MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
SECTION OF FISHERIES

COMPLETION REPORT

A survey of the fish populations of the Minnesota River

by

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ABSTRACT

Fisheries personnel from six fisheries management areas of the Minnesota Department of Natural Resources joined in a cooperative effort to collect data on species diversity, relative abundance, and age and growth characteristics of fish populations in the Minnesota River. Fish populations were sampled with electrofishing at 55 sites in three study reaches of the river. Gill nets, trap nets, and seines were also used to collect additional information from habitats where electrofishing was limited. Trotlines were used to sample channel catfish *Ictalurus punctatus* and flathead catfish *Pylodictus olivaris*. Sixty-four species, from fourteen families, were sampled during our study. Cyprinidae, Centrarchidae and Catostomidae were the most diverse of the families represented in our sample. Common carp *Cyprinus carpio* was the most abundant species in all study reaches and represented nearly 70% of the total catch. Walleye *Stizostedion vitreum*, channel catfish and flathead catfish were the most frequently captured gamefish, but each represented $<2.1\%$ of the total catch.

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INTRODUCTION

The Minnesota River is one of the most important aquatic resources in southern Minnesota, but it has become one of the more polluted systems in the state. It is the largest tributary of the Mississippi River within the state of Minnesota, flowing over 530 km through some of the state's richest and most intensively farmed agricultural land. Conversion of land in the watershed from native vegetative cover to agricultural use required that drainage be greatly accelerated and vast networks of ditches and underground tile lines have been installed for this purpose. Accelerated drainage has destabilized natural flow regimes and contributed to flooding, sediment transport, bed cutting and bank erosion. These factors, in turn, have almost certainly had significant effects on the composition of the Minnesota River fish community.

Fisheries investigations have been conducted on selected reaches of the Minnesota River, but few have evaluated fish populations along the entire length of the river. Three major investigations by the Minnesota Department of Natural Resources (MDNR) were completed for river reaches from Mankato to the mouth (Huber 1959), near a proposed dam site at New Ulm (Huber 1971), and from the Lac Qui Parle dam to Mankato (Schneider 1966). Four studies were conducted for Northern States Power on portions of the lower river by N.S.U. Corporation (1978), Texas Instruments (1979), Ecology Consultants,Inc. (1974) and Heberling (1980). Assessments of fish populations in selected reaches have also been completed by area fisheries offices (MDNR file data). Kirsch et al. (1985) were the first to survey fish populations along the entire length of the Minnesota River. During the Minnesota River Assessment Project (MRAP), Bailey et al. (1994) used Index of Biotic Integrity (IBI) methodology to evaluate fish communities at 116 sites in the Minnesota River basin.

Evaluation and management of fisheries resources in the Minnesota River has been difficult because of jurisdictional boundaries, lack of coordination, and sampling logistics. The river lies within the boundaries of six fisheries management areas and two regions of the MDNR Section of

Fisheries. Management objectives have been inconsistent among fisheries management areas and hindered management of the river as a single resource. Specialized sampling equipment and a greater number of personnel are generally needed to sample the diverse habitats found in riverine systems. Several reaches of the Minnesota River are not easily accessed, increasing distance to sampling stations and amount of time needed to complete sampling efforts.

The need to manage the Minnesota River as a single entity, and assess fisheries resources during a single time frame, has been recognized by fisheries managers. During 1992, six fisheries management areas of the MDNR Section of Fisheries joined in a cooperative effort to assess the current fish populations of the Minnesota River. The goal of this cooperative effort was to compile data on the composition of the fish community and relative abundance of selected fish populations in the Minnesota River. Additional objectives were to obtain age and growth data for several fish species and to evaluate effectiveness of various sampling methods.

This report is a summary of fish data, sampling methodology, gear evaluation and general observations obtained during the 1992 population assessment. Information pertaining to specific sampling sites are available as Study III - Stream Population Assessment reports (MDNR file data).

STUDY AREA

The Minnesota River begins at the outlet of Big Stone Lake and meanders through a valley originally excavated by Glacial River Warren (Ojakangas and Matsch 1982). The deeply incised valley, which is up to 8 km wide and as much as 76 m below the surrounding plains, is a striking geologic feature in the generally flat landscape of southern Minnesota (Waters 1977). Today the Minnesota River is termed an "underfit stream" because it occupies a gorge created by a much larger river (Fasching 1984). The overall gradient of the river is 0.14 m/km.

The watershed of the Minnesota River is large and diverse. The watershed size is nearly 44,000 km^2, most of which (88%) is within Minnesota. The elevation ranges from 640 m (Roberts County, SD) to 213 m at its confluence with the Mississippi River in St. Paul, MN. The watershed lies within the Northern Glaciated Plains, Western Corn Belt Plains and the Northern Central Hardwood forest ecoregions of Minnesota (Fandrei et al. 1988). Watershed divides in many areas are indistinct and large interior areas do not have natural outlets (SMRBC 1977). The topography of the watershed is flat to gently rolling glacial plain.

Soils in the watershed vary widely. In upland areas, soils formed in loamy material, silty mantled glacial till, and clayey mantled glacial till are most common and range from well drained to poorly drained (SMRBC 1977). Soils formed in lacustrine materials (poorly drained) and stream alluvium (usually well drained) are common in lowland areas, such as lake basins and river floodplains (SMRBC 1977). Because soils in the watershed are extremely productive, drainage patterns have been developed and modified to enhance agricultural production. Extensive man-made drainage systems including ditches, channels and underground tile lines have transformed natural wetlands and warm water streams into agricultural land. The extensive drainage has reduced residence time of water in the watershed and altered the natural hydrology of the Minnesota and most of its tributaries (Koehler and Cooper 1994).

Four impoundments are located in the upper 70 km of the Minnesota River. Natural dams of stream alluvium deposited at the mouths of the Whetstone, Pomme de Terre and Lac Qui Parle rivers have been replaced with man-made dams that now impound Big Stone, Marsh and Lac Qui Parle lakes, respectively (Waters 1977). These control structures have altered natural water levels in the impounded portions of the river. In the 1970's a new dam was constructed between Big Stone Lake and Marsh Lake to form a shallow floodplain reservoir in the Big Stone National Wildlife Refuge (NWR). Control structures have also been built at natural waterfalls near Granite Falls and Minnesota Falls. Downstream from Minnesota Falls the river runs relatively unobstructed to the

Mississippi River. Much of the floodplain is also used for agricultural production and severe bank erosion is common in areas where the wooded riparian corridor has been replaced with row crops.

METHODS

Sampling stations and study reaches

The Minnesota River was divided into sectors or "similar reaches" which were defined as a length of the river in which gradient, bottom type, discharge, habitat, and channel morphology were similar. These sectors were the same as those established by Kirsch et al. 1985. Reservoir areas (Big Stone, Big Stone NWR pool, Marsh, and Lac Qui Parle) of the upper Minnesota River were not sampled during our study. Each fisheries management area was assigned a length of river consisting of three sectors, and three sampling stations were designated within each sector (Table 1). Sampling stations were selected to best represent the diversity of habitats within each sector. Whenever possible, stations chosen were the same as those established by Kirsch et al. (1985) or by the MDNR during other fisheries assessments (MDNR file data).

Data from all sampling stations were compiled and summarized at the Hutchinson Fisheries Management Area. To aid in data presentation, the river was divided into three reaches (Figure 1), and data from all sectors within a reach were combined. Reach 1 contains all sectors between Big Stone Lake Dam and Minnesota Falls (Table 1). All sectors between Minnesota Falls and the mouth of the Blue Earth River are found in Reach 2 (Table 1). Reach 3 contains all sectors from the mouth of the Blue Earth River downstream to the confluence with the Mississippi River (Table 1).

Fish sampling

Electrofishing, gill nets, trap nets, trotlines and seines were used to sample fish populations of the Minnesota River from August 5-28, 1992. Boat electrofishing was used to sample all stations,

except the uppermost station. A stream shocker mounted in a tow barge was used to sample the uppermost station because this area could not be accessed with an electrofishing boat. Gill nets, trap nets, and seines were not required at each sampling station, but work crews used as many different gears as possible. Since experimentation with alternate gears and method of use was considered most important, no efforts were made to standardize these sampling gears among stations.

Electrofishing stations were sampled by moving the boat downstream and parallel to the river bank. Two netters at the front of each boat collected fish as they surfaced. Sampling effort was primarily directed toward shoreline areas where water depth was < 1.5 m. Mid-channel areas were also sampled as boat operators alternated between river banks. Log jams, bridge abutments, riffles, rock outcrops, and other structures in the stream channel were also sampled. A minimum electrofishing effort of 30 min was expended in each station. All electrofishing boats had similar pulsators (Coffelt VVP-15), but each had slightly different electrode configurations and output power. Electrofishing parameters and sampling protocol were adjusted when longitudinal changes in water conductivity, river size, and type of habitat occurred.

Single or double frame trapnets (91 X 183 cm) with 1.9 cm mesh (bar measure) were used at various sampling stations. In lotic areas, the cod-end was tied to a log or other object at the waters edge. The open end of the trap net was stretched downstream and at a slight angle across the flow of the river. A 12.2 X 0.76 m nylon lead extended from the open end of the net and was anchored on the downstream end. In lentic areas, or areas with slight eddies, trapnets were set with leads tied to shore and cod-end extended perpendicular to shore.

Gill nets were 30.5 m long and 1.8 m deep and had one 7.6 m long panel each of 25, 50, 75, and 100 mm mesh (bar measure). Gill nets were set in the normal fashion with buoys attached at each end of the float line and anchors at each end of the lead line. Pool habitats with slackwater areas and eddies were the preferred locations for gill net sets. Generally, gill nets were set at an angle to the current, which reduced the amount of debris contacting the net.

Seines and small mesh (6 mm bar measure) trapnets were used to sample small fish species in shallow water areas. Seines were 15.0 m long and 1.5 m deep with 6 mm mesh (bar measure). Because of the limited application of seines and difficulties in deployment, units of effort were not established for this gear. Small mesh trapnets consisting of a single frame (76 X 152) were used only in the upper three sectors of Reach 1. Data collected from these gears were used only to supplement the list of species collected during the survey.

Channel and flathead catfish were also sampled with trotlines. Trotlines were 45 m long, and had 25 hooks on 0.3 m drop lines spaced 1.2 m apart. A size 4/0 or 5/0 hook was used on each drop line. Hooks were baited with either cut or live fish (suckers, redhorse, green sunfish and black bullhead). Approximately half of the hooks were baited with cut bait and the other half with live fish. Trotlines were set by securing one end to the river bank, extending the line into the river and anchoring the other end to the river bottom. In areas with strong current the lines were angled downstream. In more lentic areas, lines were set perpendicular to shore and across the river channel.

Data collected

Fish species were categorized into two groups (large or small species) based on the type of data to be collected (Table 2). Individual lengths and weights, and bulk weights were obtained according to size group designations. This categorization is similar to that used by Kirsch et al. (1985), except for gizzard shad *Dorosoma cepedianum*. Gizzard shad were added to the small species group because they are a tightly schooling fish that can be sampled in a disproportionate number if a school is contacted with the electrofishing boat (J. Enblom, MDNR, pers comm). Large and small species were determined before sampling was initiated, so that work crews would collect data in the same manner.

Hard structures (scales or spines) were collected from several species (Table 2) and were used to determine age and growth rates. In each sector, work crews collected up to 5 hard structures from

each 25 mm length group of each species selected. The hard structures were stored in an envelope that was labeled with the species name and the river sector where the fish was captured. Hard structures from all sectors were grouped according to species and sent to one of the six fisheries management areas. Each area office was assigned a group of species for which they would complete age and growth analysis.

Pectoral spines from channel catfish *Ictalurus punctatus* and flathead catfish *Pylodictus olivaris* were removed by relaxing the fin against the body of the fish, and then rotating the spine until it was disarticulated. A knife was used to make an incision in the skin around the base of the spine, and to cut remaining connective tissue. Cross-sections of the spine were cut with a low-speed saw through the articulating process and from the mid-spine area near the distal end of the basal groove. Sections made from the articulating process were used to determine age and sections from the mid-spine were used to measure distance from foci to annulus.

Microfiche viewers and projecting microscopes were used to magnify scale impressions and spine cross-sections. Paper strips were used to mark the location of the focus and annuli of each bony structure. DisBcal89 (Missouri Department of Conservation) computer program was used to digitize foci to annuli distances and for back-calculation of length at annulus formation.

RESULTS AND DISCUSSION

Over 17,000 fish were sampled from 55 sites of the Minnesota River with electrofishing boats, gill nets, trap nets, trotlines, and seines. Large fish species accounted for 44% of the total number of fish sampled, but represented 99% of the total weight. Length frequency distributions of large fish species sampled with electrofishing, gill nets and trap nets are found in Appendix 1.

Sampling stations ranged in length from 0.6 km to 2.7 km with an average length of 1.2 km. Electrofishing effort in the three study reaches ranged from 12.5 to 20.5 h and covered a total

distance of 67 km (Table 3). Effort expended with gill nets, trap nets, and trotlines also varied among the study reaches (Table 3).

Species composition and distribution

A total of 64 fish species from 14 families was sampled during this study (Table 4). Cyprinidae (19 species), Centrarchidae (11 species) and Catostomidae (10 species) were the most diverse families sampled. Multiple species were also sampled from families Hiodontidae (2 species), Ictaluridae (6 species) and Percidae (7 species). Nine families (Acipenseridae, Lepisosteidae, Amiidae, Clupeidae, Umbridae, Esocidae, Gasterostidae, Percichthyidae and Sciaenidae) were each represented by a single species.

Our study did not result in any new species when compared to a list of 94 species compiled from past collections of fish in the Minnesota River and its tributaries (Table 4). Of the thirty species on this list which we did not sample, most have either been collected from tributaries or are rarely encountered in the Minnesota River. We did not collect twelve minnow and four darter species because these are found primarily in tributaries or were not susceptible to our sampling gears in the Minnesota River. Other species not collected were trout-perch *Percopsis omiscomaycus*, burbot *Lota lota*, paddlefish *Polyodon spathula*, and longnose gar *Lepisosteus osseus* which have limited distributions in Minnesota or are found primarily in the Mississippi River (Eddy and Underhill 1974). Greater redhorse *Moxostoma valenciennesi*, black redhorse *Moxostoma duquesnei*, and chestnut lamprey *Ichthyomyzon castaneus* were not collected during our study, however, their presence in the Minnesota River has not been well documented (Eddy and Underhill 1974). Common carp *Cyprinus carpio* was the only one of four introduced species sampled during our study (Table 4).

The number of fish species sampled differed between the three study reaches, and these differences were likely related to electrofishing efficiency. We collected 47 fish species in Reach 1, 51 species in Reach 2 and 37 species in Reach 3 (Table 4). Electrofishing boats were less effective in

Reach 3 due to the width of the river, strong current and the preponderance of deep water (> 1.5 m). The use of trap nets and gill nets was also limited in the lower river.

We collected nine fish species downstream from Minnesota Falls that were not collected in Reach 1, and the distribution of these species was probably associated with natural barriers and habitat requirements. Although historical records of fish species native to the Minnesota River above Minnesota Falls and Granite Falls are unclear, it appears these falls are a natural boundary in the distribution of certain fish species. Some fish species may have been able to traverse Minnesota Falls during high river stages, but their upstream migration was totally blocked 5 km upstream at Granite Falls (Schneider 1966). Most fish species found in the Minnesota River are also found in the Red River of the North because fish populations in these two rivers originated from either Glacial Lake Agassiz or from the Mississippi refugium (Underhill 1989). Numerous routes for fish species to migrate between these two river basins occurred during late Pleistocene and early Holocene periods (Underhill 1989).

There are no recent collections of shovelnose sturgeon *Scaphirhynchus platorynchus*, shortnose gar *Lepisosteus platostomus*, river carpsucker *Carpiodes carpio*, highfin carpsucker *Carpiodes velifer*, and gizzard shad upstream of Minnesota Falls. It appears these species are limited to the lower, free-flowing portion of the Minnesota River. These species are all found in the lower Mississippi River drainage, but are not found in the Red River of the North (Underhill 1989). It is probable that these species were late migrants from the Mississippi refugium when migration routes to the Red River basin were closed and Minnesota Falls was an effective barrier to upstream movement. Flathead catfish would likely be included among these species, but have since been introduced above Minnesota Falls and Granite Falls (MDNR file data).

Other species that we did not sample above Minnesota Falls were goldeye *Hiodon alosoides*, mooneye *H. tergisus*, silver redhorse *Moxostoma anisurum*, northern hogsucker *Hypentelium nigricans* and sauger *Stizostedion canadense*. The reasons for their absence is less clear, since they

are native to the lower Minnesota River and the Red River of the North (Underhill 1989). It is probable that these species are not well adapted to the impounded portion of the Minnesota River that contains only short reaches of free-flowing river.

Relative abundance

Of the thirty-four large fish species sampled during our study, thirteen were sampled in all study reaches (Table 5). Common carp comprised most of the electrofishing catch in all reaches and represented nearly 70% of the total sample. Bigmouth buffalo *Ictiobus cyprinellus*, shorthead redhorse *Moxostoma macrolepidotum* and smallmouth buffalo *Ictiobus bubalus* were also frequently captured, but each represented less than 7% of the total sample within a reach (Table 5).

Although no distinct trends were evident in the catch of individual species between reaches, some families appeared to be more abundant in certain reaches. Catostomids represented 18.6% of the total weight from all reaches. Reach 2 had a greater abundance of catostomids (24.4%) and a lower abundance of common carp than did other reaches (Table 5). The catch and diversity of centrarchids was greater in Reach 1 than in the other reaches, probably because members of this family are generally better suited to lentic habitat which was more common in Reach 1.

Important gamefish species, such as northern pike, channel catfish, flathead catfish, smallmouth bass, walleye, and sauger, each represented <2.1% of the total electrofishing sample (Table 5). The catch of these species was similar among reaches, except for sauger and flathead catfish which were not sampled with electrofishing in Reach 1. Walleye, channel catfish and flathead catfish were the most abundant of the gamefish species in the overall sample (Table 5). The relative abundance of fish species in electrofishing catches observed during our study was similar to previous electrofishing catches (Kirsch et al. 1985; Schneider 1966).

Gear performance

Electrofishing boats were the most effective sampling gear used during our study. This gear allowed work crews to sample a wide range of habitats and cover large areas of the river. Turbidity, deep water and high conductivity can limit electrofishing efficiency in the Minnesota River (Kirsch et al. 1985). These problems are generally increased downstream as the average size and depth of the river increase. Pool oriented species were not effectively sampled with this gear and their abundance may have been underestimated. The number of species we collected on a river-wide basis was probably an accurate estimate of species richness of the fish community in the Minnesota River. However, species richness within Reach 3 was probably underestimated because sampling effort was not increased in proportion to river size or volume. Accuracy of species richness estimates in lotic systems is dependant on the size of sampling area and amount of effort expended (Paller 1995, Angermeier and Schlosser 1989, Lyons 1992). Catch rates from electrofishing probably do not provide accurate estimates of proportional abundance between sampling areas, because physical characteristics of the river vary substantially among study reaches. Catch rates of fish sampled with electrofishing are provided in Appendix 2.

Gill nets were of limited value in our study because they were difficult to set and were easily fouled with debris. Twenty-six fish species were captured in gill nets, but all of these species were also captured by electrofishing (Table 4). Catch rates of species sampled in gill nets are found in Appendix 3. Strong currents, drifting objects and entanglement with submerged objects were the most common problems associated with this gear. Even though gill nets were set in pool habitats, drifting debris collected in the mesh and decreased net efficiency. Although gill nets provided little additional data to our study, this gear has been effectively used to sample pool habitats during periods of low discharge (MDNR file data) and to capture shovelnose sturgeon (Bellig 1987, MDNR file data).

Trapnets were more effective in sampling fish populations than were gill nets. Thirty-two species were sampled in trap nets, including one species (mooneye) that was not captured in any other gear (Table 4). Catch rates of species sampled in trap nets are found in Appendix 4. Trap nets were difficult to set in areas with steep banks or strong current, but were moderately effective in these areas if the nets were set with the cod-end tied to shore. Although trap nets are not normally used for sampling fish populations in riverine systems, they have been used effectively to sample channel catfish in the Red River of the North (Topp et al. 1994). Trap nets were more effective in the upper reaches of the Minnesota River and should be used in these areas during future fisheries assessments.

Channel and flathead catfish were sampled effectively with trotlines. Trotlines captured 44% of the channel catfish and 48% of flathead catfish collected during our study. Catch rates of channel catfish were highest in Reach 1 and the overall catch rate (Table 6) was nearly identical to the catch rate (3.6 per 24 h set) observed in the Red River of the North by Topp et al. (1994). Topp et al. (1994) also noted that trotlines sampled proportionally more large channel catfish (>450 mm) than did hoop nets or trap nets. Trotlines also sampled larger channel catfish than electrofishing in the Minnesota River (Figure 2).

Age and growth

Age and back-calculated length at annulus formation were determined for sixteen species, but only seven of these species were sampled in all study reaches (Table 7). Age and growth data were collected and summarized only to provide a general characterization of age structure and growth rates of several fish species in the Minnesota River, thus no comparisons were made between gear types or study reaches. Age structure and growth rates have been described for selected reaches of the Minnesota River (MDNR file date), but to our knowledge, our study is the first to describe these population characteristics for fish species along the entire length of the Minnesota River.

RECOMMENDATIONS

1) Fisheries data collected during our study, along with data from Kirsch et al. (1985), have provided substantial information on the diversity and relative abundance of fish species in the Minnesota River. These data can be used as a baseline for comparison with future fisheries investigations. River-wide fisheries investigations, with electrofishing as the primary sampling method, should be continued at ten year intervals. Alternate sampling methods, including those used in our study, that target individual species or habitats should be incorporated into these investigations. These cooperative efforts will provide information that will permit fisheries managers to document trends in the fish community and to develop pertinent management strategies. In years between river-wide assessments, fisheries managers should consider more frequent sampling efforts to develop or evaluate local management objectives.

2) Fish populations and aquatic habitats in tributaries to the Minnesota River should also be evaluated in years between river-wide assessments. Area managers should prioritize tributaries in their areas and schedule stream surveys and population assessments. Tributaries with existing or proposed dams should be considered high priorities. An Environmental Impact Statement (EIS) for flood control projects proposed in the Minnesota River should be considered after the completion of the Red River EIS (W. Barstad, MDNR, pers comm).

3) The Minnesota River is a significant natural resource in southern Minnesota, but there is little information available concerning the recreational use this resource receives or the economic impact associated with these uses. A comprehensive creel study designed to evaluate recreational use and to set and evaluate fish management objectives should be implemented. This creel survey should provide estimates of angler use, catch rates and harvest of sportfish in the Minnesota River. Because

channel and flathead catfish are primary components of the Minnesota River fishery, the creel should be designed to encompass all time periods when catfish are pursued by anglers.

4) Proposed projects that might degrade aquatic habitat in the Minnesota River or its tributaries, such as snag removal and bridge construction, should be critically reviewed by all management agencies. Whenever possible, a cooperative review should be done among all management agencies involved. Recommendations to reduce or eliminate degradation of aquatic habitats should be consolidated in a single document and presented to the agency or organization initiating the project.

5) Management of all lake and stream resources in the Minnesota River basin should be conducted from a watershed perspective. Fisheries managers throughout the watershed should review current management objectives and evaluate their impacts to the Minnesota River. Management of non-endemic fish species or genetically dissimilar fish stocks should be critically reviewed.

6) Seasonal protected flows should be established for tributaries to the Minnesota River utilizing Instream Flow Incremental Methodology (IFIM). Watershed management practices, such as no-till farming and riparian buffer strips, that can reduce peak flows and decrease sediment input in tributaries should be implemented. Wetland restoration in the watershed should be encouraged to lessen economic impacts of flood damage, enhance seasonal fish habitat, and to reduce the frequency and magnitude of peak flows. Drainage projects, including channel maintenance, should be critically reviewed by watershed districts and natural resource agencies.

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TABLES

Table 1. Location and length of study reach and sector boundaries (in river kilometers - rkm) used in the 1992 fisheries assessment of the Minnesota River. Fisheries management areas responsible for fish sampling in each sector are also listed.

Reach No.	Sector No. (Kirsh et al. 1985)	Upper boundary (rkm)	Lower boundary (rkm)	Length (km)	Fisheries Management Area
1		535.9	410.1	125.8	
	1	535.9	524.6	11.3	Ortonville
	2	514.6	497.7	16.9	Ortonville
	3	491.6	487.6	4.0	Ortonville
	4	466.5	421.0	45.5	Spicer
	5	421.1	415.1	6.0	Spicer
	6	415.1	410.1	5.0	Spicer
2		410.1	180.3	229.8	
	7	410.1	392.3	17.8	Hutchinson
	8	392.3	362.3	30.0	Hutchinson
	9	362.3	280.2	82.1	Hutchinson
	10	280.2	233.5	46.7	Windom
	11	233.5	193.2	40.3	Windom
	12	193.2	180.4	12.8	Windom
3		180.4	0.0	180.4	
	13a	180.4	151.4	29.0	Waterville
	13b	151.4	122.4	29.0	Waterville
	13c	122.4	93.4	29.0	Waterville
	13d	93.4	64.4	29.0	West Metro
	13e	64.4	33.8	30.6	West Metro
	14	33.8	0.0	33.8	West Metro

Table 2. Large and small species group designations of fish sampled from the Minnesota River during 1992. Columns with a 'X' indicate the type of data collected for each species or group of species.

Common name	Family	Individual Length	Individual Weight	Age Structure	Count and bulk weight
Large species					
Sturgeons	Acipenseridae	X	X		
Gars	Lepisosteidae	X	X		
Bowfin	Amiidae	X	X		
American eel	Anguillidae	X	X		
Mooneyes	Hiodontidae	X	X		
Northern pike	Esocidae	X	X	X	
Common carp	Cyprinidae	X	X		
Suckers	Catostomidae	X	X		
Catfishes (except *Noturus spp.*)	Ictaluridae	X	X	X	
Bullheads	Ictaluridae	X	X		
White bass	Percichtyidae	X	X	X	
Sunfishes (all species)	Centrarchidae	X	X	X	
Perches (except darters)	Percidae	X	X	X	
Freshwater drum	Sciaenidae	X	X		
Small species					
Gizzard shad	Clupeidae	X			X
Central mudminnow	Umbridae				X
Minnows (except common carp)	Cyprinidae				X
Madtoms (*Noturus spp.*)	Ictaluridae				X
Sticklebacks	Gasterosteidae				X
Darters	Percidae				X

Table 3. Number of sampling stations and sampling effort expended with sampling gears in each of the three study reaches of the Minnesota River during 1992. Electrofishing effort given in total hours (h) and total distance (kilometers - km), all other gears expressed as number of one day sets (d).

Gear	Reach			
	1	2	3	Total
No. sampling stations	18	19	18	55
Electrofishing - h	19.3	16.0	12.5	47.8
- distance (km)	23.5	23.6	19.9	67.0
Gillnet (d)	28	24	4	56
Trapnet - 19mm bar mesh (d)	38	37	4	79
Trapnet - 6mm bar mesh (d)	18	0	0	18
Trotline (d)[1]	12	18.6	16	46.6

[1]Trotline effort based on a 25 hook line set for 24 hours. Partial lines or sets shorter than 24 hours were adjusted accordingly.

Table 4. List of fish species known to occur in the Minnesota River basin compiled from Kirsch et al. 1985, Underhill 1989, and Bailey et al. 1994. Scientific name followed by an asterisk denotes an introduced species. Species sampled during the 1992 assessment are indicated by letters in columns for each study reach. Letters specify sampling gear: electrofishing (E), gill net (G), trotline (L), seine or small mesh trap net (S), or trap net (T).

Scientific name	Common name	Reach 1	Reach 2	Reach 3
Lamptera appendix	american brook lamprey			
Ichthyomyzon castaneus	chestnut lamprey			
Ichthyomyzon unicuspis	silver lamprey			
Polyodon spathula	paddlefish			
Scaphirhynchus platorynchus	shovelnose sturgeon		E,G	G
Lepisosteus osseus	longnose gar			
Lepisosteus platostomus	shortnose gar		E,G,T	E,T
Anguilla rostrata	american eel			
Amia calva	bowfin	E		E
Dorosoma cepedianum	gizzard shad		E,S,T	E
Oncorhynchus mykiss *	rainbow trout			
Salmo trutta *	brown trout			
Hiodon alosoides	goldeye		E,G,T	E
Hiodon tergisus	mooneye		T	
Umbra limi	central mudminnow	E,S		
Esox lucius	northern pike	E,G,L,S,T	E,G,L,S,T	E,L,T
Campostoma anomalum	central stoneroller	E	S	
Campostoma oligolepis	largescale stoneroller			
Carassius autatus *	goldfish			
Cyprinus carpio *	common carp	E,G,L,S,T	E,G,L,S,T	E,G,L,T
Hybognathus hankinsoni	brassy minnow	E,S	S	
Macrhybopsis aestivalis	speckled chub			
Macrhybopsis storeriana	silver chub		E	E
Nocomis biguttatus	hornyhead chub	E		
Notemigonus crysoleucas	golden shiner	E,S		
Notropis anogenus	pugnose shiner			
Notropis atherinoides	emerald shiner	E,S	E,S	E
Notropis blennius	river shiner		E,S	
Luxilus cornutus	common shiner	E,S	S	
Notropis dorsalis	bigmouth shiner		S	E
Notropis heterodon	blackchin shiner			
Notropis heterolepis	blacknose shiner			
Notropis hudsonius	spottail shiner	E,S	S	E
Notropis rubellus	rosyface shiner	E,S	S	E
Notropis spilopterus	spotfin shiner	E,S	E,S	E
Notropis stramineus	sand shiner		E,S	
Notropis texanus	weed shiner			
Notropis volucellus	mimic shiner		E	

Table 4. continued

Scientific name	Common name	Reach 1	Reach 2	Reach 3
Phoxinus eos	northern redbelly dace			
Phoxinus erythrogaster	southern redbelly dace			
Pimephales notatus	bluntnose minnow	E,S	E,S	E
Pimephales promelas	fathead minnow	E,S	E,S	
Rhinichthys atratulus	blacknose dace	E	S	
Rhinichthys cataractae	longnose dace			
Semotilus atromaculatus	creek chub		E,S	
Margariscus margarita	pearl dace			
Carpiodes carpio	river carpsucker		E,G,S,T	E,T
Carpiodes cyprinus	quillback	E,G	E,G,S,T	E,T
Carpiodes velifer	highfin carpsucker		E,G,S,T	E,T
Catostomus commersoni	white sucker	E,G,S,T	S,T	T
Hypentelium nigricans	northern hogsucker		E,S	
Ictiobus bubalus	smallmouth buffalo	E	E,G,S,T	E,T
Ictiobus cyprinellus	bigmouth buffalo	E,G,S	E,G,S,T	E,T
Moxostoma anisurum	silver redhorse		E,G	E
Moxostoma carinatum	river redhorse			
Moxostoma duquesnei	black redhorse			
Moxostoma erythrurum	golden redhorse	E,G,T	E,G,S,T	E,L
Moxostoma macrolepidotum	shorthead redhorse	E,G,S,T	E,G,S,T	E,T
Moxostoma valenciennesi	greater redhorse			
Ameiurus melas	black bullhead	E,G,L,S,T	T	
Ameiurus natalis	yellow bullhead	E,G,S,T		T
Ameiurus nebulosus	brown bullhead			
Ictalurus punctatus	channel catfish	E,G,L,T	E,G,L,S,T	E,L,T
Noturus flavus	stonecat	E,T		
Noturus gyrinus	tadpole madtom	E,S,T		
Pylodictus olivaris	flathead catfish	T	E,G,L,T	E,L,T
Percopsis omiscomaycus	trout-perch			
Lota lota	burbot			
Fundulus diaphanus	banded killifish			
Culaea inconstens	brook stickleback	E,S		
Morone chrysops	white bass	E,S,T	E,G,S,T	E,L,T
Ambloplites rupestris	rock bass	E,G,S,T		
Lepomis sp.	hybrid sunfish	E,T		
Lepomis cyanellus	green sunfish	E	E	E
Lepomis gibbosus	pumpkinseed	E,S,T		
Lepomis humilis	orangespotted sunfish	E,S,T	E,S	E
Lepomis macrochirus	bluegill	E,G,S,T	T	E
Micropterus dolomieu	smallmouth bass	E	E,S	E
Micropterus salmoides	largemouth bass	E,S	T	E

Table 4. continued

Scientific name	Common name	Reach 1	Reach 2	Reach 3
Pomoxis annularis	white crappie	E,S,T	E,T	E
Pomoxis nigromaculatus	black crappie	E,G,S,T	E,T	E,T
Ammocrypta clara	western sand darter			
Etheostoma caeruleum	rainbow darter			
Etheostoma exile	iowa darter	E,S		
Etheostoma flabellare	fantail darter			
Etheostoma nigrum	johnny darter	E,S	S	
Etheostoma zonale	banded darter			
Perca flavescens	yellow perch	E,G,S,T		
Percina carpodes	logperch	S	S	
Percina maculata	blackside darter	E,S	E,S	
Percina phoxocephala	slenderhead darter		E,S	
Stizostedion canadense	sauger		E,G	E
Stizostedion vitreum	walleye	E,G,S,T	E,G,S,T	E,T
Aplodinotus grunniens	freshwater drum	E,G,S,T	E,G,S,T	E,L,T

Table 5. Percent composition by weight of large fish species captured with electrofishing from the three reaches of the Minnesota River during 1992. Species marked with an asterisk were present in the sample, but represented <0.01% of the total weight.

Common name	Reach 1	Reach 2	Reach 3	Total
Shovelnose sturgeon		0.53		0.19
Shortnose gar		2.65	0.96	1.20
Bowfin	0.31		0.25	0.19
Goldeye		0.06	0.18	0.07
Mooneye		0.03		0.01
Northern pike	1.09	0.23	0.42	0.59
Carp	76.5	60.4	69.9	69.0
River carpsucker		3.05	5.81	2.75
Quillback	0.15	1.77	1.68	1.16
Highfin carpsucker		1.69	1.64	1.06
White sucker	1.15			0.42
Northern hogsucker		*		*
Smallmouth buffalo	1.53	4.97	1.80	2.81
Bigmouth buffalo	5.51	4.99	2.82	4.55
Silver redhorse		1.16	0.45	0.54
Golden redhorse	1.90	0.45	0.13	0.88
Shorthead redhorse	3.27	6.33	3.48	4.40
Black bullhead	0.07			0.02
Yellow bullhead	0.18			0.07
Channel catfish	2.35	2.30	0.30	1.74
Flathead catfish		3.31	2.00	1.73
White bass	0.12	0.99	2.97	1.25
Rock bass	0.04			0.01
Hybrid sunfish		*		*
Green sunfish	0.11	0.02		0.05
Pumpkinseed	0.01			*
Orangespotted sunfish	0.05	0.01		0.02
Bluegill	0.02		0.01	0.01
Smallmouth bass	0.05	0.10	0.20	0.11
Largemouth bass	0.30		0.01	0.11
White crappie	0.05	0.08	0.03	0.05
Black crappie	0.06	0.04	0.01	0.04
Yellow perch	0.48			0.17
Sauger		1.62	0.88	0.82
Walleye	2.86	1.33	1.90	2.05
Freshwater drum	1.73	1.88	2.16	1.91
Total kilograms	1,020	993	824	2,837

Table 7 Mean back-calculated length at annulus and total number of fish aged (N) for selected fish species collected from the Minnesota River during August 1992.

Species River reach	N	Age (years)																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Northern pike																				
Reach 1	23	329	373	529	674															
Reach 2	15	310	512	630	740	730														
Reach 3	7	364	616	713																
Channel catfish																				
Reach 1	137	136	196	250	306	352	398	437	478	509	560	574	555	583						
Reach 2	136	114	201	258	323	379	439	487	522	556	569	592	619	662	612	634	685			
Reach 3	22	138	225	292	368	434	483	520	553	586	633	600	669	692	706					
Flathead catfish																				
Reach 1	3	172	256	294	332															
Reach 2	27	156	199	275	365	429	500	566	628	689	723	773	723	740	755	780	803			
Reach 3	23	116	219	283	373	431	487	540	581	607	644	683	712	735	757	773	798	796	813	829
White bass																				
Reach 1	6	152	273	327																
Reach 2	39	151	243	306	335	354	376	402												
Reach 3	50	150	246	301	337	364	360	383	387											
Rock bass																				
Reach 1	26	54	114	119																
Hybrid sunfish																				
Reach 1	5	50	83	97																
Green sunfish																				
Reach 1	39	57	80	104	135															
Reach 2	11	59	83	111	118	128														
Pumpkinseed																				
Reach 1	8	50	65	78																

Table 7 Mean back-calculated length (mm) at annulus and total number of fish aged (N) for selected fish species collected from the Minnesota River during August 1992.

Species River reach	N	Age (years)																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Northern pike																				
Reach 1	23	329	373	529	674															
Reach 2	15	310	512	630	740	730														
Reach 3	7	364	616	713																
Channel catfish																				
Reach 1	137	136	196	250	306	352	398	437	478	509	560	574	555	583						
Reach 2	136	114	201	258	323	379	439	487	522	556	569	592	619	662	612	634	685			
Reach 3	22	138	225	292	368	434	483	520	553	586	633	600	669	692	706					
Flathead catfish																				
Reach 1	3	172	256	294	332															
Reach 2	27	156	199	275	365	429	500	566	628	689	723	773	723	740	755	780	803			
Reach 3	23	116	219	283	373	431	487	540	581	607	644	683	712	735	757	773	798	796	813	829
White bass																				
Reach 1	6	152	273	327																
Reach 2	39	151	243	306	335	354	376	402												
Reach 3	50	150	246	301	337	364	360	383	387											
Rock bass																				
Reach 1	26	54	114	119																
Hybrid sunfish																				
Reach 1	5	50	83	97																
Green sunfish																				
Reach 1	39	57	80	104	135															
Reach 2	11	59	83	111	118	128														
Pumpkinseed																				
Reach 1	8	50	65	78																

Table 7 continued

Species / River reach	N	Age (years) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Orangespotted sunfish																				
Reach 1	42	44	62	68	75															
Reach 2	12	48																		
Bluegill																				
Reach 1	26	57	112	166																
Reach 2	2	61	124																	
Smallmouth bass																				
Reach 1	9	107																		
Reach 2	8	119	204	304																
Reach 3	4	91	172	227	327															
White crappie																				
Reach 1	8	68	170	233	270															
Reach 2	22	71	172	249	281															
Black crappie																				
Reach 1	65	84	184	232																
Reach 2	12	67	153	200																
Reach 3	3	78																		
Yellow perch																				
Reach 1	124	87	153	202	223	238														
Sauger																				
Reach 2	22	194	301	362	412	448	464													
Reach 3	16	176	281	343	385	433	441													
Walleye																				
Reach 1	119	203	299	377	438	501	566	622	652											
Reach 2	44	201	316	388	442	483	526	587	637	658										
Reach 3	18	181	287	393	466	519	569	619	668	693	749									

FIGURES

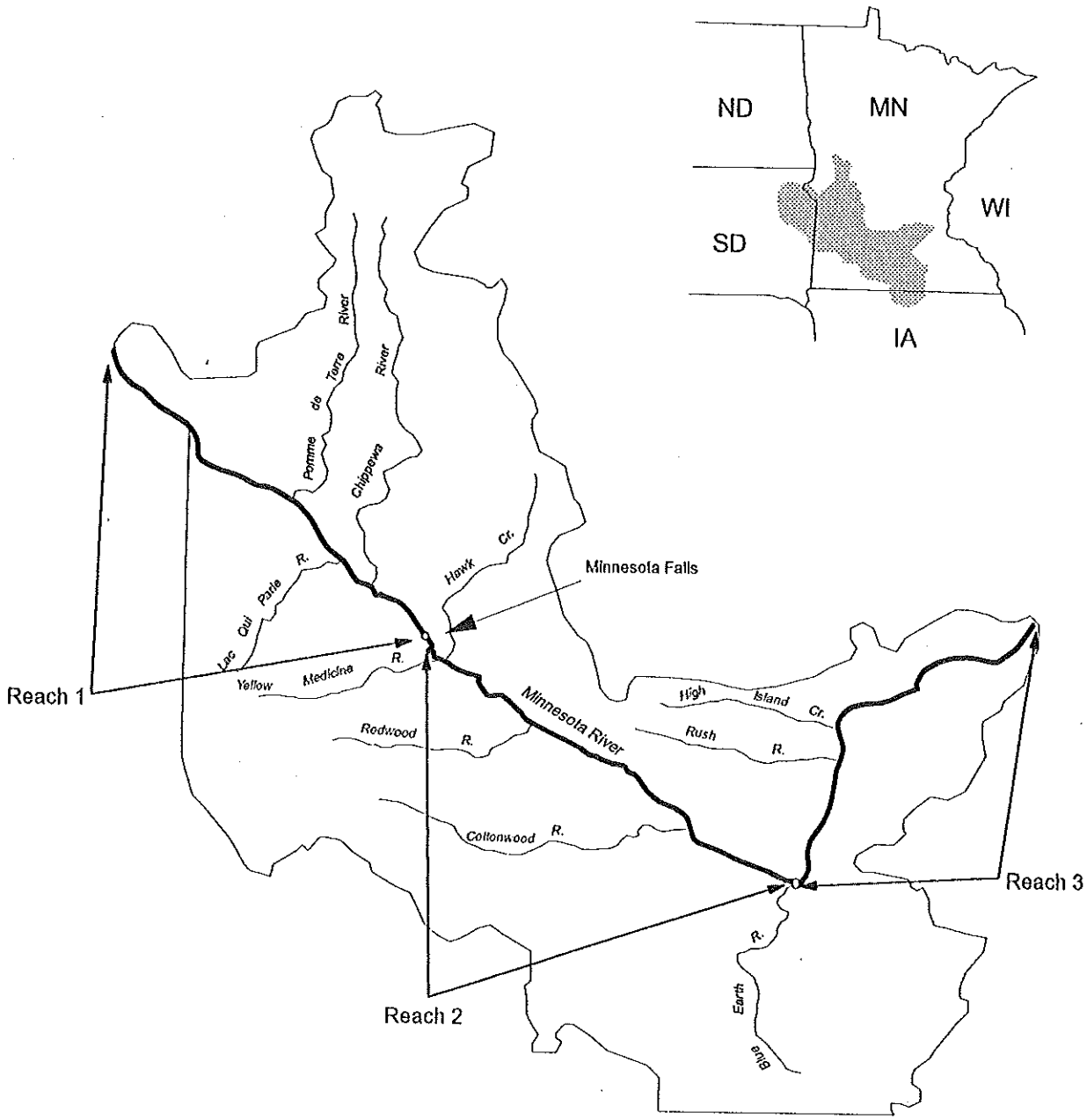

Figure 1. The study area of the Minnesota River, showing sampling reaches.

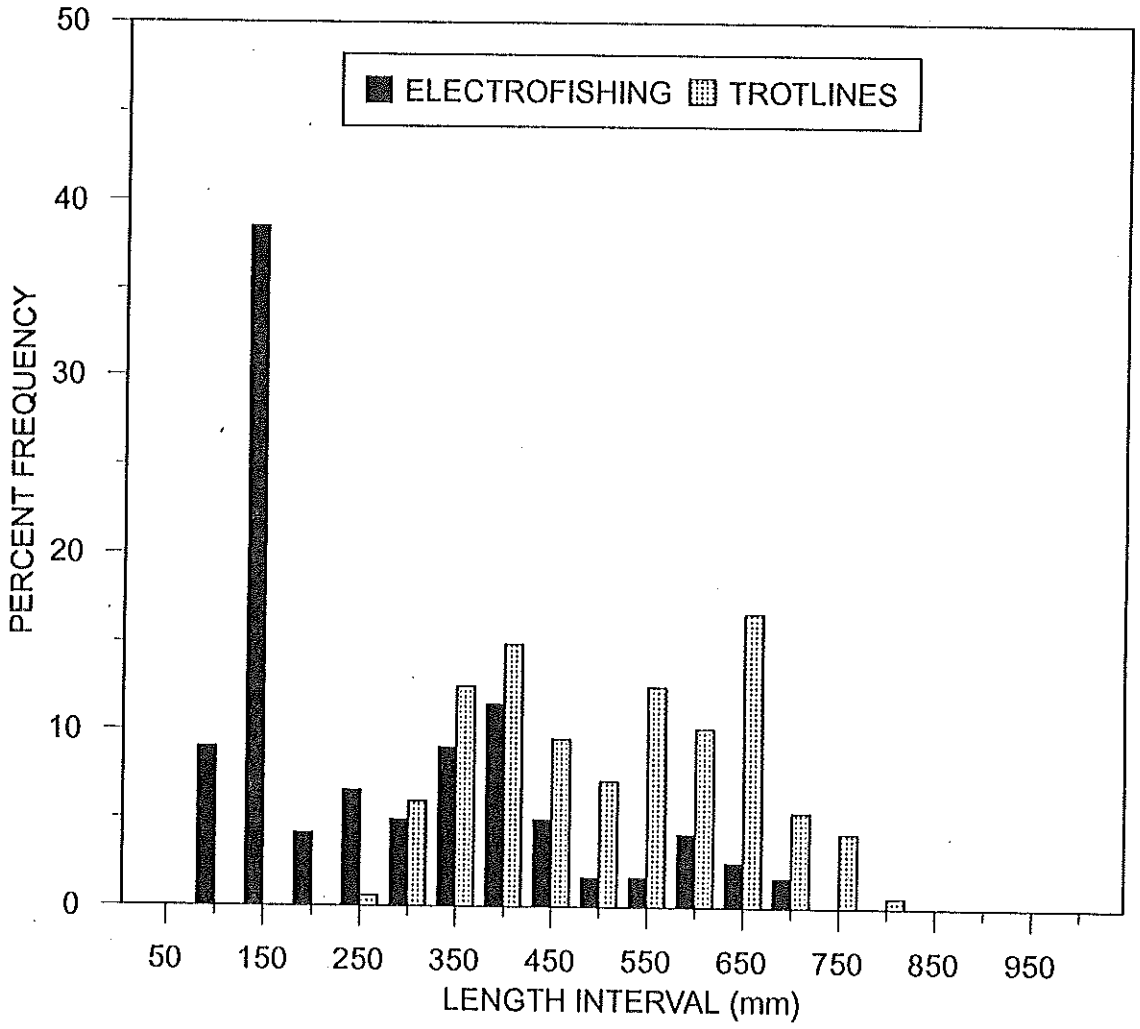

Figure 2. Length distribution of channel catfish sampled by electrofishing (N=122) and trotlines (N=168) from all reaches of the Minnesota River during August 1992.

APPENDICES

Appendix 1. Length frequency distributions of fish species sampled by electrofishing, gill nets, and trap nets in each of three study reaches of the Minnesota River during August 1992.

Reach 1

Total Length (mm)	Common name							
	Bowfin	Northern pike	Common carp	Quillback	White sucker	Smallmouth buffalo	Bigmouth buffalo	Golden redhorse
<100			2		4		4	
100-124			2		6		1	
125-149					1			
150-174		1	3		2			
175-199			5		4			
200-224		2	5		7			
225-249		2	14		7		2	2
250-274			29		4			
275-299			38		2			
300-324			45		10			1
325-349		1	18		10		1	2
350-374			22	1	10			
375-399		2	30	1	3	1		1
400-424		4	22	3	2	1	4	3
425-449		7	11		1			2
450-474		6	13			1	3	3
475-499		4	14	1			4	1
500-524		12	17	1				
525-549		5	22				1	2
550-574		4	28			1	1	3
575-599		4	24					2
600-624		5	23			1	1	
625-649		5	24				1	
650-674		2	23				1	
675-699		2	36			1	3	
700-724	1	1	18				1	
725-749		1	13					
750-774			7					
775-799		1	4					
800-824			1					
825-849								
850-874								
875-899								
900-924								
<900								
Total sample	1	71	513	7	73	6	28	22

Appendix 1. continued

Reach 1 continued

Total Length (mm)	Common name							
	Shorthead redhorse	Black bullhead	Yellow bullhead	Channel catfish	Flathead catfish	White bass	Rock bass	Green sunfish
<100	1	63	4			23		58
100-124		210	22	1		34	1	28
125-149		208	39				5	17
150-174		108	34	4			18	5
175-199	1	40	28				5	1
200-224	1	14	19			1		
225-249		7	17	4		1		
250-274			11	7				
275-299	2		3	4				
300-324	4		2	8		1		
325-349	3		1	4	1	1		
350-374	5			6	1	2		
375-399	7			4				
400-424	3			2				
425-449	15			6				
450-474	15			5				
475-499	10			3				
500-524	2			4				
525-549	1			3				
550-574				3				
575-599	1			3				
600-624								
625-649				2				
650-674								
675-699								
700-724								
725-749								
750-774								
775-799								
800-824								
825-849								
850-874								
875-899								
900-924								
<900								
Total sample	71	650	181	69	2	63	29	109

Appendix 1. continued

Reach 1 continued

Total Length (mm)	Common name						
	Pumpkinseed	Orangespotted sunfish	Bluegill	Smallmouth bass	Largemouth bass	White crappie	Black crappie
<100	11	73	8	2	1	11	14
100-124		1	13		1		1
125-149			3	2			20
150-174			2	3		5	33
175-199			3			1	4
200-224			1	2	3		2
225-249					1	1	8
250-274					1		1
275-299						1	2
300-324					1		
325-349					1		
350-374					2		
375-399					1		
400-424							
425-449							
450-474							
475-499							
500-524							
525-549							
550-574							
575-599							
600-624							
625-649							
650-674							
675-699							
700-724							
725-749							
750-774							
775-799							
800-824							
825-849							
850-874							
875-899							
900-924							
<900							
Total sample	11	74	30	9	12	19	85

Appendix 1. continued

Reach 1 continued

Total Length (mm)	Common name: Yellow perch	Walleye	Freshwater drum
<100	979		16
100-124	4	14	12
125-149	12	23	
150-174	11	45	
175-199	13	7	1
200-224	18		3
225-249	24		1
250-274	14		1
275-299	1	3	
300-324		6	
325-349		13	4
350-374		4	8
375-399		1	13
400-424		17	29
425-449		5	17
450-474		3	5
475-499		4	2
500-524		10	
525-549			
550-574		1	
575-599			
600-624			
625-649		1	
650-674		3	
675-699		1	
700-724			
725-749			
750-774			
775-799			
800-824			
825-849			
850-874			
875-899			
900-924			
<900			
Total sample	1076	161	112

Appendix 1. continued

Reach 2

Total Length (mm)	Common name: Shovelnose sturgeon	Shortnose gar	Goldeye	Mooneye	Northern pike	Common carp	River carpsucker	Quillback
<100			1					
100-124								2
125-149							2	3
150-174						1	7	2
175-199							3	2
200-224						1		
225-249					1	7		1
250-274						22	2	4
275-299						52	1	8
300-324				2		81	3	6
325-349						67	14	5
350-374		2				68	7	4
375-399		7	1			46	12	4
400-424		7	1			29	21	5
425-449	1	5	1			20	24	1
450-474		5			1	18	16	
475-499		9				33	6	
500-524		9			1	36	2	
525-549		3			1	28	2	
550-574		5			3	35		
575-599		4			2	26		
600-624		5				9		
625-649	1	8			1	10		
650-674	1	9				9		
675-699	3	3				5		
700-724	2	3				8		
725-749	1	1			1	2		
750-774								
775-799								
800-824					1			
825-849								
850-874						1		
875-899								
900-924								
<900								
Total sample	9	85	4	2	12	614	122	47

Appendix 1. continued

Reach 2 continued

Total Length (mm)	Common name							
	Highfin carpsucker	White Sucker	Northern Hog Sucker	Smallmouth buffalo	Bigmouth buffalo	Silver redhorse	Golden redhorse	Shorthead redhorse
<100								
100-124	2							2
125-149	14							6
150-174	7							15
175-199	1							8
200-224	1		1				1	1
225-249	4			1		1	2	8
250-274	3			1			7	25
275-299	2	1					4	21
300-324	4					5	1	31
325-349	5				1	5	3	42
350-374	5			3	5	1		35
375-399	3			1	6	1	2	16
400-424	4			8	3	3		4
425-449	2			11	4	3		2
450-474	1			8	1	2		1
475-499				12	7	2		
500-524				3	4	2		
525-549				1	1			
550-574				4	2			
575-599				2				
600-624					1			
625-649				3				
650-674				1				
675-699								
700-724								
725-749								
750-774								
775-799								
800-824								
825-849								
850-874								
875-899								
900-924								
<900								
Total sample	58	1	1	59	35	25	20	217

Appendix 1. continued

Reach 2 continued

Total Length (mm)	Common name							
	Black bullhead	Channel catfish	Flathead catfish	White bass	Green sunfish	Orangespotted sunfish	Bluegill	Smallmouth bass
<100		9			8	14		2
100-124	2	27			2		1	
125-149	4	13			1		1	1
150-174	1	1	1					3
175-199	3	7						1
200-224	2	9		4				
225-249		2	1	6				
250-274		5	1	2				1
275-299		5						
300-324		4						
325-349		3		3				1
350-374		2	1	16				
375-399		9	3	4				
400-424		2		1				
425-449								
450-474		1						
475-499								
500-524		2						
525-549		1	1					
550-574		1	1					
575-599		3						
600-624		1	2					
625-649		2						
650-674		2						
675-699		1						
700-724		1						
725-749			1					
750-774								
775-799								
800-824								
825-849			2					
850-874			1					
875-899								
900-924								
<900								
Total sample	12	113	15	36	11	14	2	9

Appendix 1. continued

Reach 2 continued

Total Length (mm)	Common name					
	Largemouth bass	White crappie	Black crappie	Sauger	Walleye	Freshwater drum
<100					1	5
100-124		2	1		13	
125-149		3			3	
150-174		5	4			
175-199		2				5
200-224		2	5			2
225-249	1	3	2	1		2
250-274		2		2	2	5
275-299		2			4	4
300-324		1			1	9
325-349						13
350-374				2	1	10
375-399				2	2	7
400-424				5	1	2
425-449				2	1	1
450-474				4		
475-499				5	3	1
500-524				1	2	
525-549					3	
550-574					2	
575-599					1	
600-624						
625-649						
650-674					1	
675-699						
700-724						
725-749						
750-774						
775-799						
800-824						
825-849						
850-874						
875-899						
900-924						
<900						
Total sample	1	22	12	24	41	66

Appendix 1. continued

Reach 3

Total Length (mm)	Common name: Shovelnose sturgeon	Shortnose gar	Bowfin	Goldeye	Northern pike	Common carp	River carpsucker	Quillback
<100								
100-124		2				1	3	1
125-149		1					7	2
150-174		1					10	4
175-199		1				2	3	4
200-224		1			1	2	3	2
225-249		1				1	4	9
250-274						7	5	3
275-299				1		10	2	7
300-324		1				29	10	2
325-349		1				47	9	5
350-374		1				40	10	4
375-399		1				41	8	2
400-424		5	1			28	8	2
425-449		4	2	1	1	30	7	
450-474		2		1		30	6	
475-499		5			2	31	2	
500-524		1				45	3	
525-549		1				46		
550-574		1				29		
575-599						17		
600-624						4		
625-649		1			1	5		
650-674	1					1		
675-699								
700-724						1		
725-749						1		
750-774								
775-799						1		
800-824								
825-849								
850-874								
875-899								
900-924								
<900								
Total sample	1	31	3	3	6	449	100	47

Appendix 1. continued

Reach 3 continued

Total Length (mm)	Common name							
	Highfin carpsucker	Smallmouth buffalo	Bigmouth buffalo	Silver redhorse	Golden redhorse	Shorthead redhorse	Yellow bullhead	Channel catfish
<100								2
100-124						1		6
125-149	1				1	1		
150-174	2					2		
175-199	2		1			1		2
200-224	1			3		1	1	1
225-249	6	1		1		2		1
250-274	4			2		7		2
275-299	3	1	1		2	6		
300-324	3	1		3		15		1
325-349	3		1			19		1
350-374	1	1	3			11		2
375-399			2		1	5		
400-424		3	2			5		
425-449	1	1	3			1		
450-474		4	2	2		2		1
475-499			2					
500-524		1	1					
525-549		2						
550-574		2	1					
575-599								1
600-624								
625-649								
650-674								
675-699								
700-724								
725-749								
750-774								
775-799								
800-824								
825-849								
850-874								
875-899								
900-924								
<900								
Total sample	27	17	19	11	4	79	1	20

Appendix 1. continued

Reach 3 continued

Total Length (mm)	Common name							
	Flathead catfish	White bass	Orangespotted sunfish	Bluegill	Smallmouth bass	Largemouth bass	White crappie	Black crappie
<100			2					
100-124								
125-149	2			1	1			2
150-174					1			1
175-199		1			1			
200-224		5						
225-249		4				1		
250-274	3	2					1	
275-299		2						
300-324		3						
325-349	2	16						
350-374	1	11			2			
375-399		3						
400-424	2	4						
425-449								
450-474	1							
475-499								
500-524	1							
525-549	1							
550-574								
575-599								
600-624								
625-649								
650-674								
675-699								
700-724								
725-749								
750-774								
775-799	1							
800-824								
825-849								
850-874	1							
875-899								
900-924								
<900								
Total sample	15	51	2	1	5	1	1	3

Appendix 1. continued

Reach 3 continued

Total Length (mm)	Common name: Sauger	Walleye	Freshwater drum
<100			1
100-124			1
125-149			2
150-174			4
175-199			5
200-224			1
225-249	2	1	3
250-274	3	3	7
275-299		2	7
300-324		1	12
325-349	1		13
350-374			6
375-399	3		2
400-424	1	1	3
425-449			
450-474	5	1	1
475-499		1	
500-524			1
525-549		3	
550-574			
575-599			
600-624		1	
625-649			
650-674			
675-699		1	
700-724			
725-749			
750-774		1	
775-799			
800-824			
825-849			
850-874			
875-899			
900-924			
<900			
Total sample	15	16	69

Appendix 2. Catch rates (number/h) of fish species sampled with electrofishing in each sector of the three study reaches of the Minnesota River during August 1992.

Reach 1

Common name	Sector 1	2	3	4	5	6	Reach 1 (sectors 1-6)
Bowfin				0.3			0.1
Northern pike	0.7	1.4			0.5	0.9	0.6
Common carp	21.9	14.3	20.0	21.1	17.5	11.1	17.8
Quillback			0.4				0.1
White sucker	3.0	4.9	1.9	0.6	1.0		1.8
Smallmouth buffalo				1.2		0.3	0.3
Bigmouth buffalo	1.0	2.9	3.0	0.3		0.3	1.1
Golden redhorse	0.3		3.0	0.3		1.2	0.7
Shorthead redhorse			7.0	1.5	1.4	1.5	1.8
Black bullhead	3.3	0.4		0.6		0.3	0.7
Yellow bullhead	1.0	1.1		1.5	0.5	0.3	0.7
Channel catfish				2.1	1.2	3.3	1.2
White bass			1.5	0.3		0.3	0.3
Rock bass	1.3						0.2
Hybrid sunfish				1.2		0.3	0.3
Green sunfish	0.3			1.8	1.0	9.3	2.2
Pumpkinseed	1.7						0.3
Orangespotted sunfish	6.0	1.1	1.1	0.6	0.2	0.9	1.6
Bluegill	0.7			1.5			0.4
Smallmouth bass				0.3	0.5	1.2	0.4
Largemouth bass	1.0			0.3		0.9	0.4
White crappie			0.7			0.6	0.2
Black crappie		0.4		0.3		0.6	0.2
Yellow perch	3.3	58.6	11.5				10.6
Walleye	2.6	6.1	8.1	1.2	0.2	0.6	2.8
Freshwater drum		1.8	4.1	0.3	0.7		1.0
Subtotal (large species)	48.3	92.9	62.2	38.5	24.7	33.9	47.5
Central mudminnow	2.0	0.7				0.3	0.5
Central stoneroller	2.6						0.4
Brassy minnow	0.7	0.7	1.1				0.4
Hornyhead chub	0.7				0.2		0.2
Golden shiner	3.0	6.0					1.3
Emerald shiner	45.3		1.5		0.2		7.3
Common shiner	68.0	3.9	0.4		0.2		11.2
Spottail shiner	1.3	1.1	1.9				0.6
Rosyface shiner	0.3						0.1
Spotfin shiner			6.0	0.9	1.0	0.6	1.3
Bluntnose minnow	0.3	0.7			3.4	0.9	1.0
Fathead minnow	4.3	4.6	81.5		1.2		13.0
Blacknose dace	0.3						0.1
Stonecat	2.7						0.4
Tadpole madtom	3.3	0.7			0.2	0.3	0.7
Brook stickleback		0.7					0.1
Iowa darter	1.3	1.8					0.5
Johnny darter	4.7	0.7			0.5		0.9
Blackside darter	13.7	0.7	0.4				2.3
Subtotal (small species	154.7	22.5	92.6	0.9	6.7	1.8	42.2
Total number of fish	609	323	418	130	131	121	1,732
Total effort (h)	3.0	2.8	2.7	3.3	4.2	3.3	19.3

Appendix 2. continued

Common name	Reach 2 Sector 7	8	9	10	11	12	Reach 2 (sectors 7-12)
Shovelnose sturgeon		0.7			0.3	1.5	0.4
Shortnose gar	4.4	2.8	1.9	0.4	1.2	10.2	3.0
Goldeye					0.3	0.5	0.1
Mooneye						0.5	0.1
Northern pike	0.5			0.4	0.3		0.2
Common carp	49.7	36.6	42.2	24.0	26.0	20.3	33.4
River carpsucker	3.8	4.2	2.2	3.1	0.9	2.5	2.6
Quillback		1.4	0.8	1.8	2.0	13.7	2.8
Highfin carpsucker		0.3	1.6	1.8	5.0	12.2	3.2
Northern hogsucker					0.3		0.1
Smallmouth buffalo	1.6	2.8	1.4	0.9	2.6	3.0	2.1
Bigmouth buffalo	6.0	2.8	0.8	0.9	1.5	1.0	1.9
Silver redhorse	2.2	0.3		5.3			1.1
Golden redhorse	1.6	0.7	0.5	2.7	0.3		0.9
Shorthead redhorse		9.8	8.1	25.8	9.9	15.7	11.3
Channel catfish	4.4	2.4	2.4	6.7	9.9	4.1	5.0
Flathead catfish	1.1	0.3		1.3	1.5		0.7
White bass	3.8	0.7	0.3	2.7	0.6	2.0	1.4
Green sunfish	3.3			1.3	0.3	0.5	0.7
Orangespotted sunfish	1.1	0.3		0.9	2.6		0.9
Smallmouth bass	1.6	1.4	0.5				0.6
White crappie	0.5		0.3	0.4	0.6		0.3
Black crappie			0.3		0.6		0.2
Sauger	2.2	0.3	0.3	4.4	0.6	2.5	1.4
Walleye	2.7	2.8	2.2	0.4	1.2	4.1	2.1
Freshwater drum	2.2	3.1	0.3	4.9	3.8	1.5	2.6
Subtotal (large species)	92.9	73.9	65.9	90.2	72.2	95.9	78.9
Gizzard shad		0.3		0.4	0.9	6.1	1.1
Silver chub						0.5	0.1
Emerald shiner					0.9	2.0	0.4
Spotfin shiner				0.9	0.9	0.5	0.4
Bluntnose minnow					1.2	0.5	0.3
Subtotal (small species)	0.0	0.3	0.0	1.3	3.8	9.6	2.2
Total number of fish	170	213	244	206	260	208	1,301
Total effort (h)	1.8	2.9	3.7	2.3	3.4	2.0	16.0

Appendix 2. continued

Reach 3

Common name	Sector 13a	13b	13c	13d	13e	14	Reach 3 (sectors 13a-14)
Shortnose gar	1.9	3.0	0.6	4.1	2.0	0.6	2.2
Bowfin				0.4	1.3		0.2
Goldeye	0.4	0.4	0.6				0.2
Northern pike				0.8	1.3	0.6	0.4
Common carp	17.9	33.7	37.6	39.6	70.0	23.6	35.1
River carpsucker	8.4	6.4	9.7	2.4	12.7	7.3	7.3
Quillback	5.3	5.2	9.7		0.7		3.6
Highfin carpsucker	0.8	1.5	3.0	1.6	4.7	0.6	1.8
Smallmouth buffalo	1.1	0.7	1.2		1.3	0.6	0.8
Bigmouth buffalo	0.8	1.1	2.4	2.0	2.0	0.6	1.4
Silver redhorse	1.1	0.4		0.8	0.7	2.4	0.9
Golden redhorse	0.4	0.4	0.6			0.6	0.3
Shorthead redhorse	5.7	3.4	5.5	4.1	11.3	9.7	6.1
Channel catfish	1.5	2.2	0.6	0.4	1.3	1.8	1.4
Flathead catfish	2.3	1.5		0.8	0.7		1.0
White bass	1.9	3.0	4.8	2.0	6.7	7.9	3.9
Orangespotted sunfish				0.8			0.2
Bluegill						0.6	0.1
Smallmouth bass	1.1	0.4				0.6	0.4
Largemouth bass	0.4						0.1
White crappie						0.6	0.1
Black crappie					0.7		0.1
Sauger	3.4	0.4		0.8	0.7	1.2	1.2
Walleye	0.4	1.9	1.2	1.6	2.0		1.2
Freshwater drum	2.3	1.1	4.2	0.4	6.7	16.4	4.3
Subtotal (large species)	57.0	66.7	81.8	62.9	126.7	75.8	0.0 74.3
Gizzard shad				0.8	3.3	7.9	0.0 1.6
Silver chub				0.4			0.1
Emerald shiner		0.7		18.8	149.3	662.4	108.8
Bigmouth shiner	0.8	0.4	1.2				0.4
Spottail shiner			0.6				0.1
Rosyface shiner	0.8						0.2
Spotfin shiner	14.1	27.7	3.0	1.2			9.5
Bluntnose minnow		0.7	0.6				0.2
Subtotal (small species)	15.6	29.6	5.5	21.2	152.7	670.3	0.0 120.8
Total number of fish	191	257	144	206	419	1,231	2,448
Total effort (h)	2.6	2.7	1.7	2.5	1.5	1.7	12.6

Appendix 3. Catch per unit effort, total number of fish and number of sets for gill nets used in the Minnesota River during August 1992.

Common name	Reach 1	Reach 2	Reach 3	Total
Shovelnose sturgeon		0.13	0.25	0.07
Shortnose gar		0.29		0.13
Goldeye		0.04		0.02
Northern pike	0.46	0.04		0.25
Common carp	1.14	0.46	0.25	0.79
River carpsucker		0.42		0.18
Quillback	0.21	0.04		0.13
Highfin carpsucker		0.04		0.02
White sucker		0.04		0.02
Smallmouth buffalo		0.46		0.20
Bigmouth buffalo	0.04	0.08		0.05
Silver redhorse		0.04		0.02
Golden redhorse	0.04	0.04		0.04
Shorthead redhorse	0.46	0.29		0.36
Black bullhead	1.96			0.98
Yellow bullhead	0.18			0.09
Channel catfish	1.07	0.25		0.64
Flathead catfish		0.04		0.02
White bass		0.04		0.02
Rock bass	0.07			0.04
Bluegill	0.04			0.02
Black crappie	0.14			0.07
Yellow perch	0.39			0.20
Sauger		0.04		0.02
Walleye	0.43	0.08		0.25
Freshwater drum	0.39	0.04		0.21
Total No. of fish	202	69	2	273
Number of sets	28	24	4	56

Appendix 4. Catch per unit effort, total number of fish and number of sets for trap nets used in the Minnesota River during August 1992.

SPECIES	Reach 1	Reach 2	Reach 3	Total
Shortnose gar		0.81	0.75	0.42
Goldeye		0.03		0.01
Mooneye		0.03	0.00	0.01
Northern pike	0.97	0.22	0.25	0.58
Common carp	2.55	1.84	2.00	2.19
River carpsucker		1.89	2.00	0.99
Quillback		0.03	0.50	0.04
Highfin carpsucker		0.14	1.00	0.11
White sucker	0.47	0.03		0.24
Smallmouth buffalo		0.38	1.75	0.27
Bigmouth buffalo		0.05	0.25	0.04
Silver redhorse		0.19		0.09
Golden redhorse	0.13	0.14		0.13
Shorthead redhorse	0.37	0.78	0.75	0.58
Black bullhead	7.11	0.32		3.57
Yellow bullhead	1.68		0.25	0.82
Channel catfish	0.37	0.70	0.75	0.54
Flathead catfish	0.05	0.08	0.50	0.09
White bass	1.08	0.35	0.50	0.71
Rock bass	0.39			0.19
Pumpkinseed	0.05			0.03
Orangespotted sunfish	0.05			0.03
Bluegill	0.26	0.05		0.15
Largemouth bass		0.03		0.01
White crappie	0.13	0.46		0.28
Black crappie	1.21	0.24	0.50	0.72
Yellow perch	1.13			0.54
Walleye	1.82	0.14	0.25	0.95
Freshwater drum	1.68	0.65	3.75	1.30
Total number of fish	818	354	63	1,235
Number of sets	38	37	4	79