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FISHERIES DIVISION

TECHNICAL REPORT

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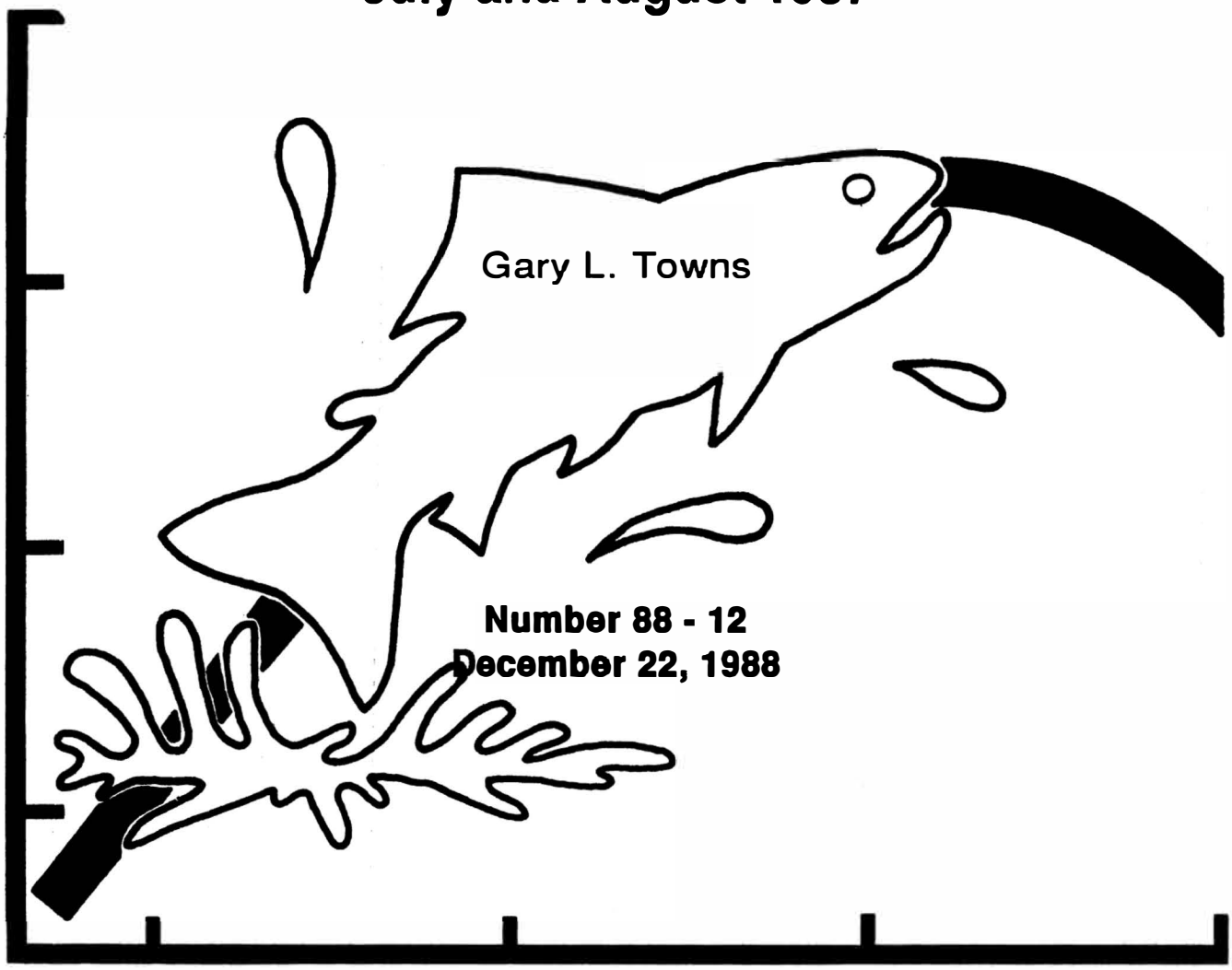

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MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION

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A FISHERY SURVEY OF THE UPPER ST. JOSEPH RIVER, JULY AND AUGUST 1987

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SUMMARY

Fish populations in the upper St. Joseph River were surveyed by the Fisheries Division of the Michigan Department of Natural Resources in July and August of 1987. Information obtained during the project will be used during the development of fishery management plans.

Rotenone was used to collect fish at nine sampling sites on the upper St. Joseph River and two sites on Nottawa Creek (a main tributary to the river). Some physical and biological conditions of the riverine environment were noted but no chemical water quality parameters were measured. This study was designed to sample fish populations only in the lotic riverine habitat. Impoundments within the river system were not sampled, however, previous trap-net surveys of Union Lake are discussed.

Over 49,750 fish were captured representing 51 species. Of this total, the two sites on Nottawa Creek produced 4,680 fish and 36 species. Two of these (brown trout and tadpole madtom) were not found in the St. Joseph River. When considering the total catch in the St. Joseph River, bluntnose minnow was the most numerous species found throughout the study area; but, disregarding all fish less than 3 inches long, golden redhorse was the most numerous. Game fish comprised 10.6% by weight and 21.6% by number of the catch. Carp accounted for 31.0% by weight and 4.1% by number of the catch. In the St. Joseph River estimates of total fish standing crop averaged 365 pounds per acre and ranged from 104 to 716 pounds per acre. At the two sites sampled in Nottawa Creek standing crop estimates were 40 and 269 pounds per acre, respectively.

Some reaches in the lower half of the St. Joseph River held fair to good populations of smallmouth bass, rock bass, and channel catfish. Both the channel catfish fishery and the developing walleye fishery are due to Fisheries Division stocking efforts. Shoreline evidence and angler reports indicated heavy fishing pressure in this area. Additionally, anglers reported that impoundments and slow, deep riverine areas occasionally provided catches of bluegills, black crappies, pumpkinseeds, largemouth bass, northern pike, carp, suckers, and redhorses.

Major factors which appeared to be limiting sport fish abundance included poor substrate (largely sand) and limited fish cover. Water quality has been degraded by sedimentation and municipal sewage inflows in the past, however, this has improved over the last decade. Boating access to the majority of the river is negligible except at road crossings or through private property. Some access is available on the impoundments.

Stocking northern pike, channel catfish, walleye, and possibly smallmouth bass would enhance game fish populations where recruitment is presently limited. Construction of fish habitat improvement structures and sediment traps in some reaches would likely increase large game fish carrying capacity.

INTRODUCTION

The upper St. Joseph River is located in the extreme southern central portion of Michigan's Lower Peninsula (Figure 1). The headwaters of the river flow in a northwesterly direction. Then, near Homer in Calhoun County, the river abruptly turns and flows in a general southwestern direction through part of Branch County and into St. Joseph County. Not far beyond the most downstream site surveyed in this study, the character of the river changes dramatically. The vast majority of the stream from that point to Lake Michigan is impounded by several large dams. The primary objective of this study was to sample fish populations in lotic riverine habitats in the upper St. Joseph River and Nottawa Creek (a main tributary).

Within the study area the river drains approximately 912 square miles. The basin is about 50 miles in length, from 3 to 40 miles wide, and includes portions of five Michigan counties. Major tributaries include Beebe Creek, Sand Creek, Soap Creek, Burnett Creek, Coldwater River, Swan Creek, Little Swan Creek, and Nottawa Creek.

There are three dams and impoundments in the study area. The largest impoundment, Union Lake, is 525 acres in size (Figure 1). Impoundments at Litchfield and Jonesville were much smaller, about 15 and 30 surface acres, respectively.

Little sportfishing takes place in the mainstream in the upper two-thirds of the study area. Occasionally, anglers in that area fish for northern pike, smallmouth bass, largemouth bass, suckers, and carp. Also, some fishermen collect bait minnows for use elsewhere. Near Union City the stream flow increases substantially due to the entry of several tributaries. In that area, sportfishing is more frequent and good catches of northern pike and smallmouth bass have been reported. Union Lake is an excellent fishery well known for black crappies, yellow perch, bluegills, largemouth bass, and channel catfish. Below Union Lake the river is fished heavily for channel catfish, smallmouth bass, northern pike, and walleyes. This area also has an excellent fishery for suckers and redhorses in the spring.

METHODS

Rotenone was used to capture fish during the survey. Techniques were similar to those described by Nelson and Smith (1980; 1981) with modifications described by Towns (1987).

Low current velocities allowed the use of small-mesh blocking seines (maximum diagonal opening of 3/16 to 1/4 inch) at every station. This precluded the need for downstream subsampler nets to estimate escapement. It was assumed that the small-mesh blocking seines captured all fish of about 2 inches and larger in total length. At each sampling station two blocking seines were used—one at approximately the midpoint and the other at the end of the

station. The mid-station net captured upstream fish which probably would have settled to the stream bottom and not drifted with the current to the downstream net. This net also may have prevented the migration of some fish upstream and out of the station when those fish first detected rotenone. In a few instances the mid-station net was not long enough to reach across the entire width of the river. This was not considered critical since this net only was used to assist in the overall collection of fish.

Based primarily on stream flow, ease of access, stream depth, and geographic distribution nine sampling stations on the mainstream and two stations on Nottawa Creek were selected (Figure 1, Table 1). The vast majority of both river mainstreams within the study area were quite shallow with fair-to-moderate stream velocities and soft substrates (mostly sand). This type of riverine habitat lends itself well to sampling with rotenone treatment methods.

Station lengths in the mainstream averaged 651 feet, but varied between 385 and 830 feet to accommodate unusual channel structure or habitat. Station widths and lengths were measured with either a measuring tape or pre-calibrated rope. Stream flows were measured with a Gurley current meter or were interpolated from nearby United States Department of Interior Geological Survey gauging stations.

All fish were identified, measured to the inch group, and weighed to the nearest 0.1 pound in aggregate by species. Most fish were weighed and measured at individual sampling sites. In a few instances, to save time and promote accuracy, some fish were preserved in formalin and later identified and measured in the laboratory.

RESULTS

Over 49,750 fish were captured during the survey. Of this total, nearly 4,700 were taken at the two sites surveyed in Nottawa Creek. As with past surveys of warmwater rivers in southern Michigan, the majority of these (80%) were small forage fish, but these accounted for only 7.1% of the total biomass. Forty-nine species of fish were captured (Table 2) in the St. Joseph mainstream and 36 species in Nottawa Creek. Two species, brown trout, and tadpole madtom, were captured only in Nottawa Creek. In the St. Joseph mainstream, 14 species were found at every station. This is substantially more than have been found consistently throughout other similar southern Michigan rivers. However, very few fish migration barriers existed within the study area. Also, this study considered only the upper third of the entire St. Joseph River. Comparative surveys of other rivers included the entire mainstreams. Each of these had several large dams which acted to diversify habitat and prevent the migration and mingling of fish species. Even so, the large number of species found at every station in this study helps to support the consistency of water quality and habitat characteristics observed throughout the upper St. Joseph River.

When considering fish larger than 3 inches (and excluding chubs, shiners, and minnows) the golden redhorse was the most numerous species in the St. Joseph mainstream, comprising 16.4% of the catch by number. Combined totals of the six species of redhorses captured comprised 32.9% of the catch (Table 3). Carp made up the highest single species catch by weight with 31.0% of the catch (but only accounted for 4.1% by number). However, the combined weight of all species of redhorses made up 49.0% of the catch. When the catch (by weight) of suckers and redhorses were combined, the resulting 56.8% greatly overshadowed the catch of carp. This predominance of redhorses and suckers has also been observed in the Battle Creek River, the Cass River, the River Raisin, and the Grand River (Table 4).

In the upper St. Joseph River, game fish comprised 10.6% of the catch by weight and 21.6% by number. This proportion was similar to that observed in a number of southern Michigan rivers (Table 4).

Standing crop estimates ranged from 104 pounds per acre at Station 1 to 716 pounds per acre at Station 2 (Figure 2). The average was 365 pounds per acre. This was the second highest of all other large southern Michigan streams surveyed to date (Table 4). The South Branch of the River Raisin had the highest average standing crop of the rivers surveyed to date with rotenone methods, however, only one station was surveyed on that stream.

The number of species present at sampling stations in the upper St. Joseph River ranged from 24 at Station 1 to 38 at Stations 8 and 9 (Table 2). No large changes occurred in the number of species present immediately below municipal areas as has been observed in previous studies in other rivers (Nelson and Smith 1981; Towns 1984).

It is believed that the great majority of the fish present at each sampling station were collected. Therefore, the total weight of each sample can be considered as a conservative estimate of standing crop. Such estimates are somewhat less than the true standing crop since some fish may have escaped capture by traveling upstream out of the station during rotenone application. It is also likely that some fish fell to the bottom of the river, became entangled in the substrate or covered with silt, and so were not collected in the blocking seines or hand nets. Efficiency of fish capture was undoubtedly better in shallow sampling stations having hard substrates and swift currents. Such conditions existed at Stations 2, 3, 5, 6, and 9 and it was generally observed by the survey team that escapement was very low at those sites. Stations 1, 4, 7, and 8 had depths exceeding 3 feet, slow current velocities, and a significant amount of soft, silty substrates. For these reasons, standing crop estimates reported for Stations 1, 4, 7, and 8 should be considered a bit more conservative than estimates for other stations.

I was convinced that the use of two blocking seines, one in the middle and one at the end of the sampling sites, substantially reduced escapement. The extra sampling effort employed with this method was offset by greater accuracy in the catch. Where there were slow stream

velocities many of these fish would not have drifted the entire length of the sampling station to be captured in a single downstream blocking seine.

FISHERY DESCRIPTION

An extensive fishery survey of the St. Joseph River was conducted in 1972 by the Fisheries Division of the Michigan Department of Natural Resources. During this project, fish were collected by electrofishing and fyke netting (Shepherd 1975). Recent studies comparing fish sampling techniques have shown rotenone methods to be far superior, both quantitatively and qualitatively, to electrofishing or electrofishing and netting combined (Towns 1984). Consequently, it is difficult to make direct comparisons between the 1975 and the 1986 surveys. However, general trends in fish populations were evident and will be discussed. Specific catch data on each station are available in Fisheries Division files on standard fish collection form R-8058.

Station 1–3

Station 1 at Moore Road in Hillsdale County, was the most upstream site sampled in 1987 (Figure 1, Table 1). This site was less than 1 mile below the Hillsdale Wastewater Treatment Plant (WWTP) and the confluence with Beebe Creek. Station 1 produced the smallest number of fish species (24) of any of the nine sites sampled on the mainstream (Table 2). It also had the lowest catch per surface acre (Figure 2).

While this reach had some gravel and rock substrate (primarily below the bridge) the majority of substrate was silt (60%) and sand (25%). Slow stream velocity, turbidity, some deep water areas (over 4 feet), and overhanging brush hampered fish recovery. These factors undoubtedly contributed to the low total catch of fish.

The composition of the catch at Station 1 was very poor from a sport fishery standpoint. Only 7.1% of the catch (by weight) was game fish. Of these, only a very few individuals were of catchable size. Carp accounted for 90% of the catch by weight. A similar condition was observed at this site in 1972 (Shepherd 1975). In that study, this same location produced the lowest weight of game fish as well as the lowest total weight of fish captured at 52 survey sites. Riverine habitat was very different at Station 2. A dense forest canopy shaded much of the area. Stream substrates consisted of very little silt (5%) and a higher quantity of gravel and rock (30%). Also, stream velocity was much swifter and fish habitat in the form of pools and riffles was more abundant than at Station 1. This site produced the highest standing crop of fish in the survey (715 pounds per acre). However, carp again dominated the catch (65% by weight). Carp, suckers, and redhorses accounted for nearly 87% of the catch by weight while

game fish represented only 4.3%. The game fish catch consisted primarily of rock bass and yellow bullhead. Stream-side residents reported that very little fishing occurs in this area.

Sand and silt substrates were prevalent in the next several river miles below Station 2. Fish habitat (logs, overhanging brush, undercut banks, etc.) was sparse and stream depths were uniformly shallow. At Station 3 sand and silt made up about 85% of the substrate. Only one large hole and some spare fish cover were present. White sucker, hog sucker, and redhorses predominated (Figure 2). Interestingly no carp were captured. One legal-sized largemouth bass (12 inches) was taken along with several catchable rock bass. This was the farthest upstream site at which smallmouth bass were observed. Evidence along the stream bank suggested that anglers use this reach occasionally.

Stations 4–6

Angling opportunities increased in this next downstream segment of the upper St. Joseph River. Deep holes and good fish cover occurred a bit more frequently than at upstream sites. Stream substrates began to change to a higher percentage of rock and gravel about halfway through this area. Station 4 included one of the deepest holes in the immediate area according to stream-side residents. Approximately 100 feet of the 810-foot sampled reach was not wadable (over 4 feet deep).

The catchable sport fish population at Station 4 was much improved over upstream areas. While accounting for only about 10% of the catch by weight, the game fish sample included three legal-sized smallmouth bass (12 to 19 inches) and three legal-sized northern pike (23 to 30 inches). Residents reported that some fishing for these species occurs along the river in this area. While much of the habitat favored the survival of fingerling and adult smallmouth bass, the predominant silt and sand substrate (80%) may greatly limit their spawning success. Only two young-of-the-year smallmouth bass were collected at this location. Many crayfish, the primary food of adult smallmouth bass, were observed during the collection.

Two rather rare species, black redhorse and greater redhorse, were captured at Station 4 (Table 2).

Riverine habitat appeared to be more favorable for game fish at Station 5. Yet, while several game fish species were present, few were of catchable size (Table 5). Species diversity was high at this site with 33 species captured. Redhorses and suckers accounted for most of the fish biomass in the sample (Figure 2). Good species diversity in this reach was also observed in 1972 (Shepherd 1975).

Station 6 was located within the village limits of Union City. The flow rate at this site was more than double the flow rate at Station 5 due to the upstream additions of Coldwater River, Burnett Creek, and various other smaller tributaries. Nearly 14% of the total survey

catch by weight was comprised of game fish, although once again, few were of catchable size. This may have been a factor of fishing pressure to some extent. Anglers reported that this site was fished rather heavily—mostly for bass and northern pike. No carp were captured, however, suckers and redhorses clearly predominated in this reach (Figure 2). Also, a single walleye fingerling was captured at Station 6, the farthest upstream that this species was observed. This individual was probably one of those stocked about 1 month earlier by the Fisheries Division at a site approximately 0.5 mile below Station 6.

In 1972 a river reach immediately upstream in Union City (Broadway Street) was sampled. A good deal of turbidity and a low catch of fish was noted at that time (Shepherd 1975). In 1987 water conditions were clear and 35 fish species and over 3,100 fish were captured at Station 6 (Page Avenue). It is uncertain whether these improvements were related to increased water quality in 1987 or poor sampling conditions in 1972 or both.

Union Lake

Union Lake was the largest impoundment within the study area (Figure 1). Although this lake was not surveyed as part of this study, it was extensively surveyed with trap nets in 1983, with trap and gill nets in September 1987, and was electrofished in October 1987. Detailed results of those surveys can be found in Fisheries Division files; a brief discussion of this large unique fishery is appropriate here.

In 1983, 12 trap-net nights produced a catch of 869 fish (483 pounds). Game fish comprised 85% by number and nearly 55% by weight of the catch. Bluegills averaged 7.1 inches and 87% of those captured were 6 inches or larger. Also, nearly half of the largemouth bass and black crappies and all of the channel catfish were legal or "acceptable size" for anglers. The catch of channel catfish was particularly impressive with 11 fish averaging 17.9 inches.

Survey results from 1987, when compared to those for 1983, indicate that the Union Lake fishery is very stable. In 1987, game fish comprised 83% by number and 52% by weight of the catch. Bluegills averaged 7.2 inches of which nearly 70% were 6 inches or larger. The black crappie fishery seems to have improved since 1983 with the average size increasing from 6.7 to 9.2 inches. The average-sized crappie captured with fyke nets in 1972 (Shepherd 1975) was 6.4 inches and bluegills averaged only 4.7 inches. But that survey was done in midsummer when larger fish are typically in deeper waters and not susceptible to capture by fyke nets. Fish scale analysis indicated that sport fish populations in 1983 and 1987 were growing at or above state average growth rates.

In 1987, three walleyes from 7 to 9 inches long were captured in trap and gill nets. Also, during an electrofishing survey in the fall of 1987, five more walleyes were captured, ranging in size from 9 to 16 inches. Fisheries Division stocked walleye fry in Union Lake in 1983 and 1984 and walleye fingerlings in the St. Joseph River just above and just below Union Lake in 1987.

During the 1972 St. Joseph River fishery survey (Shepherd 1975) no walleyes or channel catfish were captured in Union Lake or in any waters of the 1987 study area on the St. Joseph River. In 1972 sampling effort and the total number of fish caught was low. Yet enough information is present to suggest that the Union Lake sport fishery has improved substantially over the last 15 years.

Stations 7–9

Sand and silt still made up the vast majority of the substrate (80%) at Station 7, but fish habitat in the form of holes, instream logs, and pools was much better than at any of the upstream stations. Game fish accounted for over 11% of the fish biomass. This was primarily due to a large catch of channel catfish. The majority of these were large (14 to 25 inches), but the presence of seven young-of-the-year catfish (2 inches) indicated successful natural reproduction. This was the farthest upstream that channel catfish were found in the lotic environment (several were captured in Union Lake during the 1987 netting survey).

Two walleyes were captured at Station 7. Although these were of sublegal size (less than 15 inches) anglers have reported catching several legal-sized walleyes in this area in the past few years. Northern pike were present but, as at other survey sites, were low in number even though forage fish were plentiful. Streambank evidence suggested daily use of this area by anglers.

Four species of redhorses were captured at Station 7 including a fair number of the rather rare silver redhorse (Table 2).

Without the large catch of channel catfish taken at Station 8, the catch of game fish would have almost been inconsequential. Yet, because of channel catfish, the game fish catch (Figure 2) was the highest observed on the mainstream (20.5% by weight). Several other species of game fish were present including walleye (Table 5). Stream habitat was quite good at this site with a good riffle-pool complex and fair amounts of fish cover and deep water. Carp, suckers, and four species of redhorses clearly predominated (Figure 2). This station and Station 9 had the highest species diversity (38 fish species) of all survey sites.

The collection at Station 9 resulted in the highest single sample size of all survey sites. Over 11,700 fish, weighing nearly 1,425 pounds were collected. This site was wide and quite uniform in depth and substrate types. Stream substrate consisted primarily of sand and gravel with lesser amounts of boulders, rocks, and silt. Four species of redhorses were captured and their combined weight accounted for over 1,100 pounds or about 79% of the fish biomass. Channel catfish supported the highest game fish catch weight; however, catchable populations of other game fish species were present (Table 5).

Certain forage species became increasingly prevalent as the survey progressed downstream. Logperch, for example, were not present at Stations 1–3 and were present in only

small numbers at Stations 4 and 5; but, these became very abundant at the remaining sites. At Station 9, logperch numbered over 1,100 per acre. Brook silverside and mimic shiner displayed similar abundance patterns.

Nottawa Creek

The most upstream site on Nottawa Creek (Station N-1) held a very low standing crop of fish (slightly over 40 pounds per acre), however, game fish accounted for a rather large amount of this total (Figure 2). Still, only one brown trout and a few rock bass were of legal or acceptable size for the angler. Although only 17 species were captured, this was the only station on the entire survey where tadpole madtom and brown trout were captured (Table 2). Brown trout have been stocked in Nottawa Creek annually by Fisheries Division for many years. The most downstream stocking site, however, was 1.2 miles above Station N-1. Fishermen have reported catching trout in this downstream area in recent years, so apparently some of the stocked fish have migrated downstream. Station N-2 held a good population of catchable game fish (Table 5). Species diversity was much higher with 33 species captured. Redhorses and suckers clearly predominated in the catch. Carp were present, but not in large numbers.

A reason for the extreme difference in standing crop between Station N-1 and Station N-2 was not immediately apparent. There were no industrial or municipal discharges upstream from Station N-1. Station N-2 had more deep-water habitat and a more favorable substrate. But also, this downstream site was probably more enriched with nutrients from surrounding farmlands and probably sustained a higher summertime water temperature than Station N-1. These factors can promote a higher level of stream productivity and potentially a higher fish biomass.

DISCUSSION

In many respects the upper St. Joseph River fishery is similar to that which was observed in 1972 (Shepherd 1975). Carp and redhorse still predominate and game fish comprise only a small amount of the total standing crop. However, the addition of channel catfish and walleye in the lower third of the study area have substantially improved sportfishing opportunities in the 1980's.

Stream sedimentation continues to be a deterrent to the development of game fish populations. In 1972 (Shepherd 1975) reported that a gravel bottom was predominant throughout the river mainstream especially in flowing environments. However, that report noted heavy silt and sand loads in the Jonesville and Litchfield areas. This same condition was observed during the present study. Shifting sand sediments were especially evident just below

Station 2 and for the next several miles. Just above Station 2 there was once an impoundment. This impoundment undoubtedly acted as a sediment basin for many years before the dam was removed in 1961. Present excessive sand and silt loads below that point on the river could be the result of the erosion of accumulated sediment from the basin of that impoundment.

An intensive water quality study conducted in 1975 and 1976 concluded that suspended sediment concentrations of streams in the upper St. Joseph River basin were very low when compared with those of streams in many parts of the country (Cummings 1978). However, during this survey shifting sand substrate, not suspended but in close association to the streambed, was observed in great abundance at many points in the river. Alexander and Hansen (1983) stated that the presence of sand sediment in streams is deceiving in that it does not produce the turbidity commonly associated with severe stream sedimentation. This type of heavy moving substrate covers gravel and rock and fills in holes in the streambed. These are vital attachment points and living places for many species of aquatic invertebrates as well as fish. A recent study on a small cold-water stream (Alexander and Hansen 1983) determined that a significant reduction in trout and trout habitat resulted when the sand bedload was artificially increased four- to fivefold. It seems logical that the same principals would apply to coolwater and warmwater streams.

Water quality in the St. Joseph River has been degraded in the past but improvements in at least the upper part of the study area have occurred in the last decade. In 1973 a biological and sediment chemistry survey was conducted on the St. Joseph River from above the Hillsdale WWTP to below the Jonesville WWTP (Mikula et al. 1974). That study revealed high concentrations of heavy metals and oils in stream sediments and enriched conditions throughout the area. Also, substantial organic sludge deposits were evident resulting in degradation of the benthic macroinvertebrate community below the Hillsdale WWTP. During the mid-1970's Cummings (1978) found significantly increased concentrations of ammonia, organic nitrogen, nitrates, and phosphorous below the Hillsdale WWTP. In 1979 Woods and Louwers (1979) found that the daily minimum dissolved oxygen standard was not met during a late summer low-flow period below the Hillsdale WWTP. This report predicted this standard would not be met in the future under similar conditions unless the Hillsdale WWTP provided more advanced wastewater treatment.

In 1983 the new Hillsdale WWTP with tertiary treatment began operation. With the implementation of these improvements there has been an average 80% reduction of pollutants discharged to the St. Joseph River at that point. The quality of the water coming from the WWTP has usually been as clean or cleaner than the water already in the river (J. Braunscheidel, 1987, personal communication, Surface Water Quality Division, Michigan Department of Natural Resources, Jackson). Four years of this reduced pollutant loading could only have had the effect of improving water quality compared to pre-1983 conditions.

Water withdrawals for farmland irrigation were evident at several sites along the river. The effects of this consumption is uncertain, however, I suspect this can only be a deterrent to the development of the sport fishery. Most sport fish species of catchable size require sustained, relatively deep water, good cover (logs, brush, etc.), adequate forage, and favorable substrates to maintain fishable populations in rivers. Water withdrawals reduce water levels and thereby dewater aquatic habitat. Typically the most water for irrigation is extracted during the hottest, driest part of the year when river flows are already at annual lows. Fisheries professionals should strive to document the effects of such human intervention on the aquatic environment. Then society must be asked to judge the merits of water consumption for irrigation against the impacts of these withdrawals on aquatic organisms, riverine esthetics, riparian terrestrial plants and animals, and the recreational potential of the river. Michigan law allows for the reasonable use of surface water for agriculture. We must define what is reasonable and what is not.

While there were no industrial or municipal effluents to Nottawa Creek, human impacts have been substantial. The entire stream was channelized many years ago to improve the drainage of farmland. Such construction destroys valuable fish habitat by removing fish cover and reducing fish food production. Channelization also adversely alters the stream flow regime by decreasing water retention (which decreases summer flows during drought conditions) and causing more severe floods. These conditions generally cause increased erosion and higher sediment loads. In addition the loss of near-stream trees during the dredging process allows more solar heating of the stream. This is detrimental to cold-water game fish species such as trout, and coolwater fish like smallmouth bass and walleye.

Game fish populations found at Station N-2 during the survey were substantial. But a large deep hole (probably atypical of this reach) was within the station. This deep-water habitat held the channel catfish and smallmouth bass which were the most impressive part of the game fish catch. Obviously water quality and fish food production were adequate in this reach to sustain a fair game fish fishery. This fishery would be significantly improved in the lowest 6 miles of Nottawa Creek if more deep-water habitat were made available.

MANAGEMENT CONSIDERATIONS

St. Joseph River

Walleye fingerlings have been stocked in the lower part of the study area since the mid-1970's. From 1975 through 1979 small numbers of fingerlings were stocked annually in Sturgis Impoundment (5 miles below Station 9). In 1980, Fisheries Division stocked 55,000 spring fingerling walleyes in this impoundment. Then in 1981 large numbers of walleye fry were stocked in Sturgis Impoundment and Union Lake. In subsequent years, angler reports were

encouraging. Union Lake and the river below received massive fry plants in 1983 and 1984. Fingerlings were stocked in Union Lake and Sturgis Impoundment in 1985 and 1986. Union Lake received 48,700 fingerlings in 1987. Although only a few walleyes were captured in the present survey, angler reports have continued to be encouraging. Some anglers have reported a very substantial spring walleye fishery in the tailwaters of Union Lake Dam.

Walleye fingerling plants should continue and be scheduled for a least one plant every 2 years. It is not recommended to stock walleyes above Union City due to the lack of adequate deep-water habitat. But, Union Lake and the river below hold excellent forage stocks and good habitat for this species. Union Lake should receive the largest fingerlings possible to insure survival in this lentic environment. Enough natural reproduction to maintain the fishery should not be expected. Walleyes require relatively silt free water and rock or gravel substrates for successful reproduction.

The Michigan Fisheries Division in cooperation with the Federal Government stocked large numbers of channel catfish fingerlings, as well as some adults, in Sturgis Impoundment from 1975 to 1981. In the present survey, channel catfish accounted for the majority of the game fish standing crop at the three sites surveyed below Union Lake Dam. There were no fish migration blockages between Sturgis Impoundment and Union Lake Dam.

Much of the river above Union City lacks the type of deep-water habitat where channel catfish are typically found. However, if stocked in the upper part of the study area this species would probably seek out any available deep-water habitat and a fishable population may develop. Large channel catfish are piscivorous and should thrive on the abundant forage fish populations in the upper part of the study area.

Some young-of-the-year catfish were found at each of three sampling sites below Union Lake indicating successful natural reproduction. However, the stocking of fingerling catfish in Union Lake and in the river below would augment these naturally reproduced fish and help develop the fishery to its full potential.

Relatively few northern pike were found throughout the survey area. It seemed that with the available forage stocks, pike should have been in greater abundance. Only one young-of-the-year pike was captured in the entire survey. Perhaps the drainage of marshy spawning areas within the watershed has limited the spawning success of this species in recent years. Stocking fingerlings would augment native populations and potentially increase the overall catchable pike population.

The reach from Litchfield to Union City has some potential for fishery development through habitat manipulation. In other areas stream improvement via construction is either impractical or unnecessary. Sediment traps if placed at various points in the above-mentioned reach could reduce the shifting sand substrate while uncovering more productive gravel and rock. Also, sediment traps would add deep holes which are important habitat for large fish. A

thorough investigation of underlying substrate types should be made prior to proceeding with any sediment trap construction. If underlying substrates are composed primarily of sand, the benefits of such construction would be minimal. Conversely, if underlying substrates are of gravel and rock composition, the production of fish food organisms could be greatly enhanced by stream improvement measures. This would in turn enhance fish populations.

Stream improvement structures designed to armor erodible stream banks and provide deep water and cover for fish would help to increase the carrying capacity for large game fish.

Smallmouth bass were not found upstream from the dam in Litchfield. This same observation was made in 1972. Riverine habitat observed during this survey was rather poor in this reach. However, if sediment traps and stream improvement methods were employed and habitat improved, perhaps smallmouth bass (if stocked) might provide a future opportunity for anglers in that area.

Flathead catfish is another piscivorous species that does quite well in the lower end of some large river systems in Michigan. In similar surveys in the past, this species was found in the lower segments of the Grand River (Nelson and Smith 1981) and the Kalamazoo River (Towns 1984). Both of these rivers are in the same general area of Michigan and drain into Lake Michigan. In neither case has this species been stocked, but has apparently migrated upstream from Lake Michigan. Perhaps if fingerling flathead catfish were stocked in the lower parts of the study area (below Union Lake), this species would add a new dimension to the sport fishery while capitalizing on the very abundant forage fish stocks in that area.

The effects on the fish population as a result of consumptive water withdrawals for farmland irrigation should be monitored. Severe damage to the aquatic habitat may be occurring in the heat of the summer when river water levels are low and irrigation demands are high.

Access to many of the better fishing areas on the river is available only through private property or at road crossings. Steep banks at road crossings prevent most forms of boat access. The river must become more available to the public if its full potential as a recreational resource is to be achieved. Good locations for access development are river sections near Stations 6, 7, 8, and 9 (Figure 1).

Future fishery surveys of this river should be done with rotenone. Catch results from 1987 could then be closely compared and changes in the fishery accurately assessed.

Nottawa Creek

At the time of this survey, the middle portion of Nottawa Creek was being managed as a marginal brown trout fishery. This section (2-6 miles above Station N-1) has received annual plantings of yearling brown trout for many years. Trout survival in this section is limited by rather poor stream habitat. A stream habitat improvement project has been proposed by a

local sportsman's club to create better habitat (in at least 1 mile of stream) while not impeding stream flow. The reach near Station N-1 would benefit greatly from similar habitat improvement.

A thorough investigation of present stream habitat is needed from Station N-2 upstream to Athens. The catch at Station N-2 indicated that an excellent sport fishery may already be present in the lower section of Nottawa Creek. However, because the sample at Station N-2 was probably somewhat biased (because it contained a large deep hole under a bridge), the development of more fish cover and deep water in this reach would be instrumental in the development of a substantial fishery for warm- and coolwater sport fish.

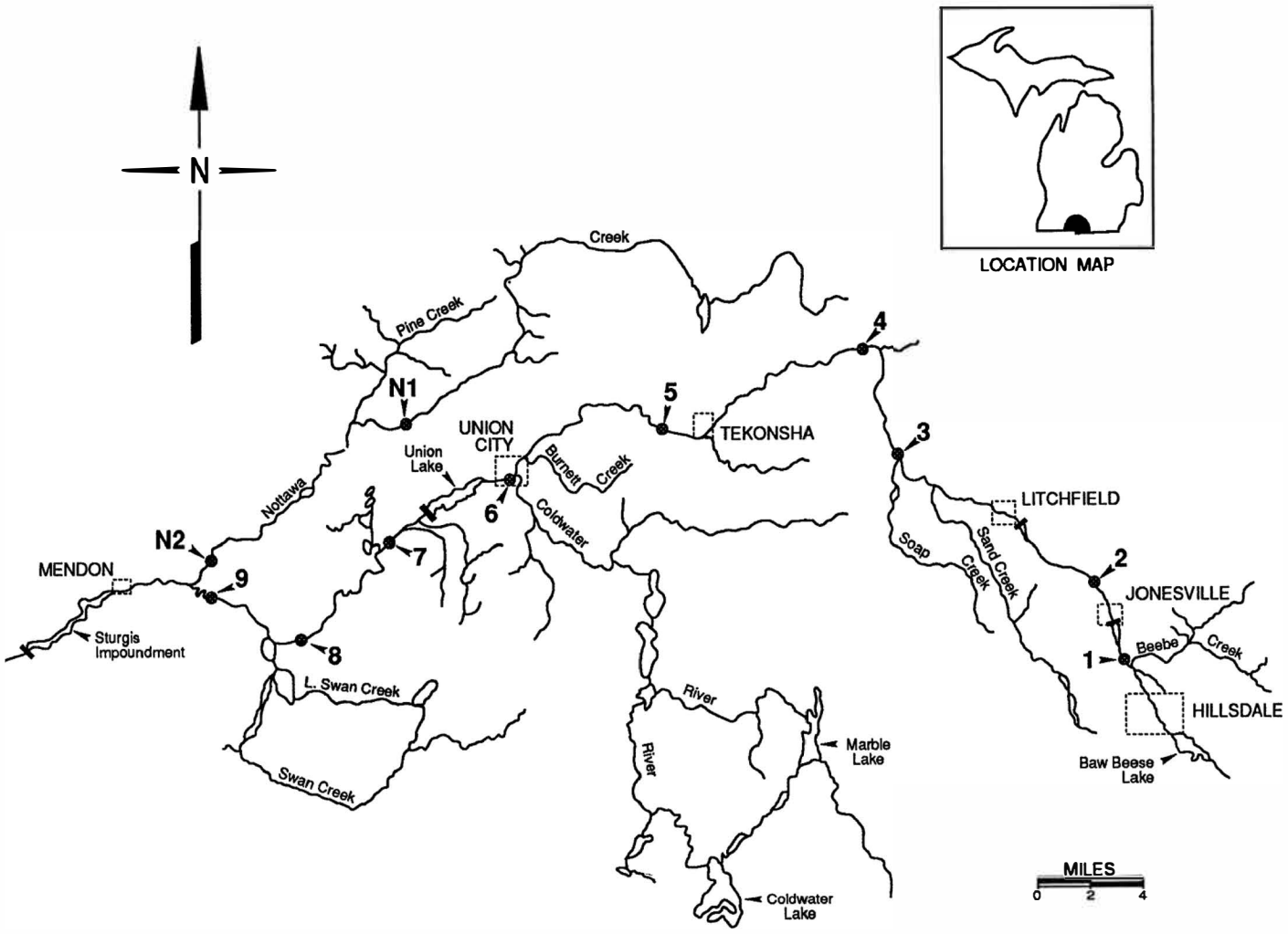

Figure 1. Locations of sampling stations during the 1987 St. Joseph River survey.

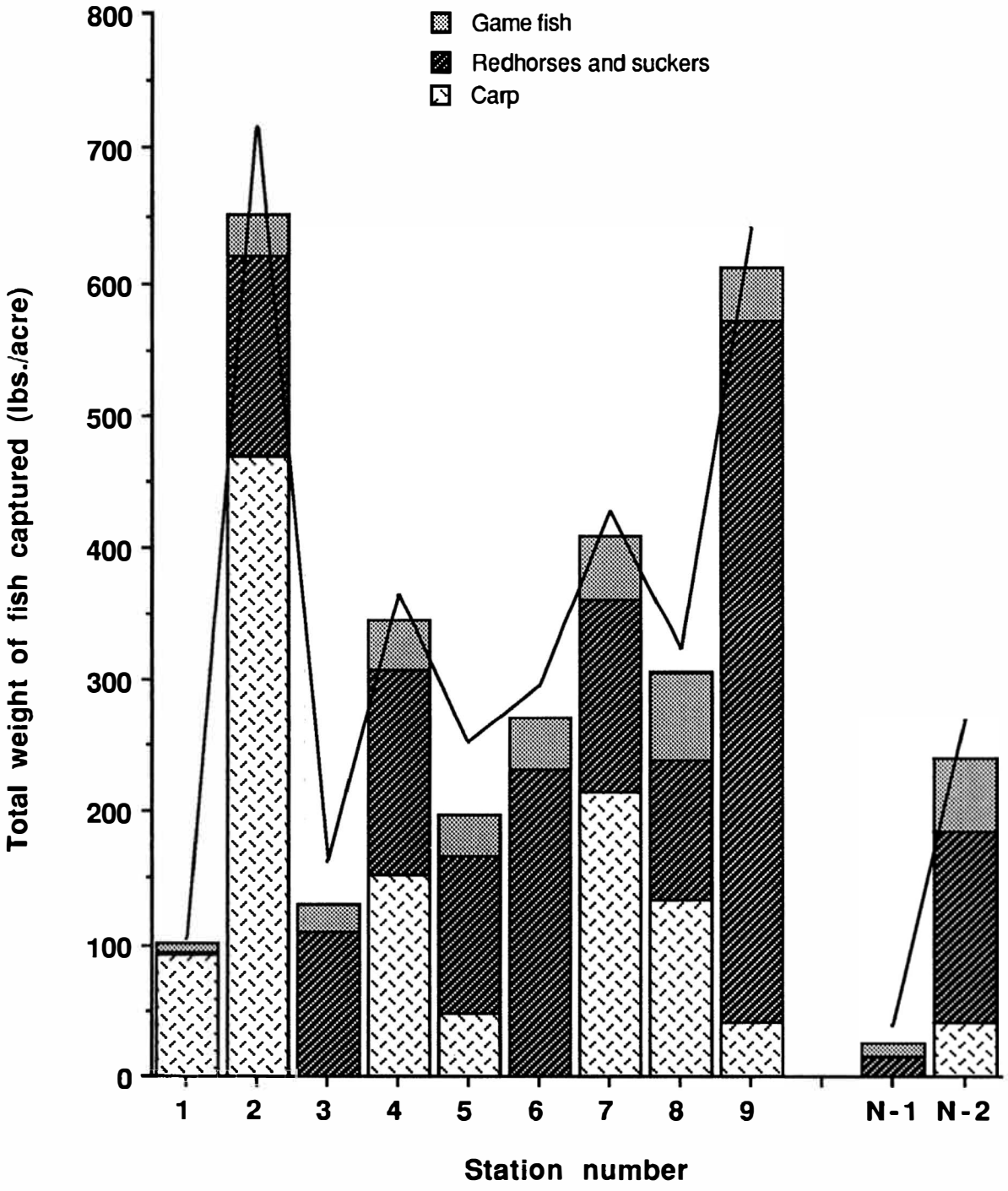

Figure 2. Total weight of game fish, redhorses and suckers, and carp captured at sampling stations on the St. Joseph River and Nottawa Creek, 1987. The solid line represents the weight of all captured fish.

Table 1. Description of 1987 sampling stations on the St. Joseph River and Nottawa Creek. "N" denotes Nottawa Creek.

Station	County	Location	Length	Upstream limit and location
1	Hillsdale	T6S, R3W, Sec. 9	536	186 ft. above Moore Rd.
2	Hillsdale	T5S, R3W, Sec. 29	676	216 ft. above Genessee Rd.
3	Calhoun	T4S, R5W, Sec. 36	758	198 ft. above S. County Line Rd.
4	Calhoun	T4S, R5W, Sec. 10	816	309 ft. above 22 Mile Rd.
5	Calhoun	T4S, R6W, Sec. 29	653	478 ft. above 14 Mile Rd.
6	Branch	T5S, R7W, Sec. 5	385	379 ft. above Page Ave., Union City
7	Calhoun	T5S, R7W, Sec. 21	832	25 ft. below Athens Rd.
8	St. Joseph	T6S, R9W, Sec. 1	585	685 ft. above Stowell Rd.
9	St. Joseph	T5S, R9W, Sec. 32	615	389 ft. above Jacksonburg Rd.
N-1	Branch	T4S, R8W, Sec. 26, 27	554	385 ft. above 4 Mile Rd.
N-2	St. Joseph	T5W, R9W, Sec. 29	431	320 ft. above Olney Rd.

Table 2. List of species captured at each station during the 1987 St. Joseph River fisheries survey. "N" denotes Nottawa Creek.

Species	Station										
	1	2	3	4	5	6	7	8	9	N-1	N-2
Chestnut lamprey *Ichthyomyzon castaneus*	—	—	—	x	x	x	—	x	x	x	—
Silver lamprey *Ichthyomyzon unicuspis*	—	—	x	—	—	—	—	—	x	—	—
Longnose gar *Lepisosteus osseus*	—	—	—	—	—	—	—	—	x	—	x
Brown trout *Salmo trutta*	—	—	—	—	—	—	—	—	—	x	—
Central mudminnow *Umbra limi*	x	—	x	x	x	—	x	—	x	—	—
Grass pickerel *Esox americanus vermiculatus*	x	x	x	x	x	x	x	x	x	x	x
Northern pike *Esox lucius*	x	—	x	x	x	x	x	x	—	—	x
Central stoneroller *Campostoma anomalum*	—	x	x	—	x	x	—	—	—	—	x
Common carp *Cyprinus carpio*	x	x	—	x	x	—	x	x	x	—	x
Hornyhead chub *Nocomis biguttatus*	—	x	x	x	x	x	x	—	x	—	—
Golden shiner *Notemigonus crysoleucas*	x	x	x	—	x	—	x	x	x	—	—
Striped shiner *Notropis chrysocephalus*	—	—	—	—	—	—	—	x	x	—	x
Common shiner *Notropis cornutus*	x	x	x	x	x	x	x	x	x	x	x
Roseyface shiner *Notropis rubellus*	—	—	x	x	x	x	—	x	x	—	x
Spotfin shiner *Notropis spilopterus*	—	—	—	—	—	—	x	x	x	—	x
Sand shiner *Notropis stramineus*	—	—	—	—	—	—	—	x	x	—	—
Mimic shiner *Notropis volucellus*	—	—	—	—	—	x	x	x	x	—	—
Bluntnose minnow *Pimephales notatus*	x	x	x	x	x	x	x	x	x	x	x
Blacknose dace *Rhinichthys atratulus*	—	x	x	—	—	x	—	—	—	—	—

Table 2. Continued:

Species	Station										
	1	2	3	4	5	6	7	8	9	N-1	N-2
Creek chub *Semotilus atromaculatus*	x	x	x	x	x	x	x	x	x	x	x
White sucker *Catostomus commersoni*	x	x	x	x	x	x	x	x	x	x	x
Creek chubsucker *Erimyzon oblongus*	—	x	—	x	—	—	—	—	—	—	—
Northern hog sucker *Hypentelium nigricans*	x	x	x	x	x	x	x	x	x	x	x
Spotted sucker *Minytrema melanops*	—	—	—	—	—	—	x	x	—	—	x
Silver redhorse *Moxostoma anisurum*	—	—	—	—	—	—	x	x	—	—	x
River redhorse *Moxostoma carinatum*	—	—	—	—	—	—	x	x	x	—	—
Black redhorse *Moxostoma duquesnei*	—	—	—	x	—	—	—	—	x	—	x
Golden redhorse *Moxostoma erythrurum*	—	x	x	x	x	x	x	x	x	x	x
Shorthead redhorse *Moxostoma macrolepidotum*	—	x	x	x	x	x	x	x	x	—	x
Greater redhorse *Moxostoma valenciennesi*	—	—	—	x	—	x	—	—	—	—	—
Yellow bullhead *Ictalurus natalis*	x	x	x	x	x	x	x	x	x	—	x
Channel catfish *Ictalurus punctatus*	—	—	—	—	—	—	x	x	x	—	x
Stonecat *Noturus flavus*	x	x	x	x	x	x	x	x	x	—	x
Tadpole madtom *Noturus gyrinus*	—	—	—	—	—	—	—	—	—	x	—
Pirate perch *Aphredoderus sayanus*	—	—	x	x	x	x	—	—	—	x	x
Brook silverside *Labidesthes sicculus*	x	—	—	—	x	x	x	x	x	—	x
Rock bass *Ambloplites ripestris*	x	x	x	x	x	x	x	x	x	x	x
Green sunfish *Lepomis cyanellus*	x	x	—	x	x	x	x	x	x	x	x

Table 2. Continued:

Species	Station										
	1	2	3	4	5	6	7	8	9	N-1	N-2
Pumpkinseed *Lepomis gibbosus*	x	x	x	x	x	x	x	x	x	—	—
Warmouth *Lepomis gulosus*	—	—	—	—	x	x	x	—	x	—	—
Bluegill *Lepomis macrochirus*	x	x	x	x	x	x	x	x	x	x	x
Smallmouth bass *Micropterus dolomieui*	—	—	x	x	x	x	x	x	x	—	x
Largemouth bass *Micropterus salmoides*	x	x	x	x	x	x	x	x	x	—	x
Black crappie *Pomoxis nigromaculatus*	x	x	—	—	—	x	x	x	—	—	x
Greenside darter *Etheostoma blennioides*	x	x	x	x	x	x	x	x	—	—	—
Rainbow darter *Etheostoma caeruleum*	x	x	x	x	x	x	x	x	x	x	x
Johnny darter *Etheostoma nigrum*	x	x	x	x	x	x	x	x	x	x	x
Yellow perch *Perca flavescens*	x	—	—	—	x	x	x	x	x	—	—
Logperch *Percina caprodes*	—	—	—	x	x	x	x	x	x	-	x
Blackside darter *Percina maculata*	x	x	x	x	x	x	x	x	x	x	x
Walleye *Stizostedion vitreum vitreum*	—	—	—	—	—	x	x	x	—	—	—
Total species per station	24	26	28	31	33	35	37	38	38	17	33

Table 3. Percent of catch, by weight and number, for various species of fish 3 inches long and larger collected during the 1987 St. Joseph River survey (Nottawa Creek catch not included). All shiners, darters, logperch, chubs, and minnows are excluded.

Species	Catch composition	
	Weight	Number
Northern pike	1.1	0.3
White sucker	3.6	7.9
Northern hog sucker	4.0	8.1
Redhorse spp.	49.0	32.9
Golden	17.3	16.4
Shorthead	19.1	12.1
Black	4.6	2.7
River	6.5	1.2
Silver	1.1	0.4
Greater	0.5	0.1
Carp	31.0	4.1
Yellow bullhead	1.1	5.1
Channel catfish	4.0	1.6
Stonecat	1.0	12.3
Smallmouth bass	1.2	2.4
Largemouth bass	0.5	0.9
Bluegill	0.8	2.2
Pumpkinseed	0.2	1.2
Rock bass	1.4	5.5
Green sunfish	0.3	3.6
Yellow perch	0.1	1.6
Central stoneroller	0.3	6.5
Other species	0.6	3.7

Table 4. Catch results of southern Michigan rivers which have recently been surveyed using rotenone.

River (survey year)	Number of sampling sites	Number of species captured	Average standing crop (lbs/acre)	Game fish[1]		Redhorses and suckers[1]		Carp[1]	
				Percent by weight	Percent by number	Percent by weight	Percent by number	Percent by weight	Percent by number
St. Joseph (1987)	9	49	365	10.6	21.6	56.6	49.0	31.0	4.1
Nottawa (1987)	2	36	154	22.6	37.5	55.1	32.5	15.1	1.6
Shiawassee[2] (1987)	14	51	294	11.4	40.1	54.5	30.1	28.7	4.7
Battle Creek[3] (1986)	7	42	163	26.5	49.1	42.1	17.9	27.9	1.4
Cass[4] (1985)	11	43	268	9.4	6.4	47.9	14.2	24.4	0.6
Raisin[5] (1984)	12	59	278	14.1	26.6	53.0	51.0	28.3	1.9
Saline[5] (1984)	2	24	117	12.3	6.3	32.9	28.7	39.5	2.0
S. Br. Raisin[5] (1984)	1	23	463	1.3	1.0	81.8	42.1	0.1	0.4
Kalamazoo[6] (1982)	14	62	186	12.8	30.1	17.3	30.3	67.5	18.2
Grand[7] (1978)	22	70	160	9.6	22.0	44.0	59.0	45.6[9]	16.0[9]

Table 4. Continued:

River (survey year)	Most numerous species by weight[1]	Most numerous game fish[1]	
		Percent by weight	Percent by number
St. Joseph (1987)	carp[8]	channel catfish (4.0)	rock bass (5.5)
Nottawa (1987)	golden redhorse[8]	channel catfish (9.0)	smallmouth bass (10.2)
Shiawassee (1987)	redhorse spp.	rock bass (4.1)	rock bass (13.4)
Battle Creek (1986)	rock bass	rock bass (10.5)	rock bass (29.5)
Cass (1985)	redhorse spp.	rock bass (3.4)	rock bass (3.2)
Raisin (1984)	northern hog sucker	smallmouth bass (7.6)	smallmouth bass (15.0)
Saline (1984)	carp	yellow bullhead (6.9)	yellow bullhead (2.5)
S. Br. Raisin (1984)	white sucker	yellow bullhead (1.0)	yellow bullhead (1.0)
Kalamazoo (1982)	carp	channel catfish (3.9)	rock bass (11.8)
Grand (1978)	carp[9]	channel catfish (3.3)	bullhead spp.[10] (5.5)

[1] Based on the catch of fish, 3 inches and longer (excluding all chubs, shiners, and darters). "Game fish" include rock bass, smallmouth bass, bullhead spp., northern pike, channel catfish, pumpkinseed, warmouth, bluegill, largemouth bass, black crappie, and yellow perch.

[2] D. Nelson, personal communication, 1988, Michigan Department of Natural Resources, East Lansing.

[3] Towns (1987).

[4] J. Leonardi, personal communication, 1987, Michigan Department of Natural Resources, Imlay City.

[5] Towns (1985).

[6] Towns (1984).

[7] Nelson and Smith (1981).

[8] All redhorse spp. combined were more numerous.

[9] Carp and goldfish included.

[10] Smallmouth bass were next in highest abundance (5.0%).

Table 5. Numbers of common fish collected per surface acre at each station, during the 1987 St. Joseph River fisheries survey. The value in parentheses indicates the number of legal- or acceptable-sized fish collected per acre at each station. "N" denotes Nottawa Creek.

Species	Station										
	1	2	3	4	5	6	7	8	9	N-1	N-2
Game fish											
Smallmouth bass	—	—	8	8	30	44	21	19	25	—	172
	—	—	(1)	(3)	(0)	(1)	(2)	(1)	(2)	—	(3)
Northern pike	2	—	3	6	7	3	2	1	—	—	2
	(0)	—	(0)	(3)	(3)	(0)	(2)	(0)	—	—	(1)
Rock bass	35	102	103	48	57	105	41	19	10	58	22
	(5)	(20)	(25)	(19)	(13)	(33)	(8)	(7)	(3)	(11)	(9)
Largemouth bass	5	5	38	6	56	29	27	62	30	—	31
	(0)	(0)	(1)	(0)	(0)	(1)	(0)	(1)	(1)	—	(1)
Yellow bullhead	5	155	5	16	81	27	44	37	57	—	39
	(0)	(33)	(0)	(9)	(0)	(9)	(17)	(7)	(7)	—	(13)
Channel catfish	—	—	—	—	—	—	13	45	28	—	16
	—	—	—	—	—	—	(10)	(33)	(13)	—	(16)
Pumpkinseed	7	15	8	8	1	17	22	6	1	2	—
	(0)	(0)	(0)	(0)	(0)	(0)	(3)	(3)	(1)	(0)	—
Bluegill	40	68	7	20	23	112	24	16	30	—	105
	(5)	(0)	(0)	(0)	(1)	(1)	(2)	(6)	(3)	—	(0)
Walleye	—	—	—	—	—	1	1	1	—	—	—
	—	—	—	—	—	(0)	(0)	(0)	—	—	—
Yellow perch	17	—	—	—	5	60	17	56	38	—	—
	(0)	—	—	—	(0)	(3)	(0)	(0)	(0)	—	—
Black crappie	3	22	—	—	—	33	18	27	—	—	19
	(2)	(0)	—	—	—	(0)	(10)	(3)	—	—	(0)
Warmouth	—	—	—	—	2	1	1	—	1	—	—
	—	—	—	—	(1)	(0)	(0)	—	(0)	—	—
Brown trout	—	—	—	—	—	—	—	—	—	2	—
	—	—	—	—	—	—	—	—	—	(2)	—
Coarse fish											
Carp	42	130	—	14	5	—	42	26	8	—	9
White sucker	28	742	421	181	829	29	39	31	16	1,696	37
Northern hog sucker	2	237	75	38	178	96	14	58	61	38	106
Redhorse spp.[1]	—	162	186	279	133	352	519	299	439	20	323
Stonecat	3	95	83	98	414	59	13	89	147	—	176
Green sunfish	8	232	—	13	18	48	43	25	19	4	88

[1]Redhorse species include golden, shorthead, black, river, silver, and greater.

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