Lake Diane

Hillsdale County (T8-9S, R3W, Sections 34, 3, 4)
Maumee Watershed, Surveyed May 2016

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Environment

Lake Diane is located near the southern edge of Hillsdale County and lies approximately four miles due south of the town of Woodbridge and about 13 miles due south of the City of Hillsdale (Figure 1). This reservoir was created by the construction of a dam on a tributary to Clear Fork Creek. Two natural lakes located on the tributary, Goforth and Hagerman, were inundated when the reservoir was created as part of a real estate venture in 1966. This lake sprawls over approximately 283 surface acres and has not been hydrologically mapped (see aerial photo, Figure 2). Lake Diane is located in the Maumee River watershed and has an outlet to Clear Fork Creek at the dam noted above.

The average lake depth is approximately 8 feet with a maximum depth of 52 feet based on depth readings during fish surveys and topographic information from before the lake's creation. There are two major basins where the inundated lakes were located. The lake water is turbid due to suspended clay sediments; secchi disk readings ranged from 1.5 to 2.5 feet during previous surveys and water quality sampling. A limnology profile including measurements of water temperature, dissolved oxygen, pH (acidity), and specific conductance was conducted on August 9, 2016 (Figure 3). There was a thermocline established from 11-15 feet with sharp declines in dissolved oxygen from 6.8 ppm (parts per million) at 11 feet, down to 4 ppm by 13 feet, and less than 1.0 ppm at 15 feet. Water temperature declined from around 80F at 0-13 feet to 60F by 19 feet and leveled off at about 52F from 22 feet down to the bottom at 28 feet. The pH ranged from 8.3 to 8.0 in the top ten feet of the lake, then dropped steadily to 6.8 by 20 feet. Specific conductivity was constant around 375 uS/cm (micro-Siemens per centimeter) from 0-11 feet then increased steadily to about 500 uS/cm by 20 feet.

Most of the shoreline is developed with permanent homes. The Department of Natural Resources public boat launch and access site (Figure 2) was developed in the early 1980's on tax-reverted property from a failed housing development project. The access site has a concrete boat ramp, dock, rest rooms, and a modest parking area with space for 15-20 vehicles. It is located off of Woodbridge Road about 2 miles south of Camden Road. High speed boating and water skiing are prohibited between the hours of 6:30 p.m. and 10:00 a.m. the following day.

History

The fish population of Lake Diane was first surveyed by MDNR Fisheries Division in 1984. A variety of sport fish were collected including bluegill, largemouth bass, black crappie, brown bullhead, and pumpkinseed sunfish. Non-game species included gizzard shad and common carp. Black crappie dominated the trap net catch and comprised 78% of the total sample by number with most in the 5- and 6-inch size groups. They exhibited poor growth in the younger age groups. Largemouth bass and bluegill were observed growing at or near state average rates and appeared to be in good condition.

In an attempt to provide increased sport fishing opportunity, an average of 2,500 tiger muskellunge fingerlings (a hybrid of northern pike and northern muskellunge) were stocked in Lake Diane each year from 1984 through 1991. It was hoped that these large predatory fish would survive well in Lake Diane because of its similarities to nearby Lake Hudson, which (after stocking) had developed into one of southern Michigan's best muskellunge lakes. Surveys conducted to evaluate the tiger muskellunge stocking program in Lake Diane indicated their survival was very low and relatively few angler reports had been received since their introduction. Muskellunge stocking in Lake Diane ended in 1991 with the statewide cessation of the tiger muskellunge rearing program.

A fisheries survey using only trap nets was conducted in April of 1995 to evaluate the muskellunge population as well as to observe other fish populations (Herman and Tolles 1996). Similar fish species were collected as in the 1984 survey with the addition of tiger muskellunge, white crappie, and channel catfish. White crappie were likely present in the earlier survey, but the two species were not separated and were all recorded as black crappie. Black and white crappie together dominated the catch in the 1995 survey (as in the previous one) comprising over 65% of the total catch by number (approximately equal numbers of each were caught). Growth patterns and size ranges for all species were similar to those observed in the 1984 survey. Panfish were growing at or slightly below state average and size distributions were below average. Only five tiger muskellunge were captured in the 1995 survey with lengths ranging from 28 to 36 inches. Largemouth bass numbers were typical of other lakes in the area and growth was about equal to the state average, similar to the 1984 survey. Channel catfish had been introduced to the lake from unknown sources and 15 individuals were captured ranging from 8 to 23 inches. There is no record of channel catfish being stocked either by the state or private individuals. All appeared to be in good health. Management recommendations from this survey were to stock additional channel catfish, although this activity was never completed by the DNR, and introduce walleye if larger fall fingerlings became available.

Another general survey conducted in May of 2001 collected over 4,600 fish using trap nets and gill nets (Braunscheidel 2003). Panfish, such as black and white crappie, bluegill, green sunfish, pumpkinseed sunfish, warmouth, and yellow perch, comprised almost 90% of the total catch by number and over 50% by weight. Similar to previous surveys, black and white crappie accounted for the major portion of the total catch (67%), and growth rates were poor. Black crappie (1,812 fish) were slightly more abundant than white crappie (1,299 fish). Bluegill made up 22% of the trap net catch by number with an average length of 5.6 inches and 27% exceeding the minimum size acceptable to anglers of 6 inches. Large predators such as bass and catfish comprised a total of 8% of the total catch by number and almost 40% by weight. Largemouth bass were present in similar abundances as previous surveys with average growth again observed. Channel catfish were much more numerous in this survey (363 fish vs. only 15 in 1995) even though there was no record of them being stocked. It appeared the catfish were reproducing naturally in the lake.

As a result of the 2001 survey, a program of regular walleye and northern muskellunge stocking was put into operation (Table 1). From 2002 through 2014 a total of 234,000 spring and fall fingerling walleye were stocked. In addition, from 2003 through 2009 a total of 3,775 fall fingerling northern muskellunge were planted, and in 2013 and 2015 a total of 850 Great Lakes muskellunge fingerlings were stocked in Lake Diane.

Finally, an early spring survey was conducted in April of 2011 to evaluate the success of these walleye and muskellunge stocking programs. This survey was timed to specifically capture these species at a time of the year when they move into the shallows to spawn. A total of 124 northern muskellunge and 34 walleye were captured during the survey. All of the stocked year classes were represented for both walleye and musky indicating survival of the stocked fish was good. The musky ranged from 19 to 41 inches with an average length of 34 inches and just one fish less than 28 inches. Growth averaged 2.7 inches below the state average and was worse for older fish. The walleye ranged from 17 to 28 inches with an average length of almost 24 inches. Walleye growth was good with a mean growth index 3 inches above the state average. Stocking has continued to maintain these fisheries.

Current Status

A general survey was conducted on Lake Diane in the spring of 2016 by the DNR Fisheries Division to evaluate the overall status of the fish community in conjunction with the walleye and muskellunge stocking program. This survey used a variety of sampling gear on May 16-19, 2016, to sample multiple habitats and the entire size range of fish present. The gear used included 2 large-mesh fyke nets and 2 inland trap nets both set for 3 nights, 2 small-mesh fyke nets and 1 gill net each set for 2 nights, and 3 seine hauls. All nets were lifted and fish removed each day for processing. Water temperature at the time of the survey ranged from 58-62 F.

All gear combined caught a total of 510 fish for an estimated total weight of 811 pounds with 15 species represented (Table 2). Large, game fish species including channel catfish, largemouth bass, northern muskellunge, and walleye made up 52% of the total catch by number and 92% by weight. Panfish such as bluegill, black and white crappie, pumpkinseed, and yellow perch accounted for 43% of the total catch by number, but only 6% by weight. Forage species were only a small portion of the catch (4% by number) and included gizzard shad, golden shiner, sand shiner, and spottail shiner.

Channel catfish (221 fish) was the single most abundant species caught in the survey. They accounted for 43% of the total catch by number and 57% by weight (Table 2). Sizes ranged from 11 to 26 inches with an average size of 18 inches (1.9 pounds); more than a third exceeded 20 inches (Table 3). Fish of all ages from age 4 through age 17 were collected during the survey (Table 4). The mean growth index was 3.7 inches below the state average for fish age ten and younger, indicating overall poor growth. State average length-at-age data are not available for catfish older than age ten.

Bluegill was the most abundant panfish species collected in the survey accounting for 24% (121 fish) of the total catch by number (Table 2). Lengths averaged 5 inches and only 3 fish exceeded the minimum size acceptable to anglers of 6 inches (Table 3). Bluegill growth was average, with a growth index 0.1 inches below the state average (Table 4). No bluegill older than age 5 were collected in the survey, but this is similar to earlier surveys. The average length and proportion of the survey catch by number was similar to earlier surveys, but the catch rates (CPE) and percent of the catch by weight were significantly less than previous surveys (Table 5). White crappie was the only other panfish species caught in significant numbers (Table 2). They comprised 17% (89 fish) of the total catch by number and ranged from 6 to 16 inches with an average length of 9 inches (Table 3). Over 75% (67 fish) exceeded the minimum size acceptable to anglers of 7 inches and 21 of these were over 10 inches. Since there is no established state average length-at-age for white crappie, growth was compared to the state averages for black crappie. Using these data, overall growth was evaluated as poor, with a mean

growth index 1.3 inches below the state average for black crappie (Table 4). Other panfish caught included 6 pumpkinseed, 2 black crappie, 2 yellow perch, and 1 hybrid sunfish.

Walleye were also caught in good numbers accounting for 13% (37 fish) of the total catch by number and 26% by weight (Table 2). All but one were over the minimum legal size limit of 15 inches with an overall average length of almost 26 inches (Table 3). There was only one fish younger than age 10 captured. Growth was good for age 10 fish with a mean growth index 2.2 inches above the state average (Table 4). Older walleye (age 11-14) were more abundant, but like the catfish, statewide average length-at-age data are not available for fish older than ten. Walleye were caught from every year of stocking except 2011 and 2014, although only one 4-year old from the 2012 stocking was captured. Walleye less than three years old are typically not collected in our surveys so the walleye stocked in 2014 would not be expected to show up in this survey.

Other large game fish caught in the survey included 4 northern muskellunge (35-40 inches) and 2 largemouth bass (2-19 inches) (Table 2).

A very small number of forage fish were collected in the 2016 survey. These included 17 gizzard shad (7-13 inches) and a single representative each of golden shiner, sand shiner, and spottail shiner. Other miscellaneous species caught included 3 carp and 2 yellow bullhead.

Analysis and Discussion

Some significant changes in the fish community have occurred since the 1995 and 2001 general surveys. The most notable changes are in the crappie population. White and black crappie dominated the fish communities, in approximately equal numbers, in both of these earlier surveys (65-67% of the total catch by number and 33-40% by weight) (Table 5). Both of these species were greatly reduced in number and only a minor component of the fish population found in the 2016 survey (17% by number and 5% by weight). In addition, white crappie were much more abundant than black crappie (89 white crappie vs. only 2 black crappie) (Table 2). There is some compensation for the reduction in crappie numbers in that the size composition of the white crappie population was greatly improved with an average length over 9 inches compared to an average length of just 7 inches in 2001. In addition, a much larger portion of the population exceeded 10 inches (24% in 2016 vs. 2% in 2001) (Figure 4). This matches with reports received in the spring of 2016 that anglers were catching a fair number of keeper sized crappie compared to the multitude of small fish caught in previous years. There have also been some changes in the bluegill population. The percent of the total survey catch by weight and catch rates (CPE) have decreased compared to previous surveys (Table 5). This indicates an overall reduction of bluegill biomass in the fish community compared to earlier surveys. Taken together, these factors show a drastic reduction in overall panfish numbers and biomass in the lake. Panfish collectively accounted for 80-90% of the total survey catches by number and 30-50% of the total catches by weight in 1995 and 2001. In this 2016 survey they comprised just 43% of the total catch by number and only 6% of the total catch by weight.

The relative increase in large predator abundance was another change noted in this latest survey. Predators comprised over 50% of the total catch by number and over 90% of the biomass caught in the survey compared to just 8% of the total survey catch in 2001 and 40% of the biomass. Channel catfish dominated the predator population similar to the 2001 survey, but new to the community was the addition of significant numbers of walleye and several muskellunge due to stocking. The 2011 early

spring survey caught over 120 musky compared to 4 in 2016 due to the warmer water temperatures during the 2016 survey. Thus, the overall predator abundance is likely even higher than was found in this 2016 sampling due to the timing of the survey. This abundant predator population is having a significant effect on the panfish and forage base as shown by the crappie and bluegill population changes noted above and the very few forage fish collected.

Channel catfish have become the most abundant species in Lake Diane and now comprise a large percentage of the fish biomass. Although catfish have never been stocked by the DNR, or permitted to be stocked by private entities, they are now well established with a naturally sustained population. Their consistently successful natural reproduction is shown by the presence of every year class from age 4 through age 17 in this survey. This abundance of an effective predator could lead to negative effects on other game fish species in the lake.

Walleye growth continues to be excellent as shown by the mean growth index more than 2 inches above the state average (Table 4). Survival of the stocked fish has historically been good, but the significance of the lack of fish from the 2011 and 2012 stockings is not yet clear. Netting surveys typically don't catch many walleye less than 3 years old so the lack of 2-year old fish from the 2014 stocking is expected. Occasional poor survival of walleye year classes is not unusual, so it is hard to say if something has affected stockings after 2006 or if the fish from 2011 and 2012 are just typical failed year classes. The large changes in the fish community noted above, and the abundance of predators in the lake, may be factors in the poor showing of these year classes, but it is still too early to be sure at this point. Future surveys will help in evaluating the success of walleye fingerlings stocked after 2006, as well as monitoring the effects of the large predator population in Lake Diane.

Management Direction

The walleye stocking program has been successful and currently supports a fishery for this highly desired game fish. Verbal communications from local anglers show they are actively targeting walleye and making use of this opportunity. Discontinuing walleye stocking could result in the loss of what has become a popular fishery. Walleye stocking should continue to support this popular fishery, but at a low level to avoid overloading the lake with predators. The current management prescription calls for stocking spring fingerling walleye every other year at a rate of 75/acre. Consideration should be given to reducing the stocking frequency and density until predator levels have been reduced. A follow-up early spring survey would be useful in evaluating the survival of the more recent stockings.

Stocking muskellunge has developed a fishable population and a popular fishery for this large game fish. Local anglers have reported there are regularly several boats at the same time on the lake targeting musky. A 2015 creel survey on the other musky lake in the area (Lake Hudson in Lenawee County) estimated over 18,500 angler hours with 17% of the anglers targeting musky. Lakes with fishable numbers of muskellunge are in short supply in the area and this opportunity should be maintained through continued stocking, but again at low levels to avoid over-stocking. An early spring survey in the next few years, similar to what was done in 2011, would be helpful in further evaluating the population of this large predator.

Monitoring of the panfish populations and overall fish community balance should continue at regular intervals due to the high predator levels in Lake Diane. A follow-up survey using electrofishing might give a more complete picture of the fish community and small fish forage base. Efforts to publicize

the channel catfish opportunity are needed to increase the harvest of this species and hopefully exert some control on their numbers in the lake. This lake could also be presented as a source for relocating adult catfish if management needs arise elsewhere.

References

Braunscheidel, Jeffrey J. 2003. Lake Diane Status of the Fishery Resource, Report No. 2003-4. Michigan Department of Natural Resources, Fisheries Division.

Herman, M.P. and Tolles, B. 1996. Report of 1995 Fisheries Survey on Lake Diane, Hillsdale County. Michigan Department of Natural Resources, Fisheries Division Lake File, Livonia.

Figure 1. Map showing location of Lake Diane in Hillsdale County, Michigan.

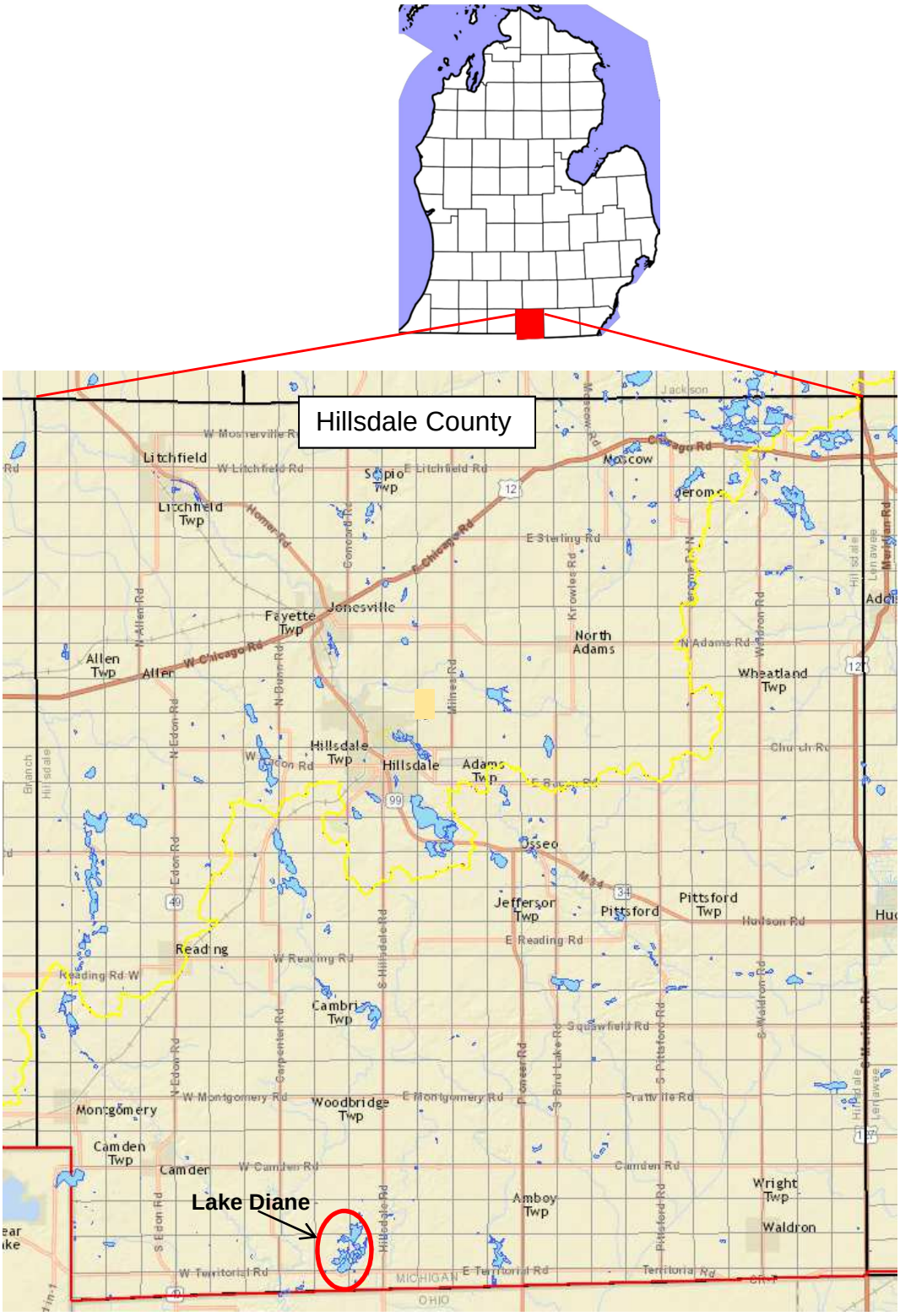


Figure 2. Aerial view of Lake Diane showing sampling locations for 2016 fish survey.

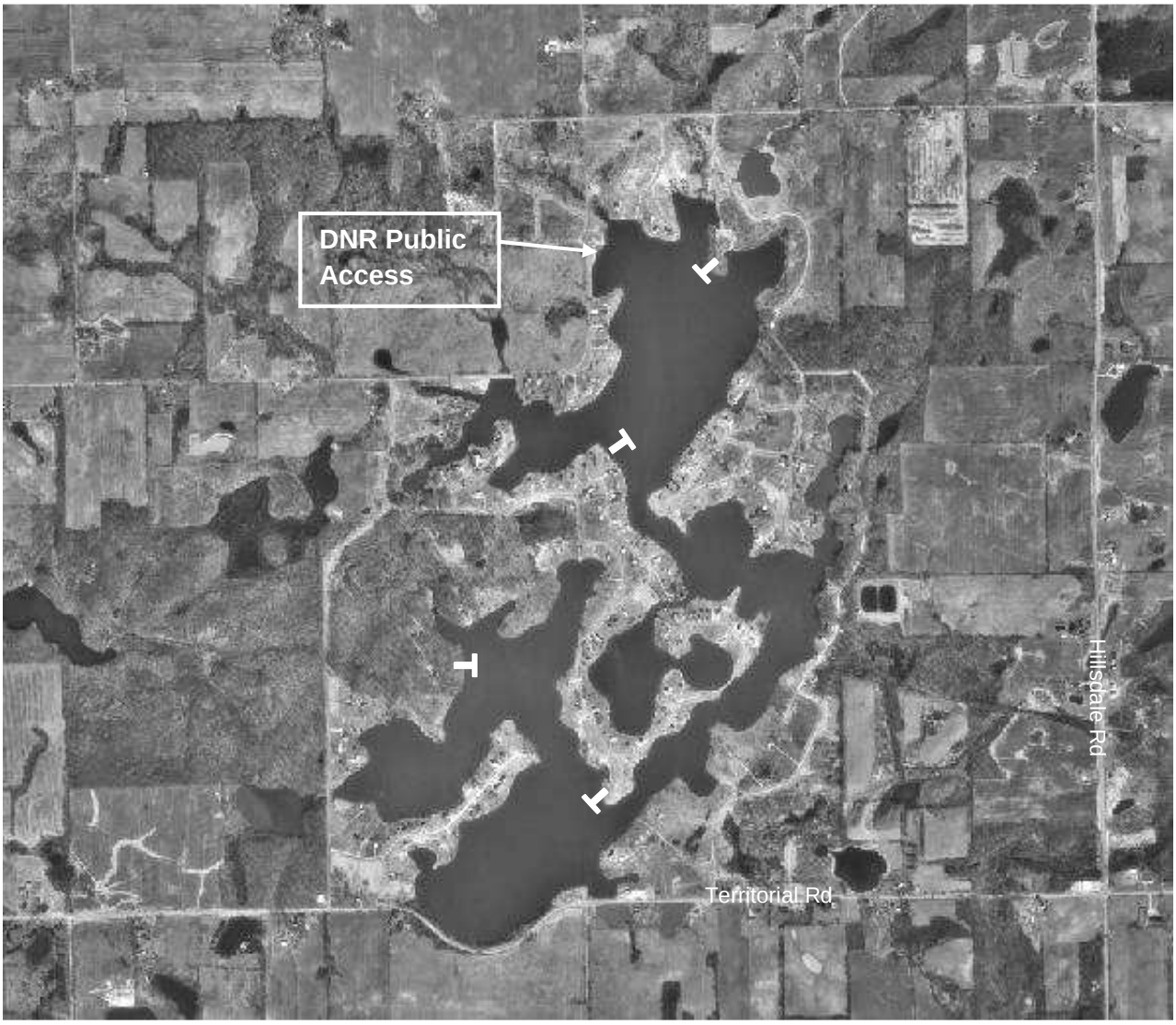
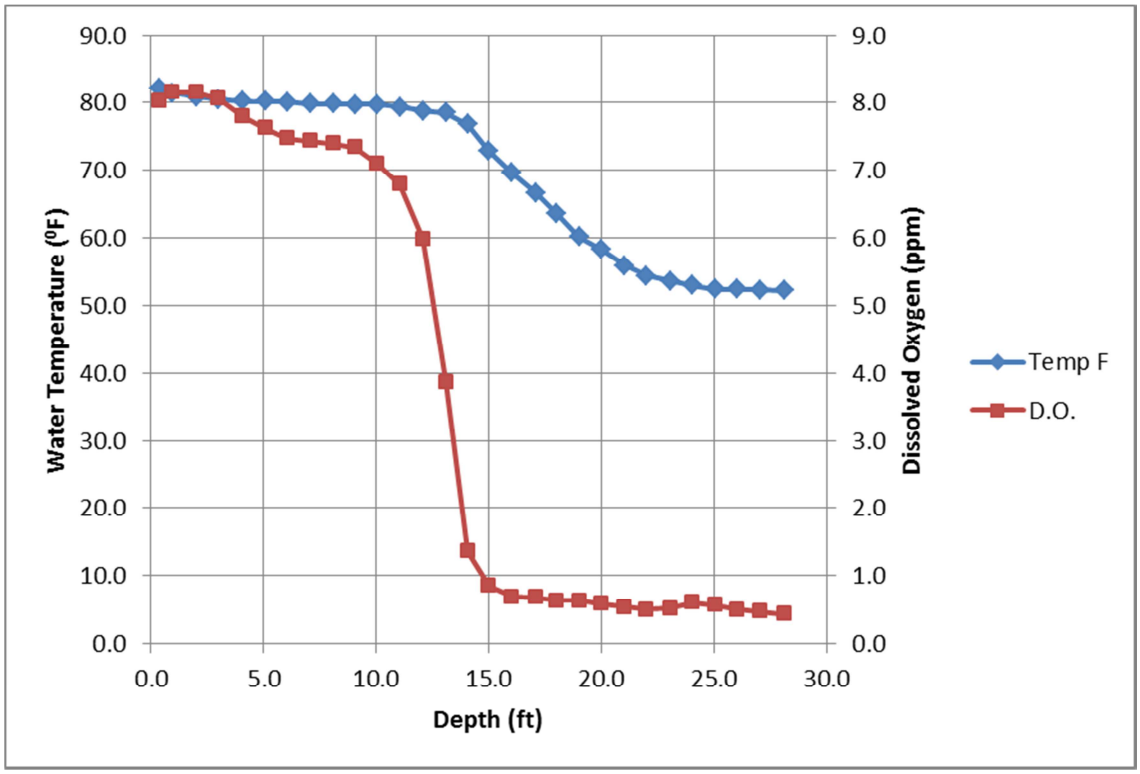


Figure 3. Limnological profiles of Lake Diane, August 9, 2016.



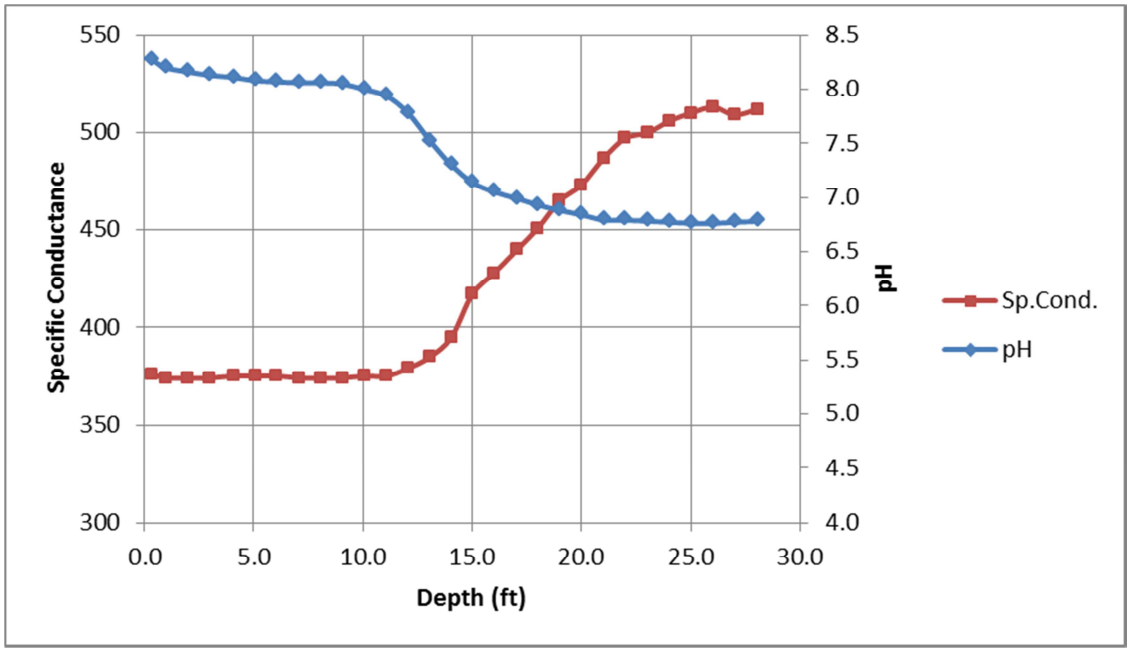


Figure 4. White crappie size distribution as percent of total white crappie catch for 2001 and 2016 Lake Diane fish surveys.

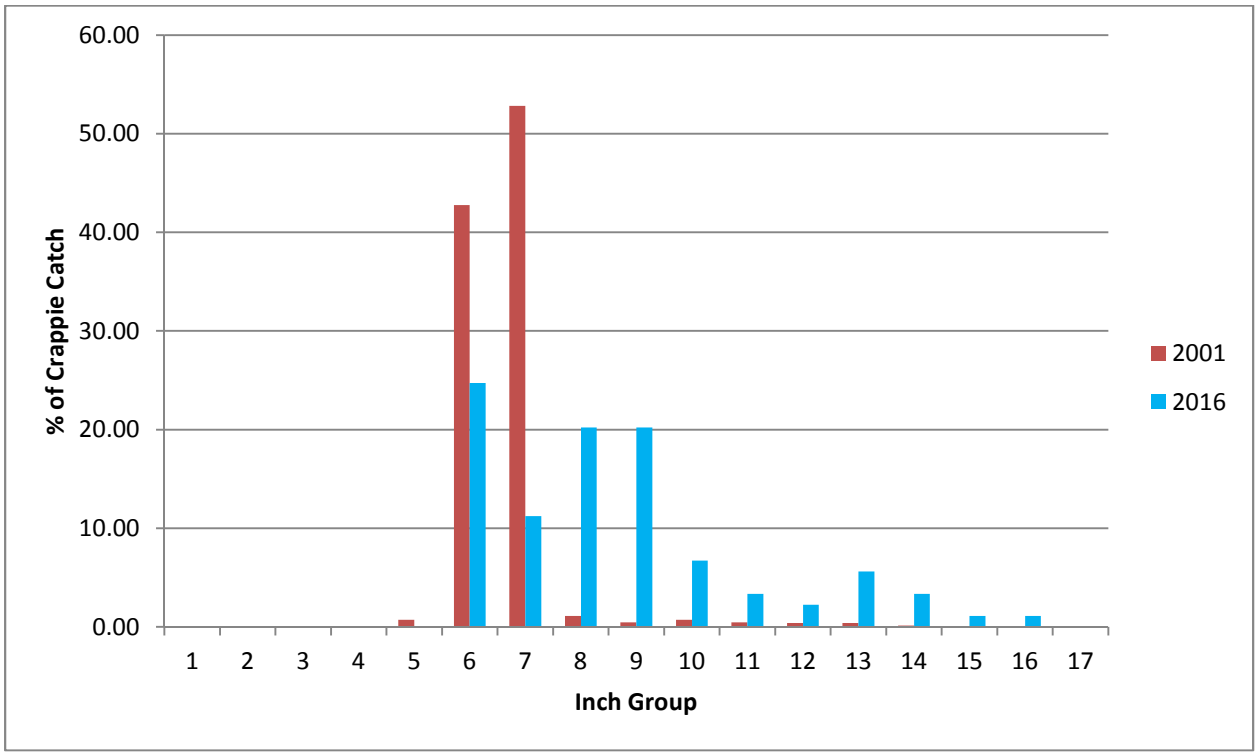


Table 1. Lake Diane 2002-2015 Stocking Summary (sf=spring fingerlings, ff=fall fingerlings).

Species	2002	2003	2004	2005	2006	2007	2009	2011	2012	2013	2014	2015
Walleye-sf	39,228		40,573		52,545			35,807			28,317	
Walleye-ff		33,501							4,241			
Muskellunge		372	1,000	1,000		850	553			425		425

Table 2. Catch and relative abundance of fishes collected with all gear types combined during the Lake Diane fisheries survey, May 16-19, 2016.

Species	Number	Percent by number	Total Weight (lb.)	Percent by weight	Length range (in)	Average length (in)	Percent legal size*
Channel catfish	221	43	465	57	11-26	18	99
Bluegill	121	24	10.3	1.3	1-6	4.9	2.5
White crappie	89	17	38	4.7	6-16	9.1	75
Walleye	37	7	214	26	14-28	26	97
Gizzard shad	17	3	6.8	1	7-13	10	--
Pumpkinseed	6	1	0.3	0	3-4	4	0
Northern muskellunge	4	1	60	7	35-40	38	0
Common carp	3	1	7.2	1	12-19	16	--
Black crappie	2	0.4	3.1	0.4	11-15	13	100
Largemouth bass	2	0.4	4	0.5	2-19	11	50
Yellow perch	2	0.4	0.1	0	5-5	5.5	0
Yellow bullhead	2	0.4	1.1	0.1	10-10	10.5	100
Golden shiner	1	0.2	0	0		3.5	--
Hybrid sunfish	1	0.2	0.1	0		5.5	0
Sand shiner	1	0.2	0	0		1.5	--
Spottail shiner	1	0.2	0	0		2.5	--
Totals	**510**		**811**				

* For game fish species without a minimum size limit this is the minimum size generally acceptable to anglers.

Table 3. Number of fish per inch group for selected species collected with all gear types combined during the 2016 Lake Diane fish survey.

Inch group	Bluegill	White crappie	Channel catfish	Walleye
0				
1	3			
2	2			
3	4			
4	48			
5	61			
6	3	22		
7		10		
8		18		
9		18		
10		6		
11		3	3	
12		2	13	
13		5	24	
14		3	16	1
15		1	16	
16		1	13	
17			15	
18			17	
19			24	
20			21	
21			26	2
22			15	3
23			10	2
24			2	3
25			4	4
26			2	7
27				9
28				6
29				
30				
Total	**121**	**89**	**221**	**37**

Table 4. Average length and age composition of selected game fish species collected in Lake Diane, May 16-19, 2016.

Species	Age	No. aged	Length range (in.)	State avg. length (in.)	Average length (in.)	Mean growth index*
Bluegill						-0.1
	I	5	1.9-3.8	1.8	2.4	
	II	1	4.1	3.8	4.1	
	III	6	4.4-4.9	5.0	4.6	
	IV	9	4.7-6.0	5.9	5.7	
	V	3	5.6-5.8	6.7	5.7	
White crappie				**		-1.3**
	III	4	6.3-6.4	7.5	6.3	
	IV	5	6.0-6.5	8.6	6.2	
	V	9	6.4-10.0	9.4	7.7	
	VI	5	6.5-10.0	10.2	8.0	
	VII	16	6.6-15.5	10.8	9.6	
	VIII	17	6.6-14.7	11.4	10.6	
	IX	7	6.9-16.2	11.9	11.0	
Channel catfish						-3.7
	IV	2	11.6-13.1	15.8	12.4	
	V	13	11.0-15.1	17.7	13.4	
	VI	9	13.5-16.9	19.3	15.4	
	VII	4	14.7-17.5	20.6	16.6	
	VIII	6	16.9-23.4	22.0	20.0	
	IX	2	18.5-19.9	23.2	19.2	
	X	8	17.4-23.6	23.8	20.0	
	XI	2	15.4-22.5		19.0	
	XII	5	19.5-25.5		22.4	
	XIII	1	20.7		20.7	
	XIV	8	18.7-26.5		23.1	
	XV	3	19.7-24.4		22.2	
	XVI	1	22.9		22.9	
	XVII	1	25.4		25.4	
Walleye						+2.2
	IV	1	14.7	15.8	14.7	
	X	10	21.5-28.1	23.1	25.3	
	XI	4	21.4-25.5		22.9	
	XII	14	24.1-28.9		27.0	
	XIII	4	25.1-28.2		26.5	
	XIV	2	23.4-26.7		25.0	

* Mean growth index is the average deviation from the state average length at age.

** Based on black crappie state average length at age.

Table 5. Comparison of selected species abundance summaries from netting surveys on Lake Diane, Hillsdale County, 1984-2016. Catch-per-unit effort (CPE) based on trap net or combined trap and large-mesh fyke net catches as noted by *.

Species	1984				1995				2001				2016			
	%No	%Wt	AvgL (in)	CPE*	%No	%Wt	AvgL (in)	CPE**	%No	%Wt	AvgL (in)	CPE**	%No	%Wt	AvgL (in)	CPE*
Bluegill	14	12	5.4	116.8	17	4	5.8	18.3	21	11	5.6	61.8	24	1.3	5.3	5.8
Black Crappie	39	33	5.9	332	32	12	7.1	52.8	39	23	6.5	109.7	0.4	0.4	13	0.2
White Crappie	39	33	5.9	332	33	11	7.2	54.5	28	18	7.2	78.9	17	4.7	9.1	7.0
Channel Catfish	0	0	--	--	2	5	14.5	2.5	8	36	15.0	21.8	43	57	18	17.2
Walleye	0	0	--	--	0	0	--	--	0	0	--	--	7	26	26	3.1

* CPE based on combined trap and fyke net catches.

** CPE based on trap net catches only.