ranged from zero to ten. Sites with the highest number of taxa occurred in the eastern bays where a mixture of emergent, floating-leaved and submerged plants was found (Figure 11). In water depths greater than 15 feet, most sites contained one or no taxa.

Emergent shoreline plants

Emergent aquatic plants offer shelter for insects and young fish as well as food, cover and nesting material for waterfowl, marsh birds and muskrats. 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. A diversity of native emergent plants occurred along undeveloped shorelines of Ada Lake.

Figure 11. Number of plant taxa found at each sample site. Ada Lake, 2007



A mixture of sedges (*Carex* spp.) (Figure 12) were common along wetland shores. Other emergent plants included arrowhead (*Sagittaria* sp.) (Figure 13), burreed (*Sparganium* sp.) (Figure 14), and wild rice (*Zizania palustri*s) (Figure 15). Many of these emergent plants occupied the transitional zone between upland and lake and some taxa extended into the water up to a depth of six feet.

Figure 12. Green heron in sedges (*Carex* spp.) on Ada Lake shoreline.

The non-native emergent plant, Purple loosestrife (*Lythrum salicaria*) (Figure 16) was recorded along Ada Lake shoreline. This emergent wetland plant has invaded many wetland areas of Cass County and spreads easily by seed. Along the Ada Lake shoreline, purple loosestrife plants were found occasionally scattered among native wetland shrubs and sedges. Leaf-eating beetles that specifically feed on purple loosestrife were also found on the Ada Lake plants and appear to be controlling the abundance of this plant. For more information about this biological control, see the MnDNR website: Biological Control of Purple Loosestrife

Figure 13. Arrowhead (*Sagittaria latifolia*).

Figure 14. Burreed (*Sparganium eurycarpum*).

Figure 15. Wild rice (*Zizania palustris*).

Figure 16. Purple loosestrife (*Lythrum salicaria*)

Emergent in-lake plants

The most common in-lake aquatic plant was Hard-stem bulrush (*Scirpus acutus*) (Figure 17). Ten acres of bulrush beds were delineated (Figure 8). Narrow bands of bulrush occurred along the east and west shores as well as the entrance to the north bay. Bulrush was usually found in sand. Spikerush (*Eleocharis* sp.) is an emergent plant that is similar to bulrush but shorter in height. Spikerush was found within bulrush beds as well as in solitary stands along the shore between Little Ada Bay and the

Figure 17. Emergent bulrush (*Scirpus*) beds in Ada Lake

northeast bay (Figure 8).

Figure 18. Floating-leaf plant beds in Ada Lake

Floating-leaf plants

Floating-leaf plant beds (Figure 18) provide similar benefits as emergents and also provide shade for fish and frogs. About 41 acres of water lily beds were mapped (Figure 8). Because surveyors avoided motoring into floating-leaf plant beds, the frequency values obtained for these taxa were lower than the actual occurrence. Frequency values for floating-leaf taxa represent the occurrence of these taxa only within the sites that were surveyed. Common taxa included watershield (*Brasenia schreberi)* (Figure 19), yellow waterlily (*Nuphar variegata*) (Figure 20), floating-leaf pondweed (*Potamogeton natans*) (Figure 21) and white waterlily (*Nymphaea odorata*) (Figure 22). Waterlily beds often contained scattered bulrush plants as well as submerged plants. Waterlily beds were usually associated with muck sediments.

Figure 19. Watershield (*Brasenia schreberi*)

Figure 21. Floating-leaf pondweed (*Potamogeton natans*)

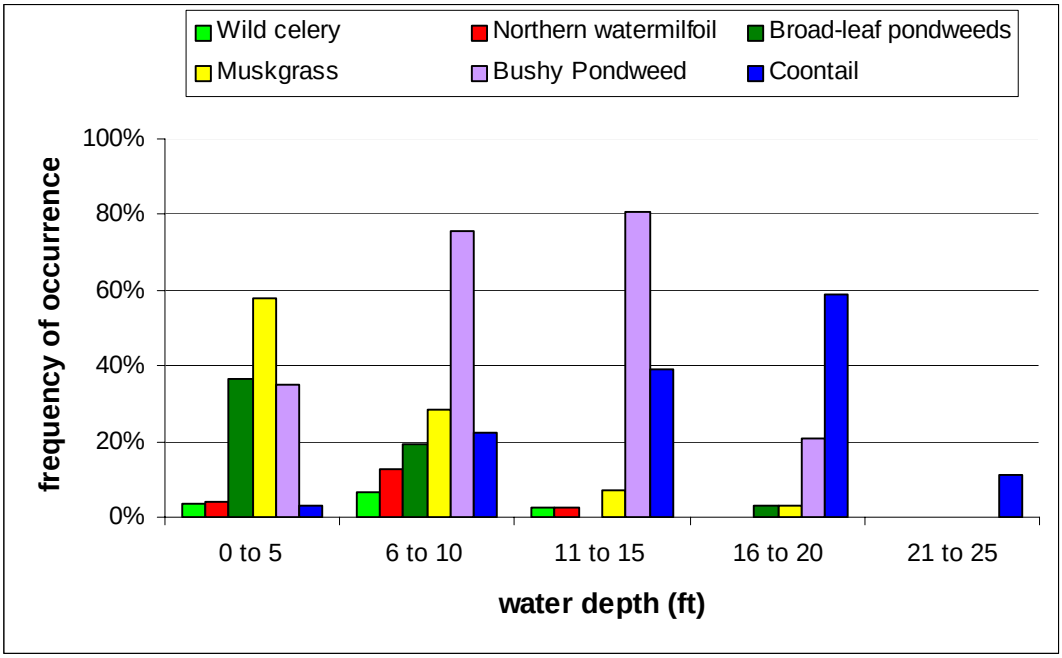
Figure 20. Yellow waterlily (*Nuphar variegata*)

Figure 22. White waterlily (*Nymphaea odorata*)

Submerged plants

Submerged plants occurred in 93 percent of the Ada Lake sample sites between shore and the 20 feet depth. A mixture of plant types was found including one annual plant, strongly-rooted perennials, and weakly rooted or free-floating plants. Common taxa included bushy pondweed (*Najas flexilis*), muskgrass (*Chara* sp.), coontail (*Ceratophyllum demersum*), northern watermilfoil (*Myriophyllum sibiricum*), broad-leaf pondweeds (*Potamogeton* spp.) and wild celery (*Vallisneria americana*). Each water depth zone contained a different mix of taxa and the abundance of individual taxa varied with water depth (Figure 23).

Figure 23. Frequency of common submerged plants by water depth interval. Ada Lake, Cass County, MN July 2007.



The most common submerged plants in Ada Lake were low-growing taxa: Bushy pondweed (*Najas flexilis*) (Figure 24) and Muskgrass (*Chara* sp.) (Figure 25).

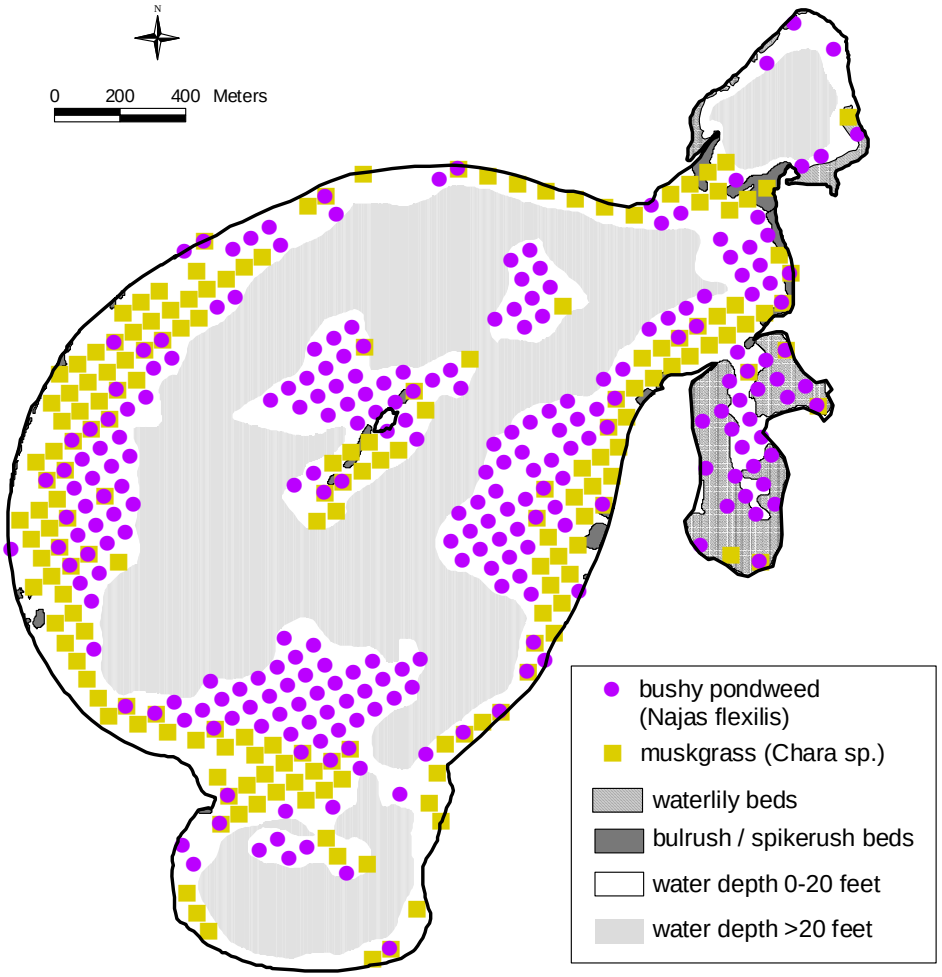
Figure 24. Bushy pondweed (*Najas flexilis*)

Bushy pondweed occurred in 53 percent of the sample sites (Table 3) and was most common in depths of six to 15 feet (Figure 23, 26). It is unique because it is one of the few annual submerged taxa 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.

Figure 25. Bed of Muskgrass (*Chara* sp.)

Muskgrass occurred in 39 percent of the sample sites (Table 3) and was most common in the 0 to 5 feet depth zone (Figure 23, 26). This macroscopic, or large, alga is common in many hard water Minnesota lakes. It has a brittle texture and a characteristic "musky" odor. Algae do not form true stems and therefore, muskgrass 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 plant 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.

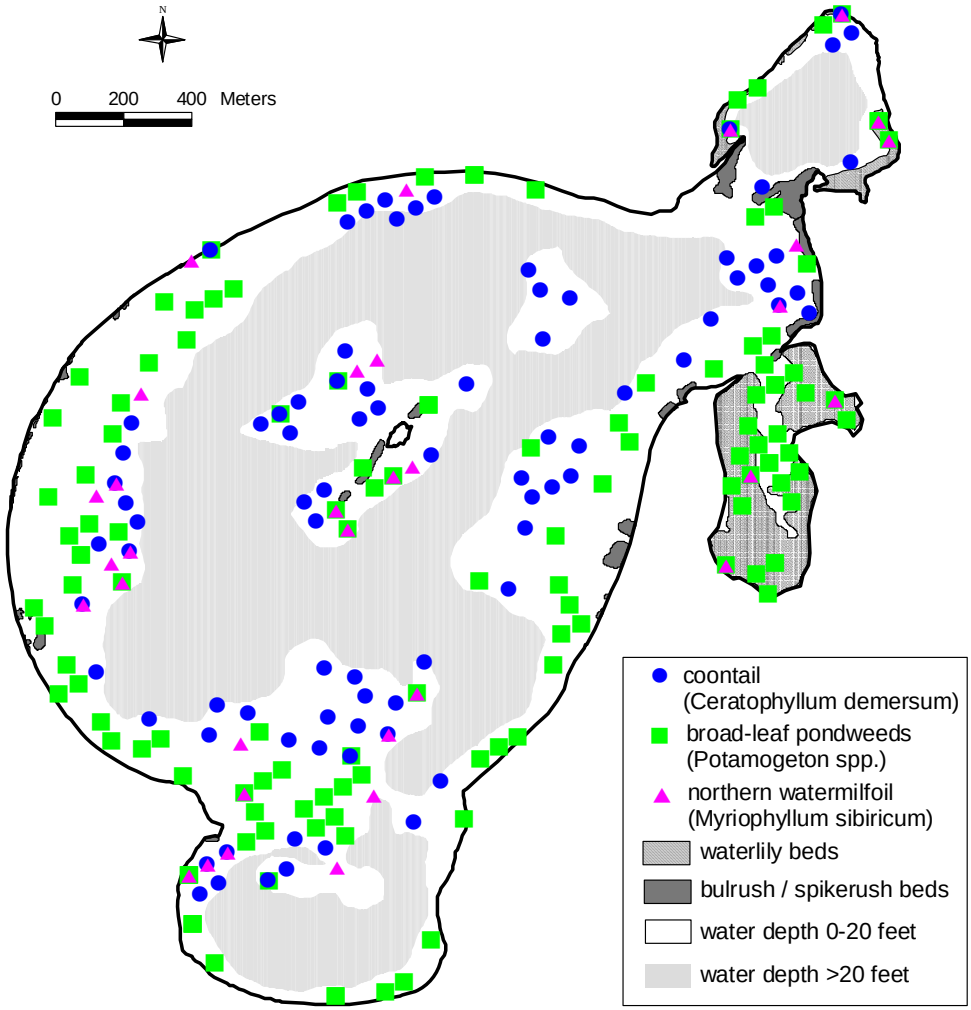
Figure 26. Distribution of bushy pondweed (*Najas flexilis*) and muskgrass (*Chara* sp.) in Ada Lake, 2007.



Coontail (*Ceratophyllum demersum*) (Figure 27) is a submerged plant that was found in 17 percent of the Lake Ada sites (Table 3) and was most common in depths of 15 to 20 feet (Figure 24, 28). It was the only taxa found beyond the depth of 20 feet. Coontail 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 leaves of this plant provide a home for insects valuable as fish food.

Figure 27. Coontail (*Ceratophyllum demersum*)

Figure 28. Distribution of coontail (*Ceratophyllum demersum*), broad-leaf pondweeds (*Potamogeton* spp.) and northern watermilfoil (*Myriophyllum sibiricum*) in Ada Lake, 2007.



Bro adleaf pondweeds in Ada 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 (Figure 29).

Figure 29. Broad-leaf pondweed (*Potamogeton amplifolius*)

Variable pondweed was the most abundant broadleaf pondweed in Ada 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 (Figure 23, 28).

Northern watermilfoil (*Myriophyllum sibiricum)* (Figure 30) 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 seven percent of the Ada Lake sample sites (Table 3). It was scattered throughout Ada Lake but was most often found in water depths less than 11 feet (Figure 26, 28).

Figure 30. Northern watermilfoil. (*Myriophyllum sibiricum*)

Figure 31. Yellow flowers of Bladderwort (*Utricularia* sp.).

Unique Plants

In addition to the commonly occurring plants in Ada Lake, there were several unique plants located during the survey including water bulrush (*Scirpus subterminalis*), creeping spearwort (*Ranunculus flammula*) and several taxa of bladderworts (*Utricularia* spp.) (Figure 31). These taxa are not widespread in Minnesota but are usually associated with undisturbed areas in clear water lakes of northern Minnesota.

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 Ada Lake is sufficiently high to allow aquatic plant growth to at least the 20 feet depth but the sandy shores of the main waterbody do not support lush aquatic plant growth. The sheltered bays do support abundant and diverse native aquatic plant communities that in turn, provide critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants).

The high number of plant taxa found in Ada 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 Ada Lake has a variety of sediment types and a mix of protected bays and open water sites. Plant taxa 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 Ada 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 2007 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 in Ada 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 submerged species have not been documented in Ada 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 abundance
  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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