CEDAR LAKE, SCOTT COUNTY:
2023 AQUATIC VEGETATION REPORT

Report by the Invasive Species Program – Division of Ecological and Water Resources Minnesota Department of Natural Resources & Scott Watershed Management Organization

Lake: Cedar (DOW# 70009100)

Lake Surface Area: 793 acres

Littoral Area: 793 acres

County: Scott

Survey Type: Point-intercept

Date of Survey (most recent): July 11, 2023

Observer[s]: April Londo (MNDNR)
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Report updated: December 20, 2023

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2023 Summary:

The most recent aquatic vegetation point-intercept survey of Cedar Lake (DOW #70009100) was completed on July 11, 2023. Plants were present throughout the lake to a depth of 5 feet (1.5 meters). Within the littoral zone (zone from the 0–15-foot depth range), 8% of sampled points contained native submersed taxa. The average number of native submersed taxa per sample point was 0.1. Cedar Lake has a Lake Vegetation Management Plan (since 2013) for the management of curly-leaf pondweed (CLP). Lake-wide herbicide treatments have reduced curly-leaf pondweed throughout the lake, but results have varied by season. Native plants continue to be sparse, and the overall plant community is severely limited due to poor water clarity and an excess of in-lake nutrients.

Summary Table. Summary of aquatic submersed plants in Cedar Lake, Scott County, Minnesota (DOW# 70009100) as indicated by results of point-intercept surveys. Values were calculated from the littoral depth range (0-15 feet).

YEAR	Treatment Date	CLP* Acres Treated	PI Survey Date	Max Depth of Growth in feet [95%] †	% Points w/ Native Submersed Taxa	Mean Native Submersed Taxa/ Point	# Submersed Taxa	AVG Secchi Depth [m]#
2009	-	-	**JUN 24**	11	3	< 0.1	3	1.3
2012	**MAY 14**	102	**SEPT 14**	11	12	0.3	7	0.9
2013	**JUN 4**	200	**JUL 29**	11	24	0.4	7	1.1
2014	**MAY 28**	400	**JUL31**	9	25	0.4	7	1.1
2015	**MAY 1**	600	**JUN 17**	11	46	0.7	8	1.0
			AUG 13	8	21	0.4	7	
2016	**APR 29**	600	**JUN 24**	10	43	0.8	7	1.0
			AUG 8	9	26	0.6	7	
2017	**MAY 10**	351	**APR 25**	9	11	0.1	5	0.9
			SEPT 22	6	11	0.3	7	
2018	**MAY 24**	396	**APR 25**	9	17	0.2	6	1.1
			JUL 11	7	20	0.3	8	
2019	**MAY 2**	793	**MAY 23**	9	8	0.1	6	0.8
			JUL 11	6	17	0.3	8	
2020	**APR 15**	793	**MAY 23**	10	29	0.4	6	0.7
			JULY 15	6	8	0.1	5	
2021	**MAY 21**	103	**MAY 13**	9	26	0.3	7	1.4
			JULY 14	8	31	0.6	11	
2022	**MAY 24**	105	**MAY 26**	11	25	0.4	11	1.1
	JUNE 7	132	**JULY 14**	7.5	34	0.6	10	
2023	**APRIL 14**	793	**MAY 25**	9.8	3	0.03	5	0.7
			JULY 11	4.7	8	0.1	6	

*CLP is short for Curly-leaf pondweed

†95th percentile calculated based on all vegetated sampling points

#AVG - average Secchi depth (water clarity measurement) from May – September

Taxa refers to groups of submersed aquatic plant species or genera

Lake Description:

Cedar Lake is a 793-acre lake northeast of New Prague, Minnesota. The lake is entirely littoral (water depth from 0 to 15 feet), and the maximum depth of water is approximately 11 feet (3.35 meters). Cedar Lake is a hypereutrophic lake meaning high in nutrients and has low water clarity (see **Table 1 – Secchi Averages** below for historic Secchi disk observations). The lake is historically dominated by curly-leaf pondweed in the spring and frequent algal blooms in the summer months. It currently is listed as impaired by the Minnesota Pollution Control Agency because of excessive phosphorous. For information regarding water quality please refer to: http://cf.pca.state.mn.us/water/watershedweb/wdip/details.cfm?wid=70- 0091-00.

Table 1-Secchi Averages. Average Secchi disk observations in meters for Cedar Lake, Scott County, Minnesota (DOW #70009100). Data gathered from the Minnesota Pollution Control Agency and Scott Watershed Management Organization (SWMO).

YEAR	MAY	JUNE	JULY	AUG	SEPT	Secchi Depth Average [May – Sept]
2009	1.4	3.1	0.8	0.5	0.7	1.3
2010	1.2	1.0	0.6	0.4	0.4	0.7
2011	1.9	1.4	0.8	0.4	0.5	1.0
2012	1.8	1.1	0.8	0.5	0.5	0.9
2013	1.5	1.6	0.7	0.6	1.0	1.1
2014	1.4	2.1	0.8	0.5	0.6	1.1
2015	1.6	1.8	0.7	0.4	0.7	1.0
2016	1.6	1.1	0.6	0.8	0.8	0.9
2017	1.0	1.2	0.9	0.7	1.2	1.0
2018	1.6	1.7	1.6	0.3	0.5	1.1
2019	1.0	1.2	-	0.4	0.6	0.8
2020	-	0.5	0.7	1.0	0.8	0.7
2021	2.7	1.5	0.7	0.7	1.6	1.4
2022	3.0	1.3	0.8	0.5	0.9	1.1
2023	-	0.6	0.6	0.3	1.2	0.7

Management History:

In 2013, a Lake Vegetation Management Plan (LVMP) was developed by the DNR and the Scott Watershed Management Organization (SWMO) for Cedar Lake to allow more than 15% of the littoral zone to be treated to control curly-leaf pondweed (CLP). The intent was to determine whether invasive plant control, in conjunction with other nutrient management efforts, would increase the distribution of native plants and potentially benefit water quality. Lake-wide herbicide treatments using endothall effectively reduced CLP in 2015-2016 with some annual increase in native plant species richness and distribution although results have not been sustainable from year to year. The LVMP to treat over the 15% littoral limit was renewed in 2018 and again in 2022 to allow for additional whole lake treatments to suppress CLP with the goal to improve the native plant community. In 2019 & 2020, fluridone was applied at a lake wide low dose (2-4 parts per billion). In 2021, a partial treatment was done to allow natives to recover after two years of lake wide fluridone treatments. In 2022, CLP grew back to nuisance levels which required two separate treatments. In 2023, fluridone was used again for whole-lake nuisance CLP growth with a similar management plan being implemented in future years to determine long-term temporal success of whole-lake treatments. CLP herbicide treatments continue to be organized by SWMO in cooperation with the Cedar Lake Improvement District (CLID). See **Table 2 – Invasive Plant Management Summary** below for more information on the management efforts.

Table 2-Invasive Plant Management Summary. Characteristics and history of herbicide treatment for Cedar Lake, Scott County, Minnesota (DOW# 70009100, Total acres: 800, littoral acres: 800, 15% littoral acres: 118.95).

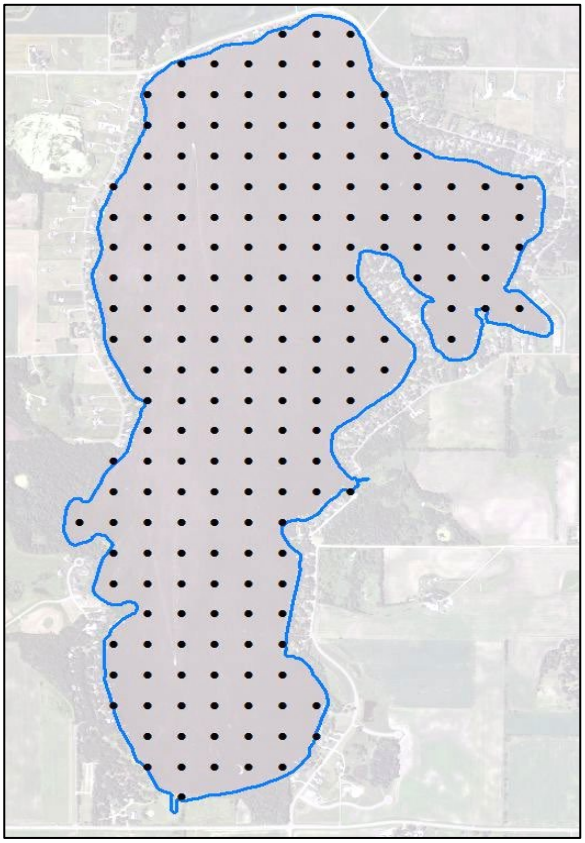
Date	Treatment [W, P, N]	Target Species	Total Acres Treated	Herbicide	Licensed Commercial Applicator
MAY 14, 2012	P	CLP	102	Endothall	PLM Lake and Land Mgmt Corp
JUN 4, 2013*	P	CLP	200	Endothall	PLM Lake and Land Mgmt Corp
MAY 28, 2014*	W	CLP	400	Endothall	PLM Lake and Land Mgmt Corp
MAY 1, 2015*	W	CLP	600	Endothall	PLM Lake and Land Mgmt Corp
APR 29, 2016*	W	CLP	600	Endothall	PLM Lake and Land Mgmt Corp
MAY 10, 2017*	P	CLP	351	Endothall	PLM Lake and Land Mgmt Corp
MAY 24, 2018*	W	CLP	396	Endothall	PLM Lake and Land Mgmt Corp
MAY 2, 2019*	W	CLP	793	Fluridone	PLM Lake and Land Mgmt Corp
APR 15, 2020*	W	CLP	793	Fluridone	PLM Lake and Land Mgmt Corp
MAY 21, 2021*	P	CLP	103	Diquat	PLM Lake and Land Mgmt Corp
MAY 24, 2022* JUNE 7, 2022*	P P	CLP CLP	105 132	Diquat Diquat	PLM Lake and Land Mgmt Corp PLM Lake and Land Mgmt Corp
APRIL 14, 2023	W	CLP	793	Fluridone	PLM Lake and Land Mgmt Corp

Treatment: W (whole lake), P (partial lake), N (no treatment)
CLP is an abbreviation for curly leaf pondweed
* LVMP year

Survey Objectives:

Point-intercept surveys were used to assess the distribution of aquatic plants in Cedar Lake. The primary purpose for this type of survey is to 1) develop baseline knowledge of the current plant community in a lake, and 2) compare year to year plant variation (in plant presence and spatial location). Moreover, this survey will help the MNDNR, and our partners monitor native plant communities and evaluate possible responses to invasive aquatic plant management efforts. It is important to note that distributions of aquatic plants may vary from year to year due to effects such as differences in weather, as well as the effects from management.

Survey Methods:



We used a point intercept survey method developed by John Madsen in "Aquatic Plant Control Technical Note MI-02, 1999". Survey points were placed 130 meters apart using a Geographic Information System (GIS). This spacing allowed for placement of 196 points. Plant samples were collected by throwing and dragging a double-sided rake along the lake bottom at each point. Plant samples were collected by throwing and dragging a double-sided rake along the lake bottom at each point for approximately 3 meters. Plant samples were assessed on the boat to determine species and rake fullness as a surrogate for density (scale of zero [no plants] to 4 [dense, matted on the surface] was used in 2012-2017 and a zero to 3 scale in 2018 and subsequent years). Frequencies of occurrence percentages (i.e., how often a plant species was found in the lake) were calculated based on the littoral zone (the portion of the lake is less than 15 feet in depth).

Survey Observations:

Historically, two annual surveys are conducted in Cedar Lake to capture curly leaf pondweed (CLP) densities in the spring and the native plant community in mid to late summer. Results for each survey across years are found in their designated section, Spring and Summer. In general, from 2009 to 2023, maximum depth of rooted vegetation was observed between 6 – 11 feet (1.8 – 3.4 meters). See **Table 3a & b – Point Intercept Metrics** for historical point-intercept survey calculations, **Table 4a & b – Plant Frequency of Occurrence** for historical plant densities.

Spring:

Spring surveys have been conducted between April to June. Note that surveys in years 2015-2016 were conducted in June after the CLP treatment while surveys in years 2017-2022 were conducted before treatment effects were observed (see **Summary Table**). In 2023, the spring survey was completed in May after a lake-wide fluridone treatment. In general, spring surveys show a decrease in CLP overtime when comparing similar months. The greatest reductions were observed in 2015 – 2016 & 2019 – 2020 during large-scale treatment years (600 – 793 acres). In general, April and May surveys show natives are sparse in the early growing season. Due to the reduction in native plants in 2019 – 2020 after the use of fluridone, less acreage was permitted for treatment in 2021 and 2022 due to the need to have native plants recover. In the 2023 spring survey water clarity was 9.8 feet (3 meters) showing increased CLP, in comparison to previous years (see **Figures 1a & b**), with abundant plant growth throughout Cedar Lake. Late summer surveys provide a better assessment of native plant response towards management.

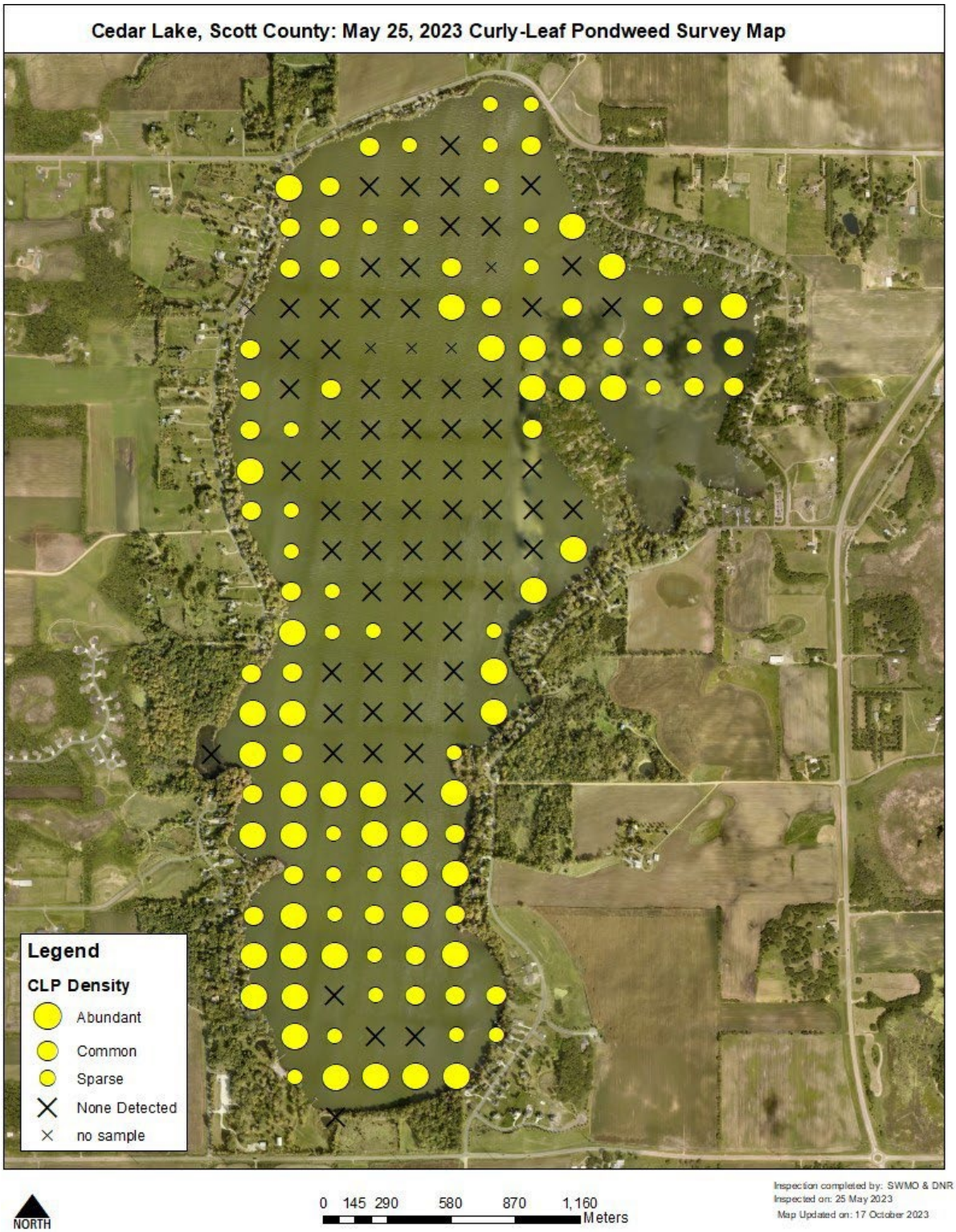


Figure 1a – Spring Point Intercept Metrics. Spring 2023 point-intercept results for Cedar Lake, Scott County, Minnesota (DOW# 70009100). Dots indicate curly leaf pondweed distribution and density at each point.

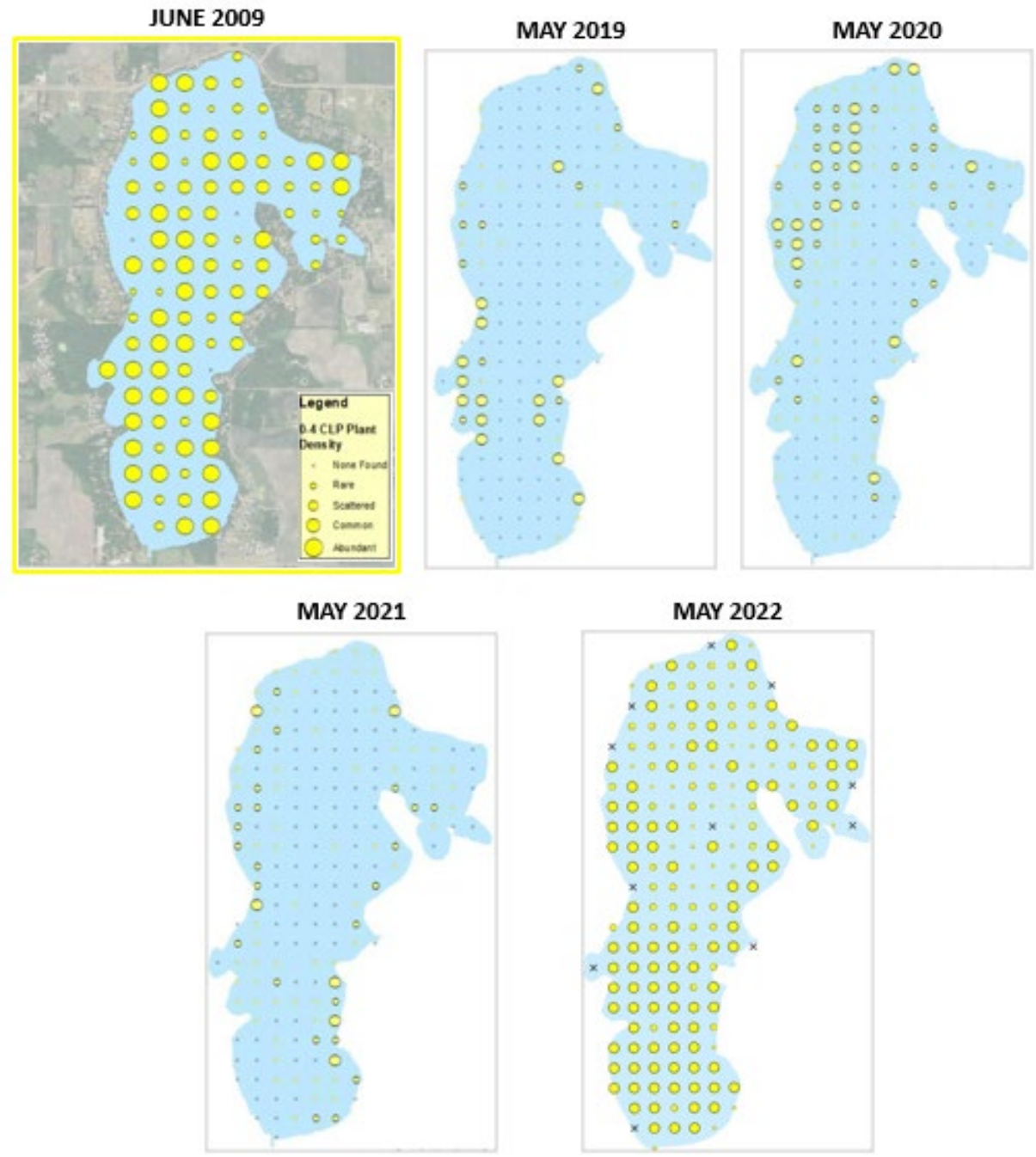


Figure – 1b. Spatial distribution and rake density rating for curly leaf pondweed prior to LVMP variance (upper left; 2009). Four distribution maps pre and post fluridone treatments in 2019 – 2022. Cedar Lake, Scott County, Minnesota (DOW# 70009100).

Table 3a – Spring Point Intercept Metrics. Spring point intercept results for Cedar Lake, Scott County, Minnesota (DOW# 70009100). Shaded values were calculated from littoral depth range (0-15 feet).

Survey Metrics	JUN 24 2009	JUN 17 2015	JUN 24 2016	APR 25 2017	MAY 25 2018	MAY 23 2019	MAY 23 2020	MAY 13 2021	MAY 26 2022	MAY 25 2023
Treated (Y/N)	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Surveyor	MNDNR	MNDNR	SWMO	MNDNR	MNDNR	MNDNR	MNDNR	SWMO/ MNDNR	SWMO/ MNDNR	SWMO/ MNDNR
Total # Points Sampled	104	196	196	129	195	191	196	185	194	180
Max Depth of Growth (95%)	11	11	10	9	9	9	10	9	11	10
# Point in Max Depth Range	98	156	136	129	162	104	170	149	185	134
# Points in Littoral (0-15 feet)	104	196	196	189	195	191	196	185	194	180
% Points w/ Submersed Native Taxa	3	46	43	11	17	8	29	26	25	3
Mean Submersed Native Taxa/ Point	< 0.1	0.7	0.8	0.1	0.2	0.1	0.4	0.3	0.37	0.03
# Submersed Native Taxa	2	7	7	4	5	5	6	6	11	4
# Submersed Non-Native Taxa	1	1	1	1	1	1	1	1	1	1

Table 3b – Spring Plant Frequency Occurrence. Historic percent frequency of occurrence for submersed vegetation within the littoral zone (0-15 feet) in early summer. Cedar Lake, Scott County, Minnesota (DOW# 70009100).

Taxonomic Name SUBMERSED PLANTS	Common Name	JUN 24 2009	JUN 17 2015	JUN 24 2016	APR 25 2017	MAY 25 2018	MAY 23 2019	MAY 28 2020	MAY 13 2021	MAY 26 2022	MAY 25 2023
*Potamogeton crispus**	Curly-leaf pondweed*	95	42	12	47	69	28	58	52	96	59
Potamogeton zosteriformis	Flat-stemmed pondweed	0	0	0	0	0	<1	0	1	4	0
Ceratophyllum demersum	Coontail	1	12	14	2	5	2	4	-	6	0
Elodea canadensis	Canadian waterweed	0	39	40	9	2	1	1	1	1	0
Heteranthera dubia	Water stargrass	0	3	10	1	4	0	7	1	12	1
Zannichellia palustris	Horned pondweed	0	10	4	0	9	4	0	20	6	0

* Denotes invasive aquatic plant

Floating, Free-floating & Emergent plants observed: *Lemna trisulca* (forked duckweed) and *Spirodela polyrhiza* (large duckweed)

Less common (< 5% frequency) submersed vegetation observed: *Stuckenia pectinata* (sago pondweed) in 2009-2016 and 2022-2023, *Najas spp.* (Naiad) in 2015, *Macroalgae* (muskgrass and stonewort) in 2015-2019 and 2022-2023, *Utricularia macrorhiza* (common bladderwort) in 2016, *Potamogeton zosteriformis* (flat-stem pondweed) in 2019 and 2021-2022, *Potamogeton pusillus* (very small pondweed) in 2022, *Elodea nuttallii* (Nuttall's elodea) in 2022, and *Tolypella spp.* (stonewort) in 2022.


Photos of curly-leaf pondweed observed in June 2009 point intercept survey (left). Photo of curly-leaf pondweed surface matting observed in 2012 before the early spring treatment (right).

Summer

Summer surveys have been conducted between July and August. The number of native taxa per point and the observed number of native species (species richness) in the lake has remained relatively constant from 2013 to 2022, although in 2021 and 2022 there was an increase in native taxa (see **Table 4a** and **Figure 2a**). There was a noticeable decrease in native taxa per point in 2020 after two years of fluridone treatments and in 2023. Outside of some seasonal variability, a positive native plant response has not been observed in Cedar Lake due to water clarity limitations. In the historical summer surveys, the most dominant native aquatic plant species observed were coontail, Canadian waterweed and water stargrass (see **Table 4b**). In 2022, coontail was observed in higher frequencies than in previous surveys while naiad and sago pondweed were observed in lower frequencies.

Two late September surveys (2016 & 2017), conducted by DNR and SWMO, were omitted from this report because they did not provide a good representation of the native plant population as most plants senesce during this time of year. Additionally, point intercept surveys conducted by Blue Water Science in May and August of 2007 are available upon request.

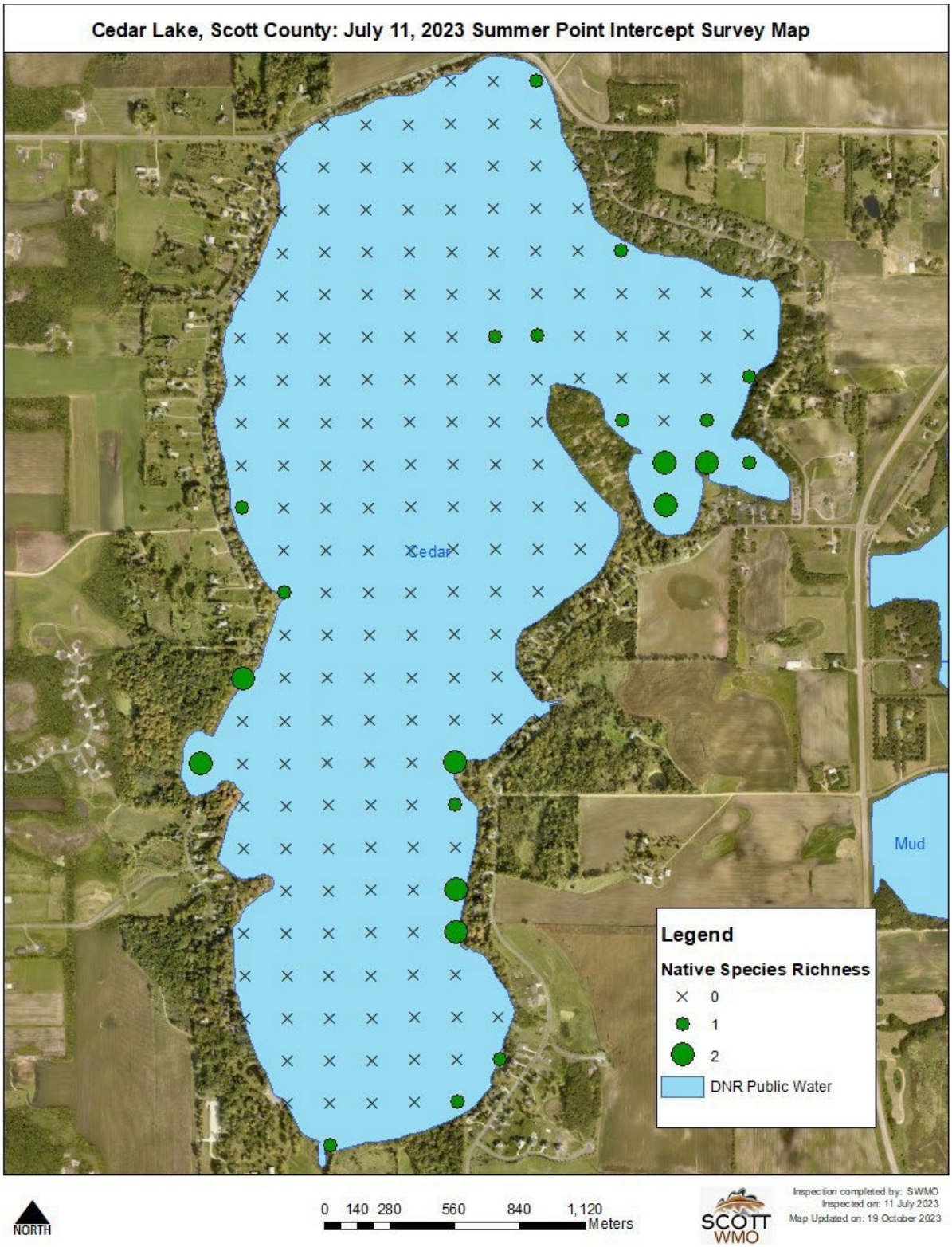


Figure 2a – Summer Point Intercept Metrics. Summer 2023 point-intercept results for Cedar Lake, Scott County, Minnesota (DOW# 70009100). Dots indicate aquatic submersed native plant species distribution and density at each point.

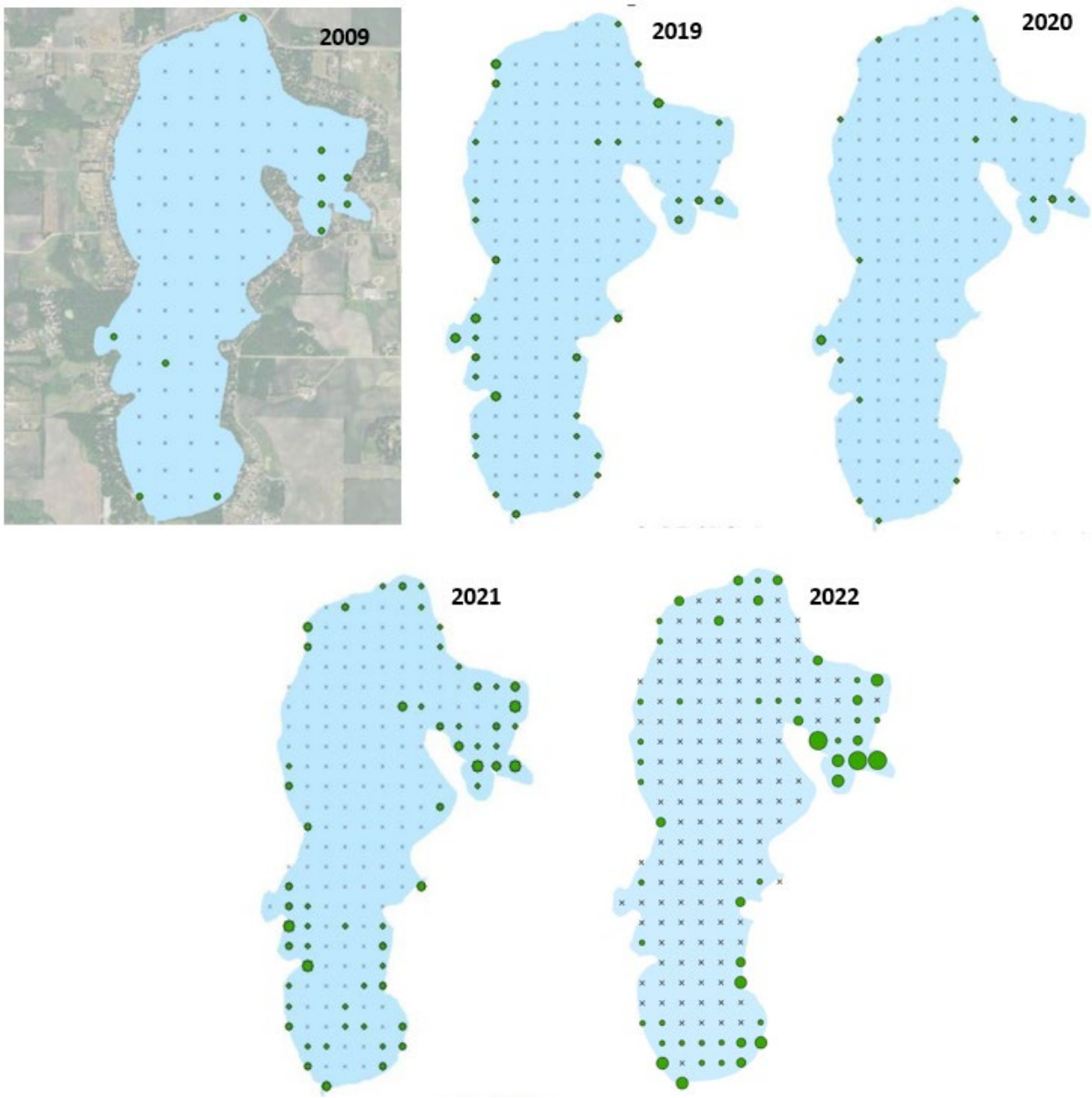


Figure 2b. Spatial distribution and species richness (# of native species per sample point) of native submersed plant species in 'late summer' surveys omitting September. Years presented are for LVMP years. Cedar Lake, Scott County, Minnesota (DOW# 70009100).

Table 4a – Summer Point Intercept Metrics. Summer point intercept results for Cedar Lake, Scott County (DOW# 70009100). Shaded values were calculated from littoral depth range.

Survey Metrics	JUL 29 2013	JUL 31 2014	AUG 13 2015	AUG 8 2016	JUL 11 2018	JUL 11 2019	JULY 15 2020	JULY 14 2021	JULY 14 2022	JULY 11 2023
Treated (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Surveyor	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR	SWMO
Total # Points Sampled	196	196	196	192	194	191	194	191	149	194
Max Depth of Growth (95%)	11	9	8	9	7	6	6	8	8	4.7
# Point in Max Depth Range	127	99	60	83	70	45	43	185	88	36
# Points in Littoral (0-15 feet)	196	196	196	191	192	191	194	191	149	194
% Points w/ Submersed Native Taxa	24	25	21	26	20	17	8	31	34	8
Mean Submersed Native Taxa/ Point	0.4	0.4	0.4	0.6	0.3	0.3	0.1	0.6	0.6	0.1
# Submersed Native Taxa	6	6	6	7	8	7	5	10	10	5
# Submersed Non-Native Taxa	1	1	1	1	1	1	1	1	1	1

Table 4b- Summer Plant Frequency Occurrence. Historic percent frequency of occurrence for submersed vegetation within the littoral zone (0-15 feet) in late summer. Cedar Lake, Scott County, Minnesota (DOW# 70009100).

Taxonomic Name SUBMERSED PLANTS	Common Name	JUL 29 2013	JUL 31 2014	AUG 13 2015	AUG 8 2016	JUL 11 2018	JUL 11 2019	JULY 15 2020	JULY 14 2021	JULY 14 2022	JULY 11 2023
*Potamogeton crispus**	Curly-leaf pondweed*	22	11	3	5	2	2	10	32	5	1
Zannichellia palustris	Horned pondweed	1	0	0	0	0	0	0	5	1	0
Ceratophyllum demersum	Coontail	21	10	7	12	13	5	-	6	20	1
Elodea canadensis	Canadian waterweed	12	17	20	24	10	2	-	3	9	0
Heteranthera dubia	Water stargrass	3	4	7	7	1	11	34	20	13	6
Najas spp.	Naiad	5	9	7	7	3	-		1	2	0
Stuckenia pectinata	Sago pondweed	3	1	2	4	1	7	9	3	1	2

* Denotes invasive aquatic plant

Floating, free-floating & emergent plants observed: *Lemna trisulca* (forked duckweed) and *Spirodela polyrhiza* (large duckweed)

Less common (< 5% frequency) submersed vegetation observed: *Potamogeton pusillus* (small pondweed) in 2012 and 2020-2021, *Zannichellia palustris* (horned pondweed) in 2013, 2016, 2018-2019, and 2021-2022, *Potamogeton praelongus* (white-stem pondweed) in 2014, Macroalgae (muskgrass & stonewort) in 2015-2016 and 2018-2022, *Ranunculus aquatilis* (white water crowfoot) in 2017, *Potamogeton zosteriformis* (flat-stem pondweed) in 2018 and 2022, and *Potamogeton foliosus* (leafy pondweed) in 2021-2023.