

Original: Fish Division ✓
cc: Education - Game
Institute for Fisheries
Research
N. V. Olds
Water Resources
Commission
R. S. Marks
C. M. Taube

Consulted copy

October 7, 1949

Report No. 1236

A STUDY OF THE KALAMAZOO RIVER TO DETERMINE THE EXTENT OF
FISH AND FISH FOOD RECOVERY TWO YEARS AFTER A MORTALITY
CAUSED BY CYANIDE POLLUTION ON SEPTEMBER 15, 1947, AT
BATTLE CREEK

By Clarence M. Taube

A study of the Kalamazoo River between the cities of Battle Creek and Kalamazoo was made on September 21 and 22, 1949. The purpose of this investigation was to determine the types and relative numbers of fish and fish food organisms present two years after occurrence of extensive mortality resulting from cyanide poisoning. A similar check of this part of the stream was run on September 24 and 25, 1947. Both investigations were made by personnel from the Institute for Fisheries Research with the aid of electric shocking machines.

The cause for the mortality of 1947 and the findings of the investigation made several days afterwards are related in Report No. 1133 of the Institute for Fisheries Research. The group making the re-check in 1949 consisted of Virgil S. Pratt, Kenneth E. Christensen, and Clarence M. Taube. The writer also took part in the investigation of 1947.

The electric shocking equipment used September 21 and 22, 1949, consisted of a 110- 120-volt, 4.2-amp., 500-watt Universal A.C. generator driven by a Universal gasoline engine. A 50-foot insulated wire cable connected the generator with the two electrodes. The engine and generator were carried in a boat.

The shocking equipment used over the same ground in 1947 consisted of a 115-volt, 5.2 amp., 600-watt Katolight A.C. generator driven by a Briggs and Stratton gasoline engine. A 100-foot insulated wire cable, equipped with floats, joined the generator with the electrodes. The engine and generator were carried in a boat.

The shocking equipment used on the two occasions are virtually equal in effectiveness, although the outfit used in 1947 may be somewhat more efficient under certain conditions. In water having properties favoring especially high conductivity the machine employed in 1947 would carry greater shocking power than the machine used in 1949 when the electrodes are held only a short distance apart (less than four feet). Loss of such efficiency would be indicated by a noticeable slowing down of the engine. This effect was not observed during either investigation. The electrodes were kept mostly at least eight feet apart. A test for conductivity made on September 22, 1949 showed that Kalamazoo River water is not extremely conductive to electric current yet is conductive enough for the results desired from a fish shocking machine.

The following data relating to electrical conductivity were obtained by Virgil S. Pratt from water at Station No. 6 on September 22, 1949:

Phenolphthalein alkalinity.....	17.2 ppm
Methyl orange alkalinity.....	207.5 ppm
pH.....	8.3
Resistivity (at 15.5° Centigrade).....	2378 ohms (corrected)
Correction factor=0.955	

During both checks on the Kalamazoo River the electrodes for the most part were held from eight to fifteen feet apart while in operation; occasionally they were brought closer together to inactivate individual fish not sufficiently shocked. Two men each held an electrode and a dip net

while walking slowly along, and the third man followed slightly behind the electrode-bearers, also carrying a dip net and towing the boat.

During the operation of 1947, nearly all of the comparatively few fish turned up by the shocking machine and observed were collected. In 1949, considerable numbers of specimens affected by the electric current were not collected since frequently so many individuals of a school of fish turned up at once that all of them could not be netted before floating out of sight into roiled water. Nevertheless, there is every reason for believing that good samples were obtained of most of the species now inhabiting the tested section of the stream.

Most of the fish collected were small. In a given habitat young fish almost invariably greatly outnumber adults, and it is logical to expect this to hold particularly true in this area where such an extensive killing occurred only two years before. A few fish of mature size were collected but several others were seen escaping after feeling the electric current.

The fish collections were preserved in formalin and later in the laboratory the specimens were individually examined and identified.

Station No. 1 is located in Calhoun County; all the other stations are in Kalamazoo County.

Following is a summary by station of the findings made in 1949, together with resumes of the results of 1947. The fish collected in 1949 are listed in Table 1.

Station No. 1

Date: September 21, 1949.

Location: T. 1 S., R. 8 W., Section 34, Bedford Township. Near western edge of Battle Creek, near east end of River Road and at the mouth of the

outlet from Hart Lake.

Temperatures: (12:20 P.M., E.S.T.) air, 66° F.; water, 60° F.

Results: Shocking was done through about a 200-foot stretch of water out from the right bank (facing upstream). This area extends from below the mouth of the outlet from Hart Lake, opposite the mouth, to a short distance above. As in 1947, one sweep was made with the electrodes near bank and another over the same length near mid-stream. The depths ranged from a few inches near bank to about four feet. During one-half hour of shocking, a total of 34 fish, representing 14 different species, was collected. A bottom sample and vegetation revealed such fish food organisms as midge and moth larvae and oligochaetes.

At this station in 1947 only two fish were collected, a common shiner and a white sucker. Factors which would lead to an explanation of the increase in numbers of fish here since September 24, 1947 are not apparent. However, previous localized mortality from other sources of pollution seems a possibility, for evidently not all pollutants of the Battle Creek area first pass through the sewage treatment plant located below this part of the Kalamazoo River.

Station No. 2

Date: September 21, 1949

Location: T. 1 S., R. 9 W., Section 26, Ross Township. Below the mouth of a small tributary stream entering from the north, our entry to the station being made via the Roy H. Kendall farm off Augusta Drive.

Temperatures: (5:00 P.M.) air, 61° F.; water, 63° F.

(Note - Temperatures at this station on September 24, 1947, at 5:00 P.M. were: air, 57° F.; water, 60° F.)

Results: The shocker was operated over a stretch of about 500 feet out from the left bank (facing upstream), beginning at a stone pile on the bank and continuing upstream. Two sweeps were made over this distance, one near shore and the other from about 15 to 20 feet out. The depth ranged from about six inches to four feet. An hour and 20 minutes was spent shocking at this location. The catch consisted of 270 fish which represented five species. Midge larvae, stone fly nymphs, and oligochaetes were found in the bottom fauna; crayfish were common in occurrence.

On the 1947 check at this station only two suckers and one golden shiner were obtained during two hours of shocking. No aquatic insects, crayfish, or other invertebrates were noted here at that time.

Station No. 3

Date: September 22, 1949.

Location: T. 2 S., R. 9 W., Section 3, Charleston Township. Out from the south bank of the river, opposite the entrance of Augusta Creek.

Temperatures: (3:30 P.M.) air, 60° F., water, 60° F.

Results: Operations at this station were confined to a stretch about 1,000 feet long out from the right bank, beginning about 800 feet downstream from the location opposite the mouth of Augusta Creek. Depths ranged from a few inches near shore to about four feet. Forty minutes were spent working on this section and 131 fish, representing 14 species, were collected. Numerous crayfish also were turned up by the shocker.

During two hours of continuous shocking at Station No. 3 on September 25, 1947, no living fish, insects, or crayfish were seen. About 25 dead carp and suckers were observed in this area at that time.

Date: September 22, 1949.

Location: T. 2 S., R. 9 W., Section 19, Charleston Township. At the US-12 bridge, just east of Galesburg.

Temperatures: (3:00 P.M.) air, 58° F.; water, 60° F.

Results: Checking at Station No. 4 involved a 100-foot stretch along the left bank, beginning downstream from the bridge, and ending at a drift pile on the immediate upstream side of the bridge. Shocking was done in water from the bank to about four feet. In the 1949 check two sweeps were made over the 100-foot distance in 20 minutes, whereas in 1947 only one sweep was made, but 30 minutes were spent working on the area. The collection of 1949 was composed of 37 fish of seven different species. Crayfish were noted as being common in abundance.

On September 25, 1947, no living fish, aquatic insects, or crayfish were found at this location, although about 12 dead carp and suckers were seen.

Station No. 5

Date: September 22, 1949.

Location: T. 2 S., R. 9 W., Section 19, Charleston Township. At the southern border of Galesburg and the first bridge downstream from the US-12 bridge.

Temperatures: (12:30 P.M.) air, 59° F., water, 60° F.

Results: Investigation here was carried on over a 1,000-foot stretch parallel to the left bank, beginning just downstream from the road bridge and continuing upstream. Two sweeps were made with the shocking machine, one near the bank and the other from 15 to 20 feet out from the bank. Over a period of one and one-quarter hours, 315 fish were taken. The collection

was composed of 22 species. Crayfish were abundant, as were midge larvae. Also present were caddis fly larvae and damsel fly nymphs.

Two and one-half hours were spent shocking at this station on September 25, 1947. Nine fish were taken, consisting of six green sunfish and one specimen each of pumpkinseed, yellow bullhead, and carp. Several live crayfish were observed. Whirligig beetles also were seen here at that time, but no other aquatic insects.

Station No. 6

Date: September 22, 1949.

Location: T. 2 S., R. 10 W., Section 21, Comstock Township. On north side of Consumers Power Co. reservoir, near dam.

Temperatures: (10:00 A.M.) air, 61° F.; water 60° F.

Results: Shocking was done for a distance of about 200 feet and depths ranging from a few inches to three and one-half feet were examined. In 15 minutes of shocking, 47 fish of six species were collected. Crayfish were abundant.

In 1947, when 30 minutes were spent here, 26 fish of five species were found. Crayfish and insects were noted as abundant.

Station No. 7

Date: September 22, 1949.

Location: T. 2 S., R. 10 W., Section 20, Comstock Township. At the first bridge downstream from the Consumers Power Co. dam.

Temperatures: (9:00 A.M.) air, 58° F.; water, 64° F.

Results: Approximately 200 feet of stream was shocked, commencing at the downstream side of the bridge and continuing upstream out from the left bank. Shocking was practiced for 40 minutes in depths up to three and one-half feet. The fish catch was 152 specimens and nine species. Crayfish were abundant. Numerous damsel flies were seen.

A half hour of shocking here in 1947 produced 27 fish of seven species.

Conclusions

Comparison of results of the investigation made on the Kalamazoo River on September 21 and 22, 1949, with those of the similar investigation of September 24, and 25, 1947, further emphasizes the sterilized condition of the affected part of the stream following its pollution by cyanide. Whereas only 67 fish were collected at seven stations in 1947, a total of 986 were taken in 1949 with almost identical equipment and methods.

Comparison of the numbers of fish per unit of area in 1947 and in 1949 reveals the extent of the kill from another viewpoint. Considered in this comparison is that stretch of the Kalamazoo River from the outlet of the Battle Creek sewage disposal plant to the western limit of Galesburg, including test Stations No. 2 through No. 5. This section which apparently was much affected by the cyanide, is about 12 miles long. The average width of the river between Battle Creek and Galesburg is estimated to be 125 feet.

A calculated area of about 47,150 square feet was examined with the fish shocking machine at these four stations combined (Station No. 2 through Station No. 5), in 1947 and again in 1949. A total of 12 fish was collected over that area during the examination in 1947, and 753 fish in 1949. The calculated numbers of fish in the shocking area as shown by the collections are 11.1 fish per acre in 1947 and 697 per acre in 1949.

Continuing further, the surface area of the 12 miles of stream has been estimated as about 182 acres. By using foregoing figures on collected fish and area, the populations within this section at the times of examination in September, 1947, and in September, 1949, are calculated as having numbered 2,184 fish and 126,854 fish, respectively.

Certain points should be kept in mind regarding these population figures.

First, the figures obviously are approximations. Areas given are based on estimates more than on definite measurements. Yet care was taken in making these estimates and they were similarly applied to the fish collection data of the two examinations. Also, the deeper parts of the stream were not worked with the shocker, so the fish composition of those locations is not known. However, the maximum depth of four feet covered in these examinations is believed to somewhat exceed the average normal depth of the river in this section, and since collecting was done over a sizable area of four-foot water, the fish fauna of the greater depths probably did not introduce a large factor of discrepancy in so far as numbers are concerned.

Second, as was pointed out earlier, numerous fish turned up by the shocker on September 21 and 22, 1949, were not collected because of extensive fish abundance. Probably not more than half of the fish seen on those days were captured, whereas the extent of capture of observed fish on September 24 and 25, 1947, because of fish scarcity, was nearly complete. Hence the population figure for 1949 is considered definitely conservative, and there is sufficient reason for believing that the disparity in size of the populations revealed by the two examinations was much greater than that shown by the figures.

Third, although the full value of disparity evidently is not expressed by these figures (11.1 fish per acre as against 697 fish per acre), even the apparent disparity they express is very significant. An estimate based on these figures gives a minimum loss of 124,670 fish by poisoning in September, 1947. The importance of this loss is emphasized further by the considerable size of many of the fish that were killed.

Fish food organisms were either scarce or entirely lacking at most stations during the first examination (1947); these organisms ranged from common to numerous when the later examination was made (1949).

Evidence now indicates that the lethal effect of the cyanide may have been even more far-reaching than was at first supposed. The considerably greater numbers of fish taken and seen in 1949 than in 1947 at Stations 6 and 7 would suggest that some killing may also have occurred in the Consumers Power Co. impoundment and below.

The later investigation showed that natural reproduction is adequately re-stocking the Kalamazoo River where two years ago it was rather barren of fish life and fish food organisms. While this section of the stream received a planting of 20,000 fingerling smallmouth black bass in 1948, wild fish migrating from tributaries and portions of the river unaffected by the cyanide doubtless have been mainly responsible for the start of recovery. Even so, it probably will yet be some time before good fishing can be expected in the section of the Kalamazoo River which suffered the heavy mortality in 1947.

INSTITUTE FOR FISHERIES RESEARCH

Clarence M. Taube

Report approved by G. P. Cooper

Report typed by B. J. Bair

TABLE 1

FISHES COLLECTED FROM THE KALAMAZOO RIVER ON SEPTEMBER 21 AND 22, 1949

Species	Numbers of Fish by Station							Total	Size Range Total Length, Inches
	Station No. 1	Station No. 2	Station No. 3	Station No. 4	Station No. 5	Station No. 6	Station No. 7		
Lamprey, <u>Ichthyomyzon castaneus</u> (?)	1							1	5.7
Chubsucker, <u>Erismyzon sucetta kernerlii</u> *				1				1	4.6
Common white sucker, <u>Catostomus c. commersonii</u>	14	244	15		18			291	1.9 - 14.3
Golden redhorse, <u>Moxostoma erythrurum</u> *		17	37		2			56	1.6 - 3.9
Bluntnose minnow, <u>Hyberhynchus notatus</u>	1		10		27			38	1.3 - 2.8
Carp, <u>Cyprinus carpio</u>	1	4			4			9	3.9 - 20.0
Creek chub, <u>Semotilus a. atromaculatus</u>	1	2	13		14			30	1.9 - 6.0
Hornyhead chub, <u>Nocomis biguttatus</u>			2		1			3	2.9 - 3.4
Blacknose dace, <u>Rhinichthys atratulus meleagris</u>	1		4		1			6	1.7 - 3.3
Common shiner, <u>Notropis cornutus</u>	2				18			20	2.5 - 5.3
Golden shiner, <u>Notemigonus crysoleucas auratus</u>					1			1	2.7
Stoneroller, <u>Campostoma anomalum pullum</u>					8			8	1.9 - 5.1
Yellow bullhead, <u>Ameiurus n. natalis</u>			1		10		1	12	2.3 - 9.5
Madtom, <u>Schilbeodes mollis</u>			2					2	1.6 - 3.6
Stonecat, <u>Noturus flavus</u>					1			1	4.8
Mudminnow, <u>Umbra limi</u>	1							1	2.1
Mud pickerel, <u>Esox vermiculatus</u>	1		1				1	3	4.4 - 9.7
Blackside darter, <u>Hadropterus maculatus</u>	4				12			16	2.3 - 3.5
Johnny darter, <u>Boleosoma nigrum</u>	1				1		1	3	1.8 - 2.6
Yellow perch, <u>Perca flavescens</u>			1		3			4	3.4 - 3.7
Largemouth bass, <u>Micropterus salmoides</u>			2	1	1	1	1	6	3.1 - 6.0
Smallmouth bass, <u>Micropterus d. dolomieu</u>			5		5	17	3	30	2.9 - 5.7
Rock bass, <u>Ambloplites r. rupestris</u>	1			1	8	1	1	12	1.4 - 6.1
Warmouth bass, <u>Chaenobryttus coronarius</u>				1				1	2.0
Bluegill, <u>Lepomis m. macrochirus</u>			10	3		8	9	30	1.6 - 3.2
Black crappie, <u>Pomoxis nigro-maculatus</u>					17			17	3.4 - 4.3
Pumpkinseed, <u>Lepomis gibbosus</u>	4	3	28	18	103	18	88	262	1.6 - 4.8
Green sunfish, <u>Lepomis cyanellus</u>	1			12	59	2	47	121	1.3 - 5.3
Longear sunfish, <u>Lepomis megalotis</u>					1			1	3.1
TOTAL	34	270	131	37	315	47	152	986	

* Identifications verified by Dr. R. M. Bailey, Curator of Fishes, University of Michigan Museum of Zoology.