Snapping Turtle, Lee Lake, September 2004

Fish Survey of Lee Lake, Lakeville, Minnesota in 2004

Survey Dates: August 31, September 1, 2, 3, 2004

Submitted to:
City of Lakeville

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Summary

Lee Lake is a 25-acre lake located in Lakeville, Minnesota. Lee Lake has a slightly above average watershed size at 313 acres which is 14 times bigger than the lake surface area. Because of this size and the potential for runoff to adversely affect water quality, Lee Lake is susceptible to poor water quality conditions. A barley straw application was applied in the spring of 2002 and 2003 and another application was applied in 2004 with the objective to improve lake water clarity. Little water quality improvement was noted in 2002, 2003 and 2004. At the end of 2003 it was speculated that a previous winterkill, with a resulting rebound in an unbalanced fish community, could adversely be impacting pond water quality and negating the benefits of the barley treatments.

In September of 2004, the City of Lakeville contracted for a fish survey. The objective of the fish survey was to determine if fish densities were high enough to account for the observed poor water quality in Lee Lake. At the same time, if fish numbers were excessive we would begin removing fish from Lee Lake.

Results of the fish survey are shown in Table 1. The fish catch was dominated by bluegill sunfish, black crappies, and black bulheads. The number of bluegills caught per net was high with the average haul of bluegills per net averaging 465 per net (Table 1). This is well above the local range of 3-25 bluegills per lift for a lake like Lee Lake. Black bullhead numbers were also above average, at 97 fish/net.

Table 1. Lee Lake trapnet results for the fish survey conducted in September 2004.

	Bluegill	Black Bullhead	Black Crappie	Large-mouth Bass	Yellow Perch	Northern Pike	Number of nets fished
Tuesday (8/31)	1,827	64	106	10	1	--	3
Wednesday (9/1)	1,179	365	153	9	--	--	4
Thursday (9/2)	1,992	500	102	11	--	1	4
Friday (9/3)	1,983	524	104	9	--	--	4
Totals	6,981	1,453	465	39	1	1	15
15 nets	465/net	97/net	31/net	3/net	--	--	--

All trapped black bullheads were removed from Lee Lake on all four days. Trapped bluegills were removed from Lee Lake after the first day, for the next three days. A summary of the number and pounds removed is shown in Table 2.

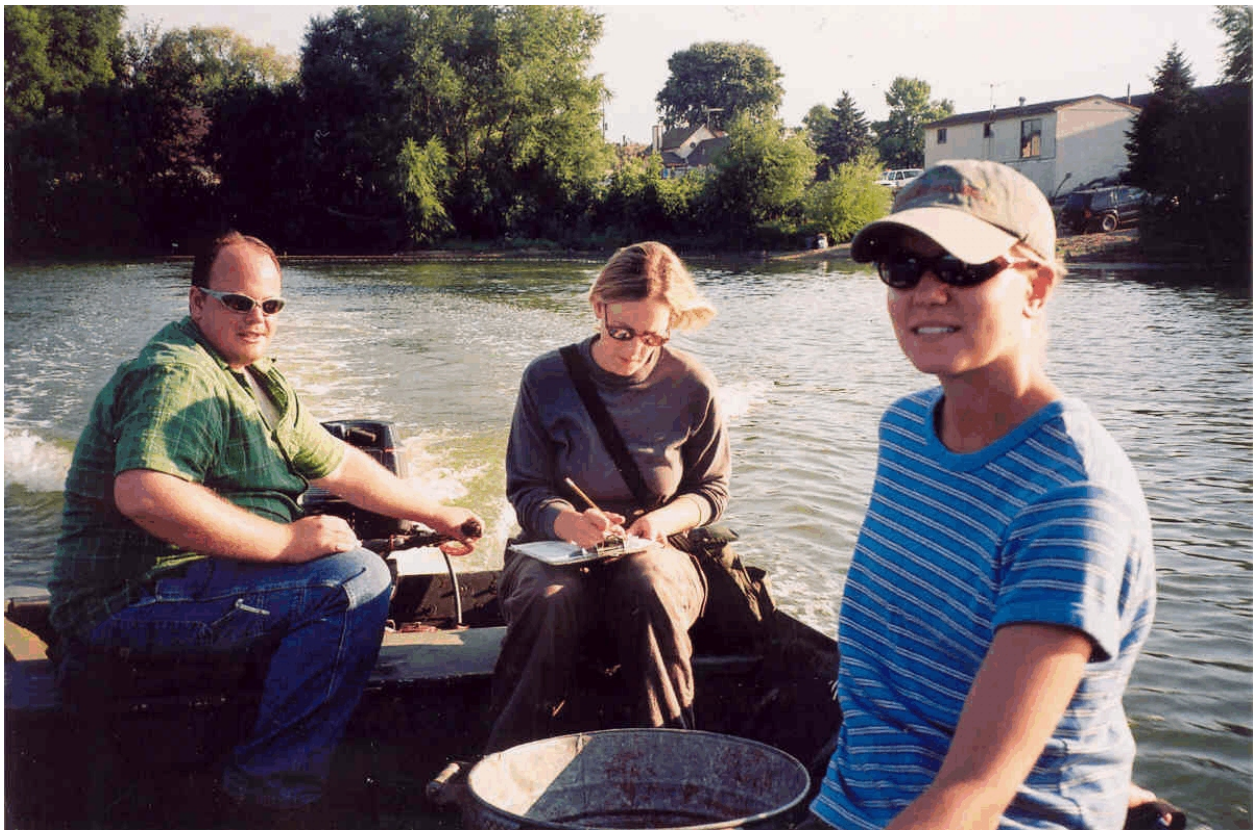
Table 2. The number of fish and the pounds of fish removed from Lee Lake in 2004.

	Bluegills	Bullheads	Total
Number of fish	5,154	1,453	6,607
Pounds of fish	479	223	702
Number per acre	206	58	264
Pounds per acre	19	9	28

Conclusions and Recommendations: Barley straw applied at 200 pounds/acre has improved other metro area lakes and it was anticipated that water quality would improve in Lee Lake as well. However water quality did not noticeably improve in Lee Lake. Based on literature excretion rates for bluegill sunfish, and the observed fish densities in Lee Lake, the poor water quality in Lee Lake could be attributed to fish effects. It is recommended that bluegills and bullheads continue to be removed until their catch rates are comparable to other small lakes like Lee in the region.

Table 3. Lee Lake water quality and notes from 1976 through 2004 for the growing season of May-September. The numbers shown in parentheses represent the number of observations.

Year	Water Quality			Notes
	Secchi Disc (ft)	Total Phos (µg/l)	Chl a (µg/l)	
1976	1.3 (3)	108 (4)	33 (2)	Poor clarity and high phosphorus for 1976 and 1977. Poor clarity still present in 1978.
1977	0.8 (2)	110 (2)	4 (1)	
1978	1.6 (6)			
1990	3.1 (6)	95 (6)	29 (6)	
1994	3.9 (14)	49 (14)	26 (14)	
1995	3.9 (15)	55 (15)	17 (15)	
1996	4.9 (14)	45 (14)	20 (14)	
1997	6.2 (13)	43 (13)	13 (13)	Good water clarity year. Possible winterkill in previous winter.
2000	3.9 (12)	102 (12)	37 (12)	
2001	5.9 (10)	48 (10)	13 (10)	Another good water clarity year.
2002	5.2 (9)	54 (9)	15 (10)	Barley straw added at 176 pounds/ac. Mild winters for 2002-2004.
2003	4.0 (7)	54 (7)	35 (7)	Barley straw added at 200 pounds/acre.
2004	4.1 (12)	55 (12)	26 (12)	Barley straw added at 200 pounds/acre. Fish removal project was initiated.



Lakeville staff heading to another trapnet location on Lee Lake to sample the fish in 2004.

Introduction

Lee Lake, a 25-acre lake, located in Lakeville, Minnesota. Lee Lake has had fluctuating water quality conditions over the last 30 years. Lee Lake has a slightly above averaged sized watershed at 313 acres which is 14 times bigger than the lake surface area. Because of this size and the potential for runoff to adversely affect water quality, Lee Lake is susceptible to poor water quality conditions. A barley straw application was applied in the spring of 2003 and 2004 with the object to improve water clarity. Little water quality improvement was noted in 2003 and 2004. At that point it was speculated that a previous winterkill, with a resulting rebound in an unbalanced fish community, could adversely be impacting pond water quality.

In September of 2004, the City of Lakeville contracted for a fish survey. The objective was to determine if fish were the cause of the poor water quality in Lee Lake.

Methods

Trapnets were used to survey fish in Lee Lake. The trapnet was a MnDNR-style with a 4 x 6 feet square frame with two funnel mouth openings and 50-feet lead. Net mesh size was ½ inch (bar length). Four standard trap nets were set on Monday morning August 30, 2004. Four nets were fished for the following 4 days (August 31, September 1, 2, and 3). Trapnet locations are shown in Figure 1 and pictures of the trapnet in place are shown in Figure 2.

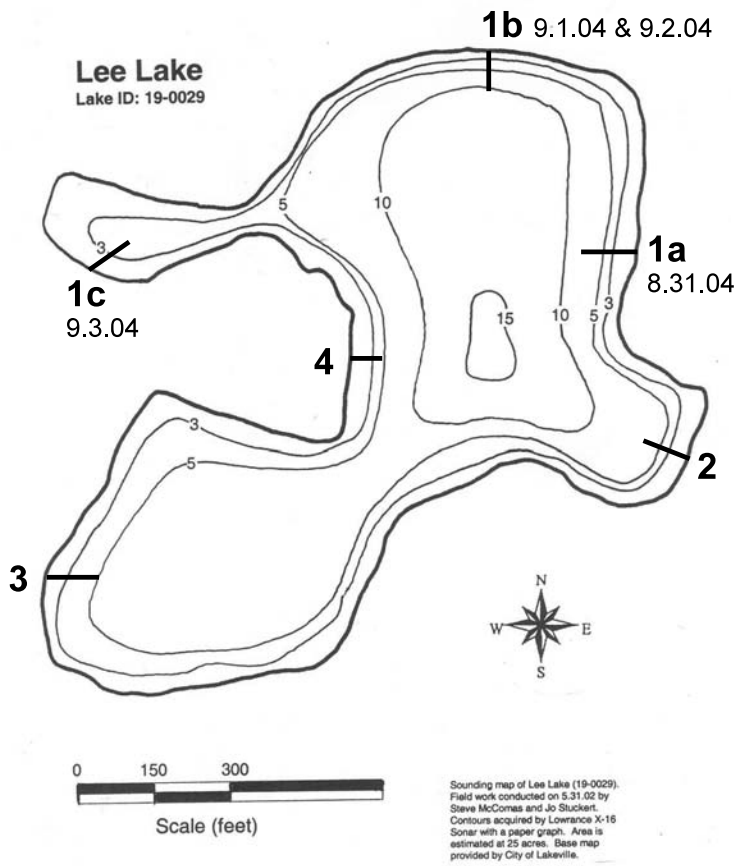


Figure 1. Map of trap net sets.

Figure 2. [top] A trapnet is a live fish trap. Fish run into the 50-foot lead net and follow it back through a series of hoops with funnel mouths. Fish end up in the back hoop (hoops are submerged in this photograph). [bottom] Fish are removed from the back hoop and transferred to tubs. Then they are counted and measured.

Results

The fish catch was dominated by bluegill sunfish, black crappies, and black bulheads. The number of bluegills caught per net was high with the average haul of bluegills per net averaging 465 per net (Table 1). This is well above the local range of 3-25 bluegills per lift for a lake like Lee Lake.

Table 1. Bluegill catch per trapnet in Lee Lake.

Net	Day 1 8.31.04	Day 2 9.1.04	Day 3 9.2.04	Day 4 9.3.04	Total of Days 1 + 2 + 3 + 4
1a	13*	--	--	--	13*
1b	--	150	58	--	208
1c	--	--	--	100	100
2	909	363	662	860	2,794
3	489	362	987	393	2,231
4	429	304	285	630	1,648
Total Bluegills Caught	1,827	1,179	1,992	1,983	6,981
Average number/lift	609	295	498	496	465
Regional Range	3-25	3-25	3-25	3-25	--

* not included in counts because the frame of the net was tilted.

Figure 3. A dip net removed fish from the trapnet. Bluegills were counted and a subsample of bluegills were measured.

Table 2. Lee Lake fish survey conducted August 31 through September 3, 2004. A total of 15 lifts were counted.

Fish Sampled

	Bluegill	Black Bullhead	Black Crappie	Largemouth Bass	Yellow Perch	Northern Pike	Number of nets fished
Tuesday	1,827	64	106	10	1	--	3
Wednesday	1,179	365	153	9	--	--	4
Thursday	1,992	500	102	11	--	1	4
Friday	1,983	524	104	9	--	--	4
Totals	6,981	1,453	465	39	1	1	15
15 nets	465/net	97/net	31/net	3/net	--	--	--

Fish Removed

	Bluegills		Black Bullhead		TOTALS		
	number	pounds	number	pounds	number	pounds	*lbs/net*
Tuesday	--	--	64	11	64	11	*4*
Wednesday	1,179	100	365	53	1,544	153	*38*
Thursday	1,992	184	500	74	2,492	258	*65*
Friday	1,983	195	524	86	2,507	281	*70*
Totals	5,154	479 (10.8 fish/lb)	1,453	223 (6.5 fish/lb)	6,607	702	*47*
pound/ac	--	19	--	9	--	28	--

City of Lakeville staff are working up fish from a trapnet catch.

Approximately 3% of the total bluegill catch was measured. From this subsample, length frequencies were determined. Overall, the bluegill population was small-sized. Ninety-nine percent of the bluegills were less than 6-inches (Table 3). Length frequencies for the other species are also shown in Table 3.

Table 3. Length frequency of bluegill, black bullhead, black crappies, and largemouth bass (total length).

Size Range (inches)	Bluegill (Percent measured 3%) (n=200)	Black Bullhead (Percent measured 11%) (n=152)	Black Crappie (Percent measured 39%) (n=182)	Largemouth Bass (Percent measured 100%) (n=39)
<3.0				
3.0				
3.5				
4.0	1	0.7		
4.5	19			3
5.0	53			
5.5	26	0.7	0.5	5
6.0	0.5	48	8	
6.5		5	6	
7.0		3	7	3
7.5			0.5	
8.0		27	9	
8.5			21	
9.0	0.5	8	40	
9.5		1	2	
10.0		7	0.5	
10.5			1	
11.0				
11.5			3	5
12.0			0.5	21
12.5			0.5	13
13.0				23
13.5				5
14.0				15
14.5				5
15.0				3

Figure 3. [top] Bluegills less than six inches (total length) dominated the bluegill population.
[middle] Black crappies were common.
[bottom] The average size of largemouth bass was between 12-14 inches.

Fish Removal

Initially, permission was received from the MnDNR to remove only bullheads from Lee Lake. A total of 1,453 bullheads weighing 223 pounds were removed from Lee Lake over the 4-day netting period. Fish were disposed of in City of Lakeville wildlife areas.

Because of the unexpected high numbers of bluegills encountered on the first day of netting, permission was requested and received from the MnDNR to remove bluegills from Lee Lake as well. All trapped bluegills on days 2, 3, and 4 were transferred to a MndNR hatchery truck and restocked in metro area ponds. A total of 5,154 bluegills weighing 479 pounds were removed from Lee Lake over the 3 removal days.

Figure 4. [top] After fish were removed from the trapnets, they were counted, a subsample was measured, and they were sorted.
[bottom] Bluegill sunfish catch on days 2, 3, and 4 was transferred from Lee Lake to other metro area lakes by the MnDNR. Black bullheads were also measured and taken to wildlife areas to be used as feed source by the City of Lakeville staff.

Turtle Results: Snapping turtles and painted turtles were also sampled in the trapnets and were common in Lee Lake. The number of turtles was typical for a lake like Lee that has a high percentage of a natural shoreline area.

Table 4. Painted turtle and snapping turtle catch per net for the four netting days and the two day total and number per lift.

	Day 1		Day 2		Day 3		Day 4		Day 1 + 2 + 3 + 4	
Net	Painted	Snapping	Painted	Snapping	Painted	Snapping	Painted	Snapping	Painted	Snapping
1a	0	0	--	--	--	--	--	--	0	0
1b	--	--	1	0	0	0	--	--	1	0
1c	--	--	--	--	--	--	5	4	5	4
2	4	0	11	4	4	3	5	1	24	8
3	5	1	0	2	2	1	1	1	8	5
4	0	1	0	2	0	0	1	0	1	3
Total Turtles Caught	9	2	12	8	6	4	12	6	39	20
Average number/lift	2.3	0.5	3	2	1.5	1	3	1.5	2.6	1.3

Figure 5. Snapping turtles, as well as painted turtles, were common.

Fish Impacts on Lee Lake Water Quality: Bluegills are abundant in Lee Lake with extremely high densities compared to regional averages. The small size of the majority of the bluegill population is not a desirable fish population feature. There was a noticeable lack of gamefish in the pond. In this case, gamefish would be important because they would serve as a population control on panfish. Without this control, bluegill numbers have exploded.

At the present density, bluegills probably are responsible for poor water quality in Lee Lake. How do they cause poor water quality? The same way midget carp could cause algae blooms. Bluegills deplete zooplankton in the water column as well as feed off the bottom. The bottom feeding results in resuspension of lake sediments, but there is another impact. Bluegills ingest sediment along with food particles, and excrete most of the sediment which is high in phosphorus. This is another way phosphorus gets in the water column. Stomach content analysis of six bluegills showed insect parts along with bottom detrital material and confirms that bluegills are feeding off the bottom. The result is an elevated phosphorus concentration in the pond resulting in abundant algae growth combined with the suspension of bottom pond sediments that together produce poor water clarity.

Bluegills can now be added to the list of fish species that can cause poor water quality in ponds.

Fish Impacts on Water Quality in Other Lakes: For centuries (going back to Chinese fish farmer reports), it's been known fish have impacts on water quality. In Minnesota, as early as 1916, carp were being seined out of lakes because of their deleterious effect on aquatic plants and water clarity (McComas 2003a).

More recently, experiments in eutrophic Swedish lakes showed dense fish populations of planktivorous and benthivorous fish resulted in high concentrations of chlorophyll, blooms of blue-green algae and low transparency (Andersson et al 1978).

A variety of fish species can cause adverse water quality impacts, and a summary of fish species that can impact water quality is shown in Table 5.

Table 5. List of fish that have been documented to cause poor water clarity.

Species	Situation	Reference
Carp	Adverse water quality and plant impacts have been known for some time.	Lamarra 1975; Zambrano et al 2001; Parkos et al 2003
Black bullheads	Eagle Lake, Cottonwood County, cleared up after a rotenone treatment	McComas, unpublished
Smallmouth buffalo	Mesocosm experiments found smallmouth buffalo enhanced turbidity, algae, nitrogen, and phosphorus.	Shormann and Cotner 1997
Crucian carp	Fish density: 1,960 lb/ac (in mesocosm) produces a lot of algae.	Andersson et al 1978
Gizzard shad	Nutrient excretion by bottom-feeding fish, in this case gizzard shad, produces nutrients for algae growth. Fish density was 370 lbs per acre.	Schaus et al 1997
Bream and roach	Fish density: 800 lb/ac (in mesocosm) produces a lot of algae.	Andersson et al 1978
Young of year walleye	Larval walleye (9 mm TL) stocked at 50 fish/m^3 produced lower clarity and more algae than ponds stocked at 10 fish/m^3.	Qin and Culver 1995
Mosquitoe fish	Water quality improves dramatically when a fungal infection kills more than 80% of the *Gambusia* (Mosquitoe Fish).	Nagdali and Gupta 2002
Fathead minnows	Ponds with fathead minnows had poorer water clarity and fewer aquatic plants than fishless ponds.	Zimmer et al 2001
Bluegill sunfish	High density of over 1,400 fish per trapnet was correlated with poor clarity and no submerged aquatic plants.	McComas, 2003b
Bluegill sunfish and black bullheads	High density of bluegill sunfish (465/lift) and black bullheads (97/lift) were suspected of causing poor water quality.	This study

Conclusions and Recommendations

Barley straw applied at 200 pounds/acre has improved other metro area lakes and it was anticipated that water quality would improve in Lee Lake as well. However water quality did not noticeably improve in Lee Lake (Table 6). Based on literature excretion rates for bluegill sunfish, and the observed fish densities in Lee Lake, the poor water quality in Lee Lake could be attributed to fish effects. It is recommended that bluegills and bullheads continue to be removed until their catch rates are comparable to other small lakes like Lee in the region.

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