

Cedar Lake Comprehensive Fish Survey Report-2016
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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 survey of Cedar Lake occurred in 2010. During this survey a total of 2,506 individual fish representing fourteen species were captured. Findings from this survey included: Largemouth Bass and Northern Pike populations were doing well, but that Walleye do not appear to perform well in Cedar Lake and remain low in abundance. That panfish numbers have declined from earlier surveys but lower panfish abundances have led to a more desirable size distribution of panfish. Forage fish numbers appear to be low. Carp and bullhead are present in the lake, but are not causing problems.

During the 2016 survey, a total of 1,802 individual fish representing sixteen species were captured. Across all surveys, the five most commonly captured fish were Bluegill (33.0% of the catch), Yellow Bullhead (18.8%), Largemouth Bass (10.1%), and Northern Pike (10.0%). Yellow Bullhead and Black Crappie and Northern Pike dominated the fyke net catch while Bluegill dominated the two electroshocking surveys.

Results indicate that 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. Similar to past surveys, this survey found that Walleye do not appear to survive well in Cedar Lake. Panfish size and growth have improved over results from past surveys. Forage fish numbers continue to be low. Carp and bullhead are present in the lake, but are causing few 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.

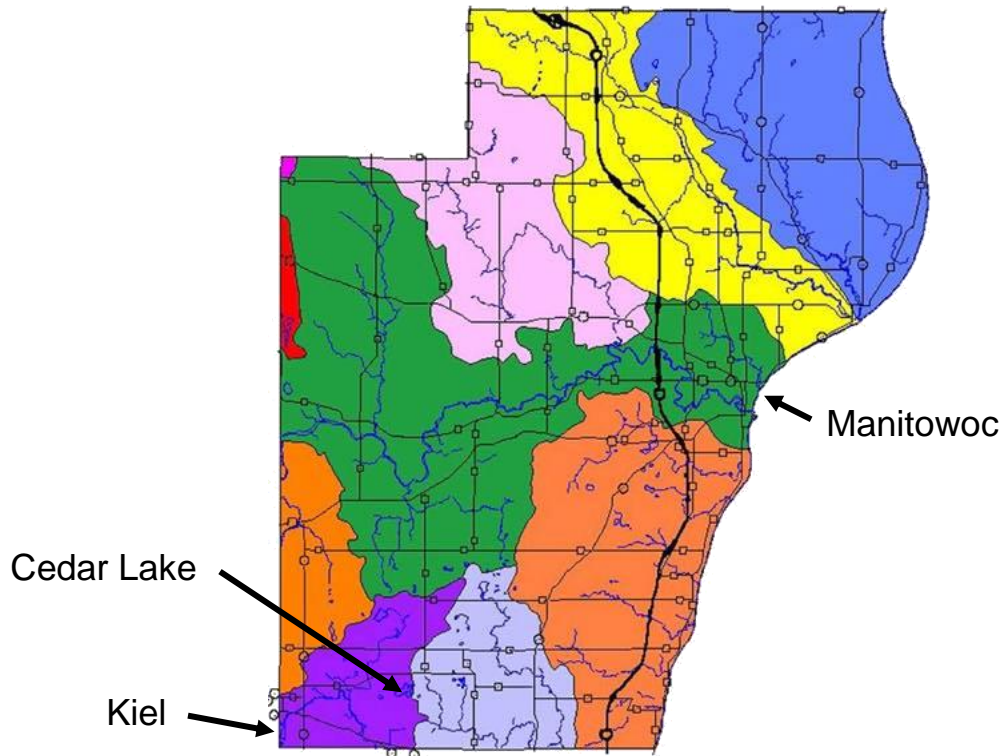


Figure 1. Cedar Lake is located between Kiel and the city of Manitowoc in the southwestern quarter of Manitowoc County.

Fish management activities on Cedar Lake have a long history including 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 Wisconsin DNR or by local sportsmen with stocking permits from DNR.

A comprehensive fish survey was conducted in 2010 on Cedar Lake to evaluate the fishery of the lake as part of Baseline Lake monitoring using multiple types of fisheries gear (Hogler and Surendonk 2011). During the 2010 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.

Conclusions from the 2010 survey include: that gamefish populations in Cedar Lake appeared to be doing well. The 14" minimum size limit for Largemouth Bass has helped the bass population in lake by increasing numbers and improving their size structure. 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. That 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 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.

In 2016, Cedar Lake was once again assessed using lake sampling protocols to determine the status of fish populations in the lake. As in previous surveys, a spring ice-out fyke net survey was followed by several rounds of electrofishing.

METHODS

Spring Fyke Netting

A standard comprehensive fisheries survey on Cedar Lake began in March and continued through May 2016. Six fyke nets were set shortly after ice-out on March 29, fished until April 1 when they were tied open (make inoperable allowing fish to pass through without being captured). On April 5 all nets were closed and fished until April 13. Fyke nets 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 spines, rays or scales were removed from a sub-sample of species for age determination.

Spring Electrofishing

Recapture Run

Shortly after the completion of fyke netting, on the night of April 20, the entire shoreline of Cedar Lake was electroshocked to look for marked fish. All fish were netted, identified, checked for marks and measured.

Centrarchid Electrofishing

On the night of May 23, 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 Petersen population estimation method was 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).

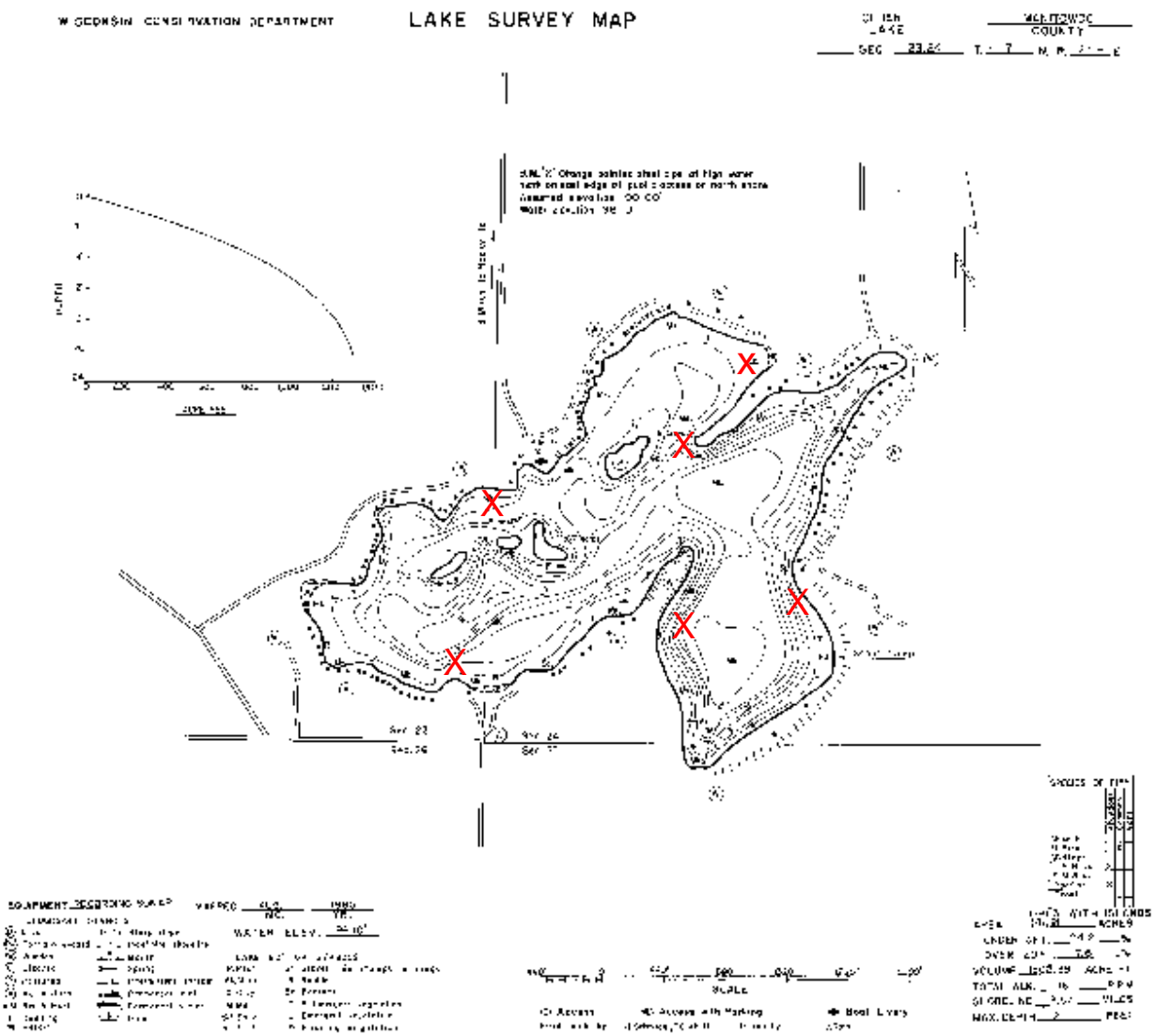


Figure 2. The locations of the six fyke nets that were fished in Cedar Lake from March 29 through April 13, 2016 are marked by an X on the lake map.

RESULTS

Spring Fyke Netting

During the fyke net portion of the survey, a total of 909 fish were captured during the 72 net nights fished for a Catch per Effort (CPE) of 12.6 fish per net per night. Of the fourteen species captured, Yellow Bullhead, Black Crappie and Northern Pike dominated the catch, with substantially fewer Bluegill, Rock Bass, Largemouth Bass and other species netted (Table 1).

Table 1. The number of each species that were captured with fyke nets fished from March 29-April 1 and April 4- April 13, 2016 in Cedar Lake. Catch per unit effort, (CPE) is expressed as the number of fish per net per night. Lengths are reported in mm and in inches () for each species.

Species	Number Caught	CPE (Fish/Net-Night)	Average Length mm (in)	Size Range mm (in)
Northern Pike	160	2.2	479 (18.9)	225-722 (8.9-28.4)
Largemouth Bass	10	0.1	377 (14.8)	269-455 (10.6-17.9)
Walleye	9	0.1	533 (21)	384-666 (15.1-26.2)
Black Crappie	196	2.7	215 (8.5)	142-367 (5.6-14.4)
Bluegill	125	1.7	160 (6.3)	105-218 (4.1-8.6)
Pumpkinseed Sunfish	23	0.3	163 (6.4)	102-257 (4.0-10.1)
Green Sunfish	9	0.1	157 (6.2)	105-218 (4.1-8.6)
Rock Bass	6	0.1	215 (8.5)	193-235 (7.6-9.3)
Warmouth	5	0.1	171 (6.7)	132-214 (5.2-8.5)
Hybrid Sunfish	4	0.1		
Yellow Perch	2	0.0	176 (6.9)	152-199 (6.0-7.8)
White Sucker	2	0.0		
Yellow Bullhead	301	4.2	282 (11.1)	242-315 (9.5-12.4)
Brown Bullhead	57	0.8	262 (10.3)	149-332 (5.9-13.1)
Total	909	12.6		

Gamefish

Northern Pike

Northern Pike were the most commonly captured gamefish during fyke netting (Table 1). The 160 pike that were captured with fyke nets ranged in length from 225 mm to 722 mm (8.9” to 28.4”) and had an average length of 479 mm (18.9”) (Table 1). Most of the captured Northern

Pike were shorter in length than the 660 mm (26") minimum harvest size with only two (1.3%) of legal harvest size (Figure 3). CPE for pike was 2.2 fish per net-night (Table 1).

Age was determined with the use of anal rays for the Northern Pike that were captured. Sexes were combined for age analysis to increase sample size. Ages ranged from age 1 through age 9 (Table 2). Age 4 was the most common age Northern Pike followed by ages 3 and 5. Age 3 pike averaged 428 mm (16.9") in length. Few captured northern pike were greater than age 6.

Length at age data collected during this survey indicates that in Cedar Lake, Northern Pike grow slower than statewide averages, although growth in 2016 was greater than what was measured in 2010 (Table 3).

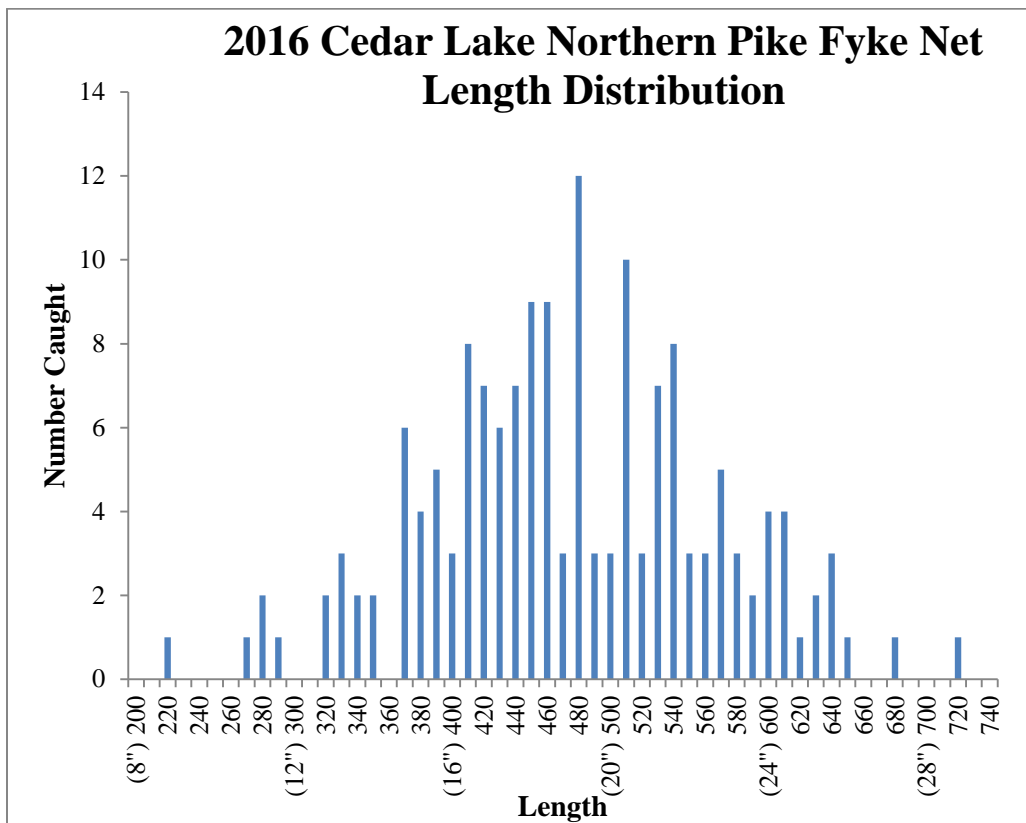


Figure 3. The length distribution of Northern Pike that were captured with fyke nets from Cedar Lake in 2016. Lengths are reported in mm and in inches (") for each species.

Table 2. Northern pike length frequency and age distribution for fish captured with fyke nets during 2016. The age distribution of the entire catch was a projection based on the distribution of ages from anal ray samples. Lengths are reported in mm and in inches () for each species.

Length (mm)	Total Captured	Age								
		1	2	3	4	5	6	7	8	9
220	1	1								
230										
340										
(10") 250										
260										
270	1		1							
280	2	1	1							
290	1	1								
(12") 300										
310										
320	2		2							
330	3		2	1						
340	2		2							
(14") 350	2				2					
360										
370	6		3	2	1					
380	4		1	3						
390	5			3		2				
(16") 400	3		3							
410	8		1	4	3					
420	7			3	4					
430	6		2	2	2					
440	7			5	2					
(18") 450	9		1		6	2				
460	9		2	3	2		2			
470	3				3					
480	12				9	3				
490	3				3					
(20") 500	3			1	2					
510	10			1	8			1		
520	3					2	1			
530	7			1	2	2	1	1		
540	8				1	3	3		1	
(22") 550	3				1	2				
560	3					3				
570	5				1	3	1			
580	3					3				
590	2				1		1			
(24") 600	4					2	1			1
610	4					2		2		
620	1							1		
630	2						1	1		
640	3						1	2		
(26") 650	1						1			
660										
670										
680	1								1	
690										
(28") 700										
710										
720	1						1			
730										
740										
Number	160	3	21	29	53	29	14	8	2	1
Ave. Length	479 (18.9")	268 (10.6")	381 (15")	428 (16.9")	481 (18.9")	544 (21.4")	571 (22.5")	565 (22.2")	615 (24.2")	607 (23.9")
S.D.	90.2 (3.6")	38.1 (1.5")	49.3 (1.9")	48.6 (1.9")	52.2 (2.1")	62.7 (2.5")	55.8 (2.2")	49.9 (2.0")	26.2 (1.0")	--

Table 3. Average length at age as determined by scales for fish captured in fyke nets on Cedar Lake during the 2016 survey, 1984 survey (Hogler 1999), 1995 survey (Hogler 1997), 2006 survey (Hogler and Surendonk 2009) and 2010 survey (Hogler and Surendonk 2011). The Statewide Average length at age is from WDNR (1990). Lengths are reported in mm and in inches (") for each species.

Species	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8	AGE 9	AGE 10+
Northern Pike										
2016	268 (10.6")	381 (15")	428 (16.9")	481 (18.9")	544 (21.4")	571 (22.5")	565 (22.2")	615 (24.2")	607 (23.9")	
2010		265 (10.4")	356 (14.0")	445 (17.5")	479 (18.9")	475 (18.7")	503 (19.8")	522 (20.6")	551 (21.7)	551 (21.7")
2006	--	372 (14.6")	464 (18.3")	543 (21.4")	598 (23.5")	652 (25.7")	755 (29.7")			
1995	274 (10.8")	392 (15.4")	454 (17.9")	582 (22.9")	580 (22.9")					
1984	220 (8.7")	438 (17.2")	564 (22.2")	699 (27.5")	902 (35.5")	957 (37.6")	996 (39.2")			
State Average	356 (14.0")	406 (16")	470 (18.5")	546 (21.5")	610 (24.0")	650 (25.6")	706 (27.8")	762 (30.0")	787 (30.9")	
Largemouth Bass										
2016	156 (6.1")	194 (7.6")	254 (10.0")	291 (11.5")	330 (13.0")	353 (13.9")	390 (15.4")	417 (16.4")	444 (17.5")	501 (19.7")
2010		148 (5.8")	238 (9.4")	297 (11.7")	318 (12.5")	346 (13.6")	370 (14.6)	409 (16.1")	388 (15.3")	435 (17.1")
2006	130 (5.1")	171 (6.7")	230 (9.1")	306 (12.0")	353 (13.9")	368 (14.6")	383 (15.1")	418 (16.5")	453 (17.8")	460 (18.1")
1995	112 (4.6")	175 (6.9")	218 (8.6")	252 (10.0")	307 (12.1")	329 (12.9")	408 (16.4")	450 (17.7")	--	500 (19.7")
1984	85 (3.3")	167 (6.6")	242 (9.5")	302 (11.9")	348 (13.7")	383 (15.1")	413 (16.3")	434 (17.1")	455 (17.8")	487 (19.2")
State Average	97 (3.8")	165 (6.5")	229 (9.0")	290 (11.4")	338 (13.3")	383 (15.1")	414 (16.3")	447 (17.6")	470 (18.5")	
Bluegill										
2016	65 (2.6")	88 (3.5")	124 (4.9")	136 (5.4")	172 (6.8")	185 (7.3")				
2010		114 (4.5")	126 (5.0")	149 (5.9")	178 (7.0")	215 (8.5")	184 (7.2")	175 (6.9")		
2006	110 (4.3")	124 (4.9")	153 (6.0")	172 (6.8")	200 (7.9")	--	--	230 (9.1")		
1995	76 (3.0")	126 (4.9")	147 (5.8")	177 (7.0")	188 (7.4")	209 (8.2")	200 (7.9")	--		
1984	52 (2.0")	89 (3.5")	123 (4.8")	152 (6.0")	172 (6.8")	193 (7.6")	198 (7.8")	215 (8.5")		
State Average	64 (2.6")	97 (3.8")	122 (4.8")	147 (5.9")	167 (6.6")	183 (7.2")	196 (7.8")	208 (8.2")		
Black Crappie										
2016			173 (6.8")	210 (8.2")	225 (8.9")	242 (9.5")				
2010		127 (4.9")	173 (6.8")	205 (8.1")	286 (11.3")	330 (13.0")				
State Average	79 (3.1")	137 (5.4")	183 (7.2")	218 (8.6")	241 (9.5")	267 (10.5")	274 (10.8")			

Largemouth Bass

Largemouth Bass were the second most common gamefish captured during spring netting (Table 1). The 10 bass ranged in length from 269 mm to 455 mm (10.6" to 17.9") and had an average length of 377 mm (14.8"). Six of the of the ten captured bass were greater in length than the 356 mm (14") minimum harvest size limit on Cedar lake (Figure 4). CPE for bass was 0.1 fish per night-night (Table 1).

Age was determined for Largemouth Bass using dorsal spines that were collected during fyke netting. Ages ranged from age 4 through age 9 (Table 4). Age 6 was the most common age bass followed by age 5 and age 7. Age 6 Largemouth Bass averaged 376 mm (14.8") in length.

Based on the average length at each age collected from this survey, Largemouth Bass in Cedar Lake grow at or near the state average rate (Table 3).

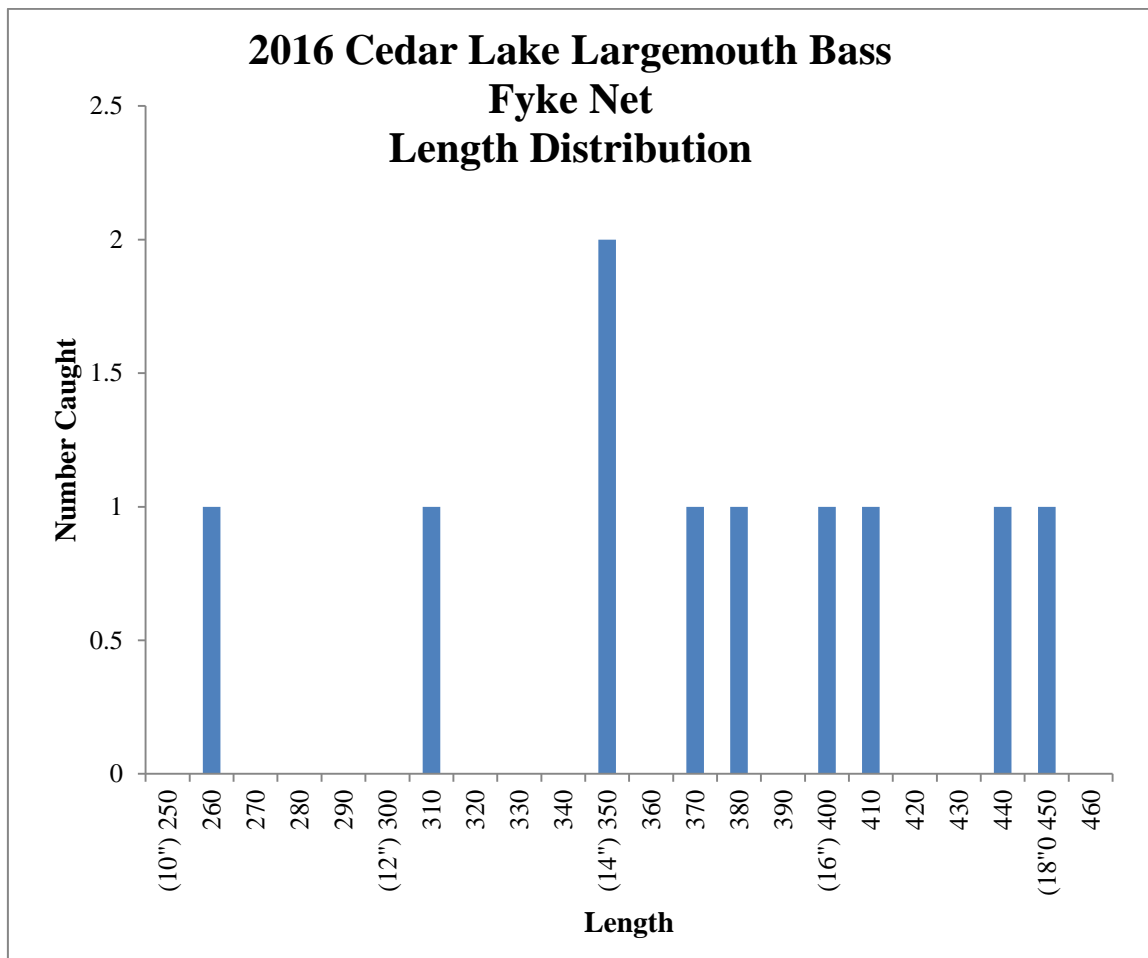


Figure 4. The length distribution of Largemouth Bass that were captured by fyke net from Cedar Lake in 2016. Lengths are reported in mm and in inches (") for each species.

Table 4. Largemouth bass length frequency and age distribution for fish captured with fyke nets during the 2016 survey. Lengths are reported in mm and in inches (") for each species.

Length (mm)	Total Number	Age					
		4	5	6	7	8	9
260	1	1					
270							
280							
290							
(12") 300							
310	1		1				
320							
330							
340							
(14") 350	2		1	1			
360							
370	1			1			
380	1				1		
390							
(16") 400	1			1			
410	1				1		
420							
430							
440	1					1	
(18") 450	1						1
Total	10	1	2	3	2	1	1
Ave. Length	377 (14.8")	269 (10.6")	335 (13.2")	376 (14.8")	402 (15.8")	441 (17.4")	455 (17.9")
S.D.	56.8 (2.2")	--	26.9 (1.1")	26.5 (1.0")	19.1 (0.8")	--	--

Walleye

During the fyke net period, only nine Walleye were captured with a CPE of 0.1 fish per net-night (Table 1). The nine Walleye ranged in length from 384 mm to 666 mm (15.1 to 26.2") and had an average length of 533 mm (21"). All captured Walleye were greater in length than the 381 mm (15") minimum harvest limit for anglers.

Panfish

Black Crappie

Black Crappie were the most commonly caught panfish during spring fyke netting (Table 1). The 196 Black Crappie that were captured ranged in length from 142 mm to 367 mm (5.6" to 14.4") and had an average length of 215 mm (8.5"). CPE for Black Crappie was 2.7 fish per net-night. 80.6% of the Black Crappie were greater in length than 200 mm (8") and 4.1% were greater than 254 mm (10") in length (Figure 5).

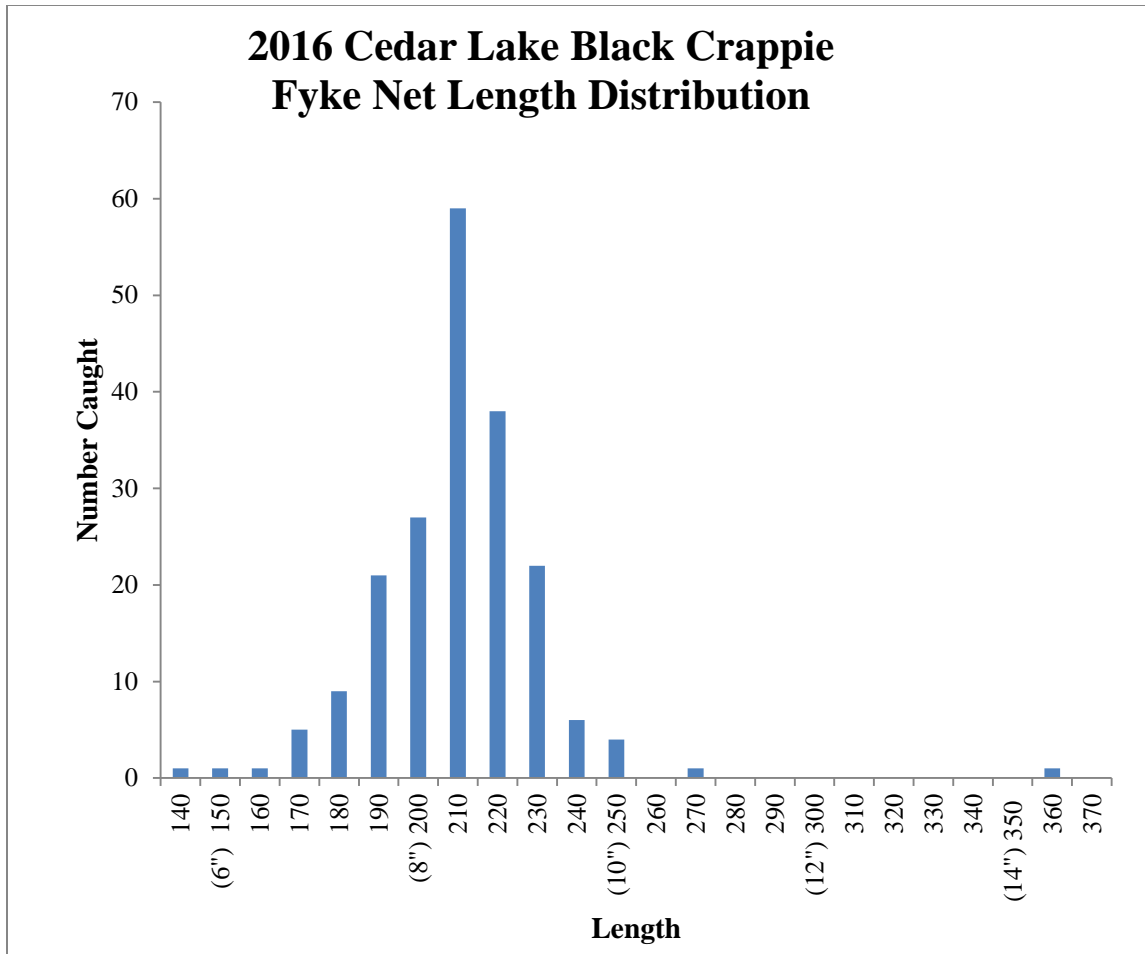


Figure 5. The length distribution of Black Crappie that were captured by fyke net from Cedar Lake in 2016. Lengths are reported in mm and in inches (") for each species.

Age was determined for Black Crappie that were captured by fyke net with the use of scales. Ages ranged from age 3 through age 7 and age 10 (Table 5). Age 4 was the most common age crappie followed by age 5. Age 4 Black Crappie averaged 210 mm (8.3") in length.

Length at age data collected during this survey indicates that in Cedar Lake, Black Crappie grow slightly slower than statewide averages (Table 3).

Table 5. Black crappie length frequency and age distribution for fish captured with fyke nets during the 2016 survey. The age distribution of the entire fyke net catch is a projection based on the distribution of ages from scale samples. Lengths are reported in mm and in inches (") for each species.

Length (mm)	Age								
	Number	3	4	5	6	7	8	9	10
130									
140	1	1							
(6") 150	1	1							
160	1	1							
170	7	4	3						
180	9	2	6	1					
190	22	2	15	5					
(8") 200	29	3	20	6					
210	61		55	6					
220	38		23	15					
230	23		6	15	2				
240	6		1	4	1				
(10") 250	4		2	2					
260	1				1				
270	1					1			
280									
290									
(12") 300									
310									
320									
330									
340									
(14") 350									
360	1								1
Total	205	14	131	54	4	1	0	0	1
Ave. Length	215 (8.5")	173 (6.8")	210 (8.2")	225 (8.9")	242 (9.5")	270 (10.6")	--	--	367 (14.4")
S.D.	20.6 (0.8")	16.1 (0.6")	13.1 (0.5")	17.8 (0.7")	13.1 (0.5")	--	--	--	--

Bluegill

Bluegill were the second most common panfish encountered during spring fyke netting with 125 captured with a CPE of 1.7 fish per net-night (Table 1). Bluegill ranged in length from 105 mm to 218 mm (4.1" to 8.6") and had an average length of 160 mm (6.3"). Most bluegill had lengths between 110 mm and 190 mm (4.3" to 7.5") (Figure 6). 64% of the Bluegill were greater in length than 150 mm (6") and 4.5% were greater than 200 mm (8") in length.

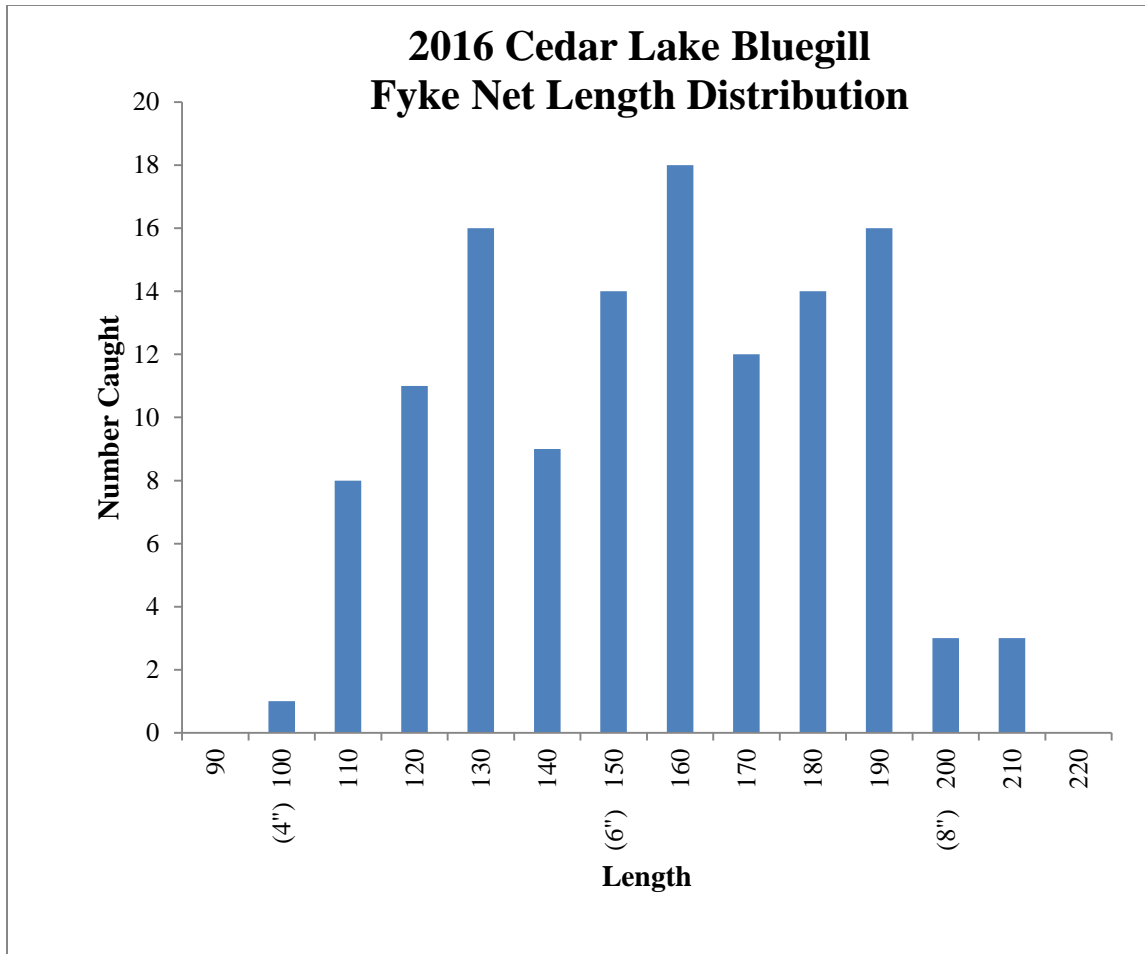


Figure 6. The length distribution of Largemouth Bass that were captured by fyke net from Cedar Lake in 2016. Lengths are reported in mm and in inches (") for each species.

Age was determined for a subsample of Bluegill that were captured during spring surveys on Cedar Lake with the use of dorsal spines. Ages ranged from age 1 through age 6 (Table 6). Age 5 was the most common age Bluegill followed by age 4 and age 6. Other age classes were captured in lower number. An age 5 Bluegill averaged 172 mm (6.8") in length.

From this data, it appears that in Cedar Lake, Bluegill grow at state average rates in Cedar Lake (Table 3). Very few Bluegill reach an age greater than age 6 which results in very few large Bluegill in the lake.

Table 6. Bluegill length frequency and age distribution for fish that were captured with fyke nets and electroshocking during the 2016 survey. The age distribution of the entire catch was a projection based on the distribution of ages from scale samples. Lengths are reported in mm and in inches (") for each species.

Length (mm)	Number	Age					
		1	2	3	4	5	6
60	1	1					
70	5		5				
80	11		11				
90	6		5	1			
(4") 100	17		2	9	6		
110	50		5	30	15		
120	44			13	27	4	
130	59			23	27	9	
140	68			8	52	8	
(6") 150	78			6	20	39	13
160	66					37	29
170	76				6	51	19
180	61					17	44
190	38					14	24
(8") 200	7					4	3
210	7					3	4
Total	594	1	28	90	153	186	136
Ave. Length	160 (6.3")	65 (2.6")	88 (3.7")	124 (4.9")	136 (5.4")	172 (6.8")	185 (7.3")
S.D.	29.9 (1.2")	--	9.3 (0.4")	14.8 (0.6")	14.8 (0.6")	21.6 (0.9")	15.4 (0.6")

Other Panfish

During fyke netting we also captured a number of other panfish species which included Green Sunfish, Pumpkinseed Sunfish, Warmouth, Yellow Perch, and Rock Bass (Table 1). They had average lengths of 157 mm (6.2"), 163 mm (6.4"), 171 mm (6.7"), 176 mm (6.9"), 215 mm (8.5") and 146 mm (5.7") respectively. Hybrid Sunfish were not measured and appeared to be crosses between Bluegill, Pumpkinseed Sunfish, Green Sunfish, Rock Bass and Warmouth in various combinations.

Other species

During fyke netting we captured 301 Yellow Bullhead making them the most commonly caught species during spring netting (Table 1). The Yellow Bullhead that we measured averaged 282 mm length (11.1"). In addition, we captured 57 Brown Bullhead (262 mm (10.3") average length) and 2- White Sucker during fyke netting.

Spring Electroshocking

Recapture Electroshocking

On the night of April 20, the entire 3.47 mile shoreline of Cedar Lake was electroshocked to look for marked fish. A total of 335 fish representing twelve species were captured during 130 minutes of electroshocking (Table 7). Largemouth Bass and Bluegill were the most abundant species captured with substantially fewer fish of other species handled. Total CPE was 153.7 fish per hour shocked or 95.7 fish per mile shocked. Seven recaptured fish from fyke netting were caught during shocking.

Table 7. Fish species captured during the April recapture electrofishing survey on Cedar Lake. Lengths are reported in mm and in inches () for each species.

Species	Total Number	Total Recap	Total New	CPE (#/ Hr Shocked)	CPE (#/ Mile Shocked)	Average Length mm (in)	Size Range mm (in)
Northern Pike	8	2	6	3.7	2.3	528 (20.8")	376-652 (14.8"-25.7")
Largemouth Bass	62	0	62	28.7	17.9	351 (13.8")	236-490 (9.3"- 19.3")
Bluegill	198	2	196	91.7	57.1	152 (6.0")	74-218 (2.9"-8.6")
Pumpkinseed Sunfish	14	0	14	6.5	4.0	170 (6.7")	126-214 (5"-8.4")
Hybrid Sunfish	13	0	13	6.0	3.7	162 (6.4")	124-199 (5"-7.8")
Green Sunfish	12	0	12	5.6	3.5	169 (6.7")	107-195 (4.2"-7.7")
Warmouth	3	0	3	1.4	0.9	297 (11.7")	148-172 (5.8"-6.8")
Black Crappie	3	1	2	1.4	0.9	215 (8.5")	206-224 (8.1"-8.8")
Yellow Bullhead	17	2	15	6.5	4.0	297 (11.7")	285-311 (11.2"-12.2")
Brown Bullhead	3	0	3	1.4	0.9	256 (10.1")	198-310 (7.8"-12.2")
Golden Shiner	1	0	1	0.5	0.3		
Common Carp	1	0	1	0.5	0.3		
Total	335	7	328	153.7	95.7		

Gamefish

Largemouth Bass were the most commonly captured gamefish during recapture electroshocking (Table 7). The 62 bass ranged in length from 236 mm to 490 mm (9.3" to 19.3") and had an average length of 351 mm (13.8"). CPE was 28.7/hr. or 17.9/mile shocked. Of the 62 bass we captured, 43.5% were greater than the 356 mm (14") minimum size limit on Cedar Lake (Figure 7).

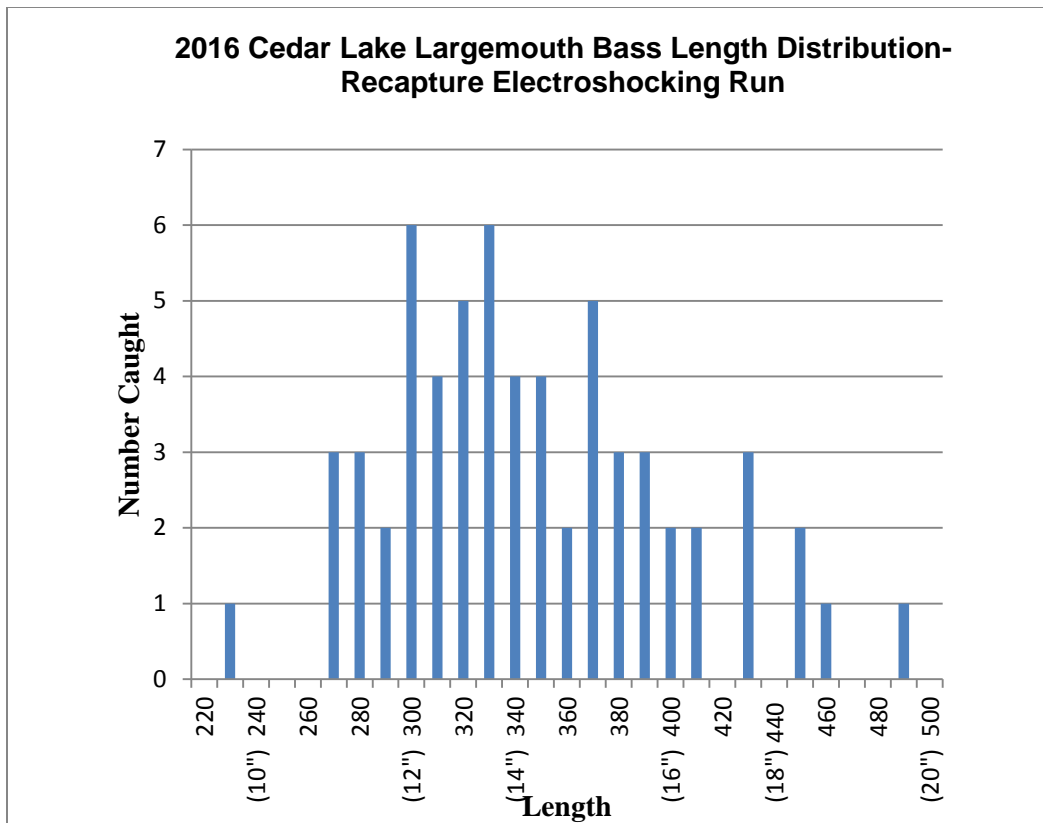


Figure 7. The length distribution of Largemouth Bass that were captured during the recapture electroshocking run on Cedar Lake in 2016. Lengths are reported in mm and in inches () for each species.

The 8 Northern Pike that were handled ranged in length from 376 mm to 652 mm (14.8” to 25.7”) and had an average length of 528 mm (20.8”) (Table 7). None of the captured Northern Pike were greater in length than the 660 mm (26”) minimum size limit on Cedar Lake. Two Northern Pike were identified as having been marked during fyke netting allowing a Peterson Population Estimate (PE) to be made. Using the Peterson method, it was estimated that the pike population in Cedar Lake was 640 adult fish with a 95% confidence range of 246 to 5,023. This translates to 4.6 pike per surface acre. This estimate should be viewed with caution because of the low number of recaptures.

Panfish

Bluegill were the most commonly handled fish during recapture shocking with 198 captured (Table 7). CPE was 91.7 per hour shocked or 57.1 per mile shocked. Bluegill ranged in length from 74 mm to 218 mm (2.9” to 8.6”) and had average length of 152 mm (6.0”). Most of the Bluegill that we captured were between 110 mm and 180 mm (4.3” to 7.1”) (Figure 8). 54% of the captured Bluegill were greater in length than 150 mm (6”) and 2.5% were greater than 200 mm (8”) in length.

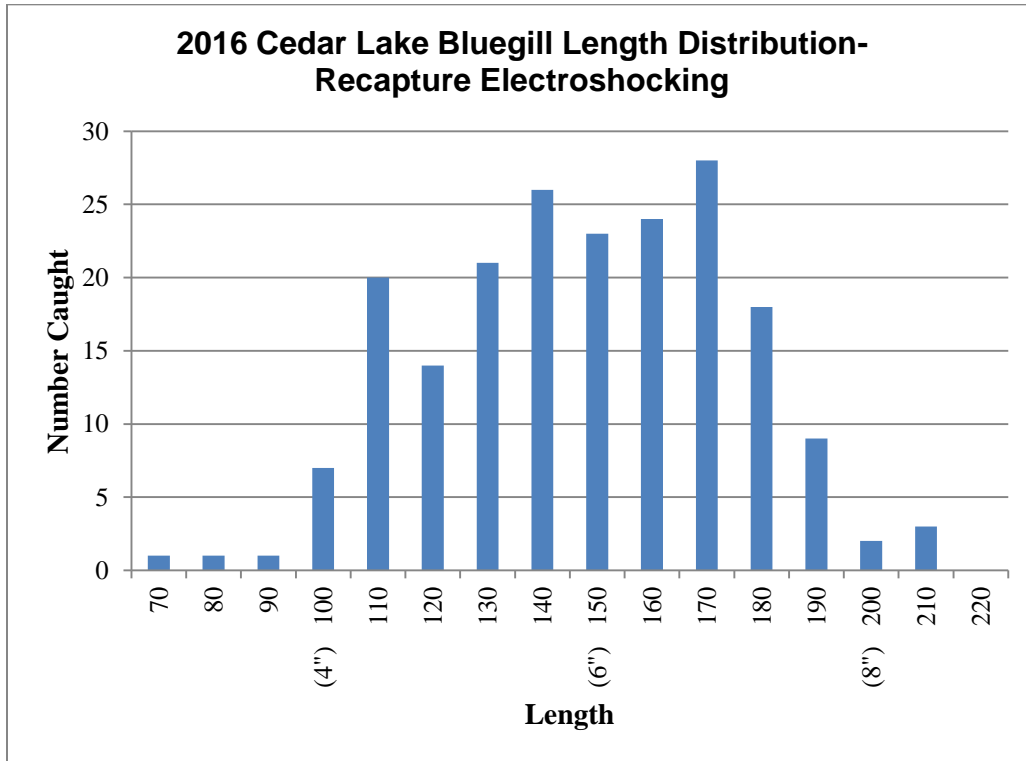


Figure 8. The length distribution of Bluegill that were captured during the recapture electroshocking run on Cedar Lake in 2016. Lengths are reported in mm and in inches (") for each species.

Two captured Bluegill had marks given during fyke netting allowing a PE to be calculated. The Peterson PE was 12,375 or 88.4 per surface acre. The 95% confidence range for Bluegill varied from 3,471 to 101,989. This estimate should be viewed with caution because of the low number of recaptures.

Other panfish were captured in substantially lower numbers with Pumpkinseed Sunfish, Hybrid Bluegill and Green Sunfish the most common (Table 7).

Other Species

During shocking we captured other species which included; Brown and Yellow Bullheads, Golden Shiner and a single Common Carp.

Centrarchid Electrofishing

During the evening of May 23, the entire shoreline was electroshocked to assess centrarchid populations. During the 135 minutes of shocking, an attempt was made to net all observed fish. 558 individual fish representing eight species were captured during shocking (Table 8). Bluegill and Largemouth Bass dominated the catch with substantially fewer fish of other species captured. Total CPE was 248.0 fish per hour shocked or 160.8 fish per mile shocked.

Table 8. Fish species captured during the May 2016 Centrarchid electrofishing survey on Cedar Lake. Lengths are reported in mm and in inches (") for each species.

Species	Total Captured	Recap	New	CPE Fish/Hr	CPE Fish/Mile	Average Length mm (in)	Size Range mm (in)
Largemouth Bass	117	5	112	52.0	33.7	320 (12.6")	152-512 (6"-20.2")
Northern Pike	13	0	13	5.8	3.7	450 (17.7")	271-659 (10.7"-25.9")
Bluegill	271	0	271	120.4	78.1	149 (5.9")	65-210 (2.6"-8.3")
Green Sunfish	109	0	109	48.4	31.4	160 (6.3")	79-211 (3.1"-8.3")
Warmouth	12	0	12	5.3	3.5	159 (6.3")	96-196 (3.8"-7.7")
Hybrid Sunfish	8	0	8	3.6	2.3	149 (5.9")	89-199 (3.5"-7.8")
Black Crappie	7	0	7	3.1	2.0	211 (8.3")	176-267 (6.9"-10.5")
Yellow Bullhead	21	3	18	9.3	6.1	249 (9.8")	190-289 (7.5"-11.4")
Total	558	8	550	248.0	160.8		

Gamefish

Largemouth Bass were the most commonly captured gamefish during this portion of the survey (Table 8). Bass CPE was 52.0 per hour or 33.7 per mile shocked. The 117 bass ranged in length from 152 mm to 512 mm (6" to 20.2") and had an average length of 320 mm (12.6"). Thirty-seven of the 117 bass (31.6%) captured were greater in length than the minimum size limit of 356 mm (14") (Figure 9).

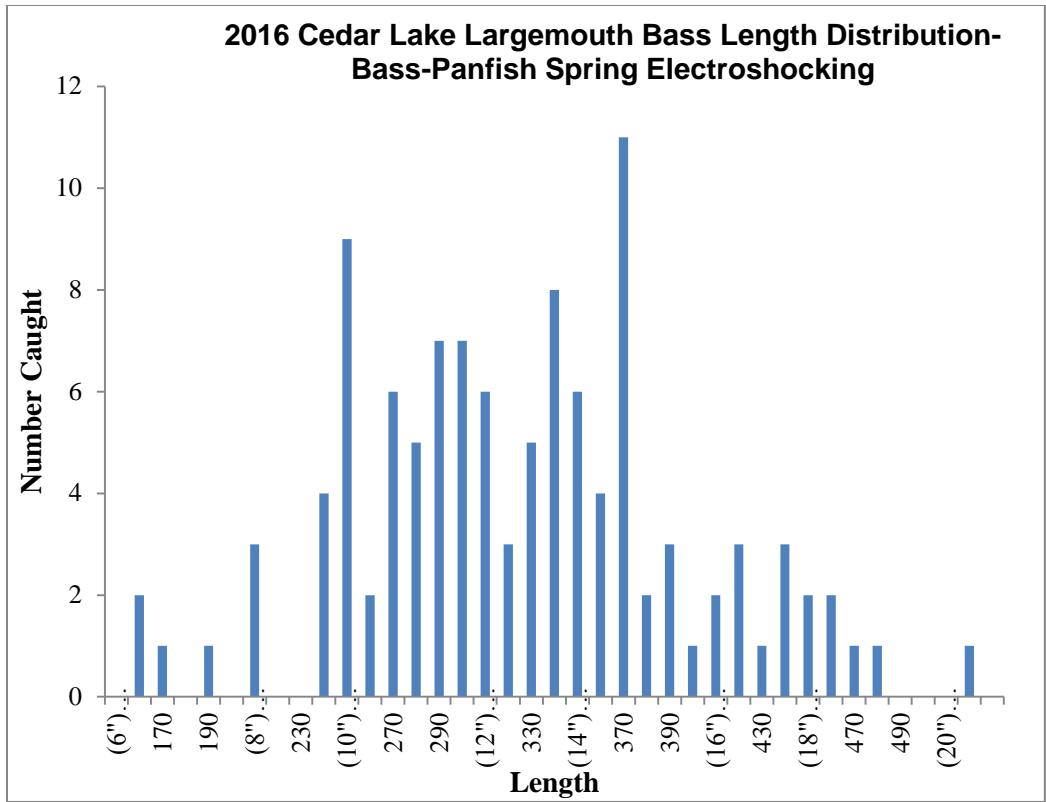


Figure 9. The length distribution of Largemouth Bass that were captured during the bass-panfish spring electroshocking run on Cedar Lake in 2016. Lengths are reported in mm and in inches (") for each species.

Age was determined for Largemouth Bass using dorsal spines that were collected during spring electroshocking. Ages ranged from age 1 through age 10 (Table 9). Age 5 was the most common age bass followed by age 4. Age 5 Largemouth Bass averaged 330 mm (13") in length.

Based on the average length at each age collected from this survey, Largemouth Bass in Cedar Lake grow above state rates through age 3, at state rates at ages 4 and 5 and below state rates from age 6 and older (Table 3).

Table 9. The length and age distribution of Largemouth Bass captured during bass-panfish spring electroshocking from Cedar Lake in 2016. Lengths are reported in mm and in inches (") for each species.

Length (mm)	Number	Age									
		1	2	3	4	5	6	7	8	9	10
140											
(6") 150	2	2									
160	1		1								
170											
180	1		1								
190											
(8") 200	3		3								
210											
220											
230	5			4	1						
240	8			5	2	1					
(10") 250	2			1		1					
260	6			4	2						
270	8			3	5						
280	9				8	1					
290	8				6	2					
(12") 300	12				8	4					
310	7				3	2	2				
320	10				2	7	1				
330	13				2	10	1				
340	10					7	3				
(14") 350	7					1	4	2			
360	13					6	5	2			
370	7					1	1	3	1	1	
380	6						2	2	2		
390	3							2	1		
(16") 400	4							1	3		
410	5							3	2		
420	1										1
430	5							2	2	1	
440	2								2		
(18") 450	4								2	2	
460	2									2	
470	1										1
480											
490	1										1
(20") 500											
510	1										1
520											
Total	167	2	5	17	39	43	19	17	15	8	2
Ave. Length	320 (12.6")	156 (6.1")	194 (7.6")	254 (10")	291 (11.5")	330 (13.0")	353 (13.9")	390 (15.4")	417 (16.4")	444 (17.5")	501 (19.7")
S.D.	67.2 (2.6")	4.9 (0.2")	16.1 (0.6")	14.2 (0.6")	22.8 (0.9")	27.2 (1.1")	20.2 (0.8")	26.1 (1.0")	27.8 (1.1")	31.4 (1.2")	15.6 (0.6")

Using the Peterson PE method with bass marking occurring during fyke netting and the recapture electroshocking run and using Centrarchid shocking as the recapture run, it is possible to calculate a PE for Largemouth Bass. The PE for Largemouth Bass in Cedar Lake is 1,685 with a 95% confidence range of 742 to 5,136. This translates to 12.0 adult bass per surface acre in Cedar Lake.

The 13 northern pike that were captured ranged in length from 271 mm to 659 mm (10.7” to (25.9”) and had an average length of 450 mm (17.7”) (Table 8). None of the pike we captured were greater in length than the 660 mm (26”) minimum size limit.

Panfish

Bluegill dominated the panfish catch during Centrarchid electroshocking with substantially lower numbers other panfish species captured (Table 8). The 271 Bluegill ranged in length from 65 mm to 210 mm (2.6” to 8.3”) and had an average length of 149 mm (5.9”). Of the captured Bluegill, most were between 110 mm and 190 mm (4.3” to (7.5”) with 53.9% greater in length than 150 mm (6”) but only 1.1% greater than 200 mm (8”) in length (Figure 10).

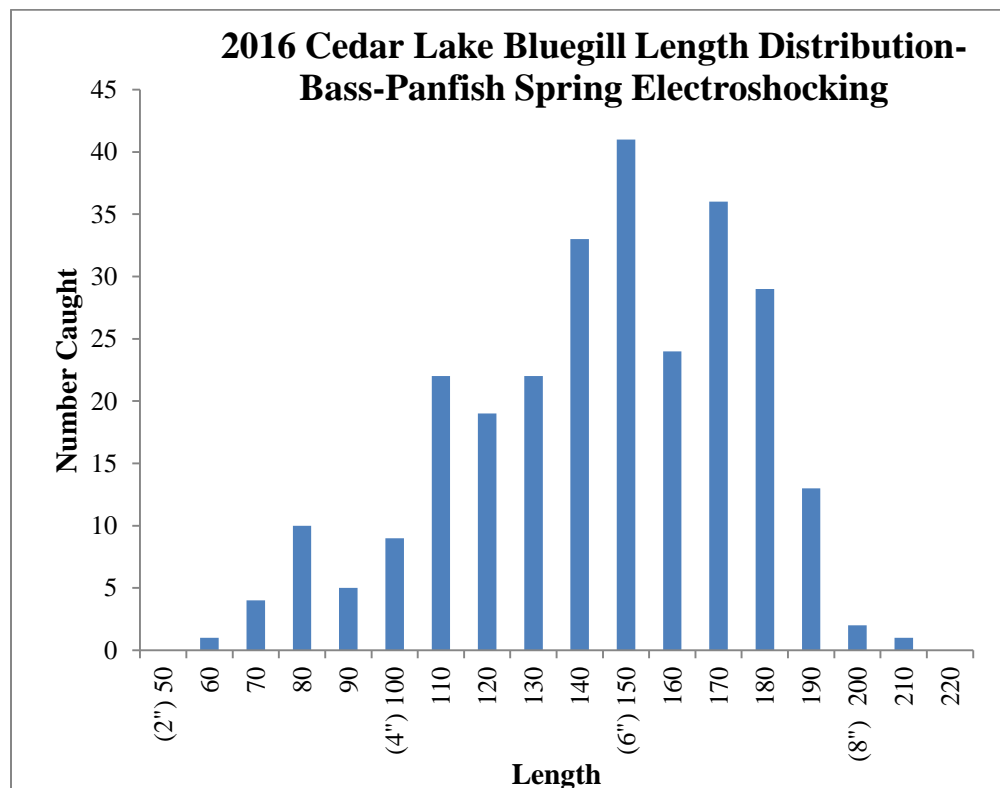


Figure 10. The length distribution of Bluegill captured during Centrarchid shocking on Cedar Lake in 2016. Lengths are reported in mm and in inches (") for each species.

The average lengths of other panfish were 211 mm (8.3”) for Black Crappie, 160 mm (6.3”) for Green Sunfish, 159 mm (6.3”) for Warmouth and 149 mm (6”) for Hybrid Sunfish (Table 8).

Other Species

The other species captured during this portion of the survey were Yellow Bullhead that averaged 249 mm (9.8”) in length (Table 8).

DISCUSSION

The 2016 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 1,802 individual fish representing sixteen species were captured. Across all surveys, the five most commonly captured fish were Bluegill (33.0% of the catch), Yellow Bullhead (18.8%), Largemouth Bass (10.1%), and Northern Pike (10.0%). Yellow Bullhead and Black Crappie and Northern Pike dominated the fyke net catch while Bluegill dominated the two electroshocking surveys.

Gamefish

Largemouth bass were the most commonly captured gamefish during this survey. This survey estimated that 1,685 (range 742 to 5136) Largemouth Bass were present in the lake (Table 5). The 2016 population estimate was more than the 1,165 estimated by the previous survey (Hogler and Surendonk 2011). The average length of Largemouth Bass captured during spring electrofishing surveys, increased to 331 mm (13") from 307 mm (12.1") noted in 2010 and continued the increasing trend observed since the 1994-95 survey. Growth expressed as length at age was less in 2016 than what was noted in previous surveys and was likely due to increased competition for food from the increasing number and size of bass found in the lake (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.

Northern pike were commonly caught during this survey. The Peterson population estimate of 640 (range 246 to 5023) in 2016 was half the 2010 estimate and continues the decline noted in the past several surveys although the current estimate is consistent with estimates from earlier surveys (Hogler 2011). Since the number of fish marked and recaptured was low, the pike PE estimate must be viewed with caution. Northern Pike captured with fyke nets averaged 479 mm (18.9") in length which was an increase noted from the previous survey of 446 mm (17.6") in 2010 and continues the trend of increasing Northern Pike size occurring since the onset of the 660 mm (26"), 2 bag harvest limits (Hogler 2011). However despite the increased average length noted in 2016, few captured northern pike were greater than the 660 mm (26") minimum size limit. Length at age in 2016 showed improved growth over the 2010 survey, but in Cedar Lake pike are still growing slower at all ages than statewide length at age averages (Table 4).

The Northern Pike population in Cedar Lake appears to be reproducing 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). Hogler (1997) found that based on angler tag returns, 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 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 rates and average size decreases in future surveys.

Walleye were rarely captured in 2016 despite the stocking efforts of the Cedar Lake Association. The lack of Walleye in the 2016 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 2016 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 (6"). Growth, as determined by length at age comparisons, appears to be near state averages in 2016 (Table 4). Overall Bluegill appear to be doing well in Cedar Lake.

Black Crappie were commonly captured in 2016 reversing the declining trend noted in the 2006 and 2010 surveys (Hogler and Surendonk 2011). 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 dropped substantially in 2016 compared to previous surveys (Hogler and Surendonk 2011). Although the reasons for this decline are not clear, likely causes include: the normal cyclic population trends observed in Yellow Perch, habitat loss that has reduced recruitment, increasing predation by more abundant and larger gamefish and angler harvest.

Other centrarchids including Rock Bass, Green Sunfish, Warmouth, Pumpkinseed Sunfish and a number of hybrid panfish were captured during this survey. The Rock Bass population appears to have declined in 2016 as compared to earlier surveys while the populations of other panfish appear to be stable. It is likely that angler harvest, increasing predator numbers or habitat loss caused by shoreline alterations and plant harvesting may be negatively impacting some species of panfish.

Other Species

Yellow Bullhead were the most abundant species captured during fyke netting (Table 1). Captured bullhead were of good size (Table 1), although abundant, and do not appear to be a problem in Cedar Lake.

Common Carp have been captured in low number during past fish surveys (Hogler and Surendonk 2011). In 2016, only a single Common Carp was captured indicating that carp are still present in the lake, but in low number 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 monitor Northern Pike. Walleye do not appear to survive well in Cedar Lake.
- Panfish size and growth have improved over results from past surveys.
- 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.

RECOMMENDATIONS

1. Monitor the Northern Pike population in succeeding surveys to determine if regulation changes are needed to promote improvement in Pike size structure.
2. Work with the Lake Association and Aquatic Plant Managers to minimize the impacts of plant harvesting on fish populations.
3. Work with the Cedar Lake Association, home owners and Water Regulation and Zoning staff to minimize new alterations of the shoreline, to restore altered shorelines to a more natural state by installation of tree drops, "fish sticks" and other habitat practices.

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