DEPARTMENT OF NATURAL RESOURCES

Minnesota River Fisheries Management Plan 2018–2022

Region	Area	Name	Tributary Number	Date
4	Hutchinson (411), Ortonville (415), Spicer (416), Waterville (417), West Metro (314)	Minnesota River	M-55	3-Apr-18
Reach	**River Mile**	**Type**	**Ecological Classification**	**Species Managed**
All	Mouth–333.0	Warmwater	II E	Channel Catfish, Flathead Catfish, Northern Pike, Paddlefish, Sauger, Shovelnose Sturgeon, Walleye, White Bass

Area Supervisor Signatures	Date	Regional Manager Signatures & Date
Ortonville	4-17-18	Southern Jack Jaren 8/2/2018
Spicer	4/16/18	
Hutchinson Scott Mackenthun	16 April 2018	
Waterville	4/17/18	
West Metro	4.17.18	Central — for BP/acting RM 8-2-18

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Prepared by Tony Sindt
Minnesota River Specialist, Sr.
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Executive Summary

The Minnesota River flows approximately 515 km (320 miles) across Minnesota before its confluence with the Mississippi River at St. Paul, and is an important and diverse aquatic resource that provides important fishing and recreation opportunities across a large portion of southern Minnesota. Primarily sought after gamefish species include Channel Catfish, Flathead Catfish, and Walleye followed by Northern Pike, Freshwater Drum, Sauger, and White Bass. The Minnesota Department of Natural Resources is responsible for managing fish populations in the Minnesota River, and prior to 2014, management was shared among five fisheries management areas. Starting during 2014, a Minnesota River Specialist was hired for coordinating and implementing all Minnesota River fisheries management activities which were outlined in the Minnesota River Fisheries Management Plan for 2013–2017. The Minnesota River Fisheries Management Plan for 2018–2022 is a modified continuation of the 2013–2017 management plan, and provides an overview of past fisheries management activities along with management goals for the next five years. The Minnesota River Fisheries Management Plan also outlines major issues and challenges affecting the Minnesota River such as barriers to fish movement, agricultural impacts, aquatic invasive species, and climate change. Fisheries management activities successfully implemented during 2013–2017 include standardized and experimental assessments, fish stocking, regulation evaluation, monitoring of commercial fishing activity, and several focused research projects. Examples of standardized assessments include annual hoop net assessments for Channel Catfish and Flathead Catfish and annual index of biotic integrity electrofishing assessments. In addition to annual stocking of Walleye into the Minnesota River and its impoundments, starting during 2015, approximately 4,000 fingerling Lake Sturgeon are annually stocked into Big Stone Lake with hopes of restoring a self-sustaining population. Also during this time, the Environment and Natural Resources Trust Fund provided funding for a 3-year special project to accelerate collection of baseline lower trophic data, quantify physical habitat characteristics, inventory backwater fish communities, and evaluate population dynamics and movement of Shovelnose Sturgeon and Paddlefish in the Minnesota River. During 2018–2022, fisheries management activities will build upon and continue past efforts with specific goals of 1) monitoring and promoting quality recreational fisheries for gamefish species, 2) monitoring and promoting fish species diversity and ecosystem health, 3) monitoring and protecting self-sustaining populations of state endangered, threatened, or special concern fish species, 4) tracking movement of acoustic tagged fish, 5) monitoring commercial fishing activity, 6) seeking external funds to enhance understanding of the Minnesota River ecosystem, 7) monitoring recreational use of the Minnesota River, 8) encouraging improved public access, and 9) addressing emerging questions and concerns with focused research projects. Appendices of this management plan also include specific protocols established for conducting standardized Minnesota River fisheries assessments, non-fisheries assessment activities, and a planned telemetry study.

Overview of the Minnesota River

The Minnesota River is a large 7th–8th order river that flows approximately 515 km (320 miles) from Big Stone Lake on the Minnesota–South Dakota Border to its confluence with the Mississippi River in St. Paul, MN (**Figure 1**) and serves as an important aquatic ecosystem, fishery, and economic and recreational resource in Southern Minnesota. The Minnesota River watershed is approximately 44,030 square kilometers (17,000 mi^2) draining portions of Minnesota (38,205 km^2, 14,751 mi^2), South Dakota, and Iowa that are highly altered for agricultural use and urban development. As a result, the Minnesota River is impacted by increased discharge, erosion, and sediment and nutrient inputs.

Five dams alter flow of the upper reaches of the Minnesota Rivers while the lower 386 km (240 miles) are completely free flowing. From upstream to downstream, the dams are Big Stone Lake (510 river kilometer [RKM], river mile [RM] 317), Big Stone National Wildlife Refuge (RKM 488, RM 303), Marsh Lake Dam (RKM 465, RM 289), Lac qui Parle Dam (RKM 438, RM 272), and Granite Falls Dam (RKM 386, RM 240). Most of the dams are associated with lakes or impoundments with independently managed fisheries. Granite Falls Dam is the exception and provides hydropower generation. Granite Falls Dam also acts as a major barrier to fish movement and therefore the fish community upstream of the dam is much less complex lacking many large river species including Flathead Catfish, Paddlefish, and Shovelnose Sturgeon.

Despite the altered nature of the Minnesota River and its unstable flow regime, it is home to a diversity of biota, including populations of gamefish (e.g., Channel Catfish, Flathead Catfish, Walleye), commercially harvested fish species (Bigmouth Buffalo, Common Carp, Freshwater Drum, Smallmouth Buffalo), and important non-game fishes (Black Buffalo, Blue Sucker, Lake Sturgeon, Paddlefish, Shovelnose Sturgeon). 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 (**Table 1**). Primary gamefish species include Channel Catfish, Flathead Catfish, and Walleye with secondary gamefish species including Northern Pike, Freshwater Drum, Sauger, and White Bass. Current management of the Minnesota River fishery includes monitoring populations, harvest regulations, and limited stocking. Big Stone Lake, Big Stone Lake National Wildlife Refuge, Marsh Lake, and Lac qui Parle Lake also receive regular walleye stocking which undoubtedly contributes to the population in the Minnesota River. Similarly, a 20-year Lake Sturgeon stocking program for Big Stone Lake began during 2015, and is expected to bolster the Minnesota River Lake Sturgeon population.

The Minnesota River is most notable for its trophy Flathead Catfish fishery, but anglers also regularly target many other species including Channel Catfish and Walleye. Yet, relative to its size, angling effort on the Minnesota River is much lower than on popular area lakes. The large size, variable flow, and navigation obstacles (logjams, sand bars, rocks) of the Minnesota River likely intimidates many boaters while some may perceive the Minnesota River as "dirty" because of its turbid water and past pollution issues. Although not all portions of the Minnesota River are easy to navigate with large fishing boats, the Minnesota River has over 50 boat ramps and canoe accesses in addition to many parks, trails, and shore fishing access locations. In addition to

angling, many people utilize the Minnesota River for paddling, hiking, viewing wildlife, camping, hunting, and other recreation.

Table 1. Fish species documented in the Minnesota River since 1960.

Common name	Scientific name	Status	Most recent record	Non-native	Upstream of Granite Falls
American Brook Lamprey	*Lethenteron appendix*	Rare	2013		
American Eel	*Anguilla rostrata*	Rare	2017		
Banded Darter	*Etheostoma zonale*	Rare	2014		X
Bighead Carp	*Hypophthalmichthys nobilis*	Rare	2016	X	
Bigmouth Buffalo	*Ictiobus cyprinellus*	Common	2017		X
Bigmouth Shiner	*Notropis dorsalis*	Rare	2010		X
Black Buffalo	*Ictiobus niger*	Rare	2017		
Black Bullhead	*Ameiurus melas*	Uncommon	2017		X
Black Crappie	*Pomoxis nigromaculatus*	Common	2017		X
Blacknose Dace	*Rhinichthys obtusus*	Uncommon	2015		X
Blackside Darter	*Percina maculata*	Common	2017		X
Blue Sucker	*Cycleptus elongatus*	Uncommon	2017		
Bluegill	*Lepomis macrochirus*	Common	2017		X
Bluntnose Minnow	*Pimephales notatus*	Common	2017		X
Bowfin	*Amia calva*	Uncommon	2017		X
Brassy Minnow	*Hybognathus hankinsoni*	Common	2017		X
Brook Silverside	*Labidesthes sicculus*	Rare	2015		
Brook Stickleback	*Culaea inconstans*	Rare	2014		X
Brown Bullhead	*Ameiurus nebulosus*	Rare	2004		X
Bullhead Minnow	*Pimephales vigilax*	Common	2017		
Burbot	*Lota lota*	Rare	1980		
Carmine Shiner	*Notropis percobromus*	Rare	2014		X
Central Mudminnow	*Umbra limi*	Rare	2014		X
Central Stoneroller	*Campostoma anomalum*	Uncommon	2017		X
Channel Catfish	*Ictalurus punctatus*	Common	2017		X
Channel/Mimic Shiner	*Notropis wickliffi/volucellus*	Common	2017		
Chestnut Lamprey	*Ichthyomyson castaneus*	Rare	2015		
Common Carp	*Cyprinus carpio*	Common	2017	X	X
Common Shiner	*Luxilus cornutus*	Uncommon	2017		X
Creek Chub	*Semotilus atromaculatus*	Uncommon	2017		X
Emerald Shiner	*Notropis atherinoides*	Common	2017		X
Fantail Darter	*Etheostoma flabellare*	Rare	2014		X
Fathead Minnow	*Pimephales promelas*	Common	2017		X
Flathead Catfish	*Pylodictis olivaris*	Common	2017		
Freshwater Drum	*Aplodinotus grunniens*	Common	2017		X
Gizzard Shad	*Dorosoma cepedianum*	Common	2017		
Golden Redhorse	*Moxostoma erythrurum*	Common	2017		X
Golden Shiner	*Notemigonus crysoleucas*	Rare	2010		X
Goldeye	*Hiodon alosoides*	Uncommon	2017		
Goldfish	*Carassius auratus*	Rare	1996	X	
Grass Carp	*Ctenopharyngodon idella*	Rare	2015	X	
Greater Redhorse	*Moxostoma valenciennesi*	Uncommon	2017		X

Common name	Scientific name	Status	Most recent record	Non-native	Upstream of Granite Falls
Green Sunfish	*Lepomis cyanellus*	Common	2017		X
Highfin Carpsucker	*Carpiodes velifer*	Uncommon	2017		X
Hornyhead Chub	*Nocomis biguttatus*	Uncommon	2015		X
Iowa Darter	*Etheostoma exile*	Rare	2014		X
Johnny Darter	*Etheostoma nigrum*	Common	2017		X
Largemouth Bass	*Micropterus salmoides*	Common	2017		X
Lake Sturgeon	*Acipenser fulvescens*	Rare	2017		X
Logperch	*Percina caprodes*	Common	2017		X
Longnose Gar	*Lepisosteus osseus*	Common	2017		
Mooneye	*Hiodon tergisus*	Common	2017		
Northern Hog Sucker	*Hypentelium nigricans*	Uncommon	2017		X
Northern Pike	*Esox lucius*	Common	2017		X
Orangespotted Sunfish	*Lepomis humilis*	Common	2017		X
Paddlefish	*Polyodon spathula*	Uncommon	2017		
Pumpkinseed	*Lepomis gibbosus*	Uncommon	2017		X
Quillback	*Carpiodes cyprinus*	Common	2017		X
River Carpsucker	*Carpiodes carpio*	Common	2017		X
River Darter	*Percina shumardi*	Rare	2015		
Rock Bass	*Ambloplites rupestris*	Uncommon	2017		X
Sand Shiner	*Notropis stramineus*	Common	2017		X
Sauger	*Sander canadensis*	Common	2017		
Saugeye	*Sander vitreus x S. canadensis*	Common	2017		
Shoal/Speckled Chub	*Macrhybopsis hyostoma/aestivalis*	Common	2017		
Shorthead Redhorse	*Moxostoma macrolepidotum*	Common	2017		X
Shortnose Gar	*Lepisosteus platostomus*	Common	2017		
Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	Common	2017		
Silver Chub	*Macrhybopsis storeriana*	Uncommon	2017		
Silver Lamprey	*Ichthyomyzon unicuspis*	Uncommon	2017		
Silver Redhorse	*Moxostoma anisurum*	Common	2017		X
Slenderhead Darter	*Percina phoxocephala*	Common	2017		X
Smallmouth Bass	*Micropterus dolomieu*	Common	2017		X
Smallmouth Buffalo	*Ictiobus bubalus*	Common	2017		
Spotfin Shiner	*Cyprinella spiloptera*	Common	2017		X
Spottail Shiner	*Notropis hudsonius*	Common	2017		X
Stonecat	*Noturus flavus*	Rare	2010		X
Tadpole Madtom	*Noturus gyrinus*	Rare	2014		X
Walleye	*Sander vitreus*	Common	2017		X
Weed Shiner	*Notropis texanus*	Rare	2017		
Western Sand Darter	*Ammocrypta clara*	Rare	1970		X
White Bass	*Morone chrysops*	Common	2017		X
White Crappie	*Pomoxis annularis*	Common	2017		X
White Sucker	*Catostomus commersonii*	Common	2017		X
Yellow Bullhead	*Ameiurus natalis*	Uncommon	2017		X
Yellow Perch	*Perca flavescens*	Common	2017		X

The Fisheries Section of the Minnesota Department of Natural Resources Fish and Wildlife Division is responsible for managing fish populations in the Minnesota River, which flows through five fisheries management areas (Ortonville, Spicer, Hutchinson, Waterville, and West Metro). Additionally, a Minnesota River Specialist based in Hutchinson, MN is responsible for coordinating and implementing all Minnesota River fisheries management activities. Minnesota River fisheries assessments are generally stratified across eleven distinct reaches of the river characterized by unique physical habitat characteristics, gradient, channel morphology, and tributary contributions (**Figure 2**).

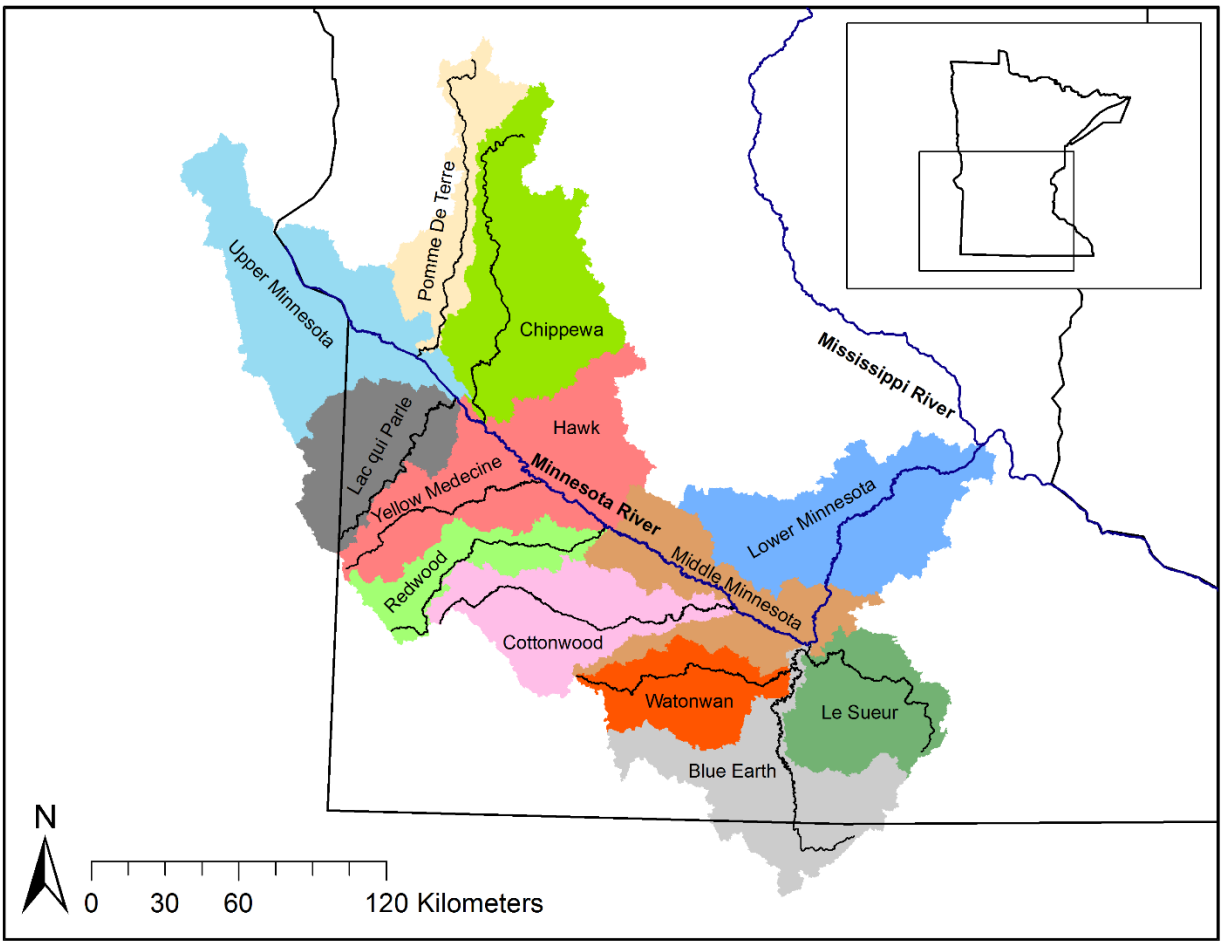

Figure 1. Location of the Minnesota River, its major tributaries, and sub-watersheds.

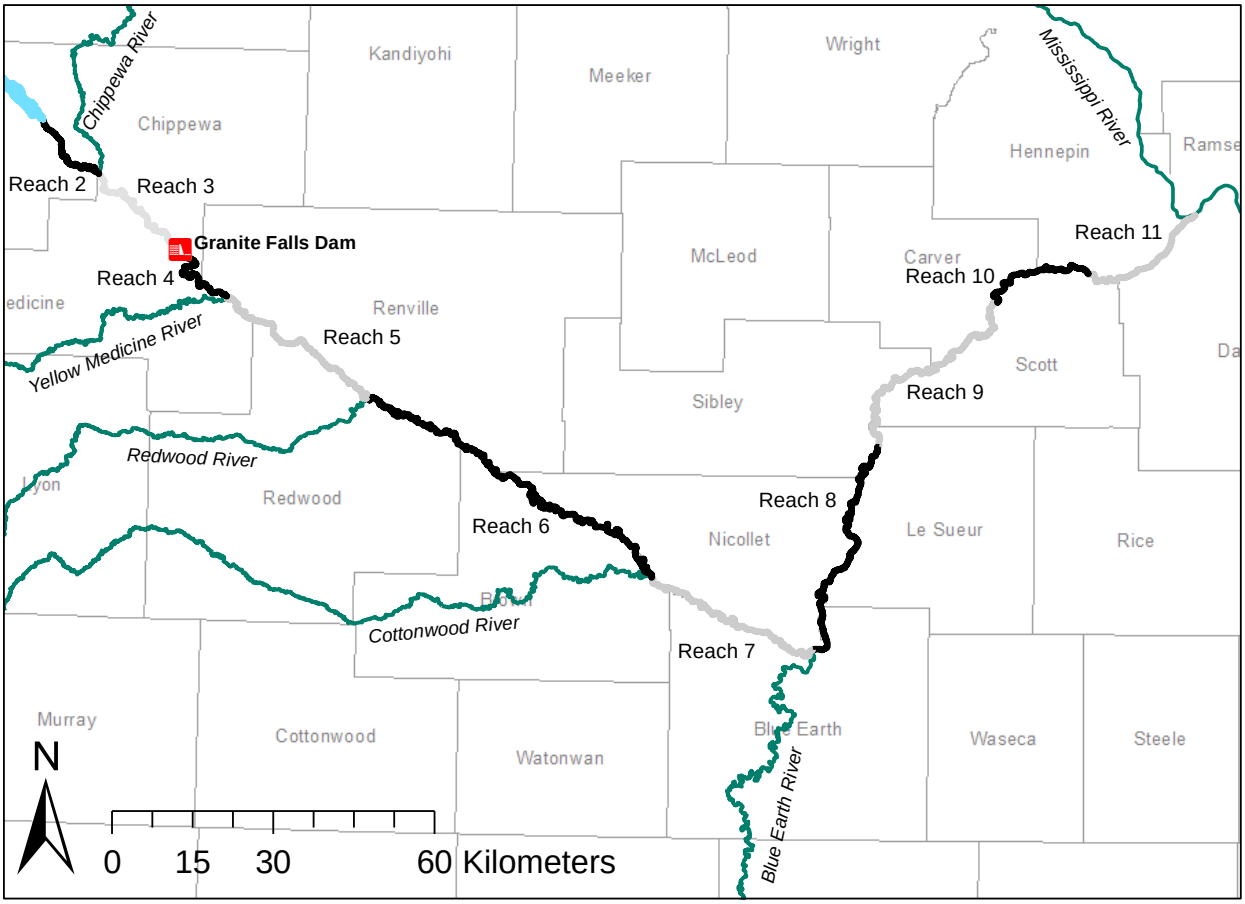

Figure 2. Location of unique Minnesota River reaches. Note: Reach 1 includes all riverine reaches of the Minnesota River upstream of the Lac qui Parle Dam (outside of map extent).

2013–2017 Fisheries Management and Accomplishments

During 2013–2017, Minnesota River fisheries management activities included standardized and experimental assessments, fish stocking, regulation evaluation, monitoring of commercial fishing activity, and several focused research projects. Standardized assessments included annual hoop net assessments for Channel Catfish and Flathead Catfish and annual August index of biotic integrity (IBI) electrofishing assessments at 16 fixed sites. Experimental assessments included low-frequency electrofishing, small hoop netting, benthic trawling, large-mesh gill netting, trammel netting, and seining. Additionally, several fisheries assessments were conducted in Minnesota River backwater habitats and nine stationary acoustic receivers were installed on Minnesota River bridge pylons. Activities associated with focused research projects included but were not limited to hoop net assessments, age and growth analyses, larval fish sampling, water quality and plankton sampling, habitat assessments, backwater fish community surveys, acoustic telemetry, and targeted Paddlefish and Shovelnose Sturgeon surveys.

During 2013–2017, Ortonville Fisheries Management Area stocked approximately 94lbs of fingerling, 2,075lbs of yearling, and 681lbs of adult walleyes into the Minnesota River downstream of Lac qui Parle Dam. Stocking of Walleye into Big Stone Lake, Big Stone

National Wildlife Refuge, Marsh Lake, and Lac qui Parle during this time period also contributed Walleye to the Minnesota River. Additionally, starting in 2015, approximately 4,000 fingerling Lake Sturgeon are annually stocked into Big Stone Lake, which is expected to bolster the Lake Sturgeon population in the Minnesota River.

Currently, Minnesota River fishing regulations are the same as general inland fishing regulations, which includes closed seasons for black bass, Flathead Catfish, Northern Pike, Sauger, sturgeon species, and Walleye. There is no open season for Paddlefish. Refer to state inland fishing regulations for specific bag limits and rules. During 2015, a closed season was implemented for Flathead Catfish from November 30 through April 1 on all inland Minnesota waters, which includes the Minnesota River. This regulation protects concentrations of over-wintering Flathead Catfish from over-exploitation. During 2016, both Zebra Mussels and Invasive Carp (Bighead Carp *Hypophthalmichthys nobilis* and Grass Carp *Ctenopharyngodon idella*) were captured from the Minnesota River resulting in the river being listed as a designated infested water. This designation changes various regulations regarding bait harvest and commercial fishing in the Minnesota River.

Research Projects:

Population dynamics of Flathead Catfish in the lower Minnesota River (Shroyer in preparation): During 2013–2016, Flathead Catfish were annually sampled with unbaited hoop nets at four study reaches of the Minnesota River to estimate abundance, obtain age and growth information, and estimate recruitment variability and mortality. Results indicate that recruitment of Minnesota River Flathead Catfish is relatively consistent and high estimated annual survival of 91% and low instantaneous mortality of 9% is indicative of a lightly exploited population. An estimated growth curve indicates that average Minnesota River Flathead Catfish reach 510 mm around age 5, 710 mm between age 8 and 9, and 860 mm around age 13. Only unusually fast-growing fish reach trophy size (1020 mm). Mark-recapture population estimates are approximately 90 ≥ 510 mm Flathead Catfish/river km (145 ≥ 20”/river mile) and approximately 8 ≥ 1020 mm Flathead Catfish/river km (13 ≥ 40”/river mile).

Evaluation of unbaited hoop nets for simultaneously assessing Channel Catfish and Flathead Catfish populations in the Minnesota River (Sindt 2018): Catches of Channel Catfish and Flathead Catfish in unbaited hoop nets were compared among months to evaluate efficacy of simultaneously assessing Channel Catfish and Flathead Catfish populations in the Minnesota River and identify sample size requirement for obtaining adequate statistical power and precision. Results indicated that unbaited hoop nets are effective for simultaneously sampling Channel Catfish and Flathead Catfish, and a minimum of 68 hoop net samples during August are required to achieve adequate precision and statistical power to detect at least 50% declines in relative abundance.

Evaluation of four larval fish sampling methods in a large Midwestern River (Lederman et al. in preparation): Four larval fish sampling gears (benthic slednet, surface slednet, glow-stick light trap, LED light trap) were compared among sampling events at four study reaches during April–August of 2014 and 2015. Overall, catches of larval fish were extremely low and suspended

sediment clogged gears and decreased sampling efficiency. A Minnesota State University, Mankato master's student conducted this project while cooperating with the MN DNR.

Evaluation of Minnesota River Walleye ancestry: A small-scale genetic analysis was performed on scale samples collected from Minnesota River walleyes. Results showed that hybridization between Walleye and Sauger is common in the Minnesota River and that fish from at least three distinct genetic strains (Upper Mississippi, Pike River, Lower Mississippi/Cannon) are present in the Minnesota River. Generally, there was a positive relationship between fish length and the likelihood of being from the "more native" Lower Mississippi/Cannon River strain.

Minnesota River Channel Catfish population dynamics upstream and downstream of the Granite Falls Dam (Sindt in preparation): Relative abundance, growth, and mortality estimates were compared between populations of Channel Catfish upstream and downstream of the Granite Falls Dam, which acts as a major barrier to upstream fish movement. Channel Catfish hoop net catch rates are more than ten times greater upstream of Granite Falls Dam than downstream. Growth rates are similar up to age 10, but fish downstream of Granite Falls Dam grow faster after age 10. Slower growth of older fish and lower survival rates results in fewer old and preferred size (≥ 610 mm) fish upstream of Granite Falls Dam. Downstream of Granite Falls Dam, over 15% of the population of stock size (280 mm) Channel Catfish exceeds preferred size. The oldest aged fish were 19 upstream of Granite Falls Dam and 24 downstream.

Enhancing understanding of the Minnesota River aquatic ecosystem (Ongoing): This project is funded for fiscal years 2016–2018 by the Environment and Natural Resources Trust Fund (allocated by the Legislative Citizen Commission on Minnesota Resources; LCCMR) and has four primary activities: 1) accelerate collection of baseline Minnesota River lower trophic data, 2) quantify physical habitat characteristics of the Minnesota River, 3) inventory Minnesota River backwater fish communities, and 4) evaluate population dynamics, movement, and habitat use of Shovelnose Sturgeon and Paddlefish.

Highlights:

- During 2013–2017, over 75 fish species were documented in the Minnesota River highlighting its diversity and importance as an aquatic ecosystem.
- Hoop nets were confirmed an efficient gear for simultaneously assessing Minnesota River Channel Catfish and Flathead Catfish populations.
- Populations of Channel Catfish and Flathead Catfish downstream of Granite Falls Dam exhibit characteristics of light exploitation resulting in an abundance of memorable and trophy size fish. These trophy fisheries might be sensitive to increased exploitation, warranting increased monitoring efforts.
- In the Minnesota River, Channel Catfish and Flathead Catfish are estimated to live up to > 20 and > 30 years, respectively.
- Mark-recapture estimates indicate that mean densities of Minnesota River Flathead Catfish are approximately 90 ≥ 510 mm/river km (145 ≥ 20"/river mile) and approximately 8 ≥ 1020 mm/river km (13 ≥ 40"/river mile).
- Mean index of biotic integrity scores for the Minnesota River continually exceed the impairment thresholds set by the Minnesota Pollution Control Agency.

- Common larval fish sampling methods are ineffective in the main stem of the Minnesota River due to high levels of suspended sediment.
- Although hoop net catch rates of Channel Catfish are ten times greater upstream of Granite Falls Dam than downstream, growth rates are similar up to age 10. However, mortality rates of Channel Catfish upstream of Granite Falls Dam are greater, resulting in a smaller proportion of fish exceeding preferable size (610 mm).
- Although previous records of Paddlefish in the Minnesota River were limited, targeted sampling captured more than 60 Paddlefish from the Minnesota River during 2016–2017. Telemetry data indicates that some Paddlefish regularly make long-distance migrations up and down the Minnesota River and move between the Minnesota River, Mississippi River, and St. Croix River.
- There is evidence that the "more native" Lower Mississippi/Cannon River strain of Walleye is more likely to obtain large sizes in the Minnesota River.
- Commercial fishermen captured the first Grass Carp and Bighead Carp from the Minnesota River during the winter of 2016–2017.
- Zebra Mussels were confirmed in the Minnesota River during 2016.
- More than 10 fish species have returned to the reach of river upstream of Minnesota Falls since removal of the Dam during 2013.

2018–2022 Fisheries Management Plan

Fisheries Management Goals:

1. Monitor and promote quality recreational fisheries for Channel Catfish, Flathead Catfish, Freshwater Drum, Norther Pike, Sauger, Walleye, and White Bass.
    - Maintain July hoop net catch rates of ≥ 1.0 Flathead Catfish/net-night and ≥ 3.0 Channel Catfish/net-night downstream of Granite Falls Dam.
    - Maintain trophy fisheries downstream of Granite Falls Dam with hoop net catch rates of memorable size (860 mm) Flathead Catfish ≥ 0.2/net-night and trophy size (1020 mm) Flathead Catfish ≥ 0.1/net-night. Maintain hoop net catch rates of preferred size (610 mm) Channel Catfish ≥ 0.3/net-night and memorable size (710 mm) Channel Catfish ≥ 0.15/net-night.
2. Monitor and promote fish species diversity and ecosystem health.
    - Compare index of biotic integrity scores with MPCA impairment thresholds.
3. Monitor and protect self-sustaining populations of state endangered, threatened or special concern fish species including Black Buffalo (T), Blue Sucker (SC), Lake Sturgeon (SC), and Paddlefish (T).
4. Track movement of acoustic tagged fish species to learn about habitat use, migration patterns, spawning habitats, and over-wintering habitats.
5. Monitor commercial fishing activity and harvest to ensure sustainability and minimize risks to non-commercial species.
6. Enhance understanding of the Minnesota River aquatic ecosystem through externally funded projects.
7. Monitor recreational use of the Minnesota River and Minnesota River accesses.

8. Encourage increased and improved public access to the Minnesota River.
9. Address emerging concerns and questions with focused research projects.

Fisheries Operational Plan:

Protocols for annual Minnesota River fisheries assessments and non-assessment activities are provided in **Appendix A** and **Appendix B**. In summary, the operational plan for 2018–2022 includes:

1. Continue annual monitoring of Channel Catfish and Flathead Catfish populations with hoop net assessments.
2. Conduct annual low-frequency electrofishing assessments to monitor recruitment of Flathead Catfish.
3. Continue to monitor health of the Minnesota River fish community through annual August index of biotic integrity electrofishing surveys at 16 fixed sites.
4. Monitor diversity of small-bodied benthic species and presence of juvenile Lake Sturgeon, Paddlefish, and Shovelnose Sturgeon with annual benthic trawl assessments.
5. Conduct annual Paddlefish tagging surveys to provide information about movement, growth, habitat use, and abundance.
6. Maintain an array of acoustic receivers in the Minnesota River to track large-scale movements of acoustic tagged fish.
7. Conduct experimental sampling to address specific questions such as presence of rare species, presence of invasive species, or use of specific habitats for spawning or over-wintering.
8. Develop additional sampling methods for monitoring populations of important gamefish, non-game fish, and invasive fish species in the Minnesota River.
9. Conduct annual winter angler use surveys.
10. Annually collect fish samples for VHS surveillance.
11. Seek dedicated funding for a Minnesota River Fisheries Technician.
12. Update the Minnesota River Fisheries Management Plan during winter 2022-2023.

Ongoing and Planned Research Projects:

Flathead Catfish telemetry: See **Appendix C** for a detailed description of the Flathead Catfish Telemetry project planned for 2018–2028.

Enhancing understanding of the Minnesota River aquatic ecosystem: This project is funded thru fiscal year 2019 by the Environment and Natural Resources Trust Fund (allocated by the Legislative Citizen Commission on Minnesota Resources; LCCMR) and has four primary activities: 1) accelerate collection of baseline Minnesota River lower trophic data, 2) quantify physical habitat characteristics of the Minnesota River, 3) inventory Minnesota River backwater fish communities, and 4) evaluate population dynamics, movement, and habitat use of Shovelnose Sturgeon and Paddlefish. More information about this project is provided in the project work plan at https://www.lccmr.leg.mn/projects/2016/work_plans_may/_2016_03i.pdf.

Knowledge and data insufficiencies:

Creel data: Insufficient creel data limits the ability to quantify exploitation of important Minnesota River gamefish species. Additionally, recreational use of the Minnesota River relative to other aquatic resources is unknown. Even if creel surveys are implemented, estimating nighttime catfish angling effort is logistically challenging.

Spawning: Spawning habitat and spawning success of Lake Sturgeon, Paddlefish, Sauger, Shovelnose Sturgeon, Walleye, and other important fish species is poorly understood for the Minnesota River. It is unknown if Paddlefish and Lake Sturgeon have self-sustaining populations within the Minnesota River.

Catfish populations: Currently, survey results indicate healthy and lightly exploited populations of Channel Catfish and Flathead Catfish downstream of Granite Falls Dam, which results in trophy fisheries. However, if exploitation significantly increased, the quality of the trophy fisheries could decline. Therefore, both populations warrant continued monitoring.

Flathead Catfish habitat use: Generalized annual movement patterns of Flathead Catfish are fairly well understood, but many nuances are unknown for the Minnesota River population. For instance, annual distances traveled, use of the Mississippi River and tributaries, and locations of important over-wintering habitats are unknown.

Small-bodied benthic species: The status of many small-bodies benthic species in the Minnesota River is poorly understood. Benthic trawl surveys will provide insight on the relative abundance and specific habitat uses of many benthic species including Banded Darter, Blackside Darter, River Darter, Shoal Chub, Silver Chub, and Slenderhead Darter. Additionally, benthic trawl surveys are likely the best method for detecting the presence of juvenile Lake Sturgeon, Paddlefish, and Shovelnose Sturgeon, which are rarely (or never) captured from the Minnesota River.

Aquatic invasive species: Future expansion and impact of Invasive Carps and Zebra Mussels on the Minnesota River ecosystem is unknown.

Historical Fisheries Management

Fish Stocking:

During the late 1800's and early 1900's many fish species were indiscriminately stocked into the Minnesota River including Pacific Salmon, Lake Whitefish, and Common Carp. Many of those stockings were unsuccessful, but Common Carp are one extreme exception. Throughout the 1900's sporadic fish stocking occurred in the Minnesota River, primarily of Walleye, but also including Bluegill, Channel Catfish, crappies, Flathead Catfish, Largemouth Bass, Northern Pike, and Smallmouth Bass. Recent (since 2000) stocking has been limited to Walleye and the re-introduction of Lake Sturgeon into Big Stone Lake starting in 2015.

Historical Fisheries Assessments:

Pre-1980: Several early fisheries surveys were conducted on portions of the Minnesota River including a biological survey from Mankato to the Mouth (Biological Survey Unit 1960), A

biological reconnaissance from Lac qui Parle Dam to Mankato (Schneider 1966), and a fish and wildlife survey near New Ulm (Huber 1971).

1978–82 (Kirsch et al. 1985): During 1978–1982, a biological survey of the Minnesota River was conducted, which included boat electrofishing surveys at 52 stations. Electrofishing surveys captured 53 different species representing 14 families with Channel Catfish and Walleye being the two most abundant game species.

1992 (Stauffer et al. 1995): During 1992, Minnesota Department of Natural Resources fisheries staff conducted fisheries assessments at 55 sites on the Minnesota River using boat electrofishing, gill nets, trap nets, seines, and trotlines. Sixty-four species were collected representing 14 families. Walleye, Channel Catfish, and Flathead Catfish were the most commonly captured game species.

1993 (Bailey 1994): As part of the Minnesota River Assessment Project fish communities were evaluated at 116 stream and river sites throughout the Minnesota River basin including several sites on the Minnesota River mainstem.

1998 (Chapman 2000): During 1998, Minnesota Department of Natural Resources fisheries staff conducted electrofishing, trap net, trotline, and seine assessments at the same stations that were surveyed during 1992. Sixty-eight species were collected representing 15 families. This survey provided the first documentation of Blue Sucker and Slender Madtom from the Minnesota River.

2004 (Chapman 2005): During 2004, Minnesota Department of Natural Resources fisheries staff conducted electrofishing, low-frequency electrofishing, trap net, trotline, gill net, and seine assessments along the Minnesota River. Sixty-four species were collected representing 14 families, including the first documented occurrence of Black Buffalo from the Minnesota River.

2009–10: During 2009 and 2010, the Minnesota Pollution Control Agency conducted a biological survey of the Minnesota River Basin at sites similar to the first Minnesota River Assessment Project survey conducted during 1993. The purpose of this survey was to measure success of restoration efforts. Electrofishing assessments were conducted at 143 stream and river sites throughout the Minnesota River watershed including eight sites on the Minnesota River.

Index of Biological Integrity Assessments: Since 2010, annual boat electrofishing assessments have been conducted at 16 fixed sites (with some exceptions) on the Minnesota River to measure fish community health through index of biotic integrity (IBI) scores. Although some individual site scores have been below impairment thresholds, overall mean IBI scores have exceeded impairment thresholds every year. Additionally, index of biotic integrity surveys were conducted at sites upstream of Minnesota Falls Dam during 2006–2009.

Historical MNDNR Fisheries Research Projects:

Comparison of methods for sampling Flathead Catfish in the Minnesota River (Stauffer and Koenen 1999): Limb lines, trotlines, deep-water electrofishing, low-frequency electrofishing, standard DC electrofishing, and hoop nets were evaluated for efficacy of capturing Flathead Catfish in the Minnesota River. In combination, sampling with low-frequency electrofishing and

trotlines were the most cost-effective and representative methods for collecting length and age data.

Angler creel survey of a 110 mile segment of the Minnesota River (Chapman 2001): A stratified-random creel survey was conducted along a 177 km (110 mile) reach of the Minnesota River between May, 1 and October, 31, 1998. Total angling effort was estimated at 49,311 hours or 278 hours/river km (448 hours/river mile). The most sought species were Channel Catfish and Flathead Catfish while the most frequently caught species were Channel Catfish, Common Carp, and Freshwater Drum. An estimated 25 Channel Catfish and 6 Flathead Catfish were harvested per river mile during the creel survey.

Special Sampling of Flathead Catfish in the Minnesota River (Chapman 2002): A total of 4,327 Flathead Catfish were sampled from the Minnesota River between 1989 and 2000 with trotlines, low-frequency electrofishing, early-winter electrofishing, standard electrofishing, hoop nets, gill nets, and yo-yo set lines. The most effective methods for capturing Flathead Catfish were trotlines for large fish and low-frequency electrofishing for small fish. A total of 2,114 fish were tagged between 1990 and 1999, of which 532 were recaptured, exhibiting both upstream and downstream movements. Age and growth analyses indicated Flathead Catfish live up to 21 years in the Minnesota River.

Fish communities of Minnesota River floodplain lakes (Schmidt and Polomis 2007): During 2006, fish were sampled in 21 Minnesota River flooplain lakes with electrofishing, gill nets, trap nets, minnow traps, and seines. A total of 19,673 fish were captured, representing 51 species and 14 families. Notable catches included Black Buffalo, Brooke Silverside, Northern Redbelly Dace, and Weed Shiner.

Movement and site fidelity of Flathead Catfish in the Minnesota River (Shroyer 2011): Eighteen radio- and acoustic-tagged adult Flathead Catfish were manually located in the lower Minnesota River during late summer and fall of 2008 and 2009. Most fish remained within 2 km of their capture locations during August–September 2008. However, 17% of fish emigrated from the study reach before the end of September, and all emigrated by the end of October. Fourteen of the 18 fish returned to the study reach during August–September 2009.

Theses: Minnesota State University, Minnesota M.S. students published two recent theses on Minnesota River fisheries. Nickel (2014) investigated connectivity relationships with abiotic conditions and community dynamics in Minnesota River backwater lakes and Nelson (2015) investigated hydrologic and temperature regime influence on growth and recruitment of fishes in an upper Midwest riverine ecosystem.

Fish Species Information

American Eel: American Eel have one of the most fascinating life histories of all Minnesota fishes. They spawn in the Sargasso sea, meaning every American Eel living in the Minnesota River traveled across the Ocean from the Sargasso Sea to the Gulf of Mexico and then swam up the Mississippi River to Minnesota. American Eel typically live in medium to large rivers (such as the Minnesota River) until they reach sexual maturity (10-20 years), and then return to the

Sargasso Sea to spawn and die. American Eel used to be more common in Minnesota prior to the construction of dams that block their migration route. Fortunately, some American Eel find a way to pass dams and navigation obstacles. Today, reports of American Eel in the Minnesota River are uncommon, but there is generally one or more per year. During 2017, an American Eel was captured from Cottonwood Lake in southern Minnesota, which would have traveled through the Minnesota River. American Eel are also found in the Mississippi River, St. Croix River, their larger tributaries, and Lake Superior. Recreational anglers catch most American Eel captured from the Minnesota River, but some have been caught during boat electrofishing surveys—in deep water near rocky or riprapped banks.

Black Buffalo: Prior to 1983, there were zero records of Black Buffalo in Minnesota. Since 1983, there have been confirmed and unconfirmed reports of Black Buffalo in several pools of the Mississippi River, the St. Croix River, and the Minnesota River (as far upstream as Granite Falls Dam). Minnesota is on the northern edge of Black Buffalos distribution, and populations are considered low. Very little is known about habitat use, spawning, and migration within Minnesota. Black Buffalo are also very difficult to distinguish from Smallmouth Buffalo, which complicates understanding of their distribution and status within Minnesota. Black Buffalo have been captured from the Minnesota River with boat electrofishing and trammel nets.

Blue Sucker: Blue Sucker are one of the rarest species in Minnesota, but in recent years have been captured with regularity from the Minnesota River, including some juveniles. Historically, Blue Sucker were a prized commercial species and found throughout the Mississippi River drainage. However, the construction of Lock and Dams for navigation during the 1930's along with water pollution highly altered the preferred habitats of Blue Sucker and fragmented populations. In Minnesota, Blue Sucker are found in the Mississippi River, St. Croix River, Minnesota River, and larger tributaries. Blue Sucker inhabit deep swift water in channels of large rivers with sand, gravel, or rock bottoms and they also spawn in swift waters. Blue Suckers have returned to the reach of river upstream of Minnesota Falls Dam since its removal in 2013, and have been observed spawning downstream of Granite Falls Dam. Blue Suckers are commonly caught during boat electrofishing surveys in fast flowing mid-channel habitats while some have been captured with trammel nets and benthic trawls.

Channel Catfish: The Minnesota River has an exceptional Channel Catfish fishery for both quantity and quality. Downstream of Granite Falls Dam single unbaited hoop net catch rates are consistently around 4.0 fish/net-night with over 15% of captured fish exceeding 610 mm (24"), over 5% of fish exceeding 711 mm (28"), and some fish exceeding 864 mm (34") and 8.2 kg (18 lbs). Upstream of Granite Falls Dam hoop net catch rates are much greater with averages around 45.0 fish/net-night with only 5% of fish exceeding 610 mm (24") and few fish exceeding 711 mm (28").

Flathead Catfish: The Minnesota River has a nationally recognized Flathead Catfish fishery with some fish exceeding 27kg (60lbs). Not only does the Minnesota River have large Flathead Catfish, it also has a rather high density population of medium size Flathead Catfish with estimated densities of 90 fish ≥ 510 mm/river km (145 ≥ 20" /river mile) and 8 fish ≥ 1020 mm/river km (13 ≥ 40"/river mile). Flathead Catfish are restricted to areas downstream of

Granite Falls Dam, but trophy size fish can be caught anywhere throughout the 386 km (240 mile) stretch of river. Tagging studies have shown that during summer months Flathead Catfish inhabit small stretches of river and tend to utilize logjams and other complex structures. However, Flathead Catfish will migrate great distances for spawning and for over-wintering in deep holes where large numbers of Flathead Catfish concentrate. Oftentimes Flathead Catfish will return to the same stretch of river each summer. Population dynamics of Minnesota River Flathead Catfish are indicative of low exploitation rates, and the population may be sensitive to increased exploitation.

Lake Sturgeon: At one time, Lake Sturgeon were nearly extirpated from the state. Fortunately, healthy populations are now found in several Minnesota Rivers (e.g., Rainy River, St. Croix River, Mississippi River) along with rebounding populations in other lakes and rivers throughout the state. In the Minnesota River, Lake Sturgeon were historically present all the way up to Big Stone Lake where historical accounts suggest abundant populations existed. Due to habitat loss, fragmentation, over-fishing, and pollution, populations declined and Lake Sturgeon were last reported from Big Stone Lake during 1946. Since then, very few Lake Sturgeon have been captured by anglers in the Minnesota River and its tributaries, and it is unknown if there is any reproduction within the Minnesota River itself. Lock and Dam 2 of the Mississippi River likely limits important movement of Lake Sturgeon between the Minnesota, Mississippi, and St. Croix Rivers. Starting during 2015, the Minnesota Department and Natural Resources began a 20-year re-introduction program that will include annually stocking approximately 4,000 fingerling Lake Sturgeon into Big Stone Lake. The intent is for a self-sustaining population to establish within Big Stone Lake, potentially supplementing the population within the Minnesota River. In recent history, MN DNR staff have not captured Lake Sturgeon from the Minnesota River.

Paddlefish: Paddlefish are a large native planktivore that inhabits large rivers and their backwaters. Similar to other large river species, the Paddlefish was once abundant in Minnesota Rivers and throughout the Mississippi River drainage. Paddlefish declined in abundance as a result of habitat degradation, overharvest, and the construction of navigation dams. Populations of Paddlefish have persisted in the Mississippi River and St. Croix River within Minnesota, but until recently, very few Paddlefish were documented in the Minnesota River (Schmidt 2004). During the 1990's and early 2000's there were various angler reports of Paddlefish, one confirmed capture by DNR fisheries staff near Minnesota Falls Dam, and multiple captures by commercial fishermen in backwaters near New Ulm. During 2016 and 2017, DNR fisheries staff increased Paddlefish sampling effort resulting in the capture of 63 Paddlefish, which indicates the presence of a more abundant population than previously believed. Substantial movement of Paddlefish between the Minnesota River, Mississippi River, and St. Croix River was also documented. However, Paddlefish reproduction within the Minnesota River has not been confirmed. The most effective method for capturing Paddlefish is drifting large-mesh (4-5" bar mesh) gill nets through current seams and eddies where congregations of Paddlefish are suspected. Boat electrofishing has also captured Paddlefish, but the risk of mortality is greater than with gill nets. Locations known to hold concentrations of Paddlefish include slackwater areas near St. Peter, Mankato, and Upper Sioux Agency State Park. Commercial fishermen also regularly capture Paddlefish in large seine hauls in backwaters around New Ulm. Paddlefish are

an important host for native lampreys, and most Paddlefish captured in the Minnesota River have attached lamprey or fresh lamprey scars. There is substantial concern about the potential impacts of invasive Bigheaded Carps on Paddlefish.

Shovelnose Sturgeon: Shovelnose Sturgeon are the smallest of the ancient sturgeon species in North America and have a distinct shovel-shaped snout. Shovelnose Sturgeon can tolerate high turbidities and are found in large rivers throughout the Mississippi River drainage inhabiting areas with strong current over sand and gravel substrates. During the mid and late-1990s Shovelnose Sturgeon were thought to be rare in the Minnesota River, but sampling may have been insufficient. In recent years, Shovelnose Sturgeon have been abundant in MN DNR fisheries assessments conducted on the Minnesota River. They are commonly captured in mid-channel habitats with boat electrofishing, drifted trammel nets, benthic trawls, and trotlines. Preliminary results from a 3-year evaluation of Minnesota River Shovelnose Sturgeon population dynamics and movement patterns indicate an abundant population of Shovelnose Sturgeon, and that most Shovelnose Sturgeon do not make large annual upstream or downstream migrations. Although it is suspected that Shovelnose Sturgeon reproduce within the Minnesota River, very few juveniles have been captured.

Walleye and Sauger: The Minnesota River has healthy populations of both Walleye and Sauger with some Walleye exceeding 711 mm (28") and Sauger exceeding 508 mm (20"). Both species are difficult to sample from the Minnesota River with traditional fisheries assessment gears, but anglers regularly target and catch both species during spring and fall. Natural reproduction by both species is suspected but the location of critical spawning habitats and the extent of natural reproduction is unknown. Along with natural reproduction, walleye are regularly stocked directly into the river, into Minnesota River impoundments (e.g., Big Stone Lake, Lac qui Parle, Marsh Lake), and many other connected lakes within the watershed. All of these stocked fish likely contribute to the population. However, recent a recent genetic study indicated that >70% of Walleye downstream of Granite Falls Dam that exceeded 508 mm (20") were the result of natural reproduction (i.e., Lower Mississippi/Cannon River strain).

White Bass: White Bass are a popular gamefish in the Minnesota River with some fish exceeding 457 mm (18"). Typically, fishing for White Bass is best during spring months, and they typically exhibit a rather patchy distribution.

Other gamefish: Other traditional gamefish species inhabiting the Minnesota River include Bluegill, crappies (Black and White), Freshwater Drum, Largemouth Bass, Northern Pike, and Smallmouth Bass. However, densities of most of these species are comparatively low and thus targeted by relatively few anglers. Bluegill, crappies, and Largemouth Bass are mostly found in backwater lakes, and anglers that find the right backwaters can be rewarded with exceptional fishing. Smallmouth Bass are most abundant upstream of Redwood Falls with the best fishing reports coming from the Montevideo area. Northern Pike reproduce in many Minnesota River backwaters but preferred habitats are limited in the main river channel. Northern Pike > 1016 mm (40") have been caught from the Minnesota River, most commonly upstream of Granite Falls Dam. Although not typically regarded as a gamefish species, some anglers target Common Carp, Freshwater Drum, Longnose Gar, Shortnose Gar, and sucker species (e.g., buffalo spp.,

redhorse spp.). Freshwater Drum are underutilized by Minnesota River anglers, despite being abundant and excellent for eating when prepared properly.

Problems and Challenges

Granite Falls Dam:

Granite Falls Dam acts as a significant barrier to fish movement, and as a result, the fish and mussel communities upstream of Granite Falls Dam are much less complex than downstream. Fish species that are currently present downstream but not upstream include: American Eel, Black Buffalo, Blue Sucker, Bullhead Minnow, Channel Shiner, Chestnut Lamprey, Flathead Catfish, Gizzard Shad, Goldeye, Longnose Gar, Mooneye, Paddlefish, Sauger, Shoal Chub, Shortnose Gar, Shovelnose Sturgeon, Silver Chub, Silver Lamprey, and Smallmouth Buffalo. Providing fish passage through the Granite Falls Dam would increase fish and mussel species diversity upstream and provide access to valuable habitat by important large river fish species. Currently, there are conceptual plans to create fish passage through Granite Falls Dam as part of a whitewater park project.

Lock and Dam 2:

Mississippi River Lock and Dam 2 serves as a partial barrier to upstream movement for some fish species and a significant barrier for others. Increasing fish passage through Lock and Dam 2 would likely increase use of the Minnesota River by American Eel, Lake Sturgeon, Paddlefish, and other species.

Agricultural Consequences:

Agricultural practices in the Minnesota River watershed have many undesirable consequences on the Minnesota River including increased amounts and rates of runoff, increased nutrient inputs, inputs of harmful chemicals (e.g., pesticides, herbicides, fertilizers), and increased erosion. Additionally, modifications to streams and rivers for agricultural purposes (e.g., ditching) throughout the Minnesota River basin has destroyed valuable fish habitat.

Imperiled Fish Species:

Resulting from past pollution, overharvest, habitat loss, and fragmentation (i.e., Dams), several Minnesota River fish species populations are likely much lower than historically. These species include but are not limited to American Eel, Black Buffalo, Lake Sturgeon, Paddlefish, and River Darter. Currently, the extent of natural reproduction in the Minnesota River is unknown for several large river species including Lake Sturgeon, Paddlefish, and Shovelnose Sturgeon.

Rare and Extirpated Species:

Several fish species are extremely rare or extirpated from the Minnesota River as a result of past pollution along with habitat loss and fragmentation (i.e., Dams). These species include but are likely not limited to River Redhorse, River Shiner, Skipjack Herring, Spotted Sucker, Trout-Perch, and Western Sand Darter.

Aquatic Invasive Species:

During 2016 and 2017 Zebra Mussels, Grass Carp, and Bighead Carp were confirmed present in the Minnesota River. To date, no other invasive carps have been captured from the Minnesota

River mainstem and there is no evidence of natural reproduction. The presence of adult Zebra Mussels in the Minnesota River is limited and very low densities of veligers have been detected. The extent to which each of these invasive species will proliferate and impact the Minnesota River ecosystem is unknown.

Similar to many waterbodies in the state, Common Carp are well established in the Minnesota River. Common Carp are hypothesized to have a limited impact on the aquatic ecosystem within the main-channel, but likely deteriorate habitat quality in backwater habitats.

Insufficient Creel Data:

Currently, creel data from the Minnesota River is insufficient for quantifying angler use, angler preferences, and exploitation rates of important gamefish (Channel Catfish, Flathead Catfish, Sauger, Walleye). Unfortunately, even when creel surveys are implemented, estimating nighttime catfish angling effort is logistically challenging.

Changing Climate and Hydrograph:

The Minnesota River has been experiencing a slow and steady change in climate along with a changing hydrograph. Increased precipitation combined with increased agricultural drainage and impervious surfaces has more the doubled the flow of the Minnesota River during the last 80 years (**Figure 3**). The increased amount of water flowing to the Minnesota River is carrying more pollutants (e.g., nutrients, bacteria, sediment) and increasing erosion. These increases in flood frequency, pollutants, and erosion along with altered hydrologic patterns will have impacts on fish populations and the entire aquatic ecosystem. Yet, how these changes will continue to affect the Minnesota River ecosystem and fisheries is largely unknown.

Impairments

According to the Minnesota Pollution Control Agency, significant portions of the Minnesota River fail to meet standards for aquatic life (fish or aquatic macroinvertebrates), aquatic recreation (swimming, boating), and aquatic consumption (eating fish). Specifically, aquatic macroinvertebrate communities are indicative of degraded conditions all the way from Big Stone Lake to the Mississippi River, however, fish communities are not considered impaired. Nutrient (particularly nitrate/nitrite) and bacteria levels exceed recommended levels for swimming and for use as drinking water in reaches from Big Stone Lake to Granite Falls Dam and from the Blue Earth River to Carver Creek. High levels of mercury and PCBs require stricter fish consumption guidelines than statewide standards for all reaches of the Minnesota River.

The biggest factors affecting the Minnesota River are increased water flow, sediment, nutrients, and bacteria. Increased amounts of water are reaching the Minnesota River because of artificial drainage, reduced water storage on the landscape (wetlands), and lack of perennial vegetation. These increased flows are carrying excess amounts of sediment, nutrient, and manure (source of bacteria) to the river. Failing septic systems and wastewater treatments plants are also a source of nutrients and bacteria. The MPCA recommends increasing temporary water storage on the landscape, managing agricultural drainage (e.g., outlet controls, grass waterways, ditch buffers), and installing more storm water treatment basins. Recommended farming practices include use

of cover crops, increasing soil organic matter, and reducing tillage to decrease soil erosion and increase water absorption.

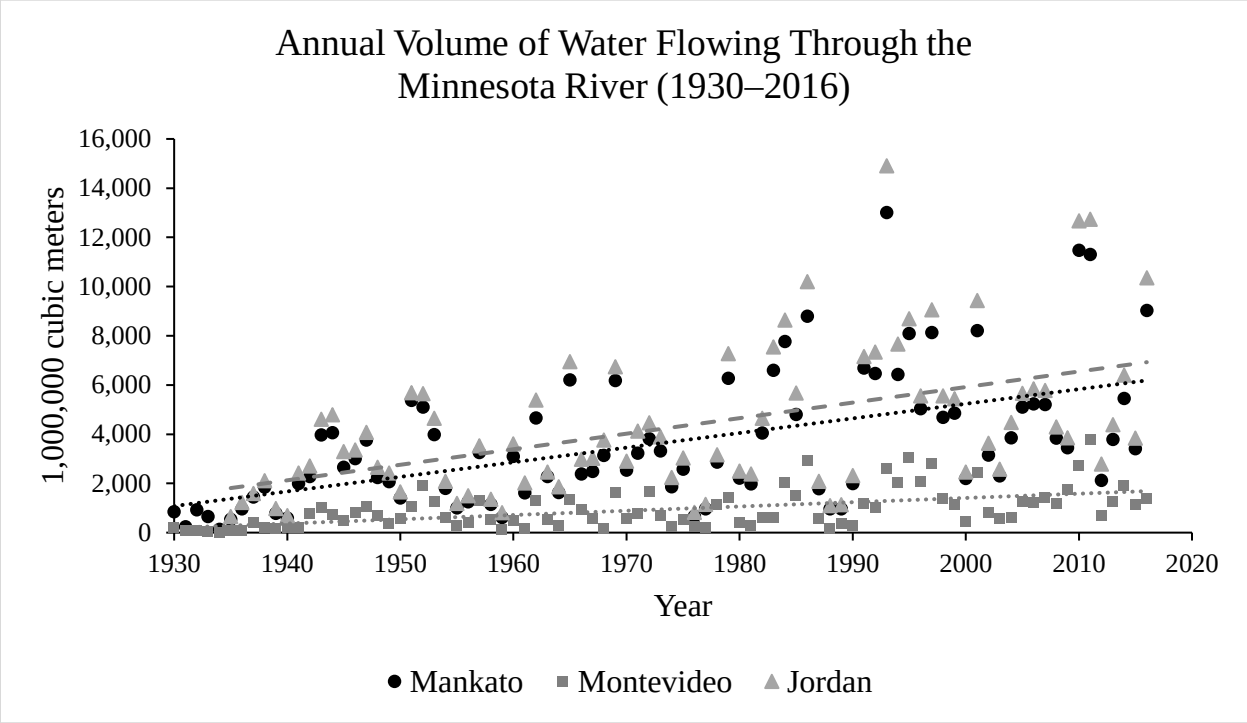

Figure 3. Annual discharge (millions of cubic meters) of the Minnesota River at Mankato, Montevideo, and Jordan from 1930 thru 2016. Discharge data obtained from the United States Geological Survey (https://waterdata.usgs.gov/nwis).

Invasive Species

Invasive Carps: There is substantial concern about potential establishment and proliferation of invasive carps within the Minnesota River and the impacts they could have on recreation and the fish community. Over the last few years, a small number of Bighead and Silver Carp have been captured from the Minnesota portions of the Mississippi River and the St. Croix River each year. During 2015, the first Grass Carp was captured from the Minnesota River (on 12/15/2015) in a commercial seine haul near New Ulm, and a few months later the same commercial fishermen captured a Bighead Carp (on 02/18/2016) from the same general location. On June 4, 2017, a bow fisher harvested a large Bighead Carp from a Minnesota River backwater near Redwood Falls, but there is no clear evidence of how that fish got into the backwater. To date, there is no evidence of established populations or reproduction within Minnesota. Invasive Carps captured from the Minnesota River likely represent large sexually mature individuals that are migrating upstream.

Zebra Mussels: During 2016, adult Zebra Mussels were confirmed in Lac qui Parle Lake and the Minnesota River upstream of Granite Falls Dam. During 2017, veligers were discovered in water samples collected from multiple locations between Montevideo and Burnsville, and one

adult mussel was found in the river near Chaska, MN. Zebra Mussels likely reached the Minnesota River through connection with infested lakes in the Chippewa River drainage.

Zebra mussels can have drastic impacts on aquatic ecosystems by filtering large amounts of nutrients and competing with native mussels. However, zebra mussels require hard substrates and standing or slow moving water for settling and attaching to hard surfaces. The extent to which Zebra Mussels spread and affect the Minnesota River is unknown, but some hypothesize that the Minnesota River does not provide suitable conditions for Zebra Mussels to proliferate.

Commercial Fishing

The earliest records of commercial fishing in the Minnesota River date back to 1945 with Bowfin, bullhead species, buffalo species, carpsucker species, Common Carp, Freshwater Drum, gar species, Gizzard Shad, Mooneye, redhorse species, and sucker species all being reported as commercially harvested at some point during the mid to late 1900s. Since 2009, Commercial Fisherman have primarily harvested Bigmouth Buffalo, Common Carp, Freshwater Drum, and Smallmouth Buffalo from the Minnesota River between Highway 169 in Mankato and Highway 4 south of Fairfax under a class "B" commercial fishing permit. In some years, total harvest has exceeded 100,000 lbs. Noteworthy bycatch includes Paddlefish from backwaters around New Ulm and the first documented occurrence of Grass Carp (12/15/2015) and Bighead Carp (2/18/16).

Fisheries staff have some concerns regarding sustainable harvest levels of Bigmouth Buffalo and Smallmouth Buffalo, especially since Bigmouth Buffalo may be a competitor with invasive carps. Additionally, there is some concern of potential spread of invasive species (e.g., Zebra Mussels, Invasive Carps) by commercial fishers.

Current class "B" commercial fishing permits are issued for the Minnesota River with the following provisions.

1) Notification - Licensed commercial operators must notify the area fisheries supervisor of each operation prior to the start of any fishing activity (M.R. Chapter 6260.0500). Notification shall be made at least two (2) days prior to mobilization and on the day of operation. If contact with the area fisheries supervisor cannot be made, the local conservation officer must be notified.
2) Inspection - Inland commercial fish operators, their helpers, records, premises, and operating sites, are subject to and must be available for supervision and inspection by the commissioner with respect to all commercial fishing activities and transactions, including the disposition of fish removed (M.R. Chapter 6260.0600).
3) Licensed commercial operators must use all reasonable means to avoid taking, killing, or injuring fish other than those which may be lawfully taken under their license. Fish of any kind not permitted to be lawfully taken in licensed commercial fishing operations must be immediately returned to the water. All commercial fish species must be removed from that water body and not released.
4) The traps and surrounding haul area are to be kept clean and free of litter, dead fish or other debris. All such material associated with the trapping operation are to be picked up each

time the traps are inspected. All hardware associated with the trapping operation are to be removed at the termination of the trapping operation. Trap panels are to be cleaned daily (M.R. Chapter 6260.1200).

5) Hoop nets, gill nets or seines used during the open water season in non-infested waters must have all plant material removed from them and must be air-dried for four (4) days before being set into a new water body. All nets, traps, buoys, anchors, stakes and lines used for commercial fishing in infested waters must be dried for a minimum of ten days or frozen for a minimum of two days before they are used in non-infested waters. At least two (2) days prior to mobilization, contact the Hutchinson Fisheries Office so that nets and gear can be visually inspected and approved for use by Fisheries staff.
6) A commercial licensee operating in infested waters containing invasive; fish, plants or invertebrates must tag all nets, traps, buoys, anchors, stakes and lines used for commercial fish harvesting with tags provided by the Commissioner, as specified in the commercial licensee's license or permit. Nets, traps, buoys, anchors, stakes and lines used by the licensee in infested waters may not be used in non-infested waters.
7) Nets used in the winter should be exposed to freezing temperatures over night or at least until any organism entangled in the net has frozen. The entire net must be exposed.
8) Uncovered holes through the ice must be marked in accordance with M.R. Chapter 6110.1500 subpart 5, item F. Marking signs must be obtained and placed by the operator.
9) All commercial fishing operators must submit reports, on forms provided by the commissioner, on their commercial fishing activities containing all information as required by the commissioner (M.R. Chapter 6260.0400).
10) This permit and all other permits issued are subject to revocation for any violation of the MN Game and Fish laws and rules governing commercial harvest of fish as well as all special conditions of this permit.
11) River Specific Restrictions: Gear must be inspected by MN DNR Fisheries personnel and tagged with Infested Waters Only tags; tags must be in place prior to use and remain on equipment.

Dams

Five dams alter the flow of the upper Minnesota River while the lower 386 km (240 miles) are completely free flowing. From upstream to downstream, the dams are Big Stone Lake (510 RKM, RM 317), Big Stone National Wildlife Refuge (RKM 488, RM 303), Marsh Lake Dam (RKM 465, RM 289), Lac qui Parle Dam (RKM 438, RM 272), and Granite Falls Dam (RKM 386, RM 240). Most of the dams are associated with lakes or impoundments with independently managed fisheries. Granite Falls Dam is the exception and provides hydropower generation. Granite Falls Dam also acts as a major barrier to fish movement and therefore the fish community upstream of the dam is much less complex lacking many large river species including: American Eel, Black Buffalo, Blue Sucker, Bullhead Minnow, Channel Shiner, Chestnut Lamprey, Flathead Catfish, Gizzard Shad, Goldeye, Longnose Gar, Mooneye, Paddlefish, Sauger, Shoal Chub, Shortnose Gar, Shovelnose Sturgeon, Silver Chub, Silver Lamprey, and Smallmouth Buffalo.

Big Stone Lake Dam: The Big Stone Lake Dam was built during 1937 as part of a depression era project to lessen the downstream impact of flooding. The dam is generally passable by fish several times per year during moderately high flows. Therefore, altering Big Stone Dam to increase fish passage is low priority.

Marsh Lake Dam: Marsh Lake Dam is owned and operated by the U.S. Army Corps of Engineers and impounds Marsh Lake. An ongoing project is restoring connectivity of Marsh Lake by converting the low head dam to a constructed rock-arch rapid that will improve fish passage. Additionally, the Pomme de Terre River is being re-routed so that its confluence with the Minnesota River is downstream of Marsh Lake Dam; increasing fish accessibility.

Lac qui Parle Dam: The Lac qui Parle Dam is owned and operated by the U.S. Army Corps of Engineers and impounds Lac qui Parle Lake, which is an important fishing and recreation lake. This dam serves as a significant barrier to upstream fish movement, but is passable during high flows.

Granite Falls Dam: Granite Falls Dam was originally built during the late 1800s as a power supply for a mechanical mill. During 1911, the city of Granite Falls bought the dam for hydropower generation. Granite Falls Dam is a run of the river dam, impounding very little water upstream. However, Granite Falls Dam serves as a significant barrier to upstream fish passage. During extremely high flows, there may be fish passage over the dam or through the floodplain where a small bypass channel goes around the city. Recently, there has been conversation about modifying the Granite Falls Dam for a whitewater park that may also provide some form of fish passage.

Minnesota Falls Dam Removal: The Minnesota Falls Dam was removed during 2013, and since then, more than 10 fish species have recolonized upstream. The dam was built during the early 1900's for hydropower and storing cooling water from the nearby power plant. The power plant closed during 2004 making the dam obsolete. Prior to removal, the area downstream of the dam was a popular fishing location and was the furthest upstream many large river species were found. Now, species such as Paddlefish and Shovelnose Sturgeon can access important habitats upstream of Minnesota Falls, but are unable to pass Granite Falls Dam. During 2017, the State of Minnesota acquired a parcel of land next to Minnesota Falls to provide public access to the area.

Floodplain Lakes

Lateral connectivity with the floodplain is important for riverine ecosystems and provides an important source of organic matter, macroinvertebrates, and plankton that fuel the food chain. Connectivity with backwater habitats is particularly important as they enhance biological productivity and promote a healthy and diverse fish community. When rivers connect with backwater habitats, they replenish nutrients and oxygen, which facilitates phytoplankton, zooplankton, and macroinvertebrate production. As backwaters recede or flow back into the river, they carry phytoplankton, zooplankton, macroinvertebrates, organic matter, and often times larval fishes. Backwater habitats within the floodplain provide important fish habitat for spawning, foraging, and escaping high flow conditions. They also provide vital nursery and

refuge habitat for larval and juvenile fishes. In fact, many fish species require backwater habitats for spawning and fry survival (e.g., Bigmouth Buffalo, Bowfin, Bluegill, Central Mudminnow, Northern Pike, Orangespotted Sunfish). Unfortunately, wetland drainage, habitat encroachment, landscape alterations, and changes to the hydrologic flow regime negatively affect backwaters habitats and the biota that depend upon them.

The Minnesota River floodplain contains hundreds of "backwaters" of various shapes, sizes, and connections that are ecologically important and provide recreational opportunities. Some are the result of oxbow cutoffs, some are natural floodplain lakes and wetlands, and others are small depressions that hold water after floodplain inundation. These backwaters provide vital habitat and food sources for Minnesota River fishes. Most Minnesota River backwaters are not managed as independent fisheries, but some of the larger backwaters provide important recreational fisheries with shoreline or boat access (e.g., Gifford, Mack Lake, Snelling). There are numerous large floodplain lakes within the Minnesota Valley National Wildlife Refuge, which are typically managed for waterfowl habitat, and some have access for angling, hunting, and other recreational use.

During 2006, Konrad Schmidt (DNR, non-game fisheries biologist) conducted fisheries surveys at 21 Minnesota River floodplain lakes and documented a total of 51 species with as many as 37 in an individual floodplain lake (Schmidt and Polomis 2007). This survey, among others, demonstrates the importance and biodiversity of backwater habitats within the Minnesota River floodplain.

Links and References

Links:

Minnesota River Basin Data Center or mrbdc.mnsu.edu

Fish Consumption Advisory or
http://www.health.state.mn.us/divs/eh/fish/eating/sitespecific.html

Minnesota Pollution Control Agency, Minnesota River Basin or
https://www.pca.state.mn.us/water/minnesota-river-basin

Minnesota Pollution Control Agency, The Minnesota River: Evaluating its health or
https://www.pca.state.mn.us/mn-river-study

Minnesota River Basin Trends or
http://mrbdc.mnsu.edu/sites/mrbdc.mnsu.edu/files/public/mnbasin/trends/pdfs/trends_full.pdf

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For a thorough report on past fisheries management, social considerations, land acquisitions, habitat needs, public land, and cultural importance refer to Minnesota River Management Plan 2014–2017.

Appendix A: Fisheries Assessment Procedures

Minnesota River Research and Assessment Team

Annual Minnesota River Fisheries Assessment Procedures

by

Tony Sindt, Minnesota River Specialist
Minnesota Department of Natural Resources
20596 Hwy 7
Hutchinson, MN 55350

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PREFACE

The Minnesota River is an important aquatic ecosystem and recreational fishery that is continually affected by land use practices, urbanization, climate change, invasive species, and conservation efforts. Prior to 2014, standardized fisheries assessments and surveys conducted on the Minnesota River by the Minnesota Department of Natural Resources (DNR) Section of Fisheries were limited and shared by six fisheries management areas. During 2014, the DNR allocated one full-time fisheries position for managing Minnesota River gamefish populations and monitoring Minnesota River ecological health. After two years of gear evaluations and protocol development, a long-term monitoring protocol is being established and continually refined. This document outlines the annual fisheries assessment schedule and protocols for monitoring long-term biological health and gamefish populations.

1. MINNESOTA RIVER

The Minnesota River is a large 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 economic and recreational resource in Southern Minnesota. The Minnesota River watershed is approximately 17,000 square miles draining portions of Minnesota (14,751 mi^2), South Dakota, and Iowa and is highly altered for agricultural use and urban development. As a result, the Minnesota River is impacted by increased erosion, sedimentation, nutrient inputs, and discharge.

Few dams alter the flow of the Minnesota River 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 lakes or impoundments with independently managed fisheries. Granite Falls Dam is the exception and provides hydropower generation. Granite Falls Dam also acts as a major barrier to fish movement and therefore the fish community upstream of the dam is much less complex lacking many large river species including Flathead Catfish and Shovelnose Sturgeon.

Despite the altered nature of the Minnesota River and its unstable flow regime it is home to a diversity of biota and supports populations of gamefish (Flathead Catfish, Channel Catfish, Walleye, Sauger, White Bass, Northern Pike) and important non-game fish (Paddlefish, Shovelnose Sturgeon, Blue Sucker, Black Buffalo). In recent years, over 75 fish species have been documented in the Minnesota River making it one of the most species rich fish communities in the state. Primary gamefish species include Channel Catfish, Flathead Catfish, and Walleye with secondary gamefish species including Freshwater Drum, Northern Pike, Sauger, and White Bass. Current management of the Minnesota River fishery includes monitoring, harvest regulations, and limited stocking. However, Big Stone Lake, Big Stone Lake National Wildlife Refuge, Marsh Lake, and Lac qui Parle Lake receive regular walleye stocking which undoubtedly contributes to the Walleye population in the Minnesota River. Similarly, a 20-years Lake Sturgeon stocking program on Big Stone Lake began during 2015, and is expected to bolster the Minnesota River Lake Sturgeon population.

The Minnesota River is most notable for its trophy Flathead Catfish fishery, but anglers also regularly target Channel Catfish, Walleyes, and many other species. Yet, relative to its size, angling effort on the Minnesota River is much lower than on some area lakes. This is likely attributed to the fact that the large size, variable flow, and navigation obstacles (logjams, sand bars, rocks) of the Minnesota River intimidate many boaters while some anglers may perceive the Minnesota River as “dirty” because of its turbid water and past pollution issues. Although not all portions of the Minnesota River are easy to navigate with large fishing boats, the Minnesota River has over 50 boat ramps and canoe accesses in addition to many parks, trails, and shore fishing access locations.

2. ANNUAL MINNESOTA RIVER FISHERIES ASSESSMENTS

2.1 ANNUAL ASSESSMENT SCHEDULE

Standardized Minnesota River fisheries assessments and non-standardized activities are conducted during specific periods each year following a standardized schedule (**Figure 1**).

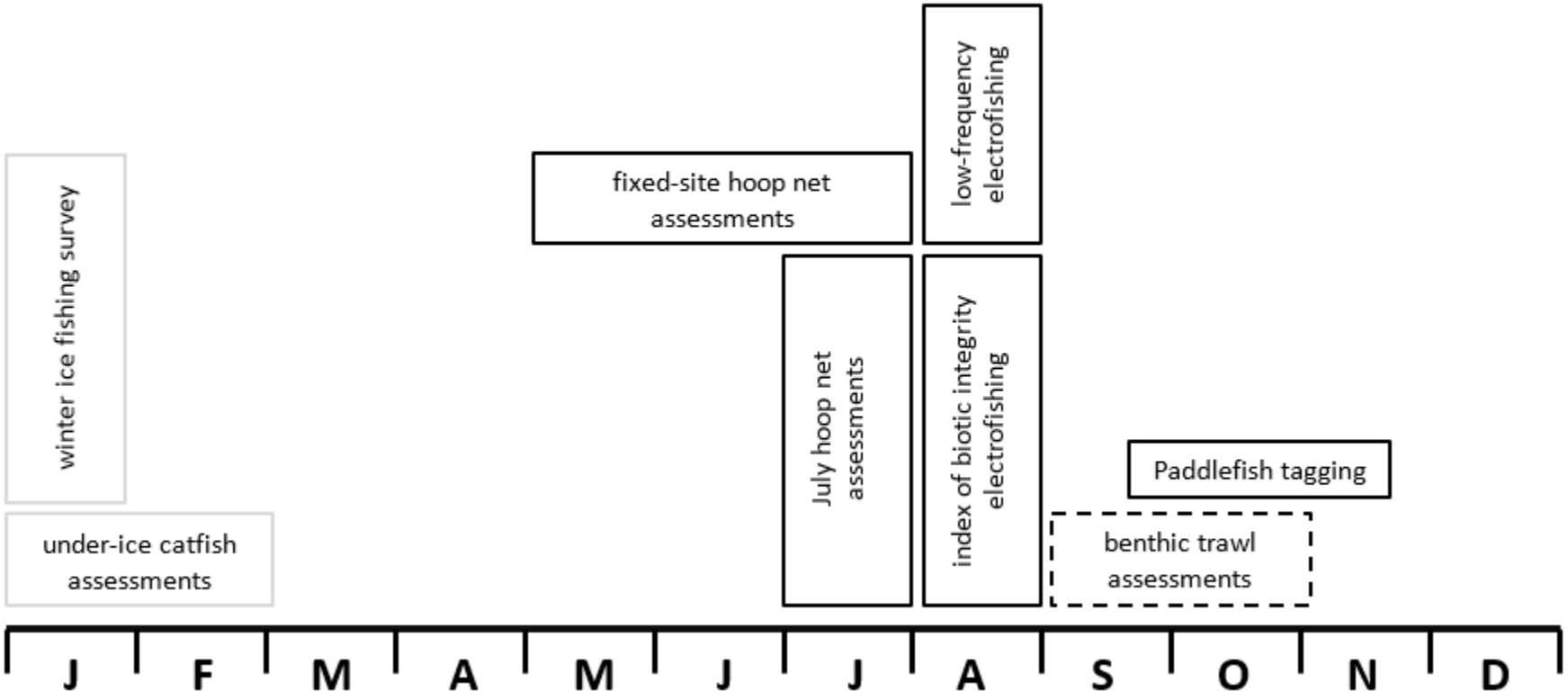

Figure 1. Calendar year schedule of standardized Minnesota River fisheries assessments (black boxes), non-standardized activities (gray boxes), and assessments that are in-progress of being developed (dashed boxes).

2.2 UNIQUE RIVER REACHES

At the coarsest scale, the Minnesota River can be divided into two unique reaches; the reach of river upstream of Granite Falls Dam (approximately 80 miles) and the reach of river downstream of Granite Falls Dam (approximately 240 miles). However, within these reaches are eleven distinct reaches characterized by unique physical habitat characteristics, gradient, channel morphology, and tributary contributions (**Table A–1**). Standardized fisheries assessments are stratified across these unique reaches to fully encompass the longitudinal gradient and habitat diversity of the Minnesota River. Some standardized fisheries assessments, such as index of biotic integrity assessments, are conducted in all eleven reaches each year. Other standardized fisheries assessments follow a rotating survey schedule, where a subset of Minnesota River reaches are surveyed each year.

Table A–1. Description and coordinates for eleven unique Minnesota River reaches.

			Upstream UTM		Downstream UTM		
Reach	Description	Length (km)	X	Y	X	Y	IBI Sites
1	Riverine reaches from Big Stone Lake Dam to Lac qui Parle Dam		229585	5021736	259706	5004935	2
2	Lac qui Parle Dam to Chippewa River confluence	24	273960	4989385	284323	4979248	1
3	Chippewa River confluence to Granite Falls Dam	29	284323	4979248	299497	4965175	2
4	Granite Falls Dam to Hawk Creek confluence	24	299497	4965175	308103	4956448	2
5	Hawk Creek confluence to Redwood River confluence	45	308103	4956448	334175	4937460	1
6	Redwood River confluence to Cottonwood River confluence	113	334175	4937460	387266	4904181	1
7	Cottonwood River confluence to Blue Earth River confluence	47	387266	4904181	417205	4890680	1
8	Blue Earth River confluence to Rush River confluence	56	417205	4890680	429313	4928435	3
9	Rush River confluence to Sand Creek confluence	57	429313	4928435	451482	4955288	1
10	Sand Creek confluence to U.S. Highway 169 bridge	26	451482	4955288	468496	4960612	1
11	U.S. Highway 169 bridge to confluence with Mississippi River	28	468496	4960612	488230	4971542	1

2.3 STANDARDIZED FISHERIES ASSSESSMENTS

Annual standardized Minnesota River fisheries assessments typically fall into two categories, gamefish assessments and fish community assessments. Gamefish assessments characterize populations of targeted gamefish and provide indices of relative abundance and size structure. Fish community assessments monitor the diversity of the fish community present and provide a measure of biotic integrity and species richness. For the Minnesota River, fish community assessments include annual index of biotic integrity (IBI) electrofishing assessments and benthic trawl (BT) assessments. Minnesota River gamefish assessments target Flathead Catfish and Channel Catfish and currently include hoop net (HN) assessments and low-frequency electrofishing (LFE) assessments for juvenile catfishes. Each standardized fisheries assessment is described below.

2.3.1 July Hoop Net Assessments

Hoop nets are the most efficient and effective gear for characterizing (e.g., relative abundance, size structure) both Channel Catfish and Flathead Catfish populations in the Minnesota River. Although HN catch rates may be greater during other months, hoop net assessments conducted during July, August, and September provide relatively unbiased catches and occur during a time of year when river levels are stable and few behavior related biases are expected (see Sindt 2018). Since IBI surveys are always conducted during August, July is designated as the standard month for conducting hoop net assessments. In an effort to accurately characterize the Minnesota River catfish populations and re-visit reaches more frequently than once every ten years, approximately half of the Minnesota River reaches are sampled with hoop nets following a five-year rotating schedule and several reaches are combined.

Sample Locations and Effort: Seven of the eleven Minnesota River reaches are included in a five-year rotating schedule for hoop net assessments (**Table A–2**; reaches 10 and 11 are combined and the lower portion of reach 2 is included with reach 3). Within each Minnesota River reach, 4–6 hoop net survey reaches are defined (**Appendix A–A**), and within each survey reach, 16–48 hoop nets are fished during the designated sample years. Within each survey reach, pairs of hoop nets are set along each bank at approximately 200–300 m intervals. All captured Flathead Catfish and Channel Catfish are measured for total length and weight. Flathead Catfish are checked for the presence of PIT tags. Flathead Catfish without PIT tags are implanted with one PIT tag in the opercular musculature and one PIT tag in the dorsal musculature (Flathead Catfish <200 mm may only be implanted with a dorsal PIT tag).

Table A–2. Minnesota River reaches included in a rotating five-year survey schedule for July hoop net assessments.

Group	Reach	Years
A	2&3	2017, 2022, 2027
B	9	2018, 2023, 2028
C	6	2019, 2024, 2029
D	10&11	2020, 2025, 2030
E	4	2021, 2026, 2031

Gear Sampling Protocols: Hoop nets are set in 3–12 feet of water (1–4 meters), parallel to the current, with the cod-end facing upstream. Hoop nets are set near shore, but away from steep slopes, back-currents, and debris (e.g., trees, rocks). An attempt is made to evenly space hoop nets throughout each survey reach, but spacing may vary depending on habitat characteristics. Hoop nets set along the same bank should not be < 200 m apart. Each hoop net is fished overnight (approximately 24 hours) and retrieved the next day. Retrieved nets that appear to have not fished effectively (e.g. collapse, twisted, snagged, torn) are noted and excluded from data analyses. Standard daily effort consists of 16–20 hoop nets, and annual July assessments are typically completed in 10–15 workdays.

Gear Specifications: Standard hoop nets have seven fiberglass hoops and are 4.8 m in length. The fist hoop is 1.2 m in diameter, and each successive hoop decreases incrementally in diameter by 5.0 cm toward the cod end. The #15 nylon netting with 2.5 cm bar mesh is protected with black asphalt type coating. Finger-style throats are attached to the second and fourth hoops. Prior to deployment, cod ends are cinched closed with a half-hitch knot

and two heavy-duty zip ties. Deployed hoop nets are anchored with a heavy-duty sand anchor attached to the cod end with a ≈7 m rope (**Figure A–2**). Nets are held taught by attaching a ≈10 m rope to the bridle on the open (downstream) end, attaching a 15lb claw anchor halfway down the rope, and then attaching a hard-shell buoy to the end of the rope.

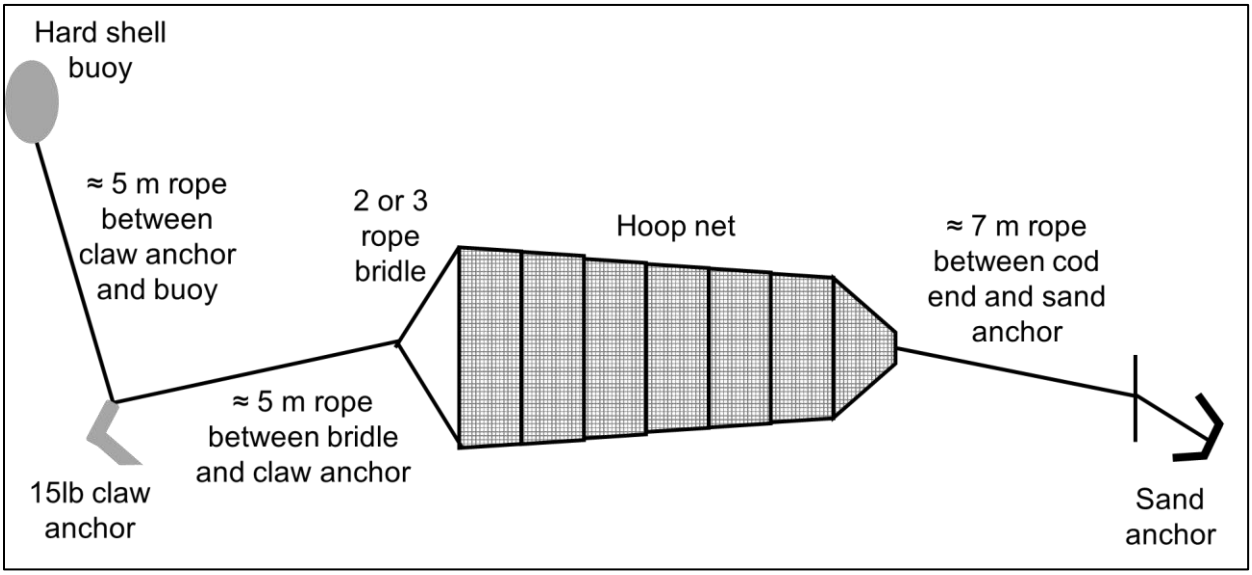

Figure A–2. Diagram of a deployed hoop net.

Data Analyses and Interpretation: The standard unit of effort for HN assessments is one approximately 24-hour net-night that includes two crepuscular periods (i.e., dusk and dawn).

$$standard\ unit\ of\ effort = 1\ net\ night = approxilmately\ 24\ hours$$

Catch per effort of Flathead Catfish, Channel Catfish, and other species of interest are calculated for each HN by dividing the total catch by the number of net nights fished (i.e., typically 1).

$$catch\ per\ effort\ (CPE) = \frac{\#\ caught}{1\ net\ night}$$

Mean catch per effort for each Minnesota River reach is calculated by summing the catch per effort of all HN fished within the respective reach and then dividing by the number of nets.

$$mean\ CPE = \frac{\sum CPE}{\#\ of\ nets}$$

The standard deviation of mean CPE is calculated as follows:

$$standard\ deviation\ of\ mean\ CPE = \sqrt{\frac{\sum(x-\bar{x})^2}{(n-1)}}$$

where x is CPE, $\bar{x}$ is mean CPE, and n is the number of nets fished.

The size structures of Channel Catfish and Flathead Catfish sampled within each unique Minnesota River reach are described using incremental proportional size distribution indices (PSD S-Q, PSD Q-P, PSD P-M, PSD M-T, PSD T-E, PSD >E) with slight modifications (**Table A–3**). Flathead Catfish are not fully recruited to hoop nets until they reach quality length (510 mm); therefore, PSD S-Q is not reported for Flathead Catfish. Additionally, Flathead Catfish in the Minnesota River commonly exceed trophy length (T), thus an additional "Exceptional" length (E; 1120 mm) category is included.

Table A–3. Proportional size distribution length categories for Flathead Catfish and Channel Catfish (with modifications for Flathead Catfish).

RSD length categories	Flathead Catfish		Channel Catfish	
	mm	inches	mm	inches
Stock			280	11
Quality	510	20	410	16
Preferred	710	28	610	24
Memorable	860	34	710	28
Trophy	1020	40	910	36
Exceptional	1120	44		

Example: An example of July HN data analyses and summary statistics are provided in **Appendix A–B**.

2.3.2 Fixed-Site Hoop Net Assessments

Fixed-site HN assessments are similar to July HN assessments (see July hoop net assessment section), but are conducted more frequently to track tagged Flathead Catfish relative abundance, movement, and growth.

Sample Locations and Effort: Fixed-site HN assessments are conducted annually at two fixed survey reaches during May, June, and July. One fixed HN survey reach is located upstream of the Hwy 4 State Water Access and the other fixed survey reach is located upstream of Henderson, MN State Water Access. Similar to July HN assessments, a pair of HN is set approximately every 200–300 m (one on each bank) for a total of 16 HN sets during each sample event. All Flathead Catfish and Channel Catfish captured in HN are measured for total length and weight and all Flathead Catfish are checked for the presence of PIT tags. Flathead Catfish without PIT tags are implanted with one PIT tag in the opercular musculature and one PIT tag in the dorsal musculature (Flathead Catfish >200 mm may only be implanted with one dorsal PIT tag).

Gear Sampling Protocols: See July hoop net assessment section.

Gear Specifications: See July hoop net assessment section.

Data Analyses and Interpretation: See July hoop net assessment section. Recapture data are used to evaluate abundance, growth, and movement.

Note: During 2016–2019, extra effort will be dedicated towards coordinating and implementing a large Minnesota River data gathering project funded by an Environment and Natural Resources Trust Fund grant. After 2019, more effort may be directed towards fixed-site HN assessments including the addition of sample periods (i.e., September and October) and fixed survey reaches.

2.3.3 Index of Biotic Integrity Electrofishing Assessments

Sample Locations and Effort: Each August, boat electrofishing assessments are conducted at 16 fixed sites (**Figure A–3** and **Appendix A–C**) to characterize the Minnesota River fish community and calculate index of biotic integrity (IBI) metrics and scores (**Appendix A–C**).

Gear Sampling Protocols: Index of biotic integrity electrofishing follows Minnesota Pollution Control Agency protocols (www.pca.state.mn.us/index.php/view-document.html?gid=6087). That is, during each IBI electrofishing survey, three 500-meter electrofishing runs are conducted in a downstream direction, each lasting approximately 20 minutes. One electrofishing run is conducted along each bank, and the third electrofishing run is performed in a zig-zag pattern from bank-to-bank focusing on mid-channel habitat. All electrofishing crews consist of one boat operator and two netters equipped with 3.175mm mesh dip nets. An attempt is made to net all stunned fish, and each fish is identified to species, measured for total length, weighed, and inspected for anomalies (e.g., deformities, lesions, tumors). Small-bodied fishes such as shiners are counted and then minimum length, maximum length, and combined weight is recorded. Electrofishing surveys are conducted when river discharge is below the median July 21st discharge for the corresponding reach of river (**Table A–4**).

Gear Specifications: Starting in 2014, all Minnesota River IBI assessments are conducted with an ETS Electrofishing box (Model MBS-2DP-MN) set to pulsed DC output, low range (0-300 volts), 30% duty cycle, 60 pulses per second, and adjusted to maximize output and obtain desired fish response. Standard electrofishing boats are equipped with two cable dropper anodes, and the boat hull acts as the cathode.

Data Analyses and Interpretation: Index of biotic integrity scores are calculated following Minnesota Pollution Control Agency (MPCA) IBI equations. Scores vary from 0 to 100, where degraded fish communities comprised of few tolerant species receive a low fish IBI score and healthy diverse fish communities receive a high fish IBI score. Since streams of different types and sizes have different native fish communities, separate IBI indices have been developed for several Minnesota stream classes. According to the MPCA classification, most of the Minnesota River is classified as a "Southern River", except the portion upstream of the Lac qui Parle confluence is classified as a "Southern Stream". The MPCA has identified the impairment threshold as 46 for Southern Rivers (confidence interval 35–57) and 45 for Southern Streams (confidence interval 36–54). 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), Development of a fish-based index of biological integrity for assessment of Minnesota's rivers and streams, document number wq-bsm2-03.
For each IBI site, the total number and weight of each species captured is reported.

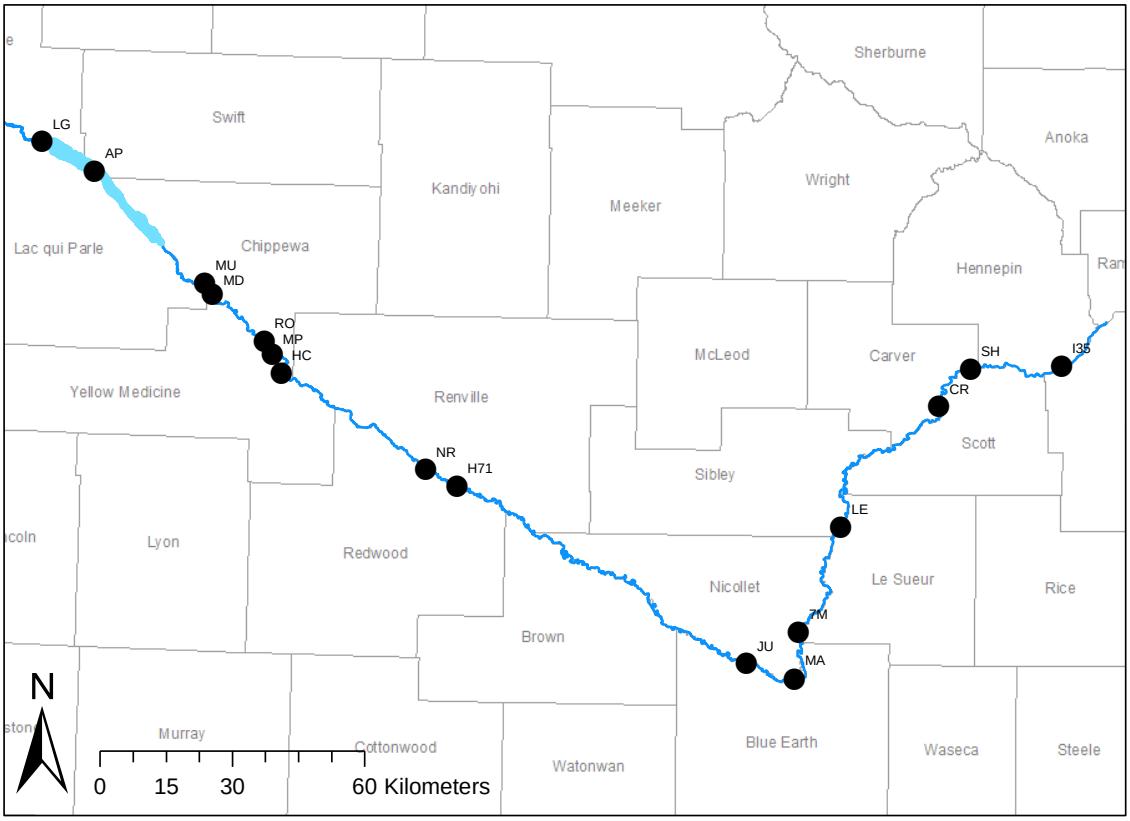

Figure A–3. Location of sixteen Minnesota River index of biotic integrity electrofishing sites.

Table A–4. Median July 21st discharge at five United State Geological Survey gaging stations on the Minnesota River. Note: Discharge at both Morton and Mankato should be taken into consideration prior to conducting the Judson IBI assessment.

USGS gage station	Median July 21st discharge (cfs)	Corresponding IBI Sites
Lac qui Parle	1,370	LG, AP
Montevideo	1,730	MU, MD, RO
Morton	2,210	MP, HC, NR, H71, JU
Mankato	4,710	JU, MA, 7M, LE
Jordan	5,780	CR, SH, I35

2.3.4 Low-Frequency Catfish Electrofishing Assessments

Low-frequency electrofishing (LFE) assessments capture small-bodied catfishes that are not susceptible to capture with hoop nets, and provide an index of recruitment strength.

Sample Locations and Effort: Low-frequency electrofishing assessments are conducted in conjunction with August IBI electrofishing surveys at nine IBI sites annually: Hazel Creek, North Redwood, Highway 71, Mankato, Seven Mile Creek, Le Sueur, Shakopee, and I-35 (**Appendix A–C**). For each assessment, designated electrofishing runs (approximately 500–1000 m) have been identified that include rip-rap or rocky substrates utilized by juvenile Flathead Catfish. During each run, all stunned Flathead Catfish are netted, measured for total length (mm) and weight (g), and are checked for the presence of PIT tags. Flathead Catfish without a PIT tag are implanted with two PIT tags, one in the opercular musculature and one in the dorsal musculature (Flathead Catfish <200 mm may only be implanted with a dorsal PIT tag). Additionally, pectoral spines are removed from up to three Flathead Catfish per 25 mm length group (up to 400 mm) for later age estimation.

Gear Sampling Protocols and Gear Specifications: Low-frequency electrofishing assessments are conducted with an ETS Electrofishing box (Model MBS-2DP-MN) set to pulsed DC output, low range (0-300 volts), 25% duty cycle, 15 pulses per second, and adjusted to maximize output and obtain desired fish response. Standard electrofishing boats are equipped with two cable dropper anodes, and the boat hull acts as the cathode. For each electrofishing run, the boat operator navigations downstream, probing in and out of cover, and often chasing down stunned catfish for the two netters to capture. Electrofishing runs last 15–20 minutes.

Data Analyses and Interpretation: Age estimates from pectoral spine sections are used to develop an age-length key for Flathead Catfish up to age 3. Catch per hour of age-0, age-1, age-2, and age-3 Flathead Catfish are calculated and reported for each site.

2.4 NON-STANDARDIZED ACTIVITIES

2.4.1 Paddlefish Tagging

During late-September, October, and early-November we attempt to capture Paddlefish at various sites along the Minnesota River. All captured Paddlefish are measured for eye to fork length and weight and are tagged with a jaw tag (on lower left jaw) and implanted with a PIT tag (in the fleshy area beneath the dorsal fin on the fishes left side). Paddlefish are typically captured with drifted or stationary large-mesh (4–6” bar mesh) gill nets or boat electrofishing. In recent years, Paddlefish have been captured in a large eddy upstream from the St. Peter boat ramp, below wing dams downstream of Mankato, in backwaters near New Ulm, and around a backwater outlet upstream from the Upper Sioux Agency State Park boat ramp. Future sampling efforts should attempt to identify other important Paddlefish habitats. Tagging and tracking tagged Paddlefish provides valuable information about movement, habitat use, growth, and abundance.

2.4.2 Under-Ice Catfish Assessments

During winter months, under-water cameras are used to locate and evaluate important overwintering habitats used by Flathead Catfish, Channel Catfish, and other species of interest. Future acoustic telemetry studies will help determine likely overwintering habitats.

2.4.3 Winter Ice Fishing Survey

During mid-January, the entire Minnesota River (and its backwaters from Montevideo to the confluence) is traveled and icehouses, ice anglers, and signs of ice fishing activity are recorded. This activity will take approximately 2 days, and will be conducted when driving conditions are safe, and ice and weather conditions are conducive to ice fishing activity. As information is gathered, fixed river and backwater sites will be identified, and visited annually, to monitor variability in ice fishing use. Additionally, anglers will be "unofficially" interviewed and ice thickness will be measured at various popular locations.

2.5 IN-DEVELOPMENT

2.5.1 Benthic Trawl Assessments

Benthic trawl assessments capture small-bodied and benthic fishes that are poorly captured with other fisheries assessment gears. Many of these species (e.g., Banded Darter, Blue Sucker, Shovelnose Sturgeon, Silver Chub, Slenderhead Darter, Speckled Chub, etc.) are considered sensitive species that serve as indicators of the Minnesota Rivers ecological health.

Sample Locations and Effort: During September and October, benthic mid-channel trawl assessments are conducted at July hoop net survey reaches following the rotating survey schedule (**Table A–2**). The goal is to conduct six or more 2-minute trawls at various locations, representative of each survey reach. However, given the nature of performing trawl surveys in the Minnesota River, some trawls may need to be much shorter than 2 minutes while other trawls may be longer than two minutes. At a minimum, 12 minutes of trawling should be performed within each survey reach.

Gear Sampling Protocols: **Sampling protocols for benthic trawl assessments need to be developed.**

Gear Specifications: Minnesota River benthic trawl assessments are performed using a Gerken Siamese Trawl (Model GSD x 8') made by Innovative Net Systems (www.fishtrawls.com). This trawl is similar to the "Mini-Missouri Trawl" but modified to provide less resistance and separates fish through different sized meshes. The body of the trawl is constructed of 6 mm mesh. Benthic trawls are deployed with otter boards.

Data Analyses and Interpretation: The standard measure of effort for benthic trawl assessments is 1 hour. That is, for each survey reach, the total number of each species captured is divided by the total number of trawl minutes. The catch per minute is multiplied by 60 to represent catch per hour (CPH) of trawling. Mean CPH for each unique Minnesota River reach is calculated by summing catch per hour across all survey reaches within the respective Minnesota River reach and dividing by the number of survey reaches.

3. APPENDIX A–A: Hoop Net Survey Reaches

Table A–5. List of July hoop net assessment survey reaches sorted from upstream to downstream. Asterisks indicates fixed HN sites.

					Upstream UTM		Downstream UTM	
Group	Site	Name	Length (km)	Hoop net sets	X	Y	X	Y
A	2.1	Monte Up	1.5	16	283651	4980203	284109	4979460
A	3.1	Monte Down	1.5	16	285028	4978309	285278	4977028
A	3.2	Hwy 212	1.5	16	286122	4975802	287592	4975611
A	3.3	Wegdahl	4.5	48	290878	4973847	292542	4971753
A	3.4	Roe	1.5	16	297128	4967504	297860	4966399
E	4.1	Memorial Park	1.5	20	299221	4964126	300708	4964021
E	4.2	Kinney Up	1.5	16	300242	4961977	299920	4961018
E	4.3	Kinney Down	4.5	48	299810	4960658	302678	4960170
E	4.4	USA State Park	3.0	32	303313	4958407	305239	4957359
C	6.1	Redwood	2.0	20	334186	4937465	335715	4937500
C	6.2	Morton Up	1.5	16	339921	4934672	340611	4934274
C	6.3	Morton Down	3.0	32	341318	4934561	343131	4933791
C	6.4	Hwy4 Up*	3.0	32	360984	4923223	362891	4921474
C	6.5	Hwy4 Down	1.5	16	363896	4921556	365107	4920755
C	6.6	Bozeman	4.5	48	377897	4913556	380335	4912696
B	9.1	Henderson Up*	3.0	32	429433	4929026	428761	4930792
B	9.2	Henderson Down	1.5	16	428893	4932707	428869	4933859
B	9.3	Belle Plaine Up	3.0	32	436437	4942703	438552	4942993
B	9.4	Belle Plaine Down	1.5	16	440018	4943160	440560	4943764
B	9.5	Jordan Up	3.0	32	446339	4948633	448477	4949024
B	9.6	Jordan Down	1.5	16	449606	4949425	450480	4950184
D	10.1	Chaska Up	1.5	16	451692	4957308	452918	4958086
D	10.2	Chaska Down	3.0	32	454001	4959061	455883	4960784
D	10.3	Shakopee	4.5	48	459544	4961406	462930	4961484
D	11.1	169	4.0	32	468515	4960590	471580	4959273
D	11.2	I35W	1.5	16	478212	4961506	479610	4961880

4. APPENDIX A–B: Large Hoop Net Calculations

Example calculation and reporting of summary statistics for July hoop net catch of Flathead Catfish (**Table A–6** and **Table A–7**). Bold text indicates statistics that are reported and used to describe the population.

Table A–6. Example calculations of Flathead Catfish catch per effort (CPE), mean CPE, and the standard deviation of the sample for ten large hoop nets.

Net #	Catch of Flathead Catfish	Net-nights	CPE
Net 1	8	1	8.0
Net 2	2	1	2.0
Net 3	0	1	0.0
Net 4	0	1	0.0
Net 5	1	1	1.0
Net 6	3	1	3.0
Net 7	2	1	2.0
Net 8	2	1	2.0
Net 9	1	1	1.0
Net 10	0	1	0.0

Sum CPE =	19.0
Number of Nets =	10
Mean CPE =	**1.9**
Standard deviation =	**2.4**

Table A–7. Example calculation of modified proportional size distribution (PSD) indices for Flathead Catfish sampled during a July hoop net assessment.

Incremental RSD	**Length group**	Number caught	**RSD**
RSD Q–P	**20"–28"**	26	**50**
RSD P–M	**28"–34"**	13	**25**
RSD M–T	**34"–40"**	9	**17**
RSD T–G	**40"–44"**	3	**6**
RSD–G	**>44"**	1	**2**

5. APPENDIX A–C: Minnesota River IBI Sites and IBI Metrics

Table A–8. Description of 16 Minnesota River index of biotic integrity (IBI) electrofishing sites. Asterisks indicate sites with low-frequency electrofishing runs.

					Upstream UTM		Downstream UTM		
Site	Code	Name	Site description	Access	X	Y	X	Y	River reach
LG	03MN082	Louisburg	Upstream of Marsh Lake near Louisburg, MN	Marsh Lake, Cement Bridge State Water Access	246463	5012282	246882	5012538	1
AP	03MN083	Appleton	Upstream of Lac qui Parle near Appleton, MN	Twin Bridges State Water Access	258363	5005824	258828	5005655	1
MU	03MN084	Montevideo Upstream	Upstream of Prien's Landing near Montevideo, MN	Prien's Landing State Water Access	283447	4980504	283679	4980096	2
MD	03MN081	Montevideo Downstream	Downstream of Prien's Landing near Montevideo, MN	Prien's Landing State Water Access	285181	4978089	285226	4977729	3
RO	03MN085	Roe	Upstream of Granite Falls, MN near Roe Access	Roe Access State Water Access	297098	4967455	297161	4966998	3
MP	04MN002	Memorial Park	Below Granite Falls, MN at Memorial Park	War Memorial City Park State Water Access	298700	4964317	299170	4964150	4
HC	03MN086	Hazel Creek*	Near Hazel Creek confluence	Kinney State Water Access	300910	4960276	301185	4959946	4
H71	03MN092	Highway 71*	Near Highway 71, upstream of Morton, MN	Morton Access State Water Access	340548	4934277	340908	4934171	5
NR	03MN093	North Redwood*	Upstream of North Redwood Access	North Redwood State Water Access	333947	4938096	333485	4937954	6
JU	03MN091	Judson	Near Judson, MN	Co Rd 42 State Water Access	406215	4894263	406691	4894131	7
MA	03MN090	Mankato*	In Mankato, MN near confluence with Blue Earth River	Land of Memories Park State Water Access	417109	4890657	417587	4890802	8

					Upstream UTM		Downstream UTM		
Site	Code	Name	Site description	Access	X	Y	X	Y	River reach
7M	03MN087	7 Mile*	Near Seven Mile Creek Park	Seven Mile Creek County Park State Water Access	418080	4901109	418470	4901416	8
LE	03MN088	LeSueur*	Near LeSueur, MN	Le Sueur State Water Access	427831	4924805	427985	4925282	8
CR	03MN089	Carver Rapids	Near Carver Rapids	Carver State Water Access	450345	4952477	449889	4952486	9
SH	03MN080	Shakopee*	Near Shakopee, MN	Shakopee State Water Access	457127	4960652	457479	4961006	10
I35	03MN079	I-35*	Near I-35 and Lilydale Ave.	MN Valley Refuge - Russel State Water Access	477691	4961454	478185	4961516	11

Table A–9. Description of metrics used to calculate Southern River fish index of biotic integrity scores.

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

Table A–10. Description of metrics used to calculate Southern Stream fish index of biotic integrity scores.

Metric name	Category	Response	Metric description
BenInsect-TolTXPct	trophic	positive	Relative abundance (%) of taxa that are benthic insectivores (excludes tolerant species)
DetNWQTXPct	trophic	negative	Relative abundance (%) of taxa that are detritivorous
MA<2Pct	reproductive	negative	Relative abundance (%) of early-maturing individuals (female mature age <=2 years)
SensitiveTXPct	tolerance	positive	Relative abundance (%) of taxa that are sensitive
SLvd	life history	negative	Taxa richness of short-lived species
TolTXPct	tolerance	negative	Relative abundance (%) of taxa that are tolerant
TolPct	tolerance	negative	Relative abundance (%) of individuals that are tolerant
DomTwoPct	dominance	negative	Combined relative abundance of two most abundant taxa
FishDELTPct	tolerance	negative	Relative abundance (%) of individuals with Deformities, Eroded fins, Lesions, or Tumors

Minnesota River Research and Assessment Team

Annual Minnesota River Non-Assessment Fisheries Activities

by

Tony Sindt, Minnesota River Specialist
Minnesota Department of Natural Resources
20596 Hwy 7
Hutchinson, MN 55350

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PREFACE

Fisheries management activities on the Minnesota River typically focus on assessing gamefish populations, fish species diversity, and other measures of ecological health. However, various other non-fisheries activities are performed on a regular or annual basis. This document provides an overview of these non-assessment activities.

1. Annual Non-Assessment Fisheries Activity Schedule

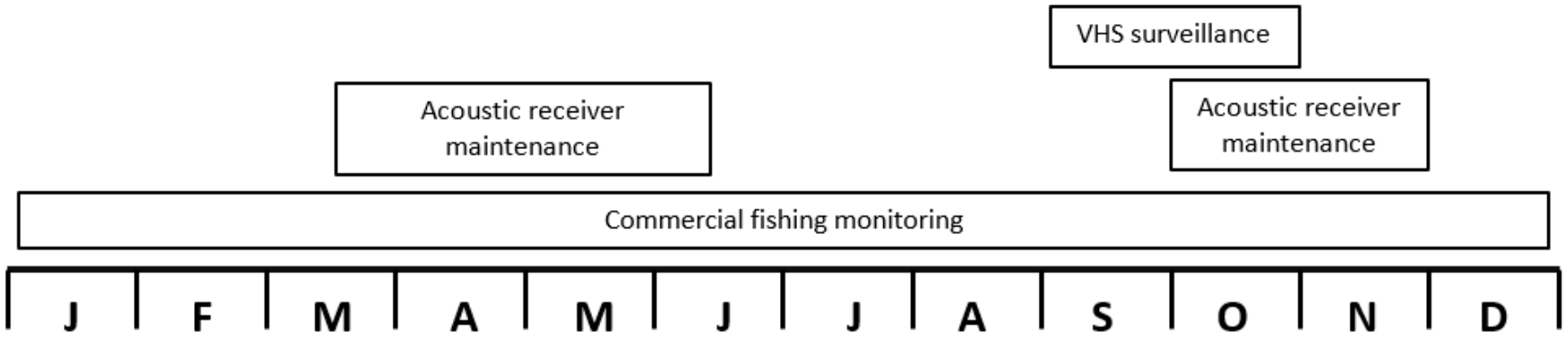

Figure B–1. Annual schedule of Minnesota River non-assessment fisheries activities.

2. Acoustic Receiver Maintenance

An array of Vemco (www.vemco.com) VR2W-69 kHz acoustic receivers is maintained in the Minnesota River to track movement of tagged fish within the Minnesota River and within the Mississippi River Basin. Maintaining acoustic receivers requires uploading data each spring (March–June) and again during the fall (October–November) prior to ice-in. Acoustic receiver batteries also require replacement each fall (Tadiran Lithium Battery Model TL-5930/F). Currently, acoustic receivers are deployed on nine Minnesota River bridges (Hwy 169 Bridge near Bloomington, MN; Hwy 41 Bridge near Chaska, MN; Hwy 19 Bridge near Henderson, MN; Hwy 22 Bridge near St. Peter, MN; Veterans Memorial Bridge in Mankato, MN; County Hwy 23 Bridge near Judson, MN; County Hwy 13 Bridge near New Ulm, MN; County Hwy 6 Bridge in Renville County, MN; and County Hwy 10 Bridge near Upper Sioux Agency State Park). Directions for maintaining receivers, uploading data, and changing batteries are provided in the product manual (http://vemco.com/wp-content/uploads/2014/06/vr2w-manual.pdf).

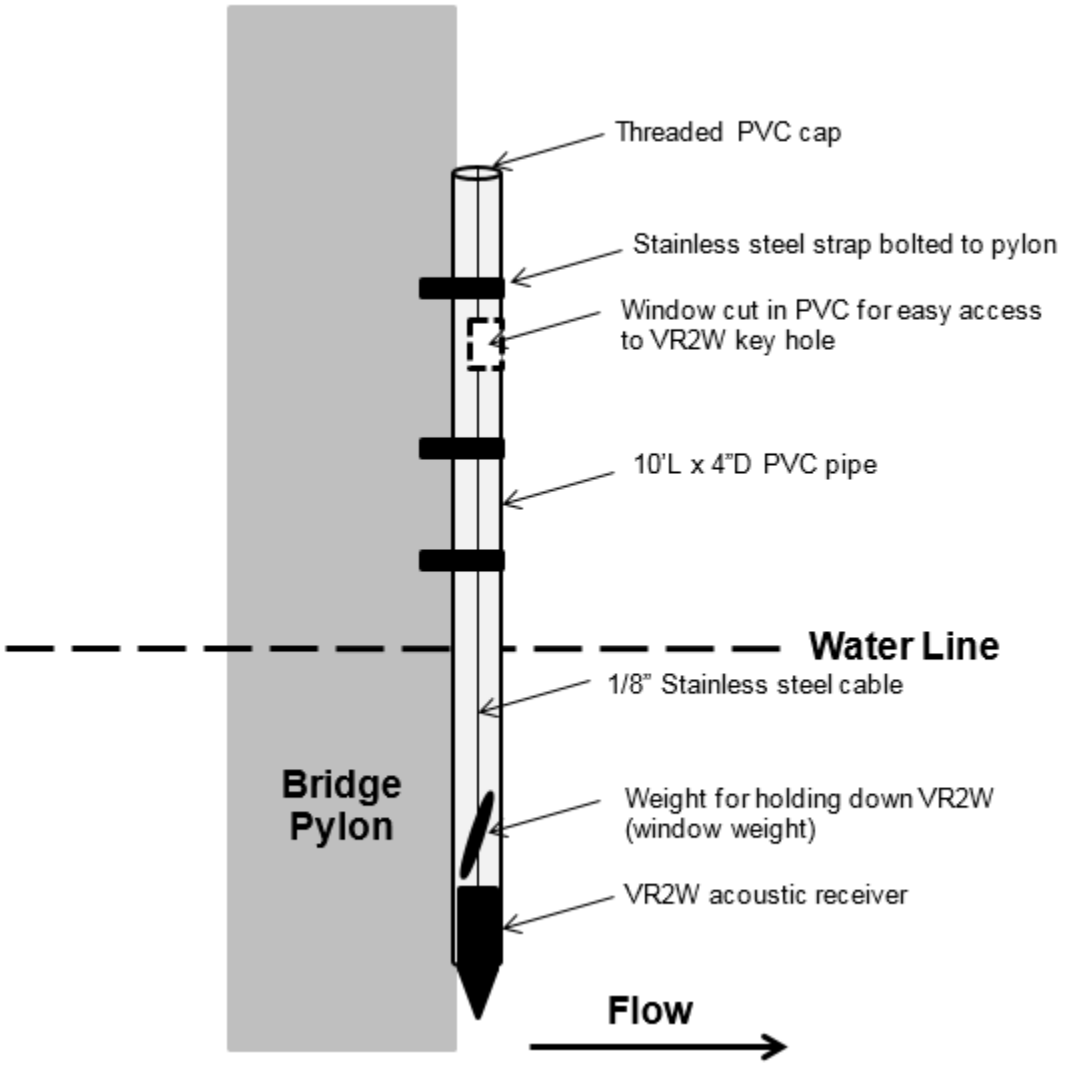

Figure B–2. Example of how acoustic receivers are attached to Minnesota River bridge pylons.

3. Minnesota River VHS Surveillance

The Minnesota Department of Natural Resources (DNR) Section of Fisheries conducts annual statewide surveillance for Viral Hemorrhagic Septicemia (VHS) as a proactive measure to detect occurrence and prevent spread. As part of this statewide surveillance, fish are annually collected from the Minnesota River and tested for VHS. Fish collection is conducted near Chaska, MN during September or October when water temperatures are between 2–20°C (36–68°F). A total of 150 VHS susceptible fish common in the Minnesota River (**Table B–1**) are collected and processed following MN DNR Pathology Lab protocols. All processed or whole fish are shipped (1-day priority USPS mail) or transported on ice to the MN DNR Pathology Lab. Prior to sampling, coordinate with Ling Shen (651-259-5138) at the Pathology Lab.

Table B–1. Common Minnesota River fish species susceptible to VHS.

Species
Black Crappie
Bluntnose Minnow
Channel Catfish
Emerald Shiner
Freshwater Drum
Gizzard Shad
Shorthead Redhorse
Silver Redhorse
Walleye
White Bass

4. Commercial Fishing Monitoring

Commercial fishing for roughfish species (e.g., Bigmouth Buffalo, Common Carp, Freshwater Drum) with large mesh seines is permitted for the Minnesota River and Minnesota River backwaters. Licensed commercial fisherman are required to notify the DNR prior to conducting any commercial fishing operations, and an effort is made by the Minnesota River Specialist or other fisheries staff to observe all Minnesota River commercial fishing seine hauls. Monitoring commercial seine hauls is important for documenting bycatch of unique species of interest (e.g., Blue Sucker, Paddlefish, Shovelnose Sturgeon) and invasive species (e.g., Invasive Carps), and identifying potentially undesirable impacts to natives fishes. Observations made during commercial fishing monitoring trips (e.g., location, catch, bycatch, other observations) are documented for future reference.

Appendix C: Flathead Catfish Telemetry Project

Minnesota River Flathead Catfish Telemetry Project (2018–2028)

Overview
During 2018, fifteen Minnesota River Flathead Catfish will be implanted with acoustic receivers to track movement patterns and habitat use over a 5–10 year period.

Study Reaches
Flathead Catfish will be implanted with acoustic transmitters at three 4 km study reaches located near the Minnesota River communities of Judson, Henderson, and Carver. Study reaches were selected based on ease of access, proximity to existing acoustic receivers deployed in the Minnesota River, and to include reaches with varying proximity to the Mississippi River.

Sampling and Tagging
During the first week of August 2018, Flathead Catfish will be captured with hoop nets from the inner 2 km of each study reach and five 610–1020 mm Flathead Catfish from each study reach will be implanted with Vemco V16 69kHz acoustic transmitter tags that transmit signals approximately every 120 seconds (varying 80–160 sec). Two of the smaller 610–910 mm Flathead Catfish from the Judson and Carver study reaches and one from the Henderson study reach will be implanted with V16-6H acoustic transmitters that last approximately 10 years. The remaining fish will be implanted with V16-4H acoustic transmitters that last approximately 5 years. Each fish will be measured for total length, weighed, implanted with an acoustic transmitter, tagged with a PIT tag in the left mandibular musculature, and tagged with an external tag below the dorsal fin.

Tracking Methods
During 2018, manual tracking surveys will be conducted at each study reach during the 2nd and 4th weeks of August, the 1st and 4th weeks of September, and during October if fish are still present in study reaches during September. For each manual tracking survey, the entire 4 km study reach will be drifted while listening for acoustic pings with a Vemco VR100 and omni-directional hydrophone.

During 2019 and 2020, at least one manual tracking survey will be conducted per month (May–September) at each study reach. Additionally, during Octobers and Novembers, telemetry data uploaded from VR2W stationary acoustic receivers will be used to inform manual tracking efforts to determine over-wintering habitats used by acoustic tagged Flathead Catfish.

During 2018–2028, stationary VR2W acoustic receivers will be uploaded at least twice per year to identify large-scale movement patterns of Flathead Catfish and identify reaches between stationary receivers where Flathead Catfish may be present during various times of year (e.g., winter).