Aquatic Vegetation Survey of

Big Waverly Lake (ID #86-0114-00)
And
Little Waverly Lake (ID #86-0106-00)

Wright County, Minnesota

2004 and 2009

Pelicans and seagulls on shore of Little Waverly Lake, August 2009

Minnesota
DEPARTMENT OF NATURAL RESOURCES

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Summary

Big Waverly and Little Waverly lakes are moderate sized (<500 acre), fertile lakes in central Minnesota. Although they are connected by a channel, the lakes differ in water quality and clarity and these differences influence the amount and types of aquatic plant growth in each lake. Big Waverly Lake was surveyed in June 2004 to assess the non-native plant, curly-leaf pondweed. Surveys of both lakes were conducted in August 2009 to assess Eurasian watermilfoil and native plants. A characterization of near shore substrate types was conducted during the 2009 surveys.

Emergent and floating-leaf plants were very sparse in these lakes. Submerged plants were found to a depth of 14 feet in Big Waverly Lake but were restricted to depths less than six feet in Little Waverly Lake. At least 70% of the Big Waverly Lake shallow water (0 to 15 feet) sites contained vegetation, compared to only 7% in Little Waverly Lake.

A total of 15 native plant species were found in Big Waverly Lake and four were present in Little Waverly. Coontail was the most common native species found in both lakes. Eurasian watermilfoil occurred in 65% of the Big Waverly Lake sites but lower clarity in Little Waverly Lake limited its occurrence to 1%. During the spring 2004 survey of Big Waverly Lake, curly-leaf pondweed was present in 35% of the sites.

Introduction

Big Waverly Lake (ID# 86-0114-00) and Little Waverly Lake (ID# 86010600) are located by the City of Waverly, in Wright County, central Minnesota. These lakes are located in the North Fork of the Crow River Watershed and are part of the Twelve Mile Creek minor watershed (Figure 1). Twelve Mile Creek flows northeast through Little Waverly Lake and empties into the North Fork of the Crow River. Big Waverly Lake is connected to Little Waverly Lake by a channel.

These lakes have bowl shaped basins and Big Waverly Lake is slightly larger in size (485 acres) than Little Waverly (330 acres). Big Waverly Lake has a maximum depth of 70 feet and about 29% is less than 15 feet in depth. Little Waverly Lake is entirely shallow, with a maximum depth of 12 feet (Figure 3).

Figure 1. Big and Little Waverly lakes in Wright County.

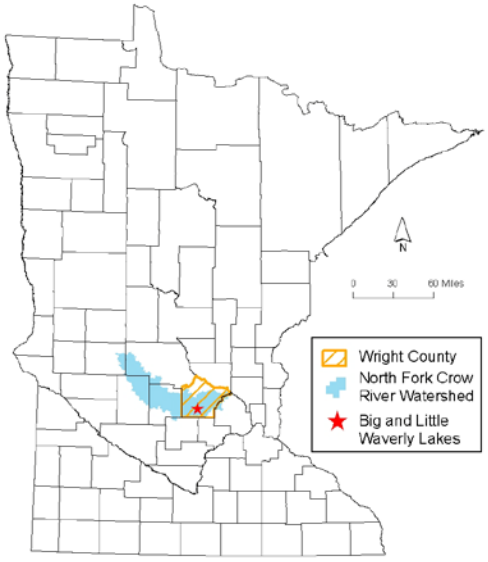


Figure 2. Land use within the Twelve Mile Creek watershed that includes Big and Little Waverly lakes. (from GAP 1990 land coverage).

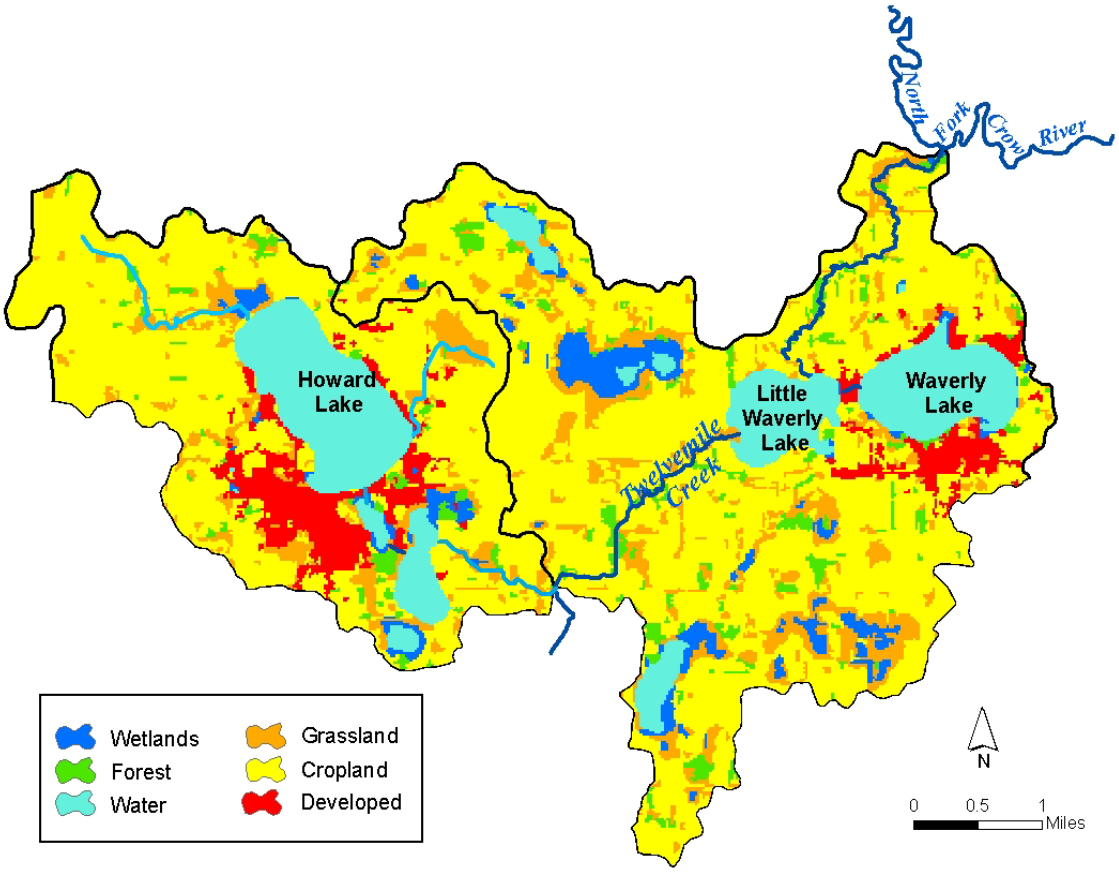
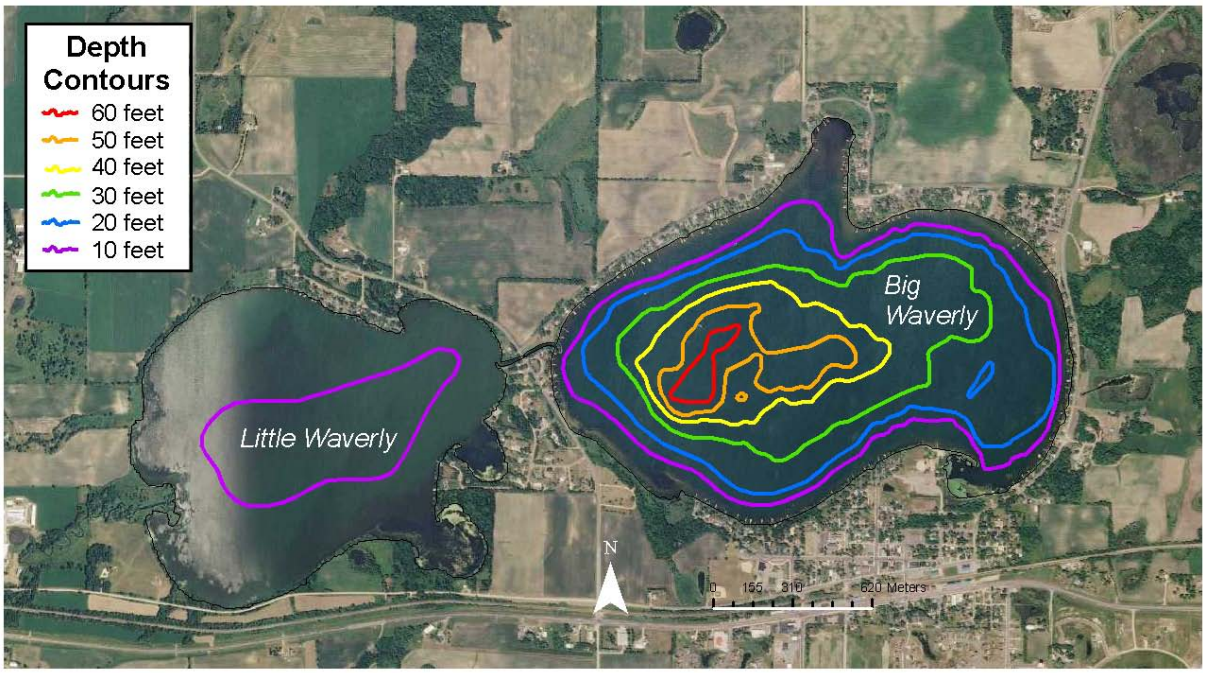


Figure 3. Depth contours of Little Waverly and Big Waverly Lakes.



Both lakes receive runoff from agricultural lands but Little Waverly is impacted to a greater extend due to watershed size and land use. The Little Waverly Watershed is over 100 times the size of the lake and land use is primarily agricultural (Lindon and Heiskary 2005.) Little Waverly Lake is described as hypereutrophic; algal blooms are common and submerged plants are sparse due to low water clarity. Big Waverly Lake's watershed is about three times larger than the lake and the majority of the land use is wetland (Lindon and Heiskary 2006). Big Waverly Lake is characterized as eutrophic (high nutrient levels) with low water clarity. These differences influence the types and quantities of aquatic plants present in each lake.

Historically, both of these lakes have experienced heavy algal growths and only moderate submerged plant growth; emergent plants such as bulrush and sedges were once reported as common along the shorelines (DNR Fisheries Lake Files, 1958 survey). In 2004, DNR Fisheries staff (Montrose Area office) mapped the remaining emergent and floating leaf plant beds and located less than a half acre of bulrush, less than 5 acres of mixed waterlily/cattail beds and about one acre of cattails. Attempts were begun in 2000 to restore waterlilies and bulrush in the southwest part of the lake (Diedrich 2006).

The non-native plant, curly-leaf pondweed (*Potamogeton crispus*) has been present in the lakes since at least 1941 and has been reported as abundant in Big Waverly Lake since at least the 1980's (DNR Fisheries Lake Files). In 2000, DNR Fisheries staff (Montrose Area) located several areas where curly-leaf pondweed formed dense beds within the 5 to 10 feet depth zone.

The non-native plant, Eurasian watermilfoil (*Myriophyllum spicatum*) was first reported in Big Waverly Lake in 1991 and in Little Waverly Lake in 1992. Herbicide applications were not successful in eradicating this plant (Diedrich 2006).

Objectives

The purpose of this vegetation survey was to provide a quantitative description of the 2009 plant population of Big Waverly and Little Waverly Lakes. Specific objectives included:

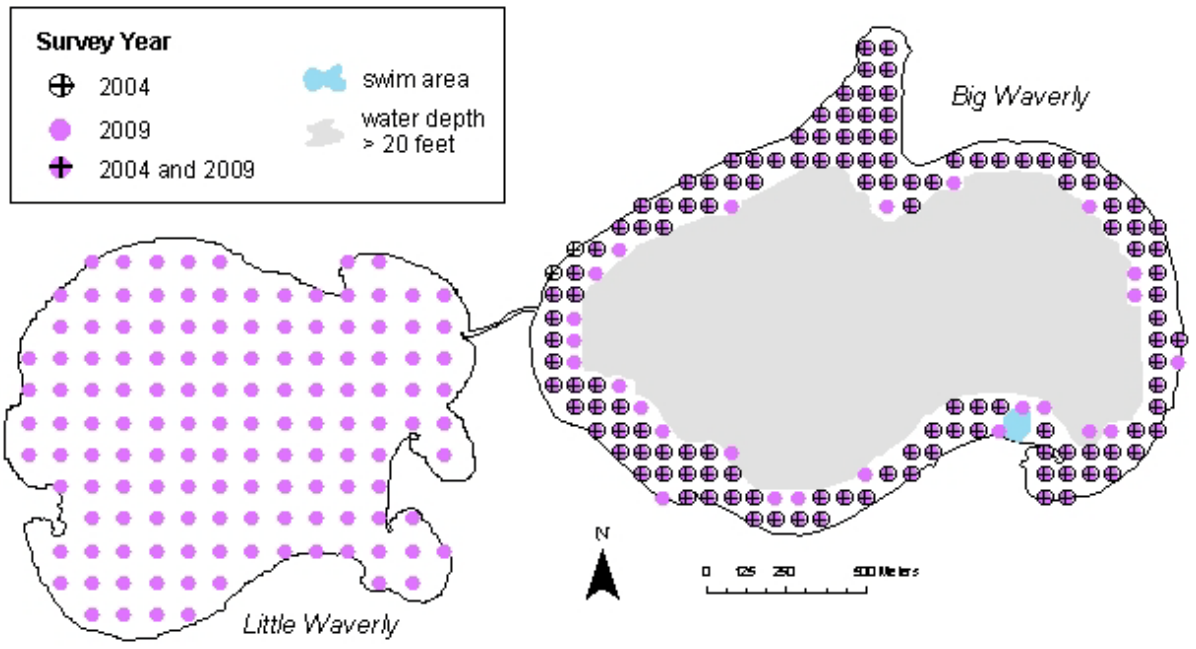
1. Estimate the maximum and optimal depths of rooted vegetation
2. Record the aquatic plant taxa that occur in the lake
3. Estimate the frequency of occurrence of common taxa
4. Develop distribution maps for the common taxa

Methods

Lakewide vegetation survey

Big Waverly Lake was surveyed June 3, 2004 and August 17, 2009. Little Waverly Lake was surveyed August 17 and 18, 2009. A point-intercept survey method was used and followed the methods described by Madsen (1999) and MnDNR (2008). A grid of survey waypoints were created using a Geographic Information System (GIS) program and downloaded into a handheld Global Positioning System (GPS) receiver. Survey points were spaced 70 meters (230 feet) apart on Big Waverly Lake and 100 meters (328 feet) apart on Little Waverly Lake (Figure 4).

Figure 4. Survey sites of Big Waverly (2004 and 2009) and Little Waverly (2009) Lakes.



During the 2004 survey of Big Waverly Lake, surveyors sampled all sites in depths less than 16 feet and some sites in the 16 to 20 feet depth zone. Additional sites in the 16 to 20 feet depth zone were sampled in 2009 (Table 1). Within the vegetated zone (0 to 15 feet depth), a total of 113 sites were surveyed in both years (Table 1). In Little Waverly Lake, 135 sites were sampled.

Table 1. Sampling effort by water depth.

Water depth interval (feet)	Number of samples		
	Big Waverly (#) indicates number of sites sampled in both yrs		Little Waverly
	2004	2009	2009
0 to 5	57 (54)	60 (57)	30
6 to 10	38 (38)	42 (41)	103
11 to 15	22 (22)	17 (15)	2
Vegetated zone (0 to 15 ft)	117 (113)	119 (113)	135
16 to 20	11	30 (11)	0
Total samples	128	149	135

Sampling was conducted by boat and 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 measured stick in water depths less than seven feet and an electronic depth finder in depths greater than eight feet.

Figure 5. Sampling rake.

Surveyors recorded all plant taxa found within a one square meter 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). Plant identification and nomenclature followed MnTaxa (2009).

Data were entered into a database and frequency of occurrence was calculated for each taxon as the number of sites in which a taxon occurred divided by the total number of sample sites. Frequency was calculated for the entire area from shore to 15 feet and sampling points were also grouped by water depth and separated into five depth zones (Table 1) for analysis.

Example: In the 0-15 feet depth zone of Big Waverly Lake, 113 samples sites were surveyed in both 2004 and 2009.

Coontail (*Ceratophyllum* demersum) occurred in 80 sites in 2009.

Frequency of coontail in 0 -15 feet depth zone of Big Waverly Lake in 2009 = 80/113 = 71%

Surveyors described bottom substrate at each sample site where water depth was seven feet and less. Standard substrate classes were used (Table 2) and if several substrate types occurred at a site, surveyors recorded the most common type.

Results

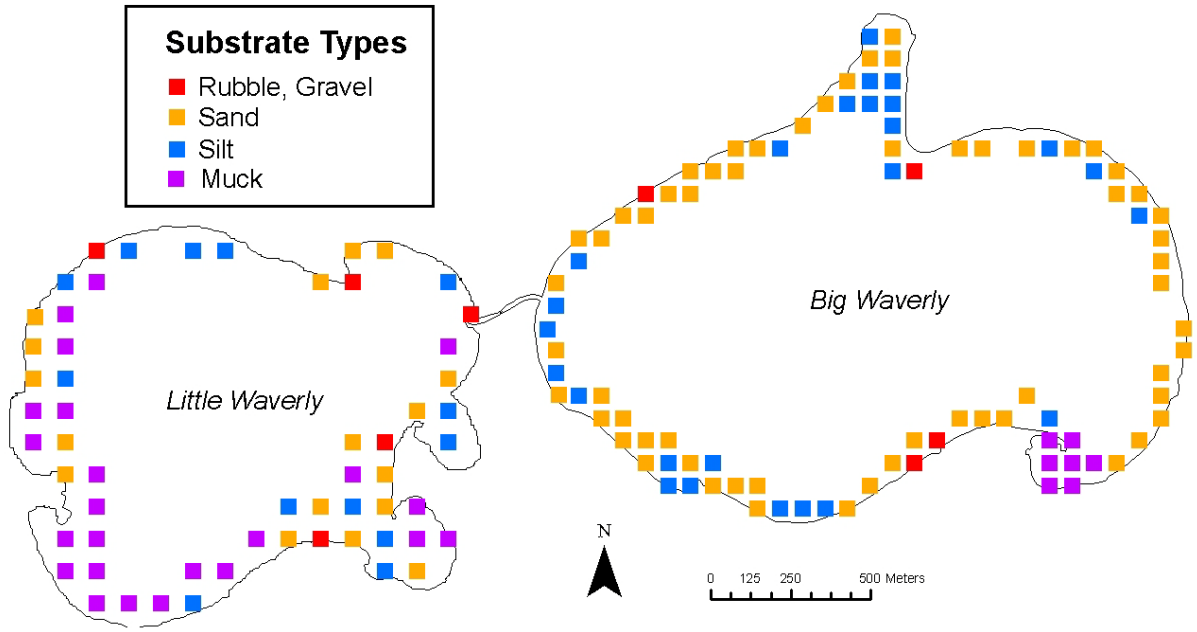
Shoal substrates

The shoal substrates of Big Waverly Lake were primarily hard substrates of sand, gravel and rubble. Softer substrates of silt and muck were found in shallow bays (Figure 6). The shoal substrates of Little Waverly Lake were primarily soft substrates of muck and silt. Hard substrates were found scattered throughout the shorelines (Figure 6).

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

Figure 6. 2009 substrate of Little Waverly and Big Waverly Lakes.



Distribution of aquatic plants

Big Waverly Lake is ringed by a band of submerged plants that extends lakeward a distance of 150 meters (492 feet) along most shores (Figure 7). Submerged plants were found to a depth of 14 feet in 2004 and to 12 feet in 2009, but were sparse in depths greater than 10 feet (Figure 8). Within the shore to 15 feet depth zone, 73% of the sites were vegetated in 2004 and 84% were vegetated in 2009. This apparent increase from 2004 to 2009 may be due to the time of year each survey was conducted. Native plants had not yet reached maximum growth when the 2004 survey was conducted.

Vegetation in Little Waverly Lake was sparse with only 7% of the sites containing plants (Figure 7). Plants were restricted to depths of 5 feet and less and within that shallow zone, only 30% of sites were vegetated (Figure 8).

Figure 7. Aquatic plant distribution in Big Waverly (2004 and 2009) and Little Waverly (2009) Lakes.

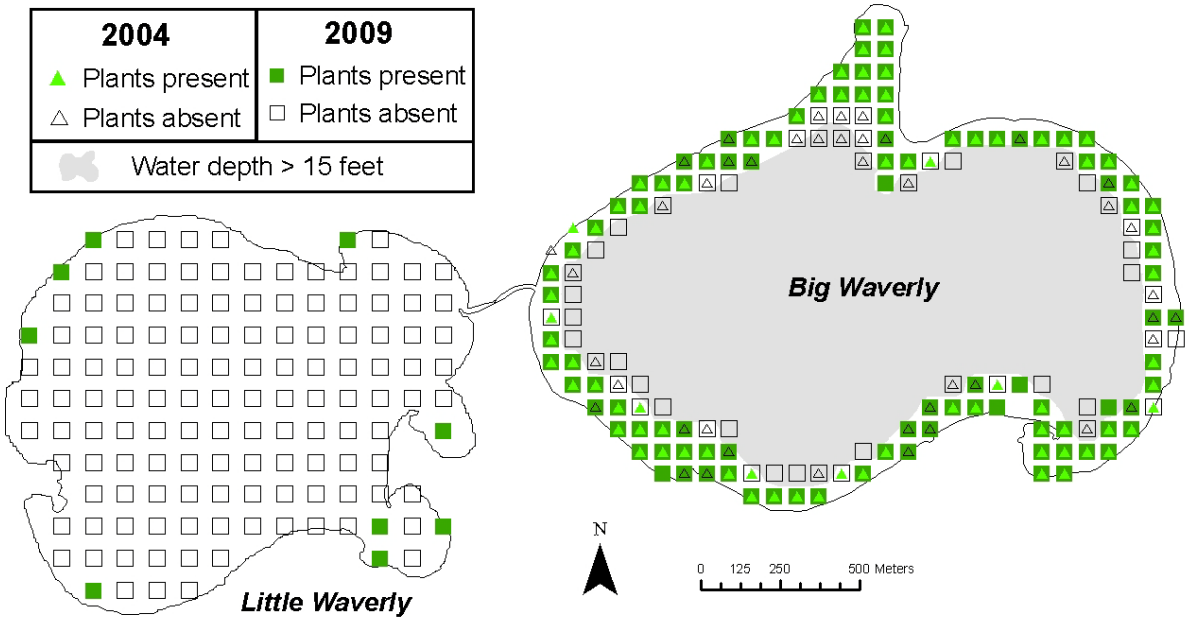
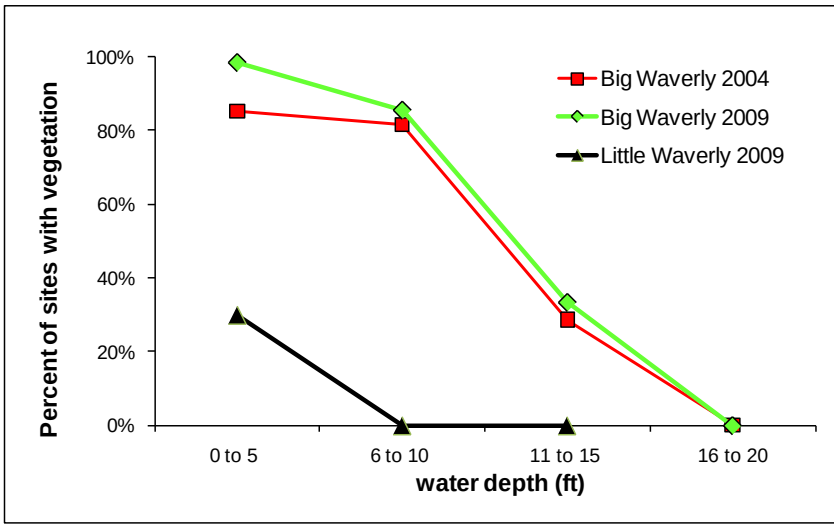


Figure 8. Plant frequency by water depth interval.



Number and types of plant species recorded

The non-native, submerged plant species, curly-leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*), were found in each lake.

A total of 15 native aquatic plant taxa were recorded in Big Waverly Lake including nine submerged, one floating-leaf, three free-floating and two emergent plants (Table 3). Three

native submerged and one emergent plant taxa were found in Little Waverly Lake (Table 3). During the August 2009 survey, 78% of the Big Waverly Lake sample sites and 4% of the Little Waverly Lake sample sites contained at least one native submerged plant species.

Table 3. Frequency of aquatic plants in Waverly and Little Waverly Lakes Point-intercept survey, 2004 and 2009.

Life Form	Common Name	Scientific Name	Big Waverly 2004	Big Waverly 2009	Little Waverly
			N = 113	N = 113	N =135
Non-native Submerged	Eurasian watermilfoil	*Myriophyllum spicatum*	61	65	1
	Curly-leaf pondweed	*Potamogeton crispus*	35	2	1
Native Submerged	Coontail	*Ceratophyllum demersum*	6	70	3
	Bushy pondweed	*Najas* sp.	---	12	---
	Sago pondweed	*Stuckenia pectinata*	3	10	1
	Water stargrass	*Heteranthera dubia*	---	10	---
	Canada waterweed	*Elodea canadensis*	---	5	1
	Muskgrass	*Chara sp.*	---	4	---
	Clasping-leaf pondweed	*Potamogeton richardsonii*	---	4	---
	White-stem pondweed	*Potamogeton praelongus*	---	1	---
	Horned pondweed	*Zannichellia palustris*	---	1	---
Floating-leaved	White waterlily	*Nymphaea odorata*	---	3	---
Free-floating	Lesser duckweed	*Lemna minor*	2	3	---
	Water Meal	*Wolffia columbiana*	---	2	---
	Turion duckweed	*Lemna turionifera*	---	1	---
Emergent	Bulrush	*Scirpus* sp.	---	---	Present*
	Narrow-leaf cattail	*Typha angustifolia*	---	Present*	---
	Giant Cane	*Phragmites australis*	---	Present*	---

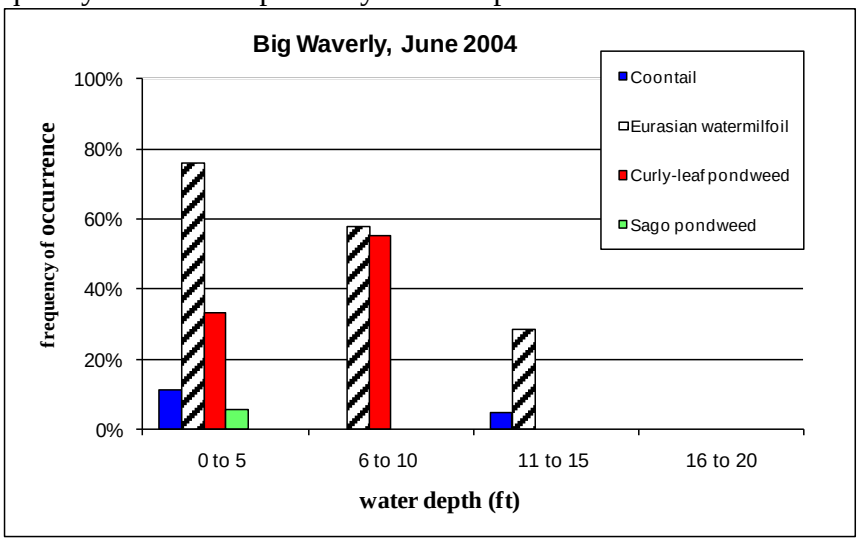
(Frequency is the percent of sample sites in which a plant taxon occurred within the shore to 15 ft water depth.)

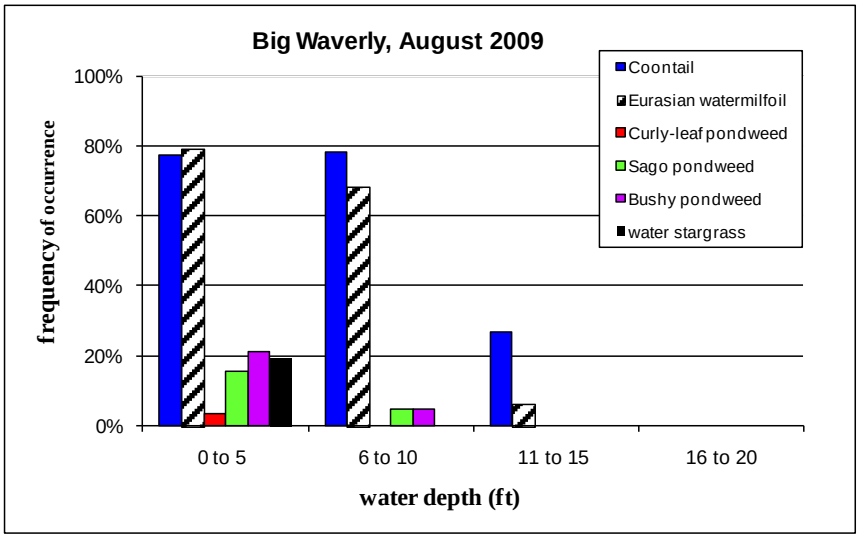
*Present – indicates plant was found outside of survey sites

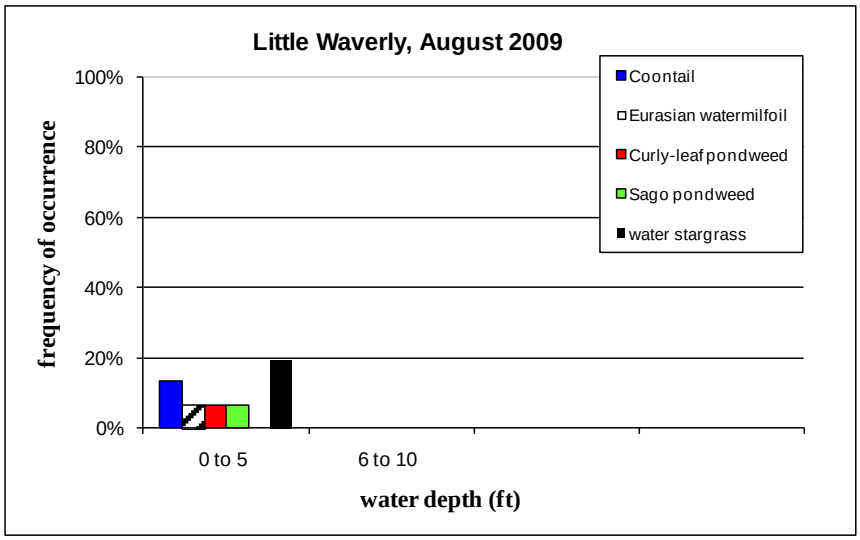
"---" indicates plant was not found in that year in the lake

Shallow water sites (0 to 5 feet) contained the highest number of plant types (Figure 9); no plants were found beyond the 5 feet depth in Little Waverly Lake and only four taxa occurred in deeper water in Big Waverly.

Figure 9. Frequency of common plants by water depth interval.







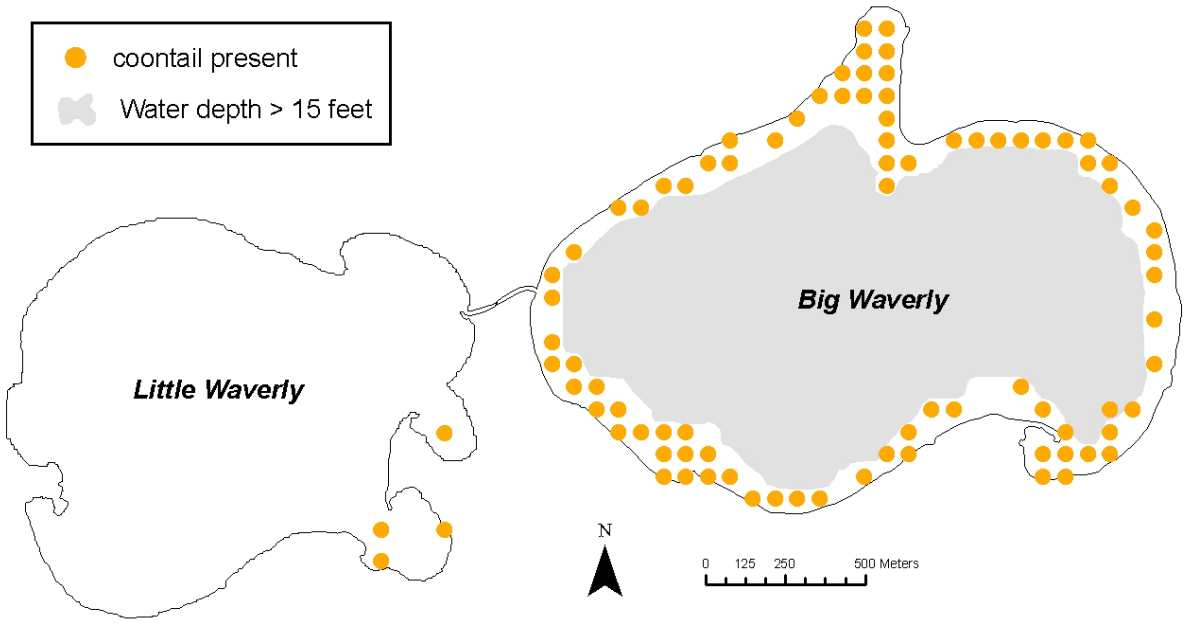
Common submerged plants

Figure 10. Coontail

Coontail (*Ceratophyllum demersum*) (Figure 10) is native to Minnesota and grows entirely submerged, either drifting freely or with its roots loosely anchored to the lake bottom. It is adapted to a broad range of lake conditions and is tolerant of higher turbidity and prefers soft substrates (Nichols 1999). Coontail is perennial and can over winter as a green plant under the ice and then begins new growth early in the spring, spreading primarily by fragmentation. It provides important cover for young fish, including bluegills, perch, largemouth bass and northern pike. It also supports aquatic insects beneficial to both fish and waterfowl.

Coontail was found in both lakes, occurring in 70% of the Big Waverly and 3% of the Little Waverly sites (Table 3, Figure 11). In Big Waverly Lake, it occurred in 1 to 12 feet of water and was one of only two plants found in depths greater than 10 feet (Figure 9). In Little Waverly Lake, coontail was restricted to depths of 2 to 5 feet (Figure 9).

Figure 11. Coontail – 2009 Big Waverly and Little Waverly Lakes.



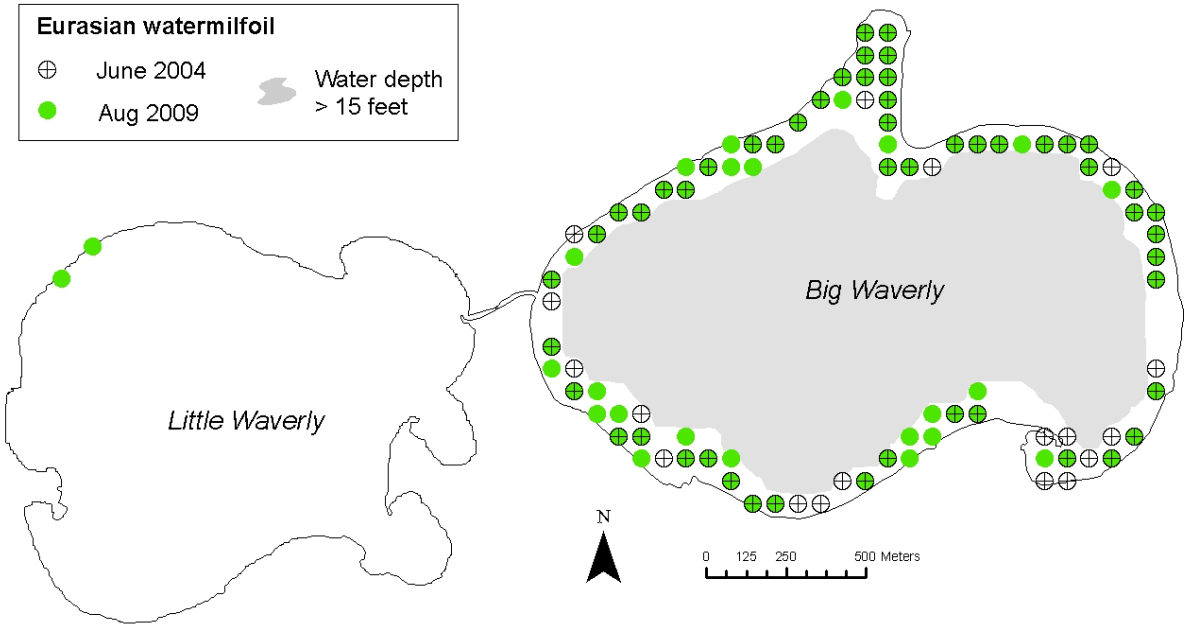
Eurasian watermilfoil (*Myriophyllum spicatum*) (Figure 12) is a rooted, perennial plant with finely divided leaves. The plant is primarily submerged but may produce flowers that extend above the water surface. There are several native watermilfoil plants in Minnesota, but Eurasian watermilfoil has been introduced into the state. Eurasian watermilfoil is adapted to survive in lower light levels than many native aquatic plants but still requires adequate light for growth.

In 2004 and 2009, Eurasian watermilfoil was found in at least 60% of the Big Waverly sites (Table 3). It occurred around the entire perimeter of the lake (Figure 13) and often reached the water surface. It was found in depths from 1 to 14 feet and was an important component of the plant community in each depth zone (Figure 9).

Figure 12. Eurasian watermilfoil

In Little Waverly Lake, Eurasian watermilfoil was found in only 1% of the Little Waverly Lake sites (Table 3, Figure 13).

Figure 13. Eurasian watermilfoil in Big Waverly (2004 and 2009) and Little Waverly (2009).



Curly-leaf pondweed (*Potamogeton crispus*) (Figure 14) is a non-native, submerged plant that has been present in Minnesota since at least 1910 (Moyle and Hotchkiss 1945) and is now found in more than 700 Minnesota lakes (Invasive Species Program 2008). Like many native submerged plants, it is perennial but has a unique life cycle that may provide a competitive advantage over native species. Curly-leaf pondweed is actually dormant during late summer and begins new growth in early fall. Winter foliage is produced and continues to grow under ice (Wehrmeister and Stuckey 1978). Curly-leaf reaches its maximum growth in May and June, when water temperatures are still too low for most native plant growth. In late spring and early summer, curly-leaf plants form structures called “turions” which are hardened stem tips that

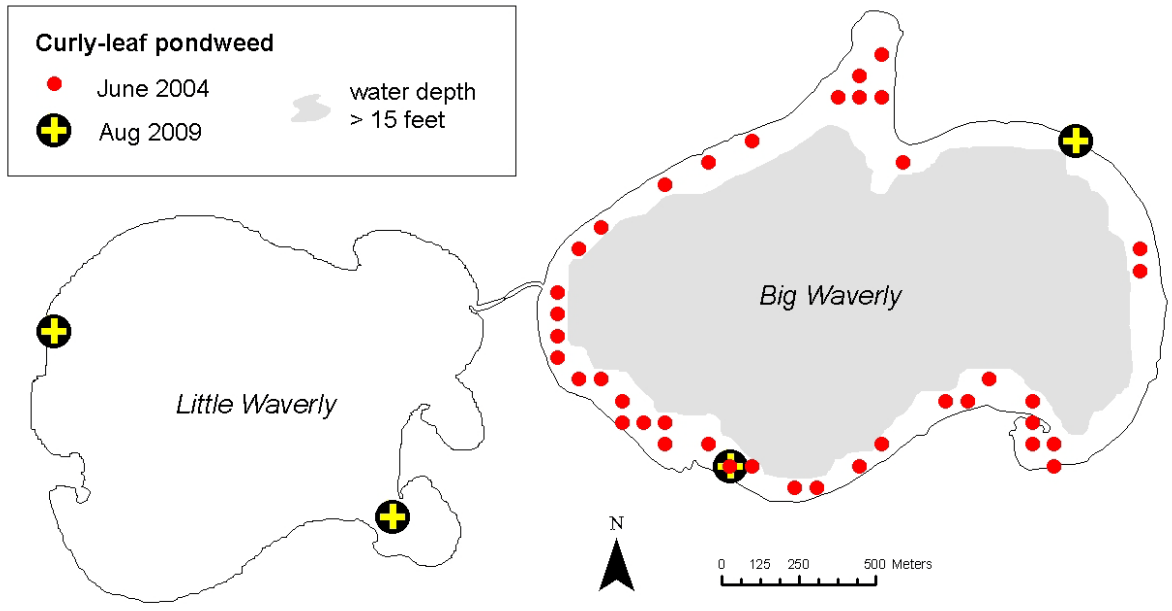
Figure 14. Curly-leaf pondweed

break off and fall to the substrate. Turions remain dormant through the summer and germinate into new plants in early fall (Catling and Dobson 1985).

The foliage of curly-leaf pondweed does provide some fish and wildlife habitat, but it may also create problems in some lakes, or in areas of some lakes. During its peak growth in spring, curly-leaf may reach the water surface at certain depths and create dense mats. These dense growths may compete with native vegetation and can also cause problems for recreational lake users. When large populations of curly-leaf pondweed decay, the release of phosphorus into the water column is often followed by increased algal growth (Bolduan et al. 1994).

In Big Waverly Lake, curly-leaf pondweed occurred in 35% of the sites during the spring 2004 survey (Figure 15). It was found in depths of 2 to 10 feet (Figure 9). Curly-leaf pondweed was present in both lakes during the late summer 2009 surveys, but had already begun to die back in both lakes.

Figure 15. Curly-leaf pondweed in Big Waverly (2004 and 2009) and Little Waverly (2009).



Other submerged species found in these lakes occurred at relatively low frequencies (Table 3) and were generally restricted to water depths less than 10 feet (Figure 9).

White waterlily *(Nymphaea odorata)* was the only floating-leaf species identified during these surveys. It was found in the southeast bay of Big Waverly Lake. Emergent plants were very sparse and only a few isolated patches of bulrush (*Scirpus*) were found.

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Shoreline of Waverly Lake, August 2009