Aquatic vegetation of Pelican Lake

June, 2010

ID# 73-0118-00

Stearns County, Minnesota

Pelican Lake 2010.

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Report Review:
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A note to readers:
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Summary

Pelican Lake is a 294 acre lake in Stearns County with relatively clear water. In late June 2010, surveyors conducted a lakewide assessment of Pelican Lake's vegetation and sampled aquatic plants at 235 sites (225 sites within the 0-20 feet depth zone).

The aquatic plant communities of Pelican Lake have historically contained a diversity of native plants and in 2010, 30 species were observed including 4 emergent, 3 floating-leaved and 23 submerged and free-floating species.

Plants occurred around the entire perimeter of the lake to a depth of at least 20 feet and within the sampled area 93% of sites contained plants. The broadest zones of plants were found on the west side of the lake.

Emergent and floating-leaf plants occupied 50 acres, but were restricted to water depths less than 6 feet. Within the shallow water (0-5 feet) zone, emergent and floating-leaf plants occurred in 25% of the sample sites. Yellow waterlily (*Nuphar variegata*) was the most common floating-leaf plant and occurred in 10% of the shallow water sites (0-5 feet). Other floating-leaf and emergent plants included white waterlily (*Nymphaea odorata*), floating-leaf pondweed (*Potamogeton natans*), bulrush (*Schoenoplectus* sp.) and narrow-leaf cattail (*Typha* sp.).

Submerged plants were found to a maximum depth of 20 feet, but scattered plants may have been present beyond that depth. Northern watermilfoil (*Myriophyllum sibiricum*) was the most common submerged species and occurred in 51% of the survey sites. It dominated the 0 to 5 feet depth zone where it was found in 62% of the sites. Other submerged plants that occurred in at least 20% of the sites were muskgrass (*Chara* sp.), coontail (*Ceratophyllum demersum*), star duckweed (*Lemna trisulca*), flat-stem pondweed (*Potamogeton zosteriformis*), narrow-leaved pondweed (*Potamogeton* sp.) and Canada waterweed (*Elodea canadensis*).

The non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*), was present in the lake but was a minor component of the plant community and was found in 4% of the sample sites.

Introduction

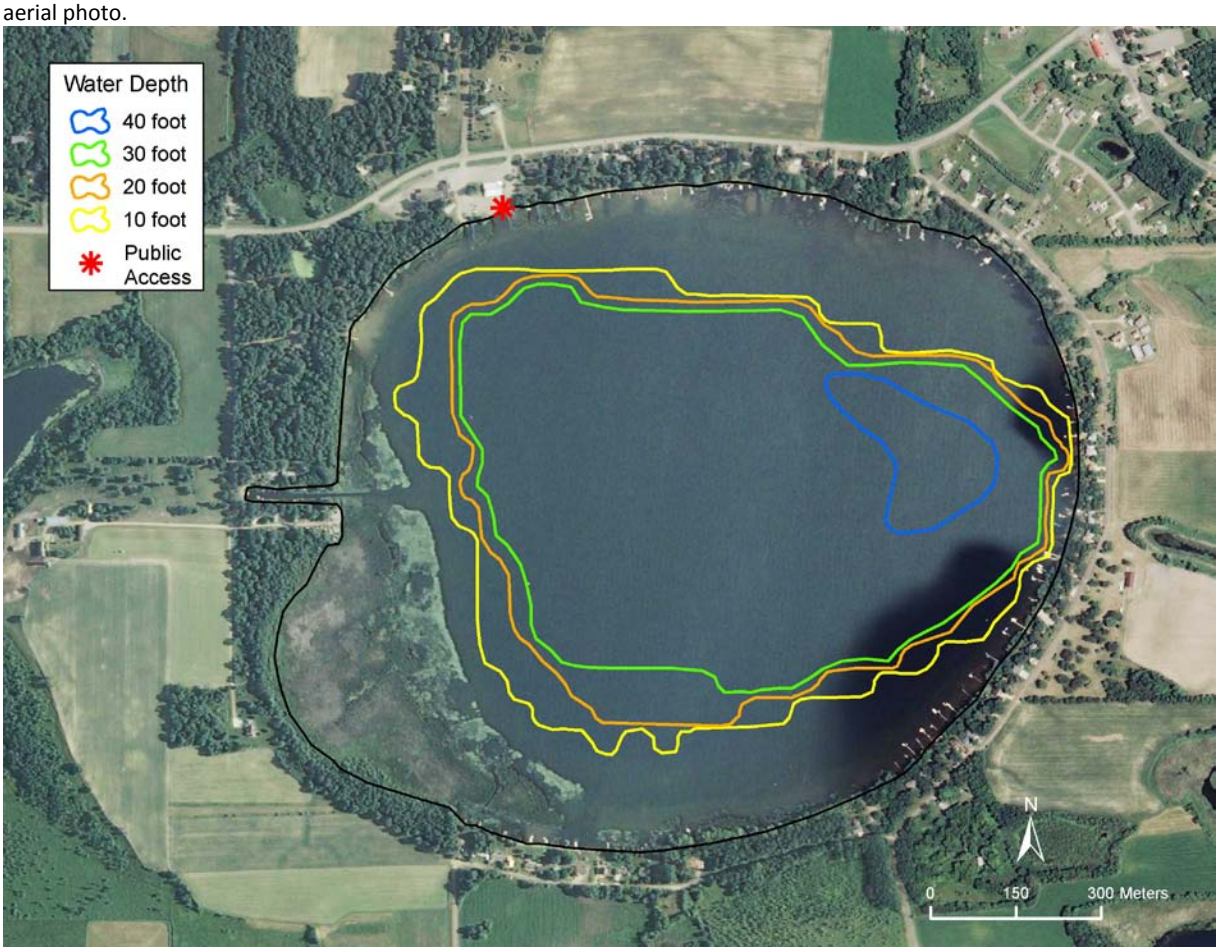
Pelican Lake is located one half mile southwest of St. Anna in Stearns County, central Minnesota (Figure 1). It is a popular lake for fishing, boating and other water recreation activities. A state owned public boat ramp is located on the northwest side of the lake off County Road 154 (Figure 2).

With a surface area of 294 acres, Pelican Lake is the 17th largest lake in Stearns County. The lake is round in outline with 3 miles of shoreline. It has a maximum depth of 46 feet and at least 40% of the lake is shallow (15 feet or less in depth) (Figure 2).

Pelican Lake is primarily landlocked with only intermittent flow. The lake can be described as a seepage lake because

Figure 1. Pelican Lake, Stearns County, Minnesota.

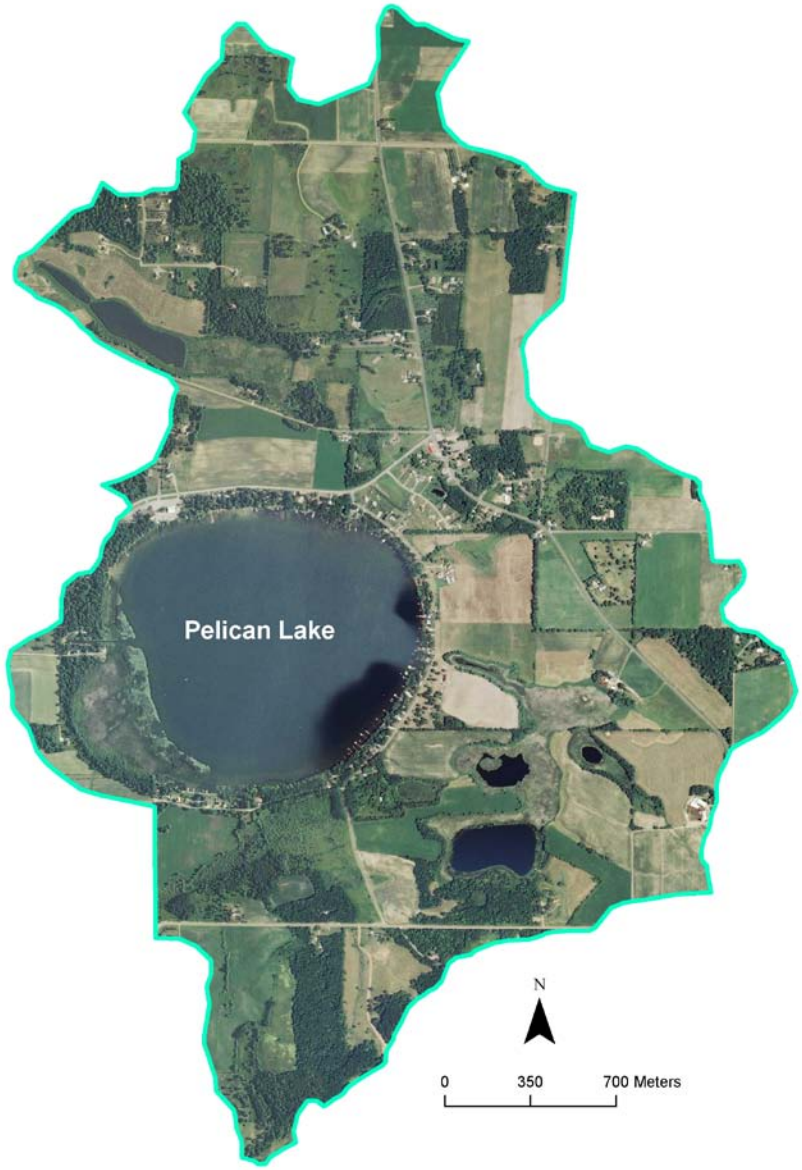
Figure 2. Pelican Lake depth contours (10 and 20 foot contours based on 2010 data). Photo source 2008 FSA color aerial photo.



it receives most of its flow from precipitation and groundwater flow. Water levels on seepage lakes can fluctuate seasonally and annually because their water level is a reflection of the elevation of the water table, which in turn reflects the amount of rain water and snow melt. Because Pelican Lake is not a flow-through lake, it is particularly susceptible to increased nutrient and particle input that may result from poor shoreland management practices.

The land area that drains directly to Pelican Lake can be referred to as the Lakeshed. The Lakeshed of Pelican Lake covers about 2,000 acres (Figure 3) and is dominated by agricultural land with small-wetlands and some forested hilly areas (Lindon and Heiskary, 2005). The immediate shoreline of Pelican Lake is heavily developed with residential homes, particularly on the eastern 2/3rds of the lake. Despite this development, trees ring the majority of the shoreline, providing at least a marginal vegetative cover within 50 meters of the lake. A larger vegetation buffer occurs along the western edge of the lake and extends at least 200 meters in some areas.

Figure 3. Immediate Lakeshed of Pelican Lake (photo source: 2008 FSA Color Aerial Photograph).



Pelican Lake is characterized as a mesotrophic (moderate nutrients), hard water lake, with relatively clear water. The Secchi disc transparency measures the depth to which a person can see into the lake and provides a rough estimate of the light penetration into the water column. Water clarity can fluctuate annually and depends on the amount of particles in the water. In 2009, mean summer (June through September) water clarity, as measured by Secchi disc readings, was 10 feet in Pelican Lake

(MPCA 2010). As a general rule, sunlight can penetrate to a depth of two times the Secchi depth and aquatic plants can grow to a depth of one and a half times the Secchi depth. Based on Secchi disk measurements alone, aquatic plants have the potential to reach depths of at least 15 feet in this lake.

Historic aquatic plant community

Previous lakewide, aquatic plant surveys of Pelican Lake were conducted in 1960, 1975, 1982 and 2000 (MnDNR Lake files). Rare plant surveys of Pelican Lake were conducted in 1997 in the northwest bay (Myhre, 1997). These surveys recorded a total of 44 aquatic plant species: 10 emergent, 4 floating-leaf, 4 free-floating and 26 submerged species (Appendix 1). Submerged plants have been found to a depth of 21 feet and included muskgrass (*Chara* sp.), 11 different native pondweeds (*Potamogeton* spp.), northern watermilfoil (*Myriophyllum sibiricum*), coontail (*Ceratophyllum demersum*), bushy pondweed (*Najas flexilis*), and Canada waterweed (*Elodea canadensis*). Several wetland emergent plants were also recorded during the 2000 survey (Appendix 1). The non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*), was first documented in the lake in 2000 but has been present in the county for decades.

Emergent and floating-leaf plants were mapped in 2010 by DNR Fisheries and the common plant beds were cattails (*Typha* sp.), bulrush (*Schoenoplectus* sp.) and white and yellow waterlilies (*Nuphar variegata* and *Nymphaea odorata*).

Objectives

The purpose of this vegetation survey was to provide a quantitative description of the 2010 plant population of Pelican Lake. Specific objectives included:

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

Methods

Lakewide vegetation survey

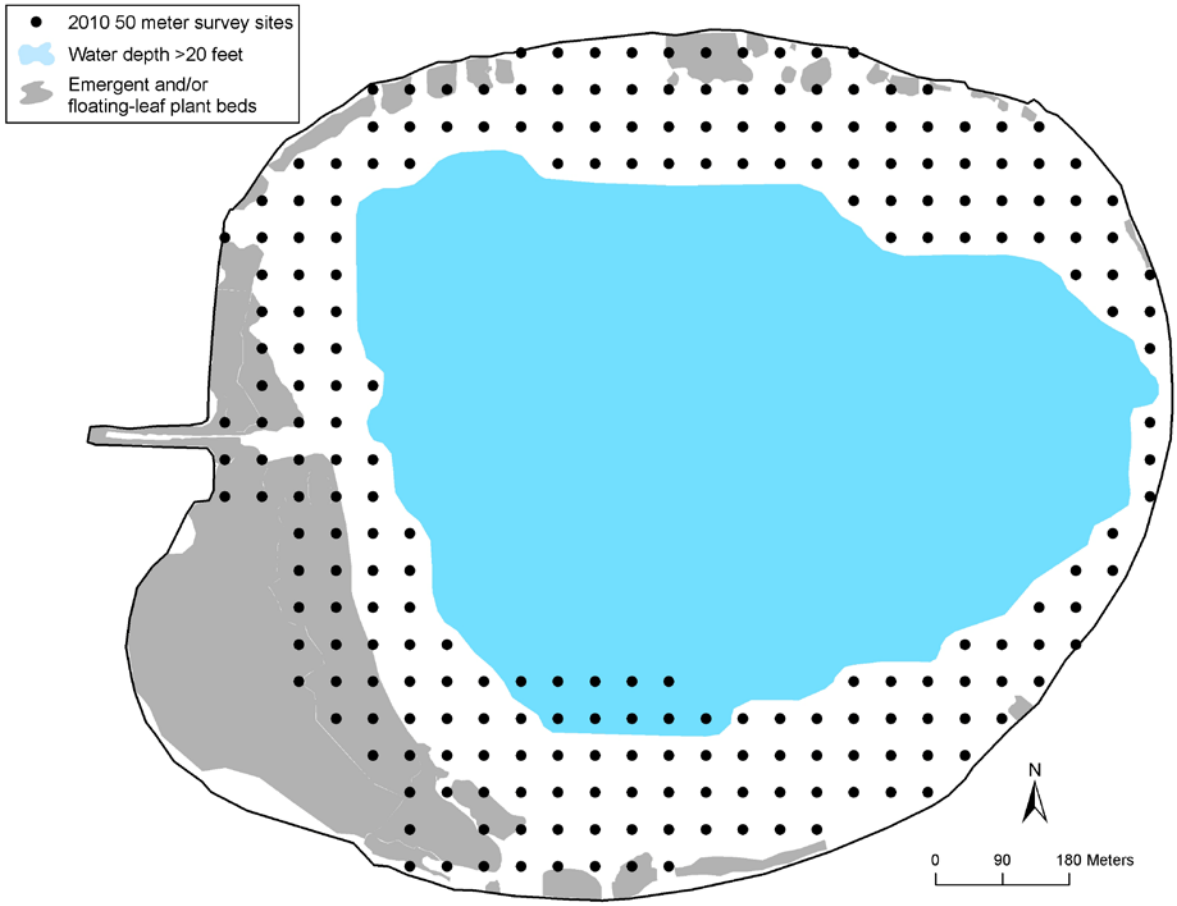
A lakewide vegetation survey was conducted using a point-intercept survey method (Madsen 1999, MnDNR 2009). Survey waypoints were created using a Geographic Information System (GIS) computer program and downloaded into a handheld Global Positioning (GPS) unit. Survey points were placed across the entire lake and spaced 50 meters (164 feet) apart. In the field, surveyors sampled sites where water depth was less than 21

Table 1. Survey effort by depth interval.

Water depth (feet)	Number of sample sites
0 to 5	147
6 to 10	43
11 to 15	10
16 to 20	25
Total (0to20)	225
21 to 25	10
Total	235

feet. Ten sites were sampled in deeper water but no vegetation was found. To minimize damage to vegetation, surveyors did not survey sites if they occurred in dense beds of emergent or floating-leaf plants; the southwest end of the lake was not included in the survey due to dense cattail beds. A total of 225 sites were surveyed within the 0-20 feet depth zone of Pelican Lake (Figure 4, Table 1).

Figure 4. 2010 vegetation survey sites on Pelican Lake.



Pelican Lake was surveyed on June 29 and 30, 2010. The survey 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 7 feet and an electronic depth finder in deeper water.

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

Substrate sampling

At each sample site where water depths were 7

feet and less, surveyors described the bottom substrate using standard substrate classes (Table 2). If more than one substrate type was found, surveyors recorded the most common type. Surveyors attempted to record a substrate description at the shore side of each row of points. If a sample site occurred near shore but in water depths greater than 7 feet, surveyors collected depth and vegetation data and then motored into shallower water and recorded the substrate type adjacent to the actual survey point.

Plant sampling

Surveyors recorded all plant species 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 water surface (Figure 5). Any additional plant species found outside of sample sites were recorded as "present" in the lake but these data were not used in frequency calculations. Plant identification followed Crow and Hellquist (2000) and Flora of North America (1993+) and nomenclature followed MnTaxa (2010).

Figure 5. Survey rake.

Data were entered into a Microsoft Access database and frequency of occurrence was calculated for each species as the number of sites in which the species occurred divided by the total number of sample sites. Frequency was calculated for the entire area from shore to 20 feet and sampling points were also grouped by water depth and separated into 4 depth zones for analysis (Table 1).

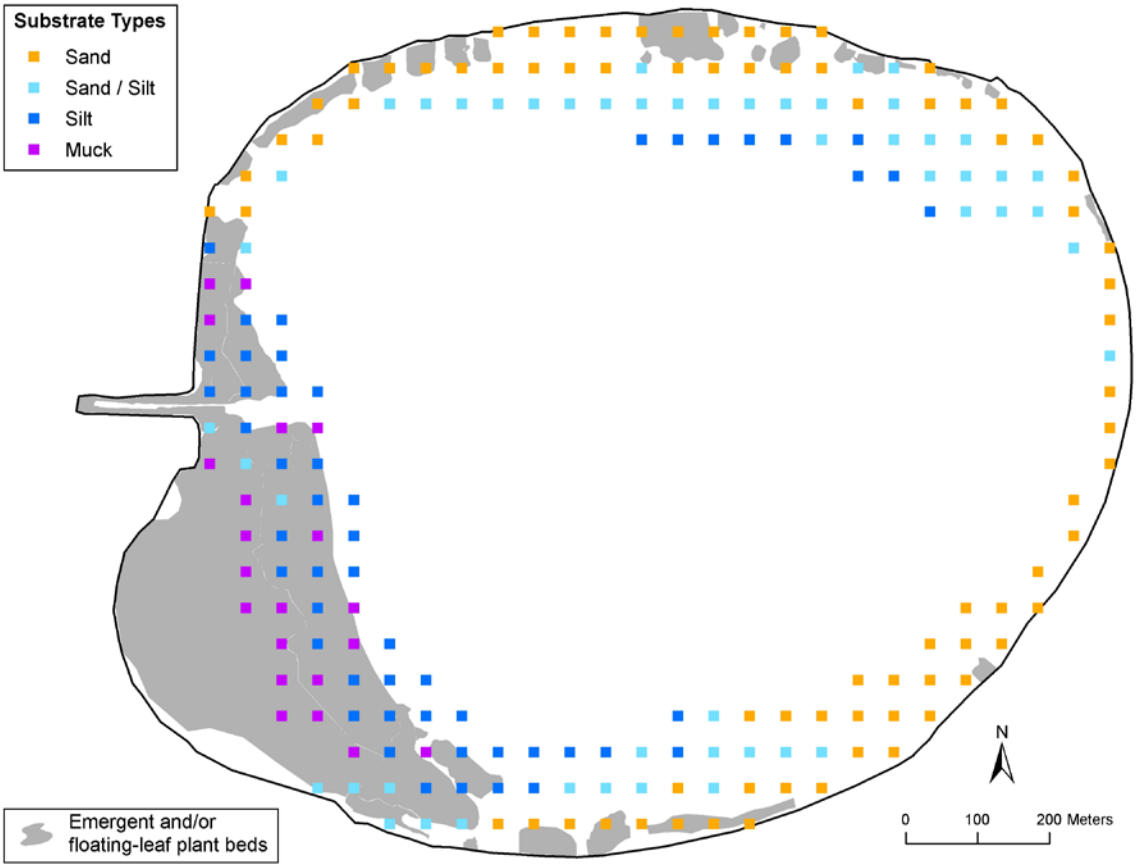
Example:
In Pelican Lake there were 225 samples sites in the 0-20 feet depth zone.
Coontail occurred in 113 sites.
Frequency of Coontail in 0 to 20 feet zone = (113/ 225)*100 = 50%

Results and Discussion

Shoal Substrates

The shoal substrates of Pelican Lake included hard substrates of sand, gravel, and rubble along the north, east and southern shores (Figure 6). Softer substrates of silt and muck were found on the west shore and in depth greater than about 4 feet (Figure 6).

Figure 6. Shoal substrates of Pelican Lake, 2010.



Types of plants recorded

In 2010, 30 native plant species (types) were recorded in Pelican Lake including 4 emergent, 3 floating-leaved, and 23 submerged and/or free-floating plants (Table 3). Several species that were recorded in 2000 [narrow-leaf pondweeds and whorled watermilfoil (*Myriophyllum verticillatum*)] were likely present in the lake in 2010 but not identified to the genus level. Some other species that were found in earlier years but not in 2010 (duckweeds (*Lemna* sp. and *Spirodela polyhriza*), yellow water buttercup (*Ranunculus flabellaris*), ribbon-leaf pondweed (*Potamogeton epihydrus*), and several emergents) are shallow water plants that may have been present in the southwest bay that was not thoroughly surveyed in 2010.

Submerged plants included macroalgae, an aquatic moss and a diversity of rooted, flowering plants that can be grouped by leaf shape and size: dissected, small, narrow, broad and grass-leaved plants. Two submerged species, southern naiad (*Najas guadalupensis*) and watermoss were documented for the first time in the lake in the 2010 survey (Appendix 1).

Table 3. Frequency of aquatic plants in Pelican Lake, June, 2010.

[Frequency is the percent of sample sites in which a plant species occurred within the 0 to 20 ft water depth).

Life Form		Common Name	Scientific Name	Frequency (%) 225
SUBMERGED	Macroalgae	Muskgrass	*Chara* sp.	31
		Stonewort	*Nitella* sp.	4
	Moss	Watermoss	*Not identified to genus*	8
	Dissected-leaf rooted plants	Northern watermilfoil	*Myriophyllum sibiricum*	51
		Coontail	*Ceratophyllum demersum*	50
		Water marigold	*Bidens beckii*	5
		Greater bladderwort	*Utricularia vulgaris*	5
		White-water buttercup	*Ranunculus aquatilis*	3
		Lesser bladderwort	*Utricularia minor*	<1
	Small-leaf rooted plants	Canada waterweed	*Elodea canadensis*	21
		Southern naiad	*Najas guadalupensis*	3
		Bushy pondweed	*Najas flexilis*	<1
	Narrow-leaf pondweeds	Narrow-leaf pondweed group[A]	*Potamogeton friesii*	24
		Sago pondweed	*Stuckenia pectinata*	14
	Broad-leaf pondweeds	Illinois pondweed	*Potamogeton illinoensis*	15
		White-stem pondweed	*Potamogeton praelongus*	14
		Clasping-leaf pondweed	*Potamogeton richardsonii*	10
		Large-leaf pondweed	*Potamogeton amplifolius*	<1
		Variable pondweed	*Potamogeton gramineus*	<1
		Curly-leaf pondweed (I)	*Potamogeton crispus*	4
	Grass-leaf rooted plants	Flat-stem pondweed	*Potamogeton zosteriformis*	35
		Wild celery	*Vallisneria americana*	6
		Water star-grass	*Heteranthera dubia*	4
Free-floating	Duckweeds	Star duckweed	*Lemna trisulca*	47

I = introduced species

[A] Species in this genus were grouped together for analysis because field identification to the species level was difficult. At least three species of narrow-leaf pondweeds were identified in the lake: Fries' pondweed (*Potamogeton friesii*), small pondweed (*Potamogeton pusillus*) and straight-leaved pondweed (*Potamogeton strictifolius*). Additional narrow-leaf pondweed species (*Potamogeton* spp.) may have also been present.

Three non-native plants were documented: The submerged plant, curly-leaf pondweed (*Potamogeton crispus*), and the emergent wetland plants, purple loosestrife (*Lythrum salicaria*) and reed canary grass (*Phalaris arundinaceae*).

Table 3 (continued). Frequency of aquatic plants in Pelican Lake, June, 2010.

[Frequency is the percent of sample sites in which a plant species occurred within the 0 to 20 ft water depth).

Life Form	Common Name	Scientific Name	Frequency (%)
			225
FLOATING-LEAVED	White waterlily	*Nymphaea odorata*	4
	Yellow waterlily	*Nuphar variegata*	1
	Floating-leaf pondweed	*Potamogeton natans*	1
EMERGENT (includes only in-lake emergents and not wetland plants)	Narrow-leaved cattail[B]	*Typha* sp.	5
	Needlegrass	*Eleocharis acicularis*	2
	Bulrush	*Schoenoplectus* sp.	1
	Arrowhead	*Sagittaria* sp.	<1

[B] narrow leaf cattail was identified in survey but it is not known whether this included *Typha angustifolia* and/or *Typha* x *glauca*.

Distribution of aquatic plants

Plants were found to a depth of 20 feet in Pelican Lake and scattered plants likely occurred beyond that depth. Within the 0-20 feet depth zone, 93% of the survey sites contained vegetation. Vegetation was most common in the 0 to 10 feet depth zone, where 99% of sites contained plants (Figure 7). Plant abundance declined with increasing water depth and in depths of 15 to 20 feet, only 56% of sites contained plants.

Plants were distributed throughout the littoral zone and the broadest zone of vegetation occurred along the north, west and southern shorelines (Figure 8). Along the eastern shoreline plant beds were restricted to the first 40 meters from shore because the depth contours were close together.

Figure 7. Aquatic plant frequency vs. water depth.

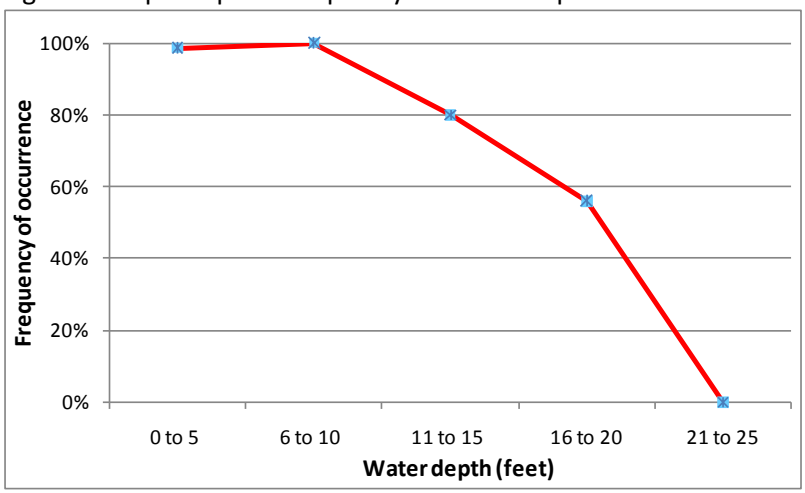
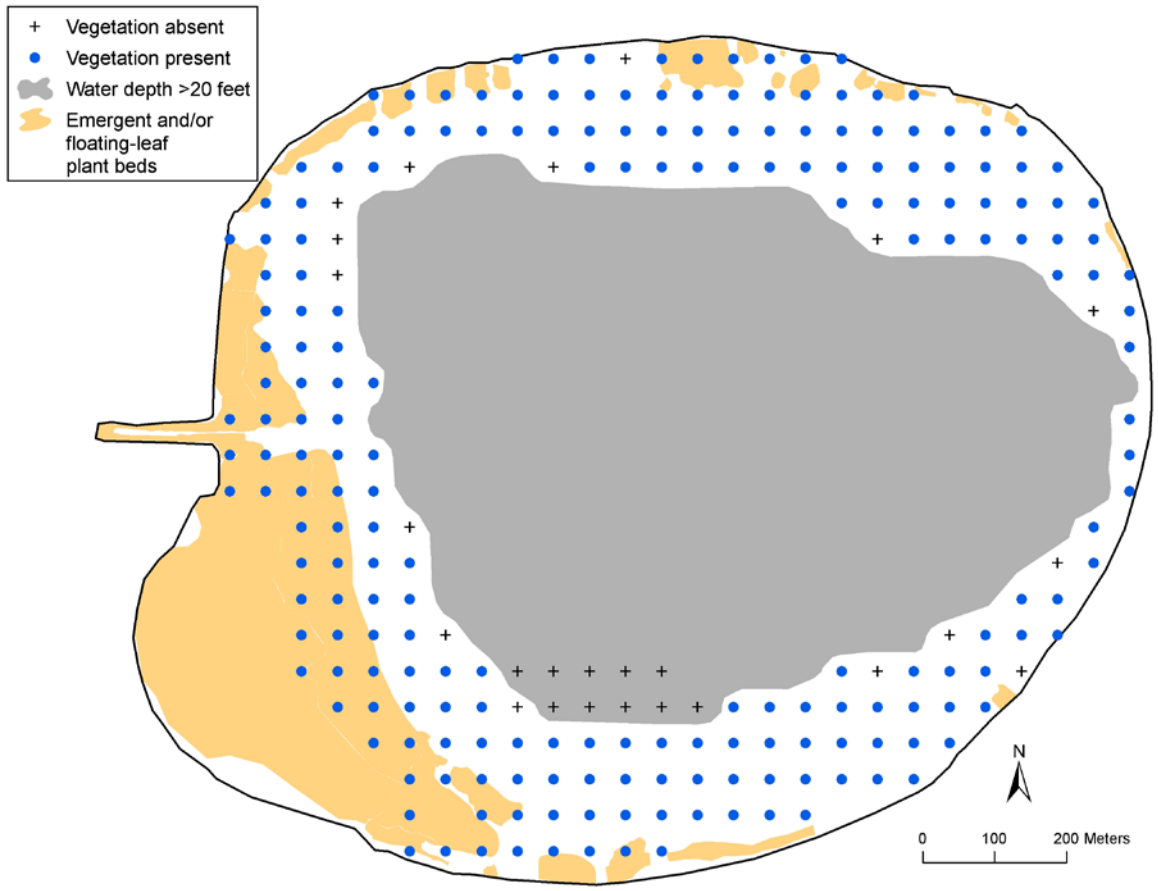


Figure 8. Distribution of aquatic plants, Pelican Lake 2010.



Plant communities richness

The highest number of plant species was found in shallow water, from shore to a depth of 5 feet (Figure 9). Most emergent and floating-leaf plants were restricted to shallow water (less than 6 feet). Most submerged species were found in depths of 10 feet and less and only 7 species (coontail, stonewort, curly-leaf pondweed, narrow-leaf pondweed, white-stem pondweed, flat-stem pondweed, and star duckweed) occurred in depths greater than 10 feet.

The number of plant species found at each one square meter sample site ranged from 0 to 10 with a mean of 4 species per site. Sites of high species richness occurred along the north and west shorelines (Figure 10).

Figure 9. Number of plant species vs. water depth, Pelican Lake, 2010.

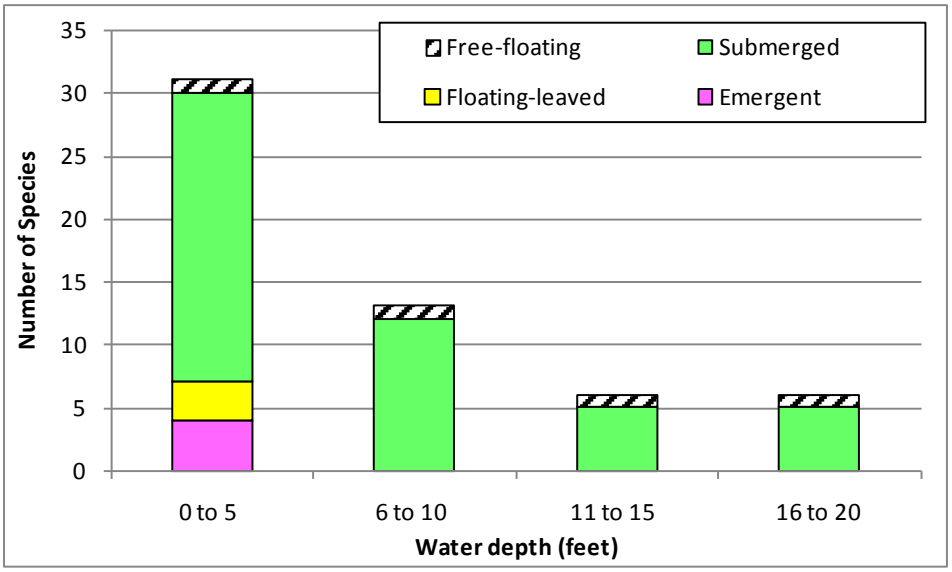
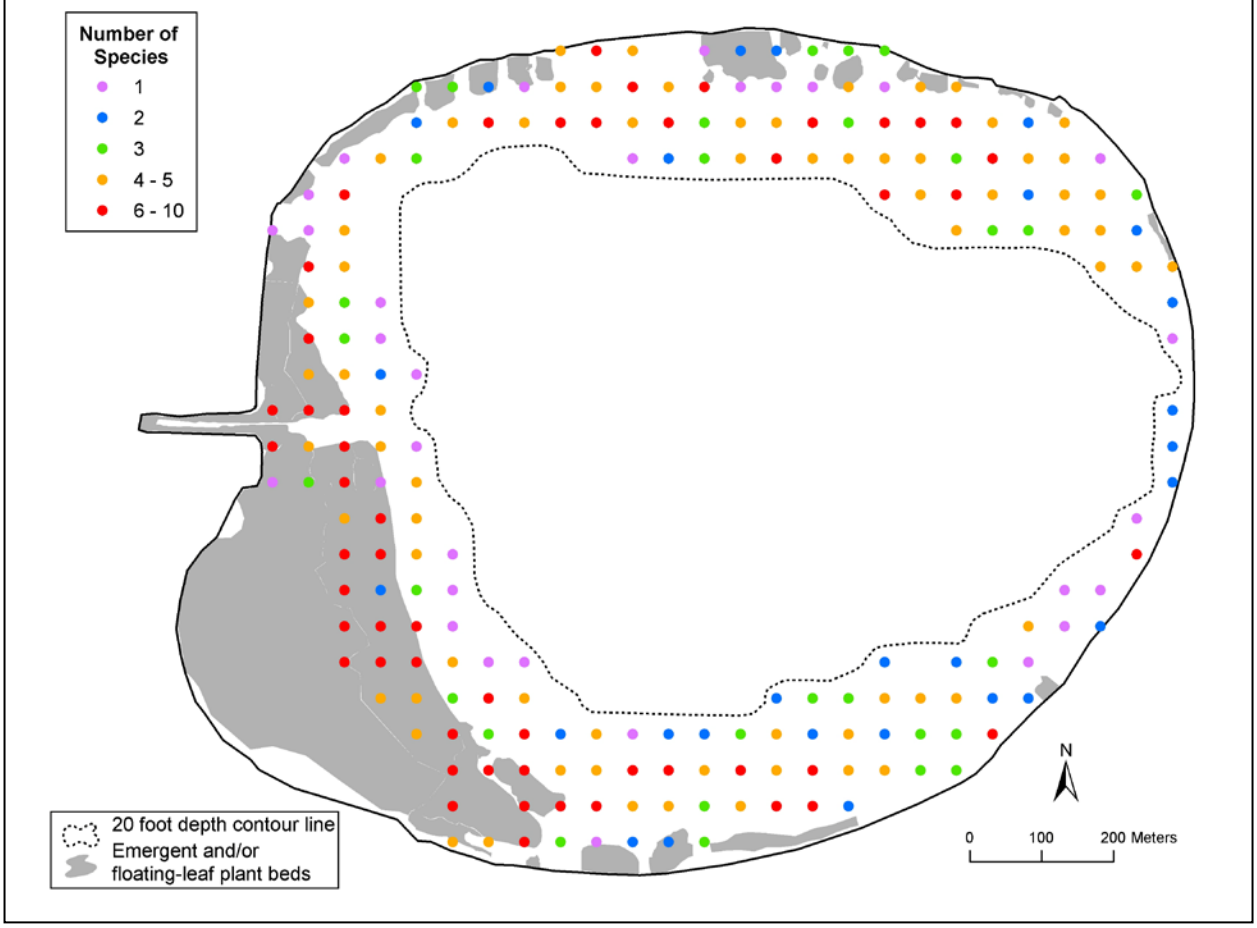


Figure 10. Number of species per site, Pelican Lake 2010.

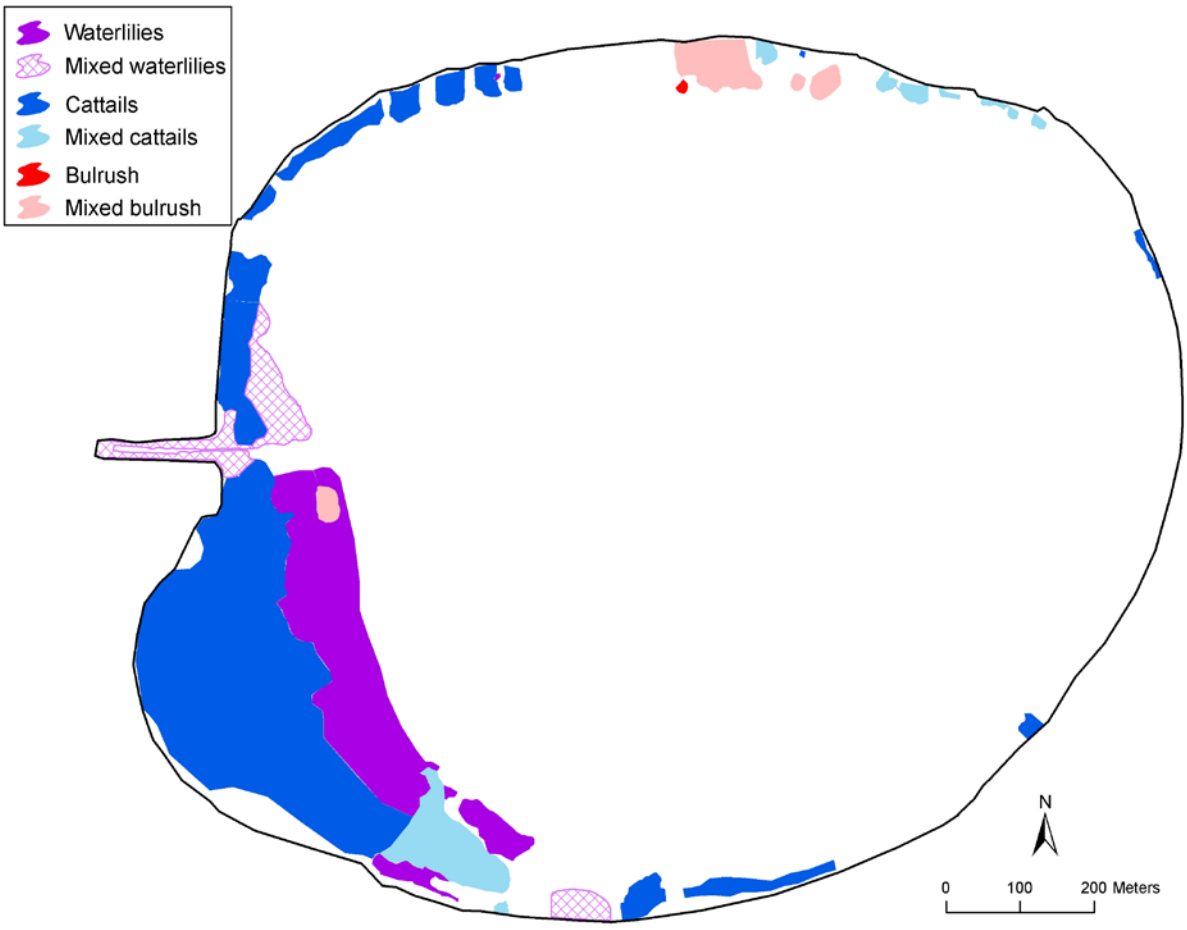


Emergent and Floating-leaf Plant Beds

Emergent and floating-leaf aquatic plants offer food, cover and nesting material for waterfowl, marsh birds and muskrats, and provide shelter and shade for insects, young fish, and amphibians. The root systems of emergent and floating-leaf plants protect shorelines against erosion by buffering the wave action and by holding soil in place.

Approximately 50 acres of cattails and waterlily plant beds were mapped in Pelican Lake. Emergent and floating-leaf plants were restricted to 5 feet and less, and were common in the shallow water zone (0 to 5 feet) where 25% of the Pelican Lake sites contained at least one emergent or floating-leaf plant. Plant beds were classified by the dominant species (Figure 11).

Figure 11. Emergent and floating-leaf plant beds of Pelican Lake, 2010 (Source MnDNR Fisheries).



Floating-leaf plants are rooted in the lake bottom and most of their leaves float on the water surface; they often produce showy flowers that emerge out of the water. In Pelican Lake, these plants included yellow waterlily (*Nuphar variegata*; Figure 12), white waterlily (*Nymphaea odorata*; Figure 13), and floating-leaf pondweed (*Potamogeton natans*). Waterlily beds, or

mixed beds of waterlilies and emergent plants, covered about 15 acres in Pelican Lake (Figure 11).

Figure 12. Yellow waterlily

Figure 13. White waterlily

Cattails (*Typha* spp.; Figure 14) are emergent plants that are found in lakes and marshes throughout Minnesota. They are perennial plants that emerge from a spreading rhizome and they have long and narrow leaves. Cattails provide shelter and food for many different kinds of fish and bird species. A total of 32 acres of cattails were mapped in Pelican Lake and the largest bed was along the west shoreline (Figure 11).

Figure 14. Cattails

Bulrush (*Schoenoplectus* sp.; Figure 15) is an emergent, perennial plant that is rooted in the lake bottom with narrow stems that may extend several feet above the water. In addition to providing valuable fish and wildlife habitat, the extensive root network of this plant help to stabilize sandy shorelines. In shallow water, bulrush may spread by underground rhizomes but is particularly susceptible to destruction by direct cutting by humans, motorboat activity and excess herbivory. Restoration of these plant beds can be very difficult, making established beds particularly unique and valuable. In Pelican Lake, bulrush was most often found on the sandy northern shores (Figure 11). A total of 2 acres of bulrush or mixed bulrush beds were mapped.

Figure 15. Bulrush

Submerged aquatic plants

Submerged plants occurred in 93% of the Pelican Lake sample sites and were found throughout the littoral zone (Figure 16, 17). The most frequently occurring species were muskgrass (*Chara* sp.), northern watermilfoil (*Myriophyllum sibiricum*), coontail (*Ceratophyllum demersum*), star duckweed (*Lemna trisulca*), flat-stem pondweed (*Potamogeton zosteriformis*), narrow-leaf pondweeds (*Potamogeton* sp.), and Canada waterweed (*Elodea canadensis*). These species were all common in the 0-10 feet zone, where they each occurred with a frequency of at least 20%. In deeper water, muskgrass, coontail and southern naiad were the dominant species (Figure 17).

Figure 16. Distribution of common submerged plants in Pelican Lake, 2010.

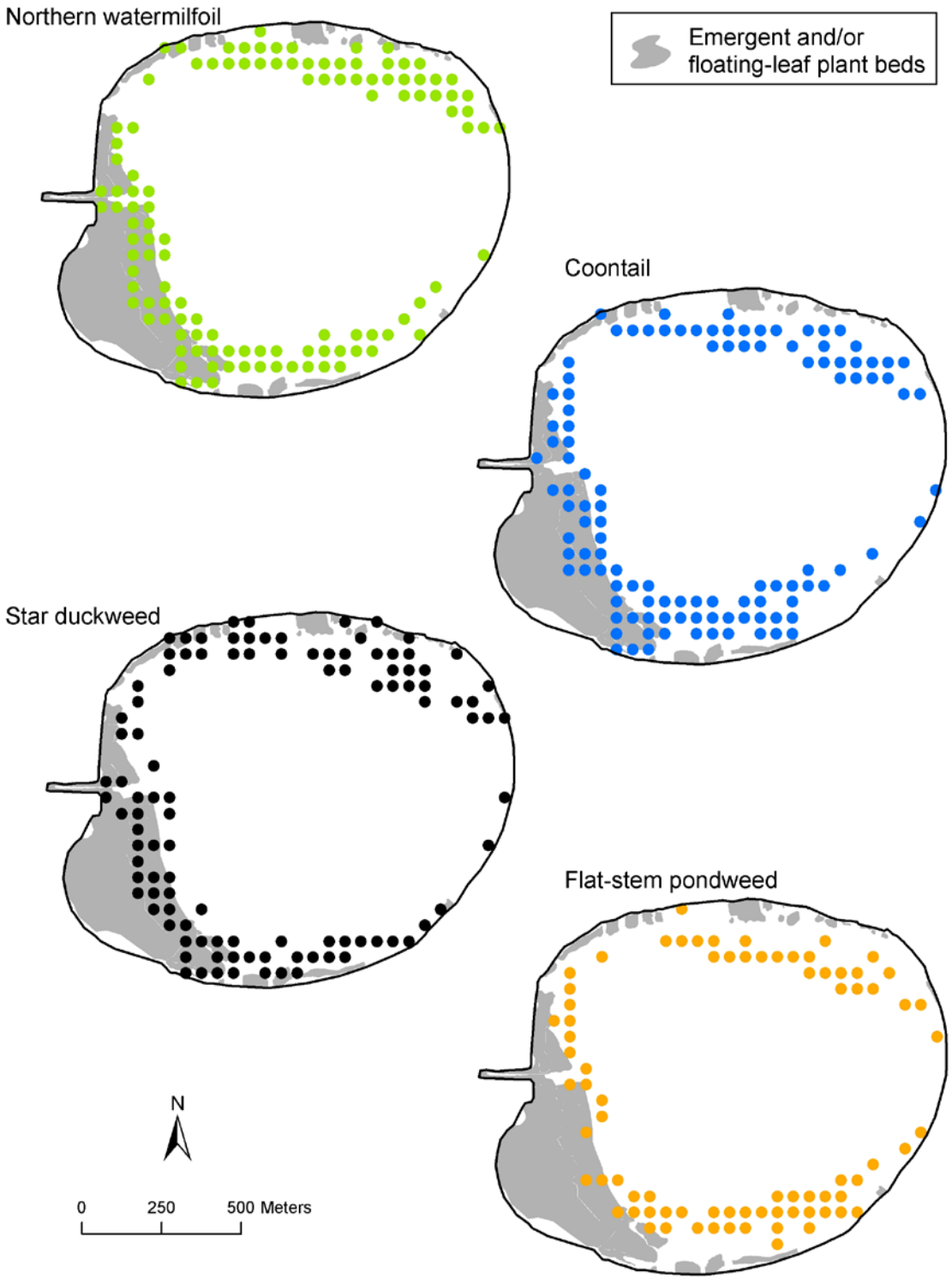


Figure 17. Distribution of common submerged plants in Pelican Lake, 2010.

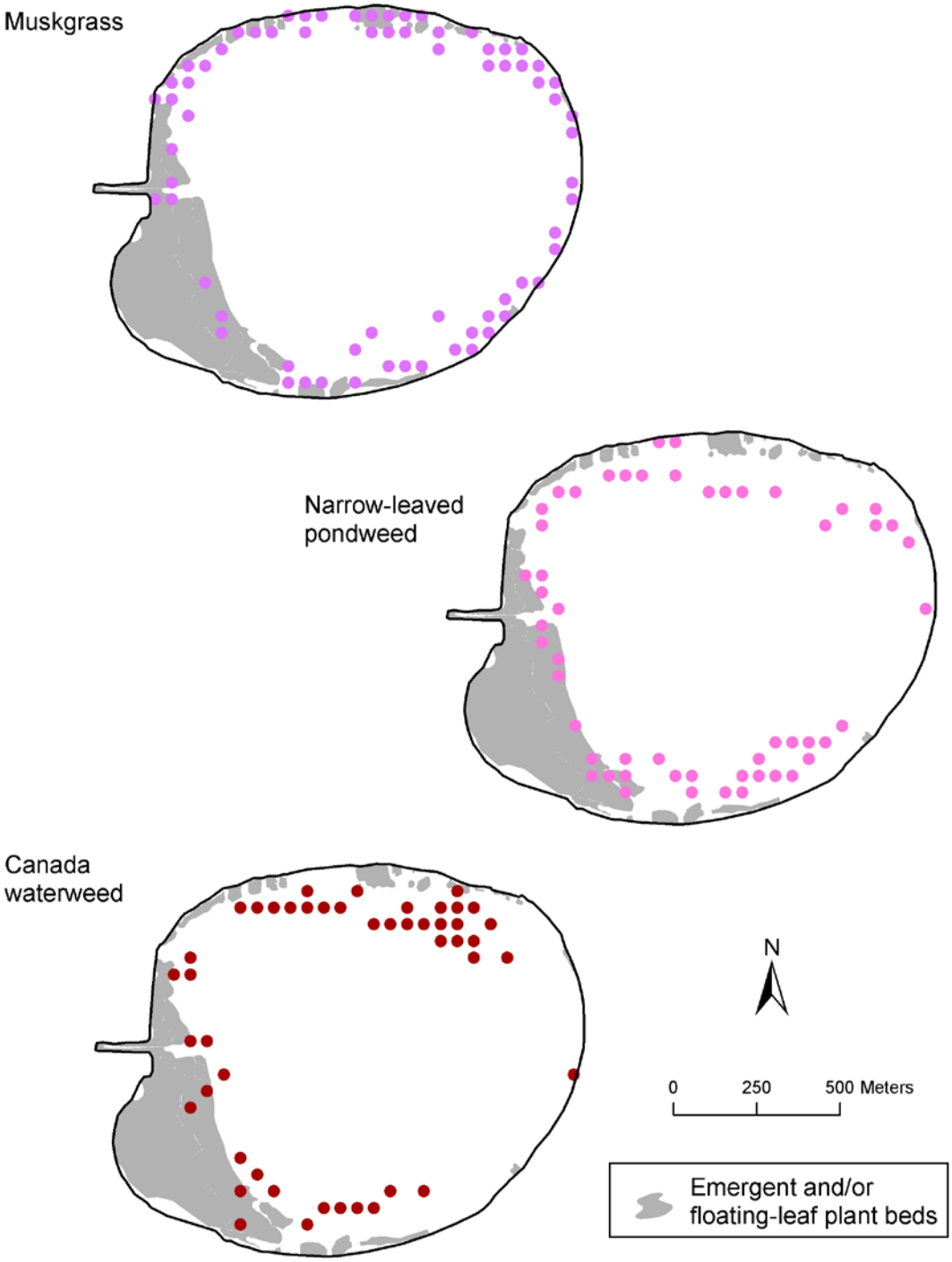
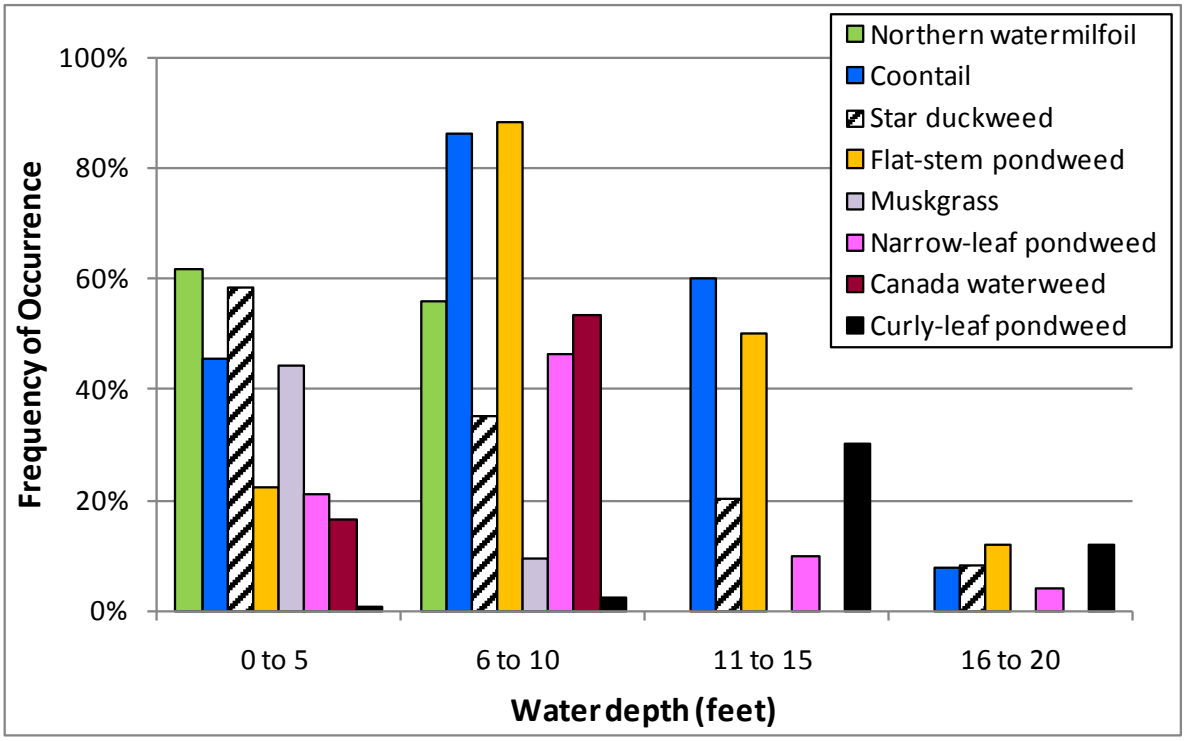


Figure 18. Common submerged plants at each water depth interval, Pelican Lake 2010.



Submerged native plants

Water-milfoils are submerged, rooted perennial plants with finely dissected leaves and flowers that extend above the water surface. Two native watermilfoils; Northern watermilfoil (Figure 19) and whorled watermilfoil have been documented in Pelican Lake. The non-native, Eurasian watermilfoil, has not yet been found in the lake. For information on how to distinguish the native watermilfoils from Eurasian watermilfoil, click here: Identifications. Water-milfoils are not tolerant of turbidity and grow best in clear water lakes. Northern watermilfoil was found in 51% of the Pelican Lake sites (Table 3). It occurred throughout the littoral zone and was the most frequently occurring plant in the 0 to 5 feet depth zone where it occurred in 62% of the sites (Figure 16, 18).

Figure 19. Northern watermilfoil

Photo by: Andrew Hipp (UW Madison-Wisc State Herbarium)

Coontail (Figure 20) grows entirely submerged and may float freely or be loosely anchored to the lake bottom. It is adapted to a broad range of lake conditions and is tolerant of higher turbidity and can grow in muck substrates. 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 stem fragmentation. The finely divided leaves of this plant provide a home for insects valuable as fish food. Coontail was found in 50%

Figure 20. Coontail

of the sample sites in Pelican Lake (Table 3) and was most common in the 6 to 10 feet depth zone where it occurred in 86% of the sites (Figure 18).

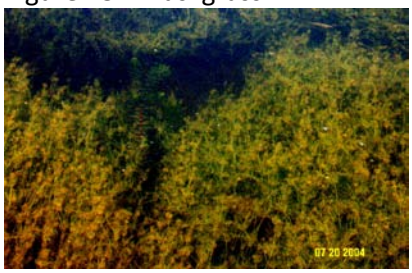
Figure 21. Star duckweed (photo by Robert Freckman- UW - Stevens Point)

Star duckweed (Figure 21) is a free-floating species that often occurs submerged near the lake bottom but it does not anchor to the substrate and can float freely with the current. This plant was present in 47% of the Pelican Lake survey sites (Table 3). It was found around the entire littoral zone (Figure 16) and was most frequent in water depths from 6 to 15 feet (Figure 18).

Figure 22. Flat-stem pondweed.

Flat-stem pondweed (Figure 22) is one of 11 native pondweeds found in Pelican Lake. Pondweeds (*Potamogeton spp. and Stuckenia spp.*) are primarily submerged, perennial plants that are anchored to the lake bottom by underground rhizomes. Depending on water clarity and depth, these plants may reach the water surface and may produce flowers that extend above the water. Pondweed seeds and tubers are an important source of waterfowl food (Fassett 1957) and the foliage of pondweeds is food for a variety of marsh birds, shore birds and wildlife and provides shelter, shade and spawning sites for a range of fish species (Borman et al. 2001). Flat-stem pondweed is named for its flattened, grass-like leaves. It was the most common pondweed in Pelican Lake and occurred with a frequency of 35% (Table 3). It occurred throughout the littoral zone (Figure 16) and was found to a depth of 18 feet (Figure 18). Along with coontail, it was one of the most frequent plants in depths greater than 5 feet.

Figure 23. Muskgrass



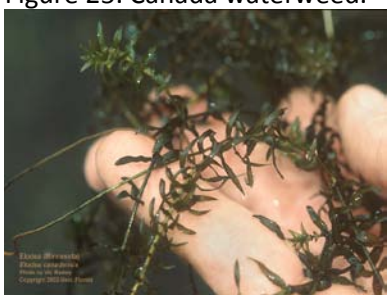
Muskgrass (Figure 23) is a freshwater macroalgae, a primitive plant that does not form true roots, flowers or vascular tissue. Macroalgae often resemble rooted plants and provide similar habitat and water quality benefits and were therefore included in this survey. Muskgrass is common in many hard water Minnesota lakes. It has a brittle texture and a characteristic "musky" odor. Because muskgrass 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 colonize open areas of lake bottom where it can act as a sediment stabilizer. Beds of muskgrass can provide important fish spawning and nesting habitat. In Pelican Lake, muskgrass occurred with a frequency of 31% (Table 3). It occurred along the shoreline of Pelican Lake (Figure 17) and was common in the 0 to 5 feet depth zone where it was found in 44% of the sites (Figure 18).

Narrow-leaf pondweeds are rooted, perennial submerged plants with small, thin leaves. Leaves grow entirely below the water surface but flowers extend above the water. There are several species of narrow-leaf pondweeds and they can be difficult to identify if not found in flower or fruit. Fries' pondweed (*Potamogeton friesii*; Figure 24), small pondweed (*Potamogeton pusillus*) and straight-leaved pondweed (*Potamogeton strictifolius*) have been previously been documented in Pelican Lake. In 2010, all narrow-leaf pondweeds were grouped together. In Pelican Lake, narrow-leaf pondweeds were found in 24% of the sites. They were most frequently found in depths of 6 to 10 feet (Table 3, Figure 18).

Figure 24. Fries' pondweed

(Photo by O Angerer)

Figure 25. Canada waterweed.

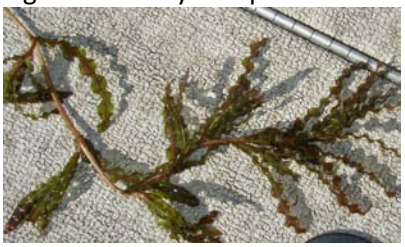


Canada waterweed (Figure 25) is a perennial submerged species that is widespread throughout Minnesota. It is adapted to a variety of conditions and is tolerant of low light and prefers soft substrates. Canada waterweed can overwinter as an evergreen plant and spreads primarily by fragments. It was found in 21% of the Pelican Lake survey sites (Table 3) and was most frequent in depths of 6 to 10 feet (Figure 18).

Non-native submerged plant

Curly-leaf pondweed (*Potamogeton crispus*; Figure 26) has been present in Minnesota since at least 1910 (Moyle and Hotchkiss 1945) and is now found in more than 750 Minnesota lakes (Invasive Species Program 2010).

Figure 26. Curly-leaf pondweed

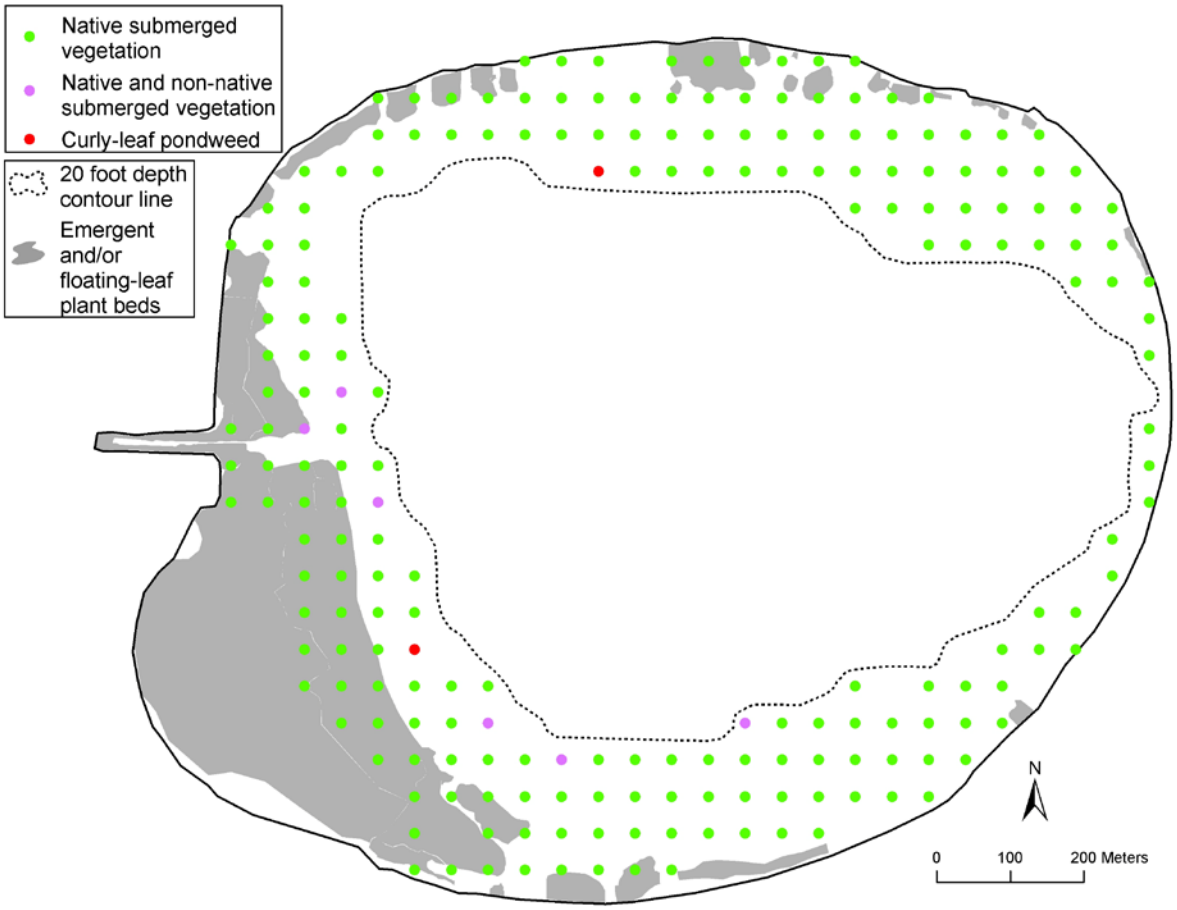


Like many submerged plants, it is perennial but it has a unique life cycle that may provide a competitive advantage over native species. Curly-leaf pondweed is actually dormant during late summer and begins new growth in early fall. Winter foliage is produced and continues to grow under ice (Wehrmeister 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).

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.

It is difficult to know when curly-leaf pondweed first appeared in Pelican Lake because most surveys are conducted in mid to late summer, after the plant has naturally died back. It was first documented in the lake in 2000, but may have been present in earlier years. In 2010, curly-leaf pondweed was found in 4% of the Pelican sample sites (Table 3) and was most common in the 11 to 20 feet depth zone where it occurred in 17% of the sites (Figure 18). Curly-leaf pondweed often co-occurred with native species (Figure 27).

Figure 27. Curly-leaf pondweed versus native submerged plants, Pelican Lake 2010.



Change in aquatic plant communities

The types and amounts of aquatic vegetation that occur within a lake are influenced by a variety of factors including water clarity, water chemistry, depth, substrate type and wave activity. 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 collected in 2010 can be used to monitor finer-scale changes that may occur, such as an increase in a particular species or a change in the depths at which individual species occur. 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 Pelican Lake increases, submerged vegetation may be more common at depths greater than 15 feet.

- 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.

- Aquatic plant management activities
  Humans can impact aquatic plant communities directly by destroying vegetation with herbicide or by mechanical means. The results of these control activities can be difficult to predict and should be conducted with caution to reduce potential negative impacts to non-target species. Motorboat activity in vegetated areas can be particularly harmful for species such as wild rice. Shoreline and watershed development can also indirectly influence aquatic plant growth if it results in changes to the overall water quality and clarity. For information on the laws pertaining to aquatic plant management: MnDNR APM Program.

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

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Appendix 1. Historical aquatic and wetland plants of Pelican Lake

Submerged plants

	Common Name	Scientific Name	1960	1975	1982	1997	2000	2010
	Water marigold	*Bidens beckii*				X	X	X
	Coontail	*Ceratophyllum demersum*		X	X	X	X	X
	Muskgrass	*Chara* sp.	X	X	X		X	X
	Canada waterweed	*Elodea canadensis*				X	X	X
	Water star-grass	*Heteranthera dubia*				X	X	X
Water milfoils	Northern watermilfoil	*Myriophyllum sibiricum*	X	X	X	X	X	X
	Whorled watermilfoil	*Myriophyllum verticillatum*					X	
	Bushy pondweed	*Najas flexilis*				X	X	X
	Stonewort	*Nitella* sp.					X	X
	Large-leaf pondweed	*Potamogeton amplifolius*	X			X	X	X
	Curly-leaf pondweed (I)	*Potamogeton crispus*					X	X
Narrow-leaf pondweeds	Fries pondweed	*Potamogeton friesii*					X	X
	Small pondweed	*Potamogeton pusillus*					X	
	Straight-leaved pondweed	*Potamogeton strictifolius*					X	
	Variable pondweed	*Potamogeton gramineus*				X	X	X
	Illinois pondweed	*Potamogeton illinoensis*				X	X	X
	White-stem pondweed	*Potamogeton praelongus*				X	X	X
	Clasping leaf pondweed	*Potamogeton richardsonii*	X	X	X	X	X	X
	Nuttall's pondweed	*Potamogeton epihydrus*	X	X				
	Flat-stem pondweed	*Potamogeton zosteriformis*	X	X		X	X	X
	White water buttercup	*Ranunculus aquatilis*					X	X
	Yellow water buttercup	*Ranunculus flabellaris*					X	
	Sago pondweed	*Stuckenia pectinata*	X	X		X	X	X
	Greater bladderwort	*Utricularia vulgaris*					X	X
	Lesser bladderwort	*Utricularia minor*					X	X
	Wild celery	*Vallisneria americana*			X	X	X	X
	Watermoss	*Not identified to genus*						X
		Total	7	7	5	14	25	22
		Max depth (feet)	15-18	n/a	n/a	n/a	21	20

Floating-leaved plants

Common Name	Scientific Name	1960	1975	1982	1997	2000	2010
Floating leaf pondweed	*Potamogeton natans*	X	X		X	X	X
White waterlily	*Nymphaea odorata*				X	X	X
Yellow waterlily	*Nuphar variegata*	X	X		X	X	X
Floating-leaf smartweed group	*Persicaria* sp.					X	
	Total	2	2	0	3	4	3

Free-floating plants

Common Name	Scientific Name	1960	1975	1982	1997	2000	2010
Star duckweed	*Lemna trisulca*				X	X	X
Turion-forming duckweed	*Lemna turionifera*				X		
Lesser duckweed	*Lemna* sp.					X	
Greater duckweed	*Spirodela polyrhiza*				X	X	
	Total	0	0	0	3	3	1

Emergent plants

Common Name	Scientific Name	1960	1975	1982	1997	2000	2010
River bulrush	*Bolboschoenus fluviatilis*					X	
Needlerush	*Eleocharis acicularis*					X	X
Broad-leaf arrowhead	*Sagittaria latifolia*				X		
Sessile fruited arrowhead	*Sagittaria rigida*	X[a]			X	X	X[a]
Bulrush	*Schoenoplectus acutus*	X	X		X	X	X[a]
	Schoenoplectus validus					X	
Three-square bulrush	*Schoenoplectus pungens*				X	X	
Giant burreed	*Sparganium eurycarpum*					X	
Broad-leaved cattail	*Typha latifolia*	X	X			X[a]	
Narrow-leaved cattail	*Typha* sp.				X		X
Wild rice	*Zizania palustris*		X				
	Total	3	3	0	5	8	4

Wetland emergent forbs

Common Name	Scientific Name	1960	1975	1982	1997	2000	2010
Swamp milkweed	*Asclepias incarnata*					X	
Aster group	*Aster* sp.					X	
Bur-Marigold	*Bidens* sp.				X		
Bulb-bearing water hemlock	*Cicuta bulbifera*				X		
Giant water hemlock	*Cicuta maculata*					X	
Purple-leaved willow-herb	*Epilobium coloratum*				X		
Boneset	*Eupatorium perfoliatum*					X	
Bedstraw	*Galium* sp.					X	
Spotted touch-me-not jewelweed	*Impatiens capensis*				X		
Purple loosestrife (I)	*Lythrum salicaria*					X	
Mint group	*Mentha* sp.					X	
Monkey-flower	*Mimulus ringens*				X		
Nodding smartweed	*Persicaria lapathifolia*				X		
Smartweed group	*Polygonum* sp.				X	X	
Skullcap group	*Scutellaria* sp.					X	
Marsh skullcap	*Scutellaria galericulata*				X		
Mad-dog skullcap	*Scutellaria lateriflora*				X		

Blue vervain	*Verbena* sp.					X	
	Total	0	0	0	16	18	0

Wetland emergent – grasses and sedges

Common Name	Scientific Name	1960	1975	1982	1997	2000	2010
Bottlebrush sedge	*Carex comosa*					X	
Broad-leaf sedge	*Carex* sp.					X	
Narrow-leaf sedge	*Carex* sp.					X	
Stream nut-grass	*Cyperus bipartitus*				X	X[a]	
Engelmann's nut-grass	*Cyperus odoratus*				X		
Barnyard grass	*Echinochloa muricata*				X		
Grass group	*Gramineae / Poaceae*					X	
Reed canary grass (I)	*Phalaris arundinaceae*				X	X	
Leafy bulrush	*Schoenoplectus atrovirens*					X	
	Total	0	0	0	4	7	0

Wetland shrubs

Common Name	Scientific Name	1960	1975	1982	1997	2000	2010
Peach-leaved willow	*Salix amygdaloides*				X		
Crack willow	*Salix fragilis*				X		
Sand-bar willow	*Salix interior*				X		
	Total				3		

I = introduced

X[a] = Species identified only to genus level

Sources:
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1997 (August 5): Karen Myhre, MnDNR Division of Ecological and Water Resources, Minnesota County Biological Survey Program (survey was focused on the northwest bay)
2000 (August 9): Montrose area DNR Fisheries Survey
2010 (June 29, 30): Simon, Van Dyne, Point Intercept survey, MnDNR Division of Ecological and Water Resources