

**Cedar Lake- 2010 Comprehensive Survey Report**  
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**ABSTRACT**

Cedar Lake is a 142 acre lake located in the southwest corner of Manitowoc County. It is a seepage lake with a maximum depth of 21 feet and is the largest lake in the county. The water is clear and hard with a gravel and muck bottom. Most of the Cedar Lake shoreline is developed with cottages as well as year-round residences. Cedar Lake has a long history of stocking that dates back to the 1930's and fish management surveys that date back to 1945. Traditionally, the lake has been managed as a largemouth bass- northern pike-bluegill lake.

The most recent previous surveys of Cedar Lake occurred in 1994-1995 and 2006. Results from these surveys, found that bluegill and largemouth bass were the most common species captured. The 2006 survey found that largemouth bass and northern pike populations have improved from levels found in the 1994-95 survey and that the walleye population remained low in number. Although overall panfish numbers declined between 1994-95 and 2006, bluegill still remained abundant.

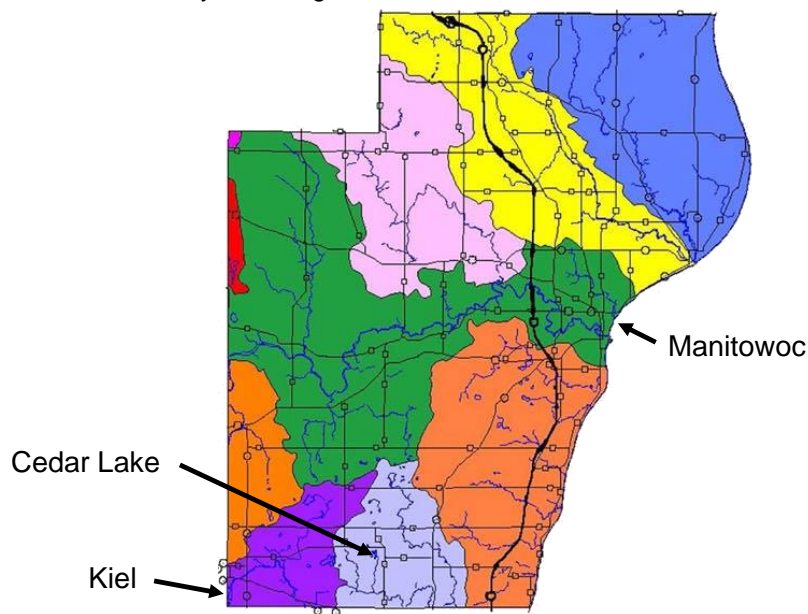
The 2010 comprehensive fisheries survey on Cedar Lake characterized the fish populations of the lake using multiple fisheries assessment gear during multiple seasons. Each gear type was efficient in capturing certain fish species and fish sizes. The use of multiple gears during different sampling seasons provided a clearer picture of the entire fish community and fish population characteristics of individual species within the lake.

During this survey a total of 2,506 individual fish representing fourteen species were captured. Across all surveys, the five most commonly captured fish were brown bullhead (35.0% of the catch), bluegill (20.6%), black crappie (10.7%), northern pike (9.8%) and largemouth bass (8.7%). Brown bullhead dominated the fyke net catch while bluegill dominated the two electroshocking surveys.

Fish populations in Cedar Lake appear to be doing well. The largemouth bass population in the lake is good. Northern pike are generally small in size but are reproducing well. Walleye do not appear to perform well in Cedar Lake and remain low in abundance. Panfish numbers have declined from earlier surveys perhaps because of predation by more numerous gamefish or because of high angler harvest. Lower panfish abundances have lead to a more desirable size distribution of panfish. Forage fish numbers appear to be low. Low forage fish numbers could lead to growth problems for gamefish in the future. Carp and bullhead are present in the lake, but are not causing problems.

## INTRODUCTION

Cedar Lake (WBIC-0045100, T17N R21E S23-24) is a 142 acre lake located in the southwest corner of Manitowoc County (Figure 1). It is a seepage lake with a maximum depth of 21 feet and is the largest lake in Manitowoc County. The water is clear and hard with a gravel and muck bottom. Much of the Cedar Lake shoreline is developed with cottages as well as year-round residences. Heavy use of the lake by anglers, boaters and other water users occurs on a regular basis. In 2001, zebra mussels were discovered in the lake. These mussels have spread throughout the lake, although recently their numbers have stabilized and may have begun to decline.



**Figure 1. Cedar Lake is located between Kiel and the city of Manitowoc in the southwestern quarter of Manitowoc County.**

Cedar Lake has a long history of stocking that dates back to the 1930's and fish management surveys that date back to 1945 (Hogler and Surendonk 2009). Traditionally, the lake has been managed as a largemouth bass- northern pike-bluegill lake although other species have been introduced into the lake by DNR or by local sportsmen with stocking permits from DNR.

The two most recent surveys of Cedar Lake occurred in 1994-1995 (Hogler 1997) and in 2006 (Hogler and Surendonk 2009). Results from these surveys, found that bluegill and largemouth bass were the most abundant species captured and that fish populations in Cedar Lake appear to be doing well (Hogler and Surendonk 2009). The 2009 survey found that largemouth bass and northern pike populations have improved since the last survey in

1994-95 and that the walleye population remains low. Although bluegill still remain abundant, overall panfish numbers have declined from earlier surveys. However the decrease in panfish number has likely resulted in a more desirable size distribution of panfish because of reduced competition for resources.

A comprehensive fish survey was conducted in 2010 on Cedar Lake to evaluate the fishery of the lake as part of baseline lake monitoring.

## **METHODS**

### **Spring Fyke Netting**

A standard comprehensive fisheries survey on Cedar Lake began in April and continued through May 2010. Six fyke nets were set shortly after ice-out on April 6, fished until April 15 and were used to capture and mark adult spawning northern pike, walleye and yellow perch for the purpose of estimating adult population size (Figure 2). Other species captured in fyke nets were also marked for potential population size estimation, but nets were set in habitats to target early spring spawning fish. All fish were identified, measured, marked with a caudal fin clip and scales were removed from a sub-sample for age determination.

### **Spring Electrofishing**

#### **Recapture Run**

Shortly after the completion of fyke netting, on the night of April 19, the entire shoreline of Cedar Lake was electroshocked to look for marked fish. All gamefish fish were netted, identified, examined for marks, and measured.

#### **Centrarchid Electrofishing**

On the night of June 5 the entire shoreline was electroshocked to estimate adult largemouth bass and panfish relative abundance. All fish were netted, identified, checked for marks and measured.

### **Statistical Analyses**

Basic fisheries statistics, such as average length, length frequencies by survey type, age distributions, and population estimates were calculated. Mean length at age was determined first by using an age length key to extrapolate length age distributions from the sub-sample of fish that were aged to the full sample length frequency, then second calculating the arithmetic mean of the length for a given age from the estimated full sample age distribution.

The Schnabel and Petersen population estimation methods were used to estimate community population size when the recapture numbers were large enough to provide an unbiased estimate of population size. For the Petersen method, population size was

estimated as the ratio between the number of fish initially marked and released during the marking period (M), times the number of fish captured and examined for marks (C) during the recapture period, divided by the number of fish that were found to have marks during the recapture period (R) using the Petersen estimator (Ricker 1975). Using the Schnabel multi-census model, each fyke netting day and each electrofishing run were defined as a sampling time period, and running population estimates were calculated for each time period (Ricker 1975). In general, Schnabel population estimates tend to be more precise than Petersen estimates because the population is sampled repeatedly in time, and with each successive time period sampled, we know the true population size with more certainty.

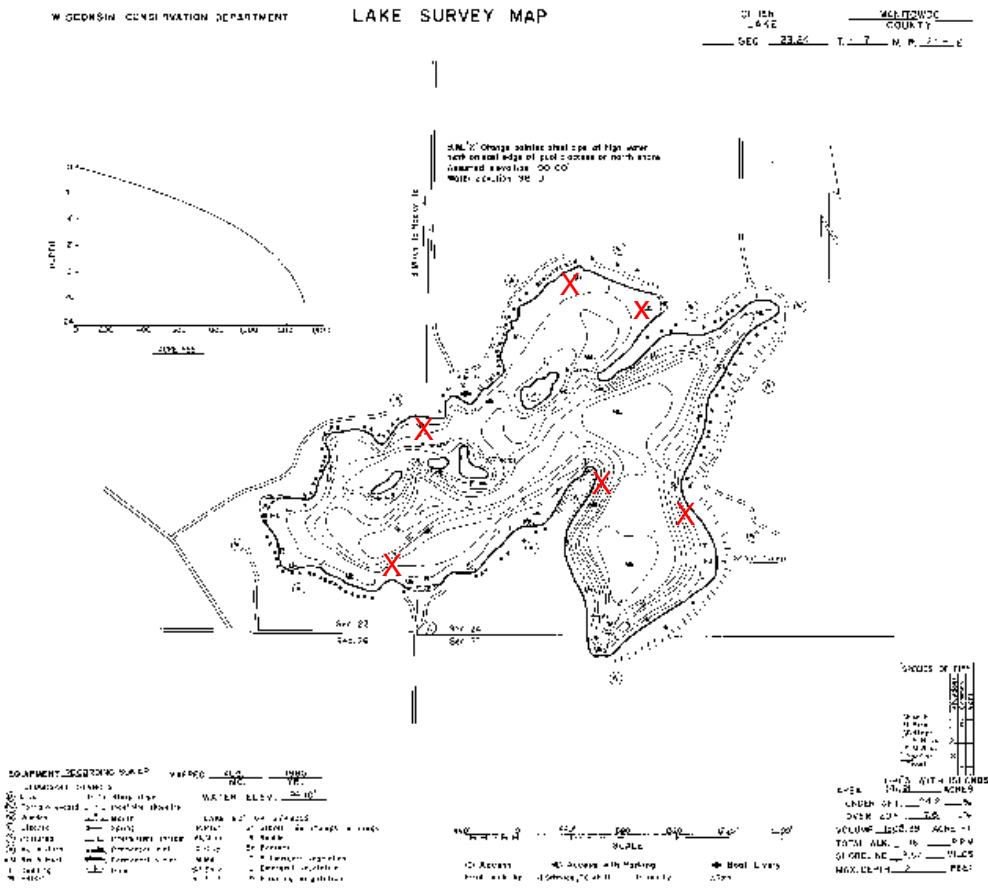


Figure 2. The locations of the six fyke nets that were fished in Cedar Lake from April 6 through April 15, 2006 are marked by an X on the lake map.

## RESULTS

### Spring Fyke Netting

During the fyke net portion of the survey, a total of 1,753 fish were captured during the 60 net nights fished for a CPE of 29.22 fish per net per night. Of the thirteen species captured, brown bullhead, black crappie and northern pike dominated the catch, with substantially fewer bluegill, rock bass, largemouth bass and other species captured (Table 1).

**Table 1. The number of each species that were captured with fyke nets fished from April 6-15, 2010 in Cedar Lake. Catch per unit effort, (CPE) is expressed as the number of fish per net per night.**

	Fyke Nets								Total	CPE
	06-Apr	07-Apr	08-Apr	09-Apr	10-Apr	12-Apr	13-Apr	15-Apr		
Northern Pike	50	38	29	15	14	27	10	7	190	3.17
White Sucker	1	2	2	0	0	0	0	1	6	0.10
Brown Bullhead	294	97	37	51	57	157	32	142	867	14.45
Rock Bass	49	22	12	4	4	10	5	11	117	1.95
Green Sunfish	2	7	2	1	2	2	3	4	23	0.38
Pumpkinseed	16	11	4	2	5	7	3	3	51	0.85
Warmouth	10	0	1	3	3	7	0	3	27	0.45
Bluegill	30	46	14	25	29	7	10	16	177	2.95
Largemouth Bass	3	6	1	2	1	4	0	7	24	0.40
Black Crappie	40	46	25	35	21	19	8	65	259	4.32
Hybrid Sunfish	1	2	1	0	1	0	0	1	6	0.10
Yellow Perch	1	0	0	1	1	0	1	0	4	0.07
Walleye	0	2	0	0	0	0	0	0	2	0.03
<b>Total</b>	<b>497</b>	<b>279</b>	<b>128</b>	<b>139</b>	<b>138</b>	<b>240</b>	<b>72</b>	<b>260</b>	<b>1753</b>	<b>29.22</b>
<b>CPE (Fish/Net/Night)</b>	<b>82.83</b>	<b>46.50</b>	<b>21.33</b>	<b>23.17</b>	<b>23.00</b>	<b>20.00</b>	<b>12.00</b>	<b>21.67</b>		

### Gamefish

#### Northern Pike

Northern pike were the most commonly captured gamefish during fyke netting (Table 1). The 190 pike that were captured with fyke nets ranged in length from 257 mm to 666 mm and had an average length of 446 mm (Table 2). The 71 female northern pike captured ranged in length from 280 mm to 666 mm and had an average length of 515 mm. The one hundred male northern pike that were captured during netting ranged in length from 252 mm to 598 mm and had an average length of 419 mm. Nineteen pike were classified as sex unknown and had an average length of 333 mm. They ranged in length from 240 mm to 517 mm.

Age was determined with the use of scales for most of the northern pike that were captured.

Sexes were combined for age analysis to increase sample size. Ages ranged from age 2 through age 12 (Table 3). Age 3 was the most common age northern pike followed by age 5. Age 3 pike averaged 356 mm in length. Few captured northern pike were greater than age 7.

Length at age data collected during this survey indicates that in Cedar Lake, northern pike exhibit growth slower than statewide averages (Table 4).

**Table 2. Gamefish length frequency for fish captured with fyke nets set in April, 2010.**

Length (mm)	Northern Pike All	Northern Pike Male	Northern Pike Female	Northern Pike Unknown	Largemouth Bass	Walleye
250	1			1		
260	2			2		
270	3			3		
280	3	1	1	1	1	
290	3	1		2		
300	3	2		1	1	
310	4	4				
320	2	2			1	
330	3	1	1	1	1	
340	3	3				
350	7	6		1	4	
360	6	4		2	2	
370	5	3	1	1	1	
380	7	3	2	2	2	
390	7	6	1		3	
400	7	6	1		2	
410	5	4	1		1	
420	11	7	4		2	
430	9	8	1		1	
440	11	9	2		1	
450	7	6	1			
460	6	4	2			
470	6	5	1			
480	7	4	3		1	
490	4	2	2			
500	9	3	4	2		
510	6	1	5			
520	5		5			
530	7		7			1
540	5		5			
550	6	3	3			
560	3		3			
570	1		1			
580	5	1	4			
590						
600	2	1	1			
610						
620	1		1			
630	3		3			
640	1		1			
650	2		2			
660	2		2			
670						
680						1
690						

700						
Total	190	100	71	19	24	2
Ave. Length	446	419	515	333	381	610
S.D.	92.49	64.68	79.67	75.07	43.6	102.5

**Table 3. Northern pike length frequency and age distribution for fish captured with fyke nets during 2010. The age distribution of the entire catch was a projection based on the distribution of ages from scale samples.**

Length (mm)	Number	Age									
		1	2	3	4	5	6	7	8	9	10
250	1		1								
260	2		1		1						
270	3		1	1	1						
280	3			3							
290	3			3							
300	3			3							
310	4			3	1						
320	2			2							
330	3			3							
340	3			2		1					
350	7			4	2	1					
360	6			5		1					
370	5			5							
380	7			6	1						
390	7			5		1	1				
400	7			1	3	1	1	1			
410	5			1	1		2		1		
420	11			1	5	3		1		1	
430	9				1	3	1	2	1		1
440	11			1	2	1	3		3		1
450	7					1	2	2	2		
460	6			1	1	1	2	1			
470	6					1	2	2		1	
480	7				1	2	1	3			
490	4				1	2	1				
500	9				4	3	1		1		
510	6				1	3		2			
520	5				2	2	1				
530	7				2	2	2		1		
540	5				1	2		1	1		
550	6					2	1		1		2
560	3					1				1	1
570	1				1						
580	5					1		3			1
590											
600	2							1			1
610											
620	1						1				
630	3							1	1	1	
640	1								1		
650	2								1	1	

660	2								1		1
Total	190		3	50	32	35	22	20	15	5	8
Ave. Length	446		265	356	445	479	475	503	522	551	551
S.D.	92.49		10.1	43.8	77.6	62.1	55.1	66.3	90.3	99.6	77.4

Using mark and recapture during spring surveys and the Schnabel technique to estimate population size, the northern pike population in Cedar Lake is likely between 756 and 4,631 individual pike or 5.3 to 32.6 northern pike per surface acre (Table 5).

**Table 4. Average length at age as determined by scales for fish captured in fyke nets on Cedar Lake during 1984 (Hogler 1999), 1995 (Hogler 1997), 2006 (Hogler and Surendonk 2009) and 2010 surveys. Average length at age from WDNR (1990) except for green sunfish which are after Becker (1983)**

Species	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8	AGE 9	AGE 10+
Northern Pike										
2010	--	265	356	445	479	475	503	522	551	551
2006	274	372	464	543	598	652	755			
1995	220	392	454	582	580					
1984	265	438	564	699	902	957	996			
(State Average)	(356)	(406)	(470)	(546)	(610)	(650)	(706)	(762)	(787)	
Largemouth Bass										
2010		148	238	297	318	346	370	409	388	435
2006	130	171	230	306	353	368	383	418	453	460
1995	112	175	218	252	307	329	408	450	--	500
1984	85	167	242	302	348	383	413	434	455	487
(State Averages)	(97)	(165)	(229)	(290)	(338)	(383)	(414)	(447)	(470)	
Rock Bass										
2010		105	120	174	213	240	258	258	266	275
2006	50	109	146	186	215	248	256			
1995		95	144	167	200	203		244		
1984	38	75	119	159	198	224	248			
(State Average)	(53)	(91)	(127)	(155)	(175)	(193)	(213)	(226)	(239)	(244)
Bluegill										
2010		114	126	149	178	215	184	175		
2006	110	124	153	172	200	--	--	230		
1995	76	126	147	177	188	209	200	--		
1984	52	89	123	152	172	193	198	215		
(State Average)	(64)	(97)	(122)	(147)	(167)	(183)	(196)	(208)		
Warmouth										
2010										
2006										
1995			109	144	147	167	174			
1984	50	89	115	133	164	194	215	226	238	
(State Average)	(41)	(91)	(147)	(178)	(190)	(203)	(221)			
Green Sunfish										
2010										
2006		110	137	155	185	210		230		
1995		105	133	159	168	203	260			
1984										
(State Average)	(43)	(74)	(99)	(127)	(150)	(168)	(183)			
Black Crappie										
2010		127	173	205	286	330				
2006										
1995		114	147	200	228	265	300			
1984	66	138	200	234	253	300				
(State Average)	(79)	(137)	(183)	(218)	(241)	(267)	(274)			



Yellow Perch									
2006			170	178	223				
1995			149	188	210	220	237		
1984	50	100	149	185	215	263	289	306	
(State Average)	(74)	(119)	(152)	(180)	(208)	(226)	(241)	(267)	

**Table 5. Population estimates for fish marked during fyke netting and recaptured by electroshocking (\* Peterson Estimate) or by fyke net (\*\* Schnabel Estimate) from Cedar Lake, 2010.**

Species	Total Marked	P.E.	Range
Northern Pike	190	1853*	756-4,631
White Sucker	6		
Brown Bullhead	867	1487**	1,334-1,657
Rock Bass	117	185**	129-275
Green Sunfish	23		
Pumpkinseed	51		
Warmouth	27		
Bluegill	177		
Largemouth Bass	24	1116*	389-2,029
Black Crappie	259	2020**	1,237-3,484
Hybrid Sunfish	6		
Yellow Perch	4		
Walleye	2		

### Largemouth Bass

Largemouth bass were the second most common gamefish captured during spring netting (Table 1). The 24 bass ranged in length from 287 mm to 480 mm and had an average length of 381 mm (Table 2).

Age was determined for largemouth bass using scales that were collected during fyke netting and from each electroshocking run. Ages ranged from age 2 through age 12 for bass that were aged (Table 6). Age 5 was the most common age bass followed by age 4 and age 6. Age 5 largemouth bass averaged 318 mm in length.

In Cedar Lake, bass when compared to statewide age at length tables, bass appear to grow at or near state rates through age 5 and slightly slower than average after age 5 (Table 4).

The Schnabel population estimate range for bass in Cedar Lake was calculated at 389 to 2,029 (Table 5) which likely is an underestimate of true bass abundance since fyke nets were set in areas that were more likely to catch pike, walleye and perch than bass. Based on this population estimate there are 2.7 to 14.3 bass per surface acre in Cedar Lake.

**Table 6. Largemouth bass length frequency and age distribution for fish captured with fyke nets during the 2010 survey. The age distribution of the entire catch was a projection based on the distribution of ages from scale samples.**

Length (mm)	Number	Age										
		1	2	3	4	5	6	7	8	9	10	11
100												
110												
120												
130	4											
140	1		1									
150	3											
160	2											
170	1											
180	6											
190												
200	3			2								
210	2			1								
220	3											
230	2											
240	6			2								
250	8			3	2							
260	6			1		1						
270	12					5	2					
280	10				2	2						
290	16				4	7	1					
300	15				4	6						
310	12					6						
320	14				1	3	1					
330	7				1	4	1					
340	9				1	2	1					
350	13					3	2	2				
360	9					1	1	2				
370	9					2	1	1		1		
380	14					1	3	3	1	2		
390	8						1		2	1	1	
400	13					1			2	1		2
410	2										1	
420	3								1			1
430	2								1			
440	1											1
450												
460												
470												
480	1											1
490												
500	1											1
Total	218	0	1	9	15	44	14	8	7	5	2	6
Ave. Length	314		148	238	297	315	346	370	409	388	404	445
S.D.		--	23.5	24.7	32.9	42.3	13	17.7	11.4	14.1	42	

### Walleye

During the fyke net period, only two walleye were captured (Table 1). The two walleye were 537 mm and 680 mm in length and had an average length of 610 mm (Table 2).

Panfish

Black Crappie

Black crappie were the most commonly caught panfish during spring fyke netting (Table 1). The 259 black crappie ranged in length from 115 mm to 353 mm and had an average length of 181 mm (Table 7).

Age was determined for black crappie that were captured by fyke net with the use of scales. Ages ranged from age 2 through age 6 (Table 8). Age 3 was the most common age crappie followed by age 4. Age 3 black crappie averaged 173 mm in length. Few captured crappie were greater than age 5 or greater in length than 250 mm.

Length at age data collected during this survey indicates that in Cedar Lake, black crappie grow at or slightly faster than statewide averages (Table 4).

**Table 7. The length frequencies for panfish and bullhead captured with fyke nets in Cedar Lake during the spring of 2010.**

Length (mm)	Brown Bullhead	Rock Bass	Green Sunfish	Pumpkin-seed	Warmouth	Bluegill	Black Crappie	Hybrid Sunfish	Yellow Perch
100		2		2		4			
110		6		4		10	1		
120		3	5	2	2	18	4	2	
130		3	4	2	4	22	2	1	1
140		2	2	10	6	22	1	1	
150	1	7	4	5	2	25	17		
160		5	3	9	4	15	59		
170	2	4	1	7		26	76	1	1
180	2	6	1	5	3	15	47	1	1
190	9	8		2	3	11	27		
200	11	12	2	2	1	5	2		1
210	30	11		1	2	3	3		
220	27	6				1			
230	23	2	1						
240	31	6					6		
250	45	16					1		
260	45	8					3		
270	32	7					2		
280	45	1					2		
290	45	1					2		
300	47						1		
310	16						1		
320	14						1		
330	5								
340	9								
350	1						1		
360	2								
370	1								
380									
390									
400									
Total	443	116	23	51	27	177	259	6	4
Ave. Length	266	206	155	157	162	155	181	146	176

S.D.	37.36	48.3	29.32	25.99	28.72	26.6	31.43	26.22	30.49
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**Table 8. Black crappie length frequency and age distribution for fish captured with fyke nets during the 2010 survey. The age distribution of the entire fyke net catch is a projection based on the distribution of ages from scale samples.**

Length (mm)	Number	Age					
		1	2	3	4	5	6
40							
50							
60							
70							
80							
90							
100							
110	1		1				
120	4		3				
130	2		2				
140	1			1			
150	17			17			
160	59			59			
170	76			76			
180	47			33	14		
190	27			14	13		
200	3			1	2		
210	3				3		
220							
230							
240	6				5	1	
250	1				1		
260	3				2	1	
270	2					2	
280	2					2	
290	2					2	
300	1						1
310	1					1	
320	1					1	
330							
340							
350	1						1
Total	260	0	6	201	40	10	2
Ave. Length	183		127	173	205	286	330
S.D.	31.9		7.5	10.7	25.3	23.3	35.4

The Schnabel population estimate range for black crappie in Cedar Lake was calculated at 1,237 to 3,484 which because of the low number of marked fish likely under estimates the

actual number of crappie in the lake (Table 5). This population estimate translates to 8.7 to 24.5 black crappie per surface acre of the lake.

### Bluegill

Bluegill were the second most common panfish encountered during spring fyke netting with 177 captured (Table 1). Bluegill ranged in length from 102 mm to 220 mm and had an average length of 155 mm (Table 7). Most bluegill had lengths between 130 mm and 170 mm, with few larger than 200 mm.

Age was determined for a subsample of captured bluegill with the use of scales. Ages ranged from age 2 through age 8 (Table 9). Age 4 was the most common age bluegill followed by age 5. Other age classes were captured in much lower number. An age 4 bluegill averaged 149 mm in length.

From this data, it appears that in Cedar Lake, bluegill are longer at age than a state average bluegill (Table 4). Very few bluegill reach an age greater than age 5 which results in very few large bluegill in the lake.

**Table 9. Bluegill length frequency and age distribution for fish captured with fyke nets during the spring netting period of the 2006 survey. The age distribution of the entire catch was a projection based on the distribution of ages from scale samples.**

Length (mm)	Number	Age							
		1	2	3	4	5	6	7	8
100	4		3	1					
110	10		3	5	2				
120	18		2	8	8				
130	22			8	14				
140	22				22				
150	25				14	9		2	
160	15				9	6			
170	26				8	14		2	2
180	15				2	13			
190	11				1	10			
200	4					1	1	2	
210	4					1	2	1	
220	1						1		
230									
Total	177	0	8	22	80	54	4	7	2
Ave. Length	155		114	126	149	178	215	184	175
S.D.	26.6		8.3	9	17	14.7	8.2	24.8	--

During spring netting it was not possible to estimate the bluegill population; because we did

not recapture any marked bluegill.

### Rock Bass

Rock bass were also commonly captured during spring fyke netting (Table 1). The 116 captured rock bass ranged in length from 105 mm to 297 mm and had an average length of 206 mm (Table 7).

Age was determined for rock bass by using scales. Ages ranged from age 2 through age 12 (Table 10). Age 5 was the most common age rock bass followed by age 4. Few rock bass were greater in age than age 6. Age 5 rock bass averaged 213 mm in length.

Rock bass growth in Cedar Lake in appears to be at of slightly greater than statewide averages for all ages (Table 4).

**Table 10. Rock bass length frequency and age distribution for fish captured with fyke nets during the spring netting period of the 2010 survey. The age distribution of the entire catch was a projection based on the distribution of ages from scale samples.**

Length (mm)	Number	Age											
		1	2	3	4	5	6	7	8	9	10	11	12
100	2		1	1									
110	6			6									
120	3			3									
130	3			3									
140	2				2								
150	7				7								
160	5				5								
170	4				4								
180	6				4	2							
190	8				3	5							
200	12				4	8							
210	11					8	3						
220	6					5	1						
230	2					1	1						
240	6					3	3						
250	16						4	4	4	3	1		
260	8						1	2	2	3			
270	7									4	2	1	
280	1												1
290	1												1
300													
Total	116		1	13	29	32	13	6	6	10	3	1	2

Ave. Length	208		105	120	174	213	240	258	258	266	268	275	290
S.D.	49.2		--	9.4	19.2	16.1	17.6	5.2	5.2	8.8	11.5	--	7.1

The Schnabel population estimate range for rock bass in Cedar Lake was calculated at 129 to 275 (Table 1). This population estimate translates to 0.9 to 1.9 rock bass per surface acre for the lake and is likely an underestimate because of the limited number of fish marked and recaptured.

#### Other Panfish

During fyke netting we also captured a number of other panfish species which included green sunfish, pumpkinseed sunfish, warmouth, yellow perch and hybrid sunfish (Table 1). They had average lengths of 155 mm, 157 mm, 162 mm, 176 mm and 146 mm respectively (Table 7). The hybrid sunfish were crosses between bluegill, pumpkinseed, green sunfish, rock bass and warmouth in various combinations.

#### Other species

During fyke netting we captured 867 brown bullhead making it the most commonly caught species during spring netting (Table 1). The brown bullhead that we measured (443 of the 867 captured) ranged in length from 155 mm to 370 mm and had an average length of 266 mm (Table 7). In addition, we captured six white sucker during fyke netting.

#### Spring Electroshocking

##### Recapture Electroshocking

On the night of April 19, the entire 3.47 mile shoreline of Cedar Lake was electroshocked to look for marked fish. A total of 353 fish representing eleven species were captured during 113 minutes of electroshocking (Table 11). Largemouth bass and bluegill were the most abundant species captured with substantially fewer fish of other species handled. During electroshocking, we recaptured three northern pike, and one each of the following species brown bullhead, rock bass and largemouth bass allowing us to calculate Peterson Population Estimates for northern pike and largemouth bass (Table 5).

**Table 11. Fish species captured during the April recapture electrofishing survey on Cedar Lake.**

Species	Total	CPE (Fish/Mile)	CPE (Fish/Hour)
Northern Pike	39	11.24	20.74
White Sucker	0	0.00	0.00
Brown Bullhead	3	0.86	1.60
Rock Bass	5	1.44	2.66
Green Sunfish	1	0.29	0.53
Pumpkinseed	29	8.36	15.43
Warmouth	3	0.86	1.60
Bluegill	168	48.41	89.36
Largemouth Bass	93	26.80	49.47



Black Crappie	3	0.86	1.60
Hybrid Sunfish	8	2.31	4.26
Yellow Perch	1	0.29	0.53
Walleye	0	0.00	0.00
<b>Total</b>	<b>353</b>	<b>101.73</b>	<b>187.77</b>

### Gamefish

Largemouth bass were the most commonly captured gamefish during April electroshocking (Table 11). The 93 bass ranged in length from 148 mm to 437 mm and had an average length of 318 mm (Table 12). Of the 93 bass we captured, 28.0% were greater than the 356 mm minimum size limit.

The 39 northern pike that were handled ranged in length from 200 mm to 577 mm and had an average length of 405 mm (Table 12). None of the captured northern pike were greater in length than the 711 mm minimum size limit on Cedar Lake.

### Panfish

Bluegill were the most commonly handled fish during April shocking with 168 captured (Table 11). The 132 bluegill that were measured ranged in length from 46 mm to 217 mm and had average length of 118 mm (Table 12). Most of the bluegill that we captured were between 80 mm and 130 mm. Only one bluegill was greater than 200 mm in length.

The only other panfish captured in substantial number were pumpkinseed sunfish with all other panfish species caught in much lower number (Table 12). Similar to bluegill only one pumpkinseed sunfish was greater in length than 200 mm.

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Table 12. Length frequency distribution of fish captured during the April recapture electrofishing survey.

Length (mm)	Largemouth Bass	Northern Pike	Bluegill	Rock Bass	Green Sunfish	Pumpkin-seed	Black Crappie	Warmouth	Hybrid Sunfish	Yellow Perch	Brown Bullhead
40			1								
50											
60			2								
70			1								
80			12								
90			20								
100			21			1					
110			17			2			2		
120			15	1		2			1		
130			15	1	1	1					
140	1		8			6			2		
150			13			8	1		1		
160			2			2	1				
170			2	1		1	1		2		1
180			1			1		1		1	
190			1			1					
200	2	1									
210	1		1	1		1					
220											
230											
240	2										
250	5	1									1
260	2	1		1							
270	8	1									
280	4										1
290	12										
300	9										
310	6										
320	4										
330	5	5									
340	4										
350	4										
360	2										
370	6	4									
380	8	1									
390	3	7									
400	4	3									
410		1									
420		1									
430	1										
440		2									
450		1									
460											
470		2									
480		3									
490		1									
500											
510		1									
520											
530											

540		1									
550		1									
560											
570		1									
Total	93	39	132	5	1	26	3	1	8	1	3
Ave. Length	318	405	118	179	130	151	166	186	144	180	240
S.D.	52.64	82.25	27.69	58.19	--	24.06	10.07	--	23.86	--	57.33

Centrarchid Electrofishing

On the night of May 19, Cedar Lake was electroshocked to assess centrarchid populations. The entire 3.47 mile shoreline was electroshocked and all fish netted during the 111 minutes of shocking. 400 individual fish representing twelve species were captured during shocking (Table 13). Bluegill and largemouth bass dominated the catch with substantially fewer fish of other species captured.

Table 13. Fish species captured during May 19 electrofishing on Cedar Lake.

Species	Number	CPE (Fish/Mile)	CPE (fish/Hour)
Largemouth Bass	102	29.39	55.14
Northern Pike	16	4.61	8.65
Brown Bullhead	8	2.31	4.32
Bluegill	170	48.99	91.89
Pumpkinseed	67	19.31	36.22
Black Crappie	5	1.44	2.70
Hybrid Sunfish	10	2.88	5.41
Rock Bass	11	3.17	5.95
Warmouth	6	1.73	3.24
Yellow Perch	3	0.86	1.62
Green Sunfish	1	0.29	0.54
Golden Shiner	1	0.29	0.54
<b>Total</b>	<b>400</b>	<b>115.27</b>	<b>216.22</b>

Gamefish

Largemouth bass were the most commonly captured gamefish during this portion of the survey (Table 13). The 102 bass ranged in length from 133 mm to 509 mm and had an average length of 296 mm (Table 14). Twenty-one (20.5%) of the captured bass were greater in length than the minimum size limit of 356 mm.

The sixteen northern pike that were captured ranged in length from 260 mm to 563 mm and had an average length of 414 mm (Table 14). None of the pike we captured were greater in length than the 711 mm minimum size limit.

**Table 14. Length frequency of gamefish and brown bullhead that were captured on Cedar Lake during electroshocking on the night of May 18, 2010.**

Length (mm)	Largemouth Bass	Northern Pike
100		
110		
120		
130	4	
140		
150	3	
160	2	
170	1	
180	6	
190		
200	1	
210	1	
220	3	
230	2	
240	4	
250	3	
260	5	1
270	3	
280	5	
290	4	2
300	5	1
310	6	
320	9	
330	1	
340	5	
350	5	1
360	5	
370	2	1
380	5	
390	2	
400	7	1
410	1	
420	1	
430		2
440		1
450		2
460		1
470		
480		
490		
500	1	
510		
520		
530		
540		2
550		
560		1

570		
580		
590		
600		
<b>Total</b>	102	16
<b>Ave. Length</b>	296	414
<b>S.D.</b>	79.65	133.29

**Panfish**

Bluegill dominated the panfish catch during centrarchid electroshocking with substantially lower numbers other panfish species captured (Table 13). The 170 bluegill ranged in length from 62 mm to 200 mm and had an average length of 113 mm (Table 15). Of the captured bluegill, 14.1% were greater than 150 mm but only 0.6% were greater than 200 mm in length. The average lengths of other panfish were 192 mm for rock bass, 138 mm for green sunfish, 148 mm for pumpkinseed, 178 mm for yellow perch, 158 mm for warmouth and 148 mm for hybrid sunfish (Table 15).

**Table 15. Panfish and bullhead length frequencies of fish captured during May electroshocking on Cedar Lake.**

Length (mm)	Bluegill	Pumpkin-seed	Black Crappie	Hybrid Sunfish	Rock Bass	Warmouth	Yellow Perch	Green Sunfish	Golden Shiner	Brown Bullhead
50										
60	8									
70	11	1								
80	17	2			1				1	
90	35	1								
100	17	2		1						
110	20	7								
120	11	8		1						
130	16	4		2		1		1		
140	11	6	1	3			1			
150	8	13		2		2				
160	8	8				1				
170	4	5				2				
180	2	4	2		3					
190	1	2			2		2			
200	1	3	1		1					
210		1			2					
220					1					
230										2
240				1						
250										1
260			1		1					
270										
280										1
290										1
300										1
310										
320										2
330										
340										
350										
360										
<b>Total</b>	170	67	5	10	11	6	3	1	1	8

<b>Ave. Length</b>	113	148	195	148	192	158	178	138	81	281
<b>S.D.</b>	30.39	31.05	42.70	36.27	43.11	14.92	30.62	--	--	36.41

## DISCUSSION

The 2010 comprehensive fisheries survey on Cedar Lake characterized the fish populations of the lake using multiple fisheries assessment gears during multiple seasons. Each gear type was efficient in capturing certain fish species and fish sizes. The use of multiple gears during different sampling seasons provided a clearer picture of the entire fish community and fish population characteristics of individual species within the lake.

During this survey a total of 2,506 individual fish representing fourteen species were captured. Across all surveys, the five most commonly captured fish were brown bullhead (35.0% of the catch), bluegill (20.6%), black crappie (10.7%), northern pike (9.8%) and largemouth bass (8.7%). Brown bullhead dominated the fyke net catch while bluegill dominated the two electroshocking surveys.

### Gamefish

Northern pike were the most commonly caught gamefish during this survey. The Peterson population estimate of 1,853 (range 756 to 4,631) in 2010 was more than double the 2006 estimate and nearly three times greater than the 1994-95 estimate of 641 (Hogler 2009). Northern pike captured with fyke nets averaged 446 mm in length in 2010 which reversed the trend of declining spring average length noted since 1974 (Hogler 2009). However despite the increased average length noted in 2010, few captured northern pike were greater than the 26" minimum size limit. Length at age in 2010 indicated that growth in 2010 was less than what was noted in 2006 and that pike were growing slower at all ages compared to statewide length at age averages (Table 4).

The northern pike population in Cedar Lake appears to be reproducing well as shown by the number of young fish captured during this survey. However, few older, large fish were captured. Previous surveys found abundant young (small) northern pike in the lake that exhibited good growth (Hogler and Surendonk, 2009). This fact indicated that angler harvest of pike reaching the size limit was likely very high. Hogler (1997) found that based on tag returns from anglers most of the pike harvest was by ice anglers. Hooking mortality of undersize northern pike released by anglers during the ice fishing season may also account for the lack of large pike in the lake. The decrease in growth rate and the stacking of fish below 26" is a concern. The northern pike population should be watched to determine if a change in regulation is warranted if growth rate remains slow and the average size and age decreases in future surveys.

Largemouth bass were commonly captured during this survey. This survey estimated that 1,116 (8.0 per acre) largemouth bass were present in the lake (Table 5). The 2010 population estimate was less than the previous survey, but in 2010 the estimate was based on the fyke net catch while in 2006 the estimate was based on electroshocking surveys (Hogler and Surendonk 2006). The average length of largemouth bass captured during spring electrofishing surveys, increased from 291 mm noted in 2006 to 307 mm in 2010 and continued the increasing trend observed since 1994-95. Growth expressed as length at age was similar to what was noted in 2006 and was near state averages at all ages (Table 4).

Consistent reproduction and recruitment with stable growth rates and increasing average length indicate that the bass population in Cedar Lake is doing well. It is likely that catch and release and additional years of the 14" minimum size limit are responsible for the improvements.

Walleye were rarely captured in 2010 despite the stocking efforts of the Cedar Lake Association. The lack of walleye in the 2010 survey was similar to the results of previous surveys that captured few walleye. It appears that walleye survive poorly in Cedar Lake with limited or no reproduction (Hogler and Surendonk 2009). Walleye stocking into Cedar Lake by the Lake Association will need to continue if they desire a limited walleye sport fishery in the lake.

#### Panfish

Bluegill were the dominant panfish captured during the 2010 survey. Since the 1994-95 survey, the bluegill length frequency structure has improved with an increasing percentage of bluegill greater in length than 150 mm. Despite the improvement in size, growth rates of bluegill have been variable since the 1980's (Table 4). Although length at age in 2010 was less than what was seen in 2006 at all ages, it still was much greater than what was observed in 1984. Since more fish are larger in overall size than what observed in higher growth years, it is likely reduced harvest and a lack of forage has resulted in larger, slower growing bluegill in the lake. Overall bluegill appear to be doing well in Cedar Lake.

Black crappie were commonly captured in 2010 reversing the declining trend noted in previous surveys (Hogler and Surendonk 2009). Growth appeared to be near state averages and the fish were robust in size. It is unclear what caused the black crappie population to increase in number and size since the 2006 survey.

Yellow perch abundance has changed little since surveys conducted by Belonger in the 1970's (Hogler 2009). They remain low in abundance and continue to be small in size. It is likely that angler harvest and limited recruitment has reduced the number of yellow perch in Cedar Lake.

Other centrarchids including rock bass, green sunfish, warmouth, pumpkinseed and a number of hybrid panfish were captured during this survey. Since the 1995 survey rock bass have increased in abundance, green sunfish have remained stable in number and warmouth, pumpkinseed and hybrid panfish have decreased in abundance. It is likely that angler harvest, increasing predator numbers or habitat loss caused by shoreline alterations

and plant harvesting have reduced panfish numbers.

#### Other Species

Brown bullhead were the most abundant species captured during fyke netting (Table 1). Captured bullhead were of good size with an average length of 266 mm (Table 7). Bullhead although abundant do not appear to be a problem in Cedar Lake.

Common carp which have been generally captured in low number during past fish surveys, were not captured during the 2010 survey. Although we did not capture any carp in 2010, it is likely they are still present in the lake in low numbers that are not likely to cause problems.

Few forage species were captured during the survey. Low abundance of forage could lead to long term decreases in abundance and growth of gamefish and panfish in the lake. High predation on forage fish and the loss of critical habitat caused by shoreline alteration and aquatic plant harvesting could be responsible for low forage fish abundance.

## **CONCLUSIONS**

- Gamefish populations in Cedar Lake appear to be doing well. The 14" minimum size limit for largemouth bass has helped the bass population in lake. Previous surveys had indicated an improvement in the northern pike size structure following the implementation of the 26", 2 bag limit regulation in the early 1990's. However, results from this survey were mixed. Future surveys should continue to monitor northern pike. Walleye do not appear to survive well in Cedar Lake.
- Panfish numbers have declined from earlier surveys; because of predation by more numerous gamefish and perhaps because of angler harvest. Lower panfish abundances have lead to a more desirable size distribution of panfish.
- Forage fish numbers appear to be low. Low forage fish numbers could lead to growth problems for gamefish in the future.
- Carp and bullhead are present in the lake, but are causing few problems.
- The status of the zebra mussel population in Cedar Lake is unclear at this time. Recent trends seem to indicate a decrease in the abundance of mussels in the lake.

## **RECOMMENDATIONS**

1. Monitor the northern pike population in succeeding surveys to determine if stunting is occurring and to determine if regulation changes are needed.



2. Work with the Lake Association and Aquatic Plant Managers to minimize the impacts of plant harvesting on fish populations.
3. Work with the Lake Association, home owners and Water Regulation and Zoning staff to reduce new alterations of the shoreline and to restore altered shorelines to a more natural state.

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