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BIOLOGICAL SURVEY OF THE MINNESOTA RIVER[a]

by

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ABSTRACT

A stream survey was conducted on the Minnesota River during the summers of 1978-82. Stream characteristics and fish and wildlife habitat parameters were delineated. A total of 37 mi of river were electrofished in 14 sectors. The catch was comprised of 53 fish species representing 14 families. A total of 52 electrofishing stations were established in the 14 sectors. Three factors that limited electrofishing effectiveness were deep water, turbidity and high conductivity. Walleye and channel catfish were the two most abundant game fish at 3.2% and 2.7% of the overall catch, respectively. Agricultural encroachment, excessive erosion rates in the watershed and high turbidity and nutrient levels are major problems. Bottomland woods, marshes and floodplain lakes provide important cover, food and nesting sites for wildlife.

Qualitative and quantitative benthic invertebrate sampling was done in a variety of substrates at a number of sites on the Minnesota River from Ortonville to Le Sueur. Common invertebrate organisms were Hydropsychidae (Trichoptera), Ephemeroptera and Chironomidae (Diptera) with a total of 212 taxa identified. Substrate and flow appeared to be the major factors influencing the distribution of benthic invertebrates.

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INTRODUCTION

The Minnesota River was surveyed to collect baseline data on the fish and wildlife resources of the river and its associated corridor. The survey report describes environmental conditions and problems and is used by a variety of local, state and federal agencies as well as private organizations as a source of resource management information. Data on wildlife habitat and stream physical characteristics was compiled during the initial phase of the survey in June and July 1978. The river was divided into 14 sectors based on changing characteristics. The second phase included electrofishing portions of each sector, during the summers of 1980 and 1982, to determine fish population characteristics. Observations regarding mussel species were made during phases one and two. Benthic invertebrate sampling was conducted as a separate investigation at 18 sites on the Minnesota River from Ortonville to Le Sueur. Sector locations, electrofishing stations, river miles and access points are found in the map series following the Appendix.

PHYSICAL CHARACTERISTICS

The Minnesota River watershed encompasses 16,900 mi^2 of which 14,920 mi^2 is in Minnesota. The river begins in the prairie region of southwestern Minnesota and flows 333 mi before joining the Mississippi River at St. Paul.

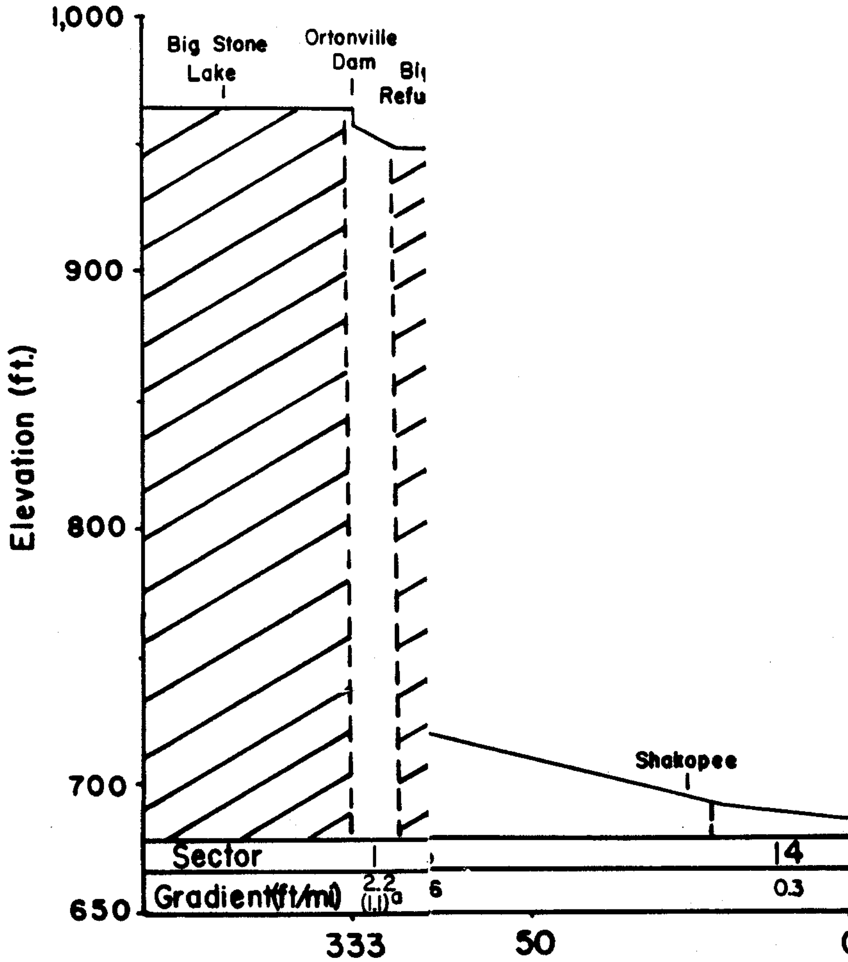
There are three reservoirs within the first 43 mi of river. The remaining 290 mi meanders through the broad valley formed by the glacial River Warren as it drained glacial Lake Agassiz 12,000 years ago. The river drops 280 ft in elevation over its entire length and the overall gradient is 0.8 ft/mi. The Minnesota River stream profile and gradient by sector are given in Figure 1. Sector 8, located between Granite Falls and Redwood Falls, had the highest gradient and was characterized by numerous riffles and small rapids. There are approximately 30 riffle areas on the Minnesota River during normal flows and their locations are indicated in the map series. In places, high gradient tributary streams deposit rock and gravel in the Minnesota River causing constriction of the channel and formation of riffles and gravel runs. The natural river channel varies in width from 47-350 ft. River banks 10 ft in height and higher are common from RM 290.0 to the river's mouth, RM 0.0.

The secchi disc transparency ranged from 0.3-5.6 ft. The highest readings were downstream of reservoirs in the upper 40 mi of river. After RM 286.6, secchi disc values were typically less than 2.0 ft. The Minnesota River flows through soils of small particle size that are susceptible to erosion. Most of the watershed is intensively farmed with row crops and sheet erosion from cropland is the major source of sediment within the Minnesota River and its tributaries (Minnesota River Basin Report 1977). Intensive farming near the river edge adds to the problem of slumping and eroding banks. A symbol in the map series indicates areas of accelerated bank erosion due to man's activities. For stream substrate types and other physical characteristics by sector, refer to the Appendix, Table 1.

Flow Data

Big Stone Lake is the source of the Minnesota River and is located on the Minnesota-South Dakota border. The average annual outflow from the lake is 108 cfs. Seven tributaries to the river have average annual flows over 100 cfs (Table 1). In addition to these major streams, there are 194 other tributaries.

Figure 1. Minnesota River



[a]Dams have reduced

Tributary watersheds upstream of Mankato are characterized by poorly drained topography. Although mainstem tributary streams are moderately high gradient, the surrounding glacial drift soils are predominantly impermeable. This results in rapid runoff during periods of excessive precipitation and snow melt. Conversely periods of low runoff, such as late summer and winter, can result in very low or no flow due to a lack of adequate ground water movement through these soils. High rates of evapotranspiration, particularly in the western part of the watershed, are also a factor. These conditions affect flows along the length of the Minnesota River and are directly responsible for the frequent extreme low flows on the uppermost portions of the Minnesota. Flows at Ortonville and Odessa are less than 10% of average annual flow approximately 50% of the time.

The Blue Earth River watershed has a well integrated drainage system with deeply incised valleys which results in rapid runoff and high flows of short duration (USGS 1974). During 1965 spring flooding, the Blue Earth River accounted for as much as 60% of the total Minnesota River flows at Mankato. With variable precipitation patterns, the Blue Earth can also dominate Minnesota River flows at other times of the year.

The Minnesota River is highly susceptible to flooding due to low stream gradient, low channel capacity and the aforementioned watershed characteristics. Big Stone, Marsh and Lac qui Parle Lakes were created by alluvial deposits from higher gradient tributaries (the Whetstone, Pomme de Terre and Lac qui Parle Rivers, respectively) damming the Minnesota River. Control structures at Big Stone Lake, Big Stone Refuge, Marsh Lake and Lac qui Parle Lake have helped reduce flood stages on the upper river. Low flow augmentation from these reservoirs is problematic because of high evapotranspiration rates and low storage capacity. Big Stone Lake has a large storage capacity but is not effectively utilized for flood control or downstream fishery, wildlife and recreational values (see Recommendation 7).

U.S. Geological Survey stream gaging stations are located at Ortonville, Montevideo, Lac qui Parle, Mankato and Jordan. Average flows for the years of record at these stations and nine major tributary stations are given in Table 1. Also shown are the average flows for the individual water years 1977-81 which demonstrate the high variability of average discharge from the drought period of 1977 extending to the survey period. Average monthly flows for the years of record also show high seasonable variability as typified by the station at Mankato where the mean monthly flow ranges from 434 cfs in January to a maximum of 8,007 in April (Table 2).

Table 1. Average flows (cfs) at USGS gauging stations on the Minnesota River and 9 tributaries for the years of record and for water years 1977-81.a

Location	Ave. flow (cfs)	Years of record	Water years				
			1977	1978	1979	1980	1981
Whetstone River near Big Stone City, SD	48	(1932-81)	20	132	114	25	9
Minnesota River at Ortonville	108	(1939-81)	2	249	251	40	2
Yellow Bank River near Odessa	56	(1940-81)	28	112	93	32	4
Pomme de Terre River at Appleton	104	(1936-81)	21	168	179	94	62
Lac qui Parle River near Lac qui Parle	121	(1934-81)	66	268	260	83	14

Table 1. Continued.

Location	Ave. flow (cfs)	Years of record	Water years 1977	1978	1979	1980	1981
Minnesota River near Lac qui Parle	622	(1943-81)	145	1,066	1,174	368	228
Chippewa River near Milan	265	(1938-81)	71	352	531	221	217
Minnesota River at Montevideo	679	(1930-81)	184	1,269	1,516	493	315
Yellow Medicine River near Granite Falls	104	(1936-81)	62	149	282	86	12
Redwood River near Redwood Falls	103	(1936-81)	66	131	297	161	25
Cottonwood River near New Ulm	270	(1939-81)	125	235	640	422	55
Blue Earth River near Rapidan	834	(1940-81)	105	687	1,596	1,175	844
Minnesota River at Mankato	2,696	(1930-81)	830	3,377	6,151	3,263	2,031
Minnesota River near Jordan	3,380	(1935-81)	964	3,785	7,132	3,721	2,361

a A water year runs from 1 October of previous year to 30 September of the year indicated.

Table 2. Average monthly flows (cfs) for the years of record, Minnesota River.

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
Ortonville (1939-1980)	19	18	19	19	21	121	422	257	196	116	51	32
Lac qui Parle (1943-1980)	150	185	148	119	144	660	2,561	1,287	1,014	787	358	175
Montevideo (1930-1980)	216	238	185	128	146	679	2,285	1,323	1,102	900	412	254
Mankato (1930-1980)	1,224	1,157	682	434	554	3,611	8,007	4,694	5,035	3,616	1,806	1,333
Jordan (1935-1980)	1,519	1,496	1,039	640	706	3,958	10,730	6,415	5,996	4,246	2,406	1,686

Dams

There are six dams on the Minnesota River with the first one at Ortonville controlling the level of Big Stone Lake. The Big Stone Refuge, Marsh Lake and Lac qui Parle dams are all used for flood control and recreational purposes. The Granite Falls dam impounds water for hydroelectric production. The Minnesota Falls dam is 2.5 mi downstream of Granite Falls and is currently used for river level control. This dam was formerly used for hydroelectric production.

Dams on the upper Minnesota River effectively block fish movements except during times of exceptionally high water. This segmentation of the river limits the dynamic nature of riverine fish populations and impairs the fishery potential of the river. There have been some limited fishery gains in the reservoirs.

WATER QUALITY

The Sioux Indian word "Minnesota" connotes cloudy water but it stretches the imagination to think that pre-settlement man gazed upon the same brown ribbon of water that characterizes the Minnesota River of today. While the river has been meandering through the typically fine soil bed of glacial River Warren for thousands of years the breaking of the prairie sod, removal of forest groves and the extensive drainage network have certainly been major contributors to the ambient "muddiness" of the stream.

The Minnesota River flows from its source at Big Stone Lake as a fertile, hard-water and moderately turbid stream. Progressing towards the mouth, turbidity, nitrate nitrogen (NO_3-N) and total phosphorus (P) exhibit moderate increases in the average values at the various monitoring stations. During the summer months (June-Aug), turbidity and NO_{3}-N average a two to three-fold increase between source and mouth. Heavy rain events, particularly before crop cover is established, can send turbidity to exceedingly high levels. Sulfate, conductivity and total hardness exhibit a moderate decrease towards the mouth. Fecal coliform bacteria levels are highly variable depending upon precipitation patterns throughout the watershed and time of year. A study by Feind, Braaten and Quade (1981) showed that there is considerable equilibrium in water quality parameters between upstream and downstream reaches of the river. Their study compiled mean values, from Minnesota Pollution Control Agency (MPCA) data for the years 1957-1975, for 23 monitoring stations along the Minnesota River and major tributaries. The data is grouped and presented in a format (seasonal and downstream) so that it can be used for water quality interpretation in respect to changes in land-use, soils and geomorphology, as well as isolating the influence of various tributaries and pollution point sources.

The MPCA classifies the Minnesota River, between the source and RM 22 near Shakopee, as a 2B, 3B interstate stream. The 2B designation indicates suitability for the propagation and maintenance of cool and warm-water fish and aquatic recreation of all kinds (including bathing). The 3B designation indicates suitability for general industrial purposes, except food processing, with only a moderate degree of treatment. The river reach between Big Stone Lake and Granite Falls has an additional 1C classification which indicates suitability for domestic consumption with appropriate treatment.

The river from RM 22 to the mouth is a 2C, 3B stream. The 2C classification indicates suitability for the propagation and maintenance of rough fish or species commonly inhabiting the waters under natural conditions and boating and other forms of aquatic recreation (excluding bathing).

The MPCA water quality monitoring network has 36 sampling stations with historical data for the Minnesota River watershed. As of 1982, only 15 stations were being sampled. The MPCA (1982) compared eight selected stations (between the source and RM 22) for the percent violation of standards of certain water quality parameters for the period January 1979 to September 1981. Fecal coliform bacteria violations were frequent at all stations except RM 288 (Lac qui Parle Lake) which had no excursions above the standard (200 organisms/100 ml). The Blue Earth River stations and the two Minnesota River stations downstream of Mankato had the highest percentage of violations (43-70%). This is the result of inadequate municipal sewage facilities and the contribution of livestock wastes in this high runoff and erosion prone area.

Violations of the turbidity standard (25 FTU) ranged from 9 to 33% and were most frequent on the lower half of the Minnesota River and the lower Blue Earth River. If winter values were excluded from the calculations these percentages would be considerably higher indicating that high solids from runoff are a major problem.

The eight stations MPCA compared had relatively low percentages of violation for the dissolved oxygen (DO) standard (5 mg/l). The station at Lac qui Parle Lake (RM 288) was the only main stem location with DO violations (7%). Tributary stations on the Pomme de Terre (RM 10) and Blue Earth (RM 100) Rivers had DO violations at 13% and 15%, respectively.

The MPCA stations also showed a low incidence of violations for the ammonia (NH_3) standard (0.04 mg/l un-ionized as N). Stations at Lac qui

Parle Lake and downstream of New Ulm and Henderson showed the occurrence of violations to be 7%, 3% and 3%, respectively. No violations of the standards for pH or temperature were recorded during the MPCA study.

The Metropolitan Waste Control Commission prepared comparative data for water quality compliance/violation at two stations on the Minnesota River for the years 1976-80 (MWCC 1980). These stations were located at Jordan (RM 39.4) and Fort Snelling (RM 3.5). The data indicated that for the five individual years violations for DO ranged from 0-11% at Jordan and 1-34% at Fort Snelling. The ammonia standard was violated from 4-36% for the five individual years at Fort Snelling but this parameter was not reported at Jordan. Generally the low flow years of 1976 and 1977 showed the highest percentage of violations for these two parameters. The data also suggests that the point source effluents, from Shakopee downstream, have a considerable impact on water quality during low flow events.

A trend analysis was performed by the Minnesota Pollution Control Agency on selected water quality parameters (MPCA 1982). Historical water quality monitoring data was compared for a 20 year period (1962-81) at Henderson, Minnesota. Linear regression analysis versus time was done for the following parameters: DO, biochemical oxygen demand (BOD), total suspended solids (TSS), P and NO_3-N. The analysis showed no apparent trend for DO, TSS and P. The regression estimate indicated that BOD has decreased 0.11 mg/l year over the period. The analysis also indicated that NO_3-N has increased at a rate of 0.27 mg/l/year, probably as a result of more intense drainage, tillage and other land use practices.

Over one-half of the annual loading of BOD, TSS and total P is carried by the river during the spring which indicates the significance of surface runoff in transporting pollutants to the stream. Organic nitrogen

(N) shows a corresponding peak at this time. Another peak for nutrients (organic N, NO_3-N, NH_3 and total P) and TSS is generally exhibited by June water quality sampling data. This is probably a result of increased rainfall following cultivation and fertilizer application.

Examination of mean annual water quality data, for the period 1967-80 (MPCA 1982), indicates that there is some deterioration in water quality from the upper end of the watershed to Shakopee. Nutrient and TSS levels reached maximums at the Henderson monitoring station (RM 64) and generally declined downstream towards the mouth. Mean annual levels at Henderson for TSS, organic N, NO_3-N, total NH_3 and total P were 202 mg/l, 1.57 mg/l, 4.49 mg/l, 0.36 mg/l and 0.36 mg/l, respectively. The Blue Earth River is a major contributing factor to this phenomenon but combining with point sources in Mankato and St. Peter does not account for the high mean levels at Henderson. Surrounding watershed and instream factors downstream of Mankato apparently exacerbate the problem.

Fish from the Minnesota River have been monitored for PCB contamination since 1975. Samples of game fish and other fish species have been routinely collected by the MDNR from representative stations along the river. Fish are processed by the MPCA and analyzed by the Minnesota Department of Health. Levels of PCB in fish tissue have shown a slight downward trend indicating that environmental contamination of the Minnesota River is diminishing in respect to that parameter.

WATER USES

The 1984 Industrial and Municipal Discharger Inventory (Minnesota Pollution Control Agency) lists 11 cities that discharge effluent to the Minnesota River. There are six additional cities that discharge effluent into tributaries just prior to their confluence with the Minnesota River. Cities that discharge more than 1.5 million gallons/day (mgd) are Burnsville (24 mgd), Shakopee (20 mgd), Mankato (10 mgd) and New Ulm (6.77 mgd). No major discharges of industrial process waste are listed. Granite Falls, Mankato and North Mankato appropriate municipal water supplies from the river.

AQUATIC VEGETATION

Aquatic vegetation is not common in the Minnesota River except for the first 30 mi downstream from the source. Reservoirs in this reach stabilize water levels and allow suspended materials to settle, thus water clarity is substantially higher than in downstream reaches. The common emergents in this area include river bulrush, narrowleaf cattail and spikerush. Narrowleaf pondweeds, coontail and common bladderwort are common submerged vegetation species. Below Lac qui Parle Lake smartweed is the only species commonly found along the main channel due to the high turbidity of the river and the drastic water level fluctuations that occur from spring through fall.

TERRESTRIAL VEGETATION

The original plant communities along the Minnesota River were bottomland hardwoods, tall-grass prairie and upland hardwoods. Wet and dry prairie dominated the landscape from Ortonville to Montevideo, upland hardwoods were interspersed with prairie from Granite Falls to the mouth. Agricultural crops have replaced the original prairie and reduced the floodplain and upland forests.

The bottomland forest consists of species tolerant of a high water table and frequent inundation. Silver maple, willow and cottonwood are common along the river banks. American elm, green ash and box elder also grow in moist soils but are less common overall, tending to reach high proportions in small tracts. Dutch elm disease was evident in numerous locations and will likely decimate the elm stands along the river corridor.

The upland hardwoods are represented by two tree communities; oak groves and "Big Woods". Oak groves occur on the south and southwest facing bluffs from Granite Falls to the mouth and are populated primarily by bur oaks. Tree species indicative of the "Big Woods" grow on the north and northeast facing bluffs from New Ulm to the mouth. Sugar maple and basswood are the primary species of the "Big Woods" and commonly grow in association with American elm, white and red oak, butternut and occasionally black walnut and quaking aspen. The most common tree species of secondary size is ironwood.

Common understory species include prickly ash, alternate leaf dogwood, wild grape, poison ivy and virginia creeper. Sumac, wild rose, hawthorne, snowberry and wild plum are common shrub and small tree species in the open areas. Red cedar occurs on steep hillsides and near rock outcrops downstream of Granite Falls. Prickly pear cacti (Opuntia compressa and Opuntia fragilis) occur on rock outcrops from Ortonville to Redwood Falls and O. compressa occurs in the Carver Rapids area south of Chaska. Ball cacti (Mammallaria (Coryphantha) viviparia) is also found in the Ortonville area, which is the eastern most extent of their range in North America.

WILDLIFE CHARACTERISTICS

The woodlands, marshes and floodplain lakes along the Minnesota River provide important habitat for the many wildlife species that utilize the area. Waterfowl habitat is better in the floodplain lakes and marshes than in the main channel because of the greater diversity and abundance of aquatic plants. Wood duck, mallard and blue-winged teal are the most numerous waterfowl species in the watershed. The Lac qui Parle Wildlife Management Area attracts approximately 60,000 Canada geese every fall. Although utilization of the river floodplain by migrating birds is the most intensive use, high numbers of waterfowl and shorebirds also nest in these areas (Comprehensive Plan for the Minnesota Valley National Wildlife Refuge 1983). White pelicans nest on an island in Marsh Lake and produce approximately 250 young annually. This is one of only two white pelican rookeries in the state and is critical to the propagation of white pelicans in Minnesota.

Muskrat, beaver, fox, raccoon and mink are the primary furbearers in the watershed. Signs of muskrat and beaver were present in every sector and individual sightings were not uncommon. Raccoon and mink utilize the habitats afforded by the Minnesota River and are found along its entire length. Red and gray fox also occur throughout the watershed. River otter have been reintroduced to the Lac qui Parle area in the past few years and initial studies indicate the population is increasing.

White-tailed deer are common along the river corridor and are the most important big game animal. Habitat is enhanced by the edge effect created when woodlands border agricultural land and the river. River woodlands also provide critical winter cover for deer and many other species in the agricultural areas of the state.

FISHERIES

Fishery survey work was conducted on the Minnesota River from June through September 1980 and August 1982. A number of fisheries related surveys have been conducted in the past. There were three major studies completed by the MDNR (Huber 1959; Schneider 1966; Huber 1971) and four studies for Northern States Power Company (NSP) on portions of the lower river (N.S.U. 1978; Texas Instruments 1979; Ecology Consultants, Inc. 1974; Heberling 1980). A study was completed for the Army Corps of Engineers by the Center for Environmental Studies, Tri-College University, Fargo, ND (1975) on the impact of the Lac qui Parle Reservoir.

During the reconnaissance phase of the present MDNR survey, stream characteristics were recorded. Parameters such as stream width, depth, bank height, vegetation and substrate were noted as well as differentiation in habitat types (pools, riffles and runs). Sector subdivisions were made on the basis of changing stream characteristics from the source at Big Stone Lake to the mouth at the Twin Cities.

Electrofishing stations were located to include representative stream habitats within the various study sectors. The number of electrofishing sampling stations per sector was determined by the length of the sector and diversity of habitat. Stations consisted of a single timed electrofishing run. One to four stations were established per sector, excluding Sector 13 which had 19 stations because of its 91 mi length. A total of 52 stations were established in the 14 sectors with an accumulated shocking time of 27 hours. All electrofishing was done during daylight hours. A legal description for the location of each electrofishing station is found in the Appendix, Table 2. Stations are also indicated on the map series.

Conventional boomshocker electrofishing using a Coffelt vvp-15 (variable voltage pulsator) was the procedure best adapted for existing conditions. Electrofishing parameters varied with changing specific conductance and median depth of the river. Water conductivity tended to decrease and depth increase with distance downstream. Common electrofishing parameters for the upper half of the river were 300 vDC, 8 amps, 36-40 pulses/sec and 10-20% pulse width and for the lower half were 150 vDC, 12 amps, 36-40 pulses/sec and 50-60% pulse width.

Three factors limiting electrofishing success on the Minnesota River were deep water, turbidity and high conductivity. Deep water was a particular problem in the lower two thirds of the river. The river below Granite Falls was characterized by many pools over 8 ft deep. It is very likely that there was some negative sampling bias for a number of species inhabiting deeper pools. Some species normally captured may have gone unnoticed in extremely turbid areas of the river. The high conductivities associated with the Minnesota River generally require higher amperage settings to achieve an effective electrical field. This is particularly true where depths exceeded 3 ft. Where clay-silt substrates predominated, as in some pool and low gradient channel areas, they appeared to attenuate the effective electrical field.

Catch

The total catch of fish from the 14 sectors of the study area contained 53 species representing 14 families (Table 3). Twenty-one additional species have been reported by previous investigators. Taxonomic reportings for several species (*Notroplis lutrensis*, *Phenocobius mirabilis* and *Notropis texanus*) by previous investigators are suspect in view of known distribution records. The total numbers of fish for all species sampled in the present survey are given in the Appendix, Table 3.

Table 3. Fish species collected or observed from the Minnesota River by various sources between 1957 and 1983.

Scientific name	FAMILY Common name	Reference
	ACIPENSERIDAE	
Scaphirhynchus platorynchus	Shovelnose sturgeon	4
	LEPISOSTEIDAE	
Lepisosteus platostomus	Shortnose gar	1,3,4
	AMIIDAE	
Amia calva	Bowfin	1,3,4
	ANGUILLIDAE	
Anguilla rostrata	American eel	3,4
	CLUPEIDAE	
Dorosoma cepedianum	Gizzard shad	1,3,4
	HIODONTIDAE	
Hiodon alosoides	Goldeye	3,4
Hiodon tergisus	Mooneye	1,3
	UMBRIDAE	
Umbra limi	Central mudminnow	3
	ESOCIDAE	
Esox lucius	Northern pike	1,3,4
	CYPRINIDAE	
Campostoma anomalum	Central stoneroller	4
Cyprinus carpio	Common carp	1,2,3,4
Hybognathus hankinsoni	Brassy minnow	3,4
Hybopsis aestivalis	Speckled chub	3,4

Table 3. Continued.

Scientific name	FAMILY Common name	Reference[a]
Hybopsis storeriana	Silver chub	3,4
Nocomis biguttatus	Hornyhead chub	2,4
Notemigonus crysoleucas	Golden shiner	1,2
Notropis atherinoides	Emerald shiner	2,3,4
Notropis blennius	River shiner	3
Notropis cornutus	Common shiner	2,4
Notropis dorsalis	Bigmouth shiner	3,4
Notropis hudsonius	Spottail shiner	2,3,4
Notropis lutrensis	Red shiner	3
Notropis rubellus	Rosyface shiner	2
Notropis spilopterus	Spotfin shiner	2,3,4
Notropis stramineus	Sand shiner	2,3,4
Notropis texanus	Weed shiner	3
Notropis volucellus	Mimic shiner	3
Phenacobius mirabilis	Suckermouth minnow	3
Pimephales notatus	Bluntnose minnow	2,3,4
Pimephales promelas	Fathead minnow	2,3,4
Rhinichthys atratulus	Blacknose dace	3
Semotilus atromaculatus	Creek chub	2,3,4
	CATOSTOMIDAE	
Carpiodes carpio	River carpsucker	1,3,4
Carpiodes cyprinus	Quillback	1,3,4
Carpiodes velifer	Highfin carpsucker	1,3,4
Catostomus commersoni	White sucker	1,3,4
Hypentelium nigricans	Northern hog sucker	1,4
Ictiobus bubalus	Smallmouth buffalo	1,3,4
Ictiobus cyprinellus	Bigmouth buffalo	1,3,4
Moxostoma anisurum	Silver redhorse	1,3,4
Moxostoma erythrurum	Golden redhorse	1,4
Moxostoma macrolepidotum	Shorthead redhorse	1,3,4
Moxostoma valenciennesi	Greater redhorse	4
	ICTALURIDAE	
Ictalurus melas	Black bullhead	1,2,3,4
Ictalurus natalis	Yellow bullhead	1,3,4
Ictalurus nebulosus	Brown bullhead	4
Ictalurus punctatus	Channel catfish	1,3,4
Noturus flavus	Stonecat	3
Noturus gyrinus	Tadpole madtom	1
Pylodictis olivaris	Flathead catfish	1,3,4
	PERCOPSIDAE	
Percopsis omiscomaycus	Trout-perch	3

Table 3. Continued

Scientific name	FAMILY Common name	Reference[a]
	GADIDAE	
Lota lota	Burbot	3
	GASTEROSTEIDAE	
Culaea inconstans	Brook stickleback	3
	PERCICHTHYIDAE	
Morone chrysops	White bass	1,2,3,4
	CENTRARCHIDAE	
Ambloplites rupestris	Rock bass	1,4
Lepomis cyanellus	Green sunfish	1,3
Lepomis gibbosus	Pumpkinseed	3
Lepomis humilis	Orangespotted sunfish	2,3,4
Lepomis macrochirus	Bluegill	3
Micropterus dolomieui	Smallmouth bass	1,3,4
Micropterus salmoides	Largemouth bass	1,3
Pomoxis annularis	White crappie	1,2,3,4
Pomoxis nigromaculatus	Black crappie	1,3,4
	PERCIDAE	
Etheostoma exile	Iowa darter	4
Etheostoma flabellare	Fantail darter	3
Etheostoma nigrum	Johnny darter	2,3,4
Etheostoma zonale	Banded darter	3
Perca flavescens	Yellow perch	2,3,4
Percina maculata	Blackside darter	4
Percina phoxocephala	Slenderhead darter	1,4
Percina shumardi	River darter	3
Stizostedion canadense	Sauger	1,3,4
Stizostedion vitreum vitreum	Walleye	1,2,3,4
	SCIAENIDAE	
Aplodinotus grunniens	Freshwater drum	1,2,3,4

a Reference Nos.:

1 - Huber 1959, 1971; Schneider 1966.
2 - Tri-College University, Fargo, ND. 1974.
3 - Heberling 1980; Texas Instruments 1979; NUS 1978; ECI 1974; Impinged BDGP.
4 - MDNR 1980 and 1982.

Although minnows and other small fish species are an integral part of the ichthyofauna of the Minnesota River, comprising 43.9% of the overall catch, they are excluded from the percent composition analysis of the catch. Life cycles of these species are generally more ephemeral and electrofishing gear is frequently less efficient for small fishes. Unusually high, low, or unrepresentative catches of this group can confound the comparative analysis of large fish species percent composition from one area or time to another. Percent composition for the large fish species catch is given in the appendix, Table 4.

Game fish, for purposes of this report, will be defined to include northern pike, channel catfish, flathead catfish, white bass, smallmouth bass, sauger and walleye. Walleye were the most common game fish taken at 3.2% of the large fish species catch. Most walleye were collected in Sectors 2, 3, 4, 9 and 13. In Sector 3, walleye were 24.2% of the catch.

Channel catfish were the second most abundant game fish taken at 2.7% of the overall catch. Northern pike were the most evenly distributed game fish. This species was taken in all sectors except Sector 1. No sauger were taken above Sector 7 but averaged greater than 2.0% of the catch per sector from Sectors 7-14. Sauger totaled 2.0% of the overall catch and were the third most abundant game fish. The remainder of the game fish, white bass, flathead catfish and smallmouth bass, accounted for a total of 2.9% of the catch. White bass were collected in Sectors 1 and 2 and not again until Sector 11.

Carp were collected in all sectors and were the most abundant species at 34.2% of the catch. Carp ranged from 12.6% of the catch in Sector 1 to 61.6% in Sector 12. Shorthead redhorse accounted for 17.6% of the catch and was the second most abundant species collected. Greater redhorse were taken in small numbers in Sectors 5, 7 and 9 and its status could be considered precarious. The greater redhorse had not been reported in earlier collections from the Minnesota River.

Shovelnose sturgeon are listed by Eddy and Underhill (1974) as not being reported from the Minnesota River in recent years. A total of 16 shovelnose sturgeon were taken in Sectors 8, 11 and 13. Conversations with the Mankato Area Conservation Officer indicated they are occasionally caught by anglers. None were reported in previous survey reports, however, conversations with R. Bellig (Gustavus Adolphus College) indicate the species is a regular component of their catches in the river near St. Peter.

Gizzard shad were the third most abundant species at 8.1% though none were taken above Sector 9. Gizzard shad comprised over 60% of the catch in Sector 14. Yellow perch made up 30% of the total catch for Sectors 1, 2 and 3. Slightly over 50% of the total catch of yellow perch were young-of-year. The largest catches were taken in the river near Big Stone Lake, Marsh Lake and Lac qui Parle Lake. No yellow perch were taken below Sector 4 demonstrating that the habitat characteristics provided by the reservoirs are essential for the presence of this species.

The large fish species total weight and percent composition by weight for the study areas are presented in the Appendix, Tables 5 and 6. None of the gizzard shad were weighed or measured because it was expected that large numbers would be collected in the lower portions of the river and that these would be predominantly young-of-the-year fish due to the considerable winter die-off of this peripheral species.

Walleye were the most abundant game fish by weight at 2.6% of the overall catch. Sector 2 yielded the greatest biomass of walleye at 10.9% of the catch. Channel catfish were second overall at 1.7% by weight. The greatest yields of channel catfish by weight occurred in Sectors 7 (4.9%) and 11 (4.5%).

Carp were the most abundant species by weight at 63.2% of the total river catch and shorthead redhorse second at 7.6%. In all sectors (excluding 6 and 8), carp comprised over 50% of the catch weight. Bigmouth buffalo were 17.5% of the total catch in Sector 4 and golden redhorse were 17.1% in Sector 6.

A total of 7,232 fish (including the small fish species) were captured in 27.0 hrs of electrofishing on the Minnesota River. Table 7 of the Appendix gives the catch per unit effort (CPUE) for each of the 14 sectors. Catch rates ranged from 70.0 to 243.6 fish/hr, for the large fish species, with a mean CPUE of 156.5. The highest CPUE for the 14 study reaches was 243.6 fish/hr recorded from Sector 5. Carp and catostomids contributed 92.4% of that total or 225.1 fish/hr.

The walleye catch rate was the highest of the game fish at 4.9 fish/hr with channel catfish second at 4.1 fish/hr. The highest catch rates per sector for walleye were 13-19 fish/hr (Sectors 2, 3 and 4) and channel catfish were 10-13 fish/hr (Sectors 7, 8 and 9). No other game fish were taken at a rate exceeding 10 fish/hr except for white bass in Sector 14 (10.1 fish/hr).

Carp were the most frequently collected species at 51.5 fish/hr. Shorthead redhorse were the second most frequently collected species at 26.4 fish/hr. The carp were predominantly mature fish with most in the

18-19 inch size group. Table 8 of the Appendix provides the length frequencies of the catch for the large fish species.

The channel catfish catch included a number of young-of-year and age 1 and 2 fish. The young-of-year appeared to be strongly associated with the faster flowing riffle and run habitat which was particularly common in Sector 9. No channel catfish were taken upstream of the Lac qui Parle dam. Six adult fish were taken between Lac qui Parle dam and Granite Falls. None were reported by Schneider (1966).

Flathead catfish ranged from 6 to 31 in. All specimens were taken below Granite Falls where the Minnesota Falls Dam appears to prevent upstream migration for this and a number of other species.

Sectors 8 and 9 had higher stream gradient and a number of riffles and runs with boulder, rubble and gravel substrates. This area yielded a small catch of mostly adult smallmouth bass (10 specimens). Huber (1959, 1971) had reported the presence of this species in small numbers. The ambient turbidity of the Minnesota River apparently precludes the establishment of exploitable numbers despite localized stocking efforts.

The sauger catch was evenly distributed from Sectors 7 through 14. No sauger were taken above the Minnesota Falls Dam. The catch contained immature and mature fish ranging in size from 6 to 22 in.

Walleye were taken in all sectors excluding 12 and 14 and ranged in size from 6 to 30 in. As with sauger, young-of-year fish appeared to be poorly represented and gaps in adult year-classes were evident.

Fish stocking and removal activities on the Minnesota River have generally been confined to the upper two-thirds of the river. Blue Earth, Brown, Yellow Medicine and Chippewa Counties have received regular fish stocking during the past 10 years. The river in Yellow Medicine County has had the most abundant and frequent stocking. Walleye fry, northern pike fingerlings and adult fish, smallmouth bass fingerlings and channel catfish fingerlings have been stocked. Blue Earth, Brown and Chippewa Counties have received scattered stockings of walleye fry, smallmouth bass fingerlings and black crappie yearlings.

Fish removal from the main river channel has been confined to Yellow Medicine and Chippewa Counties during the past 10 years. Records for Chippewa County show that rough fish removal was last carried out in 1975 and only carp were taken. In Yellow Medicine County, fish removal has occurred on a yearly basis for carp, buffalo and freshwater drum.

Fishery management for the past several years on Lac qui Parle and Marsh Lakes has consisted of fish removal and stocking. Rough fish removal and game fish rescue during occasional years of partial winterkill have been carried out on both lakes. Carp, buffalo, bullhead and white suckers have dominated the rough fish removal catch. In 1975, adult northern pike and walleye were rescued from Marsh Lake before impending winterkill. Lac qui Parle Lake has received numerous fish plantings. Recent stocking has consisted of alternate year plants of walleye fry, small numbers of adult and yearling northern pike and adult bluegill and crappie. Smallmouth bass fingerlings were planted in 1975. Marsh Lake has had stockings of walleye fry on an alternate year basis since 1978.

Mussels

A literature survey indicates as many as 42 species of the molluscan families of Ambleminae and Unionidae existed in the Minnesota River at one time. Considerable confusion exists as to taxonomic nomenclature. Most notable is a lack of agreement on the preferred description of some species of *Amblema* and *Fusconaia*. Table 4 provides a list of mussel species collected during various studies between 1947 and 1981. The species nomenclature is as it appears in the individual reports. The most comprehensive list to date was by Dawley (1947) who compiled records of 35 species.

Mussel specimens (live or recently dead) were collected during the present MDNR survey at various locations between Granite Falls and Chaska. Collection methods consisted of hand picking from exposed sand/gravel bars and stream banks. A total of 20 species were taken. Two species, Fusconaia ebenus and F. flava were recorded by the MDNR and Havlik1 but not reported in the previous literature. Fusconaia ebenus taken near Shakopee was a subfossil and is considered extirpated from the Minnesota River. Arcidens confragosus, considered a rarity in the upper Mississippi River system, was also collected at Shakopee as a subfossil. Numerous old shells of the more common species noted upstream were also seen here. Fuller (1978) was unable to find any living specimens downstream of Port Cargill which concurs with the observations of Havlik and the MDNR. The once diverse molluscan fauna of the lower Minnesota has been eliminated due to various influences but most particularly, navigation practices and past pollution sources. The reduced fauna that remains in the river upstream from the Twin Cities metropolitan area is in jeopardy because of continuing inadequate land management practices.

1 Naiad mollusks of the Minnesota River as Savage, Minnesota, March 1977- as prepared for U.S. Army Corps of Engineers contract DACW-37-77-M-1127 (personal communication).

Table 4. Mussel species collected or observed from the Minnesota River by various sources between 1947 and 1981.

Scientific name	FAMILY Common name	Reference
	AMBLEMIDAE	
Amblema costata form peruviana		6
Amblema peruviana		1,2
Amblema plicata	Threeridge	4,5
(Amblema plicata plicata)b		8
Amblema rariplicata		1,2
Fusconaia ebenus	Ebony shell	4
(Fusconaia ebena)		
Fusconaia flava	Wabash pigtoe	4,8
Fusconaia undata	Pigtoe	1,2
Quadrula metanevra	Monkeyface	6
Quadrula nodulata	Wartyback	8
Quadrula pustulosa	Pimpleback	1,2,4,8
Quadrula quadrula	Mapleleaf	1,4,5,6,8
Quadrula spp.		2
Tritogonia verrucosa	Buckhorn	1,4,8
Megalonaias gigantea	Washboard	1,2
(megalonaias nervosa)		8
	UNIONIDAE	
Elliptio crassidens	Elephant ear	1
Elliptio dilatata	Spike	4
(Elliptio dilatatus)		8
Plethobasus cyphus	Bullhead	1
Pleurobema cordatum coccineum	Ohio River pigtoe	1
(Pleurobena coccineum)	Round pigtoe	8
Alasimodonta marginata	Elktoe	4
(Alasmidonta marginata truncata)		1
Anodonta corpulenta	Stout floater	1
Anodonta gigantea		1
Anodonta grandis	Floater	1,3,4,6
(Anodonta grandis corpulenta		8
Anodonta imbecillis	Paper floater	
(Utterbackia imbecillis)		1
Anodontoides ferussacianus	Cylindrical papershell	1,2
Arcidens confragosus	Rockshell, Rock pocketbook	1,2,4,8
Lasmigona complanata	White heelsplitter	1,2,3,4,8
Lasmigona costata	Fluted shell	1,8
Strophitis undulatus	Strange floater, Squawfoot	
(Strophitis rugosus)		2
(Strophitus undulatus undulatus)		8
Actinonaias carinata	Mucket	1,4,5
(Actinonaias ligamentina carinata)		8

Table 4. Continued.

Scientific name	FAMILY Common name	Reference
Carunculina parva	Lilliput	1
(Toxolasma parvus)		
Ellipsaria lineolata	Butterfly	
(Plagiola lineolata)		1,8
Lampsilis fallaciosa	Slough sandshell	1,2
(Lampsilis teres form fallaciosa)		8
Lampsilis higginsi	Higgin's eye	1
Lampsilis ovata ventricosa	Pocketbook	5,7
(Lampsilis ventricosa)		1,3,4,6,8
Lampsilis radiata siliquoidea	Fat mucket	
(Lampsilis radiata luteola)		8
(Lampsilis siliquoidea)		1,2,3
Leptodea fragilis	Fragile papershell	1,3,4,7,8
Leptodea laevissima	Papershell	6
Ligumia recta	Black sandshell	2,4,8
(Ligumia recta latissima)		1
Obovaria olivaria	Hickorynut	1,4,5,8
Proptera alata	Pink heelsplitter	2,3,4,6
(Potamilus alatus)		8
(Proptera alata megaptera)		1
Proptera laevissima	Pink papershell	1,7
Truncilla donaciformis	Fawn foot	1,4,8
Truncilla truncata	Deertoe	1,2,3,4,6
Obliquaria reflexa	Threehorned wartyback, Threehorn	1,2,4,8

[a] Reference numbers:
1 - Dawley 1947.
2 - Minn. Dept. of Health ~~1963~~.
3 - Tri College University 1974.
4 - Minn. Dept. of Natural Resources 1978.
5 - Academy of Natural Sciences, Philadelphia 1978 (Mankato-North Mankato-LeHillier Flood Control Project).
6 - National Biocontric 1979.
7 - Mankato Bridge Relocations EIS 1981.
8 - Havlik 1977 (personal communication)

[b] Species nomenclature as listed by the author which were later changed.

BENTHIC INVERTEBRATES

Sampling of benthic invertebrates on the Minnesota River was done during the summers of 1979, 1980 and 1981. The majority of sampling effort took place from July-September 1981. Sites were located at Ortonville (Sector 1); Big Stone, Marsh Lake and Lac qui Parle Lake (Sectors

2-4); in the vicinity of Upper Sioux Agency Park below Granite Falls (Sectors 7-8); in the vicinity of Franklin (Sector 9); and at Mankato and Le Sueur (Sector 13) (Appendix Table 9).

Both qualitative and quantitative samples were taken. Qualitative samples were collected from rocks and snags. A gas lantern, New Jersey Mosquito Trap and "trouble" lights were used to collect adult insects. For quantitative sampling, a petite ponar dredge was used (area 232 cm2). Four replicates were collected at each quantitative sample area on a longitudinal transect. A variety of substrates were sampled with the ponar including silt and detritus pools, clay, gravel/sand, gravel/silt, sand and one rocky area. Material from the dredge samples was sieved in the field with a 590 micron sieve and preserved in 5% formalin. Volumes of organisms were measured with a 5 ml microburet (accuracy ± 0.01 ml).

Substrate and flow appear to be the major factors influencing benthic invertebrate distribution in the Minnesota River. The river bottom is mostly gravel/sand or sand in the main channel. Few rocky areas were noted. Stream edges and pools contained more fine sediment and detritus and during low flows the amount of sedimentation increases. Clay banks were common.

Hydropsychidae (Trichoptera), Ephemeroptera and Chironomidae were the dominant organisms on snag and rock habitat. Chironomidae and early instars of Hydropsychidae and Ephemeroptera were found in gravel/sand areas. The sand substrate and clay bank faunas were fairly habitat specific and unique. Pools contained organisms characteristic of silty areas such as oligochaetes, *Chironomus* and *Hexagenia*.

A total of 212 taxa were collected, combining both aquatic and light trap sampling (Appendix Table 10). About one-half of the total number of taxa were recorded in quantitative samples (Appendix Table 11). The number of insect taxa was 90% of the total number of taxa collected and most of these were identified to genus, species group or species. The dominant groups of organisms, in terms of the percent of the total number of taxa collected, were Chironomidae (37%), Trichoptera (13%), Ephemeroptera (11%), Coleoptera (7%) and Hemiptera (7%). Representatives of insects collected in this study were deposited in the University of Minnesota Entomology Museum. Other invertebrates were donated to the Science Museum of Minnesota.

The percent composition of chironomid subfamilies was: 67% Chironominae (59% Chironomini; 8% Tanytarsini); 16% Tanypodinae; 16% Orthocladiinae; 1% Diamesinae. Polypedilum convictum was commonly found on rocks and coarse gravel while P. illinoense was common on snag habitat. Polypedilum (Tripodura grp.) were usually found in quantitative sampling in gravel and sand. Four species of the Tripodura group were identified from reared specimens - P. digitifer, P. acifer, P. scalaenum grp. and P. griseopunctatum.

Chironomus, Tanypus and Procladius were found in quantitative samples from pools. Glyptotendipes was very abundant in clay below Big Stone Dam and was also common on snags and rocks further downstream. Xenochironomus were present in clay banks below Lac qui Parle.

One interesting chironomid habitat was the sand substrate area near Franklin. Several taxa recorded were rare or not found at other sample areas or substrate types. These include members of the Harnichia group (Cryptochironomus macropodus, Robackia, Paracladopelma, Chernovskiia), Paratendipes connectens?, Pseudochironomus, Lopescladius and Monodiamesa depectinata. Since much of the fauna of sand substrates can pass through a 590 micron sieve, the number and diversity of the sand substrate community is probably underestimated.

Orthocladiinae were not very common in the Minnesota River. Cricotopus were found in a few samples. Lopescladius was also found in a gravel/sand sample. Because of its small size, it may have been present at other areas with gravel/sand substrate but passed through the 590 micron sieve. In an unpublished study of midchannel substrates near Shakopee (MDNR) using a 250 micron sieve, Lopescladius was the second most abundant taxon present after Paratendipes connectens?.

Other Diptera collected were Simulium, Atherix, Ceratopogonidae and Empididae. Simulium was abundant downstream of Big Stone Lake and many were also found in a pool sample below Marsh Lake. Downstream from Lac qui Parle, few Simuliidae were collected.

Hydropsychidae were the most common group of Trichoptera and were very abundant on snags and rocks. Earlier instars were common in gravel/sand substrate. One set of four quantitative samples taken in gravel/sand below Mankato contained a total of 350 early instars of Potamyia flava. Other abundant hydropsychid taxa included Cheumatopsyche and Hydropsyche bidens. Most Cheumatopsyche were probably Cheumatopsyche campyla. Cheumatopsyche petteti adults were collected in light traps below Big Stone Reservoir but were not collected in light traps or aquatic sampling (pharate pupae) further downstream. Less common Hydropsychidae were H. simulans, H. frisoni? and Symphitopsyche bifida grp.

Several species of Polycentropidae and Leptoceridae were collected but were not abundant. Hydroptilidae were uncommon in aquatic sampling but large numbers of Mayatrichia ayama were present in one light trap may have been overlooked in qualitative sampling because of their small size.

Most Ephemeroptera were identified from qualitative sampling from snags and rocks. Heptageniidae, including Heptagenia and Stenonema were common on snags and rocks in shallow water. Earlier instars of Heptageniidae were found on rocks in deeper water and were also present in quantitative samples of gravel/sand.

Baetidae were fairly common, especially in areas where spring fed creeks entered the river. One specimen of the rare genus Paracloedes was found near Mankato. This is presumed to be a deep water species of large rivers (Edmunds, Jensen and Berner 1976) and may be common in the Minnesota River but very difficult to collect.

Tricorythodes, Caenis and Potamanthus were collected throughout the river. A single specimen of Brachycercus (Caenidae) was collected at Mankato. Several specimens of Potamanthus myops were reared and it is probably the most common or only species of Potamanthus present in the Minnesota River.

One specimen of Isonychia sicca (Siphlonuridae) was reared from qualitative sampling from logs. There may be at least one other species of Isonychia present in the Minnesota River based on differences in nymphal color patterns (I. rufa?).

Ephoron album (Polymitarcidae) was collected at only three sites on the Minnesota River. At two of the sites it was found in gravel/sand quantitative samples. Most of the nymphs of Ephoron were collected from muddy rip-rap at Mankato. However, on 6 August 1979, a large hatch of Ephoron album was observed near Upper Sioux Agency Park. It is possible they are more evenly distributed in gravel/sand substrate since they have also been collected in gravel/sand substrate in the Crow River (MDNR unpublished). Since deep gravel/sand runs are difficult to sample and the sample area of the petite ponar is fairly small, they may not be easily collected.

Hexagenia (Ephemeridae) were not very common. They were collected in pools near Lac qui Parle, Marsh Lake and Upper Sioux Agency. Pentagenia, a burrowing mayfly in clay banks, was not collected in these samples but was later collected in a bank sample near Shakopee (MDNR unpublished) and may also be more common.

Most taxa of Hemiptera were collected only in the upper reaches of the Minnesota River in Sectors 1-3. Metrobates hesperius (Gerridae) was collected in Sectors 7-9 and 13 and is noted to be a species of larger streams and rivers (Bennett and Cook 1981). Several specimens of Palmacorixa gilletei (Corixidae) were found burrowing in mud in the Mankato sampling area and were also found at Ortonville and Upper Sioux Agency.

Most taxa of Coleoptera were found only in qualitative or light trap sampling. Two exceptions were Stenelmis and Dubiraphia (Elmidae) which were found in quantitative samples in a variety of substrates. Only one species of each genus was recorded - Stenelmis vittipennis and Dubiraphia vittata. S. vittipennis was very abundant in one light trap sample near Upper Sioux Agency.

Few taxa of Plecoptera were present. Acroneura abnormis, A. lycorias and Perlesta placida (all Perlidae) were found. Perlesta placida was not common in aquatic sampling but was common at light traps. Two other Plecoptera taxa (Phasganophora (Perlidae) and Pteronarcys (Pteronarcyidae)) were collected in an environmental impact study at Mankato (U.S. Army Corps of Engineers 1981).

Few odonates were collected and most were early instars of Coenagrionidae.

Because of time limitations, oligochaetes were identified only as Naididae, Tubificidae or Lumbriculidae. Tubificidae and Naididae were very common in quantitative pool samples taken in the upper reaches of the Minnesota River.

Copepods and Cladocerans were also common in quantitative pool samples but may have been introduced from the water column during the sieving process. Hyalella azteca (Amphipoda) was common throughout the river.

Previous studies on the Minnesota River which contain benthic invertebrate data include a bridge location study in the Mankato area by the U.S. Army Corps of Engineers (1981), a survey of the lower Minnesota River by the Minnesota Department of Health (1964) and the biological monitoring program of the Minnesota Pollution Control Agency (MPCA) (1979, 1981). A few taxa collected in these three studies were not collected in the Minnesota DNR survey (Appendix Table 12).

The importance of substrate and flow in determining invertebrate species composition has been noted by other investigators. Benke (1984) stated that food appears to be less of a limiting factor in rivers than in small streams and where high quality food is plentiful substrate availability may be the major factor limiting secondary production. A study of the lower Mississippi (Beckett et. al. 1983) also indicated that the distribution of macroinvertebrates in the lower Mississippi is a function of current velocity and substrate composition.

In the lower Mississippi, Beckett et al. (1983) found that the benthic communities in natural bank, secondary channel and abandoned channel habitats remained fairly stable over various flow regimes while dike fields showed variation in the benthic community over different flow regimes. Common organisms found in clay banks were the mayflies Pentagenia vittigera and Tortopus incertus, Xenochironomus and Glyptotendipes (Chironomidae), Hydropsyche orris (Trichoptera) and Limnodrilus. Gravel/sand substrates were dominated by sand dwelling midges Robackia claviger and Chernovskiia orbicus. In mud/sand habitats, common organisms were Limnodrilus and Chaoborus punctipennis.

Snag habitats may produce a significant contribution to biomass and production of benthic invertebrates in the Minnesota River. Benke (1984) reported that snag habitats provided over one-half of the total invertebrate biomass and 15-16% of total production in the Satilla River, a blackwater stream of the southeastern United States, even though snags were estimated to be only 6% of the effective habitat. Several major fish species were also reported to obtain most of their food from snags. Snags contributed up to 80% of the number and biomass of drift which is a major food source for some fish species.

Sand and sand/gravel substrates, though they appear to be unproductive, may actually contribute a greater portion of secondary productivity than expected. In many larger rivers, the majority of the substrate area may be sand or sand/gravel. Benke (1984) found that sand habitat contributed 69.6 and 79.5% of total productivity at two different sites on the Satilla River.

The stream ecosystem theory outlined by Cummins (1979) states that stream characteristics vary along a continuum from stream order 1 (small headwater streams) to stream order 12 (the Mississippi River at its mouth). Stream orders are roughly grouped into headwaters (1-3), mid-sized rivers (4-6) and large rivers (7-12).

Fasching (1984, in press) compiled quadrangle map data from the Minnesota River watershed. He concluded that the Minnesota River is a sixth order stream at its "source" below Big Stone Lake but the river actually originates in South Dakota as the Little Minnesota. It becomes a seventh order river below the confluence of the Yellow Bank River near Odessa and remains a seventh order river to its mouth.

According to the stream ecosystem theory, large rivers should be dominated by groups of organisms called collectors which are adapted to filtering food from the water or gathering it from sediments (Merritt and Cummins 1978). The food sources of a large river are downstream transport of material from the lower orders upstream and from plankton communities that would be found in a larger, lentic-like river.

Most of the predominant taxa- Chironomidae, Trichoptera and Ephemeroptera - were classed as collector-filterers, collector-gatherers, scrapers (feeding on diatoms) or predators (Diptera, Tanypodinae). However, the source of food for these benthic macroinvertebrates may not be what is predicted by the stream continuum theory nor is the river especially lentic-like in character. The water is very turbid and prevents extensive algal or macrophyte growth especially during periods of high flow. Data from the lower Minnesota shows considerable variation in algal abundance depending on the season and flow (Harza Engineering 1978).

Coffmann and De la Rosa (1982) compared numbers of chironomid taxa with stream order. According to stream ecosystem theory, diversity of taxa should be greatest in orders 3-5 and should decrease in lower order or higher order streams. The mean number of chironomid taxa reported for seventh order streams was 35.3 (n=4) with a range of 16-45 taxa. In this study, 59 chironomid taxa were recorded from aquatic sampling.

The Minnesota River, though far from being considered a pristine river, is probably one of the few larger rivers in the United States which has not been altered extensively by dams and reservoirs except in the upper reaches. Mozely (1979) pointed out the lack of ecological information about benthic invertebrates in large rivers. Cummins (1979) states, "we may never know how large rivers functioned biologically as the result of hundreds of millions of years of evolution and at least 10 to 20 thousand years of acclimitization of resident populations". Because of the rare or unusual invertebrate taxa collected in some samples, further study may show that many of these are found only in unique large river habitats. The Minnesota River may also provide unique opportunities for research in secondary productivity of large river systems.

CONCLUSIONS AND RECOMMENDATIONS

1. The need for implementation and enforcement of appropriate land use practices in Minnesota is exemplified by the Minnesota River watershed. High priority should be given to controlling erosion rates. The great potential of the Minnesota River as a public resource will never be realized until this is accomplished.

2. Stream bank erosion is a major problem on the Minnesota River because of the fine textured soils and high flows. Five to 10 foot vertical eroding banks are not uncommon. The problem is greatly accelerated in many areas by agricultural encroachment such as row crops to the bank's edge.

3. Vegetation management zones or buffer strips should be established along all watercourses in the watershed. These would consist of narrow belts of natural riparian vegetation to stabilize stream banks and filter overland runoff. Tremendous benefits to water quality aesthetics, fish, wildlife and various recreation forms would result from the implementation of this strategy.

4. Turbidity, extreme flow fluctuation and excessive nutrients are the river's greatest problems from a water quality standpoint. Turbidity is the primary limiting factor to biological productivity in the Minnesota River. Turbidity arises from stream bank erosion, bottom scouring and runoff from adjacent farmland.

5. The Minnesota River constitutes a serious, negative, water quality impact on the Mississippi River system particularly in respect to turbidity, sediment and nutrients. It is a major contributor to the problems of silting and eutrophication of Lake Pepin and important backwater areas above the lake. Realization of Clean Water goals and the vast potential benefits to be derived from the Mississippi River is contingent upon legislatively mandated land-use reform on the Minnesota and other rivers of the State.

6. Off-channel areas of the Minnesota River are of critical importance to the total resource. Maintaining and in some cases enhancing the quality of backwater lakes and marshes is vital to fish, wildlife, water quality, aesthetics and recreation.

7. Reservoir management plans to include instream flow release should be prepared for Big Stone Lake, the Big Stone Fish and Wildlife Refuge Pool, Marsh Lake, Lac qui Parle Lake and the two impoundments at Granite Falls. This would facilitate the achievement of maximum benefits for water quality, fish, wildlife, recreation and flood control.

8. A significant game fish fishery exists in many areas of the Minnesota River. Few of the existing access facilities, particularly on the lower two-thirds of the river, are in good condition. This situation needs to be corrected by restoration or replacement. New access sites must reflect the environmental sensitivity of the area as well as addressing existing access problems such as scouring and sedimentation.

9. The Minnesota River, with the exception of Lac qui Parle Lake is not suitable for motorized boat traffic other than small fishing craft. Vulnerable bank soils are present along the majority of the river channel including the stretch presently used for navigation. With the exception of Lac qui Parle Lake, a minimum wake restriction should be imposed on the entire river. This should include commercial use of the river.

10. The protection of high quality instream habitat must continue to be a high priority for management agencies. Such Minnesota River species as the shovelnose sturgeon and the precarious greater redhorse are reliant on the coarse substrate riffles and fast runs. Snag removal should only be done on a very limited and carefully controlled basis because of the considerable contribution snags provide as fish habitat and aquatic invertebrate substrate.

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Table 1. Stream physical characteristics of the Minnesota River, 1978.

Sectors	1	2	3	4	5
Date	8-10 June 1978	12 June 1978	13 June 1978	14, 15 June 1978	16 June 1978
T.R.S. to T.R.S	121, 46, 9 121, 46, 25	121, 45, 34 120, 44, 21	120, 43, 30 120, 43, 33	118, 42, 24 116, 39, 20	116, 39, 20 116, 39, 34
Upstream end of sector (RM)	332.8	319.6	305.3	289.7	261.5
Length of sector (mi)	7.1	10.5	2.5	28.2	3.7
Sinuosity value	1.5	1.5	1.1	1.4	1.2
Width - average (ft)	64	81	-	154	156
Depth - Thalweg ave. (ft)	-	-	2.5	6.5	-
Depth - maximum (ft)	8.0	9.0	5.0	18.0	-
Number of riffles	-	1	-	1	1
Flow (cfs)	211	-	-	1,130	-
Gradient (ft/mi)[a]	2.2 (1.1)	0.5	0.4	0.5	5.1 (0.8)
Stream stage	normal	normal	normal	normal	normal
Secchi disc transparency (ft)	2.2	5.6	3.0	2.2	1.0
Dams (by river mile)	332.4	319.6	305.3	289.7	-
Substrate types (in order of abundance, excluding reservoirs)	sand-silt gravel-boulder	sand-silt gravel-rubble-boulder	silt-sand gravel-boulder	sand-gravel rubble-boulder	sand-gravel rubble-boulder

Table 1. Continued.

Sectors	6	7	8	9	10
Date	20 June 1978	20 June 1978	21,22 June 1978	22,23,26-28 June 1978	28,29 June 1978
T.R.S. to T.R.S.	116, 39, 34 115, 39, 1	115, 39, 1 115, 38, 28	115, 38, 28 113, 36, 4	113, 36, 4 111, 32, 22	111, 32, 22 110, 30, 34
Upstream end of sector (RM)	257.8	254.7	243.6	225.0	174.0
Length of sector (mi)	3.1	11.1	18.6	51.0	29.0
Sinuosity	1.3	2.1	1.3	1.8	1.9
Width - average (ft)	-	212	192	175	220
Depth - Thalweg ave. (ft)	7.0	7.0	6.0	7.0	7.2
Depth - maximum (ft)	23.0	30.0	34.0	25.0	21.0
Number of riffles	1	3	13	1	-
Flow (cfs)	-	-	-	-	-
Gradient (ft/mi)a	6.1 (0.6)	0.6	1.8	0.7	0.3
Stream stage	normal	normal	normal	normal	normal
Secchi disc transparency (ft)	-	1.7	0.9	0.8	1.0
Dams (by river mile)	257.8	254.7	-	-	-
Substrate types (in order of abundance, excluding reservoirs)	sand-boulder rubble	sand-gravel boulder-silt	sand-gravel boulder-rubble	sand-gravel rubble-boulder	sand-silt gravel

A P P E N D I X

Table 1. Continued.

Sectors	11	12	13	14
Date	29 June 1978	30 June 1978	6,7,10-12 June 1978	13 July 1978
T.R.S. to T.R.S.	110, 30, 34 108, 28, 1	108, 28, 1 108, 27, 14	108, 27, 14 116, 22, 33	116, 22, 33 28, 23, 22
Upstream end of sector (RM)	145.0	120.0	112.0	21.0
Length of sector (mi)	25.0	8.0	91.0	21.0
Sinuosity	1.6	1.6	1.6	1.3
Width - average (ft)	160	-	291	-
Depth - Thalweg ave. (ft)	4.0	5.0	8.4	15.6
Depth - maximum (ft)	12.0	17.0	43.0	25.0
Number of riffles	1	-	4	-
Flow (cfs)	-	-	4,030	-
Gradient (ft/mi)a	0.9	0.7	0.6	0.3
Stream stage	normal	normal	normal	normal
Secchi disc transparency (ft)	1.7	1.8	2.2	0.7
Dams (by river mile)	-	-	-	-
Substrate types (in order of abundance, exluding reservoirs)	sand-gravel silt	sand-silt gravel-rubble	sand-gravel silt-rubble	sand-silt gravel

Table 2. Locations and lengths of electrofishing runs during the 1980 and 1982 Minnesota River survey.

Electrofishing stations	Legal Description T.	R.	S.	Length (mi)
1a	121,	46,	9 & 16	0.3
1b	121,	46,	26 & 27	0.7
1c	121,	46,	25 & 26	1.0
2a	121,	45,	34	0.5
2b	120,	45,	11 & 12	1.2
2c	120,	44,	16 & 17	1.0
3a	120,	43,	30,31 & 32	1.0
3b	120,	43,	33	0.7
4a	118,	42,	24	0.5
4b	117,	41,	13	0.6
4c	117,	40,	32 & 33	1.0
5	116,	39,	28	0.6
6	116 & 115,	39,	33,34,3 & 4	0.7
7a	115,	39,	1,11 & 12	0.4
7b	115,	39,	14 & 15	1.3
8a	115,	38,	27	0.4
8b	115 & 114,	38,	35 & 2	0.5
8c	114,	37,	24	0.3
9a	113,	35,	18	0.6
9b	113,	35,	19 & 20	0.5
9c	112,	34,	11 & 14	0.4
9d	112,	33,	34 & 35	0.9
10a	111,	31,	33	0.4
10b	110,	30,	7,17 &18	1.4
11a	110 & 109,	30,	34,2 & 3	0.7
11b	109,	28,	29	0.6
11c	109 & 108,	28,	34 & 3	1.0
12	108,	27,	14 &15	0.5
13a	108,	27,	14	0.5
13b	108,	26,	6 & 7	1.2
13c	108 & 109,	27,	36 & 1	0.5
13d	109,	27,	25	0.7
13e	109,	27,	12	1.0
13f	109,	26,	6 & 31	1.1
13g	110,	26,	15 & 16	1.0
13h	111,	26,	22,27 & 28	0.8
13i	111,	26,	2 & 3	0.9
13j	112,	26,	25	0.7
13k	112,	25,	13 & 18	0.8
13l	113,	26,	25	0.5
13m	113,	25,	4 & 5	0.9
13n	114,	24,	21 & 28	1.4
13o	114,	23,	7	0.8
13p	114,	23,	31	0.7
13q	115,	23,	17 & 20	0.6
13r	115,	23,	2	0.7
13s	116,	22,	32 & 33	0.5

Table 2. Continued.

Electrofishing stations	Legal Description T.	R.	S.	Length (mi)
14a	115,	21,	6	0.6
14b	27,	24,	22,27 & 28	1.3
14c	27,	20,	5,7 & 8	0.8
14d	28,	23,	22	0.6

Table 3. Total numbers of fish for the 14 sectors of the Minnesota River, 1980-82.

Species	Sector 1	2	3	4	5	6	7	8	9	10
Shovelnose sturgeon								1		
Shortnose gar							3	5	2	1
Bowfin				2			1			
American eel										
Gizzard shad									7	6
Goldeye								1	2	1
Northern pike		1	1	2	2	3	1	3	3	2
Carp	16	44	56	68	41	18	43	66	115	75
River carpsucker							4	7	8	1
Quillback	1			3		4	3	14	29	6
Highfin carpsucker								2	6	2
White sucker	11	5	5	7	14	10		1	4	
Northern hogsucker								12	18	
Smallmouth buffalo								1	4	
Bigmouth buffalo		2	1	24	4	2	2	4	5	3
Silver redhorse				14	6	15	15	25	37	4
Golden redhorse	8	1	7	35	18	28	19	47	22	
Shorthead redhorse	1			55	38	15	53	67	171	19
Greater redhorse					3		1		1	
Black bullhead	2			1	2					
Yellow bullhead	2									
Brown bullhead	1		40							
Channel catfish				4	2		12	15	32	3
Flathead catfish							1	3	1	2
White bass	4	1								
Rock bass	2									
Green sunfish				3	2	5	2		4	
Orangespotted sunfish	1	1	8		1				2	
Hybrid sunfish		1								
Smallmouth bass				1				6	5	
White crappie						1		1		
Black crappie				1						
Yellow perch	68	35	17	2						
Sauger							4	7	16	10
Walleye	5	30	18	26	1	1	1	5	15	1
Freshwater drum	4		1	1			4	6	4	2
Subtotal	126	121	154	249	134	102	169	299	513	138
Stoneroller									14	
Brassy minnow										
Speckled chub									1	
Silver chub										
Hornyhead chub				3						
Emerald shiner	78	31	1	10	1		2		108	28
Common shiner	335	4		4		4				
Bigmouth shiner	1									
Spottail shiner			4			2				
Spotfin shiner		2	13	22	2		10	3	7	20
Sand shiner				5					9	
Bluntnose minnow	4			3						
Fathead minnow	707	24		1					2	
Creek chub				5					7	
Iowa darter	1	3		1						
Johnny darter		2								
Blackside darter			1	11		1				
Slenderhead darter				17	3	1			6	
Subtotal	1126	66	19	82	6	8	12	3	154	48
Total number by sector	1252	187	173	331	140	110	181	302	667	186
Effort(hrs)	1.80	1.55	1.35	1.45	.55	.70	1.20	1.35	2.40	1.20

Table 3. Continued.

Species	Sector 11	12	13	14	Total
Shovelnose sturgeon	3		12		16
Shortnose gar	1		19		31
Bowfin			2	1	6
American eel				1	1
Gizzard shad	29		77	210	329
Goldeye	1		1		6
Northern pike	2	1	6	1	28
Carp	82	37	646	82	1389
River carpsucker	4	2	55	6	87
Quillback	9	1	40	1	111
Highfin carpsucker	4		9		23
White sucker	1	1			59
Northern hogsucker	5				35
Smallmouth buffalo	1	1	32	1	40
Bigmouth buffalo	5	1	48		101
Silver redhorse	9	1	27	3	156
Golden redhorse	4	3	1		193
Shorthead redhorse	109	6	174	6	714
Greater redhorse					5
Black bullhead					5
Yellow bullhead					2
Brown bullhead					41
Channel catfish	17		24	2	111
Flathead catfish	7	1	28	2	45
White bass	3		35	21	64
Rock bass					2
Green sunfish	5	1	1		23
Orangespotted sunfish			3		16
Hybrid sunfish					1
Smallmouth bass	1			1	14
White crappie	1				3
Black crappie				1	2
Yellow perch					122
Sauger	7	2	29	7	82
Walleye	9		21		133
Freshwater drum	1	2	28	3	56
Subtotal	320	60	1318	349	4052
Stoneroller	4				18
Brassy minnow			1		1
Speckled chub					1
Silver chub	1		1	1	3
Hornyhead chub					3
Emerald shiner	423	8	733	410	1833
Common shiner					347
Bigmouth shiner					1
Spottail shiner					6
Spotfin shiner	6	3	40		128
Sand shiner	3		5		22
Bluntnose minnow	1		3		11
Fathead minnow	1		2		737
Creek chub	1	6			19
Iowa darter					5
Johnny darter			1		3
Blackside darter					13
Slenderhead darter	1		1		29
Subtotal	441	17	787	411	3180
Total number by sector	761	77	2105	760	7232
Effort(hrs)	1.95	.30	9.10	2.07	26.97

Table 4. Percent composition (numbers) of the large fish species for the 14 sectors of the Minnesota River, 1980-82.

	Sector 1	2	3	4	5	6	7	8	9	10
Shovelnose sturgeon								.3		
Shortnose gar							1.7	1.6	.3	.7
Bowfin				.8			.5			
American eel										
Gizzard shad									1.3	4.3
Goldeye								.3	.3	.7
Northern pike		.8	.6	.8	1.4	2.9	.5	1.0	.5	1.4
Carp	12.6	36.3	36.3	27.3	30.5	17.6	25.4	22.0	22.4	54.3
River carpsucker							2.3	2.3	1.5	.7
Quillback	.7			1.2		3.9	1.7	4.6	5.6	4.3
Highfin carpsucker								.6	1.1	1.4
White sucker	8.7	4.1	3.2	2.8	10.4	9.8		.3	.7	
Northern hogsucker								4.0	3.5	
Smallmouth buffalo								.3	.7	
Bigmouth buffalo		1.6	.6	9.6	2.9	1.9	1.1	1.3	.9	2.1
Silver redhorse				5.6	4.4	14.7	8.8	8.3	7.2	2.8
Golden redhorse	6.3	.8	4.5	14.0	13.4	27.4	11.2	15.7	4.2	
Shorthead redhorse	.7			22.0	28.3	14.7	31.3	22.4	33.3	13.7
Greater redhorse					2.2		.5		.1	
Black bullhead	1.5			.4	1.4					
Yellow bullhead	1.5									
Brown bullhead	.7		25.9							
Channel catfish				1.6	1.4		7.1	5.0	6.2	2.1
Flathead catfish							.5	1.0	.1	1.4
White bass	3.1	.8								
Rock bass	1.5									
Green sunfish				1.2	1.4	4.9	1.1		.7	
Orangespotted sunfish	.7	.8	5.1		.7				.3	
Hybrid sunfish		.8								
Smallmouth bass				.4				2.0	.9	
White crappie						.9		.3		
Black crappie				.4						
Yellow perch	53.9	28.9	11.0	.8						
Sauger							2.3	2.3	3.1	7.2
Walleye	3.9	24.7	11.6	10.4	.7	.9	.5	1.6	2.9	.7
Freshwater drum	3.1		.6	.4			2.3	2.0	.7	1.4

tr. = less than .1 percent

Table 4. Continued.

	Sector 11	12	13	14	Total
Shovelnose sturgeon	.9		.9		.3
Shortnose gar	.3		1.4		.7
Bowfin			.1	.2	.1
American eel				.2	tr.
Gizzard shad	9.0		5.8	60.1	8.1
Goldeye	.3		tr.		.1
Northern pike	.6	1.6	.4	.2	.6
Carp	25.6	61.6	49.0	23.4	34.2
River carpsucker	1.2	3.3	4.1	1.7	2.1
Quillback	2.8	1.6	3.0	.2	2.7
Highfin carpsucker	1.2		.6		.5
White sucker	.3	1.6			1.4
Northern hogsucker	1.5				.8
Smallmouth buffalo	.3	1.6	2.4	.2	.9
Bigmouth buffalo	1.5	1.6	3.6		2.4
Silver redhorse	2.8	1.6	2.0	.8	3.8
Golden redhorse	1.2	5.0	tr.		4.7
Shorthead redhorse	34.0	10.0	13.2	1.7	17.6
Greater redhorse					.1
Black bullhead					.1
Yellow bullhead					tr.
Brown bullhead					1.0
Channel catfish	5.3		1.8	.5	2.7
Flathead catfish	2.1	1.6	2.1	.5	1.1
White bass	.9		2.6	6.0	1.5
Rock bass					tr.
Green sunfish	1.5	1.6	tr.		.5
Orangespotted sunfish			.2		.3
Hybrid sunfish					tr.
Smallmouth bass	.3			.2	.3
White crappie	.3				tr.
Black crappie				.2	tr.
Yellow perch					3.0
Sauger	2.1	3.3	2.2	2.0	2.0
Walleye	2.8		1.5		3.2
Freshwater drum	.3	3.3	2.1	.8	1.3

tr. = less than .1 percent

Table 5. Total weight (lbs) of the large fish species for the 14 sectors of the Minnesota River, 1980-82.

	Sector									
Species	1	2	3	4	5	6	7	8	9	10
Shovelnose sturgeon								2.3		
Shortnose gar							4.8	6.6	2.4	.9
Bowfin				8.0			3.5			
American eel										
Gizzard shad										
Goldeye								1.5	.3	1.9
Northern pike		2.9	1.8	3.0	.8	2.7	.5	7.6	12.5	7.1
Carp	72.0	174.0	183.0	301.4	167.0	32.0	112.5	161.8	353.4	245.1
River carpsucker							5.5	8.5	12.0	1.9
Quillback	5.0			.4		6.9	2.8	11.8	30.9	7.0
Highfin carpsucker								1.3	5.5	1.1
White sucker	3.5	1.5	.9	8.4	13.5	5.5		.7	1.6	
Northern hogsucker								9.7	12.8	
Smallmouth buffalo								3.9	14.0	
Bigmouth buffalo		7.0	5.0	103.5	25.0	9.4	5.0	7.7	14.6	6.9
Silver redhorse				22.8	7.0	14.0	18.0	32.5	34.2	1.9
Golden redhorse	.9	.1	3.5	26.4	15.0	15.9	14.0	37.0	19.5	
Shorthead redhorse	.3			49.5	46.5	5.1	29.7	39.3	99.6	12.6
Greater redhorse					9.9		2.1		1.6	
Black bullhead	.2				.3					
Yellow bullhead	.1									
Brown bullhead	.3		2.3							
Channel catfish				20.5	4.0		10.8	4.8	12.9	1.5
Flathead catfish							3.1	4.4	.7	1.7
White bass	3.8									
Rock bass	.3									
Green sunfish				.1	.1	.2	.2		.1	
Orangespotted sunfish	.1	.2	.1							
Hybrid sunfish		.1								
Smallmouth bass				.3				4.1	4.1	
White crappie						.7		.5		
Black crappie										
Yellow perch	1.2	5.2	.4	.1						
Sauger							2.1	5.0	12.4	7.5
Walleye	5.1	23.6	7.3	43.1	.2	.1	.9	2.7	17.7	8.7
Freshwater drum	5.0		.4	1.4			2.5	5.9	5.1	2.8
Total weight by sector	97.8	214.6	204.7	588.9	289.3	92.5	218.0	359.6	667.9	308.6

Table 5. Continued.

Species	Sector 11	12	13	14	Total
Shovelnose sturgeon	.3		14.2		16.8
Shortnose gar	.8		26.9		42.4
Bowfin			7.5	3.7	22.7
American eel				2.2	2.2
Gizzard shad					
Goldeye	1.4		1.5		6.6
Northern pike	3.8	3.3	13.4	.2	59.6
Carp	255.0	129.5	1677.4	236.6	4100.7
River carpsucker	6.9	3.1	81.8	8.6	128.3
Quillback	9.9	.4	40.4	2.0	117.5
Highfin carpsucker	3.0		6.7		17.6
White sucker		.6			36.2
Northern hogsucker	2.2				24.7
Smallmouth buffalo	6.0	3.3	93.4	4.2	124.8
Bigmouth buffalo	12.4	8.0	178.9		383.4
Silver redhorse	14.3	2.7	30.9	.7	179.0
Golden redhorse	2.0	1.2	1.0		136.5
Shorthead redhorse	67.0	3.0	141.4	2.9	496.9
Greater redhorse					13.6
Black bullhead					.5
Yellow bullhead					.1
Brown bullhead					2.6
Channel catfish	20.7		36.1	.1	111.4
Flathead catfish	20.2	2.9	36.1	4.2	73.3
White bass	3.7		39.8	12.2	59.5
Rock bass					.3
Green sunfish	.5		.1		1.3
Orangespotted sunfish					.4
Hybrid sunfish					.1
Smallmouth bass	1.0			1.2	10.7
White crappie	.7				1.9
Black crappie				.2	.2
Yellow perch					6.9
Sauger	4.3	2.9	19.9	5.2	59.3
Walleye	19.8		43.2		172.4
Freshwater drum	1.9	3.3	38.0	2.7	69.0
Total weight by sector	457.8	164.2	2528.6	286.9	6479.4

Table 6. Percent composition (weights) of the large fish species for the 14 sectors of the Minnesota River, 1980-82.

Species	Sector 1	2	3	4	5	6	7	8	9	10
Shovelnose sturgeon								.6		
Shortnose gar							2.2	1.8	.3	.2
Bowfin				1.3			1.6			
American eel										
Goldeye								.4	tr.	.6
Northern pike		1.3	.8	.5	.2	2.9	.2	2.1	1.8	2.3
Carp	73.6	81.0	89.3	51.1	57.7	34.5	51.6	44.9	52.9	79.4
River carpsucker							2.5	2.3	1.7	.6
Quillback	5.1			tr.		7.4	1.2	3.2	4.6	2.2
Highfin carpsucker								.3	.8	.3
White sucker	3.5	.6	.4	1.4	4.6	5.9		.1	.2	
Northern hogsucker								2.6	1.9	
Smallmouth buffalo								1.0	2.0	
Bigmouth buffalo		3.2	2.4	17.5	8.6	10.1	2.2	2.1	2.1	2.2
Silver redhorse				3.8	2.4	15.1	8.2	9.0	5.1	.6
Golden redhorse	.9	tr.	1.7	4.4	5.1	17.1	6.4	10.2	2.9	
Shorthead redhorse	.3			8.4	16.0	5.5	13.6	10.9	14.9	4.0
Greater redhorse					3.4		.9		.2	
Black bullhead	.2				.1					
Yellow bullhead	.1									
Brown bullhead	.3		1.1							
Channel catfish				3.4	1.3		4.9	1.3	1.9	.4
Flathead catfish							1.4	1.2	.1	.5
White bass	3.8									
Rock bass	.3									
Green sunfish				tr.	tr.	.2	tr.		tr.	
Orangespotted sunfish	.1	tr.	tr.							
Hybrid sunfish		tr.								
Smallmouth bass				tr.				1.1	.6	
White crappie				-		.7		.1		
Black crappie										
Yellow perch	1.2	2.4	.1	tr.						
Sauger							.9	1.3	1.8	2.4
Walleye	5.2	10.9	3.5	7.3	tr.	.1	.4	.7	2.6	2.8
Freshwater drum	5.1		.1	.2			1.1	1.6	.7	.9

tr. = less than .1 percent

Table 6. Continued.

Species	Sector 11	12	13	14	Total
Shovelnose sturgeon	tr.		.5		.2
Shortnose gar	.1		1.0		.6
Bowfin			.2	1.2	.3
American eel				.7	tr.
Goldeye	.3		tr.		.1
Northern pike	.8	2.0	.5	tr.	.9
Carp	55.7	78.8	66.3	82.4	63.2
River carpsucker	1.5	1.8	3.2	2.9	1.9
Quillback	2.1	.2	1.5	.6	1.8
Highfin carpsucker	.6		.2		.2
White sucker		.3			.5
Northern hogsucker	.4				.3
Smallmouth buffalo	1.3	2.0	3.6	1.4	1.9
Bigmouth buffalo	2.7	4.8	7.0		5.9
Silver redhorse	3.1	1.6	1.2	.2	2.7
Golden redhorse	.4	.7	tr.		2.1
Shorthead redhorse	14.6	1.8	5.5	1.0	7.6
Greater redhorse					.2
Black bullhead					tr.
Yellow bullhead					tr.
Brown bullhead					tr.
Channel catfish	4.5		1.4	tr.	1.7
Flathead catfish	4.4	1.7	1.4	1.4	1.1
White bass	.8		1.5	4.2	.9
Rock bass					tr.
Green sunfish	.1		tr.		tr.
Orangespotted sunfish					tr.
Hybrid sunfish					tr.
Smallmouth bass	.2			.4	.1
White crappie	.1				tr.
Black crappie				tr.	tr.
Yellow perch					.1
Sauger	.9	1.7	.7	1.8	.9
Walleye	4.3		1.7		2.6
Freshwater drum	.4	2.0	1.5	.9	1.0

tr. = less than .1 percent

Table 7. Catch per unit of effort (fish/hr) for 14 sectors of the Minnesota River, 1980-82.

Species	Sector 1	2	3	4	5	6	7	8	9	10
Shovelnose sturgeon								.7		
Shortnose gar							2.5	3.7	.8	.8
Bowfin				1.3			.8			
American eel										
Gizzard shad									2.9	5.0
Goldeye								.7	.8	.8
Northern pike		.6	.7	1.3	3.6	4.2	.8	2.2	1.2	1.6
Carp	8.8	28.3	41.4	46.9	74.5	25.7	35.8	48.8	47.9	62.5
River carpsucker							3.3	5.1	3.3	.8
Quillback	.5			2.0		5.7	2.5	10.3	12.0	5.0
Highfin carpsucker								1.4	2.5	1.6
White sucker	6.1	3.2	3.7	4.8	25.4	14.2		.7	1.6	
Northern hogsucker								8.8	7.5	
Smallmouth buffalo								.7	1.6	
Bigmouth buffalo		1.2	.7	16.5	7.2	2.8	1.6	2.9	2.0	2.5
Silver redhorse				9.6	10.9	21.4	12.5	18.5	15.4	3.3
Golden redhorse	4.4	.6	5.1	24.1	32.7	40.0	15.8	34.8	9.1	
Shorthead redhorse	.5			37.9	69.0	21.4	44.1	49.6	71.2	15.8
Greater redhorse					5.4		.8		.4	
Black bullhead	1.1			.6	3.6					
Yellow bullhead	1.1									
Brown bullhead	.5		29.6							
Channel catfish				2.7	3.6		10.0	11.1	13.3	2.5
Flathead catfish							.8	2.2	.4	1.6
White bass	2.2	.6								
Rock bass	1.1									
Green sunfish				2.0	3.6	7.1	1.6		1.6	
Orangespotted sunfish	.5	.6	5.9		1.8				.8	
Hybrid sunfish		.6								
Smallmouth bass				.6				4.4	2.0	
White crappie						1.4		.7		
Black crappie				.6						
Yellow perch	37.7	22.5	12.5	1.3						
Sauger							3.3	5.1	6.6	8.3
Walleye	2.7	19.3	13.3	17.9	1.8	1.4	.8	3.7	6.2	.8
Freshwater drum	2.2		.7	.6			3.3	4.4	1.6	1.6
Subtotal	70.0	78.0	114.0	171.7	243.6	145.7	140.8	221.4	213.7	115.0
Stoneroller									5.8	
Brassy minnow										
Speckled chub									.4	
Silver chub										
Hornyhead chub				2.0						
Emerald shiner	43.3	20.0	.7	6.9	1.8		1.6		45.0	23.3
Common shiner	186.1	2.5		2.7		5.7				
Bigmouth shiner	.5									
Spottail shiner			2.9			2.8				
Spotfin shiner		1.2	9.6	15.1	3.6		8.3	2.2	2.9	16.6
Sand shiner				3.4					3.7	
Bluntnose minnow	2.2			2.0						
Fathead minnow	392.7	15.4		.6					.8	
Creek chub				3.4					2.9	
Iowa darter	.5	1.9		.6						
Johnny darter		1.2								
Blackside darter			.7	7.5		1.4				
Slenderhead darter				11.7	5.4	1.4			2.5	
Subtotal	625.5	42.5	14.0	56.5	10.9	11.4	10.0	2.2	64.1	40.0
Total cpue by sector	695.5	120.6	128.1	228.2	254.5	157.1	150.8	223.7	277.9	155.0
Effort(hrs)	1.8	1.5	1.3	1.4	.5	.7	1.2	1.3	2.4	1.2

Table 7. Continued.

Species	Sector 11	12	13	14	Total
Shovelnose sturgeon	1.5		1.3		.5
Shortnose gar	.5		2.0		1.1
Bowfin			.2	.4	.2
American eel				.4	.0
Gizzard shad	14.8		8.4	101.4	12.2
Goldeye	.5		.1		.2
Northern pike	1.0	3.3	.6	.4	1.0
Carp	42.0	123.3	70.9	39.6	51.5
River carpsucker	2.0	6.6	6.0	2.9	3.2
Quillback	4.6	3.3	4.4	.4	4.1
Highfin carpsucker	2.0		.9		.8
White sucker	.5	3.3			2.1
Northern hogsucker	2.5				1.3
Smallmouth buffalo	.5	3.3	3.5	.4	1.4
Bigmouth buffalo	2.5	3.3	5.2		3.7
Silver redhorse	4.6	3.3	2.9	1.4	5.7
Golden redhorse	2.0	10.0	.1		7.1
Shorthead redhorse	55.9	20.0	19.1	2.9	26.4
Greater redhorse					.1
Black bullhead					.1
Yellow bullhead					.0
Brown bullhead					1.5
Channel catfish	8.7		2.6	.9	4.1
Flathead catfish	3.5	3.3	3.0	.9	1.6
White bass	1.5		3.8	10.1	2.3
Rock bass					.0
Green sunfish	2.5	3.3	.1		.8
Orangespotted sunfish			.3		.5
Hybrid sunfish					.0
Smallmouth bass	.5			.4	.5
White crappie	.5				.1
Black crappie				.4	.0
Yellow perch					4.5
Sauger	3.5	6.6	3.1	3.3	3.0
Walleye	4.6		2.3		4.9
Freshwater drum	.5	6.6	3.0	1.4	2.0
Subtotal	164.1	200.0	144.8	168.6	150.2
Stoneroller	2.0				.6
Brassy minnow			.1		.0
Speckled chub					.0
Silver chub	.5		.1	.4	.1
Hornyhead chub					.1
Emerald shiner	216.9	26.6	80.5	198.0	67.9
Common shiner					12.8
Bigmouth shiner					.0
Spottail shiner					.2
Spotfin shiner	3.0	10.0	4.4		4.7
Sand shiner	1.5		.5		.8
Bluntnose minnow	.5		.3		.4
Fathead minnow	.5		.2		27.3
Creek chub	.5	20.0			.7
Iowa darter					.1
Johnny darter			.1		.1
Blackside darter					.4
Slenderhead darter	.5		.1		1.0
Subtotal	226.1	56.6	86.4	198.5	117.9
Total cpue by sector	390.2	256.6	231.3	367.1	268.1
Effort(hrs)	1.9	.3	9.1	2.0	26.9

Table 8. Length frequency distributions of large fish species in the Minnesota River, 1980-82.

Species: Shovelnose sturgeon

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
8																													1				
11																											1	1	1				
13																	1			1		2	2	1			2		2		1		
Totals																	1			1		2	2	1			3	1	4		1		

Species: Shortnose gar

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
7														1							1								1				
8																1						1	2	1									
9																		1							1								
10																				1													
11																			1														
13																			1	3	2	5	4	1	3								
Totals														1		1		1	2	4	3	6	6	2	4				1				

Species: Bowfin

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
4																						2											
7																					1												
13																						1	1										
14																							1										
Totals																					1	3	2										

Table 8. Continued.

Species: American eel

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
14	One specimen taken in Sector 14 at 40 inches																																
Totals																																	

Species: Goldeye

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
8																	1																
9								1							1																		
10																			1														
11															1																		
13																1																	
Totals								1							2	1	1		1														

Species: Northern pike

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
2																						1											
3																					1												
4												1											1										
5												2																					
6						1				1													1										
7														1																			
8														1				1											1				
9																								1				1		1			
10															1																1		
11																				1				1									
12																								1									
13																				1	1	1	1	1				1					
14								1																									
Totals						1		1		1		3		2	1			1		2	2	2	3	4				2	1	1	1		

Table 8. Continued.

Species: Carp

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1																			2	5	1	4	2	1	1								
2															1	4	8	8	5	5	5		5		1		2						
3		33									1						1		1			2		4	4	5	2	3					
4													2			1	5	3	10	8	13	12	6	6	1	1							
5											3					1	5	5	6	3	8	1	4	2	2	1							
6													1	1	6	5	3	1	1														
7										3	2	3	1	2	2	3	7	2	6	5	3	1	2		1								
8										5	1	2		5	8	10	9	12	2	2	5	2	2			1							
9		1								5	6	1		5	5	18	15	12	14	10	7	7	2	1	2		2	2					
10								1		2			4	1	3	2	5	16	15	5	5	8	5	2		1							
11										2			2	3	4	11	13	11	9	6	7	7	3	3	1								
12										2	1	1		2	1	2	5	5	6	5	2		2		1			1	1				
13									1	1	2	10	27	44	38	41	68	93	95	75	62	28	25	17	10	3	3	1			1	1	
14										1	1		4	2	7	5	15	12	8	13	4	3	3	2	2								
Totals		34						1	1	21	17	17	41	65	75	103	159	180	180	142	122	75	61	38	26	12	9	7	1		1	1	

Species: River carpsucker

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
7													1		2	1																	
8													1	2	2	2																	
9													1	1	2	4																	
10															1																		
11														1	1	1	1																
12														1		1																	
13									1		2	1	2	3	10	15	10	8	2		1												
14								2	1		1								1	1													
Totals								2	2		3	1	5	8	18	24	11	8	3	1	1												

Table 8. Continued.

Species: Quillback

Sector	Length (in)																																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1																			1														
4															1	1			1														
6														1	1		1				1												
7													2	1																			
8								1			2	4	3	2	2																		
9										2	6	2	8	5	4	2																	
10												1	1			4																	
11												1	3	2	3																		
12										1																							
13									1		5	6	7	12	6	3																	
14																1																	
Totals								1	1	3	13	14	24	23	17	11	1		2		1												

Species: Highfin carpsucker

Sector	Length (in)																																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
8											2																						
9											1	1	4																				
10												2																					
11									2	1		1																					
13										1	1	2	3	1	1																		
Totals									2	2	4	6	7	1	1																		

Table 8. Continued.

Species: White sucker

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1					1	2	3	2				3																					
2						1	1			3																							
3		2		1				1				1																					
4													1	1	2	3																	
5											1	4	5	3			1																
6											1	3	3	3																			
8												1																					
9							2			1		1																					
11		1																															
12												1																					
Totals		3		1	1	3	6	3		4	2	14	9	7	2	3	1																

Species: Northern hogsucker

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
8										1	2	4	1	3	1																		
9				1				1	2		3	5	2	4																			
11								1	3	1																							
Totals				1				2	5	2	5	9	3	7	1																		

Table 8. Continued.

Species: Smallmouth buffalo

Sector	Length (in)																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
8																			1														
9															1				1	1	1												
11																						1											
12																		1															
13												1	1	5	5	1			4	4	6	2	2			1							
14																				1													
Totals												1	1	5	6	1		1	6	6	7	3	2			1							

Species: Bigmouth buffalo

Sector	Length (in)																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
2												1			1																		
3																				1													
4														1	1	2	5	3	6	2		2				1	1						
5																1						1		2									
6																			1				1										
7																2																	
8															2	1	1																
9																2	2		1														
10																1	1	1															
11									1								1	1	2														
12																								1									
13														1	4		1	6	10	7	6	5	3	2	2	1							
Totals									1			1		2	8	9	11	11	20	10	6	8	4	5	2	2	1						

Table 8. Continued.

Species: Silver redhorse

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
4												2	2	1	1	4			2	1	1												
5												2	1	2		1																	
6											5	5	1		1		1	1	1														
7										2	1	2		2	2	3	3																
8										3	2	1	1	4	2	3	4	3	1	1													
9								2	3	2	3	7	4	3	6	3	1	2	1														
10								1	1			1	1																				
11							1	1				2	1	1		1		1					1										
12																			1														
13	1						1			3	2	2	2	4	3	3	4		2														
14							1	1		1																							
Totals	1						3	5	4	11	13	24	13	17	15	18	13	7	8	2	1		1										

Species: Golden redhorse

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1					2	3	2	1																									
2					1																												
3					1					1				2	2	1																	
4					1				1	3	9	11	6	1	1	1	1																
5											6	6	3	2			1																
6										1	4	14	4	1	4																		
7									1	1	4	7	4			2																	
8									1	7	7	6	11	9	3	3																	
9										1	5	8	2	4	1	1																	
11			2						1					1																			
12		1	1												1																		
13														1																			
Totals		1	3		5	3	2	1	4	14	35	52	30	21	12	8	2																

Table 8. Continued.

Species: Shorthead redhorse

	Length (in)																																
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1								1																									
4				1	3				3	3	5	6	11	10	5	4	2	1	1														
5					1	2						2		11	12	7	3																
6											1		3	3	6		2																
7					1			1	2	10	18	8	8	2	2	1																	
8				1					6	8	13	18	13	6	2																		
9					3			3	19	25	27	39	28	17	8	1			1														
10						1	1	1	1		1	4	2	3	2	2	1																
11					2		1	2	5	9	23	32	21	9	3	2																	
12									2		1	3																					
13			1			2	3	2	3	3	8	19	27	37	29	25	11	4															
14								1	3	1					1																		
Totals			1	2	10	5	5	11	44	59	97	131	113	98	70	42	19	5	2														

Species: Greater redhorse

	Length (in)																																
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
5																	2						1										
7																	1																
9																1																	
Totals																1	3						1										

Table 8. Continued.

Species: Black bullhead

	Length (in)																																
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1			1	1																													
4				1																													
5				2																													
Totals			1	4																													

Species: Yellow bullhead

	Length (in)																																
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1			1	1																													
Totals			1	1																													

Species: Brown bullhead

	Length (in)																																
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1								1																									
3				22	15	1	1	1																									
Totals				22	15	1	1	2																									

Table 8. Continued.

Species: Channel catfish

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
4																						2		2									
5																1				1													
7							1				1	1	5	1	1				1	1													
8									4	7	3			1																			
9	1	11					1	1		2	9	1	1	1	1		1	1	1														
10											2				1																		
11		4	2					1	1	1			1		1	1	1	1		1			1			1							
13			4		1					2	1			1		2	3	2	2	2	1		1		1	1							
14			1		1																												
Totals	1	15	7		2		2	2	5	12	16	2	7	4	4	4	5	4	4	5	1	2	2	2	1	2							

Species: Flathead catfish

Sector	Length (in) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
7																				1													
8												1				2																	
9												1																					
10										1								1															
11									2						1	2				1									1				
12																			1														
13						1	2	1	3	6	3		2			2	1	2	1		1	1	1					1					
14																1				1													
Totals						1	2	1	5	7	3	2	2		1	7	1	3	2	3	1	1	1					1	1				

Table 8. Continued.

Species: White bass

	Length (in)																																
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1												2	1	1																			
2	1																																
11													2		1																		
13				1						1	6	1	2	3	5	11	5																
14			2	4					1	2	6		2	4																			
Totals	1		2	5					1	3	12	3	7	8	6	11	5																

Species: Rock bass

	Length (in)																																
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1			1			1																											
Totals			1			1																											

Species: Green sunfish

	Length (in)																																
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
4	1		1	1																													
5			2																														
6			3	1	1																												
7	1						1																										
9	1		3																														
11		1	2	1			1																										
12			1																														
13					1																												
Totals	3	1	12	3	2		2																										

Table 8. Continued.

Species: Orangespotted sunfish

	Length (in)																															
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1				1																												
2						1																										
3	3	4	1																													
5			1																													
9		2																														
13		1	2																													
Totals	3	7	4	1		1																										

Species: Hybrid sunfish

	Length (in)																															
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
2		1																														
Total		1																														

Species: Smallmouth bass

	Length (in)																															
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
4								1																								
8									3	2		1																			
9										3	1		1																		
11											1																					
14													1																		
Totals								1		3	5	2	1	2																		

Table 8. Continued.

Species: White crappie

Length (in)

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
6										1																							
8										1																							
11										1																							
Totals										3																							

Species: Black crappie

Length (in)

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
4	1																																
14							1																										
Totals	1						1																										

Species: Yellow perch

Length (in)

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1	40	16		2	6	1	2	1																									
2		1		1	21	4		1	7																								
3		10	3		4																												
4					2																												
Totals	40	27	3	3	33	5	2	2	7																								

Table 8. Continued.

Species: Sauger

Sector	Length (in)																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
7							1	1		1								1															
8									1	1	1				3		1																
9							1	2	3		1	1		1	1	3	1	1	1														
10								1	4						1	1	1		1	1													
11								1	2		1				2		1																
12														1					1														
13										1	4	7	4	1	4	2	1	2	1	1	1												
14					1						1	3					1		1														
Totals					1		2	5	10	3	8	11	4	3	11	6	6	4	5	2	1												

Species: Walleye

Sector	Length (in)																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1									1	2								2															
2									6	11	4					1	2		1	2	3												
3				2				3	8		3					1		1															
4								5	2	1		1	1		1	3	1	4	2	2	1	1				1							
5									1																								
6								1																									
7														1																			
8									1	2			1			1																	
9								2	2	2				1	2	1	2	2						1									
10																													1				
11									1			1		1	1			2		1		1			1								
13					1	1						1		1		1	6	1	2	2	1	1				2		1					
Totals				2	1	1		11	22	18	7	3	2	4	4	8	11	12	5	7	5	3		1	1	3		1	1				

Table 8. Continued.

Species: Freshwater drum

	Length (in)																																
Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1														4																			
3									1																								
4															1																		
7										1	1		1	1																			
8												2	2	1	1																		
9												1	1	1		1																	
10															1	1																	
11												1																					
12																1			1														
13											2	2	3	5	7	5	1	1		1			1										
14				1					1								1																
Totals				1					2	1	3	6	7	12	10	8	2	1	1	1			1										

Table 9. Characteristics of Minnesota River invertebrate sampling sites July-September, 1979-81.

Sector	Site	Date (day, month, year)	Type of sample	Substrate[b]	Secchi disc reading (m)	Water depth (m)	Surface water velocity (cm/sec)	Water temp. (°C)
1	RM 332.4 at road SE of Hwy 12 by gaging station T. 121N, R. 46W, S. 16	170780	Qual	R,RR,SN	0.3	0.5	30	25
	RM 323.2 in Big Stone Refuge T. 121N, R. 45W, S. 30	150780	Lt					
2	RM 319.5 just below Big Stone Refuge Dam T. 121N, R. 45W, S. 34	150780	Quan	CL	0.8	0.8-0.9	30	25
			Qual	SN,SI	0.8	0.3-0.6	pool	25
	RM 318.1 at gravel road bridge 1.4 RM below Big Stone Refuge Dam T. 121N, R. 45W, S. 34	160780	Quan	GR,SI	>0.7	0.7	15	25
			Qual	SN,R	>0.7	0-0.6	15	25
			Lt					
	RM 312-311.5 above Marsh Lake reservoir T. 120N, R. 44W, S. 7,17,18	150780	Quan	MU,SA	0.6	1.2	pool	26
3	RM 305.2 below Marsh Lake Dam T. 120N, R. 43W, S. 30	180780	Qual	RR				
	RM 303.1 above Lac qui Parle Reservoir T. 120N, R. 43W, S. 33	170780	Quan	SI,DET,SA	0.1	1.4	pool	23
4	RM 289.05 below Lac qui Parle Dam T. 118N, R. 42W, S. 24	230780	Quan	CL,SA,GR	0.4	0.9-1.2	12	23
			Qual	CL,SN,R	0.4	0.9	12	23
7	RM 243.9 at Upper Sioux Agency Park T. 115N, R. 38W, S. 28	230780	Quan	R,GR	0.3	0.9	46	26
			Lt					
		140880	Qual	SN,R,GR				
			Lt					
		130881	Qual	SN,R,GR				
			Lt					

Table 9. Continued.

Sector	Site	Date (day, month, year)	Type of sample	Substrate[b]	Secchi disc reading (m)	Water depth (m)	Surface water velocity (cm/sec)	Water temp. (°C)
8	RM 243.5-242.8 downstream of Upper Sioux Agency Park in the vicinity of Hawk Creek T. 115N, R. 38W, S. 27,28	070879	Quan	GR,SA	0.2	0.5	27	26
		070879	Quan	GR,SI	0.2	0.4	pool	26
		080879	Quan	DET,MU	0.2	1.5	pool	25
		060879	Lt					
		070879	Qual	SN,R				
		080879	Qual	SN,RR				
9	RM 198 below Franklin T. 112N, R. 34W, S. 11,14	130880	Quan	SA	-	0.9	49	22
			Qual	SN				
	RM 185 at Kettner's Landing T. 111N, R. 33W, S. 2	150880	Qual	SN,R	0.3		52	
13	RM 108.9 in Mankato area T. 108N, R.27W, S. 1	120779	Quan	CL,SA,DET	0.2	2.1	pool	25
			Qual	SN,R,GR				
	RM 112 in Mankato area T. 108N, R. 27W, S. 14	110779	Lt					
		120779	Qual	SN				
	RM 106.5 in Mankato area T. 109N, R. 27W, S. 25	110779	Qual	SN,RR	0.2			
	RM 102-98 at boat landing N of Mankato T. 109N, R. 27W, S. 1 (RM 98)	040980	Quan	GR,SA	0.3	0.6	52	22
	T. 109N, R. 27W, S. 1,12 (RM 102-99)	040980	Qual	SN				
	RM 92 at St. Peter	040980	Lt					
	RM 69.5 near LeSueur	200781	Quan	SA,GR,MU	0.1	1.5-1.8	43	
		200781	Qual	SN				

[a] Qual = qualitative; Quan = quantitative; Lt = light trap.
[b] R = rock; RR = riprap; SN = snag; SI = silt; CL = clay; MU = muck; SA = sand; DET = detritus; GR = gravel.

Table 10. Invertebrate taxa collected in qualitative, quantitative dredge (Petite Ponar, sample area 232 sq. cm.) and light trap samples from the Minnesota River during July-September, 1979-81.

Taxon	Sector 1	2	3	4	7	8	9	13	Type of sample Qual	Quan	Light	Substrate[a] A	B	C	D	E	F	G	H	Total no. collected Aquatic	Light
COELENTERATA																					
Hydra		+	+						+	+			+				+			8	
TURBELLARIA				+	+		+	+	+	+		+	+		+					17	
NEMATODA		+		+		+		+	+	+						+	+	+		60	
BRYOZOA					+					+			+								
ANNELIDA																					
Tubificidae		+	+	+	+	+		+	+	+		+	+		+	+	+	+		3,982	
Naididae		+	+	+	+	+		+		+			+			+	+	+		4,362	
Lumbriculidae								+	+			+								1	
Hirudinea		+	+	+	+					+			+			+	+	+		33	
CRUSTACEA																					
Cladocera		+	+	+					+	+						+	+	+		544	
Copepoda-Calanoida		+	+	+			+		+	+						+	+	+		858	
Copepoda-Cyclopoida		+	+							+						+		+	+	11	
Isopoda		+								+								+		1	
Hyalella azteca	+	+	+	+			+	+	+	+		+	+			+	+	+		427	
INSECTA																					
Collembola		+	+					+	+	+		+					+			11	
Emphemeroptera																					
Isonychia sicca						+	+*b	+	+			+								12	
Isonychia sp.						+	+	+	+		+	+		+						24	13
Baetis intercalaris		+						+	+			+	+							44	
B. pygmaeus	+								+			+								1	
Baetis propinquus grp.						(+)c		+	+		+	+								13	1
Baetis spp.			+		+	+	+		+	+		+	+	+				+		73	
Callibaetis		(+)			(+)	(+)					+										3
Pseudocloeon					+	+		+	+	+		+	+	+	+					23	
Centroptilum					+	+		+	+	+	+		+				+			4	2
Paracloedes								+	+			+								1	
Heptagenia elegantula grp.	+			+	+	+	+	+	+			+	+	+						58	
H. flavescens grp.					+	+	+	+	+			+	+	+						89	
H. maculipennis grp.				+	+	+	+	+	+			+	+	+						52	
Heptagenia spp.					+	+				+			+		+		+			12	
Stenacron interpunctatum	+	+	+	+		+	+	+	+			+	+	+						209	
Stenacron sp.		+	+							+					+			+		12	
Stenonema exiguum					+	+	+	+	+		+	+	+	+						45	1
S. integrum						+	+	+	+			+	+							58	
S. terminatum				+	+	+	+	+	+	+		+	+							53	
Stenonema spp.					+	+	+	+	+	+		+	+	+	+					143	
Heptageniidae		+						+		+					+		+			4	
Tricorythodes	+	+		+	+	+	+	+	+	+		+	+	+			+	+	+	190	
Brachycercus								+	+			+								1	
Caenis sp. 1 (hilaris?)[f]					(+)	(+)		(+)			+										570
Caenis sp. 2 (simulans?)					(+)	(+)					+										34
Caenis sp. 3 (forcipata?)		(+)			(+)	(+)					+										21
Caenis sp.	+	+		+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	216	
Potamanthus myops					+*	(+)		(+)	+		+	+	+							7	12

Table 10. Continued.

Taxon	Sector 1	2	3	4	7	8	9	13	Type of sample Qual	Quan	Light	Substrate[a] A	B	C	D	E	F	G	H	Total no. collected Aquatic	Light
Potamanthus sp.	+			+	+	+	+	+	+	+		+	+	+	+	+	+			143	
Hexagenia		+	+		(+)	+				+	+							+		19	12
Ephoron album				+	(+)	+		+	+	+	+			+	+					25	40
Ephemeridae						+				+							+			33	
Odonata																					
Coenagrionidae (early instars)							+	+	+			+	+							6	
Gomphidae (early instar)						+				+								+		1	
Gomphurus						+			+			+								1	
Libellula		+							+			+								1	
Plecoptera																					
Acroneuria abnormis							+	+	+			+	+	+						31	
A. lycorias					+				+			+								1	
Acroneuria sp.								+	+			+								1	
Perlesta placida					(+)	(+)		+	+		+	+		+						7	175
Hemiptera																					
Metrobates hesperius					+	+	+	+	+			+								30	
Gerris dissortis		+							+			+								3	
Rheumatobates palosi	+	+							+			+								19	
Trepobates knighti		+							+			+								1	
T. subnitidus	+	+							+			+								6	
Ranatra		+							+			+								1	
Palmacorixa gilletei	+					+		+	+	+		+						+		12	
Sigara alternata		+			(+)	(+)			+	+	+	+				+		+		9	12
S. grossolineata		+							+	+	+	+				+		+		20	1
S. bicoloripennis		(+)				(+)					+										4
S. solensis					(+)						+										1
Trichocorixa borealis		+	+		(+)				+	+	+	+		+		+				29	1
T. naias		+							+	+	+	+				+		+		4	1
Cenocorixa dakotensis			+						+					+						1	
Corixidae - nymphs			+	+						+						+		+		51	
Megaloptera																					
Sialis	+	+							+	+		+					+			7	
Chauloides								+	+			+								2	
Neuroptera																					
Climacia		(+)									+										8
Sisyra		(+)									+										1
Coleoptera																					
Hydroporus (A)[d]							+		+			+								1	
Hygrotus (A)								(+)			+										1
Laccophilus (A)		+							+			+								1	
Liodessus (A)								+	+			+								1	
Gyrinus (A)					+				+			+								1	
Dineutus (A)								+	+			+								6	
Dineutus (L)[e]						+			+			+								1	
Peltodytes edentulus (A)		+				(+)		+	+		+	+								2	2
Dubiraphia vittata (A)	+			+					+			+								8	
Dubiraphia (L)		+	+	+		+			+	+		+					+	+		79	
Stenelmis vittipennis (A)			+	+	+	+	+	+	+	+	+	+	+	+	+					45	192

Table 10. Continued.

Taxon	Sector 1	2	3	4	7	8	9	13	Type of sample Qual	Quan	Light	Substratea A	B	C	D	E	F	G	H	Total no. collected Aquatic	Light
Stenelmis (L)	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+		+		53	
Anacaena (A)		+							+			+								1	
Berosus (A)								(+)			+										1
Helophorus (A)		+			+		+		+			+	+							3	
Laccobius (A)								+	+			+								1	
Paracymus (A)							+		+			+								1	
Tropisternus (A)		+						(+)	+		+	+								1	2
Coleptera - early instars		+				+		+	+	+		+						+		6	
Trichoptera																					
Cheumatopsyche campyla		(+)			(+)	(+)		(+)			+										41
C. petteti		(+)									+										24
C. aphanta					(+)						+										2
Cheumatopsyche spp.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	384	210
Hydropsyche bidens				+	+	+	+	+	+	+	+	+	+	+	+					378	52
H. simulans					+	+	+	+	+		+	+	+	+						47	7
H. frisoni?					+	+		+	+	+		+	+							9	
Hydropsyche spp.					(+)	(+)	+	(+)		+	+								+	3	154
Symphitopsyche bifida					(+)	(+)					+										12
S. bifida grp.		+			+	+		+	+			+	+	+						36	
S. slossonae								+	+			+								1	
Potamyia flava					+	+	+	+	+	+	+	+	+	+	+			+		774	122
Hydropsychidae (early instars)						+	+		+	+		+		+	+			+	+	81	
Cerotina		(+)									+										1
Cyrnellus fraternus				+	+			+	+	+	+	+	+	+						14	15
Neureclipsis bimaculata		+*							+			+								1	
Neureclipsis		+		+					+	+		+	+			+				25	
Nyctiophylax affinis					(+)	(+)		+)			+										10
Nyctiophylax				+	+				+			+	+							6	
Polycentropus cinereus		(+)				(+)					+										6
Polycentropus	+	+		+				+	+			+	+	+						15	
Polycentropidae (early instars)				+						+						+				1	
Agraylea multipunctata		(+)			(+)	(+)		(+)			+										16
Hydroptila ajax					(+)	(+)					+										4
H. angusta					(+)	(+)					+										3
H. scolops					+*	(+)			+		+		+							1	8
H. waubesiana						(+)					+										1
Hydroptila spp.		(+)			+	(+)			+		+	+	+							19	27
Mayatrichia ayama					+	(+)	+	+	+	+	+	+	+						+	27	570
Neotrichia okopa						(+)					+										23
Ochrotrichia tarsalis					(+)						+										1
Orthotrichia americana					(+)						+										1
Ceraclea ancylus								+	+				+							1	
C. maculata					+		+*		+		+	+	+							4	5
C. tarsipunctata								(+)			+										1
Ceraclea					+	+			+	+		+	+					+		9	
Nectopsyche candida				+	(+)	+		+	+		+	+	+							7	3

Table 10. Continued.

Taxon	Sector 1	2	3	4	7	8	9	13	Type of sample Qual	Quan	Light	Substratea A	B	C	D	E	F	G	H	Total no. collected Aquatic	Light
N. diarina	+	+		+	(+)			+	+		+	+	+							12	2
Nectopsyche		(+)			(+)						+										13
Oecetis avara					(+)	(+)		(+)			+										113
O. inconspicua		(+)			(+)						+										4
O. cinarescens					(+)						+										3
O. ochracea					(+)						+										8
Oecetis spp.		+		+	+	+		+	+	+		+	+							15	
Traenodes grisea					(+)	(+)					+										2
T. tarda		(+)			(+)	(+)					+										15
Leptoceridae (early instars)						+				+								+		9	
Pycnopsyche	+			+			+		+			+	+							12	
DIPTERA																					
Nephrotoma								(+)			+										1
Tipula		(+)			(+)			(+)			+										4
Pilaria		(+)									+										1
Limonia								(+)			+										3
Erioptera								(+)			+										1
Hexatoma							+	+		+					+				+		4
Chaoborus punctipennis	(+)	(+)			(+)	(+)		(+)			+										10
C. flavicans	(+)										+										1
Chaoborus		+								+								+		24	
Simulium luggeri?								+	+			+		+						1	
Simulium spp.	+	+	+			+		+	+	+		+	+	+				+		142	
Coelotanypus concinnus					(+)						+										1
Tanypus stellatus					(+)						+										6
T. punctipennis	(+)	+*			(+)				+		+	+								2	56
Tanypus		+	+						+	+		+	+			+	+	+		30	
Procladius bellus	(+)	(+)									+										43
P. freemani		(+)									+										2
Procladius		+	+	+		+			+	+		+					+	+		72	
Ablabesmyia annulata					(+)	(+)					+										2
A. mallochi					(+)	(+)					+										3
A. pulchripennis					(+)						+										1
A. rhamphe					+*				+			+								1	
Ablabesmyia			+			+	+	+	+	+		+	+					+		9	
Telopelopia okoboji					+*	(+)			+		+		+							1	3
Thienemannimyia senata		(+)				(+)					+										3
Thienemannimyia grp.	+	+		+	+	+	+	+	+	+		+	+			+	+			48	
Nilotanypus					+							+	+							1	
Labrundinia pilosella		(+)									+										13
Monodiamesa depectinata					+		+		+	+									+	2	
Lopescladius							+	+		+					+				+	35	
Corynoneura								+	+			+								1	
Thienemanniella sp. 1		+	+			+			+	+		+					+	+		5	
T. sp. 2					+	+			+	+		+	+							6	
T. sp. 3								+	+				+							1	
Epoicocladius		+								+								+		1	
Nanocladius spp.		+		+	+		+	+	+	+		+	+		+		+			7	

Table 10. Continued.

Taxon	Sector 1	Sector 2	Sector 3	Sector 4	Sector 7	Sector 8	Sector 9	Sector 13	Type of sample Qual	Type of sample Quan	Type of sample Light	Substratea A	B	C	D	E	F	G	H	Total no. collected Aquatic	Total no. collected Light
Cricotopus bicinctus grp.	+	+	+			+			+	+		+	+				+	+		31	
C. tremulus grp.		(+)				+		+	+		+	+								3	2
C. sylvestris grp.		+	+	+					+	+	+	+	+	+		+				34	1
Paralimnophyes?								+	+			+								1	
Parametriocnemus					+					+			+							1	
Smittia								+		+								+		1	
Xenochironomus xenolabis		(+)									+										2
X. taeniotus					(+)						+										1
X. scopula				+*					+							+				1	
Xenochironomus				+					+							+				22	
Glyptotendipes lobiferus	(+)	(+)			(+)						+										109
G. paripes		+*			+*			(+)	+		+	+	+							6	6
Glyptotendipes	+	+	+	+	+			+	+	+		+	+	+		+	+	+		416	
Chironomus atroviridis						(+)					+										1
C. decorus grp.	+	+*	+	+	(+)	+		+	+	+	+	+	+		+	+	+	+		414	6
C. plumosus grp.	(+)				(+)			+		+	+					+				5	9
Chironomus spp.		+	+	+		+				+						+		+		142	
Dicrotendipes nervosus	+	+		+	+				+	+	+	+	+			+				13	10
D. neomodestus		+		+	+				+	+		+	+			+		+		14	
D. modestus		(+)									+										1
Kiefferulus dux		(+)				(+)					+										2
Cryptochironomus spp.		+	+	+	+*	+	+	+	+	+	+	+	+		+	+	+	+	+	95	9
C. macropodus							+	+							+				+	52	
Chernovskiia orbicus								(+)			+										1
Chernovskiia							+	+		+					+				+	49	
Parachironomus abortivus		(+)									+										2
P. arcuatus grp.	+	+		+					+	+		+	+			+				21	
P. tenuicaudatus	(+)	(+)									+										4
P. frequens grp.	+			+	+				+	+		+	+							38	
Cladopelma viridula		(+)									+										25
Cladopelma		+	+							+								+		4	
Cryptotendipes pseudotener		(+)				(+)					+										2
Cryptotendipes		+	+	+				+		+					+		+	+		5	
Robackia claviger						(+)					+										7
Robackia							+			+									+	3	
Paracladopelma nereis						(+)					+										1
Paracladopelma spp.							+	+		+					+				+	16	
Saetheria reissi?						+				+	+				+					10	3
Paratendipes albimanus		+			+			+	+	+		+						+		4	
P. subequalis						(+)					+										1
P. connectens?							+			+									+	34	
Paralauterborniella nigrohalteralis					+*				+				+							1	
Paralauterborniella		+				+		+	+	+		+					+	+		10	
Lauterborniella varipennis	(+)										+										1
Pseudochironomus								+		+					+					1	
Microtendipes caducus	+								+				+							3	
M. pedellus	+								+				+							1	
Stenochironomus macateei					(+)	(+)					+										15

Table 10. Continued.

Taxon	Sector 1	2	3	4	7	8	9	13	Type of sample Qual	Quan	Light	Substrate[a] A	B	C	D	E	F	G	H	Total no. collected Aquatic	Light
S. taeniapennis						(+)					+										5
Endochironomus subtendens	(+)	(+)			(+)						+										21
E. nigricans	+	+							+	+	+	+	+			+				12	6
Tribelos fuscicornis					(+)	+*			+		+	+		+						1	1
Tribelos					+	+		+	+			+	+							14	
Stictochironomus						+				+							+			1	
Polypedilum fallax	+							+	+			+								14	
P. illinoense		(+)	+		+*	+*	+	+	+	+	+	+		+				+		210	4
P. convictum	+	+		+	+*	+		+	+	+	+	+	+		+			+		113	52
P. laetum								+		+					+					1	
P. sordens	(+)							(+)			+										3
P. artifer		(+)									+										1
P. griseopunctatum				+	(+)	+		+	+	+	+	+			+			+		95	138
P. digitifer					+*	+		+	+	+	+	+					+			24	55
P. acifer					(+)	+		+		+	+				+					16	1
P. scalaenum grp.		+*		+	+*	+	+	+	+	+	+	+	+		+	+	+	+	+	152	42
P. simulans	(+)	(+)									+										355
P. simulans?		+	+						+	+		+					+	+		28	
Chironomini spp.	+	+			+				+	+		+	+			+				7	
Lenziella						(+)					+										1
Cladotanytarsus					(+)	(+)					+										8
Cladotanytarsus mancus grp.		+		+				+	+	+		+	+		+	+	+			57	
Tanytarsus spp.		+						+		+					+	+	+	+		37	
Virgatanytarsus					+	+				+			+		+					3	
Paratanytarsus		+			(+)					+	+					+				9	59
Rheotanytarsus	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+		132	34
Ceratopogonidae		+	+				+	+	+	+	+	+	+		+	+	+	+	+	33	1
Atherix	+				+	+	+	+	+			+	+	+						34	
Dolichopodidae		(+)			(+)						+										3
Empididae						+		+	+			+		+						11	
Ephydridae		(+)			(+)						+										20
Muscidae					(+)			+	+		+	+								7	2
GASTROPODA																					
Physa		+		+					+	+		+	+		+	+				15	
Ferrisia		+								+						+	+			3	
Lymnaea								+	+			+								1	
PELECYPODA																					
Sphaeriidae		+	+	+				+	+	+			+		+	+	+	+		200	
Truncilla truncata				+	+				+	+			+		+					2	
Anadonta grandis		+								+						+				1	

[a] A = snag; B = rock; C = riprap; D = gravel/sand; E = clay; F = gravel/silt; G = detritus/silt/muck; H = sand.
[b] * reared.
[c] (+) found only in light trap.
[d] (A) = adult.
[e] (L) = larvae.
[f] (?) - Similar to that species reported in the literature, but identity is uncertain.

Table 11. Invertebrate taxa collected from Petite ponar dredge samples (area 232 sq. cm) on the Minnesota River July-September, 1979-81.

Taxon	Sector: RM: Substrate[a]:	2 319.5 CL	2 318.1 GR,SI	2 312-311.5 MU,SA	3 303.1 SI,DET, SA	4 289.05 CL,SA, GR	7 243.9 R,GR	8 243.2 GR,SA	8 243.2 GR,SI	8 243.1 DET,MU	9 198 SA	13 108 CL,SA, DET	13 98 GR,SA	13 69.5 SA,GR, MU
COELENTERATA														
Hydra			6		2									
TURBELLARIA						3	9							
NEMATODA		6	4	22						8		1		16
BRYOZOA							?							
ANNELIDA														
Tubificidae		182	1,375	482	1,551	41	1	3	5	34		176	4	104
Naididae		85	303	274	3,550	75	1		4	35		35		
Hirudinea		25	2		3	2	1							
CRUSTACEA														
Cladocera		3	1		147	305								
Copepoda-Calanoida		318	390	7	132	8					1			
Copepoda-Cyclopoida		7			4									
Isopoda				1										
<u>Hyalella azteca</u>		299	54	1	6									
COLLEMBOLA			8		2									
EPHEMEROPTERA														
<u>Baetis</u> spp.					1									
<u>Pseudocloeon</u>							4						1	
<u>Centroptilum</u>							1		2					
<u>Heptagenia</u> spp.							10	1	1					
<u>Stenacron</u>			5		7									
<u>Stenonema terminatum</u>							1							
<u>Stenonema</u> spp.							39	1						
<u>Heptageniidae</u>			3								4		1	
<u>Tricorythodes</u>			1				37		1	2	1			
<u>Caenis</u>		8	3			3	43	7	4	53	2		1	
<u>Potamanthus</u>						5	39	4	1				2	
<u>Hexagenia</u>				1	11					7				
<u>Ephoron album</u>						2		1						
<u>Ephemeridae?</u>									33					
ODONATA														
Gomphidae (early instars)										1				
HEMIPTERA														
<u>Palmacorixa gilletei</u>										1				
<u>Sigara alternata</u>		1												
<u>S. grossolineata</u>														
<u>Trichocorixa borealis</u>		1												
<u>T. naias</u>		1												
Corixidae - immatures					50	1								
MEGALOPTERA														
Sialis			5											
COLEOPTERA														
<u>Dubiraphia</u> (L)b			19		3				1	55				
<u>Stenelmis vittipennis</u> (A)							2						1	
<u>Stenelmis</u> (L)		1					10			1			2	
Coleoptera (early instars)				1						1				

Table 11. Continued.

Taxon	Sector: RM: Substrate^b:	2 319.5 CL	2 318.1 GR,SI	2 312-311.5 MU,SA	3 303.1 SI,DET, SA	4 289.05 CL,SA, GR	7 243.9 R,GR	8 243.2 GR,SA	8 243.2 GR,SI	8 243.1 DET,MU	9 198 SA	13 108 CL,SA, DET	13 98 GR,SA,	13 69.5 SA,GR, MU
TRICHOPTERA														
Cheumatopsyche			1		17	1	74				4			
Hydropsyche bidens							36						3	
H. frisoni?							5							
Hydropsyche spp.											3			
Potamyia flava							81			1			350	1
Hydropsychidae (early instars)								35		1	4			
Cyrnellus fraternus							2							
Neureclipsis		1												
Polycentropidae (early instars)						1								
Mayatrichia ayama							21				1			
Ceraclea							7			1				
Oecetis							4							
Leptoceridae										9				
DIPTERA														
Hexatoma											3		1	
Chaoborus				24										
Simulium spp.					79									
Tanypus		6	2	19	1									
Procladius				10	51	1			8	1				
Ablabesmyia					2					5				
Thienemannimyia grp.		3					11		1					
Monodiamesa depectinata											1			
Cricotopus bicinctus grp.			2		9									
C. sylvestris grp.		23												
Parametriocnemus							1							
Smittia														1
Lopescladius											33		2	
Thienemanniella sp. 1			3		1									
T. sp. 2							2							
Epoicocladius				1										
Nanocladius spp.			1				1						1	
Glyptotendipes decorus		222	12		3		2							
Chironomus grp.		42	139		112	5		2	68			10		1
C. plumosus grp.												5		
Chironomus spp.				30	102	2				8				
Dicrotendipes nervosus		8												
D. neomodestus		7					1							
Cryptochironomus spp.		16	25		3	21		1	2	3	1	1	1	1
C. macropodus											48		4	
Chernovskiia											46			3
Parachironomus arcuatus grp.		14												
P. frequens grp.							30							
Cladopelma				2	2									
Cryptotendipes			2		1	1								
Robackia											3			
Paracladopelma spp.											14			2

Table 11. Continued.

Taxon	Sector: 2 RM: 319.5 Substrate[b]: CL	2 318.1 GR,SI	2 312-311.5 MU,SA	3 303.1 SI,DET SA	4 289.05 CL,SA GR	7 243.9 R,GR	8 243.2 GR,SA	8 243.2 GR,SI	8 243.1 DET,MU	9 198 SA	13 108 CL,SA,	13 98 GR,SA DET	13 69.5 SA,GR, MU
DIPTERA													
Saetheria reissi							10						
Paratendipes albimanus						2							1
Paratendipes connectens?										34			
Paralauterborniella		1						5	3				
Pseudochironomus												1	
Endochironomus nigricans	11												
Stictochironomus								1					
Polypedilum illinoense									1				
P. convictum					4	23			1			4	
P. laetum												1	
P. griseopunctatum					78		2		12		1		
P. digitifer								19					
P. acifer							15					1	
P. scalaenum grp.	3	9			66	15	22		4	1		8	
P. simulans?		15	3	2									
Chironomini spp.	4					1							
Cladotanytarsus mancus grp.	2	3			43							1	
Tanytarsus spp.	5	16	1									15	
Virgatanytarsus						1	2						
Paratanytarsus	9												
Rheotanytarsus	10	2		9								24	1
Unidentified pupae	15	5		1		2	1	2	1	1	2	3	2
Ceratopogonidae	7	1		1						22		1	
GASTROPODA													
Physa	13				1								
Ferrisia	2	1											
Unidentified		1											
PELECYPODA													
Sphaeriidae	48	86	50	7	6								2
Truncilla truncata					1								
Anadonta grandis	1												
Unidentified		1											
Total number	1,410	2,507	929	5,872	676	520	107	158	249	227	231	434	135
Mean number (n = 4)	352.5	626.8	232.3	1,468	169	130	26.8	39.5	62.3	56.8	57.8	108.5	33.8
Variance	40,377	12,145	13,984	385,306	7,843	932	234	478	1,420	1,551	807	313	339
Total volume (ml)c	1.52	1.33	0.91	1.93	0.29	0.88	0	0.08	0.55	0	0.36	0.25	0.11
Mean volume (ml) (n = 4)	0.38	0.33	0.23	0.48	0.07	0.22	-	0.02	0.14	-	0.09	0.06	0.03
Variance	0.011	0.013	0.012	0.033	0.002	0.001	-	0.0002	0.006	-	0.0006	0.0003	0.0003
Total number taxa	36	32	17	31	25	32	14	16	21	18	7	23	11

a R = rock, SI = silt; CL = clay; MU = muck; SA = sand; DET = detritus; GR = gravel.
b L = larva; A = adult.
c Excluding large clams.

Table 12. Invertebrate taxa collected in previous studies of the Minnesota River that were not collected in the MnDNR survey 1979-81.

Taxon	MDH[a]	ACE[a]	PCA[a]
INSECTA			
Ephemeroptera			
Leptophlebia		+	
Heterocloeon			+
Odonata			
Hetaerina		+	
Argia		+	+
Gomphus	+		
Dromogomphus			+
Plecoptera			
Pteronarcys		+	+
Phasganophora		+	
Hemiptera			
Belostoma		+	
Megaloptera			
Corydalus		+	
Coleoptera			
Helichus		+	
Trichoptera			
Polycentropus remotus			+
Stactobiella			+
Diptera			
Chironomidae			
Labrundinia			+
Zavrelimyia			+
Psectrotanypus			+
Larsia			+
Diamesa			+
Psectrocladius			+
Orthocladius			+
Cardiocladius	+		
Micropsectra			+
Cryptocladopelma			+

[a] MDH = Minnesota Department of Health 1964.
ACE = U.S. Army Corps of Engineers 1981.
PCA = Minnesota Pollution Control Agency 1979, 81.