North End of North Center Lake, June 9, 2004

Aquatic Plant Surveys for North Center Lake, Chisago County, Minnesota in 2004

Early Summer Survey: June 9, 2004
Late Summer Survey: September 16, 2004

Prepared for:
Chisago Lakes
Lake Improvement District
Chisago County, MN

Prepared by:
Steve McComas
Jo Stuckert
Blue Water Science
(651) 690.9602

March 2005

Aquatic Plant Surveys for North Center Lake, Chisago County, Minnesota in 2004

Summary

Two aquatic plant surveys were conducted on North Center Lake (725 acres) in 2004. The early summer survey of June 9 emphasized the distribution and abundance of curlyleaf pondweed. The late summer survey of September 16 was to characterize changes in the plant community and to scout for Eurasian watermilfoil. For each survey, 25 transects and 3 depths were checked.

Curlyleaf pondweed was the most common plant in North Center Lake in early summer and showed up at 83% of the stations (Table 1). Curlyleaf pondweed is an exotic plant that dies back in mid-summer. In the early summer of 2004, curlyleaf pondweed was found around the edge on the north end of North Center Lake and throughout most of the southern basin of the lake (Figure 1). It covered approximately 505 acres out of the 725 acre lake with nuisance coverage of about 55 acres. Dense beds of curlyleaf can be a recreational nuisance but there is another problem as well. When curlyleaf dies back in early summer, it releases significant amounts of phosphorus. This can add to algae blooms in late summer.

In September, the curlyleaf pondweed had died back and a new crop of curlyleaf pondweed had sprouted. The acreage of aquatic submerged plants in South Center Lake in late summer was about 135 acres with curlyleaf and coontail dominating the plant community. However plant density was low except for a couple of shallow bays. Eurasian watermilfoil was not found in North Center Lake in 2004.

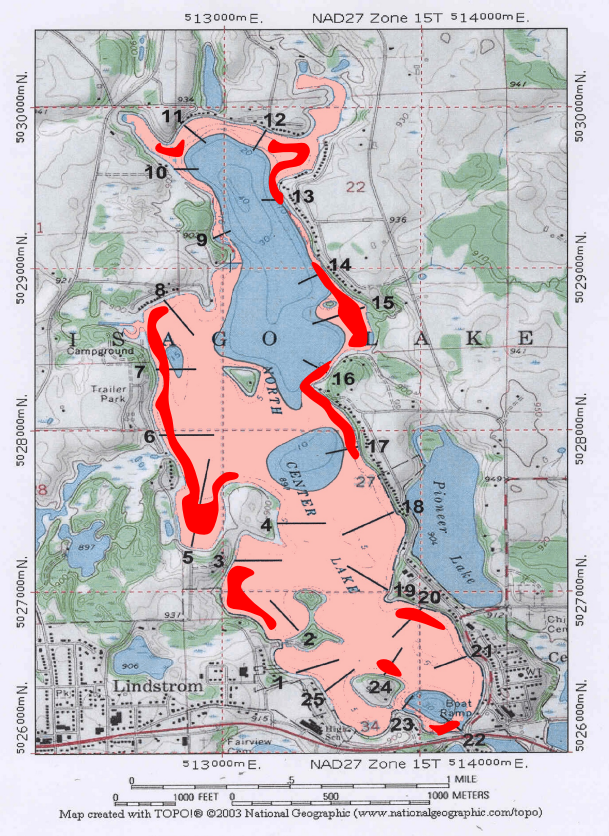


Figure 1. The coverage of aquatic plants in June of 2004 is shown in pink and nuisance curlyleaf pondweed is shown in red. Curlyleaf pondweed was the dominant plant and the area of distribution was about 505 acres with nuisance growth covering about 55 acres.

Aquatic Plant Overview: In the early summer of 2004, Curlyleaf pondweed was found throughout the southern end and around the perimeter of the north end of North Center Lake. Curlyleaf grew out to about 12 feet of water, although it was a nuisance in water depths of under 8 feet.

By the early part of September, curlyleaf pondweed densities were down but the sprouting of new curlyleaf still resulted in it being the most common plant in the plant. Coontail was the next most common plant followed by white lilies (Table 1).

The acreage of aquatic submerged plants in North Center Lake from early to late summer changed significantly as did the species composition. As is typical, coontail increased from June to September.

Table 1. The percent occurrence of aquatic plants for North Center Lake in 2004. 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 milfoil was found in 25 out of 50 stations, its percent occurrence would be 50%.

	June 9, 2004 % Occurrence (75 stations)	September 16, 2004 % Occurrence (75 stations)	Changes from June to September
Bulrush (*Scirpus sp*)	3	3	0
Spatterdock (*Nuphar variegatum*)	7	3	-
White waterlilies (*Nymphaea sp*)	5	11	+
Coontail (*Ceratophyllum demersum*)	9	20	+
Elodea (*Elodea canadensis*)	1	4	+
Northern watermilfoil (*Myriophyllum sibiricum*)	4	5	0
Curlyleaf pondweed (*Potamogeton crispus*)	83	33	-
Claspingleaf pondweed (*P. Richardsonii*)	--	1	0
Fern pondweed (*P. Robbinsii*)	--	3	+
Water celery (*Vallisneria americana*)	--	3	+
Filamentous algae	9	3	-
Aquatic Plant Coverage (acres)	505	135	-
Secchi disc (feet)	5.0	2.8	-

Conclusions and Recommendations for Aquatic Plant Management in North Center: The aquatic plant community has four species of submerged plants in early summer and seven species in late summer. This is a modest plant diversity condition.

Curlyleaf pondweed covers 505 acres in early summer and then dies back. In late summer, aquatic plants cover about 135 acres and grow out to about 7-feet of water depth.

If native plant distribution could increase, water clarity could improve as well. If curlyleaf pondweed could be controlled, native plants would probably increase.

Curlyleaf pondweed is an exotic aquatic plant that grows to nuisance conditions in early summer in North Center Lake and then dies off by the end of June. As the curlyleaf plant beds decompose in the lake, phosphorus is released and feeds into algae blooms. Nuisance curlyleaf growth was delineated in 2004.

Curlyleaf pondweed control would help improve water quality in North Center Lake. Mechanical harvesting is an effective control technique and is the recommended technique to implement. Concurrently with harvesting, other control techniques should be explored including the use of herbicides as well as the possibility of using iron filings. Research has indicated there is a potential for iron filings added to lake sediments to inhibit nuisance growth of curlyleaf pondweed.

North Center Lake, Chisago County

Lake ID: 13-0032
Size: 725 acres (source: MnDNR)
Littoral area: 608 acres (source: MnDNR)
Maximum depth: 46 ft (source: MnDNR lake map)
Mean Depth: 10 feet

Introduction

North Center Lake is a 725 acre moderately fertile lake in Chisago County, Minnesota.

The aquatic plants of North Center Lake were sampled to evaluate curlyleaf pondweed and to look for Eurasian watermilfoil and to document the extent of native plant coverage. Steve McComas, Blue Water Science, along with the assistance of Bud Kapell, Chisago Lakes Lake Improvement District, conducted two aquatic plant surveys on North Center Lake on June 9 and September 16, 2004.

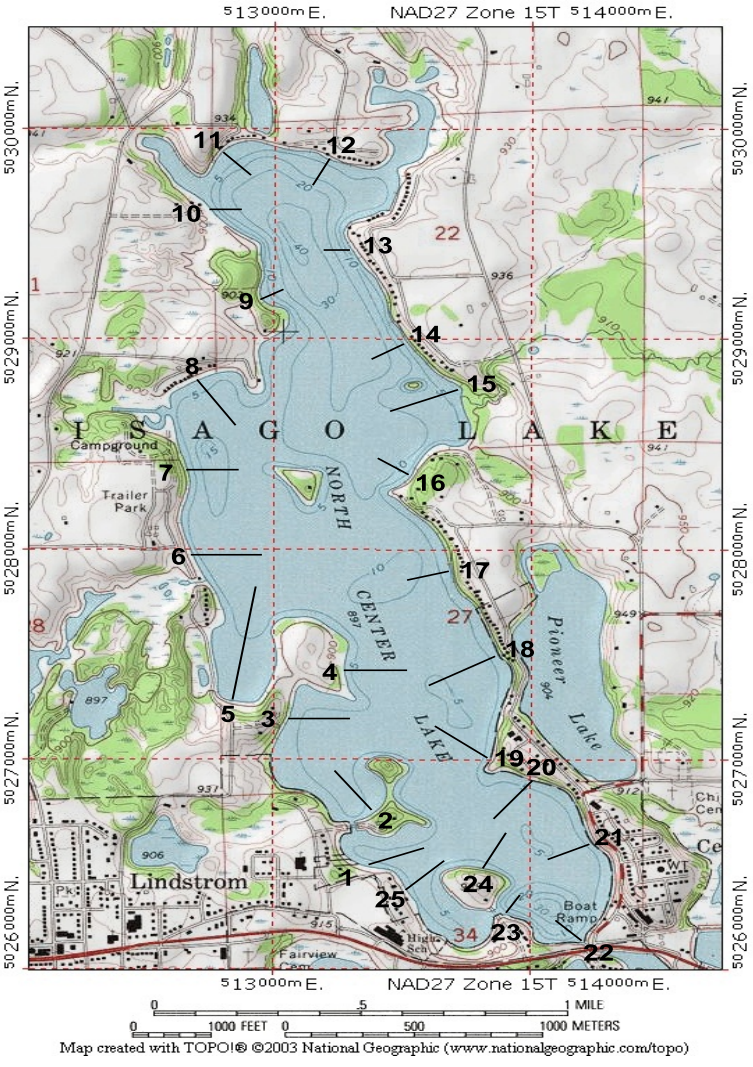


Figure 1. Transects for plant surveys on June 9 and September 16, 2004.

Methods

Several techniques were used to characterize aquatic plants in North Center Lake. We used 25 line transects with several passing through known curlyleaf areas (Figure 1). A recording sonar (Lowrance X-16) was used to delineate the depths of weed colonization. Three depths (0-4 feet, 5-8 feet, and 9-12 feet) on a transect were sampled with a rake to characterize species presence and density.

Aquatic plant density was estimated based on a scale from 1-5 with 1 being the less dense and 5 representing plants matting at the surface. Plant density ratings were based on the amount of plants collected on a rake head. A single stem or a trace of an identifiable plant was rated at a density of "1". If plants were collected up to at least one half of the rake head (7 out of 14 tines) it was rated at a density of "2". If plants covered all of the rake tines, the density was a "3". If plants covered all 14 tines and was dense on all tines (even obscuring them) the density was a "4". A density of "5" was only assigned to plants matting at the surface. An example of a plant density of a 3 is shown in Figure 2.

Two to four rake samples were collected at each depth interval. A density for each plant species was determined for each rake sample and the species density was averaged based on the number of rake samples for a depth interval.

For plant surveys of this type, depth intervals are determined based on the maximum depth of plants found in the lake. Two depth intervals are used if plant growth is 10 feet or less and three depth intervals are used if plant growth is 12 feet or greater. Aquatic plants colonized out to 12 feet in South Center Lake, so the three depth zones were used and they were: 0-4 feet, 5-8 feet, and 9-12 feet.

Figure 2. Aquatic plants were sampled with a rake. Here is a sample of curlyleaf pondweed at a density of a "3".

Results of the Early Summer Survey -- June 9

The most abundant plant in early summer in North Center Lake was curlyleaf pondweed, a non-native plant, and it was estimated to cover 505 acres of the 725 acre lake, roughly 70% of the lake. Within the 505 acres of coverage, there was an estimated 55 acres of nuisance curlyleaf growth (Figure 3). Curlyleaf growth was widespread in the southern end of shallow North Center Lake. Curlyleaf pondweed was found at 62 of the 75 stations and was by far the most common plant in North Center Lake (Table 1). Curlyleaf grew out to a depth of 12 feet. The next most common plant was coontail and it occurred at 7 out of 75 stations. Native plants are scarce in North Center lake, although there are several beds of water lilies on transects 2, 5, 10, and to the east of 12.

An inventory of plant occurrence and density is shown in Table 2.

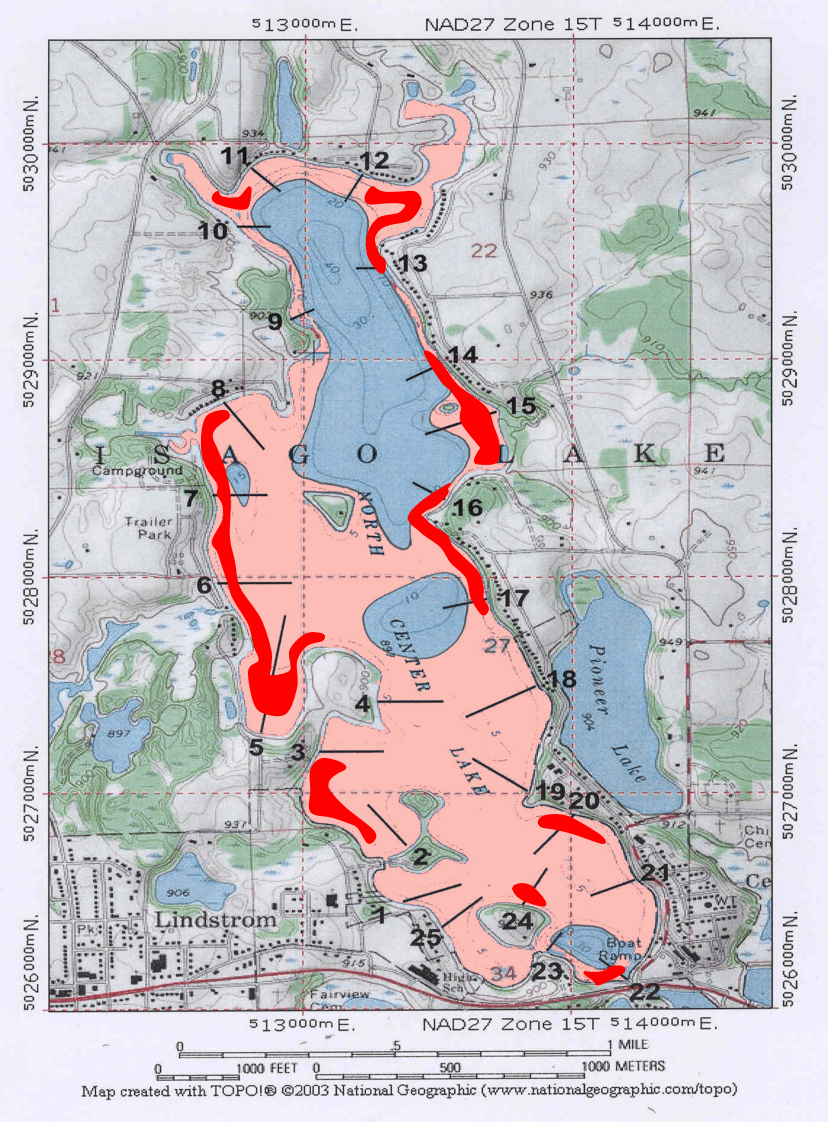


Figure 3. Aquatic plant coverage and curlyleaf coverage on June 9, 2004. Pink shading represents non-nuisance curlyleaf growth along with other plants and covers about 505 acres. Within the 505 acres are about 55 acres of nuisance curlyleaf pondweed growth, shown in red.

Table 1. North Center Lake aquatic plant occurrences and densities for the June 9, 2004 survey based on 25 transects and 3 depths, for a total of 75 stations. Density ratings are 1-5 with 1 being low and 5 being most dense. Transect 12.5 was not used in statistics. Secchi disc reading was 5.0 feet.

	Depth 0-4 feet (n=25)			Depth 5-8 feet (n=25)			Depth 9-12 feet (n=25)			All Stations (n=75)		
	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density
Bulrush (*Scirpus sp*)	2	8	0.9	--	--	--	--	--	--	2	3	0.9
Spatterdock (*Nuphar variegatum*)	2	8	2.5	3	12	1.5	--	--	--	5	7	1.9
White waterlilies (*Nymphaea sp*)	4	16	1.5	--	--	--	--	--	--	4	5	1.5
Coontail (*Ceratophyllum demersum*)	3	13	1.0	4	16	0.8	--	--	--	7	9	0.9
Elodea (*Elodea canadensis*)	1	4	0.5	--	--	--	--	--	--	1	1	0.5
Northern watermilfoil (*Myriophyllum sibiricum*)	2	8	0.8	1	4	0.3	--	--	--	3	4	0.6
Curlyleaf pondweed (*Potamogeton crispus*)	22	88	3.2	24	96	2.7	16	64	2.4	62	83	2.8
Filamentous algae	5	20	0.9	2	8	1.2	--	--	--	7	9	0.9

Figure 4. On June 9, 2004, curlyleaf pondweed on the rakehead is shown here with a density of "4".

Table 2. Individual transect data for North Center Lake on June 9, 2004. T12.5 was not used in statistics.

	T1			T2			T3			T4			T5		
	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12
Bulrush										1.3					
Spatterdock				2	1.5								3	2	
White waterlilies				1			1						2		
Coontail	0.5			0.5	0.5								2	1.3	
Elodea															
Northern watermilfoil				1										0.3	
Curlyleaf pondweed		2.5	3.5	1.8	3.4	3.8	0.5	0.8	2.4	1.4	3.8		2	3.3	3.3
Filamentous algae										0.3					

	T6			T7			T8			T9			T10		
	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12
Bulrush															
Spatterdock															
White waterlilies													2		
Coontail															
Elodea										0.5					
Northern watermilfoil															
Curlyleaf pondweed	4.5	4	1	4	3		4	2.8	0.8	2	2		2	2.8	
Filamentous algae							0.5			1			0.5		

	T11			T12			T12.5		T13			T14			T15		
	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12
Bulrush									0.5								
Spatterdock																	
White waterlilies								4									
Coontail								2									
Elodea																	
Northern watermilfoil																	
Curlyleaf pondweed		0.3				2		2	5	3.3		5	1.8	1.5	5	5	2.5
Filamentous algae				2	2					0.3							

	T16			T17			T18			T19			T20		
	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12
Bulrush															
Spatterdock															
White waterlilies															
Coontail															
Elodea															
Northern watermilfoil															
Curlyleaf pondweed	4.5	2.5		4.5	3.1		2	1.9		4	2.5	1	5	4.3	2.3
Filamentous algae															

	T21			T22			T23			T24			T25		
	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12	0 - 4	5 - 8	9 -12
Bulrush															
Spatterdock														1	
White waterlilies															
Coontail					1									0.2	
Elodea															
Northern watermilfoil				0.5											
Curlyleaf pondweed	3.5	3	2	4	3.5	4.3	2	2	3.3	3.5	2	4	0.5	0.7	0.5
Filamentous algae															

Results of the Late Summer Survey -- September 16

A significant change in the plant community was found in the September survey compared to the June survey. The widespread growth of curlyleaf pondweed found in June had died back and the new curlyleaf growth was observed in September only grew out to a water depth of about 8 feet, compared to the 12 feet found in June. Coontail was the most common native plant found in North Center Lake in September (Table 3).

A map of aquatic plant coverage is shown in Figure 5. Aquatic plants covered about 19% of the bottom or roughly 135 acres. Within the 135 acres, white lilies and spatterdock were dense in the shallow bays, but submerged plants were scarce. No Eurasian watermilfoil was found in this survey.

Typical water lily conditions for shallow water areas in September are shown in Figure 6.

The occurrence and density of plants for individual transects are listed in Table 4.

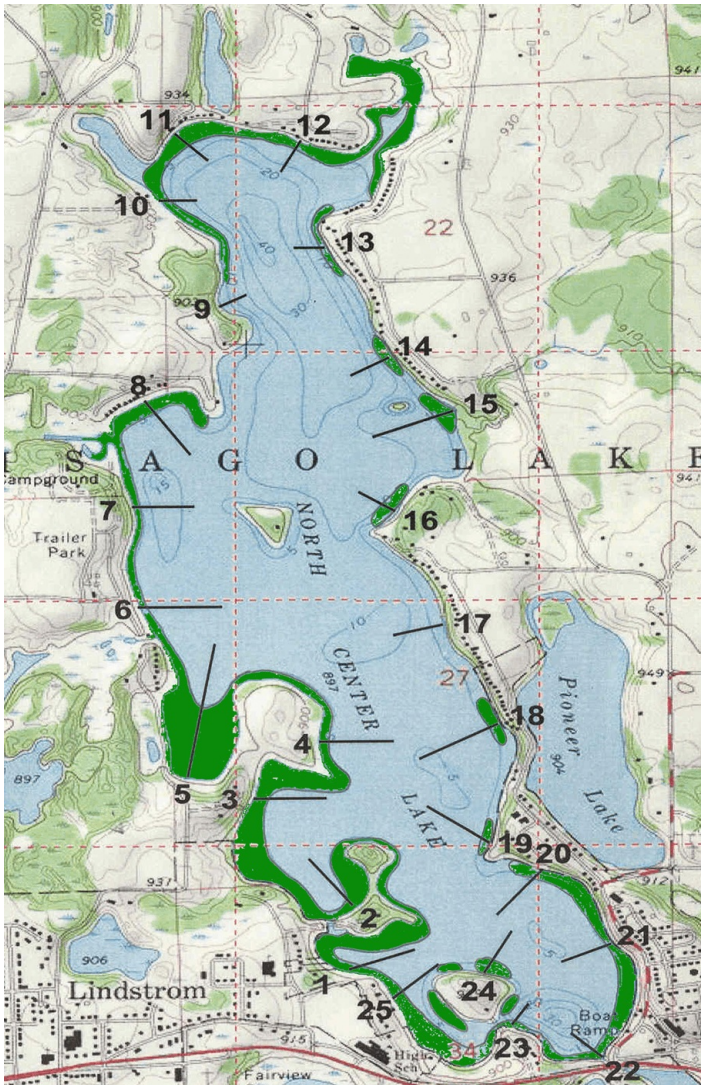


Figure 5. Aquatic plant coverage map for North Center Lake on September 16, 2004. The green area shows coverage of aquatic plants. Plants covered about 135 acres.

Table 3. North Center Lake aquatic plant occurrences and densities for the September 16, 2004 survey based on 25 transects and 3 depths, for a total of 75 stations. Density ratings are 1-5 with 1 being low and 5 being most dense. Secchi disc reading was 2.8 feet.

	Depth 0-4 feet (n=25)			Depth 5-8 feet (n=25)			Depth 9-12 feet (n=25)			All Stations (n=75)		
	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density
Bulrush (*Scirpus sp*)	2	8	1.3	--	--	--	--	--	--	2	3	1.3
Spatterdock (*Nuphar variegatum*)	1	4	0.5	1	4	1.0	--	--	--	2	3	0.8
White waterlilies (*Nymphaea sp*)	5	20	2.3	3	12	1.2	--	--	--	8	11	1.9
Coontail (*Ceratophyllum demersum*)	10	40	1.0	5	20	0.9	--	--	--	15	20	0.9
Elodea (*Elodea canadensis*)	3	12	1.2	--	--	--	--	--	--	3	4	1.2
Northern watermilfoil (*Myriophyllum sibiricum*)	4	16	0.8	--	--	--	--	--	--	4	5	0.8
Curlyleaf pondweed (*Potamogeton crispus*)	14	56	0.8	11	44	0.9	--	--	--	25	33	0.8
Claspingleaf pondweed (*P. Richardsonii*)	1	4	0.5	--	--	--	--	--	--	1	1	0.5
Fern pondweed (*P. Robbinsii*)	1	4	1.0	1	4	1.0	--	--	--	2	3	1.0
Water celery (*Vallisneria americana*)	--	--	--	2	8	1.0	--	--	--	2	3	1.0
Filamentous algae	2	8	0.8	--	--	--	--	--	--	2	3	0.8

Figure 6. White lilies were abundant in several shallow bays.

Table 4. Individual transect data for North Center Lake on September 16, 2004.

	T1			T2			T3			T4			T5		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Bulrush										2					
Spatterdock				0.5										1	
White waterlilies	3	1		0.5			2						4	0.5	
Coontail	1	0.5		1.5			0.5			1	0.5				
Elodea															
Northern watermilfoil				0.5											
Curlyleaf pondweed				1	2		0.5				1			0.5	
Claspingleaf pondweed															
Fern pondweed													1	1	
Water celery															
Filamentous algae															

	T6			T7			T8			T9			T10		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Bulrush															
Spatterdock															
White waterlilies															
Coontail								1					1	1.5	
Elodea															
Northern watermilfoil							0.5								
Curlyleaf pondweed	2			0.5				1							
Claspingleaf pondweed															
Fern pondweed															
Water celery															
Filamentous algae													1		

	T11			T12			T13			T14			T15		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Bulrush							0.5								
Spatterdock															
White waterlilies															
Coontail				0.5											
Elodea															
Northern watermilfoil															
Curlyleaf pondweed		1		0.5			0.5			0.5			0.5		
Claspingleaf pondweed															
Fern pondweed															
Water celery		1			1										
Filamentous algae															

	T16			T17			T18			T19			T20		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Bulrush															
Spatterdock															
White waterlilies															
Coontail															
Elodea															
Northern watermilfoil															
Curlyleaf pondweed		1					0.5	1			0.5		1	1	
Claspingleaf pondweed															
Fern pondweed															
Water celery															
Filamentous algae							0.5								

Table 4. Concluded.

	T21			T22			T23			T24			T25		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Bulrush															
Spatterdock															
White waterlilies													2	2	
Coontail	1			0.5			1						1.5	1	
Elodea				1			2						0.5		
Northern watermilfoil				1			1								
Curlyleaf pondweed	1	0.5					1			0.5	0.5		0.5		
Claspingleaf pondweed				0.5											
Fern pondweed															
Water celery															
Filamentous algae															

Figure 7. Curlyleaf at a density of a "1".

Comparison of Early and Late Summer Aquatic Plant Surveys in 2004

In the early summer of 2004, Curlyleaf pondweed was found throughout the southern basin and around the perimeter of the north end of North Center Lake. Curlyleaf grew out to about 12 feet of water, although it was a nuisance in water depths of under 8 feet.

By the early part of September, curlyleaf pondweed densities were down but the sprouting of new curlyleaf still resulted in it being the most common plant in the plant. Coontail was the next most common plant followed by white lilies (Table 5).

The acreage of aquatic submerged plants in North Center Lake from early to late summer changed significantly as did the species composition. As is typical, coontail increased from June to September.

Table 5. The percent occurrence of aquatic plants for North Center Lake in 2004. 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 milfoil was found in 25 out of 50 stations, its percent occurrence would be 50%.

	June 9, 2004 % Occurrence (75 stations)	September 16, 2004 % Occurrence (75 stations)	Changes from June to September
Bulrush (*Scirpus sp*)	3	3	0
Spatterdock (*Nuphar variegatum*)	7	3	-
White waterlilies (*Nymphaea sp*)	5	11	+
Coontail (*Ceratophyllum demersum*)	9	20	+
Elodea (*Elodea canadensis*)	1	4	+
Northern watermilfoil (*Myriophyllum sibiricum*)	4	5	0
Curlyleaf pondweed (*Potamogeton crispus*)	83	33	-
Claspingleaf pondweed (*P. Richardsonii*)	--	1	0
Fern pondweed (*P. Robbinsii*)	--	3	+
Water celery (*Vallisneria americana*)	--	3	+
Filamentous algae	9	3	-
Aquatic Plant Coverage (acres)	505	135	-
Secchi disc (feet)	5.0	2.8	-

Conclusions and Recommendations for Aquatic Plant Management in North Center Lake

The aquatic plant community has four species of submerged plants in early summer and seven species in late summer. This is a modest plant diversity condition.

Curlyleaf pondweed covers 505 acres in early summer and then dies back. In late summer, aquatic plants cover about 135 acres and grow out to about 7-feet of water depth.

If native plant distribution could increase, water clarity could improve as well. If curlyleaf pondweed could be controlled, native plants would probably increase.

Curlyleaf pondweed is an exotic aquatic plant that grows to nuisance conditions in early summer in North Center Lake and then dies off by the end of June. As the curlyleaf plant beds decompose in the lake, phosphorus is released and feeds into algae blooms. Nuisance curlyleaf growth was delineated in 2004.

Curlyleaf pondweed control would help improve water quality in North Center Lake. Mechanical harvesting is an effective control technique and is the recommended technique to implement. Concurrently with harvesting, other control techniques should be explored including the use of herbicides as well as the possibility of using iron filings. Research has indicated there is a potential for iron filings added to lake sediments to inhibit nuisance growth of curlyleaf pondweed.

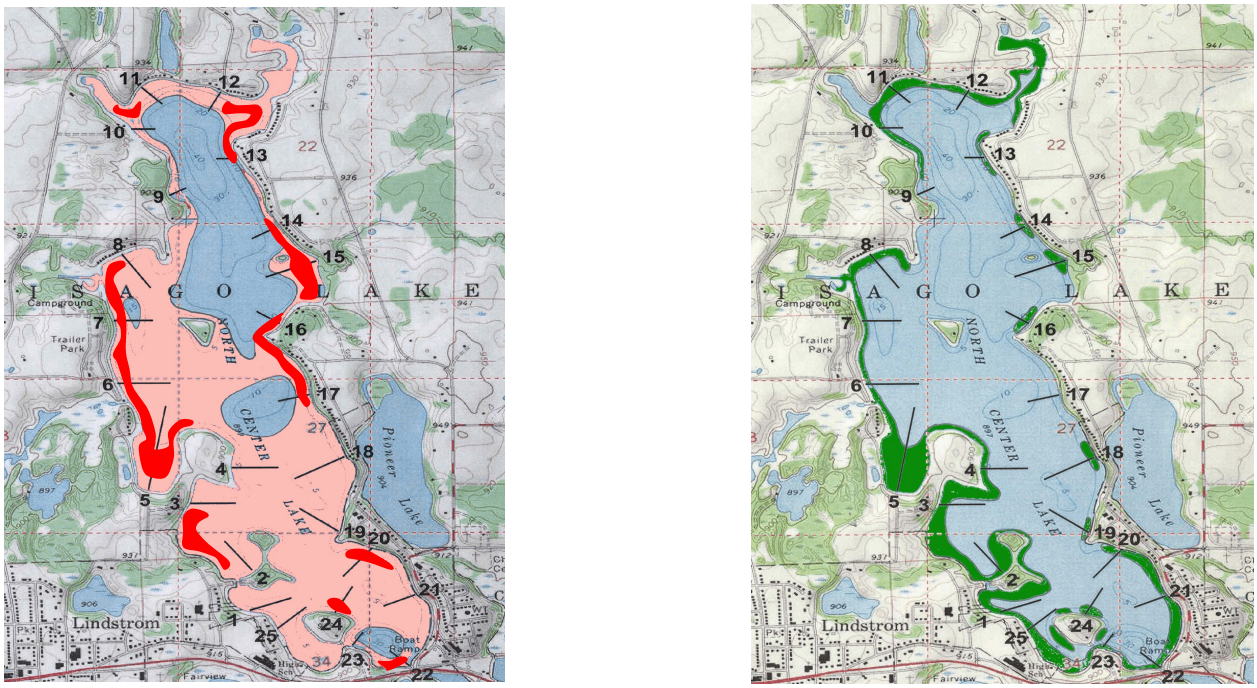
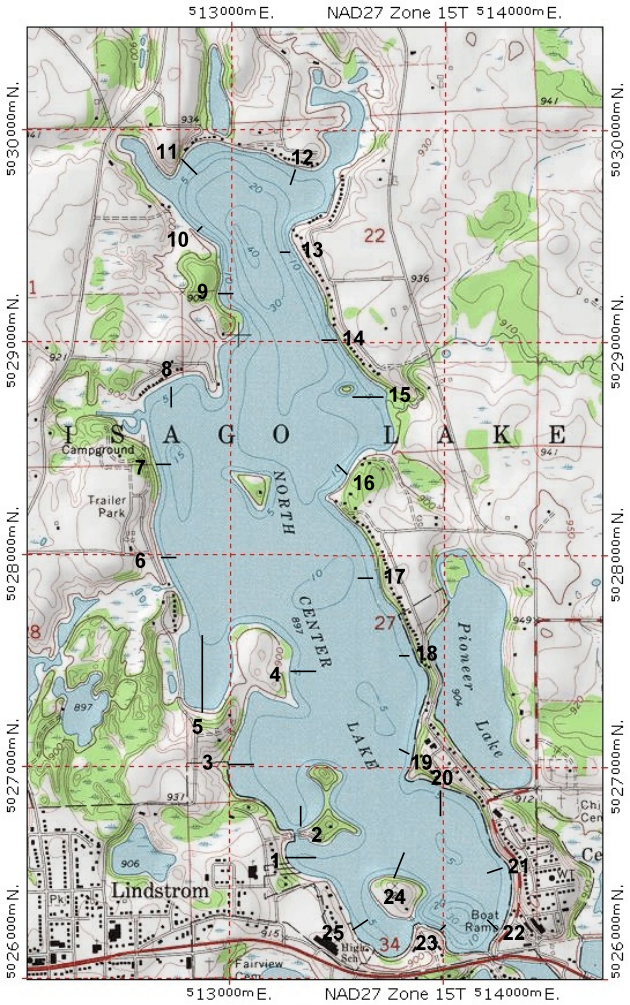


Figure 8. (left) Early summer aquatic plant coverage in 2004. Nuisance curlyleaf pondweed is shown in red and covers about 55 acres out of a total of 505 acres (shown in pink).
(right) Late summer aquatic plant coverage in 2004 was about 135 (shown in green).

Appendix

Transect Descriptions
Sonar Graphs
Previous Survey from 1995

Curlyleaf growing from turions.



Transect Number	GPS		Notes
	East	North	
1	05 13 341	50 26 561	Left of cement wall on sand beach
2	05 13 348	50 26 827	Left of the bridge
3	05 13 046	50 27 043	Two story house with a 2nd story deck and storage shed
4	05 13 315	50 27 746	Little bowl on peninsula
5	05 12 862	50 27 555	Middle of bay
6	05 12 713	50 28 000	In-between two wood retaining walls with a mobile home park
7	05 12 664	50 28 425	Three stair cases
8	05 12 718	50 28 761	Right of asphalt driveway/landing next to a gray house
9	05 13 018	50 29 249	Left of a keystone wall, a wood retaining wall on a rip-rap shore
10	05 12 884	50 29 560	Natural shoreline on peninsula
11	05 12 801	50 29 844	Biggest two story gray house on shore with a shed on shore
12	05 13 259	50 29 789	3rd house in from the point, it is a gray house
13	05 13 250	50 29 440	Four homes to the right of the point, on a cement retaining wall
14	05 13 452	50 29 014	Red steps down to the lake with retaining wall and deck on shore
15	05 13 627	50 28 746	Left of inlet
16	05 13 454	50 28 482	Left of house on point
17	05 13 639	50 27 858	Left of three sheds (?) on shore
18	05 13 832	50 27 513	Deck with wood lattice and a brown shed
19	05 13 817	50 27 091	West of point, 50 meters into the woods
20	05 13 972	50 26 865	Left of white shoreline shed
21	05 14 228	50 26 549	Left of shed with three windows
22	05 14 215	50 26 286	Left of fishing pier
23	05 14 035	50 26 259	Left of the lock road, bridge to island
24	05 13 818	50 26 548	House with three gables
25	05 13 642	50 26 300	Right of 1st house after landing, left of 2nd house