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FISHERIES DIVISION

TECHNICAL REPORT

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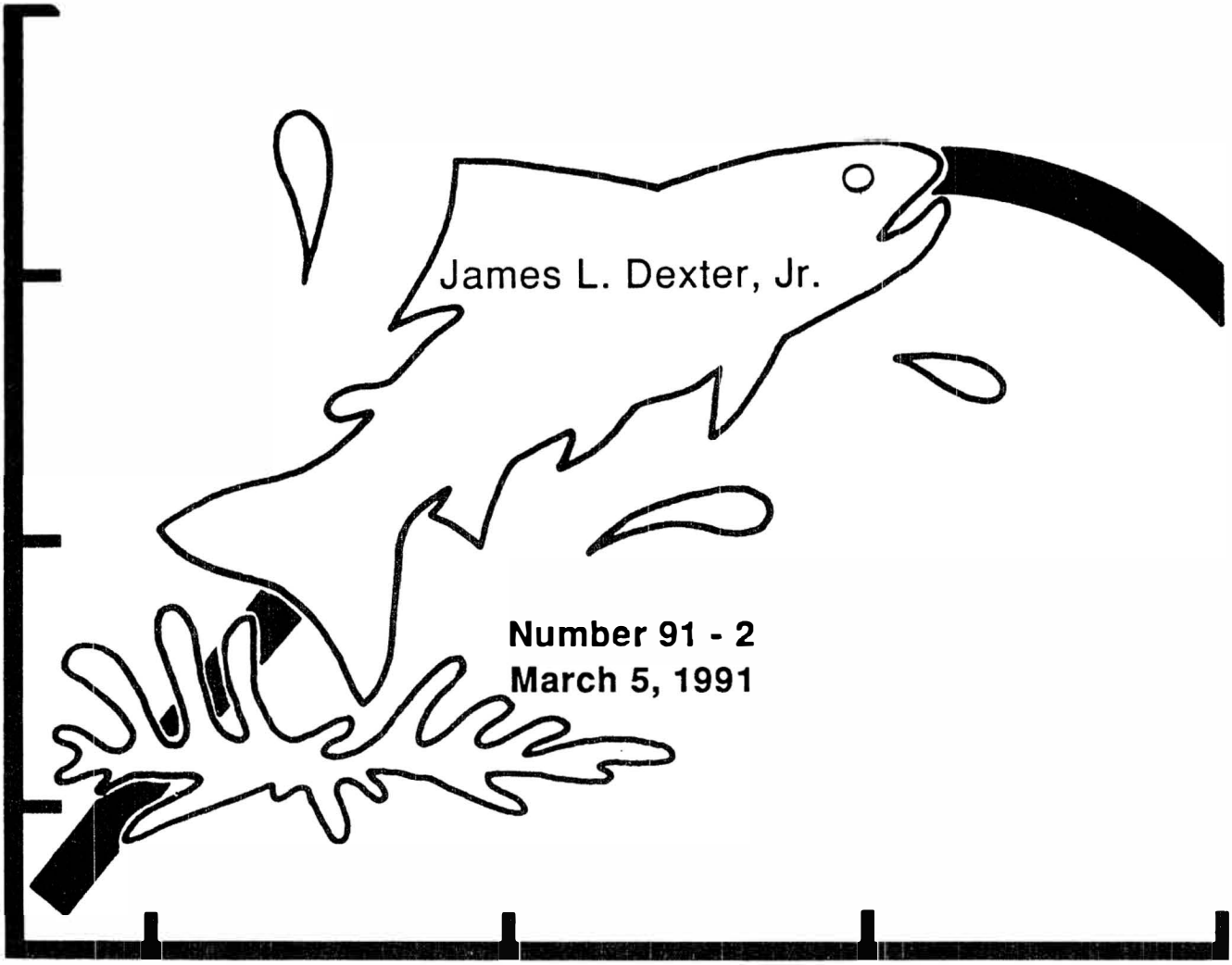

James L. Dexter, Jr.

Number 91 - 2
March 5, 1991

Michigan Department of
Natural Resources

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
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Summary.—A fishery survey of the Paw Paw River was conducted by the Michigan Department of Natural Resources Fisheries Division in July of 1989. Rotenone was used to collect fish at five sites on the Mainstream and one site on both the North and South branches. Some physical and biological conditions of the riverine environment were noted but no chemical water quality parameters were measured. No sampling was conducted in the impoundment areas.

A total of 8,108 fish representing 54 species were collected. Nine species were found at every station, while 13 species were found at only one station. Almost 79% of the fish captured were small forage fish. Carp were the most numerous species collected by weight (42.8%), but they only comprised 0.6% of the catch by number. Redhorses and suckers combined comprised 7.2% of the total catch by number and 24.5% by weight. Game fish catch by number and weight was 14.7% and 19.4%, respectively. Standing crop estimates ranged from 40-911 pounds per acre, and averaged 246 pounds per acre. Two sites located below dams highly skewed the average standing crop. Subtracting those two sites give a more realistic estimate of about 100 pounds per acre.

The Paw Paw River offers a variety of game fish species for anglers. However, our survey results indicate that there are not many big fish available. Walleye and pike are available throughout the system. Seasonally, salmonids also inhabit many sections of the river. Anglers who do fish the river have no complaints on the available fishery.

High groundwater inputs keep the Paw Paw River stable both in terms of flow and temperature. Presence of indicator species such as burbot and mottled sculpins, and scarcity and poor growth of smallmouth bass suggest that the Paw Paw is a much better coolwater system than a warmwater system. The opportunity exists to improve the sport fishery through stockings of walleye fingerlings and summer-run (Skamania) steelhead.

The Paw Paw River is located in the southwestern corner of Michigan's Lower Peninsula. Originating in eastern Van Buren County, the Paw Paw flows generally in a southwesterly direction, entering Berrien County and joining the lower St. Joseph River in Benton Harbor. The Paw Paw River watershed encompasses nearly 450 square miles (R. Popp, 1989, personal communication, Michigan Department of Natural Resources, Surface Water Quality Division, Lansing) and has an average annual discharge of 450 ft^3/s (Miller et al. 1987).

The Paw Paw River basin lies primarily in a drainage area consisting of sandy loams and glacial outwash. This highly permeable geology allows substantial groundwater contributions. The upper reaches of the Paw Paw River are classified as a second quality coldwater system, until it reaches Watervliet where it becomes a top quality warmwater system (Water Resources Commission 1968). Many of major tributaries to the Paw Paw are designated trout streams of either top or second quality coldwater. These include the West, East and North branches of the Paw Paw, Brush Creek, Mill Creek, and Blue Creek (Figure 1). The remaining smaller tributaries are generally classified as second quality warmwater streams.

Land use in the watershed is primarily cultivated farmland and vineyards. The riparian corridor is divided into emergent wetland in the lower reach, and lowland hardwoods in the middle and upper reaches. Stream gradient is low over the entire system, dropping just less than 100 feet from the South Branch to the confluence. Bottom substrates are composed of one-third sand, one-third gravel, and a one-third combination of rock, silt, and clay.

Currently, there is very little information concerning sportfishing on the Paw Paw River. Good fisheries are known to exist below the two dams on the system. At the Maple Lake dam, anglers concentrate on walleye, northern pike, and anadromous salmonids (seasonally). The Watervliet dam offers fishing for those species also, plus rock bass and smallmouth bass. Because access sites are limited, the remainder of the Mainstream is fished primarily by canoe for northern pike, walleye, and smallmouth bass. The entire mainstream also offers steelhead and salmon, but this so far appears to be an untapped resource.

The water quality of the Paw Paw River is quite good. Although extensive surveys have not been done on the mainstream, limited studies done by Snow (1975) indicate that the Paw Paw River is much less "eutrophic" than the St. Joseph River, and does not have any water quality problems except near the confluence with the St. Joseph River in Benton Harbor.

Methods

We captured fish using rotenone, according to the methods described by Nelson and Smith (1980; 1981) and Seelbach et al. (1988). Small-mesh "maxi-mini" fyke nets were used at Stations 3-7. Mid-nets were used at Stations 2, 4, 5, and 6. Station characteristics prohibited use of mid-nets at Stations 1, 3, and 7. Due to the various turbidity levels encountered at each station, varying toxic levels of rotenone (4-5 parts per million) were maintained at each station for 35 minutes and detoxified with potassium permangenate (KmNO4) for 45 minutes instead of 35 minutes. KmNO4 was applied at a rate of 2 ppm higher than that of rotenone.

Seven sampling stations (Figure 1, Table 1) were selected based on ease of access, stream depth and flow, geographic distribution, and habitat characteristics representative of the entire river. Five stations were located on the Paw Paw River Mainstream, while one additional station was located each on the North and South branches of the Paw Paw. There were several areas that we wanted to sample with rotenone but could not because of lack of access, deep water, or soft substrates.

Station lengths averaged 592 feet and ranged between 443 and 717 feet. Station lengths were determined by channel structure, habitat, and suitability for rotenone application to obtain quick mixing effects. Three separate transects were established for each station where widths and depths were measured. Stream flows were measured with

a Gurley current meter at four of seven stations. The flows at the remaining stations were estimated by using drainage area ratios based on previously measured sites, or by interpolations from the nearest United States Geological Survey gauging station.

Captured fish were identified, measured to inch group, and weighed to the nearest 0.01 pound in aggregate for most species. Some game species were weighed singly. Almost all fish were weighed and measured on-site, although some of the smaller cyprinids were preserved in formalin and identified and measured later in the laboratory. Scale samples were collected from most game species for aging. We tried to collect a minimum of 10 scale samples per inch group. Fin rays were collected from suckers and catfish for aging. Age and growth information on these species will be published later in a Michigan Department of Natural Resources (MDNR), Fisheries Research Report (P. Seelbach, 1990, personal communication, Institute for Fisheries Research, Ann Arbor).

Results

A total of 8,108 fish representing 54 species (Table 2) were collected at seven sampling sites. The number of species found per station ranged from 27 at Stations 1 and 2, to 40 at Station 6. Nine species were found at every station. These were walleye, northern pike, rock bass, bluegill, largemouth bass, green sunfish, grass pickerel, yellow bullhead, and stonecat. Thirteen species were found at only one station (Table 2).

Nearly 79% of the fish captured were small forage fish. This is typical of many rivers in southern Michigan (Towns 1984, 1985, 1987, 1988). Carp were the most numerous species collected by weight (42.8%) but they only comprised 0.6% of the catch by number (Table 3). Compared to other southern Michigan rivers which have recently been surveyed using rotenone, only the Kalamazoo and Grand rivers exhibited higher percentages of carp by weight (Table 4). Redhorses and suckers combined comprised 7.2% of the total catch by number and 24.5% by weight. The Paw Paw River exhibited the lowest percentage by number of redhorses and suckers of any previously surveyed southern Michigan river (Table 4). Game fish catch by number (14.7%) also appeared low for the Paw Paw River. However, the weight of game fish collected (19.4%) was one of the higher weights collected compared to previous rotenone surveys.

Excluding chubs, shiners, minnows, and other species less than 3 inches in length, rock bass were the most numerous species in the river, accounting for 4.7% of the catch by number (Tables 3 and 4). When all captured species are considered, common shiners, hornyhead chubs, and rosyface shiners accounted for 44.1% of the total catch by number, and 8.2% of the catch by weight.

Standing crop estimates ranged from 40 pounds per acre at Station 7 to 911 pounds per acre (almost 80% carp) at Station 6. The average was 246 pounds per acre. This is the median value of all other large southern Michigan streams surveyed and published to date (Table 4). The South Branch of the Raisin River had the highest average standing crop of the rivers surveyed to date with rotenone, however, only one station was surveyed on that stream (Towns 1988). If the standing crop estimates from below the two dams (Stations 1 and 6) were subtracted from the total average, the standing crop estimate would be approximately 100 pounds per acre, which I feel is a much more realistic representation of what the entire mainstream is like.

It is interesting to note that the two sites located below dams (Stations 1 and 6) exhibited significantly higher standing crops

than all other stations. It is unknown why this occurs, but it is consistent with other observations. Two possible reasons for this have been suggested—the increased productivity of reservoirs above the dams, and the higher stream gradients below dams.

The estimates of standing crop for all stations should be considered conservative estimates. While I firmly believe that rotenone collects nearly all of the fish at a sampling site, there are undoubtedly inefficiencies in sampling. Station 7 is a good example. No mid-net was used because of the excessive depth of the water. Water velocities were slow. The downstream blocking net was difficult to anchor because of the depth. I am convinced that many fish in this station either got under the net or did not make it all the way to the lower net. Typically, the lower end of a river system is more productive, not less. Efficiency of fish capture is undoubtedly better in shallow sampling stations having swift current and hard substrate. These type of conditions existed at Stations 1, 4, 5, and 6.

Fishery Description

This rotenone survey was the first fisheries survey conducted by the MDNR Fisheries Division on the Paw Paw River. Thus, there is no previous fisheries information for comparison.

Stations 1 and 2

Station 1, located east of County Road 665 on the South Branch, was sampled about 1 mile below the dam at Maple Lake (Figure 1). This station (and Station 2) produced the lowest number of fish species (27) of the seven sites sampled. However, the second highest weight per surface acre (Figure 2) was recorded here.

Fish habitat at Station 1 was considered fair to good. Instream vegetation, logs, deep pools, and runs were common, while tree falls and overhanging vegetation were scarce. The substrate was composed of sand (75%), silt (15%), and some gravel (10%). Stream conditions at sampling time were slightly turbid with moderately high water levels. Some difficulties arose while capturing fish at the lower net due to swift velocities and the abundance of fish.

A total of 29.8% of the catch by weight was game fish. Northern pike and tiger muskellunge accounted for almost half of that weight. Rock bass and bluegill accounted for over 15% of the total catch by number, of which almost 40% of these were of acceptable size to anglers. Interestingly, no carp and only a few shorthead redhorse were captured at this station. White suckers, hornyhead chubs, and common shiners contributed the largest percentage collected by both numbers and weight.

Station 2 was the only site sampled on the North Branch (Figure 2). Fish habitat was rated very good. Logs were abundant, overhanging brush and runs were common, and pools were scarce. Sand and silt were prevalent for the majority of the station (70%), however, gravel comprised 20% and rock and cobble 10%. Water levels were normal and the water was slightly turbid. We felt very confident we collected most fish from the sample site, as net locations, velocities, depths, and width of the site were all favorable.

A total of 18.4% of the total catch by weight was game fish. Rock bass and bluegill were again the most abundant game fish by number, with almost 36% of those acceptable size. All other game species captured were young of the year. Almost 53% of the catch by weight was made up of suckers, shiners, and chubs. No redhorse species and only one carp was collected. One small burbot

and several mottled sculpins were also collected.

Stations 3-5

These stations were generally characterized by deep pools and runs, with substrates averaging 15-50% rock and gravel. Station 3, located in Lawrence averaged 2.5 feet deep and 68 feet wide. Instream vegetation at the sample site was rare, while logs, rocks, and stumps were scarce. Fish habitat was considered fair at best. Substrates were composed of gravel (25%), sand (35%), and clay (40%).

Game fish species accounted for 45.8% of the catch by weight and 9.7% by number. Included in that catch were five adult Skamania steelhead (age 4-5). Steelhead were the most abundant fish collected by weight, followed by carp. Rock bass were the most common game fish collected by number, however, there were few of them. Several small burbot and mottled sculpins were also collected.

The substrate at Station 4 was primarily rock and gravel (75%) with the remainder composed of sand and silt. Fish habitat was rated as very good, with pools, logs, and log jams common. Shore-fishing activity was evident throughout the station. This is a popular site to fish for salmon and steelhead, which spawn in the extensive gravel areas. For the habitat available, we were surprised at the seemingly low amount of fish that were collected. Rock bass and bluegills were once again the dominant game fish by number. Two young-of-the-year rainbow trout were also collected. Almost 32% of the total weight of fish collected were game fish. These same species accounted for only 5.6% of the catch by number. Redhorse and suckers contributed only 5.7% of the total catch by number, but almost 38% of the total catch by weight. Mottled sculpins made up over 2% of the catch by number.

Fish habitat at Station 5 was rather poor. The river channel was straight with an average depth of 2.5 feet. Pools, runs, and treefalls were rated as common, however, shoreline habitat (undercut banks, rootwads, etc.) was very poor. Rock and gravel accounted for only 10% of the substrate. Sand was the predominant substrate (75%) followed by silt (8%) and clay (7%).

The most abundant game fish collected was rock bass, accounting for almost 21.9% of the total catch by weight, and 5.7% by number. Game fish species made up 27.3% of the catch by weight and 11.3% of the catch by number. Most game fish collected were small. Rock bass and suckers offer the only good fishing opportunities in this stretch. Suckers and redhorses contributed 52.5% of the catch by weight and 9.4% of the catch by number. Two small burbot and three mottled sculpins were also collected.

Stations 6 and 7

More species of fish (40) were collected at Station 6 than any other station in the survey (Table 2). Fish habitat below the Watervliet dam was rated as very good. Pools, runs, overhanging vegetation, rocks and boulders were all common. Gravel, rock, and cobble accounted for 75% of the substrate, while sand made up 25%. The average depth was 1.9 feet, however, the first 200 feet of the station were unwadeable due to the hole created by the dam.

This station is very popular with anglers because of the dam and the access through a city park. This station had the highest standing crop (910 lbs/acre) of any station surveyed. Game fish accounted for 13.4% of the catch by number, but only 6.8% of the catch by weight. This was the lowest percent by weight catch for game fish of any site

sampled. However, only sites 1 and 3 exhibited more pounds/acre of game fish than Site 6. Over 27% of the rock bass and 8% of the smallmouth bass were of acceptable size to anglers. Very few of the other game fish were large enough to be of interest to anglers.

Interestingly, no white suckers were collected at this site. Other sucker species and redhorses contributed 6.5% of the catch by number and 12.2% of the catch by weight. Forty-three carp weighing 508 pounds accounted for nearly 80% of the total weight collected, but only 3.8% of the total number. Mottled sculpins contributed 3.2% of the total catch by number. Almost 200 burbot 3-14 inches were also collected.

Station 7 was located in Benton Harbor (Figure 1). This was a very difficult site to sample because of the depth of the channel (average 4.8 feet). All work was conducted from boats. Walleye and rock bass were the most abundant game fish sampled at Station 7. Walleye from 5 to 21 inches were sampled. All game fish collected accounted for 71.6% of the total catch by number and 33.2% of the total catch by weight. This was the only station where flathead and channel catfish were collected. The three flatheads collected averaged 9.2 inches, while the one channel catfish was 15.5 inches. Only one burbot and one mottled sculpin were collected. Over 31% of the total weight collected was made up of redhorses and suckers. Five carp weighing 21 pounds accounted for 33.1% of the total catch by weight and only 2.4% of the total catch by number.

The area upstream and downstream of Station 7 is very similar. Shore-fishing access is very limited, but good boating opportunity exists. The lower Paw Paw in this area is known primarily for its walleye fishing.

Age and Growth

Very little information exists on the age and growth of river fish populations in southern Michigan. Scale samples were aged for bluegill, black crappie, smallmouth bass, largemouth bass, walleye, northern pike, tiger musky, and rainbow trout. Mean growth index values were compared, by age group, to state average lengths obtained from lake fish. The age analysis indicated faster than average growth for bluegills, ages 1-3, but below average growth for bluegills, ages 4-5. Sample size for age-4 and age-5 bluegill was, however, very small. Black crappie exhibited the opposite growth rates, growing at below state average rates for ages 1 and 2, and at above average rates for ages 3 and 5. Only yearling largemouth bass exhibited above average growth rates, while ages 2-5 were either at or below the state average.

The mean growth index of smallmouth bass was below average. Only two age-5 bass exhibited above average growth rates. Walleye had a mean growth index much above state average. Northern pike, typically one of the more sought after species on the Paw Paw River, had a mean growth index below state average. Older age groups (5-7) showed above average growth rates, while ages 3 and 4 exhibited below average growth. It is interesting to note that for pike, ages 0 and 3-6 were collected. The absence of ages 1 and 2 may be indicative of year-class failures.

Discussion

The fish community present in the Paw Paw River indicates a system very unlike other southern Michigan rivers surveyed with rotenone. However, one northern Michigan River is similar in characteristics to the Paw Paw River. The Thunder Bay River, located in Montmorency and Alpena counties, was

surveyed with rotenone in 1988. This river exhibited very low standing crops (27-59 pounds/acre) characterized by minimal small-mouth bass populations, a more significant burbot population, and a low percentage of suckers (P. Seelbach, 1990, personal communi-cation, Michigan Department of Natural Resources, Institute for Fisheries Research, Ann Arbor).

Table 4 indicates an extremely low abundance of redhorse and suckers compared to other surveyed southern Michigan systems. The percentage of game fish by weight for the Paw Paw was high, however, much of this weight was contributed by a few adult steelhead. Smallmouth bass, typically a dominant sport fish in warmwater systems, are present only marginally throughout the Paw Paw. Northern pike and walleye, present throughout the system in fairly good numbers, are indicative more of a coolwater system. But, perhaps the best indicator of the type of system the Paw Paw represents is the burbot. Burbot were captured at 5 of 7 stations surveyed (Table 2) and were abundant at Station 6 below the Watervliet dam. These fish favor coldwater systems, and have an upper tolerance temperature limit of 74°F. (Scott and Crossman 1979).

Biologists have viewed the Paw River more as a warmwater system (based on known species present) than a coldwater system, which was the classification assigned in the late 1960s. Based on the actual species assemblage and temperature data collected, the Paw Paw River does not fit either of these categories and should be classified as a coolwater system. Maximum summertime temperatures are only a few degrees above the level of a coldwater system (unpublished District data). July temperatures as measured by maximum/ minimum thermometers in 1989 and 1990 indicate average minimum temperatures in the mid- to upper 60s and maximum temperatures in the low 70s. This is indicative of substantial groundwater contribution to the yearly flows, keeping diurnal temperatures fluctuations at a minimum. Classic warmwater systems however, can fluctuate widely in daily temperatures, as much as 15 to 25°F (P. Seelbach, 1990, personal communication, Michigan Department of Natural Resources, Institute for Fisheries Research, Ann Arbor).

Overall growth rates for smallmouth bass were below average, while walleye and northern pike were above average. This may be linked to optimum temperature ranges for growth rates. This information lends addi-tional support to the classification of the Paw Paw as a coolwater system.

The Paw Paw River exhibits diverse habitat characteristics throughout its length. Undoubtedly, we as surveyors were extremely limited in our ability to adequately sample certain stretches of the river and certain habitat types due primarily to accessibility. Ideally, we would have liked to have sampled three more localities. Especially lacking was information the section between Watervliet and Benton Harbor where no accessible roads cross miles of river (Figure 1).

Management Considerations

The Paw Paw River presently offers a variety of game fish species for anglers. Unfortunately, our survey results indicate that there are not many fish (and not many big fish) available. As fisheries managers we rarely hear of fishing activity on the river. While access is limited in most sections, the anglers who do fish it do not complain about lack of access. Most anglers canoe sections of the river or fish near bridge crossings. We also do not hear complaints of poor fishing on the river.

The available habitat for managed species is very good. No large erosion sites

or severe lack of habitat were discovered in any of the surveyed areas. There is no need for habitat rehabilitation at the present time. On the surface it appears that an opportunity exists to greatly improve the present fishery. The coolwater-coldwater environment of the Paw Paw River appears to be favorable to trout; however, a substantial northern pike fishery already exists. It is well documented that pike feed heavily on trout, so trout stockings are not a viable option. Northern pike recruitment appears adequate, although some limited stocking could be initiated to offset potential year-class failures. In addition, muskellunge are present in the river (we captured one) and several have been reported caught in recent years. These fish are presumed to be escapees from Wolf Lake State Fish Hatchery, which has an outlet to the North Branch of the Paw Paw.

Smallmouth bass are not present in large numbers. Growth of this species is also poor. To stock this species successfully into a riverine habitat there usually must be some type of year class or recruitment failure. Although our sample is small, it does not seem that there is a shortage of young (1- and 2-year-old) fish. Habitat in the form of rock, gravel, deep water, and logs is certainly not limiting. Also, the temperature regimes found throughout the system are less than ideal for sustaining a good smallmouth bass population. Stocking would probably have no effect on the population.

Walleye appear to be a viable option for additional stockings into the Paw Paw River. Walleye showed exceptionally high growth rates. These walleyes most likely came from one of three sources; immigration from the St. Joseph River in Berrien County, escapement from the MDNR Fisheries Division walleye rearing ponds on a Paw Paw River tributary in Van Buren County, or our annual stocking of walleye at Maple Lake in Paw Paw. The lower St. Joseph is typically stocked with over 3 million spring fingerling walleyes per year. Some of these fish undoubtedly migrate up the Paw Paw River. Since the amount of walleyes found in our survey is by no means substantial, I believe the environment would be suitable for expanding walleye stockings when fish are available. In District 12 our river walleye stockings have proved to be generally more successful than our lake stockings.

The Paw Paw River currently receives about 6,400 spring yearling winter run steelhead. These fish are stocked just upstream of US-31—I-96 in Berrien County. Presently there is no need to expand this stocking of winter run fish. However, this very coolwater river would be an excellent candidate for summer runs (Skamania) steelhead. With maximum water temperatures rarely reaching 75°F, the Paw Paw could easily attract and hold stocked summer-run steelhead. Some Skamania presently come up from the St. Joseph River stocking, as shown in this survey. Suitable access sites are a rare commodity on the Paw Paw River. The Department should continue to actively seek quality land to purchase for additional sites.

Acknowledgments

The author wishes to thank the many Department of Natural Resources personnel who worked hard to make the survey possible. Richard Popp, Hydrologist with the Michigan Department of Natural Resources, Surface Water Quality Division, Lansing, made all the discharge measurements. Dave Johnson and Joan Duffy contributed immensely to the editorial process.

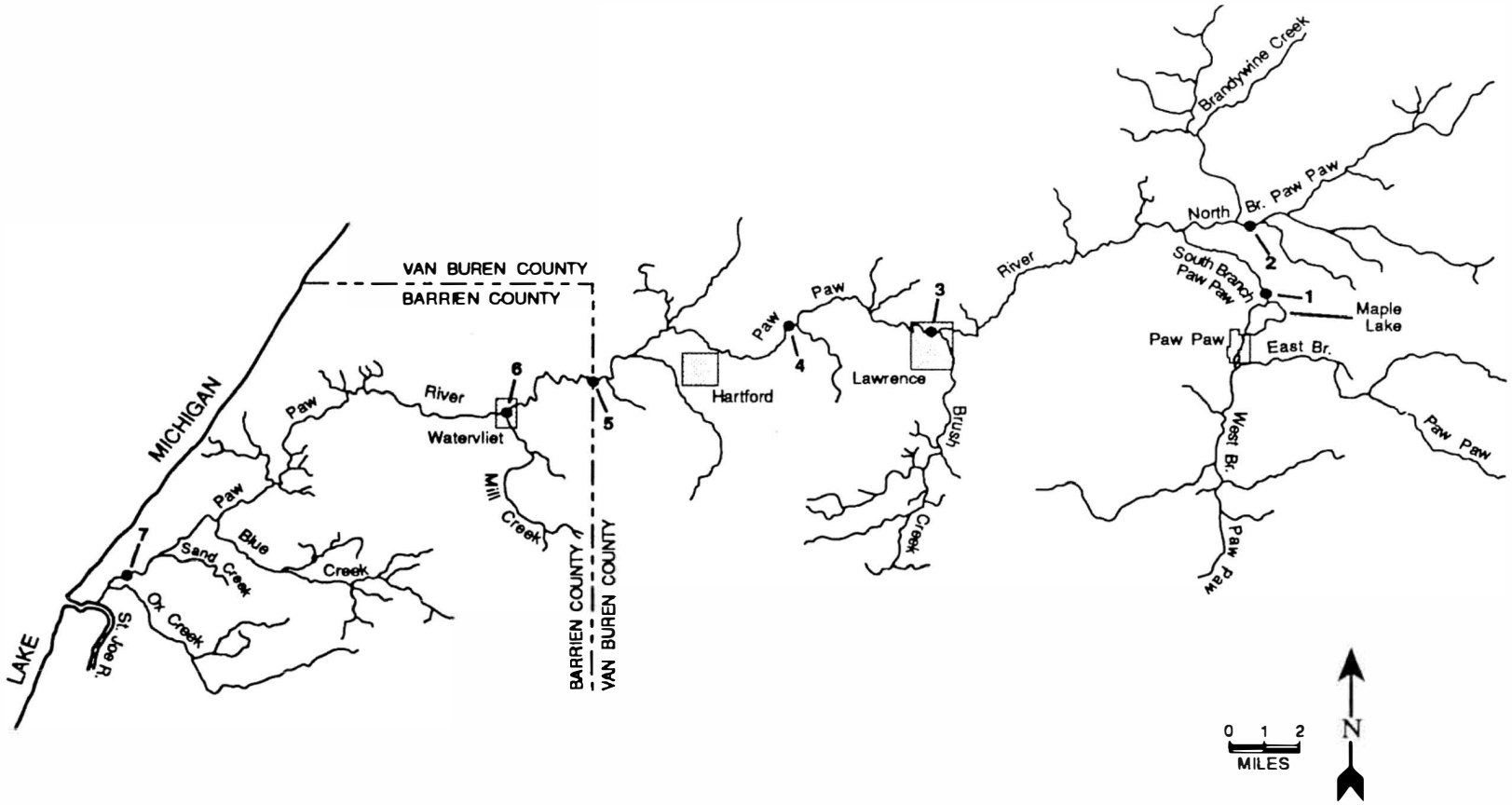

Figure 1.—Locations of rotenone sampling stations during the 1989 Paw Paw River fishery survey.

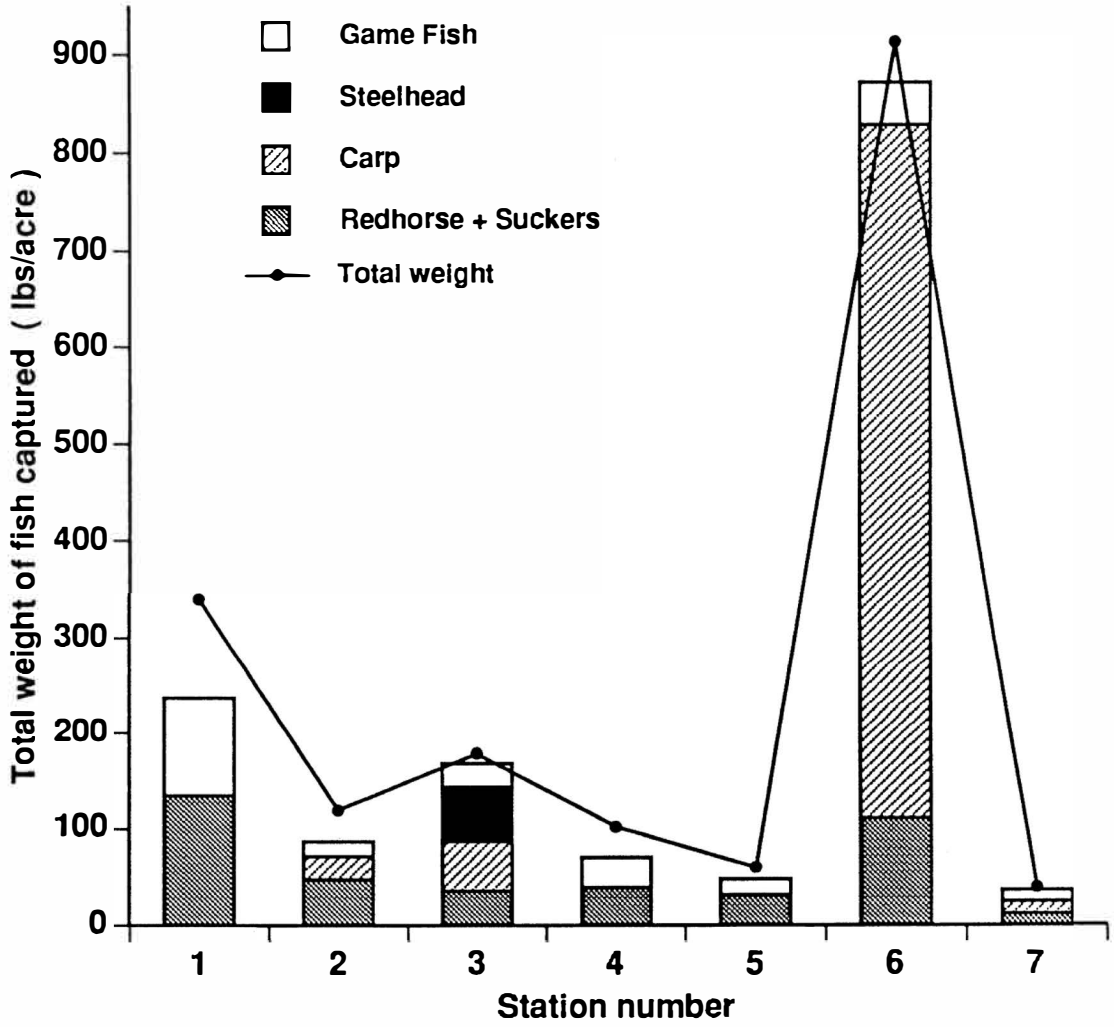

Figure 2.—The weight of game fish, steelhead, carp, redhorse, and suckers (combined) captured at each station during the 1989 Paw Paw River fishery survey. The solid line represents the total weight of all captured fished.

Table 1.—Locations of rotenone stations used during the 1989 Paw Paw River fisheries survey.

Station	County	Location	Upstream limit and description
1	Van Buren	T3S, R14W, Sec. 1	Located on the Marcelletti property (49679 C.R. 665) just below island.
2	Van Buren	T2S, R14W, Sec. 35	450 feet upstream of 35th.
3	Van Buren	T3S, R15W, Secs. 9, 10	450 feet upstream of 52nd.
4	Van Buren	T3S, R16W, Secs. 11, 12	500 feet upstream of 59½ Street.
5	Van Buren	T3S, R16W, Sec. 18 T 3S, R17W, Sec. 13	150 feet upstream of County Line Road.
6	Berrien	T3S, R17W, Sec. 23	Watervliet Dam apron.
7	Berrien	T4S, R19W, Secs. 18, 19	167 feet upstream of Colfax Bridge.

Table 2.—Species captured at each station during the 1989 Paw Paw River fishery survey.

Species	Station number 1	2	3	4	5	6	7
Smallmouth bass *Micropterus dolomieui*	—	x	—	x	x	x	x
Largemouth bass *Micropterus salmoides*	x	x	x	x	x	x	x
Rock bass *Ambloplites rupestris*	x	x	x	x	x	x	x
Walleye *Stizostedion vitreum*	x	x	x	x	x	x	x
Bluegill *Lepomis macrochirus*	x	x	x	x	x	x	x
Pumpkinseed *Lepomis gibbosus*	x	—	x	—	x	x	x
Green sunfish *Lepomis cyanellus*	x	x	x	x	x	x	x
Hybrid sunfish *Lepomis* spp.	x	x	x	—	x	—	—
Longear sunfish *Lepomis megalotis*	—	—	—	—	—	x	—
Warmouth *Lepomis gulosus*	—	—	—	x	—	x	x
Black crappie *Pomoxis nigromaculatus*	x	—	x	—	—	x	x
White crappie *Pomoxis annularis*	—	x	—	—	—	—	x
Rainbow trout *Oncorhynchus mykiss*	—	—	x	x	—	—	—
Northern pike *Esox lucius*	x	x	x	x	x	x	x
Tiger muskellunge *Esox lucius x E. masquinongy*	x	—	—	—	—	—	—

Table 2.—Continued:

Species	Station number 1	2	3	4	5	6	7
Grass pickerel *Esox americanus vermiculatus*	x	x	x	x	x	x	x
Black bullhead *Ictalurus melas*	—	—	x	x	—	x	—
Yellow bullhead *Ictalurus natalis*	x	x	x	x	x	x	x
Channel catfish *Ictalurus punctatus*	—	—	—	—	—	—	x
Flathead catfish *Pylodictus olivaris*	—	—	—	—	—	—	x
Stonecat *Noturus flavus*	x	x	x	x	x	x	x
Tadpole madtom *Noturus gyrinus*	—	—	x	x	x	x	x
Burbot *Lota lota*	—	x	x	—	x	x	x
Bowfin *Amia calva*	x	—	x	—	—	—	—
Northern brook lamprey *Ichthyomyzon fossor*	—	—	x	—	—	—	—
Chestnut lamprey *Ichthyomyzon castaneus*	x	x	x	—	—	—	—
Silver redhorse *Moxostoma anisurum*	—	—	—	—	—	x	x
Golden redhorse *Moxostoma erythrurum*	—	—	x	x	x	x	x
Black redhorse *Moxostoma duquesnei*	—	—	x	x	x	x	x
Shorthead redhorse *Moxostoma macrolepidotum*	x	—	x	x	x	x	—

Table 2.—Continued:

Species	Station number 1	2	3	4	5	6	7
White sucker *Catostomus commersoni*	x	x	x	x	x	—	—
Northern hog sucker *Hypentelium nigricans*	x	x	x	x	x	x	—
Spotted sucker *Minytrema melanops*	x	x	—	—	—	x	—
Quillback sucker *Carpiodes cyprinus*	—	—	—	—	—	x	x
Gizzard shad *Dorosoma cepedianum*	—	—	—	—	—	—	x
Alewife *Alosa pseudoharengus*	—	—	—	—	—	x	—
Common carp *Cyprinus carpio*	—	x	x	—	—	x	x
Common shiner *Notropis cornutus*	x	x	x	x	x	x	—
Spottail shiner *Notropis hudsonius*	—	—	—	—	—	—	x
Sand shiner *Notropis stramineus*	—	—	—	—	—	x	—
Spotfin shiner *Notropis spilopterus*	—	—	—	—	—	x	x
Rosyface shiner *Notropis rubellus*	—	—	x	x	x	x	—
Hornyhead chub *Nocomis biguttatus*	x	x	x	x	x	x	—
Creek chub *Semotilus atromaculatus*	—	x	—	x	—	x	—
Brassy minnow *Hybognathus hankinsoni*	—	—	—	—	—	x	—

Table 2.—Continued:

Species	Station number 1	2	3	4	5	6	7
Fathead minnow *Pimephales promelas*	—	—	—	x	—	—	—
Bluntnose minnow *Pimephales notatus*	x	—	x	—	x	x	x
Blackside darter *Percina maculata*	x	x	x	x	x	x	—
Johnny darter *Etheostoma nigrum*	x	x	x	x	x	x	x
Rainbow darter *Etheostoma caeruleum*	x	x	x	x	x	x	—
Blacknose dace *Rhinichthys atratulus*	—	—	—	x	—	—	—
Mottled sculpin *Cottus bairdi*	—	x	x	x	x	x	x
Logperch *Percina caprodes*	—	—	—	—	—	x	—
Pirate perch *Aphredoderus sayanus*	x	x	x	x	x	x	x
Central mudminnow *Umbra limi*	x	x	x	x	x	—	x
Number of species per station	27	27	36	30	29	40	30

Table 3.—The percent of catch by weight and number for various species of fish collected with rotenone during the 1989 Paw Paw River fishery survey.

Species	Percent	
	Weight	Number
Common carp	42.8	0.6
White sucker	9.5	3.0
Shorthead redhorse	5.8	1.0
Rock bass	5.5	4.7
Hornyhead chub	4.4	12.3
Rainbow trout	4.2	0.1
Common shiner	3.5	20.7
Golden redhorse	2.9	0.8
Northern pike	2.7	0.4
Northern hog sucker	2.0	1.9
Walleye	1.8	0.5
Black redhorse	1.4	0.2
Stonecat	1.3	2.0
Yellow bullhead	1.2	1.4
Quillback sucker	1.2	0.1
Spotted sucker	1.2	0.2
Bluegill	1.0	2.5
Smallmouth bass	0.8	0.5
Largemouth bass	0.7	0.5
Tiger musky	0.7	<0.1
Burbot	0.5	2.5
Silver redhorse	0.5	<0.1
Green sunfish	0.5	3.1
Grass pickerel	0.4	1.7
Bowfin	0.4	<0.1
Black crappie	0.3	0.3
Black bullhead	0.2	0.2
Creek chub	0.2	1.5
Hybrid sunfish	0.2	0.4
Gizzard shad	0.2	<0.1
Pumpkinseed	0.1	0.3
Channel catfish	0.1	<0.1
Flathead catfish	0.1	0.1
Other species	2.4	36.5

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
So. Branch 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]
Paw Paw River (1989)	7	55	246	19.4	14.7	24.5	7.2	42.8	0.6

Table 4.—Continued:

River (survey year)	Most numerous species by weight[1]	Most numerous game fish[1] Percent by weight	Most numerous game fish[1] Percent by number
Paw Paw River (1989)	Common carp	Rock bass (5.5)	Rock bass (4.7)
St. Joseph (1987)	Common 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)	Common carp	Yellow bullhead (6.9)	Yellow bullhead (2.5)
So. Branch Raisin (1984)	White sucker	Yellow bullhead (1.0)	Yellow bullhead (1.0)
Kalamazoo (1982)	Common carp	Channel catfish (3.9)	Rock bass (11.8)
Grand (1978)	Common 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, 1988, Michigan Department of Natural Resources, East Lansing, personal communication).

[3]Towns (1987).

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

[5]Towns (1985).

[6]Towns (1986).

[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.—The number of common fish per surface acre of river collected at each station during the 1989 Paw Paw River fishery survey. The value in parenthesis indicates the number of legal—or acceptable—sized fish collected per acre. Fyke-net catches are not included.

Species	Station number 1	2	3	4	5	6	7
Game fish							
Smallmouth bass	—	6	1	—	3	35	4
	—	(2)	(0)	—	(0)	(3)	(0)
Largemouth bass	31	1	2	6	1	11	4
	(1)	(0)	(0)	(0)	(0)	(0)	(0)
Rock bass	110	42	20	88	69	68	41
	(26)	(15)	(12)	(52)	(25)	(18)	(4)
Walleye	5	3	1	4	1	13	10
	(3)	(0)	(0)	(1)	(0)	(0)	(2)
Northern pike	9	2	4	4	7	18	1
	(8)	(0)	(2)	(0)	(1)	(0)	(0)
Tiger musky	1	—	—	—	—	—	—
	(1)	—	—	—	—	—	—
Bluegill	135	23	6	25	4	70	9
	(21)	(0)	(0)	(0)	(0)	(8)	(0)
Flathead catfish	—	—	—	—	—	—	2
	—	—	—	—	—	—	(0)
Channel catfish	—	—	—	—	—	—	1
	—	—	—	—	—	—	(1)
Bullheads	120	14	7	4	1	31	1
	—	—	—	(3)	(0)	(7)	(1)
Rainbow trout	—	—	6	2	—	—	—
	—	—	(6)	(0)	—	—	—
Crappie	19	3	1	—	—	7	4
	(1)	(0)	(1)	—	—	(3)	(4)
Coarse fish							
Common carp	—	1	5	—	—	61	3
Redhorse	9	—	34	—	31	108	6
White sucker	146	56	27	—	5	—	—
Northern hog sucker	11	11	36	—	15	21	—
Stonecat	70	27	26	[illegible]	29	33	—

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