Minnesota Dept. of Natural Resources
Division of Fish and Wildlife
Section of Fisheries

Vegetation survey of Chisago Lake (13-0012), Chisago County, Minnesota

Summer 2010

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Area Fisheries Supervisor Date

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Vegetation survey of Chisago Lake (13-0012), Chisago County, Minnesota

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Report by: Deb Sewell
Fisheries Management Specialist
Hinckley Area Fisheries Office

Field crew: Deb Sewell, Dean Paron, Josh Zaudtke

Introduction

Chisago Lake is an 873 acre lake located in the town of Chisago City, Minnesota, in the Sunrise River-Upper St. Croix River watershed. The lake has a maximum depth of 34 feet. 80% of the lake's surface area has a depth of less than 15 feet. Water clarity is generally higher than that of other lakes in the area. Aquatic vegetation has been found growing at depths down to approximately 12 feet.

The Chisago chain of lakes, which also includes South Lindstrom (13-0028), North Lindstrom (13-0035), North Center (13-0032), and South Center (13-0027) has a history of extreme water level fluctuations. These fluctuations are believed to be due to a net loss of water to groundwater in the system, making the lakes dependent on long term cycles in precipitation. In 2010 water levels were at 40 year lows, but were similar to 2009 levels.

Historical information on aquatic vegetation can be found in Fisheries lake surveys dating back to 1942. However, methods were not standardized until the 1995 survey, so quantitative comparisons are not possible with earlier data. The level of identification also varies considerably among the surveys. Point intercept vegetation surveys, as described by Madsen (1999) and the Minnesota Department of Natural Resources (2008), are becoming the standard for vegetation sampling in Minnesota lakes.

Eurasian watermilfoil (*Myriophyllum spicatum*), a non-native invasive species, was first documented in Chisago Lake in the fall of 2009. Eurasian watermilfoil has been present in nearby Green Lake since at least 1996, and was recently found in North Lindstrom, North Center, and South Center lakes.

Curlyleaf pondweed, another non-native invasive species, has been present in Chisago Lake since at least 1969, and has become abundant in the last 20 years. Curlyleaf pondweed begins growing earlier in the spring than most species, and reaches its peak abundance in early summer. Thick surface mats of curlyleaf pondweed can interfere with recreation. When abundant curlyleaf pondweed senesces in mid summer, nutrients are released than can contribute to algae blooms and decreased water clarity.

The goal of this survey was to document and characterize the aquatic vegetation community in Chisago Lake.

Methods

A point intercept vegetation survey was conducted on several dates between June 28 and July 1, 2010, using methodology described by Madsen (1999) and the Minnesota Department of Natural Resources (2008). Sample points were generated using ArcView GIS software to provide a density of approximately 0.7 points per acre in the portion of the lake with a depth of 15 feet or less. A Garmin GPSMap 298 GPS unit with color depth finder was used to navigate a boat to each sample point. Vegetation was observed on one side of the boat in an area approximately one meter square. A double headed garden rake was

tossed once at each point to sample vegetation that could not be visually identified from the boat. The depth finder graph was used to determine the presence or absence of vegetation in deeper water.

Data was entered in the field on a laptop computer using the DNR Fisheries Lake Survey application.

Results and discussion

Curlyleaf pondweed was the most widespread submersed vegetation species present, occurring in 68% of sample points (Figure 4, Table 2). The survey dates were later than the normal peak period for curlyleaf pondweed, and plants appeared to be senescing. According to local residents, the entire southern bay of the lake had been covered by surface mats of curlyleaf pondweed a week earlier.

Eurasian watermilfoil was found clustered in the northwest part of the lake, as well as at several scattered points in the southern bay (Figure 3). The native species northern watermilfoil was more widespread, occurring at 20.5% of sample points. In some lakes with both milfoil species present, the two will hybridize, forming a plant with characteristics intermediate between the two species. Although a few plants sampled in Chisago Lake were possibly hybrid, most plants clearly had the appearance of northern or Eurasian watermilfoil.

Other common species of submerged vegetation included narrowleaf pondweed (*Potamogeton sp*.), flat stem pondweed (*Potamogeton zosteriformis*), and coontail (*Ceratophyllum demersum*).

The relative health of a lake ecosystem can be assessed using measurements of plant or animal communities. A plant-based index of biotic integrity (IBI) was recently developed for Minnesota lakes (Beck et al. 2010). This index derives a numerical score from various aspects of point intercept survey data including maximum depth of plant growth, relative frequency of sensitive and tolerant species, and other factors (Table 3). Scores are on a scale of 0-100, with higher numbers indicating better condition of the plant community. The IBI score for Chisago Lake, 47.2, was slightly lower than the mean score (52.6) of the 97 lakes throughout Minnesota that were used to develop the plant IBI (Beck et al. 2010). More widespread use of the plant-based IBI will be required before detailed comparisons can be made.

Although eradication of Eurasian watermilfoil is not a feasible goal once it is established in a lake, milfoil that is creating nuisance conditions can be managed by the careful use of herbicides, under permit from the DNR's Aquatic Plant Management program. The DNR Invasive Species program has been researching the effectiveness of large scale treatments for Eurasian watermilfoil and curlyleaf pondweed using low concentrations of herbicides and timing applications so most native vegetation is not harmed. It is essential in planning for the management of any exotic invasive species that damage to native species be avoided as much as possible. The DNR protects native plants because they provide many benefits to lake ecosystems, such as stabilizing lake sediments, and increasing habitat for fish and wildlife. In addition, widespread destruction of native plants can lead to an overall increase in the amount of Eurasian watermilfoil in a water body because milfoil is very effective at invading disturbed habitat.

References

Beck, M.W., L.K. Hatch, B. Vondracek, and R.D. Valley. 2010. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. Ecological Indicators 10:968-979.

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.

Minnesota Department of Natural Resources. 2008. Minnesota's Sensitive Lakeshore Identification Manual: a conservation strategy for Minnesota lakeshores (version 2). Division of Ecological Resources, Minnesota Department of Natural Resources. 62 pp.

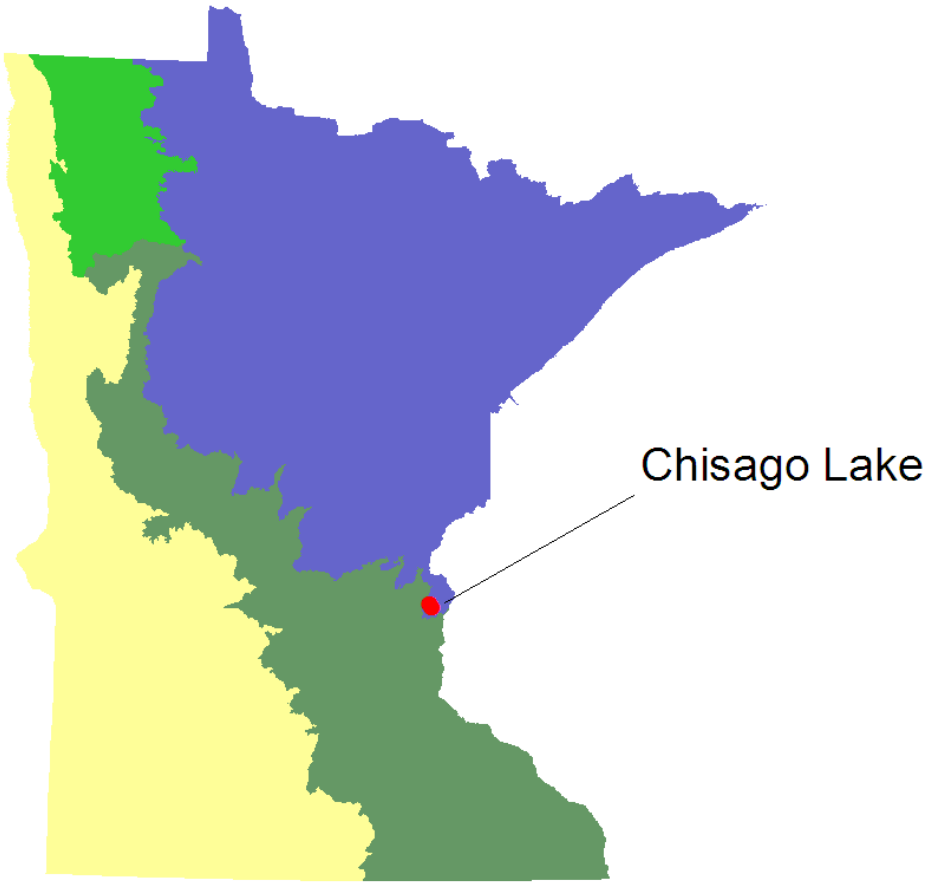

Figure 1. Location of Chisago Lake, Chisago County, Minnesota.

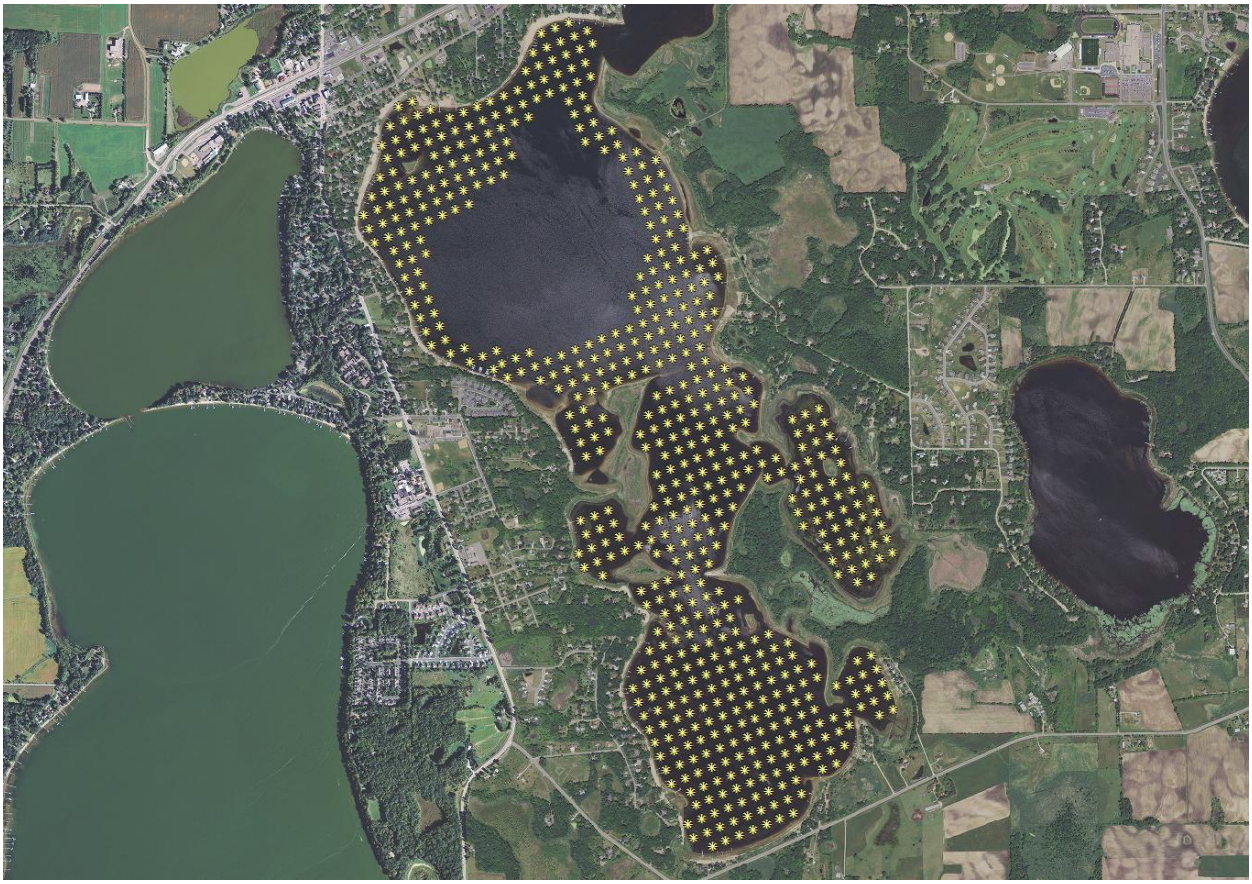

Figure 2. Grid of points that were sampled during the vegetation survey on Chisago Lake. (2010 aerial photo)

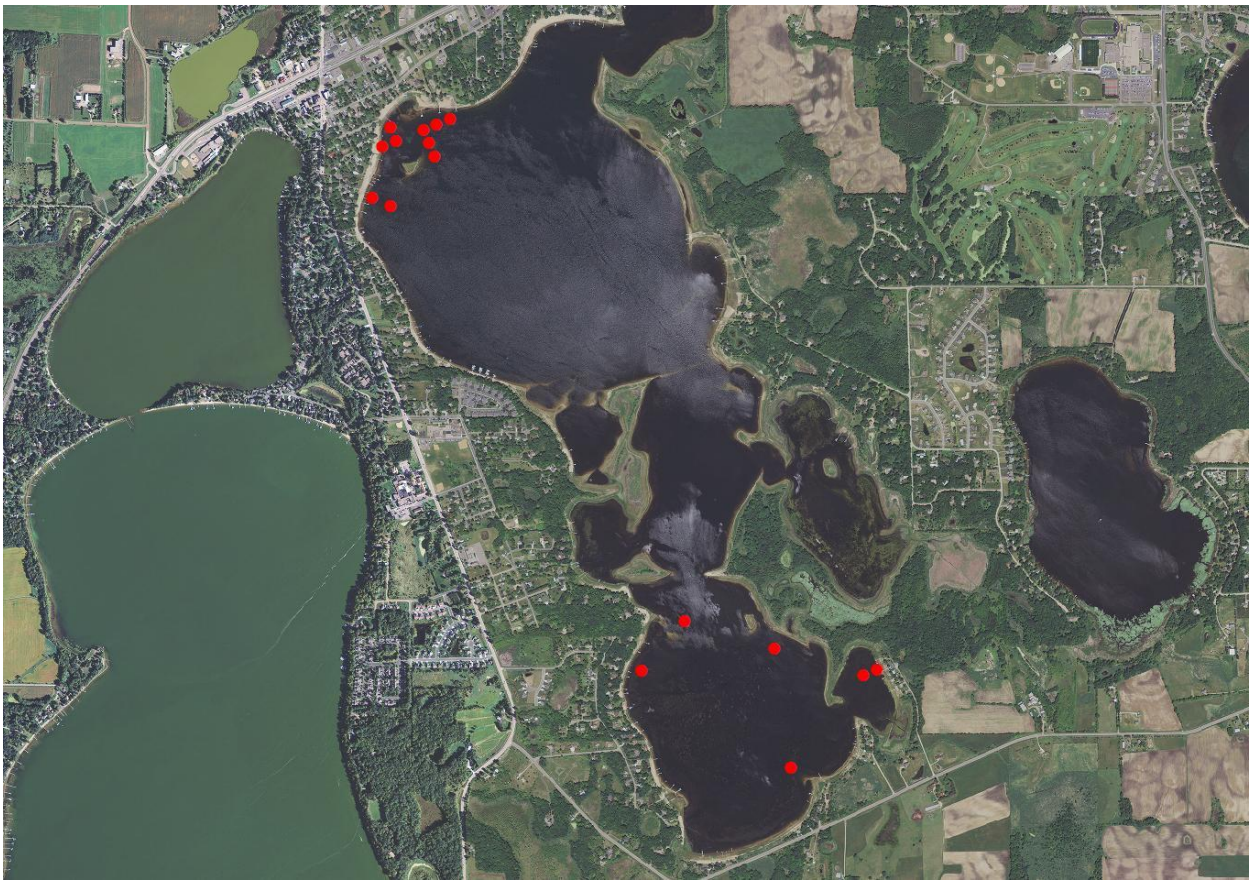

Figure 3. Points where Eurasian watermilfoil was sampled in 2010.

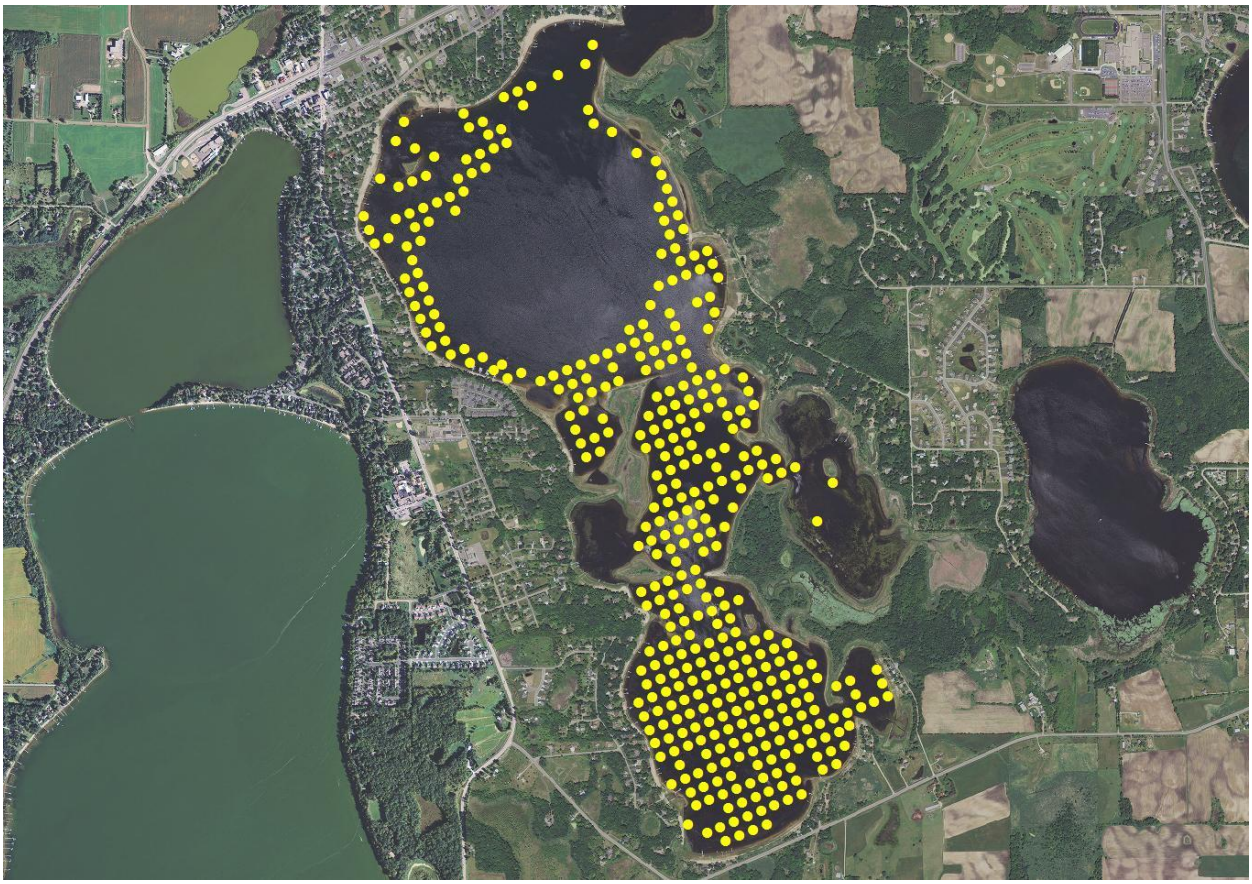

Figure 4. Points where curlyleaf pondweed was sampled in 2010.

Table 1. List of aquatic plant species that have been recorded in Chisago Lake

Common name	Scientific name	Survey years
Emergent species (10 total)		
Blue flag iris	*Iris versicolor*	G, H
Broad leaved arrowhead	*Sagittaria latifolia*	B, C, D
Chufa nut grass	*Cyperus sp.*	G
Common cattail	*Typha latifolia*	A, C, D, E, F, G, H
Hardstem bulrush	*Scirpus acutus*	A, C, D, E, F, G, H
Sedge	*Carex or Cyperaceae*	C, D, G, H
Softstem bulrush	*Scirpus validus*	A, C, D, E, F, G
Spikerush	*Eleocharis sp.*	H
Water smartweed	*Polygonum amphibium*	A, E, F, G, H
Wool grass	*Scirpus cyperinus*	G
Submerged and floating leaf species (27 total)		
Bushy pondweed	*Najas flexilis*	G, H, I
Bladderwort	*Utricularia sp.*	H
Canada waterweed	*Elodea canadensis*	A, C, G, I
Claspingleaf pondweed	*Potamogeton Richardsonii*	B, G, H
Coontail	*Ceratophyllum demersum*	C, E, F, G, H, I
Curlyleaf pondweed	*Potamogeton crispus*	D, G, H, I
Eurasian watermilfoil	*Myriophyllum spicatum*	I
Filamentous algae		G, H, I
Flat-leaf bladderwort	*Utricularia intermedia*	G
Flatstem pondweed	*Potamogeton zosteriformis*	A, G, H, I
Greater duckweed	*Spirodela polyrhiza*	E, G,
Largeleaf pondweed	*Potamogeton amplifolius*	H, I
Leafy pondweed	*Potamogeton foliosus*	G, H
Lesser duckweed	*Lemna minor*	E, G, H
Little yellow waterlily	*Nuphar microphyllum*	H
Mud plantain(water stargrass)	*Zosterella dubia*	I
Muskgrass	*Chara sp.*	A, B, D, G
Narrowleaf pondweed	*Potamogeton sp.*	G, H, I
Northern watermilfoil	*Myriophyllum sibiricum (exalbescens)*	A, D, E, F, G, H, I
Pondweed (unspecified)	*Potamogeton sp.*	C, E, F
Robbins' pondweed	*Potamogeton Robbinsii*	D, G, H, I
Sago pondweed	*Stuckenia pectinata*	G, H
Stonewort	*Nitella sp.*	A, B
Variable pondweed	*Potamogeton gramineus*	G
Water meal	*Wolffia sp.*	G
White waterlily	*Nymphaea tuberosa*	D, E, G, H, I
Yellow lotus	*Nelumbo lutea*	G, H, I
Yellow waterlily	*Nuphar variegatum*	A, F, G, H

A) 1942 Fisheries lake survey; B) 1948 Fisheries lake survey; C) 1956 Fisheries lake survey; D) 1969 Fisheries lake survey; E) 1975 Fisheries lake survey; F) 1985 Fisheries lake survey; G) 1995 Fisheries lake survey H) 2005 Fisheries lake survey; I) 2010 Fisheries vegetation point intercept survey

Table 2. Aquatic plants found in Chisago Lake during the 2010 survey

type	Common name	Scientific name	Frequency (%)
submerged	curlyleaf pondweed	*Potamogeton crispus*	64.8
	narrowleaf pondweed	*Potamogeton sp.*	28.2
	flatstem pondweed	*Potamogeton zosteriformis*	23.7
	northern watermilfoil	*Myriophyllum sibiricum*	20.5
	coontail (common hornwort)	*Ceratophyllum demersum*	17.0
	Robbins' pondweed	*Potamogeton Robbinsii*	14.6
	Eurasian watermilfoil	*Myriophyllum spicatum*	2.6
	Canada waterweed	*Elodea canadensis*	2.3
	bushy pondweed	*Najas flexilis*	2.0
	filamentous algae		1.8
	largeleaf pondweed	*Potamogeton amplifolius*	1.5
	yellow water stargrass	*Zosterella dubia*	0.2
floating leaf	white waterlily	*Nymphaea sp.*	0.3
	water lotus	*Nelumbo lutea*	0.2

average species diversity at points = 1.8 (range 0-5)

Table 3. Plant-based Index of Biotic Integrity (IBI) metrics and scores for Chisago Lake, 2010.

Metric	Raw score	Scaled score
Maximum depth of plant growth (ft), 95% occurrence	12.5	6.53
Percentage of littoral vegetated	0.971	9.71
Number of species with frequency occurrence >10%	6	4.92
Relative frequency of submersed species	0.997	0.1
Relative frequency of sensitive species	0.083	3.56
Relative frequency of tolerant species	0.475	4.96
Number of native taxa	11	3.27
	IBI score (0-100)	47.21