Aquatic Vegetation Survey of
Boy Lake (DOW 11-0143-00)
Cass County, Minnesota

2008

Boy Lake, Cass County, MN. 2008.

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Summary

Aquatic vegetation surveys of Boy Lake (11-0143-00), Cass County, Minnesota, were conducted in June and July 2008. Surveys included a lakewide assessment of vegetation and water depths at over 900 sample stations, characterization of shoal substrate types, and mapping of emergent and floating-leaf plant beds.

Thirty-three native aquatic plant species were found including six emergent, three floating-leaved, three free-floating and 21 submerged species. Non-native plant species were not found.

Emergent and floating-leaved plants were generally restricted to depths of six feet and less. About 570 acres of wild rice (*Zizania palustris*) or mixed beds of wild rice and waterlilies (*Nymphaea odorata, Nuphar variegata, Potamogeton natans*) were mapped. Approximately 170 acres of bulrush (*Scirpus* sp.) beds were delineated.

Submerged plants occurred to a maximum depth of 20 feet but were most common in depths from shore to ten feet, where 89 percent of the sites contained at least one submerged species. The most common submerged plant species were muskgrass (*Chara* sp.) (35% occurrence within the shore to 20 feet zone), flat-stem pondweed (*Potamogeton zosteriformis*) (20% occurrence) and coontail (*Ceratophyllum demersum*) (15% occurrence).

Wild rice bed on Boy Lake, 2008.

Introduction

Boy Lake (DOW 11-0143-00) is located about eight miles north of the city of Longville, in Cass County, north-central Minnesota (Figure 1). The lake occurs in the northeastern portion of the Leech Lake River Watershed. The Boy River flows through this watershed and connects a series of lakes beginning at Ten Mile Lake and continuing east through Woman and Inguadona lakes and then flows north through the east side of Boy Lake and continues northwest to Leech Lake (Figure 2). Boy Lake also receives flow from the Swift River entering from Swift Lake to the east.

Figure 1. Boy Lake, Cass County, MN.

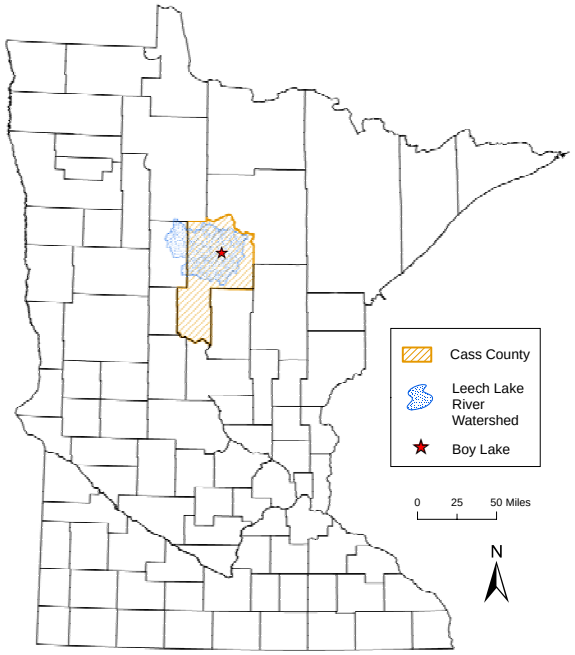
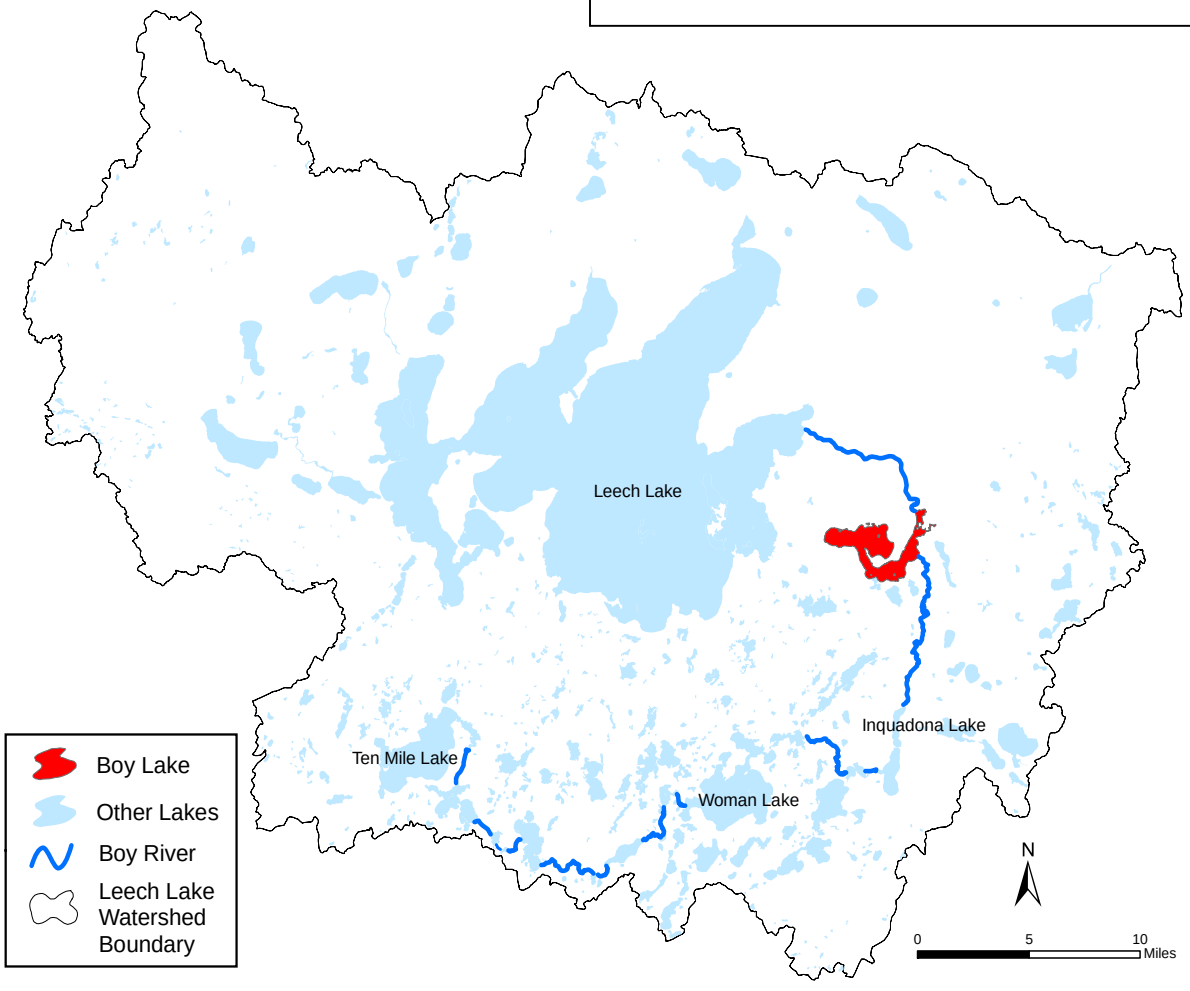


Figure 2. Location of Boy Lake along Boy River and within the Leech Lake Watershed.

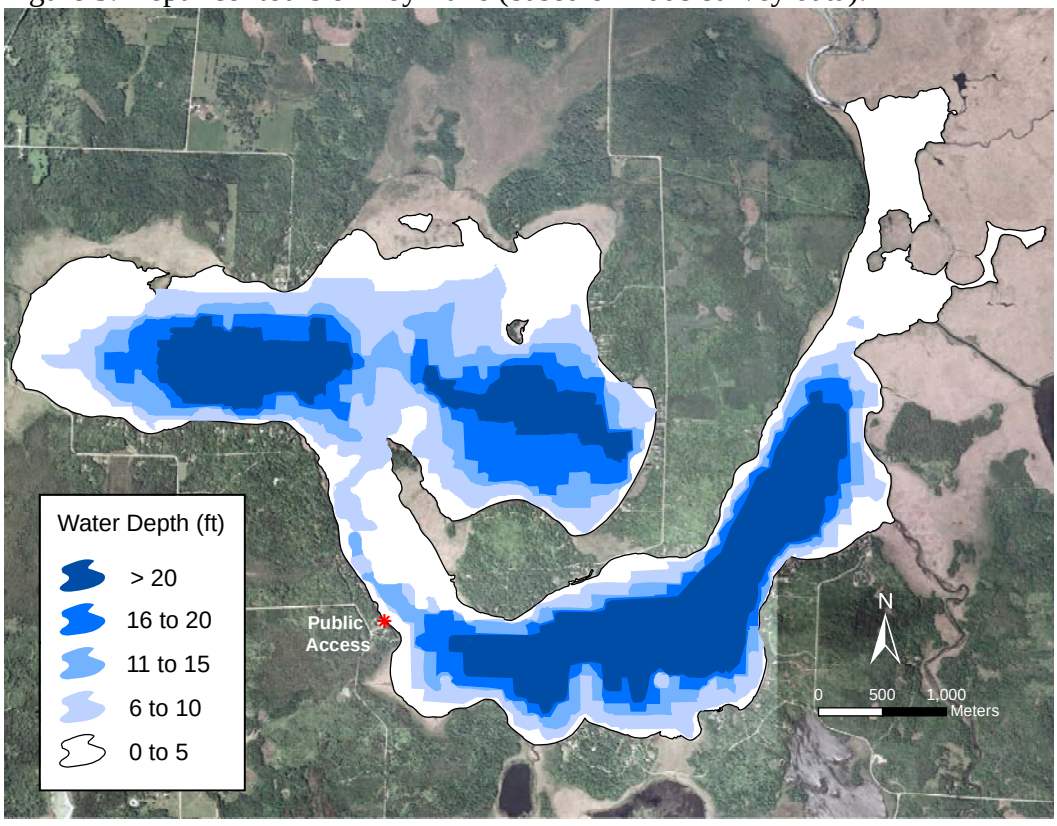


Boy Lake occurs within the Chippewa National Forest but the shoreline includes a mix of federal, state, county, tribal and private ownership. Areas of privately owned, upland shoreline have been developed with residential homes and several resorts but the shoreline remains primarily forested. Large wetlands occur adjacent to the lake including an extensive swamp that connects the northeast bay of Boy Lake to the Boy River. A public boat launch is located on the southwest corner of the lake and limited access is also possible via the north end of the Boy River.

There are about 257 Cass County lakes that are at least 50 acres in size and Boy Lake ranks 5th in size with a surface area of 3,186 acres and 21 miles of shoreline. The shoreline is irregular in outline with a large north basin connected by an elongated channel to the eastern basin. A five acre island occurs on the east side of the northern basin. Boy Lake has a maximum depth of 45 feet but more than 60 percent of the lake is less than 15 feet in depth (Figure 3). This shallow area is referred to as the "littoral" zone and rooted plants may be common in this depth zone if adequate sunlight reaches the lake bottom.

Boy Lake is mesotrophic, or 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 an 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 a half times the Secchi depth. Water clarity data are sparse for Boy Lake but in 2007, the mean Secchi disc readings at several sites in the lake, ranged from four feet to seven feet

Figure 3. Depth contours of Boy Lake (based on 2008 survey data).



(MPCA, 2007). Based on Secchi disc measurements alone, vegetation might be expected to grow to a depth of about ten feet. Boy Lake water is slightly bog-stained (MnDNR Fisheries Lake Files) which may limit the amount of light penetration. Other factors that may influence the depth of plant growth include substrate types, wind fetch, and plant species composition.

Previous vegetation surveys of Boy Lake reported abundant vegetation with at least 20 different species recorded. Common species were wild rice (*Zizania palustris*), bulrush (*Scirpus* sp.), muskgrass (*Chara* sp.), flat-stem pondweed (*Potamogeton zosteriformis*), greater bladderwort (*Utricularia vulgaris*), and coontail (*Ceratophyllum demersum*). These previous surveys report vegetation growth to a maximum depth of about 15 feet (MNDNR Fisheries).

Objectives

The purpose of this vegetation survey was to provide a quantitative description of the 2008 plant population of Boy Lake. Specific objectives included:

1) Describe the shoal sediments of the lake
2) Estimate the maximum depth of rooted vegetation
3) Estimate the percent of the lake occupied by rooted vegetation
4) Record the aquatic plant species that occur in the lake
5) Estimate the abundance of common species
6) Develop distribution maps for the common species

Methods

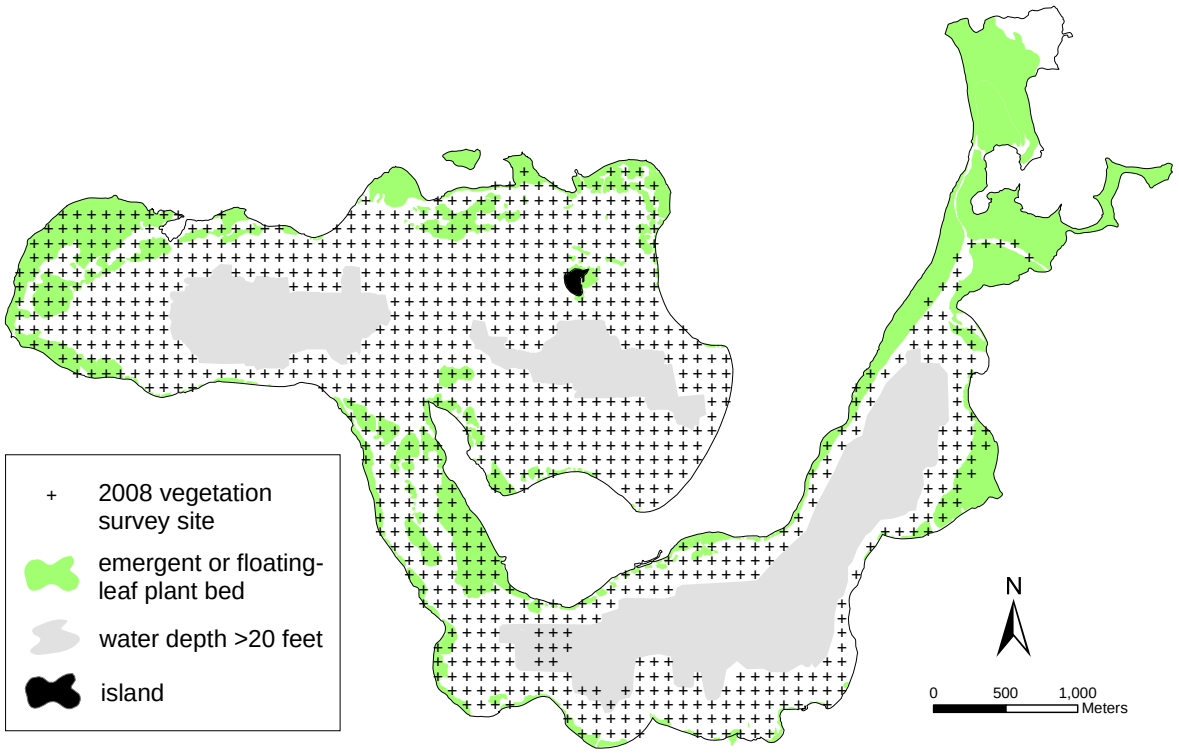
Floating-leaf and emergent vegetation beds

Farm Service Administration (FSA) true color aerial photographs, 2003-2004, were used to delineate beds of floating-leaf vegetation. Ground truthing was conducted in September 2008 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 September 2008. Surveyors motored around the lakeside perimeter of major bulrush beds and recorded locations with a handheld Global Positioning System (GPS) receiver. To avoid damage to these plant beds, surveyors did not motor into these sites. Field data were uploaded to a computer and a Geographic Information System (GIS) software program was used to estimate acreage.

Lakewide vegetation survey

A lakewide vegetation survey of Boy Lake was conducted on June 25, 26 and 30 and July 15 and 17, 2008. A point-intercept survey method was used and followed the methods described by Madsen (1999) and MnDNRa (2008). Survey waypoints were created using a GIS computer program and downloaded into a GPS receiver. Survey points were spaced 100 meters (328 feet) apart. 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 15 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 932 points were surveyed and 919 sites occurred within the vegetated zone from shore to a depth of 20 feet. (Figure 4, Table 1).

Figure 4. 2008 vegetation survey sites on Boy Lake.



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 using a measuring stick in water depths less than seven feet and an electronic depth finder in depths greater than seven feet. The surveyors recorded all plant species found within a one-meter square sample site at the pre-designated side of the boat. A double-headed, weighted garden rake (Figure 5), attached to a rope was used to survey vegetation not visible from the surface. At each sample site where water depths were seven feet and less, surveyors described the bottom substrate using standard substrate classes (Table 2). If a mixture of substrates occurred at a site, surveyors recorded the most abundant type.

Figure 5. Sampling rake.

Table 1. Sampling effort by water depth, Boy Lake, 2008.

Depth interval in feet	Number of Sample Points
0 to 5	318
6 to 10	270
11 to 15	176
16 to 20	155
Total points used in calculations	919
21 to 25	13
Total sample points	932

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 20 feet and sampling points were also grouped by water depth and separated into four depth zones for analysis (Table 1).

Example: In Boy Lake there were 919 samples sites in the shore to the 20 feet depth zone. Muskgrass (*Chara* sp.) occurred in 322 of those sites.
Frequency of muskgrass in the shore to 20 feet depth zone = 322/919 (*100) = 35 %

Table 2. Substrate classes

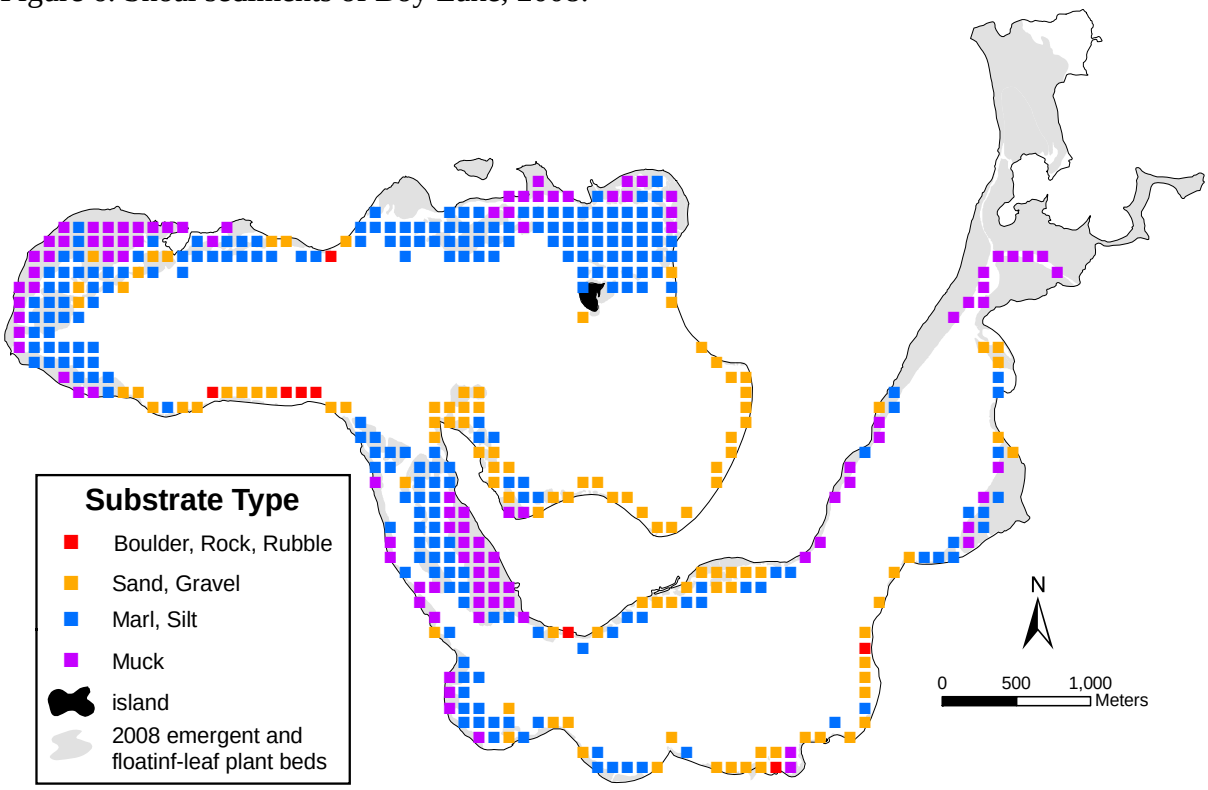
muck	decomposed organic material
marl	calcareous material
silt	fine material with little grittiness
sand	Diameter less than 1/8 inch
gravel	Diameter 1/8 to 3 inches
rubble	Diameter 3 to 10 inches
boulder	Diameter over 10 inches

Results

Shoal substrates

Boy Lake shoal areas consisted primarily of soft substrates of marl, silt and muck (Figure 6). Muck substrates were found in the waterlily and wild rice beds, which occurred in the shallow bays throughout Boy Lake. Southern shores and the east shore of the northern bay contained hard substrates of sand with occasional gravel, rubble, rock or boulder (Figure 6).

Figure 6. Shoal sediments of Boy Lake, 2008.



Distribution of aquatic plants

Aquatic plants were found around the entire perimeter of Boy Lake. In the areas of the north basin, plant beds extended more than 1000 meters from shore and much of the northeast bay was completely covered with vegetation (Figure 7). Plants were found to a maximum depth of 20 feet but were most frequent in depths of ten feet and less (Figure 8). Within the depth zone from shore to 10 feet, plants occurred in 89 percent of the sites and vegetation was less frequent in deeper depths. In depths greater than 15 feet, only three percent of the sites were vegetated.

Figure 7. Distribution of aquatic plants in Boy Lake, 2008.

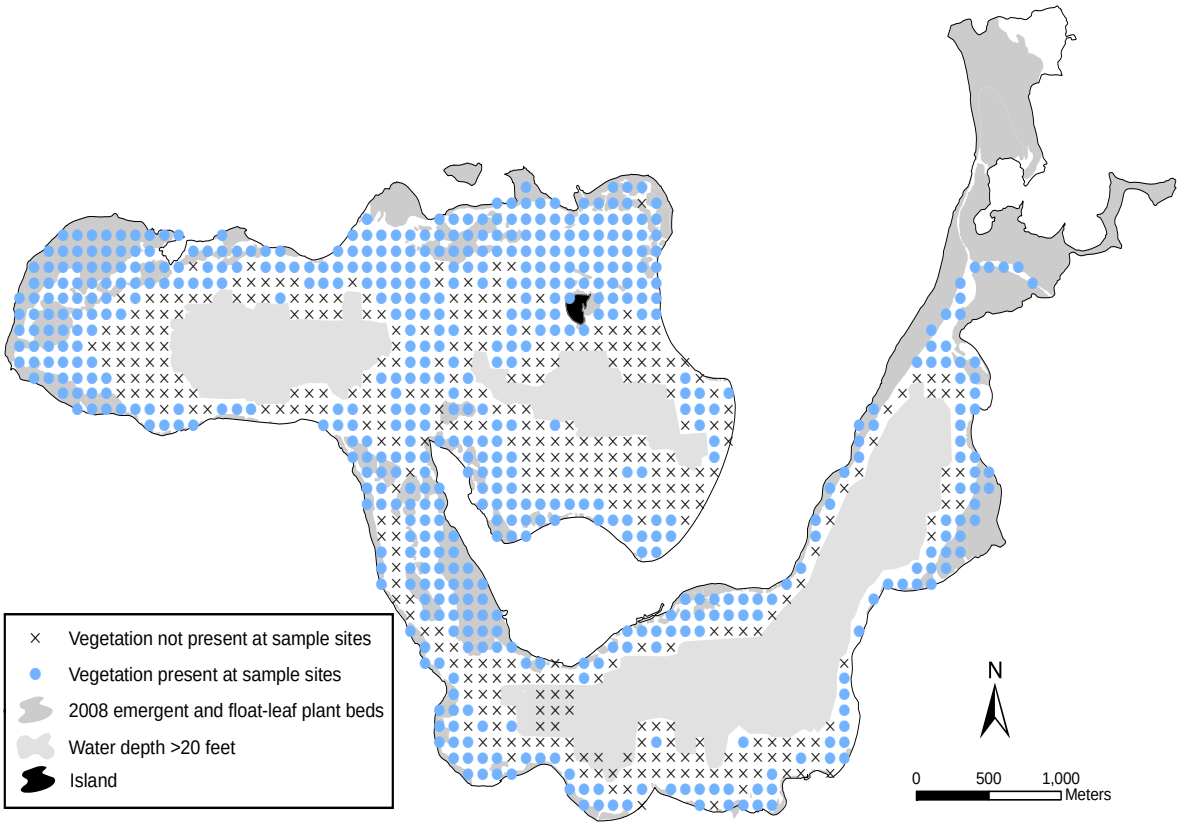
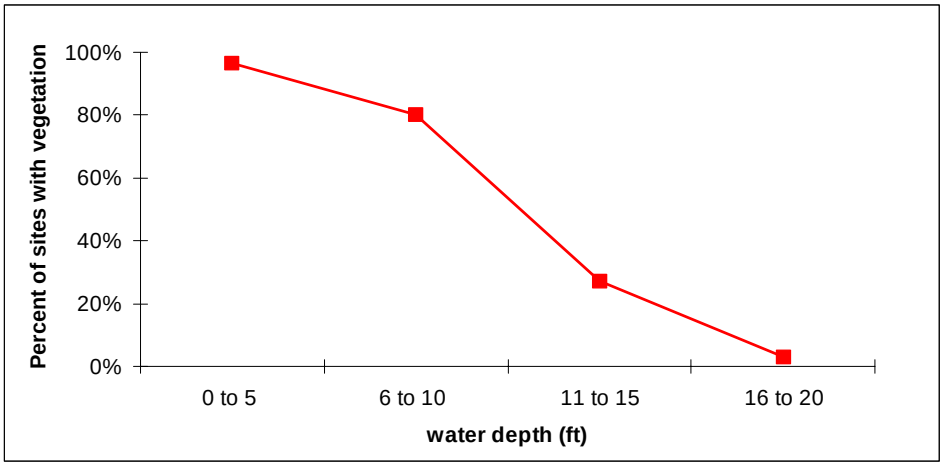


Figure 8. Plant occurrence at each water depth interval, Boy Lake 2008

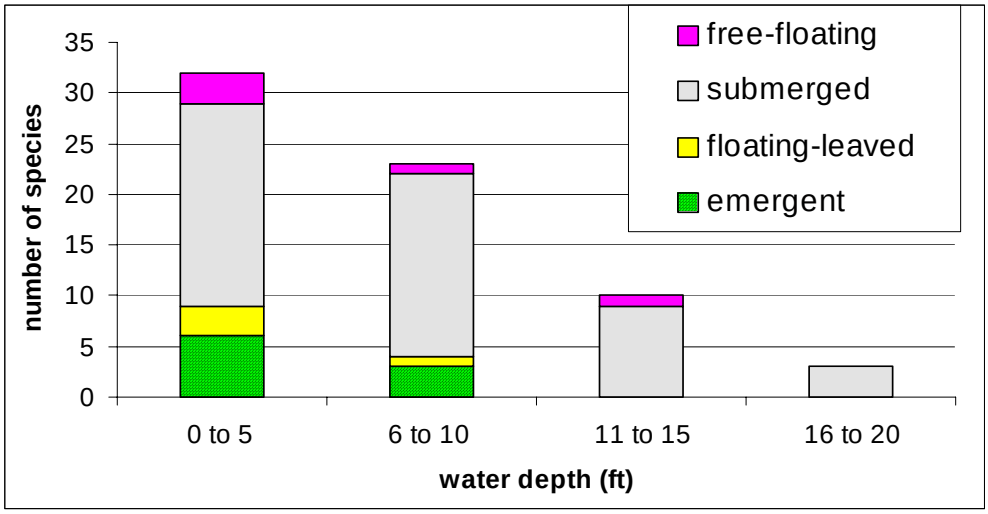


Number and types of plants recorded

A total of 33 native aquatic plant species were recorded in Boy Lake including six emergent, three floating-leaved, three free-floating and 21 submerged plant species (Table 3). Submerged plants included a diverse mix of rooted plants with a variety of leaf types as well as some large algae and an aquatic moss.

The highest number of plant species was found in shallow water, from shore to a depth of five feet (Figure 9). Emergent and floating-leaf plants were restricted to water depths of six feet and less. Most free-floating and submerged species were found in depths of ten feet and less. Only three species were present in depths greater than 15 feet (Figure 9).

Figure 9. Number of species at each water depth interval Boy Lake, 2008.



The number of plant species found at each one-meter square site ranged from zero to 12, but with a mean of only two species per site. Sites with the highest number of species occurred in depths less than six feet, where a mixture of emergent, floating-leaved and submerged species occurred (Figure 10). In water depths greater than 10 feet, most sites were either absent of vegetation or contained only one species.

Table 3. Frequency of aquatic plants in Boy Lake Point-intercept survey, June and July 2008.

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

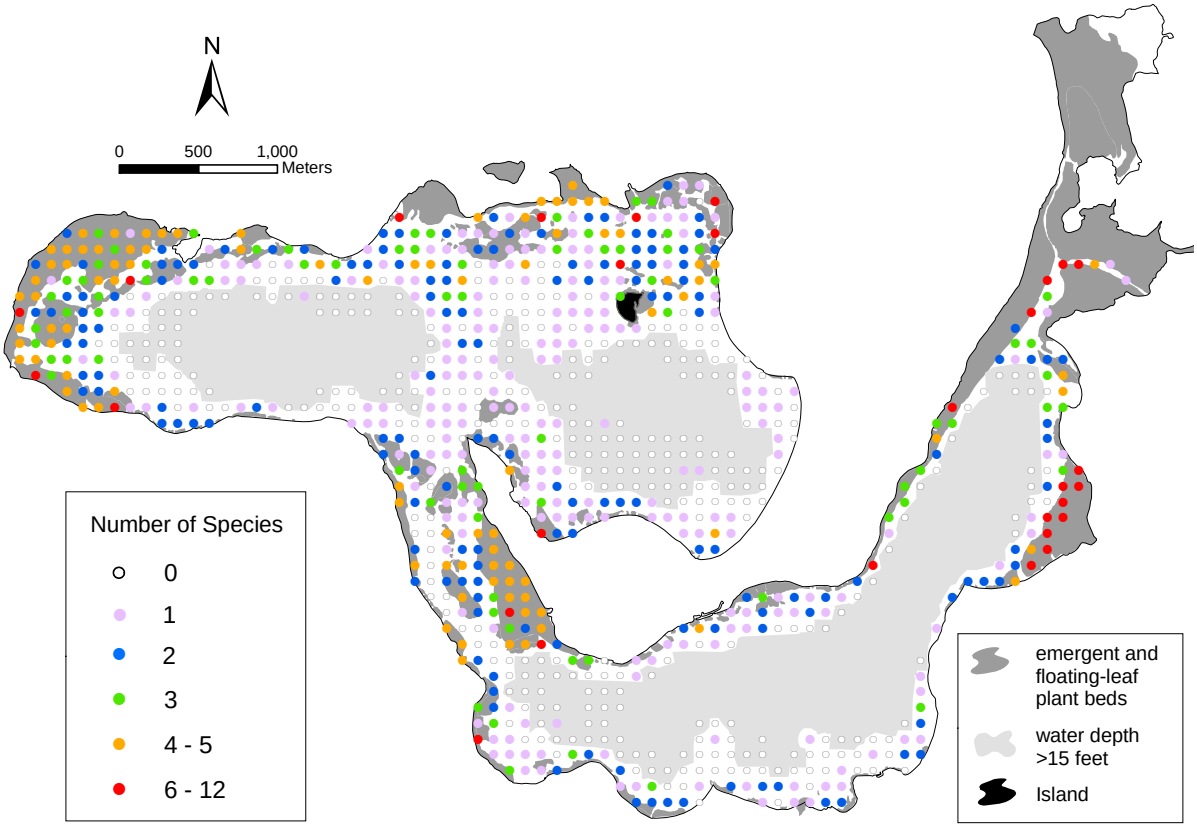
919 sample sites

Life Form		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.	Large Algae	Muskgrass	*Chara sp.*	35%
		Stonewort	*Nitella sp.*	2%
	Grass-leaf rooted plants	Flat-stem pondweed	*Potamogeton zosteriformis*	20%
		Wild celery	*Vallisneria americana*	<1%
		Water stargrass	*Zosterella dubia*	<1%
	Dissected-leaf rooted plants	Coontail	*Ceratophyllum demersum*	15%
		Greater bladderwort	*Utricularia vulgaris*	9%
		Northern water milfoil	*Myriophyllum sibiricum*	8%
		White water buttercup	*Ranunculus aquatilis*	1%
		Lesser bladderwort	*Utricularia minor*	1%
		Water marigold	*Megaladonta beckii*	<1%
	Small-leaf rooted plants	Canada waterweed	*Elodea canadensis*	6%
		Bushy pondweed	*Najas* sp.	4%
		Narrow-leaf pondweed	*Potamogeton sp.**	2%
		Fries pondweed	*Potamogeton freisii*	1%
		Sago pondweed	*Stuckenia pectinata*	1%
	Broad-leaf rooted plants ("cabbage")	White-stem pondweed	*Potamogeton praelongus*	3%
		Large-leaf pondweed	*Potamogeton amplifolius*	2%
		Illinois pondweed	*Potamogeton illinoensis*	2%
		Clasping-leaf pondweed	*Potamogeton richardsonii*	1%
		Variable pondweed	*Potamogeton gramineus*	<1%
	Moss	Water moss	*Not identified to genus*	2%
FREE-FLOATING These plants drift freely with the water current and are often found floating near or on the water surface.		Star duckweed	*Lemna trisulca*	2%
		Lesser duckweed	*Lemna minor*	<1%
		Greater duckweed	*Spirodela polyrhiza*	<1%
FLOATING These plants are rooted in the lake bottom and have leaves that float on the water surface.		Yellow waterlily	*Nuphar variegata*	4%
		Floating leaf pondweed	*Potamogeton natans*	4%
		White waterlily	*Nymphaea odorata*	3%
EMERGENT These plants extend well above the water surface and are usually found in shallow water, near shore.		Wild rice	*Zizania palustris*	13%
		Giant cane	*Phragmites australis*	<1%
		Broadleaf arrowhead	*Sagittaria latifolia*	Present
		Bulrush	*Scirpus sp.*	5%
		Giant burreed	*Sparganium eurycarpum*	Present
		Cattail	*Typha sp.*	<1%

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

"Present" indicates species was found in lake but did not occur within one of the 919 sample sites.

Figure 10. Number of plant species found at each sample site, Boy Lake, 2008.

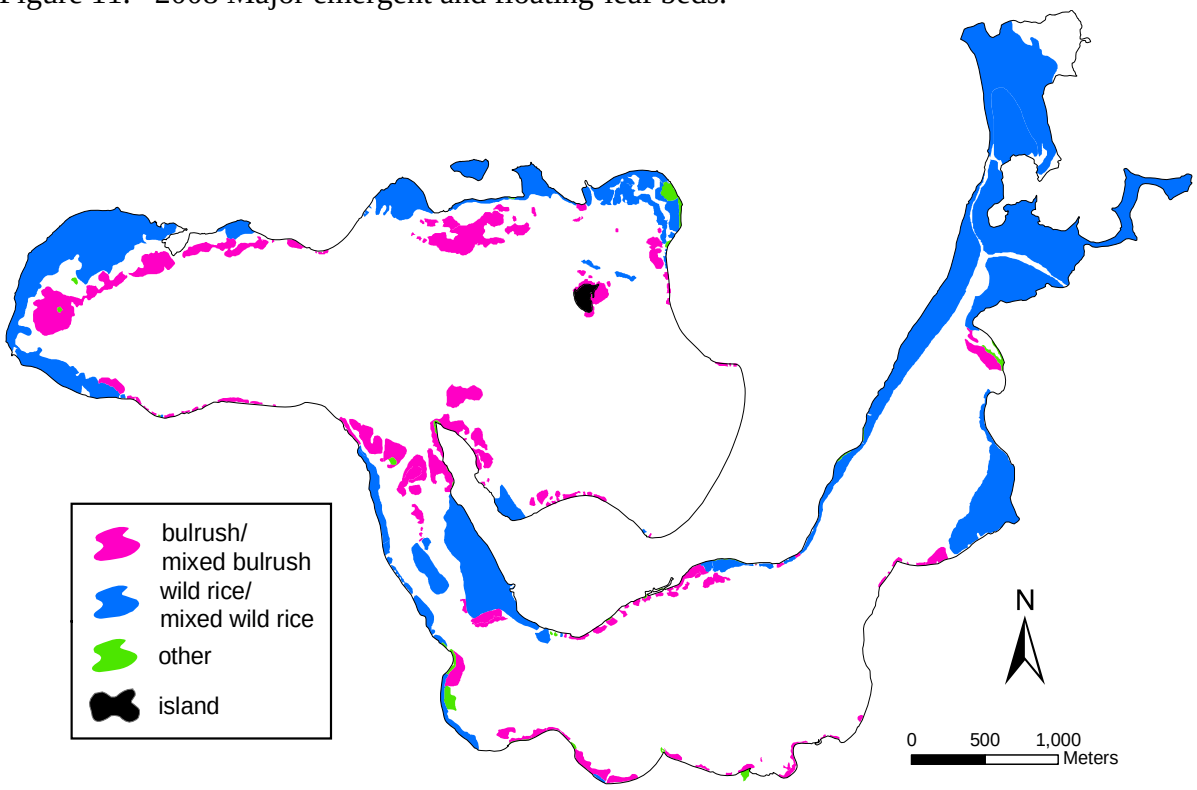


Emergent and floating-leaved plants

Emergent and floating-leaf aquatic plants offer shade and 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.

Approximately 750 acres of emergent and floating-leaf beds were mapped in Boy Lake with the largest beds occurring in the north end of the main lake, the channel south of the main lake, and the northeast outlet bay (Figure 11). Within the shore to five feet depth zone, 51 percent of the surveyed sites contained at least one emergent or floating-leaf plant. Major plant bed types included wild rice, bulrush, and wild rice or bulrush mixed with waterlilies and other species (Figure 11). Wild rice was often associated with soft bottom substrates while bulrush stands were more often found on hard substrates.

Figure 11. 2008 Major emergent and floating-leaf beds.



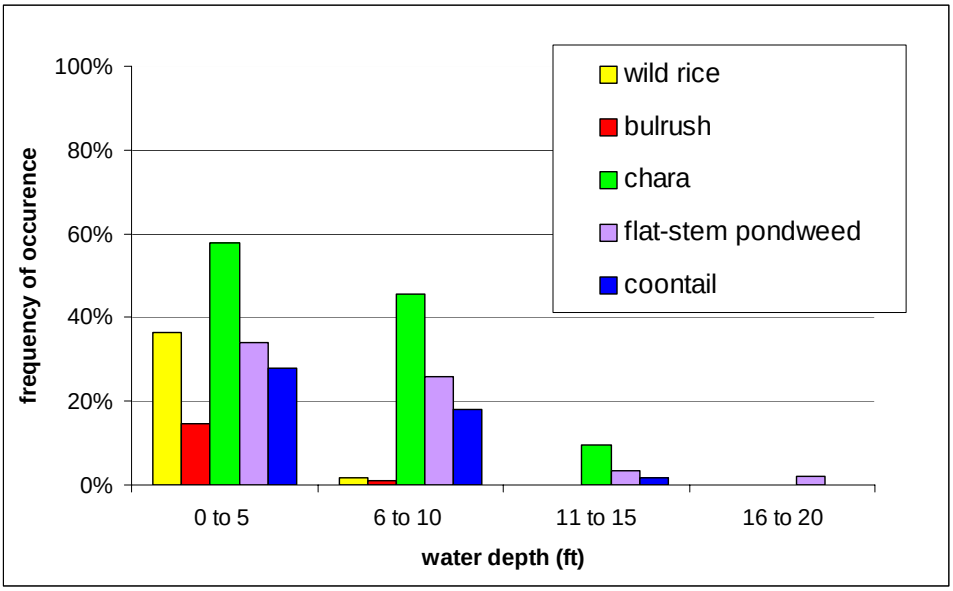
Wild rice (*Zizania palustris*) (Figure 12) was the most common emergent plant in Boy Lake and was found in 13 percent of all sites (Table 3) and in 37 percent of the sites within the shore to five feet depth (Figure 13). Because surveyors avoided motoring into emergent wild rice beds, these frequency values represent the occurrence of wild rice only within the sites surveyed and underestimate the actual occurrence of wild rice. About 570 acres of wild rice were mapped including 240 acres dominated by wild rice and 330 acres of wild rice mixed with bulrush, other emergent vegetation, and/or waterlilies.

Figure 12. Wild rice (*Zizania palustris*).

Wild rice formed extensive beds in the northern basin, the channel to the north basin and in the northeast bay. Wild rice was also a dominant plant within the Boy River.

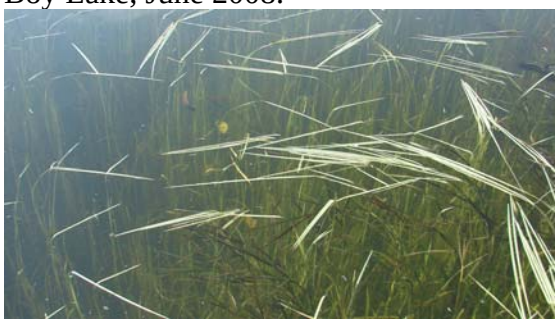
Wild rice is an annual plant that germinates each year from seed that fell to the lake bottom in the previous fall. It prefers soft substrates (Lee 1986, Nichols 1999) and generally requires moving water for growth (MnDNR 2008b). The plant begins growth underwater and then forms a floating-leaf stage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

Figure 13. Frequency of common plant species by water depth interval. Boy Lake, Cass County, MN June and July 2008.



In addition to its ecological value as habitat and food for wildlife, wild rice has important cultural and economic values in Minnesota (MnDNR 2008b). This valuable plant is increasingly threatened by factors such as lakeshore development and increased water recreational use (MnDNR 2008b).

Figure 14. Floating-leaf stage of wild rice, Boy Lake, June 2008.



Bulrush (*Scirpus* sp.) was the second most common emergent plant in Boy Lake and was found in five percent of all survey sites (Table 3) and in 15 percent of the sites from shore to the five feet depth (Figure 13). Approximately 170 acres of bulrush beds were delineated (Figure 11).

Figure 15. Emergent bulrush (*Scirpus*) beds in Boy Lake, 2008.

Bulrush (Figure 15) is a perennial emergent that may occur from shore to water depths of about six feet and its stems may extend several feet above the water surface. It may grow in pure stands or with other emergents and waterlilies. Bulrush spreads by rhizomes and regeneration is most successful on very shallow sites. Restoration of bulrush beds can be very difficult, making established beds particularly unique and valuable.

All other emergent and floating-leaved plants occurred in less than five percent of the sample sites but some of these species were common within the shallow, non-accessible areas of emergent plant beds. Waterlilies often co-occurred within the emergent beds and included yellow waterlily (*Nuphar variegata*), floating-leaf pondweed (*Potamogeton natans*) and white waterlily (*Nymphaea odorata*).

Submerged plants

Submerged plants occurred in 60 percent of the Boy Lake sample sites between shore and the 20 feet depth and were common to ten feet. A mixture of submerged plant types was found including species that were weakly anchored to the lake bottom as well as strongly rooted perennials. Leaf forms included grass-leaved plants, finely dissected leaved plants, and broad-leaved plants.

Figure 16. Muskgrass (*Chara* sp.)

Muskgrass (*Char*a sp.) occurred in 35 percent of the sample sites (Table 3), was widespread in distribution (Figure 17), and was most common species in all depth zones (Figure 13). 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.

Flat-stem pondweed (*Potamogeton zosteriformis*) was found in 20 percent of the survey sites (Table 3) and often co-occurred with muskgrass (Figure 17). It was found to a depth of 19 feet but was most common in depths of 10 feet and less (Figure 13). Flat-stem pondweed (Figure 18) is a perennial plant that is anchored to the lake bottom by underground rhizomes. It is named for its flattened, grass-like leaves. Depending on water clarity and depth, these plants may reach the water surface and may produce flowers that extend above the water. These pondweeds are anchored to the lake bottom by rhizomes and regrow each year from winter buds. Waterfowl feed on pondweed seeds and the leafy foliage provides important cover for fish and invertebrates.

Coontail (*Ceratophyllum demersum*) is a submerged plant that was found in 15 percent of the Boy Lake sites (Table 3), occurred throughout the lake (Figure 17), and was most common from shore to five feet (Figure 13). Coontail grows entirely submerged and is adapted to a broad range of lake conditions, including turbid water. This perennial plant over winters 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 coontail provide a home for insects valuable as fish food.

Figure 17. Distribution of common submerged species in Boy Lake, 2008.

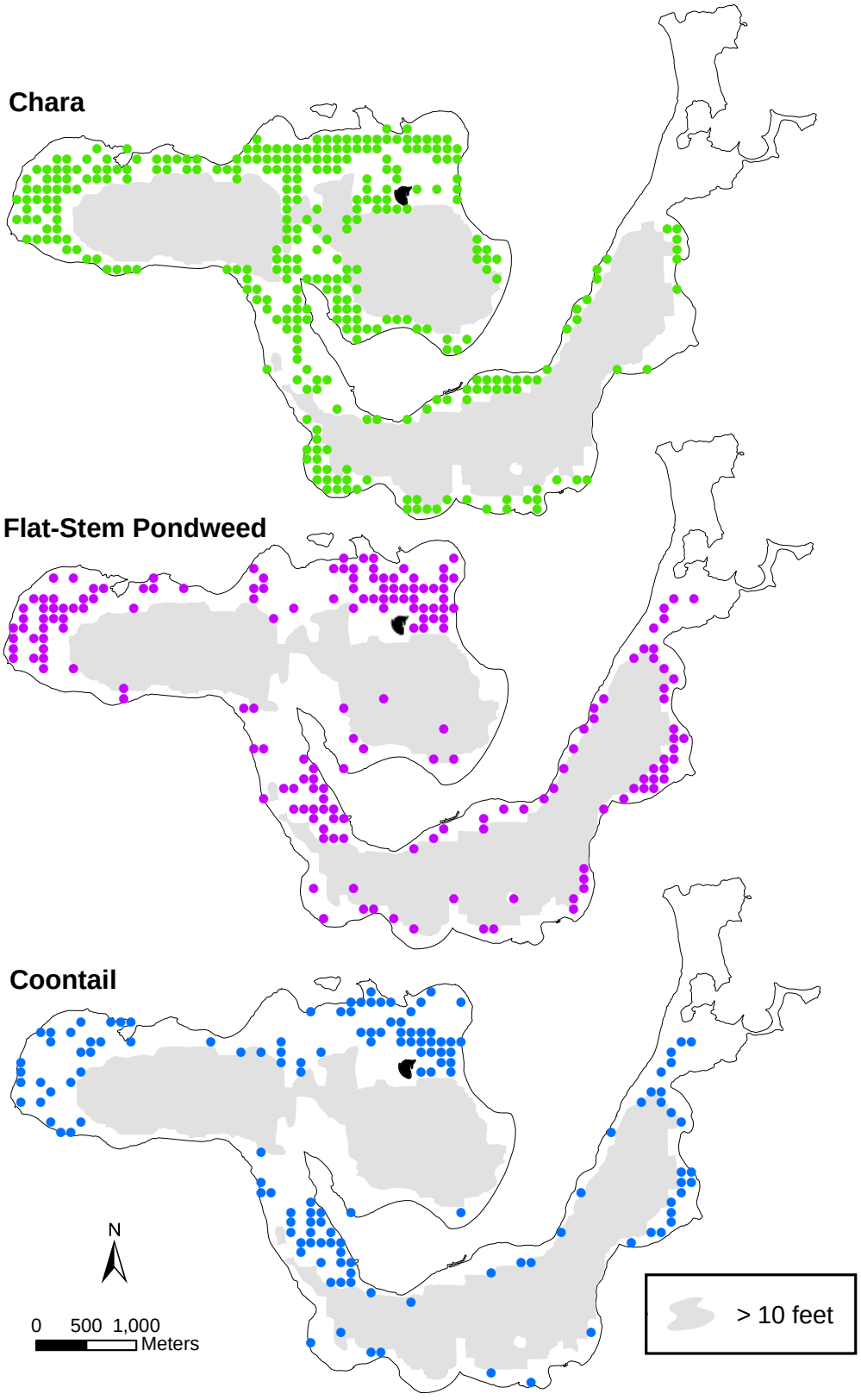


Figure 18. Flat-stem pondweed (*Potamogeton zosteriformis*)

All other submerged species occurred in less than ten percent of the sample sites but their presence in the lake is important. The wide variety of plant types provides a diversity of habitat for invertebrates, fish and other wildlife.

Figure 19. Coontail (*Ceratophyllum demersum*)

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 Boy Lake is sufficiently high to allow abundant aquatic plant growth to the 10 feet depth and scattered plant growth to 20 feet.

The plant community of Boy Lake is very similar to that found in other hardwater Cass County lakes such as Woman, Little Boy and Wabedo lakes. Muskgrass is the dominant submerged plant in all of these lakes and flat-stem pondweed, coontail, wild rice and bulrush are common. Although other species occur with lower frequency, the high number of plant species found in Boy Lake is a reflection of good 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 Boy 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.

The abundant and diverse native aquatic plant communities of Boy Lake provide critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants).

A review of past vegetation surveys indicates that, over the past 50 years, the general aquatic plant community has not likely changed greatly in Boy Lake. In all survey years, a relatively high number of native plants have been recorded, the same species remain common, and rooted plants remain well distributed throughout the lake. Data collected in 2008 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 Boy 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 Boy 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 re-grow in similar locations each year. However, a few species such as 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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