FISHERIES DIVISION

TECHNICAL REPORT

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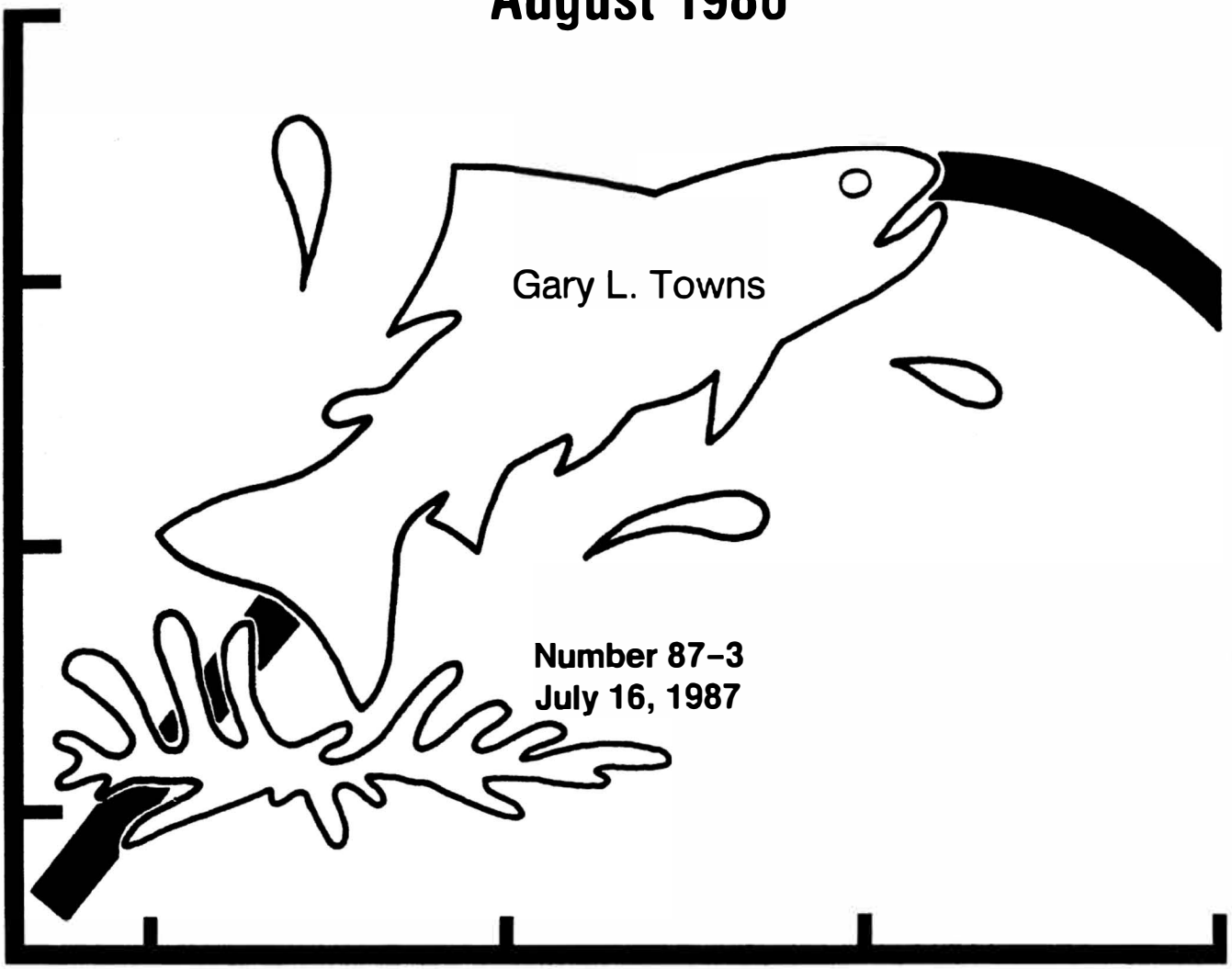

Gary L. Towns

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Michigan Department of
Natural Resources

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION

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A FISHERY SURVEY OF THE BATTLE CREEK RIVER, AUGUST 1986

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SUMMARY

Fish populations in the Battle Creek River were surveyed by the Fisheries Division of the Michigan Department of Natural Resources in August of 1986. Information obtained during this project will be used during the development of fishery management plans.

Rotenone treatment was the only method of fish collection used during the survey. Some physical and biological conditions of the riverine environment were noted at each of the seven sampling locations. No chemical water quality parameters were measured.

Over 13,600 fish were captured representing 42 species. When considering the total catch, the common shiner was the most numerous species found throughout the river; but, when disregarding all fish less than 3 inches long, rock bass were the most numerous. Game fish comprised 26.5% by weight and 49.1% by number of the catch. Carp were captured at only two sites and accounted for 27.9% by weight and 1.4% by number of the catch. Estimates of total fish standing crop averaged 163 pounds per acre and ranged from 47 to 328 pounds per acre.

Some reaches in the lower half of the river held fair to good populations of smallmouth bass, rock bass, and northern pike. Additionally, anglers reported that impoundments and slow deep riverine areas occasionally provided catches of bluegills, crappie, pumpkinseed, largemouth bass, northern pike, carp, suckers, and bowfin. Sport fish populations were not heavily exploited in some areas. This was especially true near the confluence with the Kalamazoo River in the city of Battle Creek.

Mottled sculpin, a coldwater species quite intolerant of many forms of pollution, were found at four of the seven sampling locations.

Factors which appeared to be limiting sport fish abundance include poor substrate, limited fish cover, and poor water quality in certain reaches. Water quality was 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 some species, especially northern pike, channel catfish, smallmouth bass, and possibly walleye would increase angling opportunities and recreational usage. Construction of fish habitat improvement structures in some reaches would likely increase large game fish carrying capacity.

INTRODUCTION

The Battle Creek River is located in the extreme southern central portion of Michigan's lower peninsula. The upper third of the river flows in a northern direction. The mainstream then turns and flows southwest to its confluence with the Kalamazoo River. The Battle Creek

River drains approximately 280 square miles. Its basin is about 27 miles in length, from 11 to 15 miles wide, and includes portions of three Michigan counties (Fig. 1). Major tributaries include: Big Creek, Indian Creek , Ackley Creek, and Wanondoger Creek.

Sportfishing in the upper third of the river is nearly nonexistent. Low stream flows, lack of good fish habitat (holes, riffles, and fish cover), and a relatively poor sport fish population contribute to this lack of use. Anglers report that fishing, especially for northern pike, begins a few miles below Charlotte. From that point to Bellevue, good catches of pike are occasionally taken in the mainstream. The Bellevue Impoundment produces largemouth bass, northern pike, and some panfish. Below Bellevue, anglers fish the mainstream primarily for pike; however, rock bass, smallmouth bass, suckers, and carp are also taken. The Verona Impoundment produces both largemouth and smallmouth bass, northern pike, panfish, bullheads, carp, suckers, and bowfin. There is very little documentation concerning fishing activity below the Verona Impoundment.

METHODS

Rotenone treatment was the sole method of fish capture used during the survey. Techniques were similar to those employed in the Grand River survey in 1978 (Nelson and Smith 1980, 1981). There were two major exceptions: (1) Low current velocities allowed the use of small-mesh blocking seines (maximum diagonal opening of 3/16 inches) 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. (2) On all but two of the sampling stations two blocking seines were used – one approximately half way through and the other at the end of the stations. Since the current was slow, the mid-station net was used to capture upstream fish which would have settled to the stream bottom and not drifted with the current to the downstream net.

Based on stream flow, ease of access, stream depth, geographic distribution, and other factors, seven sampling stations were selected (Fig. 1, Table 1). All of these were on the mainstream of the river. Several areas could not be sampled with the rotenone method due to one or all of the following: low current velocities, deep water, and soft substrates.

Station lengths averaged 665 feet but varied between 300 and 870 feet to accommodate unusual channel structure or habitat. Station widths and lengths were measured with either a measuring tape or precalibrated rope. Stream flows were measured with the aid of a Gurley current meter or were interpolated from the United States Department of Interior Geological Survey gaging stations.

Fish were identified, measured to inch group, and weighed to the nearest 0.1 pound in aggregate by species. Most of the captured fish were weighed and measured at individual

sampling sites. However, to save time and promote accuracy , some of the smaller fish were preserved in formalin and measured later in the laboratory.

RESULTS

Over 13,600 fish were captured during the survey. As with past surveys of warmwater rivers in southern Michigan, the vast majority (85%) of these were small forage fish. Forty-two species of fish were captured (Table 2). Seven species were found at every station. These were grass pickerel, horneyhead chub, common shiner, bluntnose minnow, white sucker, johnny darter, and blacknose darter. Total species diversity includes spotfin shiner even though only a single individual was captured. That fish was a common shiner x spotfin shiner hybrid (G. R. Smith, personal communication 1986, Museum of Zoology, The University of Michigan, Ann Arbor). The hybridization of these two species has never before been documented.

When considering fish larger than 3 inches (and excluding chubs, shiners, and minnows) rock bass was the most numerous species in the river, comprising 29.5% by number of the catch (Table 3). Of rivers in southern Michigan surveyed in recent years, the Battle Creek River was the only one in which a game fish was the most numerous species (Table 4). Although carp were caught at only two stations, this species made up a large portion of the total catch (29.7% by weight). However, carp comprised only 1.4% of the catch by number. These catch results were similar to those observed in the Raisin River in 1984 (Towns 1985) and in the Cass River in 1985 (J. Leonardi. 1987. Unpublished data, Michigan Department of Natural Resources, Imlay City). Much different results were found in two other, much larger, southern Michigan rivers (Table 4). In the Kalamazoo River, in 1982, carp comprised 67.5% by weight and 18.2% by number (Towns 1984). In the Grand River, in 1978, carp and goldfish comprised 45.6% by weight and 16.0% by number of the total catch (Nelson and Smith 1981).

Survey results indicate that game fish in the Battle Creek River made up a larger segment of the total fish community than game fish in other larger southern Michigan rivers which have been recently surveyed with rotenone methods. In the Battle Creek River, game fish comprised 26.5% by weight and 49.1% by number. Similar statistics for the Grand River in 1978 (Nelson and Smith 1981) were 9.6% and 22.0%; for the Kalamazoo River in 1982 (Towns 1984) were 12.8% and 30.1%; and for the River Raisin in 1984 (Towns 1985) were 14.1% and 26.6%, respectively. In the Cass River, game fish accounted for only 9.4% by weight and 6.4% by number of the catch (Table 4).

Standing crop estimates ranged from 47 pounds per acre at Station 2 to 328 pounds per acre at Station 7 (Fig. 2). The average was 163 pounds per acre. This was similar to estimates of standing crop in other recent river surveys (Table 4).

The number of species present at a given station in the Battle Creek River ranged from 16 species at Station 1 to 29 at Station 4 (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 rotenone techniques collected nearly all of the fish at each sampling station. 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 more 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. Efficiency of fish capture was undoubtedly better in shallow sampling stations having hard substrates and swift currents. Such conditions existed at Stations 1, 2, 4, and 5, and it was generally observed by the survey team that escapement was very low at those sites. Station 6 had a substantial amount of aquatic vegetation which entangled some fish and prevented their collection. Stations 3 and 7 had depths exceeding 4 feet and soft silty substrates. Also, current velocities were rather slow. Heavy rain during the last stages of sampling at Station 7 restricted visibility and, thus inhibited fish recovery efforts. For these reasons, standing crop estimates reported for Stations 3, 6, and 7 should be considered a bit more conservative than estimates at other stations.

I am 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. The catch of small demersal species such as darters and sculpin was probably the most affected. In slow stream velocities many of these fish would not have drifted the entire length of the sampling station to be captured in the downstream blocking seine.

Fishery description

An extensive fishery survey of the Battle Creek River was conducted in 1975 by the Fisheries Division of the Michigan Department of Natural Resources. During this project, fish were collected exclusively 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). For this reason, only rotenone sampling methods were used in the present survey. Consequently, it is difficult to make direct comparisons between the 1975 and the 1986 surveys. However, general trends in the 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.

Stations 1–3

Much of the Battle Creek River above Brookfield Road (Station 1, Fig. 1) in Eaton County has been dredged to facilitate drainage of surrounding farm lands. During low flow periods, low current velocities and shallow water greatly limit sport fish habitat. This reach probably serves as a nursery area for some sport fish (such as northern pike) and many forage species. Undoubtedly this reach provides opportunities for sucker fishing and spearing in the springtime during high flows.

At Station 1, stream flows and fish habitat appeared adequate for at least a marginal sport fishery. White suckers predominated the survey sample, comprising nearly 74% of the total catch by weight, and the sport fish catch was negligible (1% by weight). It was surprising to find mottled sculpin at this site. This coldwater species is normally found almost exclusively in trout streams. Mottled sculpin are intolerant of high water temperatures and many forms of pollution, especially low dissolved oxygen levels. The presence of several individuals indicates that stream water temperatures remain quite cool and oxygen levels remain high all year in that reach.

The Battle Creek River changed substantially after passing through Charlotte. Filamentous algae covered submerged rocks and turbidity increased. The number of species increased at Station 2 (Table 2), but standing crop dropped from 286 pounds per acre to 47 pounds per acre (Fig. 2). Fish cover was more limited at Station 2 and most of the sampled area was completely exposed to the sun. This station flowed through a cattle yard and was about 1 mile downstream of the Charlotte Wastewater Treatment Plant (WWTP)

A few more species of game fish were present at Station 2, however, none captured were of legal or acceptable size to anglers. One large northern pike (27 inches) was collected immediately downstream of the station limits. Intolerant species, such as mottled sculpin and blacknose dace, were present in large numbers. This indicates that apparently any nutrient additions from municipal wastewater or surface water runoff from nearby pastures were not significant enough to cause severely reduced oxygen levels in that section of the river.

Below Station 2, for the next 2.5 miles (Fig. 1), the stream was characterized by having straight banks, slow current velocities, and very low water transparency. The water had a greenish-gray color and filamentous algae was growing wherever there were available attachment points. Current velocities were too low for effective sampling using rotenone methods.

At Spencerville Highway the river passed through a more wooded area and fish habitat improved. Stream-side residents reported that northern pike fishing had greatly improved in that area over the last 3 years. Perhaps this was a result of improved water quality. The upgraded Charlotte Waste Water Treatment Plant began operation in 1980. These residents reported good catches of pike (22 to 34 inches) during the summer of 1986. Fishing pressure

was reported as being "quite heavy" in that area. A few miles further downstream, the river near Stine Road was reported as an excellent pike fishery by a long-time resident and angler.

There were indications along the river banks that the Ainger Road area (Station 3) receives a fair amount of fishing pressure. One local angler reported that this site was used nearly every weekend, primarily by pike fishermen.

There was some fish cover at this site in the form of logs and brush. Much of the station was rather deep and had slow current velocities. A great majority of the bottom substrate was composed of silt and sand.

Carp and white suckers clearly predominated at Station 3 making up 90% by weight of the total catch. Two legal-sized pike (20 inches or larger) were captured. Anglers reported that some smallmouth bass have been taken in that area, however, none were captured during the survey. Mottled sculpin were again present in good numbers.

Stations 4–6

Downstream from Station 3, stream velocity was reduced due to the effects of the Bellevue Dam. Fishing in the Bellevue Impoundment has been reported as good for pike and fair for bass and panfish.

Immediately below the Bellevue Dam, the nature of the stream changed dramatically. River substrates had a much higher percentage of rock and gravel. The river was shallower and had faster stream velocities. Then, after only a few miles, the character of the stream again reverted to intermittently being wide, deep, slow, and silt laden. Poor access and the slow deep nature of the stream prevented sampling with rotenone techniques. If those areas had been sampled, it is suspected that a higher percentage of rough fish species, primarily carp, would have resulted in the total catch.

Station 4 was located within the city limits of Bellevue (Fig. 1). Maximum water depth within the station was only 2 feet, this was typical of this section of the river. Game fish made up a large portion of the catch (Fig. 2). Game fish alone resulted in a standing crop estimate of 60.4 pounds per acre. However, the vast majority of these game fish was small. The area was suspected to have a fairly high degree of fishing pressure. Also, habitat for large fish was rather sparse. Average river depth was less than 1 foot and there was very little fish cover in the form of logs, brush, undercut banks, and holes. This was the farthest upstream station where smallmouth bass were collected.

Fish habitat in the form of logs, holes, and instream vegetation was much more abundant at Station 5. This was an area remote from human population centers and accessible only across private property. Fishing activity was reported as very light by riparian landowners. Station 5 was immediately downstream from an extensive area of the river in which aquatic vascular plants were very abundant.

Remoteness combined with good habitat undoubtedly accounted for the excellent catch of game fish. Of the 45 smallmouth captured, 5 were legal-sized fish (12 inches or larger). Two of these were larger than 17 inches. One legal-sized northern pike was captured. Anglers reported that northern pike were the principle species fished for in this reach. Rock bass comprised a very large portion of the catch: 61% by number and 32% by weight. Over 16% of the 269 rock bass captured were 6 inches or larger. Game fish made up over 61% of the catch by weight.

Riverine characteristics at Station 6 were similar to those at Station 5. Angler access was much better at Station 6 and evidence suggested that the area was fished frequently. The catch seemed to reflect angler usage. No legal-sized smallmouth bass were captured and just 2 of 15 northern pike exceeded the 20-inch minimum size limit. About a fourth of the surface acreage in Station 6 was covered with aquatic vascular plants—primarily eel grass, pondweed, and coontail . A more complex habitat may have been the reason for the higher species diversity at this location (Table 2). Mottled sculpin were again present at Station 6.

Station 7

The last and most downstream sampling site was in downstream Battle Creek (Fig. 1). Stream substrate consisted for the most part of rock and broken concrete with lesser amounts of gravel, sand and silt. This was the deepest reach of any surveyed and only one blocking seine could be used. Fish habitat was abundant in the form of logs, brush, boulders, and deep holes. The smallmouth bass catch was the best of any in the survey. Eight of the 43 smallmouth bass captured were legal-sized. While only one legal-sized northern pike was captured, anglers reported good fishing for this species and rock bass. The standing crop of game fish was the highest of all the survey sampling sites (Fig. 2). Carp made up over 49% of the catch by weight. The catch of suckers and redhorse was also substantial.

Apparently little fishing activity takes place in this downstream reach. Poor stream-side aesthetics and water transparency probably deter many anglers from attempting to fish.

DISCUSSION

The Battle Creek River displayed a variety of habitat and fish populations. Some sections contained excellent game fish populations (Table 6). In fact, in some reaches the smallmouth bass population appeared to be underfished.

Catch results differed substantially from those of the 1975 survey. Different sampling methods were used so it is uncertain if discrepancies can be attributed to fish population changes or selectivity of the collection gear. Generally, however, comparisons of survey results indicate that game fish populations have improved since 1975. In 1975, smallmouth bass were

captured at only a few sampling sites near Battle Creek and were not captured above Verona Dam. In 1986, good populations of smallmouth bass were found below Verona Dam and in the next 15 miles upstream to Bellevue Dam.

Fish habitat has also improved since 1975. It was apparent that there has been no channelization maintenance in the mainstream in at least the last decade. This has allowed a return of some natural fish habitat in the form of logs, holes, and brush. Sedimentation continues to be a major concern to fisheries management, but extreme sedimentation was noted only at Station 3.

Battle Creek River water quality has improved a great deal in the last decade. A study in 1976 (Lundgren 1978) indicated that the Charlotte WWTP effluent severely degraded water quality for at least 3 miles downstream of Charlotte. In 1980, the Charlotte WWTP was upgraded to a tertiary system. A subsequent study (Wuycheck 1983) determined that discharge from the new Charlotte WWTP did not adversely impact stream quality. In the 1975 fishery survey, only eight species of fish were collected at a site approximately 0.50 mile below the Charlotte WWTP. In the 1986 fishery survey at the same location (Station 2), 27 species were collected including large numbers of 2 intolerant species (Table 2).

Water quality in the lower reaches of the river has apparently also greatly improved over the last 15 years. A study of river macroinvertebrate communities in 1972 (Jackson 1973) indicated that the river below the city of Battle Creek was grossly degraded. In that project, sampling sites in the lower river averaged only one species and one individual macroinvertebrate. Although fish populations were not surveyed in that study, it is doubtful that significant game fish populations could have survived under such adverse conditions. In the same reach in 1986, good populations of northern pike, rock bass, and smallmouth bass were available to anglers (Station 7, Table 6).

Improvements in water quality have done much to enhance fish populations in the Battle Creek River over the last decade. Access development and more intensive fishery management can further develop the recreational potential of this fine southern Michigan fishery.

To some extent catch results during this survey were affected by physical characteristics of the river. Some deep reaches having slow current velocities were not sampled because the rotenone treatment method does not lend itself well to such habitat. Such reaches in the Battle Creek River include those from Station 3 to the Bellevue Dam, from 2 miles below the Bellevue Dam to Station 5, and the Verona Impoundment. These areas may have held large populations of fish species, such as carp and suckers, which are generally rather abundant in slow, deep, warmwater riverine environments, thus, overall catch statistics for this survey are somewhat biased toward those species which are primarily found in reaches having at least moderate current velocities and rather shallow depths (less than 4 feet). However, other rotenone treatment surveys on southern Michigan rivers have encountered similar deep-slow water areas

in which rotenone sampling was avoided. This fact helps to make catch data from these various rivers comparable.

Management Considerations

Fishable populations of smallmouth bass were found in the lower river up to the Bellevue Dam. Substrate types and fish cover are not ideal for this species above Bellevue. If fingerling smallmouth were stocked, it could increase the sportfishing potential in the area near Charlotte. This species may do quite well in the 2- to 3-mile reach above Charlotte.

Northern pike is presently the principle sport fish sought by anglers in the Battle Creek River, yet few small pike were collected during the survey. Over the past century much of the marshland adjacent to the river has been drained for farming and development. This has reduced natural pike spawning and nursery areas. Stocking pike fingerlings would augment natural recruitment and increase the adult pike population. When considering the present habitat, this species seems to be the game fish best suited for the river between Bellevue and Charlotte and from the Calhoun County-Eaton County boundary to T Drive North in Calhoun County.

Walleyes do well in the lower section of some other rivers in southern Michigan. Stocked walleyes might survive in sufficient numbers to create a moderate fishery in some of the deep water reaches of the Battle Creek River below Bellevue. Walleye reproductive success has been poor in most cases in southern Michigan so periodic plantings would be necessary.

Channel catfish are an excellent game fish in large river systems. In 1968, a private group stocked 4,500, 6- to 10-inch channel catfish near Pennsfield (E. H. Bacon, personal communication. 1971. Michigan Department of Natural Resources, Jackson). Angler reports indicated that occasionally some of these fish were caught in later years. One riparian interviewed during the 1986 survey reportedly caught a large catfish (approximately 20 pounds) only a few years ago. It is doubtful that these fish were successful at reproduction since none were taken during this survey. However, channel catfish would be a fine addition to the fishery, even if periodic stocking were necessary.

The presence of mottled sculpin in a stream usually indicates the potential for trout management. In most of the area where sculpin were found in the Battle Creek; however, River, stream habitat was very limited. In addition, a substantial northern pike fishery is already established there (Stations 3 and 6, Fig. 1). Since trout and pike are not compatible, a good northern pike fishery would have to be sacrificed for replacement with a marginal brown trout fishery. For these reasons, any attempts at trout management in the mainstream below the city of Charlotte are not advised. However, the 2-mile reach immediately above Charlotte warrants further investigation in this regard. Even in that section substrate types, fish cover, and slow-current velocities would limit the establishment of a substantial trout fishery. Some

of the downstream tributaries, such as Indian Creek, may hold more promise for trout management.

In the majority of the Battle Creek River the construction of fish habitat or stream improvement structures is either impractical or unnecessary. There are a few exceptions. Approximately 1 mile of the river immediately below the Bellevue Dam has excellent substrate and stream flow for game fish, but it is also quite wide and shallow (Station 4). Fish cover structures designed to divert stream flow and maintain deep water areas would increase the large game fish carrying capacity in that reach. This is a prime area for fishery development due to its accessibility. Fish populations in some sections of the river above Bellevue would also benefit from stream improvement construction. Such structures would have to be well designed, since hydraulic pressure during peak flows would wash away any poorly secured cover.

Access to many of the better fishing areas on the river is only available 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 3, 5, and 7 (Table 1).

Future fishery surveys of this river should be done with rotenone methods. Catch results from 1986 could then be closely compared and changes in the fishery more accurately assessed.

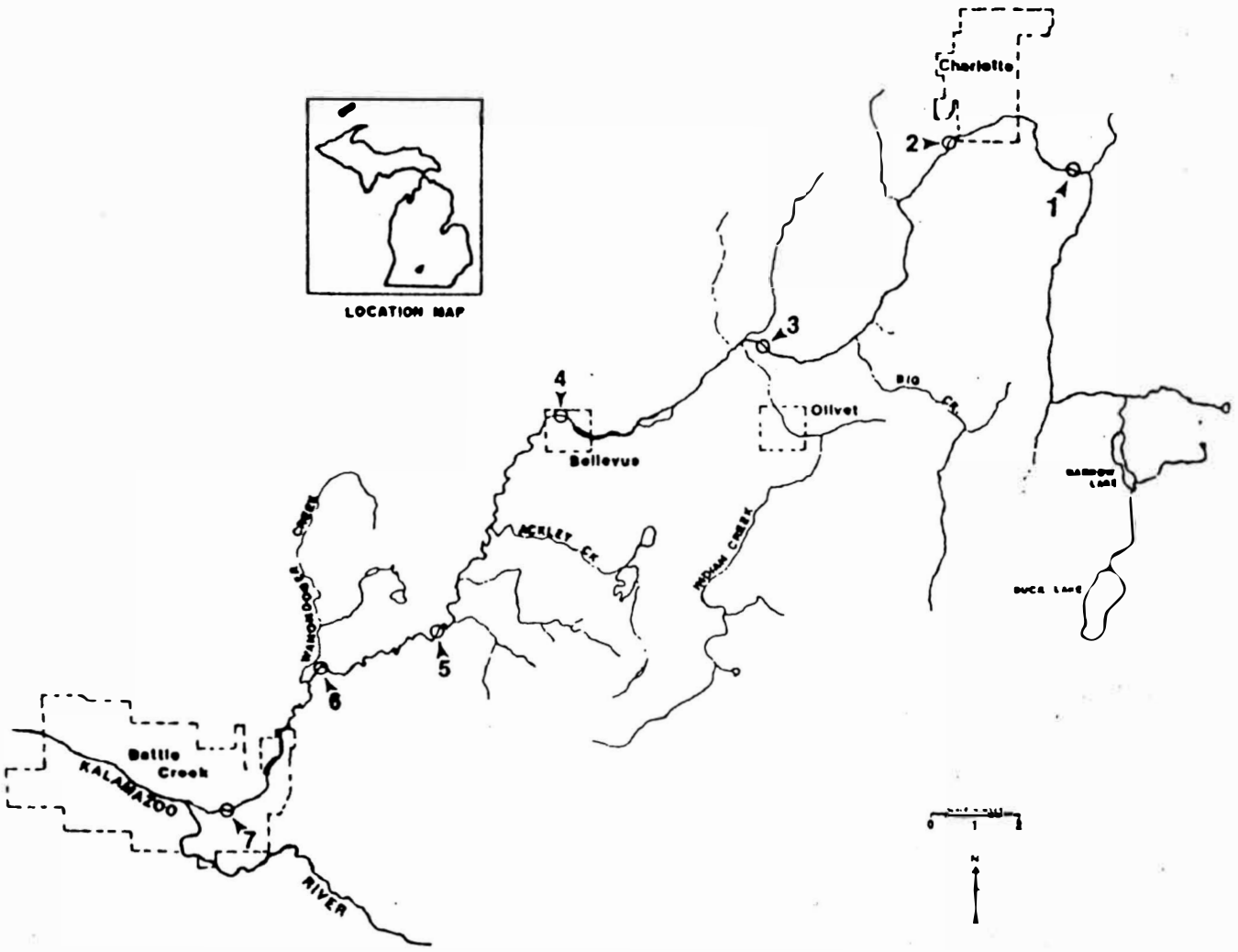

Figure 1. Locations of sampling stations during the 1986 Battle Creek River survey.

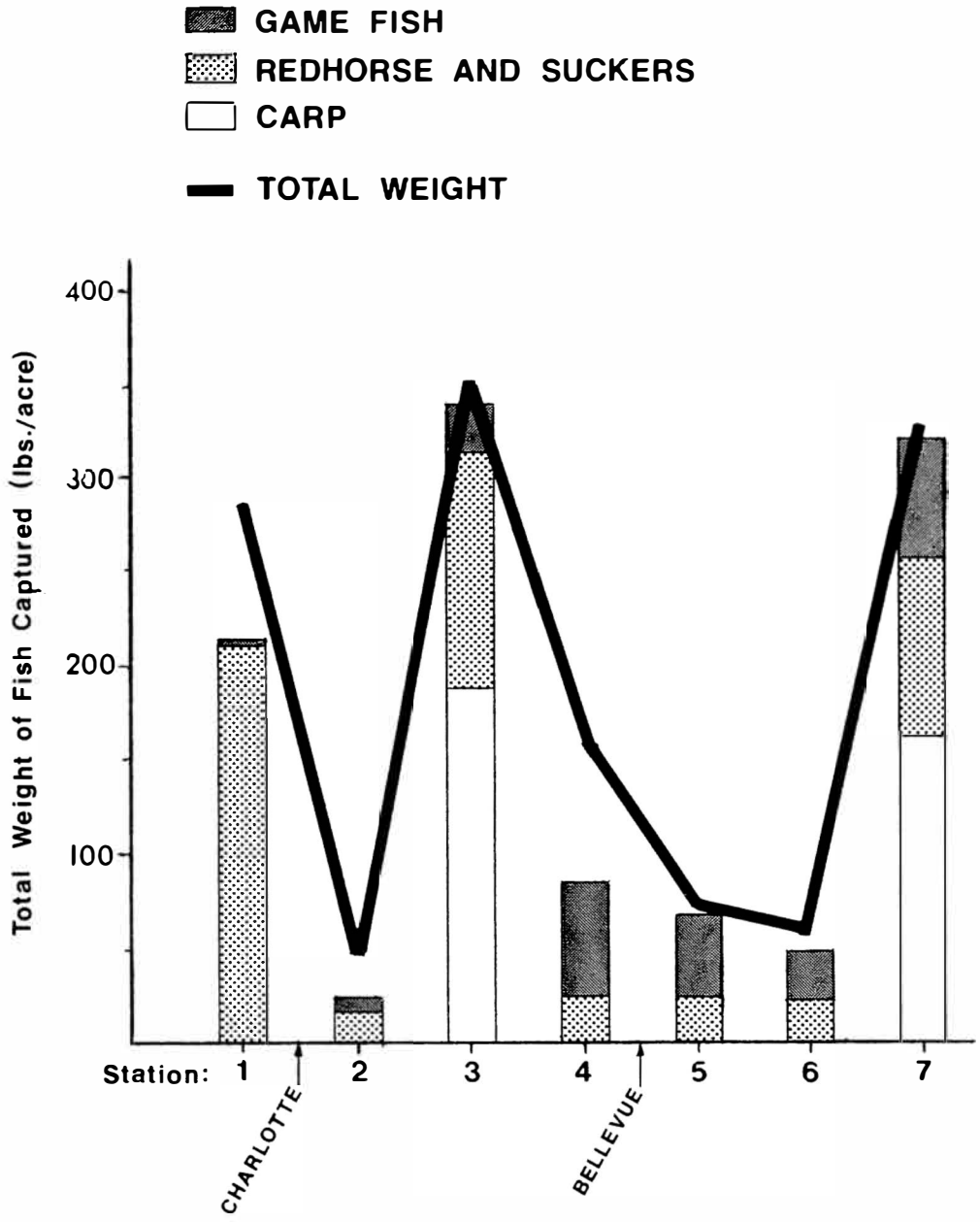

Figure 2. The weight of game fish, redhorse and suckers (includes northern hog sucker, white sucker, and all redhorse sp.), and carp captured at each station during the 1986 Battle Creek River fishery survey. The solid line represents the weight of all fish captured.

Table 1. Locations of sampling stations during the 1986 Battle Creek River fishery survey.

Station	County	Location	Length (feet)	Upstream limit and description[1]
1	Eaton	T2N,R4W,Secs.28,29	300	130 ft. upstream from Brookfield Rd. (0.13 acre)
2	Eaton	T2N,R5W,Secs.24,25	850	350 ft. upstream from Kalamo Rd. (0.51 acre)
3	Eaton	T1N,R5W,Secs.17,18	640	400 ft. upstream from Ainger Rd. (0.54 acre)
4	Eaton	T1N,R6W,Sec.28	740	Approx. 800 ft. downsteam from Ionia St.—along cemetery (1.03 acres)
5	Calhoun	T1S,R7W,Sec.23	730	N1/2 NE1/4 of NE1/4 of Sec. 23 40 ft. upstream from small (1 cfs) stream entering from SE (0.97 acre)
6	Calhoun	T1S,R7W,Secs.21,22	870	200 ft. downstream from 9 Mile Rd. (1.70 acres)
7	Calhoun	T2S,R7W,Sec.7	520	At Division St. Bridge (0.70 acre)

[1]Includes river surface acreage sampled (in parentheses).

Table 2. List of species captured at each station during the 1986 Battle Creek River fishery survey.

Species	Station 1	2	3	4	5	6	7
Chestnut lamprey *Ichthyomyzon castaneus*	–	–	–	x	x	x	x
Bowfin *Amia calva*	–	x	–	–	–	x	–
Central mudminnow *Umbra limi*	x	x	x	x	x	x	–
Grass pickerel *Esox americanus vermiculatus*	x	x	x	x	x	x	x
Northern pike *Esox lucius*	–	x	x	x	x	x	x
Central stoneroller *Campostoma anomalum*	–	x	–	x	–	–	x
(Common) carp *Cyprinus carpio*	–	–	x	–	–	–	x
Horneyhead chub *Nocomis biguttatus*	x	x	x	x	x	x	x
Golden shiner *Notemigonus crysoleucas*	–	–	–	x	–	x	–
Striped shiner *Notropis chrysocephalus*	–	–	–	–	–	–	x
Common shiner *Notropis cornutus*	x	x	x	x	x	x	x
Spotfin x common shiner (hybrid) *Notropis* sp.	–	–	x	–	–	–	–
Rosyface shiner *Notropis rubellus*	–	–	–	x	x	x	x
Northern redbelly dace *Phoxinus eos*	–	x	–	–	–	–	–
Bluntnose minnow *Pimephales notatus*	x	x	x	x	x	x	x
Fathead minnow *Pimephales promelas*	–	x	–	–	–	–	–
Blacknose dace *Rhinichthys atratulus*	x	x	–	–	–	–	–
Creek chub *Semotilus atromaculatus*	x	x	x	x	x	x	–
White sucker *Catostomus commersoni*	x	x	x	x	x	x	x

Table 2. Continued:

Species	Station 1	2	3	4	5	6	7
Creek chubsucker *Erimyzon oblongus claviformis*	–	x	–	x	–	–	–
Northern hog sucker *Hypentelium nigricans*	–	–	–	x	x	x	x
Golden redhorse *Moxostoma erythrurum*	–	–	–	x	x	x	x
Greater redhorse *Moxostoma valenciennesi*	–	–	–	–	x	x	x
Black bullhead *Ictalurus melas*	–	–	–	x	–	–	x
Yellow bullhead *Ictalurus natalis*	x	–	–	x	x	x	x
Stonecat *Noturus flavus*	x	–	x	x	x	x	x
Tadpole madtom *Noturus gyrinus*	–	x	x	x	x	x	–
Brook stickleback *Culaea inconstans*	x	x	x	–	–	–	–
Rock bass *Ambloplites rupestris*	–	x	–	x	x	x	x
Green sunfish *Lepomis cyanellus*	–	x	x	x	x	–	x
Pumpkinseed *Lepomis gibbosus*	x	x	x	x	–	–	x
Warmouth *Lepomis gulosus*	–	x	–	–	–	–	–
Bluegill *Lepomis macrochirus*	–	x	x	x	–	–	x
Longear sunfish *Lepomis megalotis*	–	–	x	x	–	–	x
Smallmouth bass *Micropterus dolomieui*	–	–	–	x	x	x	x
Largemouth bass *Micropterus salmoides*	–	x	x	x	x	x	x
Black crappie *Pomoxis nigromaculatus*	–	x	–	x	–	x	–
Rainbow darter *Etheostoma caeruleum*	–	–	–	–	–	x	x

Table 2. Continued:

Species	Station 1	2	3	4	5	6	7
Johnny darter *Etheostoma nigrum*	x	x	x	x	x	x	x
Yellow perch *Perca flavescens*	x	x	x	–	–	x	–
Blackside darter *Percina maculata*	x	x	x	x	x	x	x
Mottled sculpin *Cottus bairdi*	x	x	x	–	–	x	–
Number of species per station	16	27	22	29	22	27	27

Table 3. Percent of catch by weight and number for various species of fish larger than 3 inches collected with rotenone during the 1986 Battle Creek River survey. Chubs, shiners, minnows, and darters are excluded.

Species	Catch composition (percent)	
	Weight	Number
Northern pike	6.5	3.0
White sucker	23.4	8.5
Northern hog sucker	3.7	3.4
Golden redhorse	10.1	5.0
Greater redhorse	4.9	1.0
Carp	27.9	1.4
Yellow bullhead	1.6	1.9
Bowfin	0.2	0.1
Stonecat	1.6	9.4
Tadpole madtom	0.1	2.0
Smallmouth bass	6.5	8.0
Largemouth bass	0.3	1.2
Bluegill	0.2	0.9
Pumpkinseed	0.9	4.3
Green sunfish	1.0	6.6
Rock bass	10.5	29.5
Mud pickerel	0.5	3.3
Mottled sculpin	0.1	7.2
Other spp.	0.1	2.1

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

River (survey year)	Number of sampling sites	Number of species captured	Average standing crop (lbs/acre)	Game fish[1]		Redhorse and suckers[1]		Carp[1]	
				Percent by weight	Percent by number	Percent by weight	Percent by number	Percent by weight	Percent by number
Battle Creek (1986)	7	42	163	26.5	49.1	42.1	17.9	27.9	1.4
Cass[2] (1985)	11	43	268	9.4	6.4	47.9	14.2	24.4	0.6
Raisin[3] (1984)	12	59	278	14.1	26.6	53.0	51.0	28.3	1.9
Saline[3] (1984)	2	24	117	12.3	6.3	32.9	28.7	39.5	2.0
S.Br. Raisin[3] (1984)	1	23	463	1.3	1.0	81.8	42.1	0.1	0.4
Kalamazoo[4] (1982)	14	62	186	12.8	30.1	17.3	30.3	67.5	18.2
Grand[5] (1978)	22	70	160	9.6	22.0	44.0	59.0	45.6[6]	16.0[6]

Table 4. Continued:

River (survey year)	Most numerous species by weight[1]	Most numerous game fish[1]	
		Percent by weight	Percent by number
Battle Creek (1986)	rock bass	rock bass (10.5)	rock bass (29.5)
Cass[2] (1985)	redhorse spp.	rock bass (3.4)	rock bass (3.2)
Raisin[3] (1984)	northern hog sucker	smallmouth bass (7.6)	smallmouth bass (15.0)
Saline[3] (1984)	carp	yellow bullhead (6.9)	yellow bullhead (2.5)
S.Br. Raisin[3] (1984)	white sucker	yellow bullhead (1.0)	yellow bullhead (1.0)
Kalamazoo[4] (1982)	carp	channel catfish (3.9)	rock bass (11.8)
Grand[5] (1978)	carp[6]	channel catfish (3.3)	bullhead spp.[7] (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] J. Leonardi, personal communication. 1987. Michigan Department of Natural Resources, Imlay City.

[3] Towns (1985)

[4] Towns (1984)

[5] Nelson and Smith (1981)

[6] Carp and goldfish included.

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

Table 5. Numbers of common fish collected per surface acre, at each station, during the 1986 Battle Creek River survey. The value in parentheses indicates the number of legal- or acceptable-sized game fish collected.[1]

Species	Station 1	2	3	4	5	6	7
Smallmouth bass	—	—	—	47	46	20	61
	—	—	—	(1)	(5)	(0)	(11)
Northern pike	—	4	26	23	3	9	4
	—	(0)	(4)	(0)	(1)	(1)	(1)
Rock bass	—	22	—	154	277	168	79
	—	(0)	—	(48)	(45)	(36)	(30)
Largemouth bass	—	10	2	15	2	9	3
	—	(0)	(0)	(0)	(0)	(1)	(0)
Bullhead spp.	8	—	—	30	5	4	29
	(8)	—	—	(5)	(1)	(1)	(9)
Bluegill	—	39	15	2	—	—	9
	—	(0)	(0)	(0)	—	—	(1)
Pumpkinseed	31	45	15	16	—	—	67
	(0)	(0)	(0)	(0)	—	—	(0)
Carp	—	—	20	—	—	—	26
White sucker	608	731	777	111	19	49	27
Redhorse spp.	—	—	—	30	13	20	61
Hog sucker	—	—	—	17	16	9	29
Mottled sculpin	146	441	244	—	—	14	—

[1] Legal- or acceptable-sized game fish are defined as: bluegill, pumpkinseed, and rock bass, 6 inches and up; bullhead, 7 inches and up; smallmouth and largemouth bass, 12 inches and up; northern pike, 20 inches and up.

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