

# Aquatic Vegetation of **SULLIVAN LAKE**

Morrison County, MN  
DOW 49-0016-00  
**June 25 and 30, 2003**



Surveyed: June 25 and 30, 2003  
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## **Introduction**

Sullivan Lake is located in Morrison County of north-central Minnesota, three miles northeast of the town of Harding and about nine miles southwest of Mille Lacs Lake, at the north end of the Mississippi River-Sartell Watershed (Figure 1). The Platte River flows through the lake and provides a broad connection to Platte Lake. Sullivan Lake is approximately 1221 acres in area with a maximum depth of 57 feet. The shoreline is mostly developed except for the wetlands on the north shore (Figure 2). Sullivan Lake is described as mesotrophic with a mean summer Secchi Disk reading of about eight feet (MPCA 2003).

### Vegetation Survey Objectives

The goals of the 2003 Point Intercept vegetation survey of Sullivan Lake include:

- 1) Estimate the maximum depth of rooted vegetation
- 2) Estimate the percent of the littoral zone occupied by rooted vegetation
- 3) Record the aquatic plant species that occur in the lake
- 4) Collect quantitative estimates of species abundance
- 5) Develop distribution maps for the common species

In addition to the Point-Intercept Survey, DNR Fisheries staff mapped areas of developed shoreline where curly leaf pondweed formed surface mats.

Data from the 2003 vegetation surveys can be used to monitor annual changes in the native and exotic plant species composition and will be used to guide vegetation management decisions.

## **Methods**

A Point-Intercept vegetation survey of Sullivan Lake was conducted on June 25 and 30, 2003 following the methodology described by Madsen (1999). Sample points were established within the lake zone from shore to the 30 foot water depth using a 125 meter by 125 meter grid. This resulted in a total of 237 sample points but only 215 sample points occurred within the vegetated zone from shore to the 25 foot depth (Figure 3). Sample points that fell on land or in water depths greater than 25 feet were not included in the calculations.

A Trimble GeoExplorer 3 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 using a measured stick in water depths less than eight feet and an electronic depth finder in water depths greater than eight feet. The surveyor recorded any plant species 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. If curly leaf pondweed was present at a site, surveyors recorded whether or not it formed surface mats at that site. Nomenclature followed Crow and Hellquist (2000). Voucher specimens were collected for selected species.

Data were entered into an Excel database spreadsheet 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. Sampling points were grouped by water depth and separated into five depth zones for analysis: 0 to 5 feet, and 6 to 10 feet, 11 to 15 feet, 16 to 20 feet and 21 to 25 feet.

## Results

### Maximum rooting depth and percent of lake with vegetation

A secchi disk reading for Sullivan Lake was recorded as 13 feet on June 25, 2003 and as eight feet on June 30, 2003. Rooted vegetation was found to a maximum depth of 22 feet and within the zone from shore to the 25 foot depth, vegetation was found in 77% of the sample sites. Vegetation was most often found in water depths less than 16 feet (Figure 4). From the 16 foot depth to the 25 foot depth, only seven to eight percent of the sample sites contained vegetation (Figure 4).

### Species composition

A total of 33 native and one non-native aquatic plant species were recorded in Sullivan Lake during the 2003 survey (Table 1). This survey focused on in-lake vegetation and the majority (20) of the species found were submerged. Submerged species accounted for 84% of all vegetation found (Figure 5) and the community was dominated by the non-native curly leaf pondweed (*Potamogeton crispus*).

[Curly-leaf pondweed](#) (*Potamogeton crispus*) was found in 27% of all sample points (Table 1) and accounted for 14% of all vegetation recorded (Figure 5). Other common submersed species included [flat-stem pondweed](#) (*Potamogeton zosteriformis*) (18% frequency), [largeleaf pondweed](#) (*Potamogeton amplifolius*) (17%), Robbin's pondweed (*Potamogeton robbinsii*) (17%), whitestem pondweed (*Potamogeton praelongus*) (14%) and variable pondweed (*Potamogeton gramineus*) (11%) (Table 1). All other submerged taxa occurred at frequencies of less than 10%.

Emergent taxa accounted for 10% of all vegetation found within sample points (Figure 5) and common species included [wild rice](#) (*Zizania palustris*) (9% frequency), [hardstem bulrush](#) (*Scirpus acutus*) (9%) and spikerush (*Eleocharis* sp.) (5%) (Table 1).

Floating leaf species, made up 3% of the plant community sampled and common species were [yellow waterlily](#) (*Nuphar variegata*) (4% frequency) and [white waterlily](#) (*Nymphaea odorata*) (2%) (Table 1). The remaining 3% of the plant community sampled was made up of free-floating species, or [duckweeds](#) (Table 1).

### Distribution by water depth

Species richness, or the number of species per sample point, was highest in the shore to five foot depth zone where the mean number of species per sample point was three. The shallow north bay had the highest species richness, where as many as nine species were found in some sample points (Figure 6). Species richness decreased with increasing water depth.

Emergent, free-floating (duckweeds) and floating-leaf species were restricted to water depths of eight feet and less and were primarily found in the shallow northern bay (Figure 7). Wild rice, hardstem bulrush, spikerush, waterlilies, and duckweeds were most abundant in depths less than 6 feet where they each occurred at a frequency of at least 20% (Figure 8). These species also occurred in the 6 to 10 foot depth zone but their frequencies were reduced to less than 10% (Figure 8).

Submerged species occurred at all depths from shore to 22 feet but the majority of submerged species were found in water depths of ten feet and less (Figure 9). Curly leaf pondweed was the dominant species in the shore to 5 foot zone, where it occurred at a frequency of 23%, and the 11 to 15 foot zone, where it reached a maximum frequency of 71%. Within the 11 to 15 foot zone, curly leaf formed dense mats that reached the water surface, particularly in depths of eight to 13 feet (Figure 10). Curly leaf was not found in depths greater than 15 feet.

Native pondweeds such as flatstem pondweed, largeleaf pondweed, Robbin's pondweed and whitestem pondweed dominated the six to ten foot zone and were also common at the shore to 5 foot depth zone and the 11 to 15 foot depth zone (Figures 9, 10). Flatstem pondweed and narrowleaf pondweed were the only species found in depths greater than 15 feet and occurred at less than 10% frequency at these depths (Figure 9).

## **Discussion**

Curly leaf pondweed is an exotic plant with a unique life history that provides a competitive advantage over native plant species. Unlike native aquatic plants that begin growth in late spring and reach maximum growth in mid-summer, curly leaf pondweed starts new growth in late summer and continues into winter. At ice-off, curly leaf stems begins to elongate more rapidly and reach the water's surface well before native species (Madsen and Crowell 2002).

Good spring water clarity in Sullivan Lake provides suitable conditions for spring growth of the exotic curly leaf pondweed and lack of snow cover during the 2002-2003 winter may have also allowed growth of curly leaf under the ice. Curly leaf growth in Sullivan Lake is limited by water depth however and major portions of the lake remain too deep for curly leaf or any plant growth.

Despite the dominance of curly leaf pondweed, Sullivan Lake supports one of the richest native plant communities in central Minnesota. While curly leaf may dominate in the spring, it typically dies back by mid-summer and in Sullivan Lake the water clarity remains sufficiently high to allow growth of native vegetation.

Monitoring changes in aquatic plant communities can help reflect changes in the overall water quality of the lake and watershed. Data collected during the 2003 survey can be compared to future quantitative surveys of Sullivan Lake to better estimate how the plant community may be changing. This information can also be used to guide aquatic plant control activities and focus management efforts at areas where curly leaf is creating the most problems for boater and avoid areas of high native species diversity.

## Literature Cited

Crow, G.E. and C.B. Hellquist. 2000. Aquatic and wetland plants of Northeastern North America. 2 volumes. The University of Wisconsin Press.

Madsen, J. D. (1999). "Point intercept and line intercept methods for aquatic plant management." *APCRP Technical Notes Collection* (TN APCRP-M1-02). U.S. Army Engineer Research and Development Center, Vicksburg, MS. [www.wes.army.mil/el/aqua](http://www.wes.army.mil/el/aqua).

Madsen, J.D. and W. Crowell. Curlyleaf pondweed (*Potamogeton crispus* L.). Lakeline. Spring 2002. pp 31-32.

MPCA. 2003. Minnesota Pollution Control Agency website. Lake Water Quality Assessment Program. <http://data.pca.state.mn.us/cgi-bin/lkwq95ReadFull.pl?lakeid=18-0374>

**Table 1. Aquatic plants of Sullivan Lake, MN 2003.**

\* = voucher specimen collected

P = present in lake but not in sample sites

Common Name	Scientific Name	2003
Coontail	<i>Ceratophyllum demersum</i>	13
muskgrass	<i>Chara</i> sp.	1
Canada waterweed	<i>Elodea canadensis</i>	2
Water marigold	<i>Megaladonta beckii</i>	5
Northern watermilfoil	<i>Myriophyllum sibiricum</i>	6
Bushy pondweed	<i>Najas flexilis</i>	6
Stonewort	<i>Nitella</i> sp.	4
Largeleaf pondweed	<i>Potamogeton amplifolius</i>	17
Curly leaf pondweed	<i>Potamogeton crispus</i>	27
Variable pondweed	<i>Potamogeton gramineus</i>	11
Illinois pondweed	<i>Potamogeton illinoensis</i>	9
Whitestem pondweed	<i>Potamogeton praelongus</i>	14
Clasping leaf pondweed	<i>Potamogeton richardsonii</i>	2
Robbin's pondweed	<i>Potamogeton robbinsii</i>	17
Flatstem pondweed	<i>Potamogeton zosteriformis</i>	18
Narrowleaf pondweed	<i>Potamogeton</i> sp.	3
White water buttercup	<i>Ranunculus</i> sp.	4
Greater bladderwort	<i>Utricularia vulgaris</i>	p
Wild celery	<i>Vallisneria americana</i>	6
Water stargrass	<i>Zosterella dubia</i>	4
Floating leaf pondweed	<i>Potamogeton natans</i>	1
Yellow waterlily	<i>Nuphar variegata</i>	4
White waterlily	<i>Nymphaea odorata</i>	2
Lesser duckweed	<i>Lemna minor</i>	4
Star duckweed	<i>Lemna trisulca</i>	6
Greater duckweed	<i>Spirodela polyrhiza</i>	4
Sweet flag	<i>Acorus calamus</i>	1
Spikerush	<i>Eleocharis</i> sp.	5
Horsetail	<i>Equisetum</i>	1
Broad-leaf arrowhead	<i>Sagittaria</i> sp	p
Hardstem Bulrush	<i>Scirpus acutus</i>	9
Burreed	<i>Sparganium</i> sp.	p
Wild Rice	<i>Zizania palustris</i>	9
Broad-leaf cattail	<i>Typha latifolia</i>	p

Figure 1. Location of Sullivan Lake.

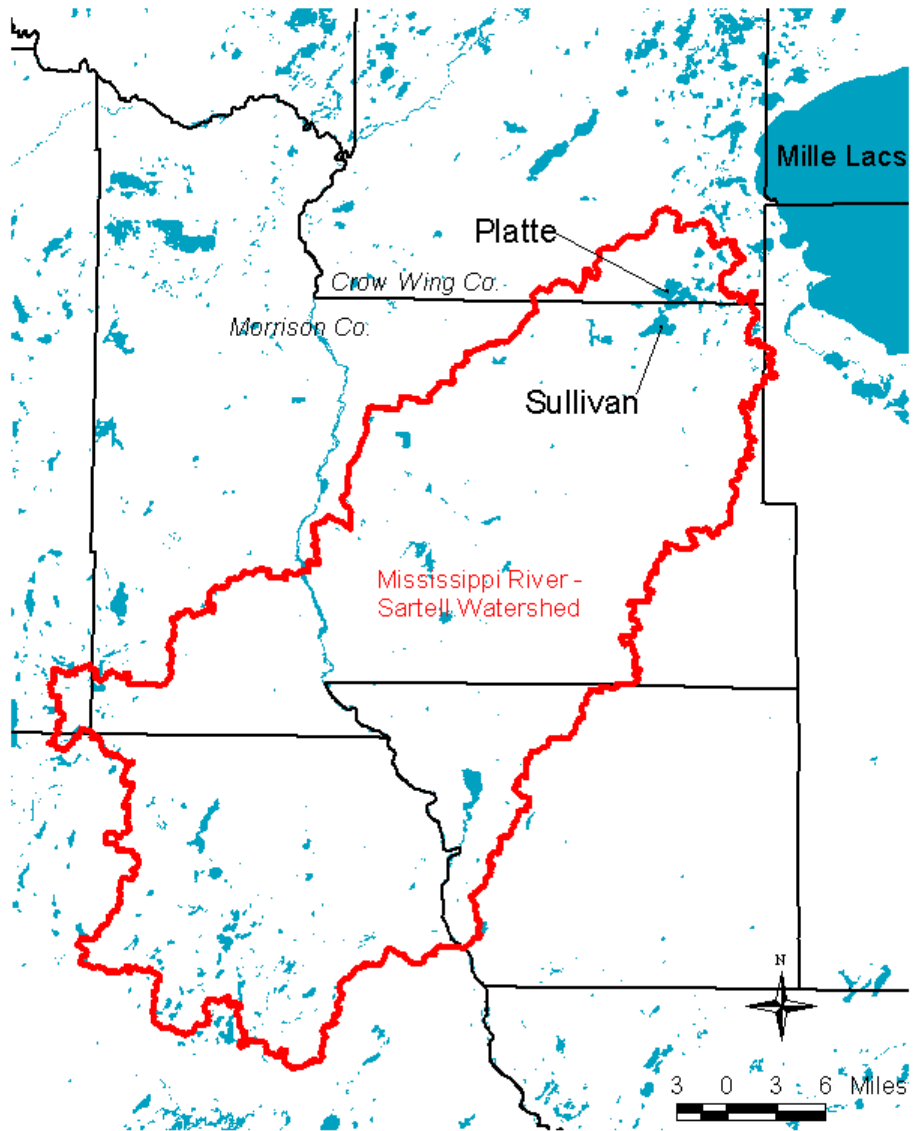
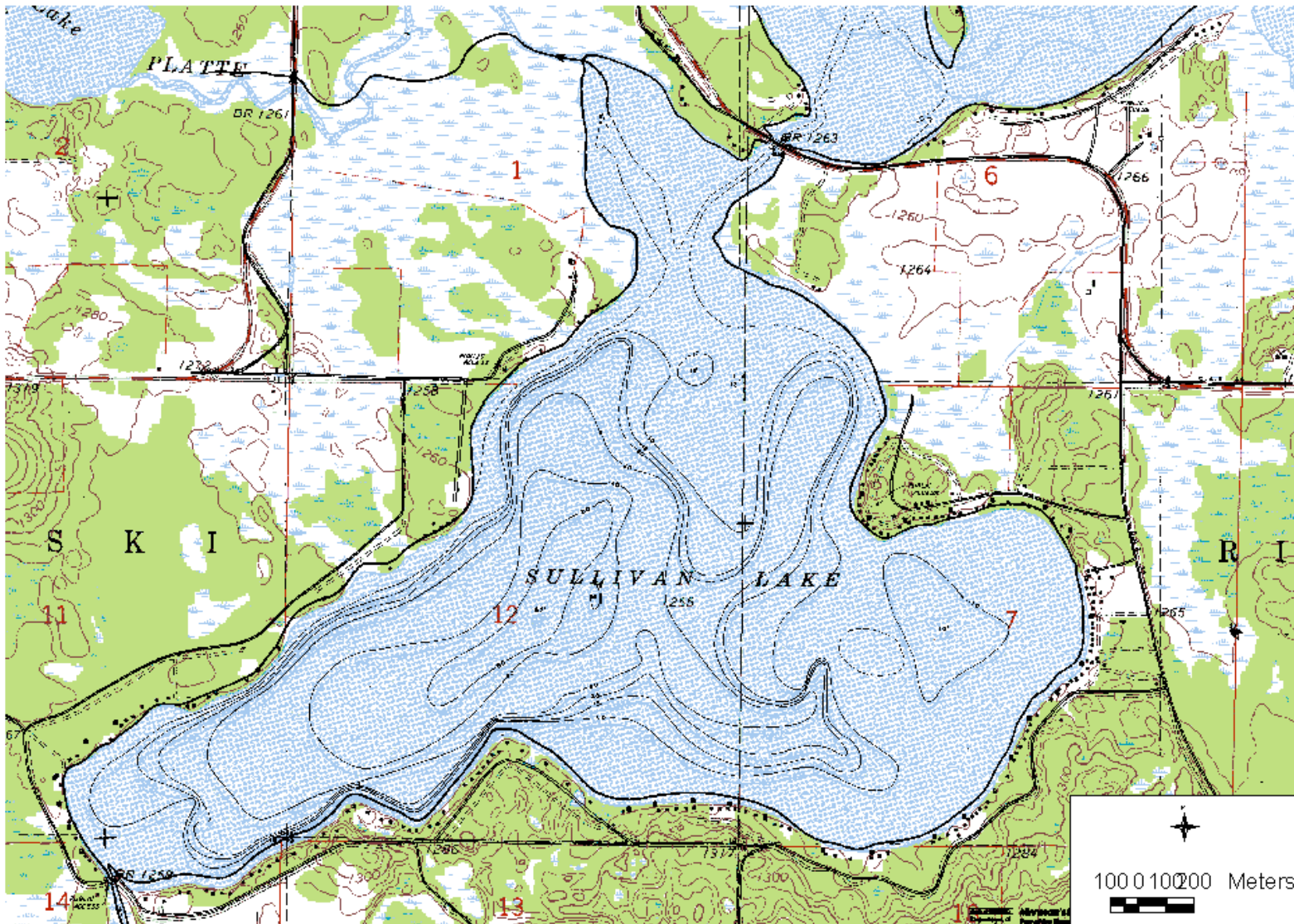


Figure 2. Platte Lake depth contours and shoreline development



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Figure 3. Sullivan Lake 2003 Vegetation sample points.

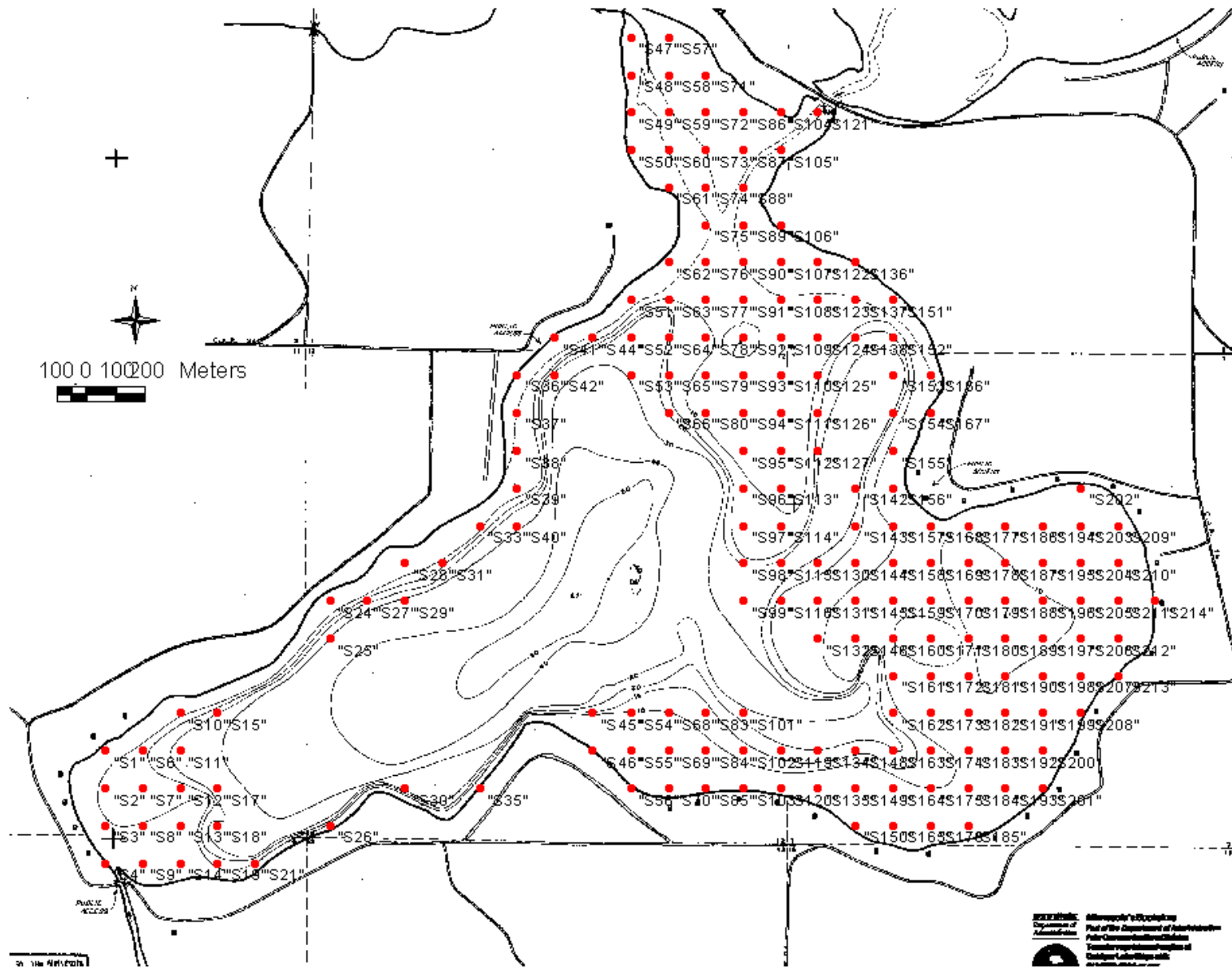
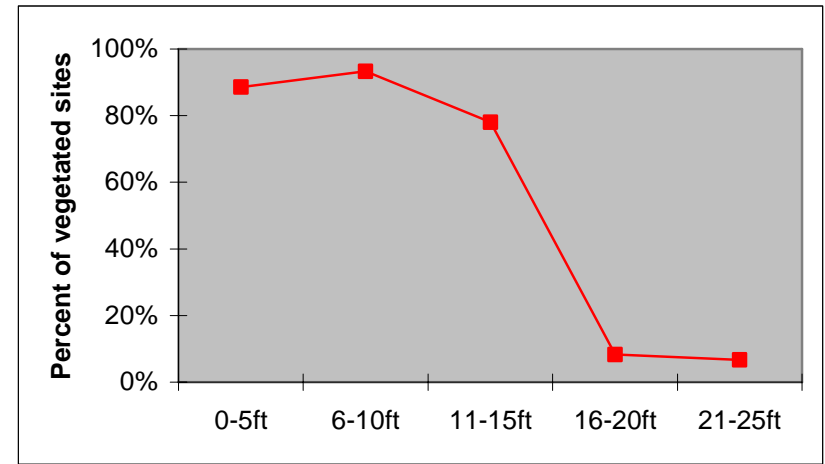
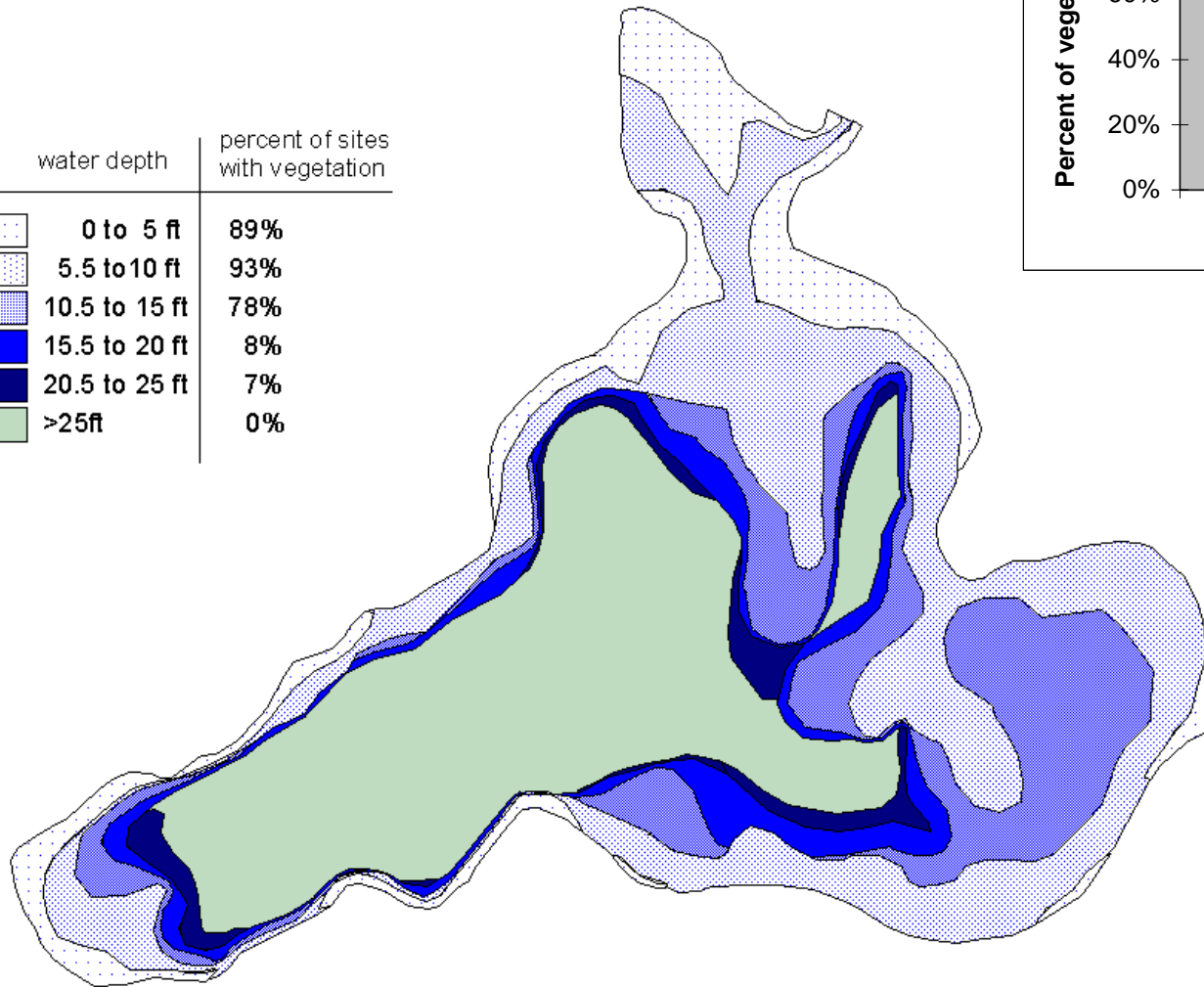
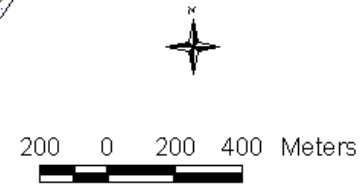


Figure 4. Depth zone of Sullivan Lake, 2003

water depth	percent of sites with vegetation
0 to 5 ft	89%
5.5 to 10 ft	93%
10.5 to 15 ft	78%
15.5 to 20 ft	8%
20.5 to 25 ft	7%
>25ft	0%



D. Perleberg, MN DNR Ecological Services Sept, 2003.



**Figure 5. Composition of Sullivan Lake Vegetation 2003**

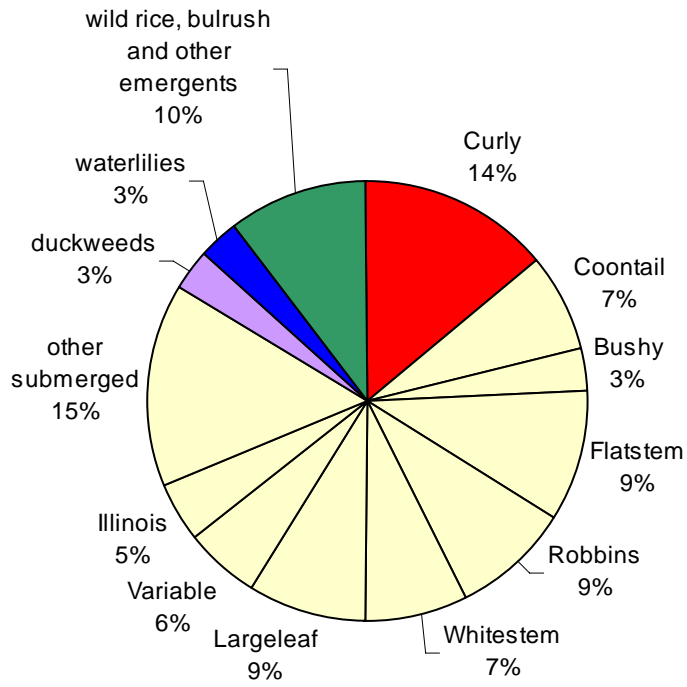
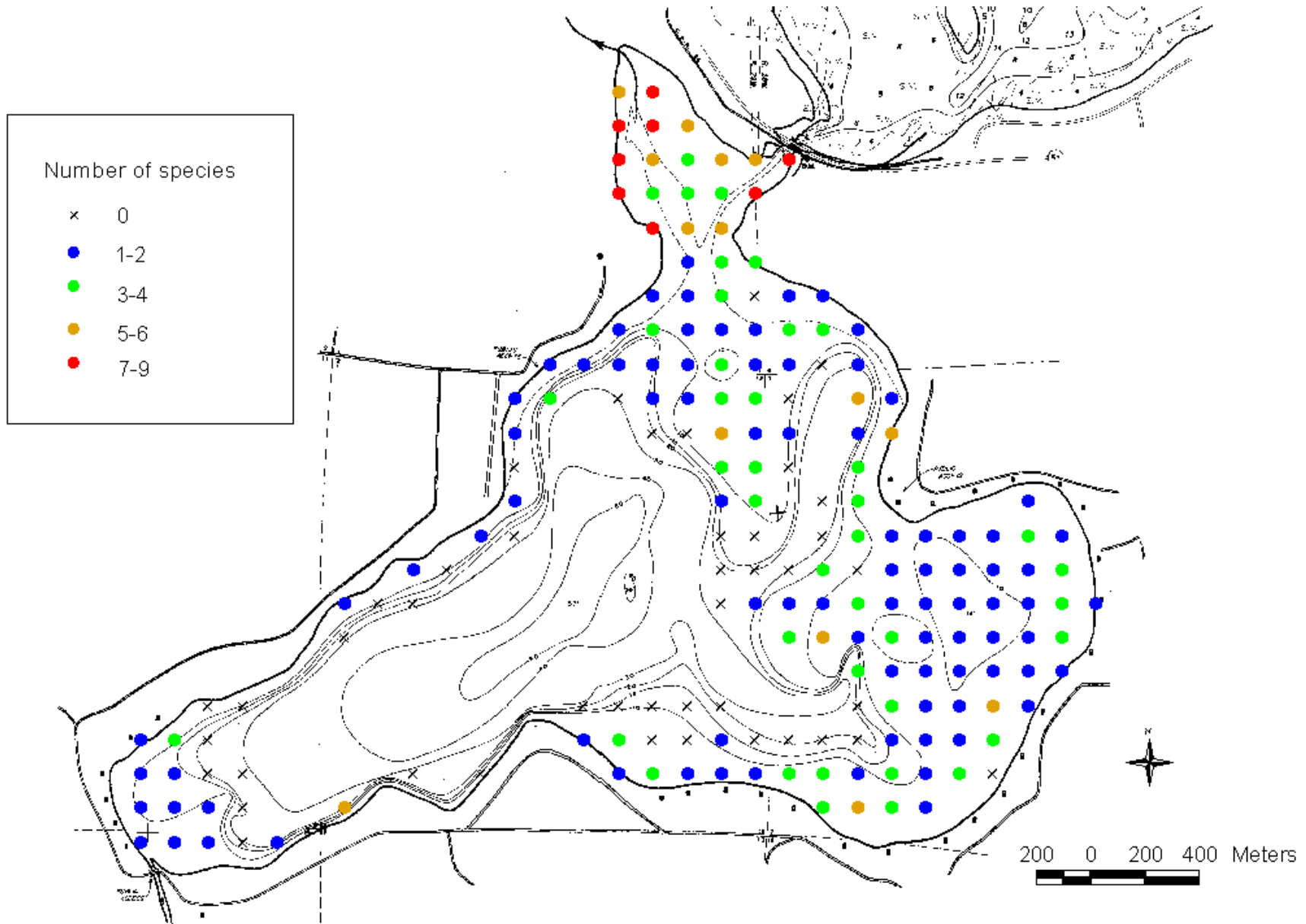
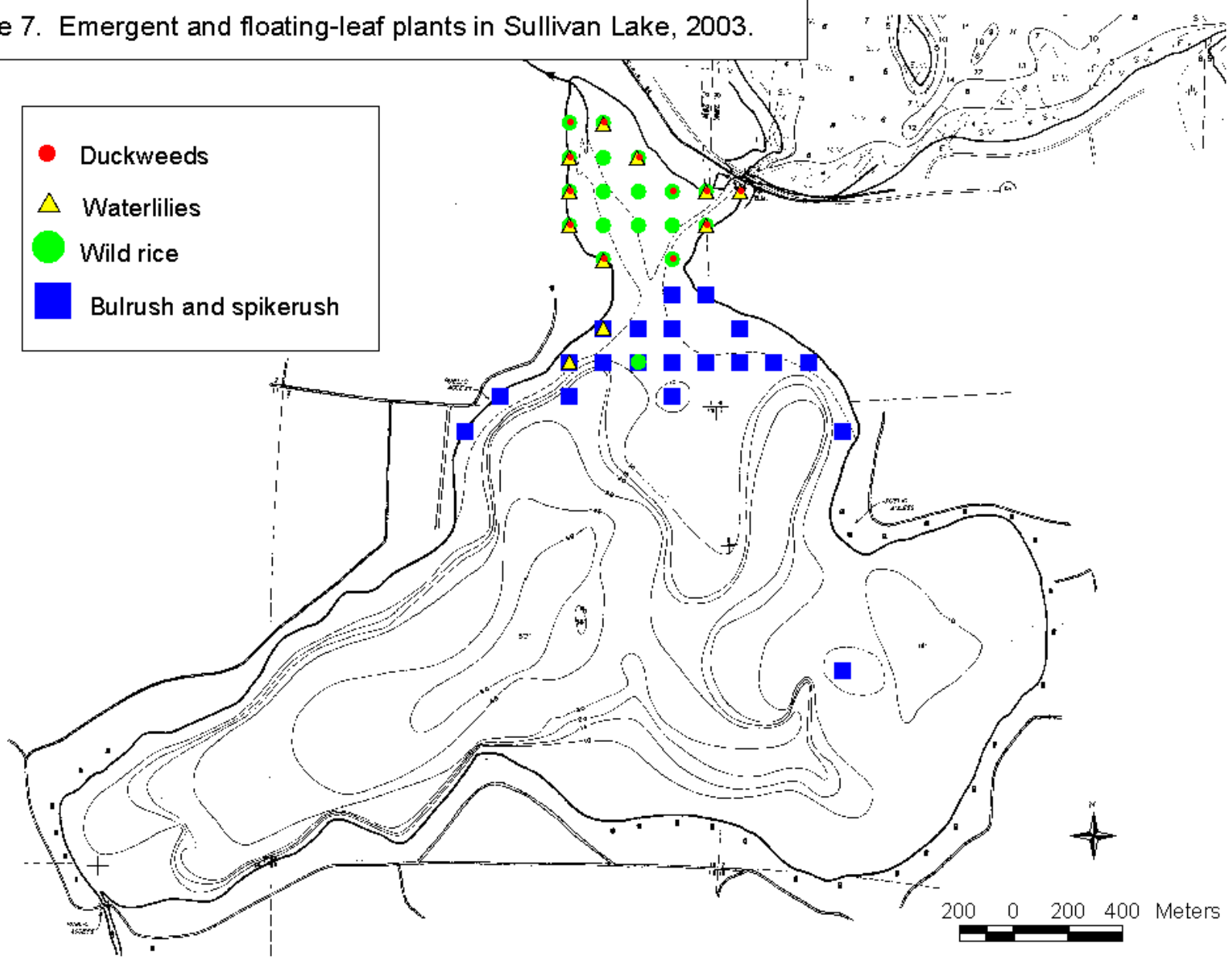


Figure 6. Plant species richness in Sullivan Lake 2003



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Figure 7. Emergent and floating-leaf plants in Sullivan Lake, 2003.



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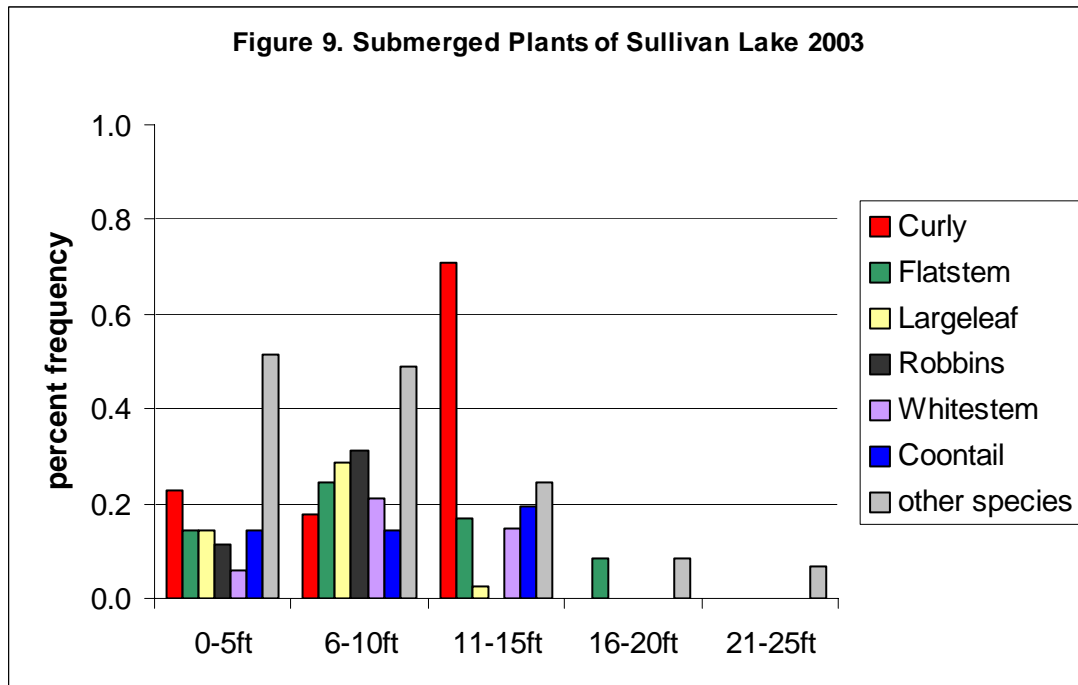
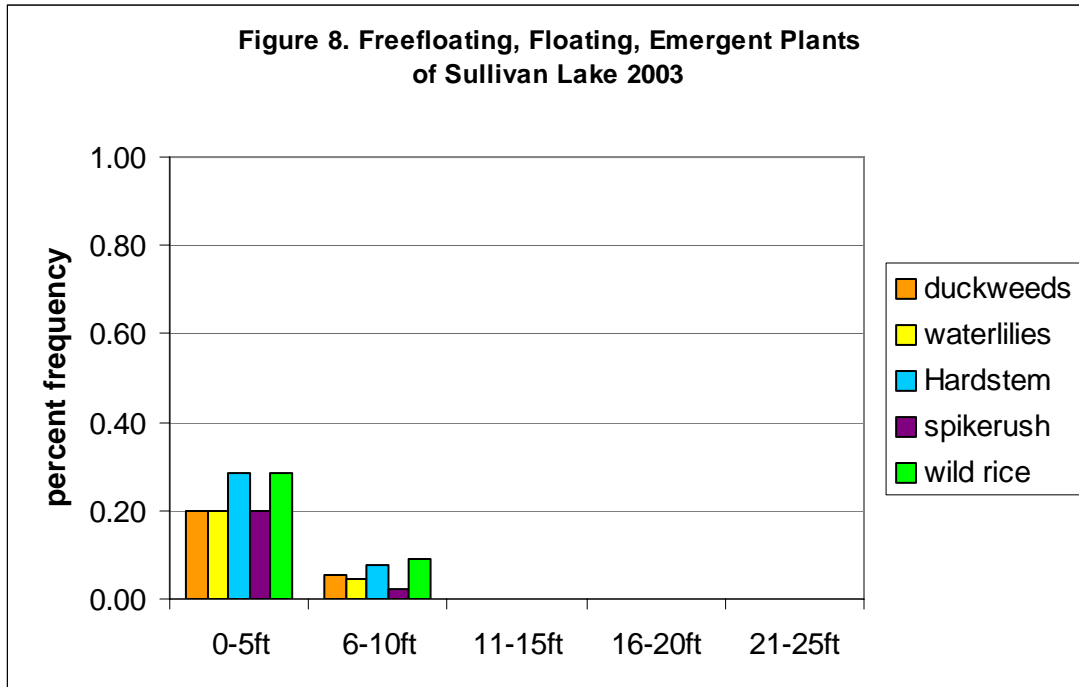
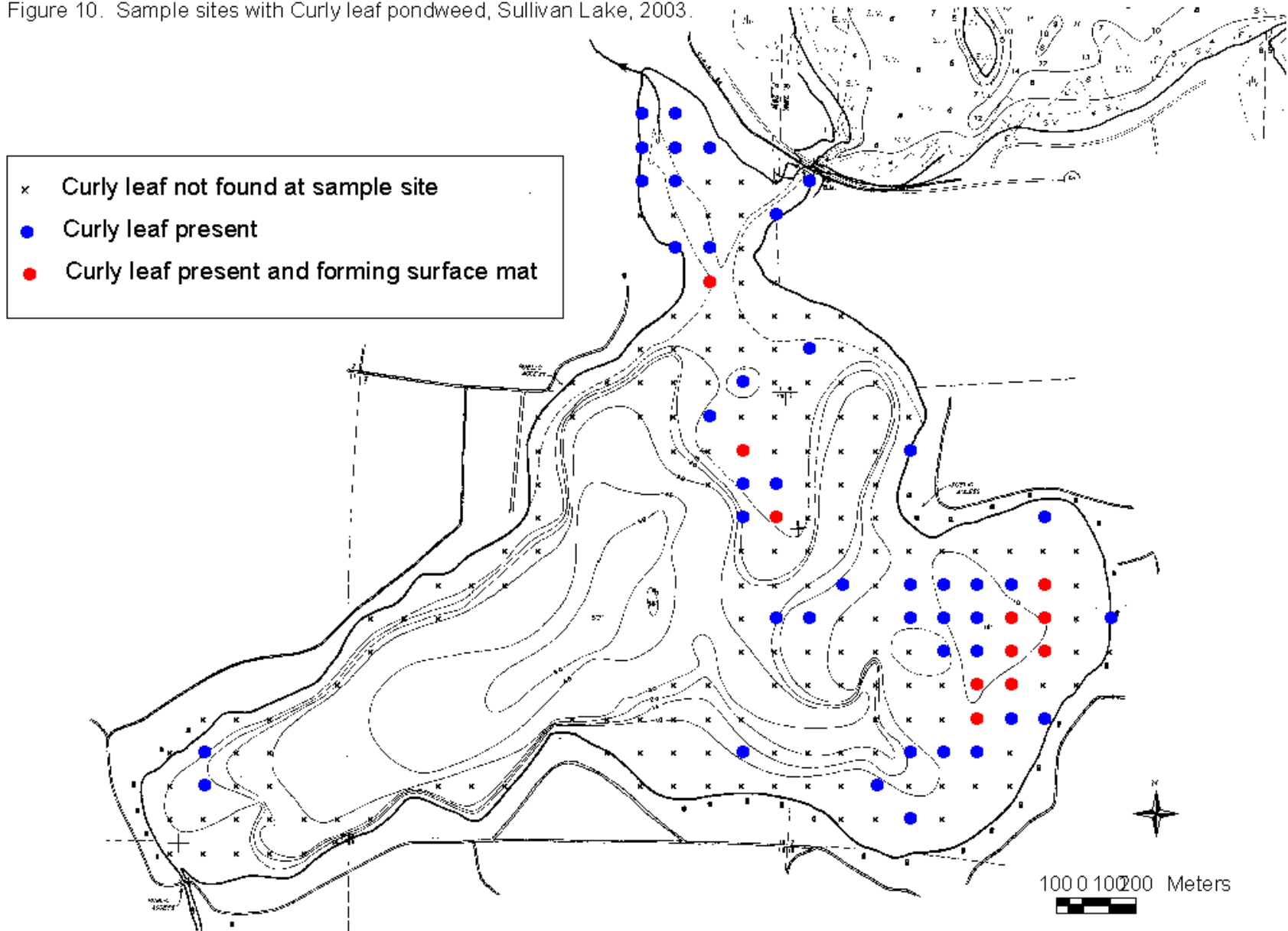
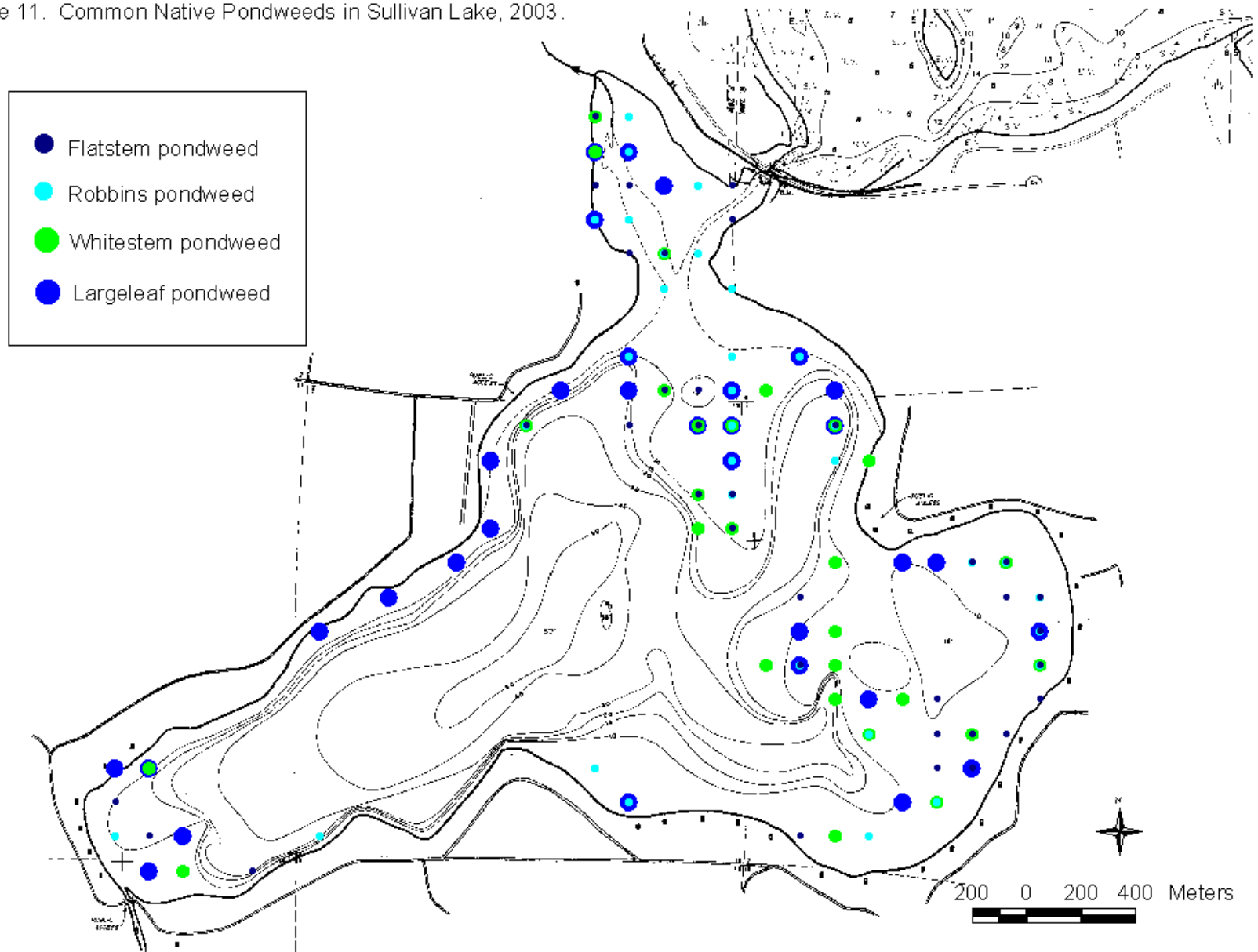


Figure 10. Sample sites with Curly leaf pondweed, Sullivan Lake, 2003.



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Figure 11. Common Native Pondweeds in Sullivan Lake, 2003.



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