

Kangaroo Lake Comprehensive Fisheries Survey Report-2012

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ABSTRACT

Kangaroo Lake has a surface area of 1,123 acres, is the largest lake in Door County. This lake has a maximum depth of 12 feet and an average depth of 6 feet. Kangaroo Lake has a Trophic State Index (TSI) rating of eutrophic indicating nutrient rich, productive lake water. At times, because the lake is shallow, lake water can be very turbid due to wind action or from heavy boating use.

Since the 1940's, surveys approximately every ten years have tracked the fish populations of the lake. Before the 2012 survey, the most recent surveys were conducted in 2004 and 2008. These surveys found that yellow perch, walleye and smallmouth bass dominated the fish community of Kangaroo Lake.

The 2012 comprehensive fisheries survey of Kangaroo Lake characterized the fish populations of the lake with the use of multiple types of fisheries gear. The use of multiple gears gave a much clearer picture of the status of the fish population of Kangaroo Lake.

A total of 2,969 fish were collected during the fyke net and electroshocking surveys. The most abundant fish were rock bass, walleye and smallmouth bass. Despite an unseasonably early and warm spring, results from the 2012 survey were consistent with the previous two surveys.

Fish populations in Kangaroo Lake appear to be in a state of change. Bass and panfish populations are up with a stable walleye population that is lower in abundance than the historic highs measured in the 1970's and early 1980's. Likely the changes are due to a combination of changing lake conditions that favor panfish and bass and angler harvest of desirable species like walleye. In general, the fish population of the lake appears to be in good condition.

It is recommended that Fish Management staff (1) continue to monitor the fish population of Kangaroo Lake on a regular basis, (2) during the next several fish surveys determine the status of walleye, smallmouth bass and panfish populations, and (3) encourage the restoration and enhancement of fish habitat in the lake.

INTRODUCTION

Kangaroo Lake (WBIC 98600) has a surface area of 1,123 acres and is the largest lake in Door County (Figure 1). It is a shallow lake with a maximum and average depth of 12 feet and 6 feet respectively. Because the lake is shallow lake water can be very turbid at times due to wind action or from heavy boating use. Water quality in Kangaroo Lake is good although the lake has a Trophic State Index (TSI) rating of eutrophic indicating that the lake has seen some nutrient enrichment from its watershed (WDNR 2001).

In the late 1800's, a causeway was constructed across the northern third of the lake creating a two basin lake (Door County SWCD 2000). The north basin is shallow, clear, and contains a variety of open water and wetland plants. The shoreline of this basin is lightly developed. Much of the shoreline and the surrounding land in this basin are part of the Kangaroo Lake Preserve Natural Area.

The south basin is highly developed and experiences heavy boating use during summer months. In this basin, once abundant aquatic vegetation has been reduced to small patches of native plants and stands of non-native Eurasian water milfoil.

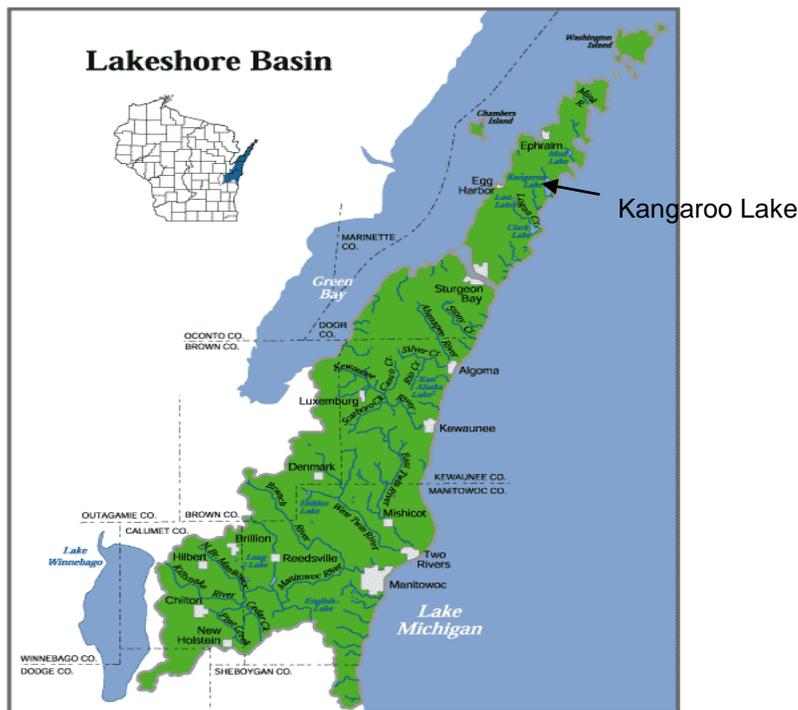


Figure 1. Location of Kangaroo Lake in northern Door County.

Hogler in past survey reports (2005 and 2009) detailed the past 70 years of stocking and fish survey results regarding Kangaroo Lake. In this report, I will only compare the last two fish surveys conducted in 2004 and 2008.

Walleye were the most abundant gamefish captured during the 2004 survey (Hogler 2005). Although walleye have been the most abundant gamefish captured in surveys since 1980, their abundance has been declining since 1983. As was the case in 1995, a large percentage of captured walleye were juvenile fish. It appears that reproduction is good, indicating recruitment into the population. The presence of very old walleye (greater than 15 years of age) indicated that walleye are able to survive in the lake although their low adult abundance suggests that total annual mortality (natural and angler) is probably high. The trend in the smallmouth bass population was not as clear. Fyke net and electrofishing data suggest that the smallmouth bass population is increasing in number, but the results were not consistent across all surveys. Panfish populations continue to grow in Kangaroo Lake, with yellow perch dominate the panfish community. Bluegill increased in abundance while rock bass numbers declined in 2004. Based on the 2004 survey, new walleye regulations were developed and passed at the 2006 spring hearings and were effective April 1, 2007 that changed the standard walleye regulation of 381 mm (15”) size minimum and a 5 daily bag limit to 457 mm (18”) size minimum and a daily bag limit of 3.

Walleye were the most abundant gamefish captured during the 2008 fish survey (Hogler 2009). The fall electrofishing survey captured a large number of young of year walleye indicating that reproduction is occurring. If lake conditions remain stable, good recruitment and conservative regulations may lead to improved walleye numbers in the future. The smallmouth bass population continued to increase in abundance in 2008 while northern pike numbers remained steady. Panfish populations continue to grow in Kangaroo Lake. Yellow perch continued to dominate the panfish community in the lake with increasing numbers of bluegill and rock bass captured in 2008.

Based on the past two and historic fish survey data, it appears that fish populations in Kangaroo Lake appear to be in a state of change after more than 20 years of stability. Walleye abundance was down, while bass and panfish abundances were increasing. It is not clear if the increasing number of smallmouth bass and panfish were linked to the decline in walleye abundance or to environmental conditions in the lake that have begun to shift toward a condition that again will favor a bass-bluegill fish community in Kangaroo Lake.

A comprehensive fish survey was conducted in 2012 on Kangaroo Lake to evaluate the fishery of the lake as part of baseline lake monitoring.

METHODS

Spring Fyke Netting

A standard comprehensive fisheries survey on Kangaroo Lake began in March 2012 and continued through October. Eight fyke nets were set shortly after ice-out on March 21, fished until March 28 and were used to capture and mark adult spawning northern pike and walleye 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 had scales or a dorsal spine removed from a sub-sample for age determination.

Spring Electrofishing I

Shortly after the completion of fyke netting, on the night of April 2, three shoreline segments of Kangaroo Lake were electroshocked to look for marked fish (Figure 3). All gamefish and panfish fish were netted, identified, examined for marks, and measured. Other species were identified and counted.

Spring Electrofishing II

On the night of May 14, the same segments were electroshocked to estimate adult bass and panfish relative abundance (Figure 3). All gamefish and panfish were netted, identified, checked for marks and measured. Other species were identified and counted.

Fall Electroshocking

On the night of October 2, the same segments were electroshocked to determine the abundance young-of-year (yoy) fish and to assess the general population of fish (Figure 3). All gamefish fish were netted, identified, and measured. Other species were visually rated as common or present based on their abundance.

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 by using an age length key then calculating the arithmetic mean of the length for a given age from the 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).

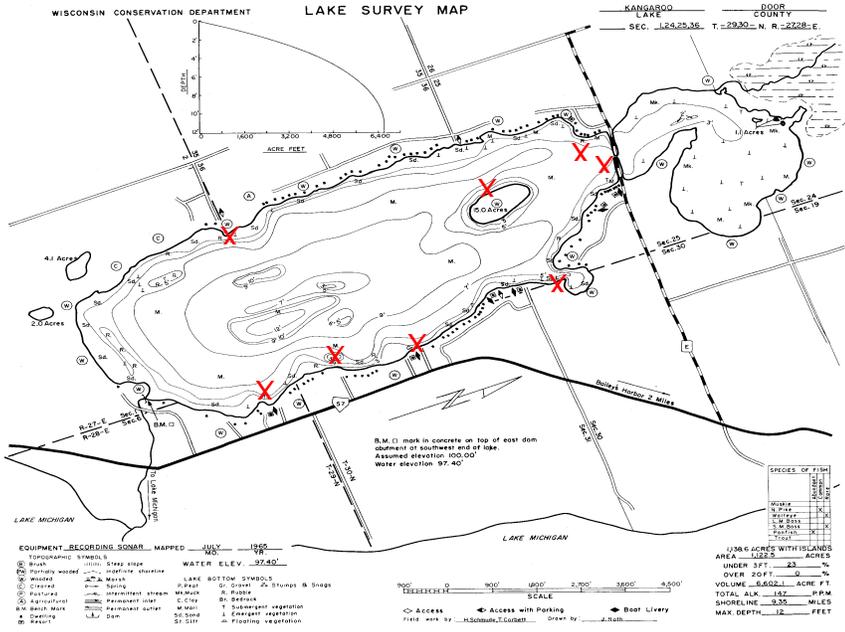


Figure 2. The locations of the eight fyke nets that were fished in Kangaroo Lake from March 22 through March 28, 2012 are marked by an X on the lake map.

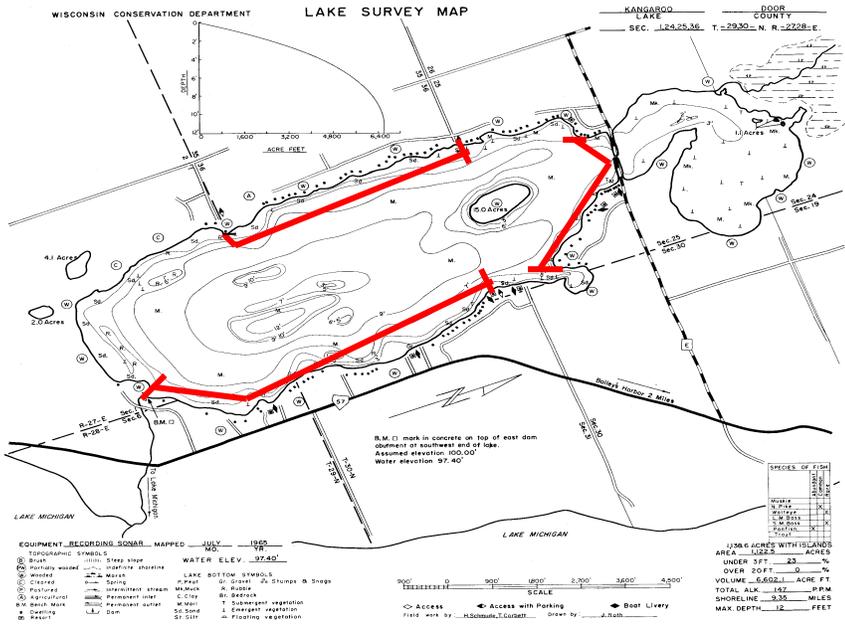


Figure 3. Location of the three electrofishing transects that were shocked on Kangaroo Lake during all electrofishing surveys during 2012.

RESULTS

Spring Fyke Netting

Eight fyke nets were set on March 21 and fished until March 28 with a total effort of 56 net-nights. During this period, we captured 2,332 individual fish that represented fourteen species with a total catch per effort (CPE) of 49.23 fish per net per night (Table 1). Rock bass, walleye and bluegill dominated the catch with fewer individuals of other species captured. The most commonly captured gamefish were walleye, northern pike and smallmouth bass.

Table 1. Species captured from Kangaroo Lake with fyke nets during spring 2012. The Peterson Estimates are based on marking fish caught and fyke nets and recaptured during electrofishing on April 4.

Species	Total Captured	Fish Recaptured In Fyke Nets	CPE (Fish/ net-night)	Pop. Estimate (Peterson)
Gar sp.	6		0.11	
Bowfin	2		0.04	
Rainbow Trout	2		0.04	
Northern Pike	63	4	1.2	
Carp	0		--	
Longnose Sucker	21		0.38	
White Sucker	110		1.96	
Bullhead sp.	9		0.16	
Rock Bass	1,560		27.86	
Pumpkinseed	7		0.13	
Bluegill	184		3.29	
Smallmouth Bass	102	5	1.91	364-13,095
Largemouth Bass	10		0.18	
Yellow Perch	6		0.11	
Walleye	250	63	5.59	331-751
Total	2,332	72	49.23	

Gamefish

Walleye

Walleye were the most commonly captured gamefish during fyke netting (Table 1). The 250 walleye that were captured ranged in length from 233 mm to 644 mm and had an average length of 453 mm (Table 2). 76% (221/250) of the captured walleye were greater than 381 mm (15”) in length and 43.2% were greater in length than 457 mm (18”). Few walleye were greater than 580 mm (22.75”) in length.

Using fyke nets to mark walleye and electroshocking to recapture walleye and the Peterson technique to estimate population size, the walleye population in Kangaroo Lake is likely between 331 and 752 individual adult walleye or 0.3 to 0.7 walleye per surface acre (Table 1). However, because we captured a large number of males during the survey and few female walleye, it is likely that we missed the peak spawning which resulted in a population estimate that underestimates the true population size of walleye in the lake.

Age was determined for walleye using either scales for fish less than 275 mm in length or a dorsal spine for walleye greater than 275 mm in length. With the entire age sample combined (all sexes), captured walleye from this survey ranged from age 2 through age 11 (Table 3). Age 3 and age 4 walleye were the most common ages in our sample with age 3 walleye averaging 414 mm in length. A walleye with a length of 233 mm was captured but not aged. Based on the other ages in this sample, it is likely that this fish was age 1.

Growth, as measured by the average length at each age of walleye in Kangaroo Lake, appears to be above state rates at all ages (Table 4). Transition from using scales to age walleye to spines may account for large differences in growth observed in table 4 between the 2004 and the 2008 and 2012 surveys.

Table 2. The length distribution of walleye by sex captured with fyke nets from March 21 through March 28, 2012 from Kangaroo Lake.

	Combined	Male	Female	Unknown
200				
210				
220				
230	1	1		
240				
250				
260				
270				
280				
290				
300				
310				
320				
330	1	1		
340	2	1		1
350	3	3		
360	7	7		
370	14	14		
380	3	3		
390	9	9		
400	21	19	2	
410	20	16	3	1
420	20	12	5	3
430	16	7	7	2
440	12	6	5	1
450	13	10	3	
460	11	6	5	
470	15	7	8	
480	18	11	3	4
490	10	6	4	
500	10	3	5	2
510	10	5	4	1
520	5	2	3	
530	8	4	4	
540	4	1	3	
550	7	5	2	
560	2		2	
570				
580	3		3	
590				
600	1		1	
610	3		3	
620				
630				
640	1		1	
650				
Total	250	159	76	15
Ave. Length	453	434	491	453
SD. Length	60.41	54.41	57.56	44.02

Table 3. The all sexes combined age distribution of walleye captured on Kangaroo Lake with fyke nets, March 2012. All ages were determined by ageing with the 2nd dorsal spine.

Length (mm)	Number	Age										
		1	2	3	4	5	6	7	8	9	10	11
300												
310												
320												
330	1		1									
340	2		2									
350	3		3									
360	7		6	1								
370	13		10	2	1							
380	3		2	1								
390	7		1	6								
400	20			20								
410	19			18	1							
420	18			16	2							
430	14			9	5							
440	11			3	8							
450	13			1	11			1				
460	11				8	2	1					
470	12				9	1	2					
480	13				6		7					
490	8				3	1	3	1				
500	7				3	1	2	1				
510	8				3		1	1	2	1		
520	5					1	2			1	1	
530	7					2	2			2	1	
540	3						1	1		1		
550	6						2		1	1	1	1
560	1									1		
570	0											
580	3						1		2			
590	0											
600	1								1			
610	2							1	1			
620	0											
630	0											
640	1									1		
650	0											
Total	219	0	25	77	60	8	24	6	7	8	3	1
Ave. Length	450		367	414	463	499	506	522	567	552	537	550
SD. Length	59		13	16	26	29	31	53	41	41	13	

Table 4. Average length at age as determined by spines or scales for fish captured on Kangaroo Lake in 2012, 2008, and 2004 compared to statewide averages.

Species	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8	AGE 9	AGE 10+
Northern pike										
2012	--	--	382	551	576	653	632	629		
2008	--	347	496	564	630	692	776	845	825	--
2004	--	330	370	483	675	770	--	--	910	1007
(State Average)	(356)	(406)	(470)	(546)	(610)	(650)	(706)	(762)	(787)	--
Rock Bass										
2012	--	100	121	164	221	247	265	281	277	
2008	--	--	134	175	224	230	246	254	260	275
2004	--	--	--	--	--	--	--	--	--	--
(State Average)	(53)	(91)	(127)	(155)	(178)	(196)	(211)	(226)	(239)	(249)
Bluegill										
2012	--	111	143	187	223	248	--	--	--	--
2008	--	115	144	185	200	218	229	232	256	270
2004	--	105	130	179	184	--	--	--	--	--
(State Average)	(64)	(97)	(122)	(147)	(167)	(183)	(196)	--	--	--
Smallmouth Bass										
2012	--	174	271	351	406	435	452	466	--	--
2008	--	205	321	370	396	419	432	475	--	--
2004	--	178	235	373	418	423	480	450	--	--
(State Average)	(97)	(168)	(236)	(292)	(343)	(381)	(432)	(457)	(472)	--
Walleye										
2012	233	367	414	463	499	506	522	567	552	
2008	237	374	481	495	533	533	525	558	607	638
2004	210	233	373	411	477	499	525	533	555	562
(State Average)	(152)	(254)	(324)	(381)	(432)	(457)	(497)	(526)	(551)	--

Northern Pike

The 63 northern pike that were captured during fyke netting ranged in length from 351 mm to 728 mm and had an average length of 545 mm (Table 5). Most of the captured pike were small, with only 8 of the 639 (12.7%) pike that we captured greater than 660 mm (26"). Since we did not capture any northern pike during recapture shocking, we could not make a population estimate for this species.

Ages were obtained from scale samples that were collected with ages 3 through 8 in the collected sample (Table 5). Age 5 northern pike were the most abundant age pike followed by age 4. Age 5 northern pike had an average length of 576 mm. Very few northern pike older than age 5 were captured.

Growth of northern pike in Kangaroo Lake, when compared to statewide age at length tables, appears to be less than state rates and less than obtained in the previous at most ages (Table 4). The small number of fish aged especially larger size pike likely influenced the average length at age we obtained.

Table 5. Northern pike length frequency and age distribution of fish captured with fyke nets and aged during spring 2012 netting on Kangaroo Lake.

Length (mm)	Total Number	Age					
		3	4	5	6	7	8
350	2	2					
360	1	1					
370	1	1					
380	2	2					
390	1	1					
400	3	3					
410	1	1					
420	1			1			
430							
440							
450	1		1				
460	1			1			
470	3		2	1			
480	2		1				
490	1			1			
500	2		2				
510	1			1			
520	1		1				
530	2			1			1
540	3		1	2			
550	1		1				
560	3			3			
570	2			2		1	
580	2			2			
590	1			1			
600	7		5	2			
610	1			1			
620	2		1	1			
630	4			2		2	
640	1					1	
650	2			1	1		
660							
670	6			2	3	1	
680	1				1		
690							
700							
710							
720	1						1
730							
740							
750							
Total	63	11	15	25	5	5	2
Ave. Length	545	382	551	576	653	632	629
SD. Length	99.83	21.91	58.95	71.42	49.06	42.98	140.01

Smallmouth and Largemouth Bass

A total of 102 smallmouth bass were captured by fyke net during this survey (Table 1). These bass ranged in length from 163 mm to 482 mm and had an average length of 366 mm (Table 6). 66.7% of the smallmouth bass that we captured were greater than 356 mm (14") in length and 9.8% were greater than 457 mm (18") in length. Using fyke nets to mark smallmouth bass and electroshocking to recapture smallmouth bass and the Peterson technique to estimate population size, the smallmouth bass population in Kangaroo Lake is likely between 364 and 13,095 individual adult smallmouth bass (Table 1). That population estimate has a wide variance because of the few bass recaptured.

Age estimates were made with the use of scales. Ages 2 through 8 were present in the aged sample. Age 5 bass were the most common although other ages were also represented in the sample (Table 6). Age 5 smallmouth bass averaged 406 mm in length.

When age at length data from this survey was compared to statewide average age at length data, it appears that smallmouth bass in Kangaroo Lake are growing better (longer at age) than smallmouth bass from other populations across Wisconsin (Table 4). Length at age in 2012 was similar to average length at age obtained in previous surveys.

The ten largemouth bass captured during fyke netting ranged in length from 220 mm to 493 mm and had an average length of 415 mm. 90% of the captured largemouth bass were greater than 356 mm in length (14") and 40% were greater than 457 mm (18") in length. Similar to smallmouth bass, we could not calculate a Peterson population estimate for largemouth bass because of a lack of recaptured fish. Ages 5, 6, 7 and 11 were represented in the scale samples that were collected from largemouth bass during spring fyke netting in Kangaroo Lake. Each age group had similar numbers of fish in it.

Panfish

Rock Bass

Rock bass were the most commonly captured fish during this survey (Table 1). Of the 1,560 rock bass that were handled, 1,288 were measured. The measured fish ranged in length from 97 mm to 293 mm and had an average length of 189 mm (Table 7). Captured rock bass were generally large in size with 82.7%, 43.9% and 13.7% greater in length than 150 mm (6"), 200 mm (8") and 254 mm (10"), respectively. A population estimate could not be calculated for rock bass.

Table 6. Smallmouth bass length frequency and age distribution of fish captured with fyke nets during spring 2012 netting on Kangaroo Lake.

Length (mm)	Total Captured	Age							
		1	2	3	4	5	6	7	8
150									
160	2		2						
170	1		1						
180	4		4						
190									
200	2		2						
210	1		1						
220	1			1					
230	1			1					
240	1			1					
250	1			1					
260	1			1					
270	2			2					
280	4			4					
290	3			3					
300									
310	3				3				
320									
330									
340	6				6				
350	1				1				
360	3				3				
370	10				4	6			
380	1					1			
390	8					8			
400	6					4	2		
410	8					4	3	1	
420	8					4	4		
430	6					1	4	1	
440	5					1	4		
450	6					1	3	1	1
460	2						1	1	
470	4					1	1	2	
480	1								1
490									
500									
Total	102	0	10	14	17	31	22	6	2
Ave. Length	366		174	271	351	406	435	452	466
S.D.	84		19	23	20	26	21	25	23

Table 7. Panfish length frequency of fish captured with fyke nets on Kangaroo Lake in spring 2012.

Length (mm)	Brown Bullhead	Rock Bass	Pumpkin-seed	Bluegill	Yellow Perch
50					
60					
70					
80					
90		3		3	
100		13		4	
110		25		6	
120		39	1	4	
130		40	1	10	
140		103		12	
150		139	1	11	2
160		122	1	11	1
170		80	2	20	1
180		78		26	2
190		80		14	
200		85		14	
210		139		12	
220	1	123		7	
230		74		3	
240		53	1	2	
250		49		1	
260	1	28			
270	1	7			
280		5			
290		3			
300					
310					
320					
330	2				
340					
350					
360	2				
Total	7	1288	7	160	6
Ave. Length	308	189	165	174	168
SD. Length	53	40	39	34	11

Scales were used to determine the age of the 202 captured rock bass that had an ageing structure collected. Age 2 through age 9 rock bass were encountered in our sample (Table 8). Age 5 and age 4 dominated the sample with other ages less common. Age 5 rock bass averaged 221 mm in length.

Growth, as measured by length at age for rock bass in Kangaroo Lake was at or above statewide averages (Table 4). This indicates that growth is good for rock bass in the lake.

Table 8. The age distribution of rock bass that were captured with fyke nets during spring 2012 netting on Kangaroo Lake and aged.

Length (mm)	Number	Age								
		1	2	3	4	5	6	7	8	9
90	2		2							
100	2		1	1						
110	10			10						
120	12			12						
130	4			1	3					
140	12			1	11					
150	10				10					
160	10				10					
170	10				10					
180	10				9	1				
190	10				4	6				
200	10					10				
210	10					10				
220	18					16	2			
230	24					20	4			
240	12					6	5	1		
250	15						8	7		
260	9						2	6	1	
270	4						1	1	1	1
280	5							1	3	1
290	3							2	1	
300										
Total	202	0	3	25	57	69	22	18	6	2
Ave. Length	200		100	121	164	221	247	265	281	277
S.D.	50		4.16	7.29	16.87	15.15	11.18	12.86	8.24	4.24

Bluegill

During fyke netting we captured 184 bluegill (Table 1). The 160 bluegill that were measured ranged in length from 96 mm to 250 mm and had an average length of 174 mm (Table 7). 121 of 160 (75.6%) of the measured bluegill were greater than 150 mm (6”) and 24.4% were greater than 200 mm (8”) in length. A population estimate was not calculated for bluegill because we did not recapture and previously marked fish.

Age for bluegill was estimated using scales collected from the subsample of measured bluegill collected during netting. Ages 2 through 6 were found in our sample, with age 4 bluegill the most common age class (Table 9). Following age 5, bluegill age class abundance dropped rapidly.

When bluegill length at age for Kangaroo Lake were compared to state averages, bluegill in Kangaroo Lake were consistently larger than an average bluegill across the state at all ages (Table 4). Average length at age measured in 2012 was similar to what was observed in 2008.

Table 9. Bluegill length frequency and age distribution of fish captured with fyke nets and measured during spring 2012 netting on Kangaroo Lake.

Length (mm)	Number	Age					
		1	2	3	4	5	6
50							
60							
70							
80							
90	3		3				
100	4		4				
110	6		4	2			
120	4		2	2			
130	10		2	8			
140	12			11	1		
150	11			8	3		
160	11			2	8		
170	20			2	18		
180	26				26		
190	14				13	1	
200	14				14		
210	12				11	1	
220	7				1	6	
230	3					3	
240	2					1	1
250	1						1
Total	160	0	15	35	95	12	2
Ave. Length	173		111	143	187	223	248
S.D.	36.68		11.67	14.14	17.59	11.17	3.54

During fyke netting, we also captured 7 pumpkinseed sunfish and 6 yellow perch (Table 1). The sunfish ranged in length from 125 mm to 240 mm and had an average length of 165 mm (Table 7). Yellow perch ranged in length from 152 mm to 189 mm and had an average length of 168 mm

Other Species

In addition to the species already discussed, we captured a number of other species during fyke netting (Table 1). These species included in decreasing abundance, white sucker, longnose sucker, bullhead, gar, bowfin and rainbow trout. It is likely that some of these species, chiefly the suckers and the rainbow trout migrated up Heins Creek and into Kangaroo Lake from Lake Michigan.

Spring Electrofishing I

On the night of April 4, we shocked the 3 designated shoreline segments (Figure 3) over the course of 161 minutes to look for fish that were marked during fyke netting. During shocking, we captured 273 fish of ten species with a total CPE of 74.79 fish per mile or 100.37 fish per hour shocked (Table 10). Rock bass dominated our catch with lower numbers of bluegill, walleye and other species captured (Table 10).

Table 10. Species captured from Kangaroo Lake by electroshocking during electroshocking on April 4.

Species	Number Captured	Recaptured Number	CPE (Fish/mile)	CPE (Fish/ hr)
Gar sp.				
Bowfin	9		2.47	3.31
Rainbow Trout				
Northern Pike	1		0.27	0.37
Carp				
Longnose Sucker				
White Sucker	8		2.19	2.94
Bullhead sp.	1		0.27	0.37
Rock Bass	115		31.51	42.28
Pumpkinseed				
Bluegill	55		15.07	20.22
Smallmouth Bass	27	2	7.40	9.93
Largemouth Bass	1	1	0.27	0.37
Yellow Perch	4		1.10	1.47
Walleye	52	25	14.25	19.12
Total	273	28	74.79	100.37

We captured marked walleye, smallmouth bass, and largemouth bass enabling us to calculate Peterson Population Estimates and ranges for walleye and smallmouth bass (Table 1). A population was not made for largemouth bass because of the low number of fish that we marked.

We measured all game fish that we captured during shocking. The 27 smallmouth bass ranged in length from 166 mm to 440 mm and had an average length of 298 mm (Table 11). 37% of the captured smallmouth bass were greater in length than the 356 mm (14”) minimum size limit for the lake. The measured walleye ranged in length from 233 mm to 558 mm with an average length of 442 mm (Table 11). Twenty-five walleye (48.1%) were greater than the 457 mm (18”) minimum size limit. We also measured a single northern pike at 700 mm and one largemouth bass at 372 mm.

Table 11. The length frequency of fish captured during electrofishing on April 4, 2012 on Kangaroo Lake.

Length (mm)	Smallmouth Bass	Largemouth Bass	Walleye
150			
160	1		
170			
180	2		
190	3		
200	2		
210	3		
220	1		
230	1		1
240			
250			1
260			
270			
280	2		
290			
300			
310			
320			
330	1		
340			
350	1		
360			3
370		1	5
380			
390			1
400	2		5
410	3		5
420	4		3
430			
440	1		2
450			2
460			4
470			5
480			2
490			1
500			5
510			
520			1
530			1
540			3
550			2
Total	27	1	52
Ave. Length	298	372	442
S.D.	102.86	--	68.61

Spring Electrofishing II

On the night of May 14, we electroshocked the 3 designated shoreline segments (Figure 3) to characterize the bass and panfish populations of Kangaroo Lake. During the 100 minutes of electroshocking, we captured 118 fish for a total CPE of 35.76 fish per mile shocked or 70.66 fish per hour shocked (Table 12). Rock bass and smallmouth bass were the most abundant fish with lower numbers of other species captured.

Table 12. Catch and CPE of fish captured on Kangaroo Lake during May 2012 electroshocking.

Species	Number Captured	CPE (Fish/mile)	CPE (Fish/ hr)
Bowfin	1	0.30	0.60
Longnose Gar	17	5.15	10.18
Rainbow Trout			
Northern Pike	2	0.61	1.20
Common Carp	1	0.30	0.60
Longnose Sucker			
White Sucker	6	1.82	3.59
Brown Bullhead			
Rock Bass	51	15.45	30.54
Pumpkinseed			
Bluegill			
Smallmouth Bass	28	8.48	16.77
Largemouth Bass			
Yellow Perch	7	2.12	4.19
Walleye	5	1.52	2.99
Total	118	35.76	70.66

Gamefish

The 28 smallmouth bass that were captured during shocking ranged in length from 75 mm to 472 mm and averaged 237 mm in length (Table 13). 21.4% of the captured bass were greater in length than the 356 mm (14”) size minimum. The age of captured bass ranged from age 1 through age 6 (Table 14). Most of the bass were age 2 with substantially fewer bass of other ages captured.

Table 13. The length frequency of fish captured during electrofishing on May 14, 2012 on Kangaroo Lake.

Length mm	Smallmouth Bass	Rock Bass	Yellow Perch	Walleye
50				
60		1		
70	1			
80				
90			1	
100			2	
110		3	3	
120				
130			1	
140	2	2		
150	5	5		
160	2	5		
170	7	6		
180		4		
190	1	5		
200		4		
210	1	2		
220		6		
230		3		
240		5		
250				
260				
270	1			
280				
290				
300				
310				
320				
330	1			
340	1			
350				
360	1			
370				
380				
390	1			1
400				
410				
420				1
430				
440	2			
450				
460	1			
470	1			
480				
490				2
500				
510				
520				1
530				
540				
550				
Total	28	51	7	5
Ave. Length	237	187	112	466
S.D.	117.51	39.43	12.01	55.38

Table 14. The age frequency of smallmouth bass captured during May 2012 shocking on Kangaroo Lake.

Length (mm)	Age					
	1	2	3	4	5	6
70	1					
80						
90						
100						
110						
120						
130						
140		2				
150		5				
160		2				
170		7				
180						
190		1				
200						
210		1				
220						
230						
240						
250						
260						
270			1			
280						
290						
300						
310						
320						
330				1		
340				1		
350						
360				1		
370						
380						
390					1	
400						
410						
420						
430						
440						2
450						
460						1
470						1
Total	1	18	1	3	1	4
Ave. Length	75	168	279	347	395	456
S.D.	--	16.47	--	18.90	--	14.82

Although targeting bass, we captured 5 walleye and 2 northern pike during the May shocking survey (Table 12). The walleye ranged in length from 390 mm to 521 mm and had an average length of 466 mm (Table 13). The two northern pike were measured at 512 mm and 672 mm, respectively.

Panfish

During that shocking survey, we captured 51 rock bass that averaged 187 mm in length and 7 yellow perch that averaged 112 mm in length (Table 13).

Other Species

During May electroshocking survey, we also captured a number of other species (Table 12). In decreasing abundance, these species included longnose gar, white sucker, bowfin and carp.

Fall Electroshocking

On the night of October 16, we shocked the 3 shoreline segments (Figure 3) to assess the abundance of yoy walleye and to characterize the fish population of the lake. During the 133 minutes of shocking, we captured 246 fish of 4 species (Table 15). Although we did not net non-game fish, we made a visual estimate of abundance of the other species that we observed that night. Total gamefish CPE was 70.28 fish per mile or 111.31 fish per hour shocked. Smallmouth bass dominated the catch with fewer fish of other species captured.

Table 15. Species captured from Kangaroo Lake by electroshocking on the night of October 2, 2012.

Species	Number	CPE (Fish/mile)	CPE (Fish / hr)
Northern Pike	1	0.27	0.45
Smallmouth Bass	222	60.82	100.45
Largemouth Bass	16	4.38	7.24
Walleye	7	1.92	3.17
Bluegill	Common		
Yellow Perch	Present		
Rock Bass	Common		
Bowfin	Present		

Gamefish

Smallmouth and Largemouth Bass

The 222 smallmouth bass that we captured (Table 15) during electrofishing ranged in length from 72 mm to 490 mm and had an average length of 161 mm (Table 16). Based on the length frequency, it is likely that bass less than 120 mm in length were yoy smallmouth bass indicating successful reproduction in 2012. Only 4 of the 222 captured smallmouth bass were greater than the 356 mm (14") minimum size limit.

The 16 largemouth bass ranged in length from 130 mm to 505 mm and had an average length of 329 mm (Table 16). 9 of 16 captured largemouth bass were greater than 356 mm (14") in length.

Other Gamefish

During electroshocking we captured 7 walleye (Table 15). The captured walleye had an average length of 302 mm (Table 16). Walleye less than 240 mm in length were likely yoy walleye indicating some level of successful reproduction in 2012. We also captured a single 600 mm northern pike.

Panfish

Rock bass and bluegill were visually rated as being common (Table 15). The other observed species, yellow perch and bowfin, were judged to be present (less common) along the shoreline transects.

Table 16. The length frequency of fish captured during electrofishing on October 16, 201208 on Kangaroo Lake.

Length (mm)	Northern Pike	Smallmouth Bass	Largemouth Bass	Walleye
70		2		
80		5		
90		18		
100		30		
110		23		
120		13		
130		2	3	
140		1	1	
150		8		
160		24		
170		18		
180		17		
190		24		1
200		3		
210		5		1
220		2		1
230		6	1	2
240		1		
250		10		
260		4		
270		1		
280		1	1	
290				
300				
310				
320			1	
330				
340				
350				
360			1	
370				
380			1	
390				
400				
410			1	
420		1	2	
430				
440			1	
450			1	
460				
470			1	
480		2		1
490		1		
500			1	
510				
520				1
600	1			
Total	1	222	16	7
Ave. Length	600	161	329	302
S.D.	--	65	135	139

DISCUSSION

The 2012 comprehensive fisheries survey on Kangaroo Lake characterized the fish populations of the lake with the use of multiple gear types. The use of multiple gears gave a much clearer picture of the status of the fish population of Kangaroo Lake.

A total of 2,969 fish were collected during the fyke net and electroshocking surveys. The most abundant fish were rock bass, walleye and smallmouth bass. Despite an unseasonably early and warm spring, results from the 2012 survey were consistent with the previous two surveys.

Gamefish

Walleye

Walleye in Kangaroo Lake continue to be highly desired by anglers (based on a creel survey, interviews with anglers or just the survey data). Survey results from 2012 indicated that spring walleye number and CPE improved over what was observed in 2008 (Table 17). Although walleye abundance is still less than what it was in the 1980's, the CPE trend is increasing. These survey results suggest that the change to the walleye regulation for Kangaroo Lake from (381 mm) 15" minimum size and a daily bag limit of 5 to 18" (457 mm) minimum size and a daily bag of 3 in 2007 may be working to increase the number of larger walleye in the lake. If lake conditions remain stable, good recruitment and conservative regulations may lead to improved walleye numbers in the future.

The fall survey captured young of year walleye throughout all survey segments (Table 15). The number of yoy walleye captured in 2012 was much less than was caught in 2008 which may indicate that the 2012 year class although present, is weak. However, age classes 2 through 4 were present in good numbers and should provide anglers good fishing opportunities in the coming years (Table 3).

Estimated growth (length at age) for walleye continues to be above statewide averages (Table 4). Although we seldom capture forage fish in our surveys, we see large numbers of "minnows" around our fyke nets. The mesh size is too large in the fyke nets to capture these minnows. In addition, the sucker run likely provides additional food resources for walleye.

Table 17. Summary of fyke net surveys, numbers of fish and fish per net-night (CPE) from Kangaroo Lake 1973-2012.

Species	1973	1980	1983	1995	2004	2008	2012
Walleye	193 (2.5)	234 (8.7)	1,498 (11.7)	1,297 (8.5)	242 (4.7)	278 (4.3)	313 (5.6)
Northern Pike	223 (2.9)	14 (0.5)	112 (0.9)	151 (1.0)	38 (0.7)	55 (0.9)	67 (1.2)
Smallmouth Bass	2 (0.1)	11 (0.4)	7 (0.1)	25 (0.2)	21 (0.4)	36 (0.6)	107 (1.9)
Largemouth Bass	13 (0.2)	0	1 (0.0)	9 (0.1)	1 (0.0)	28 (0.6)	10 (0.2)
Bowfin	10 (0.1)	0	13 (0.1)	30 (0.2)	37 (0.7)	110 (1.7)	2 (0.1)
Rock Bass	220 (2.9)	139 (5.2)	112 (0.9)	1,112 (7.3)	33 (0.6)	392 (6.1)	1,560 (27.9)
Bluegill	132 (1.7)	4 (0.2)	10 (0.1)	437 (2.9)	377 (7.3)	1,196 (18.7)	184 (3.3)
Pumpkinseed	8 (0.1)	0	0	21 (0.1)	8 (0.2)	65 (1.0)	7 (0.1)
Yellow Perch	424 (5.6)	0	2,559 (20.0)	9,619 (62.9)	8,270 (159.0)	1,297 (20.3)	6 (0.1)
Bullhead sp.	0	0	2 (0.0)	0	24 (0.5)	63 (1.0)	9 (0.2)
Gar sp.	0	2 (0.1)	0	1 (0.0)	1 (0.0)	7 (0.1)	6 (0.1)
White Sucker	172 (2.3)	145 (5.4)	501 (3.9)	1,118 (7.3)	213 (4.1)	286 (4.5)	110 (2.0)
Longnose Sucker	0	101 (1.5)	1 (0.0)		1 (0.0)	858 (13.4)	21 (0.4)
Trout	3 (0.0)	4 (0.2)	3 (0.0)	8 (0.1)	3 (0.1)	4 (0.9)	2 (0.1)
Carp	0	0	1 (0.0)	0	0	1 (0.0)	0

Smallmouth and Largemouth Bass

The smallmouth population increased in abundance since 1995 and in 2012 increased markedly based on fyke net data (CPE) (Table 20). In Kangaroo Lake, smallmouth bass is the co-dominant top predatory gamefish with walleye. The size and age distribution of smallmouth bass in the lake indicated that they have had consistent reproduction and are firmly established in the lake. It is likely that changing lake conditions over the past decade have favored this upsurge in smallmouth bass abundance. Growth of smallmouth bass in Kangaroo Lake is good indicating sufficient forage is available (Table 4).

The fall survey in 2012 captured many young bass (age 0 and age 1) indicating very good reproduction the past two years (Table 16). Nearly all the yoy bass were captured when structure such as rocky points were encountered.

Increases in young bass numbers may lead to increases in spawning number and ultimately to more bass in the lake. Although there is no clearly defined interaction between smallmouth bass and walleye in the fisheries literature, anglers worry that the

increasing number of smallmouth bass may lead to reduced walleye number as they compete for food resources and habitat.

No clear trend is apparent for largemouth bass from fyke net data (Table 17). However, results from other survey gears indicate that largemouth bass are present and producing sporadic year classes that maintain their population in Kangaroo Lake. The lack of preferred habitat such as woody debris and aquatic vegetation limits their abundance in Kangaroo Lake.

Northern Pike

Northern pike CPE's have remained steady since 1980, although pike abundance may have slightly improved based on the 2008 and 2012 surveys (Table 17). The high pike CPE in 1973 is likely a sampling artifact since nets were set north of the causeway during that survey likely capturing northern pike that were moving towards spawning areas, while since 1980 fyke nets have only been set south of the causeway. Natural reproduction is occurring in Piel Creek as documented by a joint effort of the Lake Association and the Nature Conservancy (Paul Maulberg, personal communication).

Panfish

Overall panfish abundance has been fairly stable since the 1980's, however the species make-up has been highly variable (Table 17). Yellow perch dominated the panfish community for many years, but bluegill and rock bass have become more abundant over the past three surveys. In 2012, we saw very few yellow perch in our surveys. In past surveys, yellow perch were the most common fish that we captured. This decrease in the number captured and CPE may be due more to the unusual weather conditions we encountered this spring and net placement than an indication of a collapse in the perch population.

Rock bass number increased substantially in 2012 (Table 17). This factor may be due somewhat to the weather this spring but likely is a reflection of increasing rock bass numbers in the lake. Since rock bass can be fairly long lived, eat minnows and are not targeted by anglers, they may be a major predator of the available forage in the lake. At this time, rock bass growth is at or above statewide averages (Table 4).

Bluegill are increasing in abundance, although CPE declined in 2012 likely due to weather conditions (Table 17). Increasing the amount and distribution of aquatic plants could lead to increased bluegill number. Growth (length at age) is above statewide averages (Table 4).

Other Species

Several other species that were captured are worth noting. White sucker and longnose sucker CPE's decreased in 2012 (Table 17). This change may be due to weather conditions or decreased flow at the weir at outlet of the lake. Fry and fingerling of these species are important food source for fish in the lake.

Other predators, bowfin and gar, continued to be present i in low abundances (Table 17). These species appear to have little impact on other species in the lake.

Bullhead sp. appears to be increasing in number, but limited data make this trend shaky (Table 17). Carp were rarely captured in 2012, but are present in the lake (Table 17). It is not known if the carp population is high enough to cause damage to existing bulrush stands or to stands that are being rehabilitated.

CONCLUSIONS

Fish populations in Kangaroo Lake appear to be in a state of change. Bass and panfish populations are up while the walleye population is stable although lower than historic highs. Likely the changes are due to a combination of changing lake conditions that favor panfish and bass and angler harvest of walleye. In general, the fish population of Kangaroo Lake appears to be in good condition and similar to the previous survey.

RECOMMENDATIONS

- Continue to monitor the fish population of Kangaroo Lake on a regular basis. The next survey is scheduled for 2018.
- During the next several surveys, determine if (1) the current walleye regulations have been effective in improving the abundance and size structure of walleye in the lake, (2) the status of the smallmouth bass population in the lake and (3) panfish abundance and species make-up.
- Encourage the reestablishment of natural shorelines by removing hard structures that have been placed on the shoreline. This will also help plant communities as well as many other animal populations.

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