CEDAR LAKE, SCOTT COUNTY:
2019 AQUATIC VEGETATION REPORT

Report by the Invasive Species Program – Division of Ecological and Water Resources
Minnesota Department of Natural Resources

Lake: Cedar (DOW# 70009100)

Lake Surface Area: 800 acres

Littoral Area: 800 acres

County: Scott

Survey Type: Point-intercept

Date of Survey (most recent): July 11, 2019

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2019 Summary:

The most recent aquatic vegetation point-intercept survey of Cedar Lake (DOW #70009100) was completed on July 11. Plants were present throughout the lake to a depth of 6 feet (1.83 meters). Within the littoral zone (zone from the 0-15 foot depth range), 17% of sampled points contained native submersed taxa. The average number of native submersed taxa per sample point was 0.3. Cedar Lake has a Lake Vegetation Management Plan (since 2013) for the management curly-leaf pondweed. 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 excess 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 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	
			JUL 11	7	20	0.3	8	1.1
2019	**MAY 2**	793	**MAY 23**	9	8	0.1	6	0.8
			JUL 11	6	17	0.3	8	

*CLP is short for Curly-leaf pondweed

†95th percentile calculated based on all vegetated sampling points

Taxa refers to groups of submersed aquatic plant species or genera

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

Lake Description:

Cedar Lake is an 800-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 as a result of excessive phosphorous. For information concerning; 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 (DOW #70009100). Data gathered from the Minnesota Pollution Control Agency and SCWMO.

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	NA	0.4	0.6	0.8

Management History:

In 2013, a Lake Vegetation Management Plan was developed by the DNR and the Scott County Watershed Management Organization (SCWMO) for Cedar Lake to allow treatment of more than 15% of the littoral zone to control curly-leaf pondweed (CLP). The intent was to determine whether invasive plant control, in conjunction with other management efforts, would increase the distribution of native plant and potentially benefit water quality. Lake-wide herbicide treatments using endothall effectively reduced CLP with some annual increase in native plant species richness and distribution although results have not been sustainable from year to year. The plan was renewed in 2018 to allow for additional whole lake treatments to suppress CLP and potentially improve the native plant community. In 2019, fluridone was applied at a lakewide low dose (2-4 parts per billion). CLP herbicide treatments continue to be organized by SCWMO in cooperation with the Cedar Lake Improvement District. 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 (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	800	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

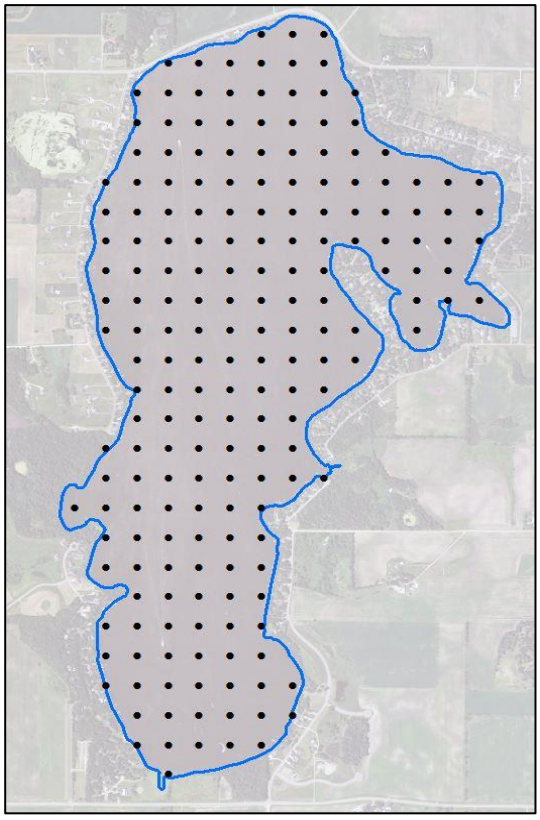
* LVMP year

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 DNR 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 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 2019, 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 were conducted from April to June. Note that surveys in years 2015-2016 and 2019 were conducted in June after the CLP treatment while surveys in years 2017-2018 were conducted before treatment effects were observed (see ***Summary Table***). In general, spring surveys show a decrease in CLP overtime when comparing similar months. The greatest reductions were observed in 2015-2016 during large-scale treatment years (up to 600 acres). In general, April and May surveys show natives are sparse in the early growing season. Late summer surveys provide a better assessment of native plant response towards management.

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

Survey Metrics	JUN 24 2009	JUN 17 2015	JUN 24 2016	APR 25 2017	MAY 25 2018	MAY 23 2019
Treated (Y/N)	N	Y	Y	Y	Y	Y
Surveyor	MNDNR	MNDNR	SCWMO	MNDNR	MNDNR	MNDNR
Total # Points Sampled	104	196	196	129	195	191
Max Depth of Growth (95%)	11	11	10	9	9	9
# Point in Max Depth Range	98	156	136	129	162	104
# Points in Littoral (0-15 feet)	104	196	196	189	195	191
% Points w/ Submersed Native Taxa	3	46	43	11	17	8
Mean Submersed Native Taxa/ Point	< 0.1	0.7	0.8	0.1	0.2	0.1
# Submersed Native Taxa	2	7	7	4	5	5
# Submersed Non-Native Taxa	1	1	1	1	1	1

Table 4a- 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 (DOW# 70009100).

Taxonomic Name	**Common Name**	**JUN 24 2009**	**JUN 17 2015**	**JUN 24 2016**	**APR 25 2017**	**MAY 25 2018**	**MAY 23 2019**
SUBMERSED PLANTS							
*Potamogeton crispus**	Curly-leaf pondweed*	95	42	12	47	69	28
Ceratophyllum demersum	Coontail	1	12	14	2	5	2
Elodea canadensis	Canadian waterweed	0	39	40	9	2	1
Heteranthera dubia	Water stargrass	0	3	10	1	4	0
Zannichellia palustris	Horned pondweed	0	10	4	0	9	4

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, Najas spp. (Naiad) in 2015, *Macroalgae* (Muskgrass and Stonewort) in 2015-2019, *Utricularia macrorhiza* (Common bladderwort) in 2016, *Potamogeton zosteriformis* (Flat-stem pondweed) in 2019.

* denotes invasive aquatic plant

Summer

Summer surveys were conducted between July and August. The number of native taxa per point and the observed number of native species in the lake has remained relatively constant since 2013 (see ***Table 3b*** and ***Figure 2***). Outside of some seasonal variability, a positive native plant response has not been observed in Cedar Lake due to limitations in water clarity. In the summer, the most dominant native aquatic plant species observed are coontail, Canadian waterweed, water stargrass, and naiad (see ***Table 4b***). In 2019, Canadian waterweed and coontail were observed at lower frequencies than in previous surveys possibly due to fluridone susceptibility.

Two late September surveys, conducted by DNR and SCWMO, 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.

Table 3b- 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
Treated (Y/N)	Y	Y	Y	Y	Y	Y
Surveyor	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR
Total # Points Sampled	196	196	196	192	194	191
Max Depth of Growth (95%)	11	9	8	9	7	6
# Point in Max Depth Range	127	99	60	83	70	45
# Points in Littoral (0-15 feet)	196	196	196	191	192	191
% Points w/ Submersed Native Taxa	24	25	21	26	20	17
Mean Submersed Native Taxa/ Point	0.4	0.4	0.4	0.6	0.3	0.3
# Submersed Native Taxa	6	6	6	7	8	7
# Submersed Non-Native Taxa	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 (DOW# 70009100).

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

Floating, Free-floating & Emergent plants observed: *Lemna trisulca* (Forked duckweed), *Spirodela polyrhiza* (Large duckweed)

Less common (< 5% frequency) submersed vegetation observed: *Potamogeton pusillus* (Small pondweed) in 2012, *Zannichellia palustris* (Horned pondweed) in 2013, 2016, 2018, 2019, *Potamogeton praelongus* (White-stem pondweed) in 2014, *Macroalgae* (Muskgrass and Stonewort) in 2015, 2016, 2018, 2019, *Ranunculus aquatilis* (White water crowfoot) in 2017, *Potamogeton zosteriformis* (Flat-stem pondweed) in 2018.

* denotes invasive aquatic plant

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

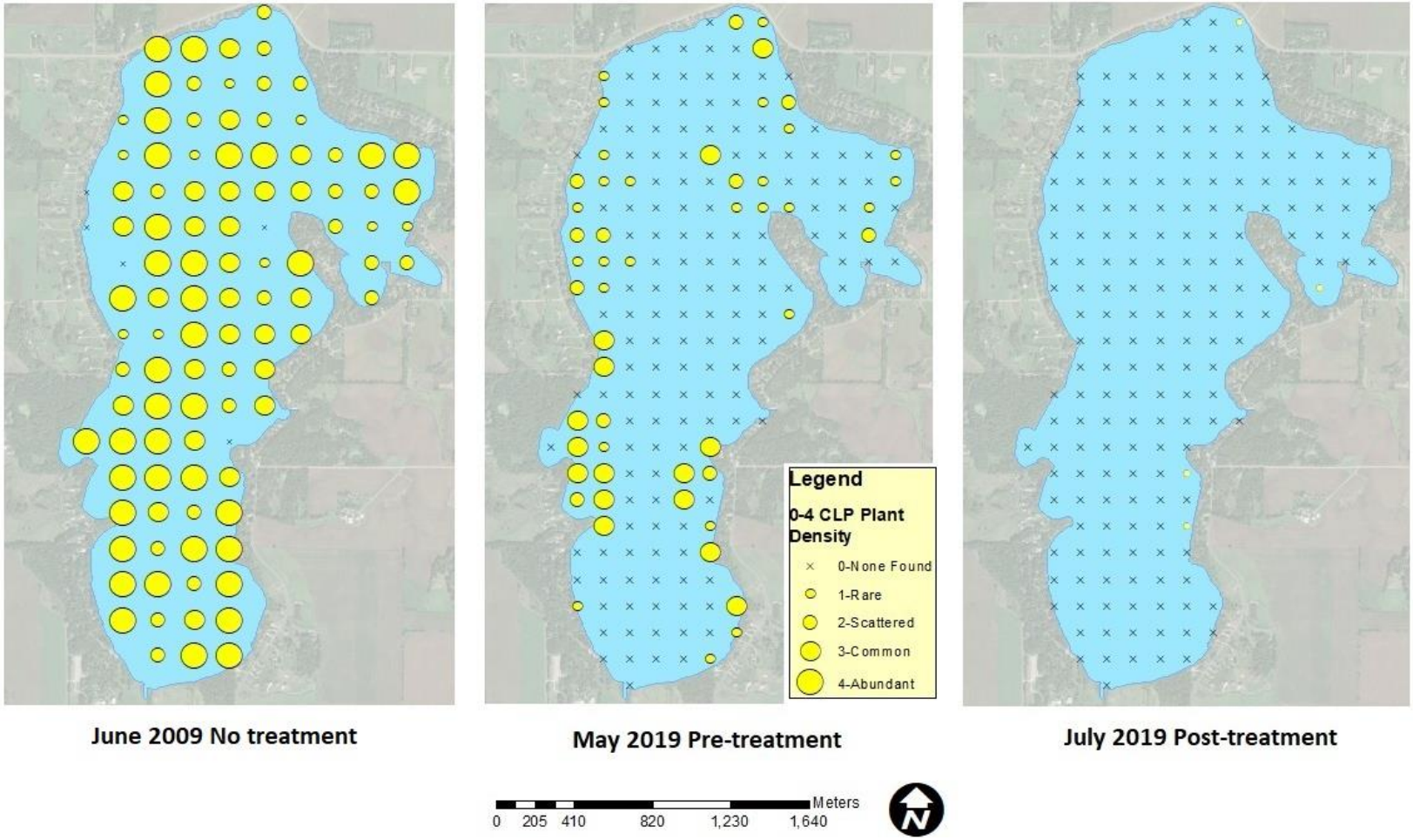


Figure 1. Spatial distribution and rake density rating of curly-leaf pondweed prior to LVMP variance (2009) in addition to two distribution maps pre and post fluridone treatments in 2019. The LVMP will remain active through 2021. Cedar Lake, Scott County (DOW# 70009100).

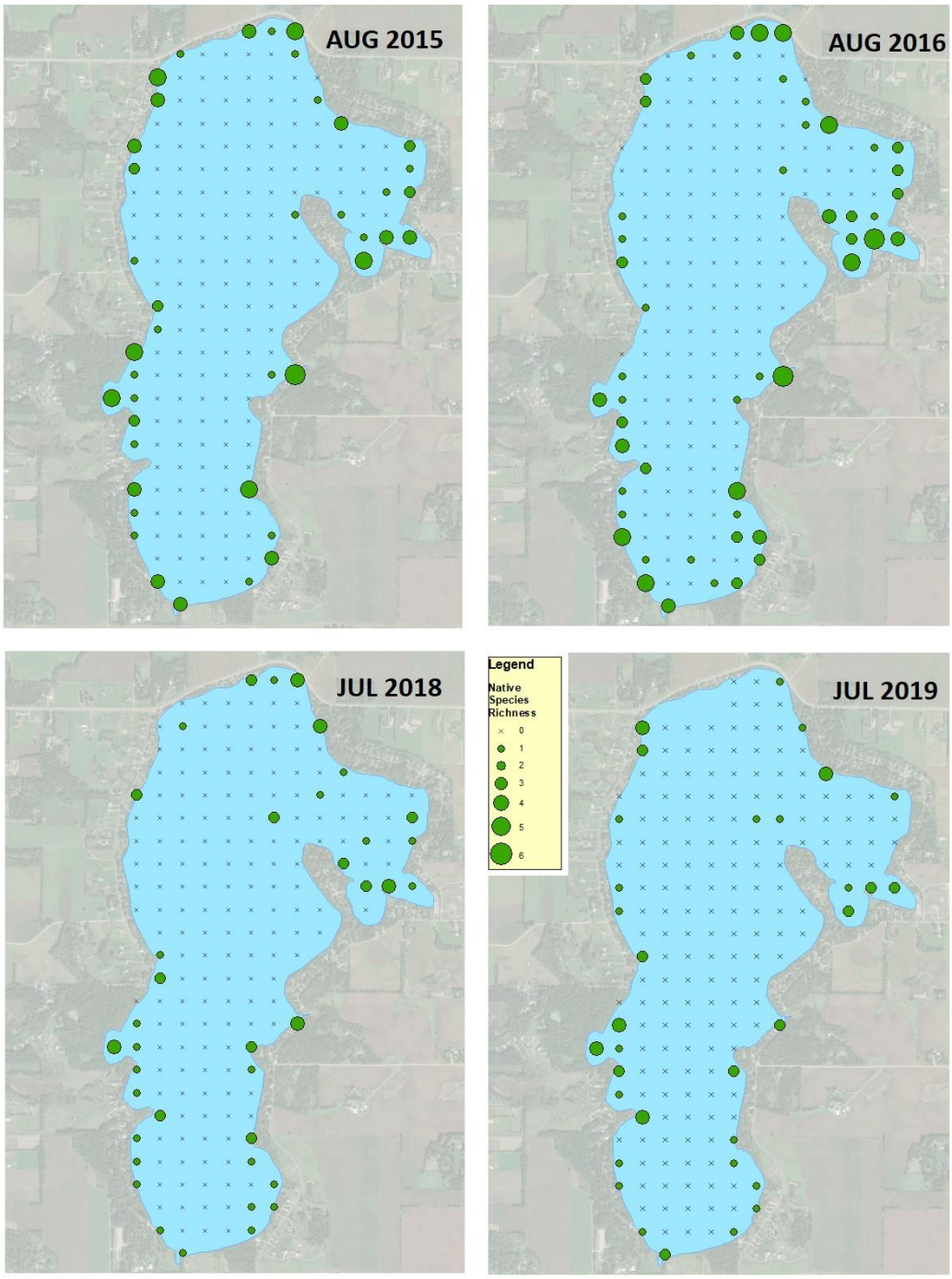


Figure 2. Spatial distribution and species richness (# of native species per sample point) of native submersed plant species in 'late summer' surveys omitting September. Years presented above are for LVMP years. Cedar Lake, Scott County (DOW# 70009100).

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