Birch Lake, Ramsey County, Minnesota (Google Maps)

Aquatic Plant Point-Intercept Survey for Birch Lake, Ramsey County, Minnesota, 2013

Prepared for:
Birch Lake Improvement District

Prepared by:
Steve McComas and
Jo Stuckert
Blue Water Science
St. Paul, MN

December 2013

Aquatic Plant Point-Intercept Survey for Birch Lake, Ramsey County, Minnesota, 2013

Summary

One aquatic plant point-intercept survey was conducted on Birch Lake (123 acres) in the summer of 2013. The September 5, 2013 survey was to characterize the aquatic plants community of Birch Lake.

In September, fern pondweed was the dominant plant and was found at 26 out of 45 sample sites (58% of the sites)(Table S-1). Plants grew out to about 6 feet of water which was also about the deepest depth in the lake.

Figure S-1. Water lilies in Birch Lake on September 5, 2013.

Table S-1. Birch Lake aquatic plant occurrences and densities for the 2007 and 2013 surveys. Density ratings are 1-5 with 1 being low and 5 being most dense.

	2007 June 1 (n=57)			2007 September 5 (n=47)			2013 September 5 (n=45)		
	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density
Arrowhead (*Sagittaria*)	1	2	1.0	--	--	--	--	--	--
Three square (*Scirpus americanus*)	1	2	1.0	--	--	--	--	--	--
Bulrush (*Scirpus sp*)	--	--	--	1	2	1.0	--	--	--
Cattail (*Typha sp*)	--	--	--	--	--	--	2	4	3.0
Watershield (*Brasenia schreberi*)	2	4	1.0	2	4	4.5	--	--	--
Spatterdock (*Nuphar variegatum*)	8	15	4.0	1	2	4.0	2	4	2.0
White waterlilies (*Nympaea tuberosa*)	1	2	1.0	1	2	2.0	3	7	2.7
Coontail (*Ceratophyllum demersum*)	--	--	--	1	2	1.0	1	2	0.5
Chara (*Chara sp*)	7	13	1.1	--	--	--	6	13	1.7
Needle spikerush (*Eleocharis acicularis*)	1	2	1.0	--	--	--	--	--	--
Elodea (*Elodea canadensis*)	14	26	1.0	3	6	1.0	--	--	--
Northern watermilfoil (*Myriophyllum sibiricum*)	1	2	2.0	--	--	--	--	--	--
Milfoil (*M. sp*)	16	30	1.6	--	--	--	--	--	--
Eurasian watermilfoil (*M. spicatum*)	2	4	1.5	16	34	1.5	3	7	1.0
Naiads (*Najas flexilis*)	--	--	--	1	2	1.0	2	4	1.5
Cabbage (*Potamogeton amplifolius*)	17	31	1.6	20	43	0.9	5	11	1.6
Illinois pondweed (*P. illinoensis*)	1	2	0.5	--	--	--	2	4	2.0
Fern pondweed (*P. Robbinsii*)	52	96	3.6	47	100	3.8	26	58	2.3
Stringy pondweed (*P. sp*)	--	--	--	--	--	--	3	7	1.0
Flatstem pondweed (*P. zosteriformis*)	--	--	--	--	--	--	4	9	1.5
Rosette (*Sagittaria sp*)	1	2	1	--	--	--	--	--	--
Water celery (*Vallisneria americana*)	--	--	--	12	26	1.5	17	38	1.6
TOTAL NUMBER OF SUBMERGED AQUATIC PLANT SPECIES	10	--	--	7	--	--	10	--	--

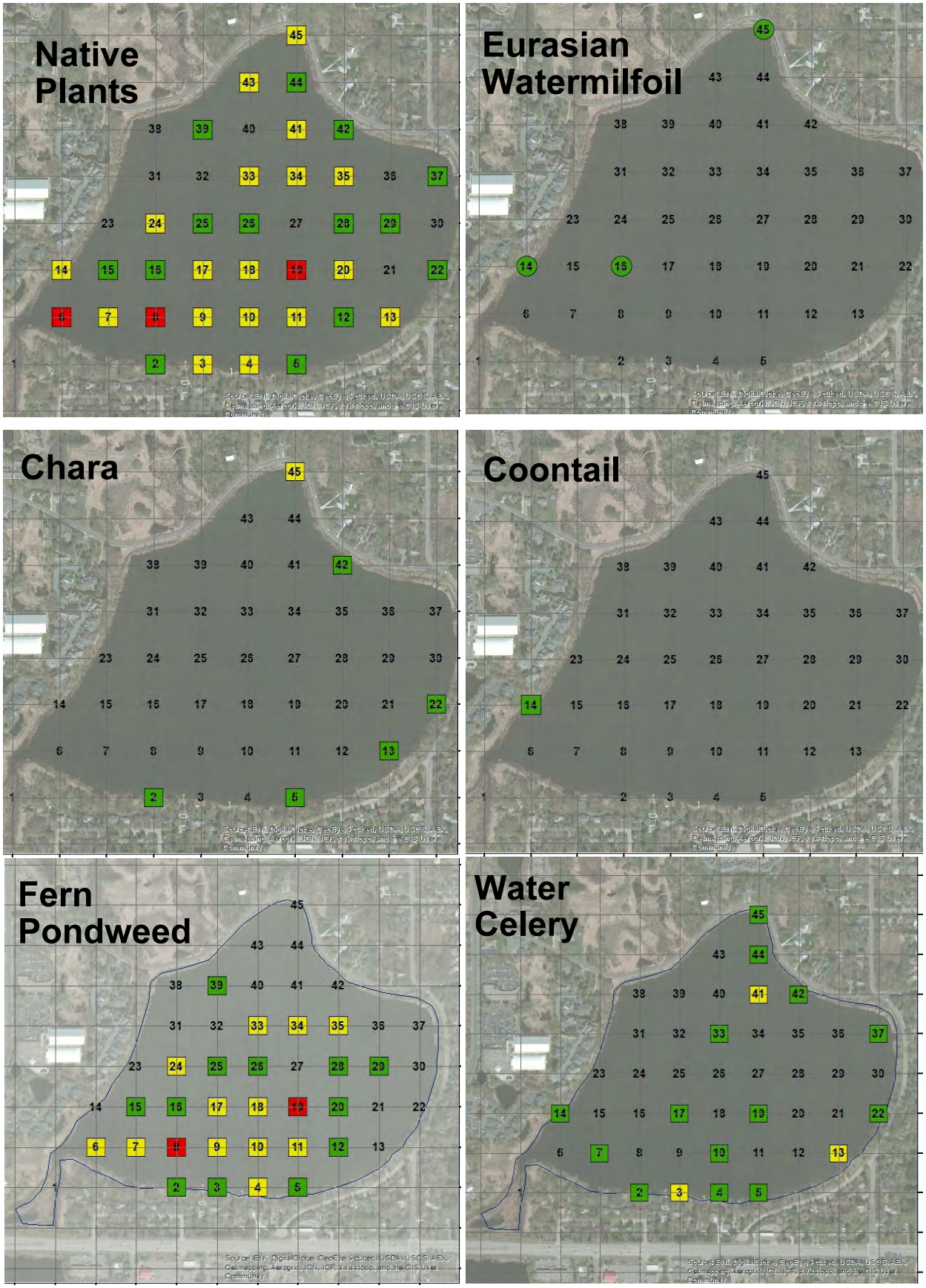

Figure S-2. Coverage Maps for September 5, 2013: (top-left) Native aquatic plant; (top-right) Eurasian watermilfoil; (middle-left) Chara; (middle-right) Coontail; (bottom-left) Fern pondweed; and (bottom-right) Water celery. Key: Green shading = light growth, yellow shading = moderate growth, and red shading = heavy growth.

Conclusions and Recommendations for Aquatic Plant Management in Birch Lake:
The aquatic plant community in 2013 has ten species of submerged plants in late summer. This is a good plant diversity condition. Eurasian watermilfoil was the only non-native plant present.

Eurasian watermilfoil covers about 8 acres in late summer but was found to have mostly light growth. Eurasian watermilfoil control is probably unnecessary at this time.

In late summer, aquatic plants cover about 98 acres and grow out to about 6-feet of water depth. Fern pondweed was abundant all around Birch Lake. In the future, native plants may produce heavy growth in some areas of this shallow lake. If heavy growth needs to be managed, harvesting is the recommended plant control technique.

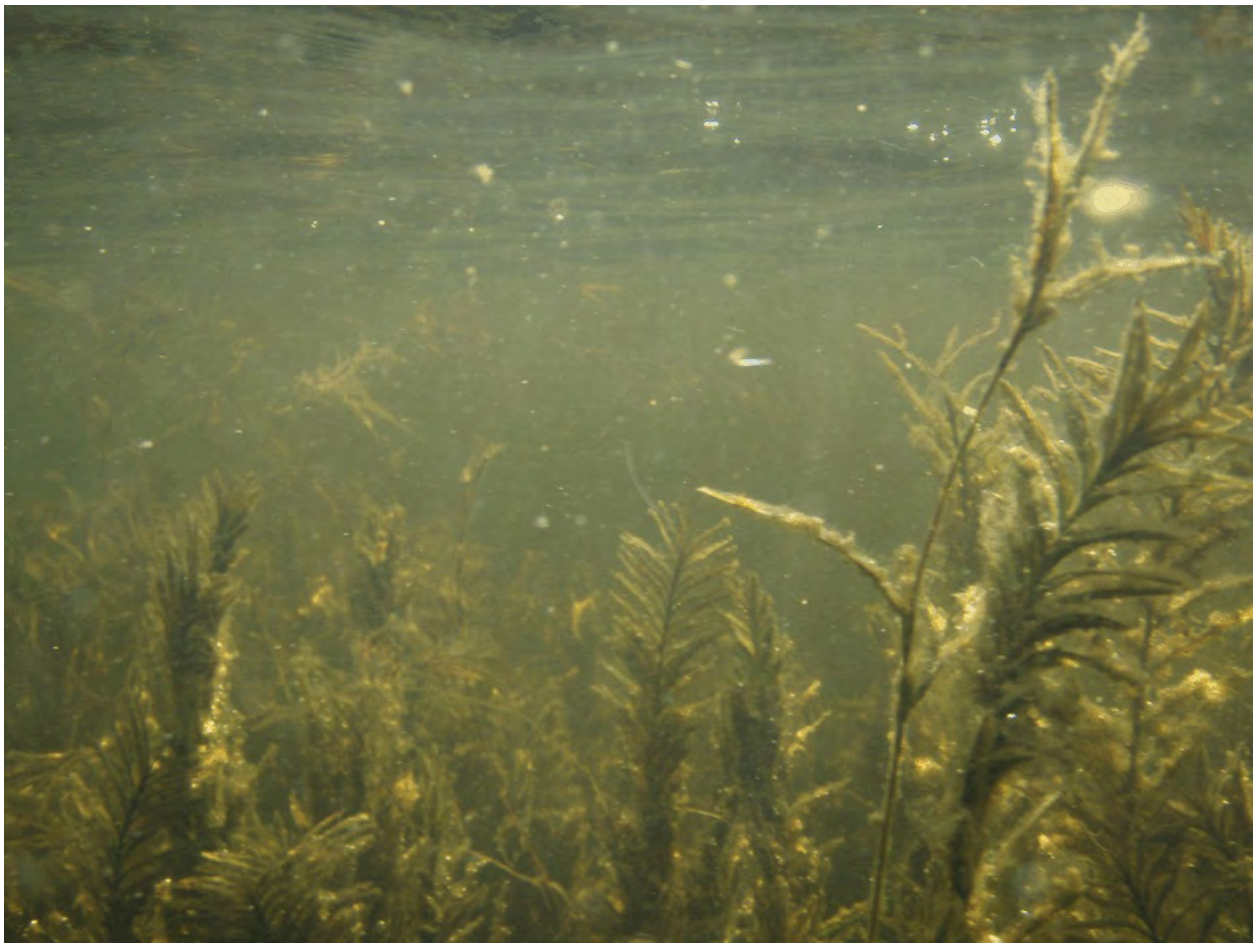

Figure S-3. Fern pondweed is the dominant plant in Birch Lake.

Aquatic Plant Point-Intercept Survey for Birch Lake, Ramsey County, Minnesota, 2013

1. Introduction

Birch Lake is located in Ramsey County and lies within the Vadnais Lake Area Water Management Organization (Figure 1). Birch Lake is a shallow lake with a maximum depth of about 6 feet. The 123 acre lake has clear water and abundant aquatic vegetation.

Figure 1. Birch Lake aerial map from Google Earth.

Methods - Aquatic Plant Surveys

An aquatic plant survey of Birch Lake (123 acres) using a point intercept sampling method was conducted by Blue Water Science on September 5, 2013. A map and sampling grid were prepared by Blue Water Science and a consisted of a total of 45 points that were distributed throughout the lake (Figure 2). Points were spaced 100 meters apart. Each point represented about 2.73 acres. GPS coordinates used a UTM WGS84 datum. For the survey, all sites were checked and plants were found out to 6 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 4 (Figure 3). A density of a "1" indicated sparse growth with one or two stems present on the rake sampler. A 4 rating indicated heavy plant growth.

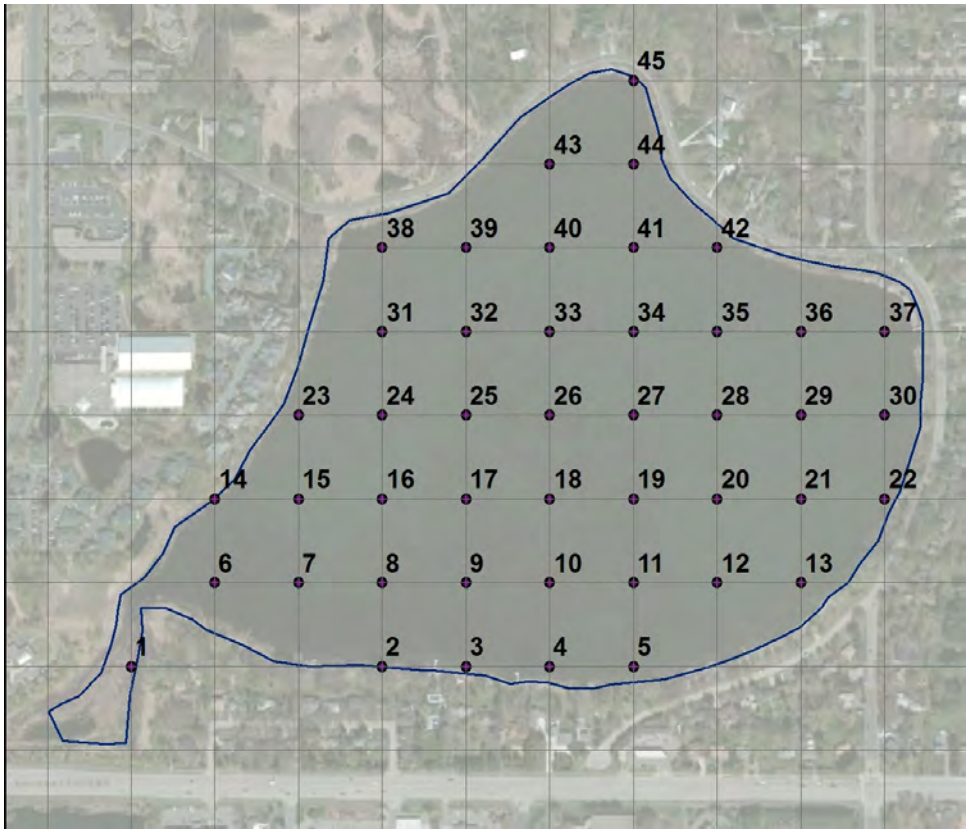

Figure 2. Sample point locations for the Birch Lake aquatic plant survey on September 5, 2013.

Figure 3. Plant density ratings based on rake sampling. A density of 5 is assigned when plants are matted at the surface.

Results of the September 5, 2013 Plant Survey

The most abundant plant in Birch Lake was fern pondweed and it was found at 26 of the 45 sample sites (58%)(Table 1). Eurasian watermilfoil was found growing out to water depths of 5 feet and growth was light. Eurasian watermilfoil was found at 3 sites (Figure 4).

A native aquatic plant coverage map is shown in Figure 4. Native plants were dominated by fern pondweed. A summary of plant density and occurrence for individual sites is shown in Table 2.

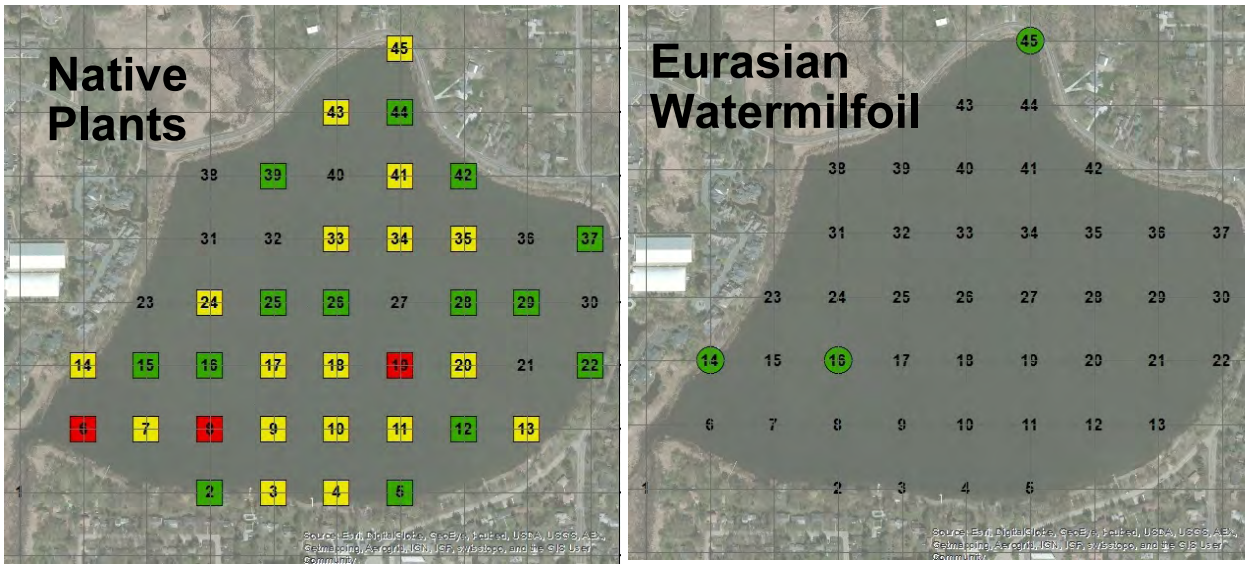

Figure 4. Aquatic plant coverage maps for September 5, 2013.
[top] Native plant coverage was about 95 acres.
[bottom] Eurasian watermilfoil, a non-native species, coverage was about 8 acres.

Table 1. Birch Lake aquatic plant occurrences and densities for the September 5, 2013 survey. Density ratings are 1-5 with 1 being low and 5 being most dense.

	2013 September 5 (n=45)		
	Occur	% Occur	Density
Cattail (*Typha sp*)	2	4	3.0
Spatterdock (*Nuphar variegatum*)	2	4	2.0
White waterlilies (*Nympaea tuberosa*)	3	7	2.7
Coontail (*Ceratophyllum demersum*)	1	2	0.5
Chara (*Chara sp*)	6	13	1.7
Eurasian watermilfoil (*M. spicatum*)	3	7	1.0
Naiads (*Najas flexilis*)	2	4	1.5
Cabbage (*Potamogeton amplifolius*)	5	11	1.6
Illinois pondweed (*P. illinoensis*)	2	4	2.0
Fern pondweed (*P. Robbinsii*)	26	58	2.3
Stringy pondweed (*P. sp*)	3	7	1.0
Flatstem pondweed (*P. zosteriformis*)	4	9	1.5
Water celery (*Vallisneria americana*)	17	38	1.6
TOTAL NUMBER OF SUBMERGED AQUATIC PLANT SPECIES	10	--	--

Table 2. Individual site data for June 13, 2012. Numbers in the columns under plant headings represent the plant density rating.

site	depth (ft)	Cattails	Spatter-dock	White lilies	Cabbage	Chara	Coontail	EWM	Fern pond-weed	Flatstem pond-weed	Illinois pond-weed	Naiads	Stringy pond-weed	Water celery	NO PLANTS
1	1	5													
2	4					1			1					1	
3	4								2				1	3	
4	5								3			2		1	
5	2					1			1					2	
6	4		1	4					3						
7	5								3					1	
8	5								4						
9	6				2				3						
10	5								3					1	
11	5				2				3						
12	6								1						
13	4					1				1		1	1	3	
14	2		3	1	1		0.5	1					1	1	
15	5								1						
16	5							1	1						
17	5				1				3					2	
18	5								3						
19	5								4					2	
20	5								1		3				
21	5														1
22	3					2								2	
23	5														1
24	5								3						
25	5				2				2		1				
26	5								2	1					
27	5														1
28	5								1						
29	5								1						
30	4														1
31	5														1
32	5														1
33	5								3					1	
34	5								3						
35	5								3						
36	5														1
37	4													1	
38	4														1
39	5								1						
40	5														1
41	5													3	
42	4					2				1				1	
43	5									3					
44	5													1	
45	1	1		3		3		1						1	
Average		**3.0**	**2.0**	**2.7**	**1.6**	**1.7**	**0.5**	**1.0**	**2.3**	**1.5**	**2.0**	**1.5**	**1.0**	**1.6**	
occurrence (45 sites)		2	2	3	5	6	1	3	26	4	2	2	3	17	9
% occurrence		4	4	7	11	13	2	7	58	9	4	4	7	38	

Comparison of Aquatic Plant Surveys in 2007 and 2013

Aquatic plant surveys have been conducted in Birch Lake in 2007 and 2013. All the surveys were point-intercept surveys. Coverage maps are shown in Figure 5. The number of submerged aquatic plants has been fairly stable with only seasonal averages changing (Table 3).

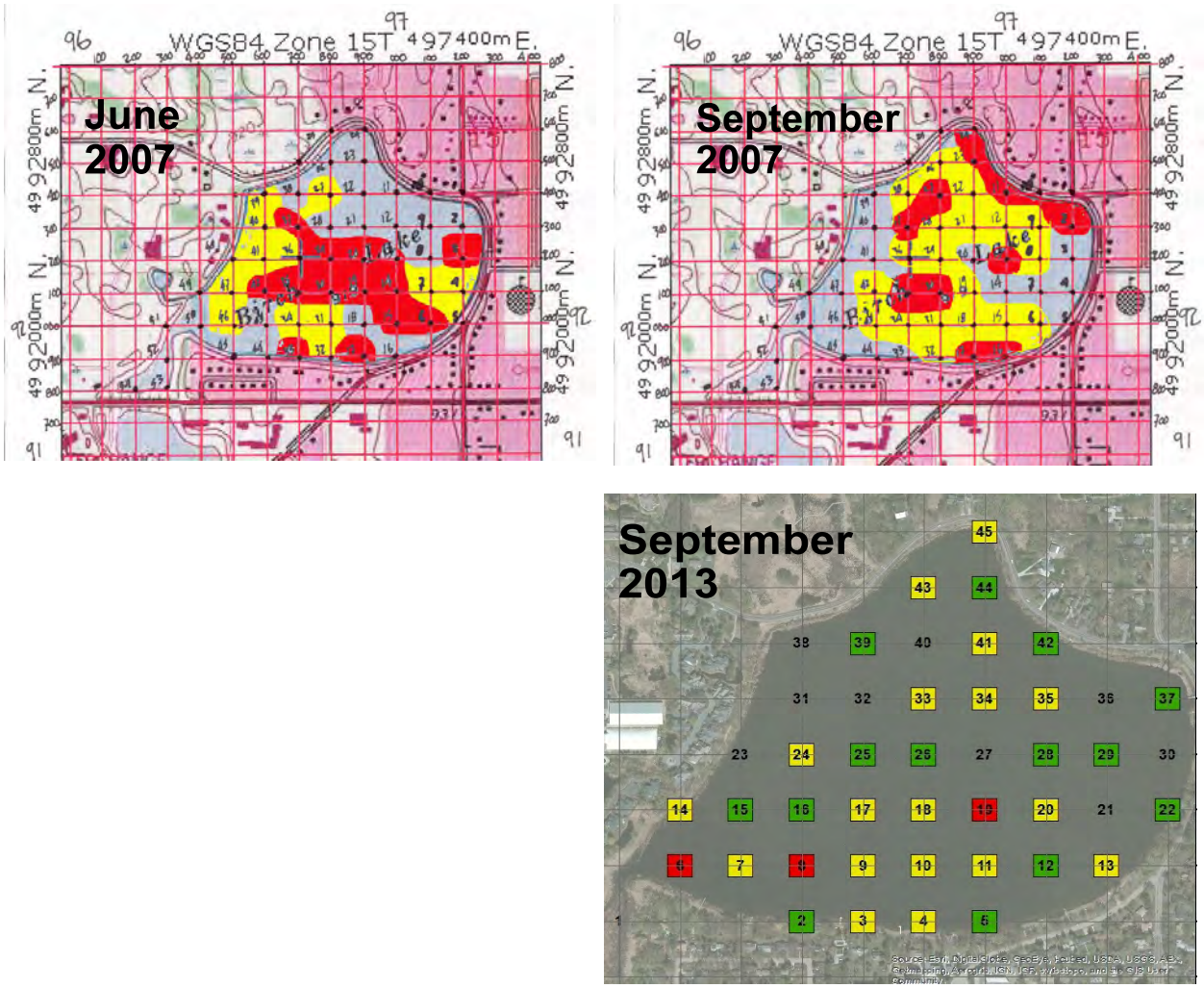

Figure 5. (Top - left) 2007: Aquatic plant coverage for June 1, 2007. Yellow shading = abundant growth and red shading = plants are matting at the surface. Fern pondweed was the dominant plant.
(Top - right) 2007: Aquatic plant coverage for September 5, 2007. Yellow shading = abundant growth and red shading = plants are matting at the surface. Fern pondweed was the dominant plant.
(Bottom - left) 2013: Aquatic plant coverage for September 5, 2013. Green shading = light growth, yellow shading = moderate growth, and red shading = heavy growth.

Table 3. Birch Lake aquatic plant occurrences and densities for the 2007 and 2013 surveys. Density ratings are 1-5 with 1 being low and 5 being most dense.

	2007 June 1 (n=57)			2007 September 5 (n=47)			2013 September 5 (n=45)		
	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density
Arrowhead (*Sagittaria*)	1	2	1.0	--	--	--	--	--	--
Three square (*Scirpus americanus*)	1	2	1.0	--	--	--	--	--	--
Bulrush (*Scirpus sp*)	--	--	--	1	2	1.0	--	--	--
Cattail (*Typha sp*)	--	--	--	--	--	--	2	4	3.0
Watershield (*Brasenia schreberi*)	2	4	1.0	2	4	4.5	--	--	--
Spatterdock (*Nuphar variegatum*)	8	15	4.0	1	2	4.0	2	4	2.0
White waterlilies (*Nympaea tuberosa*)	1	2	1.0	1	2	2.0	3	7	2.7
Coontail (*Ceratophyllum demersum*)	--	--	--	1	2	1.0	1	2	0.5
Chara (*Chara sp*)	7	13	1.1	--	--	--	6	13	1.7
Needle spikerush (*Eleocharis acicularis*)	1	2	1.0	--	--	--	--	--	--
Elodea (*Elodea canadensis*)	14	26	1.0	3	6	1.0	--	--	--
Northern watermilfoil (*Myriophyllum sibiricum*)	1	2	2.0	--	--	--	--	--	--
Milfoil (*M. sp*)	16	30	1.6	--	--	--	--	--	--
Eurasian watermilfoil (*M. spicatum*)	2	4	1.5	16	34	1.5	3	7	1.0
Naiads (*Najas flexilis*)	--	--	--	1	2	1.0	2	4	1.5
Cabbage (*Potamogeton amplifolius*)	17	31	1.6	20	43	0.9	5	11	1.6
Illinois pondweed (*P. illinoensis*)	1	2	0.5	--	--	--	2	4	2.0
Fern pondweed (*P. Robbinsii*)	52	96	3.6	47	100	3.8	26	58	2.3
Stringy pondweed (*P. sp*)	--	--	--	--	--	--	3	7	1.0
Flatstem pondweed (*P. zosteriformis*)	--	--	--	--	--	--	4	9	1.5
Rosette (*Sagittaria sp*)	1	2	1	--	--	--	--	--	--
Water celery (*Vallisneria americana*)	--	--	--	12	26	1.5	17	38	1.6
TOTAL NUMBER OF SUBMERGED AQUATIC PLANT SPECIES	10	--	--	7	--	--	10	--	--

Curlyleaf Pondweed Growth Potential Based on Lake Sediments: Lake sediment sampling results from 2008 have been used to predict areas that could support heavy curlyleaf pondweed growth. Research has found curlyleaf is limited or enhanced based on lake sediment characteristics. Curlyleaf does best in sediments with a high pH and low iron content (McComas, unpublished).

Curlyleaf Pondweed was not observed in Birch Lake in 2013. If it is found in Birch Lake, it is predicted that curlyleaf will grow at light densities based on the sediment analysis. The low pH and high iron content contribute to the low curlyleaf growth potential. If treatment is considered in the future, the latest research indicates the use of harvesting can produce annual control but long-term control is unlikely.

Table 4. Birch Lake sediment data and ratings for potential curlyleaf pondweed growth.

Site	pH (su)	Bulk Density (g/cm^3 dry)	Organic Matter (%)	Fe:Mn Ratio	Potential for Curlyleaf Growth
Light	6.8	1.04	5	4.6	Light (green)
Moderate	6.2	0.94	11	5.9	Moderate (yellow)
Heavy	>7.7	<0.51	>20	<1.6	Heavy (red)
1	5.9	0.445	41.4	7.5	Light
3	5.7	0.767	54.3	12.4	Light
4	5.7	0.720	66.6	12.6	Light
5	5.8	0.770	52.3	8.1	Light
6	5.8	0.794	56.9	10.7	Light
7	5.9	0.553	48.6	16.0	Light
8	5.8	0.799	49.8	6.1	Light
9	5.7	1.342	1.0	18.3	Light
10	6.1	1.071	6.4	11.8	Light
11	6.0	0.774	20.3	5.4	Light
12	5.8	0.615	33.2	10.6	Light
13	5.9	0.775	16.4	14.8	Light
14	5.8	0.748	52.3	21.5	Light
15	5.9	0.790	52.2	16.5	Light
16	5.9	0.585	55.7	16.4	Light
17	6.0	0.539	40.9	6.0	Light
18	6.0	0.684	36.7	17.2	Light
19	6.0	0.638	38.4	11.1	Light
20	6.1	0.867	12.5	8.5	Light

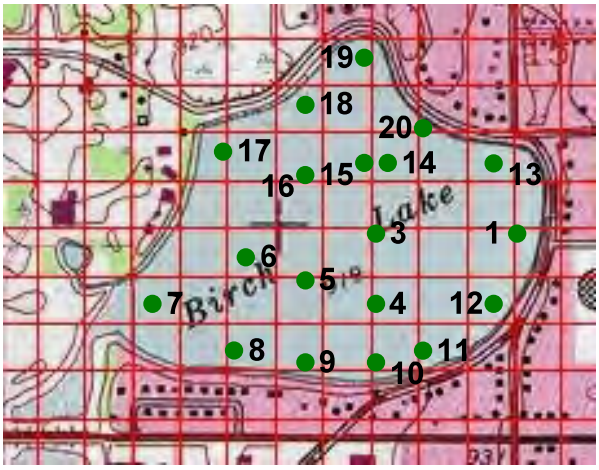

Figure 6. Sediment sample locations are shown with a circle. The circle color indicates the potential for curlyleaf pondweed growth to occur at that site. Key: green = light growth.

Growth Characteristics

Figure 7. Light growth (left) refers to non-nuisance growth that is mostly below the surface and is not a recreational or ecological problem. Moderate growth (middle) refers to growth that is just below the water surface. Heavy growth (right) refers to nuisance matting curlyleaf pondweed. This is the kind of nuisance growth predicted by high sediment pH and a sediment bulk density less than 0.51.

Eurasian Watermilfoil Growth Potential Based on Lake Sediments: Lake sediment sampling results from 2008 have been used to predict lake bottom areas that have the potential to support heavy EWM growth. Eurasian watermilfoil has been found in Birch Lake but it is sparse. 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 5 and Figure 8).

The sediment nitrogen conditions in Birch Lake are relatively high but organic matter is also relatively high which typically inhibits heavy milfoil growth. Eurasian watermilfoil may grow in Birch Lake, but it is predicted that it not will produce extensive perennial nuisance matting conditions (which are defined as heavy growth conditions).

Table 5. Birch Lake sediment data and ratings for potential EWM growth.

Site	NH_4 Conc (ppm)	Organic Matter (%)	Potential for EWM Growth
Light Growth	<4	>20	Light (green)
Moderate Growth	4-10	0.6 - 2 and 18 - 20	Moderate (yellow)
Heavy Growth	>10	2-17	Heavy (red)
1	8	41.4	Light
3	10	54.3	Light
4	40	66.6	Light
5	18	52.3	Light
6	15	56.9	Light
7	13	48.6	Light
8	15	49.8	Light
9	4	1.0	Light
10	8	6.4	Moderate
11	8	20.3	Light
12	9	33.2	Light
13	10	16.4	Heavy
14	16	52.3	Light
15	19	52.2	Light
16	17	55.7	Light
17	13	40.9	Light
18	14	36.7	Light
19	27	38.4	Light
20	8	12.5	Moderate

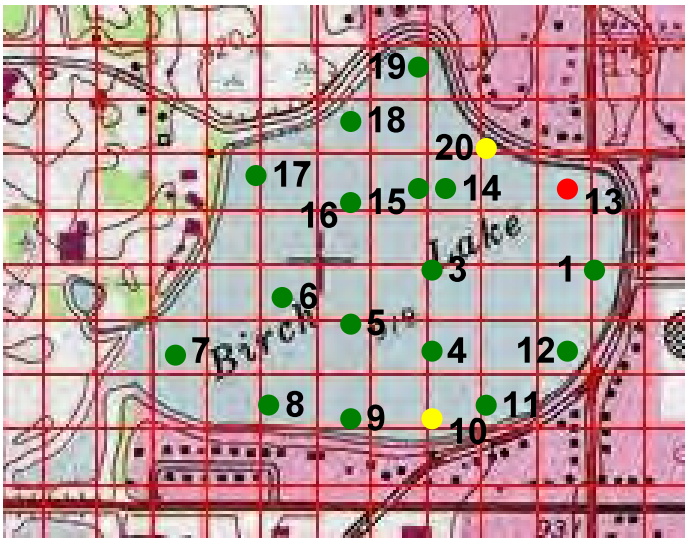

Figure 8. Sediment sample locations are shown with a circle. The circle color indicates the potential for EWM growth to occur at that site. Key: green = low; yellow = medium; red = high potential.

Growth Characteristics

Figure 9. Light growth (left) refers to non-nuisance growth that is mostly below the surface and is not a recreational or ecological problem. Heavy growth (right) refers to nuisance matting Eurasian watermilfoil. This is the kind of nuisance growth predicted by high sediment nitrogen values and a sediment organic matter content less than 20%.

Conclusions and Recommendations for Aquatic Plant Management in Birch Lake

The aquatic plant community in 2013 has ten species of submerged plants in late summer. This is a good plant diversity condition. Eurasian watermilfoil was the only non-native plant present.

Eurasian watermilfoil covers about 8 acres in late summer but was found to have mostly light growth. Eurasian watermilfoil control is probably unnecessary at this time.

In late summer, aquatic plants cover about 98 acres and grow out to about 6-feet of water depth. Fern pondweed was abundant all around Birch Lake. In the future, native plants may produce heavy growth in some areas of this shallow lake. If heavy growth needs to be managed, harvesting is the recommended plant control technique.

Figure 10. September 2013 pictures.
(Top - left) Water lilies in Birch Lake were common in the southwest corner.
(Top - right) Decomposed fern pondweed, a major component of the lake sediments.
(Bottom - left) Water celery was found throughout Birch Lake.
(Bottom - right) Fern pondweed was the most abundant plant in Birch Lake.

Aquatic plant projects

Currently, Birch Lake has a variety of native emergent and submergent aquatic plant species. Aquatic plants are vital for helping sustain clear water conditions and contribute to fish habitat.

The primary aquatic plant goal is to maintain and/or protect native aquatic plants in Birch Lake. The role of aquatic plants in Birch Lake is shown in Figure 11.

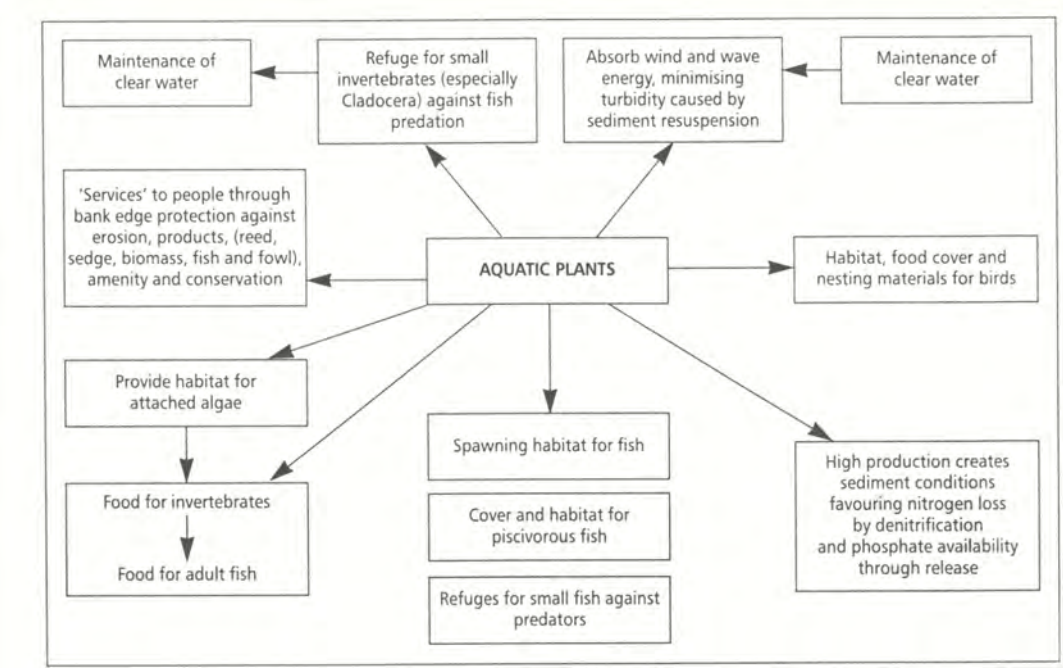

Figure 11. Links between aquatic plants and other organisms, including ourselves (source: Moss and others. 1996. A guide to the restoration of nutrient-enriched shallow lakes. Broads Authority Norwich, England).

Aquatic Plant Harvesting Program

A variety of options are available for managing dense aquatic plant growth. Manual methods, such as weed rakes, can be used to create a channel and remove plants at the same time. Mechanical harvesting is a better option for large projects.

Another option is harvesting channels about 20 to 30 feet wide through the surface matted growth which would allow unrestricted navigation and should not harm the lake. Mechanical harvesters pick-up most of the plants that are cut (Figure 12). Hiring a mechanical harvester to cut channels or clear cut areas would cost about $600 - $800 per acre.

However, the ongoing harvesting operation that is managed by the Birch Lake Improvement District for the heavy growth of the fern pondweed and maybe another plant species or two in Birch Lake is cost effective and is the recommended option. Herbicide controls could increase phosphorus levels and promote algae blooms, however, spot herbicide treatments would be acceptable.

Figure 12. A mechanical harvester used in Birch Lake is a good aquatic plant management option for heavy growth of pondweeds.

Appendix A - 2007 Plant Survey

Table A-1. Birch Lake aquatic plant occurrences and densities for the June 1, 2007 survey based on 57 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=57)		
	Occur	**% Occur**	**Density**
Three square (*Scirpus americanus*)	1	2	1.0
Arrowhead (*Sagittaria*)	1	2	1.0
Watershield (*Brasenia schreberi*)	2	4	1.0
Spatterdock (*Nuphar variegatum*)	8	15	4.0
White waterlilies (*Nympaea tuberosa*)	1	2	1.0
Chara (*Chara sp*)	7	13	1.1
Needle spikerush (*Eleocharis acicularis*)	1	2	1.0
Elodea (*Elodea canadensis*)	14	26	1.0
Northern watermilfoil (*Myriophyllum sibiricum*)	1	2	2.0
Milfoil (*M. sp*)	16	30	1.6
Eurasian watermilfoil (*M. spicatum*)	2	4	1.5
Cabbage (*Potamogeton amplifolius*)	17	31	1.6
Illinois pondweed (*P. illinoensis*)	1	2	0.5
Fern pondweed (*P. Robbinsii*)	52	96	3.6
Rosette (*Sagittaria sp*)	1	2	1
filamentous algae	3	6	1.3

Table A-2. Individual site data for June 1, 2007.

Site	Depth (ft)	Three Square	Arrow-head	Water-shield	Spatter dock	White Water lilies	Chara	Needle Spike-rush	Elodea	NWM	Milfoil	EWM	Cabbage	Illinois Pond-weed	Fern Pond-weed	Arrow-head	FA
2	4														4		
3	3														4.5		
4	3														4		
5	3	1													2		
6	5										1		2		4.5		
7	5														4		
8	5														4		
9	5														3.5		
10	1														2		
11	4														3		
12	5								1						3.5		
13	5								1			1	1		5		
14	5										2		2		4.5		
15	5						1		1		1		2		4.5		
16	2			1				1							3		
17	3												1		5		
18	5						1				1		2		3		
19	5						1		1						4.5		
20	5								1		1.5				5		
21	5						1		0.5						3		
22	5								1						3.5		
23	4						0.5								3		
24	3				1	1									2.5		
25	3														3		
26	4								1.5		1				3.5		
27	5								1						4		
28	5												1		3.5		
29	5										2		2		5		
30	5								1		2		2		5		
31	5												1		4		
32	4										1				4		
33	3											2	1		4.5		
34	5													0.5	4		
35	5										2.5		2.5		5		
36	5								1				2		4		
37	5								1		1		2		4.5		
38	5														3		
39	4														4		
40	5														3		
40.5	3				1												
41	5								1		1.5		2		4		
42	5										2		1		5		
43.5	4			1							2		1		2		
44	3						2				3.5					1	
45	4						1			2					3		1
46	5														4		
47	5								1		1				4		1
48	5														4		
49	4				5										3		2
50	3				5										2		
51	3		1		5										2		
52	3				5										2		
53	3				5										2		
54	3				5										2		
Average		**1.0**	**1.0**	**1.0**	**4.0**	**1.0**	**1.1**	**1.0**	**1.0**	**2.0**	**1.6**	**1.5**	**1.6**	**0.5**	**3.6**	**1.0**	**1.3**
occurrence (54 sites)		1	1	2	8	1	7	1	14	1	16	2	17	1	52	1	3
% occurrence		2	2	4	15	2	13	2	26	2	30	4	31	2	96	2	6

Table A-3. Birch Lake aquatic plant occurrences and densities for the September 5, 2007 survey based on 57 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.

	All Stations (n=47)		
	Occur	**% Occur**	**Density**
Bulrush (*Scirpus sp*)	1	2	1.0
Watershield (*Brasenia schreberi*)	2	4	4.5
Spatterdock (*Nuphar variegatum*)	1	2	4.0
White waterlilies (*Nympaea tuberosa*)	1	2	2.0
Coontail (*Ceratophyllum demersum*)	1	2	1.0
Elodea (*Elodea canadensis*)	3	6	1.0
Eurasian watermilfoil (*Myriophyllum spicatum*)	16	34	1.5
Naiads (*Najas flexilis*)	1	2	1.0
Cabbage (*Potamogeton amplifolius*)	20	43	0.9
Fern pondweed (*P. Robbinsii*)	47	100	3.8
Water celery (*Vallisneria americana*)	12	26	1.5

Table A-4. Individual site data for September 5, 2007.

Site	Depth (ft)	Bulrush	Water-shield	Spatter-dock	White Water-lilies	Coontail	Elodea	Eurasian Water-milfoil	Naiads	Cabbage	Fern Pond-weed	Water Celery
2	3										5	
3	3										3	
4	3										3	
5	1										1	1
6	2.5									1	4	2
7	4										3	
8	4									1	4	
9	3.5										4	
10	on shore											
11	2										5	
12	4										4	
13	4									1	4.5	
14	4								1	1	3	2
15	4									1	4	
16	2		4								4.5	1
17	3										4.5	0.5
18	4							1		1	4	1
19	4							0.5			4	
20	4										3.5	
21	4							0.5			4	
22	4										4	
23	3										4.5	2
24	2.5										5	
26	3										4	
27	4									1	4.5	
28	4									2	3	
29	4							2		0.5	4	
30	4							2		1	4.5	1
31	4							1		0.5	4	2
32	3									0.5	4	1
33	2.5							4.5			3	1
34	4							2			4	
35	4							1		1	5	
36	4										4	
37	4						1	1			4.5	
38	4									1	4	
39	2										5	
40	3.5									0.5	3	
41	4									0.5	3.5	
42	4						1			1	4	
43	4							1			4	
44	2							2			2	3
45	3		5					1		1	3	
46	3						1	1			4.5	
47	3.5									1	4.5	
48	3										3	
49	4	1			2			1			2	
50	2.5			4		1		3		0.5	3	
Average		**1.0**	**4.5**	**4.0**	**2.0**	**1.0**	**1.0**	**1.5**	**1.0**	**0.9**	**3.8**	**1.5**
occurrence (47 sites)		1	2	1	1	1	3	16	1	20	47	12
% occurrence		2	4	2	2	2	6	34	2	43	100	26