Aquatic Vegetation Survey of

Trout Lake (DOW #31-0216-00)

Itasca County, Minnesota

2005

Trout Lake. 2005

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Funding: Collection of these data was made possible by support from the Heritage Enhancement Fund and Game and Fish Fund.

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This report should be cited as:
Perleberg, D and S. Loso. 2009. Aquatic vegetation of Trout Lake (DOW 31-0216-00) and, Itasca County, Minnesota, 2005. Minnesota Department of Natural Resources, Ecological Resources Division, 1601 Minnesota Dr., Brainerd, MN 56401. 18 pp.

Summary

An aquatic vegetation survey of Trout Lake (31-0216-00), Itasca County, Minnesota, was conducted in July and August 2005. The survey included a lakewide assessment of vegetation and water depths at 891 sample stations within the shore to 25 feet depth zone.

A total of 30 native aquatic plant species were recorded including six emergent, three floating-leaved, three free-floating and 18 submerged plants. Non-native aquatic plants have not been documented in the lake.

Aquatic plants occurred around the entire perimeter of the lake and vegetation was present in 74% of the sample sites. Emergent and floating-leaved plants were generally restricted to depths of five feet and less. Within that depth zone, 31% of the survey sites contained at least one emergent or floating-leaf plant. Beds of hard-stem bulrush (*Schoenoplectus acutus)* occurred on sandy substrates and waterlily beds (*Nymphaea odorata* and *Nuphar variegata)* were found within protected bays.

Submerged plants were found to 24 feet but plant occurrence was highest in depths from shore to 15 feet zone, where 89% of the sites contained vegetation. In depths of 16 to 25 feet, plant occurrence was 12%. The most frequently occurring species were muskgrass (*Chara sp.*) (35% occurrence), coontail (*Ceratophyllum demersum*) (31%), star duckweed (*Lemna trisulca*) (19%), narrow-leaved pondweeds (*Potamogeton* spp.) (12%), and northern watermilfoil (*Myriophyllum sibiricum*) (11%).

Vegetation survey crew on Trout Lake, 2005

Introduction

Trout Lake is located in Itasca County, northeastern Minnesota, in the Mississippi River - Grand Rapids Watershed (Figure 1). There are about 270 lakes in this watershed and about 440 lakes in Itasca County that are at least 50 acres in size. Trout Lake is the sixth largest lake in the watershed and the 16th largest lake in the county, with a surface area of 1890 acres and 13.5 miles of shoreline.

Trout Lake receives flow from Trout Creek, which enters the lake on the northeast side and outflows to the southeast where it joins the Swan River (Figure 2). The Swan River continues southward about 25 miles and empties into the Mississippi River (Figure 2).

Figure 1. Location of Trout Lake in Minnesota.

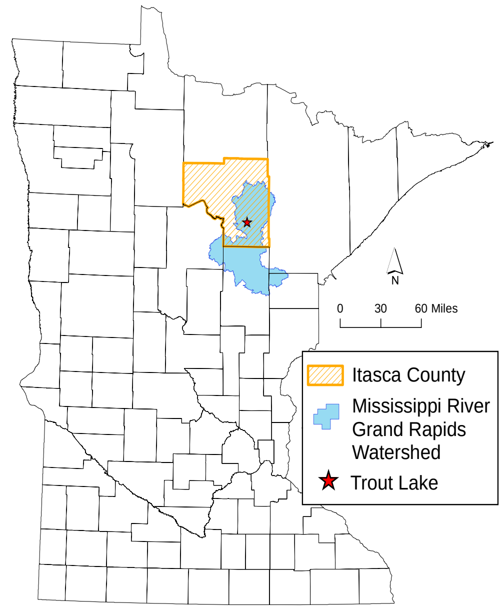
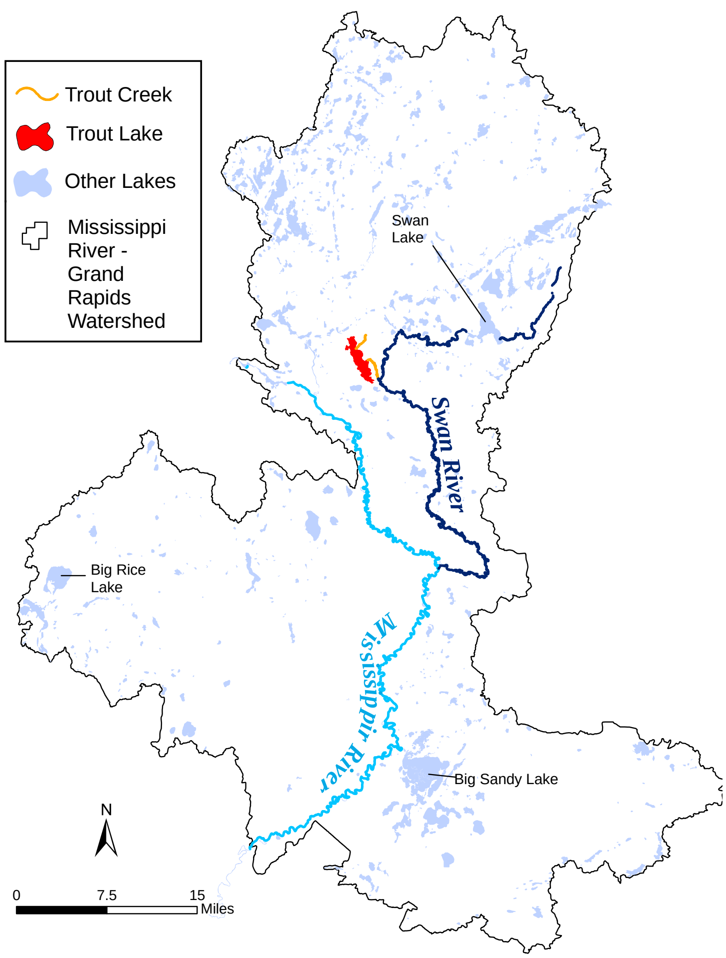


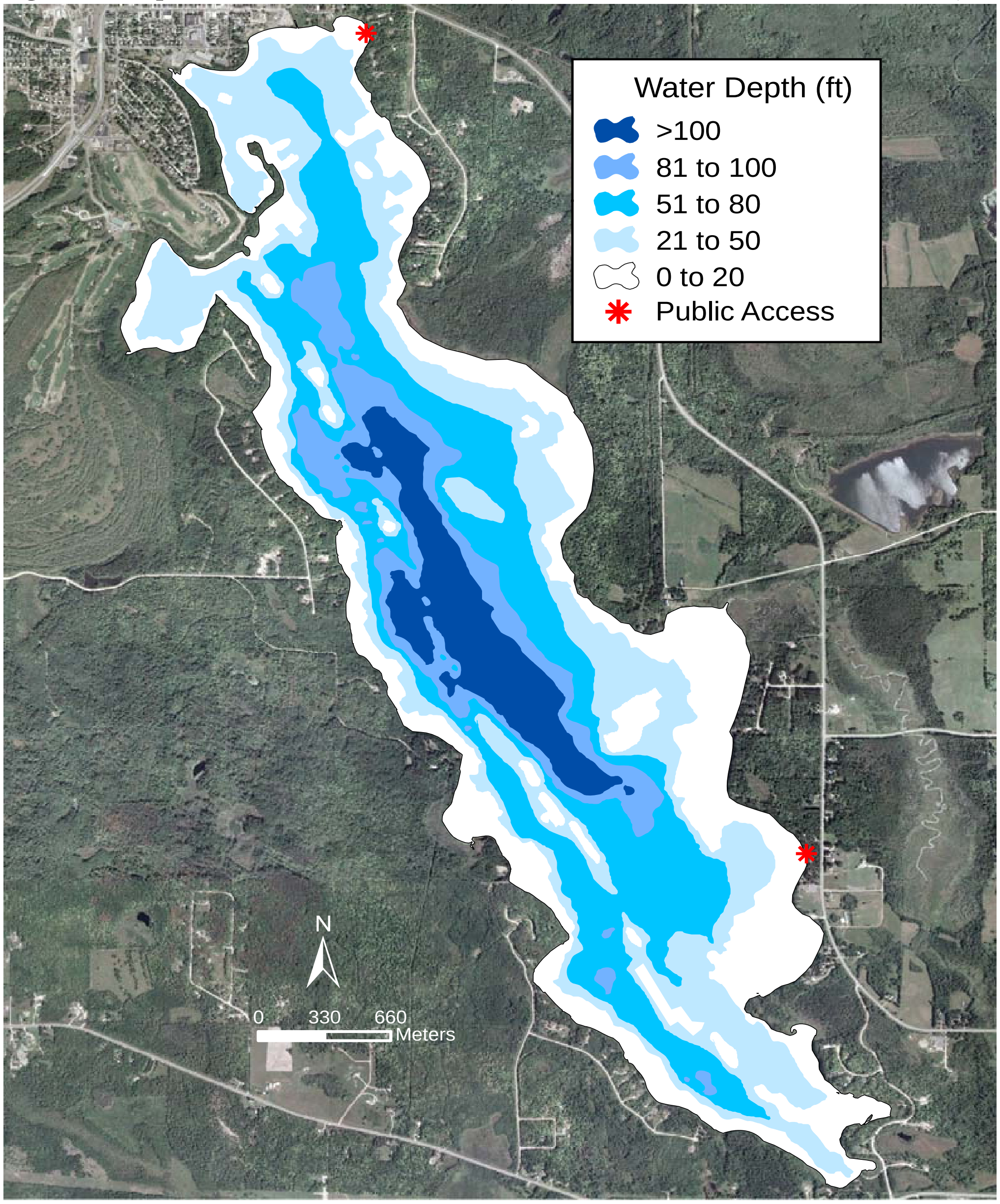
Figure 2. Trout Lake in Mississippi River - Grand Rapids Watershed.



The city of Coleraine is located on the north side of Trout Lake and a city owned public beach and boat ramp are accessible from State Highway 169. A township owned public water access is on the southeast end of the lake. Most of the other shorelines are privately owned and include forested tracts and residential homes (Figure 3). Trout Lake Eagle Wildlife Management Area (WMA) connects to Trout Lake on the southeast section of the lake.

Trout Lake is an ice-block lake with an elongated basin that is about 4.5 miles in length. It has a maximum depth of 135 feet and 23% of the lake basin is less than 15 feet in depth (Figure 3). This shallow area that rings the lake shoreline is referred to as the littoral zone. Rooted submerged plants are often common in the littoral zone if

Figure 3. Depth contours of Trout Lake (20 foot contour based on 2005 data).



adequate sunlight reaches the lake bottom.

Trout Lake water quality, ecology and basin morphometry have been impacted by human disturbances to the watershed (Heiskary 1988). From 1907 to 1940, fine ore tailings from mining operations were released into the lake (Heiskary 1988). Until 1987, the wastewaters from the cities of Coleraine and Bovey were discharged into the lake (Heiskary 1988). Trout Lake water quality was sampled in 1987 and found to have relatively high average total phosphorus concentrations compared to other lakes in the region (Heiskary 1988). Blue-green algal blooms were reported in the summer of 1987.

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. Between 1997 and 2006, mean summer water clarity, as measured by Secchi disc readings, was about 17 feet in Trout Lake (MPCA, 2008). 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 25 feet in Trout 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 Trout Lake found plants growing to a depth of 24 feet (MnDNR 1999) with abundant plant growth described within the shallow bays in 1975 and 1984. Nearly 40 different aquatic native plant taxa have previously been recorded in Trout Lake and numerous emergent plants occur along the shorelines (MnDNR 1999 and Myhre 2000). Non-native aquatic plants have not been documented in Trout Lake.

Objectives

The purpose of this vegetation survey was to provide a quantitative description of the 2005 aquatic plant population of Trout 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

Trout Lake was surveyed on July 19 and August 2, 3, 2005. 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 Global Positioning System (GPS) receiver. Survey points were placed across the entire lake and spaced 50 meters (164 feet) apart, resulting in about one survey point per acre. Two field crews, each consisting of two surveyors and one boat, conducted the survey. Within the shore to 25 feet depth zone, a total of 891 sites were surveyed (Figure 5, Table 1). Two additional sites were sampled but the data were not included in analyses because the sites occurred in water greater than 25 feet and no vegetation was found. 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 essentially follows The Flora of North America (1993+). Voucher specimens were collected for most plant taxa and are stored at the MnDNR in Brainerd or at the University of Minnesota Herbarium in St. Paul.

Figure 5. 2005 vegetation survey sites on Trout Lake.

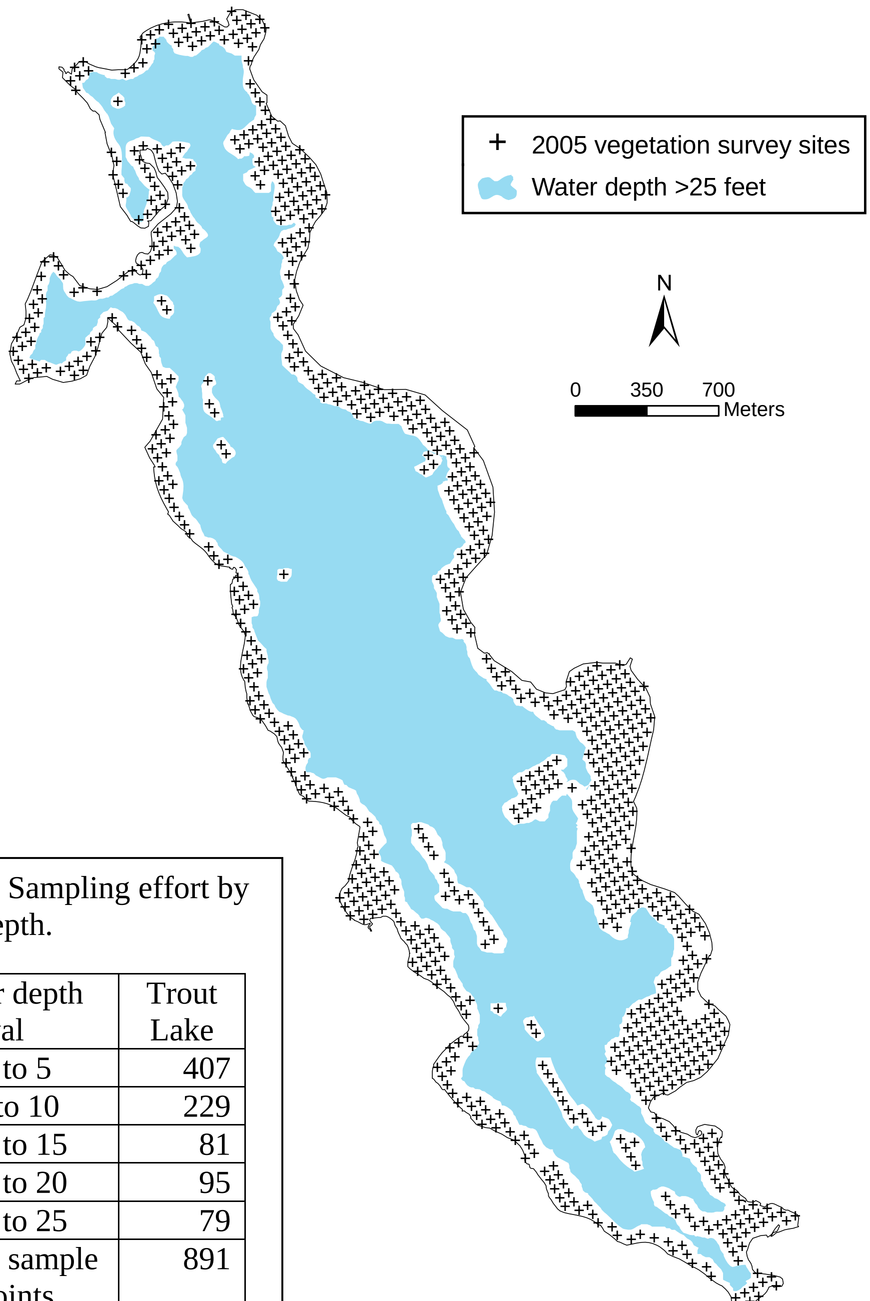


Table 1. Sampling effort by water depth.

Water depth interval	Trout Lake
0 to 5	407
6 to 10	229
11 to 15	81
16 to 20	95
21 to 25	79
Total sample points	891

Data were entered into a database and frequency of occurrence was calculated for each taxon as the number of sites in which a taxon occurred divided by the total number of sample sites. Frequency was calculated for the entire area from shore to 25 feet and sampling points were also grouped by water depth and separated into five depth zones for analysis (Table 1).

Figure 6. Sampling rake.

Example: In Trout Lake there were 891 samples sites.

Muskgrass (*Chara* sp.) occurred in 312 sites.

Frequency of Muskgrass in Trout Lake = 312/891 (*100) = 35%

Mapping floating-leaf vegetation beds

Farm Service Administration (FSA) true color aerial photographs (2003-2004) were used to delineate dense beds of waterlilies. Stands of bulrush beds were not visible from photographs and were not delineated.

Results

Distribution of aquatic plants

Aquatic plants occurred around the entire perimeter of the lake (Figure 7). Bands of vegetation were narrowest on the west shore where, in some areas, water depths increased sharply from shore. Areas of the east shore had broader bands of vegetation that, in some areas, extended more than 400 meters (1300 feet) lakeward. In the south end of the lake, vegetation was occasionally found on offshore, shallow sandbars.

Plant distribution by water depth

Plants were found to a maximum depth of 24 feet in Trout Lake. Within the shore to 25 feet zone, vegetation occurred in 74% of the sites. Percent of vegetated sites decreased with increasing water depth (Figure 8). Vegetation was most common in the shore to 15 feet zone where 89% of the sites contained plants.

Number of plant taxa recorded and distribution by water depth

A total of 30 native aquatic plant taxa were recorded in Trout Lake in 2005, including six emergent, three floating-leaved, three free-floating and 21 submerged taxa (Table 2). Several taxa that were located during the 1999 and/or 2000 surveys were not found in 2005; these species may have been present in 2005 but present in low numbers and not observed, or present but not identified to the species level.

Figure 7. Distribution of aquatic plants in Trout Lake, 2005.

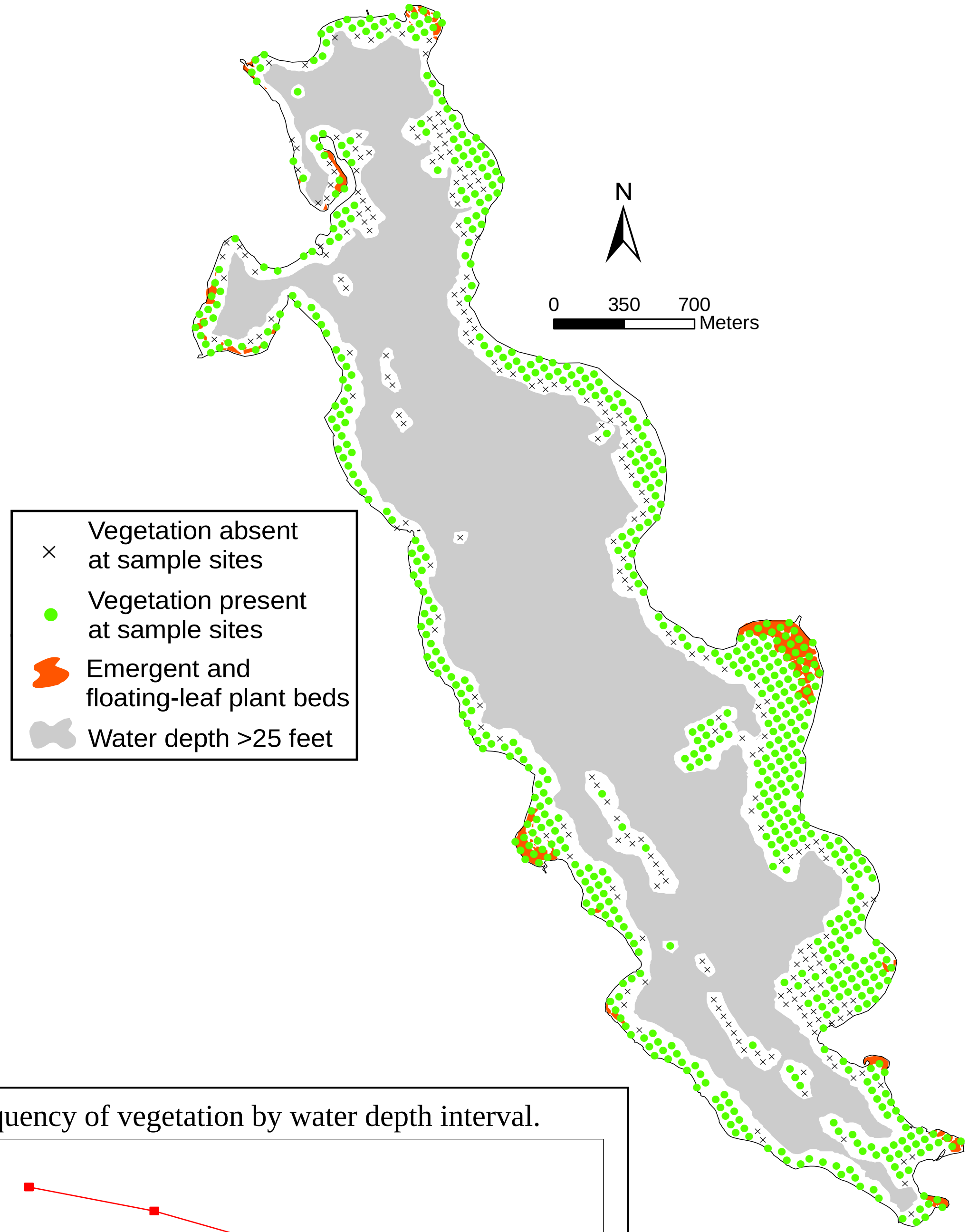


Figure 8. Frequency of vegetation by water depth interval.

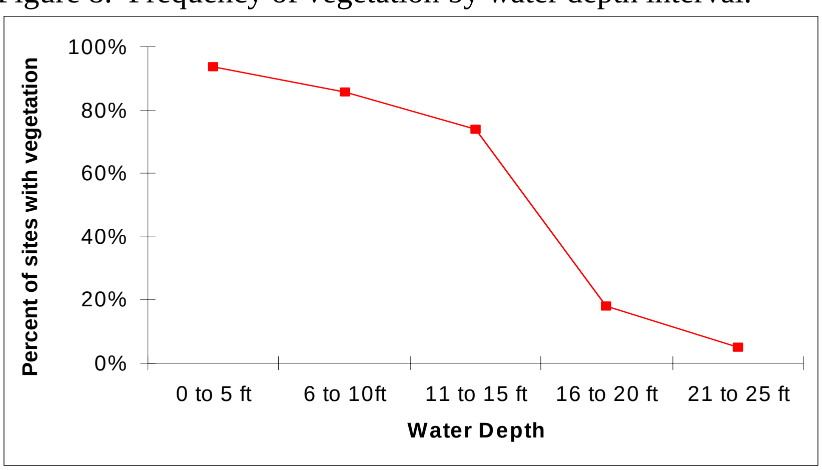


Table 2. Frequency of aquatic plants in Trout Lake, July and August 2005.
(Frequency is the percent of sample sites in which a plant taxon occurred within the shore to 25 ft water depth.)
891 sample sites

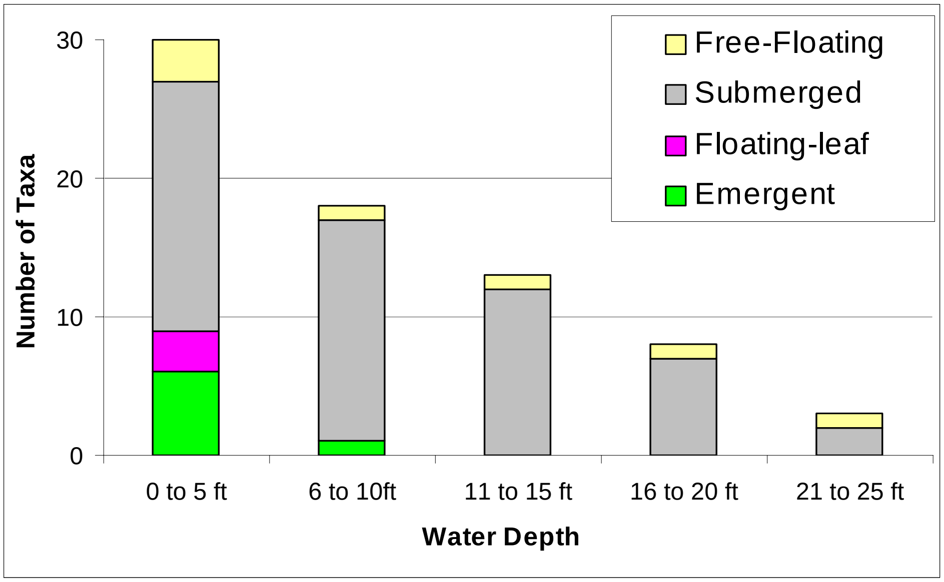
Life Form		**Common Name**	**Scientific Name**	**Frequency**	**Located only in previous survey**
SUBMERGED plants grow primarily under the water surface. Upper leaves may float near the surface and flowers may extend above the surface. Plants may or may not be anchored to the lake bottom.	Large Algae	Muskgrass	*Chara sp.*	35	
	Grass-leaf rooted plants	Wild celery	*Vallisneria americana*	9	
		Flat-stem pondweed	*Potamogeton zosteriformis*	6	
		Water stargrass	*Heteranthera dubia*	2	
	Dissected-leaf rooted plants	Coontail	*Ceratophyllum demersum*	31	
		Northern water milfoil	*Myriophyllum sibiricum*	11	
		Whorled water milfoil	*Myriophyllum verticillatum*	---	2000
		White water buttercup	*Ranunculus aquatilis*	9	
		Water marigold	*Megaladonta beckii*	<1	
	Small-leaf rooted plants	Sago pondweed	*Stuckenia pectinata*	7	
		Blunt-tipped pondweed	*Stuckenia filiformis*	---	2000
		Narrow-leaf pondweed	*Potamogeton sp.**	7	
		Fries pondweed	*Potamogeton friesii*	6	
		Leafy pondweed	*Potamogeton foliosis*	<1	
		Small pondweed	*Potamogeton pusillus*	---	2000
		Straight-leaved pondweed	*Potamogeton strictifolius*	---	2000
	Broad-leaf rooted plants (“cabbage”)	White-stem pondweed	*Potamogeton praelongus*	4	
		Variable pondweed	*Potamogeton gramineus*	3	
		Clasping-leaf pondweed	*Potamogeton richardsonii*	2	
		Illinois pondweed	*Potamogeton illinoensis*	1	
	Bushy-leaved plants	Bushy pondweed	*Najas flexilis*	3	
		Canada waterweed	*Elodea canadensis*	1	
		Marestail	*Hippuris vulgaris*	---	1999
FREE-FLOATING plants drift freely with current and float near or on water surface.		Star duckweed	*Lemna trisulca*	19	
		Turion-forming duckweed	*Lemna turionifera*	<1	
		Greater duckweed	*Spirodela polyrhiza*	<1	
FLOATING plants are rooted in the lake bottom and have leaves that float on the water surface.		White waterlily	*Nymphaea odorata*	5	
		Yellow waterlily	*Nuphar variegata*	1	
		Floating leaf pondweed	*Potamogeton natans*	1	
		Floating-leaf arrowhead	*Sagittaria cuneata*	---	2000
EMERGENT plants extend well above the water surface and are usually found in shallow water, near shore.		Hardstem bulrush	*Schoenoplectus acutus*	10	
		Broad-leaf cattail	*Typha latifolia*	<1	
		Needlegrass	*Eleocharis acicularis*	<1	
		Spikerush	*Eleocharis sp.*	<1	
		Horsetail	*Equisetum fluviatile*	---	1999
		Broad-leaf arrowhead	*Sagittaria latifolia*	---	1999
		Giant burreed	*Sparganium eurycarpum*	Present	
		Giant cane	*Phragmites australis*	Present	

*Some specimens of “narrow-leaved pondweeds” were positively identified as *Potamogeton freisii* (Fries pondweed) and *Potamogeton foliosis* (leafy pondweed). However, it is not known whether other “look-a-like” narrow-leaf pondweed species occurred in the lake. Therefore, a separate group of “unidentified narrow-leaf pondweeds” (*Potamogeton* sp.) are reported here.

“—“ = plant taxa not found in 2005; “present’ = plant taxa found in 2005 but occurred outside of sample sites.

Most emergent plant and floating-leaf plants occurred in water depths of six feet and less and most rooted submerged plants were restricted to depths of 15 feet and less (Figure 9). Only seven taxa occurred in depths greater than 15 feet and only three submerged taxa occurred in depths greater than 20 feet.

Figure 9. Number of taxa found at each water depth interval



The number of plant taxa found at each one square meter sample site ranged from zero to eight, with a mean of one. Sites with the highest number of taxa occurred near shore, within mixed beds of emergent, floating-leaved and submerged plants (Figure 10). In water depths greater than 15 feet, most sites contained fewer than two taxa.

Figure 10. Number of plant taxa at each sample site, Trout Lake, 2005

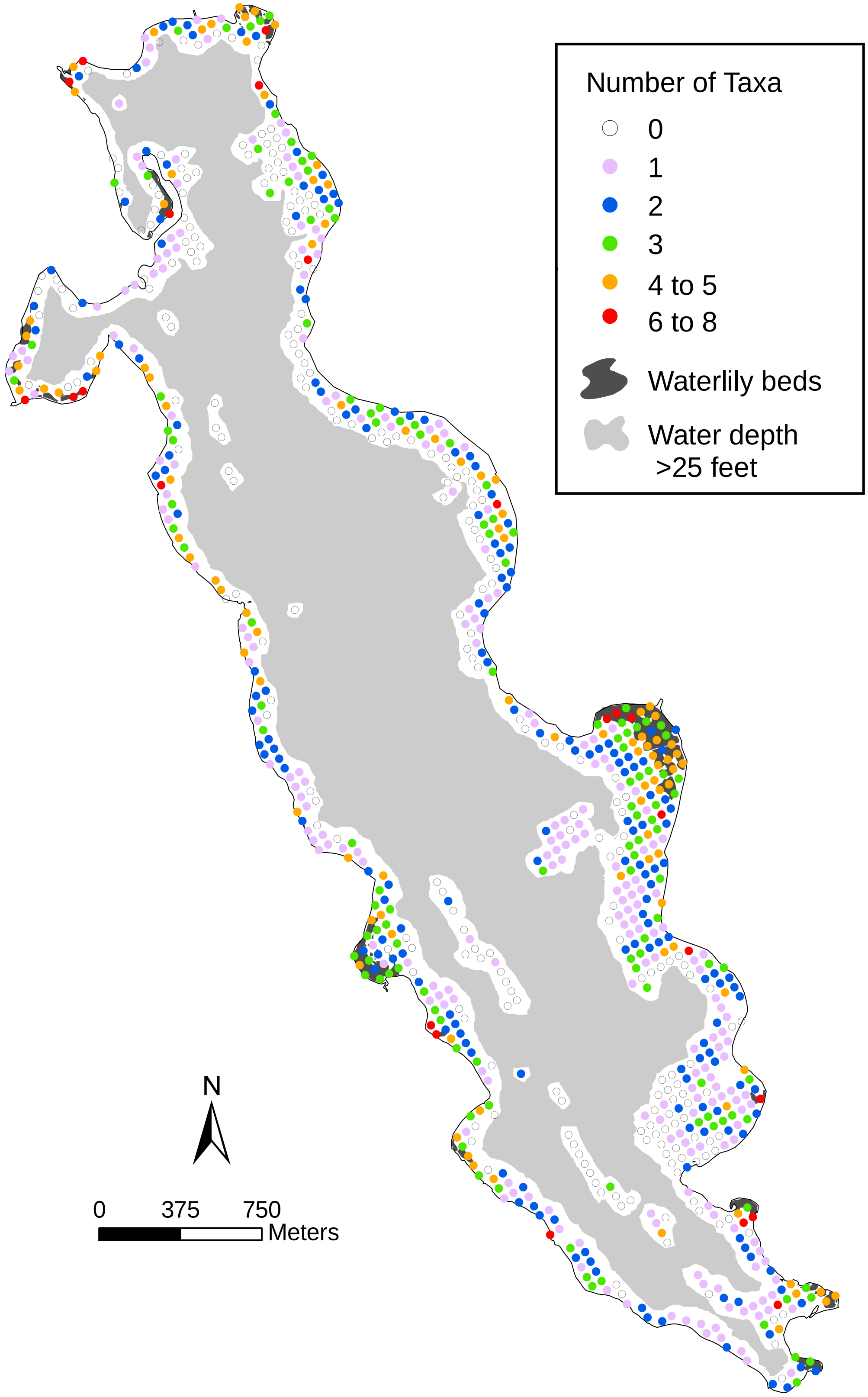
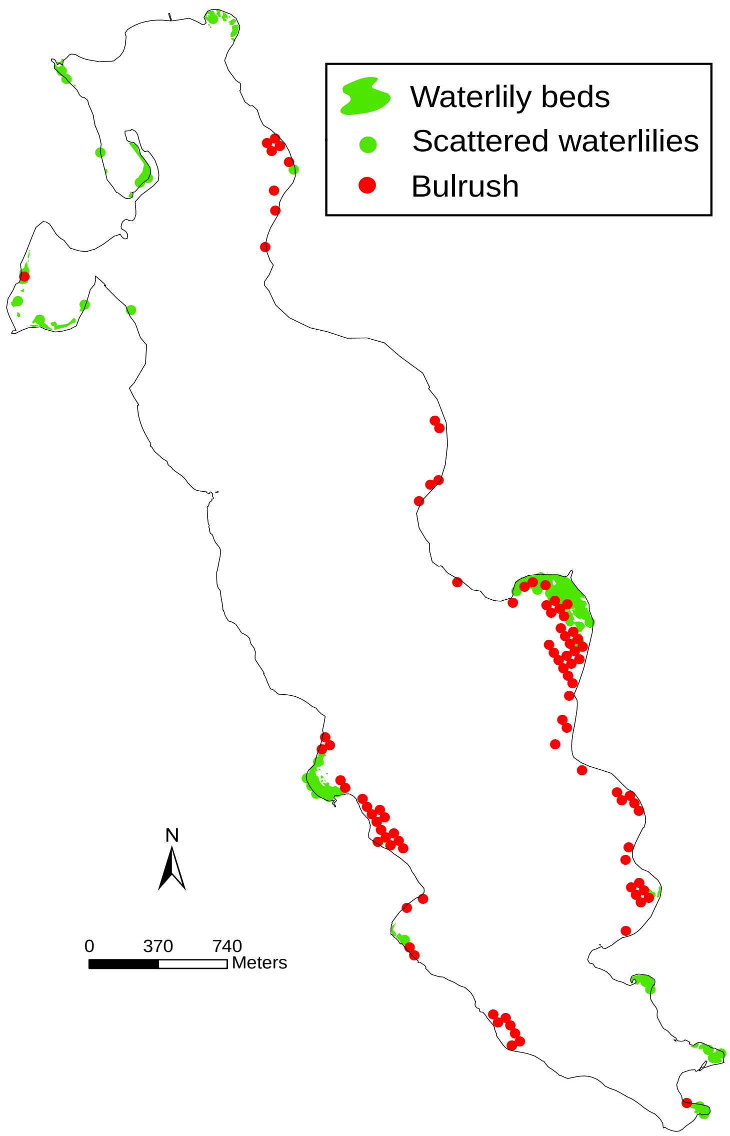


Figure 11. Major emergent and floating-leaf beds 2005.



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 and 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.

Within the shore to five feet depth zone, 31% of the survey sites contained at least one emergent or floating-leaf plant. Major plant bed types included bulrush and waterlilies (Figure 11). Waterlilies were often associated with soft substrates and bulrush was more typically found on hard substrates.

Hard-stem bulrush (*Schoenoplectus acutus*) (Figure 12) was the most common emergent in Trout Lake and was found in 10% of the sites (Table 2). Bulrush was found in 21% of the sample sites between shore and the five feet depth and usually occurred in sand.

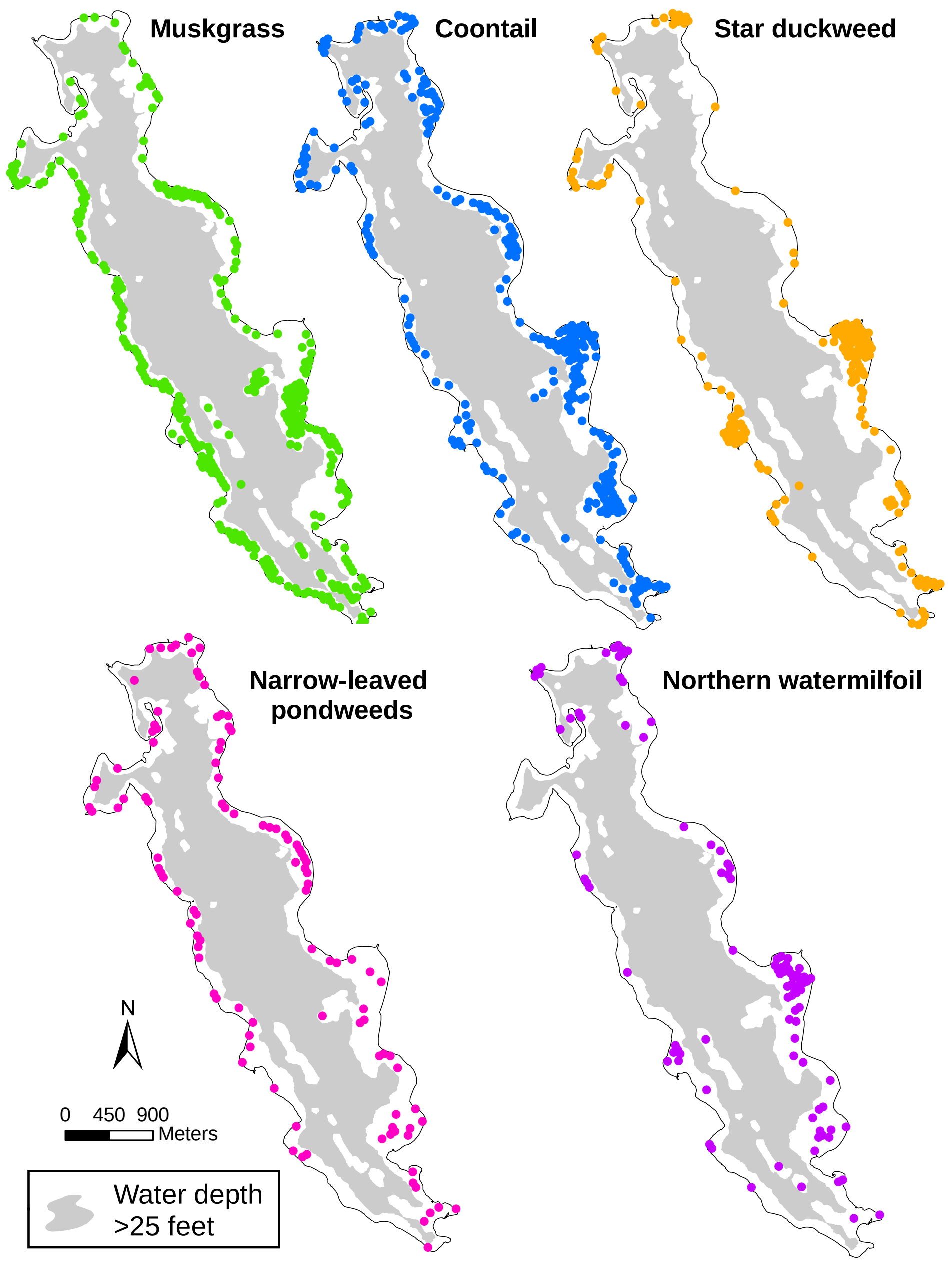
Figure 12. Mixed bed of bulrush and waterlilies, Trout Lake, 2005.

Waterlily beds, or mixed beds of waterlilies and emergents (Figure 12), covered about 33 acres in Trout Lake. Floating-leaf plants included yellow waterlily (*Nuphar variegata*), white waterlily (*Nymphaea odorata*), and floating-leaf pondweed (*Potamogeton natans*). Waterlily beds often contained scattered bulrush plants, and submerged plants.

Submerged and free-floating plants

Within the depth zone from shore to 25 feet, 72% of the sample sites contained at least one submerged or free-floating plant. The four most frequent taxa were muskgrass (*Chara* sp.), coontail (*Ceratophyllum demersum*), star duckweed (*Lemna trisulca*), narrow-leaved pondweeds (*Potamogeton* spp.), and northern watermilfoil (*Myriophyllum sibiricum*). These species occurred in more than 10% of the survey sites (Table 2) and were widespread throughout the littoral zone (Figure 13).

Figure 13. Distribution of common submerged species in Trout Lake, 2005.

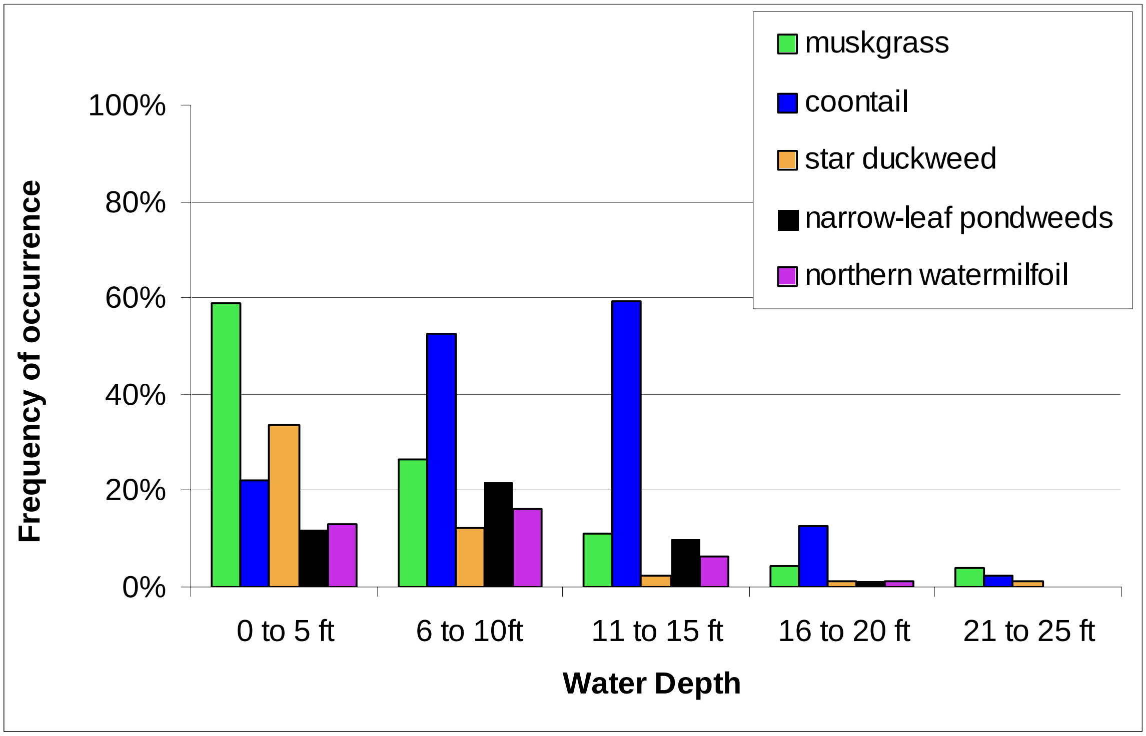


Muskgrass (*Chara* sp.) (Figure 14) was the most common submerged plant in Trout Lake, occurring in 35% of the sites (Table 2). Muskgrass was found around the entire shoreline and was often the only species found on off-shore shallow bars (Figure 13). Muskgrass could be found growing in thick beds with no other vegetation and in other areas it co-occurred within mixed beds of pondweeds and other submerged plants. Muskgrass was the dominant plant in depths less than six feet (Figure 15).

Figure 14. Muskgrass

This macroscopic, or large, algae 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 taxa 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.

Figure 15. Frequency of common plants by water depth interval. Trout Lake, July and August 2005.



Coontail (*Ceratophyllum demersum*) (Figure 16) occurred in 31% of the survey sites (Table 2). It occurred at all depths sampled and dominated the six to 20 feet water depth zone (Figure 15). Coontail grows entirely submerged and its roots are only 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.

Figure 16. Coontail

Star duckweed (*Lemna trisulca*) was present in 19% of the Trout Lake survey sites (Table 2). It was most common in the shallow bays (Figure 13) and was often found in water depths of ten feet and less (Figure 15). Star duckweed (Figure 17) 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.

Figure 17. Star duckweed

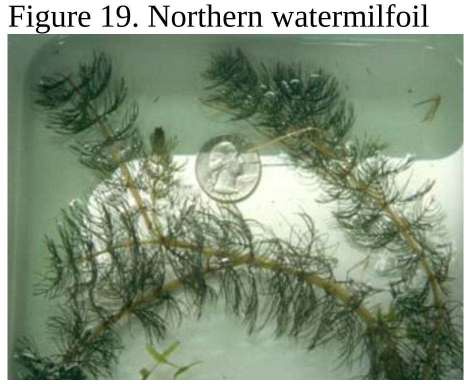
Photo credit: Dr. Robert Freckman, Univ. Of Wisconsin-Stevens Point

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 18) and leafy pondweed (*Potamogeton foliosis*) were positively identified in the lake, but additional narrow-leaf species may have also been present. In Trout Lake, all narrow-leaf pondweeds were found in 12% of the sites and were most frequently found in depths of 6 to 10 feet (Figure 15). Fries' pondweed was found in 6% and leafy pondweed was found in less than 1% of the sample sites (Table 2).

Figure 18. Fries' pondweed

Northern watermilfoil (*Myriophyllum sibiricum*) (Figure 19) was found in 11% of Trout Lake survey sites. It was common in water depths of ten feet and less (Figure 15). Northern watermilfoil was found in scattered shallow locations throughout Trout Lake (Figure 13). Northern watermilfoil is a rooted, perennial submerged plant with finely dissected leaves. It may reach the water surface, particularly in depths less than ten feet and its flower stalk extends above the water surface. It spreads primarily by stem fragments and over-winters by hardy rootstalks and winter buds. Northern watermilfoil is not tolerant of turbidity and grows best in clear water lakes. For information on how to distinguish this native plant from the non-native, Eurasian watermilfoil: identification.

Figure 19. Northern watermilfoil



Other submerged species were present in less than ten% of the sample sites but their presence contributes to the overall habitat diversity within the lake.

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 2005 water clarity of Trout Lake was sufficiently high to allow a diversity of aquatic plant growth to a depth of about 15 feet. Beyond that depth, vegetation was sparse and was dominated by species that are more tolerant of low light conditions.

The near-shore zone of Trout Lake includes a diversity of substrate types and large areas of undeveloped shorelines. This provides for a mixed habitat of bulrush beds along sandy shores and waterlily and wild rice beds in softer sediments. The abundant and diverse native aquatic plant communities found in these near-shore areas provide critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants).

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 increases, submerged vegetation are expected to expand to deeper water. A greater number of species may be found in depths of 10 to 15 feet and species like coontail may be more frequent in depths of 20 feet and beyond.
- 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 Trout Lake but if they invade, 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 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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