Fish and Wildlife Resources of the Mississippi River from Lake Itasca to Lake Winnibigoshish

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Minnesota Department of Natural Resources
Division of Fish and Wildlife
Ecological Services Section

FISH AND WILDLIFE RESOURCES OF THE MISSISSIPPI RIVER FROM LAKE ITASCA TO LAKE WINNIBIGOSHISH

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GULF
OF MEXICO

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SUMMARY

A fish and wildlife resources survey of that portion of the Mississippi River headwaters extending from Lake Itasca to Lake Winnibigoshish was conducted during July of 1975. The Mississippi River outlets from Lake Itasca at an elevation of 1,467 feet above mean sea level, and drops 168 feet in elevation over a course of approximately 84 miles to Lake Winnibigoshish. Localized average stream gradients ranged from 0.1 to 14.9 feet per mile, while sinuosity values ranged from 1.2 to 3.2. Sand was the dominant stream substrate type, comprising up to 100 percent of the substrate in localized areas. Forty-one (41) species of aquatic plants were recorded during the survey, and the greatest species diversity and abundance of aquatic vegetation was noted downstream from Bemidji.

Substantial acreages of the headwaters area are in public ownership, and the dominant land use classification is forestry. Forested areas are typically coniferous or mixed conifer/hardwood types, and the most common components of these woodlands include tamarack, black and white spruces, balsam fir, red pine, jack pine, aspen and birch. Sixty-three (63) species of birds and four species of mammals were observed during the survey. During previous faunal surveys of this area, 111 species of birds, 52 species of mammals and 18 species of amphibians and reptiles have been recorded. The headwaters area represents the geographic breeding range limits for several species of birds and mammals.

The river's character is influenced by interjoinment with several lakes and impoundment by two dams prior to inleting into Lake Winnibigoshish. Impacts resulting from channel modification, erosion, and shoreline development were of minimal consequence. Surface waters of the river were hard and fertile; water quality characteristics common to the watershed and region. Data showed that Lake Bemidji, Wolf Lake, and Cass Lake were all in a eutrophic condition, and that significant percentages of the phosphorus and nitrogen loadings were attributable to known point sources.

A total of 1,727 fishes representing nine families and 36 species were caught during the survey. Twenty-two (22) of these 36 species were classified as small forage fishes and collectively they comprised 57 percent of the total catch. Eighty (80) percent of the total catch was comprised of cyprinid and percid species of fish. White suckers, rock bass and yellow perch were the three most abundant large fish species, and bigmouth and common shiners the two most abundant forage fish species. These species comprised 75 and 69 percent of their respective group catches. Sector abundances of fishes, as indicated by electrofishing catch rates, ranged from 8.0 to 157.6 fish per hour for large fishes, 3.0 to 864.0 per hour for forage fishes, and 37.4 to 936.0 per hour for all species combined. Fish species diversity index values (based on a comparison of the number of individual fishes and the number of species in a sample area; a higher value indicating an area well represented by several species of fish in the sample) ranged from 1.63 to 3.19 for the 10 sectors. The overall median value was calculated to be 3.56, which is substantially higher than the statewide median value and was attributed to the abundance of several species of forage fishes and yellow perch.

Sample catches from the 10 sectors of the study area were characterized by marked variations in fish species distribution, composition and abundance. None of the 36 species were caught at all 10 sectors, and only four of the large fish species and two of the forage fish species were caught at five or more of the 10 sectors. Sample catches from upstream sectors of the study area were mainly comprised of forage fishes, while samples from the downstream sectors were more variable in composition but often dominated by yellow perch. Several of the species samples were comprised entirely (or nearly so) of adult size fish.

This portion of the Mississippi River is of limited value for most species of game and sport fish. However, characteristics of the fishery noted during the survey show it to be quite typical of small headwaters streams.

INTRODUCTION

Previous Surveys

No previous fish and wildlife resource surveys of this scope have been conducted along this portion of the Mississippi River. Moyle's 1940 survey of the upper Mississippi River system included only that portion of the Mississippi River Headwaters Watershed upstream to Crosby in Crow Wing County. Johnson's 1965-67 fisheries survey of the Mississippi River extended from Grand Rapids to Brainerd, and Peterson's 1961 biological reconnaissance of the river extended from the Lake Winnibigoshish Dam to the Pokegama Lake Dam. In addition to these surveys, various biological aspects of the upper Mississippi River area have been studied under programs at the University of Minnesota's Itasca Biology Station and at Bemidji State University.

The Study Area

The study area is located in north-central Minnesota and includes that portion of the Mississippi River within the Mississippi River Headwaters Watershed (Figure 1) which extends from Lake Itasca to Lake Winnibigoshish. Following a general northeasterly course from its source at Lake Itasca in southeastern Clearwater County, the river flows for approximately 84 miles through portions of Hubbard and Beltrami Counties to Lake Winnibigoshish on the Cass-Itasca County line (Figure 2).

Methods

The 1975 survey was conducted in two phases. During the initial reconnaissance phase (July 2-17), the entire 84 miles of stream were canoed and physical characteristics and observations of vegetation and wildlife recorded on U.S. Geological Survey Topographic Maps. The study area was also divided into 10 sectors or similar reaches during this phase of the survey. Sector delineations were based on broad changes in stream physical characteristics and are listed in Table 1 (upstream locations) and shown on Figure 2.

During the second phase of the survey (July 18-25), portions of each of the 10 sectors except sector 2, were electrofished in order to determine fisheries characteristics. Accessibility to, and characteristics of the stream were important factors in determining electrofishing station locations. Electrofishing was completed with a 14 foot flat-bottom boat equipped with booms, a 230 volt gas operated generator, and a Smith-Root Type IV control panel that pulses direct current. Best results were obtained while operating the electrofishing unit at 60 pulses per second, 300-500 volts and 5-6 amps. Sector 2 was sampled with a hand-held seine. Table 2 contains a sector listing of the locations and lengths of electrofishing stations.

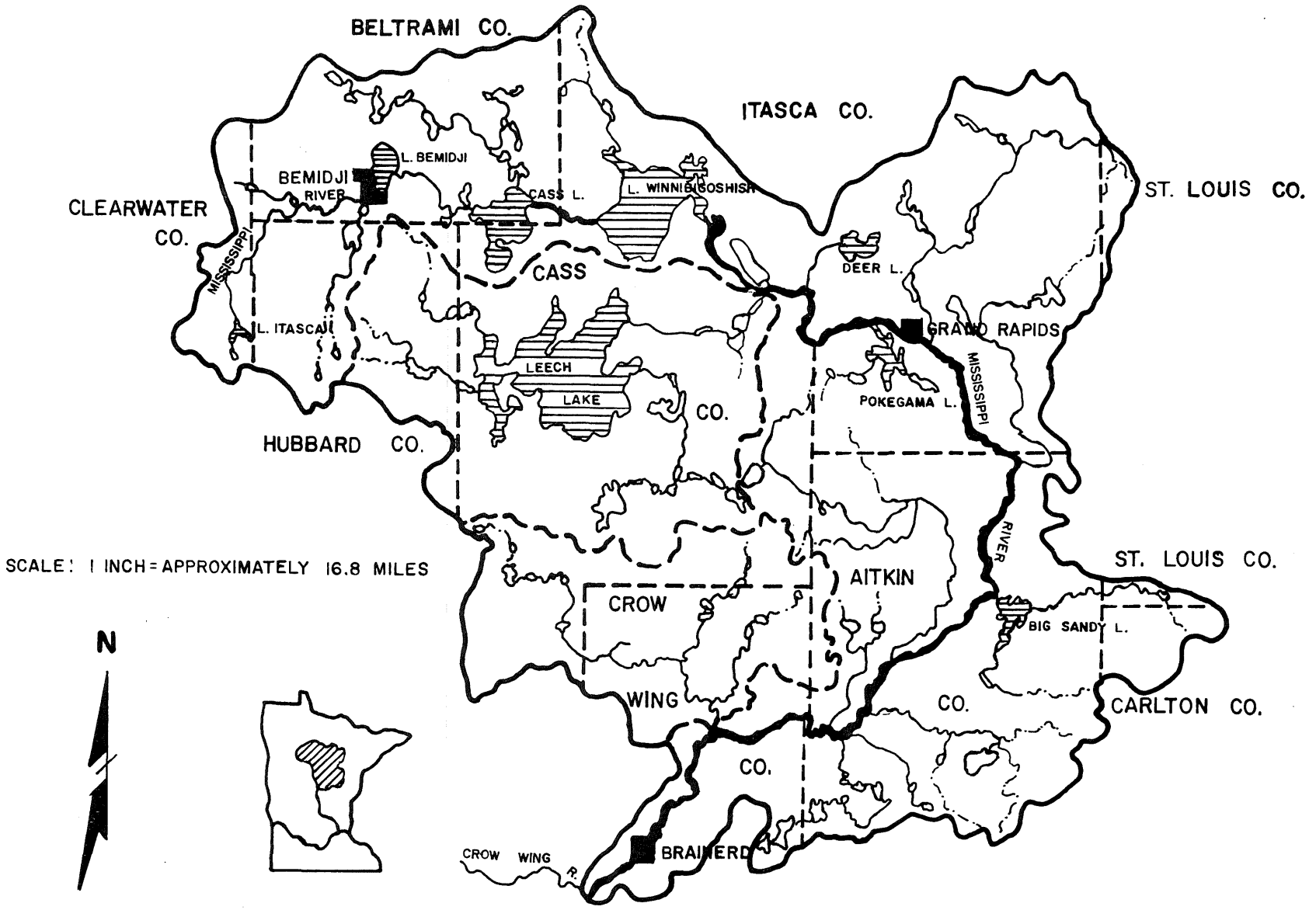


Figure 1: Mississippi River Headwaters Watershed.

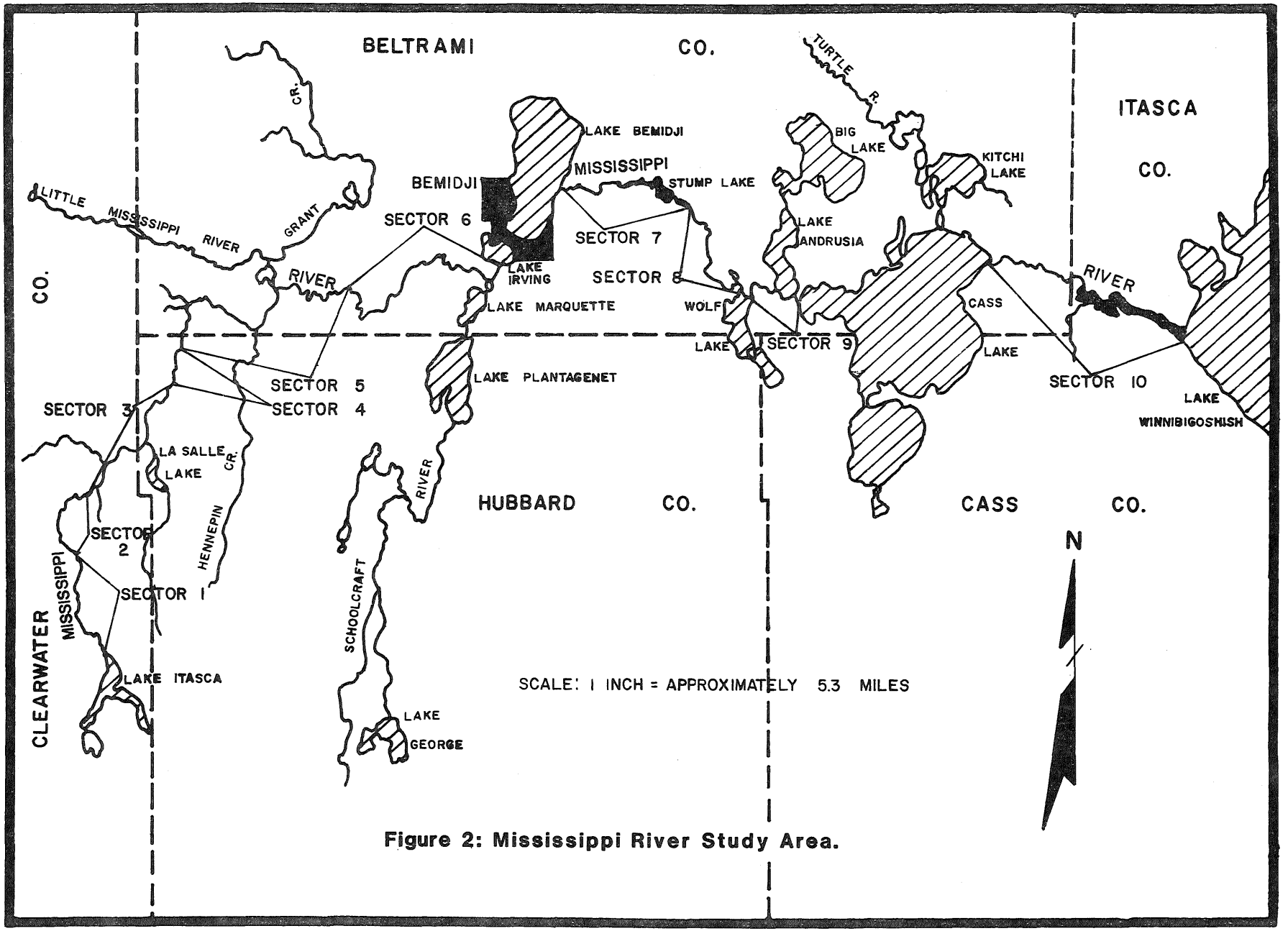


Figure 2: Mississippi River Study Area.

Table 1. Upstream locations and lengths of the 1975 survey sectors.

Sector	Upstream Location of Sector	Length (Miles)	Comments
1	SW ¼, Sec. 35, T. 144N., R. 36W	7.3	Outlet from Lake Itasca
2	SW ¼, Sec. 9, T. 144N., R. 36W.	3.1	
3	SW ¼, Sec. 36, T. 145N., R. 36W.	11.4	
4	SW ¼, Sec. 8, T. 145N., R. 35W.	1.7	
5	SW¼, Sec. 5, T. 145N., R. 35W.	21.6	
6	NW ¼, Sec. 28, T. 146N., R. 34W.	13.1	Excludes L. Irving and Bemidji
7	NW ¼, Sec. 16, T. 146N., R. 33W.	5.9	
8	SW ¼, Sec. 3, T. 146N., R. 32W.	6.2	Excludes Wolf Lake
9	SE ¼, Sec. 25, T. 146N., R. 32W.	2.7	Excludes Lake Andrusia
10	NE ¼, Sec. 21, T. 146N., R. 30W.	10.5	Excludes Cass Lake

Table 2. Locations and lengths of the 1975 electrofishing stations.

Sector	Electrofishing Station	Station Location	Length (ft.)
1	1	Sec. 22, T. 144N., R. 36W.	1,200
2	2 (seined)	Sec. 4 & 9, T. 144N., R. 36W.	400
3	3a	Sec. 30 & 19, T. 145N., R. 35W.	1,210
3	3b	Sec. 18 & 19, T. 145N., R. 35W.	1,600
4	4	Sec. 8, T. 145N., R. 35W.	1,600
5	5a	Sec. 32 & 33, T. 146N., R. 35W.	2,400
5	5b	Sec. 28 & 29, T. 146N., R. 34W.	2,800
6	6	Sec. 20 & 21, T. 146N., R. 33W.	4,200
7	7a	Sec. 6 & 1, T. 146N., R. 32 & 33W.	4,210
7	7b	Sec. 5 & 32, T. 146 & 147N., R. 32W.	3,600
8	8a	Sec. 3 & 10, R. 146N., R. 32W.	1,600
8	8b	Sec. 10, T. 146N., R. 32W.	3,800
8	8c	Sec. 22,23 & 26, T. 146N., R. 32W.	6,700
9	9a	Sec. 30,24 & 25, T. 146N., R. 21 & 32W.	7,600
9	9b	Sec. 29, T. 146N., R. 31W.	3,000
10	10	Sec. 21 & 22, T. 146N., R. 30W.	5,800

CHARACTERISTICS OF THE WATERSHED AND STUDY AREA

Topography, Geology and Soils

The headwaters watershed includes all of the area drained by the Mississippi River upstream from the confluence of the Crow Wing River in Crow Wing County; an area of approximately 7,068 square miles. Approximately 20 percent or roughly 1,400 square miles of the watershed drains into the Mississippi River upstream from Lake Winnibigoshish. The river's course within the watershed is roughly circular; its linear distance extending for 376 miles but its source at Lake Itasca located only 75 air miles northwest from the confluence of the Crow Wing River.

Lake Itasca is situated at an elevation of 1,467 feet above mean sea level (U.S.G.S. Topographic Map). From Lake Itasca the river meanders toward Bemidji through areas of bog and dense forest. From the vicinity of Bemidji the river flows eastward, again through densely forested areas and several headwaters lakes before entering Lake Winnibigoshish at an elevation of 1,299 feet above sea level. Surface topography over the watershed ranges from areas of minimal topographic relief characteristic of former glacial lakes, to areas of very rough hilly topography. Surface elevations over most of the watershed range from 1,300 feet to 1,500 feet above sea level, but are as high as 1,900 feet in the headwaters area. The watershed is traversed by several extensive terminal moraines which alternate with wide level areas of till and outwash plain.

Most of the watershed is covered by a mantle of glacial drift material ranging from 200 to 400 feet in thickness and underlaid by precambrian bedrock. Small scattered areas of bedrock outcroppings are present in the eastern portion of the watershed. The glacial drift consists of deposits of sandy to clayey-gray soils in the area upstream from Grand Rapids. Loam soils with limey-clay subsoils cover most of the swampy regions in the northern portion of the watershed. Light colored sandy soils with sand subsoils extend eastward in an east-west belt from the vicinity of Bemidji.

Land Use and Ownership

Land throughout the watershed is primarily forested. Agriculture has not been intensively developed because of the poor quality of surface soils. Considerable residential and water oriented recreational development is present around and near the headwaters lakes.

The federal, state and several county governments own a large proportion of the land area within the upper portion of the watershed. Private land ownership is the primary ownership status only within the vicinity of Bemidji. Approximately 60 percent of the river's corridor from Lake Itasca to the vicinity of Bemidji is in public ownership (mainly the Mississippi Headwaters State Forest, county and tax-forfeited lands) and much of the remaining 40 percent is corporately owned. Approximately 80 percent of the river's corridor from the vicinity of Cass Lake to Lake Winnibigoshish lies within the Chippewa National Forest.

Federal land holdings within the watershed include portions of the Chippewa National Forest and Rice Lake National Wildlife Refuge. State land ownership includes all or portions of 16 state forests, three state parks, numerous wildlife management areas and tax-forfeited tracts. County land ownership ranges from about nine percent in Beltrami County to nearly 20 percent in Aitkin and Cass Counties of their respective land areas.

GENERAL CHARACTERISTICS OF THE RIVER

Tributary Streams

Topographic maps show 28 tributaries to the Mississippi River within the study area, but only 13 of these tributaries have well defined inlets (listed in Table 3). The remaining 15 tributaries are located between Lake Itasca and Bemidji and enter the river valley where the floodplain is characterized by extensive areas of sedge bog.

Dams, Impoundments and Lakes

Two dams are located between Lake Itasca and Lake Winnibigoshish. The Ottertail Dam is a fixed crest structure with a 22 foot head which is owned and operated by the Ottertail Power Company and located approximately 6 miles downstream from Bemidji at the end of sector 7. The impoundment (Stump Lake) behind this dam extends 1.5 miles upstream and has a maximum depth of 24 feet. The Knudsen Dam is a stop log structure with a 4 foot head and is owned by the U.S. Forest Service and located at the outlet from Cass Lake (beginning of sector 10).

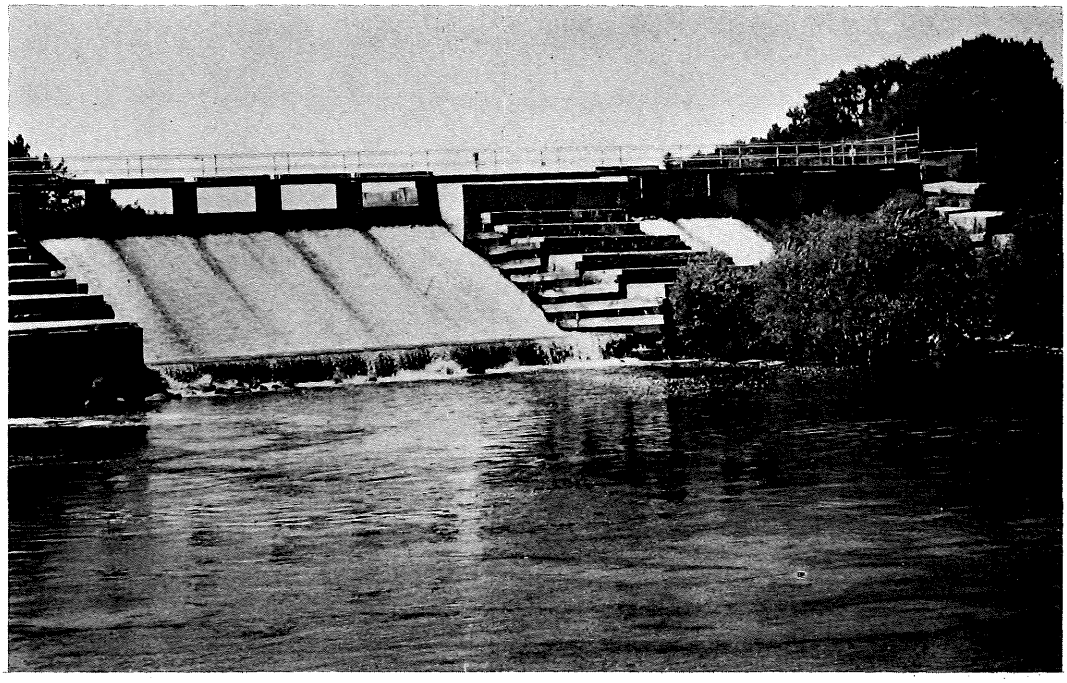
The Mississippi River flows directly through five lakes before inleting into Lake Winnibigoshish. These are Lakes Irving, Bemidji and Andrusia, Wolf Lake and Cass Lake and they range in size and maximum depth from 644 to 15,596 acres, and from 16 to 120 feet for Lake Irving and Cass Lake respectively.

Stream Alterations

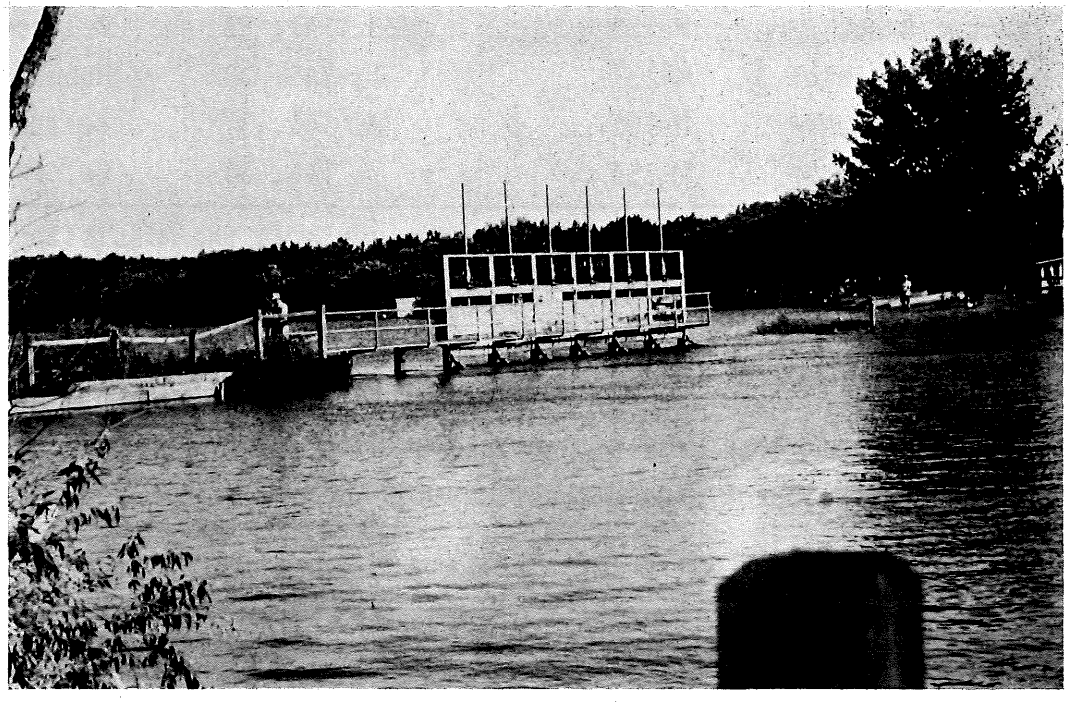
The only record of a major stream alteration found in Department of Natural Resources files was the excavation of a 600 foot channel for the construction of the Beltrami CSAH 5 bridge in sector 5. This alteration cut off approximately 900 feet of the natural stream channel.

Erosion and Pollution

Stream bank erosion was noted in 6 of the 10 sectors during the survey. Except for the area immediately downstream from Lake Bemidji in sector 7, bank erosion was estimated to occur along less than one percent of the river's shoreline. Natural slumping of steep sandy banks was the major cause of bank erosion. Bank erosion noted in sector 7 was mainly concentrated along an area of residential shoreline development.



Ottertail Dam located at the downstream end of sector 7.



Knudsen Dam located at the upstream end of sector 10.

Table 3. Tributary streams of the Mississippi River from Lake Itasca to Lake Winnibigoshish.

Sector	Name	Tributary Number 1/	Location of Mouth (Sec.,T.,R.)	County
1	Sucker Creek	M-167	27, 144, 36	Clearwater
2	Unnamed Creek	M-166	4, 144, 36	Clearwater
3	Unnamed Creek	M-165	35, 145, 36	Clearwater
3	Bear Creek	M-164	26, 145, 36	Clearwater
3	LaSalle Creek	M-163	19, 145, 35	Hubbard
5	Unnamed Creek	M-162	34, 146, 35	Beltrami
5	Little Mississippi River	M-161	25, 146, 35	Beltrami
5	Unnamed Creek	M-160	28, 146, 34	Beltrami
6	Schoolcraft River	M-159	20, 146, 33	Beltrami
7	Balsam Brook 2/	M-158	28, 147, 33	Beltrami
9	Wolf Lake Inlet 3/	M-157	1, 145, 32	Hubbard
9	Unnamed Creek 4/	M-156	8, 146, 31	Beltrami
10	Turtle River 5/	M-155	7, 146, 30	Beltrami

1/ DNR stream identification system: M identifies this as the Mississippi River System and 167 identifying Sucker Cr. as the 167th identified tributary of the Mississippi River upstream from the Iowa border.

2/ Inlet located on the west side of Lake Bemidji.

3/ Inlet located on the south side of Wolf Lake.

4/ Inlet located on the north side of Lake Andrusia.

5/ Inlet located on the north side of Cass Lake.

Two potential sources of pollution were noted during the survey. The first was a film of oil observed in the vicinity of a pipeline crossing in sector 3 (Sec. 35 of Bear Creek Twp.), and the second was the effluent from the Bemidji wastewater treatment facility into the upstream end of sector 7.

Natural slumping of a steep sandy bank in sector 6.

Shoreline Developments

Residential development of the river's shoreline was generally minimal and was the most heavily concentrated in the vicinity of Bemidji. Excluding the immediate Bemidji vicinity, commercial shoreline development consisted of seven resorts with associated boat launching and docking facilities; all located downstream from Bemidji in sectors 7, 9 and 10. Similar developments were also present around the headwaters lakes downstream from Bemidji. Recreational shoreline development consisted of six designated sites providing canoe access, picnicking and camping facilities; four located upstream from Bemidji in sectors 1, 3 and 5, one located near Wolf Lake in sector 8, and the Knudsen Dam Recreation Area located in sector 10.

Access

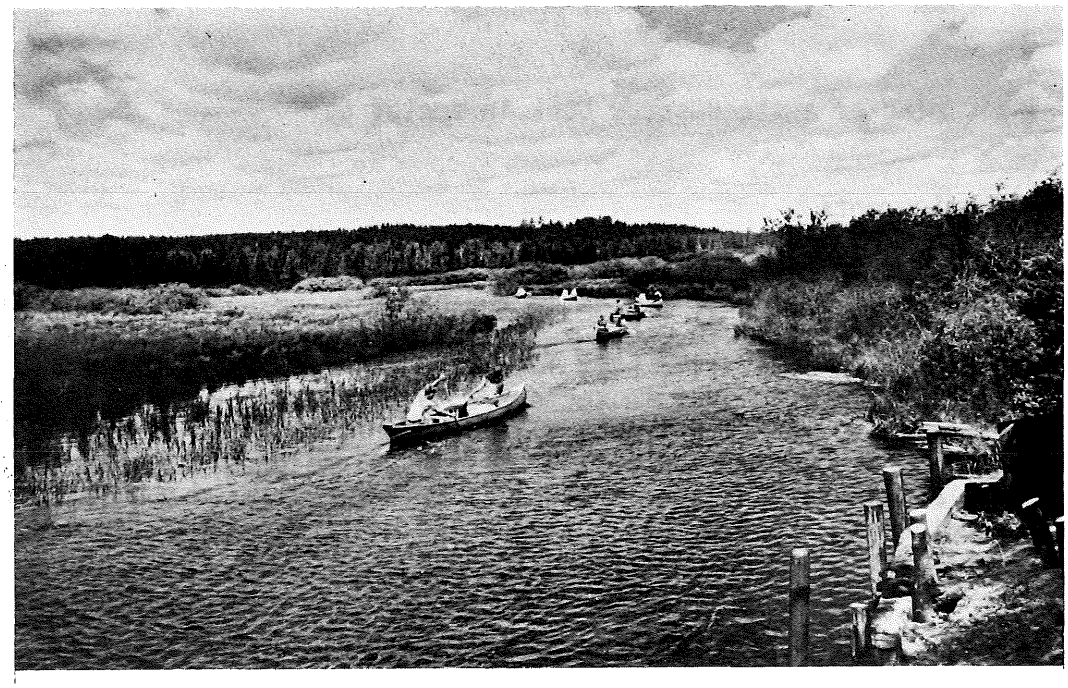
Boat access was generally restricted to the area downstream from Bemidji where the river was accessible from various sites (mostly private) around the headwaters lakes. In addition to these sites and the six designated recrea-

tion sites (Wannigan, Coffee Pot, Bear Den, Pine Point and Island Point Landings, and the Knudsen Dam Recreation Area), canoe access was available at a number of undeveloped sites located along the river. Table 4 contains a listing of many of the canoe access points, both developed and undeveloped, located between Lake Itasca and Lake Winnibigoshish.

Uses of the River

Primary uses of the river are for fish and wildlife habitat and several related non-consumptive water uses such as hunting, fishing, recreational boating and aesthetic enjoyment. Additional uses of the river include wastewater assimilation, biologically oriented educational and research programs, hydro power generation and wild rice harvesting.

Recreational boating is an important use of this portion of the river, but is generally restricted to canoe and small motorized watercraft. At normal stream stages, dense growths of submerged aquatic vegetation in sector 1 and numerous riffle areas in sector 2 can impede navigation. The Clearwater County Road 40 bridge is a navigational obstruction at high stream stages and the Coffee Pot Landing foot bridge obstructs navigation at normal stream stages (both are located in sector 3). Channel obstruction of portions of sectors 5 and 6, which results from the shifting of floating sedge bog, can occasionally impede navigation through these areas. Boating with either canoe or small motorized watercraft is normally unimpeded from the lower portion of sector 6 through sector 10. The only impediments to boating through this area are the two dams previously noted and a short segment of riffle area located downstream from the Ottertail Dam.



Canoeing party leaving Pine Point Landing - sector 5.

PHYSICAL CHARACTERISTICS OF THE RIVER

Free flowing portions of the stream increased in average width and depth

Table 4. Canoe access points along the Mississippi River from Lake Itasca to Lake Winnibigoshish.

Sector	Name	Location	Ownership
1	Clearwater CSAH 30	S. 34, T. 144N., R. 36W.	County
1	TH 200	S. 27, T. 144N., R. 36W.	State
1	Wannigan Landing	S. 22, T. 144N., R. 36W.	State
2	Clearwater CSAH 37	S. 4, T. 144N., R. 36W.	County
2	Clearwater CSAH 2	S. 35, T. 145N., R. 36W.	County
3	Clearwater CSAH 40	S. 26, T. 145N., R. 36W.	County
3	Coffee Pot Landing	S. 25, T. 145N., R. 36W.	State
4	State Forest Road	S. 5, T. 145N., R. 35W.	State
5	Bear Den Landing	S. 34, T. 146N., R. 35W.	State
5	Pine Point Landing	S. 25, T. 146N., R. 35W.	State
6	Iron Bridge Campground	S. 28, T. 146N., R. 34W.	State
6	Grant Valley Twp. Road	S. 24, T. 146N., R. 34W.	Township
7	Beltrami CSAH 19	S. 2, T. 146N., R. 33W.	County
7	Ottertail Dam	S. 3, T. 146N., R. 32W.	Utility
8	Beltrami CSAH 12	S. 3, T. 146N., R. 32W.	County
8	Island Point Landing	S. 14, T. 146N., R. 32W.	State
8	Beltrami CSAH 8	S. 23, T. 146N., R. 32W.	County
9	Beltrami CSAH 8	S. 25, T. 146N., R. 32W.	County
9	Beltrami CSAH 33	S. 29, T. 146N., R. 31W.	County
10	Beltrami CSAH 39	S. 22, T. 146N., R. 30W.	County
10	Public Access	S. 24, T. 146N., R. 30W.	Federal
10	National Forest Road	S. 24, T. 146N., R. 30W.	

with increasing distance from Lake Itasca. Average stream widths ranged from 25 feet near Lake Itasca to 200 feet near Cass Lake, and average stream depths ranged from two to six feet at these respective locations (see Table 5 for a listing of various physical characteristics). Stream stages observed during the survey were generally high.

Individual stream sectors were characterized by much variation in gradient and sinuosity. Stream gradients ranged from 0.1 feet per mile in sector 10 to 14.9 feet per mile in sector 2 and averaged 2.0 feet per mile for the entire study area. Average stream gradients were higher upstream from Bemidji than downstream (2.2 compared to 1.6 feet per mile) with much of the gradient change in the downstream sectors occurring at the Ottertail Dam. Figure 3 shows the stream channel gradient profile through the study area. The degree of natural channel meandering or sinuosity also varied markedly, and generally in an inverse relationship to stream gradient. The highest sinuosity value (3.2) was recorded for sector 5 where the river channel meandered across a broad floodplain. The lowest value (1.2) was recorded for the impounded, nearly straight stream channel through sector 7.

Sand was the dominant bottom substrate type observed during the survey, particularily in those sectors characterized by low stream gradient. Higher percentages of coarser substrates were generally associated with increasing gradients. Photographs contained in the text provide some perspective of various of the stream's physical characteristics.

Mean monthly flows recorded at the USGS Lake Winnibigoshish gauging station during 1975 ranged from 274 to 1,448 cfs, and averaged 940 cfs for the year (Table 6). This discharge rate was 1.82 times greater than the 91 year average annual discharge rate of 516 cfs.

Table 6. Mean monthly flows (cfs) from the Mississippi River during 1975 (Lake Winnibigoshish gauging station).

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Maximum	1010	1000	995	655	1030	1030	1040	1480	1450	1000	900	895
Minimum	924	995	767	120	122	1030	244	1320	996	800	895	891
Mean	998	998	918	274	573	1030	1064	1448	1296	889	897	893

1975 maximum discharge = 1,480 cfs

1975 minimum discharge = 120 cfs

1975 mean discharge = 940 cfs

Water temperature data gathered during the survey indicated surface water temperatures to fluctuate with ambient temperatures but generally to be slightly lower.

CHEMICAL CHARACTERISTICS OF THE RIVER

Surface waters within the study area are hard and fertile, and are generally

Table 5. Physical characteristics of the Mississippi River from Lake Itasca to Lake Winnibigoshish observed during July 1975.

Physical Characteristic	Sector				
	1	2	3	4	5
Date(s) surveyed	7-2	7-3	7-3	7-7	7-7,8
Water stage (high, normal, low)	high	high	high	high	high
Sector width (ft.)-Ave.(range)	35(30-50)	20(10-40)	25(10-40)	25(20-40)	40(25-55)
Sector depth (ft.)-Ave.(range)	2.5(1-8)	2(1-6)	3.5(1-9)	4(1-8)	(1-10)
Gradient (ft./mile)	2.3	14.9	1.5	2.9	1.0
Sinuosity value	1.6	1.6	2.2	1.2	3.2
Bank height (ft.)-Ave.(range)	1-2(0-20)	8(1-40)	1-2(0-20)	3-5(1-15)	2-3(0-30)
Percent banks eroded		<1	<1		<1
Percent of bottom substrate types:					
Muck (silt or detritus)			2		60
Sand	95	30	90	60	40
Gravel	5	25	8	20	
Rubble		40		20	
Boulder		5		<1	
Percent of bank cover types:					
Wooded	4	99	5	98	3
Wetland/sedge meadow/bog	95		95		97
Cropland (hay)					
Grassland	1	1		2	
Other					

Table 5 (Cont.). Physical characteristics of the Mississippi River from Lake Itasca to Lake Winnibigoshish observed during July 1975.

Physical Characteristic	Sector				
	6	7	8	9	10
Date(s) surveyed	7-9, 10	7-10, 15	7-15, 16	7-16	7-17
Water stage (high, normal, low)	high	normal	high	high	high
Sector width (ft.)-Ave.(range)	40(30-60)	150(60-200)	110(50-200)	90(70-300)	200(90-2000)
Sector depth (ft.)-Ave.(range)			6(---)	6(3-15)	
Gradient (ft./mile)	1.6	0.3	2.4	0.7	0.1
Sinuosity value	2.1	1.2	1.5	1.4	1.4
Bank height (ft.)-Ave.(range)	4(1-40)	5(1-40)	5(1-60)	2-3(1-35)	10-15(1-30)
Percent banks eroded		>1	<1		<1
Percent of bottom substrate types:					
Muck (silt or detritus)					
Sand	90	98	50	100	90
Gravel	10		30		9
Rubble			10		<1
Boulder		2	10		
Percent of bank cover types:					
Wooded	60	59	90	80	74
Wetland/sedge meadow/bog	20	40	9	20	25
Cropland (hay)	15		<1		
Grassland	5	1			
Other	<1	<1	<1	<1	1

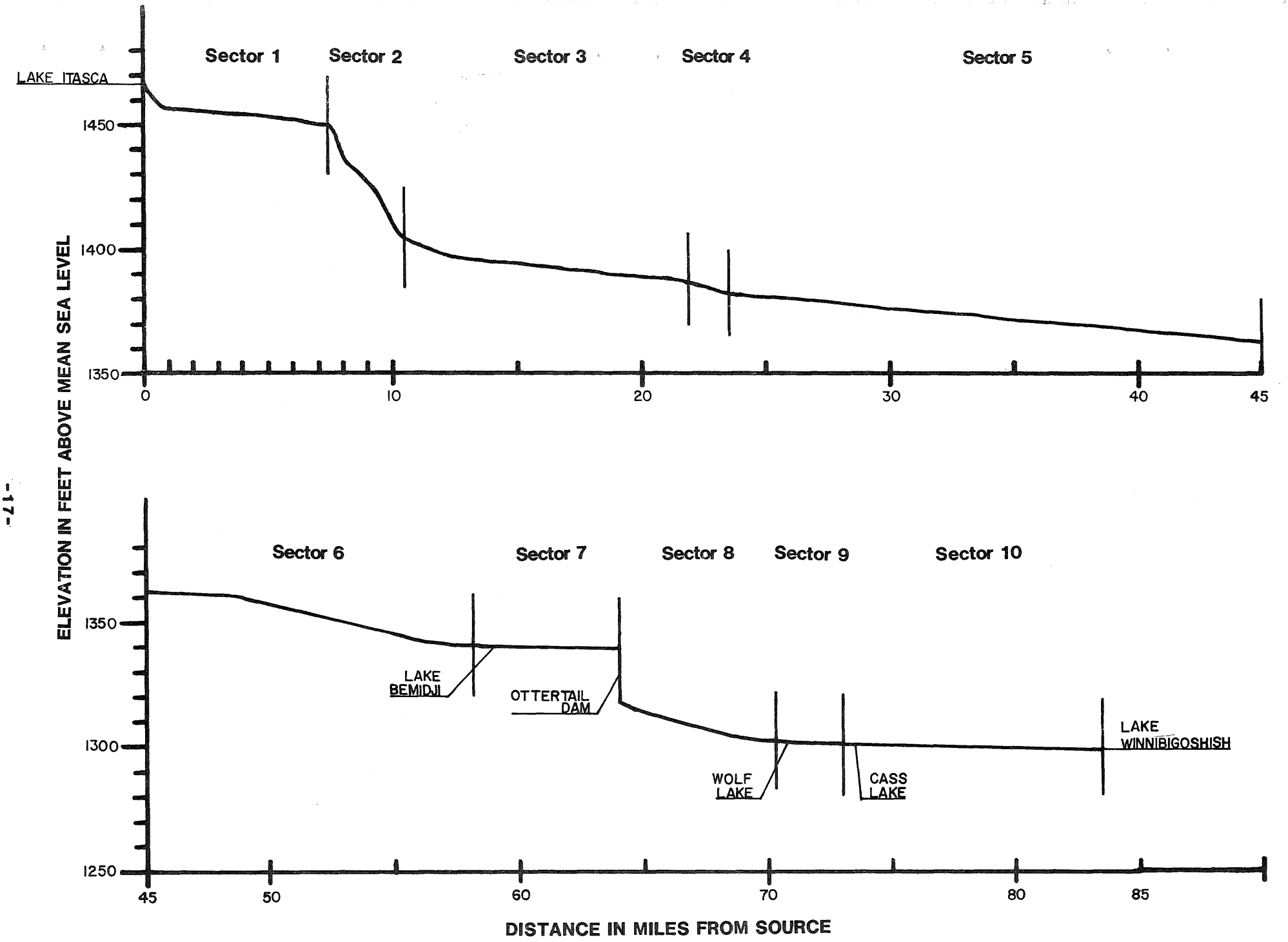


Figure 3: Stream Channel Gradient Profile of the Mississippi River from Lake Itasca to Lake Winnibigoshish.

characteristic of the quality of waters throughout the watershed and region. Data for a number of water quality parameters were gathered at approximately monthly intervals from sampling stations located near Lake Itasca and downstream from Bemidji during 1968 and 1975. Mean water quality values indicative of hardness exhibited only minor spatial and temporal variations (between sampling periods but not necessarily between sampling dates within each period). Mean values for parameters indicative of water fertility were generally higher at the sampling station located downstream from Bemidji and during the 1968 sampling period. Spatial and/or temporal variations in mean values were also observed for such parameters as pH, dissolved oxygen and B.O.D. Tables 7 and 8 summarize the range in values and mean values of the various parameters measured at the two sampling stations and during the two sampling periods. Water quality data were provided by the Minn. Pollution Control Agency (Raw Data Retrieval - Storet Retrieval Data 77/03/31).

Total alkalinity values at the Trunk Highway 200 sampling station located near Lake Itasca ranged from 140-180 and 170-230 mg/l respectively for the 1968 and 1975 sampling periods. Respective mean values at this sampling station were 163 and 184 mg/l. Corresponding values at the County State Aid Highway 8 sampling station located near the Ottertail Dam downstream from Bemidji were comparable during 1968 and slightly lower during 1975. Both the range and mean total alkalinity values observed during 1975 increased slightly over 1968 levels at both sampling stations. Mean 1975 values were 184 and 178 mg/l at the respective TH 200 and CSAH 8 sampling stations.

Total phosphorus concentrations, particularily those observed at the CSAH 8 station and during the winter months have exceeded the 0.1 mg/l concentration associated with algal blooms. No concentrations greater than 0.1 mg/l were observed in 10 samples from the TH 200 station, but concentrations greater than 0.1 mg/l were observed in 6 of the 10 samples from the CSAH 8 station during the 1968 sampling period. The higher phosphorus concentrations observed at the downstream station were at least partially attributable to nutrient loading from Bemidji's municipal wastewater effluent. This is suggested by water quality data gathered during 1972 by the Environmental Protection Agency in conjunction with the National Eutrophication Survey. The survey data indicated that Lake Bemidji, Wolf Lake, Lake Andrusia, and possibly Allen's Bay of Cass Lake were all in a eutrophic condition. Sources of phosphorus loading of these lakes were found to range from 100 percent non-point (primarily upstream non-point sources) for Lake Bemidji, to 49 percent point (indirectly attributable to Bemidji's wastewater effluent) for Wolf Lake. As phosphorus retention increased downstream, loading attributable to known sources decreased to 48 percent in Lake Andrusia and 34 percent in Cass Lake.

Total phosphorus concentrations observed during 1975 either remained similar to or decreased from 1968 levels. Although the 1975 concentration observed at the downstream station decreased by approximately 36 percent, the decrease was not significant. None of the 1975 samples exceeded the 0.1 mg/l concentration associated with algal blooms.

Mean organic nitrogen values recorded for both sampling stations and sampling periods were quite comparable. Both of the 1968 mean values were 0.51 mg/l while the 1975 values were 0.46 and 0.52 mg/l respectively for the

Table 7. The range in values and mean value of various water quality parameters measured at two sampling stations along the upper Mississippi River during 1968.

Parameter	Sampling Station			
	T H 200 (Clearwater Co.)		C S A H 8 (Beltrami Co.)	
	Range in Values	Mean Value	Range in Values	Mean Value
Water Temperature (^{o}F)	31.0-70.0	49.3	31.0-70.0	52.0
Specific Conductivity (micromhos/cm)	280-330	307	240-320	299
pH Value	7.3-8.2	7.7	7.6-8.7	8.2
Turbidity (Turbidometer - JTU)	0.5-12.0	4.1	1.0-17.0	6.7
Chlorine (mg/l)	<1.0-4.0	1.5	<1.0-5.7	2.5
Total Phosphorus (mg/l)	0.01-0.10	0.05	0.06-0.17	0.11
Ammonia Nitrogen (mg/l)	<0.05-0.22	0.10	0.05-0.18	0.11
Organic Nitrogen (mg/l)	0.18-0.78	0.51	0.05-0.79	0.51
Nitrite Nitrogen (mg/l)	<0.02-0.02	<0.02	<0.02-0.02	<0.02
Nitrate Nitrogen (mg/l)	<0.02-0.24	0.09	0.02-0.44	0.16
Dissolved Oxygen (mg/l)	5.8-12.8	9.2	7.8-14.9	11.8
B.O.D. - 5 day (mg/l)	1.3-3.3	2.0	1.5-4.0	2.7
Total Solids (mg/l)	180-240	210	180-230	223
Total Hardness (mg/l)	150-180	161	150-210	171
Total Alkalinity (mg/l)	140-180	163	140-180	163

Table 8. The range in values and mean value of various water quality parameters measured at two sampling stations along the upper Mississippi River during 1975.

Parameter	Sampling Station			
	T H 200 (Clearwater Co.)		C S A H 8 (Beltrami Co.)	
	Range in Values	Mean Value	Range in Values	Mean Value
Water Temperature (^{o}F)	32.0-72.0	46.5	32.0-71.0	48.4
Specific Conductivity (micromhos/cm)	270-390	311	270-370	301
pH Value	7.6-8.3	7.9	8.0-8.3	8.2
Turbidity (Turbidometer - JTU)	1.2-5.0	2.5	1.2-4.2	2.1
Chlorine	1-4	2.2	3-8	4.7
Total Phosphorus (mg/l)	0.03-0.09	0.05	0.05-0.10	0.07
Ammonia Nitrogen (mg/l)	<0.05-0.37	<0.14	<0.05-0.32	<0.13
Organic Nitrogen (mg/l)	0.30-0.72	0.46	0.27-0.80	0.52
Nitrite Nitrogen (mg/l)	<0.01-0.03	<0.05	<0.01-0.04	<0.02
Nitrates Nitrogen (mg/l)	<0.10-0.19	<0.11	<0.10-0.19	<0.11
Dissolved Oxygen (mg/l)	3.6-11.1	8.2	6.9-12.8	10.3
B.O.D. - 5 day (mg/l)	0.5-2.9	1.8	0.7-3.4	1.9
Total Hardness (mg/l)	160-220	174	150-200	176
Total Alkalinity (mg/l)	170-230	184	150-210	178

TH 200 and the CSAH 8 stations. Total nitrogen values (not shown in Tables 7 and 8) greater than the 0.1 mg/l level associated with algal blooms were observed in 2 of the 21, and 9 of the 22 samples collected from the respective upstream and downstream sampling stations (sampling periods combined). The National Eutrophication Survey data show the known point source levels of nitrogen loading to range from zero (100% non-point) for Lake Bemidji to 19 percent for Wolf Lake and 8 percent for Cass Lake.

Mean values for chlorine were higher at the CSAH 8 sampling station and during the 1975 sampling period. Values were 1.5 and 2.5 mg/l at the TH 200 station, and 2.2 and 4.7 mg/l at the CSAH 8 station for the 1968 and 1975 sampling periods. None of the mean values or monthly values exceeded the 10 mg/l concentration considered indicative of domestic or road salt pollution.

Water acidity/alkalinity (pH) mean values were slightly lower at the upstream sampling station during both sampling periods. No appreciable change in mean pH values between sampling periods were observed although the range in values observed at the CSAH 8 sampling station was much broader during the 1968 sampling period. The slightly more acidic condition of the upstream river reach results from the boggy characteristic of the contributing watershed. All pH values fell within the range considered to provide adequate protection for freshwater fish and bottom dwelling invertebrate fish food organisms (1976 Quality Criteria for Water).

Observed mean values for dissolved oxygen and B.O.D. were lower at the TH 200 station, and decreased from the 1968 to the 1975 sampling period. The higher dissolved oxygen values observed at the downstream station resulted from increased photosynthetic activity, which also accounted for the increased percentage of oxygen saturations (88.2% vs. 112.5% at the 63-74°F Temp. interval) observed at this station. Supersaturation was observed in 3 of the 21 samples from the upstream station and 8 of the 22 samples from the downstream station, and occurred more frequently during the afternoon when water temperatures were generally highest. Low dissolved oxygen concentrations (<5.0 mg/l) were observed in only 2 samples from the upstream station. The higher mean B.O.D. values observed at the downstream station resulted from the increased productivity level of the downstream river reach and the subsequent increase in biochemical demand.

The 1968 water quality data were collected when stream flows were near the 91 year average, while the 1975 data were collected when the average flow was considerably higher than the 91 year average. Total runoff measured at the Lake Winnibigoshish gauging station was 4.01 inches during the 1968 water year and 8.85 inches during 1975.

AQUATIC PLANTS, ALGAE, AND BOTTOM FAUNA

Twenty-one (21) species of submerged or floating-leaved aquatic plants and 20 species of emergent aquatic plants were noted during the survey (a sector listing of the species occurrences and relative abundances is included in Table 13 of Appendix A). Relative abundance designations used in Table 13 are: (A) abundant, (C) common, (O) occasional and (S) scarce. Commonly occurring species or groups of species included reed canary grass, wild rice, bulrushes, common cattail, arrowheads, pondweeds, coontail and duckweeds.

Aquatic plants were observed at all sectors but there was a noticeable variation in species diversity and abundance between sectors, particularily with respect to stream gradient and bottom substrate type and stability. Diversity and abundance generally increased as stream gradient decreased and bottom substrates stabilized. Sectors 2 and 4 exhibited the least diversity of plant species, and although average stream gradients through sectors 1, 3 and 8 were greater or near that of sector 4, species diversities were also greater. This likely resulted from the fact that in sectors 1, 3 and 8, much of the gradient occurred within localized portions of the respective sector. Relative abundances of aquatic plants increased as the availability of lentic habitats increased. With respect to this, Stump Lake and the remainder of sector 7 contained the greatest abundance of aquatic vegetation.

Algae was noted to be most abundant in the headwaters lakes located downstream from Bemidji. The increased relative abundance of aquatic plants and algae noted in the river reach resulted from several factors including increased availability of lentic habitats, low stream gradient and more stabilized bottom substrates, and increased nutrient levels.

Clams (Mollusca), stoneflies (Pleocoptera), mayflies (Ephemeroptera) and caddisflies (Tricoptera) were noted during the survey.

TERRESTRIAL VEGETATION

Much of the river's immediate corridor through sector 1 was characterized by a wet sedge meadow vegetation type. Bog birch was an important component of this type from Wannigan Landing downstream to the end of the sector. Adjacent corridor vegetation consisted mainly of black spruce, tamarack and balsam fir on mesic (wet) sites, while red pine occurred on the more xeric (dry) sites. Black spruce and tamarack with an understory of alder, red-osier dogwood and willow bordered the river throughout the lower portion of sector 1. White spruce and balsam poplar in association with trembling aspen, paper birch, green ash and red pine were the primary upland trees species of the lower portion of sector 1.

Sector 2 was characterized by a very narrow floodplain with upland vegetation generally extending to the river's edge. Trembling aspen, white spruce and balsam fir were the dominant tree species, while paper birch, green ash, American elm and jack pine occurred as associated species. Speckled alder and red-osier dogwood were the primary shrub species, while beaked hazel occurred occasionally.

The wet sedge meadow floodplain characteristic of sector 1 also characterized much of sector 3. Bog birch was replaced by willow which gradually decreased in stem density downstream through the sector. Black spruce and tamarack were the dominant tree species bordering the sedge meadow. Trembling aspen became an important component of upland woodlands in the downstream portion of the sector. The stream channel became restricted to a very narrow floodplain from Coffee Pot Landing downstream to the mouth of LaSalle Creek, and also near the end of the sector. Black ash, American elm, balsam poplar and jack pine were dominant components of adjacent woodlands along these restricted floodplain reaches.

Black ash dominanted the floodplain overstory corridor vegetation of sector 4, while green ash occurred commonly as an associated species. White spruce, trembling aspen and balsam poplar were the dominant tree species of adjacent upland woodlands, while red pine and jack pine occurred more commonly as components of these upland woodlands further downstream. Willows and red-osier dogwood were the dominant shrubs found throughout the sector.

Floodplain vegetation along the upper portion of sector 5 was similar in composition to what was noted for the lower portion of sector 3. Tamarack and black spruce were the principal floodplain tree species. Balsam poplar, American elm and jack pine were the principal components of adjacent upland woodlands. The floodplain from Pine Point Landing downstream to the mouth of the Little Mississippi River was more characteristic of marsh type habitat consisting of emergent vegetation interspersed with areas of open water than the wet sedge meadow type habitat which occurred further upstream. From the confluence of the Little Mississippi River downstream through the remainder of the sector, the river channel meandered across a broad floodplain of floating sedge bog.

Balsam poplar, trembling aspen, paper birch and green ash were the dominant upland woodland tree species along the upstream portion of sector 6. Red pine, jack pine and white spruce occurred as associated species. The sedge meadow characteristic of sector 3 became evident downstream from CSAH 7 and persisted to within 3 miles of Lake Irving (agriculture was a minor land use along this portion of the sector). At this point silver maple and box elder became the dominant floodplain tree species, while black ash, green ash and basswood occurred as associated species. Upland woodlands throughout the lower portion of sector 6 consisted mainly of jack pine and paper birch.

Woodlands throughout sector 7 consisted of mixed stands of upland hardwoods and conifers (paper birch, trembling aspen, red pine and white spruce) which generally extended to the river's edge. Shrubs occurring throughout sector 7 included willows, red-osier dogwood and beaked hazel. Black cherry, chokecherry and juneberry were also present.

Bottomland woodlands consisting mainly of black ash, American elm and green ash dominated the entire floodplain corridor of sector 8 (except for the last mile which was marsh). Upland woodlands throughout this sector were primarily a mixture of hardwoods and conifers consisting of trembling aspen, balsam poplar and paper birch with some red pine, jack pine and bur oak. Shrubs found throughout sector 8 included willows, alder, red-osier dogwood and hazel.

Except for several small wetland areas in sector 9, characteristic corridor vegetation was upland woodlands consisting of trembling aspen and bur oak. Red pine and jack pine occurred in scattered areas. Shrub species found throughout the sector included red-osier dogwood, willow, alder, wild rose and smooth sumac.

Terrestrial vegetation throughout sector 10 consisted of stands of either trembling aspen, balsam poplar, paper birch and bur oak, or upland hardwoods mixed with red pine and jack pine. Alder, willows, beaked hazel and red-osier dogwood occurred commonly throughout sector 10.

Many of the photographs on the following pages show characteristic aquatic, riparian and terrestrial vegetation types along the river. Table 13 in Appendix A also includes a sector listing of the relative abundances of terrestrial plant species noted during the survey.

FISHERY CHARACTERISTICS

Species Composition, Catch Rates and Size

Fourteen (14) species of large fishes and 22 species of forage fishes were caught during the survey (a sector listing of species occurrences is included in Table 13 of Appendix A). Large fishes comprised 43 percent (741) of the total of 1,727 fishes caught. Catch rates averaged 96.1 fish per hour for large fishes and 117.6 per hour for forage fishes. The overall average catch rate was 213.7 fish per hour for the nine sectors electrofished. Several of the large fish species samples were characterized by disproportionate percentages of adult, juvenile and young-of-the-year size fishes. Underhill and Dobie (1965) listed an additional six species of fish (longnose, pearl and finescale dace, banded killifish, brook stickleback and green sunfish) as occurring in the Mississippi River within the Itasca Park Region.

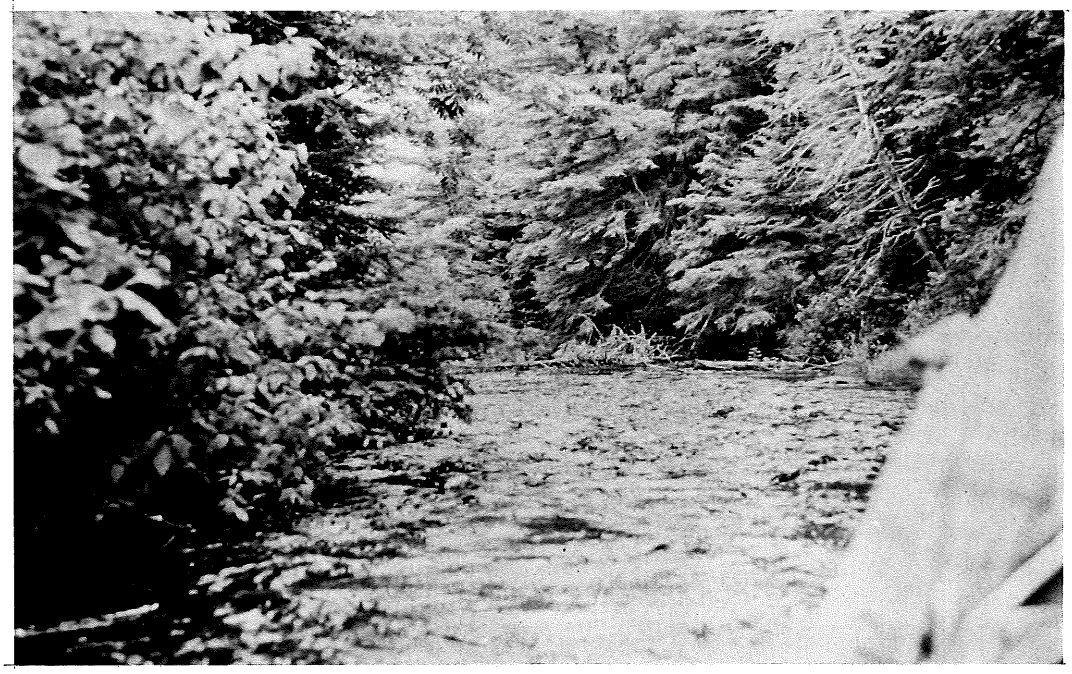
White suckers, rock bass and yellow perch were the three most numerous large fish species caught, and collectively they comprised 75 percent of the total catch by number and 63 percent by weight. Yellow perch numbers exceeded 52 percent of the total catch and white suckers comprised nearly 35 percent of the large fish species biomass. Six of the large fish species (black and yellow bullheads, burbot, largemouth bass, bluegill and walleye) each contributed less than two percent to the total number of large fishes. Eight of the 22 forage fish species caught during the survey were notropid shiners which collectively comprised over 76 percent of the total number. The common shiner alone comprised over 45 percent of the total number of forage fishes and nearly 59 percent of the notropid shiners. Fifteen (15) of the 22 forage fish species (central mudminnow, northern redbelly dace, bluntnose and fathead minnows, mimic, sand, spotfin, spottail and blackchin shiners, brassy minnow, tadpole madtom, log perch, Johnny and Iowa darters, and mottled sculpin) each contributed less than two percent to the total catch.

Combined large fish species catch rates (catch per unit of effort or CPE) ranged from 8.0 fish per hour at sector 1 to 157.6 per hour at sector 9 and averaged 96.1 per hour for the nine sectors electrofished. Catch rates for forage fishes were more extreme, ranging from 3.0 fish per hour at sector 5 to 864.0 per hour at sector 4. The average catch rate of forage fishes for the nine sectors electrofished was 117.6 fish per hour.

Length-frequency distribution data and size class composition data for the large fish species show the northern pike and yellow perch samples to consist of approximately 90 and 75 percent respectively of young-of-the-year and juvenile size fish. Ninety (90) percent of the rock bass caught were adult size fish, and all three bullhead species samples consisted of 100 percent adult size fish. No young-of-the-year northern redhorse were caught and only about five percent of the white sucker sample consisted of young-of-the-year size fish. The nine largemouth bass caught were all young-of-the-year size fish.

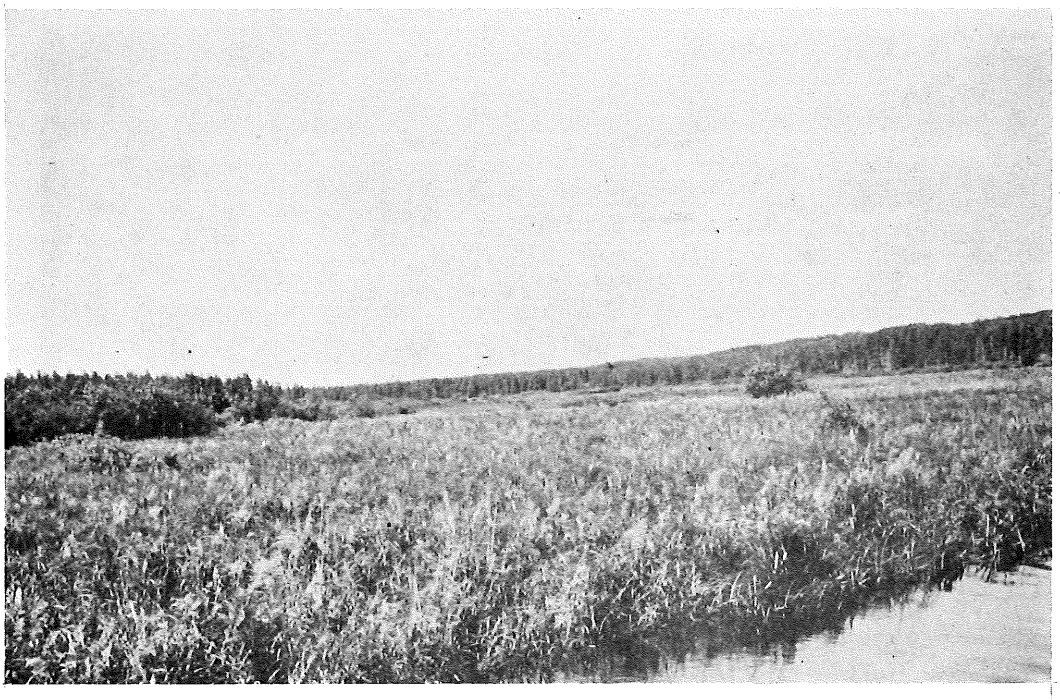
River and adjacent corridor near Trunk Highway 200 - sector 1.

River and adjacent corridor near Wannigan Landing - sector 1.



Segment of higher stream gradient - sector 2.

Narrow and meandered segment of stream channel characteristic of much of sectors 3 and 5.



Broad floodplain area characteristic of portions of sectors 1, 3, 5 and 6.

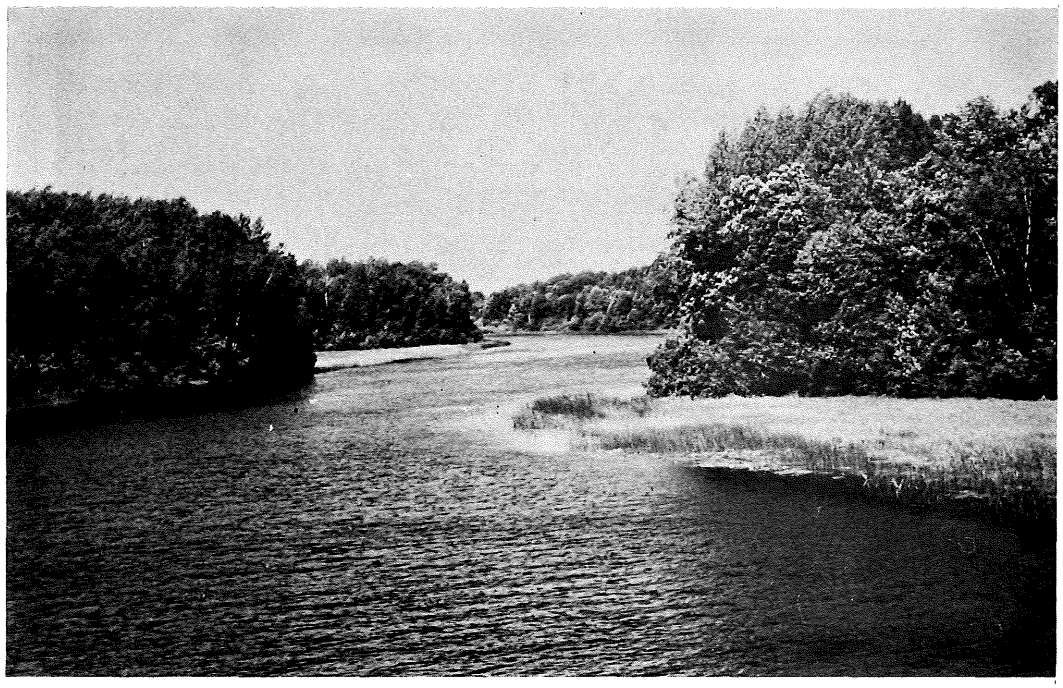
River and adjacent corridor near Coffee Pot Landing - sector 3.

Riparian vegetation characteristic of portions of sectors 2 and 4.

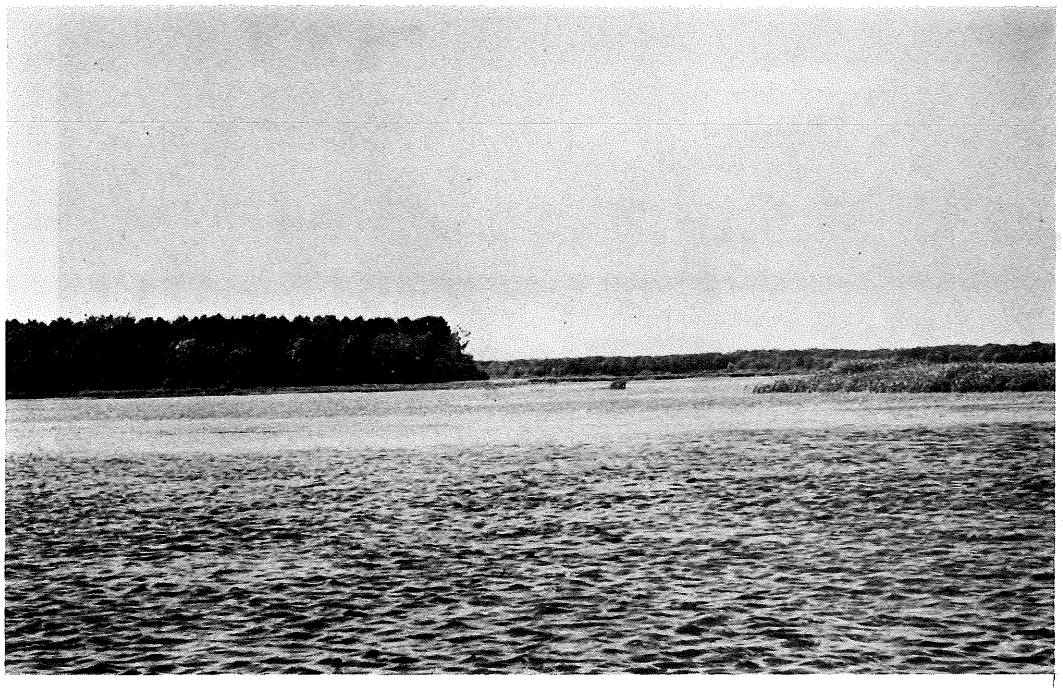
Aquatic vegetation characteristic of portions of sector 5.

Aquatic vegetation characteristic of much of Stump Lake - sector 7.

River and adjacent corridor downstream from the Ottertail Dam - sector 8.



River and adjacent corridor downstream from Cass Lake - sector 10.



Lower portion of sector 10 near Lake Winnibigoshish.

Table 9 summarizes the species composition by numbers and weight, the catch per unit of effort and the median length interval of each large fish species; and the species composition by numbers and CPE of each forage fish species. Table 9a summarizes the length-frequency distribution data for the large fish species. Tables 14-23 and 14a-23a in Appendix B are sector summarizations of the data shown in Tables 9 and 9a respectively. Figure 4 shows the percent large fish species composition by numbers and weight, and Figure 5 shows the sector catch rates of the large fishes. Figure 6 shows the size class compositions for 11 of the large fish species samples.

Species Composition Comparison with Statewide Average

Peterson (1975) calculated the average fish species composition of large warmwater rivers to consist of 71 percent Catostomidae and carp, 14 percent game fish such as northern pike, walleye and largemouth bass, five percent sport fish (sunfish, crappies and rock bass), nine percent other fish such as yellow perch, bullheads and freshwater drum, and a trace of small fishes such as minnows and darters. Diversity index values (excluding small fishes) for warmwater rivers usually ranged from 1.8 to 2.6, but in extreme cases ranged from 0.00 in a large polluted river to 3.54 in a small river. The overall median value for warmwater rivers was calculated to be 2.23. When small fishes were included in the calculations, diversity values increased about 10 percent above this median value for large warmwater rivers and about 30 percent for small warmwater rivers.

Species composition of electrofishing samples from the study area consisted of seven percent Catostomidae, three percent game fish, seven percent sport fish, 26 percent other fishes, and 57 percent small fishes. The combined sector diversity index value (excluding small fishes) was calculated to be 2.51 (Table 10). When small fishes were included in the calculation, the value increased to 3.56 (42% increase). These combined sector values were higher than those calculated by Peterson (1962) for the Mississippi River between Lake Winnibigoshish and the Pokegama Dam (2.51 vs. 2.09 and 3.56 vs. 3.17 respectively).

Distribution and Characteristics of the Fishery

From its source at Lake Itasca downstream to Lake Winnibigoshish, the Mississippi River underwent a transition in habitat conditions from those characteristic of a small stream to those characteristic of a medium sized stream. Accompanying this transition was a corresponding change in both the distribution and abundance of dominant fish species. Spatial distributions or sector occurrences for the majority of fish species were quite limited and in some instances were very restricted. None of the 36 species were caught at all 10 sectors. Only four of the 14 large fish species (northern pike, white suckers, rock bass and yellow perch) and two of the 22 forage fish species (northern creek chubs and common shiners) were caught at five or more of the 10 sectors. Three of the large fish species (black bullheads, largemouth bass and bluegills) and nine of the forage fish species (fathead minnows, mimic, spotfin, spottail and blackchin shiners, brassy minnows, log perch, Iowa darters and mottled sculpins) were each caught at only one of the 10 sectors.

Table 9. A summary of the fish species composition, catch per effort (CPE), and median length of fishes sampled during July 1975 - Mississippi River from Lake Itasca to Lake Winnibigoshish (9.7 miles and 7.68 hours electrofished, 15 electrofishing runs).

Species	Number	% by Number	Weight (lbs.)	% by Weight	CPE in Fish/hr.	Median Length (in inches)
Northern pike	34	4.6	26.5	9.2	4.2*	16.0-16.9
Northern redhorse	23	3.1	39.0	13.6	3.0	15.0-15.9
White sucker	99	13.4	99.1	34.6	12.9	10.5-10.9
Brown bullhead	20	2.7	17.8	6.2	2.6	10.5-10.9
Black bullhead	11	1.5	1.3	0.4	1.4	6.0- 6.4
Yellow bullhead	14	1.9	8.6	3.0	1.8	10.0-10.4
Burbot	8	1.1	2.2	0.7	1.0	10.5-10.9
Largemouth bass	9	1.2	0.3	0.1	1.2	<3.0
Rock bass	69	9.3	34.2	11.9	9.0	8.0- 8.4
Bluegill	5	0.7	1.0	0.3	0.7	6.0- 6.4
Pumpkinseed	31	4.2	2.0	0.6	4.0	3.5- 3.9
Black crappie	18	2.4	4.1	1.4	2.2*	5.0
Yellow perch	388	52.4	46.7	16.3	50.5	4.5- 4.9
Walleye	12	1.6	3.4	1.1	1.6	7.5- 7.9
Subtotals	741	100.0	286.2	100.0	96.1*	

Table 9 (Cont.). A summary of the fish species composition, catch per effort (CPE), and median length of fishes sampled during July 1975 - Mississippi River from Lake Itasca to Lake Winnibigoshish (9.7 miles, 7.68 hours electrofished, 15 electrofishing runs).

Species	Number	% by Number	CPE in Fish/hr.	Species	Number	% by Number	CPE in Fish/hr.
Central mudminnow	4	0.4	0.5	Spotfin shiner	3	0.3	0.4
Blacknose dace	32	3.2	2.6*	Spottail shiner	3	0.3	0.4
Hornyhead chub	68	6.9	8.5*	Blacknose shiner	33	3.3	3.2*
Northern creek chub	40	4.1	4.8*	Blackchin shiner	17	1.7	2.2
Northern redbelly dace	18	1.8	2.2*	Brassy minnow	3	0.3	0.4
Golden shiner	39	3.9	5.1	Tadpole madtom	4	0.4	0.5
Bluntnose minnow	11	1.1	1.4	Log perch	1	0.1	0.1
Fathead minnow	1	0.1	0.1	Johnny darter	6	0.6	0.8
Mimic shiner**	8	0.8	---*	Iowa darter**	2	0.2	---*
Bigmouth shiner	235	23.8	30.6	Mottled sculpin	2	0.2	0.3
Sand shiner	11	1.1	0.6*	Subtotals	986	100.0	117.6*
Common shiner	445	45.1	52.7*	Totals	1,727	100.0	213.7*

* Values exclude the sector 2 fish data

** Sampled in sector 2 only

Table 9a. A summary of the length-frequency distributions of the 14 large fish species sampled during July 1975 - Mississippi River from Lake Itasca to Lake Winnibigoshish.

Total Length in Inches	Northern pike	Northern redhorse	White sucker	Brown bull-head	Black bull-head	Yellow bull-head	Burbot	Large-mouth bass	Rock bass
<3.0								9	7
3.0 - 3.4			2						
3.5 - 3.9	2		1						1
4.0 - 4.4	3		2						1
4.5 - 4.9			4						
5.0 - 5.4	1		3		2				5
5.5 - 5.9	1		3		4		3		1
6.0 - 6.4	4		5		3				1
6.5 - 6.9	2	1	2		1				6
7.0 - 7.4			2		1				5
7.5 - 7.9			5			1			5
8.0 - 8.4		3	4			1			6
8.5 - 8.9	1	1	3	1		1			9
9.0 - 9.4		1	1	1		2			7
9.5 - 9.9		1	6	2		2			6
10.0 - 10.4			5	3		1			3
10.5 - 10.9			6	4		2	2		1
11.0 - 11.4				2		1	1		3
11.5 - 11.9			7	3			1		2
12.0 - 12.9			6	2		3			
13.0 - 13.9		2	1	1					
14.0 - 14.9	2	1	4	1			1		
15.0 - 15.9	1	2	2						
16.0 - 16.9	2	1	8						
17.0 - 17.9	6	5	7						
18.0 - 18.9	3	2	7						
19.0 - 19.9	3	3							
20.0 - 20.9			3						
21.0 - 21.9									
22.0 - 22.9	3								
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	34	23	99	20	11	14	8	9	69

Table 9a (Cont.). A summary of the length-frequency distributions of the 14 large fish species sampled during July 1975 - Mississippi River from Lake Itasca to Lake Winnibigoshish.

Total Length in Inches	Blue-gill	Pumpkin-seed	Black crappie	Yellow perch	Walleye				
<3.0	1	10	4	134	1				
3.0 - 3.4		3		13	2				
3.5 - 3.9		5		29	2				
4.0 - 4.4		3		10					
4.5 - 4.9	1	1	1	12					
5.0 - 5.4		3	6	30					
5.5 - 5.9		4	1	24					
6.0 - 6.4	1			30					
6.5 - 6.9	1	2		14	1				
7.0 - 7.4				19					
7.5 - 7.9			1	15	1				
8.0 - 8.4	1			19					
8.5 - 8.9			2	14					
9.0 - 9.4			1	8					
9.5 - 9.9				11					
10.0 - 10.4				1					
10.5 - 10.9				1	1				
11.0 - 11.4			1	1					
11.5 - 11.9			1	1	1				
12.0 - 12.9				2					
13.0 - 13.9					2				
14.0 - 14.9									
15.0 - 15.9					1				
16.0 - 16.9									
17.0 - 17.9									
18.0 - 18.9									
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30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	5	31	18	388	12				

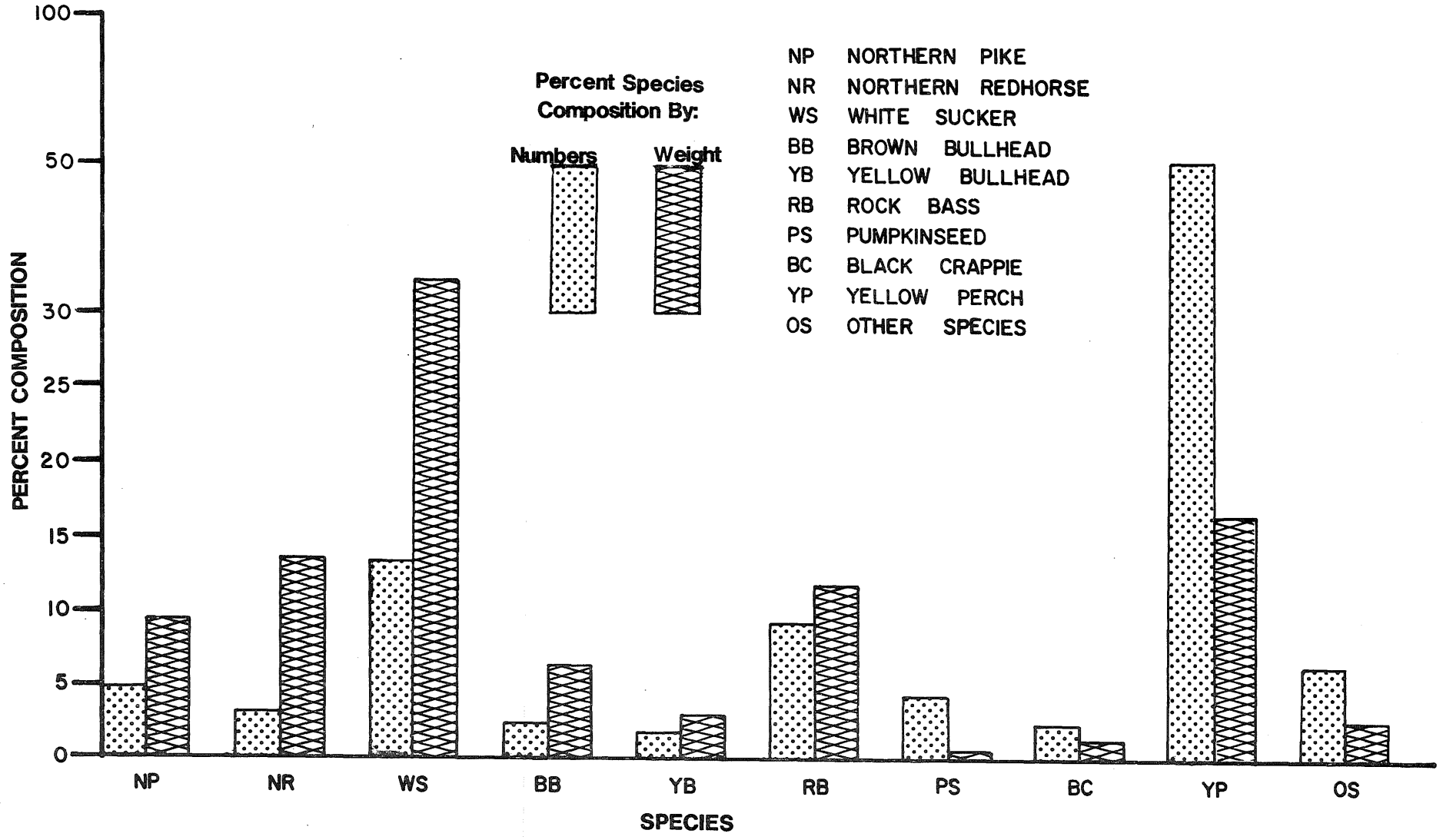

Figure 4: Percent Composition by Numbers and Weight (Sectors Combined) of the Large Fish Species Caught in the Mississippi River from Lake Itasca to Lake Winnibigoshish.

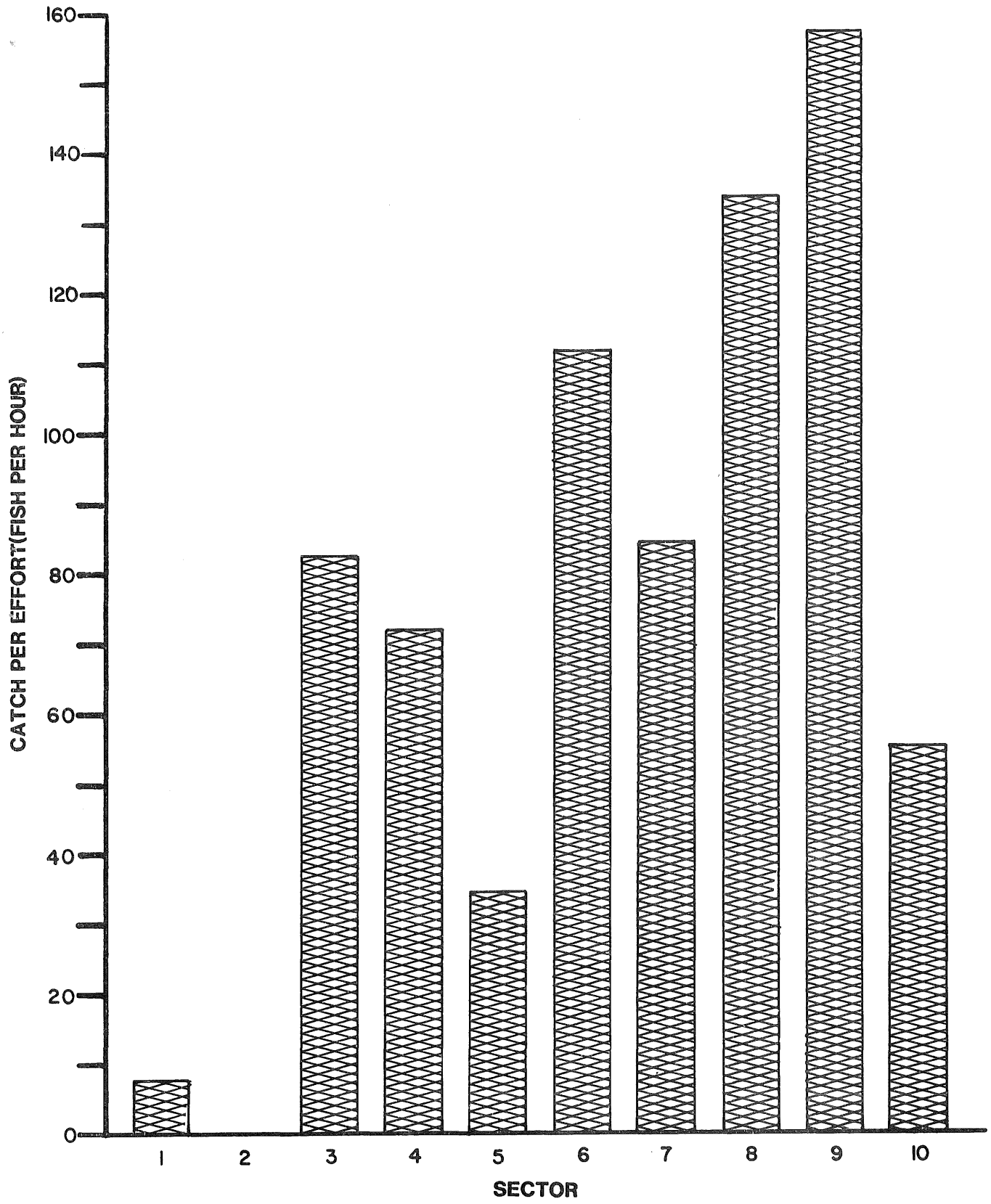

Figure 5: Combined Species Catch Per Efforts (by Sector) of the Large Fish Species Caught in the Mississippi River from Lake Itasca to Lake Winnibigoshish.

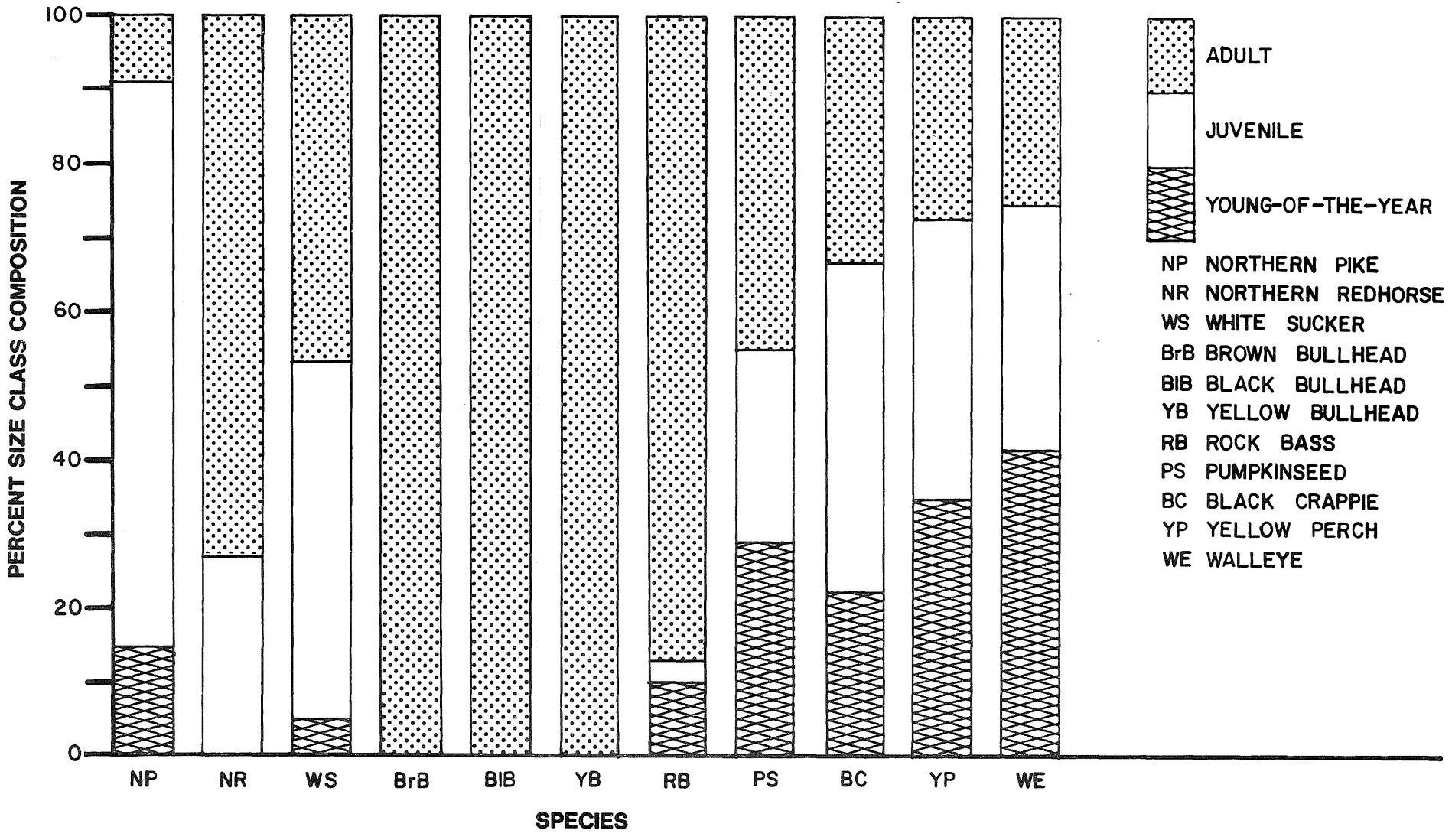

Figure 6: Size Class Structures of 11 of the Large Fish Species Caught in the Mississippi River from Lake Itasca to Lake Winnibigoshish.

Table 10. Diversity index values for the Mississippi River between Lake Itasca and Lake Winnibigoshish (from data gathered during July 1975).

Sector	$\overline{d}$ without Minnows	$\overline{d}$ with Minnows
1	0.00	1.91
2	0.92	2.55
3	1.54	2.54
4	1.40	1.63
5	1.81	2.07
6	1.10	1.64
7	2.41	3.15
8	1.61	2.12
9	1.80	2.06
10	2.63	3.19
Median	1.61	2.10
Combined	2.51	3.56

Northern pike, white suckers, rock bass and yellow perch were the four most widely distributed large fish species, and except for sectors 1 and 2 their distributions were quite uniform throughout the study area. Catch rate data for these four species indicated a definite increase in yellow perch abundance in the interconnected river lakes sectors (sectors 6-10), higher northern pike densities in sectors 3 and 4, and no apparent pattern of sector preference for either white suckers or rock bass. Data for the remaining eight large fish species (northern redhorse, brown, black and yellow bullheads, burbot, largemouth bass, pumpkinseeds, bluegills, black crappies and walleyes) indicated more restricted distributions, both in terms of sector occurrence and abundance. Except for black bullheads, the data did indicate higher densities in the interconnected river lakes sectors of all eight species.

Northern creek chubs and common shiners were the two most widely distributed forage fish species; common shiners being caught at nine of the 10 sectors and creek chubs at five sectors. Catch rate data for these two species indicated much higher densities in the headwaters sectors. Catch rate data for the remaining 11 forage fish species caught at more than one sector each (central mudminnows, blacknose dace, hornyhead chubs, northern redbelly dace, golden shiners, bluntnose minnows, bigmouth, sand and blacknose shiners, tadpole madtoms and Johnny darters) also indicated higher densities of mudminnows, both species of dace, creek chubs, blacknose and sand shiners, and darters in the headwaters sectors. Catch rates of golden and bigmouth shiners, bluntnose minnows and madtoms were higher in the interconnected river lakes sectors. Catch rate data available for those forage fish species caught at only one sector each (fathead minnows, spotfin, spottail and blackchin shiners, brassy minnows, log perch and mottled sculpins) indicated low densities.

Forage fishes comprised a high proportion of the total catch in sectors 1-4, a very low proportion in sectors 5 and 6, and an intermediate proportion in sectors 7-10. Forage fishes comprising 90.7 percent of the total catch, white suckers - 4.8 percent, northern pike - 3.2 percent, and centrarchids - 0.9 percent were the principal fishes present in sectors 1-4. Combined species catch rates for sectors 1-4 ranged from 337.9 to 936.0 fish per hour and averaged 620.6 per hour. The boggy, detritus habitat characteristic of sector 5 was dominated by white suckers, brown and black bullheads. Forage fishes comprised only 8.0 percent of the sector 5 catch, and the combined species catch rate totaled only 37.4 fish per hour. Forage fishes comprised a variable proportion of the sample catches from the interconnected river lakes sectors, ranging from 9.7 to 55.7 percent of the total catches. Although yellow perch was often the dominant species in the sample catches from these sectors (ranging from 12.7 to 71.0% and averaging 40.5%), game fish comprised 1.3 to 7.0 percent (averaging 3.2%), centrarchids comprised 2.7 to 25.3 percent (averaging 13.6%), suckers and redhorse comprised 3.1 to 10.1 percent (averaging 7.8%), and bullheads and other fishes comprised 0.0 to 19.0 percent (averaging 5.0%) of the samples. Combined species catch rates for sectors 6-10 ranged from 85.9 fish per hour to 356.0 per hour and averaged 170.2 per hour. Table 11 is a sector summarization of the percent composition and catch rates of various groups of fishes.

Table 11. The composition and catch rates of various groups of fishes electrofished from the Mississippi River between Lakes Itasca and Winnibigoshish during July 1975.

Sector	Large Fishes (Percent)							Forage Fishes	
	Game Fish	Centrarchids	Suckers & Redhorse	Yellow Perch	Bullheads & Other Fishes	Total	Catch Rate (No./Hr.)	Percent	Catch Rate (No./Hr.)
1			1.4			1.4	8.0	98.6	580.0
2 [1]/	2.3	1.2				3.5	[1]/	96.5	[1]/
3	9.7	1.0	12.2	0.5	1.0	24.5	82.6	75.5	255.2
4	0.9	1.3	5.5			7.7	72.0	92.3	864.0
5			24.0	8.0	60.0	92.0	34.4	8.0	3.0
6	3.2	8.1	8.1	71.0		90.3	112.0	9.7	12.0
7	7.0	25.3	3.1	33.6	1.7	70.7	84.2	29.3	34.9
8	2.2	11.6	9.8	55.8	1.3	80.8	134.0	19.2	31.8
9	1.3	2.7	7.9	29.3	3.1	44.3	157.6	55.7	198.4
10	2.5	20.2	10.1	12.7	19.0	64.6	55.5	35.4	30.4

[1]/ Seined

Discussion of the Fishery

The electrofishing data shows three prominent characteristics about the fishery. Firstly, several of the large fish species samples contained very disproportionate percentages of the various size classes of fishes. Secondly, the average fish species composition was significantly different from Peterson's calculated statewide average for warmwater rivers. Thirdly, the fishery was characterized by extreme sector variations in species composition and abundance.

Distorted size class structures were apparent for the three bullhead species, white sucker, northern redhorse, rock bass and the largemouth bass samples. In all cases except for largemouth bass, samples contained a much higher than expected percentage of adult size fishes. No attempt was made to determine whether the samples represented population characteristics of their respective species, but there are a number of factors which may explain the observed size class structures. These include inadequate sample size, inadequate sampling of habitat types, physical or chemical characteristics of the sampling area such as excessive depth or turbidity, or dense aquatic vegetation, inherent limitations of the electrofishing equipment, and differential vulnerability of fishes (with respect to species, size, habits, etc.) to the electrofishing equipment.

Although the percent species composition of this study area differed significantly from the statewide average composition, it does not appear to be inconsistent with Peterson's observations that small warmwater river habitats generally contain a greater number of small fish species, and that the numbers and percentages of large fishes generally increase as stream size increases. This is also consistent with species composition data from Peterson's 1962 study area and from Enblom's 1974 survey of the Mississippi River between St. Cloud and Fridley. In these two studies the percentages of small fishes in the samples decreased from 57 percent to 27.5 and 16.4 percent respectively. Conversely, the percentages of large rough fishes increased from seven percent in this study area, to 14.3 and 49.6 percent respectively in the downstream areas.

The unusually high percentages of other fishes observed in both this study area and Peterson's area (26 and 43.6% respectively) as compared to both the statewide average figure and to Enblom's study area (9.0 and 4.6% respectively) is attributable to the abundance of yellow perch. Their abundance in sectors 6-10 and in Peterson's study area is probably more indicative of the accessibility of several lakes containing very high percentages of perch in their fisheries, than of the suitability of the river habitats for perch. This is further suggested by gillnet data from several headwaters lakes (shown in Table 12) which shows yellow perch to comprise over 74 percent of the total catch. This compares to a statewide average gillnet catch composition consisting of about 25 percent perch.

In warmwater streams, diversity index values lower than 1.8 (exclusive of minnows) are usually associated with some type of environmental stress (Peterson 1975). Stress conditions may result from various chemical, physical or biological characteristics of the stream. Although the combined sector diversity index value (2.51 - exclusive of minnows) would not indicate a stress condition, several of the sector values and the median value would suggest the presence of some type of stress condition, particularily in the sectors upstream from Bemidji. Since this portion of the river remains virtually undeveloped and

Table 12. A comparison of gillnet catch data from several upper Mississippi River headwaters lakes.

Species	Carr Lake		Lake Irving		Lake Bemidji		Wolf Lake		Lake Andrusia		Cass Lake		Lake Winni.		Totals	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Whitefish					2	0.2					2	0.1			4	0.1
Northern cisco													131	15.5	131	2.1
Tullibee	13	59.1			71	6.1	33	3.2	57	6.6	112	4.9			286	4.5
Northern pike	2	9.1	9	8.3	50	4.3	49	4.7	40	4.6	84	3.7	68	8.0	302	4.8
Common shiner									2	0.2	16	0.7			18	0.3
Northern redhorse	1	4.5	3	2.7			3	0.3			6	0.3	7	0.8	20	0.3
White sucker			9	8.3	47	4.0	34	3.3	15	1.7	47	2.1	13	1.5	165	2.6
Brown bullhead					2	0.2	1	0.1	1	0.1	5	0.2			9	0.1
Burbot							4	0.4			1	<0.1			5	0.1
Largemouth bass											2	0.1			2	<0.1
Rock bass							6	0.6	7	0.8	48	2.1			61	1.0
Pumpkinseed									2	0.2	37	1.6			39	0.6
Yellow perch	5	22.7	79	72.5	905	77.7	777	74.3	661	76.4	1663	73.2	604	71.4	4694	74.2
Walleye	1	4.5	9	8.3	88	7.5	138	13.2	80	9.2	249	11.0	23	2.7	588	9.3
Totals	22	100.0	109	100.0	1165	100.0	1045	100.0	865	100.0	2272	100.0	846	100.0	6324	100.0

underutilized, any problems associated with a stress condition would most likely result from the stream's physical characteristics.

Physical conditions most likely to influence species diversity and organism abundance are bottom substrate type, stream bed slope, variations in stream flow, water temperature and turbidity (Peterson 1975). Such conditions may at least partially explain the observed sector variations in species composition, diversity and abundance since various reaches of the stream, and particularily the portion upstream from Bemidji, were characterized by fairly steep gradient, unstable substrate types and a corresponding lack of aquatic vegetation or boggy corridors and dense aquatic vegetation; or in general poor habitat quality and diversity. The disparities in species composition and abundance can further be attributed to natural characteristics of the stream, namely Peterson's observation that small warmwater rivers generally contain a greater number of small fish species and fishes, and the numbers and percentages of large fishes increase as stream size increases.

Records of Past Management

Records of fish removal and stocking for this portion of the upper Mississippi River date back to 1909 and except for a single stocking of 52,337 fingerling northern pike into the Mississippi River in Cass County, the entire management program has been directed toward the headwaters lakes. Records of fish removal and stocking for Lakes Irving and Bemidji, Wolf Lake, Lake Andrusia, Cass Lake and Lake Winnibigoshish are summarized in Table 24 of Appendix C for the years of 1970-1978.

Management records also indicate a general closure of the six headwaters lakes to dark house spearing from the mid 1940's to the early 1950's. This restriction was limited to the winter of 1949-50 on Cass Lake, and included only the portion of Lake Winnibigoshish in the Winnibigoshish Dam area. All fishing was prohibited from an area 300 feet above and below the Winnibigoshish Dam until 1972. Cass Lake and Lake Winnibigoshish are open to the netting of whitefish and tullibees. There are no records of fish habitat improvements for this reach of the Mississippi River.

WILDLIFE CHARACTERISTICS

Sixty-three (63) species of birds and four species of mammals were observed during the survey (their sector occurrences are listed in Table 13 of Appendix A). Hickey, Emlen, and Kendeigh (1965) listed 111 species of birds as breeding in recent years in the forests, lakes and bogs in and around Itasca State Park. Sargeant and Marshall (1959) listed 52 species of mammals known or suspected of occurring within Itasca State Park, and Lang and Marshall (1968) found 18 species of amphibians and reptiles to occur within the park.

Fifty-three (53) of the 63 species of birds observed during the survey were nongame species. This listing was represented by six species of raptors, five species of flycatchers, four species of swallows and four species of wood warblers. Hickey's (et al.) list of birds included 98 nongame species and was represented by 12 species of raptors, seven species of woodpeckers, eight species of flycatchers, six species of swallows and 18 species of wood warblers.

Game bird species included six species of ducks (mallard, blue-winged teal, American wigeon, wood duck, ring-necked duck and common goldeneye), ruffed grouse, coot, woodcock and common snipe. Waterfowl were observed most frequently from the lower portion of sector 6 through sector 10. Eighteen (18) broods of wood ducks, two broods of goldeneyes and one brood of mallards were observed in sector 7. No broods of teal, ring-necked ducks or wigeon were observed, but all three species are known to nest locally. The river and associated wetland habitats are reported to be well utilized by migrating waterfowl, particularily when and where wild rice is available. Hickey (et al.) listed three additional species of waterfowl (black duck, ruddy duck and hooded merganser) as nesting locally, and also spruce grouse, Virginia rail and sora rail as occurring within the area.

This portion of the upper Mississippi River area represents the geographic breeding range limits for a number of bird species, particularily those associated with boreal forest habitats. These species include the gray jay, boreal chickadee, Tennessee warbler, Cape May warbler, palm warbler, Connecticut warbler and Canada warbler. Bird species which have recently extended their ranges into the area include the red-shouldered hawk, yellow rail and sharp-tailed sparrow.

Only four species of mammals were observed during the survey. Sargeant and Marshall's list of mammals included 17 game and 35 nongame species. Game species included white-tailed deer, black bear and seven species of furbearers. Nongame species included 15 species of shrews, moles, pocket gophers and mice, six species of bats and eight species of squirrels. This portion of the upper Mississippi River area also represents the geographic range limits for several species of mammals, including both gray and fox squirrels, the plains pocket gopher, gray fox and the Eastern timber wolf. Recent data indicates that the Eastern mole, fisher and cougar may also inhabit the area.

Lang and Marshall's list of amphibians and reptiles known to occur in Itasca State Park included two species of turtles, the black-banded skink, four species of snakes, three species of salamanders, the American toad and seven species of frogs. No additional species are known for this region with the possible exceptions of the Blanding's turtle and the Eastern hognose snake (both species have been recorded in Cass County).

No species of animals listed as either endangered or threatened (unofficial state listing - The Uncommon Ones) occur within the area. The Eastern timber wolf is officially listed as threatened under the terms of the federal Endangered Species Act of 1973. Wildlife species which are known or suspected of occurring within the area, and which are included in The Uncommon Ones as animals in need of special consideration are the Eastern timber wolf, fisher, common tern, Cooper's hawk, bald eagle, osprey, western grebe and Blanding's turtle (species of changing or uncertain status); and the bobcat, common loon, great blue heron, pileated woodpecker, snapping turtle and common newt (species of special interest). None of the 36 species of fish which were caught during this survey and none of the six additional species listed by Underhill and Dobie for the Mississippi River are included in any of these listings.

CONCLUSIONS AND RECOMMENDATIONS

The Mississippi River emanates from Lake Itasca as a small stream, scarcely 20 feet wide and one-half foot deep; but increases in widths approaching one-half mile and depths exceeding 12 feet near Lake Winnibigoshish. This transition however, was not necessarily one of general gradualness. Although increases in stream width and depth through the reach extending from Lake Itasca to Bemidji were comparatively uniform, this reach was also characterized by lengthy segments of low gradient and boggy corridors alternated with segments of steep gradient and wooded corridors. Stream characteristics became discernibly different shortly downstream from Bemidji. Differences were primarily attributed to physical influences of impoundment and interjoinment with several lakes, and resulted in a stream reach characterized by decreased and more uniform gradient, irregularity in width and depth, and frequent segments of marshy floodplain. Differences in physical characteristics between these two reaches were accompanied by corresponding discernible differences in their fishery characteristics.

Survey results showed this uppermost portion of the Mississippi River, particularily the reach extending from Lake Itasca to Bemidji, to be of minimal value for most species of game and sport fishes; being essentially restricted to a low density northern pike population. Factors limiting habitat suitability of this reach for game and sport fish included.

1) Segments characterized by unstable substrates in relation to stream gradient. Substrate shifting inhibits establishment of aquatic macrophytes and invertebrates, and generally results in a habitat of extremely limited productivity.

2) Lengthy segments characterized by minimal gradient, boggy corridors, and extensive areas of dense aquatic vegetative growth. Such conditions periodically contribute to heavy organic loading, and as a result of natural biological processes, diurnal fluctuations in dissolved oxygen, carbon dioxide and pH levels can become extreme.

3) Instream flow regimes which probably result in periodic flow conditions below minimum required levels.

Game and sport fish habitat values of the river reach downstream from Bemidji did improve as evidenced by the increased percentages of these fishes comprising the sample catches. The area between Lake Bemidji and the Ottertail Dam does provide suitable spawning and nursery conditions for several species of centrarchids and northern pike. The Ottertail Dam tailwaters area has, historically, had a significant walleye spawning run (Strand, 1980). Investigation of walleye and white sucker spawning activities in this area indicated a high rate of egg mortality resulting from excessive current speed, and subsequent egg deposition on unsuitable substrates. A high mortality of eggs not lost through drift was also noted. This was attributed to excessive growths of filamentous algae and periphyton on the riffle substrate materials, which, at least partially resulted from effluent discharge from Bemidji's sewage treatment plant. Strand's investigations led to the conclusion that approximately one-third of the annual walleye production in the lake-river complex between the Ottertail and Knudsen Dams occurs in the river segments, but that the contribution from the Ottertail Dam tailwaters area was insignificant.

The grassy floodplain areas between Wolf Lake and Lake Winnibigoshish provide good northern pike spawning habitats. The high percentages of yellow perch comprising the sample catches are probably more the result of accessibility from several lakes containing high perch populations, than of the suitability of stream habitat conditions. Management opportunities for improvement of the game and sport fish fishery in the lake-river complex sectors are limited, due to the opportunity for interchange of fishes between areas. Areas which have been identified as valuable spawning habitats should be afforded protection from adverse impact. Furthermore, the river fishery will likely respond to management strategies applied to the interjoined lakes.

Water quality standards violations have been observed downstream from Bemidji. Dissolved oxygen levels have been noted to decrease sharply, and total phosphorus levels and fecal colliform bacteria levels have frequently exceeded standards. Such conditions have contributed to the eutrophication of several lakes downstream from Bemidji, and high percentages of the nutrient loadings have been traced to improperly treated effluent being discharged from Bemidji's wastewater treatment facility. Implementation of current proposals to either upgrade the existing level of effluent treatment prior to discharge, or to construct an on-land absorbtion system will reduce downstream loadings and resulting impacts.

Despite the river's conspicuous deficiency in the quality of habitat needed to support a viable game and sport fish fishery, particularily upstream from Bemidji, existing fishery characteristics are for the most part the result of natural conditions. Headwaters streams are typically dominated by forage fishes while harboring fewer species and lower densities of larger fishes; a characteristic which gradually reversed with increasing distance from its source.

The upper headwaters area of the Mississippi River is geographically situated in a very unique biotic region, being located near the southwestern terminus of the northern coniferous forest zone and in close proximity to both the eastern deciduous forest and tall-grass prairie zones. Although logging and fire resulted in conversion of extensive tracts of the original coniferous forest cover to second growth woodlands of mixed hardwood/conifer cover, floral and faunal components of this area remain most characteristic of the coniferous forest type. This area represents the breeding range limits for several species of birds and mammals associated with boreal forest habitats, and also for several species more commonly associated with deciduous forest or grassland habitats.

Resource exploitation of, and adjacent to this portion of the upper Mississippi River has been comparatively minimal, and consequently this area has retained much of its biological and ecological integrity. In addition, this area is of considerable recreational, educational and historical importance. Fruition of a current proposal to include most of the study area as part of a nearly 350 mile long component of the National Wild and Scenic Rivers System would surely help insure its primitive character and integrity.

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APPENDIX A

Table 13. Sector occurrences of the species of flora and fauna noted during the 1975 Mississippi River survey from Lake Itasca to Lake Winnibigoshish.

Common Name	Scientific Name	Sector									
AQUATIC PLANTS		1	2	3	4	5	6	7	8	9	10
Common cattail	*Typha latifolia*	A		O		C	A	C	C	C	A
Greenfruited burreed	*Sparganium chlorocarpum*	O				O	O	O			
Giant burreed	*Sparganium eurycarpum*	O				O	O	S		O	
Floatingleaf burreed	*Sparganium fluctuans*	O		O					O		
Claspingleaf pondweed	*Potamogeton Richardsonii*	C	O	O	C	O	O	A	C	C	C
Sago pondweed	*Potamogeton pectinatus*	C	S	S				C	A	C	C
River pondweed	*Potamogeton nodosus*	O	S	O		O	C			O	
Floatingleaf pondweed	*Potamogeton natans*	S				C	O	C			O
Bluntleaf pondweed	*Potamogeton obtusifolius*					C			C	O	C
Narrowleaf pondweed	*Potamogeton* spp.			O	O			A			C
Broadleaf pondweed	*Potamogeton* spp.							C			
Arrowhead	*Sagittaria* spp.	C		O	C	C	C			O	O
Canada waterweed	*Elodea canadensis*	C	O	O	C		S	A	O		C
Wild celery	*Vallisneria americana*	O		O	C	O					O
Wild rice	*Zizania aquatica*					C	C	C	O	O	A
Cane grass	*Phragmites communis*					C	A	A			
Rice cutgrass	*Leersia oryzoides*						C				
Reed canary grass	*Phalaris arundinacea*					A	A	A		C	C
Needle rush	*Eleocharis acicularis*	C		S							
Spikerush	*Eleocharis palustris*		O			C	C		C	C	C
Hardstem bulrush	*Scirpus acutus*							A	C	C	C
Softstem bulrush	*Scirpus validus*	A	O	O		C	A				C
River bulrush	*Scirpus fluviatilis*	C		O		C	C	O	C	C	C
Wild calla	*Calla palustris*	O						O			
Sweet flag	*Acorus calamus*					C	C	O	O		
Greater duckweed	*Spirodela polyrhiza*	C				O	C	A	C	C	C
Lesser duckweed	*Lemna minor*	C	S	O		C	C	A	C	C	C
Star duckweed	*Lemna trisulca*	C		O	O	O		A	C	C	
Blue flag	*Iris versicolor*	O		S	O	O		O	O		
Dock	*Rumex* spp.	O		S	S		O	S	S	O	
Smartweed	*Polygonum* spp.			O		C	C		O	C	C

Table 13 (Cont.). Sector occurrence of the species of flora and fauna noted during the 1975 Mississippi River survey from Lake Itasca to Lake Winnibigoshish.

Common Name	Scientific Name	Sector									
AQUATIC PLANTS		1	2	3	4	5	6	7	8	9	10
Coontail	*Ceratophyllum demersum*	A		O		C	C	A	C	C	
White waterlily	*Nymphaea tuberosa*	C					C	A	C	C	C
Yellow waterlily	*Nuphar variegatum*						C	C	C	C	C
Yellow water buttercup	*Ranunculus flabellaris*		S	O	C	S					
White water buttercup	*Ranunculus* spp.		S	O		O		A	O	O	
Marsh marigold	*Caltha palustris*							S	S		
Marestail	*Hippuris vulgaris*						O				O
Water milfoil	*Myriophyllum exalbescens*					O					O
Water parsnip	*Sium suave*							S			
Greater bladderwort	*Utricularia vulgaris*	S				O	S				
TERRESTRIAL PLANTS											
Ferns	POLYPODIACEAE				A				C		
Balsam fir	*Abies balsamea*		C	O	S			O			
Black spruce	*Picea mariana*	A		C	C	O					
White spruce	*Picea glauca*	C	C	O	O		O	O	O		O
Tamarack	*Larix laricina*	A		C	C	C	O	S			
White pine	*Pinus strobus*		S					O	S		O
Red pine	*Pinus resinosa*	O			O	S	S	O	O	C	C
Jack pine	*Pinus banksiana*		O	S		O	C	O	O	C	C
Grasses	GRAMINEAE	A	A	A	A	A	A	A	A	A	A
Sedges	CYPERACEAE	A		A	A	A		A	A	A	A
Willow	*Salix* spp.	A		A	A	A	A	C	C	C	A
Balsam poplar	*Populus balsamifera*	C		O	O	C	C	C	C	O	C
Trembling aspen	*Populus tremuloides*	O	C	O	O	O	O	C	A	C	C
Big-toothed aspen	*Populus grandidentata*							O			
Cottonwood	*Populus deltoides*							S			
Hazel	*Corylus* spp.		O				O	C	C		C
Ironwood	*Ostrya virginiana*							S			
Paper birch	*Betula papyrifera*	O	O	O	S	O	O	A	O	O	C

Table 13 (Cont.). Sector occurrence of the species of flora and fauna noted during the 1975 Mississippi River survey from Lake Itasca to Lake Winnibigoshish.

Common Name	Scientific Name	Sector									
TERRESTRIAL PLANTS		1	2	3	4	5	6	7	8	9	10
Bog birch	*Betula pumila*	A									
Alder	*Alnus* spp.	A	A	A	C	C	C		C	C	A
Northern red oak	*Quercus borealis*							C		S	O
Northern pin oak	*Quercus ellipsoidalis*								O	O	
Bur oak	*Quercus macrocarpa*					S	O	C	O	C	
American elm	*Ulmus americana*		O	O		O	O		O	O	
Meadow rue	*Thalictrum* spp.			O			O		O		
Canada anemone	*Anemone canadensis*	O			O		O				
Bloodroot	*Sanguinaria canadensis*		C								
Juneberry	*Amelanchier* spp.							O			
Strawberry	*Fragaria* spp.								C		
Cherry	*Prunus* spp.					S		O			
Wild rose	*Rosa* spp.	O								C	
Bramble	*Rubus* spp.	O					O				
Vetch	*Vicia* spp.			O					O		
Sumac	*Rhus* spp.						S			C	O
Sugar maple	*Acer saccharum*							C	S		
Silver maple	*Acer saccharinum*						A				S
Box elder	*Acer negundo*						C				
Mountain maple	*Acer spicatum*										O
Touch-me-not	*Impatiens biflora*			O							O
Basswood	*Tilia americana*						S	O	S	O	
Wild sarsaparilla	*Aralia nudicaulis*								O		
Red-osier dogwood	*Cornus stolonifera*	A	A	A	A	C	A	C	C	C	C
Round-leaved dogwood	*Cornus rugosa*								C		O
Black ash	*Fraxinus nigra*	O			A	O	A	O	C	O	O
Green ash	*Fraxinus pennsylvanica*	O	O	O			C	C	C	O	O
Milkweed	*Asclepias* spp.						C	O	C	C	O
Skullcap	*Scutellaria* spp.			O	S						
Harebell	*Campanula rotundifolia*						O		O		
Yarrow	*Achillea millefolium*						O	O		O	

Table 13 (Cont.). Sector occurrence of the species of flora and fauna noted during the 1975 Mississippi River survey from Lake Itasca to Lake Winnibigoshish.

Common Name	Scientific Name	Sector									
FISHES		1	2	3	4	5	6	7	8	9	10
Central mudminnow	*Umbra limi*			X						X	
Northern pike	*Esox lucius*		X	X	X		X	X		X	X
Blacknose dace	*Rhinichthys atratulus*	X	X	X	X						
Hornyhead chub	*Nocomis biguttatus*		X	X	X				X		
Northern creek chub	*Semotilus atromaculatus*	X	X	X	X		X				
Northern redbelly dace	*Chrosomus eos*	X	X								
Golden shiner	*Notemigonus crysoleucas*							X			X
Bluntnose minnow	*Pimephales notatus*							X		X	X
Fathead minnow	*Pimephales promelas*	X									
Mimic shiner	*Notropis volucellus*		X								
Bigmouth shiner	*Notropis dorsalis*						X			X	X
Sand shiner	*Notropis stramineus*		X	X							
Common shiner	*Notropis cornutus*	X	X	X	X	X		X	X	X	X
Spotfin shiner	*Notropis spilopterus*				X						
Spottail shiner	*Notropis hudsonius*									X	
Blacknose shiner	*Notropis heterolepis*	X	X								
Blackchin shiner	*Notropis heterodon*							X			
Brassy minnow	*Hybognathus hankinsoni*	X									
Northern redhorse	*Moxostoma macrolepidotum*				X		X		X	X	
White sucker	*Catostomus commersoni*	X		X	X	X		X	X	X	X
Brown bullhead	*Ictalurus nebulosus*					X		X		X	X
Black bullhead	*Ictalurus melas*					X					X
Yellow bullhead	*Ictalurus natalis*			X				X	X	X	
Tadpole madtom	*Noturus gyrinus*							X	X		
Burbot	*Lota lota*							X		X	X
Largemouth bass	*Micropterus salmoides*							X			
Rock bass	*Ambloplites rupestris*			X	X		X	X	X	X	X
Bluegill	*Lepomis macrochirus*							X			
Pumpkinseed	*Lepomis gibbosus*							X	X		X
Black crappie	*Pomoxis nigromaculatus*		X					X	X		
Yellow perch	*Perca flavescens*			X		X	X	X	X	X	X
Walleye	*Stizostedion vitreum*						X		X	X	

Table 13 (Cont.). Sector occurrence of the species of flora and fauna noted during the 1975 Mississippi River survey from Lake Itasca to Lake Winnibigoshish.

Common Name	Scientific Name	Sector									
FISHES		1	2	3	4	5	6	7	8	9	10
Log perch	*Percina caprodes*						X				
Johnny darter	*Etheostoma nigrum*			X			X				
Iowa darter	*Etheostoma exile*		X								
Mottled sculpin	*Cottus bairdi*				X						
BIRDS											
Common loon	*Gavia immer*	X					X				
Red-necked grebe	*Podiceps grisegena*										X
Great blue heron	*Ardea herodias*	X				X	X	X	X	X	X
Green heron	*Butorides virescens*						X	X			
American bittern	*Botaurus lentiginosus*	X				X					
Mallard	*Anas platyrhynchos*	X				X	X	X			X
Blue-winged teal	*Anas discors*	X				X					
American wigeon	*Anas americana*								X		
Wood duck	*Aix sponsa*	X	X			X		X		X	X
Ring-necked duck	*Aythya collaris*					X					
Common goldeneye	*Bucephala clangula*						X	X	X		X
Turkey vulture	*Cathartes aura*									X	X
Red-tailed hawk	*Buteo jamaicensis*			X		X	X		X		X
Broad-winged hawk	*Buteo platypterus*	X									X
Bald eagle	*Heliaeetus leucocephalus*										X
Osprey	*Pandion haliaetus*			X				X		X	
American kestrel	*Falco sparverius*			X							
Ruffed grouse	*Bonasa umbellus*		X								
American coot	*Fulica americana*										X
American woodcock	*Philohela minor*			X							
Common snipe	*Capella gallinago*			X			X				
Spotted sandpiper	*Actitis macularia*								X		
Black tern	*Chlidonias niger*			X		X	X	X	X	X	X
Rock dove	*Columba livia*			X							
Mourning dove	*Zenaida macroura*						X				

Table 13 (Cont.). Sector occurrence of the species of flora and fauna noted during the 1975 Mississippi River survey from Lake Itasca to Lake Winnibigoshish.

Common Name	Scientific Name	Sector									
BIRDS		1	2	3	4	5	6	7	8	9	10
Cuckoo	*Coccyzus* spp.		X						X		
Ruby-throated hummingbird	*Archilochus colubris*							X			
Belted kingfisher	*Megaceryle alcyon*		X	X		X	X	X	X		
Common flicker	*Colaptes auratus*		X	X		X	X	X			X
Eastern kingbird	*Tyrannus tyrannus*			X		X	X	X	X	X	
Great-crested flycatcher	*Myiarchus crinitus*	X					X				
Least flycatcher	*Empidonax minimus*						X	X			
Eastern phoebe	*Sayornis phoebe*		X	X	X		X	X	X		
Eastern wood peewee	*Contopus virens*						X		X		
Barn swallow	*Hirundo rustica*	X	X				X				
Tree swallow	*Iridoprocne bicolor*						X				
Cliff swallow	*Petrochelidon pyrrhonota*						X	X			
Purple martin	*Progne subis*	X									
Blue jay	*Cyanocitta cristata*	X			X		X				
Common crow	*Corvus brachyrhynchos*	X		X			X		X	X	
Black-capped chickadee	*Parus atricapillus*		X	X							
White-breasted nuthatch	*Sitta carolinensis*						X				
Red-breasted nuthatch	*Sitta canadensis*	X			X						
Long-billed marsh wren	*Telmatodytes palustris*					X	X				X
Gray catbird	*Dumetella carolinensis*			X			X				
American robin	*Turdus migratorius*						X	X			
Veery	*Catharus fuscescens*						X		X		
Eastern bluebird	*Sialia sialis*							X			
Cedar waxwing	*Bombycilla cedrorum*		X		X		X	X	X		X
Red-eyed vireo	*Vireo clivaceus*		X	X	X	X	X		X		X
Yellow warbler	*Dendroica petechia*			X		X	X		X		
Blackburnian warbler	*Dendroica fusca*					X					
Common yellowthroat	*Geothlypis trichas*	X			X	X	X		X		
American redstart	*Setophaga ruticilla*			X			X	X			
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*					X			X		X
Red-winged blackbird	*Agelaius phoeniceus*	X		X		X	X	X	X		

Table 13 (Cont.). Sector occurrence of the species of flora and fauna noted during the 1975 Mississippi River survey from Lake Itasca to Lake Winnibigoshish.

Common Name	Scientific Name	Sector									
BIRDS		1	2	3	4	5	6	7	8	9	10
Brown-headed cowbird	*Molothrus ater*						X				
Rose-breasted grosbeak	*Pheucticus ludovicianus*						X				
American goldfinch	*Spinus tristis*	X					X	X			
White-crowned sparrow	*Zonotrichia leucophrys*	X				X					
White-throated sparrow	*Zonotrichia albicollis*		X								
Swamp sparrow	*Melospiza georgiana*		X								
Song sparrow	*Melospiza melodia*	X	X	X	X	X	X		X		
MAMMALS											
Beaver	*Castor canadensis*	X		X		X	X	X	X	X	X
Muskrat	*Ondatra zibethica*			X		X	X	X	X	X	
Porcupine	*Erithrezon dorsatum*				X						
White-tailed deer	*Odocoileus virginianus*			X							

Nomenclature in Table 13 is based on the following references:

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APPENDIX B

Table 14. The species composition and CPE of fishes sampled in sector 1 of the upper Mississippi River during 1975 (0.23 miles and 0.25 hours electrofished, 1 electrofishing run).

Species	Number	% by Number	Weight (lbs.)	% by Weight	CPE in Fish/hr.
White sucker	2	100.0	0.2	100.0	8.0
Subtotals	2	100.0	0.2	100.0	8.0
Blacknose dace	1	0.7			4.0
Northern creek chub	16	11.0			64.0
Northern redbelly dace	17	11.7			68.0
Fathead minnow	1	0.7			4.0
Common shiner	82	56.6			328.0
Blacknose shiner	25	17.2			100.0
Brassy minnow	3	2.1			12.0
Subtotals	145	100.0			580.0
Totals	147	100.0			588.0

Table 14a. The length-frequency distribution of the large fish species sampled in sector 1 of the upper Mississippi River during July 1975.

Total Length in Inches	White sucker								
<3.0									
3.0 - 3.4									
3.5 - 3.9									
4.0 - 4.4									
4.5 - 4.9	1								
5.0 - 5.4									
5.5 - 5.9									
6.0 - 6.4									
6.5 - 6.9									
7.0 - 7.4									
7.5 - 7.9	1								
8.0 - 8.4									
8.5 - 8.9									
9.0 - 9.4									
9.5 - 9.9									
10.0 - 10.4									
10.5 - 10.9									
11.0 - 11.4									
11.5 - 11.9									
12.0 - 12.9									
13.0 - 13.9									
14.0 - 14.9									
15.0 - 15.9									
16.0 - 16.9									
17.0 - 17.9									
18.0 - 18.9									
19.0 - 19.9									
20.0 - 20.9									
21.0 - 21.9									
22.0 - 22.9									
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	2								

Table 15. The species composition of fishes sampled in sector 2 of the upper Mississippi River during July 1975 (0.08 miles seined).

Species	Number	% by Number
Northern pike	2	66.7
Black crappie	1	33.3
Subtotals	3	100.0
Blacknose dace	12	14.5
Hornyhead chub	3	3.6
Northern creek chub	3	3.6
Northern redbelly dace	1	1.2
Mimic shiner	8	9.6
Sand shiner	6	7.2
Common shiner	40	48.2
Blacknose shiner	8	9.6
Iowa darter	2	2.4
Subtotals	83	100.0
Totals	86	100.0

Table 15a. The length-frequency distributions of the large fish species sampled in sector 2 of the upper Mississippi River during July 1975.

Total Length in Inches	Northern pike	Black crappie							
<3.0		1							
3.0 - 3.4									
3.5 - 3.9	1								
4.0 - 4.4									
4.5 - 4.9									
5.0 - 5.4									
5.5 - 5.9									
6.0 - 6.4									
6.5 - 6.9									
7.0 - 7.4									
7.5 - 7.9									
8.0 - 8.4									
8.5 - 8.9	1								
9.0 - 9.4									
9.5 - 9.9									
10.0 - 10.4									
10.5 - 10.9									
11.0 - 11.4									
11.5 - 11.9									
12.0 - 12.9									
13.0 - 13.9									
14.0 - 14.9									
15.0 - 15.9									
16.0 - 16.9									
17.0 - 17.9									
18.0 - 18.9									
19.0 - 19.9									
20.0 - 20.9									
21.0 - 21.9									
22.0 - 22.9									
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	2	1							

Table 16. The species composition and CPE of fishes sampled in sector 3 of the upper Mississippi River during July 1975 (0.53 miles and 0.58 hours electrofished, 2 electrofishing runs).

Species	Number	% by Number	Weight (lbs.)	% by Weight	CPE in Fish/hr.
Northern pike	19	39.6	12.1	50.8	32.6
White sucker	24	50.0	9.5	39.9	41.4
Yellow bullhead	2	4.2	1.3	5.4	3.4
Rock bass	2	4.2	0.6	2.5	3.4
Yellow perch	1	2.1	0.1	0.4	1.7
Subtotals	48	100.0	23.8	100.0	82.6
Central mudminnow	3	2.0			5.2
Blacknose dace	2	1.3			3.4
Hornyhead chub	41	27.7			70.7
Northern creek chub	12	8.1			20.7
Sand shiner	5	3.4			8.6
Common shiner	80	54.0			137.9
Johnny darter	5	3.4			8.6
Subtotals	148	100.0			255.2
Totals	196	100.0			337.9

Table 16a. The length-frequency distributions of the large fish species sampled in sector 3 of the upper Mississippi River during July 1975.

Total Length in Inches	Northern pike	White sucker	Yellow bull-head	Rock bass	Yellow perch				
<3.0				1					
3.0 - 3.4		1							
3.5 - 3.9	1				1				
4.0 - 4.4	2								
4.5 - 4.9									
5.0 - 5.4		1							
5.5 - 5.9		2							
6.0 - 6.4	4	1							
6.5 - 6.9	2	1							
7.0 - 7.4		1							
7.5 - 7.9		3							
8.0 - 8.4				1					
8.5 - 8.9		1							
9.0 - 9.4									
9.5 - 9.9		2							
10.0 - 10.4		1	1						
10.5 - 10.9		3	1						
11.0 - 11.4									
11.5 - 11.9		4							
12.0 - 12.9		3							
13.0 - 13.9									
14.0 - 14.9	2								
15.0 - 15.9									
16.0 - 16.9	1								
17.0 - 17.9	4								
18.0 - 18.9	2								
19.0 - 19.9	1								
20.0 - 20.9									
21.0 - 21.9									
22.0 - 22.9									
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	19	24	2	2	1				

Table 17. The species composition and CPE of fishes sampled in sector 4 of the upper Mississippi River during July 1975 (0.30 miles and 0.25 hours electrofished, 1 electrofishing run).

Species	Number	% by Number	Weight (lbs.)	% by Weight	CPE in Fish/hr.
Northern pike	2	11.1	0.1	2.8	8.0
Northern redhorse	1	5.5	0.1	2.8	4.0
White sucker	12	66.6	1.6	45.7	48.0
Rock bass	3	16.6	1.7	48.5	12.0
Subtotals	18	100.0	3.5	100.0	72.0
Blacknose dace	17	7.9			68.0
Hornyhead chub	22	10.2			88.0
Northern creek chub	7	3.2			28.0
Common shiner	165	76.4			660.0
Spotfin shiner	3	1.4			12.0
Mottled sculpin	2	0.9			8.0
Subtotals	216	100.0			864.0
Totals	234	100.0			936.0

Table 17a. The length-frequency distributions of the large fish species sampled in sector 4 of the upper Mississippi River during July 1975.

Total Length in Inches	Northern pike	Northern redhorse	White sucker	Rock bass					
<3.0									
3.0 - 3.4			1						
3.5 - 3.9			1						
4.0 - 4.4									
4.5 - 4.9									
5.0 - 5.4	1								
5.5 - 5.9	1		1						
6.0 - 6.4			4						
6.5 - 6.9		1	1						
7.0 - 7.4				1					
7.5 - 7.9			1						
8.0 - 8.4			1						
8.5 - 8.9			1						
9.0 - 9.4									
9.5 - 9.9			1	1					
10.0 - 10.4									
10.5 - 10.9				1					
11.0 - 11.4									
11.5 - 11.9									
12.0 - 12.9									
13.0 - 13.9									
14.0 - 14.9									
15.0 - 15.9									
16.0 - 16.9									
17.0 - 17.9									
18.0 - 18.9									
19.0 - 19.9									
20.0 - 20.9									
21.0 - 21.9									
22.0 - 22.9									
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	2	1	12	3					

Table 18. The species composition and CPE of fishes sampled in sector 5 of the upper Mississippi River during July 1975 (0.98 miles and 0.67 hours electrofished, 2 electrofishing runs).

Species	Number	% by Number	Weight (lbs.)	% by Weight	CPE in Fish/hr.
White sucker	6	26.0	7.1	54.6	9.0
Brown bullhead	5	21.7	2.9	22.3	7.5
Black bullhead	10	43.4	1.1	8.4	14.9
Yellow perch	2	8.6	1.9	14.6	3.0
Subtotals	23	100.0	13.0	100.0	34.4
Common shiner	2	100.0			3.0
Subtotals	2	100.0			3.0
Totals	25	100.0			37.4

Table 18a. The length-frequency distributions of the large fish species sampled in sector 5 of the upper Mississippi River during 1975.

Total Length in Inches	White sucker	Brown bullhead	Black bullhead	Yellow perch					
<3.0									
3.0 - 3.4									
3.5 - 3.9									
4.0 - 4.4									
4.5 - 4.9									
5.0 - 5.4									
5.5 - 5.9			2						
6.0 - 6.4			4						
6.5 - 6.9			3						
7.0 - 7.4	1								
7.5 - 7.9			1						
8.0 - 8.4									
8.5 - 8.9		1							
9.0 - 9.4		1							
9.5 - 9.9		1							
10.0 - 10.4									
10.5 - 10.9									
11.0 - 11.4		1							
11.5 - 11.9	1	1							
12.0 - 12.9	1			2					
13.0 - 13.9									
14.0 - 14.9	1								
15.0 - 15.9									
16.0 - 16.9	1								
17.0 - 17.9									
18.0 - 18.9	1								
19.0 - 19.9									
20.0 - 20.9									
21.0 - 21.9									
22.0 - 22.9									
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	6	5	10	2					

Table 19. The species composition and CPE of fishes sampled in sector 6 of the upper Mississippi River during July 1975 (0.79 miles and 0.50 hours electrofished, 1 electrofishing run).

Species	Number	% by Number	Weight (lbs.)	% by Weight	CPE in Fish/hr.
Northern pike	1	1.7	0.7	3.5	2.0
Northern redhorse	5	8.9	8.9	45.4	10.0
Rock bass	5	8.9	4.1	20.9	10.0
Yellow perch	44	78.5	4.9	25.0	88.0
Walleye	1	1.7	1.0	5.1	2.0
Subtotals	56	100.0	19.6	100.0	112.0
Northern creek chub	2	33.3			4.0
Bigmouth shiner	2	33.3			4.0
Log perch	1	16.7			2.0
Johnny darter	1	16.7			2.0
Subtotals	6	100.0			12.0
Totals	62	100.0			124.0

Table 19a. The length-frequency distributions of the large fish species sampled in sector 6 of the upper Mississippi River during July 1975.

Total Length in Inches	Northern pike	Northern redhorse	Rock bass	Yellow perch	Walleye				
<3.0				1					
3.0 - 3.4				3					
3.5 - 3.9				14					
4.0 - 4.4				3					
4.5 - 4.9				4					
5.0 - 5.4				4					
5.5 - 5.9									
6.0 - 6.4				2					
6.5 - 6.9				1					
7.0 - 7.4				3					
7.5 - 7.9			1	1					
8.0 - 8.4				5					
8.5 - 8.9			1						
9.0 - 9.4				1					
9.5 - 9.9			2	2					
10.0 - 10.4									
10.5 - 10.9									
11.0 - 11.4			1						
11.5 - 11.9									
12.0 - 12.9									
13.0 - 13.9		1							
14.0 - 14.9									
15.0 - 15.9	1				1				
16.0 - 16.9									
17.0 - 17.9		4							
18.0 - 18.9									
19.0 - 19.9									
20.0 - 20.9									
21.0 - 21.9									
22.0 - 22.9									
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	1	5	5	44	1				

Table 20. The species composition and CPE of fishes sampled in sector 7 of the upper Mississippi River during July 1975 (1.48 miles and 1.92 hours electrofished, 2 electrofishing runs).

Species	Number	% by Number	Weight (lbs.)	% by Weight	CPE in Fish/hr.
Northern pike	7	4.3	11.7	27.9	3.6
White sucker	7	4.3	0.4	0.9	3.6
Brown bullhead	1	0.6	0.7	1.6	0.5
Yellow bullhead	2	1.2	0.8	1.9	1.0
Burbot	1	0.6	0.4	0.9	0.5
Largemouth bass	9	5.5	0.3	0.7	4.7
Rock bass	17	10.4	5.7	13.6	8.9
Bluegill	5	3.0	1.0	2.3	2.6
Pumpkinseed	30	18.5	1.9	4.5	15.6
Black crappie	6	3.7	2.3	5.5	3.1
Yellow perch	77	47.5	16.6	39.7	40.1
Subtotals	162	100.0	41.8	100.0	84.2
Golden shiner	27	40.3			14.1
Bluntnose minnow	6	8.9			3.1
Common shiner	16	23.9			8.3
Blackchin shiner	17	25.4			8.8
Tadpole madtom	1	1.5			0.5
Subtotals	67	100.0			34.9
Totals	229	100.0			119.3

Table 20a. The length-frequency distribution of the large fish species sampled in sector 7 of the upper Mississippi River during July 1975.

Total Length in Inches	Northern pike	White sucker	Brown bull-head	Yellow bull-head	Burbot	Large-mouth bass	Rock bass	Blue-gill	Pumpkin-seed
<3.0						9	5	1	10
3.0 - 3.4									3
3.5 - 3.9							1		5
4.0 - 4.4		2							3
4.5 - 4.9		3						1	1
5.0 - 5.4		2							2
5.5 - 5.9									4
6.0 - 6.4								1	
6.5 - 6.9							1	1	2
7.0 - 7.4							1		
7.5 - 7.9									
8.0 - 8.4				1			2	1	
8.5 - 8.9							3		
9.0 - 9.4				1			3		
9.5 - 9.9							1		
10.0 - 10.4									
10.5 - 10.9					1				
11.0 - 11.4			1						
11.5 - 11.9									
12.0 - 12.9									
13.0 - 13.9									
14.0 - 14.9									
15.0 - 15.9									
16.0 - 16.9	1								
17.0 - 17.9	1								
18.0 - 18.9									
19.0 - 19.9	2								
20.0 - 20.9									
21.0 - 21.9									
22.0 - 22.9	3								
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	7	7	1	2	1	9	17	5	30

Table 20a (Cont.). The length-frequency distributions of the large fish species sampled in sector 7 of the upper Mississippi River during July 1975.

Total Length in Inches	Black crappie	Yellow perch							
<3.0	3	2							
3.0 - 3.4		2							
3.5 - 3.9		10							
4.0 - 4.4		4							
4.5 - 4.9		3							
5.0 - 5.4		4							
5.5 - 5.9		5							
6.0 - 6.4		5							
6.5 - 6.9		4							
7.0 - 7.4		5							
7.5 - 7.9		5							
8.0 - 8.4		9							
8.5 - 8.9		8							
9.0 - 9.4	1	2							
9.5 - 9.9		5							
10.0 - 10.4		1							
10.5 - 10.9		1							
11.0 - 11.4	1	1							
11.5 - 11.9	1	1							
12.0 - 12.9									
13.0 - 13.9									
14.0 - 14.9									
15.0 - 15.9									
16.0 - 16.9									
17.0 - 17.9									
18.0 - 18.9									
19.0 - 19.9									
20.0 - 20.9									
21.0 - 21.9									
22.0 - 22.9									
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	6	77							

Table 21. The species composition and CPE of fishes sampled in sector 8 of the upper Mississippi River during July 1975 (2.29 miles and 1.35 hours electrofished, 3 electrofishing runs).

Species	Number	% by Number	Weight (lbs.)	% by Weight	CPE in Fish/hr.
Northern redhorse	2	1.1	1.9	2.7	1.5
White sucker	20	11.0	35.4	51.0	14.8
Yellow bullhead	3	1.6	2.2	3.1	2.2
Rock bass	14	7.7	9.9	14.2	10.4
Pumpkinseed	1	0.5	0.1	0.1	0.7
Black crappie	11	6.0	1.8	2.5	8.1
Yellow perch	125	69.0	16.3	23.5	92.6
Walleye	5	2.7	1.7	2.4	3.7
Subtotals	181	100.0	69.3	100.0	134.0
Hornyhead chub	2	4.6			1.5
Common shiner	38	88.4			28.1
Tadpole madtom	3	7.0			2.2
Subtotals	43	100.0			31.8
Totals	224	100.0			165.9

Table 21a. The length-frequency distributions of the large fish species sampled in sector 8 of the upper Mississippi River during July 1975.

Total Length in Inches	Northern redhorse	White sucker	Yellow bull-head	Rock bass	Pumpkin-seed	Black crappie	Yellow perch	Walleye	
<3.0							51	1	
3.0 - 3.4									
3.5 - 3.9									
4.0 - 4.4							2		
4.5 - 4.9						1	1		
5.0 - 5.4					1	6	7		
5.5 - 5.9						1	8		
6.0 - 6.4							18		
6.5 - 6.9				3			7	1	
7.0 - 7.4							9		
7.5 - 7.9			1	3		1	8		
8.0 - 8.4	1	1		1			2		
8.5 - 8.9				1		2	3		
9.0 - 9.4				2			5		
9.5 - 9.9				1			4		
10.0 - 10.4		2		1					
10.5 - 10.9		2						1	
11.0 - 11.4				1					
11.5 - 11.9		2		1					
12.0 - 12.9			2						
13.0 - 13.9								2	
14.0 - 14.9		2							
15.0 - 15.9									
16.0 - 16.9		3							
17.0 - 17.9		3							
18.0 - 18.9		4							
19.0 - 19.9	1								
20.0 - 20.9		1							
21.0 - 21.9									
22.0 - 22.9									
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	2	20	3	14	1	11	125	5	

Table 22. The species composition and CPE of fishes sampled in sector 9 of the upper Mississippi River during July 1975 (2.01 miles and 1.25 hours electrofished, 2 electrofishing runs).

Species	Number	% by Number	Weight (lbs.)	% by Weight	CPE in Fish/hr.
Northern pike	1	0.5	0.1	0.1	0.8
Northern redhorse	10	5.0	17.5	21.3	8.0
White sucker	25	12.6	38.8	47.4	20.0
Brown bullhead	6	3.0	7.3	8.9	4.8
Yellow bullhead	7	3.5	4.3	5.2	5.6
Burbot	1	0.5	0.9	1.1	0.8
Rock bass	12	6.0	5.9	7.2	9.6
Yellow perch	129	65.4	6.3	7.7	103.2
Walleye	6	3.0	0.7	0.8	4.8
Subtotals	197	100.0	81.8	100.0	157.6
Central mudminnow	1	0.4			0.8
Bluntnose minnow	4	1.6			3.2
Bigmouth shiner	230	92.7			184.0
Common shiner	10	4.0			8.0
Spottail shiner	3	1.2			2.4
Subtotals	248	100.0			198.4
Totals	445	100.0			356.0

Table 22a. The length-frequency distributions of the large fish species sampled in sector 9 of the upper Mississippi River during July 1975.

Total Length in Inches	Northern pike	Northern redhorse	White sucker	Brown bull-head	Yellow bull-head	Burbot	Rock bass	Yellow perch	Walleye
<3.0							1	77	
3.0 - 3.4								5	2
3.5 - 3.9								3	2
4.0 - 4.4	1								
4.5 - 4.9								4	
5.0 - 5.4								15	
5.5 - 5.9								10	
6.0 - 6.4								4	
6.5 - 6.9							1	2	
7.0 - 7.4							2	2	
7.5 - 7.9							1	1	1
8.0 - 8.4		2	2		1		2	3	
8.5 - 8.9			1		1		3	3	
9.0 - 9.4		1	1						
9.5 - 9.9		1	3		2				
10.0 - 10.4			1				1		
10.5 - 10.9			1	1	1				
11.0 - 11.4					1				
11.5 - 11.9				2			1		1
12.0 - 12.9			2	1	1				
13.0 - 13.9		1	1	1					
14.0 - 14.9		1	1	1		1			
15.0 - 15.9		1	1						
16.0 - 16.9			6						
17.0 - 17.9			2						
18.0 - 18.9		1	1						
19.0 - 19.9		1							
20.0 - 20.9			2						
21.0 - 21.9		1							
22.0 - 22.9									
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	1	10	25	6	7	1	12	129	6

Table 23. The species composition and CPE of fishes sampled in sector 10 of the upper Mississippi River during July 1975 (1.10 miles and 0.92 hours electrofished, 2 electrofishing runs).

Species	Number	% by Number	Weight (lbs.)	% by Weight	CPE in Fish/hr.
Northern pike	2	3.9	1.8	5.4	2.2
Northern redhorse	5	9.8	10.6	32.0	5.4
White sucker	3	5.8	6.1	18.4	3.3
Brown bullhead	8	15.6	6.9	20.8	8.7
Black bullhead	1	1.9	0.2	0.6	1.1
Burbot	6	11.7	0.9	2.7	6.5
Rock bass	16	31.3	6.3	19.0	17.4
Yellow perch	10	19.6	0.3	0.9	10.9
Subtotals	51	100.0	33.1	100.0	55.5
Golden shiner	12	42.9			13.0
Bluntnose minnow	1	3.6			1.1
Bigmouth shiner	3	10.7			3.3
Common shiner	12	42.9			13.0
Subtotals	28	100.0			30.4
Totals	79	100.0			85.9

Table 23a. The length-frequency distributions of the large fish species sampled in sector 10 of the upper Mississippi River during July 1975.

Total Length in Inches	Northern pike	Northern redhorse	White sucker	Brown bull-head	Black bull-head	Burbot	Rock bass	Yellow perch	
<3.0								3	
3.0 - 3.4								3	
3.5 - 3.9								1	
4.0 - 4.4							1	1	
4.5 - 4.9									
5.0 - 5.4							5		
5.5 - 5.9						3	1	1	
6.0 - 6.4							1	1	
6.5 - 6.9							1		
7.0 - 7.4					1		1		
7.5 - 7.9									
8.0 - 8.4									
8.5 - 8.9							1		
9.0 - 9.4							2		
9.5 - 9.9				1			1		
10.0 - 10.4				2			1		
10.5 - 10.9				4		1			
11.0 - 11.4						1	1		
11.5 - 11.9						1			
12.0 - 12.9				1					
13.0 - 13.9									
14.0 - 14.9									
15.0 - 15.9		1	1						
16.0 - 16.9		1							
17.0 - 17.9	1	1	1						
18.0 - 18.9	1	1	1						
19.0 - 19.9		1							
20.0 - 20.9									
21.0 - 21.9									
22.0 - 22.9									
23.0 - 23.9									
24.0 - 24.9									
25.0 - 25.9									
26.0 - 26.9									
27.0 - 27.9									
28.0 - 28.9									
29.0 - 29.9									
30.0 - 30.9									
31.0 - 31.9									
32.0 - 32.9									
33.0 - 33.9									
34.0 - 34.9									
35.0 - 35.9									
36.0 - 36.9									
TOTALS	2	5	3	8	1	6	16	10	

APPENDIX C

Table 24. Fish removal and stocking records for several Mississippi River headwaters lakes (1970-1978).

Lake	Date	Species	Size	Numbers or Pounds
		FISH REMOVED		
Irving	1971-72	Bullheads		14,900 lbs.
Irving	1974-75	Bullheads		14,650 lbs.
Irving	1974-75	Suckers		457 lbs.
Irving	1974-75	Perch		975 lbs.
Irving	1974-75	Burbot		296 lbs.
Irving	1974-75	Redhorse		3 lbs.
Wolf	1971-72	Bullheads		10,700 lbs.
Andrusia	1969-70	N. pike	Ad.	94 - fish rescue
Andrusia	1969-70	N. pike	Yrl.	850 - fish rescue
Andrusia	1969-70	N. pike	Fgl.	300 - fish rescue
Winnibigoshish	1970-71	Burbot		57 lbs.
Winnibigoshish	1970-71	Perch		340 lbs.
Winnibigoshish	1970-71	Bullheads		35,350 lbs.
Winnibigoshish	1970-71	Suckers		45 lbs.
Winnibigoshish	1971-72	Burbot		63 lbs.
Winnibigoshish	1971-72	Perch		425 lbs.
Winnibigoshish	1971-72	Suckers		300 lbs.
Winnibigoshish	1971-72	Dogfish		24 lbs.
Winnibigoshish	1971-72	Bullheads		40,900 lbs.
		FISH STOCKED		
Bemidji	1970	N. pike	Ad.	526
Bemidji	1970	N. pike	Yrl.	1,950
Bemidji	1970	N. pike	Fgl.	532
Bemidji	1970	Walleye	Fgl.	2,588
Bemidji	1971	N. pike	Ad.	2,379
Bemidji	1971	N. pike	Yrl.	3,146
Bemidji	1971	Walleye	Fgl.	13,260
Bemidji	1972	Walleye	Fgl.	3,900
Bemidji	1973	N. pike	Yrl.	320
Bemidji	1974	N. pike	Ad.	6
Bemidji	1974	N. pike	Fgl.	352

Table 24 (Cont.). Fish removal and stocking records for several Mississippi River headwaters lakes (1970-1978).

Lake	Date	Species	Size	Numbers or Pounds
		FISH STOCKED		
Bemidji	1975	Walleye	Fgl.	485
Bemidji	1975	Walleye	Yrl.	36
Bemidji	1975	N. pike	Yrl.	1,808
Bemidji	1975	N. pike	Fgl.	472
Bemidji	1977	Walleye	Fgl.	55,000
Bemidji	1977	N. pike	Fgl.	160
Bemidji	1977	N. pike	Yrl.	1,770
Bemidji	1977	N. pike	Ad.	336
Bemidji	1978	Walleye	Yrl.	25
Bemidji	1978	N. pike	Fgl.	930
Bemidji	1978	Muskie	Fgl.	500
Wolf	1970	N. pike	Yrl.	988
Wolf	1970	Walleye	Fry	500,000
Wolf	1971	Walleye	Fry	515,000
Wolf	1972	Walleye	Fry	1,500,000
Wolf	1973	Walleye	Fry	2,317,000
Wolf	1973	N. pike	Yrl.	27
Wolf	1974	N. pike	Yrl.	76
Wolf	1975	Walleye	Fry	1,463,000
Wolf	1976	Walleye	Fry	1,500,000
Wolf	1977	Walleye	Fry	300,000
Wolf	1977	Muskie	Yrl.	200
Wolf	1978	Walleye	Fry	750,000
Andrusia	1971	N. pike	Fgl.	200,000 (est.)
Andrusia	1971	Walleye	Fry	1,000,000
Andrusia	1972	Walleye	Fry	1,782,000
Andrusia	1972	N. pike	Fgl.	400,000
Andrusia	1973	N. pike	Fgl.	2,000
Andrusia	1975	N. pike	Fgl.	287,000
Andrusia	1976	N. pike	Fgl.	154,375
Andrusia	1976	Walleye	Fry.	1,000,000

Table 24 (Cont.). Fish removal and stocking records for several Mississippi River headwaters lakes (1970-1978).

Lake	Date	Species	Size	Numbers or Pounds
		FISH STOCKED		
Andrusia	1977	Walleye	Fry	660,000
Andrusia	1977	N. pike	Fgl.	100,000 (est.)
Andrusia	1977	Muskie	Yrl.	420
Andrusia	1978	Walleye	Fry	500,000
Andrusia	1978	N. pike	Fgl.	250,000
Cass	1970	N. pike	Ad.	86
Cass	1970	N. pike	Fgl.	81,175
Cass	1970	Muskie	Ad.	4
Cass	1972	Muskie	Fgl.	1,000
Cass	1973	Muskie	Fgl.	800
Cass	1974	Muskie	Fgl.	2,055
Cass	1975	Muskie	Fry	119,000
Cass	1977	N. pike	Fgl.	400
Winnibigoshish	1970	Walleye	Fry	9,161,000
Winnibigoshish	1970	N. pike	Ad.	96
Winnibigoshish	1971	Walleye	Fry	9,705,000
Winnibigoshish	1972	Walleye	Fry	10,000,000
Winnibigoshish	1972	N. pike	Fgl.	120,000
Winnibigoshish	1972	Muskie	Fgl.	513
Winnibigoshish	1973	Walleye	Fry	8,690,000
Winnibigoshish	1973	N. pike	Fgl.	250,900
Winnibigoshish	1974	N. pike	Fgl.	190,000
Winnibigoshish	1975	N. pike	Fgl.	90,000
Winnibigoshish	1975	Muskie	Fgl.	150
Winnibigoshish	1976	Walleye	Fry	24,381,000
Winnibigoshish	1976	N. pike	Fgl.	57,600
Winnibigoshish	1977	Walleye	Fry	10,000,000
Winnibigoshish	1977	N. pike	Yrl.	5,000
Winnibigoshish	1978	Walleye	Fry	9,200,000