Long Lake, Apple Valley, May 22, 2015

Aquatic Plant Point-Intercept Surveys for Long Lake, Apple Valley, Minnesota, 2015

Surveys conducted on May 22 and August 29, 2015
(Previous Aquatic Plant Surveys Conducted in 2005, 2010, 2013, and 2014)

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Aquatic Plant Point-Intercept Surveys for Long Lake, Apple Valley, Minnesota in 2015

Summary

Two aquatic plant point-intercept surveys were conducted on Long Lake (34 acres) in the summer of 2015. The May 22 survey was to evaluate curlyleaf pondweed and native plants and the August 29 survey was to look for Eurasian watermilfoil and characterize all aquatic plants.

In the early summer of 2015, curlyleaf pondweed (Figures S1 and S2) was found throughout most of Long Lake and out to about 5 feet of water depth. It was widespread in the lake, showing up at 43 out of 49 sample sites. In August, no curlyleaf pondweed observed and stringy pondweed distribution declined. Elodea was the most common plant in the August survey (Table S1). Plants grew out to about 3 feet of water.

The acreage of aquatic submerged plants in Long Lake decreased from early to late summer primarily because of the decreased coverage of curlyleaf pondweed and stringy pondweed (Figure S2)(Table S1).

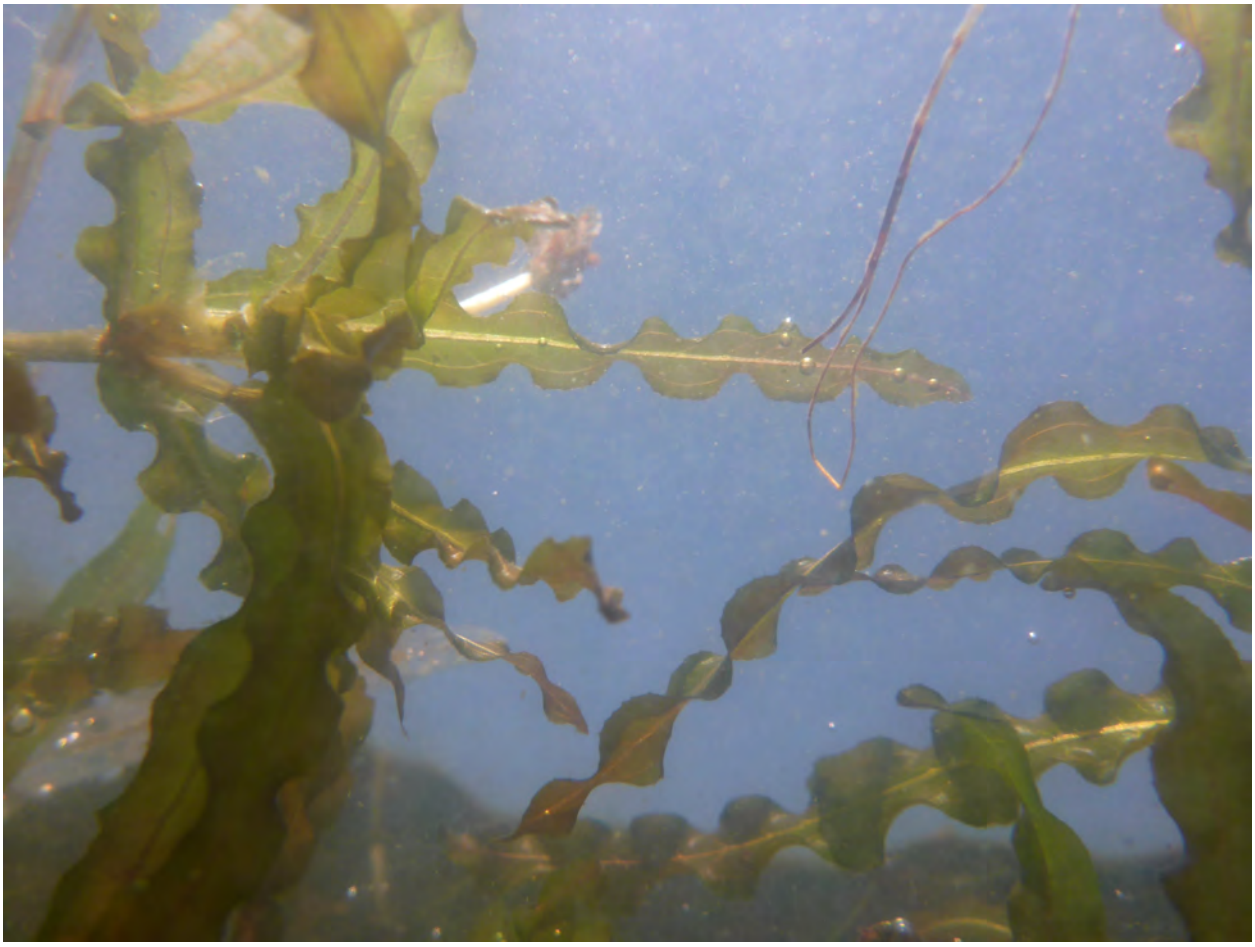


Figure S1. Curlyleaf pondweed in Long Lake on May 22, 2015.

Table S1. The percent occurrence of aquatic plants for Long Lake in 2005, 2010, 2013, 2014, and 2015. Percent occurrence is calculated based on the number of times a plant species occurs at a sampling station divided into the total number of stations for the survey. For example, if coontail was found in 25 out of 50 stations, its percent occurrence would be 50%. Red shading represents curlyleaf occurrence following a winter drawdown.

	June 3, 2005 % Occur (29 stations)	June 11, 2010 % Occur (29 stations)	June 23, 2013 % Occur (49 sites)	June 8, 2014 % Occur (49 sites)	May 22, 2015 % Occur (49 sites)	Sept 1, 2005 % Occur (29 stations)	August 20, 2010 % Occur (29 stations)	August 5 2013 % Occur (49 sites)	July 25, 2014 % Occur (49 sites)	Aug 29, 2015 % Occur (49 sites)
Smartweed (*Polygonus sp*)	--	3%	--	--	--	--	--	--	--	--
Burreed (*Sparganium sp*)	--	3%	--	--	--	--	--	--	--	--
Duckweed (*Lemna sp*)	--	3%	--	--	--	--	--	2%	14%	--
Coontail (*Ceratophyllum demersum*)	--	--	2%	--	--	--	3%	2%	--	2%
Elodea (*Elodea canadensis*)	14%	--	33%	4%	2%	39%	--	45%	5%	27%
Naiads (*Najas flexilis*)	--	--	--	--	--	--	--	--	6%	--
Curlyleaf pondweed (*Potamogeton crispus*)	93%	69%	94%	63%	87%	--	7%	67%	78%	--
Floatingleaf pondweed (*P. natans*)	--	7%	--	2%	--	4%	7%	--	--	--
Stringy pondweed (*P. sp*)	7%	--	6%	33%	47%	--	--	18%	67%	--
Flatstem pondweed (*P. zosteriformis*)	--	--	--	--	--	--	--	2%	--	--
Sago pondweed (*Stuckenia pectinata*)	--	3%	4%	--	--	--	--	--	14%	--
Number of submerged plants	3	3	5	4	3	2	3	5	5	2
Aquatic Plant Coverage (acres)	32	18	32	30	34	13	2	31	32	25

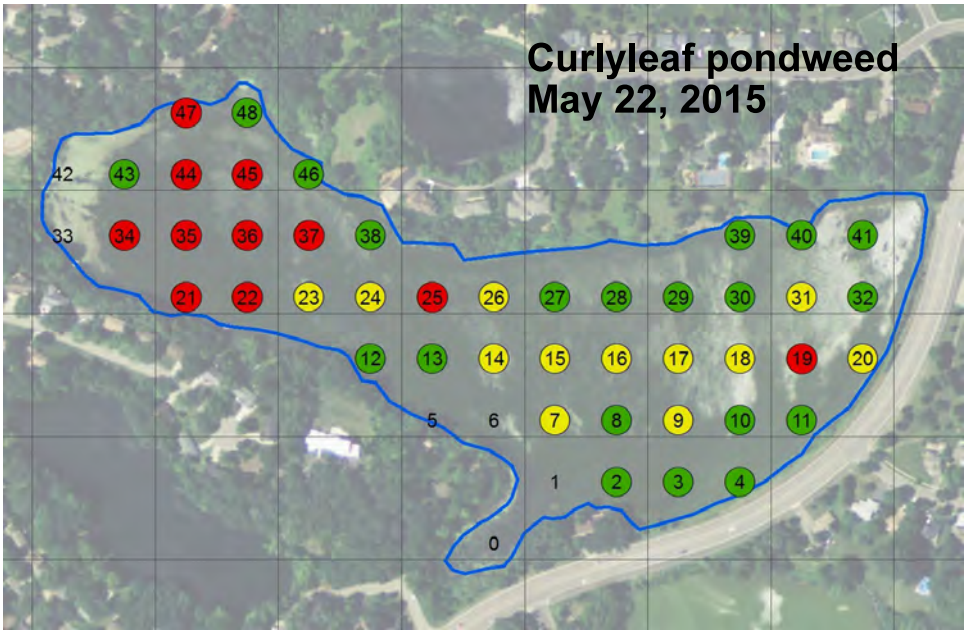


Figure S2. Early summer curlyleaf pondweed coverage on May 22, 2015.
Key: Green shading = light growth and yellow shading = moderate growth.

Conclusions: The aquatic plant community in 2015 had 3 species of submerged plants in early summer and 2 species in late summer. This is a low plant diversity condition. Curlyleaf pondweed was the only non-native plant present.

Curlyleaf pondweed covered about 29 acres in early summer. Curlyleaf pondweed growth ranged from light to heavy with the heaviest growth in the west end of Long Lake.

In late summer in 2015, aquatic plants covered about 27% of the lake and grew out to about 3-feet of water depth (which is the maximum depth of Long Lake at normal lake levels).

Eurasian watermilfoil was not found in either survey.

Curlyleaf pondweed previously has been managed in Long Lake with drawdowns. Over the 2009-2010 and the 2013-2014 winters, Long Lake was drawn down. In the early summer of 2010 and 2014, curlyleaf distribution was reduced compared to surveys conducted prior to the drawdown. However, curlyleaf data from May in 2015 indicates curlyleaf pondweed has returned from the 2013-2014 drawdown.

Figure S3. Stringy pondweed was common in Long Lake on May 22, 2015.

Aquatic Plant Point-Intercept Surveys for Long Lake, Apple Valley, Minnesota, 2015

Lake ID: 19-0022
Size: 34 acres
Littoral area: 34 acres
Maximum depth: 5 ft (at normal lake level)

Introduction

Long Lake is located within the City of Apple Valley. Observations of nuisance aquatic plant growth have been made in the past and have been documented in point-intercept aquatic plant surveys conducted in 2005, 2010, 2013, 2014, and 2015. The aquatic plant community is of interest because the non-native curlyleaf pondweed is present. Also, it is important to maintain a good distribution of native plants to help sustain good water quality.

Figure 1. Point locations for the aquatic plant surveys. Lake map with UTM coordinates using the NAD1983 datum.

Methods - Aquatic Plant Surveys

Two aquatic plant surveys of Long Lake (34 acres) using a point intercept sampling method were conducted by Blue Water Science in 2015. The early season survey was conducted on May 22, 2015 and the late summer survey was conducted on August 29, 2015. A map and sampling grid were prepared by Blue Water Science and a consisted of a total of 49 points that were distributed throughout the lake. Points were spaced 50 meters apart. Each point represented about 0.7 acres. GPS coordinates used a UTM WGS84 datum. For each survey, the maximum depth of plant growth was found in the course of sampling. For the May survey, plants were found to 5 feet and all 49 sites were sampled. In the August survey, all sites were checked and plants were found out to 5 feet. At each sample point, plants were sampled with a rake sampler. A plant density rating was assigned to each plant species on a scale from 1 to 5 (Figure 2). A density of a "1" indicated sparse growth with one or two stems present on the rake sampler. A 4.5 or 5 rating indicated matting surface plant growth. Visual observations of surface growth were mapped in the field.

Chart of Aquatic Plant Density Ratings

Figure 2. Aquatic plant density ratings from 1 to 5. A density rating of 4.5 or 5 is used for plants topping out at the surface.

Results of the Early Summer Survey -- May 22, 2015

The most abundant plant in early summer in Long Lake was curlyleaf pondweed and it was found at 43 out of 49 sample sites (87%)(Table 1). Curlyleaf pondweed was found growing out to water depths of 5 feet. Curlyleaf growth was light to heavy (Figure 3). Curlyleaf coverage is about 30 acres of the 34 acre Long Lake (Figure 3). The dominant native aquatic plant was stringy pondweed (Figure 4).

A summary of plant density and occurrence for individual transects is shown in Tables 1 and 2. Eurasian watermilfoil was not found in this survey.

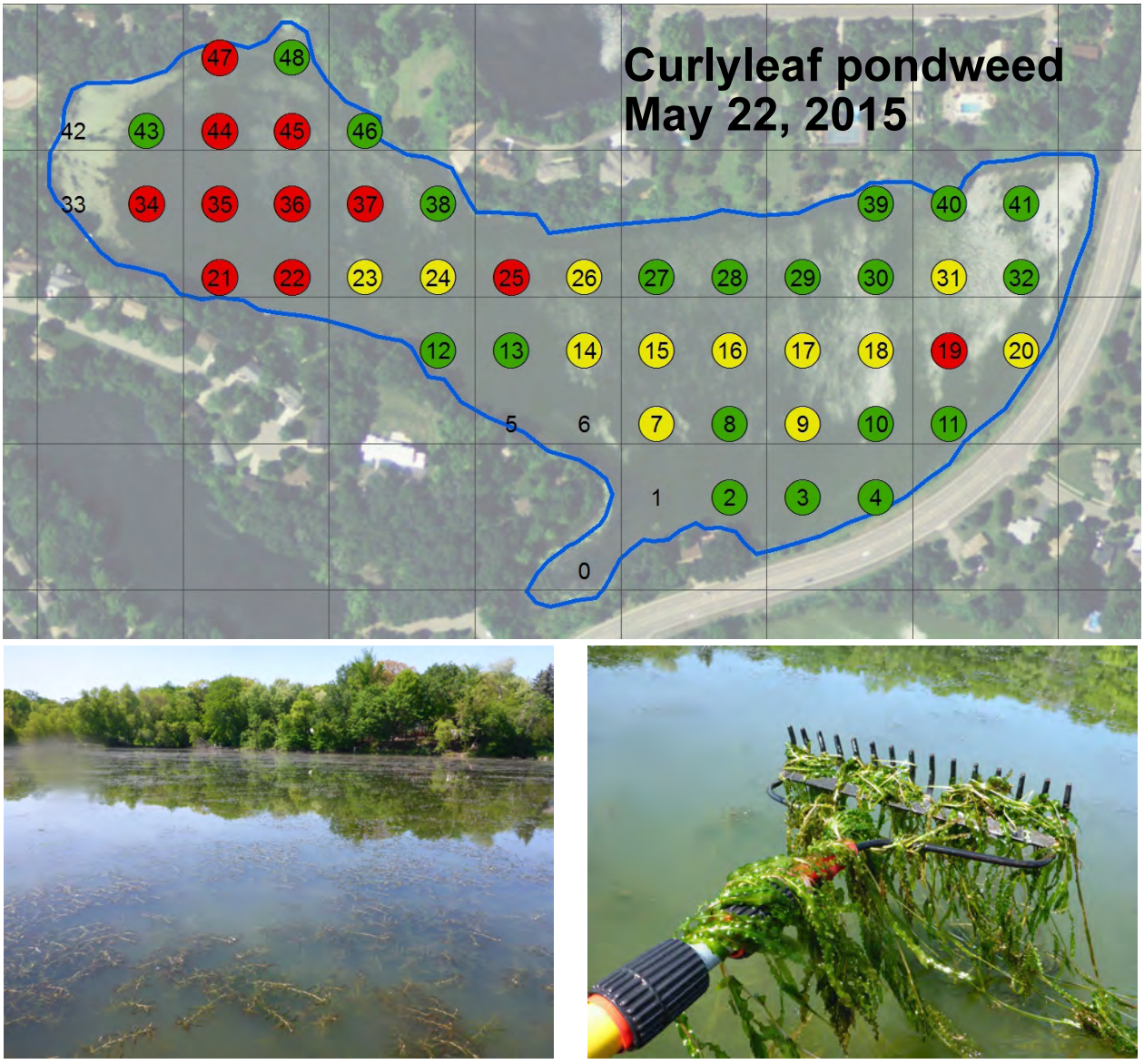


Figure 3. Curlyleaf pondweed coverage map for June 8, 2014.
(Key: green = light growth, yellow = moderate growth, and red = heavy growth)
[bottom-left] Curlyleaf pondweed topping out at the water surface on May 22, 2015.
[bottom-right] Curlyleaf pondweed on a sample rake on May 22, 2015.

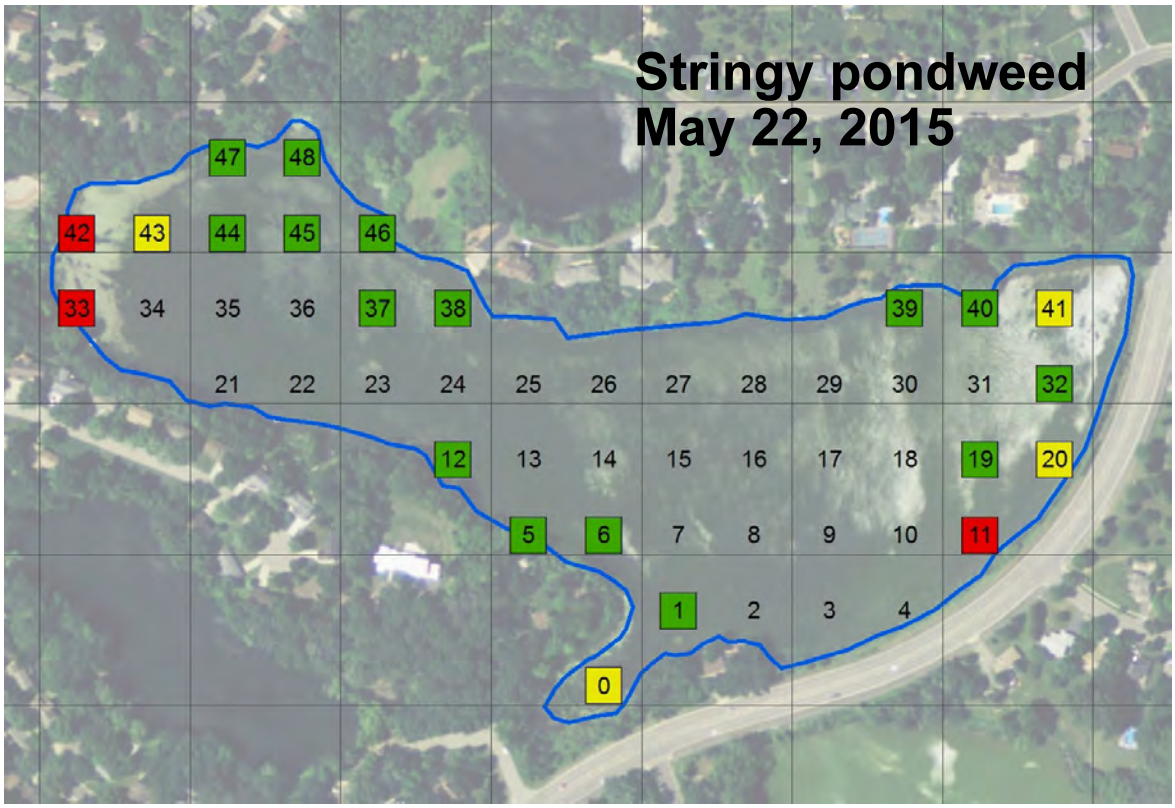


Figure 4. Aquatic plant coverage maps for May 22, 2015.
[top] Stringy pondweed coverage was about 15 acres. The native submerged aquatic plant coverage is the same as the stringy pondweed map.
[bottom] Stringy pondweed on a sample rake on May 22, 2015.

Table 1. Long Lake aquatic plant occurrences and densities for the May 22, 2015 survey based on 49 sites. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=49)		
	Occur	% Occur	Density
Elodea (*Elodea canadensis*)	1	2	1.0
Curlyleaf pondweed (*Potamogeton crispus*)	43	88	2.7
Stringy pondweed (*P. sp*)	22	45	1.9

Table 2. Individual site data for May 22, 2015. Numbers indicate plant density.

Site	Depth (ft)	Curlyleaf pondweed	Curlyleaf - stems	Elodea	Stringy pondweed
0	1				3
1	3				1
2	3	2			
3	4	2	8		
4	4	1	3		
5	3				1
6	3				1
7	4	3	13		
8	5	2	10		
9	4	3			
10	4	1		1	
11	3	1	4		4
12	3	1	1		1
13	5	2	8		
14	5	3			
15	5	3			
16	4	3			
17	4	3			
18	4	3			
19	4	4	19		1
20	3	3	15		3
21	3	5	25		
22	3	4			
23	3	3			
24	4	3	18		
25	4	4	20		
26	4	3	13		
27	4	2	8		
28	4	2	12		
29	4	2	12		
30	4	2	6		
31	4	3	16		
32	2	2	6		1
33	2				4
34	4	5	35		
35	3	4	30		
36	4	4	20		
37	4	4	25		1
38	3	2	10		2
39	3	2	7		1
40	3	1	4		1
41	2	1	4		3
41	2				4
42	3	2	12		3
43	3	4	30		1
45	3	4	20		1
46	3	2	12		1
47	3	4	25		2
48	3	1	6		2
Average		2.7	13.8	1.0	1.9
occurrence (49 sites)		43	33	1	22
% occurrence		88	67	2	45

Results of the Late Summer Survey -- August 29, 2015

The most abundant plant on the August 29, 2015 point-intercept plant survey for Long Lake was elodea, found at 13 out of 49 sites (27%) but at light growth (Figure 5 and Table 3). Both curlyleaf pondweed and stringy pondweed died back and were not observed in August.

A summary of plant density and occurrence for elodea and coontail for individual sites is shown in Tables 3 and 4.

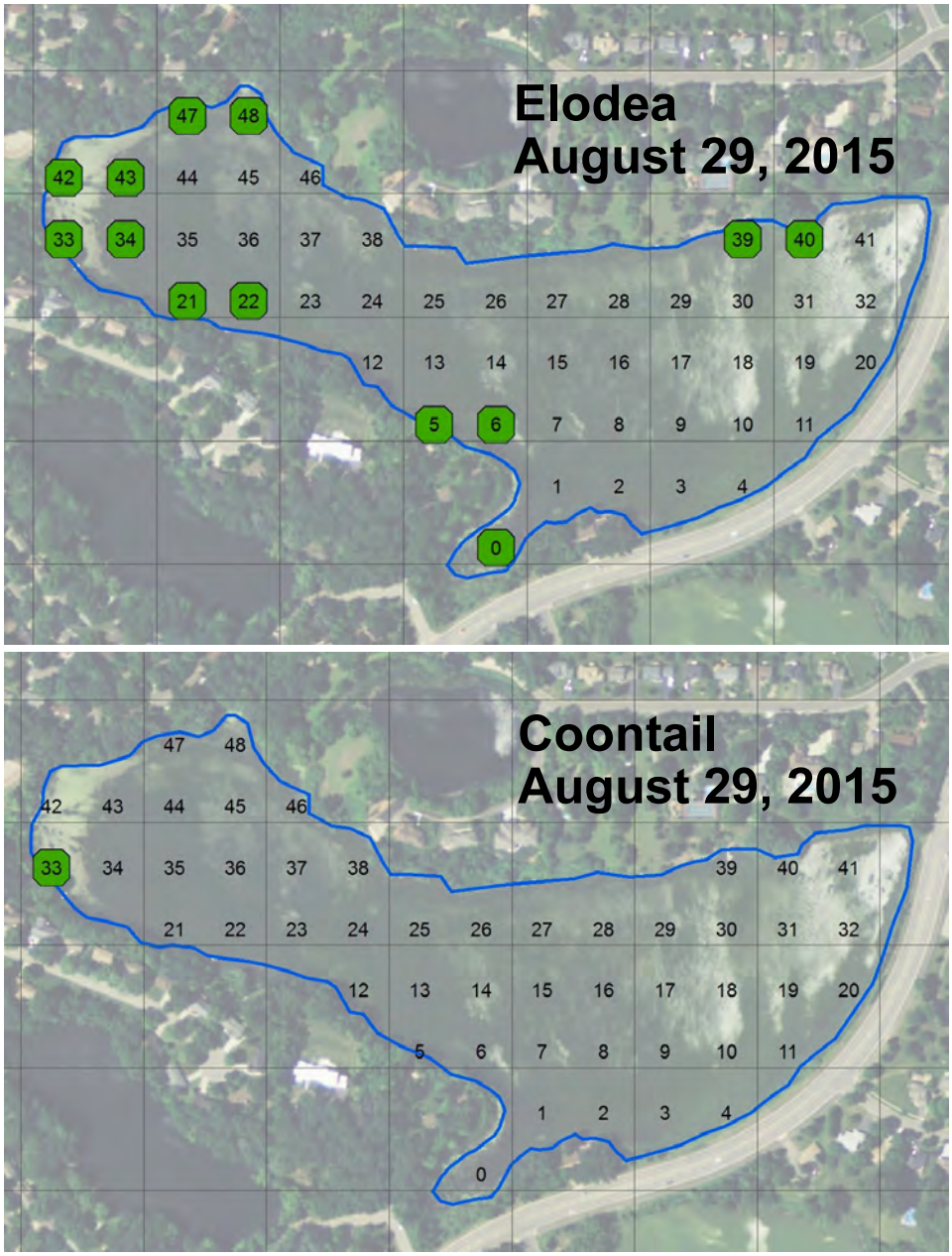


Figure 5. Aquatic plant coverage maps for August 29, 2015.
[top] Elodea coverage. [bottom] Coontail coverage.
(Key: green = light growth)

Table 3. Long Lake aquatic plant occurrences and densities for the August 29, 2015 survey based on 49 sites. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=49)		
	Occur	% Occur	Density
Coontail (*Ceratophyllum demersum*)	1	2	1.0
Elodea (*Elodea canadensis*)	13	27	1.2

Table 4. Individual site data for August 29, 2015. Numbers indicate plant density.

Site	Depth (ft)	Coontail	Elodea
0	2		2
1	3		
2			
3			
4			
5	3		1
6	3		2
7			
8	4		
9			
10			
11			
12	1		
13			
14			
15	1		
16			
17			
18			
19			
20			
21	3		1
22	3		1
23			
24	5		
25			
26			
27			
28	4		
29	4		
30	4		
31			
32			
33	2	1	2
34	4		1
35			
36			
37	5		
38			
39	2		1
40	2		1
41	2		
42	2		1
43	3		1
44			
45	4		
46			
47	3		1
48	2		1
Average		1.0	1.2
occurrence (49 sites)		1	13
% occurrence		2	27

Figure 6. Aquatic plant growth conditions were likely limited due to low light availability caused by algae blooms.

Comparison of Early and Late Summer Aquatic Plant Surveys in 2015

Aquatic plants decreased in Long Lake from May to August in 2015 (Figure 7). It is possible that the influence of the 2013-2014 drawdown may have lost it's impact to control curlyleaf and to enhance native aquatic plants. Instead, poor water clarity may have limited native plant distribution comparing the May to August surveys.

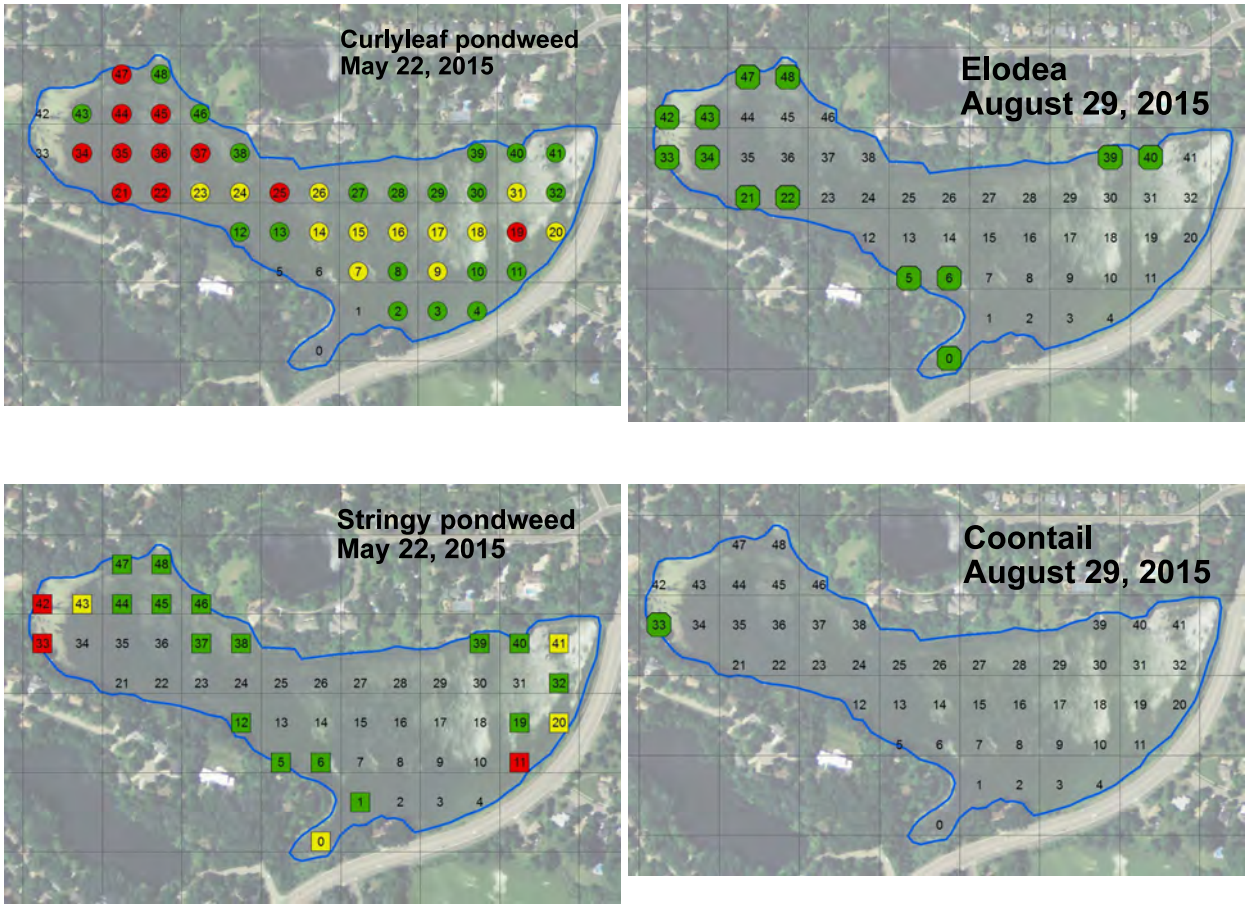


Figure 7. (top-left) Curlyleaf pondweed coverage on May 22, 2015.
(top-right) Elodea coverage on August 29, 2015.
(bottom-left) Stringy pondweed coverage on May 22, 2015.
(bottom-right) Coontail coverage on August 29, 2015.
(Key: Green shading = light growth, yellow shading = moderate growth, and red shading = heavy growth)

Comparison of Early and Late Summer Aquatic Plant Surveys in 2005, 2010, 2013, 2014, and 2015

Aquatic plant surveys have been conducted in Long Lake in 2005, 2010, 2013 through 2015. No Eurasian watermilfoil has been observed in the plant surveys from 2005 - 2015. Curlyleaf pondweed has been the dominant plant in the early season surveys and elodea was the dominant native plant in the late season surveys in 2005, 2013, and 2015 whereas, curlyleaf pondweed was dominant in 2014 (Table 5). Curlyleaf pondweed distribution was reduced in 2010 after a lake drawdown over the 2009-2010 winter and in 2014 after a 2013-2014 winter drawdown.

Curlyleaf was well distributed in the May, 2015, one year after a drawdown. The two drawdowns in Long Lake have produced curlyleaf control for one year after the drawdown, with curlyleaf returning significantly in the second year.

In late summer in 2005, 2013, and 2015, elodea has been a significant native species. In 2014, stringy pondweed was the dominant native species. In 2010 and 2015, plant coverage was relatively sparse.

Table 5. The percent occurrence of aquatic plants for Long Lake in 2005, 2010, 2013, 2014, and 2015. Percent occurrence is calculated based on the number of times a plant species occurs at a sampling station divided into the total number of stations for the survey. For example, if coontail was found in 25 out of 50 stations, its percent occurrence would be 50%.

	June 3, 2005 % Occur (29 stations)	June 11, 2010 % Occur (29 stations)	June 23, 2013 % Occur (49 sites)	June 8, 2014 % Occur (49 sites)	May 22, 2015 % Occur (49 sites)	Sept 1, 2005 % Occur (29 stations)	Aug 20, 2010 % Occur (29 stations)	August 5 2013 % Occur (49 sites)	July 25, 2014 % Occur (49 sites)	Aug 29, 2015 % Occur (49 sites)
Smartweed (*Polygonus sp*)	--	3%	--	--	--	--	--	--	--	--
Burreed (*Sparganium sp*)	--	3%	--	--	--	--	--	--	--	--
Duckweed (*Lemna sp*)	--	3%	--	--	--	--	--	2%	14%	--
Coontail (*Ceratophyllum demersum*)	--	--	2%	--	--	--	3%	2%	--	2%
Elodea (*Elodea canadensis*)	14%	--	33%	4%	2%	39%	--	45%	5%	27%
Naiads (*Najas flexilis*)	--	--	--	--	--	--	--	--	6%	--
Curlyleaf pondweed (*Potamogeton crispus*)	93%	69%	94%	63%	87%	--	7%	67%	78%	--
Floatingleaf pondweed (*P. natans*)	--	7%	--	2%	--	4%	7%	--	--	--
Stringy pondweed (*P. sp*)	7%	--	6%	33%	47%	--	--	18%	67%	--
Flatstem pondweed (*P. zosteriformis*)	--	--	--	--	--	--	--	2%	--	--
Sago pondweed (*Stuckenia pectinata*)	--	3%	4%	--	--	--	--	--	14%	--
Number of submerged plants	3	3	5	4	3	2	3	5	5	2
Aquatic Plant Coverage (acres)	32	18	32	30	34	13	2	31	32	25

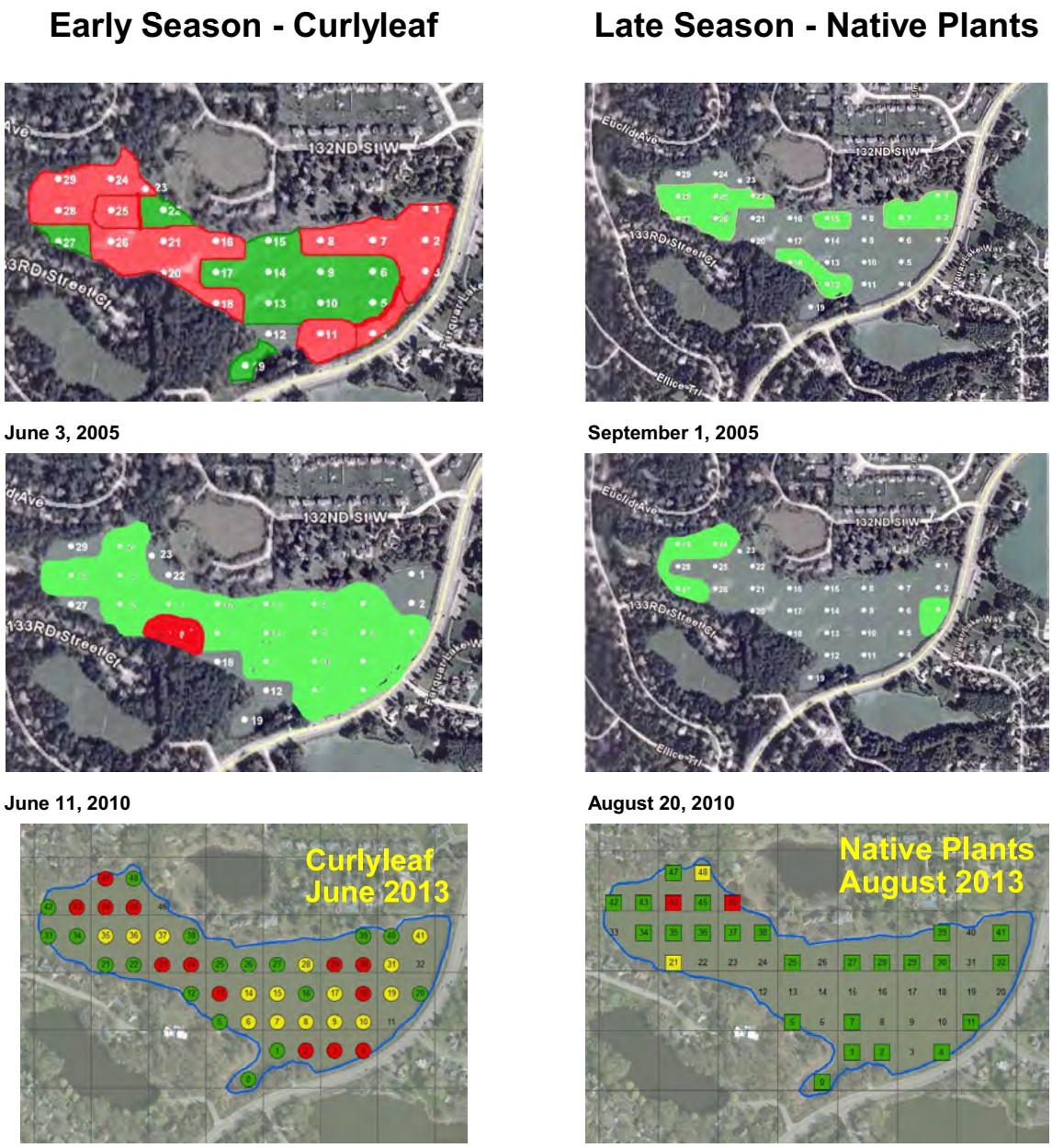


Figure 8. 2005: Early summery curlyleaf coverage: green shading represents non-nuisance curlyleaf growth (15 ac) and red shading is nuisance growth (18 ac). Late summer native plant coverage: green shading represents 13 ac.
2010: Early summer curlyleaf coverage: green shading represents non-nuisance curlyleaf growth (22 ac) and red shading is nuisance growth (1 ac). Late summer native plant coverage: green shading represents 4.7 ac.
2013: Early summer curlyleaf coverage: 32 ac. Late summer native plant coverage: 20 ac.
Green shading = light growth, yellow shading = moderate growth, and red shading = heavy growth.

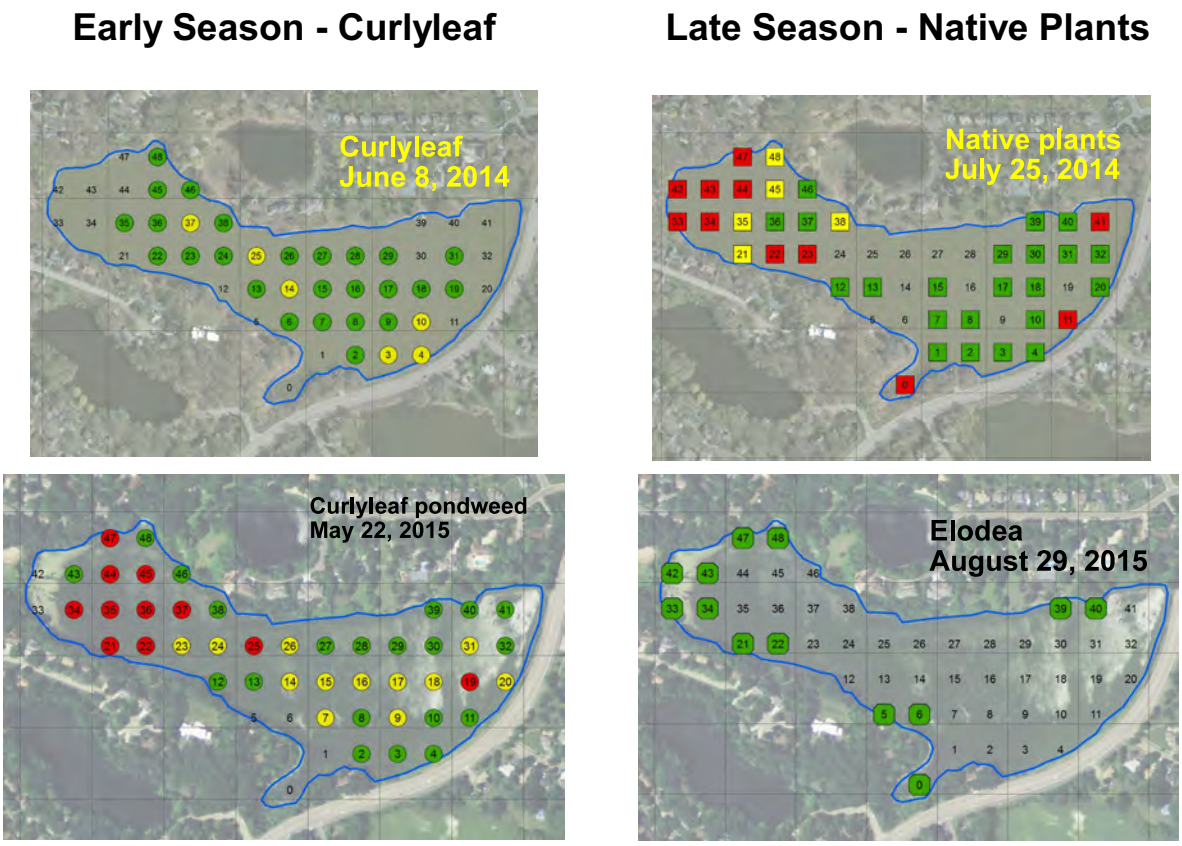


Figure 8. Concluded:
2014: Early summer curlyleaf coverage: 21 ac. Late summer aquatic plant coverage: 24 ac.
2015: Early summer curlyleaf coverage: 30 ac. Late summer aquatic plant coverage: 9 ac.
Green shading = light growth, yellow shading = moderate growth, and red shading = heavy growth.

Conclusions: The aquatic plant community in 2015 had 3 species of submerged plants in early summer and 2 species in late summer. This is a low plant diversity condition. Curlyleaf pondweed was the only non-native plant present.

Curlyleaf pondweed covered about 29 acres in early summer. Curlyleaf pondweed growth ranged from light to heavy with the heaviest growth in the west end of Long Lake.

In late summer in 2015, aquatic plants covered about 27% of the lake and grew out to about 3-feet of water depth (which is the maximum depth of Long Lake at normal lake levels).

Eurasian watermilfoil was not found in either survey.

Curlyleaf pondweed previously has been managed in Long Lake with drawdowns. Over the 2009-2010 and the 2013-2014 winter, Long Lake was drawn down. In the early summer of 2010 and 2014, curlyleaf distribution was reduced compared to surveys conducted prior to the drawdown. However, curlyleaf data from May in 2015 indicates curlyleaf pondweed has returned from the 2013-2014 drawdown.

Figure 9. Stringy pondweed was present in Long Lake on July 25, 2014.

Appendix

Potential Curlyleaf Pondweed Growth in the Future

Lake Areas that Could Support Nuisance Curlyleaf Growth Based on Lake Sediment Characteristics: Lake sediment sampling results from 2005 have been used to predict lake bottom areas that have the potential to support heavy growth of curlyleaf pondweed. Based on the key sediment parameters of pH, sediment bulk density, organic matter, and the Fe:Mn ratio (McComas, unpublished), the predicted growth characteristics of curlyleaf pondweed are shown in Table A1 and Figure A1.

Curlyleaf pondweed growth is predicted to produce moderate growth conditions (defined as where plants top out at the surface but do not form a heavy matted condition) over most of the lake in water depths of 3 to 5 feet. In fact curlyleaf has been found to top out in a number of areas in Farquar and Long Lakes and this was documented in a plant survey in May of 2005. However, the sediment data would indicate stem densities should be less than 400 stems/m^2. In 2014, stem densities were generally below the 400 stem/m^2.

Table A1. Farquar and Long Lakes sediment data and ratings for potential nuisance curlyleaf pondweed growth.

Site	pH (su)	Bulk Density (g/cm^3 dry)	Organic Matter (%)	Fe:Mn Ratio	Potential for Nuisance Curlyleaf Pondweed Growth
Non-Nuisance	**6.8**	**1.04**	**5**	**4.6**	**Low (green)**
Light Nuisance	**6.2**	**0.94**	**11**	**5.9**	**Medium (yellow)**
Heavy Nuisance	**>7.7**	**<0.51**	**>20**	**<1.6**	**High (red)**
Farquar Lake					
1	6.6	0.85	6.5	10.75	Medium
2	6.2	0.74	12.3	6.96	Medium
3	6.7	1.27	1.6	6.09	Low
4	6.1	1.46	0.6	9.21	Medium
5	6.7	1.54	0.4	9.99	Low
6	6.1	0.78	14.2	13.00	Medium
7	6.2	0.74	12.8	9.67	Medium
8	6.4	1.02	3.9	8.05	Medium
Farquar Lake					
1R	6.8	0.88	8.3	9.44	Medium
2R	6.3	0.82	10.7	7.58	Medium
7R	6.3	0.72	13.5	5.72	Medium

Site	pH (su)	Bulk Density (g/cm^3 dry)	Organic Matter (%)	Fe:Mn Ratio	Potential for Nuisance Curlyleaf Pondweed Growth
Non-Nuisance	**6.8**	**1.04**	**5**	**4.6**	**Low (green)**
Light Nuisance	**6.2**	**0.94**	**11**	**5.9**	**Medium (yellow)**
Heavy Nuisance	**>7.7**	**<0.51**	**>20**	**<1.6**	**High (red)**
Long Lake					
1	7.1	0.96	4.1	10.90	Medium
2	6.5	0.95	6.1	6.99	Medium
3	6.4	0.79	10.0	7.26	Medium
4	6.1	0.58	19.8	6.71	Medium
5	6.0	0.63	22.2	7.18	Medium

Figure A1. Lake sediment sample locations shown with dots. Long Lake is on the left and Farquar is on the right. The dot color indicates the potential for nuisance curlyleaf pondweed to occur at that site. Key: yellow dot = medium growth potential.

Potential Eurasian Watermilfoil Growth in the Future (EWM is not present as of 2014)

Lake Areas that Could Support Nuisance Eurasian Watermilfoil Growth Based on Lake Sediment Characteristics: Lake sediment sampling results from 2005 have been used to predict lake bottom areas that have the potential to support heavy growth of EWM. Based on the key sediment parameters of NH_4 and organic matter (McComas, unpublished), a table and map were prepared that predict what type of growth could be expected in the future (Table A2 and Figure A2).

The sediment nitrogen conditions in Farquar and Long Lakes are relatively high. As of 2014, Eurasian watermilfoil has not been found in either Farquar or Long Lakes. However, if it did invade the lakes, it is predicted that Eurasian watermilfoil could produce perennial nuisance matting conditions (which are defined as heavy matted condition) based on sediment characteristics in a number of locations (Figure 9).

Table A2. Farquar and Long Lakes sediment data and ratings for potential nuisance Eurasian watermilfoil growth.

Site	NH_4 Conc (ppm)	Organic Matter (%)	Potential for Nuisance EWM Growth
Non-Nuisance or Light Nuisance	<10	>20	Low (green) to Medium (yellow)
Heavy Nuisance	>10	<20	High (red)
Farquar Lake			
1	14.7	6.5	High
2	29.8	12.3	High
3	8.3	1.6	Medium
4	5.7	0.6	Medium
5	4.9	0.4	Low
6	21.2	14.2	High
7	22.5	12.8	High
8	6.7	3.9	Medium
Farquar Lake			
1R	13.6	8.3	High
2R	15.7	10.7	High
7R	6.9	13.5	Medium

Site	NH_4 Conc (ppm)	Organic Matter (%)	Potential for Nuisance EWM Growth
Non-Nuisance or Light Nuisance	<10	>20	Low (green) to Medium (yellow)
Heavy Nuisance	>10	<20	High (red)
Long Lake			
1	13.8	4.1	High
2	34.9	6.1	High
3	16.5	10.0	High
4	20.6	19.8	High
5	32.2	22.2	Medium

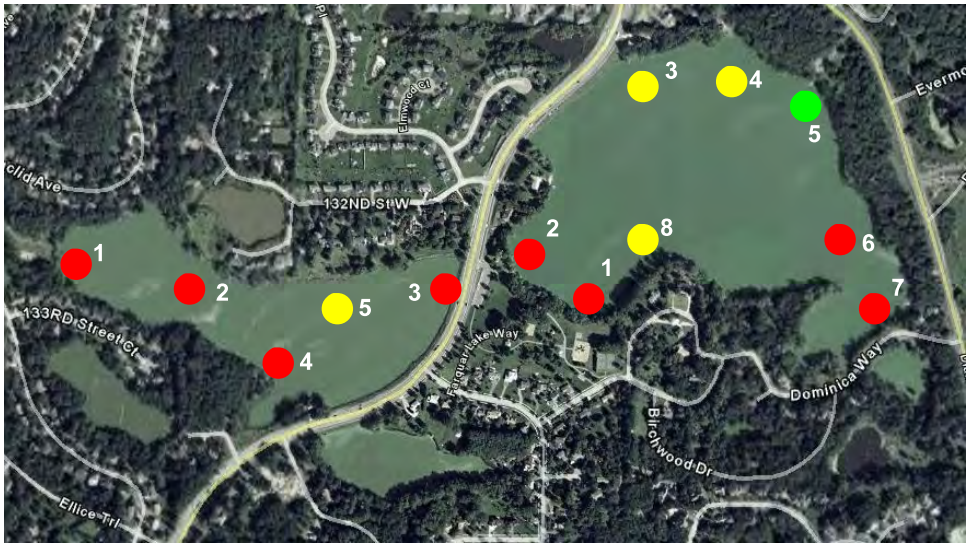


Figure A2. Lake sediment sample locations shown with dots. Long Lake is on the left and Farquar Lake is on the right. The dot color indicates the potential for nuisance Eurasian watermilfoil to occur at that site. Key: green dot = low; yellow dot = medium; red dot = high potential.

Aquatic invasive species warming up

The shredded invasive curlyleaf pondweed mystery

THE LAKE DETECTIVE

BY STEVE McCOMAS

The curlyleaf pondweed growing season is about over for the year. It should be dying back by now, but it had a pretty good run in a lot of lakes this spring and early summer. Curlyleaf pondweed, a non-native invasive, is found in more than 750 Minnesota lakes, according to the DNR.

At this time, there is no known method to control the heavy growth of curlyleaf pondweed on a long-term basis. Herbicides and mechanical harvesting will subdue curlyleaf for a season, but it will come back the following year.

However, in mid-June, I was surveying curlyleaf in Long Lake in Apple Valley and found the curlyleaf leaves in the top foot of the canopy throughout the whole lake were shredded and the curlyleaf community was not matted at the surface like it usually is. The other native plants were not bothered. At first I thought it might be hail damage, but there wasn't any hail that week. What had happened to the curlyleaf? I had a plant mystery on my hands.

I collected some plants and brought them back to the laboratory where I shook some of the plants over a tub of water and a number of insects fell off the plants. I collected the bugs and looked at them under a microscope. They must have been the culprits feeding on the Long Lake curlyleaf, but under the microscope they were pretty nondescript, probably working undercover.

Could these insects be feeding on the curlyleaf in Long Lake? Could these aquatic invertebrates control curlyleaf? Could this be a new curlyleaf control technique? I'll have to identify the suspects first, then check their backgrounds.

Zebra mussel update

Spring has finally given way to summer, and water temperatures have been above 60 degrees for over a month. That means male and female zebra mussels have been producing gametes (sperm and eggs) for over a month as well. Zebra mussels start releasing gametes when water temperatures get above 55F. The gametes meet in the water column, get fertilized, and in short order produce veligers, which are weak swimmers and will settle out and start forming a shell in a few days. They will establish an attachment to a solid surface with byssal threads. However, a new 2013 mussel invasion won't likely be discovered for another month or two until the zebra mussel shells grow up to about ¼ inch (6 mm) or larger so we can see them. The 2013 zebra mussel class will consist primarily of juveniles and will not likely reproduce this season.

There is one extra thing to guard against this boating season. Both juveniles and adults sometimes think aquatic plants are solid surfaces and suitable habitat for attachment. I was out on Lower Prior Lake last week and zebra mussels were growing on the stems of aquatic plants. Therefore, leaving a lake that has a zebra mussel population and transporting plants on trailers could also result in transporting zebra mussels.

Veligers and young zebra mussels will continue to be produced through July and August until water temperatures drop into the 50s in September. The zebra mussel season is in full swing right now.

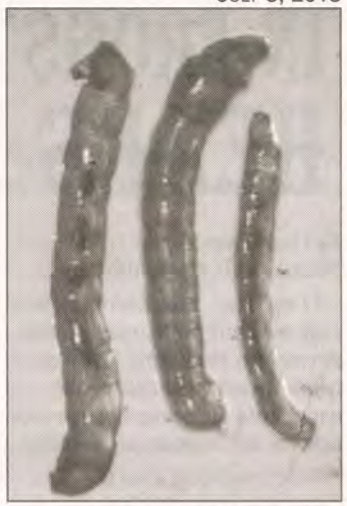
The growing potential for problems with Asian carp

Just when it looked like the Asian carp scare in the Great Lakes may have been a little exaggerated, it turns out they could be more of a problem than some figured. In the carps' native habitat, they have been thought to have very specific spawning requirements. It was generally figured silver and bighead carp spawned only in rivers, with at least a length of 62 miles (100 kilometers) with a flow velocity of 1 to 10 feet per second to keep eggs suspended in the river.

At first glance, there didn't seem to be many Great Lakes tributary rivers that matched these characteristics. However, a recent U.S. Geological Survey study has some new findings.

They found Asian carp eggs can stay in suspension in rivers as short as 16 miles with flows as low as 0.5 feet per second. This means several tributary rivers to the Great Lakes that initially did not appear to be suitable spawning habitat now appear to be able to support Asian carp spawning.

It is only a prediction at this time, but in nature, if a fish has a chance to accomplish something, however remote, the odds are they will pull it off.



Here are the suspects in a line-up in the shredded curlyleaf pondweed mystery. They all appear to be in the midge fly family (chironomid), but that's all the Lake Detective knows at this time. Eventually these larvae would turn into a midge and fly away. Can these chironomids control curlyleaf? The case is ongoing.

Photo courtesy of Steve McComas

2005 data

June 3, 2005: Long Lake aquatic plant occurrences and densities for the June 3, 2005 survey based on a total of 29 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=29)		
	Occur	% Occur	Density
Elodea (*Elodea canadensis*)	4	14	0.8
Curlyleaf pondweed (*Potamogeton crispus*)	27	93	4.0
Stringy pondweed (*P. pusillus*)	2	7	1.0

June 3, 2005: Transect data for Long Lake for June 3, 2005.

Station number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Depth (ft)	3	3	3	4	4	4.5	3.5	3	4.5	4.5	3	1	4.5	5	4.5
Elodea	0.5							0.5							
Curlyleaf pondweed	5	5	5	4.5	3.5	3.5	5	5	3	2	5		2	2	2.5
Stringy pondweed															

Station number	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Depth (ft)	3	4.5	3.5	1	3	3	4.5	3	3	4	3	1	3	1
Elodea				1								1		
Curlyleaf pondweed	5	2	5		5	5	3.5	5	5	4.5	5	1	5	5
Stringy pondweed				1								1		

September 1, 2005: Long Lake aquatic plant occurrences and densities for the September 1, 2005 survey based on a total of 29 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=29)		
	Occur	% Occur	Density
Elodea (*Elodea canadensis*)	11	39	0.7
Floatingleaf pondweed (*Potamogeton natans*)	1	4	3.0

September 1, 2005: Transect data for Long Lake for September 1, 2005.

Station number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Depth (ft)	2	3	3	4	4	4.5	3.5	3	4	4	3	1	4	4.5
Elodea	0.5	0.5					0.5					0.5		
Floatingleaf pondweed														

Station number	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Depth (ft)	3	4.5	3.5	1	3	4.5	3	2	4	3.5	2	2	1	1.5	1.5
Elodea	0.5			0.5				1			1	1	1	1	
Floatingleaf pondweed								3							

2010 data

June 11, 2010: Long Lake aquatic plant occurrences and densities for the June 11, 2010 survey based on a total of 29stations. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=29)		
	Occur	% Occur	Density
Smartweed (*Polygonum sp*)	1	3	1.0
Burreed (*Sparganium sp*)	1	3	1.0
Duckweed (*Lemna sp*)	1	3	0.5
Curlyleaf pondweed (*Potamogeton crispus*)	20	69	1.5*
Floatingleaf pondweed (*P. natans*)	2	7	0.8
Sago pondweed (*Stuckenia pectinata*)	1	3	1.0

*average stem density estimated at 58 stems/m^2

June 11, 2010: Transect data for Long Lake for June 11, 2010.

Station number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Depth (ft)	1	2	1	4	3	4.5	2	3	4	4	1	1	4	4
Smartweed														
Burreed														
Duckweed														
Curlyleaf pondweed			2	1	2	2	0.5	3	2	1	1		3	2
Curlyleaf - stems per rake			*8*	*4*	*8*	*7*	*1*	*7*	*12*	*4*	*4*		*16*	*9*
Floatingleaf pondweed														
Sago pondweed														

Station number	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Depth (ft)	1	3	4	3	1	2.5	2	1	1	1	2	2.5	1	1	1
Smartweed														1	
Burreed									1						
Duckweed									0.5						
Curlyleaf pondweed	0.5	0.5	1			4	0.5			0.5	2	0.5		0.5	
Curlyleaf - stems per rake	*1*	*1*	*4*			*20*	*1*			*1*	*6*	*1*		*1*	
Floatingleaf pondweed										1	0.5				
Sago pondweed												1			

August 20, 2010: Long Lake aquatic plant occurrences and densities for the August 20, 2010 survey based on a total of 29 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=29)		
	Occur	% Occur	Density
Coontail (*Ceratophyllum demersum*)	1	3	1.0
Curlyleaf pondweed (*Potamogeton crispus*)	2	7	0.8
Floatingleaf pondweed (*Potamogeton natans*)	2	7	1.5

August 20, 2010: Point-intercept data for Long Lake for August 20, 2010. Numbers represent plant density at that station.

Station number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Depth (ft)	3	4	1	5	3	4	3.5	5	4	4	4.5	4	4	4
Coontail														
Curlyleaf pondweed			0.5											
Floatingleaf pondweed														

Station number	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Depth (ft)	4	4	4	4	1	4.5	5.5	4.5	2	3	4.5	4	3	3	3.5
Coontail													1		
Curlyleaf pondweed										1					
Floatingleaf pondweed										2					1

2013 data

June 23, 2013: Long Lake aquatic plant occurrences and densities for the June 23, 2013 survey based on 49 sites. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=49)		
	Occur	% Occur	Density
Coontail (*Ceratophyllum demersum*)	1	2	1.0
Elodea (*Elodea canadensis*)	16	33	1.3
Curlyleaf pondweed (*Potamogeton crispus*)	46	94	2.7
Stringy pondweed (*P. sp*)	3	6	2.0
Sago pondweed (*Stuckenia pectinata*)	2	4	1.5

June 23, 2013: Individual site data for June 23, 2013.

Site	Depth (ft)	Curlyleaf pondweed	Coontail	Elodea	Sago pondweed	Stringy pondweed
0	2	1				3
1	3	1		1	1	
2	4	4.5				
3	4	4				
4	3	4		1		
5	3	1		1		
6	4	3				
7	5	3				
8	5	3				
9	4	3		1		
10	5	3				
11	3					
12	4	2				
13	5	4				
14	5	3				
15	5	3				
16	4	2				
17	4	3				
18	5	4				
19	4	3				
20	3	2				
21	2	2				
22	4	2				
23	4	4				
24	5	4				
25	3	1		1		
26	4	1		1		
27	3	1		2		
28	3	3				
29	4	4				
30	3	4				
31	3	3		1		
32	2				2	
33	2	1				
34	4	2				2
35	4	3		1		
36	4	3				
37	4	3		1		
38	3	1		2		
39	3	2				
40	2	2				
41	3	3		2		
42	2	1		1		
43	5	4.5				
44	3	4				
45	4	4.5	1	2		
46	2			1		
47	4	4.5				
48	2	1		2		1
Average		2.7	1.0	1.3	**1.5**	**2.0**
occurrence (49 sites)		46	1	16	2	3
% occurrence		94	2	33	4	6

August 5, 2013: Long Lake aquatic plant occurrences and densities for the August 5, 2013 survey based on 49 sites. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=49)		
	Occur	% Occur	Density
Duckweed (*Lemna sp*)	1	2	1.0
Coontail (*Ceratophyllum demersum*)	1	2	1.0
Elodea (*Elodea canadensis*)	22	45	1.5
Curlyleaf pondweed (*Potamogeton crispus*)	33	67	1.4
Stringy pondweed (*P. sp*)	9	18	1.4
Flatstem pondweed (*P. zosteriformis*)	1	2	1.0

August 5, 2013: Individual site data for August 5, 2013.

Site	Depth	Duckweed	Curlyleaf	Coontail	Elodea	Flatstem	Stringy	No Plants
0	2	1					1	
1	3		1		1			
2	4		2				1	
3	4		2					
4	3		2				1	
5	3				1			
6	4		2					
7	3		2		1			
8	4		2					
9	4		1					
10	4		1					
11	3				1			
12	4							1
13	5		1					
14	5		1					
15	5		1					
16	4		3					
17	4		1					
18	4		1					
19	4		1					
20	3							1
21	2		1		3	1		
22	4							1
23	4		1					
24	5		1					
25	4		1		1			
26	4		2					
27	4		1		1			
28	4		2		1			
29	4		2		1			
30	4		2		1			
31	3							1
32	3				2			
33	2							1
34	4		1	1			1	
35	4		1		1		1	
36	4		1		1			
37	4		1		1			
38	3		1		2			
39	2				1			
40	1							1
41	2				1			
42	2						2	
43	2						1	
44	3		1		1		4	
45	4		2		1			
46	2				4			
47	2		1		2		1	
48	3				3			
Average		**1.0**	**1.4**	**1.0**	**1.5**	**1.0**	**1.4**	
occurrence (49 sites)		1	33	1	22	1	9	6
% occurrence		2	67	2	45	2	18	

2014 data

June 9, 2014: Long Lake aquatic plant occurrences and densities for the June 9, 2014 survey based on 49 sites. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=49)		
	Occur	% Occur	Density
Elodea (*Elodea canadensis*)	2	4	1.0
Curlyleaf pondweed (*Potamogeton crispus*)	31	63	1.7
Floatingleaf pondweed (*P. natans*)	1	2	1.0
Stringy pondweed (*P. sp*)	16	33	1.8

June 9, 2014: Individual site data for June 9, 2014. Numbers in boxes indicate plant density.

Site	Depth (ft)	Elodea	Curlyleaf pondweed	Curlyleaf - stems	Floatingleaf pondweed	Stringy pondweed	No plants
0	3					3	
1	3					3	
2	5		2	8			
3	5		3	20			
4	4		3	20			
5	4						1
6	5		1	4			
7	5		2	8			
8	5		1	2			
9	5		1	3			
10	3		3	20			
11	4						1
12	3						1
13	5		2	10		1	
14	5		3	15			
15	6		1	3			
16	5		1	4			
17	5		2	12			
18	6		1	4			
19	5		2	9			
20	5					2	
21	3					2	
22	4		1	5		1	
23	5		1	1			
24	6		2	5			
25	5		3	20			
26	5		1	2			
27	5		1	3			
28	5		1	2			
29	6		1	4			
30	6						1
31	5		1	1			
32	4					1	
33	4					2	
34	4					3	
35	5		1	4		1	
36	5		2	10			
37	5		3	10			
38	5		1	6			
39	5						1
40	5	1				1	
41	5					1	
41	5					2	
42	4				1	3	
43	5	1				2	
45	6		2	8			
46	5		2	7			
47	5						1
48	5		1	3		1	
Average		1.0	1.7	7.5	1.0	1.8	1.0
occurrence (49 sites)		2	31	31	1	16	6
% occurrence		4	63	63	2	33	12

July 25, 2014: Long Lake aquatic plant occurrences and densities for the July 25, 2014 survey based on 49 sites. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=49)		
	Occur	% Occur	Density
Duckweed (*Lemna sp*)	7	14	1.3
Elodea (*Elodea canadensis*)	5	10	1.8
Naiads (*Najas flexilis*)	3	6	1.0
Curlyleaf pondweed (*Potamogeton crispus*)	38	78	2.1
Stringy pondweed (*P. sp*)	33	67	2.5
Sago pondweed (*Stuckenia pectinata*)	7	14	1.3
Filamentous algae	2	4	1.0

July 25, 2014: Individual site data for July 25, 2014. Numbers in boxes indicate plant density.

Site	Depth (ft)	Duckweed	Curlyleaf	Elodea	Naiads	Sago	Stringy	Fila algae
0	2	3				1	5	
1	4	1	3					
2	4		3				1	
3	4		1				1	
4	3	1	1			1	1	
5	3		1					
6	4		1					
7	4	1	2				1	
8	5	1	3				1	
9	4		3					
10	4						1	
11	3	1					4	
12	4		1			1	1	
13	5		2				1	
14	5		2					
15	5		3				1	
16	5		2					
17	4		3				1	
18	4		3			1		
19	4		3					
20	3		2				1	
21	3	1	2	1			3	
22	4		3	1			4	
23	5		3				4	
24	5		2					
25	5		2					
26	4		3					
27	4		3					
28	4		3					
29	4		1				1	
30	4		1				1	
31	4					2	1	
32	3					1	1	
33	2						5	
34	4		1		1		5	
35	4		3				3	
36	5		4				2	
37	5		3				2	
38	3		1	2			3	
39	4		2					
40	2					2		
41	3			4				
42	1				1		5	1
43	3				1		5	1
44	4		1				4	
45	5		2				3	
46	4		1	1			2	
47	4						5	
48	4		1				3	
Average		1.3	2.1	1.8	1.0	1.3	2.5	1.0
occurrence (49 sites)		7	38	5	3	7	33	2
% occurrence		14	78	10	6	14	67	4