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MICHIGAN DEPARTMENT OF NATURAL RESOURCES

Fisheries Division

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INVENTORY OF FISH AND EVALUATION OF WATER QUALITY DURING MINIMUM FLOW PERIOD IN THE ST. JOSEPH RIVER

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SUMMARY

During July and August, 1972, water quality and fisheries studies were conducted on the St. Joseph River from its headwaters to the mouth. A total of 52 stations were surveyed in the mainstream: 44 in Michigan and 8 in Indiana. Electro-fishing gear was used to sample the fish population at all the stations. In addition, nets were used at 36 stations. Dissolved oxygen, pH, hardness, temperature, and turbidity values of water were also recorded.

The survey results were as follows:

1. Numbers of game fish collected at each station ranged from one at station #13 (Union City) to 188 at station #38 (Mishawaka Impoundment). The weight of game fish varied from 0.1 lbs. at station #3 (Moore Rd., Hillsdale) to 36.4 lbs. at station #24 (Three Rivers Impoundment). A total of 4,782 fish were captured of which 2,694 were game fish and 2,088 were non-game fish.

2. Numbers of non-game fish collected per station ranged from 3 at station #9 (Hadley Rd., Litchfield) to 166 at station #48 (Berrien Springs Impoundment). Weights of non-game fish varied from 2.4 lbs. at station #12 (10-1/2 Mile Rd., Union City) to 185.5 lbs. at station #37 (Mishawaka Impoundment).

3. A total of 2,153 fish were weighed, of which 1,228 were game fish and 925 non-game fish. The weight of the game fish totaled 309.5 lbs. and the non-game fish totaled 1,456.6 lbs.

4. Of the 2,694 game fish collected, 739 were black crappies and 729 bluegills.

5. Of the 2,088 non-game fish captured, 695 were carp and 656 were redhorse.

6. The two lowest dissolved oxygen values found on the survey were 4.5 and 5.5 ppm. These concentrations were recorded below the Hillsdale and South Bend Waste Water Treatment Plants.

7. Turbidity in the river was heavy in the sections from Three Rivers to South Bend and Buchanan to Benton Harbor. Relatively moderate turbidity was found in the river from Union City to Three Rivers and South Bend to Buchanan. Waters were clear from Baw Beese Lake to Union City.

8. Carp and redhorse averaged 2.3 fish per station in the section that was clear of turbidity. Carp and redhorse averaged 16.0 fish per station in the sections moderate in turbidity and 25.9 fish per station in the sections heavy in turbidity.

9. Results of the PCB's and pesticide analyses revealed concentrations in all samples below the tolerance limit established by the Food and Drug Administration (FDA) for fish for human consumption. Four fish sampled did reveal mercury concentrations exceeding the tolerance limit established by the FDA.

10. Quality water is lacking in some respects in the headwaters, especially compared to headwater areas of most other southern Michigan streams. Impoundments and siltation have degraded the quality of the waters. Also the waste assimilating capabilities of the stream are taxed in the headwaters mainly due to low flow.

11. A good number of catchable-sized game fish were collected throughout the mainstream. The overall water quality of the river compared to other major southern Michigan streams surveyed was very good. Gravel and rubble bottom was prevalent throughout a majority of the mainstream.

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PART A: FISHERIES REPORTS I & II

INTRODUCTION

A survey was made of the fish population and water quality in the St. Joseph River during the seasonal minimal flow period of July and August, 1972, by personnel of the Fisheries Division of The Michigan Department of Natural Resources. In addition to the fisheries resource of the river, other biological and water quality considerations which directly influence the river were also considered. The primary purpose of this report is to provide current information on the fish population and fishery habitat within the river mainstream.

The survey included the entire river, from the headwaters in Hillsdale County, Michigan, through northwestern Indiana, to the mouth of the river at Benton Harbor on Lake Michigan. Tributaries to the mainstream were not surveyed.

A concurring survey by the Water Quality Control Division of the Bureau of Water Management analyzed in detail the water quality of the river. These results will be presented in a separate report but fish were captured and preserved during the fisheries survey for pesticides and toxic materials sampling. These fish were analyzed also by the Water Quality Control Division and the results are detailed in Part B of this report.

BASIN DESCRIPTION

The St. Joseph River and its tributaries drain approximately 2,600 square miles of southwestern Michigan and 1,685 miles of northwestern Indiana. The river rises in Baw Beese Lake in northern Hillsdale County. From its source it flows in a large arc north (the northbend) through the Michigan counties of Hillsdale, Calhoun, Branch and St. Joseph. (See map #1.) Crossing the state line into Indiana, the river cuts a southerly arc (the southbend) through Elkhart and St. Joseph counties of Indiana. The river re-enters Michigan in southeastern Berrien County and flows northwest to discharge into Lake Michigan.

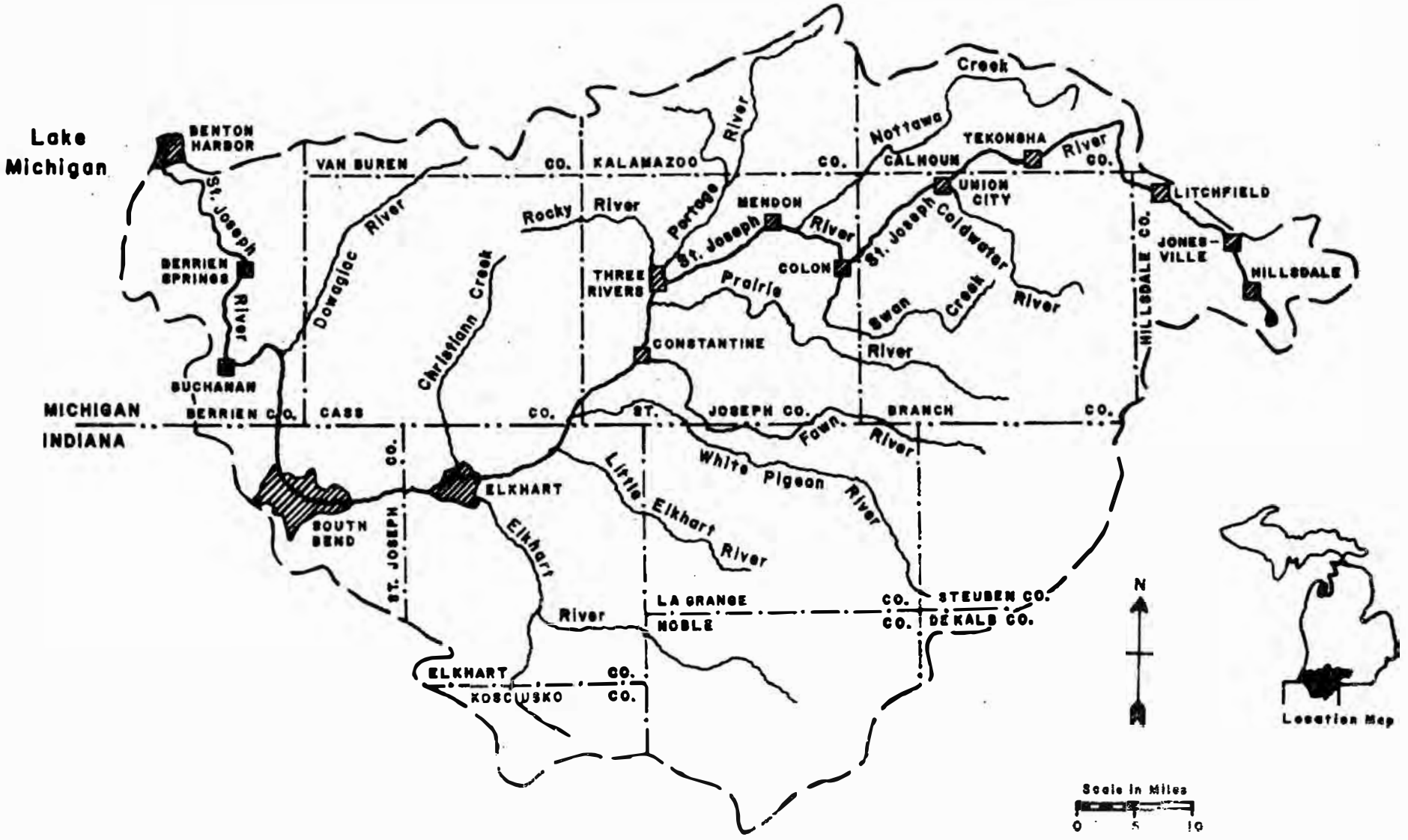
Tributaries of the St. Joseph River in Michigan also drain all of Cass and portions of Kalamazoo and Van Buren counties. Tributaries in Indiana also drain all of Lagrange and portions of Steuben, Noble and Kosciusko counties.

The basin is approximately 85 miles long and from 5 miles in width at each end to 55 miles in width at its middle. Through this basin the river sweeps in a large S curve 210 miles long with a fairly uniform drop of 570 feet from the headwaters to the confluence of the river with Lake Michigan.

The northbend of the St. Joseph River flows through cities and villages of Hillsdale, Jonesville, Litchfield, Tekonsha, Union City, Colon, Mendon, Three Rivers and Constantine, Michigan. The southbend of the river flows through Bristol, Elkhart, Mishawaka and South Bend, Indiana. The last segment of the river's course meanders through Niles, Buchanan and Berrien Springs, Michigan to the mouth at St. Joseph, Michigan.

Principal tributaries to the mainstream in Michigan include: Coldwater River, Nottawa Creek, Portage River, Rocky River, Prairie River,

MAP I– ST. JOSEPH RIVER BASIN



CARTOGRAPHIC SERVICES/ DNR EA

Fawn River, Pigeon River and Dowagiac Creek. Major tributaries in Indiana are the Little Elkhart and Elkhart Rivers.

GUIDELINES AND PROCEDURES

The fisheries survey was conducted by Fisheries Division personnel during the period July 17 - August 10, 1972. Water samples taken by the Water Quality Control Division were collected to coincide with fish collections.

The survey was scheduled during the late summer during the annual low-flow period. Fish spawning and migrations are completed by late summer and low water facilitates the capture of fish. Also zones of pollution are more apparent during low-flows. When waste unloading in a river is fairly constant the year around, low-flows for assimilation and dilution must be considered. Inadequate dilution of organic wastes and higher summer temperatures decrease dissolved oxygen levels. A survey at this time of the year gives us a picture of the river's environment at its annual ebb and a view of the minimum fish populations the river can sustain.

SAMPLING STATION SELECTION

The St. Joseph River survey was divided into 14 study sections. Eleven sections in Michigan and 3 sections in Indiana. These study sections were selected on a basis of unique management areas such as head waters or sections between impoundments. Three or four survey stations were selected within each section. These survey stations were selected on a basis of accessibility to the river, in a somewhat regular interval of spacing, and below known sources of waste water disposal. (See Table #1.) The study sections and the individual survey stations were selected with the assistance of the Water Control Division, District #3.

TABLE # 1

LOCATION OF FISHERIES SAMPLING SITES-ST. JOSEPH RIVER

ZONE # 1: BAW BEESE LAKE TO COLON

SECTION M-1 (Baw Beese Lake to Jonesville Pond Dam)

STATION	DESCRIPTION	EQUIPMENT USED	SAMPLING PERIOD
*1. Baw Beese Lake	T6S, R3W, Sec.35	Boom Shocker & 2 Fyke Nets	20 min., 2 sets 1 night
2. Above Hillsdale W.W.T.P.	T6S, R3W, Sec.22	Stream Shocker	20 minutes
*3. Moore Rd.	T6S, R3W, Sec.16	Fiberglass Boat	20 minutes
4. Jonesville Pond	T5S, R3W, Sec.4	Fiberglass Boat & 2 Fyke Nets	20 min., 2 sets 1 night

SECTION M-2 (Jonesville to M-49 in Litchfield)

*5. Genesee Rd.	T5S, R3W, Sec.32	Stream Shocker	20 minutes
6. Sterling Rd.	T5S, R4W, Sec.25	Stream Shocker	20 minutes
7. Herring Rd.	T5S, R4W, Sec.23	Stream Shocker	20 minutes
*8. Above Anderson Rd.	T5S, R4W, Sec.15	Stream Shocker	20 minutes

SECTION M-3 (M-49 to City Limits of Union City)

9. Hadley Rd.	T5S, R4W, Sec.6	Stream Shocker	20 minutes
*10. T. Drive S	T4S, R5W, Sec.25	Stream Shocker	20 minutes
11. T. Drive S.	T4S., R6W, Sec.23	Stream Shocker	20 minutes
*12. 10-1/2 Miles Rd.	T4S, R7W, Sec.26	Stream Shocker	20 minutes

SECTION M-4 (Union City to Stowell Rd. above Colon)

13. Broadway St.-Union City,	T5S, R7W, Sec.5	Fiberglass Boat	20 minutes
*14. Union Lake	T5S, R8W, Sec. 12	Boom Shocker & 2 Fyke Nets	20 minutes 2 sets, 1 night
*15. Athens Road	T5S, R8W, Sec. 22	Fiberglass Boat	20 minutes
16. Above Stowell Rd.	T6S, R9W, Sec.1	Fiberglass Boat	20 minutes

TABLE #1 Continued

ZONE #2: COLON TO MOTTVILLE DAM

SECTION M-5 (Stowell Rd. to Buckner Rd. In Mendon)

*17.	Sturgeon Lake	T6S, R9W, Sec.2	Boom Shocker & 2 Fyke Nets	20 minutes 2 sets, 1 night
18.	Bennett Rd.	T5S, R9W, Sec.32	Stream Shocker	20 minutes
*19.	N. Sturgis Rd.	T5S, R9W, Sec.30	Fiberglass Boat	20 minutes
20.	Nottawa Rd.	T5S, R10W, Sec.26	Fiberglass Boat	20 minutes

SECTION M-6(Buckner Rd., to Three Rivers Dam)

21.	Buckner Rd.	T5S, R10W, Sec.23	Fiberglass Boat & 2 Fyke Nets	20 minutes 2 sets, 1 night
22.	Covered Bridge Rd.	T6S, R11W, Sec.12	Fiberglass Boat & 2 Fyke Nets	20 minutes 2 sets, 1 night
*23.	Schweitzer Rd.	T6S, R11W, Sec.10	Fiberglass Boat & 2 Fyke Nets	20 minutes 2 sets, 1 night
*24.	Three Rivers Imp.	T6S, R11W, Sec.15	Boom Shocker & 2 Fyke Nets	20 minutes 2 sets, 1 night

SECTION M-7 (Broadway St., Three Rivers to Constantine Dam)

25.	Third & E. Broadway	T6S, R11W, Sec.19	Fiberglass Boat & 2 Fyke Nets	20 minutes 2 sets, 1 night
*26.	Constantine Rd.	T6S, R11W, Sec.31	Fiberglass Boat & 2 Fyke Nets	20 minutes 2 sets, 1 night
27.	Withers Rd.	T7S, R12W, Sec.1	Fiberglass Boat & 2 Fyke Nets	20 minutes 2 sets, 1 night
*28.	Constantine Imp.	T7S, R12W, Sec.23	Boom Shocker & 2 Fyke Nets	20 minutes 2 sets, 1 night

SECTION M-8 (Below Constantine Dam to Mottville Dam)

29.	N. Washington St.	T7S, R12W, Sec.23	Fiberglass Boat & 2 Fyke Nets	27 minutes, 2 sets, 1 night
*30.	N. River Rd.	T7S, R12W, Sec.27	Fiberglass Boat & 2 Fyke Nets	27 minutes, 2 sets, 1 night
31.	Mottville Dam	T8S, R12W, Sec.6	Fiberglass Boat & 2 Fyke Nets	27 minutes 2 sets, 1 night

TABLE #1 Continued

ZONE #3: BELOW MOTTVILLE DAM TO BERTRAND

SECTION I-1 (Below Mottville Dam to Elkhart Dam)

32.	Thomas Rd.	T8S, R12W, Sec.12	Fiberglass Boat & 2 Fyke Nets	20 minutes, 2 sets, 1 night
*33.	Bristol	T38N, R6E, Sec.27	Boom Shocker & 2 Fyke Nets	20 minutes, 2 sets, 1 night
*34.	Nibbyville	T38N, R6E, Sec.32	Boom Shocker & 2 Fyke Nets	20 minutes, 2 sets, 1 night
35.	Elkhart Imp.	T37N, R5E, Sec.4	Fiberglass Boat & 2 Fyke Nets	20 minutes, 2 sets, 1 night

SECTION I-2 (Below Elkhart Dam to Mishawaka Dam)

36.	Below Elkhart W.W.T.P.	T37N, R4E, Sec.12	Fiberglass Boat & 2 Fyke Nets	27 minutes, 2 sets, 1 night
*37.	Vistula Rd.	T37N, R4E, Sec.9	Boom Shocker & 2 Fyke Nets	27 minutes, 2 sets, 1 night
38.	Mishawaka Imp.	T37N, R3E, Sec.12	Boom Shocker & 2 Fyke Nets	27 minutes, 2 sets, 1 night

SECTION I-3 (Below Mishawaka Dam to Bertrand)

39.	Memorial Park	T37N, R3E, Sec.17	Boom Shocker & 2 Fyke Nets	27 minutes, 2 sets, 1 night
*40.	Darden Rd.	T38N, R2E, Sec.23	Fiberglass Boat & 2 Fyke Nets	27 minutes, 2 sets, 1 night
41.	Bertrand	T8S, R17W, Sec.22	Fiberglass Boat & 2 Fyke Nets	27 minutes, 2 sets, 1 night

ZONE # 4: BERTRAND TO LAKE MICHIGAN

SECTION M-9 (Bertrand to Buchanan Dam)

*42.	U.S.-12	T8S, R17W, Sec.10	Boom Shocker & 2 Fyke Nets	20 minutes, 2 sets, 1 night
43.	Niles Imp.	T7S, R17W, Sec.35	Boom Shocker & 2 Fyke Nets	20 minutes, 2 sets, 1 night
*44.	Below Niles W.W.T.P.	T7S, R17W, Sec.22	Boom Shocker & 2 Fyke Nets	20 minutes, 2 sets, 1 night
45.	Buchanan Imp.	T7S, R18W, Sec.25	Boom Shocker & 2 Fyke Nets	20 minutes, 2 sets, 1 night

TABLE #1 Continued

SECTION M-10 (Below Buchanan Dam to Berrien Springs Dam)

46.	Below Buchanan	T7S, R18W, Sec.23	Boom Shocker & 2 Fyke Nets	27 minutes, 2 sets, 1 night
*47.	Bear Cave Campgrounds	T7S, R18W, Sec.12	Boom Shocker & 2 Fyke Nets	27 minutes, 2 sets, 1 night
48.	Berrien Springs Imp.	T6S, R17W, Sec.19	Boom Shocker & 2 Fyke Nets	27 minutes, 2 sets, 1 night

SECTION M-11 (Below Berrien Springs Dam to Lake Michigan)

*49.	Below Dam	T6S, R17W, Sec.7	Boom Shocker & 2 Fyke Nets	20 minutes, 2 sets, 1 night
50.	Arden	T5S, R18W, Sec.34	Boom Shocker & 2 Fyke Nets	20 minutes, 2 sets, 1 night
51.	River Road	T5S, R18W, Sec.4	Boom Shocker & 2 Fyke Nets	20 minutes, 2 sets, 1 night
*52.	Benton Harbor	T4S, R19W, Sec.25	Boom Shocker & 2 Fyke Nets	20 minutes, 2 sets, 1 night

* Weighing Stations

Prior to the field survey, a check of the river was made to confirm that the sites selected were accessible by boat. A preliminary site survey familarized crew chiefs with the areas and also aided in determining the type of equipment needed for individual sites.

FISHERIES SAMPLING TECHNIQUES

The primary method of fish sampling used throughout the survey was electro-fishing. The unit of effort for each study section was an 80-minute shocking period. Most sections were divided into 4 survey stations which were electro-fished for a 20 minute period each. Sections divided into 3 stations were elctro-fished for a 27-minute period each.

In addition, two fyke nets per station were used, where netting was practical. Fyke nets were set at all stations beginning with section M-6 (Mendon). Only the impounded areas above Mendon were netted. The effort for each fyke net set was one night. An attempt was made to sample the variety of habitat present at each station.

A variety of electro-fishing gear was utilized depending upon depths of waters. A 110 volt, A.C., 6 amp generator, towed behind an operator in a small boat, was used in waters that could be waded. This same generator was used in a 14 foot fiberglass boat for intermediate waters that were too deep to wade and too shallow to maneuver a 16 foot barge. The 16 foot barge, equipped with a 240 volt, A.C., 10 amp generator, was used to survey the deeper waters if a launching site was available. If launching the barge was impossible, the 14-foot fiberglass boat was used.

Fish passing through the electrical field were stunned temporarily and retrieved with a scap net. These fish, including those live

trapped in fyke nets, were collected in tubs for measuring and returned to the water. Fish were also weighed at 24 of the total 52 stations that were surveyed.

Fish from each survey site were separated according to species and measured to the nearest inch group. Maximum and minimum lengths were recorded to the nearest tenth of an inch for each species group. The total weight of each species group was recorded to the nearest tenth of a pound at stations where the fish were weighed. Average lengths and weights were computed for a species that included ten or more fish.

Tallies for game fish (panfish, bass, northern pike, channel catfish, etc.) were separated from non-game fish (bullheads, carp, suckers, redhorse, gars, etc.). Minnows and other forage species were noted during the collection but not included as a portion of the fish collection.

Fish samples were collected during the survey, frozen, and sent to Water Quality Control Division in Lansing for analysis of heavy metals, PCB's and pesticides. A minimum of four species were collected within each study section for sampling.

Biological and streamside observations were made at each survey station. The air and water temperatures and weather conditions were recorded. Water conditions, such as turbidity (secchi disk reading), color and odor were noted. The dissolved oxygen (DO), pH, and water hardness were determined at each station with a Hach chemical kit. Other observations recorded were the occurrence of fish cover, occurrence and species of aquatic vegetation, river bottom types, forage species present, and any other observations significant for fisheries or water quality.

REPORT I :
DATA SUMMARY - OF - ENTIRE RIVER SURVEY

Samples were taken at 52 stations along the mainstream of the river. Thirty-seven stations were in flowing environments and 13 were in impoundments. Two stations were in natural lakes (Baw Beese and Sturgeon lakes).

RESULTS

FISH NUMBERS

A total of 4,782 fish were captured during the survey of which 2,694 were game fish and 2,088 were non-game fish. Electro-fishing accounted for 47% and netting efforts accounted for 53% of the catch. The electro-fishing catch was divided almost equally between game fish (1,110) and non-game fish (1,123).

The nets caught more game fish (1,584) than non-game fish (965). Nets set in impoundments were more selective for schooling game fish, thereby increasing the game fish catch. Sixty percent of the game fish were captured at 15 of the 36 stations netted. These 15 stations were impoundments or natural lakes. Of the 944 game fish collected at these 15 stations, 892 were schooling fish (bluegills and crappies).

Numbers of game fish collected per station ranged from one at Station #13, to 188 at Station #38 (See Table #2, Fish Population Survey Summary Sheet). Three other stations (#3, #7, & #10) accounted for only 2 game fish apiece.

Numbers of non-game fish per station varied from 3 and 4 at Station #9 and #7, to 166 at Station #48. The total number of fish, game and non-game, varied from 6 at Station #7 to 300 at Station #38.

FISH SPECIES

A total of 47 species were collected during the survey including 13 game species, 16 non-game species and 20 forage species (Table #3).

TABLE #2

FISH POPULATION SURVEY

SUMMARY SHEET

SECTION	STATION		GAME			NON-GAME			TOTALS		
			No. Spp.	No. Fish	Wt. Lbs.	No. Spp.	No. Fish	Wt. Lbs.	No. Spp.	No. Fish	Wt. Lbs.
M-1	I	1	8	115	21.6	5	11	23.9	16	126	45.5
	F	2	4	38		1	23		7	61	
	F	3	1	2	0.1	2	8	7.2	6	10	7.3
	I	4	4	24		3	9		7	33	
M-2	F	5	3	15	4.4	2	18	6.7	13	33	11.1
	F	6	4	13		2	31		12	44	
	F	7	1	2		2	4		5	6	
	F	8	8	18	8.6	5	24	12.7	17	42	21.3
M-3	F	9	4	15		1	3		9	18	
	F	10	2	2	1.8	3	8	25.7	5	10	27.5
	F	11	2	4		3	16		14	20	
	F	12	5	24	6.7	2	6	2.4	14	30	9.1
M-4	F	13	1	1		3	7		9	8	
	I	14	6	127	19.4	5	70	74.2	15	197	93.6
	F	15	2	3	0.7	4	16	15.4	9	19	16.1
	F	16	5	15		4	19		13	34	
M-5	I	17	7	60	14.1	7	51	88.9	19	111	103.0
	F	18	4	8		5	15		12	23	
	F	19	2	7	3.8	4	36	29.7	11	43	33.5
	F	20	2	4		3	16		7	20	

TABLE #2 Continued

SECTION	STATION		GAME			NON-GAME			TOTALS		
			No. Spp.	No. Fish	Wt. Lbs.	No. Spp.	No. Fish	Wt. Lbs.	No. Spp.	No. Fish	Wt. Lbs.
M-6	I	21	5	107		6	86		13	193	
	I	22	9	117		5	53		16	170	
	F	23	4	38	9.7	5	29	49.9	11	67	59.6
	I	24	6	133	36.4	6	31	73.1	14	164	109.5
M-7	F	25	4	13		5	21		10	34	
	F	26	5	26	16.7	6	33	47.7	11	59	64.4
	I	27	5	49		5	25		10	74	
	I	28	5	95	8.5	5	34	41.2	11	129	49.7
M-8	F	29	6	113		6	21		15	134	
	F	30	6	48	14.8	5	50	95.6	11	98	110.4
	I	31	7	96		6	44		15	140	
I-1	F	32	4	19		3	44		10	63	
	F	33	7	18	7.0	5	119	146.7	15	137	153.7
	F	34	9	63		5	72		16	135	
	I	35	6	106	12.6	5	28	20.6	13	134	33.2
I-2	F	36	6	84		4	87		13	171	
	I	37	9	91	19.2	4	53	185.5	14	144	204.7
	I	38	7	188		5	112		14	300	
I-3	F	39	9	109		4	25		15	134	
	F	40	7	72	9.0	4	24	70.5	13	96	79.5
	F	41	10	58		5	13		17	71	

Table #2 Continued

SECTION	STATION		GAME			NON-GAME			TOTALS		
			No. Spp.	No. Fish	Wt. Lbs.	No. Spp.	No. Fish	Wt. Lbs.	No. Spp.	No. Fish	Wt. Lbs.
M-9	F	42	7	55	14.2	6	33	74.7	15	88	88.9
	F	43	7	32		4	15		13	47	
	F	44	7	52		7	75		15	127	
	I	45	9	54	26.1	7	64	88.9	20	118	115.0
M-10	F	46	9	76		4	94		13	170	
	F	47	7	56	7.8	6	90	74.4	13	146	82.2
	I	48	7	35		7	166		15	201	
M-11	F	49	6	40	29.9	6	16	29.4	18	56	59.3
	F	50	6	79		4	32		14	111	
	F	51	6	52		3	35		12	87	
	F	52	6	23	16.4	6	73	171.6	12	96	188.0
TOTALS				2694	309.5		2088	1456.6		4782	1766.1
AVERAGE			5.6	51.8	12.9	4.4	40.2	60.7	12.6	91.9	73.6

The numbers of species in the Totals column includes Forage species

F= Flowing Environment

I= Impounded

TABLE #3

SPECIE LIST

GAME FISH	
Channel Catfish	Ictalurus punctatus
Northern Pike	Esox lucius
Yellow Perch	Perca flavescens
Smallmouth Bass	Micropterus dolomieui
Largemouth Bass	_____ salmoides
Warmouth Bass	Chaenobryttus gulosus
Green Sunfish	Lepomis cyanellus
Pumkinseed Sunfish	_____ gibbosus
Bluegill Sunfish	_____ macrochirus
Longear Sunfish	_____ megalotis
Rock Bass	Ambloplites rupestris
White Crappie	Pomoxis annularis
Black Crappie	_____ nigromaculatus
NON-GAME FISH	
Spotted Gar	Lepisosteus productus
Longnose Gar	_____ osseus
Dogfish	Amia calva
Quilback	Carpiodes cyprinus
White Sucker	Carostomus commersonnii
Hog Sucker	Hypentelium nigricans
Lake Chubsucker	Erimyzon sucetta
Spotted Sucker	Minytrema melanops
Redhorse	Moxostoma Spp.
Carp	Cyprinus carpio
Goldfish	Carassius auratus

Black Bullhead	Ictalurus melas
Brown Bullhead	_____ nebulosus
Yellow Bullhead	_____ natalis
Stonecat	Noturus flavus
Mud Pickerel	Esox americanus

FORAGE FISH

Alewife	Alosa pseudoharengus
Creek Chub	Semotilus atromaculatus
Hornyhead Chub	Hybopsis biguttata
Riverchub	_____ micropogan
Blacknose Dace	Rhinichthys atratulus
Golden Shiner	Notemigonus crysoleucas
Common Shiner	Notropis cornutus
Spottail Shiner	_____ hudonius
Satinfin Shiner	_____ analostanus
Spotfin Shiner	_____ spilopterus
Bluntnose Minnow	Pimephales promelas
Stoneroller	Campostoma anomalum
Blackside Darter	Percina maculata
Log Perch	_____ caprodes
Johnny Darter	Etheostoma nigrum
Rainbow Darter	_____ caeruleum
Fantail Darter	_____ flabellare
Greenside Darter	_____ blennioides
Brook Silversides	Labidesthes sicculus
Mudminnow	Umbra limi

Species Identifications by Paul Scheppelman, District #12, Plainwell, and Raymond E. Shepherd, District #13, Jackson.

The number of game species collected ranged from one species at Stations #3, #7, and #13, to 10 species at Station #41. Bluegills and black crappies were the most abundant game fish found. Bluegills were captured at 42 of the Stations surveyed and black crappies were captured at 39 Stations. A total of 2,674 game fish were collected on the survey (Table #4).

Numbers of non-game species collected ranged from one at Stations #2 and #9 to 7 species at Stations #17, #44, #45 and #48. White suckers were collected at 46 Stations, carp at 44 Stations and redhorse at 42 Stations. Of the 2,088 non-game fish collected, 695 were carp and 656 redhorse (Table #5).

WEIGHTS OF FISH

All game and non-game fish, excluding forage species, were weighed at 24 predetermined survey stations. Game fish at these stations varied from 0.1 lbs at Station #3 to 36.4 lbs at Station #24. Weights of non-game fish varied from 2.4 lbs at Station #12 to 185.5 lbs at Station #37. A total of 2,153 fish were weighed, of which 1,228 were game and 925 non-game fish. The weight of game fish totaled 309.5 lbs and non-game fish totaled 1,456.6 lbs. Although fifty-seven per cent of the fish weighed (by number) were game fish; their weight was less than 18% of the total weight.

Electro-fishing methods accounted for 1,119 of the fish captured at weigh stations. These fish weighed 1,021.0 lbs. Five hundred and nineteen of these fish were game species which weighed 104.4 lbs. The remaining 600 were non-game fish which weighed 916.6 lbs.

Netting methods at weigh stations accounted for 1,034 fish weighing 745.1 lbs. Seven hundred and nine of these were game fish weighing 205.1 lbs and 325 non-game fish weighing 540.0 lbs. The higher number of game fish netted is explained by the large number of schooling game fish

TABLE #4

NUMBERS OF GAME FISH

Study Sections

SPECIES	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	I-1	I-2	I-3	M-9	M-10	M-11	Totals
B.Crappie	8	5	3	54	17	121	125	90	115	80	10	40	39	32	[illegible]
Bluegill	106	2	2	49	18	236	28	145	29	21	20	31	16	26	729
P.Seed	14	3	-	4	10	9	3	4	1	65	102	45	20	20	300
S.M.Bass	-	2	6	8	6	8	19	6	29	19	46	35	35	65	284
W.Crappie	-	-	-	-	-	-	-	-	-	139	18	-	-	-	157
L.M.Bass	20	11	1	17	5	13	5	4	4	12	4	10	1	2	109
C.Catfish	-	-	-	-	-	-	-	-	7	18	2	17	21	43	108
Rock Bass	8	20	19	1	7	-	1	1	5	1	16	5	7	5	96
Perch	14	-	11	12	15	1	-	-	7	-	-	-	-	-	60
Gr.Sunfish	4	1	2	1	-	1	-	2	3	6	12	4	11	-	47
LongearSunfish	-	-	-	-	-	1	-	-	3	2	8	4	15	-	33
N.Pike	3	4	1	-	1	4	4	3	3	-	1	2	-	2	28
Warmouth Bass	2	-	-	-	-	1	-	1	-	-	-	-	-	-	4
Totals	179	48	45	146	79	395	185	256	206	363	239	193	165	195	2696

TABLE #5

NUMBERS OF NON-GAME FISH

Study Sections

SPECIES	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	I-1	I-2	I-3	M-9	M-10	M-11	Totals
Carp	7	3	3	12	29	97	36	11	20	62	36	81	179	119	695
Redhorse	-	4	18	78	45	34	36	42	208	106	8	19	44	14	656
W.Sucker	31	53	8	12	19	18	5	24	12	39	6	50	109	9	395
Bullhead	2	5	-	2	4	19	4	-	7	38	9	11	4	-	105
S.Sucker	-	-	-	-	14	4	17	28	3	5	2	5	8	3	89
LongnoseGar	2	5	-	-	2	25	15	8	2	2	-	15	5	1	77
H.Sucker	-	12	3	6	3	-	-	1	10	-	-	-	-	-	35
Dogfish	5	-	-	1	2	1	-	-	-	-	-	-	-	-	14
Quillback	-	-	-	-	-	-	-	-	-	-	1	4	1	5	11
M.Pickerel	2	-	1	-	-	-	-	-	1	-	-	-	-	-	4
Lk.Chubsucker	1	-	-	-	-	1	-	-	-	-	-	-	-	-	2
Spotted Gar	1	-	-	-	-	-	-	1	-	-	-	-	-	-	2
Goldfish	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
Stonecat	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Totals	51	77	33	112	118	199	113	115	263	252	62	187	350	156	2088

captured in impoundments.

Table #6 lists the weights of the top 3 non-game and top 5 game species collected on the survey.

T A B L E # 6

Fish Species With the Highest Weights

Species	Total Wt. (lbs)	Total Number	Ave. Wt. (lbs)	Total Wt. (%)	Total No. (%)
Carp	792.9	301	2.63	44.8	14.0
Redhorse	428.1	306	1.40	24.2	14.2
W. Sucker	126.7	146	0.87	7.2	6.8
Subtotal Non-game	1,347.7	753	--	76.2	35.0
Black Crappie	61.4	329	0.19	3.5	15.3
N. Pike	53.4	17	3.14	3.0	0.8
Bluegill	51.9	353	0.15	2.9	16.4
L.M. Bass	40.3	78	0.52	2.3	3.6
S.M. Bass	37.5	133	0.28	2.1	6.2
Subtotal Game	244.5	910	--	13.8	42.3
TOTALS	1,592.2	1,663	--	90.0	77.3

WATER CHEMISTRY AND RELATED OBSERVATIONS

The dissolved oxygen (DO), acidity (pH), and water hardness were determined at each station prior to the electro-fishing survey. A Hach chemical kit was used to determine these values. Air and water temperatures were also taken. Surface water temperatures on the survey reflected air temperatures.

(DO)

Dissolved oxygen values taken on the survey ranged from 4.5 to 13.0 ppm. The average value was 9.0 ppm. The water quality standards set by the Michigan Water Resources Commission states that for intolerant warm-water species (bass, pike and panfish) the average DO be not less than 4.0 ppm. The National Technical Advisory Committee recommends that DO concentrations may range between 4 and 5 ppm for short periods providing that water quality is favorable in all other respects.

Low concentrations of dissolved oxygen can be attributed usually to introduction of organic wastes which are acted upon immediately by bacteria. The subsequent process of decomposition consumes oxygen from the water.

The lowest DO value on the survey (4.5 ppm) was recorded 2 miles below the South Bend W.W.T.P. (Station #41). The next lowest value of 5.5 ppm was recorded a mile below the Hillsdale W.W.T.P. (Station #3). Values of 6.0 ppm were recorded one-half mile below the village of Mendon (Station #21) and also one mile below the Mishawaka W.W.T.P. (Station #39).

The lowest DO values recorded were somewhat above the minimum dissolved oxygen standards. However, these oxygen values were determined in the daylight hours (9 am to 3 pm) and are probably higher than night-time values. Oxygen values usually increase rapidly during morning hours, reaching a maximum in the afternoon and a minimum in the early morning before sunrise.

pH

The pH values on this survey ranged from 7.5 to 9.0. The most

common value, 8.5, was found at 41 of the 52 stations. Values of pH between 5.0 and 9.0 are not lethal for most fully developed freshwater fish, provided that other conditions are favorable. There is a gradual deterioration of fish habitat if pH values fall outside this range.

The pH of a stream may also be an indicator of productivity. The higher the pH of stream water the richer the waters generally are in carbonates, bicarbonates, and associated salts. Such streams support a more abundant aquatic life and larger fish populations than streams with acid waters (pH below 7), which generally are low in nutrients.

HARDNESS

Water hardness on the survey ranged from 205 to 393 ppm. The highest and lowest values both occurred in Zone #1, which reflected the greatest fluctuation in water hardness. Zones #2, #3, and #4 exhibited less fluctuation in hardness values. There, water hardness ranged from 222 to 308 ppm. Waters of hardness between 121 and 180 ppm are considered hard. Values above 180 ppm are considered very hard.

Hardness in water is often correlated with productivity, hard-water streams are usually more productive than soft-water streams. Also, the specific conductivity of water usually increases with hardness. The specific conductivity indicates the degree of mineralization and is a measure of the capacity of water to conduct an electric current. The extremely hard water encountered on this survey were undoubtably an aid to electro-fishing.

ODOR

Water odor was not noticed in Zone #1. However, in Zone #2, a moderately strong odor was apparent below Three Rivers (Station #25). Also in Zone #2 a slight odor was noticed three miles below Three Rivers (Station #25), and below Constantine (Station #29). A moderate odor was apparent in

Zone #3 below the Elkhart W.W.T.P. (Station #36). In Zone #4, a slight odor was noticeable below the Niles W.W.T.P. (Station #44) and also at Benton Harbor - St. Joseph (Station #52).

TURBIDITY

Water encountered on the river from Stations #1 through #12 (turbidity segment #1) were clear (see Table #7). The station in this segment with the most turbidity was below the Hillsdale W.W.T.P. (Station #3) where the secchi disk was visible at 3.5 feet. The water clarity at the remaining stations in segment #1 were very clear and the secchi disk value was equal to or exceeding the 5.5 value recorded at Baw Beese Lake. The exact secchi disk value could not be found at these remaining stations because the water was too shallow to determine the depth at which the disk disappeared.

Turbidity segment #2 begins at Union City and continues downstream to Schweitzer Road, below Mendon (Station #13 to #23). The water in this segment was moderate in turbidity and the secchi disk values, except for Station #18, ranged from 3.0 to 2.5 feet. The secchi disk value below Colon (Station #18) was 2.0 feet.

Turbidity segment #3 exhibited a relatively heavy turbidity. This segment extends from Three River Impoundment downstream to Mishawaka Impoundment in Indiana (Stations #24 to #38). Secchi disk values in this segment ranged from 2.1 to 1.1 feet below Constantine.

Turbidity segment #4 begins below the Mishawaka Impoundment and continues downstream to Bear Cave below Buchanan (Station #39 to #47). Turbidity in this segment was relatively moderate. Secchi disk values in this segment, except Station #44, ranged from 3.0 to 2.2 feet. The value below Niles W.W.T.P. (Station #44) was 2.0 feet.

Waters in turbidity segment #5, Berrien Springs Impoundment to

Benton Harbor - St. Joseph (Station #48 to #52) were heavy in relative turbidity. Secchi disk values in this segment ranged from 2.0 to 1.0 feet. The 1.0 value at Benton Harbor - St. Joseph was the lowest recorded on the survey.

Twenty-eight carp and redhorse were collected by electro-fishing means in Segment #1 where the waters were relatively clear of turbidity. This is an average of 2.3 carp and redhorse per station.

A total of 288 carp and redhorse were collected by electro-fishing at 18 stations where secchi disk values ranged from 3.0 to 2.2 feet. Carp and redhorse averaged 16.0 fish per station at these stations.

A total of 570 carp and redhorse were collected by electro-fishing at the remaining 22 stations where secchi disk values ranged from 2.1 to 1.0 feet. This is an average of 25.9 carp and redhorse per station for these stations.

Electro-fishing data are used for this comparison because an electro-fishing effort was made at all stations throughout the survey.

TABLE #7

TURBIDITY SEGMENTS - ST. JOSEPH RIVER

Segment #1		S-2		S-3		S-4		S-5	
Station	Secchi Disk (ft.)	Sta.	S.D. (ft)	Sta.	S.D. (ft)	Sta.	S.D. (ft)	Sta.	S.D. (ft)
1	5.5	13	2.5	24	1.7	39	2.5	48	1.8
2	C	14	2.5	25	2.0	40	2.4	49	1.8
3	3.5 R	15	1.5	26	2.0	41	2.2	50	1.5
4	S.T	16	2.5	27	2.0	42	2.5	51	2.0
5	C	17	2.8	28	1.5	43	2.5	52	1.0
6	C	18	2.0	29	2.0	44	2.0		
7	C	19	2.5	30	1.1	45	2.8		
8	C	20	3.0	31	1.8	46	2.5		
9	S.T R	21	3.0	32	1.4	47	3.0		
10	S.T R	22	3.0	33	1.8				
11	C	23	2.5	34	2.1				
12	S.T R			35	2.1				
				36	1.9				
				37	1.5				
				38	1.5				

C = Clear
S.T = Slight Turbidity
R = Rain

AQUATIC VEGETATION AND COVER

Fish cover was primarily in the form of aquatic vegetation. Aquatic vegetation and fish cover was sparse throughout most of the river. Aquatic vegetation was most prominent in the segment of the river that was clear or slightly turbid.

In Zone #1 aquatic vegetation including duckweed, coontail, wild celery, narrow leafed potamogeton species and filamentous algae were very abundant below Hillsdale W.W.T.P. Vegetation was also abundant in the impoundments above Jonesville (Station #4) and Litchfield (Station #7).

In Zones #2, #3 and #4, aquatic vegetation was usually sparse or non-existent. Water lilies were present around the shore in varying quantities of most impoundments. In flowing environments moderate growths of aquatic vegetation were found below Constantine Impoundment, village of Constantine and also below the South Bend W.W.T.P. Floating clumps of algae from the bottom were common below the city of Three Rivers.

SUBSTRATE

A gravel bottom was predominate throughout the river mainstream, especially in flowing environments. Rubble, sand in varying amounts and thin layers of silt were also present in flowing environments.

Impoundments characteristically had silt bottoms but usually the shore had solid, rocky, gravel or sandy bottoms. An estimate was not made of the thickness of silt in the deeper impoundments. However, silt in the impoundments, in Hillsdale County, above Jonesville and Litchfield, is obviously very thick. The impoundment above Jonesville has filled in almost completely.

Soil erosion is a problem in some of the counties in the St. Joseph River Basin, particularly Hillsdale County. The following is a list of the

expected averages of land with erosion problems for the St. Joseph River Basin counties in 1975 (data published by Michigan State University Agriculture Experiment Station, East Lansing).

LANDS WITH EROSION PROBLEMS

St. Joseph River Basin for 1975

County	(cropland, pasture, range, forest, woodland & other land) Per 1,000 acres
Berrien	47.9 A
Branch	5.5
Calhoun	33.9
Cass	5.0
Hillsdale	120.6
Kalamazoo	4.5
St. Joseph	0.0
Van Buren	14.4
Total	231.8

IMMEDIATE SHORE AND SURROUNDING AREA

The immediate banks of the St. Joseph River are mostly light to heavily wooded except for river sections flowing through villages or cities.

The first four miles of the river flows through the city of Hillsdale. From here to above the city limits of Elkhart, Indiana, the river flows through a series of villages and small cities, and a series of impoundments (See Table #7 for list of impoundments on the mainstream). The area has a farm-based economy with small factories occurring at most all population centers. Homes are not frequent along the banks upstream but tend to increase in frequency in the downstream areas. None of the impoundments in this section were heavily settled.

The section of the river above Elkhart to below South Bend is very heavily developed. This section of the river flows through a continuous heavy residential, commercial and industrial complex. At South Bend the river flows adjacent to the campus of various colleges including that of the University of Notre Dame.

The final section of the river flows through Berrien County which is intensively farmed. The county ranked first in 1959 and third in 1964 in Michigan for the value of farm products sold.

New homes and subdivisions were present along the river below South Bend to Niles. From Niles to Benton Harbor the river flows through two small villages, two impoundments and through a farming countryside covered with orchards. Homes along the river increase in frequency downstream to a large residential, commercial and industrial terminus at Benton Harbor - St. Joseph.

REPORT II: DATA SUMMARY FOR STUDY SECTIONS

For convenience of discussion the 14 study sections will be divided into 4 zones (see table #1 & map #1). Zone #1 encompasses the large arc of the mainstream from its beginning at Baw Beese Lake outlet to the village of Colon. This zone is approximately 65 miles long and contains the major portion of the "northbend" of the St. Joseph River. Zone #2 is the lessor portion of the northbend of the river. This zone is approximately 45 miles long, beginning at Colon and continuing to Mottville just above the state line. Zone #3 contains the "southbend" of the St. Joseph River lies almost entirely in Indiana. This zone is approximately 45 miles long, beginning below Mottville Dam and continuing thru Indiana to Bertrand, Michigan. Zone #4, the "discharge" segment, lies entirely in Michigan. This zone is approximately 55 miles in length, beginning at Bertrand and ending at Lake Michigan.

D I S C U S S I O N

Zone #1, Baw Beese Lake to Colon

Zone #1 includes Study Sections M-1 through M-4 and survey stations #1 through #16.

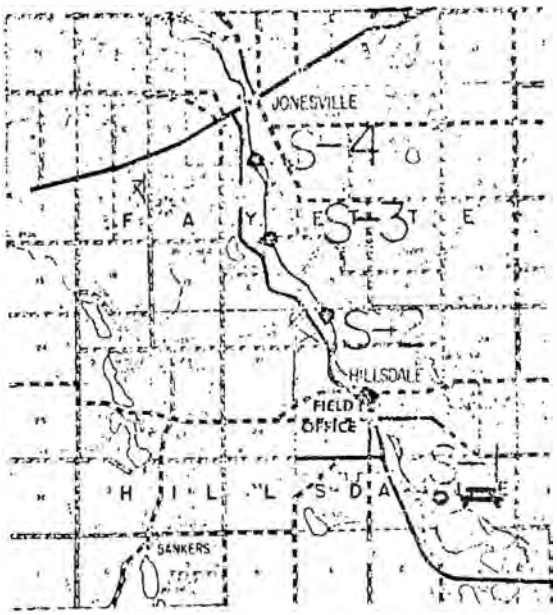
Fish were weighed at 8 of the 16 stations surveyed. Only 3 stations were suitable for netting. These were Baw Beese Lake (Station #1), Jonesville Pond (Station #4), and Union Lake (Station #14). The remaining 13 stations were too shallow in depth for netting.

Section M-1, Baw Beese Lake to Jonesville Pond Dam

The St. Joseph River has its origin at the Baw Beese Lake outlet. A lake-level control structure sets the lake elevation and also acts as a barrier to fish movements. Baw Beese Lake is typical of the warmwater lakes in this area. Sixteen species totaling 126 fish and weighing 45.5 lbs were captured at this station (See table 2).

SUMMARY FOR SECTION M-1

(Baw Beese Lake to Mill Pond South of Jonesville)



Weather: Sky - Partly Cloudy to Cloudy
Precipitation - None

Nets: 2 Overnight Fykes at S-1 & S-4

Electro Fishing: 80 minutes, 4 stations

Weigh Stations: S-1 & S-3

	WATER CONDITIONS						TEMPERATURE	
	Secchi Disk	Color	Odor	D.O.	pH.	Hardness	Air	Water
S-1:	5.5'	Clear	None	9.0 ppm	9.0	205 ppm	82°F.	80°F.
S-2:	Visible on bottom	Clear	None	11.5	8.5	393	84°F.	77°F.
S-3:	3.5'	Dark Gray	None	5.5	7.5	291	76°F.	74°F.
S-4:	Visible on bottom (2.5')	Brown	None	10.0	8.5	256	79°F.	81°F.

OBSERVATIONS

S-1: Cover moderate. Vegetation moderate: Species of Chara, Ceratophyllum, Numphar and Sagittaria. Bottom soft and silty. Shoreline settled.

S-2: Cover sparse. Vegetation moderate: Species of Elodea and Potamogeton. Bottom silt and sand. Station just above Hillsdale W.W.T.P.

S-3: Cover heavy. Vegetation very heavy: Species of Lemna, Ceratophyllum, Numphar, Potamogeton, Vallisneria and Typha, and heavy strings of filamentous algae. Bottom silt over gravel.

S-4: Cover heavy. Vegetation very heavy: Species of Lemna, Ceratophyllum and Potamogeton. Bottom thick silt, impoundment filling in. Too weedy to Electro-fish efficiently.

FISHERIES COLLECTION M-1

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs.)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Bluegill	48	58	106	2.2	8.8	4.8	60	7.0	0.1
Largemouth Bass	13	7	20	2.2	11.8	7.7	17	4.4	0.3
Pumpkinseed	8	6	14	2.9	8.3	5.6	12	2.3	0.2
Perch	9	5	14	1.6	9.6	5.9	14	1.5	0.1
Black Crappie	1	7	8	5.8	8.1	-	-	-	-
Rock Bass	3	5	8	2.3	7.7	-	8	1.0	-
Green Sunfish	2	2	4	3.1	5.2	-	1	0.1	-
Northern Pike	-	3	3	15.4	20.8	-	3	5.1	-
Warmouth Bass	-	2	2	5.7	6.3	-	2	0.3	-
Subtotal	84	95	179				117	21.7	
Non-Game Fish									
White Sucker	30	1	31	4.4	15.4	8.4	7	7.1	-
Carp	-	7	7	17.6	22.8	-	-	-	-
Dogfish	4	1	5	17.8	26.8	-	4	18.7	-
Bullhead	-	2	2	13.2	14.1	-	2	2.1	-
Mud Pickerel	2	-	2	9.8	12.7	-	2	0.7	-
Longnose Gar	-	2	2	24.6	26.5	-	2	1.7	-
Spotted Gar	-	1	1	18.5	-	-	1	0.7	-
Lake Chubsucker	1	-	1	5.3	-	-	1	0.1	-
Subtotal	37	14	51				19	31.1	

Totals: 230 Fish (78% Game Fish) Sample Size 136 Fish (86% Game Fish)
17 Species (53% Game Fish) Wt. 52.8 lbs (41% Game Fish)

Forage Species: Bluntnose Minnow, Golden Shiner, Creek Chub, Mud-minnow and Fantail Darter.

Station #2 is the first survey site on the river and is located just above the Hillsdale Waste Water Treatment Plant and below a small impoundment. From here through the remainder of Zone #1 the species diversity, number and weight of the fish captured at each station fluctuated appreciably.

At Station #2 61 fish were captured but only 7 species. Thirty-two of these fish were bluegills which were probably migrants from the impoundment above.

Station #3 (Moore Rd.), is located just below a tributary, Beebe Creek, and is also the first station below the Hillsdale Waste Water Treatment Plant. A ten year old 100-acre impoundment and a housing development is situated upstream on Beebe Creek (Lake Bellaire). At Station #3 only 6 species (10 fish) were collected. The lowest weight of game fish of the entire survey at 0.1 lbs was recorded there. Also, the lowest total weight of all fish (game and non-game) recorded for the entire survey was at Station #3.

Jonesville POnd (Station #4) is another impoundment on the headwaters and lies adjacent to a golf course. The impoundment is almost completely silted in, and is weedy. Aquatic vegetation at Station #3 and #4 was the heaviest encountered in the entire survey.

Section M-2

Fish species and numbers increase below JOnesville at Genesee Rd. (Station #5) and Sterling Rd. (Station #6). Station #7 (Herring Rd.) is situated on a narrow impoundment above Litchfield. The impoundment is weedy and contains thick layers of silt; only 6 fish were collected here. This is the least number of fish collected on the entire survey. The 5 species of fish collected here and at Station #10 (T. Drive South) was the least number of species collected on the entire survey.

SUMMARY FOR SECTION M-2

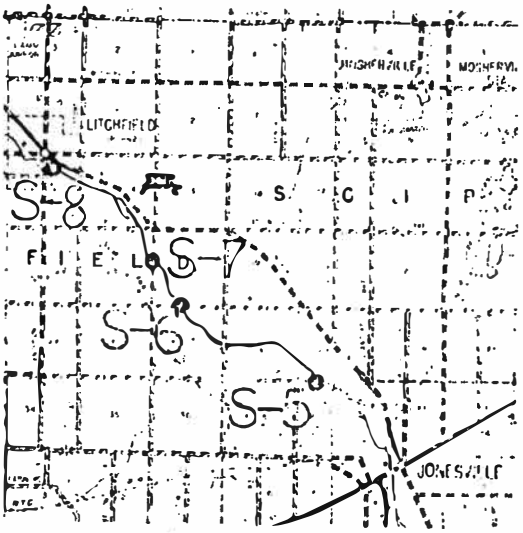
(City Limits of Jonesville To 49, Litchfield)

Weather: Sky - Partly Cloudy to Cloudy
Precipitation - Light Rain

Nets: None

Electro-Fishing: 80 minutes, 4 stations

Weigh Stations: S-5 & S-8



WATER CONDITIONS

	Secchi Disk	Color	Odor	D.O.	pH.	Hardness	Air	Water
S-5:	Visible on bottom	Clear	None	9.5 ppm	8.5	376 ppm	79°F.	78°F.
S-6:	"	Clear	None	8.0	8.5	274	77°F.	73°F.
S-7:	"	Clear	None	11.0	8.5	376	74°F.	77°F.
S-8:	"	Clear	None	8.0	8.5	274	84°F.	77°F.

OBSERVATIONS

S-5: Cover moderate. Vegetation sparse, Potamogeton Species. Bottom sand and gravel with small amounts of silt.

S-6: Cover moderate, overhanging brush. Vegetation sparse: Species of Lemna, Typha and Potamogeton. Bottom gravel, except heavy silt and shifting sand at bridge crossing.

S-7: Cover heavy. Vegetation heavy, Potamogeton species. Bottom heavy silt and sand, small areas of gravel (Station above dam at Litchfield).

S-8: Cover moderate. Vegetation moderate: Species of Potamogeton, Lemna and Vallisneria. Bottom sand and gravel. Forage species numerous (Station just below dam at Litchfield).

FISHERIES COLLECTION M-2

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs.)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Rock Bass	20	-	20	2.8	9.7	7.0	10	1.7	0.2
Largemouth Bass	11	-	11	8.0	15.1	10.9	11	6.9	0.6
Black Crappie	5	-	5	5.5	8.0	-	5	0.6	-
Northern Pike	4	-	4	5.6	23.8	-	2	1.3	-
Pumpkinseed	3	-	3	2.8	3.2	-	1	0.1	-
Bluegill	2	-	2	4.9	5.4	-	1	0.1	-
Smallmouth Bass	2	-	2	7.6	16.0	-	2	2.2	-
Green Sunfish	1	-	1	4.0	-	-	1	0.1	-
Subtotal	48		48				33	13.0	
Non-Game Fish									
White Sucker	53	-	53	4.1	17.0	8.5	23	11.8	0.5
Hog Sucker	12	-	12	7.6	15.2	10.0	5	4.4	-
Bullhead	5	-	5	3.3	10.1	-	5	0.8	-
Redhorse	4	-	4	9.0	14.3	-	4	2.3	-
Carp	3	-	3	9.1	23.1	-	1	0.3	-
Subtotal	77		77				38	19.6	

Totals: 125 Fish (38% Game Fish) Sample Size 71 Fish (46% Game Fish)
13 Species (62% Game Fish) Wt. 32.6 lbs (40% Game Fish)

Forage Species: Bluntnose Minnow, Common Shiner, Creek Chub, Stone Roller, Blacknose Dace, Golden Shiner, Hornyhead Chub, Blackside, Greenside, Rainbow and Johnny Darters.

Below this impoundment at Anderson Rd. (Station #8) 17 species of fish were collected. This is the highest number of species collected in Zone #1. Four bass from 10 to 16 inches were collected, including the first smallmouth bass collected on the survey.

Section M-3

Fish species collected decreased to 9 at Hadley Rd. below Litchfield (Station #9) and then to the record low of 5 species at T Drive South (Station #10). Only 10 fish were collected at Station #10. Aquatic vegetation was heavy at Station #9 and #10.

Fish numbers and species exhibited more stability from T Drive South (Station #11) to the end of Zone #1 at Stowell Rd. (Station #16).

Section M-3 (Stations #9 thru #12) is the least settled and the wildest section sampled along the mainstream. Also no impoundments are present in this section. Station #9 and #10 still exhibit the influence of the impoundments and villages above. Below Station #10 the river shows its first recovery. Fish were not plentiful at Station #11 (T Drive South) and Station #12 (10-1/2 Mile Rd.). However, 14 species of fish were found at each station. Aquatic vegetation was sparse at each station.

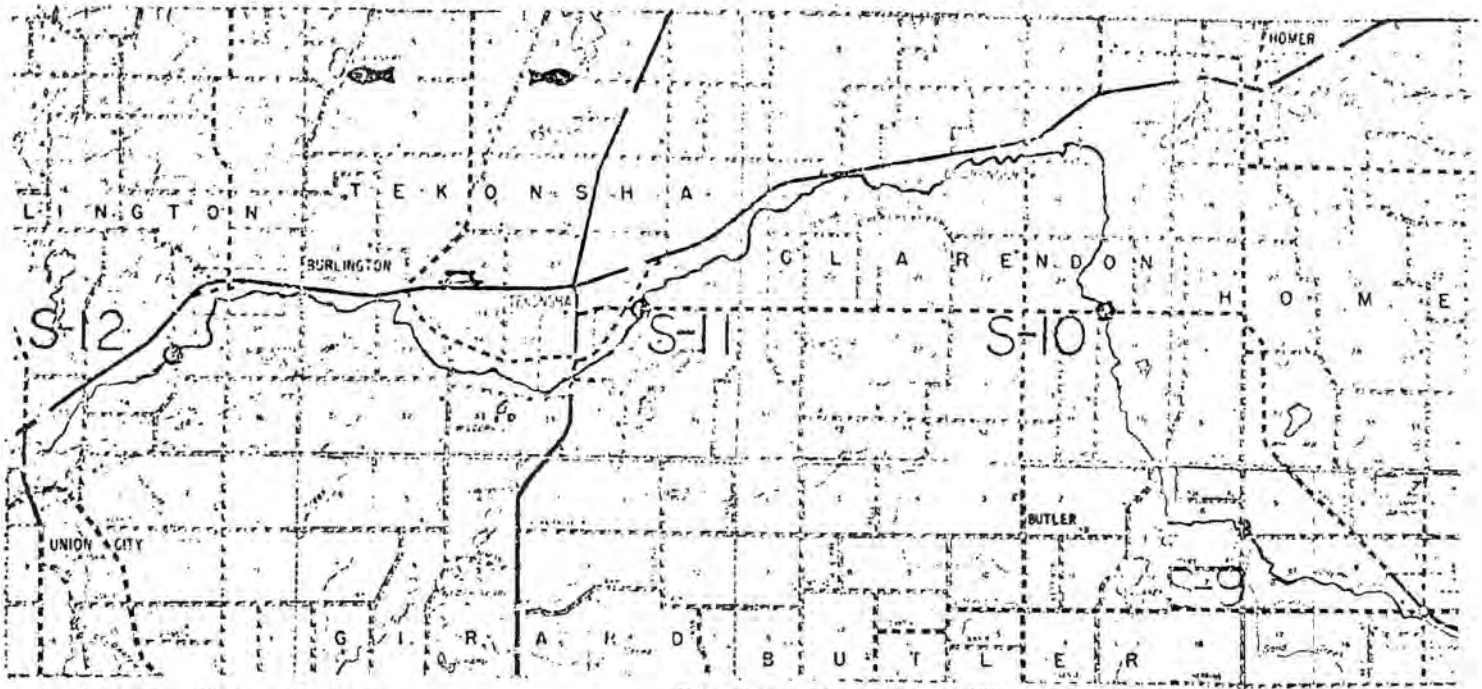
Station #12 has a unique position on the mainstream. This station has the advantage of being over 20 miles below the last village or impoundment. Also this is the last station where the waters were clear. Here 30 fish were collected, of which 24 were game fish. Three of those fish were smallmouth bass, 14 to 15 inches in length. A total of 9.1 lbs of fish were collected of which 6.7 lbs were game fish. This was the only station where game fish weighed substantially more than non-game fish.

Section M-4

Only 8 fish were captured at Broadway St.,-Union City (Station

SUMMARY FOR SECTION M-3

(M-44 in Litchfield to 9 Mile Road, Union City)



Weather: Sky - Cloudy
Precipitation - Showers

Electro Fishing: 80 minutes, 4 Stations

Weigh Stations: S-10 & S-12

Nets: None

	WATER CONDITIONS						TEMPERATURE	
	Secchi Disk	Color	Odor	D.O.	pH	Hardness	Air	Water
S-9:	Visible on Bottom	Slight Turbidity	None	8.5 ppm	8.5	393 ppm	73°F.	72°F.
S-10:	Visible on Bottom	Slight Turbidity	None	8.0	8.5	342	76°F.	73°F.
S-11:	Visible on Bottom	Clear	None	7.0	8.5	308	77°F.	76°F.
S-12:	Visible on Bottom	Slight Turbidity	None	7.5	8.5	308	80°F.	76°F.

OBSERVATIONS

S-9: Cover moderate. Vegetation, none in sample area, heavy Potamogeton species below bridge. Bottom mostly silt and sand with small areas of gravel.

S-10: Cover moderate. Vegetation heavy, Potamogeton species. Bottom mostly silt and sand with small areas of gravel.

S-11: Cover sparse. Vegetation sparse: Species of Typha and Potamogeton. Bottom mostly boulders, rubble and gravel, current swift. Banks wooded.

S-12: Cover sparse. Vegetation sparse: Species of Lemna, Sagittaria and Radicula. Bottom mostly gravel with some rubble, silt and shifting sand. Banks wooded.

FISHERIES COLLECTION M-3

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Rock Bass	19	-	19	1.9	8.5		5	1.3	-
Perch	11	-	11	4.2	5.0		11	0.2	-
Smallmouth Bass	6	-	6	4.5	15.1	-	5	5.0	-
Black Crappie	3	-	3	4.1	6.5	-	2	0.1	-
Bluegill	2	-	2	5.1	-	-	-	-	-
Green Sunfish	2	-	2	4.4	4.6	-	1	0.1	-
Largemouth Bass	1	-	1	6.6	-	-	1	0.1	-
Northern Pike	1	-	1	19.1	-	-	1	1.7	-
Subtotal	45		45				26	8.5	
Non-Game Fish									
Redhorse	18	-	18	4.5	16.0		6	4.6	-
White Sucker	8	-	8	6.5	18.2	-	4	6.1	-
Hog Sucker	3	-	3	4.3	14.7	-	-	-	-
Carp	3	-	3	17.2	24.3	-	3	17.3	-
Mud Pickerel	1	-	1	3.8			1	0.1	-
Subtotal	33		33				14	28.1	

Totals: 78 Fish (58% Game Fish) Sample Size 40 Fish (65% Game Fish)
13 Species (62% Game Fish) Wt. 36.6 (23% Game Fish)

Forage Species: Bluntnose minnow, Hornyhead, River and Creek Chubs, Common Shiner, Log perch, Rainbow and Greenside darters.

#13) and only one was a game fish. A noticeable increase in turbidity began at this station and continued downstream to the mouth of the river.

Fifteen species and 197 fish were collected at Union Lake. This was the highest number of fish collected in Zone #1. At only one other station on the entire survey were substantially more fish captured. Non-game fish captured at Union Lake totaled 70, and game fish 127. Non-game fish however, weighed 74.2 lbs as opposed to 19.4 lbs for game fish. Turbidity in the impoundment was heavy. The secchi disk reading was 2.5 feet compared to 5.5 feet for Baw Beese Lake.

The source of turbidity first encountered at Station #13, one mile above Union Lake was not apparent. Tributary and mainstream waters above Station #13 were clear; drains could be found in Union City that contributed to this turbidity. However, 60 of the 70 non-game fish collected in Union Lake were bottom feeding fishes (redhorse and carp). Movement upstream of redhorse and carp from Union Lake to Union City may have caused the turbid waters there. At Athens Rd. (Station #15) only 3 game fish weighing 0.7 lbs were collected. At Stowell Rd. (Station #16), the last station in Zone #1, species and numbers of fish began to increase again.

Zone #2, Colon to Mottville

Zone #2 includes Study Section M-5 through M-8 and Stations #17 through #31. Fish were weighed at 7 of the 15 stations surveyed in this zone. Sturgeon Lake (Station #17) was the only station netted in Section M-5. All stations beginning with Section M-6 (Station #21, Buckner Road) to the mouth of the river were netted in addition to the electro-fishing.

Section M-5

Species and numbers of fish expressed more stability in Zone #2

SUMMARY FOR SECTION M-4

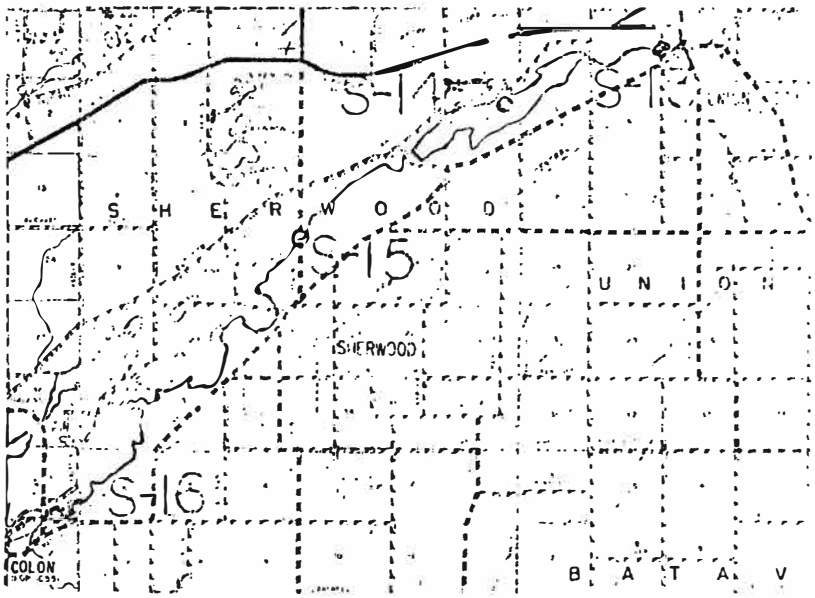
(Adolph Road, Union City, To Stowell Road)

Weather: Sky - Partly Cloudy to Cloudy
Precipitation - Showers

Nets: 2 Overnight Fykes at S-14

Electro Fishing: 80 minutes, 4 Stations

Weigh Stations: S-14 & S-15



WATER CONDITIONS

	Secchi Disk	Color	Odor	D.O.	pH	Hardness	TEMPERATURE Air	Water
S-13:	2.5'	Light Brown	None	8.0 ppm	8.5	256 ppm	80°F.	74°F.
S-14:	2.5'	Gray-Brown	None	9.5	8.5	222	77°F.	78°F.
S-15:	2.5'	Light Brown	None	10.0	8.5	325	87°F.	78°F.
S-16:	2.5'	Light Brown	None	6.5	8.5	256	85°F.	76°F.

OBSERVATIONS

S-13: Cover sparse. Vegetation sparse. Bottom sand and gravel. A noticeable increase in turbidity at this station.

S-14: Cover sparse. Vegetation sparse, some Typha species. Bottom silty. Shoreline settled - water looks rich in nutrients.

S-15: Cover sparse. Vegetation sparse. Bottom sand and gravel.

S-16: Cover sparse. Vegetation sparse. Bottom sand and gravel, some rubble. Banks wooded.

FISHERIES COLLECTION M-4

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs.)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Black Crappie	2	52	54	4.1	11.3	4.1	52	7.1	0.1
Bluegill	28	21	49	3.0	8.3	4.5	45	2.9	0.1
Largemouth Bass	17	-	17	5.0	14.0	9.5	16	8.2	0.5
Perch	10	2	12	4.2	7.7	5.7	10	0.9	0.1
Smallmouth Bass	8	-	8	4.8	8.8	-	2	0.5	-
Pumkinseed	4	-	4	3.2	5.7	-	4	0.4	-
Green Sunfish	1	-	1	-	5.9	-	1	0.1	-
Rock Bass	1	-	1	-	7.0	-	-	-	-
Subtotal	71	75	146				130	20.1	
Non-Game Fish									
Redhorse	72	6	78	3.3	18.6	9.3	61	26.1	0.4
White Sucker	10	2	12	6.2	18.5	9.1	7	4.7	-
Carp	10	2	12	11.9	28.3	18.0	11	48.5	4.4
Hog Sucker	6	-	6	6.3	15.7	-	4	3.7	-
Bullhead	-	2	2	7.8	11.5	-	2	1.1	-
Stonecat	1	-	1	-	8.1	-	-	-	-
Dogfish	1	-	1	-	24.3	-	1	5.5	-
Subtotal	100	12	112				86	89.6	

Totals: 258 Fish (57% Game Fish Sample Size 216 Fish (60% Game Fish)
15 Species (53% Game Fish) Wt. 109.71lbs. (18% Game Fish)

Forage Species: Common Shiner, Golden Shiner, Creek Chub, Brook Silversides, Blacknose Dace, Log Perch, Greenside and Johnny Darters.

than in Zone #1.

Fish species and numbers in Section M-5 decreased from a high at Sturgeon Lake (Station #17) to a low at Nottawa Road in Mendon (Station #20). The 19 species collected at Sturgeon Lake was the highest number of species collected for any station in Zone #2. Also, this was the second highest number of species recorded on the entire survey.

The 20 fish and 7 species captured at Mendon was the lowest number collected in Zone #2. Only 4 of the 20 fish collected were game fish.

Sturgeon Lake is greatly influenced by the fish species of the river mainstream. The other natural lake on the survey, Baw Beese, is influenced little by the river. Game fish captured at Baw Beese Lake numbered 115 and weighed 21.6 lbs and non-game fish captured numbered 11 and weighed 23.9 lbs. At Sturgeon Lake a total of 60 game fish weighing 14.1 lbs were collected. The non-game fish collected numbered 51 and weighed 88.9 lbs. The 11 non-game fish captured at Baw Beese Lake were dogfish, gars, mud pickerel and bullheads. At Sturgeon Lake 47 of the 51 non-game fish captured were suckers, redhorse and carp. The secchi disk reading was 5.5 feet at Baw Beese Lake compared to 2.8 feet at Sturgeon Lake.

Section M-6

Species and numbers of fish collected were high at most stations in Section M-6 (Stations #21 thru #24). The 193 fish collected at Buckner Rd. (Station #21) was one of the largest collections on the entire survey. Of the fish collected, 103 were game fish including 38 catchable size bluegills and black crappies.

A noticeable increase in fishing activity began at Section M-6 below Mendon. Fishing boats on the main stream were first noted in this

SUMMARY FOR SECTION M-5

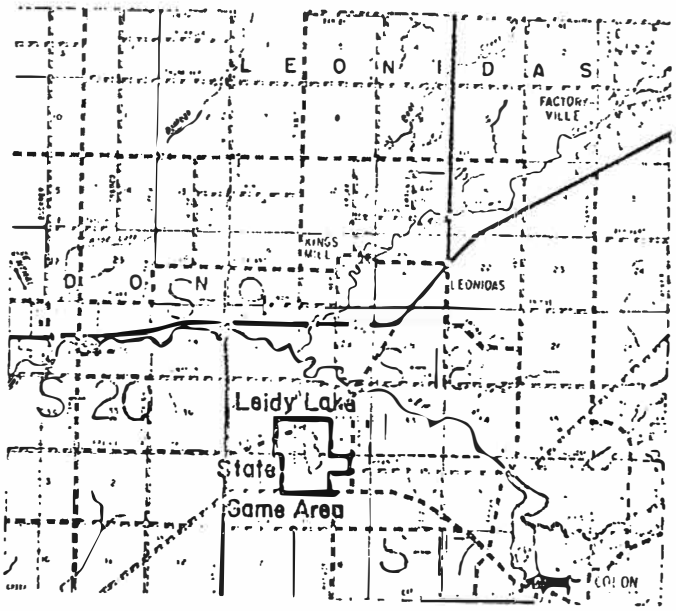
(Stowell Road to Buckner Road, Mendon)

Weather: Sky - Partly Cloudy
Precipitation - None

Nets: 2 Overnight Fykes at S-17

Electro - Fishing: 80 minutes, 4 Stations

Weigh Stations: S-17 & S-19



WATER CONDITIONS

	Secchi Disk	Color	Odor	D.O.	pH	Hardness	TEMPERATURE Air	Water
S-17:	2.8'	Gray-Brown	None	10.0 ppm	8.5	239 ppm	81°F.	78°F.
S-18:	2.0'	Brown	None	13.0	9.0	256	86°F.	85°F.
S-19:	2.5'	Brown	None	9.5	8.5	239	88°F.	82°F.
S-20:	3.0'	Brown	None	11.0	8.5	256	88°F.	85°F.

OBSERVATIONS

S-17: Cover moderate. Vegetation moderate around shore: Species of Numphar, Sagittaria and Scirpus. Bottom silt and sand. Some development around shore.

S-18: Cover sparse. Vegetation sparse, Potamogeton species present. Bottom mostly gravel, some boulders and sand. River wide, shallow and swift. Banks wooded.

S-19: Cover sparse. Vegetation sparse, some Scirpus species. Bottom sand and gravel. Some development along banks.

S-20: Cover sparse. Vegetation sparse, Sagittaria species present. Bottom mostly gravel with some sand.

FISHERIES COLLECTION M-5

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Bluegill	9	9	18	3.0	8.5	5.9	17	2.5	0.1
Black Crappie	3	14	17	4.8	11.6	8.2	16	5.7	0.4
Perch	14	1	15	4.9	7.5	5.7	15	1.0	0.1
Pumkinseed	10	-	10	2.6	6.5	4.7	7	0.9	-
Rock Bass	7	-	7	2.4	6.0	-	2	0.4	-
Smallmouth Bass	6	-	6	4.5	16.5	-	6	3.5	-
Largemouth Bass	5	-	5	6.1	11.4	-	3	0.9	-
Northern Pike	-	1	1	-	24.3	-	1	3.0	-
Subtotal	54	25	79				67	17.9	
Non-Game Fish *									
Redhorse	30	15	45	9.2	23.9	16.8	34	72.0	2.1
Carp	22	7	29	9.3	15.4	12.1	20	20.7	1.4
White Sucker	15	4	19	5.9	18.7	9.8	16	11.0	0.7
Spotted Sucker	10	4	14	8.7	17.2	12.3	12	11.1	0.9
Bullhead	3	1	4	6.8	11.8	-	1	0.1	-
Hog Sucker	3	-	3	11.9	12.5	-	1	1.0	-
Longnose Gar	2	-	2	20.8	25.2	-	2	1.6	-
Dogfish	2	-	2	15.3	22.8	-	1	1.1	-
Subtotal	87	31	118				87	118.6	

Totals: 197 Fish (40% Game Fish) Sample size 154 Fish (44% Game Fish)
17 Species (47% Game Fish) Wt. 136.5 lbs (13% Game Fish)

* One Spotted Gar missed at station S-17

Forage Species: Golden, common and spotfin shiners, Brook Silversides, Log Perch Blackside, Greenside and Johnny Darters.

section. This is because the mainstream affords, for the first time, sufficient navigability for boats with motors. Bank fishing and fishermens paths along the bank were also observed. Fishing activity appeared to be moderate to heavy throughout the remainder of the river.

Fishing activity was heavy at Station #22 (Covered Bridge Rd. Impoundment). Fishermen were seen fishing out of boats, on the bank and off the bridge. A few fair sized bluegills, crappies and two large northern pike were netted in the impoundment.

The Covered Bridge at this station is over 280 feet in length and is one of the 6 in existence in Michigan. The bridge looks especially appropriate for this area because of the horse and buggies used by the Amish residents.

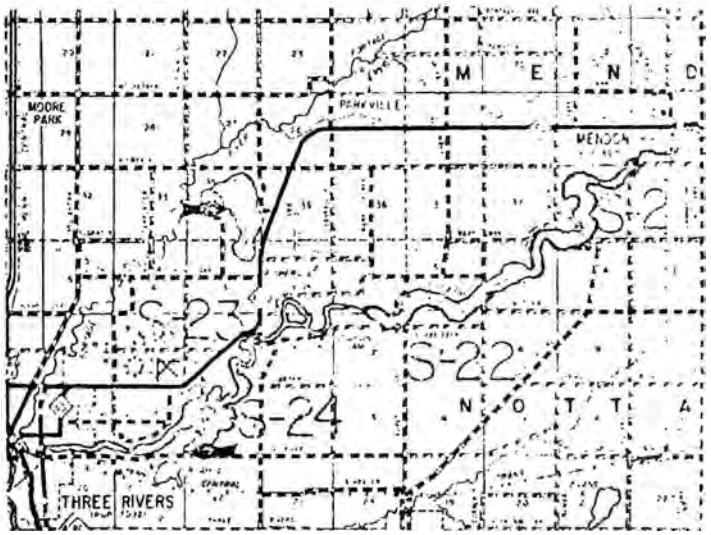
Station #23 was the only station in Section M-6 that was sampled in a flowing environment. Here fish species dropped, but numbers of fish dropped even more dramatically. Twelve of the 17 black crappies collected there were over 8 inches in length.

The brightest spot on the entire survey for bluegills was encountered at Three Rivers Impoundment (Station #24). A total of 164 fish were collected here of which 133 were game fish. This was the second highest number of game fish collected on the entire survey; game fish taken weighed 36.4 lbs and non-game fish weighed 73.1 lbs. One hundred and ten of the game fish were bluegills with a total weight of 26.7 lbs; 91 of these bluegills ranged from 6.0 to 8.5 inches in length.

Fish species per station from Schweitzer Road to the Indiana State Line (Stations #23 thru #31 in Zone #2, and Station #32 in Zone #3) were relatively low for stations in this segment. Fish species collected at stations in this segment of the river ranged from 10 to 20 species per station.

SUMMARY FOR SECTION M-6

(Buckner Road to Three Rivers Dam)



Weather: Sky - Clear to Partly Cloudy
Precipitation - None

Nets: 2 Overnight Fykes, 4 Stations

Electro Fishing: 80 minutes, 4 stations

Weigh Stations: S-23 & S-24

	WATER CONDITIONS						TEMPERATURE	
	Secchi Disk	Color	Odor	D.O.	pH.	Hardness	Air	Water
S-21:	3.0'	Brown	None	6.9 ppm	8.0	239 ppm	86°F.	80°F.
S-22:	3.0'	Green-Brown	None	12.0	8.5	239	88°F.	84°F.
S-23:	2.5'	Gray-Green	None	9.0	8.5	239	80°F.	83°F.
S-24:	1.7'	Gray-Brown	None	9.5	9.0	308	92°F.	84°F.

OBSERVATIONS

S-21: Cover moderate along shore, sparse otherwise. Vegetation moderate along shore: Species of Sagittaria, Numphar, Vallisneria, and Potamogeton. Bottom hard gravel. River wide and deep, current sluggish. Banks wooded and heavily used. All stations netted from here to mouth.

S-22: Cover sparse. Vegetation sparse: Species of Typha, Numphar and Potamogeton. Bottom sand and gravel, boulders near shore. Some development on shore.

S-23: Cover sparse, few trees submerged. Vegetation sparse: Species of Numphar and Sagittaria. Bottom sand and gravel, current sluggish. Banks wooded and heavily used by fishermen.

S-24: Cover sparse. Vegetation, sparse, except for Numphar species. Bottom sand and silt.

FISHERIES COLLECTION M-6

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs.)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt,	Ave.
Bluegill	36	200	236	2.0	9.1	6.5	128	29.8	0.2
Black Crappie	7	114	121	4.2	11.8	6.8	31	7.5	0.2
Largemouth Bass	10	3	13	2.2	16.3	8.9	7	4.1	-
Pumpkinseed	9	-	9	3.0	5.2	-	1	0.1	-
Smallmouth Bass	8	-	8	4.6	6.2	-	2	0.2	-
Northern Pike	-	4	4	21.0	31.2	-	2	4.4	-
Perch	1	-	1	5.4	-	-	-	-	-
Longear Sunfish	1	-	1	4.0	-	-	-	-	-
Green Sunfish	1	-	1	-	5.6	-	-	-	-
Warmouth Bass	-	1	1	-	7.0	-	-	-	-
Subtotal	73	322	395				171	46.1	
Non-Game Fish									
Carp	18	79	97	7.6	28.1	12.2	24	67.7	2.8
Redhorse	6	28	34	10.4	24.1	18.8	4	8.7	2.2
Longnose Gar	3	22	25	7.8	34.3	24.7	25	33.7	1.3
Bullhead	-	19	19	7.5	12.5	9.7	3	1.7	-
White Sucker	-	18	18	10.1	23.6	17.6	2	5.0	-
Spotted Sucker	1	3	4	11.2	17.8	-	1	0.8	-
Dogfish	-	1	1	-	25.6	-	1	5.4	-
Lake Chubsucker	1	-	1	6.4	-	-	-	-	-
Subtotal	29	170	199				60	123.0	

Totals: 594 Fish (66% Game Fish) Sample Size 231 Fish (74% Game Fish)
18 Species (56% Game Fish) Wt. 169.1 lbs (27% Game Fish)

Forage Species: Golden and Common Shiners, Log Perch and Brook Silversides.

Sections M-7 and M-8

At Stations #25 (3rd and E. Broadway, Three Rivers), #27 (Withers Rd.) and #32 (Thomas Rd.) 10 fish species were collected. Eleven species were collected at Station #23 (Schweitzer Rd.), #26 (Constantine Rd.), #28 (Constantine Impoundment), and #30 (N. River Rd.).

At Broadway St.-Three Rivers (Station #25) 34 fish were collected. This was the lowest number of fish collected in the electro-fishing and netting segment. Also at Station #25, an odor plus a gas ebullation from the river bottom were evident and an oil slick was present on the surface.

From Station #25 to the end of Zone #2 (Mottville Impoundment) the numbers of fish collected slowly increased. At Station #26 through #30 a fair number of black crappies from 7 to 12 inches were collected.

Zone #3, Mottville to Bertrand

Zone #3 includes Study Sections I-1 through I-3 and Stations #32 through #41. This zone is the southbend of the St. Joseph River and, except for Stations #32 and #41, lies entirely in Indiana. The Indiana segment lies within a heavily populated residential and industrial area.

Section I-1

Only ten fish species were collected at Station #32 (Thomas Rd.-Michigan). Otherwise fish species per station in Zone #3 ranged from 13 to a high of 17 at Station #41 (Bertrand-Michigan). Numbers of fish collected per station in the Indiana segment were high, compared to the other zones, with a peak of 300 fish collected at Mishawaka Impoundment (Station #38).

The 63 fish collected at Thomas Rd. (Station #32), lowest number collected in Zone #3, is misleading. This section of the river is below Mottville Impoundment and is also a fast-flowing productive riffle area. The nets set here rolled in the current and consequently caught fewer fish.

SUMMARY FOR SECTION M-7

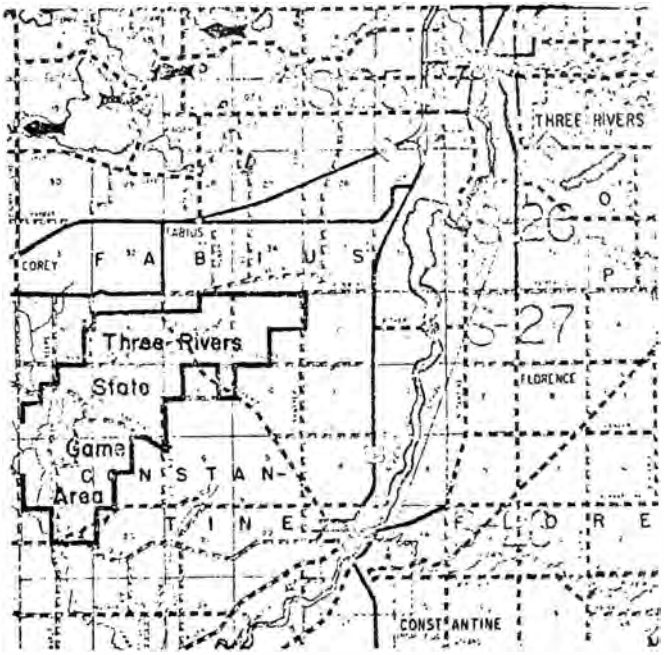
(Broadway Street, Three Rivers to Constantine Dam)

Weather: Sky - Clear to Partly Cloudy
Precipitation - Light Rain

Nets: 2 Overnight Fykes, 4 Stations

Electro - Fishing: 80 minutes, 4 Stations

Weigh Stations: S-26 & S-28



	WATER CONDITIONS						TEMPERATURE	
	Secchi Disk	Color	Odor	D.O.	pH.	Hardness	Air	Water
S-25:	2.0'	Dark Gray-Green	moderate	9.0 ppm	8.5	239 ppm	85°F	82°F
S-26:	2.0'	Brown-Green	none	9.0	8.5	222	73°F	79°F
S-27:	2.0'	Brown	slight	9.0	8.5	308	76°F	78°F
S-28:	1.5'	Brown-Green	none	9.0	8.5	291	68°F	76°F

OBSERVATIONS

S-25: Cover sparse, some submerged tree limbs. Vegetation sparse, some Potamogeton species, also some clumps of floating brown algae. Bottom sand and gravel with black ordorous silt along shore. Gas ebullition and trace of an oil slick on surface.

S-26: Cover sparse. Vegetation sparse, some Sagittaria species, along shore. Bottom sand and gravel.

S-27: Cover moderate. Vegetation moderate, Numphar species. Bottom silt.

S-28: Cover sparse. Vegetation sparse: Species of Numphar and Sagittaria. Bottom sand and gravel.

FISHERIES COLLECTION M-7

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs.)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Black Crappie	4	121	125	4.2	12.0	7.0	77	11.8	0.2
Bluegill	14	14	28	3.0	7.5	4.9	21	1.4	0.1
Smallmouth Bass	16	3	19	2.1	11.0	5.6	15	2.1	0.2
Largemouth Bass	4	1	5	5.4	12.6	-	5	1.9	-
Northern Pike	-	4	4	18.9	25.3	-	3	7.9	-
Pumkinseed	1	2	3	4.3	6.1	-	1	0.1	-
Rock Bass	-	1	1	-	8.3	-	-	-	-
Subtotal	39	146	185				122	25.2	
Non-Game Fish									
Redhorse	18	18	36	9.0	19.5	14.2	16	18.8	1.2
Carp	9	27	36	13.4	28.3	16.9	29	57.4	2.0
Spotted Sucker	14	3	17	6.5	13.5	8.5	11	2.1	0.2
Longnose Gar	0	15	15	20.8	31.6	27.2	6	7.2	-
White Sucker	1	4	5	11.0	16.1	-	4	3.1	-
Bullhead	0	4	4	9.4	10.8	-	1	0.3	-
Subtotal	42	71	113				67	88.9	

Totals: 298 Fish(62% Game Fish) Sample Size 189 Fish (65% Game Fish)
13 Species (54% Game Fish) Wt. 114.1 lbs (22% Game Fish)

Forage Species: Common Shiner and Log Perch.

SUMMARY FOR SECTION M-8

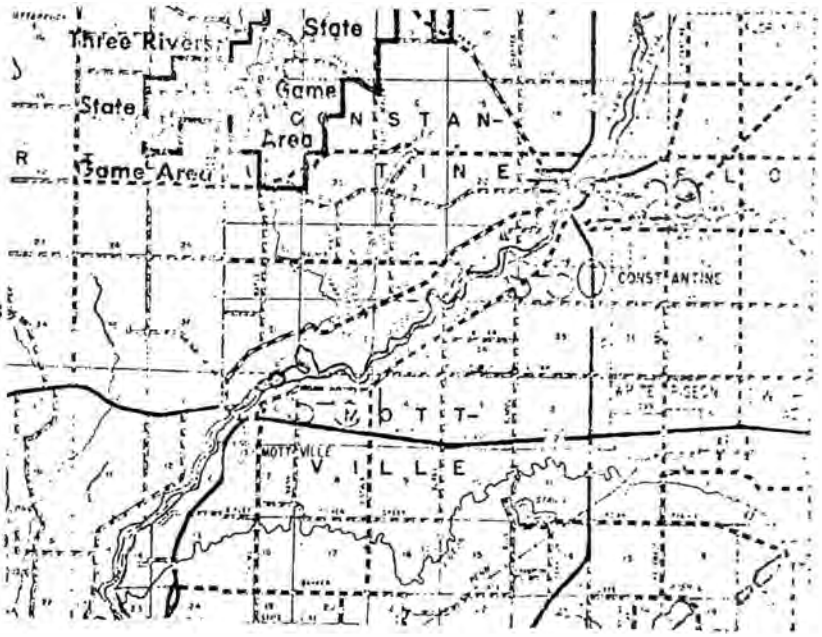
(Below Constantine Dam to Mottville Dam)

Weather: Sky - Partly Cloudy to Cloudy
Precipitation - Rain

Nets: 2 Overnight Fykes, 3 Stations

Electro - Fishing: 81 minutes, 3 Stations

Weigh Stations: S-30



	WATER CONDITIONS						TEMPERATURE	
	Secchi Disk	Color	Odor	D.O.	pH.	Hardness	Air	Water
S-29:	2.0	Green-Brown	slight	11.5	9.0	308 ppm	68°F	82°F
S-30:	1.1	Dark Green-Brown	none	10.0	8.5	256	68°F	77°F
S-31:	1.8	Green-Brown	none	10.0	8.5	239	68°F	73°F

OBSERVATIONS

S-29: Cover moderate. Vegetation moderate: Species of Vallisneria, Sagittaria and Potamogeton. Bottom rubble and gravel with thin layers of silt near shore. Current swift. Nets set below W.W.T.P. covered with slime. Banks residential and wooded.

S-30: Cover moderate, trees and stumps. Vegetation moderate along shore: Species Numphar, Sagittaria and Potamogeton. Bottom sand and gravel. Banks wooded and settled.

S-31: Cover sparse. Vegetation sparse: Species of Numphar, Sagittaria, and Potamogeton around shore. Impoundment settled on the south shore.

FISHERIES COLLECTION M-8

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs.)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Bluegill	72	73	145	2.8	7.3	4.7	19	1.3	0.1
Black Crappie	2	88	90	3.3	12.5	6.4	25	5.6	0.2
Smallmouth Bass	5	1	6	2.4	11.0	-	-	-	-
Largemouth Bass	3	1	4	2.3	14.0	-	1	1.6	-
Pumkinseed	3	1	4	3.1	6.0	-	1	0.1	-
Northern Pike	0	3	3	23.0	31.3	-	1	5.9	-
Green Sunfish	2	0	2	2.9	3.5	-	-	-	-
Warmouth Bass	1	0	1	-	6.5	-	1	0.3	-
Rock Bass	1	0	1	5.3	-	-	-	-	-
Subtotal	89	167	256				48	14.8	
Non-Game Fish									
Redhorse	8	34	42	7.0	22.0	17.3	21	45.1	2.1
Spotted Sucker	25	3	28	6.8	15.7	11.6	10	7.0	0.7
White Sucker	5	19	24	12.8	18.5	16.8	11	19.5	1.8
Carp	2	9	11	10.2	27.2	20.3	6	20.1	-
Longnose Gar	0	8	8	21.9	35.3	-	2	3.9	-
Spotted Gar	0	1	1	21.8	-	-	-	-	-
Hog Sucker	0	1	1	14.2	-	-	-	-	-
Subtotal	40	75	115				50	95.6	

Totals: 371 Fish (69% Game Fish) Sample Size 98 Fish (49% Game Fish)
16 Species (56% Game Fish) Wt. 110.4 lbs (13% GameFish)

Forage Species: Golden and spotfin shiners, Bluntnose minnow and Log Perch.

This section contained a multitude of redhorse. In the fast current many fish that were stunned with electro-fishing gear floated down stream and escaped capture. Forty of the 63 fish captured here were redhorse.

At Bristol, Indiana (Station #33) 103 of the 137 fish collected were redhorse. Also, this was the first station on the river where channel catfish were captured. A weight of 146.7 lbs of fish was collected at Bristol of which 7.0 lbs were game fish. This amounts to less than 5 per cent game fish by weight and the lowest weight ratio of game to non-game fish recorded on the survey.

At Elkhart Impoundment (Station #35) 106 of the 134 fish collected were game fish. Seventy-three of the game fish were black crappies. However, only 7 of these were catchables (7 - 11 inches).

Section I-2

Twenty-five of the 38 black crappies netted below the Elkhart Waste Water Treatment Plant (Station #36) were from 7 to 11 inches. Thirteen of the 15 channel catfish captured were 13 to 22 inches. A slight odor was noticed at this station and nets raised after setting overnight were covered with a slime mold.

The highest weight of fish collected on the survey was recorded from the Mishawaka Impoundment (Station #37). Game fish at Station #37 weighed 19.2 lbs or less than 10% of the total 204.7 lbs caught. The 34 carp captured at Station #37 weighed 163.0 lbs.

This was the first station on the survey where white crappies were collected. White crappies were not collected at any of the Michigan stations. Eighteen of the 51 black and white crappies collected were catchables 7 to 12 inches. Ten largemouth bass were collected of which

SUMMARY FOR SECTION I-1

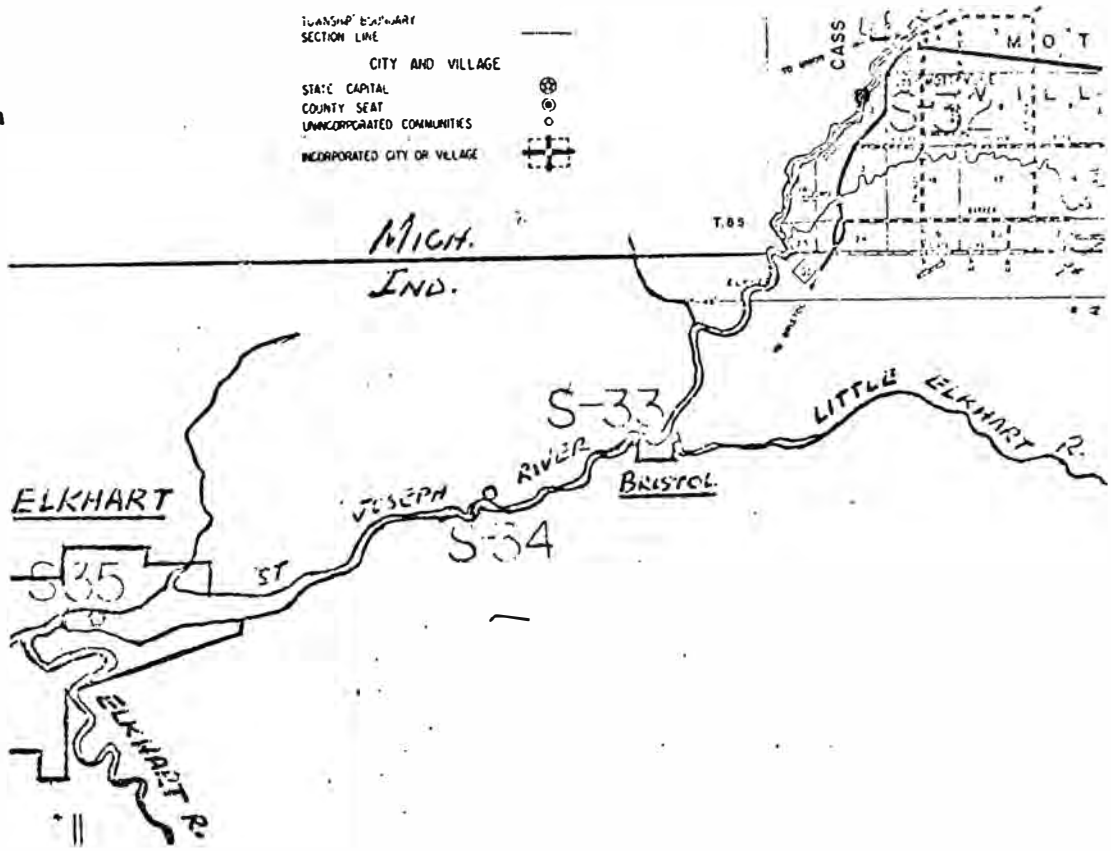
(Below Mottville Dam to Elkhart Dam)

Weather: Sky - Partly Cloudy to Cloudy
Precipitation - Rain

Nets: 2 Overnight Fykes, 4 Stations

Electro - Fishing: 80 minutes, 4 Stations

Weigh Stations: S-33 & S-34



	WATER CONDITIONS						TEMPERATURE	
	Secchi Disk	Color	Odor	D.O.	pH.	Hardness	Air	Water
S-32:	1.4'	Greenish Brown	None	10.0 ppm	8.5	256 ppm	68°F	73°F
S-33:	1.8'	Greenish Brown	None	9.0	8.5	291	62°F	66°F
S-34:	2.1'	Greenish Brown	None	10.0	8.5	256	62°F	69°F
S-35:	2.1'	Greenish Brown	None	9.0	8.5	256	64°F	68°F

OBSERVATIONS

S-32: Cover sparse. Vegetation Sparse: Species of Numphar, Sagittaria and Scirpus. Bottom gravel and current swift. Banks wooded. Many Redhorse missed.

S-33: Cover sparse to moderate. Vegetation sparse to moderate mostly Potamogeton species. Bottom gravel. Banks wooded. Many Redhorse missed.

S-34: Cover sparse. Vegetation sparse: Species of Sagittaria and Potamogeton, Bottom gravel. Banks wooded.

S-35: Cover sparse. Vegetation, none observed. Bottom sand and gravel. Banks residential expensive homes.

FISHERIES COLLECTION I-1

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Black Crappie	2	113	115	4.7	11.2	6.3	75	9.0	0.1
Bluegill	8	21	29	3.3	7.0	5.0	19	1.6	0.1
Smallmouth Bass	29	0	29	2.3	17.4	7.7	14	4.9	0.4
Perch	7	0	7	4.6	7.5	-	4	0.4	-
Channel Catfish	2	5	7	9.8	18.4	-	2	2.6	-
Rock Bass	1	4	5	4.2	7.9	-	2	0.3	-
Largemouth Bass	4	0	4	2.9	14.8	-	2	0.4	-
Northern Pike	1	2	3	22.0	26.5	-	-	-	-
Longear Sunfish	3	0	3	2.9	3.8	-	3	0.1	-
Green Sunfish	3	0	3	5.3	6.6	-	3	0.3	-
Pumkinseed	1	0	1	-	6.8	-	-	-	-
Subtotal	61	145	206				124	19.6	
Non-Game Fish									
Redhorse	187	21	208	4.0	28.3	13.5	123	137.9	1.1
Carp	11	9	20	7.5	29.2	17.7	7	16.6	-
White Sucker	4	8	12	2.4	19.7	15.0	3	1.1	-
Hog Sucker	10	0	10	7.2	15.1	12.0	7	6.0	-
Bullhead	0	7	7	7.3	13.5	-	2	1.5	-
Spotted Sucker	2	1	3	9.8	12.7	-	3	2.1	-
Longnose Gar	0	2	2	22.0	24.6	-	2	2.1	-
Mud Pickerel	1	0	1	10.2	-	-	-	-	-
Subtotal	215	48	263				147	167.3	

Totals: 469 Fish (44% Game Fish) Sample Size 271 Fish (46% Game Fish)
19 Species (58% Game Fish) St. 186.9 lbs (10% Game Fish)

Forage Species: Golden and Common Shiners, Bluntnose Minnow, Blackside Darter and Log Perch.

6 were 10 to 17 inches in length. Swimming beaches, diving docks and skiing ramps were present on the impoundment.

The highest number of game fish (186) and also the highest number of total fish (300) for the entire survey was collected at Mishawaka Impoundment (Station #38). Crappies were the most abundant game fish. Twenty-four black crappies and 106 white crappies were collected, but only 13 of the combined total were over 7 inches in length. The predominant non-game fish collected were 38 bullheads ranging from 8 to 12 inches in length.

Section I-3

One hundred and nine of the 134 fish collected at Station #39 (Memorial Park, Mishawaks, Ind.) were game fish but only 8 were of catchable size.

Twenty-nine smallmouth bass were collected below the City of South Bend (Station #40). This was the highest number of smallmouth bass collected at any station. However, only three were over 10 inches long.

Ten species of game fish were collected at Station #41 (Bertrand, Michigan). This was the largest number of game species collected on the survey. Only 71 fish were collected at Station #41 but 50 were game fish. The 4.5 ppm of dissolved oxygen found there was the lowest concentration found on the survey.

Zone #4, Bertrand to Lake Michigan

Zone #4 includes Study Sections M-9 through M-11 and Stations #42 through #52. This zone lies entirely in Berrien County.

Section M-9, M-10 and M-11

A number of fish species in this zone ranged from 12 to 20 per station. Number of species per station exhibited a decline below South Bend.

SUMMARY FOR SECTION I-2

(Below Elkhart Dam to Mishawaka Dam)

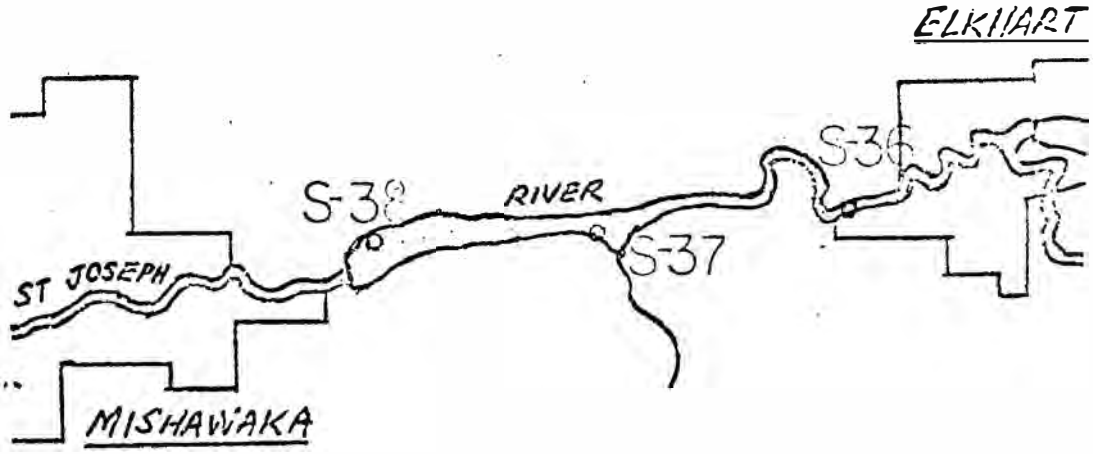
Weather: Sky - Cloudy
Precipitation - Rain

MICHIGAN
INDIANA

Nets: 2 Overnight
Fykes, 3 Stations

Electro-Fishing: 81
minutes, 3 Stations

Weigh Station: S-37



WATER CONDITIONS

	Secchi Disk	Color	Odor	D.O.	pH.	Hardness	TEMPERATURE Air	Water
S-36:	1.9'	Greenish Brown	Moderate	9.0 ppm	8.5	274 ppm	60°F	67°F
S-37:	1.5'	Greenish Brown	None	8.0 ppm	8.5	274	68°F	68°F
S-38:	1.5'	Greenish Brown	None	8.0 ppm	8.0	256	68°F	68°F

OBSERVATIONS

S-36: Cover sparse except near shore. Vegetation moderate along shore: Species of Numphar and Sagittaria. Bottom sand and gravel. Banks wooded. Nets covered with slime. Station below W.W.T.P.

S-37: Cover sparse. Vegetation sparse: Species of Numphar and Sagittaria. Bottom sand and gravel. Banks wooded. Swimming beaches and diving docks along shore.

S-38: Cover sparse. Vegetation sparse, except along shore, Numphar species. Bottom sand and gravel. Banks residential and wooded.

FISHERIES COLLECTION T-2

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs.)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
White Crappie	0	139	139	5.3	12.0	6.6	33	4.3	0.1
Black Crappie	6	74	80	4.8	11.6	7.4	18	3.0	0.2
Pumkinseed	62	3	65	2.0	6.7	4.6	19	1.0	0.1
Bluegill	14	7	21	2.5	6.6	3.9	5	0.4	-
Smallmouth Bass	19	0	19	4.7	12.0	6.2	7	1.3	-
Channel Catfish	5	13	18	7.1	22.5	14.1	1	0.3	-
Largemouth Bass	12	0	12	2.3	16.8	11.0	10	8.7	0.9
Green Sunfish	6	0	6	2.6	3.9	-	1	0.1	-
Longear Sunfish	2	0	2	3.8	4.3	-	2	0.1	-
Rock Bass	1	0	1	5.8	-	-	-	-	-
Subtotal	127	236	363				91	19.2	
Non-Game Fish									
Redhorse	60	46	106	8.2	22.1	16.0	9	12.7	-
Carp	25	37	62	11.7	29.0	19.7	34	163.0	4.8
White Sucker	9	30	39	6.5	18.1	15.7	7	6.7	-
Bullhead	0	38	38	8.1	12.4	10.3	-	-	-
Spotted Sucker	5	0	5	11.5	14.4	-	3	3.1	-
Longnose Gar	0	2	2	21.7	27.0	-	-	-	-
Subtotal	99	153	252				53	185.5	

Totals: 615 Fish (59% Game Fish) Sample Size 144 (63% Game Fish)
16 Species (62% Game Fish) Wt. 204.71lbs. (9% Game Fish)

Forage Species: Golden, Common & Satinfin Shiners, Bluntnose Minnow and Log Perch.

SUMMARY FOR SECTION I-3

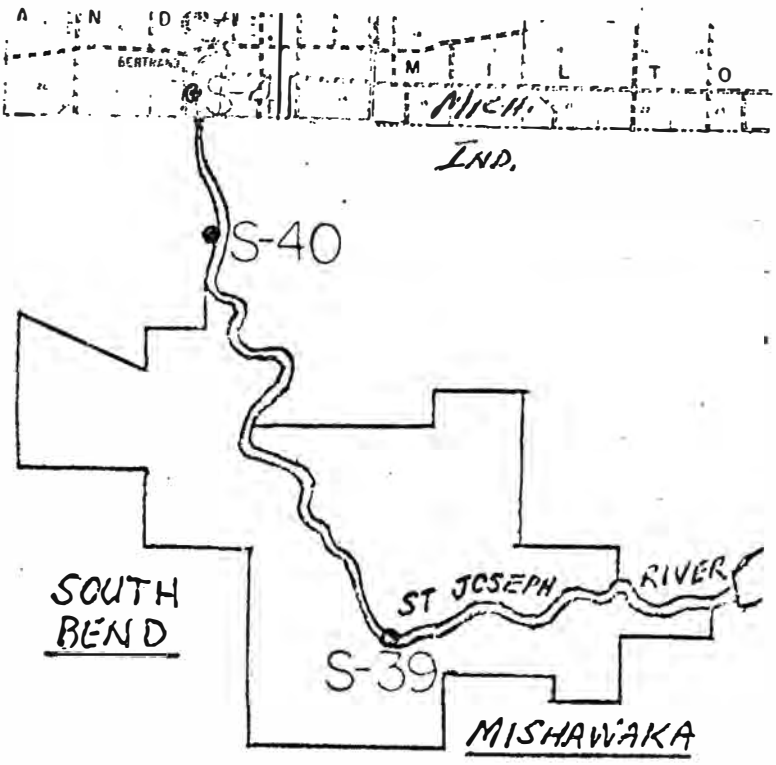
(Below Mishawaka Dam to Bertrand)

Weather: Sky - Partly Cloudy
Precipitation - None

Nets: 2 Overnight Fykes, 3 Stations

Electro-Fishing: 81 minutes, 3 Stations

Weigh Station: S-40



WATER CONDITIONS

	Secchi Disk	Color	Odor	D.O.	pH.	Hardness	TEMPERATURE Air	Water
S-39:	2.5'	Brownish Gray	None	6.0 ppm	8.0	256 ppm	60°F	66°F
S-40:	2.4'	Greenish Brown	None	6.5	8.5	308	74°F	69°F
S-41:	2.2'	Greenish Brown	None	4.5	8.0	274	68°F	70°F

OBSERVATIONS

S-39: Cover sparse. Vegetation sparse: Species of Elodea, Ceratophyllum, Numphar and Potamogeton. Bottom gravel and rubble: Banks residential and wooded.

S-40: Cover sparse. Vegetation moderate: Potamogeton species. Bottom gravel and rubble. Banks wooded. Station below W.W.T.P.

S-41: Cover sparse. Vegetation; none observed. Bottom gravel and rubble. Banks wooded.

FISHERIES COLLECTION I-3

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Pumkinseed	61	41	102	1.7	5.9	3.9	23	1.7	0.1
Smallmouth Bass	44	2	46	2.0	12.2	6.7	29	5.1	0.2
Bluegill	5	15	20	3.9	6.9	5.3	9	0.8	-
White Crappie	0	18	18	5.5	11.9	7.1	4	0.4	-
Rock Bass	15	1	16	3.2	9.0	6.3	2	0.5	-
Green Sunfish	12	0	12	3.5	5.4	4.2	-	-	-
Black Crappie	5	5	10	5.6	12.2	7.5	-	-	-
Longear Sunfish	8	0	8	3.0	5.5	-	4	0.4	-
Largemouth Bass	3	1	4	3.2	10.1	-	1	0.1	-
Channel Catfish	0	2	2	16.6	17.6	-	-	-	-
Northern Pike	0	1	1	-	33.7	-	-	-	-
Subtotal	153	86	239				72	9.0	
Non-Game Fish									
Carp	29	7	36	11.9	34.7	23.5	13	64.9	5.0
Bullhead	0	9	9	9.9	13.5	-	-	-	-
Redhorse	7	1	8	7.0	15.4	-	6	2.8	-
White Sucker	6	0	6	6.8	15.5	-	4	2.3	-
Spotted Sucker	2	0	2	11.8	12.2	-	-	-	-
Quillback	0	1	1	8.8	-	-	1	0.5	-
Subtotal	44	18	62				24	70.5	

Totals: 301 Fish (79% Game Fish) Sample Size 96 Fish (75% Game Fish)
17 Species (65% Game Fish) Wt. 79.5 lbs (11% Game Fish)

Forage Species: Golden, Common & Spotfin Shiners, Bluntnose Minnow and Blackside Darter.

Seventeen species were collected at South Bend (Station #41), 15 at Station #42 and 13 at the Niles Impoundment (Station #43). Numbers of fish collected per station also declined in this area to a low of 47 collected at Station #43. This was the least number of fish collected in Zone #4 and also the least number collected in this segment.

Fish species increased from 15 below Niles (Station #44) to a high of 20 at Buchanan Impoundment (Station #45). This was the largest number of species collected at a station on the entire survey. Fish species dropped to 13 below Buchanan (Station #46) and at Bear Cave Campground (Station #47). Numbers of species were also low in the collection below Pipestone Creek (Station #51) and in Benton Harbor-St. Joseph (Station #52); only 12 fish species were collected at each of these stations.

Numbers of fish collected in Zone #4 increased from a low of 47 at Niles Impoundment (Station #43) to a high of 201 fish at Berrien Springs Impoundment (Station #48). Below Berrien Springs, (Station #49) numbers of fish collected dropped to 56 individuals.

A fair number of large black crappies were collected at Station #44, below the Niles W.W.T.P. and the mouth of the Dowagiac River. Thirteen of the 18 crappies collected ranged from 10 to 13 inches in length.

At Station #46, 16 of the 27 black crappies collected ranged from 7 to 12 inches. And 7 of the 13 smallmouth bass collected ranged from 10 to 16 inches in length.

The highest number of fish collected in Zone #4 was 201 fish at the Berrien Springs Impoundment. This was the second highest number of fish collected on the survey. Non-game fish accounted for 166 of the total number. Eighty-five of the non-game fish were white suckers and 70 were

SUMMARY FOR SECTION M-9

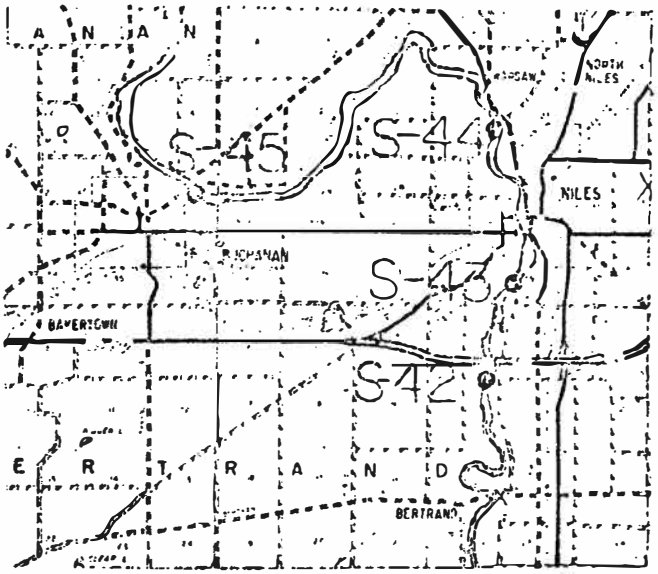
(Bertrand to Buchanan Dam)

Weather: Sky - Cloudy
Precipitation - Rain

Nets: 2 Overnight Fykes, 4 Stations

Electro-Fishing: 80 minutes, 4 Stations

Weigh Stations: S-42 & S-44



	WATER CONDITIONS						TEMPERATURE	
	Secchi Disk	Color	Odor	D.O.	pH	Hardness	Air	Water
S-42:	2.5'	Brown	None	10.0 ppm	8.5	239 ppm	78°F	74°F
S-43:	2.5	Brown	None	10.0	8.5	239	78°F	74°F
S-44:	2.8	Brownish Green	None	8.0	8.0	291	73°F	76°F
S-45:	2.0	Brownish Green	None	8.0	8.0	274	69°F	76°F

OBSERVATIONS

S-42: Cover sparse. Vegetation sparse; Species of Sagittaria and Numphar. Bottom sand and gravel.

S-43: Cover sparse. Vegetation sparse; Species of Sagittaria and Numphar. Bottom sand and gravel.

S-44: Cover sparse. Vegetation sparse; Species of Sagittaria, Numphar and Anacharis. Bottom sand, gravel with frequent silt deposits. Banks wooded. Station just below Niles W.W.T.P.

S-45: Cover sparse. Vegetation sparse, Sagittaria species. Bottom gravel. Banks steep and wooded.

FISHERIES COLLECTION M-9

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Pumkinseed	33	12	45	2.7	6.6	4.2	30	2.6	0.1
Black Crappie	1	39	40	5.6	13.2	9.7	16	8.3	0.5
Smallmouth Bass	28	7	35	2.2	14.9	7.8	25	4.9	0.2
Bluegill	15	16	31	1.6	8.3	4.5	18	1.7	0.1
Channel Catfish	0	17	17	9.3	18.7	14.2	6	8.0	-
Largemouth Bass	8	2	10	6.6	13.8	9.5	2	2.7	-
Rock Bass	0	5	5	6.3	8.1	-	5	1.5	-
Green Sunfish	4	0	4	2.6	6.2	-	2	0.3	-
Longear Sunfish	1	3	4	4.0	5.5	-	3	0.2	-
Northern Pike	0	2	2	23.8	30.1	-	2	10.1	-
Subtotal	90	103	193				109	40.3	
Non-Game Fish									
Carp	35	46	81	9.3	30.6	18.5	27	106.2	3.9
White Sucker	32	18	50	5.6	16.4	13.7	35	31.6	0.9
Redhorse	10	9	19	5.5	17.1	12.0	12	6.3	0.5
Longnose Gar	1	14	15	11.5	31.5	25.5	8	9.5	-
Bullhead	0	11	11	9.6	13.2	9.7	10	5.9	0.6
Spotted Sucker	4	1	5	9.8	15.3	-	2	1.1	-
Quillback	0	4	4	7.9	16.0	-	3	3.0	-
Goldfish	2	0	2	8.9	12.5	-			
Subtotal	84	103	187				97	163.6	

Totals: 380 Fish (51% Game Fish) Sample Size 206 Fish (53% Game Fish)
18 Species (56% Game Fish) Wt. 203.9 lbs (20% Game Fish)

Forage Species: Golden and Common Shiners, Bluntnose Minnow, Brook Silverside and Log Perch.

SUMMARY FOR SECTION M-10

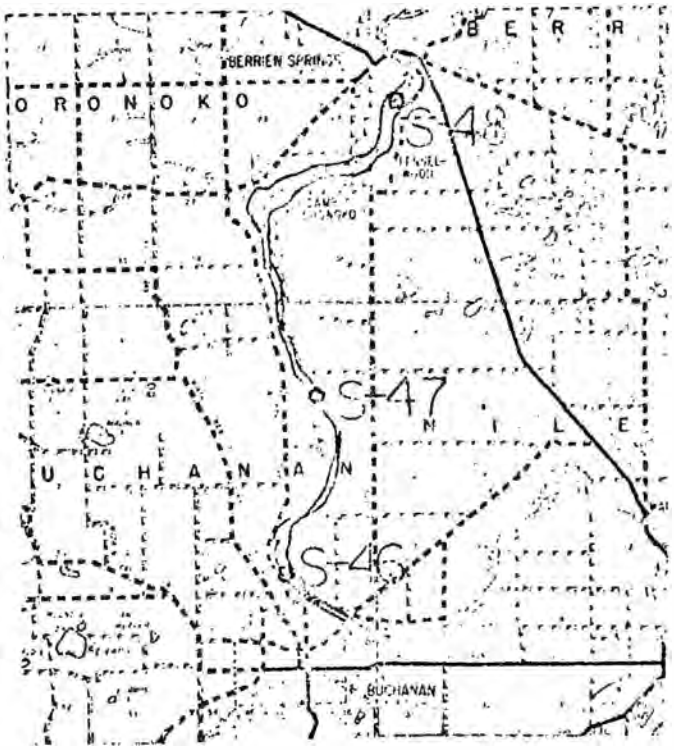
(Below Buchanan Dam to Berrien Springs Dam)

Weather: Sky - Cloudy
Precipitation - None

Nets: 2 Overnight Fykes, 3 Stations

Electro-Fishing: 81 minutes, 3 Stations

Weigh Station: S-47



	WATER CONDITIONS						TEMPERATURE	
	Secchi Disk	Color	Odor	D.O.	pH.	Hardness	Air	Water
S-46:	2.5'	Greenish Brown	None	8.0 ppm	8.5	274 ppm	74°F	76°F
S-47:	3.0	Greenish Brown	None	10.0	8.5	291	74°F	76°F
S-48:	1.8	Greenish Brown	None	10.0	8.5	256	69°F	76°F

OBSERVATIONS

S-46: Cover sparse. Vegetation, none observed. Bottom sand and gravel. Area below dam heavily fished.

S-47: Cover sparse. Vegetation sparse, Sagittaria species. Bottom sand and gravel. Banks wooded. Historic natural cave, public admitted for fee.

S-48: Cover sparse. Vegetation sparse; Species of Typha and Sagittaria. Bottom sand and gravel with silt deposits.

FISHERIES COLLECTION M-10

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Black Crappie	1	38	39	5.6	12.9	8.4	8	2.1	-
Smallmouth Bass	27	8	35	1.7	17.9	8.4	10	1.9	0.2
Pumkinseed	19	3	22	3.2	5.5	4.1	16	0.6	0.1
Channel Catfish	4	17	21	7.2	18.8	12.7	-	-	-
Bluegill	4	12	16	4.1	7.7	5.8	9	2.1	-
Longear Sunfish	15	0	15	2.3	5.0	4.1	8	0.3	-
Green Sunfish	8	3	11	2.8	6.9	4.7	3	0.6	-
Rock Bass	5	2	7	5.1	7.6	-	2	0.2	-
Largemouth Bass	0	1	1	-	16.2	-	-	-	-
Subtotal	83	84	167				56	7.8	
Non-Game Fish									
Carp	95	84	179	6.6	23.2	12.1	59	55.1	0.9
White Sucker	18	91	109	8.4	15.4	12.4	16	9.2	0.6
Redhorse	20	24	44	7.3	17.5	12.5	7	6.7	-
Spotted Sucker	5	3	8	9.2	12.7	-	4	1.8	-
Longnose Gar	0	5	5	20.2	30.3	-	1	0.6	-
Bullhead	0	4	4	9.4	12.1	-	3	1.0	-
Quillback	0	1	1	-	14.2	-	-	-	-
Subtotal	138	212	350				90	74.4	
Totals	517 Fish (32% Game Fish) Sample Size 146 Fish (38% Game Fish) 16 Species (56% Game Fish) Wt. 82.2 lbs (9% Game Fish)								

Forage Species: Log Perch

carp. The white suckers were noticeably thin in appearance.

At Station #49 (below Berrien Springs) only 56 fish were collected of which 40 were game and 16 non-game fish though only slightly more. A total of 59.3 lbs of fish were collected of which 29.9 lbs were game and 29.4 were non-game fish. This was one of the two stations on the survey where game fish weighed more than non-game fish. The area below Berrien Springs Dam (First impoundment above Lake Michigan) is heavily fished. The bend of the north bank below the dam is edged with dip netting scaffolds used for trapping fish, primarily redhorse and suckers, during spring migrations. Eleven of the channel catfish collected at Station #49 weighed 18.1 lbs. Nine of the catfish ranged from 13 to 19 inches. Five of the 17 smallmouth bass collected measured 11 to 13.5 inches in length.

At Arden (Station #50) 24 channel catfish and 18 smallmouth bass were collected. Sixteen of the larger catfish ranged from 13 to 23 inches and 5 of the larger smallmouth bass ranged from 11 to 14 inches.

At Station #51 (below Pipestone Ck.) 25 smallmouth bass were collected. Eight of the bass ranged from 10 to 18 inches long.

The last site surveyed, Station #52 (Benton Harbor-St. Joseph) was very turbid. The secchi-dish reading was 1.0 feet, lowest on the survey. Few game fish of catchable size were collected. Of the 188.0 lbs of fish collected 171.6 lbs were non-game fish. Fifty-nine of these were carp which weighed 134.8 lbs.

SUMMARY FOR SECTION M-11

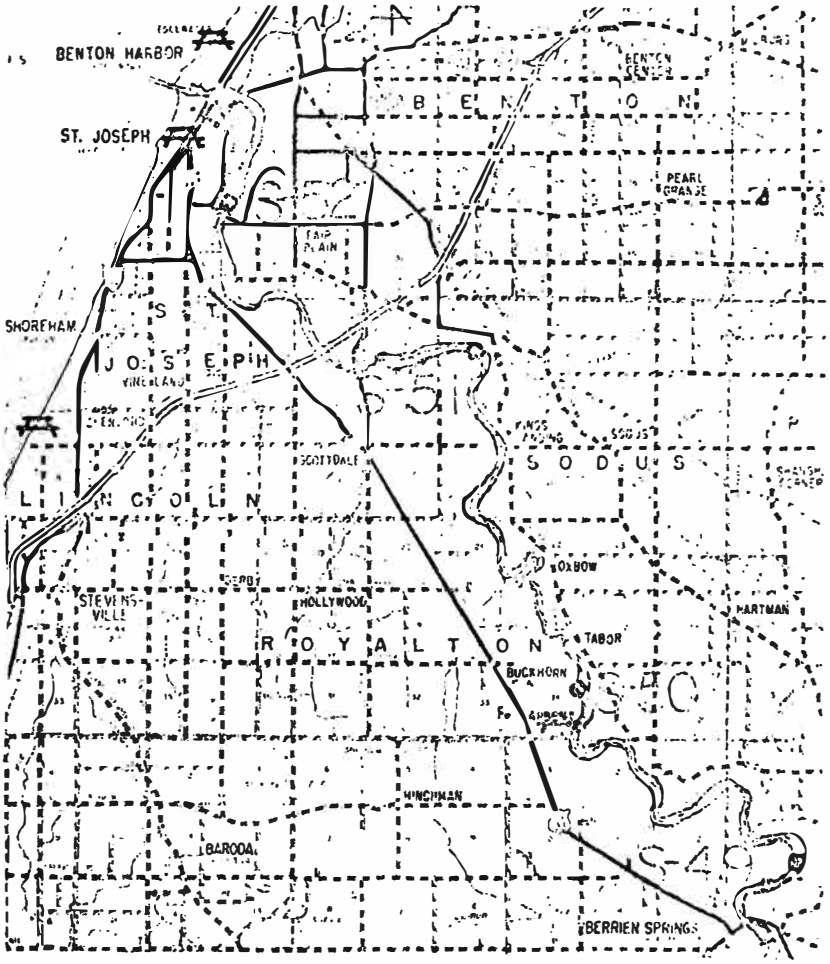
(Below Berrien Springs Dam to Lake Michigan)

Weather: Sky - Cloudy
Precipitation - Light Rain

Nets: 2 Overnight Fykes, 4 Stations

Electro-Fishing: 80 minutes, 4 Stations

Weigh Stations: S-49 & S-52



WATER CONDITIONS

TEMPERATURE

	Secchi Disk	Color	Odor	D.O.	pH	Hardness	Air	Water
S-49:	1.8'	Greenish Brown	None	9.0 ppm	8.5	256 ppm	71°F	76°F
S-50:	1.5	Greenish Brown	None	10.0	8.5	274	68°F	76°F
S-51:	2.0	Greenish Brown	None	10.0	8.5	308	68°F	73°F
S-52:	1.0	Brownish Gray	Slight	11.0	8.5	274	64°F	72°F

OBSERVATIONS

S-49: Cover sparse, few logs and stumps. Vegetation, none observed. Bottom sand and gravel, current swift. Banks wooded. Area heavily fished.

S-50: Cover sparse, some overhanging brush. Vegetation, none observed. Bottom sand and gravel, current swift. Banks wooded.

S-51: Cover sparse. Vegetation sparse, some Sagittaria species. Bottom sand, gravel with some silt deposits. Banks wooded.

S-52: Cover sparse. Vegetation sparse; Species of Typha, Numphar and Sagittaria. Bottom sand and gravel with silt deposits. Banks commercially developed.

FISHERIES COLLECTION M-11

SPECIES	NUMBER OF FISH			LENGTH (inches)			WEIGHT Sample (lbs.)		
Game Fish	Electro Fishing	Fyke Nets	Total Catch	Min.	Max.	Ave.	Size	Wt.	Ave.
Smallmouth Bass	38	27	65	2.3	18.2	8.1	21	5.9	0.3
Channel Catfish	19	24	43	9.9	23.4	15.5	14	22.1	1.6
Black Crappie	14	18	32	5.2	10.7	7.0	4	0.6	-
Bluegill	6	20	26	3.9	7.4	5.0	2	0.3	-
Pumpkinseed	13	7	20	3.8	6.8	5.1	17	2.9	0.2
Rock Bass	2	3	5	6.4	7.4	-	1	0.2	-
Largemouth Bass	1	1	2	6.1	6.9	-	2	0.3	-
Northern Pike	0	2	2	28.0	34.4	-	2	14.0	-
Subtotal	93	102	195				63	46.3	
Non-Game Fish									
Carp	80	39	119	7.9	27.2	16.1	67	155.1	2.3
Redhorse	4	10	14	7.6	22.1	13.6	3	5.8	-
White Sucker	5	4	9	10.2	15.8	-	7	7.5	-
Quillback	3	2	5	5.5	17.4	-	4	5.5	-
Dogfish	4	1	5	17.2	26.4	-	5	25.1	-
Spotted Sucker	2	1	3	10.0	11.5	-	2	1.0	-
Longnose Gar	0	1	1	-	23.8	-	1	1.0	-
Subtotals	98	58	156				89	201.0	

Totals: 351 Fish (56% Game Fish) Sample Size 152 Fish (41% Game Fish)
15 Species (53% Game Fish) Wt. 247.3 lbs (19% Game Fish)

Forage Species: Golden, Satinfin, Spotfin & Spottail Shiners, Bluntnose Minnow, Alewife, and Log Perch.

CONCLUDING OBSERVATIONS

Fish were collected at all the survey stations and a fair number of the game fish were of catchable size. A gravel and rubble substrate was encountered through a major portion of the stream. The overall water quality of the river, compared to other large rivers recently surveyed in Southern Michigan, was high.

However, water quality in the headwaters area (Hillsdale to Litchfield) is lacking. Primarily because the volume of the river is small and therefore the quality of the waters is easily altered.

There are three small impoundments on the river in the section from Hillsdale to Litchfield. (See Table #8, Dams on the St. Joseph River, Page 68). The first impoundment begins just below the river's origin at Baw Beese Lake and continues down to the city of Hillsdale. The other two impoundments are located at Jonesville and Litchfield. Both are weedy and filled with silt (the heaviest aquatic weed growth on the survey was encountered in the area between Hillsdale and Litchfield). These three impoundments increase the temperatures of the headwaters because they are open-water areas which absorb more sunlight than narrow flowing areas. They also add to the nutrient input of the stream because the increase in water temperatures and the sluggish flow of the impoundments enhances plankton production.

Also, three miles below its origin the St. Joseph River receives the effluent of the Hillsdale Waste Water Treatment Plant (including the run-off from the city area above during heavy rains). The low flows of the river in this area during late summer limits its dilution and waste

TABLE # 8

DAMS ON THE ST. JOSEPH RIVER

Name & Owner	Location	Head (feet)	Pond Area (acreage)
	Michigan		
F.W. Stock & Sons Dam #1 F.W. Stock & Sons	Hillsdale County T6S, R3W, Sec. 26	12	11
Jonesville Mill Pond C. G. White	Hillsdale County T6S, R3W, Sec. 4	--	35
F.W. Stock & Sons Dam #2 Litchfield Grain Co.	Hillsdale County T5S, R4W, Sec. 14	5	13
Union City Municipal Dam Village of Union City	Branch County T5S, R8W, Sec. 11	16	525
Sturgis Power Dam City of Sturgis	St. Joseph County T6S, R11W, Sec. 1	26	480
Three Rivers Power Dam Essex Wire	St. Joseph County T6S, R11W, Sec. 17	12	240
Constantine Hydro Plant Michigan Gas and Electric Company	St. Joseph County T7S, R12W, Sec. 23	11	555
Mottville Hydro-Plant Michigan Gas and Electric Company	St. Joseph County T8S, R12W, Sec. 6	11	487
French Paper Co. Dam French Paper Company	Berrien County T7S, R17W, Sec. 35	12-15	92 (confined to River Channel)
Buchanan Hydro-Electric Indiana and Michigan Electric	Berrien County T7S, R18W, Sec. 25	13	300
Berrien Springs Hydro-Electric Indiana & Michigan Electric	Berrien County T6S, R17W, Sec. 18	23	600
	Indiana		
Elkhart Hydro-Electric Indiana & Michigan Electric	Elkhart County T37N, R5E, Sec. 4	20	661
Mishawaka Hydro-Electric Indiana & Michigan Electric	St. Joseph County T37N, R3E, Sec. 12 & 13	24	1100

Concluding Observations Continued

assimilation capabilities. In August of 1972 the discharge of the river above the treatment plant decreased to less than six cubic feet per second (see Table #9)

TABLE #9

St. Joseph River

RIVER DISCHARGE IN CUBIC FEET PER SECOND

Study Section	Location	7-16-67	4-22-70	7-7-71	8-22-72
	300' above Hillsdale				
M-1	W.W.T.P.	---	24.50	---	5.49
M-1	Moore Road	15	---	7.19	---
M-3	Burlington	65	393	84	90
M-7	Three Rivers	241	2730	492	598
M-8	Mottville	550	3350	577	633
I-2	Elkhart	1380	7670	1110	1160
M-9	Niles	1620	8990	1370	1370

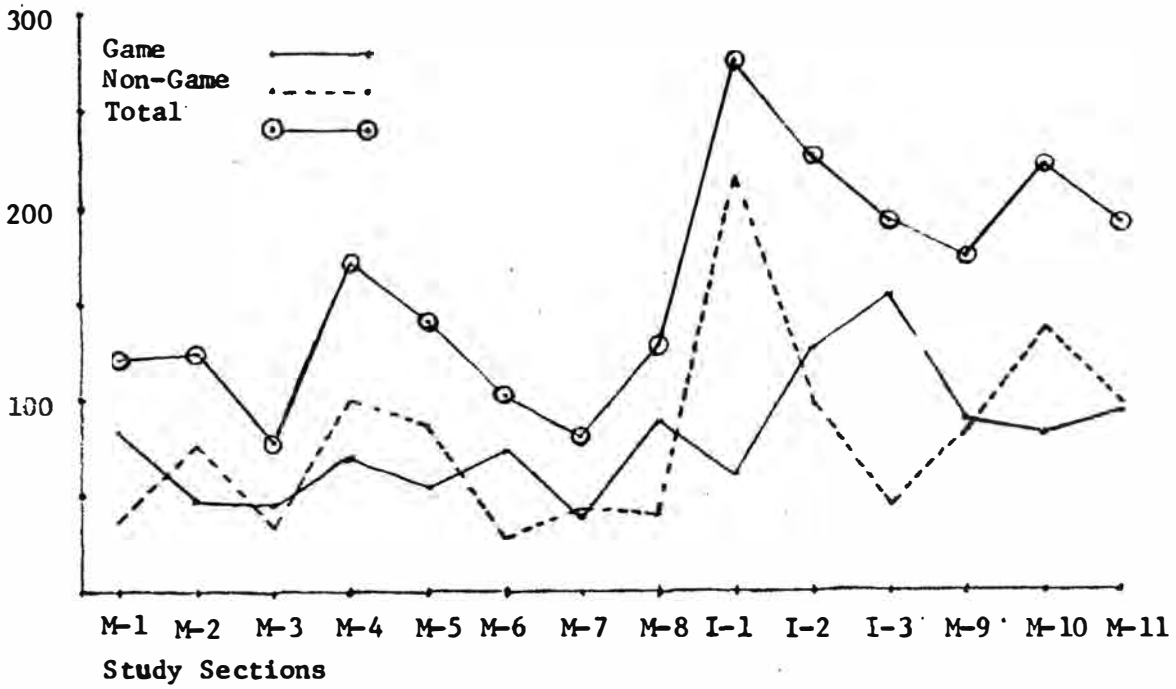
The poor quality of the water in this area probably contributed to the low catch of fish collected at Station #3 (Moore Rd., just below the city of Hillsdale). Only ten fish were collected there. Two were game fish weighing 0.1 pounds and eight were non-game fish weighing 7.2 pounds. Their total weight was the least number of pounds collected on the survey. Also, four of the six stations recording the lowest numbers of fish species were collected in the Hillsdale-Litchfield area (Stations 2,3,4 and 7).

An overall view of the fisheries data (numbers, species and weights of fish) for the survey is represented in graphs #1, #2, and #3. Electro-

ST. JOSEPH RIVER SURVEY

GRAPH # 1

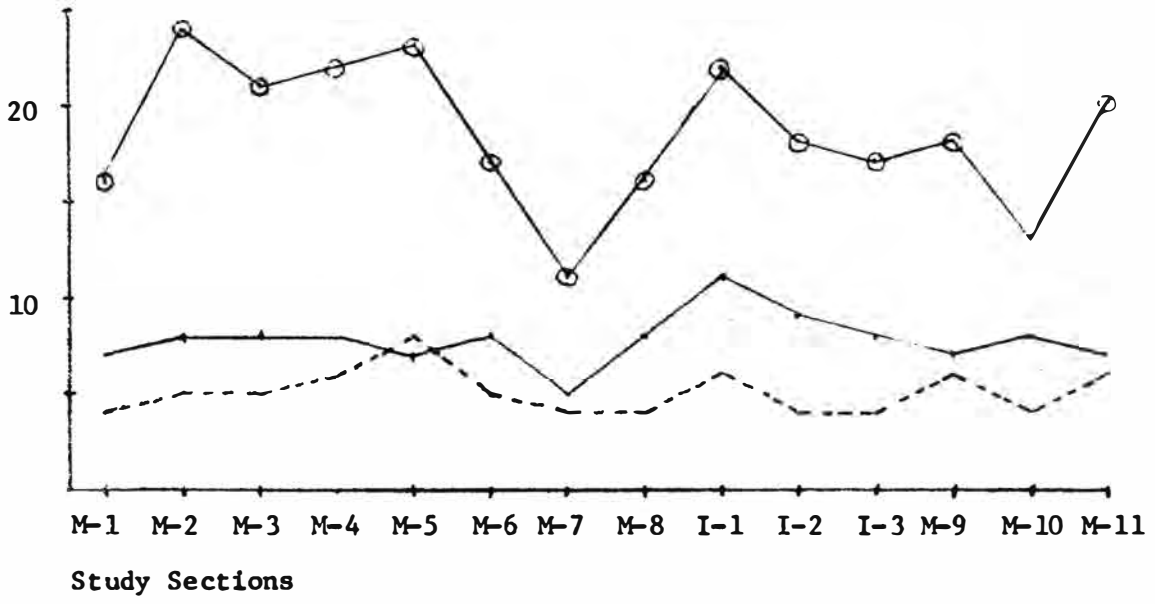
NUMBER OF FISH PER STUDY SECTION



SPECIES (Electro-Fishing Data Only) NUMBERS

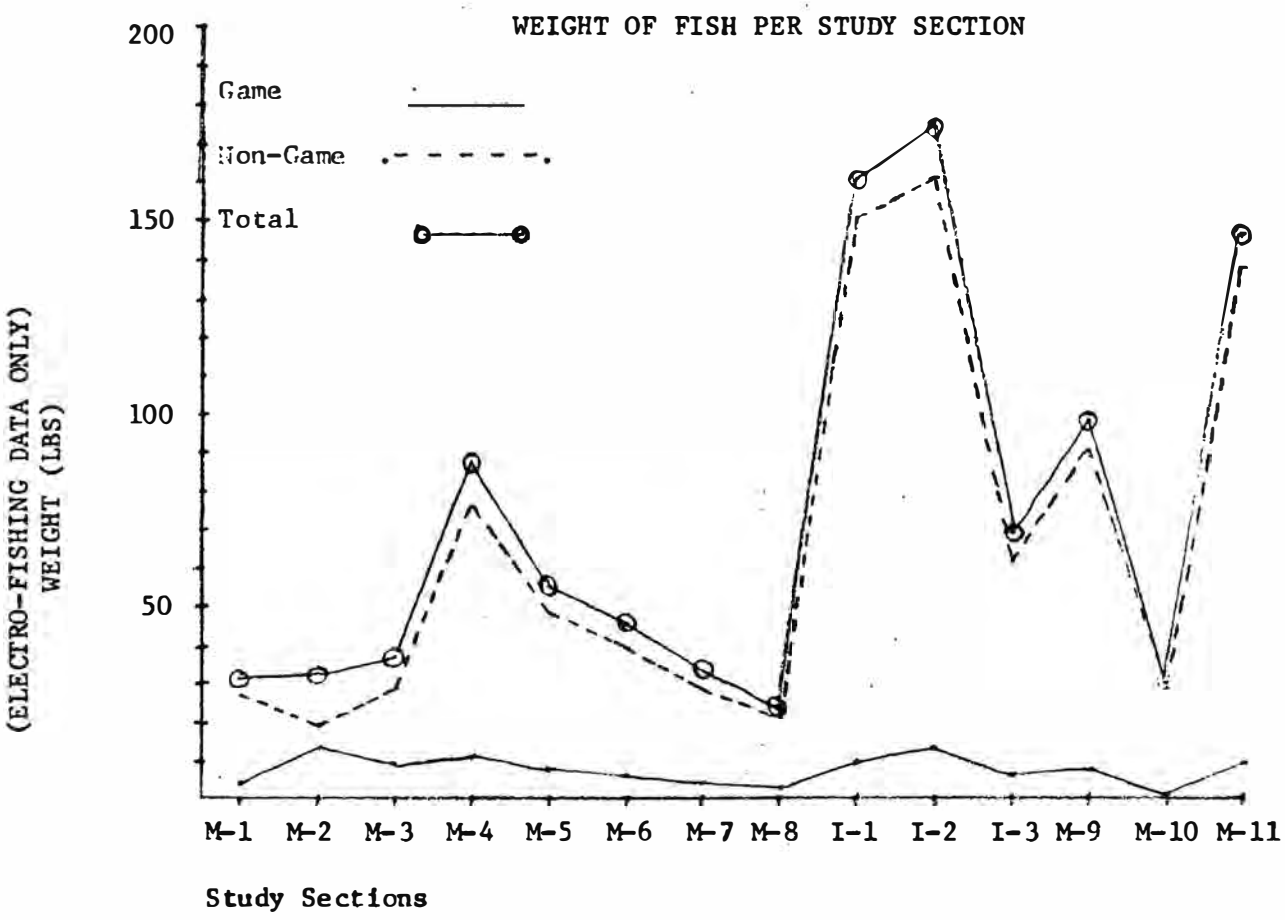
GRAPH # 2

NUMBERS OF SPECIES PER STUDY SECTION
(Totals Include Forage Species)



ST. JOSEPH RIVER SURVEY

GRAPH # 3



Concluding Observations Continued

fishing data was used for this comparison because the electro-fishing effort was equal for all the study sections. Comparing the configuration of the three graphs, there is, for unexplained reasons, a decline in fish numbers, species and weights in study sections M-6 through M-8. Numbers of fish captured (Figure #1) per study section is below average and shows a decline in numbers captured at study sections M-6 through M-8. Section M-3 also exhibits a decline in numbers of fish collected. The number of fish species captured per study section (Figure #2) is also below average for sections M-6 through M-8. Study sections M-1 and M-10 also exhibit a decline in the number of fish species captured. The total weight of fish captured per study section (Figure #3) also declines in section M-6 through M-8. Section M-10 shows a decline in weight also.

Graphs #1 and #3 also aids in demonstrating a concluding observation. That is the dominance of non-game fish in the total collection. Notice in Graph #1 that the lines representing non-game fish and the total numbers of fish collected have a similar configuration of ups and downs. The dominance of the weight of non-game fish to the total weight of the catch is demonstrated more dramitically in Graph #3. Lines representing the weights of non-game fish have almost the same configuration as the lines representing the total weight of fish collected.

It is hoped that the data presented in this paper will provide a better understanding of the fisheries and related characteristics of the St. Joseph River and serve also as a bench mark for future surveys.

S T . J O S E P H R I V E R S U R V E Y

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INVENTORY OF FISH AND EVALUATION OF WATER QUALITY DURING MINIMUM FLOW PERIOD IN THE ST. JOSEPH RIVER

Part B: Heavy Metals, PCB's and Pesticide Analysis,
Water Quality Control Division, Lansing

PART B

MICHIGAN WATER RESOURCES COMMISSION
BUREAU OF WATER MANAGEMENT
DEPARTMENT OF NATURAL RESOURCES
STAFF REPORT

Chlorinated Hydrocarbons and Heavy Metals in Fish from the St. Joseph River 1972

Introduction

A comprehensive water quality and fishery survey of the St. Joseph River was conducted cooperatively between Fisheries Division and Water Resources Commission staff of the Michigan Department of Natural Resources, July - August, 1972. As part of the survey, fish samples were retained for analysis of chlorinated hydrocarbon and heavy metal concentrations. Skinless fillets of thirty-nine samples collected from thirty-one locations (Table #1) were analyzed for DDT and its analogs, dieldrin, polychlorinated biphenyls (PCB's), Hg, Pb, Cd, Cr, Ni, Cu, Zn, and As. The Michigan Department of Agriculture Laboratory was contracted to do the analyses. This report summarizes the results of those analyses and will be incorporated into the comprehensive survey report.

Polychlorinated Biphenyls

Concentrations of polychlorinated biphenyls (PCB's) ranged from 0.0 (not detected) to 2.06 mg/kg in the edible portions of the fish on a wet weight basis (Table #2). The PCB concentration in all samples was below the 5.0 mg/kg tolerance limit established by the Food and Drug Administration (FDA) for fish for human consumption.

Overall, the concentrations of PCB's in the fish collected from the St. Joseph River were similar to the concentrations reported for fish collected from the Kalamazoo River above the City of Marshall, <0.01 - 0.24 mg/kg (Hesse and Willson, 1972), from the River Raisin above the Waterloo Dam, <0.01 - 3.08 mg/kg (unpublished BWM memo to Ed Bacon 3/10/72) and the Tittabawassee River, 0.01 - 0.77 mg/kg (Basch, et al., 1972). The St. Joseph River fish were much lower in PCB's than were fish collected from the Kalamazoo River downstream from the City of Battle Creek where concentrations ranged up to 109.9 mg/kg PCB's as Arclor 1242 (Hesse and Willson, 1972).

Chlorinated Hydrocarbon Pesticides

DDT or its analogs were present in 20 of the 39 fish samples from the St. Joseph River. The concentrations of total DDT ranged from trace amounts to 0.80 mg/kg. This compares with a range of 0.015 to 0.889 mg/kg for fish from the Kalamazoo River (Hesse and Willson, 1972), 0.002 to 0.171 mg/kg for River Raisin fish (unpublished BWM memo to Ed Bacon, 3/10/72) and 0.02

Table #1. Concentrations of chlorinated hydrocarbon pesticides and polychlorinated biphenyls (PCB's) in fish collected from the St. Joseph River, July, August, 1972 (Concentrations in mg/kg, wet weight.)

Station	Species	Length	Crude Fat %	Dieldrin	DDE	DDD	DDT	Total DDT	PCB's 1254
1	Largemouth bass	10.2, 10.4, 10.6	0.1	----	---	---	---	N.D.	N.D.
3	White sucker	15.3	0.9	Tr	0.01	0.03	---	0.04	0.11
5	White sucker	13.8, 13.6	0.6	----	Tr	Tr	Tr	Tr	Tr
6	N. pike	23.8	0.4	----	0.01	0.02	---	0.03	0.16
8	Largemouth bass	10.1, 12.4	0.2	Tr	---	---	---	N.D.	N.D.
9	White sucker	8.1, 9.5	0.6	----	Tr	Tr	---	Tr	Tr
10	Carp	17.2	0.3	----	0.01	0.03	---	0.04	0.27
10	N. pike	19.1	0.1	----	---	---	---	N.D.	N.D.
12	Smallmouth bass	15.7	0.2	Tr	---	---	---	N.D.	N.D.
14	Carp	14.6	0.6	----	---	---	---	N.D.	N.D.
17	N. pike	24.3	0.1	----	---	---	---	N.D.	N.D.
17	Carp	14.2, 14.1	0.2	----	---	---	---	N.D.	N.D.
17	Black crappie	11.7, 10.5	0.2	----	---	---	---	N.D.	N.D.
21	Black crappie	11.3, 11.8	0.1	----	---	---	---	N.D.	N.D.
24	N. pike	23.2	0.1	----	---	---	---	N.D.	N.D.
24	Carp	15.1	1.4	Tr	Tr	Tr	---	Tr	N.D.
25	Black crappie	9.2, 10.7	0.1	----	---	---	---	N.D.	N.D.

Table #1, Continued.

Station	Species	Length	Crude Fat%	Dieldrin	DDE	DDD	DDT	Total DDT	PCB's 1254
26	Carp	16.2	0.6	----	Tr	Tr	---	Tr	Tr
26	N. pike	25.3	0.1	----	---	---	---	N.D.	N.D.
29	Largemouth bass	13.5	0.1	----	Tr	---	---	Tr	N.D.
30	Carp	14.4	0.4	----	---	---	---	N.D.	N.D.
31	N. pike	23.0	0.1	----	---	---	---	N.D.	N.D.
42	Carp	15.5	0.6	Tr	0.23	0.24	0.23	0.70	2.06
45	N. pike	23.8	0.2	----	0.03	0.05	---	0.08	0.40
45	Largemouth bass	13.8	0.17	----	0.04	0.09	---	0.13	0.88
46	Smallmouth bass	13.5, 13.8	0.2	----	---	---	---	N.D.	N.D.
47	Carp	14.1	0.3	Tr	0.06	0.10	---	0.16	0.83
49	Carp	16.8	0.1	Tr	0.07	0.11	0.10	0.28	0.89
52	Carp	17.2	1.2	0.01	0.14	0.13	0.15	0.42	1.18
32	N. pike	23.2	0.2	----	---	---	---	N.D.	N.D.
35	Black crappie	10.7, 11.2	0.1	----	---	---	---	N.D.	N.D.
36	Carp	14.4	0.3	Tr	---	---	---	N.D.	N.D.
37	Largemouth bass	13.0	0.2	----	---	---	---	N.D.	N.D.

Table #1, Continued.

Station	Species	Length	Crude Fat%	Dieldrin	DDE	DDD	DDT	Total DDT	PCB's 1254
37	Carp	13.7	0.3	Tr	Tr	Tr	---	Tr	N.D.
38	Carp	16.1	0.1	Tr	Tr	0.02	---	0.02	0.16
39	Carp	14.3	1.6	----	0.02	0.05	---	0.07	0.32
39	Largemouth bass	10.2	1.6	Tr	Tr	0.02	---	0.02	0.16
40	Carp	14.2	1.0	0.01	0.05	0.05	0.06	0.16	0.51
41	Carp	17.6	0.4	0.01	0.06	0.11	---	0.17	0.77

TR = Trace

ND = Not Detected

QNS= Quantity Not Sufficient

Table #2, Concentrations of heavy metals in fish collected from the St. Joseph River, July - August, 1972. (Concentrations in mg/kg, wet weight).

Station	Species	Length	Hg	Pb	Cd	Cr	Ni	Cu	Zn	As
1	Largemouth bass	10.2, 10.4 10.6	0.57	0.4	0.04	0.16	0.2	0.33	5.84	N.D.
3	White sucker	15.3	0.30	0.6	0.04	0.16	0.2	0.36	6.61	0.02
5	White sucker	13.8, 13.6	0.32	0.3	0.03	0.12	0.2	0.45	6.01	0.02
6	N. pike	23.0	0.42	0.3	0.11	0.21	0.2	0.29	4.42	N.D.
8	Largemouth bass	10.1, 12.4	0.28	0.3	0.03	0.19	0.3	0.37	6.01	N.D.
9	White sucker	8.1, 9.5	0.11	QNS	QNS	QNS	QNS	QNS	QNS	QNS
10	Carp	17.2	0.36	0.4	0.05	0.16	0.3	0.62	8.04	N.D.
10	N. pike	19.1	0.20	0.5	0.04	0.12	0.2	0.30	5.17	N.D.
12	Smallmouth bass	15.1	0.55	0.3	0.02	0.17	0.2	0.29	3.95	N.D.
14	Carp	14.6	0.16	0.5	0.28	0.07	0.3	0.39	10.09	N.D.
17	N. pike	24.3	0.34	0.2	0.04	0.31	0.2	0.26	4.97	N.D.
17	Carp	14.2, 14.1	0.02	0.2	0.03	0.33	0.3	0.86	5.84	0.01
17	Black crappie	10.5, 11.7	0.35	0.2	0.02	0.14	0.2	0.36	5.98	0.03
21	Black crappie	11.3, 11.8	0.11	0.3	0.03	0.13	0.3	0.26	4.43	0.01
24	N. pike	23.2	0.35	0.4	0.04	0.24	0.2	0.20	4.91	N.D.
24	Carp	15.1	0.02	0.5	0.16	0.14	0.03	0.47	10.33	0.02

Table #2. (Continued)

Station	Species	Length	Hg	Pb	Cd	Cr	Ni	Cu	Zn	As
25	Black crappie	9.2, 10.7	0.15	0.4	0.05	0.11	0.1	0.35	5.95	N.D.
26	Carp	16.2	0.26	0.5	0.12	0.16	0.2	0.39	9.79	0.01
26	N. pike	25.3	0.18	0.3	0.05	0.18	0.3	0.29	4.31	0.02
29	Largemouth bass	13.5	0.38	0.3	0.03	0.13	0.2	0.35	4.89	0.02
30	Carp	14.4	0.05	0.3	0.03	0.15	0.2	0.37	8.51	0.02
31	N. pike	23.0	0.20	0.4	0.04	0.18	0.3	0.30	4.95	N.D.
42	Carp	15.5	0.36	0.4	0.06	0.14	0.3	0.51	10.27	0.02
45	N. pike	23.8	0.40	0.2	0.03	0.13	0.2	0.16	4.09	0.02
45	Largemouth bass	13.8	0.90	0.2	0.04	0.11	0.2	0.31	5.34	0.04
46	Smallmouth bass	13.5, 13.8	0.56	0.4	0.03	0.15	0.4	0.30	4.37	0.02
47	Carp	15.1	0.29	0.4	0.04	0.20	0.2	0.49	9.51	N.D.
49	Carp	16.8	0.13	0.5	0.04	0.19	0.3	0.45	9.01	N.D.
52	Carp	17.2	0.18	0.4	0.04	0.14	0.3	0.49	11.17	N.D.
32	N. pike	23.2	0.17	0.4	0.09	0.06	0.2	0.29	4.28	0.01
35	Black crappie	10.7, 11.2	0.30	0.5	0.05	0.17	0.2	0.26	6.07	N.D.
36	Carp	14.4	0.06	0.2	0.03	0.19	0.2	0.45	9.72	N.D.

Table #2, (Continued)

Station	Species	Length	Hg	Pb	Cd	Cr	Ni	Cu	Zn	As
37	Largemouth bass	13.0	0.41	0.2	0.02	0.50	0.2	2.06	8.45	0.02
37	Carp	13.7	0.06	0.3	0.02	0.16	0.3	0.39	9.45	N.D.
38	Carp	16.1	0.10	0.3	0.03	0.16	0.1	0.31	9.08	0.02
39	Carp	14.3	0.14	0.3	0.03	0.13	0.2	0.32	10.34	0.02
39	Largemouth bass	10.2	0.21	QNS	QNS	QNS	QNS	QNS	QNS	QNS
40	Carp	14.2	0.17	0.4	0.04	0.24	0.3	0.79	10.78	N.D.
41	Carp	17.6	0.15	0.3	0.04	0.20	0.3	0.43	10.84	N.D.

Tr = Trace

ND = Not Detected

QNS= Quantity Not Sufficient

to 0.17 mg/kg for Tittabawassee River fish (Basch, et al., 1972). The FDA tolerance limit is 5.0 mg/kg of DDT in fish flesh for human consumption.

Dieldrin was present in 14 of the 39 fish samples. The concentrations were at very low levels, from trace amounts to 0.01 mg/kg. The FDA tolerance limit for dieldrin is 0.3 mg/kg.

Heavy Metals

The heavy metals included in the analysis were Hg, Pb, Cd, Ni, Cu, Zn and As. Concentrations in mg/kg of these metals in the edible portion of the fish ranged from 0.06 to 0.90 for Hg; 0.2 to 0.6 for Pb; 0.02 to 0.28 for Cd; 0.06 to 0.33 for Cr; 0.03 to 0.4 for Ni; 0.16 to 2.06 for Cu; 3.95 to 11.7 for Zn; and 0.0 (not detectable) to 0.04 for As (Table #3). Lucas, et al. (1970) reported concentrations of trace elements in fish from the Great Lakes. Average concentrations detected in that study were 0.09 mg/kg for Cd; 1 mg/kg for Cr; 1.3 mg/kg for Cu and 0.02 mg/kg for As. Uthe and Bligh (1971), reporting on metals in fish from two inland lakes in a non-industrial area in Canada, found concentrations ranging from 0.07 to 0.7 for Hg; $<$ 0.5 mg/kg for Pb; $<$ 0.05 mg/kg for Cd, $<$ 0.01 to 0.03 mg/kg for Cr; $<$ 0.2 mg/kg for Ni; 0.50 to 0.94 for Cu; 12-19 mg/kg for Zn; and $<$ 0.05 to 0.70 for As. Concentrations in mg/kg of heavy metals in tissue of fish collected from selected background locations in Michigan ranged from 0.1 to 0.4 for Hg; 0.1 to 0.5 for Pb; 0.0 to 0.2 for Cd; 0.0 to 0.3 for Cr; 0.0 to 0.5 for Ni; 0.3 to 1.6 for Cu, 10 to 26 for Zn and 0.036 to 0.215 for As (Hesse and Evans, 1972).

Although analytical sensitivities were not comparable in all cases, concentrations of heavy metals in fish from the St. Joseph River were generally within or below the ranges of concentrations reported in the above studies. Four samples did have Hg concentrations exceeding the 0.5 mg/kg tolerance limit established by the FDA. These were found at Stations #1, #12, #45, and #46. No tolerance limits have been established in the United States for any other heavy metals in fish tissue.

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St. Joseph River
Toxic Substances

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