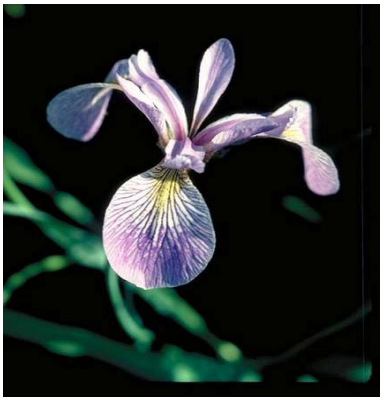
Aquatic Vegetation Survey of

Grave Lake (DOW #18-0110-00)

Crow Wing County, Minnesota

2002

Blue flag iris, a native plant found along Grave Lake shoreline.



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Summary

Grave Lake is a shallow, 157 acre lake in north central Minnesota. The aquatic vegetation survey conducted in June 2002 included a lakewide assessment of vegetation and water depths at 66 sample stations.

A total of 12 native aquatic plant taxa were recorded including four emergent, two floating-leaved, and six submerged plants. Aquatic plants were sparsely scattered around the lake 29 percent of the sample sites contained plants. Plants were found to a depth of 12 feet and were most frequent in the shore to 8.5 feet depth zone, where 67 percent of the sites contained plants.

The most frequently occurring plants were flat-stem pondweed (*Potamogeton zosteriformis*), sago pondweed (*Stuckenia pectinata*), and narrow-leaf pondweed (*Potamogeton* sp.).

Introduction

Grave Lake is located in Crow Wing County, north-central Minnesota, in the Mississippi River- Brainerd Watershed (Figure 1). There are about 201 lakes in this watershed and about 260 lakes in Crow Wing County that are at least 50 acres in size. Grave Lake is the 89th largest lake in the watershed and the 123rd largest lake in the county, with a surface area of 157 acres and about two miles of shoreline.

The Mississippi River flows southwest through the watershed and is connected to Grave Lake by the Nokasippi River. Hay Creek flows west through Grave Lake and

Figure 1. Location of Grave Lake in Minnesota.

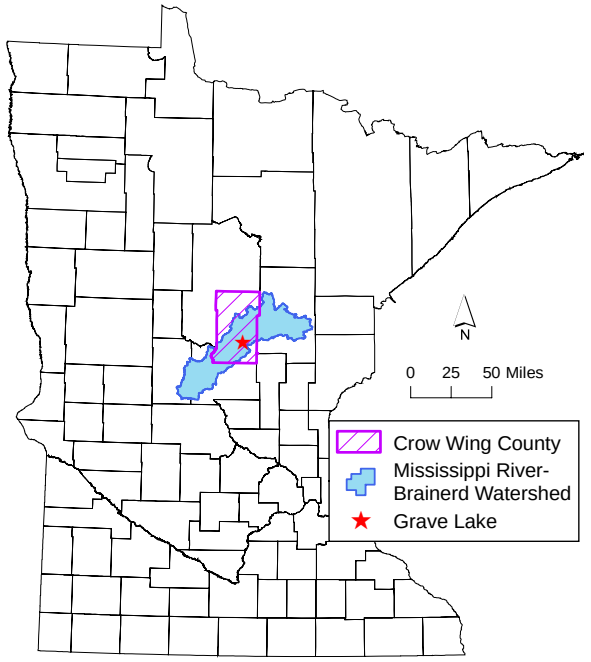
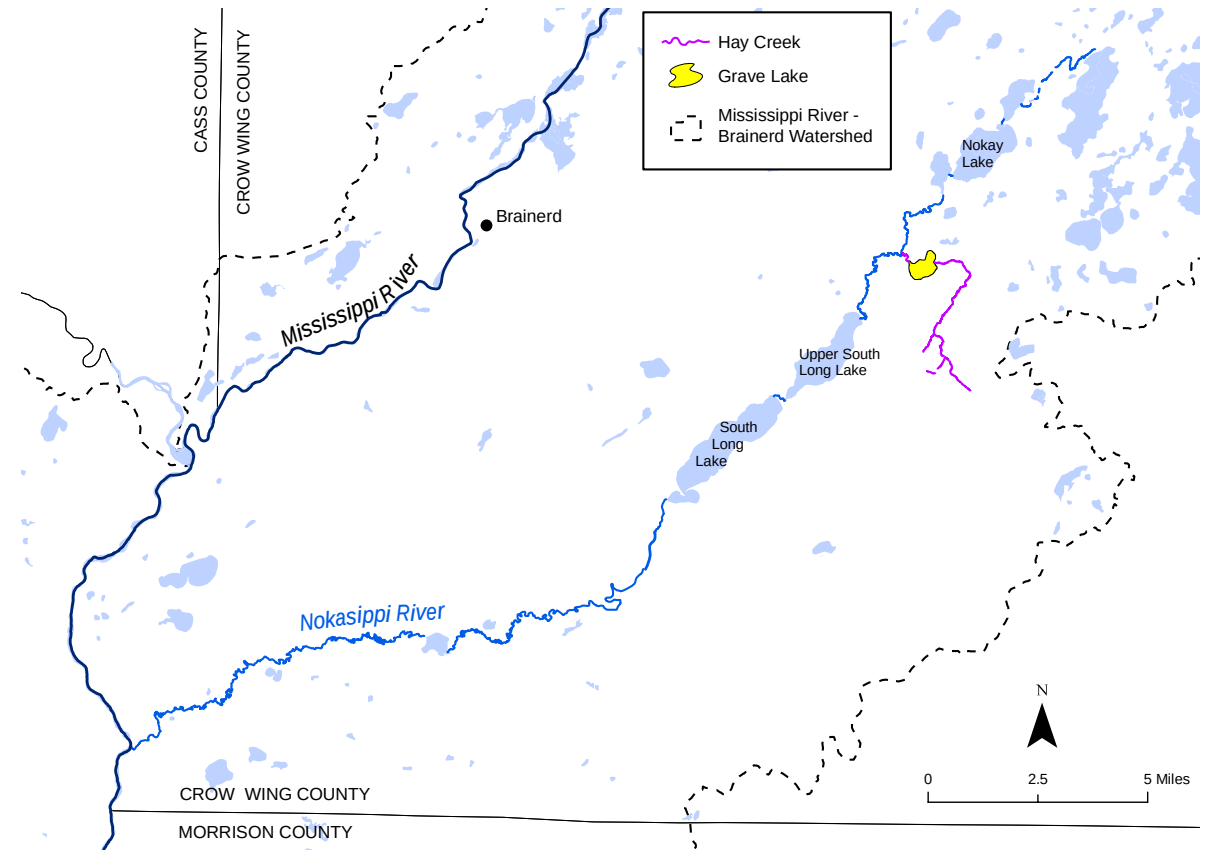


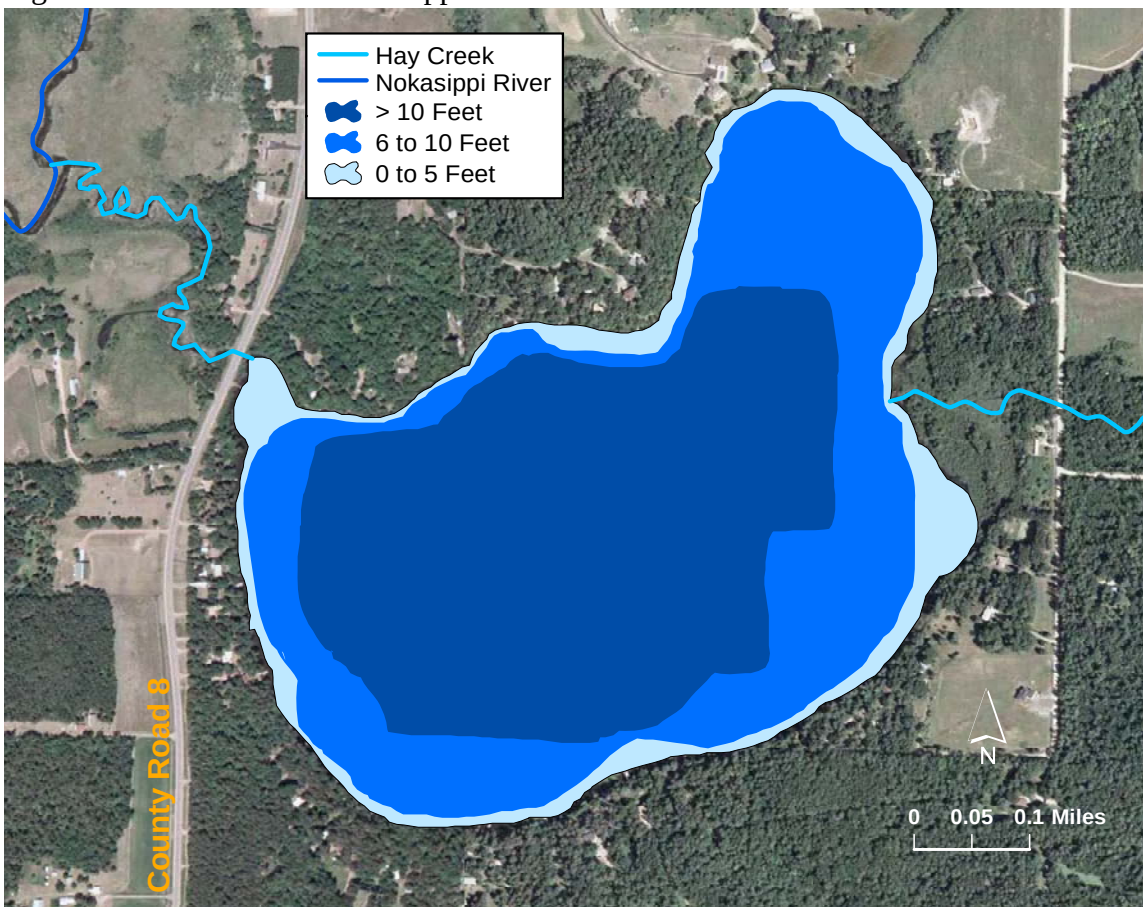
Figure 2. Flow from Grave Lake to Nokasippi River and onto Mississippi River.



then meets the Nokasippi River, which then flows southwest into the Mississippi River (Figure 2).

The uplands surrounding Grave Lake remain mostly forested but heavily developed with residential homes. Grave Lake is bowl-shaped with a maximum depth of about 13 feet (Figure 3).

Figure 3. Grave Lake in Mississippi River- Brainerd Watershed



The Secchi disc (Figure 4) 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. In 2002, mean summer water clarity, as measured by Secchi disc readings, was four feet in Grave Lake. 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 half times the Secchi depth. Based on Secchi disk measurements alone, aquatic plants are expected to grow to about six feet in Grave Lake. Other factors that may influence the depth of plant growth include substrate type, wind fetch, and plant species composition.

Figure 4. Measuring Secchi Disc transparency

Previous vegetation surveys of Grave Lake found plants growing to depths of seven feet with plant growth described along the shorelines of the lake (MnDNR Fisheries Lake Files). More than 17 different aquatic plant taxa have previously been recorded in Grave Lake including bulrush (*Scirpus* sp.), Canada waterweed (*Elodea canadensis*), greater bladderwort (*Utricularia vulgaris*), flat-stem pondweed (*Potamogeton zosteriformis*), and clasping-leaf pondweed (*Potamogeton richardsonii*).

Objectives

The purpose of this vegetation survey was to provide a quantitative description of the 2002 plant population of Grave Lake. Specific objectives included:

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 the abundance of common species
5. Develop distribution maps for the common species

Methods

Lakewide vegetation survey

Grave Lake was surveyed on June 25, 2002. A point-intercept survey method was used and followed the methods described by Madsen (1999). Survey waypoints were created using a Geographic Information System (GIS) computer program and downloaded into a handheld Trimble GeoExplorer 3 Global Positioning System (GPS) unit. Survey points were placed across the entire lake and spaced 100 meters (328 feet) apart resulting in 66 survey sites (Figure 5). One field crew, consisting of two surveyors and one boat, conducted the survey.

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 depths greater than eight feet.

Surveyors recorded all plant taxa 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 surface (Figure 6). Plant identification and nomenclature followed Crow and Hellquist (2000).

Data were entered into a Microsoft Access database and frequency of occurrence was calculated for each taxon as the number of sites in which taxa occurred divided by the total number of sample sites. Frequency was calculated for the entire area from shore to 13 feet and sampling points were also grouped by water depth and separated into two depth zones for analysis (Table 1).

Figure 5. 2002 vegetation survey sites on Grave Lake.

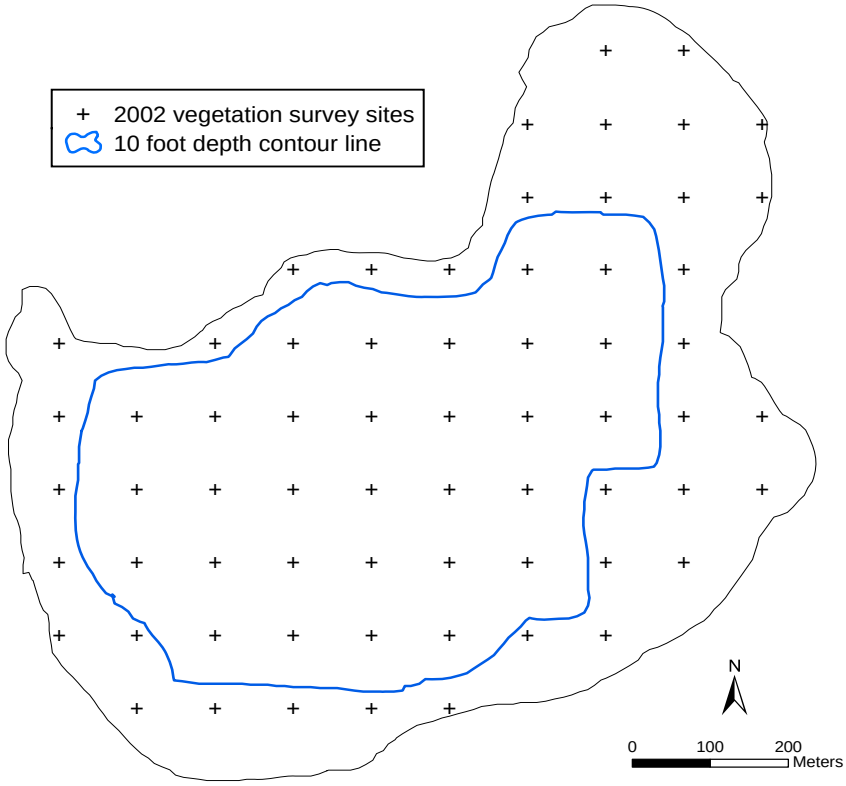


Figure 6. Sampling rake.

Table 1. Sampling effort by water depth.

Water depth interval	Number of sample sites
0 to 8.5	24
9 to 13	42
Total sample points	66

Example:
In Grave Lake there were 66 samples sites in the 0-13 feet depth zone.

Muskgrass (*Chara* sp.) occurred in 12 sites.

Frequency of muskgrass in 0 to 13 feet zone = 12 / 66 (*100) = 18 %

Results

Number of plant species recorded

A total of 12 native aquatic plant taxa were recorded in Grave Lake including four emergent, two floating-leaved, and six submerged taxa (Table 2). One non-native emergent plant, reed canary grass (*Phalaris arundinaceae*), was often found along shore.

Table 2. Frequency of aquatic plants in Grave Lake Point-intercept survey, June 2002.

(Frequency is the percent of sample sites in which a plant taxon occurred within the shore to 13 ft water depth.)

66 sample sites

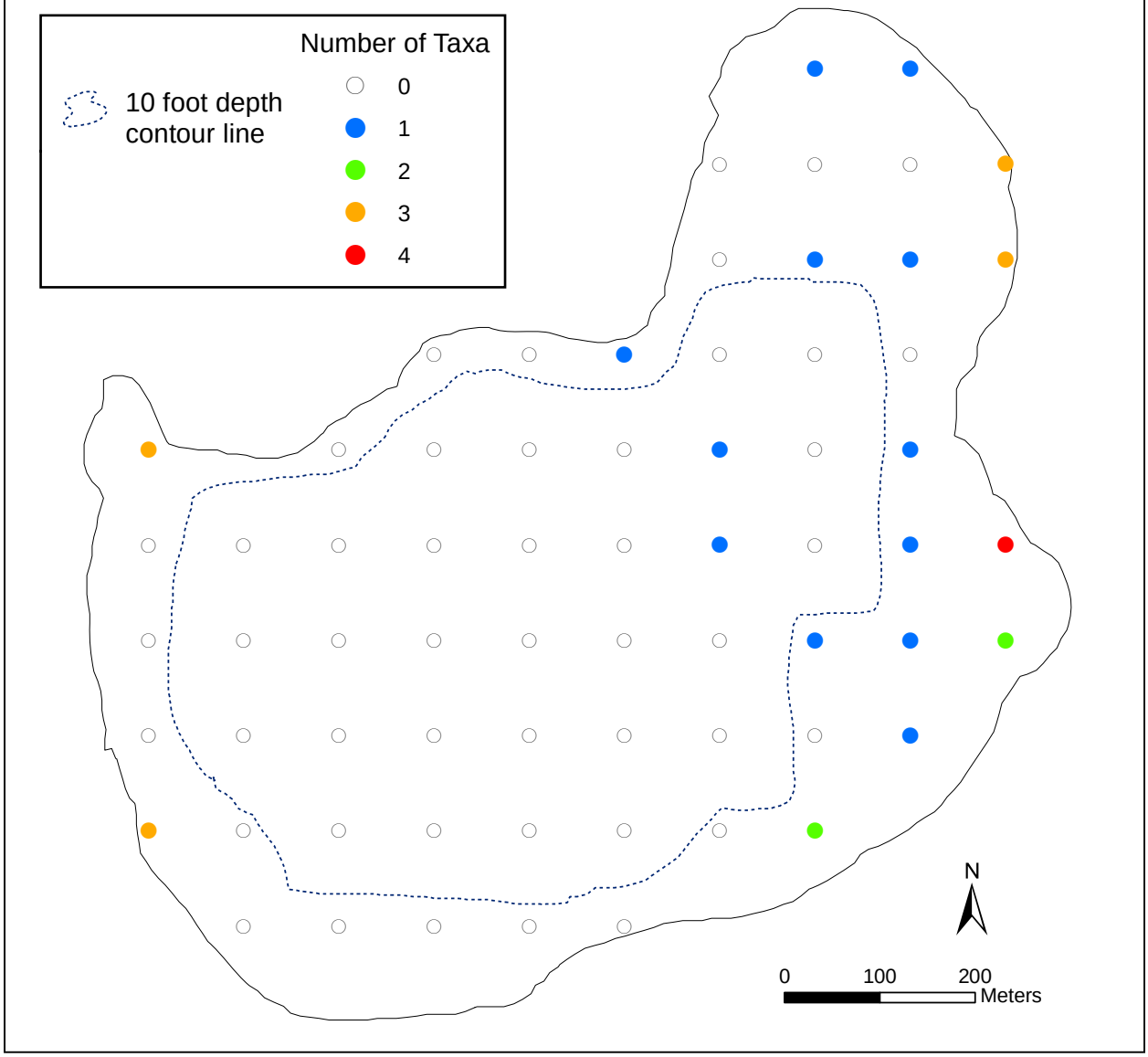
Life Form	Common Name	Scientific Name	Frequency
NATIVE SUBMERGED	Flat-stem pondweed	*Potamogeton zosteriformis*	18
	Sago pondweed	*Stuckenia pectinata*	12
	Narrow-leaf pondweed	*Potamogeton* sp.	3
	Northern water milfoil	*Myriophyllum sibiricum*	2
	Water stargrass	*Zosterella dubia*	2
	Wild celery	*Vallisneria americana*	2
FLOATING	White waterlily	*Nymphaea odorata*	6
	Yellow waterlily	*Nuphar variegata*	5
EMERGENT	Hard-stem Bulrush	*Scirpus acutus*	Present
	Blue flag iris	*Iris versicolor*	Present
	Reed canary grass	*Phalaris arundinaceae*	Present
	Sedge	*Carex* sp.	Present
	Cattail	*Typha* sp.	Present

Distribution of aquatic plants

Aquatic plants were found in 19 of the 66 sample sites (29 percent occurrence). Plants were found to a maximum depth 12 feet but in water depths greater than 10 feet, only two sample sites contained vegetation. Vegetation was most common in the shore to 8.5 feet zone where 67 percent of the sites contained plants.

The number of plant taxa found at each one square meter sample site ranged from zero to four. The highest number of plant taxa were found in shallow water sites less than four feet in depth. In depths greater than seven feet, sites contained either one or no plant taxa (Figure 7).

Figure 7. Number of plant taxa at each sample site, Grave Lake, 2002.



Emergent and floating-leaf plants

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.

Figure 8. Bulrush

Hard-stem bulrush (*Scirpus acutus*) (Figure 8) is an emergent, perennial plant that occurs in lakes and wetlands throughout Minnesota (Ownbey and Morley 1991). Bulrush stems are round in cross section and lack showy

leaves. Clusters of small flowers form near the tips of long, narrow stalks. This emergent may occur from shore to water depths of about six feet and its stems may extend several feet above the water surface. In low water conditions it can grow outside of water. Bulrush stands are particularly susceptible to destruction by excess herbivory and direct removal by humans. Hard-stem bulrush was the most common emergent plant in Grave Lake but it was not found in any of the sample sites.

Figure 9. Yellow waterlily

Floating-leaf plants found in Grave Lake were yellow waterlily (*Nuphar variegata*; Figure 9), and white waterlily (*Nymphaea odorata*; Figure 10). Waterlilies were found in sites less than five feet in depth and often co-occurred with two or three submerged taxa.

Figure 10. White Waterlily

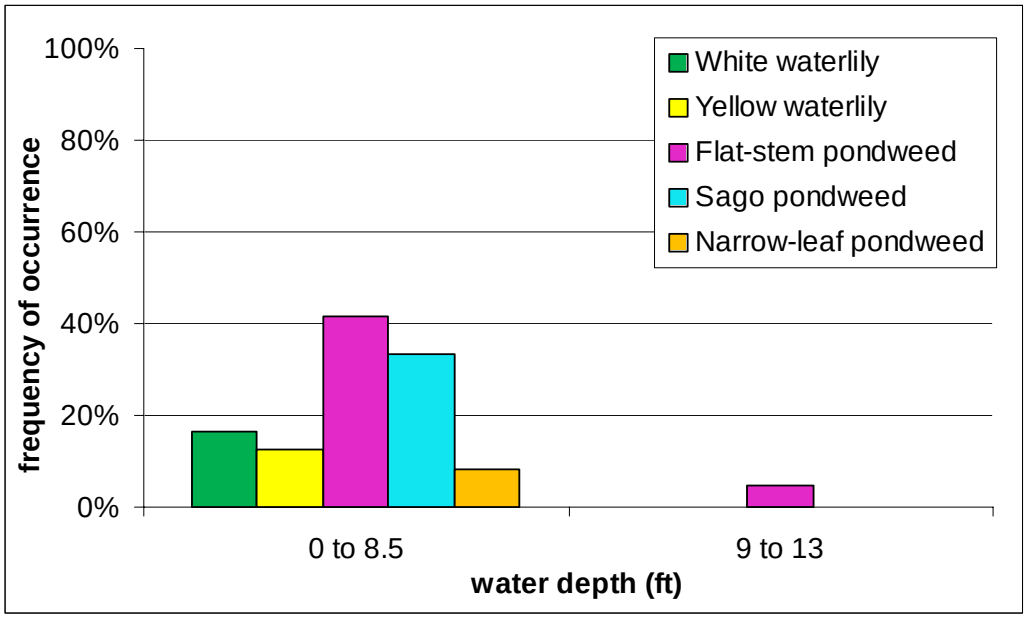
Submerged plants

Submerged plants occurred in 29 percent of the Grave Lake sites. The most frequently sampled native submerged taxa were flat-stem pondweed (*Potamogeton zosteriformis*), sago pondweed (*Stuckenia pectinata*), and narrow-leaf pondweed (*Potamogeton* sp.).

Figure 11. Flat- stem pondweed

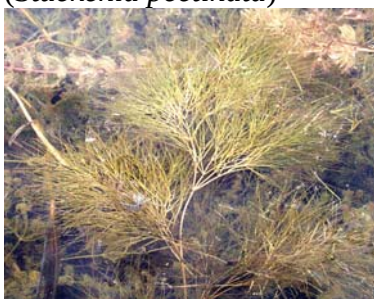
Flat-stem pondweed (*Potamogeton zosteriformis*) (Figure 11) is a perennial plant that is anchored to the lake bottom by underground rhizomes and over-winters by winter buds. It is named for its flattened, grass-like leaves. Depending on water clarity and depth, these plants may reach the water surface and may produce flowers that extend above the water. Flat-stem pondweed occurred in 18 percent of the sites (Table 2) and was the only plant found beyond the 10 feet water depth (Figure 12).

Figure 12. Frequency of common plants by water depth interval.



Sago pondweed (*Stuckenia pectinata*) (Figure 13) is a perennial submerged plant that can tolerate poor water quality conditions. It is also an important waterfowl food. The stipules of sago pondweed are fused to the leaf. The leaves are very thin and look like pine needles, and they can branch out numerous times per leaf (Borman et al. 2001). Sago pondweed was found in 12 percent of all Grave Lake survey sites (Table 2) and was found in depths less than nine feet (Figure 12).

Figure 13. Sago pondweed (*Stuckenia pectinata*)



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. For analysis, all narrow-leaf pondweeds were grouped together. In Grave Lake, narrow-leaf pondweeds were found in three percent of the sites and were found in depths of zero to 8.5 feet (Figure 12).

All other submerged species were only found in two percent of the survey sites.

A second vegetation survey was conducted on July 29, 2002 by DNR Fisheries staff (MN DNR 2002). During that survey they recorded several additional aquatic plant species: bushy pondweed (*Najas flexilis*), Canada waterweed (*Elodea canadensis*), coontail (*Ceratophyllum demersum*), lesser duckweed (*Lemna minor*) and spikerush (*Eleocharis* sp.). Most of these species were described as "rare" with the exception of bushy pondweed, which was described as "common" or "abundant" at sites. This particular species begins its growth later in the summer and was therefore not recorded during the

earlier June 25 survey. The other species likely were present in June but were simply not present in the sample sites. If future surveys of Grave Lake are conducted, surveyors should be aware of this seasonality difference, particularly with respect to the species bushy pondweed.

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 type and wave activity. The abundant and diverse native aquatic plant communities found in this lake provides critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants).

Data collected in 2002 can be used to monitor finer-scale changes that may occur, such as an increase in a particular taxa or a change in the depths at which individual taxa 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 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 plant species have not been found in Grave Lake. Curly-leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*) may form dense surface mats that may shade out native plants. The impact of 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 abundance
  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 in a variety of ways. 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. For information on the laws pertaining to aquatic plant management, click here: MnDNR APM Program or contact your local DNR office. Limiting these types of activities can help protect healthy aquatic ecosystems.

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