Aquatic Vegetation of
Upper Twin Lake (29-0157-00) Hubbard County
and
Lower Twin Lake (80-0030-00) Wadena County, Minnesota

June 22-23, 2005

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Summary

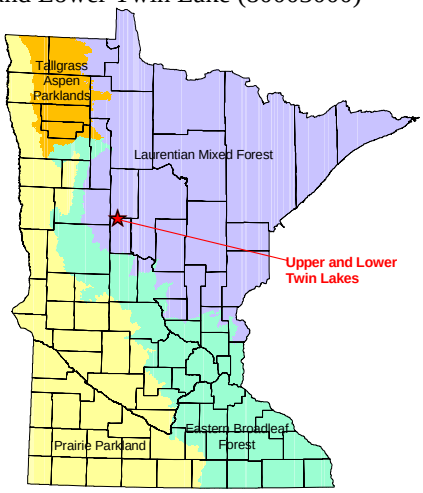
Upper and Lower Twin Lakes are relatively small, shallow lakes located south of Park Rapids, Minnesota. Vegetation surveys were conducted on June 22 and 23, 2005 to assess the aquatic plant community and provide quantitative estimates of the frequency at which the common submerged plant species occur.

A total of 29 native aquatic plant species were recorded in the lakes, including five emergent, four floating-leaved, two free-floating and 18 submerged species. Wild rice (*Zizania aquatica*) was present in over half of the Lower Twin Lake sites and yellow waterlily (*Nuphar variegata*) was common in both lakes. Submerged vegetation occurred across the entire area of Upper Twin Lake to a maximum depth of 10 feet and in about one-third of Lower Twin Lake to a depth of 12 feet. Within the depth zone from shore to 12 feet, 94 percent of the Upper Twin sites and 95 percent of the Lower Twin sites contained vegetation.

The most common native submerged species were Canada waterweed (*Elodea canadensis*), flatstem pondweed (*Potamogeton zosteriformis*), northern watermilfoil (*Myriophyllum sibiricum*), coontail (*Ceratophyllum demersum*) and muskgrass (*Chara* sp.). These species occurred in more than 20 percent of the sites in at least one of the lakes. The non-native submerged species, curly-leaf pondweed (*Potamogeton crispus*) was also present and abundant but it was not the dominant species in either lake.

Introduction

Figure 1. Upper Twin Lake (29015700) and Lower Twin Lake (80003000)

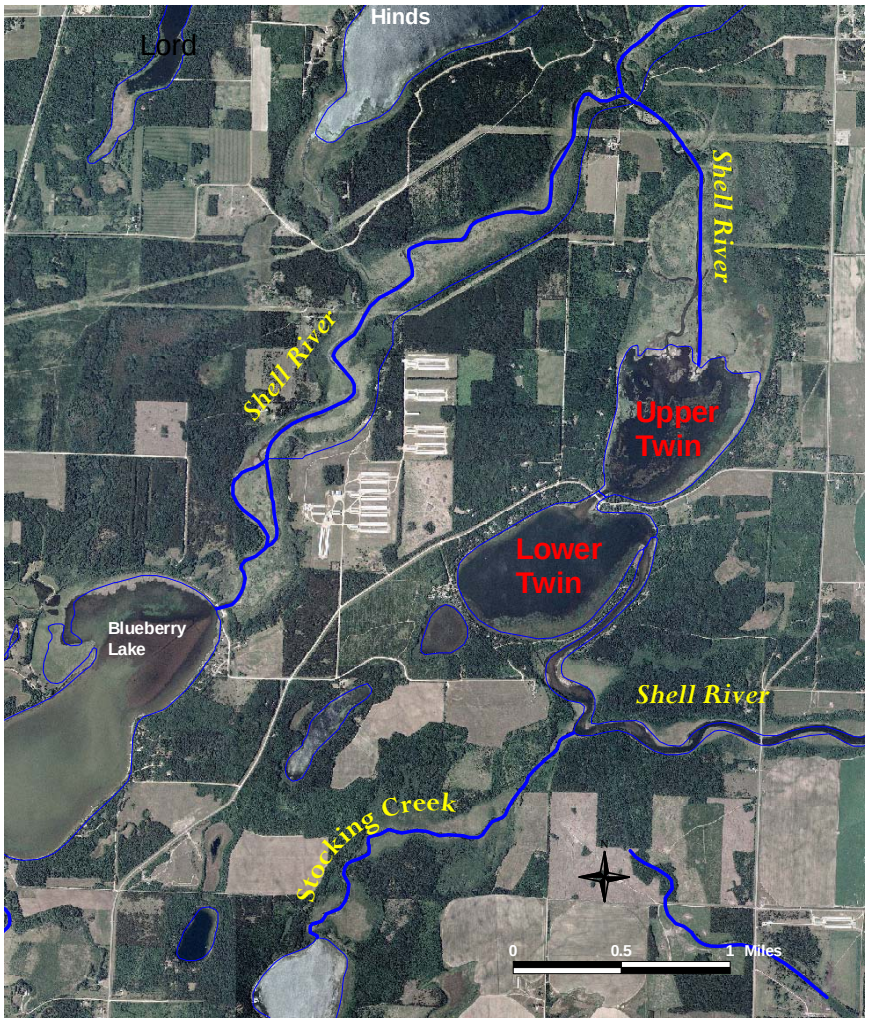


Upper Twin Lake (DOW 29-0157-00) and Lower Twin Lake (DOW 80-0030-00) are located about eight miles south of Park Rapids, Minnesota within the Laurentian Mixed Forest Province ecological region (Fig. 1).

The lakes lay at the northern edge of the Crow Wing River Watershed. The Shell River enters the north end of Upper Twin and flows out of the south end of Lower Twin (Fig. 2). The lakes are connected by a channel where the Shell River flows between them.

Some uplands adjacent to Upper and Lower Twin Lakes remain forested but large areas have been converted to agriculture (Fig. 2). A large wetland complex occurs at the north end of Upper Twin and that lake remains relatively undeveloped. Residential homes occur around all of Lower Twin except for a marshy area on the southeast side. A public boat launch is located on the Shell River in the channel connecting the two lakes (Fig. 3).

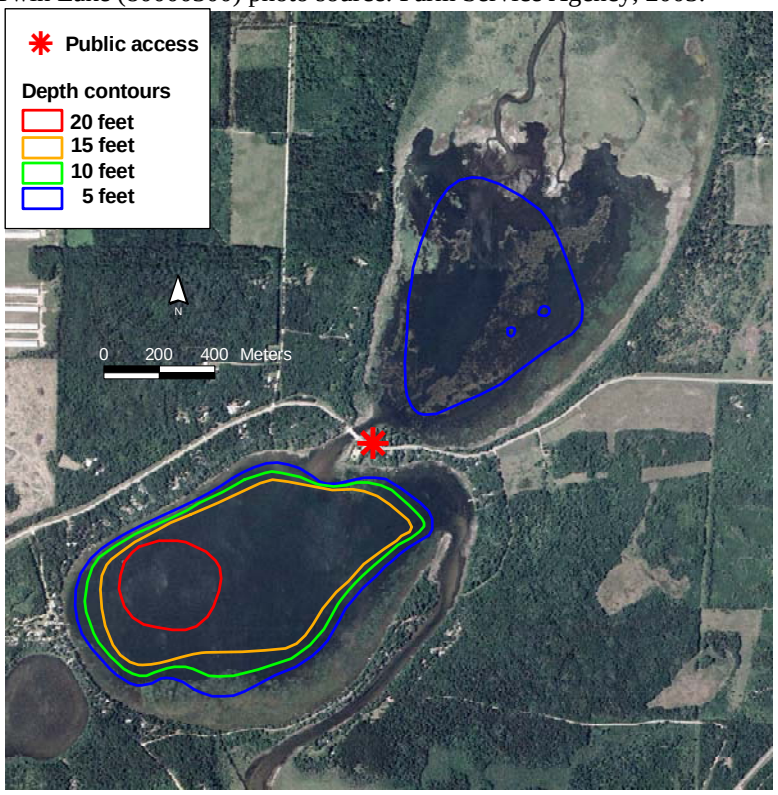
Figure 2: Inlets and outlets of Upper and Lower Twin Lakes.



Upper Twin is entirely shallow lake with a surface area of about 225 acres and a maximum depth of 12 feet (Fig. 3). Lower Twin is larger and deeper with a surface area of 391 acres and a maximum depth of 26 feet (Fig. 3).

Both lakes are described as eutrophic (high nutrients). Mid-summer water clarity averages 6.5 feet in Upper Twin and 6.3 feet in Lower Twin as

Figure 3. Depth contours of Upper Twin Lake (29015700) and Lower Twin Lake (80000300) photo source: Farm Service Agency, 2003.



measured by Secchi depth readings between 1995 and 2003 (MPCA 2005).

Aquatic plant surveys have previously been conducted on these lakes in 1949 by MnDNR Game Lake Program and in 1988 by MnDNR Fisheries Lake Survey Program (MnDNR Lake Files). Historically, vegetation has been described as abundant with plant growth to a depth of 12 feet in Lower Twin and to nine feet in Upper Twin. Wild rice was estimated to cover about 25 acres of Lower Twin Lake in 1949. Both previous surveys list a variety of common native species including wild rice (*Zizania aquatica*), bulrush (*Scirpus* sp.), yellow waterlily (*Nuphar* sp.), white waterlily (*Nymphaea* sp.), coontail (*Ceratophyllum demersum*), Canada waterweed (*Elodea canadensis*), native pondweeds (*Potamogeton* spp.), northern milfoil (*Myriophyllum* sp.) and muskgrass (*Chara* sp.) (MnDNR Lake Files).

Upper and Lower Twin Lakes are among several lakes in this watershed where the non-native plant, curly-leaf pondweed (*Potamogeton crispus*) has invaded.

Vegetation Survey Objectives

The purpose of vegetation survey of Upper and Lower Twin Lakes was to describe the current aquatic plant community including:

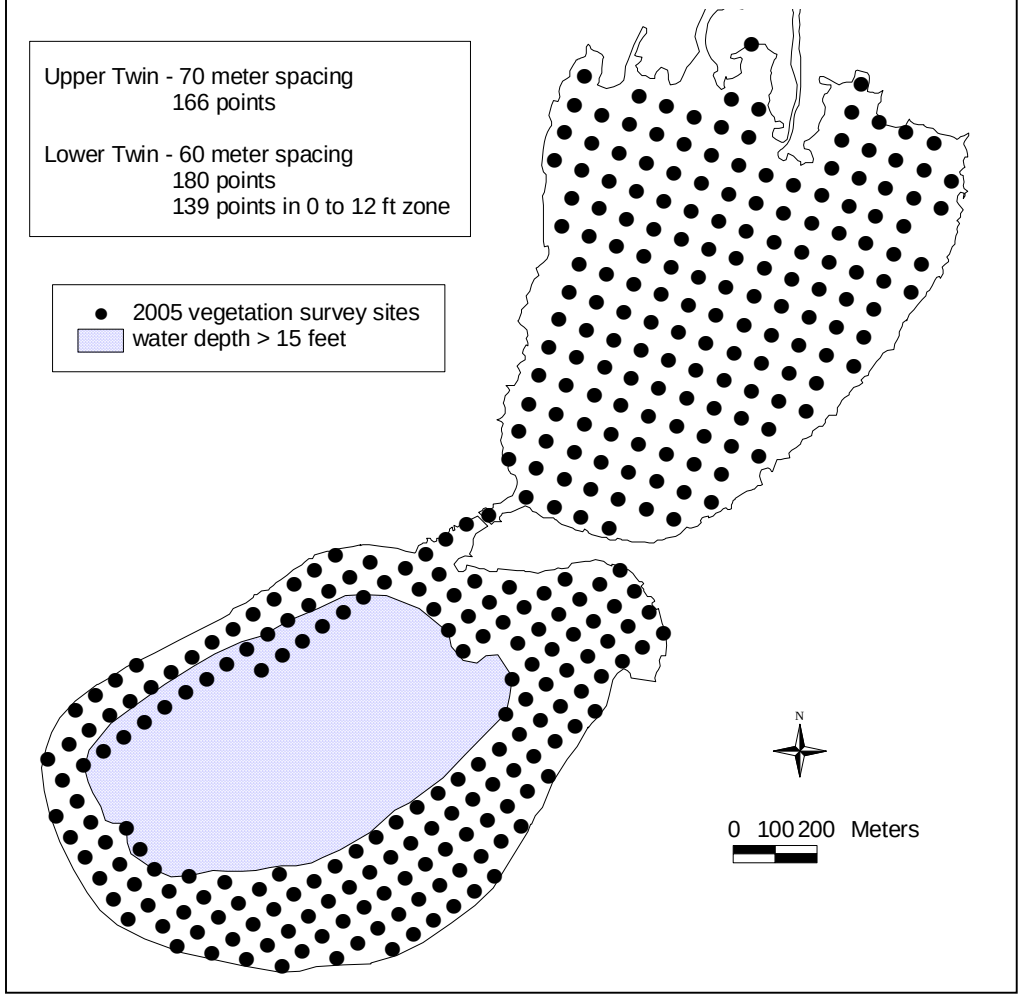
1) Estimate the maximum depth of rooted vegetation
2) Estimate the percent of the lake occupied by rooted vegetation
3) Record the aquatic plant species that occur in the lake
4) Estimate frequencies of occurrence of individual species
5) Develop distribution maps for the common species

Methods

A Point-Intercept vegetation survey of Upper Twin Lake was conducted on June 22, 2005 and of Lower Twin Lake on June 23, 2005 following the methodology described by Madsen (1999). Survey waypoints were created using Geographic Information System (GIS) software. To establish a minimum of 100 points within the vegetated zone of each lake, sample point spacing

was different on each lake. Survey points were spaced 70 meters apart on Upper Twin Lake and 60 meters apart on Lower Twin (Fig. 4).

Figure 4. 2005 vegetation survey points on Upper Twin (29-0157-00) and Lower Twin (80-00030-00) Lakes.



Survey waypoints were downloaded into a Global Positioning System (GPS) receiver and the GPS unit was used to navigate the boat to each sample point. One side of the boat was designated as the sampling area. At each site, water depth was recorded in one foot increments using a measured stick in water depths less than eight feet and an electronic depth finder in water depths greater than eight feet. The surveyors recorded all plant species found within a one meter squared sample site at the pre-designated side of the boat. A double-headed, weighted garden rake, attached to a rope (Fig. 5) was used to survey vegetation not visible from the surface. If curly-leaf pondweed was present at a site, surveyors recorded whether or not it formed surface mats at that site.

Figure 5. Rake used to sample vegetation

The entire basin of Upper Twin was sampled but in Lower Twin, surveyors sampled to a depth of 16 feet after initial sampling found no vegetation in depths greater than 12 feet. Surveyors sampled a total of 166 points in Upper Twin and 180 points in Lower Twin (Fig. 4).

Nomenclature for plant identification followed Crow and Hellquist (2000).

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 vegetated zone of each lake (shore to 12 feet). In Upper Twin Lake, all 166 sample points occurred within this depth range and in Lower Twin Lake, 139 sample points were in this depth range. Sampling points were also grouped by water depth and separated into five depth zones for analysis: 0 to 3 feet, and 4 to 6 feet, 7 to 9 feet, 10 to 12 feet, 13 to 20 feet.

Example:
In Lower Twin Lake, there were 180 sample sites but only 139 occurred within the vegetated zone from shore to 12 feet.
In 2005, muskgrass occurred in 55 of the sample sites within the shore to 12 feet zone.
Frequency of muskgrass in vegetated zone of Lower Twin Lake = 55/139 (*100) = 40%

Results

Number of species recorded
A total of 29 native aquatic plant species were recorded in Upper and Lower Twin Lakes, including five emergent, four floating-leaved, two free-floating and 18 submerged species (Table 1). Curly-leaf pondweed (*Potamogeton crispus*), a non-native, submerged aquatic plant species was documented in the lake.

Maximum depth of vegetation and percent of lake with vegetation
Vegetation was found to the maximum depth sampled (10 feet) in Upper Twin Lake and to 11 feet in Lower Twin Lake. While nearly the entire basin of Upper Twin supports vegetation only two-thirds of Lower Twin is shallow enough for aquatic plant growth. Within the depth zone from shore to 12 feet, 95 percent of the Upper Twin sites and 94 percent of the Lower Twin sites contained vegetation (Fig. 6).

In both lakes, plants were most abundant in depths less than ten feet, where nearly all sample sites were vegetated (Fig. 7). In depth zone from 10 to 12 feet, at least half the sites lacked vegetation and no vegetation was found beyond that depth zone (Fig. 7).

Distribution of species by water depth
The highest number of plant species was found in the zone from shore to a depth of three feet (Fig. 8). Free-floating and floating-leaved species were only found to a depth of six feet.

Table 1. Aquatic Plants of Upper Twin (29-0157-00) and Lower Twin (80-00030-00) Lakes, June 22-23, 2005

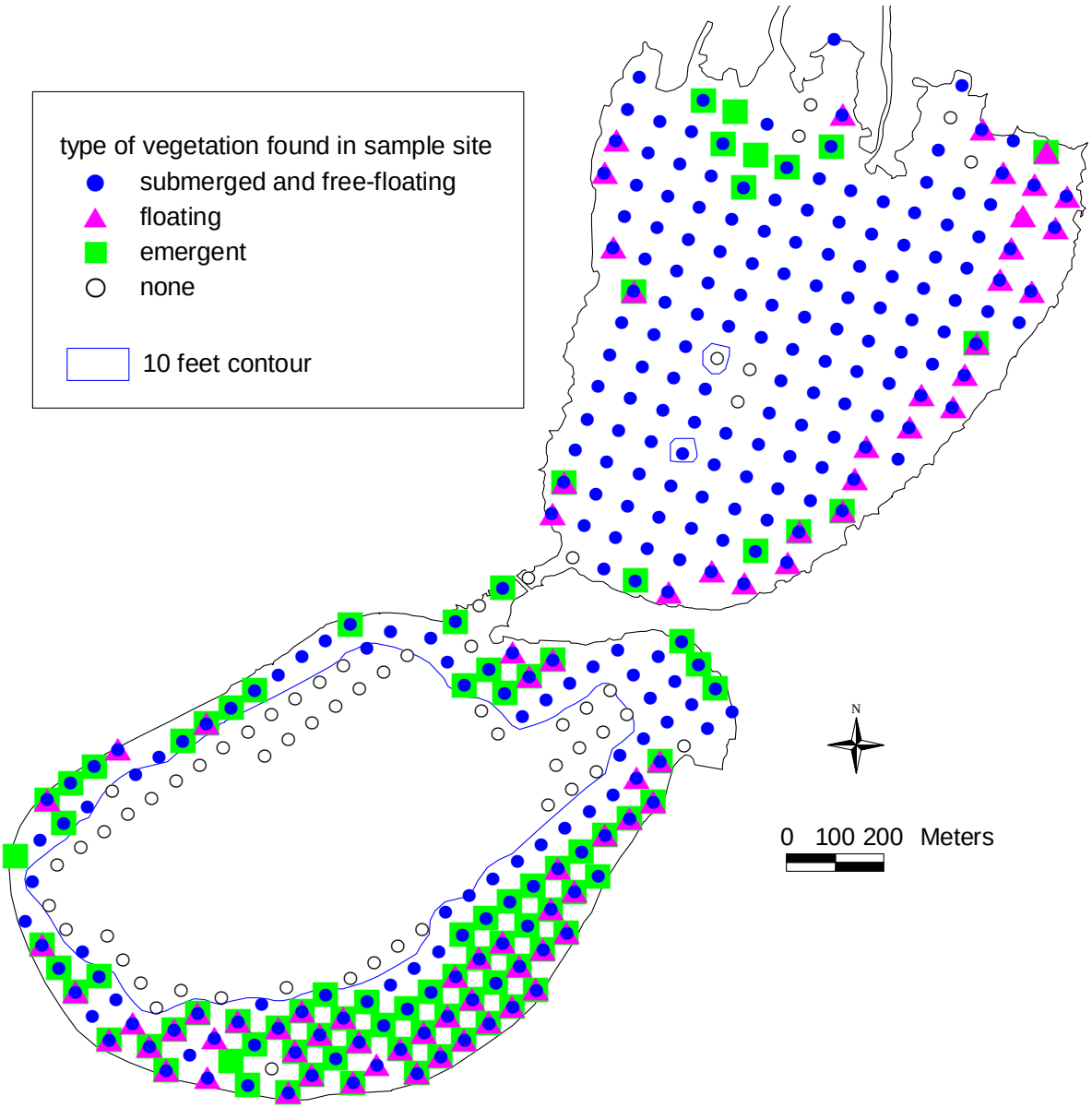
Frequency calculated for entire vegetated zone (shore to 12 feet depth)
Frequency = percent of sites in which species occurred

			U.pper Twin 166 samples	Lower Twin 139 samples
Life Form	**Common Name**	**Scientific Name**	**Frequency**	
SUBMERGED-ANCHORED These plants grow primarily under the water surface. Upper leaves may float near the surface and flowers may extend above the surface. Plants are often rooted or anchored to the lake bottom.	Canada waterweed	*Elodea canadensis*	59	43
	Curly-leaf pondweed	*Potamogeton crispus*	43	38
	Flat-stem pondweed	*Potamogeton zosteriformis*	28	32
	Northern watermilfoil	*Myriophyllum sibiricum*	15	46
	Coontail	*Ceratophyllum demersum*	23	16
	Muskgrass	*Chara sp.*	2	40
	White water buttercup	*Ranunculus sp.*	18	17
	Narrowleaf pondweed	*Potamogeton freisii**	12	20
	Whitestem pondweed	*Potamogeton praelongus*	13	2
	Greater bladderwort	*Utricularia vulgaris*	2	9
	Clasping-leaf pondweed	*Potamogeton richardsonii*	3	2
	Sago pondweed	*Stuckenia pectinata*	2	1
	Water stargrass	*Zosterella dubia*	1	2
	Stonewort	*Nitella sp.*	2	---
	Wild celery	*Vallisneria americana*	----	1
	Bushy pondweed	*Najas flexilis*	---	2
	Large-leaf pondweed	*Potamogeton amplifolius*	1	- --
	Illinois pondweed	*Potamogeton illinoensis*	1	---
	Water marigold	*Megaladonta beckii*	---	1
FREE-FLOATING These plants float on the water and drift with water currents.	Lesser duckweed	*Lemna minor*	10	---
	Star duckweed	*Lemna trisulca*	1	---
FLOATING These plants are rooted in the lake bottom and have leaves that float on the water surface. Many have colorful flowers that extend above the water	Yellow waterlily	*Nuphar variegata*	14	32
	White waterlily	*Nymphaea odorata*	5	5
	Watershield	*Brasenia schreberi*	1	---
	Floating-leaf pondweed	*Potamogeton natans*	3	9
EMERGENT These plants extend well above the water surface and are usually found in shallow water, near shore.	Wild Rice	*Zizania palustris*	5	53
	Hardstem bulrush	*Scirpus acutus*	2	14
	spikerush	*Eleocharis sp.*	1	--
	Giant Cane	*Phragmites australis*	1	--
	Cattail	Typha sp.	1	2

* Potamogeton freisii was confirmed in the lake but other narrow-leaf pondweeds (*Potamogeton* spp.) may also have been present. All narrow-leaf pondweeds were grouped together for analysis.

Highlite = non-native species

Figure 6. Distribution of emergent, floating and submerged vegetation in Upper Twin (29-0157-00) and Lower Twin (80-00030-00) Lakes, June 22-23, 2005.



Emergent plants were mostly restricted to depths less than six feet except for one site in eight feet of water where wild rice occurred but did not reach the water surface. Submerged species occurred at all water depths within the vegetated zone with most species present in depths from shore to six feet. Nine submerged species were found in depths greater than six feet and only four species occurred in depths greater than nine feet (Fig. 8).

Figure 7. Frequency of vegetation vs. water depth, Upper Twin (29-0157-00) and Lower Twin (80-00030-00) Lakes, June 2005

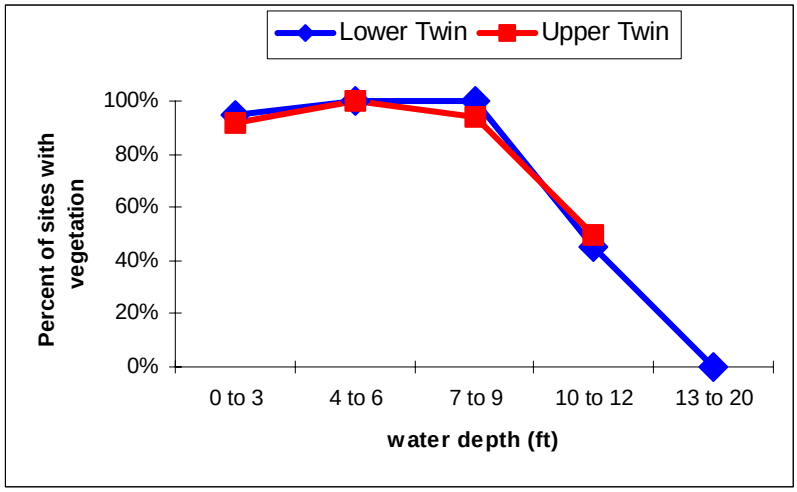
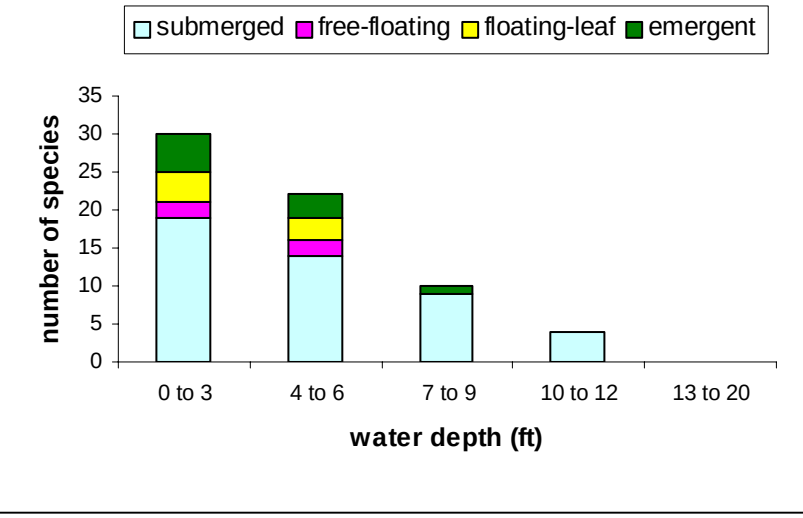


Figure 8. Total number of species found at each depth zone. Upper Twin (29015700) and Lower Twin (800003000) Lakes, June 2005



Emergent and Floating-leaf plants

Within the depth zone from shore to six feet, emergent plants occurred in 11 percent of the Upper Twin sites and 67 percent of the Lower Twin shallow sites (Fig. 6). Wild rice (*Zizania aquatica*) was the most common emergent species and was found in seven percent of the Upper Twin shallow sites (shore to six feet) and in 60 percent of the Lower Twin shallow sites. Other emergent species included bulrush (*Scirpus* sp.)(Fig. 9), spikerush (*Eleocharis* sp.) giant cane (*Phragmites australis*) and cattail (*Typha* sp.) (Table 1).

Floating-leaf plants were present in 23 percent of the Upper Twin shallow sites (shore to six feet)

Figure 9. Emergent vegetation (bulrush) in Lower Twin Lake (80-0030-00) June 23, 2005

and in 41 percent of the Lower Twin shallow sites (Fig. 6). Yellow waterlily (*Nuphar variegata*) was the most common floating-leaf species and occurred in 18 percent of the Upper Twin shallow sites and in 37 percent of the Lower Twin shallow sites. Other floating-leaf species found were White waterlily (*Nymphaea odorata*), Watershield (*Brasenia schreberi*), and floating-leaf pondweed (*Potamogeton natans*).

Common submerged species

In Upper Twin Lake, 92 percent of the sample sites contained submerged vegetation and native submerged species were present in 84 percent of the sites. In Lower Twin, within the shore to 12 feet zone, submerged plant were present in 92 percent the sites and native submerged species occurred in 91 percent of the sites. In shallow areas of both lakes, submerged vegetation often reached the water surface (Fig 10).

Fig. 10. Submerged vegetation in Lower Twin Lake (80-0030-00) June 23, 2005.

The most common native submerged species were Canada waterweed (*Elodea canadensis*), flatstem pondweed (*Potamogeton zosteriformis*), northern watermilfoil (*Myriophyllum sibiricum*), coontail (*Ceratophyllum demersum*) and muskgrass (*Chara* sp.). These species occurred in more than 20 percent of the sites in at least one of the lakes (Table 1). Canada waterweed (*Elodea canadensis*) was present in 59 percent of the Upper Twin sites and in 43 percent of the Lower Twin sites (Table 1). This species is tolerant of lower turbidity (Nichols 1999) and most abundant in lake areas with fine sediments enriched with organic matter (Borman et al. 1997). It occurred throughout the vegetated zone of both lakes (Fig. 11). It was most abundant in depths less than seven feet and in Upper Twin Lake it was the dominant species in that shallow water zone (Fig. 12).

Flatstem pondweed (*Potamogeton zosteriformis*) occurred in 28 percent of the Upper Twin sites and in 32 percent of the Lower Twin sites (Table 1). This species prefers soft sediments but is not tolerant of turbidity (Nichols 1999). It was widespread in both lakes (Fig. 11) but was common at different depth zones. In Upper Twin, it reached its maximum frequency at depths of four to six feet but in Lower Twin it was more abundant in depths of seven to nine feet, where it was the dominant species (Fig. 12).

Northern watermilfoil (*Myriophyllum sibiricum*) was more frequent in Lower Twin (46 percent

Figure 11. Distribution of common aquatic plant species in

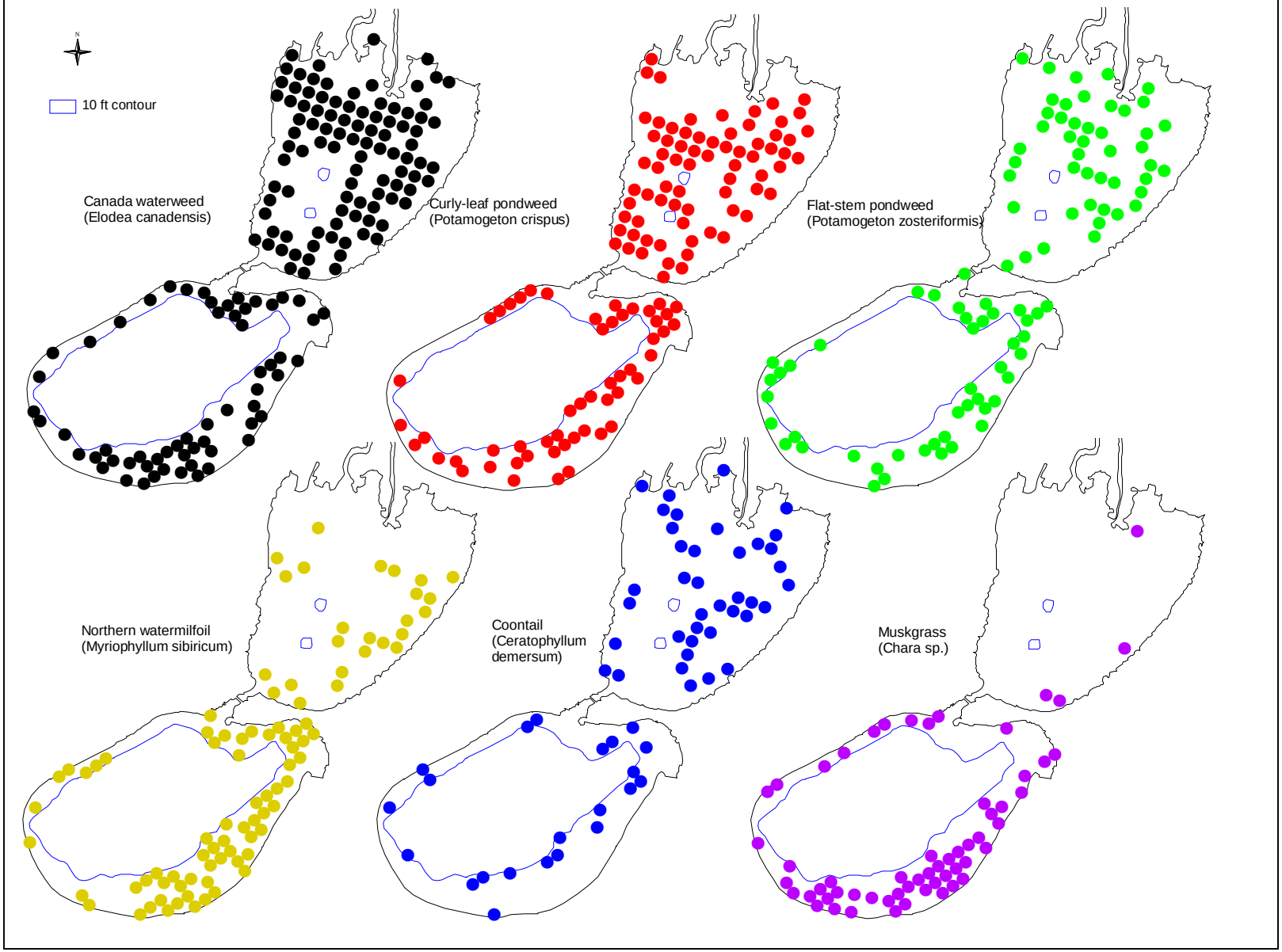
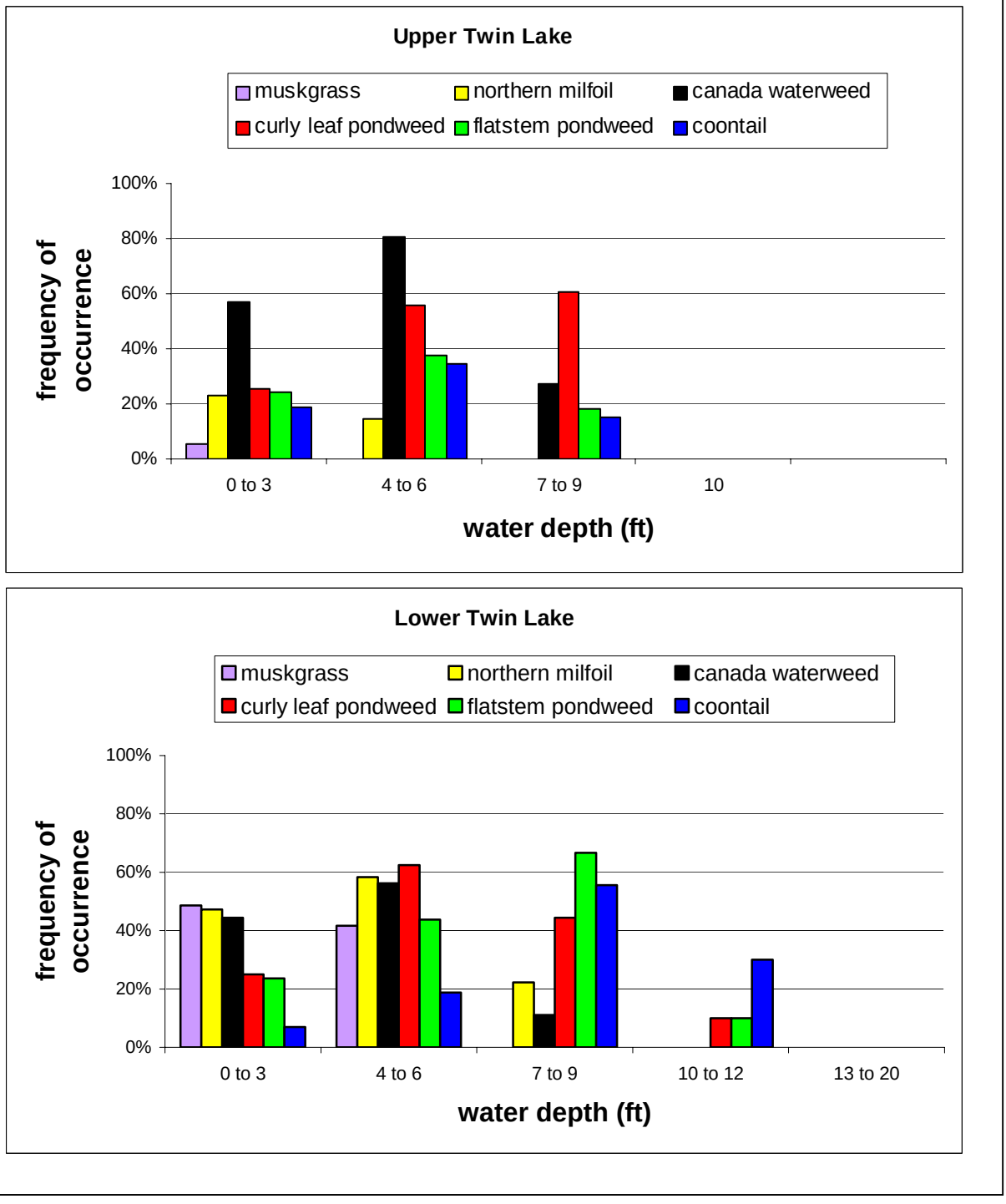


Figure 12. Frequency of common aquatic plant species vs. water depth.
Upper Twin (29015700) and Lower Twin (800003000) Lakes, June 2005



frequency) than in Upper Twin (15 percent frequency) (Table 1 and Fig. 11). Northern milfoil prefers soft sediments but is not turbidity tolerant (Nichols 1999). In Upper Twin it was found to a depth of six feet but occurred to a depth of nine feet in Lower Twin (Fig. 12).

Coontail (*Ceratophyllum demersum*) was found in 23 percent of the Upper Twin site and in 16 percent in Lower Twin (Table 1). Like Canada waterweed, this species is turbidity tolerant and prefers soft sediments (Nichols 1999). Similar to flat-stem pondweed, this species was more common in depths great than three feet (Fig. 12).

Muskgrass (*Chara* sp.) was not an important component of the Upper Twin community (two percent frequency) but occurred in 40 percent of the Lower Twin sites (Table 1). Muskgrass is a macroscopic algae that is common in many hardwater Minnesota lakes. 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 invade open areas of lake bottom where it can act as a sediment stabilizer. Unlike the other common submerged species, muskgrass is often found on sandy lake bottoms (Borman, et al. 1997). In was found to a depth of three feet in Upper Twin and to six feet in Lower Twin (Fig. 12).

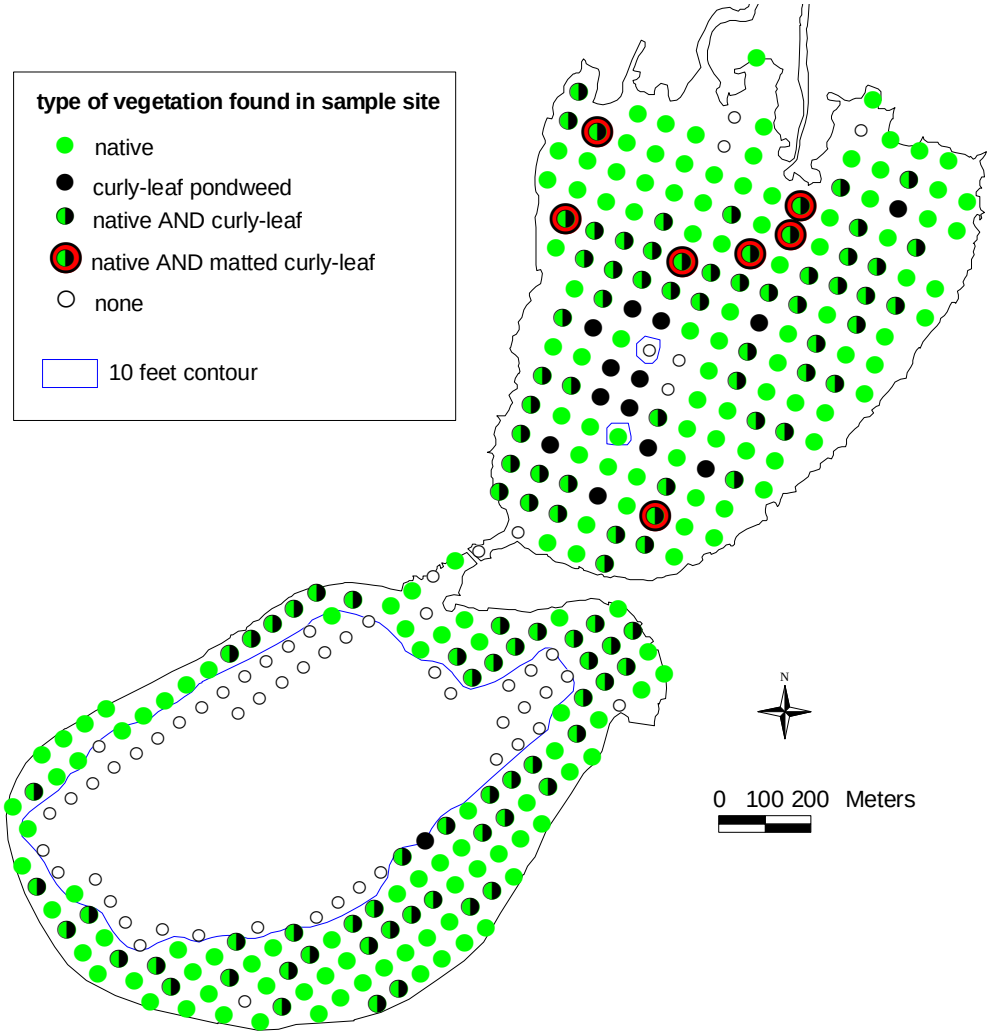
All other native submerged species occurred in less than 20 percent of the sample sites of each lake (Table 1).

Curly-leaf pondweed (*Potamogeton crispus*) had a frequency of 43 percent in Upper Twin and 38 percent in Lower Twin (Table 1). Like many of the common native submerged species in these lakes, curly-leaf pondweed prefers soft substrates and is tolerant of turbidity. It occurred throughout the vegetated zone of both lakes (Fig. 11) and was most common in depths from four to nine feet (Fig. 12).

Curly-leaf pondweed 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 at least 700 Minnesota lakes (Invasive Species Program 2005). Like many native submerged plants, it is perennial but it 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 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). During its peak growth in spring, curly-leaf may reach the water surface at certain depths and create dense mats. During the June 2005 survey, curly-leaf surface mats were reported in only four percent of the Upper Twin sample sites (Fig 13).

For more information on curly-leaf pondweed, see pg 51 of this report: Management of Curly-leaf pondweed

Figure 13. Submerged vegetation in Upper Twin (29-0157-00) and Lower Twin (80-00030-00) Lakes, June 22-23, 2005



Discussion

The broad shallow zones of Upper and Lower Twin Lake provide ideal conditions for aquatic plant growth. The lake supports a diversity of native plant species and the mix of emergent, floating and submerged plant communities provide multiple benefits including fish and wildlife habitat, shoreline protection and nutrient uptake (click here for more information on: value of aquatic plants)

Despite the presence and high abundance of the non-native species, curly-leaf pondweed, native species remain important in these lakes. By contrast, in nearby Blueberry Lake in Wadena County, curly-leaf pondweed has become the dominant species and forms dense surface mats over much of the lake while few native species are found in depths greater than five feet. The high abundance of native submerged species in Upper and Lower Twin Lakes may help buffer against the potential negative impacts of curly-leaf pondweed.

Monitoring changes in aquatic plant community

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. 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. Data from the 2005 vegetation survey can also be used to monitor annual changes in the native and non-native plant species composition. In general, factors that may lead to change in native and non-native aquatic plant communities include:

- Change in water clarity
  If clarity increases in Upper and Lower Twin Lakes, submerged vegetation may be be more common beyond the nine feet depth.
- Snow and ice cover
  Curly-leaf pondweed, in particular, may fluctuate in abundance in response to snow cover. Many native submerged plants also 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, curly-leaf and some native 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.
- Natural fluctuation in plant species.
  Many submerged plants are perennial and regrow in similar locations each year. However, a few species such as wild rice (*Zizania aquatica*) and bushy pondweed (*Najas flexilis*) are annuals and are dependant on the previous years seed set for regeneration.
- Aquatic plant management activities
  Herbicide and mechanical control of aquatic plants can directly impact the aquatic plant community. Monitoring these control activities can help insure that non-target species are not negatively impacted.

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