Aquatic Vegetation of
Little Sand Lake
(11-0275-00)
and
Sand Lake
(11-0279-00)
Cass County, Minnesota
July 11-12, 2006

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Acknowledgments

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Summary

This survey assessed the aquatic plant community of Little Sand Lake (11-0275-00) and Sand Lake (11-0279-00) in Cass County, Minnesota.

In Sand Lake, the zone from shore to a depth of 30 feet was sampled and the entire area of Little Sand Lake (maximum depth of seven feet) was sampled. Within this area, 79 percent of the sample sites contained vegetation; 94 percent of sites in Little Sand Lake were vegetated and 71 percent of the Sand Lake sites contained plants. In Sand Lake, plant occurrence was greatest in depths from shore to 15 feet where 91 percent of the sites were vegetated.

A total of 45 native aquatic plant species were recorded in Little Sand and Sand Lakes including 28 submerged, five floating-leaved and 12 emergent plant species. Waterlilies dominated Little Sand Lake and submerged plants were common in both lakes. Common species included white waterlily (*Nymphaea odorata*), yellow waterlily (*Nuphar variegata*), watershield (*Brasenia schreberi*), bushy pondweed (*Najas flexilis*), Canada waterweed (*Elodea canadensis*), a variety of pondweeds (*Potamogeton* spp.) and water celery (*Vallisneria americana*).

Several unique species were also present including water bulrush (*Scirpus subterminalis*), pipewort (*Eriocaulon aquaticum*), Quillwort (*Isoetes* sp.), leafless watermilfoil (*Myriophyllum tenellum*), creeping water buttercup (*Ranunculus flabellaris*), and small bladderworts (*Utricularia* spp.). Many of these species are restricted to clear, soft-water lakes of northern Minnesota. There presence in these lakes is indicative of the high water clarity and relatively undisturbed aquatic plant community.

Introduction

Little Sand Lake and Sand Lake are located about eight miles east of the city of Hackensack in northern Cass County, Minnesota (Fig. 1).

There are no permanent inlets to the lake and a channel connects Little Sand to Sand Lake. An outlet stream on the north end of Sand Lake flows north to Widow Lake and then to the Boy River with continues east and north through a series of lakes before emptying into Leech Lake (Fig. 1).

These lakes are among the smallest in Cass County. Little Sand Lake has a surface area of about 43 acres and a maximum depth of eight feet (Fig. 2). Sand Lake has a surface area of 134 acres with a maximum depth of 54 feet (Fig. 2).

Sand and Little Sand lakes are described as oligotrophic (low nutrients) with high water clarity as indicated by an average Secchi depth of 22 feet between 2002 and 2006 for Sand Lake (MPCA 2006).

The majority of shoreline adjacent to these lakes remains forested and is moderately developed with homes. A DNR public access is located on the northeast corner of Little Sand Lake and smaller boats can access Sand Lake through a narrow channel connecting the lakes (Fig. 2).

Previous vegetation surveys of Sand and Little Sand Lakes were conducted in 1999 (DNR Fisheries Lake Files).

Figure 1. Location of Little Sand and Sand Lakes in Cass Co., Minnesota

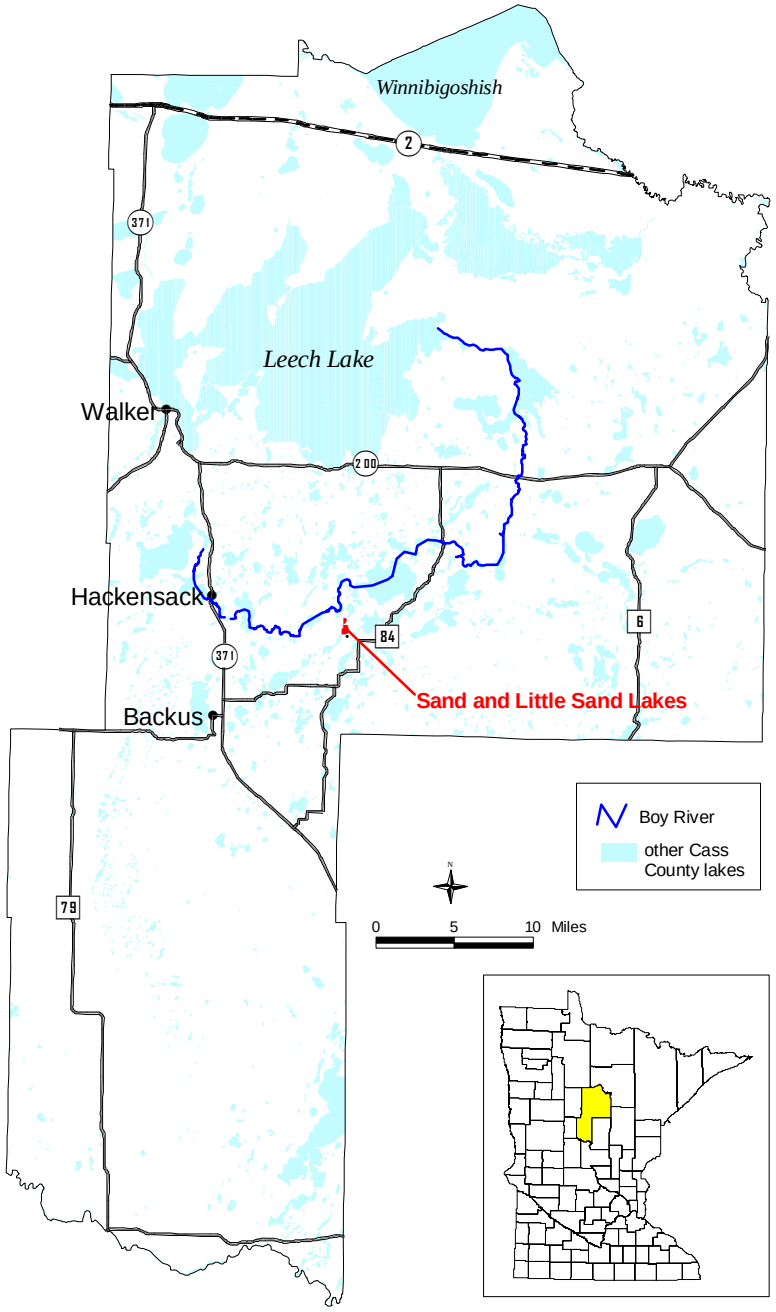
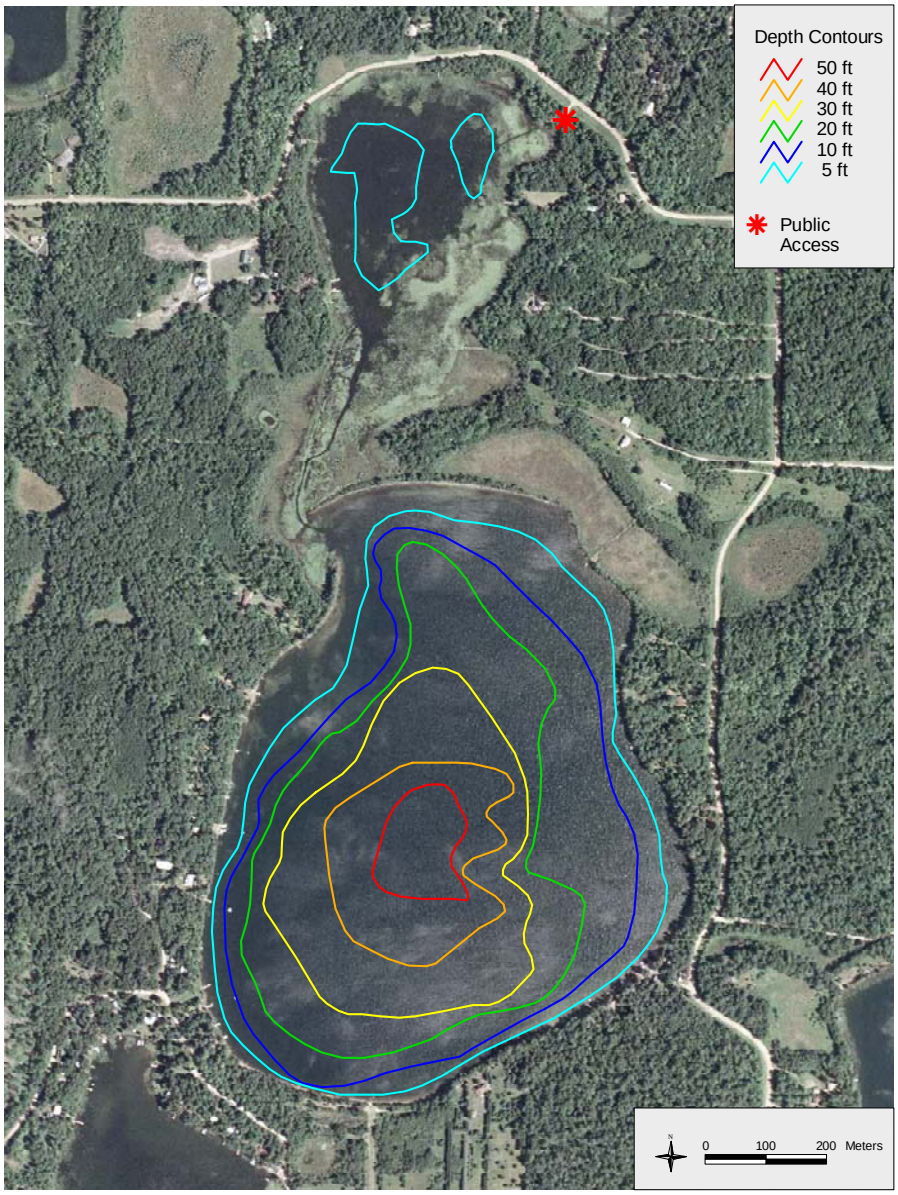


Figure 2. Depth contours of Little Sand and Sand Lakes, Cass County, MN.



Vegetation Survey Objectives

The purpose of this vegetation survey was to describe the 2006 aquatic plant populations of Little Sand and Sand Lakes. 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 vegetation survey of Sand and Little Sand Lakes was conducted by boat and canoe on July 11 and 12, 2006. 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 40 meter by 40 meter grid across the lake surface (Fig. 3). In the field, surveyors decided not to sample in depths greater than 30 feet because they consistently were not finding vegetation beyond the 26 feet depth. Several sites on the south end of Little Sand and the northwest end of Sand Lake were not sampled due to shallow water and dense floating-leaf vegetation. A total of 341 sites were sampled including 94 sites in Little Sand Lake and 247 sites in Sand Lake (Table 1).

The GPS receiver 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. 4). At each sample site where water depths was six feet and less, surveyors described the bottom substrate using standard substrate classes (Table 2).

Figure 3. Vegetation sample points on Little Sand and Sand Lakes, Cass Co.

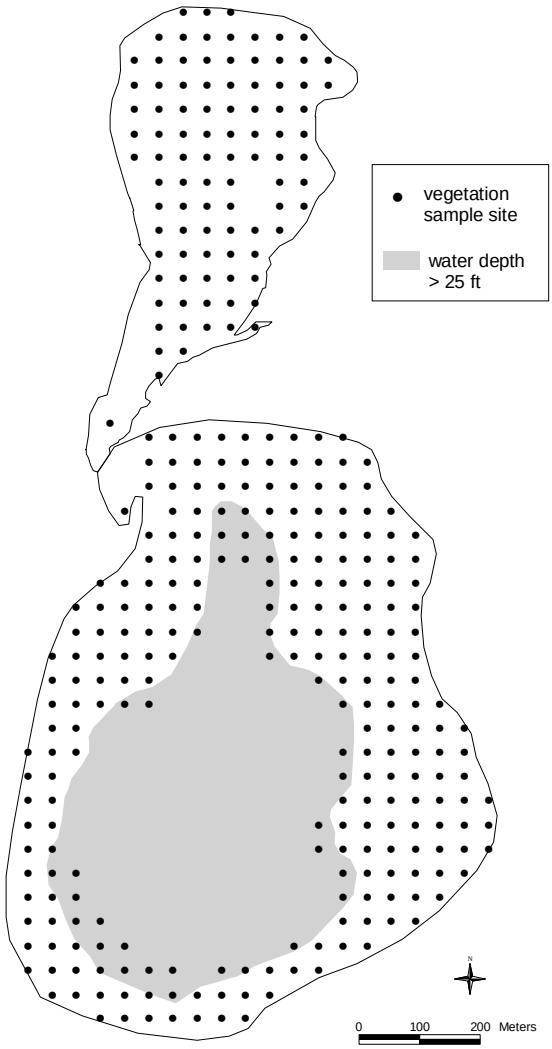


Table 1. Sampling effort by water depth Sand and Little Sand Lakes, 2006.

Depth interval in feet	Number of sample points		
	Little Sand Lake	Sand Lake	Lakes combined
0 to 5	86	46	132
6 to 10	8	75	82
11 to 15	0	35	35
16 to 20	0	27	27
21 to 25	0	35	35
26 to 30	0	29	29
Total	94	247	341

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 (3-10”)	diameter 3 to 10 inches
bolder (>10”)	diameter over 10 inches

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 Little Sand and Sand Lakes there were 341 samples sites from shore to the 30 feet depth.

Bushy pondweed (*Najas flexilis*) occurred in 108 of those sites.

Frequency of bushy pondweed in the shore to 30 feet depth zone = 108/341 (*100) =32 %

Frequency was calculated for the entire area from shore to 30 feet and sampling points were also grouped by water depth and separated into six depth zones for analysis: shore to five feet, six to 10 feet, 11 to 15 feet, 16 to 20 feet, 21 to 25 feet, and 26 to 30 feet (Table 1).

Figure 4. Sampling vegetation with rake.

Results

Shoal substrates

Near shore substrates of Sand Lake were primarily sand with silt found at the north end of the lake. Little Sand Lake had mostly muck bottom (Fig. 5).

Number and types of plant species recorded

A total of 44 native aquatic plant species were recorded in Little Sand and Sand Lakes including 27 submerged, five floating-leaved and 12 emergent plant species (Table 3).

Distribution and plants with water depth

Plants were found to a maximum depth of 29 feet in Sand Lake and to seven feet (the maximum depth sampled) in Little Sand Lake. Vegetation was found in 79 percent of all sites sampled; 94 percent of sites in Little Sand Lake were vegetated and 71 percent of the Sand Lake sites contained plants. In Sand Lake, plant occurrence was greatest in depths from shore to 15 feet where 91 percent of the sites were vegetated.

Figure 5. Shoal substrates of Sand and Little Sand Lakes, 2006.

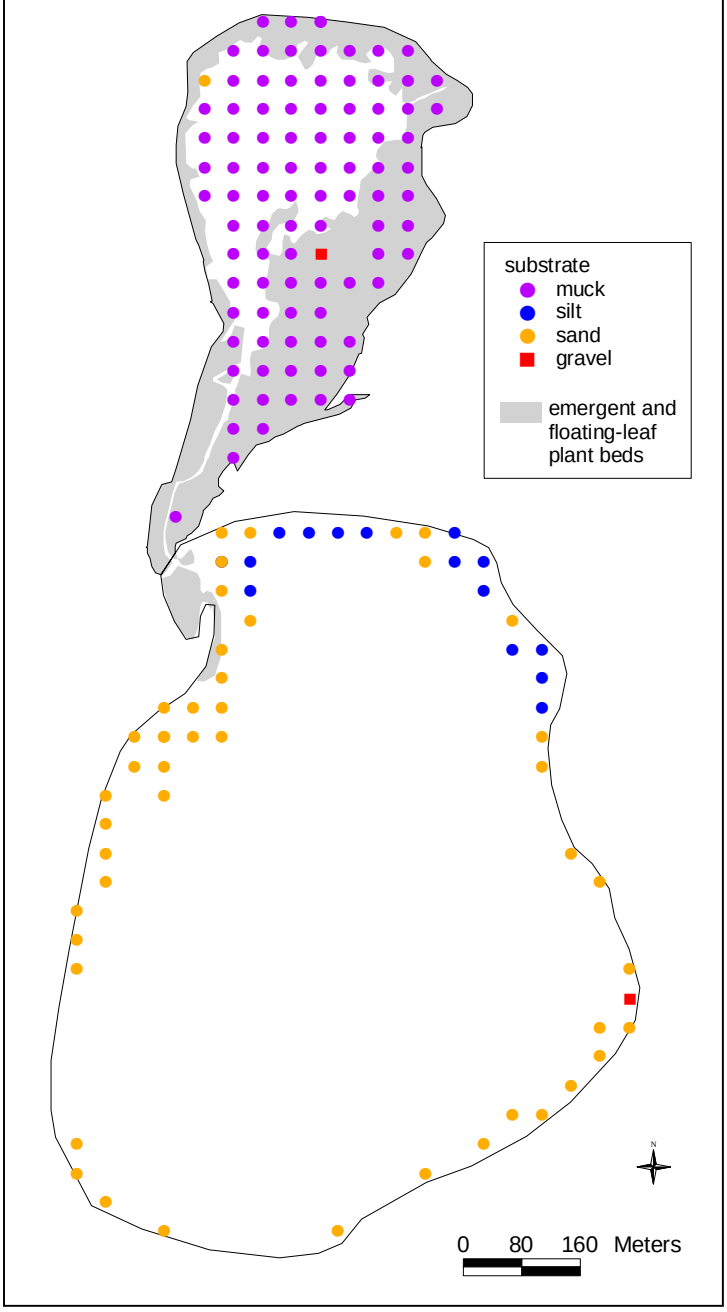
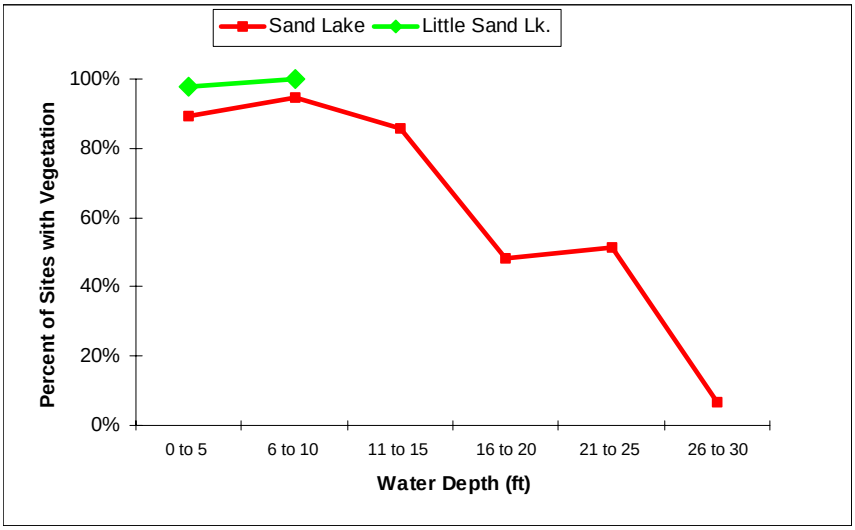


Table 2. Frequency of aquatic plants in Sand and Little Sand Lakes, June 2006.

Frequency calculated for vegetated zone (shore to 30 feet depth)
Frequency = percent of sites in which species occurred
P= present; indicates species was found in the lake but not within a sample site.

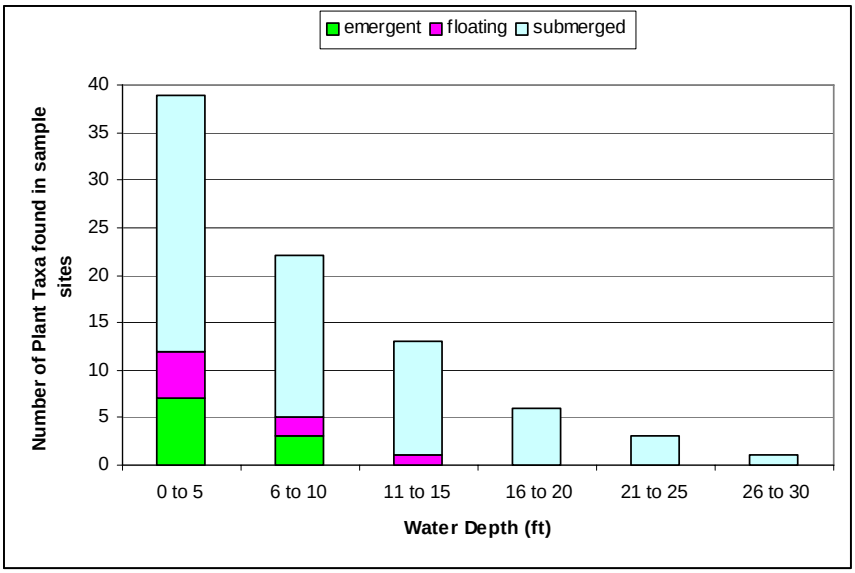
Group		Common name	Scientific name	Little Sand	Sand	Both lakes
Submerged	Algae	Muskgrass	Chara sp.	4	14	11
		Stonewort	Nitella sp.	--	<1	<1
		Bushy pondweed	Najas flexilis	35	30	32
		Canada waterweed	Elodea canadensis	28	26	27
	Pondweeds	Clasping-leaf pondweed	Potamogeton richardsonii	--	25	18
		Variable pondweed	Potamogeton gramineus	6	20	16
		Robbins pondweed	Potamogeton robbinsii	4	21	16
		Flatstem pondweed	Potamogeton zosteriformis	---	18	13
		Large-leaf pondweed	Potamogeton amplifolius	14	10	11
		Narrow-leaf pondweed	Potamogeton sp.	---	12	9
		Whitestem pondweed	Potamogeton praelongus	7	1	3
		Illinois pondweed	Potamogeton illinoensis	---	<1	<1
		Freis pondweed	Potamogeton freisii	---	---	p
		Sago pondweed	Stuckenia pectinata	---	<1	<1
		Water bulrush	Scirpus subterminalis	57	<1	16
		Wild Celery	Vallisneria americana	4	15	12
	Bladder worts	Flat-leaved bladderwort	Utricularia intermedia	17	--	5
		Greater Bladderwort	Utricularia vulgaris	---	<1	1
		Humped Bladderwort	Utricularia gibba	2	---	1
		Water marigold	Megaladonta beckkii	1	6	4
	Water milfoils	Leafless watermilfoil	Myriophyllum tenellum	---	6	4
		Northern watermilfoil	Myriophyllum sibiricum	---	1	1
	Water buttercup	Creeping water buttercup	Ranunculus flabellaris	---	1	1
		White water buttercup	Ranunculus aquatilis	---	<1	<1
		Quillwort	Isoetes sp.	---	1	1
		Pipewort	Eriocaulon aquaticum	1	<1	1
		Water stargrass	Heteranthera dubia	---	2	1
		Coontail	Ceratophyllum demersum	1	--	<1
Floating		Water shield	Brasenia schreberi	48	--	13
		White waterlily	Nymphaea odorata	33	1	10
		Yellow waterlily	Nuphar variegata	45	1	13
		Floating-leaf Burreed	Sparganium sp.	2	--	1
		Floating-leaf pondweed	Potamogeton natans	20	1	6
Emergent		sedge	Carex sp.	p	--	p
		Spikerush	Eleocharis sp.	3	1	1
		Needlerush	Eleocharis sp.	--	6	4
		Arrowhead	Sagittaria sp.	1	6	4
		Blue Flag	Iris versicolor	p	--	p
		Soft rush	Juncus effusus	p	--	p
		Rice Cutgrass	Leersia oryzoides	p	--	p
		Cattail	Typha sp.	---	<1	<1
		Water Arum	Calla palustris	p	--	p
		Bulrush	Scirpus sp.	1	2	1
		Cane	Phragmites maximus	p	--	p
		Wild Rice	Zizania palustris	p	p	p

Figure 6. Plant abundance vs. water depth. Sand and Little Sand Lakes, June 2006.



The highest number of plant taxa was found in shallow water, from shore to a depth of five feet (Fig. 7). Emergent and floating-leaved plants were most often found in depths less than six feet but emergents were occasionally found to seven feet and floating leaved plants were found to a maximum depth of 12 feet. Submerged plants were found to a maximum depth of 29 feet but only three taxa occurred in depths greater than 20 feet.

Figure 7. Number of plant taxa vs. water depth. Sand and Little Sand Lakes, June 2006.



At individual sample sites, the number of plant taxa found ranged from zero to eight. Shallow water, near-shore sites contained the highest number of taxa with as many as eight taxa per square meter at some sites (Fig. 8).

Figure 8. Number of plant taxa found at each sample site. Sand and Little Sand Lakes, June 2006.

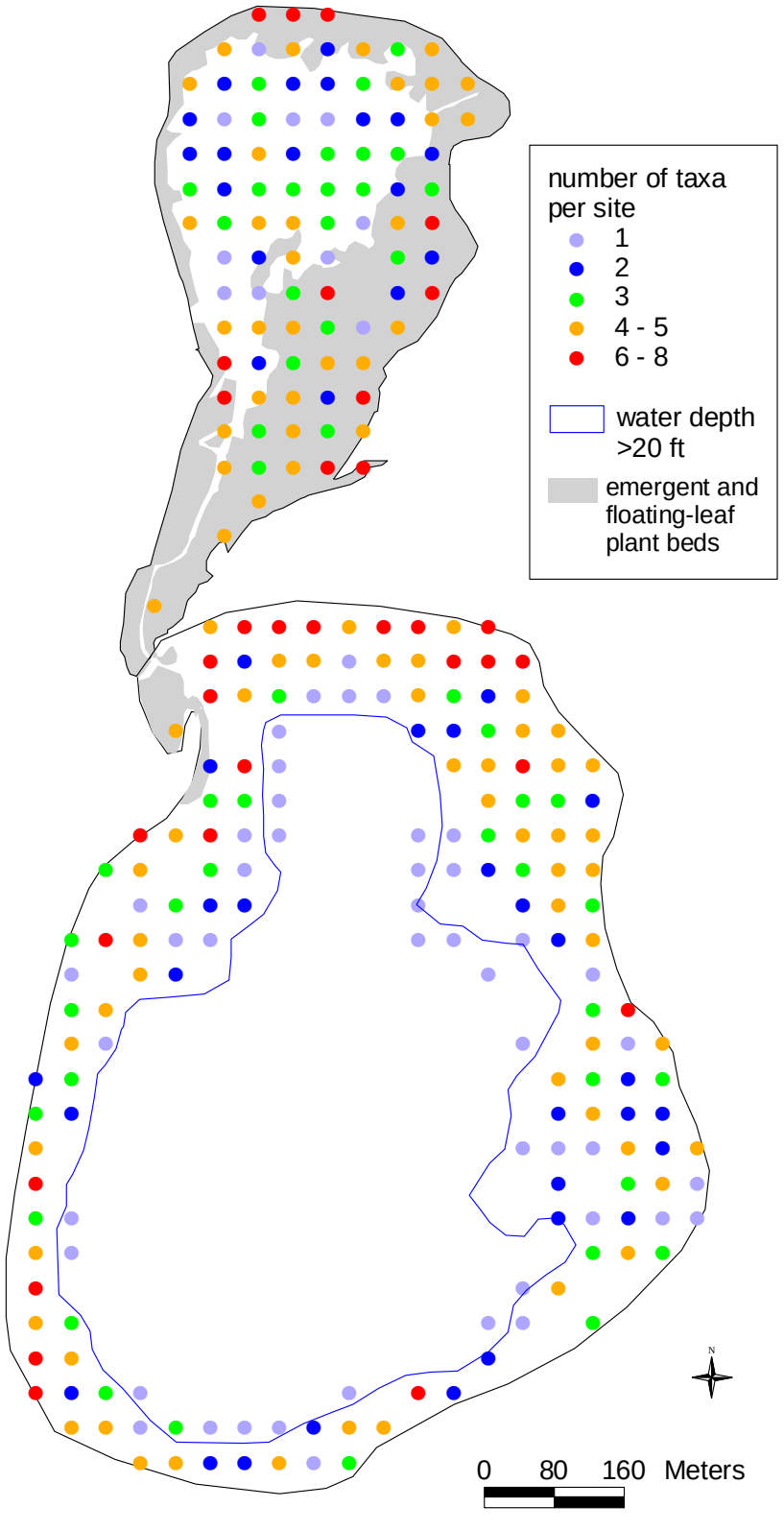
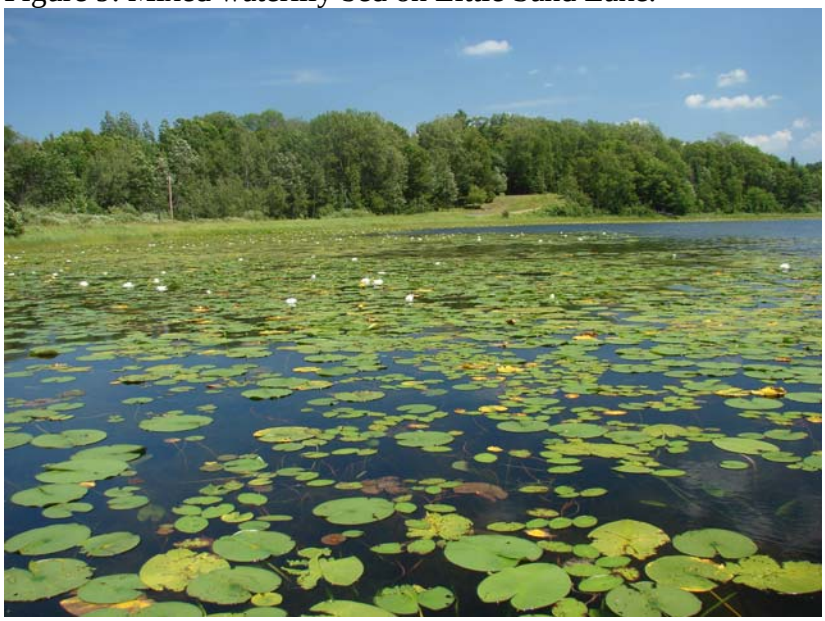


Figure 9. Mixed waterlily bed on Little Sand Lake.



Floating-leaved and emergent plants

The major beds of emergent and floating-leaved plants occurred in Little Sand Lake, the channel between the two lakes and the northwest corner of Sand Lake (Fig. 8). In Little Sand Lake, 68 percent of survey sites contained floating and/or emergent plants compared to only 35 percent of the sites within the shallow water (shore to seven feet) sites of Sand Lake. These beds were dominated by waterlilies (Fig. 9), which were the most common plant group within the shore to five feet depth (Fig. 10).

Figure 10. Distribution of common species by water depth, Sand and Little Sand Lakes, June 2006.

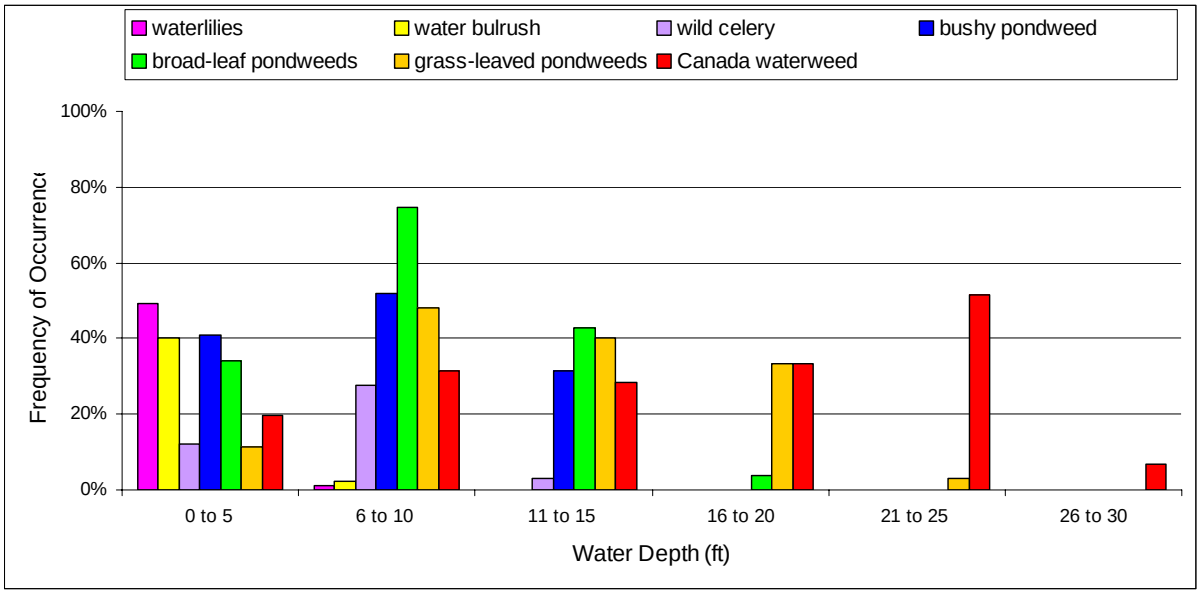


Figure 11. White water lily (*Nymphaea odorata*)

Figure 12. Yellow water lily (*Nuphar variegata*)

Figure 13. Watershield (*Brasenia schreberi*).

Emergent and submerged plants also occurred within the waterlilies and these mixed beds of vegetation provide multiple values for the lake ecosystem. The root systems of emergent and floating-leaf plants act to stabilize the lake bottom and beds of these plants help buffer the shoreline from wave action. Water lily beds provide shade for fish and frogs. These sites also offer shelter for insects and young fish as well as food, cover and nesting material for waterfowl, marsh birds and muskrats. Many of the emergent and floating-leaved plants have showy, colorful flowers that emerge above the water.

Waterlilies include white water lily (*Nymphaea odorata*) (Fig. 11), yellow water lily (*Nuphar variegata*) (Fig. 12), watershield (*Brasenia schreberi*) (Fig. 13) and floating-leaf pondweed (*Potamogeton natans*).

Distribution patterns for waterlilies and frequently occurring submerged plants are shown in Figures 14 and 15.

Common submerged plants

Submerged plants occurred in 71 percent of Sand Lake sample sites (shore to 30 feet) and in 95 percent of Little Sand Lake sites. A wide variety of submerged forms were found including large algae, grass-leaved plants, broad-leaved plants, and plants with finely dissected leaves. Submerged plant species that were common in both lakes included bushy pondweed (*Najas flexilis*), Canada waterweed (*Elodea canadensis*), broad-leaf pondweeds (*Potamogeton richardsonii, P. gramineus. P. robbinsii, and P. amplifolius)* and water celery (*Vallisneria americana*).

Figure 14. Distribution of common flowering plants in Little Sand Lake, June 2006.

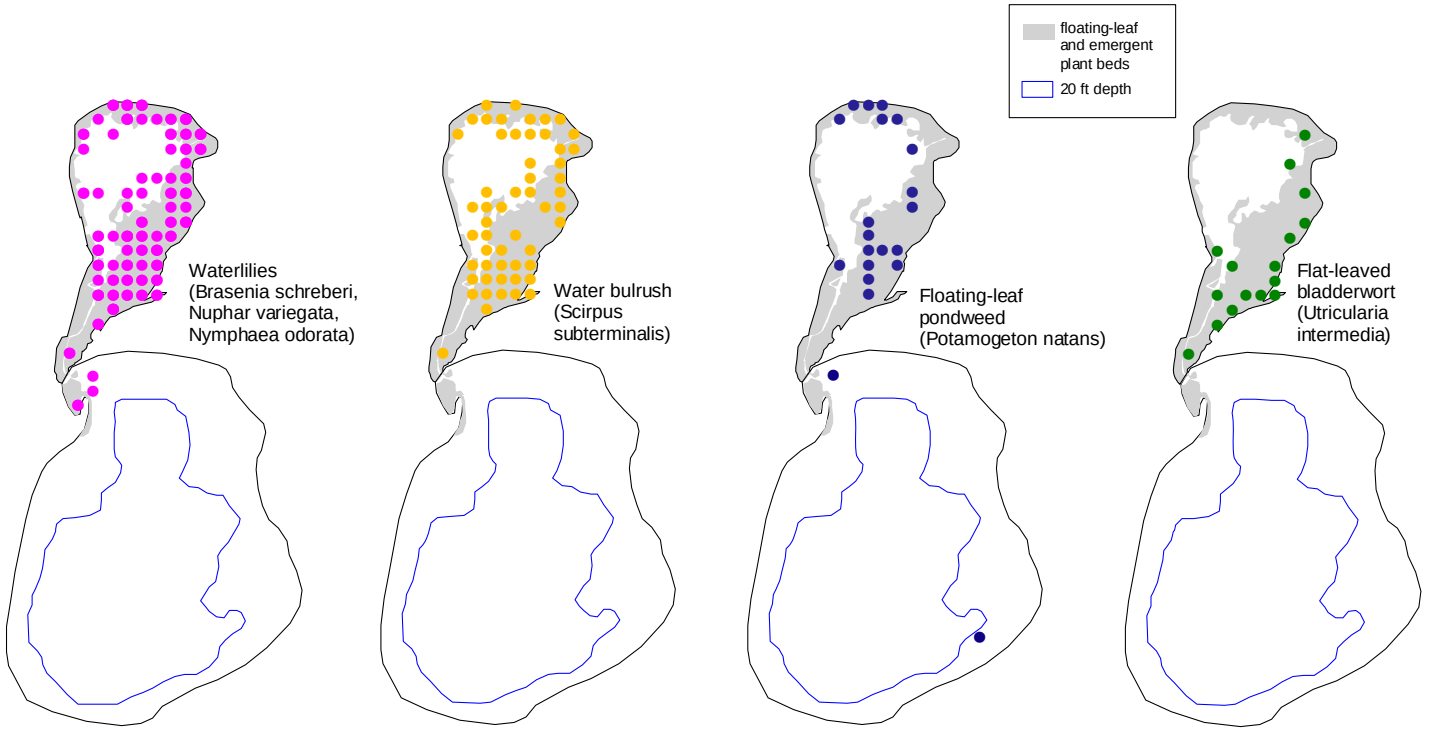
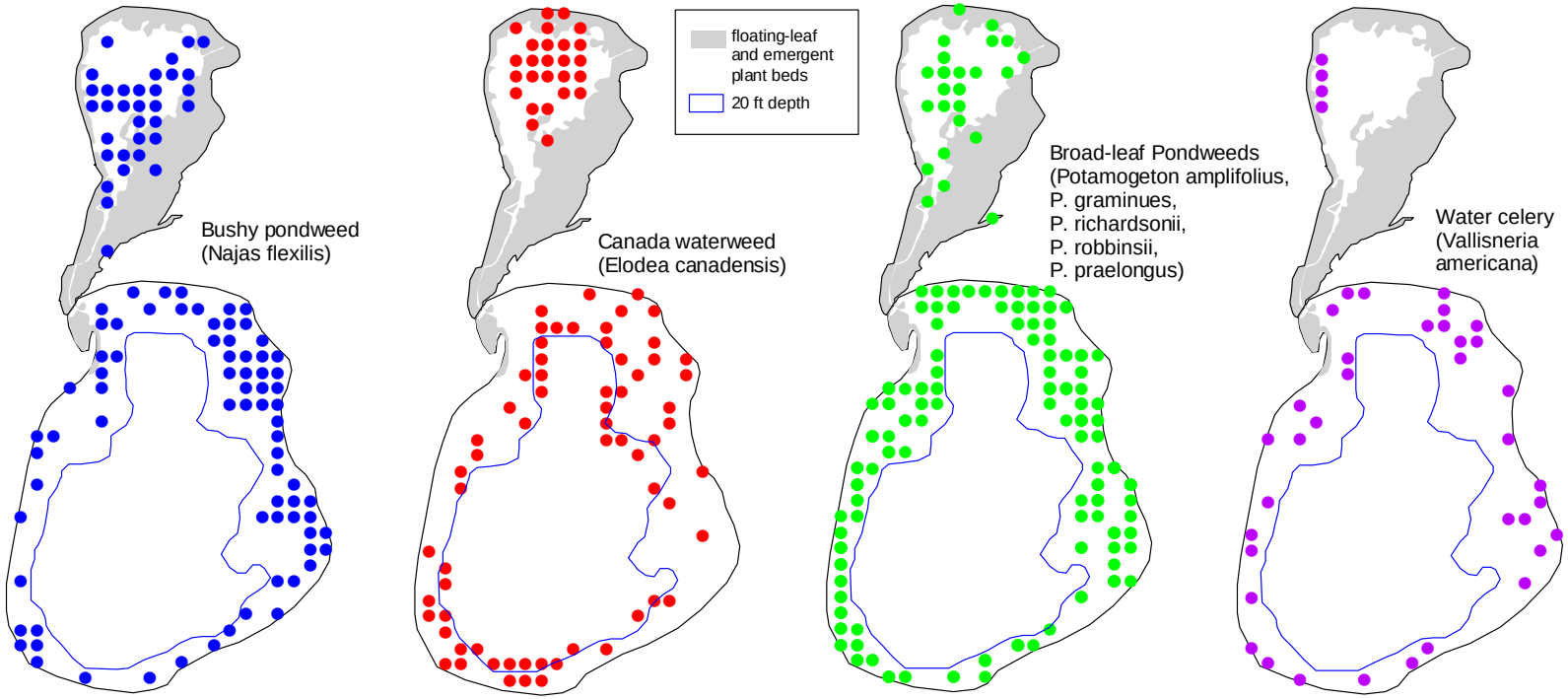


Figure 15. Distribution of common plants in Sand and Little Sand Lakes, June 2006.



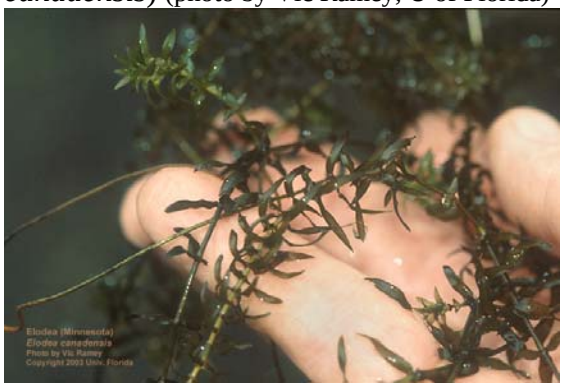
Bushy pondweed (*Najas flexilis*) (Fig. 16) is unique because it is one of the few annual submerged species in Minnesota and must re-establish every year from seed. The seeds and foliage of this plant are an important duck food and beds of this plant provide good fish cover. In Sand, bushy pondweed was the most abundant species, occurring in 35 percent of the sample sites. In Little Sand Lake, it the second most frequent species, occurring in 30 percent of the sites (Table 3). Bushy pondweed was restricted to depths of 13 feet and less (Fig. 14) and often co-occurred with pondweeds (*Potamogeton* spp) (Fig. 15).

Figure 16. Bushy pondweed (*Najas flexilis*)

A related plant, Slender naiad (*Najas gracillima*) was also recorded in Little Sand Lake in 2007 (Myhre, pers. comm. 2007). Slender naiad is listed as a rare species in Minnesota. It is similar in appearance to bushy pondweed but is limited to lakes of lower alkalinity (Engel 1999).

Canada waterweed (*Elodea canadensis*) (Fig. 17) is a rooted, perennial submerged species that is widespread throughout Minnesota and is adapted to a variety of conditions. It is tolerant of low light and prefers soft substrates. This species can over winter as an evergreen plant and spreads primarily by fragments. The branching stems of this plant can form thick underwater plant beds that are valuable habitat for a variety of fish and invertebrates.

Figure 17. Canada waterweed (*Elodea canadensis*) (photo by Vic Ramey, U of Florida)



In Sand and Little Sand Lakes, it was found in 26 and 28 percent of all sites, respectively (Table 3). Bushy pondweed was most common in depths greater than five feet (Fig. 14). In Sand Lake, it was one of only three species to occur in depths greater than 20 feet and was the only species to occur in depths greater than 25 feet.

Figure 18. Clasping-leaf pondweed (Potamogeton richardsonii) in Sand Lake.

Broadleaf pondweeds in Sand and Little Sand Lakes include clasping-leaf pondweed (*Potamogeton richardsonii),* variable pondweed *(P. gramineus),* Robbins pondweed (*P. robbinsii),* and large- pondweed *(P. zosteriformis*). These rooted, perennial plants with wide leaves are often called “cabbage” plants by anglers. These plants are primarily submerged but many will form floating leaves in shallower water.

Clasping-leaf pondweed (Fig. 18) was the most abundant broadleaf pondweed in Sand Lake, occurring in 25 percent of the sites. Large-leaf pondweed (Fig. 19) was the most frequent broad-leaf pondweed in Little Sand Lake, occurring in 14 percent of the sites (Table 3). Broad-leaf pondweeds occurred throughout both lakes (Fig. 15) and in Sand Lake they were most common in depths less than 16 feet (Fig. 14).

Figure 19. Large-leaf pondweed (Potamogeton amplifolius)

Wild Celery (*Vallisneria americana*) is a rooted, perennial submerged plant with long, grass-like leaves (Fig. 20). Beds of wild celery provide food and shelter for fish and all parts of the plant are consumed by waterfowl, shorebirds and muskrats (Borman et al. 1997). Wild celery is a particularly important food source for canvasback ducks (Varro 2003).

Figure 20. Water celery (*Vallisneria americana)*

It was found in 15 percent of the Sand Lake sites and in four percent of the Little Sand Lake sites (Table 3 and Fig. 15). Wild Celery was most common in depths of six to 10 feet (Fig. 14).

Unique Plants

In addition to the commonly plants in Sand and Little Sand Lakes, there were several unique plants located during the survey. These species are not widespread in Minnesota and are usually associated with low alkalinity lakes of northern Minnesota. Although some were found infrequently during the survey, their presence is an important indicator of the water quality and chemistry of these lakes.

Water bulrush (*Scirpus subterminalis*) (Fig. 21) is a bulrush plant that grows primarily under water. It was the most common species found in Little Sand Lake, occurring in 57 percent of the sample sites (Table 3).

Figure 21. Water bulrush Copyright 1996 D.W. Taylor

Several species of bladderwort (*Utricularia intermedia, U. gibba and U. vulgaris)* were found in the lakes. These small plants are often confused as algae because of their fine stems and leaves. They prefer

Figure 22. Bladderwort (Utricularia sp.) flower

soft substrates (Nichols 1999) but also float freely in the water column and may be found in protected areas such as waterlily beds. These plants have specialized air bladders that regulate their position in the water column. They also act as "underwater Venus fly-traps" by catching and digesting small insects in the bladders. They also have small but showy yellow flowers that emerge above the water surface (Fig. 22).

Pipewort (*Eriocaulon aquaticum*) begins as an underwater plant and sends up a small white-capped flower stalk at the end of summer (Fig. 23).

Quillwort (*Isoetes* sp.) (Fig. 24) is a submerged plant that is primarily found in softwater lakes (Nichols 1999) of northeastern Minnesota (Ownbey and Morley 1991). It is specially adapted to live in very low carbon environments (Bolton and Adams 1986). This is not a flowering plant but reproduces and spreads by megaspores that are produced late in the summer. These plants are not flowering plants and are named for their leaf-like structures that resemble "quills." Quillworts are among a specialized group of aquatic plants that are compact, slow-growing and ever-green and capable of surviving in low nutrient habitats (Madsen 1991).

Figure 23. Pipewort (*Eriocaulon aquaticum*)

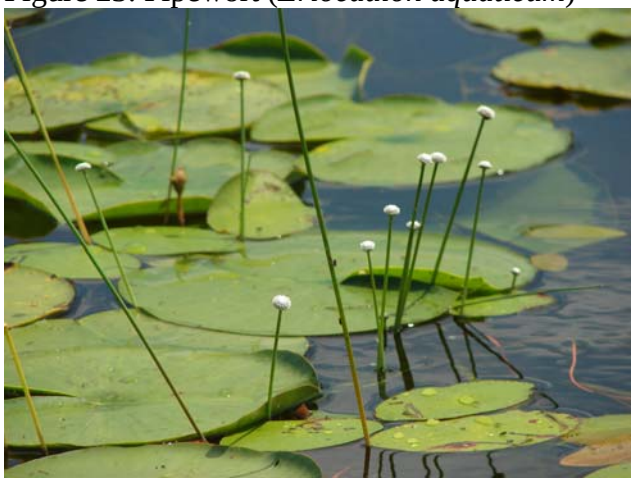


Figure 24. Quillwort (*Isoetes* sp.)
Photo: C. Taylor USDA-NRCS PLANTS Database

Other small yet unique plants that were found during the survey were leafless watermilfoil (*Myriophyllum tenellum*) and creeping water buttercup (*Ranunculus flabellaris*). While some of these plants were found infrequently (less than one percent of the sample sites), they may be more common but missed at some survey sites because they are difficult to collect on the sample rake.

Discussion

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 and wave activity. Sand and Little Sand Lakes support abundant and diverse native aquatic plant communities that in turn, provide critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants).

The high number of plant species found in Sand and Little Sand Lakes is a reflection of good water quality and relatively undisturbed lake bottom. Many of the plants found require clear, quiet water and are not found in lakes with higher turbidity or sites of heavy wave or boating activity.

Data collected in 2006 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. 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.

In general, factors that may lead to change in the aquatic plant communities include:

- Change in water clarity
  If water clarity in Sand and Little Sand Lakes decreases, submerged vegetation may be restricted to shallower water.
- Change in water level
  Many aquatic plants are adaptable to water level fluctuations and in low water years, aquatic plants may expand in distribution. The extent and duration of these distribution changes can be difficult to predict.
- Snow and ice cover
  Many submerged plants 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, some 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.
- Invasive species
  Non-native submerged species have **not** been documented in Sand and Little Sand Lakes but if they invade the lake, they may directly or indirectly impact the native plant community. Non-native plant species, such as Eurasian watermilfoil (*Myriophyllum spicatum*) or curly-leaf pondweed (*Potamogeton crispus*) may form dense surface mats that may shade out native plants. The impact of these invasive species varies among lakes but the presence of a healthy native plant community may help mitigate the harmful effects of these exotics.
- 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*) and wild rice (*Zizania palustris*) 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, click here: MnDNR APM Program or contact your local DNR office. Motorboat activity in vegetated areas can be particularly harmful for species such as bulrush and 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. Herbicide and mechanical control of aquatic plants can directly impact the aquatic plant community. Limiting these types of activities can help protect native aquatic plant species.

Photo credits:

Canada waterweed (pg. 16) Vic Ramey, U of Florida. Copyright Univ. of Florida 1993. At Univ. of Florida Center for Aquatic Plants: http://aquat1.ifas.ufl.edu/welcome.html

Quillwort (pg. 18): W. Carl Taylor @ USDA-NRCS PLANTS Database / USDA NRCS. 1992. Western wetland flora: Field office guide to plant species. West Region, Sacramento, CA. At: USDA, NRCS. 2007. The PLANTS Database (http://plants.usda.gov, 18 January 2007). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Water bulrush (pg.18): Dean Wm. Taylor copyright 1996. @ CalPhotos. Univ. of California, Berkeley. http://calphotos.berkeley.edu

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