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A Fisheries Survey of the Dowagiac River, July 1988 and 1989

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Abstract.–A fishery survey of the Dowagiac River was conducted by the Michigan Department of Natural Resources, Fisheries Division in July 1988 and 1989. Rotenone was used to collect fish at six unimpounded sites on the mainstem of the river. Some physical and biological conditions of the riverine environment were also noted. High groundwater inputs keep the Dowagiac River stable both in terms of flow and temperature. Presence of indicator species such as brown trout and mottled sculpin confirmed that the Dowagiac River is a coldwater system.

A total of 8,800 fish representing 36 species were collected. At least four species of game fish were found at every station, while seven game fish species were found at one station. Almost 68% of the fish captured were small forage fish. White suckers were the most numerous species collected by weight (45.3%) and comprised 18.7% of the catch by number. Game fish catch by weight and number was 12.1% and 4.9%, respectively. Brown trout were the most numerous game fish by both total weight (6.2%) and number (1.5%). Standing crop estimates for all fish combined ranged from 48-402 pounds per acre, and averaged 148 pounds per acre.

The upper and middle Dowagiac River do not offer a variety of game fish species, but instead a unique opportunity for trout anglers. The lower river contains potamodromous steelhead, chinook salmon and coho salmon, as well as resident brown trout and smallmouth bass. The fishery could be improved by habitat (meander) restoration within portions of the middle and lower river. Allowing fish passage at Pucker Street Dam would also improve the fishery by giving potamodromous fish access to more spawning areas within the river.

The Dowagiac River is located in the southwestern corner of Michigan's Lower Peninsula. Originating in the lower tier of townships in Van Buren County, the Dowagiac River flows in a southwesterly direction across Cass County and enters Berrien County before joining the St. Joseph River in Niles, Michigan. The Dowagiac River watershed encompasses an area of 302 square miles (Berry 1992) and has an average annual discharge of 301 cubic feet per second (255 square mile drainage area) at the town of Sumnerville (Blumer et al. 1997).

The surficial geology of the watershed consists of glacial deposits from the Wisconsinan Stage (10,000 to 75,000 years ago). The inner lobe of the Kalamazoo Moraine separates Dowagiac Creek, the largest tributary, from the mainstem. Glacial sediments within the watershed consist of glacial outwash sand and gravel, ice-contact sand and gravel with end moraines of coarse-textured till and glacial lake deposits (Kirby and Hampton 1998). These highly permeable surficial materials along with head-pressure provided by elevated moraines allow for substantial groundwater contributions to the Dowagiac River and tributaries. Approximately 80% of the watershed consists of recharge areas, and 20% consists of discharge

[1] Deceased

areas (Kirby and Hampton 1998). This high groundwater yield maintains cold water temperatures and stable flows throughout the river system.

The entire Dowagiac River mainstem is classified as a second quality coldwater stream (1967 Michigan Department of Natural Resources, Fisheries Division, Stream Classification) and is designated as a trout stream (Anonymous 1967). Many major tributaries are also designated trout streams and are classified as top or second quality coldwater systems. These include Cook Lake and Osborn drains; and Wilson, Glenwood, Dowagiac, Peavine, Pokagon, and McKinzie creeks (Figure 1).

Land use in the watershed is predominately agricultural (64%), followed by forest (21%), wetlands (6%), urban (6%), and water (3%). Upland areas are used for hog production and irrigated croplands. Lowland areas are used for specialty crops. In order to increase production in headwater muck lands (Decatur Marsh), most of the Dowagiac River mainstem was straightened and deepened through a massive dredging project completed in the late 1920s. This channelization increased drainage and opened agricultural land in the headwaters.

Angler use of the river from the headwaters to Pucker Street Dam is relatively low. High water velocities and deep water prevent anglers from wading in the river or fishing from boats effectively. Despite the relatively low gradient of the river (3.2 ft/mile), water velocities are accelerated by the straight narrow channel and lack of woody debris. Those anglers that do battle the strong currents target brown trout. Angler pressure increases significantly in the last four miles of stream that has not been significantly straightened. Although the gradient is higher (5-25 ft/mile) in this reach, the river meanders more and gives anglers an opportunity to wade or boat in parts of the river. Anglers target resident smallmouth bass and brown trout, as well as migrating adult steelhead, chinook salmon, and coho salmon in the lower river below Pucker Street Dam.

The water quality of the Dowagiac River is good. All water quality parameters are within normal ranges except for nitrates, total phosphorus, and suspended solids (MDEQ 1997). These elevated parameters are closely related to non-point sources within an agricultural based watershed. Water quality in the tributary streams is rated as good to excellent (MDEQ 1997).

The purpose of this survey was to determine standing crop and assemblage structure of fish within the Dowagiac River. Standing crop was compared among sites within the river, and overall standing crop was compared to other rivers within Michigan. Abundance of fish actively pursued by anglers (game fish) was also examined. This information was used to develop management plans to improve the fishery.

Methods

We captured fish using rotenone, according to the methods described by Nelson and Smith (1980, 1981). Small-mesh "maxi-mini" fyke nets were used to sample small fish that passed through blocking nets, and mid-reach nets were used to reduce catch at the lower blocking net. Due to various turbidity levels encountered at each station, varying toxic levels of rotenone (2-4 ppm) were maintained at each station for 35 minutes and detoxified with potassium permanganate ($KMnO_4$) for 45 minutes. $KMnO_4$ was applied at a rate of 6 ppm.

Six 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. 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 637 feet and ranged between 286 and 1,020 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 all stations. Stream flows were compared to estimated flows using drainage area ratios based on previously measured sites, or by interpolations from the United States Geological Survey (USGS) gauging station in Sumnerville.

Habitat characteristics were subjectively estimated using mostly visual techniques. Depth

and frequency of pools were determined by visual observations according to Lagler (1952). Deep pools were over two feet in depth. The frequency of pools was high if the ratio of pools to riffles was about 75% to 25% and scarce if pools made up less than 25% of the stream area. Stream gradient was estimated from contour lines of USGS topographic maps. Substrate composition was determined by visual estimation of the percentage of substrate type for an entire reach. Fish cover was subjectively determined by the presence of woody debris (logs), brush, rocks, undercut banks, water depth, or objects hanging over the water.

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 singularly. 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 per species.

Average length and weight, actual catch by number and weight, percent contribution of a species to the sampled portion of the fish community (total % by number and weight), and population abundance (standing crop) were calculated. Acceptable size of game fish was also calculated, which was the proportion of the catch that exceeded the minimum legal size limit or was large enough to be acceptable to anglers. Acceptable sizes were 8 in for brown trout, 6 in for rock bass, 12 in for smallmouth bass, 12 in for largemouth bass, 6 in for pumpkinseed, 6 in for bluegill, 7 in for black crappie, 7 in for yellow perch, 7 in for and yellow bullhead.

Water temperatures were assessed at the road crossing nearest to each of the 6 sampling stations. Temperature data were collected at two-hour intervals for the entire month of July using digitally recording thermographs. Temperature data were collected in 1992 for station 4, in 1993 for station 6, and in 1997 for stations 1, 2, 3, and 5. For each station, maximum, minimum, and mean monthly temperatures were determined following methods described by Wehrly et al. (1998).

Survey Results

A total of 8,800 fish representing 36 species were collected at six sampling sites (Table 2). The number of species found per station ranged from 18 at Station 5 to 26 at Station 4. Seven species were found at every station: white sucker, grass pickerel, central mudminnow, mottled sculpin, green sunfish, bluegill, and Johnny darter. Eleven species were found at only one station (Table 2).

Nearly 68% of the fish captured were small forage fish. This is typical of many rivers in southern Michigan (Dexter 1991; Towns 1984, 1985, 1987, 1988). White sucker was the most numerous species collected by weight (45.3%). White sucker and common shiner were the most numerous species by number with 18.7% of each (Table 3). Compared to other southern Michigan rivers that have been surveyed using rotenone, the Dowagiac River was about average in percentage of redhorse and suckers by weight (Table 4). Common carp comprised 14.6% of total catch by weight and 0.1% by number. The Dowagiac River exhibited the lowest percentage by number of common carp of any southern Michigan river previously surveyed using rotenone (Table 4). Game fish catch by number (4.9%) was low for the Dowagiac River and was the second lowest in southern Michigan behind the South Branch Raisin River. However, the weight of game fish collected (12.1%) was about average and compared to rotenone surveys on Saline and Kalamazoo rivers.

Excluding chubs, shiners, minnows, and other species less than 3 inches in length, white sucker was the most numerous species in the river, accounting for 18.7% of the catch by number (Tables 3 and 4). When all captured species are considered, common shiner, creek chub, bluntnose minnow, blackside darter, mottled sculpin, and other forage fishes accounted for 68.2% of the total catch by number, and 14.7% of the catch by weight. Brown trout was the most numerous game fish species by both total weight (6.2%) and number (1.5%) for the Dowagiac River (Table 5).

Standing crop estimates ranged from 48 pounds per acre at Station 3 to 402 pounds per acre at Station 1. The average was 148 pounds per acre. This was below the median value of all other large southern Michigan streams surveyed

and published to date (Table 4). Dowagiac River standing crop was similar to Nottawa Creek and Battle Creek River.

Population estimates were dominated by white sucker, mottled sculpin, and creek chub at all stations (Table 6). Station 5 had the highest population of brown trout at 59 fish per acre. The highest population of game fish was at station 6 with 88 smallmouth bass per acre.

Mean July stream temperature ranged from 64.7°F to 69.1°F (Table 7). The coldest temperatures were recorded at stations 4 and 5. Station 6, downstream of Pucker Street Dam, had the highest mean July temperature.

Fishery Description

This was the first comprehensive fishery survey of the Dowagiac River by Fisheries Division. There have been other surveys dating back to 1939. These surveys only sampled a few locations and habitats using electrofishing gear. Most of these surveys targeted trout and results were not a good representation of the fish community. However, they provided useful fisheries information that was used for comparison.

Station 1 at Atwood Road in Cass County, was the most upstream site sampled in this survey (Figure 1; Table 1). This station produced the highest standing stock of the six sites sampled at 402 pounds per acre. Fish habitat at Station 1 was considered fair to good. Deep holes and overhanging vegetation were common, while logs were scarce. The substrate was composed of sand (88%) and silt (12%). Stream conditions at sampling time were clear with low water levels (average depth of 1.3 ft). This station had some of the best habitat in terms of deep holes.

At station 1, of 8% of the catch by weight was game fish. Brown trout accounted for 90% of that weight, and 60% were of legal size. Rock bass and bluegill accounted for 48.9% of the catch by number, but only 11% were of an acceptable size. White sucker, mottled sculpin, and creek chub contributed the largest percentage by number, while white sucker and common carp contributed the most by weight.

Station 2 was located about 5 miles downstream of Station 1 (Figure 1). Station 2 was just below the median standing crop at 85 pounds per acre (Figure 2). Fish habitat was rated as fair. Logs and woody debris were common, and pools were scarce. The substrate consisted of sand (78%), silt (12%), clay (8%), and gravel (2%). The water was clear with a low level. Stream width (38 ft), depth (1.8), and velocity (0.73 ft/sec) were all favorable at this sample site for the rotenone survey.

Game fish contributed to 9.8% of the total catch by weight at station 2. Brown trout were the most abundant game fish by number (50%) and weight (67.4%), with 9.4% over legal size. Other game fish that were harvested included bluegill, rock bass, largemouth bass, and yellow perch, and only bluegill and rock bass had acceptable sizes. White sucker, creek chub, bluntnose minnow, and mottled sculpin made up 80% of the total catch by number.

Stations 3 and 4 were characterized as very straight runs with no variability in stream morphology. Both stations were deeper, with an average depth of 1.9 ft, and ranged in width from 43 to 49 ft.

Fish habitat in station 3 was considered poor. The stream shape was homogenous and cover was limited. Cover in the form of woody debris, overhanging vegetation, rocks, and boulders was scarce. The substrate was composed of sand (80%), clay (12%), rock (5%), silt (2%), and gravel (1%). This station is about one mile downstream of Dowagiac Creek, which receives a discharge from the city of Dowagiac Waste Water Treatment Plant.

This station had the lowest standing crop with 48 pounds per acre. Game fish species accounted for 13.1% of the catch by weight and 3.4% by number. The most numerous game fish by number was brown trout at 31%. Legal sized brown trout made up 22% of the trout catch. Rock bass was the only other game fish with acceptable sizes. Common shiner, creek chub, mottled sculpin, and white sucker were 71.1% of the catch by number. Station 3 is one of two sites on the river where spotfin shiners were collected.

Fish habitat at station 4 was rated as fair. Cover in the form woody debris and overhanging vegetation was scarce. However, this station had more gravel substrate (34%), followed by silt (30%), sand (28%), and rock-cobble (8%). The water was low and slightly turbid.

More species of fish (26) were collected at this station than any other on the Dowagiac River. Game fish accounted for 3.0% of the catch by number and 8.5% of the catch by weight. Again, brown trout were the dominant game fish, representing 70.9% of the catch. Two brown trout collected were in the 2-inch class, indicating natural reproduction in this section of river. White sucker, common shiner, bluntnose minnow, hornyhead chub, blackside darter, and mottled sculpin made up 86.9% of the total catch by number. This was the only site on the river where golden shiner, emerald shiner, and blacknose dace were collected (Table 2).

The only similarities between Stations 5 and 6 were that the water current is fast and gravel is the predominant substrate. The channel at Station 5 is straight and deep, while Station 6 has a more natural and meandering channel with varied depths.

Station 5 is located at Dodd County Park and is the most accessible station on the river. Cover was poor, but the substrate was good. Woody debris and overhanging brush were scarce at this station. The average depth was 2.3 ft, but the water level was below normal and water was turbid. The substrate was composed of gravel (77%), cobble (8%), rock (8%), sand (5%), and silt (2%).

Interestingly, no rock bass (the second most abundant game fish in survey) were collected at Station 5. Again, brown trout were the most numerous game fish by number (51.4%) and weight (91.5%). Over 36% of the trout were of legal size. There were only 18 species collected, which is the lowest number for the survey. White sucker were the most numerous species at 45% of the total catch. Common shiner, blackside darter, and mottled sculpin made up 43% of the catch by number. High water velocity in addition to moderate amounts of debris in the water caused the lower net to fail. Only the fish that were caught in the mid-net were used in the analysis. This partly explains the lower number of species and low total number and weight of the sample. However, standing crop (173 pounds per acre) for this station was similar to others in the survey.

Station 6 was much different than the other stations. This station was near the confluence to the St. Joseph River and was three miles downstream of the Pucker Street Dam (Figure 1). The habitat was rated as excellent. The stream channel was sinuous and had good fish habitat. Deep holes, woody debris, and tree falls were common. Substrate consisted of gravel (65%), sand (27%), cobble (5%), and silt (3%). Average depth was 1.6 ft, and the average width was 77.8 ft. Water level was moderately high and clear. The river was as close to "normal" flow as possible. The Niles Hydroelectric Plant (Pucker Street Dam) was not operating or storing water at the time of the survey. Peaking operations at this facility can change water depths by two or more feet (J. Dexter, Michigan Department of Natural Resources, personal communication).

Game fish made up 31.0% of the total catch by weight and 8.5% by number. Surprisingly, no brown trout were caught at this station. Smallmouth bass were the most common game fish, comprising 64.2% by number and 80.5% by weight. Only 3.4% of the smallmouth bass were of legal size. Redhorse and white sucker accounted for 57.6% of the total catch by weight, while sand shiner, rainbow darter, and blackside darter were most numerous, comprising 55.1% of the catch. Only 22 species of fish were collected. Six fish species were only observed here, including shorthead redhorse, rosyface shiner, sand shiner, longear sunfish, smallmouth bass, and logperch. Anglers reported that the brown trout fishery had declined at this station since 1979.

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, rock bass, and brown trout (Table 8). Mean growth index values were compared, by age group, to the state average length obtained from lake fish. The age analysis indicated slower than normal growth for all species except brown trout. There were only two largemouth bass, which were growing below state average. Rock bass exhibited slow growth with ages 1-3, but had above average growth for ages 4 and 5.

Although six different year classes were observed with smallmouth bass, all ages were growing below the state average. There were

four year classes of brown trout present, and all were growing above the state average. Two age-0 fish were identified indicating some natural reproduction in the river or tributaries. The absence of age-3 and -4 brown trout may indicate two year-class failures.

Discussion

The fish community in the Dowagiac River is very different from other southern Michigan rivers surveyed with rotenone. The average standing crop (148 lbs/acre) and number of species captured (36) was low compared to other rotenone sampled rivers in Michigan (Table 4). The percent of suckers and carp was also low. Considering the above characteristics, the Dowagiac River is most like the Nottawa and Battle Creek rivers.

Dowagiac River is the only rotenone sampled river to have brown trout as the most numerous game fish by weight and number. The presence of brown trout and mottled sculpin indicate a coldwater system (Scott and Crossman 1979, Raleigh et al. 1986, Wehrly et al. 1998). Brown trout were found at every station but Station 6, while mottled sculpin were found at all stations.

The estimates of standing crop for all stations should be considered conservative estimates. Although rotenone collects nearly all fish at a sampling site, there were undoubtedly inefficiencies in sampling. Due to fast currents, blocking nets at stations 3-5 were backed with trap net leads adding additional net material. However, it is possible that some fish got through unnoticed. The lower blocking net blew out at Station 5 due to fast currents and moderate amounts of debris in the water. Only the upper half of Station 5 (286 ft), which was sampled with a mid-reach net, was used for analysis,. Some species may not have been observed because the lower part of station 5 was not sampled. Furthermore, Station 6 was surveyed a year later in July of 1989. There may have been some differences in the river between years, although no differences were recorded as significant. The upper blocking net at Station 6 was set on the west side of the island. On the east side, the current was too strong, so there could have been some escapement upstream. For the most part, all stations had fast currents with shifting sand substrates; therefore, difficulties in sampling were similar at all stations.

The Dowagiac River was classified as a coldwater system in 1967. Our stream temperature results confirmed the 1967 coldwater classification. Mean July temperatures were in the mid to upper 60s for the entire study area. The Dowagiac River would classify as a cold to cool system compared to other streams in Lower Michigan (Wehrly et al. 1998). These cold summer temperatures are indicative of substantial groundwater contributions to the river throughout most of its length. Most of the Dowagiac River provides suitable temperatures to support brown trout throughout the year (Wehrly and Wiley 1998).

The cold and stable flows of the Dowagiac River have made it an attractive place for fish rearing and management. From 1873 to 1881, the first state fish hatchery operated along the Dowagiac River in Pokagon Township near the town of Sumnerville. Atlantic salmon *Salmo salar*, chinook salmon *Oncorhynchus tshawytscha*, brook trout *Salmo trutta*, Arctic grayling *Thymallus arcticus*, lake whitefish *Coregonus clupeaformis*, American eels *Anguilla rostrata*, and common carp were raised and distributed across the state from this site. Although the hatchery was eventually moved to Paris, Michigan, stocking of fish into the Dowagiac River continued. Various combinations of rainbow, brook, and brown trout were stocked from the early 1900s to 1964. Since 1975, only brown trout have been stocked.

The first significant fisheries survey on the river occurred in 1939 to determine trout potential of the river (Moffett 1940). It was determined that the potential for trout was good due to cold water temperatures and high dissolved oxygen concentrations; however, habitat and fish foods were scarce. The channel was described as one long run with a lack of pools and riffles. Creek chub and common shiner were the dominant fish with brown and rainbow trout as the main game fish.

Surveys conducted in 1953, 1958, 1973, and 1977 reported similar findings of poor habitat with white suckers dominating the population and brown trout being the most numerous game fish. Most surveys recommended habitat

improvement to increase trout production, but no projects ever materialized.

In the current survey, growth of all game fish except rock bass was below state average, while brown trout were 1.1 inches above state average by age group. This also supports the classification of Dowagiac River as a coldwater stream. River temperatures are optimal for brown trout, but are too cold for other game fish.

Management Considerations

The Dowagiac River does not offer a variety of game fish species for anglers. Brown trout are the dominant game fish by number and weight. Although anglers do catch some trout, habitat is limiting for good trout production. Some anglers canoe the river with limited success. Other than bridge crossings, access is limited along most of the river.

In order to provide a better fishery, habitat restoration and angler access projects are needed. Since the dredging of most of the river channel in the 1920s, habitat in the form of riffles and pools has been lost. The channel is very straight and deep with high banks. The river's connection to riparian wetlands was virtually cut off when the channel was vertically incised. A restoration project that reconnects old meanders to portions of the river would provide more riffle and pool habitats as well as slower stream velocities. These restored habitats would increase cover for fish and promote macroinvertebrate production. Fish Division should continue to support local efforts to restore the river, such as the Partnership for MEANDRS (Meeting Ecological and Agricultural Needs within the Dowagiac River System): (www.MEANDRS.org). In conjunction to habitat restoration, access development projects are also needed. Access is limited to state land at Sink Road and Dodd Park; Nature Conservancy property at Frost Road; and city of Niles and Niles Township property at Pucker Street Dam.

The Dowagiac River receives 8,500 (50-100 per acre) yearling brown trout (Seeforellen strain) annually. The fish are stocked at seven locations along the river from the Cass/Van Buren County line to just downstream of the Pucker Street Dam. Presently, there is no need to increase stocking above Pucker Street Dam. If habitat and access are improved through restoration projects, stocking levels may have to be adjusted to accommodate natural reproduction and/or angler harvest.

The lower river, below Pucker Street Dam, has excellent habitat and is a popular fishery. Since fish ladders were installed in 1992 at Berrien Springs and Buchanan dams on the St. Joseph River, potamodromous fish from Lake Michigan have access to the lower river. Steelhead, chinook salmon, and coho salmon run the lower river and provide an excellent fishery. Although our survey found mostly smallmouth bass, the lower river seems to be better suited for trout management due to low summer stream temperatures. This portion of the river also has the potential to become a significant source of naturally produced steelhead and salmon. Redds have been frequently observed. Substrates are primarily gravel and cobble, and the water is cool with stable flows. Historically, the lower Dowagiac River was also known for its run of lake sturgeon. Several sturgeon were caught in this area in the mid- to late 1800s (Ballard 1948).

We recommend that a two-crew stream shocking survey be conducted below the Pucker Street Dam to evaluate the natural reproduction of brown trout, steelhead, and chinook and coho salmon. Salmon and steelhead did not have access to the lower river during this survey.

Long term management should consider fish passage at the Pucker Street Dam through dam removal. This will also decrease water temperatures in the lower river. The middle portion of the Dowagiac River has the potential to provide spawning habitat for potamodromous trout, salmon, and lake sturgeon - provided that meander restoration occurs.

Acknowledgments

The authors wish to thank the many Department of Natural Resources personnel that worked hard to make the survey possible, in particular, the District 12 Fisheries Crew for organizing equipment during the survey and Rick Popp for stream flow analyses.

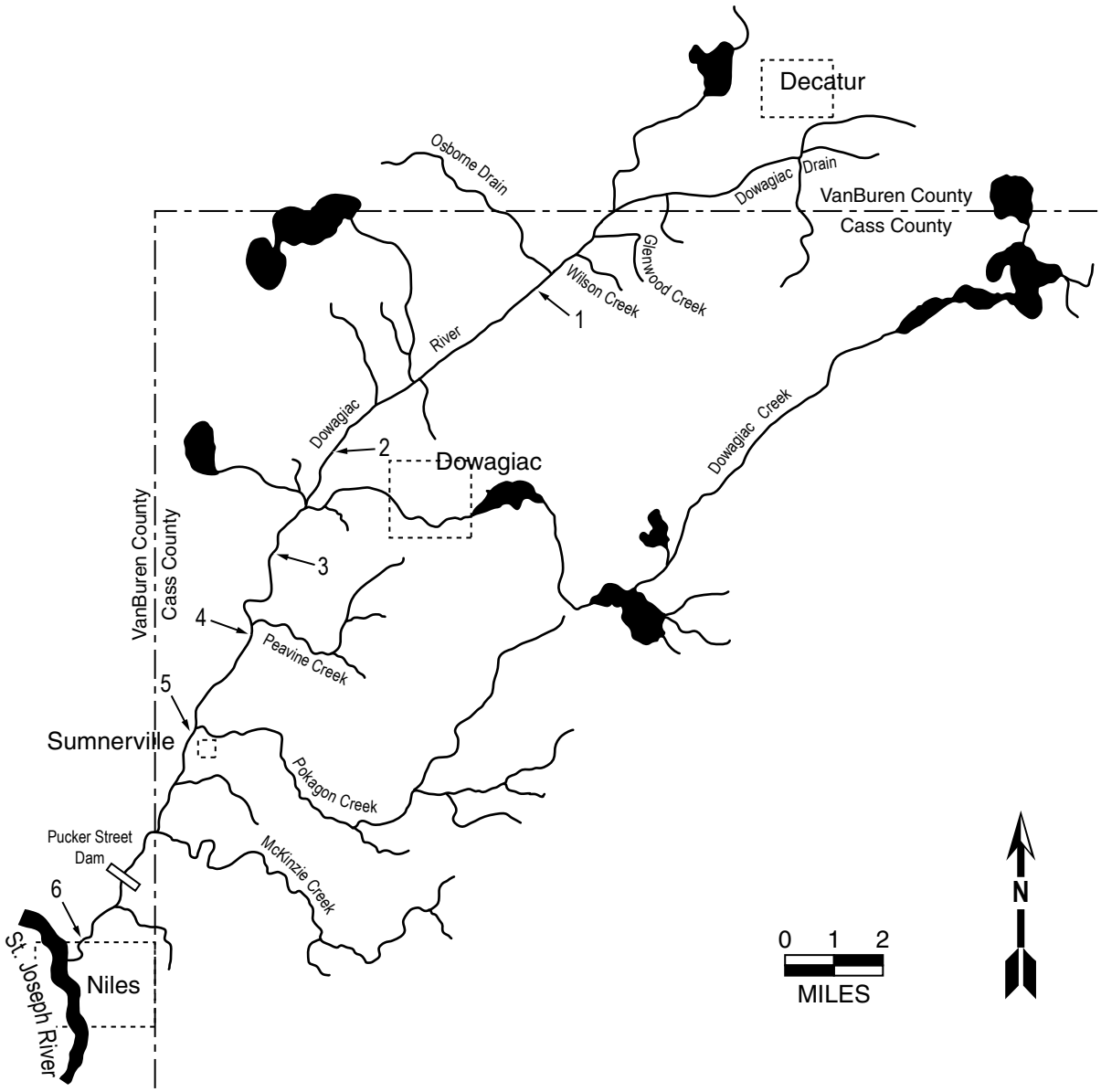

Figure 1.–Locations of rotenone sampling stations during the 1988 Dowagiac River fish survey.

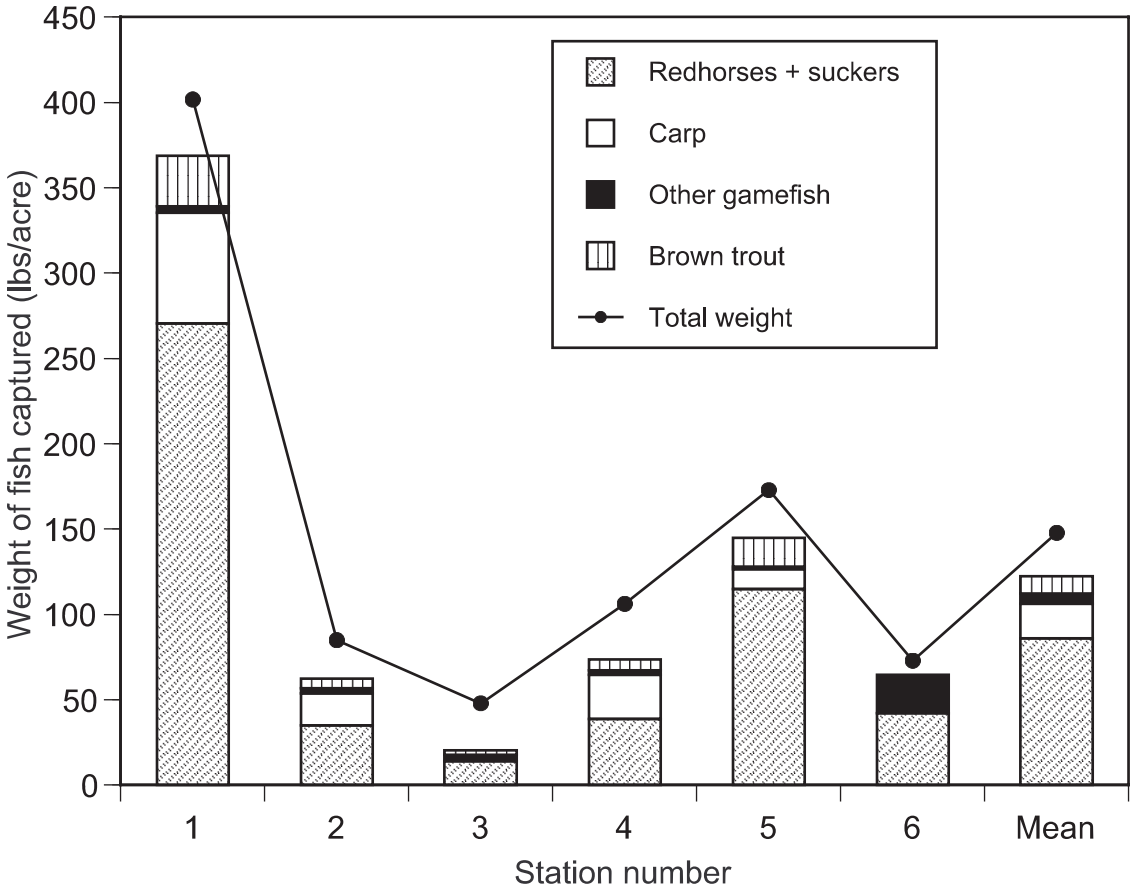

Figure 2.–The weight of brown trout, other gamefish, carp, and redhorses + suckers captured at each station during the 1988 Dowagiac River fish survey. The solid line represents total weight of all captured fish.

Table 1.–Description of 1989 rotenone sampling stations on the Dowagiac River.

Station	County	Location	Length (feet)	Upstream limit and location
1	Cass	T5S, R15W, Sec. 8, 9	694	544 ft. above Atwood Rd.
2	Cass	T5S, R16W, Sec. 26	777	577 ft. above Middle Crossing Rd.
3	Cass	T6S, R16W, Sec. 4, 9	482	382 ft. above Frost Rd.
4	Cass	T6S, R16W, Sec. 17	1020	1020 ft. above Sink Rd
5	Cass	T6S, R16 W, Sec. 31	286	613 ft. above Dodd Park canoe launch
6	Berrien	T7S, R17W, Sec. 23	560	310 ft. above US 31

Table 2.–List of species captured at each station during the 1989 Dowagiac River rotenone survey.

Species	Station number					
	1	2	3	4	5	6
Spotfin shiner *Cyprinella spiloptera*	–	–	x	–	–	x
Common carp *Cyprinus carpio*	x	x	–	x	x	–
Common shiner *Luxilus cornutus*	x	x	x	x	x	–
Hornyhead chub *Nocomis biguttatus*	–	–	x	x	–	x
Golden shiner *Notemigonus crysoleucas*	–	–	–	x	–	–
Emerald shiner *Notropis atherinoides*	–	–	–	x	–	–
Rosyface shiner *Notropis rubellus*	–	–	–	–	–	x
Sand shiner *Notropis stramineus*	–	–	–	–	–	x
Bluntnose minnow *Pimephales notatus*	x	x	x	x	–	–
Blacknose dace *Rhinichthys atratulus*	–	–	–	x	–	–
Creek chub *Semotilus atromaculatus*	x	x	x	x	x	–
White sucker *Catostomus commersoni*	x	x	x	x	x	x
Lake chubsucker *Erimyzon succetta*	x	–	–	–	–	–
Northern hog sucker *Hypentelium nigricans*	–	x	x	x	x	x
Golden redhorse *Moxostoma erythrurum*	–	–	–	x	–	x
Shorthead redhorse *Moxostoma macrolepidotum*	–	–	–	–	–	x
Yellow bullhead *Ameiurus natalis*	x	x	x	–	–	x
Stonecat *Noturus flavus*	–	–	x	x	x	x
Grass pickerel *Esox americanus*	x	x	x	x	x	x
Central mudminnow *Umbra limi*	x	x	x	x	x	x
Brown trout *Salmo trutta*	x	x	x	x	x	–
Pirate perch *Aphredoderus sayanus*	x	–	–	x	–	–
Mottled sculpin *Cottus bairdi*	x	x	x	x	x	x
Rock bass *Ambloplites rupestris*	x	x	x	x	–	x
Green sunfish *Lepomis cyanellus*	x	x	x	x	x	x
Pumpkinseed *Lepomis gibbosus*	x	–	x	x	x	–
Bluegill *Lepomis macrochirus*	x	x	x	x	x	x
Longear sunfish *Lepomis megalotis*	–	–	–	–	–	x
Smallmouth bass *Micropterus dolomieu*	–	–	–	–	–	x
Largemouth bass *Micropterus salmoides*	x	x	–	x	x	–
Black crappie *Pomoxis nigromaculatus*	x	–	x	x	x	–
Rainbow darter *Etheostoma caeruleum*	–	x	x	x	x	x
Johnny darter *Etheostoma nigrum*	x	x	x	x	x	x
Yellow perch *Perca flavescens*	–	x	–	–	–	–
Logperch *Percina caprodes*	–	–	–	–	–	x
Blackside darter *Percina maculata*	x	x	x	x	x	x
Total species per station	20	19	21	26	18	22

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

Species	Percent of catch	
	Weight	Number
White sucker	45.3	18.7
Common carp	14.6	0.1
Brown trout	6.2	1.5
Northern hog sucker	5.6	1.7
Creek chub	5.5	8.5
Common shiner	5.4	18.7
Shorthead redhorse	3.7	0.2
Smallmouth bass	3.4	1.0
Rock bass	1.5	0.4
Mottled sculpin	1.4	10.4
Stonecat	1.3	1.2
Green sunfish	1.2	4.3
Golden redhorse	0.9	<0.1
Blackside darter	0.7	6.5
Hornyhead chub	0.6	2.4
Grass pickerel	0.5	0.5
Yellow bullhead	0.5	0.2
Sand shiner	0.4	5.5
Bluegill	0.3	1.2
Logperch	0.2	0.8
Bluntnose minnow	0.2	7.6
Johnny darter	0.1	3.8
Rainbow darter	0.1	3.3
Pumpkinseed	0.1	0.2
Spotfin shiner	0.1	0.3
Black crappie	0.1	0.2
Longear sunfish	0.1	<0.1
Other species	0.1	0.9

Table 4.–Catch results for southern Michigan rivers which have recently been surveyed using rotenone (n = number, w = weight, a = average).

River	Year	Sampling sites (n)	Species captured (n)	Standing crop[a] lbs/acre (a)	Game fish[b] Percent by w	Game fish[b] Percent by n	Redhorse and suckers Percent by w	Redhorse and suckers Percent by n	Carp Percent by w	Carp Percent by n
So. Branch Raisin[c]	1984	1	23	463	1.3	1.0	81.8	42.1	0.1	0.4
St. Joseph[d]	1987	9	49	365	10.6	21.6	56.6	49.0	31.0	4.1
Shiawassee[e]	1987	14	51	294	11.4	40.1	54.5	30.1	28.7	4.7
Raisin[c]	1984	12	59	278	14.1	26.6	53.0	51.0	28.3	1.9
Cass[f]	1985	11	43	268	9.4	6.4	47.9	14.2	24.4	0.6
Paw Paw River[g]	1989	7	55	246	19.4	14.7	24.5	7.2	42.8	0.6
Kalamazoo[h]	1982	14	62	186	12.8	30.1	17.3	30.3	67.5	18.2
Battle Creek[i]	1986	7	42	163	26.5	49.1	42.1	17.9	27.9	1.4
Grand[j]	1978	22	70	160	9.6	22.0	44.0	59.0	45.6[k]	16.0[k]
Nottawa[d]	1987	2	36	154	22.6	37.5	55.1	32.5	15.1	1.6
Dowagiac River	1988	6	36	148	12.1	4.9	49.9	18.9	14.6	0.1
Saline[c]	1984	2	24	117	12.3	6.3	32.9	28.7	39.5	2.0

[a] Based on catch of fish, 3 inches and longer (excluding all chubs, shiners, and darters).
[b] Game fish include rock bass, smallmouth bass, bullhead spp., northern pike, channel catfish, pumpkinseed, warmouth, bluegill, largemouth bass, black crappie, and yellow perch.
[c] Towns (1985).
[d] Towns (1988).
[e] D. Nelson, 1988, Michigan Department of Natural Resources, East Lansing (personal communication).
[f] J. Leonardi, 1987, Michigan Department of Natural Resources, Imlay City (personal communication).
[g] Dexter (1991).
[h] Towns (1986).
[i] Towns (1987).
[j] Nelson and Smith (1981).
[k] Carp and goldfish included.

Table 5.–Most numerous species by weight and game fish by percentage weight and percentage number of catch for southern Michigan rivers, which have recently been surveyed using rotenone.

River	Year	Species[a]	Game fish[b] (% weight)	Game fish[b] (% number)
Battle Creek[c]	1986	Rock bass	Rock bass (10.5)	Rock bass (29.5)
Nottawa[d]	1987	Golden redhorse[d]	Channel catfish (9.0)	Smallmouth bass (10.2)
Raisin[e]	1984	Northern hog sucker	Smallmouth bass (7.6)	Smallmouth bass (15.0)
Saline[e]	1984	Common carp	Yellow bullhead (6.9)	Yellow bullhead (2.5)
Dowagiac River	1988	White sucker	Brown trout (6.2)	Brown trout (1.5)
Paw Paw River[f]	1987	Common carp	Rock bass (5.5)	Rock bass (4.7)
Shiawassee[g]	1987	Redhorse spp.	Rock bass (4.1)	Rock bass (13.4)
St. Joseph[d]	1987	Common carp[d]	Channel catfish (4.0)	Rock bass (5.5)
Kalamazoo[h]	1982	Common carp	Channel catfish (3.9)	Rock bass (11.8)
Cass[i]	1985	Redhorse spp.	Rock bass (3.4)	Rock bass (3.2)
Grand[j]	1978	Common carp[k]	Channel catfish (3.3)	Bullhead spp.[l] (5.5)
So. Branch Raisin[e]	1987	White sucker	Yellow bullhead (1.0)	Yellow bullhead (1.0)

[a] Based on the catch of fish, 3 inches and longer (excluding all chubs, shiners, and darters).
[b] Game fish include rock bass, smallmouth bass, bullhead spp., northern pike, channel catfish, pumpkinseed, warmouth, bluegill, largemouth bass, black crappie, and yellow perch.
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[g] D. Nelson, 1988, Michigan Department of Natural Resources, East Lansing (personal communication).
[h] Towns (1986).
[i] J. Leonardi, 1987, Michigan Department of Natural Resources, Imlay City (personal communication).
[j] Nelson and Smith (1981).
[k] Carp and goldfish included.
[l] Smallmouth bass were next in highest abundance (5.0%).

Table 6.–The number of common fish per surface acre of river collected at each station during the 1989 Dowagiac River fishery survey. The value in parentheses 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	
Game fish												
Brown trout	36	(21)	47	(4)	20	(4)	55	(9)	59	(22)	–	–
Rock bass	15	(9)	13	(4)	9	(5)	6	(5)	–	–	9	(6)
Smallmouth bass	–	–	–	–	–	–	–	–	–	–	88	(3)
Largemouth bass	11	(0)	9	(0)	–	–	3	(0)	6	(0)	–	–
Pumpkinseed	5	(0)	–	–	7	(0)	9	(0)	9	(0)	–	–
Bluegill	71	(0)	19	(2)	15	(0)	3	(0)	31	(0)	34	(0)
Black crappie	5	(0)	–	–	7	(0)	6	(0)	9	(0)	–	–
Yellow perch	–	–	1	(0)	–	–	–	–	–	–	–	–
Yellow bullhead	4	(0)	4	(0)	7	(2)	–	–	–	–	6	(2)
Nongame fish												
Common carp	11		3		–		3		3		–	
Redhorse	–		–		–		1		–		19	
White sucker	1,004		312		154		372		1,319		13	
Northern hog sucker	–		19		39		43		13		74	
Mottled sculpin	389		319		250		209		366		39	
Creek chub	376		366		372		97		66		–	
Bluntnose minnow	18		418		104		331		–		–	
Green sunfish	298		112		98		32		22		56	
Johnny darter	145		35		54		31		47		155	

Table 7.–July minimum, maximum, and mean stream temperature (°F) for the Dowagiac River.

Station	Location	Year	Temperature (°F)		
			Minimum	Maximum	Mean
1	Dewey Lake Rd.	1997	59.7	74.7	67.1
2	Middle Crossing Rd.	1997	61.1	71.0	66.1
3	Frost Rd.[a]	1997	62.1	71.4	66.7
4	Sink Rd.	1992	62.8	68.1	65.4
5	Indian Lake Rd	1997	61.2	68.2	64.7
6	US 31	1993	57.9	82.9	69.1

[a] Data from July 1 through July 13.

Table 8.–Average total weighted length (inches) at age, and mean growth index for fish sampled from Dowagiac River with rotenone, July 1988 and 1989. Mean growth index is the average deviation from the state average length at age. Number of fish aged is given in parentheses.

Species	Age								Mean growth index
	0	1	2	3	4	5	6	7	
Brown trout	2.8 (2)	6.6 (83)	10.2 (8)	– (–)	– (–)	18.0 (1)			+1.1
Bluegill		2.5 (22)	3.4 (36)	4.2 (2)					-0.7
Black crappie		3.7 (12)							-1.1
Largemouth bass		4.3 (2)							–
Rock bass		2.6 (4)	3.6 (5)	4.8 (1)	7.2 (10)	7.8 (4)			+0.1
Smallmouth bass		4.9 (26)	7.8 (17)	10.3 (10)	11.4 (2)	14.4 (2)		15.7 (1)	-0.8

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