



# Fisheries Management

## STREAM SURVEY REPORT

**Stream Name:** Minnesota River

**Survey Type:** IBI Survey

**Kittle ID Number:** M-55

**Survey ID Dates:** 8/14/2023–9/14/2023

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### Reason for survey

Monitor the biological health of the Minnesota River by conducting annual index of biotic integrity (IBI) electrofishing assessments.

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### Stream Location

Counties: Big Stone, Blue Earth, Brown, Carver, Chippewa, Dakota, Hennepin, Lac Qui Parle, Le Sueur, Nicollet, Redwood, Renville, Scott, Sibley, Yellow Medicine

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### Area Fisheries Office

Area Name: Hutchinson

ORG Code: F401

Region Name: Southern Region

Region Number: 4

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### Watershed Characteristics

Drainage Basin: Minnesota River

Size (mi<sup>2</sup>): 17,008 mi<sup>2</sup>

### Stream Characteristics

Stream Length (miles):320

Stream Type: Warmwater

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### Surveys and Investigations

Full IBI Survey: 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2022

Partial IBI Survey: 2003, 2004, 2009, 2021, 2023

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**STREAM SURVEY REPORT**  
**INDEX OF BIOTIC INTEGRITY (IBI) SURVEY ON MINNESOTA RIVER (M-55)**

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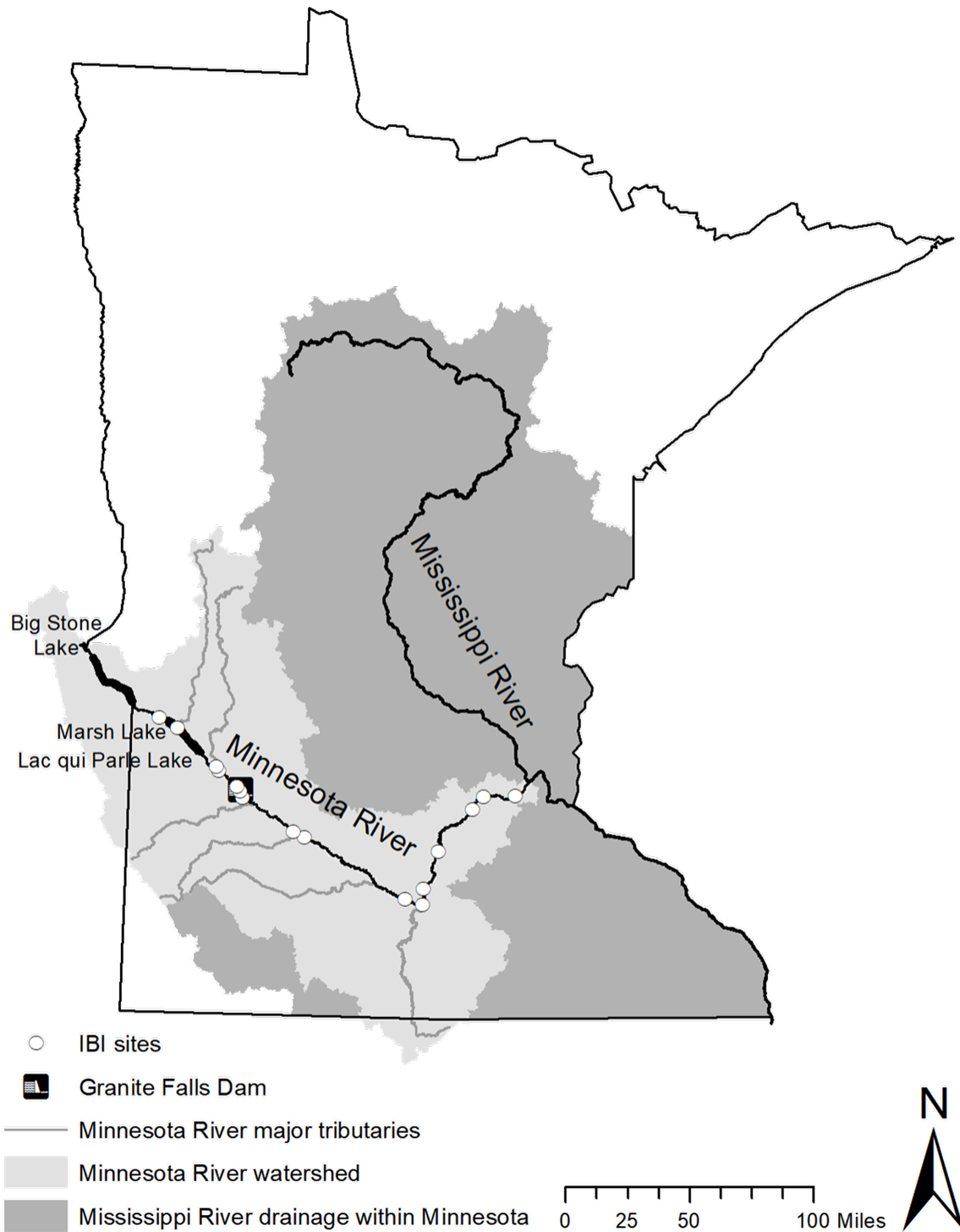


Figure 1. Location of the Minnesota River and Minnesota River Watershed within the Mississippi River Drainage of Minnesota and the location of 16 index of biotic integrity (IBI) electrofishing sites.

**STREAM SURVEY REPORT**  
INDEX OF BIOTIC INTEGRITY (IBI) SURVEY ON MINNESOTA RIVER (M-55)

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## **INTRODUCTION**

The Minnesota River is a 7th–8th order river that flows approximately 320 miles from Big Stone Lake on the Minnesota–South Dakota Border to its confluence with the Mississippi River in St. Paul, MN and serves as an important aquatic ecosystem, fishery, and recreational resource in Southern Minnesota (Figure 1). The approximately 17,000 square mile watershed of the Minnesota River drains portions of Minnesota (14,751 mi<sup>2</sup>), South Dakota, and Iowa that are dominated by agricultural use with some urban development. As a result, the Minnesota River is impacted by increased erosion, sedimentation, nutrient inputs, and flow.

Unlike many medium to large rivers, the flow of the Minnesota River is altered by very few dams and the lower 240 miles are completely free flowing. From upstream to downstream, the dams are Big Stone Lake (RM 317), Big Stone National Wildlife Refuge (RM 303), Marsh Lake Dam (RM 289), Lac qui Parle Dam (RM 272), and Granite Falls Dam (RM 240). Most of the dams are associated with impoundments that have fisheries managed independently from the Minnesota River. Granite Falls Dam is the one exception and is used for hydro-power generation. Granite Falls Dam also acts as a major barrier to fish movement and therefore the fish community upstream of Granite Falls Dam is less complex than downstream and lacks many large river species such as Flathead Catfish and Shovelnose Sturgeon.

Despite an accumulation of anthropogenic impacts (climate change, habitat fragmentation, introductions of non-native species, artificial drainage, land-use changes, etc.) on the Minnesota River and its biota, the Minnesota River fish community remains resilient and supports healthy populations of gamefish and important non-game fish. In recent years, over 80 fish species have been documented in the Minnesota River making it one of the most diverse fish communities in the state. Primary sportfish species in the Minnesota River include Channel Catfish, Flathead Catfish, and Walleye with secondary sportfish species including Freshwater Drum and Sauger. Additionally, the Minnesota River is home to four fish species listed as state endangered, threatened, or special concern (Black Buffalo, Blue Sucker, Lake Sturgeon, Paddlefish), along with a diversity of other important and unique riverine species. Unfortunately, most reaches of the Minnesota River were listed as impaired by the MPCA in 2017 for some combination of excess phosphorous and nitrogen, high levels of bacteria, excess sediment, unhealthy aquatic insect communities, and fish consumption advisories. Thus, monitoring health of the Minnesota River fish community remains a priority.

In an effort to monitor the biological health of the Minnesota River, the Fisheries Section of the Minnesota Department of Natural Resources (MNDNR) Fish and Wildlife Division has been conducting annual Minnesota River fish index of biotic integrity (IBI) assessments using boat electrofishing surveys since 2010. Additionally, catches of Freshwater Drum, Sauger, and

**STREAM SURVEY REPORT**  
**INDEX OF BIOTIC INTEGRITY (IBI) SURVEY ON MINNESOTA RIVER (M-55)**

---

Walleye during IBI assessments are useful for monitoring their relative abundances. During 2023, IBI assessments were conducted at 11 of 16 fixed sites (Figure 1 & Table 1). Below average discharge during most of August through September prohibited access to several IBI sites.

Table 1. Coordinates (UTM; 15N) of Minnesota River BIB sample site endpoints.

IBI electrofishing station			Upstream UTM		Downstream UTM	
Abbreviation	Code	Name	X	Y	X	Y
LG	03MN082	Louisburg	246463	5012282	246882	5012538
AP	03MN083	Appleton	258363	5005824	258828	5005655
MU	03MN084	Montevideo Upstream	283447	4980504	283679	4980096
MD	03MN081	Montevideo Downstream	285181	4978089	285226	4977729
RO	03MN085	Roe	297098	4967455	297161	4966998
MP	04MN002	Memorial Park	298700	4964317	299170	4964150
HC	03MN086	Hazel Creek	300910	4960276	301185	4959946
H71	03MN092	Highway 71	340548	4934277	340908	4934171
NR	03MN093	North Redwood	333947	4938096	333485	4937954
JU	03MN091	Judson	406215	4894263	406691	4894131
MA	03MN090	Mankato	417109	4890657	417587	4890802
7M	03MN087	7 Mile	418080	4901109	418470	4901416
LE	03MN088	LeSueur	427831	4924805	427985	4925282
CR	03MN089	Carver Rapids	450345	4952477	449889	4952486
SH	03MN080	Shakopee	457127	4960652	457479	4961006
I35	03MN079	I-35	477691	4961454	478185	4961516

**STREAM SURVEY REPORT**  
**INDEX OF BIOTIC INTEGRITY (IBI) SURVEY ON MINNESOTA RIVER (M-55)**

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**METHODS**

*Fish Index of Biotic Integrity*

In the past, water quality has been tested to evaluate the health of aquatic systems.

However, water quality parameters don't necessarily reflect the cumulative effect of various chemical, physical, and biological stressors.

Biological communities (e.g., fish, macroinvertebrates) on the other hand are subjected to the cumulative impact of these stressors and ultimately provide a better

representation of ecosystem health. During the early 1980s biologists began developing methods for using biotic communities to measure ecosystem biotic integrity. In Minnesota, the Minnesota

Pollution Control Agency (MPCA) has been using index of biotic integrities (IBIs) for stream assessments since the 1990's, and more recently developed a statewide fish-based IBI to assess the health of Minnesota's streams and rivers. Fish IBI scores are based on a suite of fish community metrics (Table 2) derived from standardized sampling protocols and provide insight into the biotic health of aquatic systems. Scores vary from 0 to 100, with degraded fish communities comprised of a few tolerant species receiving low fish IBI scores and healthy diverse fish communities receiving high fish IBI scores. Since streams of different types and sizes have different native fish communities, separate IBI indices have been developed for several Minnesota stream classes. The Minnesota River is classified as a Southern River and the MPCA has identified the impairment threshold as 46 for Southern Rivers with a confidence interval of 35–57. Fish IBI scores above the upper confidence limit reflect good biological condition, scores below the lower confidence limit reflect poor biological condition, and scores within the confidence interval require further interpretation. For more information on the MPCA's fish-based index of biotic integrity see MPCA (2014).

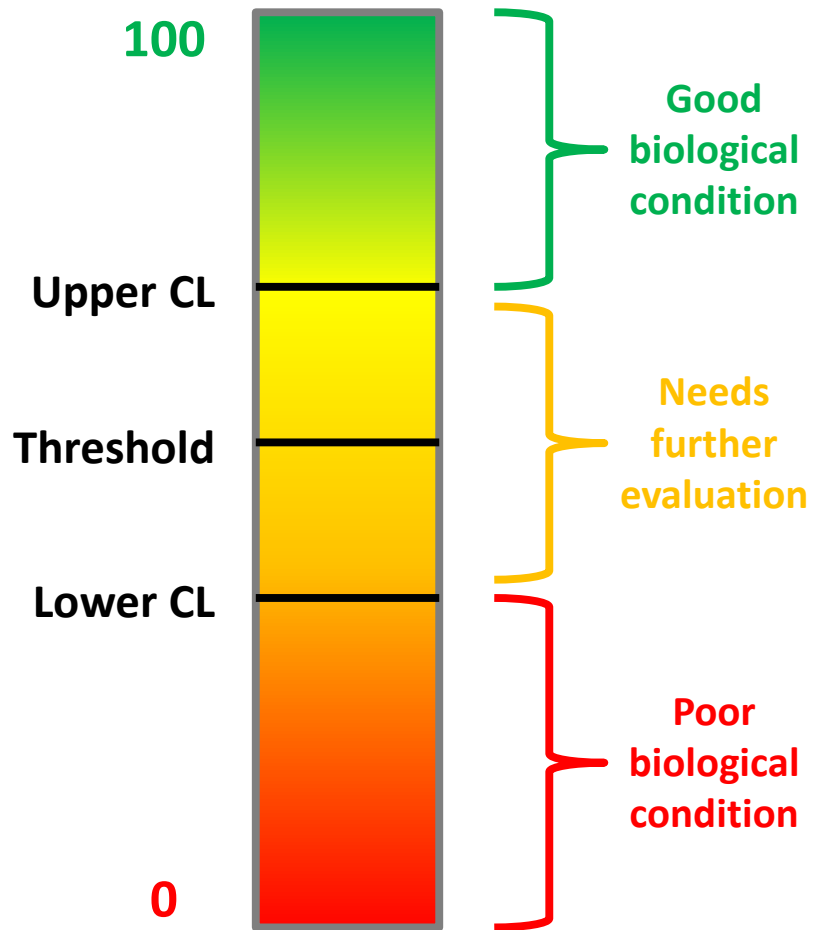


Figure 2. Diagram describing fish IBI score interpretation.

**STREAM SURVEY REPORT**  
**INDEX OF BIOTIC INTEGRITY (IBI) SURVEY ON MINNESOTA RIVER (M-55)**

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*Fish Community Survey*

During 2023, IBI electrofishing surveys were completed at 11 of 16 fixed sites between August 14<sup>th</sup> and September 14<sup>th</sup> (Table 3). Electrofishing surveys follow MPCA protocols (MPCA 2017). Each survey consisted of three 500-m electrofishing runs; one run along each bank and one run focusing on mid-channel habitats. The boat operator attempted to complete each run in 1,200 seconds (20 minutes) while two netters equipped with 3.175-mm mesh nets attempted to net all stunned fish. Abnormally low water levels during most of August through September prohibited access to several IBI sites and impacted efficacy of electrofishing efforts at many sites (Figure 3).

**RESULTS**

Complete (13–16 sites) fish IBI assessments were conducted on the Minnesota River annually during 2010–2019, and 2022 (Table 4). Partial (6–12 sites) assessments were completed in 2003, 2004, 2009, 2021, and 2023. No assessments were conducted during 2020 because of the COVID-19 pandemic. During 2023, low water conditions only allowed for the completion of IBI assessments at 11 of 16 sites. Across the 11 sites, a total of 51 species (and two hybrids) were captured and site-specific species diversity varied 12–27 (Table 5; Appendix A). Three species were collected at all 11 sites (Common Carp, Emerald Shiner, Shorthead Redhorse) and the most abundant species were Emerald Shiner (2,760), Spotfin Shiner (278), and Gizzard Shad (231; Table 6). Average catch rates of 18.4 Freshwater Drum per hour, 3.4 Sauger per hour (downstream of Granite Falls Dam), and 5.9 Walleye per hour during 2021–2023 IBI assessments exceeds management goals (MNDNR 2024). Fish IBI scores for 10 of 11 sites evaluated during 2023 exceed the upper confidence level threshold of 57, indicating good biological condition. The IBI score of 49 for the Montevideo-Upstream site is above the impairment threshold, but within the IBI confidence interval that suggests a need for further interpretation. The historical mean fish IBI score for the Minnesota River has exceeded the impairment threshold since annual IBI assessments were implemented in 2010, and the mean score for 2023 is well above the impairment threshold at 68. Results from the 2023 IBI assessment should be interpreted carefully since five of the sites were not assessed and low water levels during the survey period created abnormal river conditions during electrofishing surveys. Fish IBI scores from sites downstream of the Granite Falls Dam are generally greater than fish IBI scores from sites upstream of Granite Falls Dam, and this was again true in 2023 with mean scores of 70 downstream and 66 upstream.

**DISCUSSION**

A primary fisheries management goal for the Minnesota River is to maintain a healthy and diverse fish community. Since 2010, the biological condition and health of the Minnesota River

**STREAM SURVEY REPORT**  
**INDEX OF BIOTIC INTEGRITY (IBI) SURVEY ON MINNESOTA RIVER (M-55)**

---

fish community has been evaluated by the Minnesota Department of Natural Resources with comprehensive fish index of biotic integrity (IBI) electrofishing assessments. Fish IBI scores reflect several fish community metrics that provide insight into the health of the ecosystem. Scores range from 0 to 100, where degraded fish communities comprised of a few tolerant species receive low fish IBI scores and healthy diverse fish communities receive high fish IBI scores. Mean fish IBI scores from 2010–2022 have exceeded the impairment threshold established by the Minnesota Pollution Control Agency. The 2023 IBI assessment was affected by low water conditions that prohibited access to 5 of 16 sites and impacted the effectiveness of electrofishing assessments. Despite challenges associated with low river conditions, the mean fish IBI scores for the 11 Minnesota River IBI sites assessed in 2023 was 68, which again exceeds the impairment threshold of 57 and indicates good biological condition. During the 2023 assessment, a total of 51 fish species (and two hybrids) were collected which highlights the rivers tremendous fish species diversity.

Despite many human alterations to the Minnesota River and its watershed, the fish community remains in good biological condition. This is likely a result of continued efforts to improve land, soil, and water management within the watershed and the resiliency of the fish community native to the Minnesota River. Yet, with the continued threat of various chemical (e.g., nitrogen, phosphorous), physical (e.g., erosion, sediment, floods, climate change), and biological stressors (e.g., invasive species) impacting the Minnesota River, it is important to continue monitoring biological health and the potential impacts of these stressors.

## **REFERENCES**

- MPCA. 2014. Development of a fish-based index of biological integrity for assessment of Minnesota’s rivers and streams. Document number wq-bsm2-03. Minnesota Pollution Control Agency, Environmental Analysis and Outcomes Division, St. Paul, MN.
- MPCA. 2017. Fish data collection protocols for lotic waters in Minnesota. Document number wq-bsm3-12b. Minnesota Pollution Control Agency, Environmental Analysis and Outcomes Division, St. Paul, MN.
- MNDNR. 2024. The Minnesota River fisheries management plan 2024–2028. Minnesota Department of Natural Resources.

**STREAM SURVEY REPORT**  
**INDEX OF BIOTIC INTEGRITY (IBI) SURVEY ON MINNESOTA RIVER (M-55)**

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Table 2. Description of metrics used to calculate Southern River fish index of biotic integrity scores.

Metric name	Response	Metric description
DetNWQTXPct	negative	Relative abundance (%) of taxa that are detritivorous
GeneralPct	negative	Relative abundance (%) of individuals that are generalist feeders
Insect-TolPct	positive	Relative abundance (%) of individuals that are insectivore species (excludes tolerant species)
Piscivore	positive	Taxa richness of piscivorous species
SLvdPct	negative	Relative abundance (%) of individuals that are short-lived
SSpnTXPct	negative	Relative abundance (%) of taxa that are serial spawners (multiple times per year)
TolPct	negative	Relative abundance (%) of individuals that are tolerant
VtolTXPct	negative	Relative abundance (%) of taxa that are very tolerant
SensitiveTXPct	positive	Relative abundance (%) of taxa that are sensitive (scoring adjusted for gradient)
SLithop	positive	Taxa richness of simple lithophilic spawning species (scoring adjusted for gradient)
DomTwoPct	negative	Combined relative abundance of two most abundant taxa
FishDELTpct	negative	Relative abundance (%) of individuals with Deformities, Eroded fins, Lesions, or Tumors



**STREAM SURVEY REPORT**  
**INDEX OF BIOTIC INTEGRITY (IBI) SURVEY ON MINNESOTA RIVER (M-55)**

---

Table 3. Sample site data for 11 Minnesota River IBI electrofishing assessments performed during 2023.

Site	Name	Date	River mile	Effort (sec)	Water temp	Transparency tube (cm)	Conductivity ( $\mu$ S/cm)
03MN082	LG	09/14/2023	318	2,850	19	20	944
03MN084	MU	08/16/2023	277	2,700	23	25	742
03MN081	MD	08/16/2023	274	3,510	23	27	707
03MN085	RO	08/17/2023	260	3,450	23	32	700
04MN002	MP	08/29/2023	257	3,600	24	32	758
03MN086	HC	08/14/2023	251	3,690	23	16	700
03MN091	JU	08/24/2023	122	3,540	29	21	864
03MN090	MA	08/22/2023	112	3,610	26	26	630
03MN088	LE	09/05/2023	75	3,600	26	21	805
03MN080	SH	08/21/2023	26	3,540	24	15	735
03MN079	I35	08/28/2023	10	3,570	26	24	824

**STREAM SURVEY REPORT**  
**INDEX OF BIOTIC INTEGRITY (IBI) SURVEY ON MINNESOTA RIVER (M-55)**

Table 4. Fish IBI scores for 16 sites on the Minnesota River sampled 2003–2023. Asterisks denote years impacted by extremely low water conditions.

Site	Year																Mean		
	2003	2004	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*	2022*		2023*	
<b>Downstream of Granite Falls Dam</b>																			
I35	-	-	-	69	69	76	66	76	68	72	71	78	83		77	63	80	73	
Shakopee	-	-	-	80	65	72	39	73	75	68	65	68	73		70	36	81	67	
Carver	-	-	-	57	40	-	54	60	55	-	57	58	66		-	-	-	56	
LeSueur	-	-	-	67	59	61	63	73	66	60	69	76	61		73	57	65	65	
7 Mile	-	-	-	70	63	-	72	73	64	65	59	68	73		-	-	-	67	
Mankato	-	-	-	66	73	66	56	67	68	58	58	68	75		82	58	68	66	
Judson	-	-	-	72	67	74	57	68	57	58	65	60	78		64	63	64	65	
Hwy 71	-	-	-	52	65	71	72	54	73	65	80	59	73		COVID	-	60	-	66
North Redwood	69	54	-	55	62	-	64	61	65	68	63	48	67		-	69	-	62	
Hazel Creek	63	58	-	60	54	72	58	50	62	37	55	58	65		81	60	64	60	
Memorial Park	-	53	66	41	50	68	42	58	76	61	75	72	77		83	71	67	64	
Downstream mean	-	-	-	63	61	70	58	65	66	61	65	65	72		76	60	70	65	
<b>Upstream of Granite Falls Dam</b>																			
Roe	64	67	70	66	56	80	63	79	79	62	49	52	62		-	69	68	66	
Monte Down	58	52	58	59	64	62	60	64	70	49	45	59	68		61	72	72	61	
Monte Up	56	49	51	44	66	64	51	48	51	47	35	52	76		78	66	49	55	
Appleton	43	39	54	58	56	58	48	58	55	59	63	74	66		76	76	-	59	
Louisburg	42	47	61	51	76	76	59	67	52	67	69	76	67		-	-	74	63	
Upstream mean	53	51	59	56	64	68	56	63	61	57	52	63	68		72	71	66	61	
Mean	-	-	-	60	62	69	58	64	65	60	61	64	71		75	63	68	63	

**STREAM SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

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Table 5. Catch summary for 11 IBI sites sampled on the Minnesota River during 2023.

Site	Abbr.	Species count	Total catch
04MN002	MP	27	223
03MN091	JU	23	341
03MN088	LE	23	261
03MN090	MA	22	964
03MN086	HC	22	331
03MN081	MD	21	220
03MN082	LG	20	172
03MN085	RO	19	191
03MN080	SH	17	990
03MN079	I35	17	613
03MN084	MU	12	88

**RIVER SURVEY REPORT**  
**IBI SURVEY ON MINNESOTA RIVER (M-55)**

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Table 6. Ranked fish species frequency of occurrence and total catch for 11 index of biotic integrity electrofishing surveys performed on the Minnesota River during 2023.

Species	Frequency	Total catch
emerald shiner	100.0	2760
common carp	100.0	106
shorthead redhorse	100.0	90
golden redhorse	90.9	83
freshwater drum	90.9	81
walleye	90.9	57
spotfin shiner	81.8	278
channel catfish	81.8	53
bigmouth buffalo	72.7	117
gizzard shad	63.6	231
bluegill	63.6	82
white bass	63.6	57
bluntnose minnow	63.6	15
largemouth bass	54.5	30
sauger	54.5	23
quillback	54.5	21
smallmouth buffalo	54.5	12
blackside darter	45.5	31
bullhead minnow	45.5	28
silver redhorse	45.5	19
slenderhead darter	45.5	19
common shiner	36.4	27
yellow perch	36.4	22
sand shiner	36.4	19
mimic shiner	36.4	18
shortnose gar	36.4	9
logperch	27.3	29
orangespotted sunfish	27.3	11
white sucker	27.3	10
flathead catfish	27.3	9
black bullhead	18.2	4
Johnny darter	18.2	4
smallmouth bass	18.2	4
green sunfish	18.2	3
northern pike	18.2	3
river carpsucker	18.2	3
hybrid sunfish	18.2	2
spottail shiner	9.1	5
carmine shiner	9.1	4
greater redhorse	9.1	2

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

---

Species	Frequency	Total catch
blue sucker	9.1	1
bowfin	9.1	1
fantail darter	9.1	1
fathead minnow	9.1	1
highfin carpsucker	9.1	1
hornyhead chub	9.1	1
longnose gar	9.1	1
mooneye	9.1	1
rock bass	9.1	1
shovelnose sturgeon	9.1	1
silver chub	9.1	1
walleye x sauger	9.1	1
yellow bullhead	9.1	1

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

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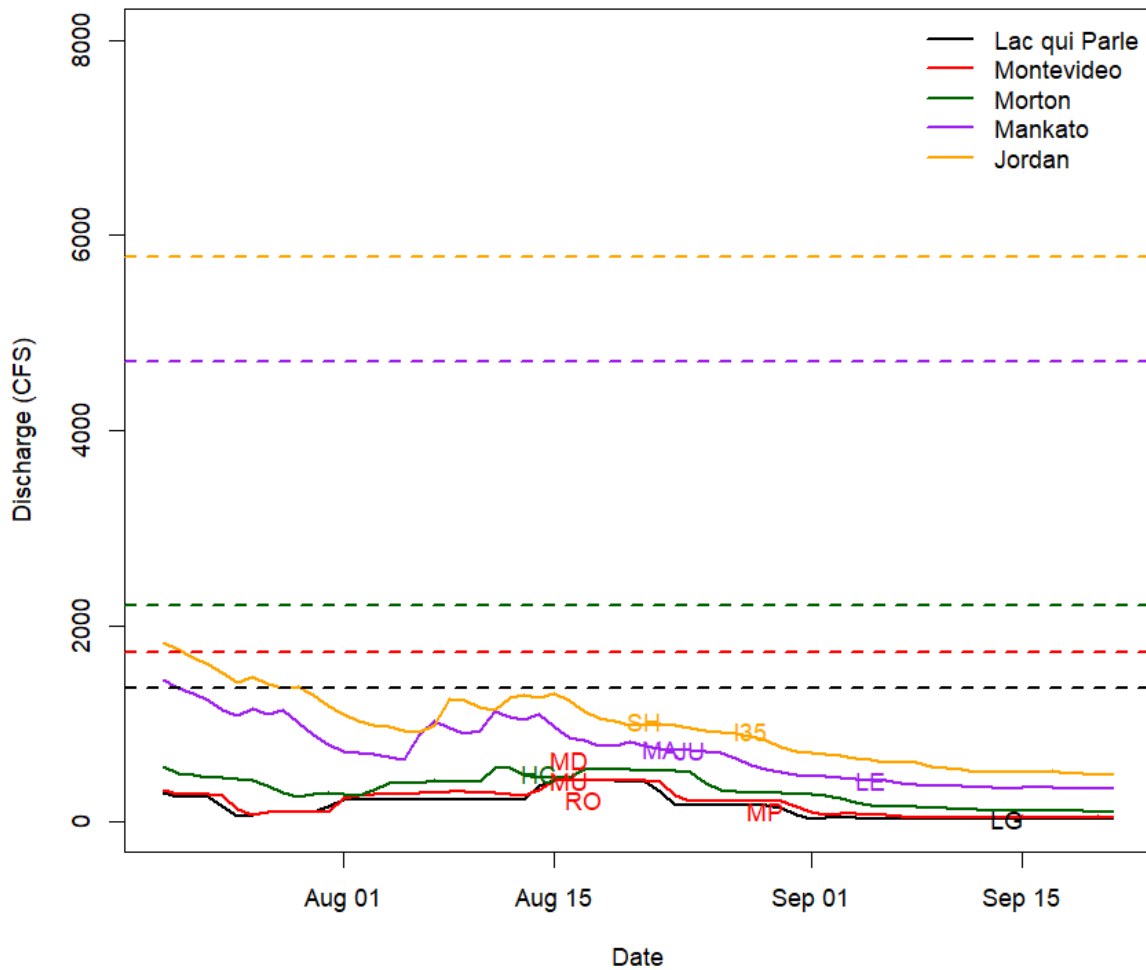


Figure 3. Discharge (cfs) of the Minnesota River at Lac qui Parle, Montevideo, Morton, Mankato, and Jordan during July 20<sup>th</sup>–September 21<sup>st</sup>, 2023. Dashed lines indicate target maximum discharge (median July 21<sup>st</sup> discharge 1993–2013) levels for standardized IBI assessments. Site codes indicate dates that IBI surveys were performed on corresponding hydrograph lines. All 2023 IBI assessments were conducted when river discharge was significantly below target levels.

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

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**APPROVAL**

Fisheries Specialist: \_\_\_\_\_ Date: \_\_\_\_\_

Manager/Supervisor: \_\_\_\_\_ Date: \_\_\_\_\_

Regional Manager: \_\_\_\_\_ Date: \_\_\_\_\_

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

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**APPENDIX A. Fish species and numbers caught at each IBI survey site during 2023.**

Table 7. Species collected at the Louisburg IBI site (03MN082).

Species name	Catch
bluegill	46
white bass	17
golden redhorse	17
common carp	17
freshwater drum	11
emerald shiner	10
shorthead redhorse	10
orangespotted sunfish	8
walleye	6
spottail shiner	5
largemouth bass	5
channel catfish	4
yellow perch	4
greater redhorse	2
green sunfish	2
black bullhead	2
northern pike	2
bigmouth buffalo	2
quillback	1
yellow bullhead	1



**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

---

Table 8. Species collected at the Montevideo Upstream site (03MN084).

Species name	Catch
emerald shiner	26
spotfin shiner	22
common carp	14
shorthead redhorse	8
freshwater drum	5
golden redhorse	3
channel catfish	3
common shiner	2
bigmouth buffalo	2
bluntnose minnow	1
northern pike	1
white sucker	1

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

---

Table 9. Species collected at the Montevideo Downstream site (03MN081).

Species name	Catch
emerald shiner	74
spotfin shiner	20
golden redhorse	18
common carp	17
shorthead redhorse	17
channel catfish	12
freshwater drum	11
walleye	11
bigmouth buffalo	10
white bass	7
bluegill	5
blackside darter	3
silver redhorse	3
common shiner	2
yellow perch	2
bluntnose minnow	2
smallmouth bass	2
white sucker	1
largemouth bass	1
rock bass	1
fathead minnow	1

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

---

Table 10. Species collected at the Roe site (03MN085).

Species name	Catch
white bass	24
blackside darter	23
common shiner	22
spotfin shiner	21
bluegill	16
yellow perch	13
freshwater drum	13
golden redhorse	11
channel catfish	9
white sucker	8
shorthead redhorse	6
emerald shiner	6
walleye	5
common carp	4
Johnny darter	3
slenderhead darter	2
bluntnose minnow	2
black bullhead	2
hornyhead chub	1

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

---

Table 11. Species collected at the Memorial Park site (04MN002).

Species name	Catch
bigmouth buffalo	80
emerald shiner	23
largemouth bass	17
bluegill	11
golden redhorse	11
shorthead redhorse	8
logperch	8
spotfin shiner	8
silver redhorse	7
channel catfish	6
quillback	5
walleye	5
sand shiner	4
bluntnose minnow	4
bullhead minnow	4
gizzard shad	4
sauger	3
smallmouth buffalo	2
common carp	2
slenderhead darter	2
blackside darter	2
smallmouth bass	2
white bass	1
hybrid sunfish	1
shortnose gar	1
mooneye	1
blue sucker	1

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

---

Table 12. Species collected at the Hazel Creek site (03MN086).

Species name	Catch
emerald shiner	226
gizzard shad	13
shorthead redhorse	11
bullhead minnow	10
spotfin shiner	8
bigmouth buffalo	7
golden redhorse	6
common carp	6
channel catfish	6
sand shiner	5
shortnose gar	4
silver redhorse	4
carmine shiner	4
quillback	4
smallmouth buffalo	4
yellow perch	3
freshwater drum	2
river carpsucker	2
largemouth bass	2
walleye	2
longnose gar	1
bluegill	1

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

---

Table 13. Species collected at the Judson site (03MN091).

Species name	Catch
emerald shiner	190
gizzard shad	30
spotfin shiner	13
shorthead redhorse	12
common carp	11
channel catfish	10
walleye	10
quillback	8
sand shiner	8
bigmouth buffalo	7
golden redhorse	7
flathead catfish	7
freshwater drum	6
sauger	6
silver redhorse	4
bullhead minnow	3
shortnose gar	2
bluntnose minnow	2
hybrid sunfish	1
shovelnose sturgeon	1
river carpsucker	1
smallmouth buffalo	1
walleye/sauger	1

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

---

Table 14. Species collected at the Mankato site (03MN090).

Species name	Catch
emerald shiner	869
gizzard shad	27
shorthead redhorse	10
common carp	9
golden redhorse	8
freshwater drum	7
bigmouth buffalo	5
sauger	5
walleye	4
spotfin shiner	3
smallmouth buffalo	3
bluntnose minnow	2
quillback	2
white bass	2
mimic shiner	1
silver redhorse	1
bullhead minnow	1
channel catfish	1
highfin carpsucker	1
slenderhead darter	1
bluegill	1
flathead catfish	1

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

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Table 15. Species collected at the LeSueur site (03MN088).

Species name	Catch
emerald shiner	146
gizzard shad	16
logperch	14
freshwater drum	14
common carp	14
spotfin shiner	11
slenderhead darter	10
walleye	7
bigmouth buffalo	4
largemouth bass	4
shorthead redhorse	3
sauger	3
blackside darter	2
sand shiner	2
shortnose gar	2
bluntnose minnow	2
green sunfish	1
mimic shiner	1
smallmouth buffalo	1
golden redhorse	1
orangespotted sunfish	1
Johnny darter	1
fantail darter	1



**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

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Table 16. Species collected at the Shakopee site (03MN080).

Species name	Catch
emerald shiner	866
gizzard shad	76
common carp	7
logperch	7
freshwater drum	7
sauger	4
shorthead redhorse	4
slenderhead darter	4
white bass	3
walleye	3
channel catfish	2
orangespotted sunfish	2
blackside darter	1
mimic shiner	1
quillback	1
golden redhorse	1
largemouth bass	1

**RIVER SURVEY REPORT**  
IBI SURVEY ON MINNESOTA RIVER (M-55)

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Table 17. Species collected at the I-35 site (03MN079).

Species name	Catch
emerald shiner	324
spotfin shiner	172
gizzard shad	65
mimic shiner	15
bullhead minnow	10
common carp	5
freshwater drum	5
walleye	4
white bass	3
bluegill	2
sauger	2
shorthead redhorse	1
bowfin (dogfish)	1
smallmouth buffalo	1
common shiner	1
silver chub	1
flathead catfish	1