Aquatic Vegetation of German Lake
Le Sueur County, Minnesota
(DOW 40-0063-00)
June 22, 2004

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Summary

This survey assessed the aquatic plant community of German Lake (40-0063-00) in LeSueur County, southern Minnesota. The zone from shore to a depth of 15 feet was sampled using a point-intercept, or grid, survey method. Within this area, 65 percent of the sample sites contained vegetation.

The non-native, submerged plant, curly-leaf pondweed (*Potamogeton crispus*) dominated the plant community and was found in 48 percent of the survey sites. Curly-leaf pondweed was most common in water depths of six to ten feet, where it occurred in 75 percent of the survey sites. It was one of the few plant species found in depths greater than five feet.

Another non-native, submerged plant, Eurasian watermilfoil (Myriophyllum spicatum) was observed in German Lake. It was first reported in the lake in 2002 and during the 2004 survey it occurred in only one percent of the sample sites.

Lower mid-summer water clarity in German Lake likely restricts native aquatic plants to shallow water where they can obtain sufficient light. Native plants occurred in 35 percent of the sample sites. Twenty-two native plant species were recorded but only a few occurred in more than five percent of the sample sites: muskgrass (*Chara* sp.), coontail (*Ceratophyllum demersum*), and narrow-leaf pondweed (*Potamogeton freisii*).

Introduction

German Lake (DOW 40-0063-00) is located about eight miles northwest of the city of Waterville in LeSueur County, Minnesota. It occurs at the western edge of the ecological region known as the Eastern Broadleaf Forest Province (Fig. 1).

German Lake lies at the western edge of the Cannon River Watershed (Fig. 2) and outlets to the Cannon River (Munson 1991). Four different land types occur within the watershed and German Lake is within the Big Woods land type (Fig. 2).

The Big Woods area was once dominated by oak woodland and maple-basswood forest but today most of the land is cropland or pasture. Within the sub-watershed that includes German Lake most land is now classified as agricultural (Munson 1991).

Figure 1: Location of German Lake in LeSueur Co., Minnesota

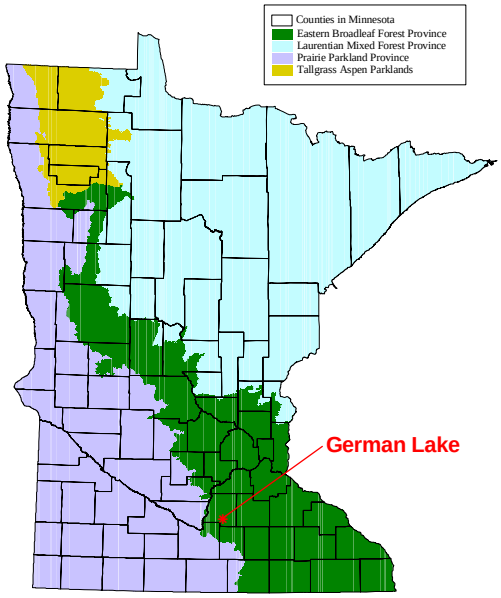
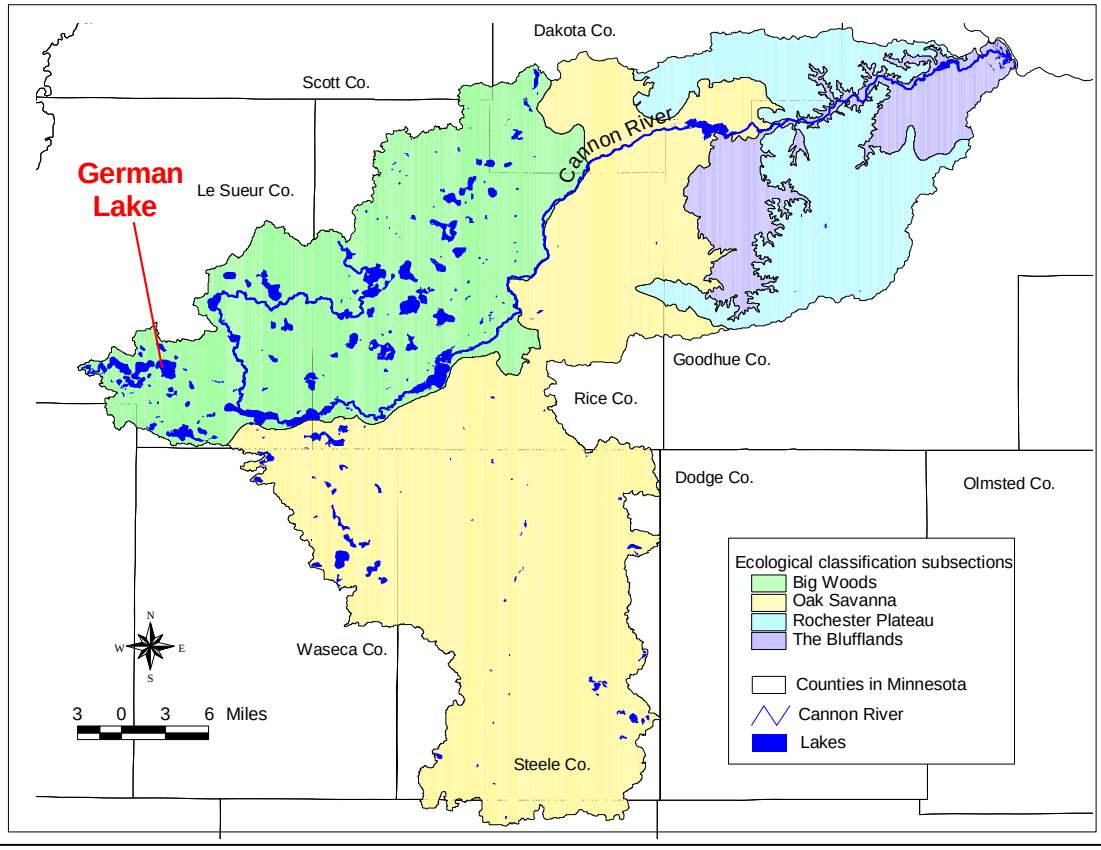
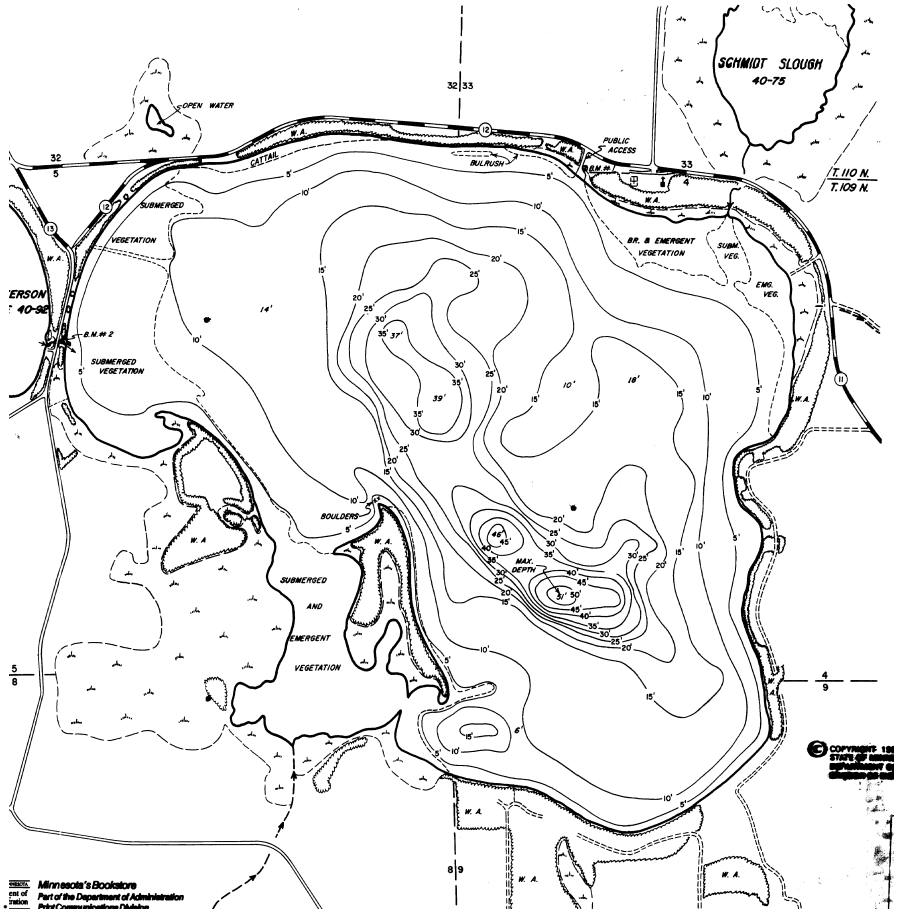


Figure 2. Location of German Lake within the Cannon River Watershed.



German Lake is a mid-sized (899 acres) lake with a maximum depth of 51 feet and at least 58 percent of the lake less than 15 feet deep (Fig. 3). An island, approximately 17 acres in area, occurs at the south end of the lake. The lake is described as eutrophic (high nutrients) with low water clarity as indicated by the 2004 mean summer Secchi depth of 2.5 feet (MPCA 2003). A 1990 water quality study concluded that these conditions are likely a result of excessive nutrients supplied to the lake from the watershed and nutrient recycling processes occurring in the lake (Munson 1991). The shoreline of German Lake is moderately developed with a public access located on the north shore.

Figure 3. Hydrologic contour map of German Lake, Le Sueur County, Minnesota. Source: MnDNR 1969



Previous vegetation surveys of German Lake were conducted in 1982, 1987 and 1997 (DNR Fisheries Lake Files). Bulrush (*Scirpus* spp.) occurred along the north shore and narrow leaf cattail (*Typha angustifolia*) was common in the northeast bay and near the island. Yellow waterlily (*Nuphar* sp.) and white waterlily (*Nymphaea* sp.) were present but not widespread. The most common native submerged species reported were coontail (*Ceratophyllum demersum*), Canada waterweed (*Elodea canadensis*), and muskgrass (*Chara* sp.). The non-native curly-leaf pondweed (*Potamogeton crispus*) was reported in all of these previous surveys. The non-native Eurasian watermilfoil (*Myriophyllum spicatum*) was first documented in the lake in 2002.

Submerged vegetation was reported to a maximum depth of 12 feet in 1997 and to only 2.5 feet in 1987 with a note that vegetation was reduced in this year in response to high water levels.

Vegetation Survey Objectives

The purpose of this vegetation survey was to describe the 2004 aquatic plant populations of German Lake. Specific objectives include:

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 (or grid) vegetation survey of German Lake was conducted on June 22, 2004. The surveys followed the methods described by Madsen (1999).

Survey waypoints were created and downloaded into a Global Positioning System (GPS) receiver. Sample points were established in using ArcView GIS program using a 100 meter by 100 meter grid across the lake surface (Fig. 4). In the field, surveyors decided not to sample in depths greater than 15 feet because they consistently were not finding vegetation beyond the 13 feet depth. Areas along the southeast shore and northeast shore were not sample due to shallow water (Fig. 4). As a result, 216 sites were actually sampled and 200 of those fell within the vegetated zone from shore to the 13 feet depth.

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. 5).

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.

Example:
In German Lake there were 216 samples sites in the zone from shore to the 15 feet depth. Curly-leaf pondweed occurred in 103 of those sites.
Frequency of curly-leaf pondweed in the shore to 15 feet depth zone of German Lake
= 103/216 (*100) = 48%
Frequency was calculated for the entire area from shore to 15 feet and sampling points were also grouped by water depth and separated into three depth zones for analysis: shore to five feet, six to 10 feet, and 11 to 15 feet.

Figure 4. 2004 Vegetation Survey Points on German Lake, Le Sueur County, Minnesota.

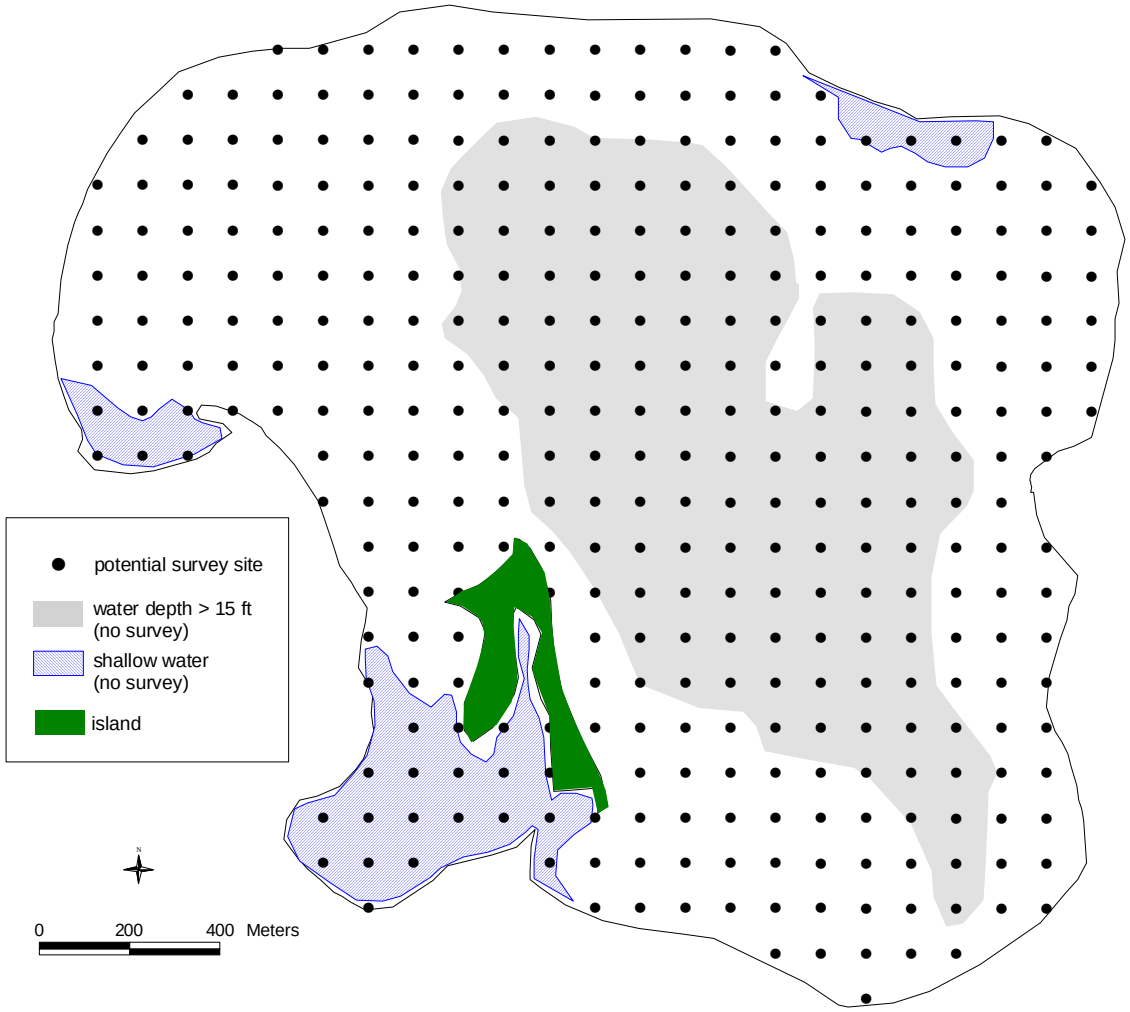


Figure 5. Sampling vegetation with rake.

Results

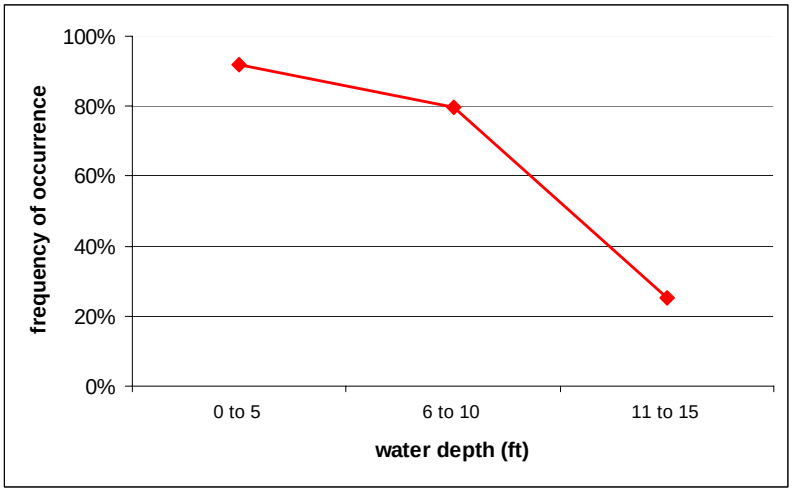
Number and types of plant species recorded

A total of 22 native aquatic plant species were recorded in German Lake including 14 submerged, one free-floating, three floating-leaved and four emergent plant species (Table 1). Two non-native, submerged species were also found: curly-leaf pondweed, (*Potamogeton crispus*), and Eurasian watermilfoil (*Myriophyllum sibiricum*).

Distribution and plants with water depth

Aquatic plants were found to a maximum depth of 13 feet in German Lake and 65 percent of the sample sites within shore to 15 feet depth zone contained vegetation. Plant abundance was greatest from shore to a water depth of five feet where 92 percent of the sites were vegetated. In depths from 11 to 15 feet, only 25 percent of the sites contained plants (Fig. 6).

Figure 6. Frequency of aquatic plants vs. water depth, German Lake, LeSueur Co. (40-0063-00), June 22, 2004.



Non-native plants in German Lake

Non-native plants dominated German Lake during the 2004 survey and the most abundant non-native species was curly-leaf pondweed (Fig. 7). Curly-leaf pondweed was the only species present in 31 percent of the sample sites (Fig. 7, 8). Eurasian watermilfoil was present in two sample sites (Fig. 8). Sixteen percent of the sample sites contained a mix of native and non-native species (Fig. 7).

Table 1. Aquatic Plants of German Lake, LeSueur County (40-0063-00) June 22, 2004

Frequency calculated for vegetated zone (shore to 13 feet depth)
Frequency = percent of sites in which species occurred (200 sample sites)

Life Forms	Common Name	Scientific Name	Frequency
SUBMERGED These plants grow primarily under the water surface. Upper leaves may float near the surface and flowers may extend above the surface. Plants may be are rooted or loosely anchored to the lake bottom, or may drift with the current.	Curly-leaf pondweed	*Potamogeton crispus*	48
	Muskgrass	*Chara sp.*	16
	Narrow-leaf pondweed	*Potamogeton freisii***	13
	Coontail	*Ceratophyllum demersum*	10
	Flat-stem pondweed	*Potamogeton zosteriformis*	5
	Sago pondweed	*Stuckenia pectinata*	2
	Wild celery	*Vallisneria americana*	2
	Bushy pondweed	*Najas flexilis*	1
	Eurasian watermilfoil	*Myriophyllum spicatum*	1
	Water marigold	*Megaladonta beckii*	<1
	Canada waterweed	*Elodea canadensis*	<1
	Illinois pondweed	*Potamogeton illinoensis*	<1
	White-stem pondweed	*Potamogeton praelongus*	<1
	Northern watermilfoil	*Myriophyllum sibiricum*	<1
	White water buttercup	*Ranunculus sp.*	<1
	Stonewort	*Nitella sp.*	<1
FREE-FLOATING These plants float on the water and drift with water currents.	Greater duckweed	*Spirodela polyrhiza*	<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*	<1
	White waterlily	*Nymphaea odorata*	<1
	Floating-leaf pondweed	*Potamogeton natans*	present*
EMERGENT These plants extend well above the water surface and are usually found in shallow water, near shore.	Cattail	*Typha sp*	<1
	Bulrush	*Scirpus sp.*	1
	Spikerush	*Eleocharis sp.*	<1
	River bulrush	*Scirpus fluviatile*	present

*present indicates species was found in the lake but not within a sample site.

**Potamogeton freisii was identified in the lake but it is not known whether all narrowleaf pondweeds found were P. freisii. Therefore, Potamogeton sp. was recorded in the database.

Figure 7. Percent of sites with native and non-native species.

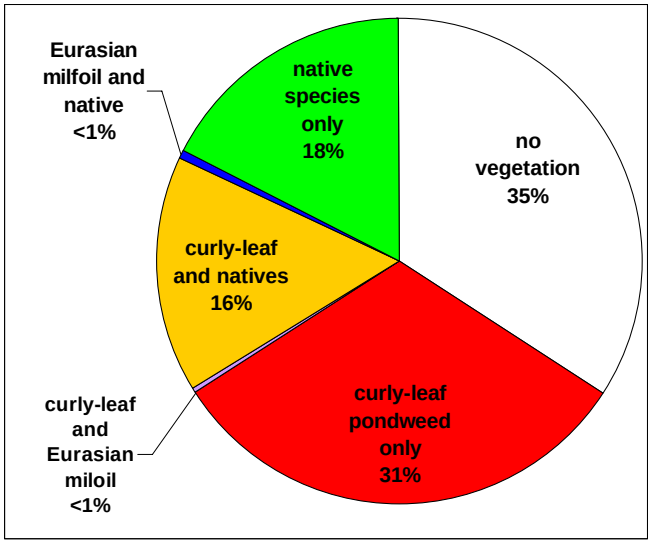
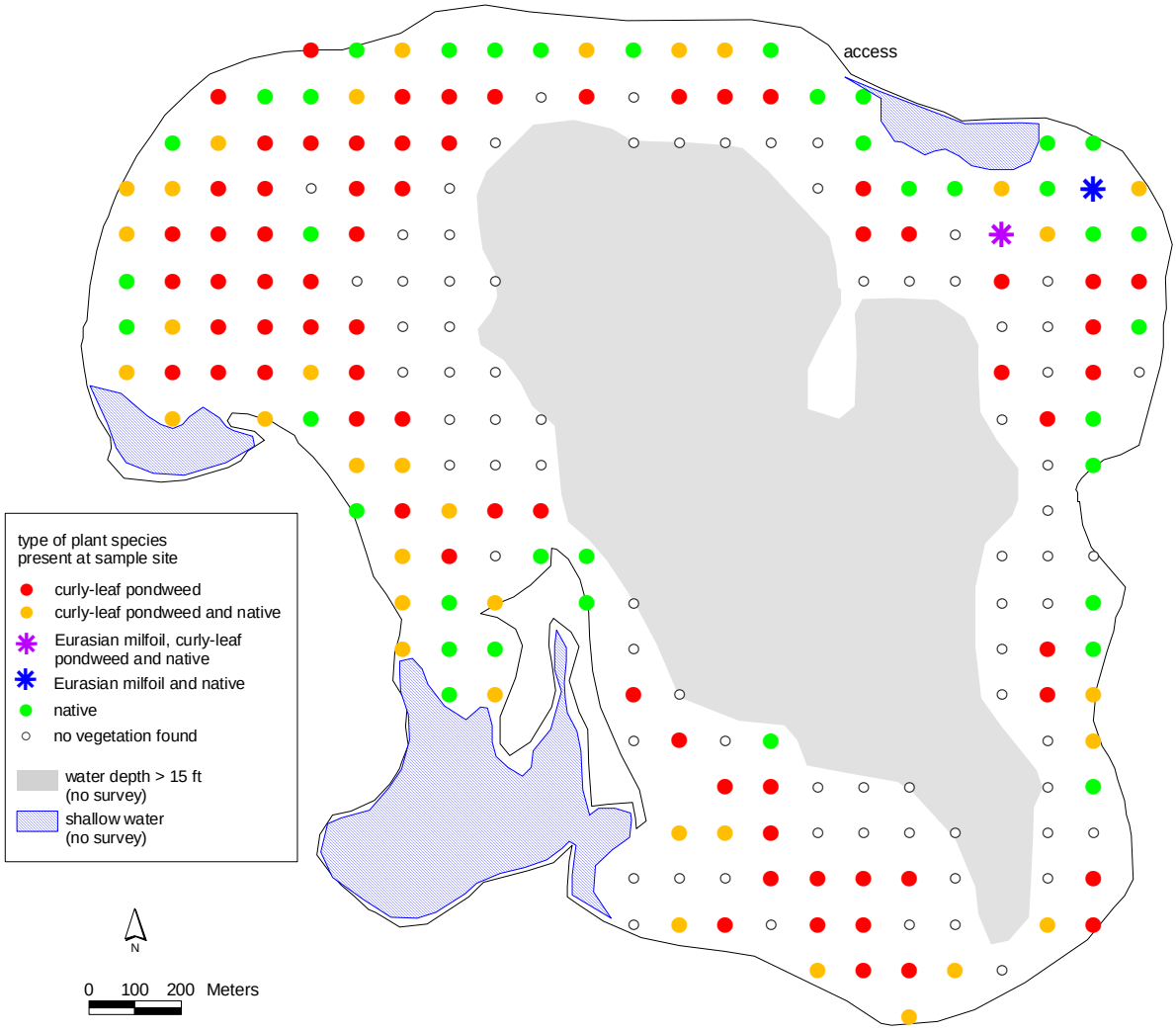


Figure 8. Distribution of native and non-native plants in German Lake, LeSueur Co (40-0063-00) June 22, 2004.

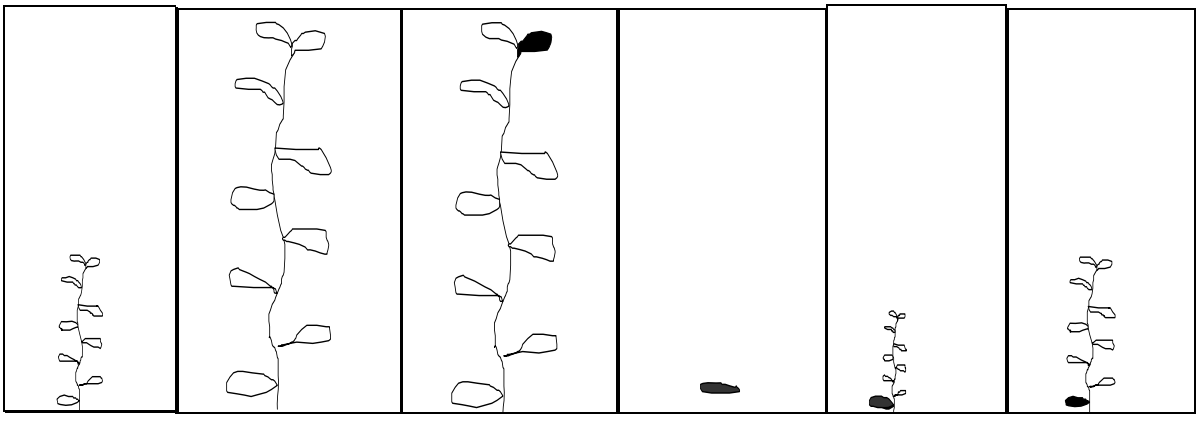


Curly-leaf pondweed (*Potamogeton crispus*) was the most abundant species in German Lake and occurred in 48 percent of the sample sites (Table 1). Curly-leaf pondweed is a submerged plant that is named for its wavy leaf margins (Fig. 9). It grows below the water surface but may reach the water surface at certain depths and create dense mats. It may also form flowers that extend above the water surface.

Figure 9. Turions forming at tips of curly-leaf pondweed (*Potamogeton crispus*) plants.

Curly-leaf pondweed is not native to Minnesota but has been present in the state 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 (re-growing from rootstalk each season) 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 (Fig. 10). 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 (Fig. 10). 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.

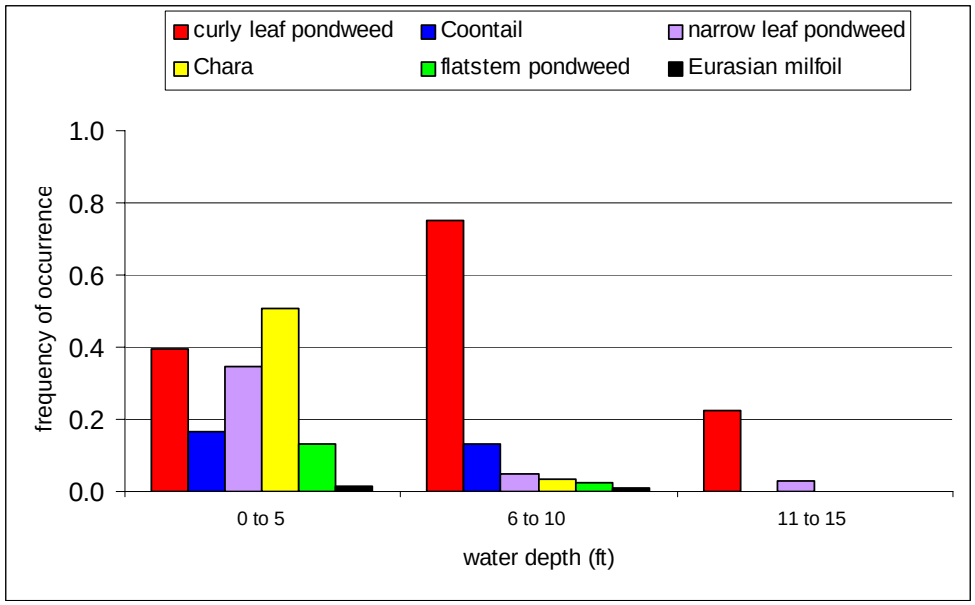
Figure 10. Life cycle of Curly-leaf pondweed (*Potamogeton crispus*).



Winter	**Spring**	**Late Spring**	**Summer**	**Fall**	**Winter**
Plants continue Growing Under ice	Plants reach maximum growth	Plants die back and form turions	Turions remain dormant	Turions germinate	New plants sprout from turions

During the spring of 2004, curly-leaf pondweed occurred at all depth sampled in German Lake, and was the most common species in depths greater than five feet (Fig. 11). It reached a maximum frequency in the six to 10 feet water depth, where it occurred in 75 percent of the sample sites (Fig. 11).

Figure 11. Frequency of common plant species by water depth.
German Lake, LeSueur Co (40-0063-00), June 22, 2004.



Eurasian watermilfoil (*Myriophyllum spicatum*) (Fig. 12) was found in only two sample sites (one percent) during the June 2004 survey (Table 1). It occurred to a two to six feet of water in the northeast end of the lake (Fig. 8). This non-native species is adapted to survive in lower light levels than many native aquatic plants but still requires adequate light for growth. Lower summer water clarity in German Lake may prevent this species from becoming abundant in depths greater than six feet.

Fig. 12. Eurasian watermilfoil (*Myriophyllum spicatum*).

Native vegetation in German Lake

Native vegetation was found in 35 percent of the sample sites and 18 percent of the sites contained only native vegetation (Fig. 7, 8). Native species were mostly restricted to water depths less than eleven feet and were most common in water depths less than six feet (Fig. 11).

Muskgrass (*Chara* sp.) was the most common native plant species in German Lake and occurred in 16 percent of the sample sites (Table 1). It was only found to a maximum depth of seven feet and was most frequent in depths less than six feet (Fig. 11). Muskgrass is a submerged, 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 German Lake, muskgrass was often found at sandy sites of the north and east shores, where curly-leaf pondweed was less frequent (Fig. 13).

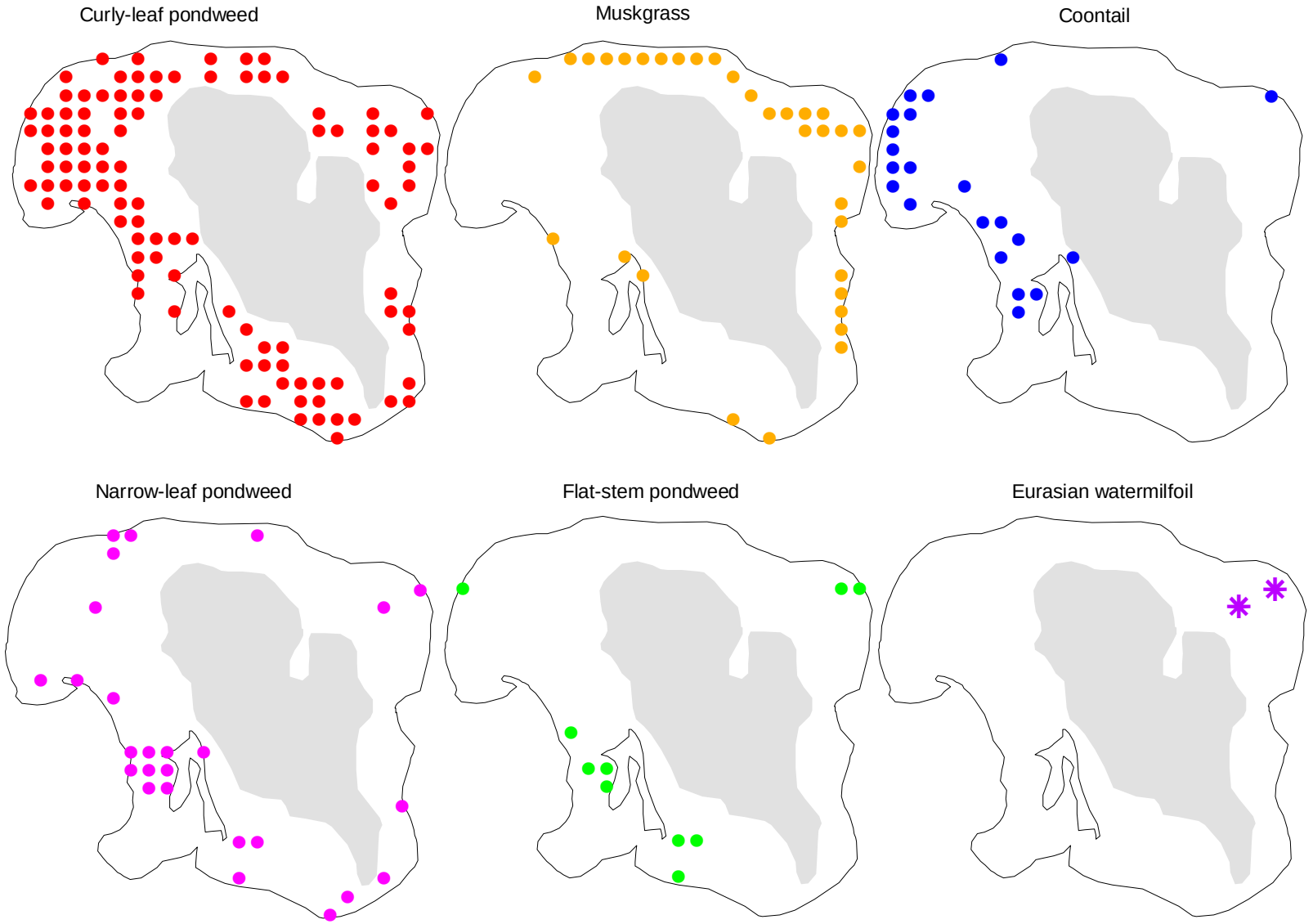
Narrow-leaf pondweed (*Potamogeton freisii*) occurred in 13 percent of the sample sites (Table 1) and was most common in depths of five feet and less (Fig. 11). Narrow-leaf pondweed was the only native species found beyond the ten feet depth and occurred to a maximum depth of 13 feet. If was most common in the shallow waters west of the island (Fig. 13).

Coontail (*Ceratophyllum demersum*) was present in 10 percent of the German Lake sample sites (Table 1) and occurred to a depth of 10 feet (Fig. 11). This perennial grows entirely submerged and is adapted to a broad range of lake conditions, including turbid water. It is often found growing in deeper water than other native species because it is more tolerant of low light conditions. Coontail was primarily found along the west shore of German Lake (Fig. 13)

Flat-stem pondweed is closely related to curly-leaf pondweed, but flat-stem is native to Minnesota. This submerged plant can over-winter by rhizome and winter buds and can grow in a variety of water depths. In German Lake it was found in five percent of the sites surveyed in 2004 (Table 1), occurring most frequently in the water depths up to five feet (Fig 11).

All other native species were present in less than five percent of the sample sites (Table 1).

Figure 13: Distribution of common submerged plants, German Lake, Le Sueur County (40006300), June 22, 2004.



Discussion

Curly-leaf pondweed is probably not a recent invader in German Lakes. It has been present in Minnesota for at least 100 years and present in German Lake since at least 1982.

Rooted aquatic plants are generally restricted to water depths where they can obtain sufficient sunlight for growth. As a general rule, native plants may grow to a depth of about twice the mid-summer Secchi Disc reading. In German Lake, based on Secchi Disc readings, plants would not be expected to be common beyond a depth of 5 feet. Curly-leaf pondweed, however, can take advantage of relatively clear water in the spring before native species are present, and it therefore is found growing in deeper water. As curly-leaf dies back in early summer, water clarity may further decline as the dying curly-leaf releases nutrients that may result in increased algal growth.

All vegetation, native and non-native can benefit a lake by providing habitat for fish and invertebrates, buffering the shorelines from wave action, stabilizing sediments and utilizing nutrients that would otherwise be available for algae. Native vegetation can be of greater value because it has coevolved with the native fish and wildlife species that utilize the lake. (Click here for more information on: value of aquatic plants).

Curly-leaf pondweed has the potential to cause recreational problems on lakes, particularly if it forms extensive surface mats that interfere with boat use. These problems are temporary because the plant typically dies back by early July. Longer-term ecological problems may occur if extensive stands of curly-leaf form annually and contribute significant nutrient loads to the lake. For more information on management of curly-leaf pondweed see page 51 in this report: MnDNR Invasive Species Annual Report

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 2004 vegetation survey can also be used to monitor annual changes in curly-leaf pondweed, Eurasian watermilfoil and 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 water clarity in German Lake increases, submerged vegetation is expected to expand in distribution and grow at greater water depths.
- 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 bushy pondweed (*Najas flexilis*) 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: MnDNR APM Program. Motorboat activity in vegetated areas can be particularly harmful for species such as bulrush. 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. Monitoring these control activities can help insure that non-target species are not negatively impacted.

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