

**Aquatic Vegetation of Portage Lake
Hubbard County, Minnesota
(DOW 29-0250-00)**

**August 10-11, 2004
May 20, 2005
May 17-18, 2006**



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Summary

Portage Lake is a shallow, nutrient rich lake located near Park Rapids, Minnesota. Vegetation surveys were conducted in August 2004 to assess the native aquatic plant community and in May 2005 and May 2006 to assess the non-native, curly-leaf pondweed population. These surveys provide quantitative estimates of the frequency at which the common submerged plant species occur.

Submerged aquatic plants occur throughout the lake to a depth of 15 feet but are most frequent in water depths less than 10 feet. The native plant community is dominated by coontail (*Ceratophyllum demersum*), a species tolerant of low light and high turbidity. Twelve other native submerged plant species were found but were generally restricted to water depths less than 10 feet where sufficient light is available for growth.

The non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*) has been present in Portage Lake since at least 2002. In early summer 2002, it formed dense surface mats and the lake association began efforts to control the plant through herbicide applications. Curly-leaf pondweed occurred in seven percent of the sites in May 2005 and in 13 percent of the sites in May 2006. These surveys provide estimates of the actual curly-leaf abundance in the lake and indicate that curly-leaf abundance remained relatively low in both spring 2005 and spring 2006.

Another non-native plant, hybrid pink waterlily (*Nymphaea* sp.) was documented in Portage Lake. This plant was likely purchased as a water garden plant and placed into the lake. It has since spread to numerous areas around the lakeshore. Although it has an attractive flower, this exotic plant should not be planted in or near Minnesota lakes because it has the potential to crowd out native plant species.

Introduction

Portage Lake (DOW 29-0250-00) is located three miles north of the city of Park Rapids in Hubbard County, Minnesota within the ecological region called the [Laurentian Mixed Forest Province](#) (Fig. 1).

The lake lies at the northern edge of the Crow Wing River Watershed and is one of several lakes in this watershed where the non-native plant, curly-leaf pondweed (*Potamogeton crispus*) has been found (Fig. 2). Flow leaves the eastern end of Portage Lake through a creek to Fish Hook Lake, then south through the Fish Hook River, east through the Shell River, and then to the Crow Wing River.

Figure 1: Location of Portage Lake, Hubbard County, MN.

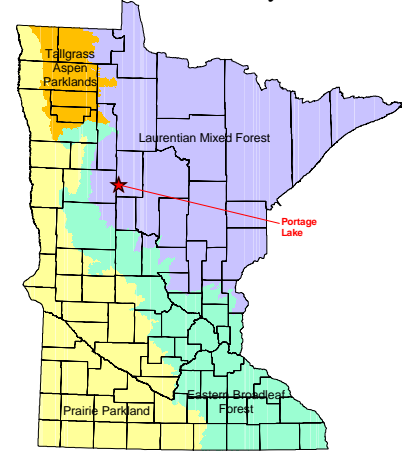
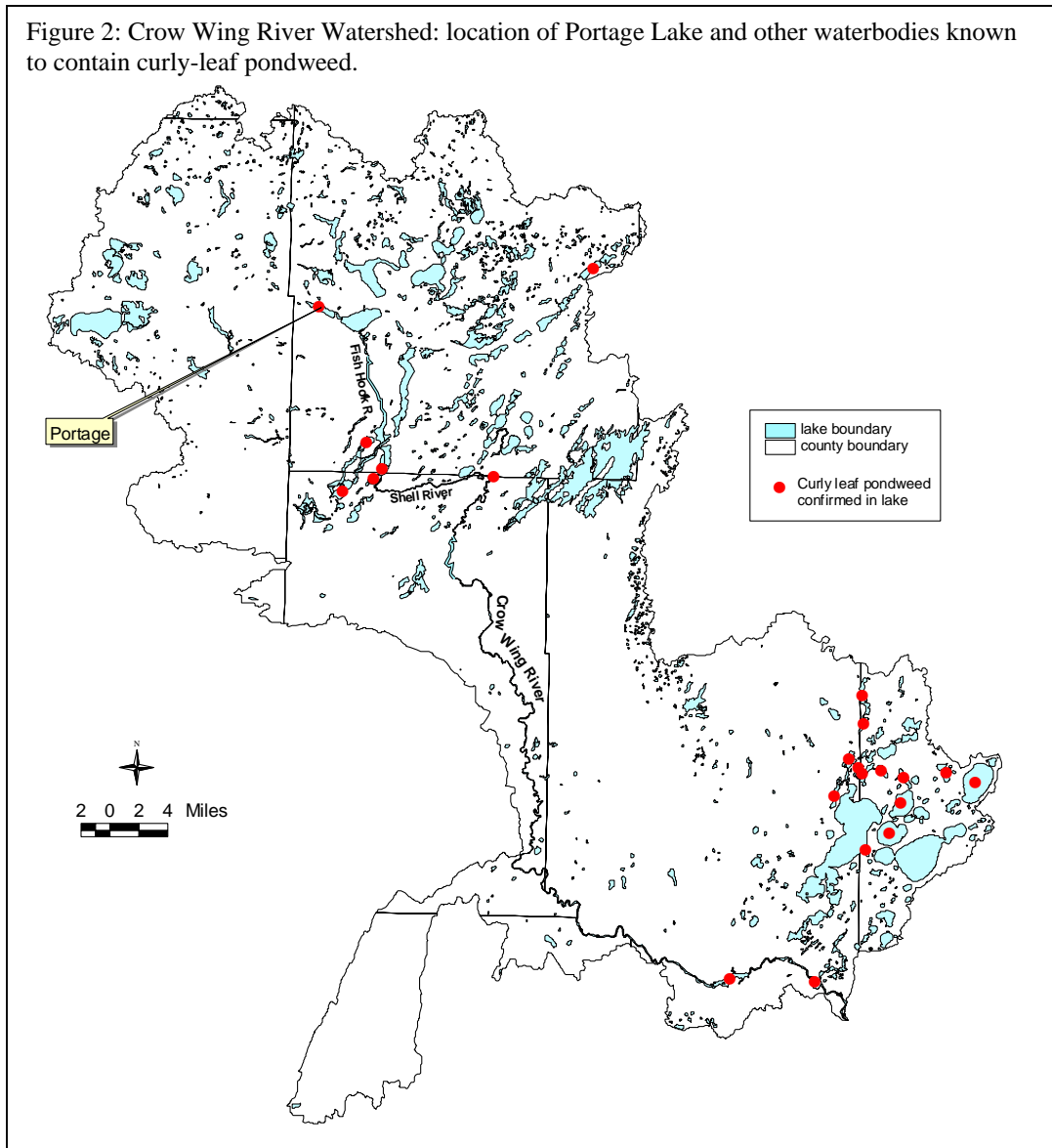


Figure 2: Crow Wing River Watershed: location of Portage Lake and other waterbodies known to contain curly-leaf pondweed.



Within the sub-watershed containing Portage Lake, land use is a mix of forested and agricultural land. Much of the shoreline adjacent to Portage Lake remains forested but it has been developed for seasonal and permanent residences (Fig. 3.) A public boat launch is located on the south shore.

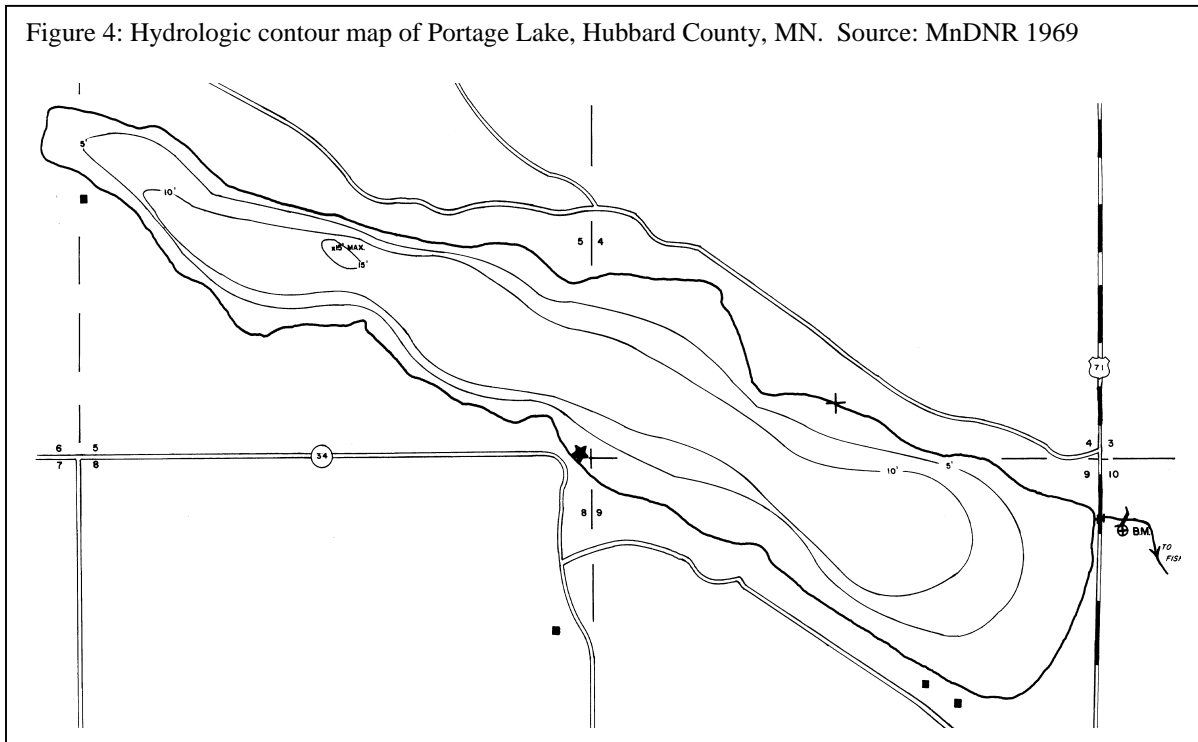
Portage Lake is an elongated basin with a surface area of about 412 acres. It is shallow, with a maximum depth of 17 feet (Fig. 4).

Figure 3. Aerial photograph of Portage Lake, Hubbard County source: Farm Service Agency, 2003.



The lake is described as eutrophic (moderate-high nutrients) with low water clarity as indicated by a mean summer Secchi depth of about four feet between 1996 and 2005 feet (MPCA 2005). In recent years, reports of mid-summer algal blooms have been common.

Figure 4: Hydrologic contour map of Portage Lake, Hubbard County, MN. Source: MnDNR 1969



Vegetation Survey Objectives

The purpose of vegetation surveys of Portage Lake was to describe the current aquatic plant community including:

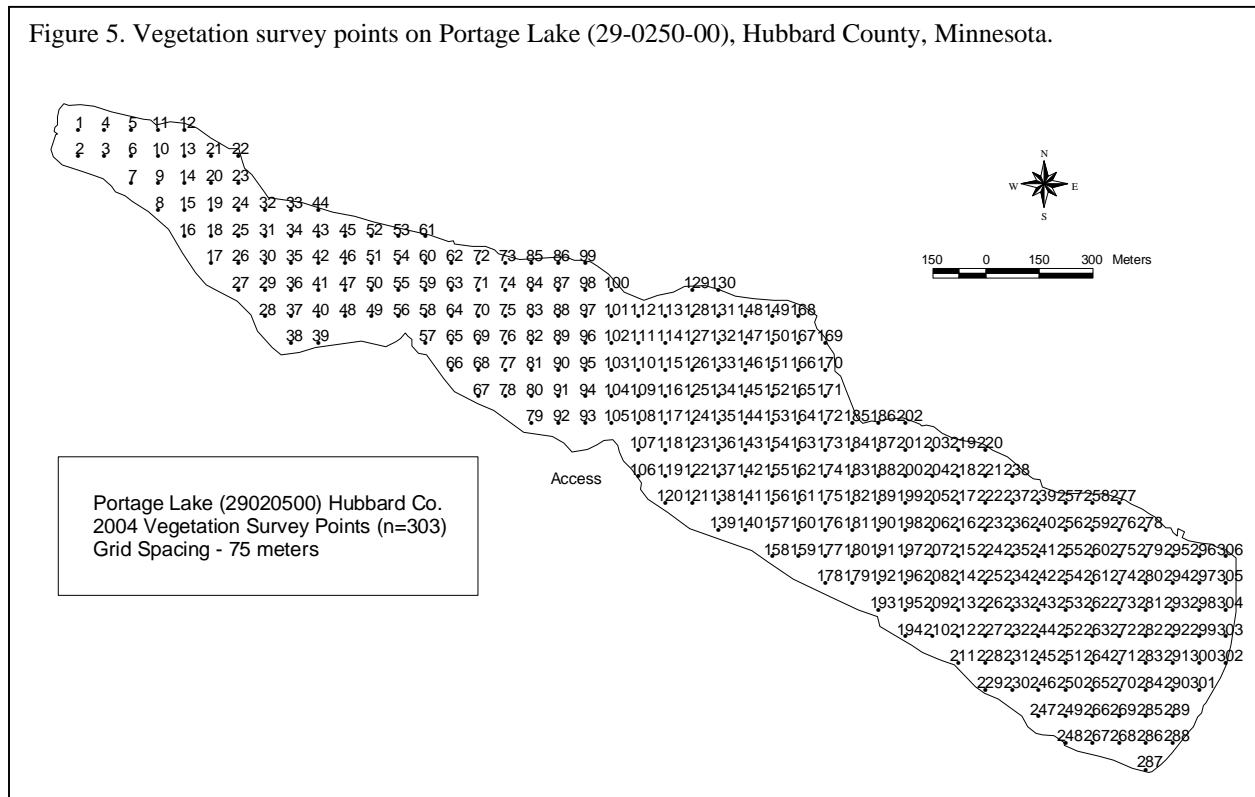
- 1) Estimate the maximum depth of rooted vegetation
- 2) Estimate the percent of the lake occupied by rooted vegetation
- 3) Record the aquatic plant species that occur in the lake
- 4) Estimate frequencies of occurrence of individual species
- 5) Develop maps of the distribution of the common species

The August 2004 survey assessed the native plant community. The survey was repeated in May 2005 and May 2006 to specifically estimate the abundance and distribution of curly-leaf pondweed, a non-native species that reaches its peak growth in late spring.

Methods

Aquatic Vegetation Survey Methods

A Point-Intercept vegetation survey of Portage Lake was conducted on August 10 and 11, 2004 following the methodology described by Madsen (1999). The survey was repeated on May 20, 2005 and on May 18 and 19, 2006. Sample points were established using a GIS software program using a 75 meter by 75 meter grid across the lake surface (Fig. 5). A total of 303 sites were sampled during each survey.



Survey waypoints were created and downloaded into a Global Positioning System (GPS) receiver. 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 was used to survey vegetation not visible from the surface (Fig. 6). If curly-leaf pondweed was present at a site, surveyors recorded whether or not it formed surface mats at that site.

Figure 6: Rake used to sample vegetation.



Nomenclature followed Crow and Hellquist (2000). Voucher specimens were collected for most plant species.

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.

Example:

There were 303 samples sites.

In 2004, Coontail occurred in 124 of those sample sites.

Frequency of coontail in 2004 = $124/303 (*100) = 41\%$

Frequency was calculated for the entire vegetated lake and sampling points were also grouped by water depth and separated into six depth zones for analysis: 0 to 3 feet, and 4 to 6 feet, 7 to 9 feet, 10 to 12 feet, 13 to 15 feet, and 16 feet.

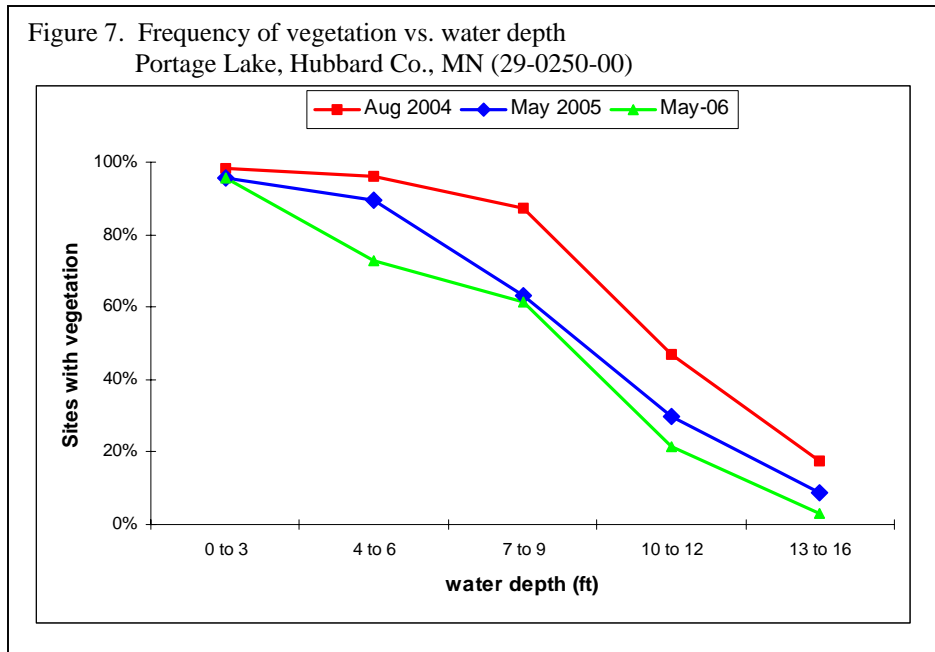
Results / Discussion

The data from the August 2004 survey cannot be directly compared to the May 2005 or May 2006 survey data because native plant species reach peak growth in late summer and the exotic, curly-leaf pondweed reaches peak growth in mid to late spring. Lower frequency values for native species during the May 2005 and May 2006 surveys are expected and do not necessarily indicate that these native species have actually decreased in abundance in the lake. Similarly, curly-leaf pondweed naturally senesces by mid-summer and a low frequency value for this species in August may not be predictive of its potential growth in the following spring. In order to compare changes in native species abundance, a survey should be repeated in late summer. To estimate changes in curly-leaf pondweed abundance, results of the May 2005 and May 2006 surveys are compared.

Maximum depth of vegetation and percent of lake with vegetation

As expected, vegetation was found in more sites during the August 2004 survey (57 percent of sites vegetated) than during the May 2005 (49 percent of sites vegetated) and May 2006 (41 percent of sites vegetated) when most plant species were still in early growth stages.

During all surveys, vegetation occurred to a maximum depth of 15 feet but plant growth was most abundant in water depths less than ten feet where at least 60 percent of the sites in this zone contained vegetation (Fig 7). Plant abundance decreased with increasing water depth and in depths greater than 12 feet, fewer than 20 percent of the sites contained vegetation (Fig. 7). Plant occurrence was greater at all depths during the August 2004 survey but the same general trend of decreasing vegetation with increasing water depth was seen during all surveys.



Number of species recorded

A total of 26 native aquatic plant species were recorded in Portage Lake, including 13 submerged species, five free-floating, three floating-leaved, and five emergent. In addition, several native wetland emergent plant species were also recorded (Table 1).

Two non-native aquatic plant species were documented in the lake. Curly-leaf pondweed (*Potamogeton crispus*) is an exotic, submerged aquatic plant and a hybrid pink waterlily (*Nymphaea* sp.) is a non-native floating-leaved plant.

The highest number of plant species was found during the August 2004 survey (Table 1). Fewer species were found during the May 2005 and May 2006 surveys because most native species do not reach their peak biomass until later in the summer. For this reason, direct comparisons between species occurrence and abundance in May and August are not useful. For example, the fact that Illinois pondweed (*Potamogeton illinoensis*) was found during the August 2004 survey but not during the May 2005 or May 2006 surveys is likely because the species had not yet

Table 1. Aquatic Plants of Portage Lake Hubbard County (29-0250-00)

August 2004, May 2005, May 2006

Frequency calculated for entire lake (shore to 16 feet depth)

Frequency = percent of sites in which species occurred
303 sample sites

Life Form	Common Name	Scientific Name	Frequency		
			Aug 2004	May 2005	May 2006
SUBMERGED 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.	Coontail	<i>Ceratophyllum demersum</i>	40	24	17
	Muskgrass	<i>Chara sp.</i>	28	31	18
	Canada waterweed	<i>Elodea canadensis</i>	15	10	9
	Bushy pondweed	<i>Najas flexilis</i>	8		6
	Curly-leaf pondweed	<i>Potamogeton crispus</i>	<1	7	13
	Illinois pondweed	<i>Potamogeton illinoensis</i>	5		
	Sago pondweed	<i>Stuckenia pectinata</i>	5	<1	
	Northern watermilfoil	<i>Myriophyllum sibiricum</i>	2	1	2
	Water stargrass	<i>Zosterella dubia</i>	2	1	1
	Wild celery	<i>Vallisneria americana</i>	2		
	Narrow-leaf pondweed	<i>Potamogeton sp.</i>	1		1
	White water buttercup	<i>Ranunculus longirostris</i>	1	1	<1
Whitestem pondweed	<i>Potamogeton praelongus</i>	<1			
Greater bladderwort	<i>Utricularia vulgaris</i>	<1		1	
FREE-FLOATING These plants float on the water and drift with water currents.	Star duckweed	<i>Lemna trisulca</i>	2	5	6
	Greater duckweed	<i>Spirodela polyrhiza</i>	<1		
	Lesser duckweed	<i>Lemna minor</i>	<1		
	Watermeal	<i>Wolffia sp.</i>	<1		
	Water moss	Not identified to genus	1		<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	<i>Nuphar variegata</i>	5	3	3
	Floating leaf pondweed	<i>Potamogeton natans</i>	<1		
	Hybrid Pink Waterlily	<i>Nymphaea sp. x</i>	p*		
	Water smartweed	<i>Polygonum amphibium</i>	p		
EMERGENT These plants extend well above the water surface and grow in shallow water, near shore.	Wild Rice	<i>Zizania palustris</i>	4		
	Hardstem bulrush	<i>Scirpus acutus</i>	<1		
	Spikerush	<i>Eleocharis sp.</i>	p		
	Cattail	<i>Typha sp.</i>	p	p	P
	Giant cane	<i>Phragmites australis</i>	p	p	p
WETLAND EMERGENTS These plants grow along shore and may extend into wet soils	Swamp Milkweed	<i>Asclepias incarnata</i>	p		
	Marsh marigold	<i>Caltha palustris</i>		p	
	Sedges	<i>Carex sp.</i>	p		
	Joe-pye weed	<i>Eupatorium maculatum</i>	p		
	Water dock	<i>Rumex sp.</i>	p		
	Reed Canary Grass	<i>Phalaris arundinaceae</i>	p	p	
	Marsh Skullcap	<i>Scutellaria galericulata</i>	p		

P = present; indicates plant was found during survey but did not occur within a specific sample site.

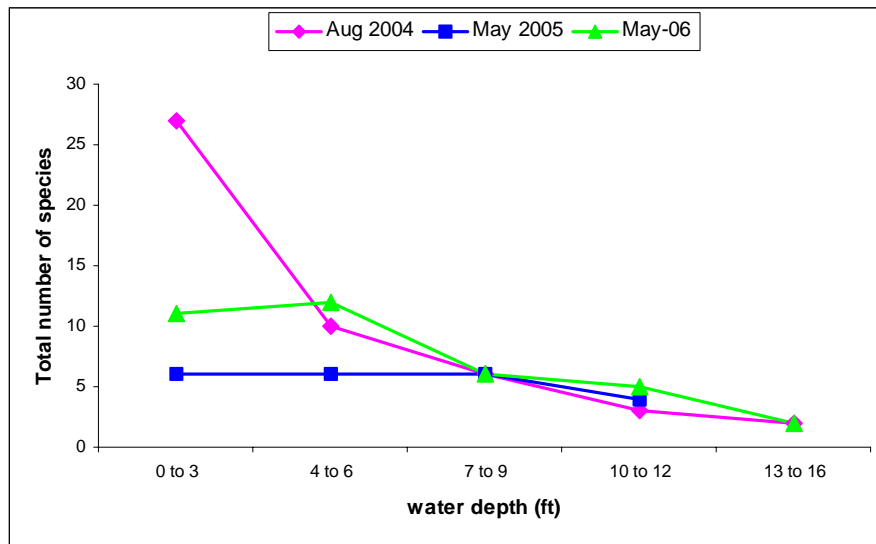
Highlite = non-native species

sprouted from rhizomes. Similarly, the fact that coontail (*Ceratophyllum demersum*) was present in only 24 percent of the sites in May 2005, compared to 40 percent of the sites in August 2004 is most likely because it is not fully grown in May. It does not indicate that the plant has actually decreased in abundance from 2004 to 2005.

Distribution of species by water depth

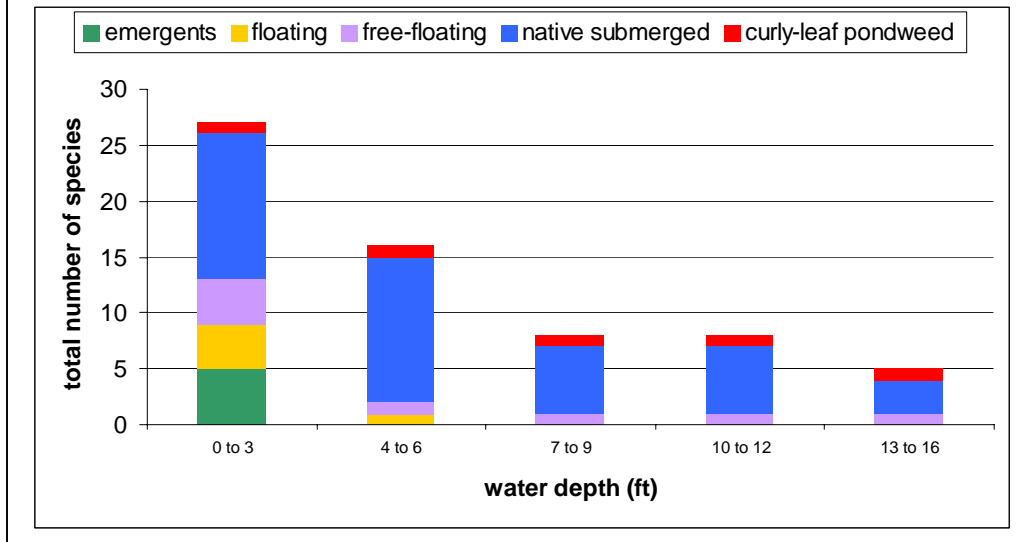
In all years, the greatest number of plant species was found in shallow water less than four feet (Fig. 8). During August 2004, 25 native species and the two non-native species were found in the zero to three feet depth zone and less than 15 species were found in the same zone during the May 2005 and May 2006 surveys. In all survey years, the number of species found declined as water depth increased (Fig. 8).

Figure 8. Total number of species found at each depth zone, August 2004, May 2005, May 2006. Portage Lake, Hubbard Co., MN (29-0250-00).



Emergent and floating-leaf species were restricted to the shallow water less than six feet in depth while some submerged and free-floating species occurred at all depth zones sampled (Fig. 9). The greatest number of native submerged species occurred in depths of six feet. Only six native submerged species were found in depths greater than nine feet and only three native submerged species occurred in depths greater than 12 feet. The non-native submerged species, curly-leaf pondweed, occurred at all water depths to a maximum depth of 15 feet (Fig. 9).

Figure 9. Types of plant species found at each depth zone in any survey year (2004-2006). Portage Lake, Hubbard Co., MN (29-0250-00)



Common submerged plant species

Because plant species differ in their habitat preferences and reproductive strategies, some species are better adapted to certain lake conditions than other species. Although fourteen different submerged species were found in Portage Lake, only a few species occurred commonly. During the August 2004 survey, the most common submerged plants were native species: coontail (*Ceratophyllum demersum*), muskgrass (*Chara* sp.), Canada waterweed (*Elodea canadensis*), and bushy pondweed (*Najas flexilis*). Some of these species were also common during the May 2005 and/or May 2006 surveys but had not yet reached their maximum growth for those years. The non-native species, curly-leaf pondweed (*Potamogeton crispus*) was not common during the August 2004 survey but was one of the most common species found during the May 2005 and May 2006 surveys. All other submerged species found in Portage Lake occurred in less than six percent of the sample sites during all survey years (Table 1).

[Coontail](#) is the most common submerged flowering plant in Minnesota and is adapted to a broad range of lake conditions, including turbid water. Coontail is perennial and can overwinter 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. In Portage Lake, coontail dominated the submerged plant community in August 2004 and was found in 40 percent of the sample sites (Table 1). It was found throughout the lake basin (Fig. 10) and occurred at all water depths to a maximum of 15 feet. Coontail was most common in the seven to nine feet depth zone, where it was found in 87 percent of the sample sites (Fig. 11). In the August 2004 it was the only species found beyond the nine feet depth but during the May 2005 and May 2006 surveys, it co-occurred in deeper water with several other species, including curly-leaf pondweed (Figs. 11).

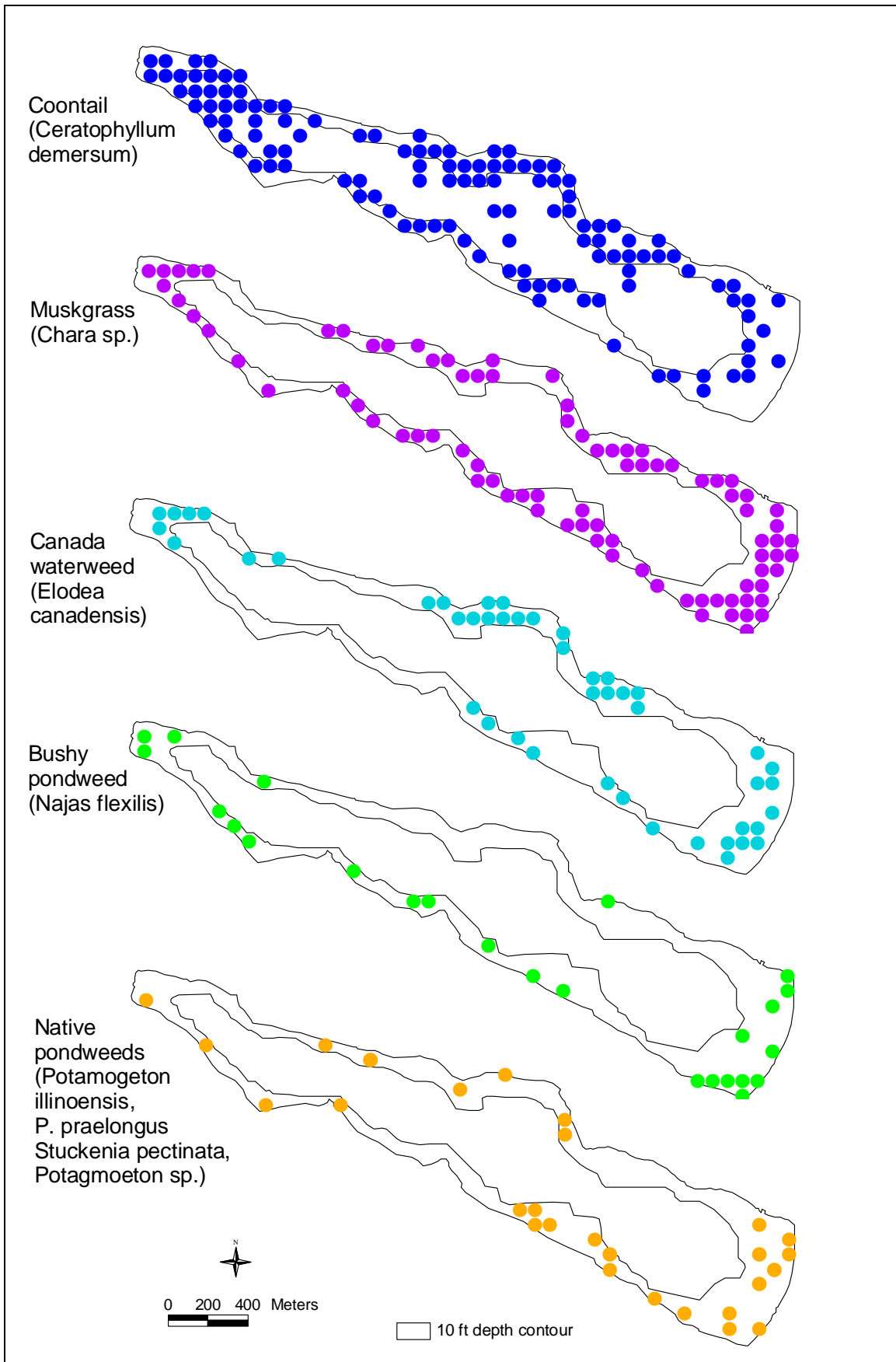
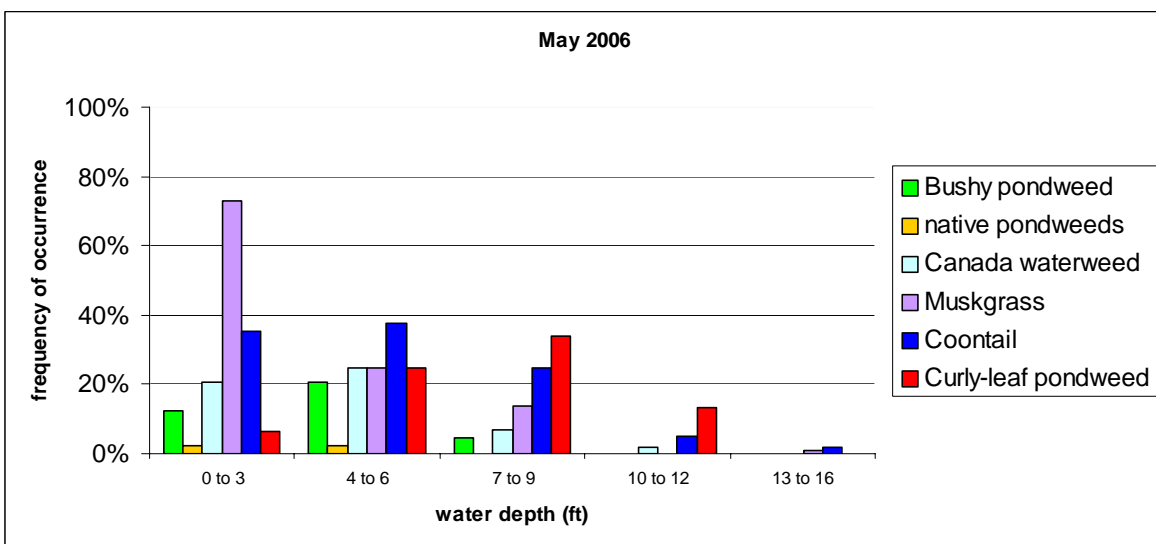
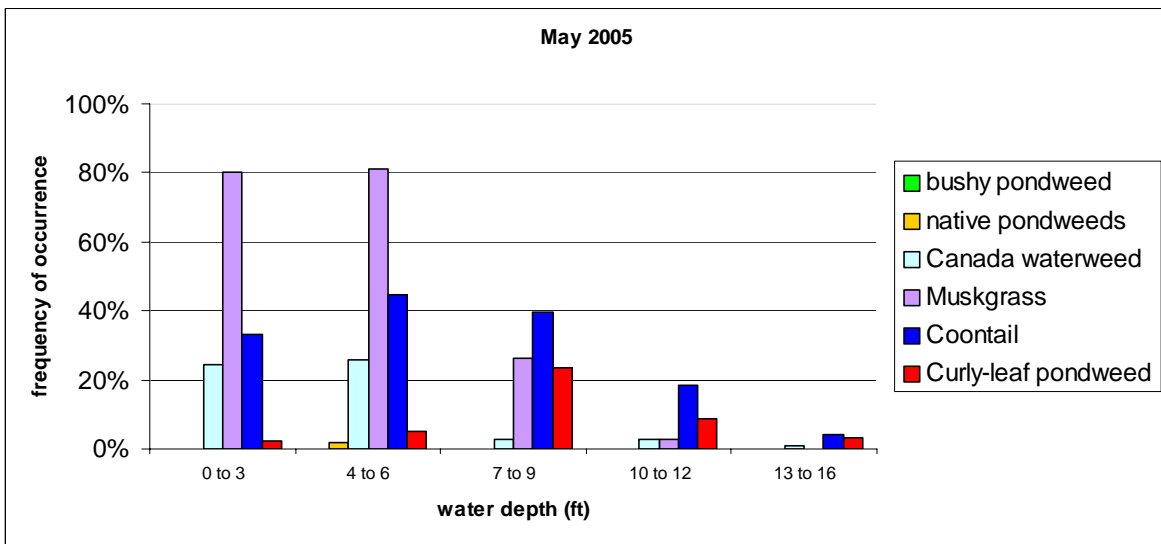
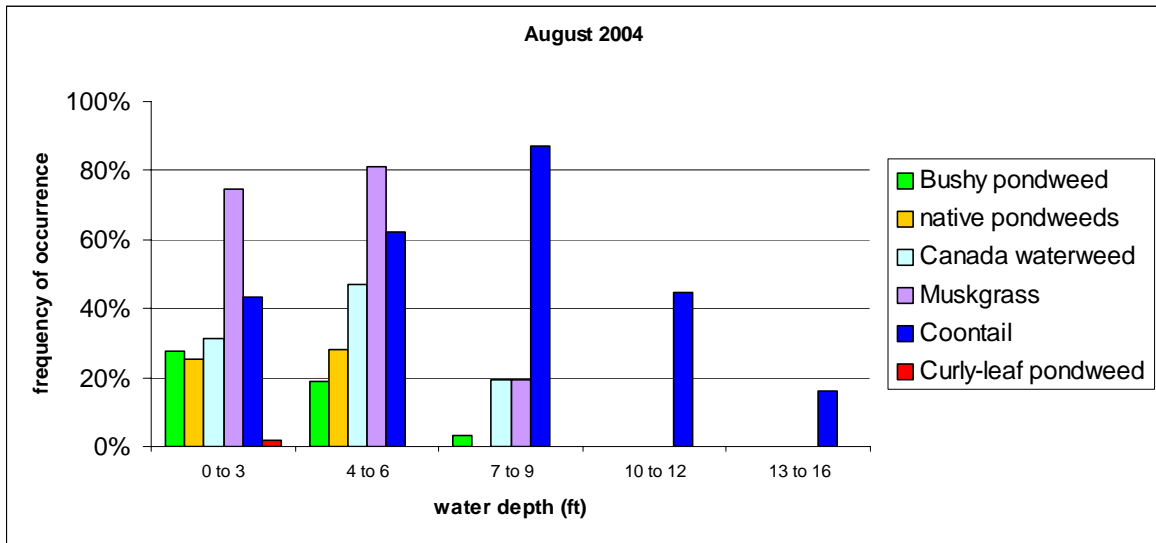


Figure 11. Frequency of common aquatic plants vs. water depth. Portage Lake, 2004-2006



[Muskgrass](#) (*Chara* sp.) is a macroscopic algae that is common in many hardwater Minnesota lakes. It is named for its characteristic musky odor. Because this species does not form true stems, it is a low-growing plant, often found entirely beneath the water surface where it may form low “carpets” on the lake bottom. Muskgrass is adapted to variety of substrates and is often the first species to invade open areas of lake bottom where it can act as a sediment stabilizer. In Portage Lake, muskgrass occurred in 29 percent of the sample sites in August 2004 (Table 1). It was well distributed around the lake but was mostly restricted to water depths less than ten feet (Fig. 10). Muskgrass was most common in depths of six feet and less where it was the most abundant species in both August 2004 and May 2005 surveys (Figs. 11).

[Canada waterweed](#) (*Elodea canadensis*) is another perennial submerged species that is widespread throughout Minnesota because it is adapted to a variety of conditions. It is tolerant of low light and prefers soft substrates. This species can overwinter as an evergreen plant and spreads primarily by fragments. In Portage Lake, it was present in 15 percent of the August 2004 sample sites (Table 1). It was most often found in shallow water in depths less than 10 feet (Fig. 10) and reached its maximum abundance in depths of six feet and less (Fig. 11).

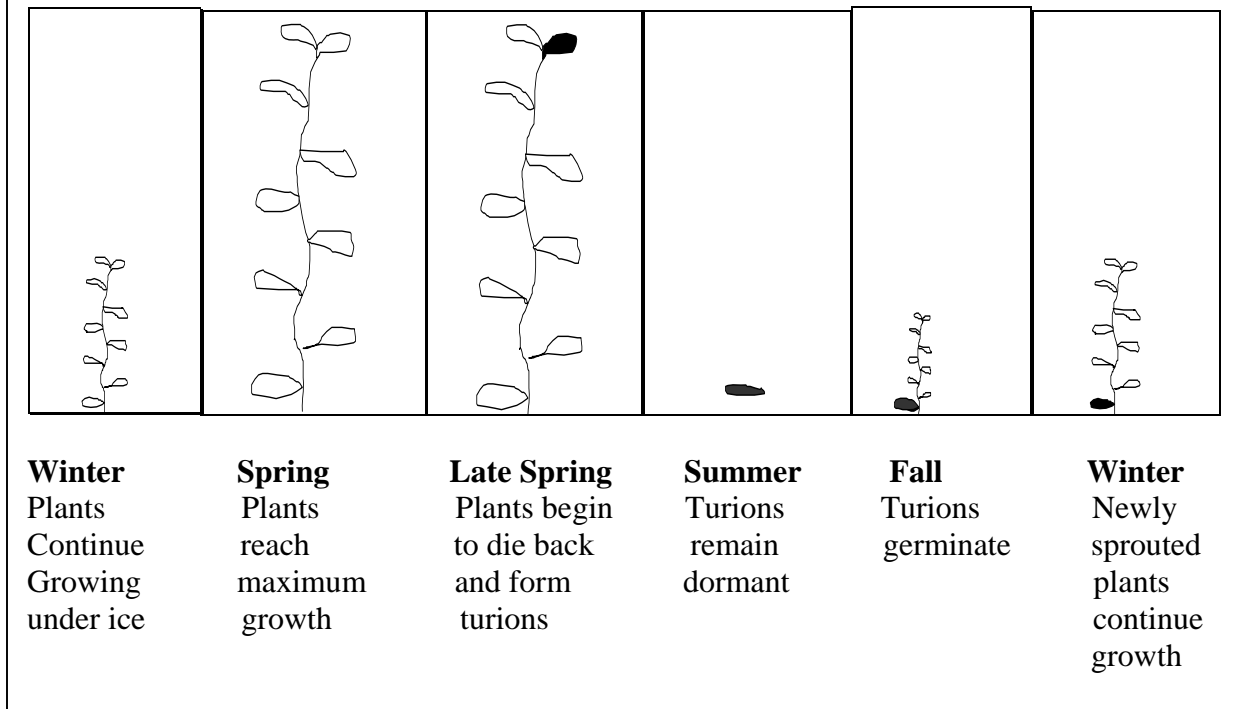
[Bushy pondweed](#) (*Najas flexilis*) is unique because it is one of the few annual submerged species in Minnesota and must re-establishes every year from seed. It is most commonly found in mid to late summer, following seed germination and growth. In Portage Lake, bushy pondweed occurred in eight percent of the sample sites in August 2004 and six percent of the May 2006 sites, but was not found during the May 2005 survey (Table 1). In August 2004, bushy pondweed was primarily found along the south shore and in the shallow east and west ends of the lake (Fig. 10). It was most common in depths of three feet and less and was not found in depths greater than nine feet (Fig. 11).

Other native pondweeds found in Portage Lake included [broad-leaf pondweeds](#) such as Illinois pondweed (*Potamogeton illinoensis*) and white-stem pondweed (*P. praelongus*), and [narrow-leaf pondweeds](#) such as sago pondweed (*Stuckenia pectinata*). At least nine percent of the August 2004 survey sites contained at least one of these native pondweeds (Fig. 10). These species were found in water depths less than ten feet (Fig. 11).

[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 coontail and Canada waterweed, it is perennial but it has a unique life cycle, which gives it a competitive advantage over native species. Curly-leaf pondweed is actually dormant during late summer and begins new growth in early fall (Fig. 12). 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).

As expected, curly-leaf pondweed was not found in many of the August 2004 survey sites because it had already died back for the year. By May 2005, it was found in seven percent of

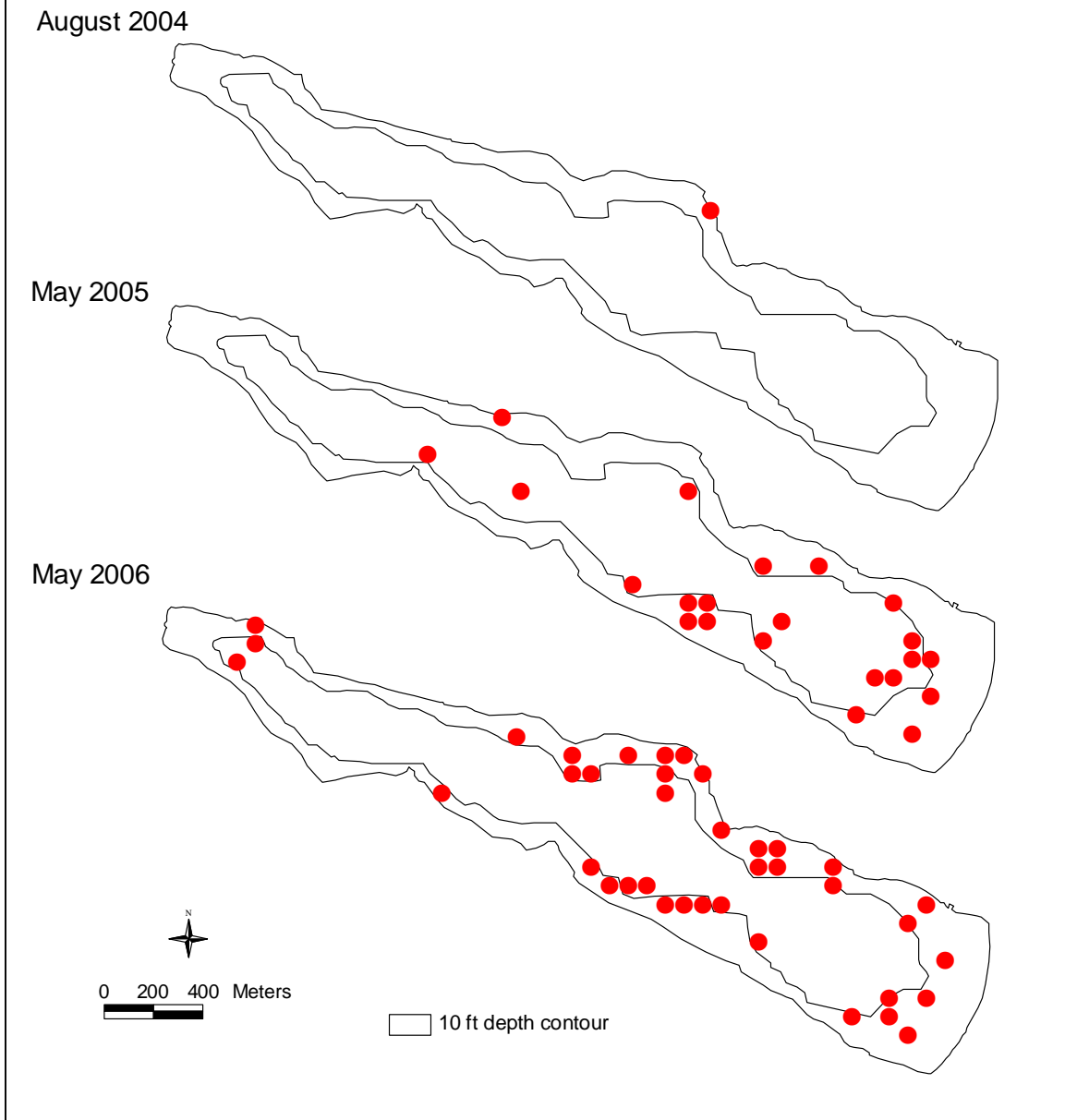
Figure 12. Life cycle of Curly-leaf pondweed (*Potamogeton crispus*).



survey sites and occurred in 13 percent of the May 2006 sites (Table 1.) However, the difference between the May 2005 and May 2006 curly-leaf abundance is not statistically meaningful. In other words, these surveys provide an estimate of the actual abundance of curly-leaf in each year and the results obtained do not indicate that a significant change occurred in the curly-leaf abundance between 2005 and 2006. These results simply indicate that curly-leaf abundance was relatively low in both spring surveys.

Curly-leaf pondweed was scattered throughout about two-thirds of the lake in May 2005 and by May 2006 was also found in the western end of the lake (Fig. 13). Plants did not reach the surface at the time of the early spring survey but turions (overwintering buds) were present on some plants. Curly-leaf was found in all water depths up to 15 feet, but was most common in water depths of seven to nine feet, where it reached its maximum frequency of 22 percent (Fig. 11).

Figure 13. Distribution of curly-leaf pondweed in Portage Lake. Aug 2004, May 2005, May -2006



Native floating-leaf and emergent plant community

While the focus of this survey was on the submerged plant community, the floating and emergent plants of Portage Lake also provide critical fish and wildlife habitat as well as benefits such as shoreline stabilization and water clarity maintenance (Fig. 14). Common emergent plants include [wild rice](#) (*Zizania aquatica*) and [bulrush](#) (*Scirpus acutus*) and the most common floating-leaved plant was [yellow waterlily](#) (*Nuphar variegata*).

Figure 14. Marsh marigold (*Caltha palustris*) and other emergent and Wetland emergent plants in Portage Lake (29-0250-00). May, 2005.



Non-native pink waterlilies

The non-native, pink-flowered waterlily (*Nymphaea* sp.) was found at scattered locations around Portage Lake shoreline (Fig. 15). Pink waterlilies are hybrid plants that are not native to Minnesota. Although they have attractive flowers, these exotics have the potential to out-compete native aquatic plants. Another concern is that if these water garden plants are placed into lakes, other harmful exotics, such as zebra mussels may be living on the plant and could also be introduced into the lake.

Figure 15. Non-native Pink Waterlilies (*Nymphaea* sp.)



While pink waterlilies and other exotic water plants are available for purchase for water gardens it is illegal to place them into lakes.

To avoid unintentional introductions of exotics, such as pink waterlilies, lake residents should consult with the DNR before planting any vegetation along the shoreline or in the lake. A permit is required to place seeds or plants into Minnesota lakes and this process helps to ensure that only native plants are used in lakeshore restoration projects. [Click here for information on Permit to Transplant Aquatic Plants](#) or contact your local DNR Area Fisheries office.

Monitoring changes in aquatic plant community

Data from the 2004 Portage Lake vegetation survey provides baseline data on the native plant community. Data from the May 2005 and May 2006 surveys can be used to monitor annual changes in the distribution and frequency of curly-leaf pondweed. To analyze change in the native plant community, a survey should be repeated in late summer and results compared to the August 2004 survey. Detecting change in the curly-leaf population may be more complicated. It is often impossible to know whether a decline in curly-leaf is due to environmental conditions, or due to management activities, or a combination of both. Because curly-leaf pondweed reaches peak biomass in late spring, a spring survey is appropriate to estimate its distribution and abundance in the lake. However, in lakes such as Portage, where early season herbicide applications occur, it is not possible to survey curly-leaf pondweed during its peak biomass. Therefore, repeat spring vegetation surveys should be conducted as close to the spring herbicide treatment date as possible.

In general, factors that may lead to change in native and non-native aquatic plant communities include:

- Change in water clarity
If Portage Lake clarity increases, submerged vegetation may be more common at depths greater than 10 feet.
- Snow 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, particularly if there is little snow cover and sunlight reaches the lake bottom. In years following low snow cover, 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. Click here for information on the laws pertaining to aquatic plant management: [MnDNR APM Program](#) or contact your local DNR Area Fisheries office.

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