

Cedar Lake- 2006 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. Much 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 when largemouth bass, walleye, bluegill and yellow perch were stocked. In the years since, most of the fish stocked into the lake were largemouth bass or northern pike. In 2001, zebra mussels were discovered in the lake and quickly spread along the shoreline.

A 1945 fisheries survey of the lake with fyke nets indicated that bluegill was the most abundant fish species with crappies, largemouth bass, rock bass, bullheads, and warmouth also captured but less abundant. A survey conducted in 1961 used seines and electroshocking gear to assess the fish populations of the lake. The most common fish in seine hauls were bluegill, black crappie, largemouth bass, and northern pike. Similar results were obtained during the electroshocking survey. In 1974 a fisheries survey captured 1,188 fish and results indicated that bluegill was the most common fish with yellow perch, largemouth bass and northern pike also commonly caught. Other less commonly captured fish included walleye, black crappie, pumpkinseed, rock bass, warmouth, bullhead, white sucker, carp, and golden shiner. A comprehensive survey of Cedar Lake in 1985 captured 4,292 fish representing twelve species. Overall, bluegill and yellow perch dominated the catch. The most recent survey of Cedar Lake occurred in 1994-1995. During this survey, 21 species of fish were captured, with bluegill and largemouth bass dominating the catch.

The 2006 comprehensive fisheries survey on Cedar Lake characterized the fish populations of the lake using multiple fisheries assessment gear during multiple seasons. During this survey a total of 2,718 individual fish representing seventeen species were captured. Across all surveys, bluegill dominated the catch (46.8%) followed by largemouth bass, northern pike and rock bass.

Fish populations in Cedar Lake appear to be doing well. Largemouth bass and northern pike populations have improved since the last survey in 1994-95. Walleye do not appear to do 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. The long term impact of zebra mussels on fish populations in Cedar Lake are not clear at this time.

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 the 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. Since, mussels have spread throughout the lake.

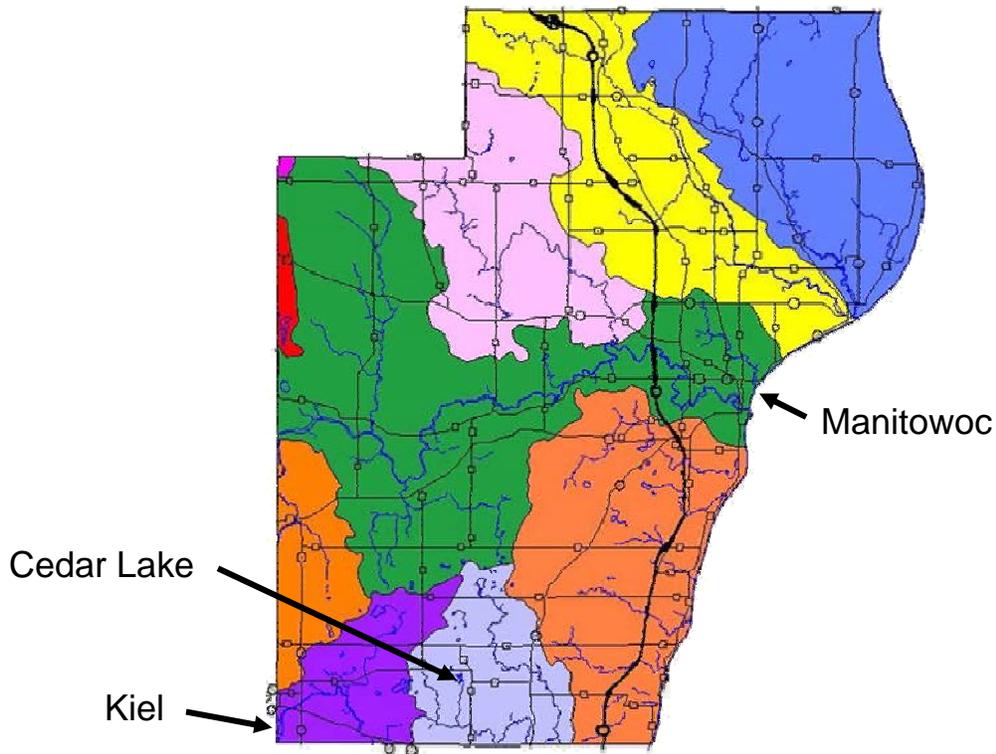


Figure 1. Cedar Lake is located between Kiel and the city of Manitowoc in the southwestern quarter of Manitowoc County.

Traditionally the lake has been managed as a largemouth bass- northern pike-bluegill lake although other species have been introduced into the lake. Cedar Lake has a long history of stocking that dates back to the 1930's when largemouth bass, walleye, bluegill and yellow perch were stocked. In the years since, most of the fish stocked into the lake were largemouth bass or northern pike.

Hogler (1999) described the past fish survey history of Cedar Lake and in this report I will only summarize the survey results. Surveys have been conducted on Cedar Lake approximately every ten years starting in the 1940's. A 1945 fisheries survey of the lake with fyke nets indicated that bluegill was the most abundant fish species, with crappies, largemouth bass, rock bass, bullheads, and warmouth also captured. A survey conducted in 1961 used seines and electroshocking gear to assess the fish populations of the lake. The most common fish in seine hauls were bluegill, black crappie, largemouth bass, and

northern pike. Similar results were obtained during the electroshocking survey. In 1974 a fisheries survey captured 1,188 fish. Results from the survey indicated that bluegill was the most common fish with yellow perch, largemouth bass and northern pike also commonly caught. Other fish captured included walleye, black crappie, pumpkinseed, rock bass, warmouth, bullhead, white sucker, carp, and golden shiner.

A comprehensive survey of Cedar Lake in 1985 characterized the fish populations of the lake. A total of 4,292 fish representing twelve species were captured during the survey (Hogler 1999). Overall, bluegill and yellow perch dominated the catch. Black bullhead, black crappie, largemouth bass and warmouth were also commonly caught with fewer northern pike, white sucker, rock bass and pumpkinseed captured. Only a few walleye and no carp were collected. Results from this survey were similar to those of earlier surveys. At the time of the survey, the fish populations of Cedar Lake were characterized as being in good condition. It was suggested that harvest and habitat loss may have negatively impacted the abundance and size of fish in Cedar Lake.

The most recent survey of Cedar Lake occurred in 1994-1995. During this survey, 21 species of fish were captured, with bluegill and largemouth bass dominating the catch (Hogler 1997). It was found during this survey that: bass were abundant, although few large fish were captured, and that the 14" largemouth bass size limit appeared to have been successful in increasing the average size of bass. Northern pike were present in good number but were small in size, and exhibited average growth rates. Additionally, panfish numbers and size had declined since the 1974 survey. Panfish growth rates were at or above state averages indicating that overharvest or low recruitment due to habitat loss could be reducing their abundance.

A comprehensive fish survey was conducted in 2006 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 2006 and continued through October. Six fyke nets were set shortly after ice-out on April 10, fished until April 19 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

Shortly after the completion of fyke netting, on the night of April 25, the entire shoreline of Cedar Lake was electroshocked to look for marked fish. All gamefish fish were netted, identified, examined for marks, and measured.

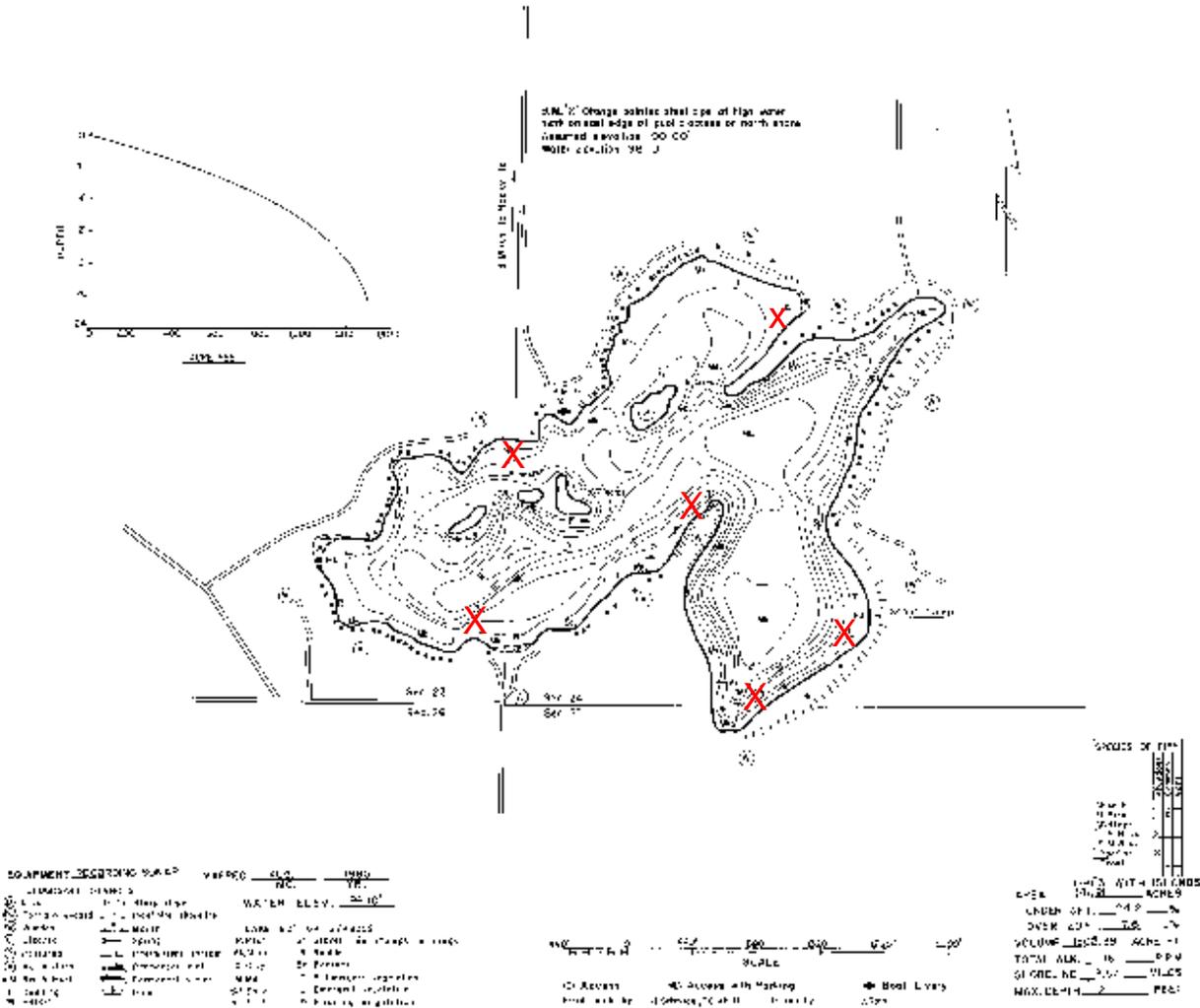


Figure 2. The locations of the six fyke nets that were fished in Cedar Lake from April 10 through April 19, 2006 are marked by an X on the lake map.

Summer Surveys

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.

Fish Community

Five mini-fyke nets were set on July 17 and fished through July 19 to index juvenile gamefish abundance and fish community composition (Figure 3). All fish were identified to species and counted. Gamefish and panfish species were counted and measured.

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.

RESULTS

Spring Fyke Netting

During the fyke net portion of the survey, a total of 1,041 fish were captured during the 36 net nights fished for a CPE of 29.6 fish per net per night. Of the twelve species captured, bluegill and northern pike dominated the catch, with substantially fewer rock bass, largemouth bass and other species captured (Table 1).

Table 1. Species captured from Cedar Lake with fyke nets during April 10-19, 2006. Schnabel Population Estimates were estimated with fyke net catches only, while the Peterson Estimates were using fyke net catch for marking and electroshocking (either April or May) as the recapture run.

Species	Number	CPE (#/Net Night)	Schnabel P.E. (95% Range)	Peterson P.E. (95% Range)
Northern Pike	197	5.5	2709 (1280-6252)	876 (156-8760)
Brown Bullhead	70	1.9	265 (142-542)	--
Yellow Bullhead	21	0.6	48 (22-121)	--
Rock Bass	100	2.8	381 (221-714)	--
Green Sunfish	81	2.3	547 (244-1368)	432 (147-2160)
Pumpkinseed	23	0.6	112 (34-204)	--
Warmouth	25	0.7	--	--
Bluegill	355	9.9	--	14157 (4826-70785)
Largemouth Bass	88	2.4	757 (309-1893)	5500 (1528-55000)
Black Crappie	54	1.5	577 (175-1048)	--
Hybrid Sunfish	12	0.3	--	--
Walleye	2	0.1	--	--
Yellow Perch	9	0.3	--	--
White Sucker	1	0.03		
Black Bullhead	1	0.03		
Common Carp	1	0.03		
Golden Shiner	2	0.1		
TOTAL	1041			

Gamefish

Northern Pike

Northern pike were the most commonly captured gamefish during fyke netting (Table 1). The 197 pike ranged in length from 240 mm to 790 mm and had an average length of 418 mm (Table 2). The 72 female northern pike captured ranged in length from 277 mm to 790 mm and had an average length of 486 mm. Ninety male northern pike were captured during netting and ranged in length from 252 mm to 598 mm with an average length of 397 mm. Thirty-five pike were classified as sex unknown and had an average length of 335 mm. They ranged in length from 240 mm to 517 mm.

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 1280 and 6252 individual pike or 9.0 to 44.0 northern pike per surface acre (Table 1).

Age was determined for most of the northern pike that were captured using scales. Sexes were combined for age analysis to increase sample size. Ages ranged from age 2 through age 7 (Table 2). Age 2 was the most common age northern pike followed by age 3. Age 2 pike averaged 372 mm in length. Few captured northern pike were greater than age 5.

Length at age data collected during this survey indicates that in Cedar Lake, northern pike exhibit growth similar to statewide averages (Table 3).

Largemouth Bass

Largemouth bass were the second most common gamefish captured during spring netting (Table 1). The 88 bass ranged in length from 206 mm to 462 mm and had an average length of 348 mm (Table 4).

The Schnabel population estimate range for bass in Cedar Lake was calculated at 309 to 1893 (Table 1). This population estimate translates to 2.2 to 13.3 bass per surface acre for the lake.

Age was determined for largemouth bass using scales that were collected during fyke netting and the April recapture electroshocking run. Ages ranged from age 1 through age 10 for bass that had scales removed for age analysis (Table 4). Age 3 was the most common age bass followed by age 5. Age 4 or 6 bass were also very common. Age 3 largemouth bass averaged 230 mm in length.

In Cedar Lake, bass when compared to statewide age at length tables appear to grow at or near state rates (Table 3). Bass less than six years of age were found to be longer at each age, while fish age six or greater were shorter at each age.

Table 2. Northern pike 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)	Northern Pike				Age							
	Female	Male	Unknown	Total	1	2	3	4	5	6	7	
240			1	1	1							
250		1	4	5	5							
260		1	2	3	3							
270	1	1	1	3	2	1						
280			1	1	1							
290			3	3	3							
300		2	1	3	3							
310		3	1	4	2	2						
320		10	5	15		15						
330		4	2	6		6						
340	3	6	3	12		12						
350	3	6		9		9						
360	1	8		9		9						
370	4	3	3	10		10						
380	1	5		6		5	1					
390	5	4	1	10		10						
400	7	5		12		10	2					
410	1	1	2	4		4						
420	3	1		4		3	1					
430	3	2	2	7		5	2					
440	3	4	1	8		7	1					
450	1	3		4		1	3					
460	1	1		2		2						
470	3	2		5		1	4					
480	1			1			1					
490	2	2		4			4					
500	1	3		4			3	1				
510		1	2	3			3					
520	1	1		2				2				
530	1	2		3				3				
540	2	1		3				3				
550	1	2		3				1	2			
560	1	1		2				1	1			
570	3	2		5				2	2			
580	2	1		3				1	2			
590	2	1		3					3			
600												
610	1			1					1			
620	2			2					2			
630	2			2					2			
640	5			5					2	3		
650	2			2					1	1		
660												
670												
680												
690	1			1						1		
700												
710												
720	1			1								1
730												
740												
>750	1			1								1
Total	72	90	35	197	20	112	25	15	18	5	2	
Ave. Length	486	397	335	418	274	372	464	543	598	652	755	
S.D.	113.5	81.6	71.5	108.3	23.0	41.6	37.6	22.9	32.4	21.7	49.5	

Table 3. Average length at age as determined by scales for fish captured in fyke nets on Cedar Lake during 1984, 1995 and 2006 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										
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										
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										
2006	50	109	146	186	215	248	256			
1995		95	144	167	200	203				
1984	38	75	119	159	198	224	248	244	--	--
(State Average)	(53)	(91)	(127)	(155)	(175)	(193)	(213)	(226)	(239)	(244)
Bluegill										
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										
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)			
Pumpkinseed										
2006										
1995										
1984										
(State Average)	(51)	(86)	(113)	(135)	(150)	(162)	(167)	(176)	(191)	
Green Sunfish										
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										
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 4. Largemouth bass length frequency and age distribution for fish captured with fyke nets and during April electroshocking periods 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)	Fyke Net	Recap. Shock	Total Spring	Age										
				1	2	3	4	5	6	7	8	9	10	
100			0											
110		1	1	1										
120			0											
130		1	1	1										
140			0											
150		2	2	1	1									
160		2	2		2									
170		2	2		2									
180		3	3		3									
190		2	2		1	1								
200	2	6	8			8								
210	1	6	7			7								
220	1	7	8			8								
230		7	7			7								
240	1	7	8			8								
250	1	5	6			4	2							
260	2	3	5			2	3							
270	2	3	5			4	1							
280	2	4	6			1	4	1						
290	3	3	6			1	5							
300	1	2	3				3							
310	1	3	4				4							
320	2		2				1	1						
330	3	6	9				2	7						
340	13	6	19				2	9	6	2				
350	12	7	19				8	8	2	1				
360	9	11	20					9	9	2				
370	9	9	18					9	7	2				
380	4	3	7					5	2					
390	6	5	11					1	6	3	1			
400	3	3	6						3	3				
410	3	2	5							1	4			
420	2		2							1	1			
430	2	2	4							1	2	1		
440			0											
450	2		2								1	1		
460	1	1	2									1	1	
470		1	1									1		
480			0											
490			0											
Total	88	125	213	3	9	51	35	50	35	16	9	4	1	
Ave. Length	348	291	315	130	171	230	306	353	368	383	418	453	460	
S.D.	53.8	80.1	75.5	20.1	12.7	24.1	33.1	20.1	18.9	27.7	17.2	17.1	--	

Walleye

During the 36 net nights of effort, two walleye were captured (Table 1). The two walleye were 545 mm and 652 mm in length and had an average length of 595 mm. The captured walleye were aged using scales and both were found to be age 4.

Panfish

Bluegill

Bluegill were the most common fish encountered during spring fyke netting with 355 captured (Table 1). Bluegill ranged in length from 95 mm to 235 mm and had an average length of 125 mm. Most bluegill had lengths between 100 mm and 150 mm, with few larger than 200 mm (Table 5).

Table 5. 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)	Total	Age							
		1	2	3	4	5	6	7	8
50									
60									
70									
80									
90	10	10							
100	49	42	7						
110	111	87	24						
120	58	41	17						
130	34	5	21	8					
140	28		15	10	3				
150	11		1	10					
160	18		3	10	5				
170	13		1	5	7				
180	10			4	5	1			
190	4			2	2				
200	6				6				
210	2					2			
220									
230	1								1
240									
250									
Total	355	185	89	49	25	6	0	0	1
Ave. Length	125	110	124	153	172	200	--	--	230
S.D.	25.9	8.9	15.2	16.8	17.2	11.0	--	--	--

During spring netting it was not possible to estimate the bluegill population because we did not recapture any marked bluegill.

Age was determined for a subsample of captured bluegill with the use of scales. Ages ranged from age 1 through age 5 and age 8 (Table 5). Age 1 was the most common age bluegill followed by age 2.

From this data, it appears that in Cedar Lake, bluegill are longer at age than a state average bluegill (Table 3). Young bluegill are present in good number in the lake, but show a steady decline in abundance as they age. Very few bluegill reach an age greater than age 5 which results in very few large bluegill in the lake.

Rock Bass

Rock bass were the second most common panfish captured during spring fyke netting (Table 1). The 100 captured rock bass ranged in length from 25 mm to 282 mm and had an average length of 183 mm (Table 6).

Table 6. Rock bass 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)	Total	Age							
		1	2	3	4	5	6	7	8
<50	1	1							
60									
70									
80									
90	2		2						
100	2		2						
110	7		7						
120	8		4	4					
130	4			4					
140	4			4					
150	3			1	2				
160	7			6	1				
170	8			4	4				
180	3				3				
190	3				3				
200	11				5	6			
210	4				3	1			
220	5				1	4			
230	8					3	3	2	
240	5					2	3		
250	6						4	2	
260	4						4		
270	3						1	2	
280	2							2	
290									
300									
Total	100	1	15	23	22	16	15	8	
Ave. Length	183	50	109	146	186	215	248	256	
S.D.	54.4	--	9.9	18.3	19.9	13.2	12.6	20.5	

The Schnabel population estimate range for rock bass in Cedar Lake was calculated at 221 to 714 (Table 1). This population estimate translates to 1.6 to 5.1 rock bass per surface acre for the lake.

Age was determined for rock bass by using scales. Ages ranged from age 1 through age 7 (Table 4). Age 3 was the most common age rock bass followed by age 4. Age 3 rock bass averaged 146 mm in length.

From this data it appears that in Cedar Lake, rock bass begin to spawn at age 2 and most spawn by age 3 or 4. Growth of rock bass in Cedar Lake in 2006 was similar to what was observed in 1995 and was greater than statewide average length at age (Table 3).

Green Sunfish

Green sunfish were commonly captured during netting (Table 1). The 81 green sunfish ranged in length from 109 mm to 235 mm and had an average length of 168 mm (Table 7). Most green sunfish had lengths between 150 mm and 200 mm and appeared to be very robust in body size.

Table 7. Green sunfish 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)	Total	Age							
		1	2	3	4	5	6	7	8
100	1				1				
110	3		1	1	1				
120	2			1	1				
130	3			1	2				
140	6			1	5				
150	9				8	1			
160	12			2	10				
170	16				12	4			
180	11				2	9			
190	5				1	3	1		
200	4					3	1		
210	5					2	3		
220	2					1	1		
230	2						1		1
240									
250									
260									
270									
280									
290									
300									
Total	81								
Ave. Length	168								
S.D.	27.9								

A Schnabel population estimate range was calculated for green sunfish based on fyke net catch. It was estimated that the population ranged from 244 to 1368, however this should be viewed cautiously because the low number of fish marked and recaptured.

Age was determined for green sunfish by using scales. Ages ranged from age 2 through 6 and age 8 (Table 7). Age 4 was the most common age green sunfish followed by age 5. Age 4 green sunfish averaged 155 mm in length. Growth of green sunfish in Cedar Lake in 2006 was similar to the previous survey and when compared to statewide age at length tables, appears to be above state rates (Table 3).

Several other species of panfish including black crappie, warmouth, pumpkinseed, yellow perch and several hybrid crosses were captured during netting (Table 1). Average lengths were 169 mm, 155 mm, 161 mm, 194 mm and 132 mm respectively (Table 8). It is likely that the hybrid crosses were between bluegill, rock bass, green sunfish and warmouth.

Table 8. Panfish length frequency for fish captured with fyke nets during the spring netting period of the 2006 survey.

Length	Black Crappie	Warmouth	Pumpkinseed	Yellow Perch	Hybrid Sunfish
110	10		1		2
120	10	5	2		3
130	1	2	1		3
140		1	2		2
150	1	4	2		1
160	3	5	2		
170	4	3	6	3	
180	4		4	1	1
190	2	4	2	2	
200	2	1	1	1	
210	5				
220	4				
230	3			1	
240	2				
250	2			1	
260					
270					
280					
290					
300	1				
Total	54	25	23	9	12
Ave. Length	169	155	161	194	132
S.D.	50.4	25.4	24.5	28.3	19.5

Population estimates were made for black crappie and pumpkinseed. It was estimated that the crappie population ranged between 34 and 204 individuals and the pumpkinseed population is between 34 and 204 (Table 1). Because capture and recapture numbers are low, these estimates should be viewed cautiously.

Age was determined for a limited number of yellow perch and black crappie by the use of scales. Captured yellow perch ranged in age from 3 to 5. Age 4 yellow perch were the most common age perch and averaged 178 mm in length. The age of captured black crappie ranged from age 2 through age 7, with age 4 crappie the most common.

Other species

Bullhead

During fyke netting we captured all three species of bullhead in Cedar Lake. Brown bullhead were the most common and black bullhead the least common bullhead collected (Table 1). The average lengths for each species was 291 mm for brown bullhead, 321 mm for yellow bullhead and the single black bullhead was 312 mm in length (Table 9).

Table 9. Bullhead length frequency for fish captured with fyke nets during the spring netting period of the 2006 survey.

Length	Brown Bullhead	Yellow Bullhead	Black Bullhead
140	1		
150			
160			
170			
180			
190			
200			
210			
220	1		
230	1		
240	2		
250	4		
260	5		
270	4	1	
280	8	1	
290	8	1	
300	11	4	
310	5	2	1
320	11	2	
330	7	3	
340		1	
350	2	5	
360		1	
370			
380			
390			
400			
Total	70	21	1
Ave. Length	291	321	312
S.D.	31.2	26.1	

In addition, one white sucker, one common carp and two golden shiner were captured during spring fyke netting.

Spring Electroshocking

On the night of April 25, the entire 3.47 mile shoreline of Cedar Lake was electroshocked to look for marked fish. Total electrofishing time was 105 minutes. A total of 326 fish representing fourteen species were captured (Table 10). Largemouth bass and bluegill were the most abundant species captured with substantially fewer fish of other species handled.

Table 10. Fish species captured during the April recapture electrofishing survey on Cedar Lake.

Species	Number	CPE (# / Mile)	CPE (# / Hr.)
Northern Pike	20	5.76	11.43
Common Carp	2	0.58	1.14
White Sucker	2	0.58	1.14
Yellow Bullhead	3	0.86	1.71
Rock Bass	12	3.46	6.86
Green Sunfish	16	4.61	9.14
Pumpkinseed	7	2.02	4.0
Warmouth	1	0.29	0.57
Bluegill	121	34.87	69.14
Largemouth Bass	125	36.02	71.43
Black Crappie	2	0.58	1.14
Hybrid Sunfish	10	2.88	5.71
Yellow Perch	4	1.15	2.29
Walleye	1	0.29	0.57
TOTAL	326	93.95	186.29

During electroshocking, we recaptured two marked largemouth bass, three green sunfish and three bluegill. These recaptures allowed us to calculate Peterson Population estimates and ranges for these species (Table 1). The Peterson estimates were 5,500 for largemouth bass, 432 for green sunfish and 14,147 for bluegill.

Gamefish

Largemouth bass were the most commonly captured gamefish during April electroshocking (Table 10). The 125 bass ranged in length from 100 mm to 475 mm with an average length of 291 mm (Table 11). The twenty northern pike that were handled ranged in length from 220 mm to 665 mm and had an average length of 416 mm (Table 11). The single walleye that was captured was 507 mm in length (Table 11).

Panfish

Bluegill dominated the panfish catch (Table 10). Substantially fewer number other panfish species were captured. The 121 bluegill ranged in length from 65 mm to 185 mm and had an average length of 111 mm (Table 12). The average lengths of other panfish were 178 mm for rock bass, 148 mm for green sunfish, and 163 mm for pumpkinseed. Yellow perch had an average length of 192 mm and the single warmouth was 197 mm in length.

Table 11. Gamefish length frequency for fish captured during the April electroshocking survey.

Length (mm)	Northern Pike	Walleye	Largemouth Bass
100			
110			1
120			
130			1
140			
150			2
160			2
170			2
180			3
190			2
200			6
210			6
220	1		7
230	1		7
240			7
250			5
260			3
270			3
280	1		4
290	1		3
300			2
310			3
320			
330			6
340	1		6
350	1		7
360	1		11
370			9
380			3
390			5
400			3
410	1		2
420			
430	1		2
440			
450			
460	1		1
470			1
480			
490			
500		1	
510			
520	1		
530	1		
540			
550	2		
560	1		
570	2		
580			
590			
600			
610			
620	1		
630			
640			
650	1		
660	1		
Total	20	1	125
Ave. Length	416	500	291
S.D.	248.1		80.1

Table 12. Panfish length frequency for fish captured during the April electroshocking survey.

Length (mm)	Rock Bass	Green Sunfish	Pumpkin-seed	Bluegill
50				
60				2
70				3
80				10
90	1	1		9
100	1	1		23
110		1	1	28
120				19
130		1		12
140		4	1	7
150		2		6
160	3	1	1	1
170		1	2	
180	1	2	2	1
190		1	1	
200	3	1		
210	2			
220				
230				
240				
250				
260	1			
270				
280				
290				
300				
Total	12	16	8	121
Ave. Length	178	148	163	111
S.D.	47.7	31.5	26.1	21.3

Summer Surveys

Centrarchid Electroshocking

On the night of June 5, Cedar Lake was electroshocked to assess centrarchid populations. The entire 3.47 mile shoreline was electrofished and all fish netted during the 95 minutes of shocking. 205 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 June 5 electrofishing on Cedar Lake.

Species	Number	CPE (# / Mile)	CPE (# / Hr.)
Northern Pike	4	1.15	2.53
Golden Shiner	2	0.58	1.27
Yellow Bullhead	4	1.15	2.53
Brown Bullhead	2	0.58	1.27
Rock Bass	5	1.44	3.16
Green Sunfish	5	1.44	3.16
Pumpkinseed	6	1.73	3.80
Bluegill	125	35.73	79.11
Largemouth Bass	45	12.97	28.48
Hybrid Sunfish	2	0.58	1.27
Yellow Perch	4	1.15	2.53
Walleye	1	0.29	0.63
TOTAL	205	59.08	129.75

Gamefish

Largemouth bass were the most commonly captured gamefish during this portion of the survey (Table 13). The 45 bass ranged in length from 120 mm to 455 mm and had an average length of 296 mm (Table 14). The four northern pike that were captured ranged in length from 500 mm to 660 mm and had an average length of 588 mm. The single walleye that was captured was 370 mm in length.

Panfish

Bluegill dominated the panfish catch (Table 10). Substantially lower numbers of other panfish species were captured. The 125 bluegill ranged in length from 50 mm to 209 mm and had an average length of 110 mm (Table 14). Average lengths of other panfish were 188 mm for rock bass, 180 mm for green sunfish, and 177 mm for pumpkinseed.

In addition to collecting information on centrarchids, we recaptured several previously marked fish and were able to calculate Peterson Population Estimates for largemouth bass, northern pike and bluegill. The Peterson estimate for bass was 1,583 with a 95% confidence range of 725 to 4,316. The pike estimate was 876 (95% range of 156-8,760) and bluegill had a PE of 19,542 with a range of 6,662 to 97,770.

Table 14. Length frequency of fish captured during the June 5 electroshocking survey on Cedar Lake.

Length (mm)	Largemouth Bass	Walleye	Rock Bass	Green Sunfish	Pumpkin-seed	Bluegill	Brown Bullhead	Yellow Bullhead	Yellow Perch
50						2			
60						6			
70						8			
80						9			
90						10			
100						13			3
110						19			
120	2					22			
130						16			
140	3			1		9			
150			1			9			
160	1		1		1	1			1
170					1				
180	1			3	3				
190					1				
200	1		1			1	1		
210			1						
220			1	1					
230	1								
240									
250	6								
260	1								
270	2								
280	2								
290	1							2	
300								2	
310	1								
320	3								
330	2						1		
340	1								
350	2								
360	4								
370	3	1							
380	1								
390	2								
400	3								
410									
420	1								
430									
440									
450	1								
Total	45	1	5	5	6	125	2	4	4
Ave. Length	296	370	188	180	177	110	265	295	115
S.D.	87.6		31.1	28.3	10.3	27.1	91.9	5.8	30.1

Summer Fish Community

Five mini-fyke nets set in Cedar Lake on July 17, were lifted on July 18 and July 19 and then removed. A total of 824 fish, representing 10 species were captured during mini-fyke netting (Table 15). Total effort was 10 net nights resulting in an overall CPE of 82.4 fish per net night. Fish number and species composition were similar between the two days of netting although more fish were captured on July 18 than on July 19.

Table 15. Fish captured on Cedar Lake during July 2006 mini-fyke netting.

Species	07/18/2006	07/19/2006	Total	CPE
Bluegill	325	168	493	49.3
Green Sunfish	49	77	126	12.6
Pumpkinseed	9	17	26	2.6
Hybrid Sunfish	86	32	118	11.8
Rock Bass	21	17	38	3.8
Largemouth Bass	1	1	2	0.2
Yellow Perch	8	4	12	1.2
Northern Pike	1	1	2	0.2
Brown Bullhead	1	3	4	0.4
Warmouth	0	3	3	0.3
Total	501	323	824	82.4

Panfish, chiefly bluegill dominated the catch on both survey days. Most captured fish were less than 100 mm in length. Bluegill ranged in length from 44 mm to 128 mm and had an average length of 54 mm (Table 16). Green sunfish, pumpkinseed hybrid sunfish and rock bass had average lengths of 63 mm, 87 mm, 76 mm and 105 mm respectively.

Very few gamefish were captured during the mini-fyke net survey, with only two largemouth bass and two northern pike collected.

Table 16. Length frequency of fish captured during mini-fyke netting on Cedar Lake July 17-19, 2006.

Length (mm)	Largemouth Bass	Bluegill	Green Sunfish	Pumpkin-seed	Hybrid Sunfish	Rock Bass	Yellow Perch	Warmouth	Brown Bullhead
30									
40		72	16		5				
50		234	38		18	2	1		
60	2	61	41	3	21	18		1	
70		42	17	7	13	1			
80		13	2	1	9	1	1	1	
90		4	1	4	3	1	3		
100		1		6	4		1		
110		1		2	3		1		
120		2	1	2	1	1	4		
130					6	1	1		
140					2	2			1
150					1	2			
160			1		3	3			
170			5						
180								1	1
190			1						
200									
210						1			1
220						2			
230						1			
240									1
250									
260						1			
270									
280									
290									
300									
Total	2	430	123	25	89	37	12	3	4
Ave. Length	60	54	63	87	76	105	102	107	193
S.D.		11.7	29.1	18.9	31.1	61.9	22.9	64.3	42.7

Fall Surveys

Fall Recruitment and Index Sampling

The entire shoreline was shocked on the night of October 10 to assess young-of-year abundances and the general condition of the fish community. In 94 minutes of effort, a total of 322 individual fish representing twelve species were captured. The CPE was 201.3 fish per hour or 92.8 fish per mile. It was noted that most fish were captured in association with aquatic vegetation, rock or woody debris. Few fish were captured in areas where vegetation was lacking or where bottom sediments had been altered by human activities (sand blankets).

Bluegill dominated the catch with substantially fewer largemouth bass captured (Tables 17 and 18). Additionally, two bluntnose minnow were captured but not measured.

The 90 captured largemouth bass ranged in length from 58 mm to 453 mm and had an average length of 286 mm (Table 17). Twenty-five or 27.8% of the captured bass were greater than the 356 mm minimum size limit for harvest.

Eighteen northern pike were captured during electrofishing. They ranged in length from 127 mm to 743 mm and had an average length of 423 mm (Table 17). Based on spring ageing, the northern pike less than 200 mm were young of year fish. Only one captured northern pike was greater than the 660 mm minimum size length for harvest.

The 178 captured bluegill ranged in length from 62 mm to 198 mm and had an average length of 114 mm (Table 18). Based on spring ageing, it is likely that bluegill less than 100 mm are young of year fish.

Other captured panfish included rock bass, green sunfish, pumpkinseed sunfish, yellow perch, warmouth and black crappie. They had average lengths of 131 mm, 153 mm, 153 mm, 148 mm and 130 mm respectively (Table 18).

During fall shocking we also captured yellow and brown bullhead and bluntnose minnow. The captured yellow bullhead had an average length of 270 mm and the brown bullhead had an average length of 260 mm (Table 18).

Table 17. Length frequency of gamefish captured during fall electroshocking on Cedar Lake on October 10. Note that categories from 510-570 mm, 590-610 mm and 650-730 are skipped in the length frequency.

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

Length (mm)	Largemouth Bass	Northern Pike
580		2
620		1
630		1
640		1
740		1
Total	90	18
Ave. Length	286	423
S.D.	91.6	186.5

Table 18. Length frequency of panfish captured during fall electroshocking on Cedar Lake on October 10.

Length	Brown Bullhead	Yellow Bullhead	Rock Bass	Green Sunfish	Pumpkin-seed	Bluegill	Black Crappie	Warmouth	Yellow Perch
50									
60						10			
70			1			11			
80			3			21			
90						12			
100			1		1	17			
110				1		23			1
120						22		1	
130	1				1	17			2
140			1	1		13		1	1
150						9			
160						5			1
170			2	1		12			
180					1	4			
190			1	1		2			
200					1				
210									
220							1		1
230			1						
240									
250		1							
260		1							
270									
280									
290	2								
300		1							
310									
320									
330	1								
Total	4	3	10	4	4	178	1	2	6
Ave. Length	260	270	131	153	153	114	225	130	148
S.D.	88.7	26.5	56.7	35.1	45.7	32.6	--	14.1	38.7

DISCUSSION

The 2006 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 2,718 individual fish representing seventeen species were captured. Across all surveys, bluegill dominated the catch (46.8%) followed by largemouth bass, northern pike and rock bass. Bluegill were the most common fish caught with each gear type used during this survey.

Gamefish

Largemouth bass were the dominant gamefish captured during this survey. This survey estimated that 5,500 (39.3 per acre) largemouth bass were present in the lake (Table 1). The 2006 population estimate was greater than the previous survey estimate of 3,558 bass (Hogler 1997). The average length of largemouth bass captured during spring electrofishing increased from 270 mm in 1995 to 291 mm in 2006. Additionally, growth expressed as length at age also increased from 1995 to 2006 for ages 1 through 6 (Table 3). Length at age in 2006 was slightly longer than statewide averages.

Improvements in number, average length and growth 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.

Northern pike were also commonly caught during this survey. The Peterson population estimate of 876 in 2006 was greater than the 1995 estimate of 641 (Hogler 1997) and much greater than estimated by biologists in 1974 (Belonger 1975). In 2006, the average length of pike during spring fyke netting was 418 mm (Table 2) which continued the decreasing length trend noted by Hogler since the survey conducted by Belonger in 1974 (Hogler 1997). Few captured northern pike were greater than the 26" minimum size limit. Length at age in 2006 was similar to the previous survey and was near statewide averages (Table 3).

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 during this survey. Since growth appears to be near average and young fish are present, it appears that pike are harvested quickly as they reach the minimum size limit. Additionally, Hogler (1997) using angler tag returns found that ice anglers harvested the greatest share of northern pike. 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.

Walleye were rarely captured in 2006 despite stocking efforts of the Cedar Lake Association. The lack of walleye in 2006 is similar to earlier surveys by Hogler (1997) and Belonger (1975) that indicated poor survival of stocked walleye and the lack of natural

reproduction by walleye in the lake. It appears that stocking walleye into Cedar Lake will only produce a limited sport fishery dependent on stocking to maintain the population.

Panfish

Bluegill were the dominant panfish captured during the 2006 survey. The spring population estimate of 14,157 (Table 2) was less than the 36,908 estimate in 1995 (Hogler 1997). However, panfish estimates should be viewed cautiously because in many cases too few fish were marked or recaptured making estimates highly variable. Bluegill length frequency structure has improved with a greater percent of bluegill greater than 150 mm in length in 2006 than in 1995. Growth in 2006 was similar to growth in 1995 and was greater than statewide averages at most ages (Table 3). It is likely that angler harvest, increasing predator numbers or habitat loss caused by shoreline alterations and plant harvesting have reduced bluegill number in the lake and have also increased growth rates.

Other centrarchids including rock bass, green sunfish, warmouth, pumpkinseed and black crappie were captured during this survey although in much lower number than bluegill. Since the 1995 survey rock bass have increased in abundance, green sunfish remained stable and warmouth, pumpkinseed and black crappie have decreased in abundance. Average length of captured fish increased for all species with the greatest increase in average length noted in rock bass with average length increasing from 166 mm in 1995 (Hogler 1997) to 183 mm in spring fyke net surveys (Table 6). Growth of rock bass was much greater than state averages (Table 3). It is likely that angler harvest, increasing predator numbers or habitat loss caused by shoreline alterations and plant harvesting have reduced panfish number, except rock bass and have also increased growth rates. Rock bass have likely increased in number and size because they are not highly sought after by anglers, quickly grow larger than what can be consumed by predators or perhaps are utilizing abundant zebra mussels as a food source.

Yellow perch abundance has changed little since surveys conducted by Belonger in the 1970's. They remain low in abundance and continue to show average growth.

Other Species

All three bullhead species were captured in 2006. Brown bullhead were the most abundant and black bullhead the least abundant. Captured bullhead were of good size (Table 9) and do not appear to be a problem in Cedar Lake.

Common carp were captured during this survey, but were in low number. They do not appear to be a problem in the lake.

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

- Fish populations in Cedar Lake appear to be doing well. Minimum size limits for largemouth bass and northern pike have helped those populations. Walleye do not appear to do 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 led 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 long term impacts of zebra mussels on fish populations in Cedar Lake are not clear at this time.

RECOMMENDATIONS

1. Continue to monitor the impacts of size limits and zebra mussels on fish populations in the lake.
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.
4. Recommend to anglers that they voluntarily use circle hooks to help reduce ice fishing mortalities of released undersize northern pike.

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