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TO: Mike Donofrio

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SUBJECT: 218 Shoe Lake, Manitowoc County Spring Electroshocking Survey Report

Shoe Lake is located in the southwestern corner of Manitowoc County, near the village of Kiel (Figure 1). It has a surface area of 9 acres and a maximum depth of 34 feet. The lake is lightly developed with only a single residence along its wood or wetland shoreline. The lake bottom drops quickly in depth which limits the size of the littoral zone (Figure 2). Currently it is managed as a Largemouth Bass and panfish lake, however, in the past it was managed as a two-story lake with Rainbow Trout stockings to provide a unique fishing opportunity.



Figure 1. Shoe Lake is located in the southwest corner of Manitowoc County just to the northeast of Kiel.

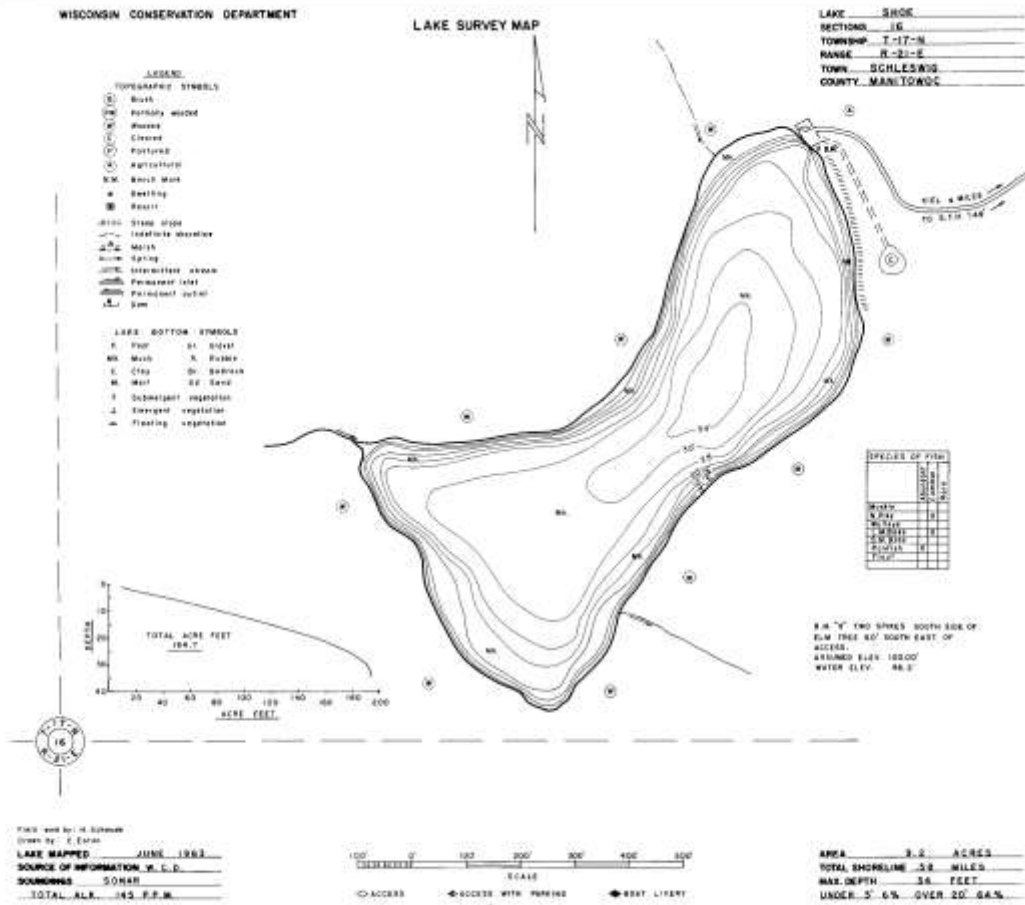


Figure 2. The bottom topography map of Shoe Lake showing the rapid fall-off of the bottom in the northwest and southeast sides of the lake.

The most recent surveys of Shoe Lake were conducted in 1995 and 2007. These electroshocking surveys were performed after dark as general surveys of the lake's fish population. During the evening of November 1, 1995, the entire shoreline of the lake was electroshocked and in 25 minutes of shocking, 201 fish were netted. Largemouth Bass dominated the catch followed by Bluegill. Most bass were small in size and probably were young of the year (YOY). Adult Largemouth Bass numbers were low and could reflect either high angler harvest, or mortality from low dissolved oxygen levels caused by poor water quality.

On evening of May 31, 2007, the entire shoreline of Shoe Lake was electroshocked. During the 22 minutes of shocking, we captured 73 individual fish that represented seven species. Largemouth Bass dominated the catch followed by Bluegill. It should be noted however, thousands of small Bluegill were seen, but not captured during the survey. Other captured species included Northern Pike, Yellow Perch, Black Crappie, Pumpkinseed and Carp. Like the 1995 survey, young fish dominated the catch with few older individual fish captured. Although the overall number and catch rates of fish per mile declined in 2007 compared to the 1995 survey, it appeared that the fish population of Shoe Lake had not changed greatly during 12 years between these two surveys. Poor water quality and limited spawning habitat likely limits some fish species in the lake.

Since the 1970's, water quality in Shoe Lake has been declining. This decline in water quality has resulted in several fish kills that have affected multiple species. In 1987, there was a large die-off of fish that was attributed to a heavy infestation of parasites on internal organs and a high level of bacteria that along with low dissolved oxygen caused the kill. In February 1994, a winter kill occurred when dissolved oxygen levels were less than 4 mg/l throughout the water column. This kill appeared to be of a moderate severity and affected Largemouth Bass and Bluegill. Since 2007, there have been several small fish kills and several other complaints of poor water quality and poor fishing.

During May 2018, Shoe Lake was surveyed as part of baseline monitoring to assess the bass and panfish populations of the lake.

Shoe Lake was electroshocked on the night of May 23, 2018. Water conditions were clear and the water temperature at the time of the survey was 71 F. The entire shoreline (.6 miles) was electroshocked in 25 minutes at water depths that ranged from 1 foot to 12 feet. All fish were netted, identified and measured. Aging structures were removed from Largemouth Bass (dorsal spine), Black Crappie and Bluegill (scales).

A total of 103 individual fish, representing six species were captured during shocking resulting in a total catch per effort (CPE) of 171.7 fish per mile shocked or 257.5 fish per hour shocked (Table 1). The dominant species caught were Black Crappie and Yellow Perch. Other species were captured in lower number.

Table 1. Fish collected during electroshocking from Shoe Lake on May 23, 2018. Catch per Effort (CPE) is measured as the number of fish per mile of shoreline captured or the number of fish per hour shocked.

Species	Number Caught	CPE (Fish/Mile)	CPE (Fish/Hour)	Size Range	Average Length
Largemouth Bass	5	8.3	12.5	161 mm- 406 mm (6.3"-16")	303 mm (11.9")
Black Crappie	51	85	127.5	152 mm-205 mm (6"-8.1")	171 mm (6.7")
Bluegill	14	23.3	35	72 mm-134 mm (2.8"-5.3")	105 mm (4.1")
Yellow Perch	25	41.7	62.5	117 mm- 172 mm (4.6"-6.8")	140 mm (5.5")
Yellow Bullhead	5	8.3	12.5	118 mm-278 mm (4.6"-10.7")	205 mm (8.1")
Golden Shiner	3	5	7.5		
Total	103	171.7	257.5		

Largemouth Bass were the only gamefish captured during shocking. The five Largemouth Bass ranged in length from 161 mm to 406 mm (6.3" to 16") and had average length of 303 mm (11.9") (Tables 1 and 2). Sectioned dorsal spines were aged with ages 1, 2, 5 and 12 represented in our sample (Table 3). All age groups were nearly evenly spread throughout our captured sample. Based on this limited age sample,

growth for Largemouth Bass in Shoe Lakes as measured as average length at age was at or above statewide average growth for Bass.

Table 2. The length distributions of fish captured from Shoe lake during May 2018 electroshocking.

Length (in) mm	Largemouth Bass	Black Crappie	Bluegill	Yellow Perch	Yellow Bullhead
3" 70			1		
80					
90			7		
4" 100			1		
110				2	1
120			3	3	
130			2	9	1
140				6	
6" 150		4		2	
160	1	24		2	
170		13		1	
180		7			
190		2			
8" 200		1			
210					
220					
230					1
240					
10" 250	1				
260					1
270					1
280					
290					
12" 300					
310					
320					
330					
340	1				
14" 350	1				
360					
370					
380					
390					
16" 400	1				
Total	5	51	14	25	5
Ave. Length	303 mm (11.9")	171 mm (6.7")	105 mm (4.1")	(140 mm (5.5"))	205 mm (8.1")
SD	97.0 mm (3.5")	10.8 mm (0.4")	18.9 mm (0.7")	14.2 mm (0.6")	75.2 (3")

Table 3. The age distribution of Largemouth Bass, Black Crappie and Bluegill captured from Shoe Lake.

Species	Age	Number	Average Length
Largemouth Bass	1	1	161 mm (6.3")
	2	1	252 mm (9.9")
	5	2	349 mm (13.7")
	12	1	406 mm (16")
Black Crappie	3	49	170 mm (6.7")
	4	2	197 mm (7.8")
Bluegill	1	9	92 mm (3.6")
	2	5	128 mm (5.0")

Black Crappie were the most common fish that were captured in the survey. The 51 Black Crappie ranged in length from 152 mm to 205 mm (6" to 8.1") and had an average length of 171 mm (6.7") (Table 1). Most Crappie were similar in size and were between 160 mm and 180 mm (6.3" and 7.1") in length (Table 2). Scales were collected from Crappie and aged. Ages 3 and 4 were noted in our sample, with age 3 the dominant year class (Table 3). The average length at age for Black Crappie in Shoe Lake was slightly above statewide average length at age.

Other panfish captured in the survey included Yellow Perch and Bluegill (Table 1). The 25 Yellow Perch that were captured ranged in size from 117 mm to 172 mm (4.6" to 6.8") and had an average length of 140 mm (5.5"). Bluegill ranged in length from 72 mm to 134 mm (2.8" to 5.3") with an average length of 105 mm (4.1"). Scales were collected from the 14 Bluegill that were captured for aging. Age classes 1 and 2 were identified in our sample. Most bluegill were aged as 1 year old (Table 3).

Other fish species captured during shocking included Yellow Bullhead and Golden Shiner (Table 1). The 5 Bullhead ranged in length from 118 mm to 278 mm (4.6" to 10.7") and had an average length of 205 mm (8.1") (Table 2).

This one-night electroshocking survey provided a snapshot of the condition of fish population in Shoe Lake in 2018. When compared to the previous two one-night surveys conducted in the spring of 2007 and the fall of 1995, the trend shows a decline in the total number of fish captured although this trend is species specific (Table 4). Largemouth Bass numbers are down substantially dropping from 138 fish captured in 1995 to 42 in 2007 to 5 captured in 2018. Age analysis shows many missing year classes indicating many years of poor recruitment. Bluegill numbers also show this decreasing trend with only very young fish captured in 2018. Conversely, Black Crappie and Yellow Perch have increased in number during this period. Both species are more tolerant to low dissolved oxygen than are Largemouth Bass and Bluegill. Data collected sporadically through the lake self-help program since 1995, suggests that the lake remains mesotrophic based on secchi depth. Mesotrophic lakes are characterized by moderately clear water, but have an increasing chance of low dissolved oxygen in deep water.

The data further suggests that secchi depth has been mostly impacted by suspended sediments which are tiny particles of soil or organic matter that are suspended in the water. Poor recruitment of Largemouth Bass and other fish may be due to high exploitation of a fishery limited by a small littoral zone or more likely from episodes of poor water quality.

It is recommended to continue to survey Shoe Lake on a ten year cycle although it may be prudent to survey Shoe Lake within the next 5 years to determine if the decline trend of Bass and Bluegill number has continued. Stocking may be required to restore the fish populations of the lake if future surveys show the decline numbers has continued and if water quality improves or is shown not to be the factor limiting the fish community.

Table 4. Shoe Lake electroshocking survey results from 1995, 2007 and 2018.

Species	2018		2007		1995	
	Number Caught	CPE (Fish/Hour)	Number Caught	CPE (Fish/Hour)	Number Caught	CPE (Fish/Hour)
Largemouth Bass	5	12.5	42	105	138	345
Northern Pike			1	2.5		
Black Crappie	51	127.5	4	10	12	30
Bluegill	14	35	20	50	41	102.5
Yellow Perch	25	62.5	3	7.5	7	17.5
Sunfish sp			1	2.5	1	2.5
Yellow Bullhead	5	12.5			1	2.5
Golden Shiner	3	7.5				
Total	103	257.5	71	177.5	200	500