Aquatic Vegetation of
Tamarack Lake (DOW 09-0067-00)
Carlton County, Minnesota
July 7, 2005

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Acknowledgments

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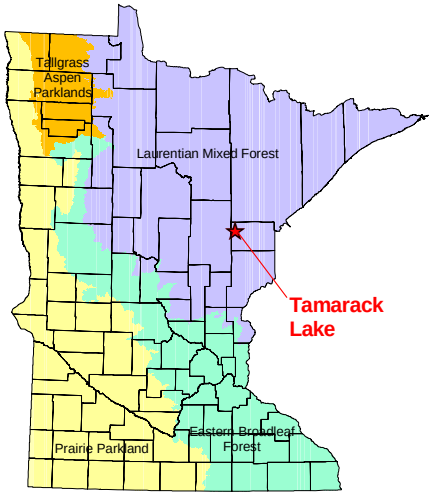
Summary

Tamarack Lake is an example of a northern Minnesota lake where natural "bog-stain" limits the extent of aquatic vegetation growth. The Tamarack River flows through this lake providing adequate conditions for wild rice (*Zizania aquatica*) growth. Beds of wild rice and other emergent and floating-leaved species were common in shallow water. However, submerged vegetation occurred in only 46 percent of sample sites and was limited to depths less than eight feet, primarily because of naturally low water clarity. Common submerged species include coontail (*Ceratophyllum demersum*), wild celery (*Vallisneria americana*), star duckweed (*Lemna trisulca*), flat-stem pondweed (*Potamogeton zosteriformis*) and northern watermilfoil (*Myriophyllum* sp.).

Introduction

Figure 1. Location of Tamarack Lake (09-0067-00) in Minnesota.



Survey Lake Description

Tamarack Lake (09-0067-00) is located about two miles south of the town of Wright, Carlton County, Minnesota. The lake occurs within the ecological region called the Laurentian Mixed Forest Province, or the true forested region of the state (Fig. 1).

Tamarack Lake occurs within the major watershed of the Grand Rapids branch of the Mississippi River. The Tamarack River enters the lake on the east and through the outlet on the north end of the lake; flow continues northwest to the Prairie River, west into Big Sandy Lake, and north to the Mississippi River (Fig. 2). Land use in this portion of the watershed is a mix of upland and lowland deciduous forest, lowland conifer forest, shrubland and open crop and grassland.

Tamarack Lake has a surface area of 228 acres and a maximum depth of about 48 feet. Over 75 percent of the lake is shallow, with depths less than 15 feet (Fig. 3). An eastern basin and a western basin are separated by a narrow shallow zone where water depths are less than five feet.

Residential development is heavy along the north end of the eastern basin as well as the most of the western basin (Fig. 3). A public access is located on the southwest end of the lake.

Figure 2. Water flow to and from Tamarack Lake (09-0067-00) Carlton County.

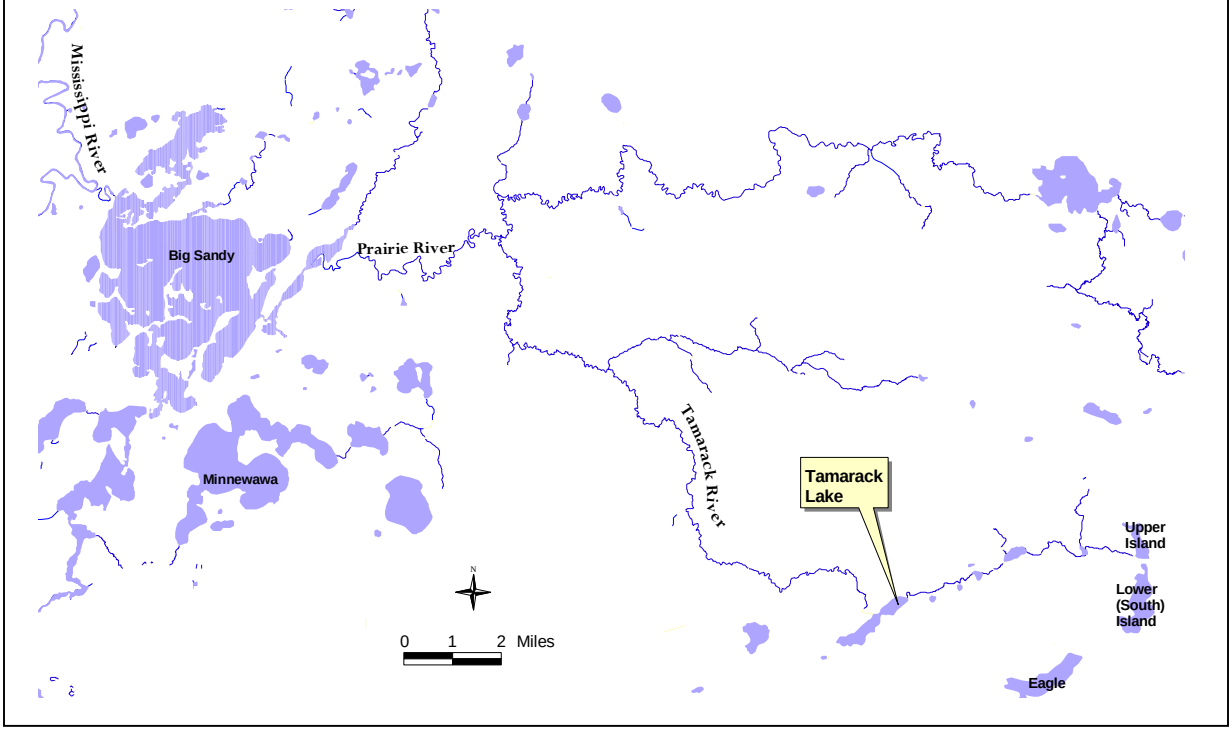
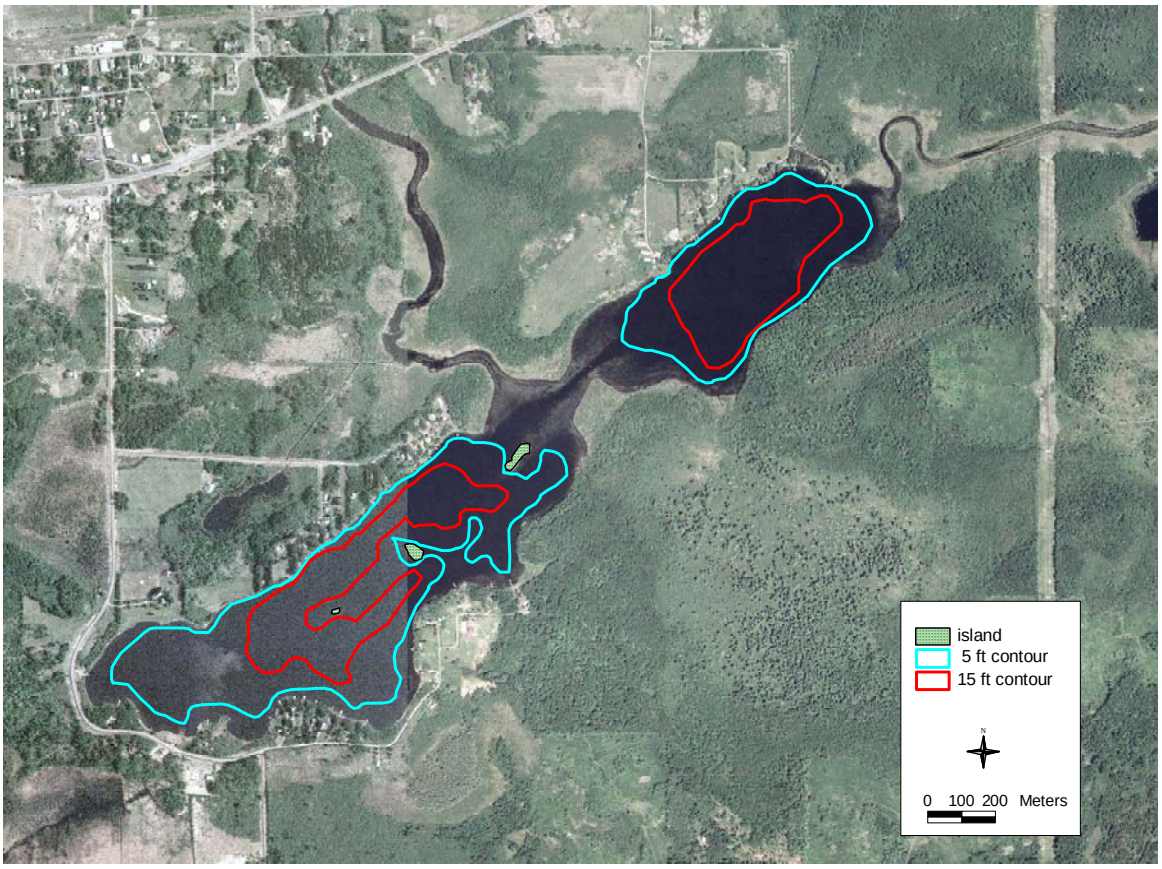


Figure 3. Hydrologic contour map Tamarack Lake (09-0067-00) based on 2005 vegetation survey. (photo source: Farm Service Admin 2003)



Tamarack Lake is classified as eutrophic, indicating higher concentrations of nutrients, algae and lower water clarity. Water clarity, as measured by mean summer Secchi Disc readings from 2001 through 2004, was about five feet (MPCA 2005). Low clarity in this lake is primarily attributed to a natural tannin, or bog, stain. Shoal substrates have been described as muck with several areas of sand/gravel or sand/rubble (MnDNR 1990).

Historically, the aquatic plant community has been described as including a ring of emergent and floating-leaved plants around the shoreline with submerged plants common in water depths less than three feet and most abundant in the western basin and where the Tamarack River enter the lake on the northeast side (MnDNR Fisheries files).

Vegetation Survey Objectives

The purpose of the 2005 survey of Tamarack Lake was to describe the current aquatic plant community, including:

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 maps of the distribution of the common species

Methods

A Point-Intercept vegetation survey of Tamarack Lake was conducted on July 7, 2005 following the methodology described by Madsen (1999). Sample points were established with Geographic Information System (GIS) software using a 60 meter by 60 meter grid across the lake surface. After the survey points were generated in the GIS, they were uploaded into a Global Positioning System (GPS) unit, which 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. A double-headed, weighted garden rake, attached to a rope was used to survey vegetation not visible from the surface (Fig. 4). The surveyors recorded all plant species found within a one meter squared sample site at the pre-designated side of the boat.

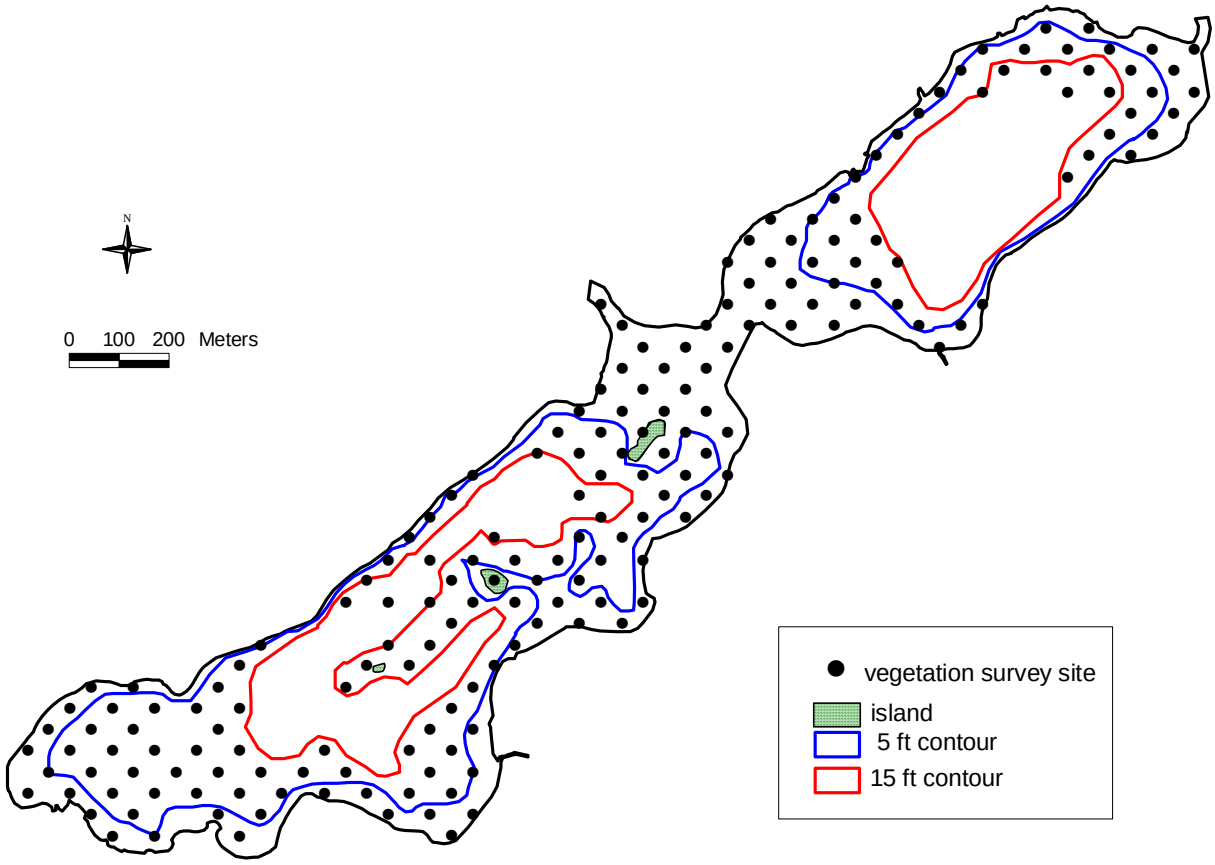
Nomenclature followed Crow and Hellquist (2000). Voucher specimens were collected for most plant species and are stored at the MnDNR in Brainerd. After initial field sampling, surveyors decided not to sample in depths greater than 20 feet because they were consistently not finding vegetation beyond that depth. A total of 193 points were sampled in Tamarack Lake and 192 of these points fell within the shore to 20 foot zone (Fig. 5).

Figure 4. Rake used to sample vegetation.

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. Frequency values were calculated for the entire sampled area and data were also grouped by water depth and separated into four depth zones for analysis: 0 to 5 feet, and 6 to 10 feet, 11 to 15 feet, and 16 to 20 feet.

Example:
On Tamarack Lake, there were 192 sample sites within the shore to 20 feet zone.
Coontail occurred 44 of those sites.
Frequency of coontail in Tamarack Lake = 44 /192 = 23%

Figure 5. 2005 Vegetation survey sites on Tamarack Lake (09-0067-00). (No survey in depths > 20 ft).



Results / Discussion

Distribution of vegetation with water depth

Aquatic plants occurred to a maximum depth of eight feet in Tamarack Lake. Plants were most common from shore to the ten feet depth where, 97 percent of all of the sample sites contained vegetation. Plant occurrence declined with increasing water depths and in depths from six to ten feet, only 23 percent of the sites were vegetated (Fig. 6).

Types of aquatic plants found

During the surveys of Tamarack Lake, a total of 29 aquatic plant species were found, including six emergent, four floating-leaved, and 19 submerged (Table 1). No non-native aquatic plant species were observed during the survey.

All species occurred in the zone from shore to a depth of five feet and only 11 species occurred beyond that depth (Fig. 7). Only four species were found in depths of seven to eight feet.

Table 1. Aquatic Plants of Tamarack Lake, Carlton County (DOW 09-0067-00) July 7, 2005

Frequency calculated for zone from shore to 20 feet depth
Frequency = percent of sites in which species occurred
192 sample sites

Life Forms	Common Name	Scientific Name	Frequency
SUBMERGED These plants grow primarily under the water surface. Upper leaves may float near the surface and flowers may extend above the surface. Plants are usually rooted or loosely anchored to the lake bottom.	Coontail	*Ceratophyllum demersum*	0.23
	Wild celery	*Vallisneria americana (v)*	0.11
	Star duckweed	*Lemna trisulca (v)*	0.10
	Flatstem pondweed	*Potamogeton zosteriformis*(v)	0.09
	Northern water milfoil	*Myriophyllum sibiricum(v)*	0.08
	Water marigold	*Megaladonta beckii (v)*	0.06
	Muskgrass	*Chara* sp. (v)	0.06
	White water buttercup	*Ranunculus* sp. (v)	0.06
	Robbins' pondweed	*Potamogeton robbinsii (v)*	0.06
	River pondweed	*Potamogeton nodosus (v)*	0.04
	Narrow-leaf pondweed	*Potamogeton* sp. (v)	0.03
	White-stem pondweed	*Potamogeton praelongus (v)*	0.03
	Variable pondweed	*Potamogeton gramineus (v)*	0.03
	Greater bladderwort	*Utricularia vulgaris*	0.03
	Clasping-leaf pondweed	Potamogeton richardsonii	0.02
	Water Moss	Not identified to genus	0.02
	Stonewort	*Nitella* sp.	0.02
	Large-leaf pondweed	*Potamogeton amplifolius (v)*	0.01
	Canada waterweed	*Elodea* sp.	0.01
FLOATING These plants are rooted in the lake bottom and have leaves that float on the water surface.	White waterlily	*Nymphaea odorata (v)*	0.08
	Yellow waterlily	*Nuphar variegata (v)*	0.07
	Floating-leaf burreed	*Sparganium* sp. (v)	0.03
	Water smartweed	*Polygonum amphibium (v)*	0.01
EMERGENT These plants extend well above the water surface and are usually found in shallow water, near shore.	Wild rice	*Zizania aquatica*	0.27
	Spikerush	*Eleocharis* sp (v)	0.04
	Arrowhead	*Sagittaria* sp.	0.03
	Bulrush	*Scirpus* sp.	0.02
	Horsetail	*Equisetum fluviatile*	0.01
	Cattail	*Typha* sp.	0.01

V = voucher specimen collected

Figure 6. Distribution of aquatic vegetation vs. water depth in Tamarack Lake (09-0067-00) July 7, 2005.

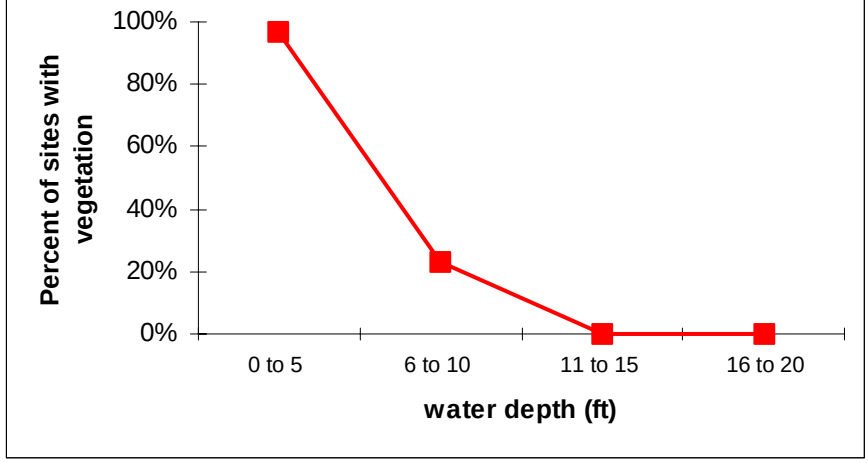
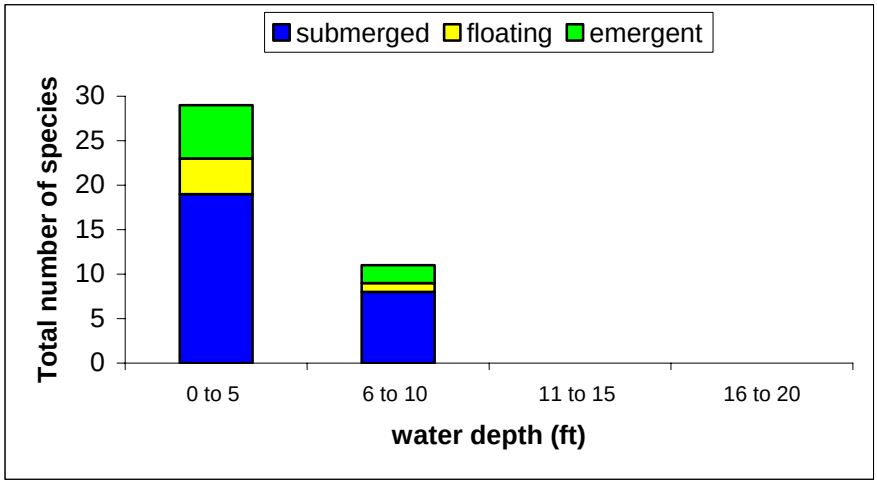


Figure 7. Types of plants in each water depth zone in Tamarack Lake (09-0067-00) July 7, 2005.

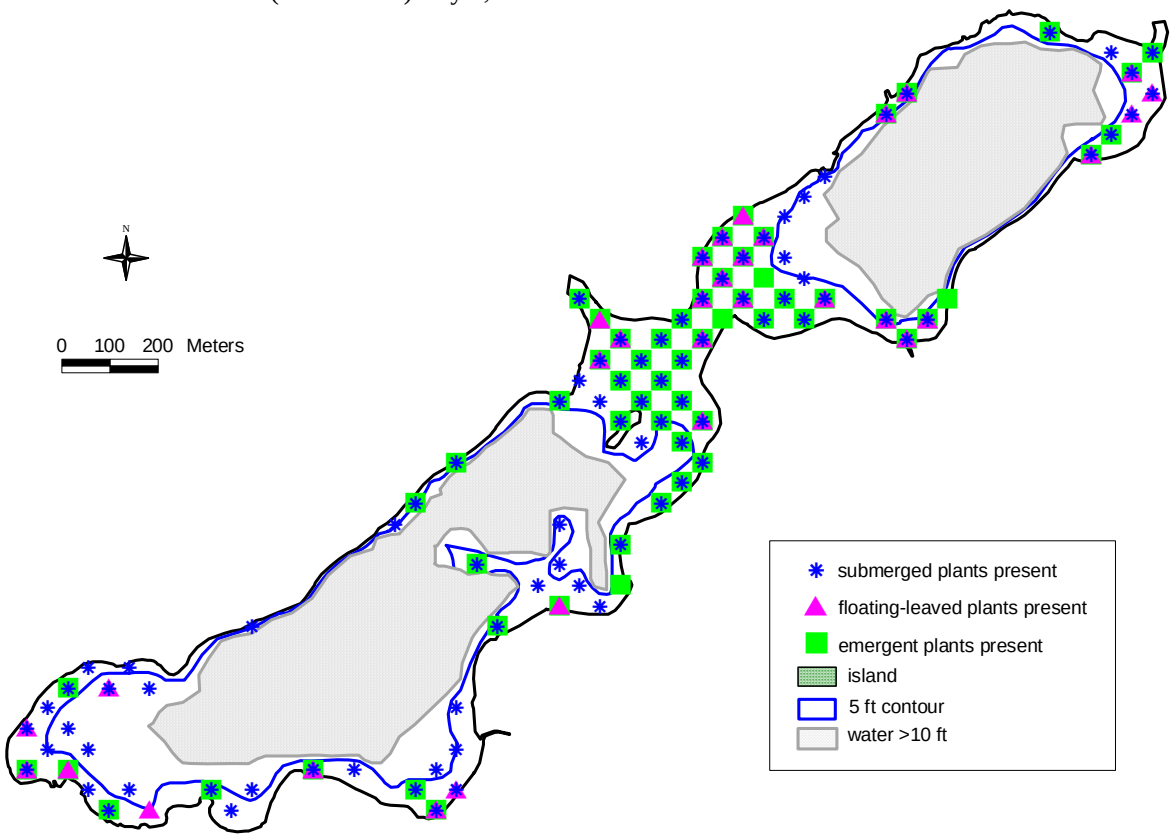


Emergent and floating-leaved plants

Most emergent and floating-leaved species were restricted to depths less than six feet (Fig. 7) and within this zone, 73 percent of the sample sites contained at least one emergent or floating-leaf species. Emergent and floating-leaved species were most common in the shallow area between the two main basins and scattered smaller beds were found around the shore (Fig. 8).

Wild rice (*Zizania aquatica*) was most common species in this group and was found in 27 percent of all sites sampled (Table 1). It occurred to a maximum depth of seven feet but was most common in depths less than six feet, where it was found in 58 percent of the sites (Fig. 9). Wild rice grows as a floating-leaved species in early spring and becomes emergent during the summer.

Figure 8. Distribution of emergent, floating and submerged vegetation in Tamarack Lake (09-0067-00) July 7, 2005.



Other emergent species found in Tamarack Lake included spikerush (*Eleocharis* sp.), arrowhead (*Sagittaria* sp.), Bulrush (*Scirpus sp*.), and cattail (*Typha* sp.).

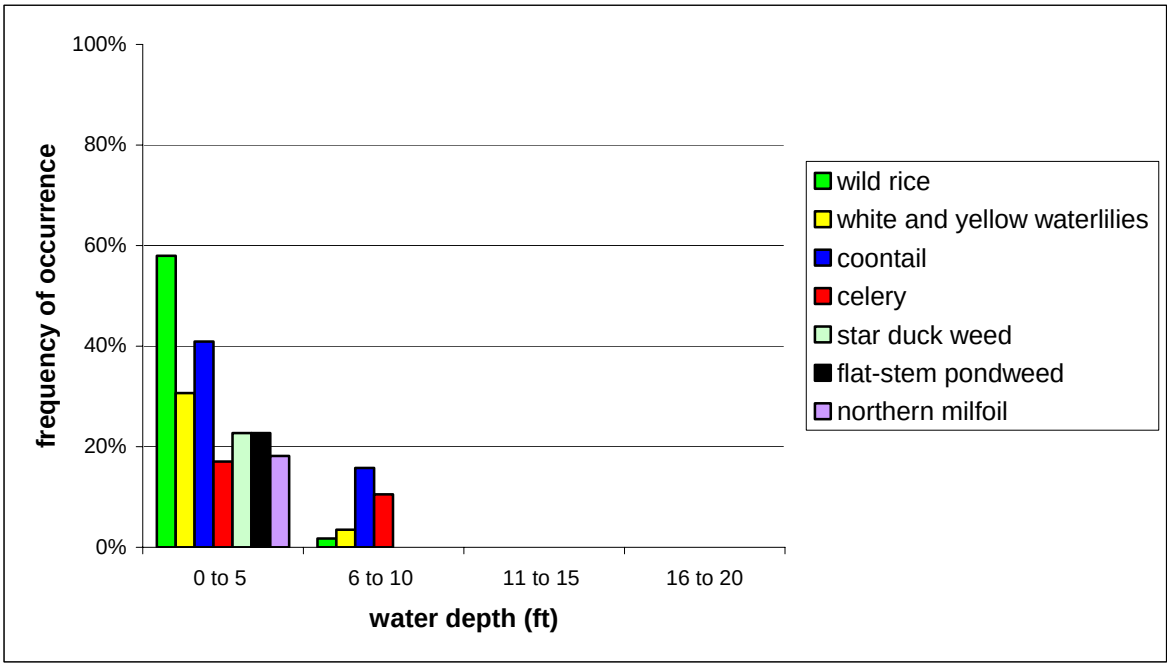
White waterlily (*Nymphaea odorata*) and Yellow waterlily (*Nuphar variegata*) were the most common floating-leaved species present and were found in eight and seven percent of all sites, respectively. Combined, waterlilies were present in 31 percent of sites in depths less than six feet (Fig. 9). Other floating-leaved species included floating-leaved burreed (*Sparganium* sp.) and floating-leaved smartweed (*Polygonum amphibium*).

Submerged and free-floating plants

Submerged plants were the most abundant type of vegetation in Tamarack Lake and were found in 46 percent of all sites surveyed. They occurred to a maximum depth of eight feet but most submerged species were restricted to depths of five feet and less (Fig. 7) and within that zone, 86 percent of sites contained submerged plants.

The five most common submerged species in Tamarack Lake were Coontail (*Ceratophyllum demersum*), occurring in 23 percent of all sites, Wild celery (*Vallisneria americana*) (11 percent), star duckweed (*Lemna trisulca*) (10 percent), Flat-stem pondweed (*Potamogeton zosteriformis*) (9 percent) and Northern watermilfoil (*Myriophyllum* sp.) (8 percent), (Table 1). These species are all perennial and at least moderately tolerant of low clarity.

Figure 9. Frequency of common aquatic plant species by depth zone in Tamarack Lake (09-0067-00) Carlton County, MN July 7, 2005.



Coontail occurred to a maximum depth of seven feet but was most common in depths less than six feet (Fig. 9). It was widespread in distribution (Fig. 10). Wild celery occurred in both basins (Fig. 10) but only to a depth of six feet. Star duckweed was restricted to depths of four feet and less (Fig. 9) and was primarily found in the northeast half of the lake (Fig. 10). Flat-stem pondweed and northern watermilfoil occurred in both basins (Fig. 10) but in depths less than six feet.

All other submerged species were found in less than seven percent of all surveyed sites (Table 1), but the high number of different species provides diverse structure for invertebrates and fish and other wildlife in Tamarack Lake. (Click here for more information on: value of aquatic plants).

Factors influencing aquatic plant community

The plant community of Tamarack Lake is typical of "bog-stained" lakes in northern Minnesota. The water flow of the Tamarack River through the lake provides appropriate conditions for species like wild rice and river pondweed (*Potamogeton nodosus*), which are not often found in stagnant waters. Naturally low water clarity limits the depth at which submerged species grow. Species tolerant of lower light, such as coontail, are more common in this lake than are species requiring higher light levels. Factors that may lead to change in the aquatic plant community of Tamarack Lake include:

- **Change in water clarity**
  Light availability is a significant factor limiting plant distribution and abundance. The amount of light available to submersed aquatic plants is typically dependent on both

Figure 10. Distribution of common aquatic plant species in Tamarack Lake (09-0067-00), July 7, 2005.
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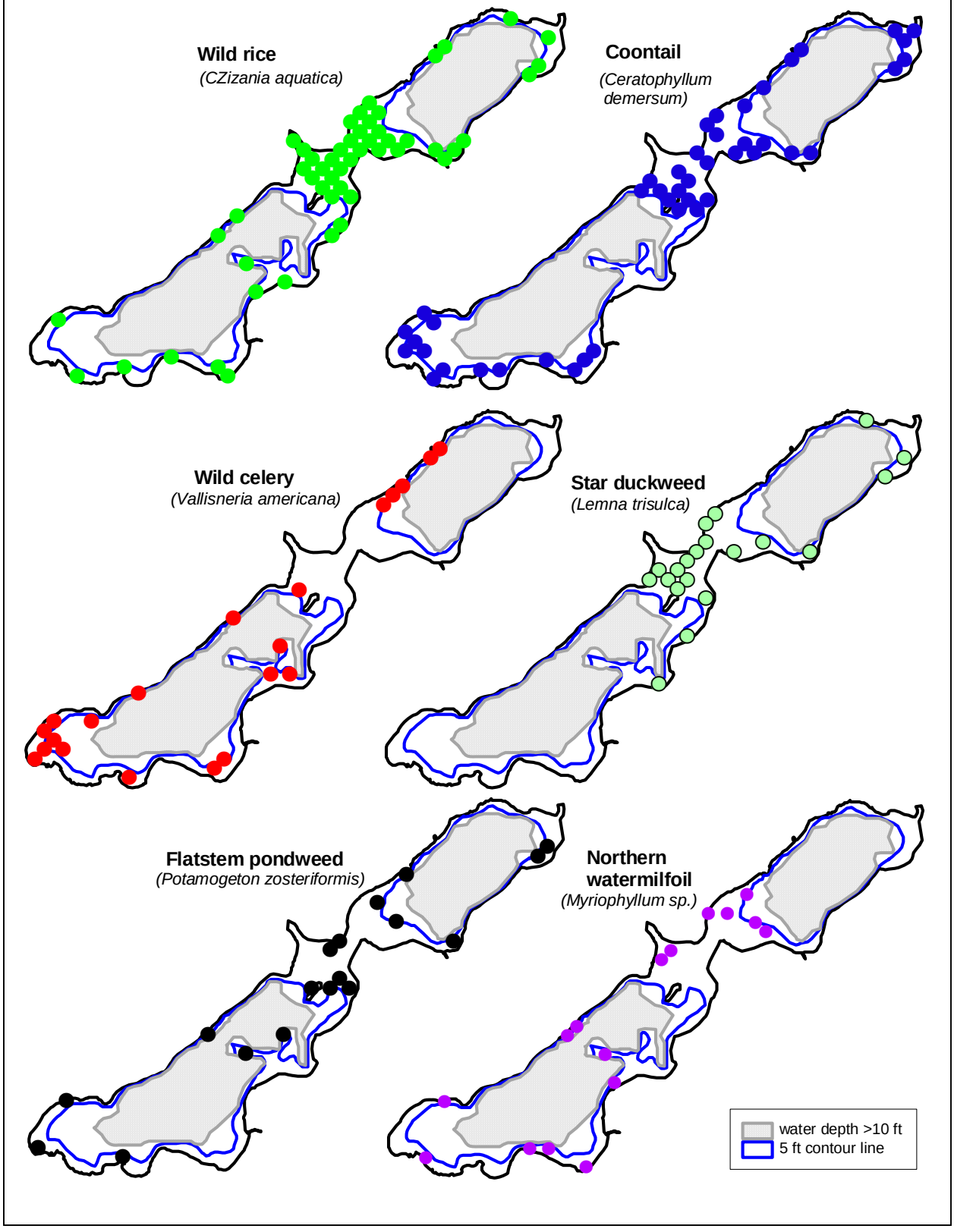

water clarity and depth. "Bog-stain" that occurs in Tamarack Lake is one reason for lower water clarity. Excess nutrients, such as elevated phosphorus levels, that result in higher algal levels, can also create lower water clarity. If water clarity decreases, submerged vegetation may be less common.

Figure 11. Emergent and floating-leaf bed in Tamarack Lake (09-0067-00). July 7, 2005

- **Water level fluctuations**
  Most aquatic plants are adapted to minor changes in water levels, but large fluctuations may result in changes in plant distribution and species composition. Wild rice, in particular, is sensitive to rapid changes in water levels. It is particularly vulnerable during its "floating-leaf" stage in the spring when wave action from heavy storms can uproot the plant.
- **Snow 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, some submerged plants may increase in abundance.
- **Water temperatures / length of growing season**
  In years with cool spring temperatures, submerged plant growth may be less dense than in years with early springs and prolonged warm summer days.
- **Natural fluctuation in plant species.**
  Many submerged plants are perennial and grow in similar locations each year. However, a few species, such as wild rice (*Zizania aquatica*), are annuals and are dependant on the previous years seed set for regeneration.
- **Herbivores**
  Native wildlife, such as muskrats and native crayfish, as well as non-native species like carp and rusty crayfish, can cause declines in aquatic plant communities.
- **Human activities**
  Humans can impact aquatic plant communities directly by destroying vegetation with herbicide or by mechanical means. For information on the laws pertaining to aquatic plant management: MnDNR APM Program. Motorboat activity in vegetated areas can be particularly harmful for species such as 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.

The 2005 vegetation survey of Tamarack Lake gives a "snapshot" of the aquatic plant community. Data collected during the 200e survey can be compared to future quantitative surveys of these lakes to better estimate how the plant community may be changing. Monitoring changes in aquatic plant communities can help reflect changes in the overall water quality of the lake and watershed.

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Figure 12. Tamarack Lake (09-0067-00) July 7, 2005