Kangaroo Lake Comprehensive Fisheries Survey Report
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ABSTRACT

Kangaroo Lake is the largest lake in Door County and has a surface area of 1,123 acres. The 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 water. At times, because the lake is shallow, lake water can be very turbid due to wind action or from heavy boating use.

Because of concerns about the perceived decline in the fishery of Kangaroo Lake, a comprehensive fish survey was conducted in 2004 to evaluate the fish populations of the lake. The survey began in April and continued through October.

Fyke nets were set on Kangaroo Lake shortly following ice-out and ran from April 6 through April 20. During the fyke net portion of the survey, a total of 9,289 fish were captured for a CPE of 179 fish per net per night. Of the seventeen species captured, yellow perch dominated the catch. Substantially fewer bluegill, walleye and white sucker were captured. On the night of April 27, the lake was electroshocked to look for fish marked during fyke netting. A total of 68 fish were captured during the survey, with walleye the most numerous with 50 caught. Others included 3 northern pike, 8 smallmouth bass, 1 largemouth bass and 6 yellow perch.

Kangaroo Lake was electrofished on the nights of May 26 and June 10 to capture centrarchids. 164 fish representing thirteen species were captured. Bluegill were the most commonly caught species followed by white sucker and smallmouth bass.

Four mini-fyke nets were fished on the nights of July 26 and July 27 on Kangaroo Lake. A total of 495 fish representing eight species were captured during netting. The most commonly caught fish were bluntnose minnow and mimic shiner, with substantially fewer fish of other species captured.

Kangaroo Lake was electroshocked on the night of October 18. During the 145 minutes of electroshocking, 104 fish representing eight species were captured. Rock bass, yellow perch and smallmouth bass dominated the catch. Fewer numbers of northern pike, walleye and bluegill were captured.

The 2004 comprehensive fisheries survey on Kangaroo Lake adequately characterized the fish populations of the lake. A total of 10,120 fish were captured during the fisheries survey. The most abundant fish were yellow perch. The most common gamefish were walleye followed by smallmouth and largemouth bass.

Fish populations in Kangaroo Lake appear to be in a state of change. Walleye populations are down, although reproduction seems to be good, while bass and panfish populations are increasing. Walleye stocking is not recommended, but I do recommend that changes in walleye size and bag limits be considered to help improve the walleye population. I also recommend that shoreline and nearshore habitat be protected and that plans designed to increase the number of aquatic plants in the lake be implemented.

INTRODUCTION

Kangaroo Lake (WBIC 98600) is the largest lake in Door County and has a surface area of 1,123 acres (Figure 1). The 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 water. At times, because the lake is shallow, lake water can be very turbid due to wind action or from heavy boating use.

In the late 1800's a causeway was constructed across the northern third of the lake creating a north basin of 300 acres and a south basin of 800 acres (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. Once abundant aquatic vegetation has been reduced to patches of native plants and stands of non-native Eurasian watermilfoil. The Lake Association has established a slow-no-wake zone along the southern shore and a voluntary no-wake-zone in other lake areas to promote the reestablishment of native plant beds, reduce boating induced turbidity and slow the spread of Eurasian watermilfoil (NES Ecological Services 2004).

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

Most of the past efforts to manage the fishery of Kangaroo Lake focused on fish stocking. Records indicate that in 1935 the lake was stocked with bluegill, bullhead, large and smallmouth bass, yellow perch and walleye (Mackenthun 1947). These stockings continued throughout the 1930's and 40's. In the 1950's and 60's stocking focused on walleye, while in the early 1970's northern pike were stocked (Kernen 1974).

Despite the numerous stocking events, fish surveys to evaluate these stockings have been limited. Mackenthun (1947) reported that smallmouth bass and bluegill dominated the fish population of the lake. Walleye, northern pike, common sunfish and rock bass were also captured during his survey. Mackenthun indicated that walleye had poor growth rates and recommended that walleye stocking be dropped. He indicated that vegetation was relatively scarce along the shoreline except for bulrush beds on either end of the lake and several scattered bulrush beds.

A 1959 survey (Wiegert 1959) indicated that rock bass, bluegill and walleye dominated the fishery. Substanually fewer bass (both largemouth and smallmouth), northern pike and sunfish were captured. It appeared that all species of fish were growing normally. He also indicated that bulrush were common and that pondweeds were only occasionally observed.

When Kernen surveyed the lake in 1973, he found that walleye was the dominant gamefish in the lake, although he indicated that several year classes appeared to be missing from the population (Kernen 1974). Growth appeared to be less than normal for the fish captured. Bass and northern pike populations appeared to be depressed from previous surveys. Yellow perch and rock bass were the most common panfish captured during his survey.

Several fyke net surveys were conducted in the 1980's that indicated that walleye and yellow perch were the dominant species in the lake (Lychwick 1996). Abundance of walleye greater than 250 mm in length went from 1.6 per acre in 1973 to 1.9 per acre in 1980 and to 2.7 per acre in 1983. In a 1995 survey, Lychwick found that yellow perch walleye, rock bass and white sucker were the most common fish captured during fyke netting. Substanually fewer bluegill northern pike, and bass were captured. Abundance of yellow perch was estimated to be 62.9 per net night up from 5.6 per net night in 1973. Walleye abundance (>250 mm) was estimated to be 1.0 per acre, a greater than 60% decrease from 1983. It was hypothesized that the reduction in walleye abundance was due to several years of poor reproduction and angler harvest. Catch rates for other gamefish increased from surveys conducted in the 1980's. The growth rates of captured gamefish appeared to be near State averages.

Because of concerns about the perceived decline in the fishery of Kangaroo Lake since the 1995 survey, a comprehensive fish survey was conducted in 2004 to evaluate the fishery of the lake.

METHODS

A comprehensive fisheries survey on Kangaroo Lake began in April 2004 and continued through October and followed lake sampling protocols. On April 6, fyke nets were set to capture spring spawning fish and fished through April 20. All fish were identified, measured, marked with a caudal fin clip and a subsample had a scale or spine removed for ageing.

Shortly after the completion of fyke netting, three 1-mile sections of the shoreline were electroshocked on the night of April 27 to look for marked fish. All fish were netted, identified, checked for marks and measured.

On the nights of May 26 and June 10, the same 3 sections of shoreline were electroshocked to capture and characterize bass and panfish populations. All fish were netted, identified, measured and the centrarchids had a scale removed for ageing.

Four mini-fyke nets were set and were fished on July 27 and July 28 to capture young-of-year (yoy) and other small fish. All fish were identified to species, measured to the nearest 1 mm and a subsample had a scale removed for ageing.

On the night of October 18, the three shoreline sections were electroshocked to characterize young-of-year fish. All gamefish and on half the lake, all fish were netted, identified and measured.

Basic fisheries statistics, such as average length, length frequencies by survey type, age distributions, and population estimates were calculated. The Schnabel and Peterson methods were used to estimate community population size when possible.

RESULTS

Spring Surveys

Fyke Net

On April 6, one net was set on Kangaroo Lake shortly following ice-out. Over the course of the next week, six additional nets were set along the shoreline (Figure 2). Nets were moved if necessary during the course of the survey to reduce fish mortality or to survey other areas that might have been spawning locations. Overall, there were 48 net lifts for a total effort of 52 net-nights during the netting that ran from April 6 through April 20.

During the fyke net portion of the survey, a total of 9,289 fish were captured for a CPE of 179 fish per net per night. Of the seventeen species captured, yellow perch dominated the catch (Table 1). Substantially fewer bluegill, walleye and white sucker were captured.
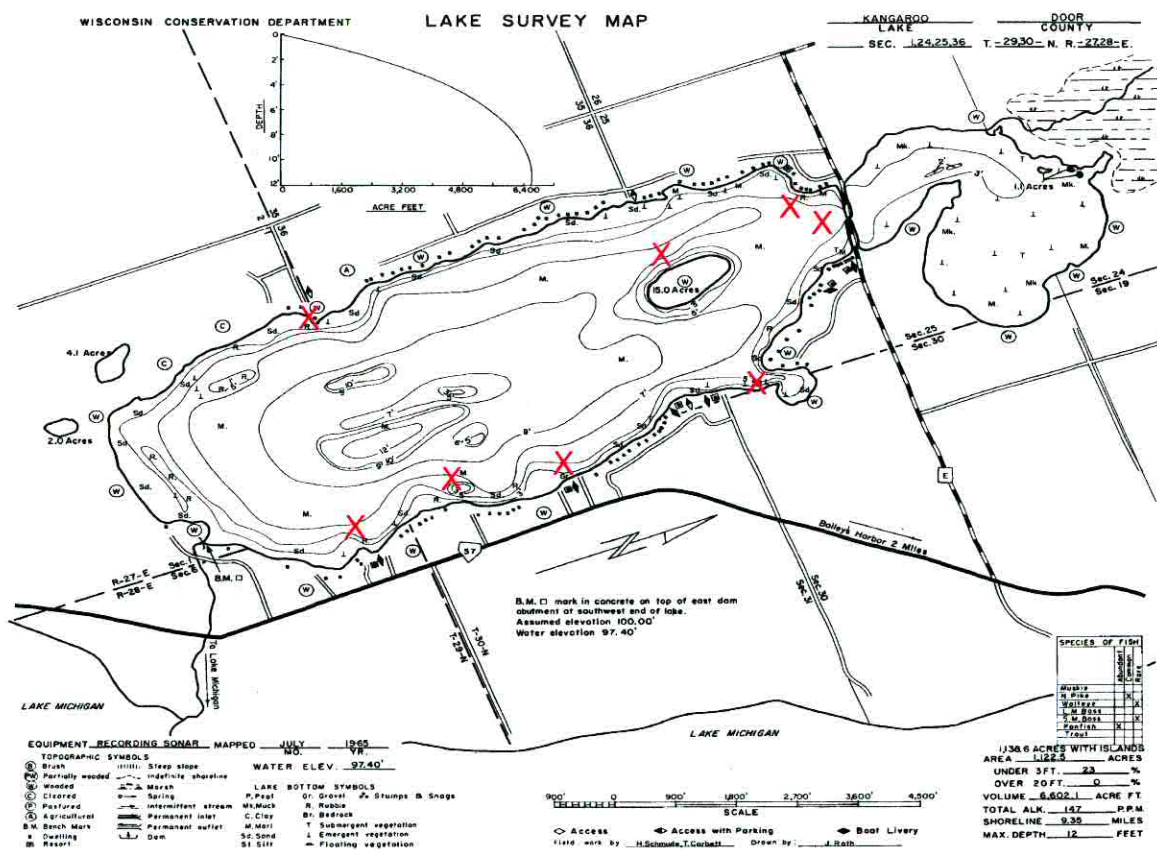
Figure 2. Fyke net locations on Kangaroo Lake during the 2004 survey. Net locations are noted by an X.

Table 1. Species captured from Kangaroo Lake with fyke nets during spring 2004.

Species	Number Captured	Number Recaptured	Population Estimate Range
Gar sp.	1		
Bowfin	37		
Coho Salmon	1		
Rainbow Trout	1		
Brook Trout	1		
Northern Pike	38	2	82-492
Common Shiner	1		
Longnose Sucker	1		
White Sucker	213		
Bullhead sp.	24		
Rock Bass	33		
Pumpkinseed	8		
Bluegill	377	34	1118-2724
Smallmouth Bass	21		
Largemouth Bass	2		
Yellow Perch	8270	47	196044-418268
Walleye	242	34	382-930
Total	**9289**	**117**	

<u>Gamefish</u>

Walleye

Walleye were the most commonly captured gamefish during fyke netting (Table 1). The 242 walleye ranged in length from 210 mm to 637 mm and had an average length of 335 mm (Table 2).

Using mark and recapture during spring surveys and the Schnabel technique to estimate population size, the walleye population in Kangaroo Lake is likely between 382 and 930 individual walleye or 0.3 to 0.8 walleye per surface acre.

Age was determined for most of the walleye captured using a dorsal spine. Ages ranged from 1 though greater than age 20 for the sampled fish. Age 2 fish (210 mm through 250 mm) were the most common, followed by age 4 walleye (Table 2). Fish that were assigned to ages 10 and greater were grouped into the age 10+ group to facilitate analysis.

From this data it appears that in Kangaroo Lake walleye begin to spawn at age 4 or age 5. Young fish appear to be present in the lake, but numbers decline steadily with age. Growth of walleye in Kangaroo Lake when compared to Statewide age at length tables, appear to be growing at or slightly better than normal rates although growth appears to slow after age 9 (Table 3).

Northern Pike

The 38 northern pike that were captured during spring surveys ranged in length from 321 mm to 1050 mm and averaged 515 mm in length (Tables 1 and 4). Using the Schnabel method to estimate population number, it was estimated that between 82 and 492 northern pike were in the lake at the time of the survey (Table 1). This estimate should be viewed with caution because the low number northern pike that were captured during fyke netting does not allow for an accurate estimate.

Ages were obtained from reading anal spines. For captured and aged northern pike, ages ranged between age 2 and age 11 (Table 4). Age 3 and age 4 fish were the most common age northern pike captured. Other ages were present but in lower number. Growth appears to be slower than statewide averages for ages 2 through 4, but improves for older fish. Once again because of limited samples, growth data should be viewed cautiously.

Smallmouth and Largemouth Bass

Few smallmouth bass or largemouth bass were captured by fyke net. Twenty-one smallmouth were captured that ranged in length from 168 mm to 482 mm with an average length of 282 mm (Table 1). Growth is above state averages (Table 3). Only three largemouth bass were captured and ranged from 135 mm to 413 mm.

Table 2. Length frequency and age distribution of captured walleye from Kangaroo Lake during the fyke net survey, April 2004.

Length (mm)	Number	Age 1	2	3	4	5	6	7	8	9	10+
200											
210	7	2	5								
220	24		24								
230	52		52								
240	52		52								
250	9		9								
260											
270											
280											
290											
300											
310											
320											
330											
340											
350											
360											
370	6			5	1						
380	5				5						
390	2			1	1						
400	4				4						
410											
420	2				2						
430											
440											
450	2					2					
460	2				1	1					
470	8				1	7					
480	10				2	5	3				
490	7					5	1	1			
500	10						8	1	1		
510	7					1	4	1	1		
520	6						1	3	2		
530	6							1	4	1	
540	4							2	2		
550	3							1			2
560	2							1	1		
570	1										1
580	2									1	1
590	2								1		1
600	1										1
610	1										1
620	2										2
630	1										1
640											
650											
Total	240	2	142	6	17	21	17	11	12	2	10
Average	335	210	233	373	411	477	499	525	533	555	562

Table 3. Average length at age as determined by spines or scales for fish captured on Kangaroo Lake in 2004.

Species	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8	AGE 9	AGE 10+
Northern pike	--	330	370	483	675	770	--	--	910	1007
(State Average)	(356)	(406)	(470)	(546)	(610)	(650)	(706)	(762)	(787)	
Bluegill	--	105	130	179	184	--	--			
(State Average)	(64)	97)	(122)	(147)	(167)	(183)	(196)			
Smallmouth Bass	--	178	235	373	418	423	480	450		
(State Average)	(97)	(168)	(236)	(292)	(343)	(381)	(432)	(457)	(472)	
Walleye	210	233	373	411	477	499	525	533	555	562
(State Average)	(152)	(254)	(324)	(381)	(432)	(457)	(497)	(526)	(551)	

Other gamefish that were captured included 1 coho salmon, 1 brook trout and 1 steelhead, most likely originating from Lake Michigan.

Panfish

Yellow perch were the most abundant species captured during the spring survey. A total of 8,270 yellow perch were collected or 159 per net night (Table 1). The 822 perch that were measured ranged in length from 131 mm to 273 mm and had an average length of 171mm (Table 5).

Bluegill were the next most abundant panfish that were captured during spring surveys. A total of 377 were captured that ranged in length from 82 mm to 281 mm with an average length of 179 mm (Table 5).

A total of 33 rock bass were captured during the spring survey (Table 1). They ranged in length from 95 mm to 298 mm and had an average length of 227 mm (Table 5).

Eight pumpkinseed were captured that ranged in length from 111 mm to 227 with an average length of 151 mm (Table 1, Table 5).

Other Species

Several other species including white sucker, longnose sucker, bowfin, bullhead sp., common shiner and gar sp. were captured during spring netting (Table 1). Of these species, bowfin were the most numerous.

Table 4. Length frequency and age distribution for northern pike captured in Kangaroo Lake, April 2004. Note that the categories 800 to 890 mm are not shown on this table.

Length (mm)	Number	Age								
		2	3	4	5	6	7	8	9	10+
300										
310										
320	2	1	1							
330	1	1								
340	1	1								
350	3		3							
360	1		1							
370	1		1							
380	3		3							
390	3		3							
400	1		1							
410	3			3						
420	1			1						
430										
440										
450	1			1						
460										
470										
480										
490										
500										
510										
520	1			1						
530										
540	2			2						
550										
560	1			1						
570	1			1						
580										
590										
600										
610										
620										
630										
640										
650										
660	2				2					
670										
680	1				1					
690										
700	1				1					
710										
720										
730										
740										
750										
760										
770	1					1				
780										
790										
910	1								1	
920	1									1
930										
940										
950										
960										
970										
980										
990										
1000+	2									2
Total	35	3	13	10	4	1	0	0	1	3
Average	515	330	370	483	675	770			910	1007

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Table 5. Length frequency of panfish species captured during spring netting on Kangaroo Lake, April 2004.

Length (mm)	Yellow Perch	Bluegill	Pumpkinseed	Rock Bass
50				
60				
70				
80		1		
90		1		1
100		5		2
110		14	1	2
120		25		1
130	21	16	1	
140	120	7	2	1
150	104	5	2	1
160	104	17		
170	136	26	1	
180	125	66		
190	86	62		
200	53	47		
210	24	45		
220	17	19	1	1
230	10	5		
240	9	6		1
250	7	2		3
260	5			10
270	1			5
280		1		4
290				1
300				
Total	822	370	8	33
Average	171 mm	179 mm	151 mm	227 mm

Spring Surveys- Electrofishing

Recapture Run

On the night of April 27, three transects were electrofished to recapture fish marked during fyke netting. The three transects roughly corresponded with the fyke net locations (Figure 3).

A total of 68 fish were captured during the survey, with walleye the most numerous with 50 caught. Others included 3 northern pike, 8 smallmouth bass, 1 largemouth bass and 6 yellow perch. We recaptured 17 fish marked during the fyke net portion of the survey, all were walleye. The Peterson Population estimate for walleye was 580 based on survey results.
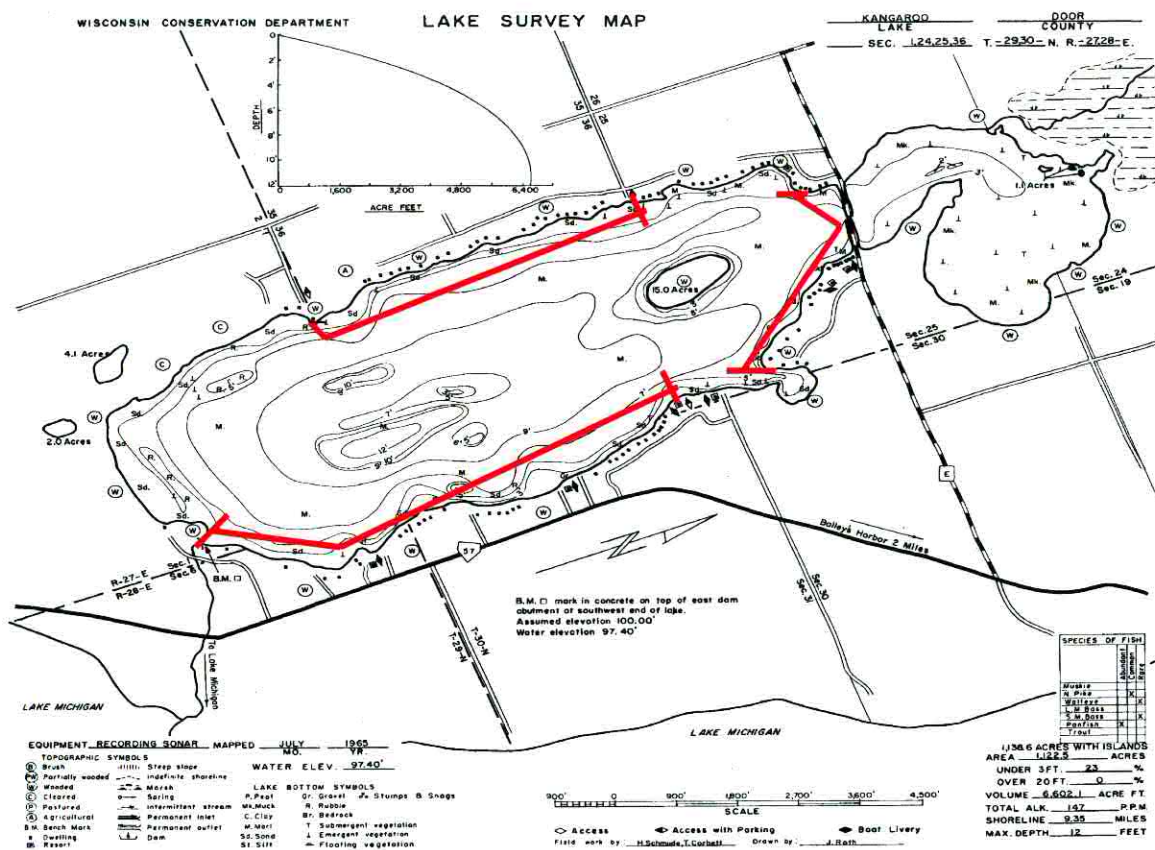
Figure 3. Location of the three electrofishing transects that were shocked on Kangaroo Lake during all electrofishing surveys during 2004.

Centrarchid Sampling

Kangaroo Lake was electrofished on the nights of May 26 and June 10 to capture bass and panfish. The three shocking stations that were used in April to collect recapture information were again used for this portion of the survey (Figure 3). A total of 164 fish representing thirteen species were captured (Table 6). Bluegill were the most commonly caught species followed by white sucker and smallmouth bass.

Table 6. Abundance of species collected during centrarchid sampling on Kangaroo Lake, May-June 2004.

Species	May 26	June 10	Total
Longnose Gar	1	3	4
Bowfin	5	3	8
Rainbow Trout	1	0	1
Common Carp	7	5	12
Common Shiner	0	6	6
White Sucker	13	11	24
Black Bullhead	0	1	1
Rock Bass	5	11	16
Bluegill	3	43	46
Smallmouth Bass	14	10	24
Largemouth Bass	1	0	1
Yellow Perch	11	5	16
Walleye	4	1	5
Total	**65**	**99**	**164**

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The captured bluegill ranged from 70 mm to 205 mm with an average length of 141 mm (Table 7).

Table 7. Length frequency fish captured and measured during May-June electrofishing on Kangaroo Lake, 2004.

Length (mm)	Bluegill	Rock Bass	Smallmouth Bass
50			
60			
70	2		
80	2	2	
90		1	
100	1	5	
110	5	3	
120	9	2	
130	7	2	
140	2		
150	1		
160	1		3
170	4		9
180	4		3
190	6	1	2
200	2		1
210			1
220			
230			
240			
250			1
260			
270			
280			
290			
300			
310			
320			
330			
340			
350			1
360			
370			
380			
390			
400			
410			
420			1
430			1
440			
450			
460			1
470			
480			
490			
500			
Total	46	16	24
Average	141	111	219

Bluegill ranged in age from 2 through age 5 (Table 8). Age 2 bluegill were the most common and averaged 105 mm in length. Growth for bluegill was greater than statewide averages, but since sample size was low, caution should be used when interpreting the data (Table 3).

Table 8. Bluegill age frequency from May-June electrofishing on Kangaroo Lake, 2004.

Length (mm)	Number	Age			
		2	3	4	5
50					
60					
70	2	2			
80	2	2			
90					
100	1	1			
110	5	5			
120	9	7	2		
130	7		7		
140	2		2		
150	1				1
160	1			1	
170	4			4	
180	4			4	
190	6			3	3
200	2			1	1
Total	46	17	11	13	5
Average	141	105	130	179	184

Rock bass were also commonly captured during this portion of the survey. The 16 rock bass ranged in length from 80 mm to 205 mm in length and averaged 111 mm in length (Table 7). One 82 mm rock bass was age 1 and the remainder were age 2 fish.

The 24 captured smallmouth bass ranged in length from 160 mm to 465 mm and had an average length of 219 mm (Table 7). Most of the captured smallmouth bass were less than 200 mm, with few greater than 355 mm.

Ages 2 through 8 were present in the sampled bass. Most of the captured bass were age 2 fish, with substanually fewer fish in other age classes. Growth appeared to be as good as or slightly better than statewide age at length data for smallmouth bass.

Table 9. Age distribution of smallmouth bass captured during spring 2004 surveys in Kangaroo Lake.

Length (mm)	Number	Age						
		2	3	4	5	6	7	8
150								
160	1	1						
170	3	2	1					
180	1	1						
190	1	1						
200	1	1						
210	1	1						
220								
230	1		1					
240								
250	1		1					
260								
270								
280								
290	1		1					
300								
310								
320								
330								
340								
350	1			1				
360								
370								
380	1			1				
390	2			1	1			
400	1				1			
410	1					1		
420	4				1	3		
430	1					1		
440	1					1		
450	1							1
460	1				1			
470								
480	1						1	
490								
500								
Total	45	26	4	3	4	6	1	1
Average		178	235	373	418	423	480	450

Summer Surveys- Mini-fyke Netting

Four mini-fyke nets were fished on the nights of July 26 and July 27 on Kangaroo Lake. A total of 495 fish representing eight species were captured during netting. The most commonly caught fish were bluntnose minnow and mimic shiner, with substanually fewer fish of other species captured (Table 10).

Table 10. Species abundance for fish captured with mini-fyke nets on Kangaroo Lake, July 2004.

Species	Number
Bluntnose Minnow	152
Common Shiner	2
Mimic Shiner	126
Rock Bass	9
Bluegill	59
Largemouth Bass	61
Smallmouth Bass	20
Yellow Perch	66
Total	495

Largemouth bass were the most commonly captured gamefish (Table 10). They ranged in length from 32 mm to 46 mm in length and had an average length of 35 mm (Table 11). Because of their size it is likely these were young of year (yoy) largemouth bass.

Table 11. Length frequency of measured fish from the mini-fyke net on Kangaroo Lake, July 2004.

Length	Bluegill	Largemouth Bass	Rock Bass	Smallmouth Bass	Yellow Perch
10			1		
20					
30		44		6	8
40	37	12		9	17
50	11		1	2	13
60	7		2		15
70	1		4		6
80	3		1		
90					2
100					3
110					
120					
Total	59	56	9	17	64
Average	47	35	60	38	53

Smallmouth bass were also captured during this survey. The 38 smallmouth ranged in length from 31 mm to 57 mm with an average length of 38 mm (Table 11). Similar to largemouth it is likely these were yoy bass.

Yellow perch, bluegill and rock bass were also captured during mini-fyke netting. They had average lengths of 53 mm, 47 mm and 60 mm, respectively (Table 11).

Fall Survey- Electrofishing

Kangaroo Lake was electroshocked on the night of October 18 using the three electrofishing survey transects used during previous surveys (Figure 3). During the 145 minutes of electroshocking, 104 fish representing eight species were captured (Table 12). Rock bass, yellow perch and smallmouth bass dominated the catch. Fewer numbers of northern pike, walleye and bluegill were captured.

Table 12. Abundance of fish species captured during fall electroshocking on Kangaroo Lake, October 2004.

Species	Number
Northern Pike	9
White Sucker	8
Rock Bass	35
Bluegill	6
Smallmouth Bass	15
Largemouth Bass	1
Yellow Perch	25
Walleye	5
Total	**104**

Smallmouth bass were the most common gamefish captured. The smallmouth ranged in length from 63 mm to 186 mm and had an average length of 121 mm (Table 13). From the length frequency and using ageing samples from earlier surveys, the smallmouth captured during this portion of the survey were likely yoy or yearling bass.

Nine northern pike were captured and ranged in length from 257 mm to 894 mm with an average length of 388 mm (Table 13). Five walleye were also captured and they had an average length of 410 mm.

Rock bass were the most common panfish captured during fall shocking. The 35 rock bass had an average length of 129 mm (Table 13). Yellow perch and bluegill were also captured. They had average lengths of 142 mm and 93 mm respectively (Table 13).

Table 13. Length frequency of measured fish captured during fall electroshocking on Kangaroo Lake, October 2004.

Length (mm)	Yellow Perch	Bluegill	Walleye	Northern Pike	Smallmouth Bass	Rock Bass	Largemouth Bass
50		1					
60	2				2		
70					3	1	1
80	2				2	6	
90	2	2				3	
100	1	2					
110	2					1	
120						1	
130	3	1				2	
140	1				1	4	
150	1					8	
160					3	8	
170	3				2	1	
180	3		1		2		
190	3						
200	3		1				
210							
220							
230							
240							
250				1			
260							
270							
280				3			
290							
300				1			
310				1			
320							
330							
340							
350							
360							
370							
380							
390							
400							
410							
420				1			
430							
440							
450							
460							
470							
480				1			
490			1				
500							
510							
520							
530							
540							
550							
560			1				
570							
580							
590							
600							
610							
620			1				
630							
640							
>650				1			
Total	**26**	**6**	**5**	**9**	**15**	**35**	**1**
Average	**142**	**93**	**410**	**388**	**121**	**129**	**70**

DISCUSSION

The 2004 comprehensive fisheries survey on Kangaroo Lake characterized the fish populations of the lake. Each gear type was more efficient in capturing certain species of fish than other gear. The use of multiple gears gave a much clearer picture of the fish populations of the lake.

A total of 10,120 fish were collected during the fisheries surveys. The most abundant fish were yellow perch. The most common gamefish were walleye, followed by smallmouth and largemouth bass.

Gamefish

Walleye were the most abundant gamefish captured during surveys in 2004. Although walleye have been the most abundant gamefish captured in surveys since 1980, their abundance has been declining since 1983 (Table 14). 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. Growth (length at age) is at or above statewide averages and is similar through age 8 to results from the 1995 survey (Lychwick 1996). The presence of very old walleye (greater than 20 years of age) shows that walleye are able to survive in the lake although low adult abundance suggests that total annual mortality (natural and angler) is probably high.

Table 14. Summary of fyke net surveys, numbers of fish and fish per net-night (CPE) from Kangaroo Lake 1973-2004. The 1973-1995 data is after Lychwick (1996).

Species	1973	1980	1983	1995	2004
Walleye	193 (2.54)	234 (8.67)	1498 (11.7)	1297 (8.48)	242 (4.7)
Northern Pike	223 (2.93)	14 (0.52)	112 (0.89)	151 (1.0)	38 (0.7)
Smallmouth Bass	2 (0.03)	11 (0.41)	7 (0.05)	25 (0.16)	21 (0.4)
Largemouth Bass	13 (0.17)		1 (0.01)	9 (0.06)	1 (0.02)
Bowfin	10 (0.13)		13 (0.10)	30 (0.20)	37 (0.7)
Rock Bass	220 (2.89)	139 (5.15)	112 (0.88)	1112 (7.27)	33 (0.63)
Bluegill	132 (1.74)	4 (0.15)	10 (0.08)	437 (2.86)	377 (7.3)
Pumpkinseed	8 (0.11)			21 (0.14)	8 (0.15)
Yellow Perch	424 (5.58)		2559 (20.0)	9619 (62.9)	8270 (159.0)
Bullhead sp.			2 (0.02)		24 (0.46)
Gar sp.		2 (0.07)		1 (0.01)	1 (0.02)
White Sucker	172 (2.26)	145 (5.37)	501 (3.91)	1118 (7.31)	213 (4.1)
Longnose Sucker		101 (1.48)	1 (0.01)		1 (.02)
Trout	3 (0.04)	4 (0.15)	3 (0.02)	8 (0.06)	3 (0.06)
Carp			1 (0.01)		

The trends in smallmouth and largemouth populations are not as clear. Fyke net data (CPE) suggest that smallmouth bass populations are increasing (Table 14). The increasing number of smallmouth bass may be linked to the decline in walleye abundance since both complete for food resources and adult fish of one species may prey on the young of the other species. No trend is apparent for largemouth bass from fyke net data. However, results from other survey gears indicate that bass populations are present and producing good numbers of young of the year fish in Kangaroo Lake (Tables 6, 10 and 12). Growth appears to be good for smallmouth bass (Table 3).

Northern pike populations have remained steady since 1980 although much lower than seen in 1973 (Table 14). In 1973 nets were set north of the causeway and likely captured northern pike that were moving towards spawning areas in the adjacent wetland areas. Culverts under the causeway may inhibit movement between the north and south basins of the lake. Improved passage between the basins could improve fish populations in the lake.

Panfish

Panfish populations continue to grow in Kangaroo Lake. Yellow perch dominate the panfish community and are at their highest measured abundance since 1973 (Table 14). Bluegill are also increasing in abundance and had their measured highest CPE in 2004. Growth (length at age) is at statewide averages. Rock bass declined in number since 1995 and had their lowest CPE since 1973.

Other Species

Several other species were captured that are worth noting. Bullhead sp. appears to be increasing in number, but limited data make this trend shaky (Table 14). Bowfin have also increased in number since 1973, but likely are not a problem in the lake.

The gar sp. population has remained steady since 1973 (table 14). The white sucker population has declined since 1995, and is now similar in CPE to those measured in surveys before 1995.

CONCLUSIONS

Fish populations in Kangaroo Lake appear to be in a state of change. Walleye populations are down, while bass and panfish populations are increasing. The 1995 survey by Lychwick (1996) found good evidence of successful walleye reproduction, but he also noted a declining adult population. Lychwick (1996) suggested that low adult numbers could be attributed to poor spawning years or high angler harvest. He also suggested that as walleye number decreased, panfish numbers have increased. The survey in 2004 also found good numbers of juvenile walleye, low adult numbers and increasing panfish populations. While it is possible that 1993 and 2002 were good spawning years and other years produced few walleye causing the low adult abundance, this scenario is unlikely. I suspect that high harvest of fish soon after they reach 381 mm (15 inches - the minimum legal length) is a major cause of low walleye numbers on Kangaroo Lake. Further evidence of this conclusion is the lack of a strong

1993 year class presence in the age sample. While stocking of walleye may improve adult number over the short term, it will not improve the walleye population in the long term and may actually hurt the walleye population of the lake. For that reason and because we do see reproduction occurring, stocking at this time is not recommended. However, since it appears that walleye may not reach spawning age by the time they reach 15", changes in the walleye minimum size and bag limit number should be explored.

Kangaroo Lake is a large shallow lake with a sand-gravel bottom. As a shallow lake it is susceptible to turbid (cloudy) water caused by wind action or by boating activities. This turbidity along with alterations of the natural shoreline can negatively influence fish populations by burying needed habitat, suffocating eggs, or reducing feeding, nursery and predator refuges needed by fish throughout life.

It is clear that since surveys conducted in the 1940's, physical and biological characteristics of the lake have changed. Most of these changes have occurred because the lake has become more developed and has experienced heavier boating use over the past 60 years. Extensive beds of bulrush, pond weed and other plant species are now only present in limited areas south of the causeway, while plant communities north of the causeway are more abundant. The exotic plant species, eurasian water milfoil has also become abundant in the lake. The shoreline in the southern basin has also been altered by placement of rock, concrete and sheet piling. It also appears that boating activity (and speed of the boats) has increased since the 1940's and may negatively impact fish populations in the lake.

These changes in the southern basin have likely affected fish populations in the lake. Fish species that need vegetation for spawning or spawn near vegetation such as northern pike or black crappie have declined in number as plant communities have declined. Forage minnow abundance, survival of young fish or growth of adult fish could also have been negatively influenced by the lack of vegetation. Finally, because plants provide structure for fish, reduced plant abundance has made it more difficult for anglers to find and catch fish.

RECOMMENDATIONS

- DNR Fisheries should investigate if harvest regulation changes for walleye could improve the population in the lake. If regulation changes are needed, DNR and the Lake Association should work together to make the needed changes.

- Encourage the recolonization of aquatic plants by establishing no wake areas or by temporary placement of wave and turbidity barriers to get plants started. **Reestablishment of aquatic plants is necessary to have a healthy stable fish community in the lake.**

- Encourage shoreline residents to reestablish 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.

- Encourage the Lake Association and Town of Baileys Harbor to improve water flow and fish movement under the causeway by replacing the current culverts with larger sized culverts.

- Monitor the movement and abundance of exotics such eurasian water milfoil, zebra mussels or rusty crayfish into Kangaroo Lake. If these species get firmly established in the lake, more changes in the fish community are likely.

- Encourage the Lake Association and its members to protect designated sensitive areas.

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