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Minnesota River Fisheries Management Plan 2023–2027

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Overview

The Minnesota River is a tributary of the Mississippi River, and its 17,000 square-mile watershed includes a large portion of southern Minnesota and small portions of Iowa and South Dakota that are dominated by row-crop agriculture with patchy areas of urban development (Figure 1). The mainstem Minnesota River flows 320 miles from its headwaters of Big Stone Lake on the Minnesota-South Dakota border to its confluence with the Mississippi River in St. Paul, MN. The Minnesota River basin consists of eleven sub-watersheds that from upstream to downstream include the Upper Minnesota, Pomme de Terre, Lac qui Parle, Chippewa, Yellow Medicine, Hawk Creek, Redwood, Middle Minnesota, Cottonwood, Watonwan, Le Sueur, Blue Earth, and Lower Minnesota (Figure 2). The Blue Earth River is the largest tributary that flows into the Minnesota River near the city of Mankato, MN and both the Watonwan and Le Sueur Watersheds flow directly into the Blue Earth River. The Minnesota River is generally characterized as a low-gradient, productive, warmwater river with a relatively unaltered channel and a floodplain that includes an abundance of oxbows, chutes, and floodplain lakes. There are five remaining dams on the Minnesota River mainstem, including dams that regulate reservoir water levels on Big Stone Lake, Big Stone National Wildlife Refuge, Marsh Lake, and Lac qui Parle Lake. Granite Falls Dam is the furthest downstream dam (river mile 240) that provides hydroelectricity for the city of Granite Falls, MN, and acts as a significant barrier to upstream fish passage. Thus, the fish community upstream of Granite Falls Dam is much less diverse, lacking large river species such as Flathead Catfish, Paddlefish, and Shovelnose Sturgeon.

The Minnesota River basin has a diverse fish assemblage of 104 documented species, 86 of which likely inhabit the Minnesota River mainstem currently (Table 1). Ninety-seven of the species are native to the watershed, including five large river species that may be functionally extirpated (River Redhorse, River Shiner, Skipjack Herring, Spotted Sucker, and Western Sand Darter). There are seven non-native species (and one hybrid) that have spread or been intentionally introduced into the watershed (Bighead Carp, Brown Trout, Common Carp, Goldfish, Grass Carp, Rainbow Trout, Tiger Muskellunge, and Yellow Bass). In the mainstem of the Minnesota River there are 49 species (including the non-native Common Carp) that are locally abundant to common and widespread. There are an additional 37 species (including non-native Bighead Carp, Goldfish, and Grass Carp) that are rare in the Minnesota River mainstem (e.g., American Eel, Black Buffalo, Goldeye), including many species that primarily inhabit floodplain lakes (e.g., Central Mudminnow, Weed Shiner), mainstem reservoirs (e.g., Yellow Bullhead, White Crappie), or smaller streams (e.g., Blacknose Dace, Fantail Darter) that can be incidentally found in the mainstem. Fourteen other species (including non-native Brown Trout, Rainbow Trout, Tiger Muskellunge, and Yellow Bass) are extremely unlikely in the mainstem and primarily inhabit a limited number of lakes (e.g., Cisco, Least Darter) or smaller streams (e.g., American Brook Lamprey, Rainbow Darter, Trout-perch) within the basin. Anglers can find 22 species classified as “game fish” in the Minnesota River mainstem. The Minnesota River fishery is most notable for its “trophy” Flathead Catfish, abundant Channel Catfish and Walleye, and a diversity of unique river species (e.g., Freshwater Drum, Shovelnose Sturgeon). A vast majority of what Minnesota River anglers target, catch, and harvest includes Channel Catfish, Common Carp, Flathead Catfish, Freshwater Drum, Sauger, Shovelnose Sturgeon, and Walleye (Chapman 2001; Sindt 2023a). Other species such as crappies, gar, Largemouth Bass, Northern Pike, Smallmouth Bass, sunfishes, redhorse, and White Bass are infrequently caught by anglers. Catfishing is culturally important along the Minnesota River, and the city of Franklin, MN claims to be the “Catfish Capital” and holds catfish derby days as an annual city celebration.

Although many low-head dams and other barriers have been removed or modified for fish passage throughout the Minnesota River basin, the distributions of 30 fish species are significantly truncated by the two large hydro-power dams on the Minnesota (Granite Falls Dam) and Blue Earth (Rapidan Dam) Rivers and the distributions of an additional 20 species are noticeably impacted by smaller dams (e.g., Crissy Lake Dam on the Pomme de Terre River, Lac qui Parle Dam on the Minnesota River) or the natural falls on the Redwood River. Several fish species are significantly impacted by Granite Falls Dam but have remaining populations upstream. For example, Lake Sturgeon were historically present in the Minnesota River all the way upstream to Big Stone Lake, but the combination of dams, pollution, and over-harvest led to their extirpation from upstream of Granite Falls Dam during the mid-1900's. A re-introduction program was initiated in 2015, and Lake Sturgeon are once again abundant in Big Stone Lake and present in the Minnesota River upstream of Granite Falls Dam. Longnose Gar and Shortnose Gar thrive in large river systems and are both considered nearly extirpated upstream of Granite Falls Dam except for small remnant populations in headwater lakes. Additionally, Mississippi River Lock and Dam 2 is a significant hinderance to fish passage and likely has a negative impact on upstream migrations of large river fish species (e.g., American Eel, Flathead Catfish, Lake Sturgeon, Paddlefish) from the Mississippi and St. Croix Rivers into the Minnesota River.

Despite an accumulation of anthropogenic impacts on the Minnesota River and its biota (climate change, habitat fragmentation, introductions of non-native species, artificial drainage, land-use changes, etc.), the Minnesota River fish community remains resilient and healthy. Frequent fish community assessments conducted by the Minnesota Department of Natural Resources (MNDNR) and Minnesota Pollution Control Agency (MPCA) are consistently indicative of "good biological condition" and "supportive of aquatic life". Additionally, other fish population assessments by the MNDNR provide evidence that relative abundance and size distributions of important game fish species (e.g., Channel Catfish, Flathead Catfish, Walleye) are remaining steady. Unfortunately, most reaches of the Minnesota River were listed as impaired by the MPCA in 2017 for some combination of excess phosphorous and nitrogen, high levels of bacteria, excess sediment, unhealthy aquatic insect communities, and fish consumption advisories. Although the Minnesota River fish community remains resilient with few species considered extirpated, endangered, or threatened, greater than 25% of the rivers native freshwater mussel species are extirpated.

The Minnesota River is among the most heavily fished waterbodies in the MNDNRs southern region, but angling effort is dispersed among dozens of accesses and hundreds of miles of river. The Minnesota River has over 50 boat ramps and canoe accesses but can be difficult to navigate with watercrafts during high- and low-flows. Numerous public accesses (e.g., public water accesses, city and county parks, state parks, national wildlife refuges, etc.) along the Minnesota River make it very accessible for anglers fishing from shore, and over half of all angling effort is by shore-based anglers. The Fisheries Section of the MNDNR 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). The Minnesota River is prioritized as an important and unique resource, and therefore the MNDNR employs a Minnesota River Fisheries Specialist that is responsible for coordinating and implementing all Minnesota River fisheries management activities which typically includes monitoring fish populations, angler surveys, focused research projects, oversight of commercial fishers, and limited fish stocking. Details about Minnesota River fisheries assessment methods

are provided in the Minnesota River Fisheries Standardized Fisheries Assessment Procedures document (Sindt 2023b).

Refer to the Minnesota River Fisheries Management Plan 2014–2017 (MNDNR 2013) for a more comprehensive summary of past fisheries management, social considerations, land acquisitions, habitat needs, public land, and cultural importance.

2018–2022 Fisheries Management Accomplishments

Overview

Since 2018, the MNDNR has completed an extensive number of fisheries assessments, research projects, and other fisheries management activities that were guided by the 2018–2022 Minnesota River Fisheries Management Plan (MNDNR 2018). Annual fisheries surveys have focused on assessing Channel Catfish and Flathead Catfish populations and monitoring fish community health. During 2022, the MNDNR conducted the first creel survey of the Minnesota River fishery since 1998. Research projects varied from evaluations of fish sampling methodologies to population assessments of Paddlefish and Shovelnose Sturgeon to an evaluation of seasonal trends of plankton communities. Additionally, general fisheries management activities have included fish stocking, permitting of commercial fishing operations, and implementation of a regulation allowing the use of cast-nets for capturing Gizzard Shad.

Fisheries Assessments

Summer catfish assessments

Annual summer hoop net surveys for assessing Channel Catfish and Flathead Catfish populations began during 2017 (see Sindt 2023b for details). Hoop net assessments were not conducted during 2018 because of prolonged flood conditions nor during 2020 because of the COVID-19 pandemic. Hoop net catch rates of Channel Catfish and Flathead Catfish met or exceeded all management goals during 2019, 2021, and 2022 with Channel Catfish catch rates varying from 4.2 to 26.1 per net-night and Flathead Catfish catch rates varying from 1.3 to 1.7 per net-night (MNDNR 2018; Table 2). During 2017, the annual hoop net assessment was conducted upstream of Granite Falls Dam where management goals have not been established given the high abundance of Channel Catfish and lack of Flathead Catfish. Relatively stable catch rates and size distributions of Channel Catfish and Flathead Catfish that exceed management goals are indicative of stable and healthy populations.

Fish community health assessments

Standardized index of biotic integrity (IBI) assessments have been conducted annually by the MNDNR since 2010 (although impacted by extreme water levels or the COVID-19 pandemic during some years). These standard assessments consist of boat electrofishing surveys conducted at 16 fixed stations throughout the Minnesota River that are used to assess the biological health of the fish community (see Sindt 2023b for details). Fish IBI's were developed by the MPCA to assess the health of Minnesota's streams and rivers and are based on a suite of fish community metrics that provide insight into the biological health of aquatic systems. Scores vary from 0 to 100, with degraded fish communities comprised of a few tolerant species receiving low fish IBI scores and healthy diverse fish communities receiving high fish IBI scores. For "southern rivers", such as the Minnesota River, the MPCA has identified the impairment threshold as 46, with a confidence interval of 35 to 57. Fish IBI scores above the upper confidence limit reflect good biological condition, scores below the lower confidence limit reflect poor biological condition, and scores within the confidence interval require further interpretation.

Since 2010, mean IBI scores for the Minnesota River have been indicative of good biological condition, annually varying from 58 to 75 (Table 3). However, mean IBI scores for the five stations located upstream of Granite Falls Dam were between the impairment threshold and upper confidence interval during 5 of the last 12 assessments. Index of biotic integrity scores tend to be lower at sites upstream of Granite Falls, which likely reflects the lower fish species diversity in that reach of river.

Flathead Catfish recruitment index and PIT tagging

Eleven low-frequency electrofishing surveys for juvenile Flathead Catfish were conducted at some of the fixed sample stations during 2018, 2019, and 2021 (see Sindt 2023b for details; Table 4). A total of 77 Flathead Catfish less than 400 mm were captured. Formal analyses of low-frequency electrofishing data have not been completed.

From 2018 through 2022, 717 Minnesota River Flathead Catfish were implanted with one or two passive integrated transponder (PIT) tags by MNDNR staff. Thirty-nine previously PIT tagged Minnesota River Flathead Catfish were recaptured. Formal analyses of Flathead Catfish recapture data have not been completed.

2022 Minnesota River creel survey

During 2022, the MNDNR conducted the first creel survey of the Minnesota River fishery since 1998 (Sindt 2023a). The creel survey used a modified roving-access design for estimating angler effort, catch, and harvest from May through October, and learning about angler demographics and preferences. Effort, catch, and harvest estimates were assumed conservative because the survey design excluded shore anglers dispersed away from the 40 discrete access sites visited by creel clerks and excluded night angling effort. Creel clerks completed 309 creel shifts and interviewed nearly 1,200 individual anglers or groups of anglers. Total estimated angling effort was 91,463 hours, which is equivalent to 392.5 hours per river mile. Unlike most lake fisheries, a majority (55%) of angling effort was by shore anglers. Minnesota River anglers primarily targeted Channel Catfish, Flathead Catfish, Walleye, and “no particular species”, and primarily caught and harvested Channel Catfish, Freshwater Drum, and Walleye (Table 5). Mean catch rates of anglers specifically targeting popular game fishes were 0.26 Channel Catfish per hour, 0.04 Flathead Catfish per hour, and 0.27 Walleye (and Sauger) per hour. As expected, the Minnesota River remains an important fishery for Channel Catfish, Flathead Catfish, and Walleye and has an emerging Freshwater Drum fishery. Despite having dispersed angling effort, the Minnesota River is among the most heavily fished waterbodies within the MNDNR’s southern region during the open-water season.

Research

Acoustic telemetry (ongoing research)

An array of acoustic telemetry receivers was initially established in the Minnesota River during 2015 and has since been expanded to 12 acoustic receivers. The acoustic receiver array in the Minnesota River is an expansion of a much larger array further downstream in the Mississippi and St. Croix Rivers. To date, the MNDNR has surgically implanted acoustic transmitters into 14 Paddlefish, 27 Flathead Catfish, and 36 Shovelnose Sturgeon in the Minnesota River. Since 2018, the acoustic telemetry array along with active tracking efforts have detected 63 fish initially tagged in the Minnesota River and 39 additional fish that were initially tagged in the Mississippi or St. Croix Rivers. Acoustic telemetry data continually enhance understanding of fish species migration patterns and habitat uses. For instance, acoustic telemetry of Paddlefish has documented their ability to make large-scale migrations and regular movements between

the Minnesota, Mississippi, and St. Croix Rivers. More specific to the Minnesota River is an increased understanding of Flathead Catfish seasonal movement patterns and specific habitat uses (Appendix A). For instance, most of the tagged Flathead Catfish annually migrate to one of four over-wintering habitats within the Minnesota River.

Comparing Channel Catfish populations in the fragmented Minnesota River (Sindt 2021)
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 passage. Channel Catfish hoop net catch rates are more than ten times greater upstream of Granite Falls Dam than downstream. Growth rates are generally similar between reaches for fish up to 24 inches, but growth of larger fish tends to be faster downstream of Granite Falls Dam. Slower growth of older fish results in a smaller proportion of the population being 24 inches or larger upstream of Granite Falls Dam. The oldest aged fish were 19 years upstream of Granite Falls Dam and 24 years downstream.

Evaluation of four larval fish sampling methods in a large Midwestern River (Lederman et al. 2020)
Four larval fish sampling gears (benthic slednet, surface slednet, glow-stick light trap, LED light trap) were compared during April–August of 2014 and 2015. Overall, catches of larval fish were low and suspended sediments clogged gears and affected sampling efficiency. Of the four gears, the surface slednet provided the greatest catch rate of larval fish and sampled the greatest diversity of fish species. A Minnesota State University, Mankato master's student conducted this project in cooperation with the MNDNR.

Evaluation of Minnesota River physical habitat features (Vaske et al. 2019a)
The goal of this study was increasing understanding of physical habitat characteristics of the Minnesota River to provide insight into how future anthropogenic changes and climate changes may impact physical habitat and ecosystem health. During 2016 through 2018, channel dimensions and other physical habitat characteristics were quantified at 12 sites along the Minnesota River. Habitat complexity varied widely among the study sites with channel sinuosity varying from 1.05 to 2.76, mean thalweg depth varying from 4.3 to 22.8 feet, and percent of woody debris coverage varying from 0.18 to 2.38%. Land cover types varied at different scales among study sites, but in general, floodplain wetlands dominated land cover types at the local scales (e.g., riparian zone) while agriculture dominated land cover types at larger scales (e.g., greater than 500 m zone). Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

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 identifying sample size requirements for obtaining adequate statistical power and precision. Results indicate that unbaited hoop nets are effective for simultaneously sampling Channel Catfish and Flathead Catfish, and a minimum of 68 hoop nets fished during August are required to achieve adequate precision and statistical power to detect at least 50% declines in relative abundances.

Minnesota River backwater fish communities (Vaske et al. 2019b)
The goals of this study included refining protocols for monitoring backwater fish communities, increasing understanding of fish communities inhabiting Minnesota River backwaters, and collecting baseline data for evaluating future impacts of altered hydrology and habitat or establishment of invasive species. During August 2016 through September 2018 fisheries assessments were conducted in 12 backwaters using a suite of sampling gears including boat electrofishing, gill nets, fyke nets, and seines. Surveyed backwaters varied from 5 to 262 acres, 3.9 to 15.1 feet in maximum depth, low to high connectivity with the main channel, and from river mile 20 to 269. Fish species richness captured in each backwater varied from 14 to 30 for a total of 51 unique fish species that represented a diversity of feeding habits, spawning behaviors, pollution tolerances, and preferred habitat types. Seines captured the most species (40 of 51) while gill nets captured the fewest species (21 of 51). A combination of seining and boat electrofishing captured 98% of the fish species sampled during the study. Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Minnesota River Shovelnose Sturgeon: population dynamics and movement patterns (Sindt et al. 2019a)
Although perception is that Shovelnose Sturgeon are relatively abundant in the Minnesota River, historically collected data are insufficient for monitoring the population. The goal of this study was to establish a baseline understanding of Minnesota River Shovelnose Sturgeon population dynamics and evaluate movement patterns. During August 2016 through November 2018 targeted sampling was conducted at four Minnesota River sites and 391 Shovelnose Sturgeon were captured varying from 11.0 to 30.5 inches (from the tip of their snout to the fork in their tail) and estimated ages of 2 to 15 years. Fall trotlines set when water temperatures fell below 50°F were the most effective for capturing Shovelnose Sturgeon from the Minnesota River, but like most evaluated methods, trotlines primarily captured fish larger than 22 inches. Estimated growth, annual mortality rate, and population density are relatively similar to estimates reported for other populations of Shovelnose Sturgeon, and particularly other populations in the upper Mississippi River basin. Both active and passive telemetry indicated that most Shovelnose Sturgeon surgically implanted with acoustic transmitters exhibited small home ranges of less than 15 river miles during a two-year period, but four fish migrated greater than 60 river miles. Results provide evidence of an abundant Minnesota River Shovelnose Sturgeon population with typical to fast growth rates, consistent reproduction, and moderate annual adult mortality rates reflective of a healthy population. However, very few young (i.e., under age 5) fish were captured, likely resulting from size bias of sampling methods, but potentially indicating poor reproduction during recent years. Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Paddlefish in the Minnesota River (Sindt et al. 2019b)
Prior to 2016, Minnesota Department of Natural Resources fisheries assessments only captured one Paddlefish from the Minnesota River. With a seemingly increasing number of recreational angler and commercial fisher reports of Paddlefish catches during recent years, the goal of this study was to increase understanding of the presence and habitat use of Paddlefish in the Minnesota River. With experimental targeted sampling efforts, 85 Paddlefish were captured varying from 26 to 43 inches (from their eye to the fork in their tail) during August 2016 through October 2018. All Paddlefish were captured from one of four small reaches of the Minnesota

River, two of which appear to have large congregations of Paddlefish nearly year-round. Acoustic transmitters were surgically implanted into 14 Paddlefish that exhibited a mean linear home range of approximately 75 river miles but varied widely 0 to 250 river miles. Four fish tagged during this study emigrated from the Minnesota River while six Paddlefish initially captured in the St. Croix River or Mississippi River immigrated into the Minnesota River. Results from this study provide encouraging evidence of a more abundant population of Paddlefish inhabiting the Minnesota River than previously perceived, and that Paddlefish frequently move between the Minnesota, Mississippi, and St. Croix Rivers. Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Population dynamics of Flathead Catfish in the lower Minnesota River (Shroyer 2018)
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 20 inches around age 5, 28 inches between age 8 and 9, and 34 inches around age 13. Only unusually fast-growing fish reach 40 inches. Mark-recapture population estimates are approximately 145 fish 20 inches or larger per river mile and approximately 13 fish 40 inches or larger per river mile.

Spatial and temporal trends of Minnesota River phytoplankton and zooplankton (Sindt and Wolf 2021)
Over 100 water, phytoplankton, and zooplankton samples were collected from the Minnesota River during 2016 through 2018 to explore spatiotemporal trends in plankton communities and evaluate relationships with physicochemical factors. Phytoplankton and zooplankton community structure exhibited seasonal patterns but only the zooplankton community differed spatially. Cyanobacteria (mean ± SE; 11.27 ± 1.43 mm^3/L) and diatoms (8.12 ± 1.08 mm^3/L) dominated phytoplankton biovolume with seasonal peaks in Cyanobacteria occurring during July–September and peaks in diatoms occurring during May, August, and September. All phytoplankton taxa except Cryptophyta exhibited a negative relationship with relative river discharge. Crustacean zooplankton biomass was greatest at two upstream sites (146.7 ± 32.6 µg/L) where cladocerans and copepods were likely exported from upstream of dams where water residence time is greater. Within the lower free flowing reach, rotifers dominated the zooplankton community (207.9 ± 40.9 individuals/L and 6.5 ± 1.0 µg/L). Thus, spatial differences in zooplankton community structure were primarily attributed to the influence of dams. Seasonal patterns in zooplankton community structure included peaks in Chydoridae, cyclopoid, immature copepod, and rotifer biomass during May and Bosminidae biomass during October. Excluding the influence of dams on zooplankton, the cumulative effects of month and relative river discharge were the most important for explaining variability in plankton community structure. Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Regulation Changes

During 2019, regulations were implemented that allowed the use of cast nets for capturing Gizzard Shad for use as bait from the Minnesota River downstream of Granite Falls Dam from July 1st through November 30th. Anglers interested in using cast nets for capturing Gizzard Shad must apply for a permit from the MNDNR, which requires completion of an online aquatic invasive species training course and tagging of their cast net(s) with “infested waters” tags. Cast nets must be 5 feet in diameter or less and constructed with 3/8-to-5/8-inch monofilament mesh. Gizzard Shad harvested with cast nets must be used for bait on the same waterbody and may not be transported off the waterbody. Additionally, cast net permittees are required to provide an annual report to the MNDNR that includes the number and species of fish caught with the cast net.

Commercial Fishing

During 2018–2022 a limited number of commercial seine hauls were performed in the Minnesota River (within Brown County) by one licensed commercial fisher operating with a class “B” commercial fishing permit. Reported commercial harvest was approximately 23,000 pounds of buffalo species, 5,000 pounds of Common Carp, 3,000 pounds of carpsucker species, and less than 500 pounds of Freshwater Drum.

Fish Stocking

During 2018–2022, Ortonville Fisheries Management Area stocked approximately 532 pounds of yearling and 1,864 pounds of adult walleyes into the Minnesota River between Granite Falls and Ortonville, MN. Stocking of Walleye fry into Big Stone Lake, Big Stone National Wildlife Refuge, Marsh Lake, and Lac qui Parle during this time also contributed Walleye to the Minnesota River. Additionally, annual stocking of Lake Sturgeon fingerling into Big Stone Lake has contributed Lake Sturgeon to downstream impoundments (e.g., Lac qui Parle) and the Minnesota River.

2023–2027 Fisheries Management Plan

Overview

Fisheries management goals during 2023–2027 are similar to goals established in the 2018–2022 Minnesota River Fisheries Management Plan. Standardized fisheries surveys will continue to focus on assessing important game fish populations (e.g., Channel Catfish and Flathead Catfish) and evaluating overall fish community health. Targeted fisheries surveys will be implemented to enhance understanding about populations of unique large rivers fish species, including several species of conservation concern. Focused research projects will further enhance understanding of the Minnesota River ecosystem and its fish community. For instance, acoustic telemetry studies will provide information about fish species movement patterns and habitat use while benthic trawl surveys will increase understanding of the status and distribution of under-studied benthic fish species. The 2023–2027 fisheries management goals include an increased emphasis on the importance of angler access to the Minnesota River and addressing fish passage barriers throughout the Minnesota River basin.

Fisheries Management Goals and Benchmarks

- Populations of Channel Catfish, Flathead Catfish, Freshwater Drum, Sauger, and Walleye continue to provide quality recreational fishing in the Minnesota River.
    - Abundances of Channel Catfish and Flathead Catfish provide July hoop net catch rates of ≥ 3 Channel Catfish and ≥ 1 Flathead Catfish per net.

    - Abundance of large Channel Catfish downstream of Granite Falls Dam provide July hoop net catches of at least one 24” or larger Channel Catfish in every three hoop nets (≥ 0.33 per net) and at least one 28” or larger Channel Catfish in every seven hoop nets (≥ 0.15 per net).
    - Abundance of large Flathead Catfish downstream of Granite Falls Dam provide July hoop net catches of at least one 34” or larger Flathead Catfish in every five hoop nets (≥ 0.2 per net) and at least one 40” or larger Flathead Catfish in every ten hoop nets (≥ 0.1 per net).
    - Abundances of Freshwater Drum, Sauger (downstream of Granite Falls Dam), and Walleye provide three-year average august boat-electrofishing (during annual IBI assessments) catch rates of at least 10, 1, and 2 per hour, respectively.
- The Minnesota River has a healthy and diverse fish community.
    - Index of biotic integrity electrofishing assessments sample fish community’s indicative of “good biological condition”.
    - The fish community of the Minnesota River mainstem has more than 60 native species.
- Self-sustaining populations of the state endangered, threatened, or special concern Black Buffalo (T), Blue Sucker (SC), Lake Sturgeon (SC), and Paddlefish (T) inhabit the Minnesota River.
- Populations of commercially harvested native fish species (Bigmouth and Smallmouth Buffalo, carpsucker species, and Freshwater Drum) are healthy and sustained.
- Minnesota River fisheries management continually adapts to changes in Minnesota River angler demographics and preferences.
- Knowledge about the Minnesota River ecosystem and its fish populations is continually expanded.
- Fish habitat is expanded in the Minnesota River basin by removing or modifying fish passage barriers (e.g., dams).
- Anglers have quality shore angling and boat access along the Minnesota River.

Operational Plan

Fisheries Assessments

- Annually monitor Channel Catfish and Flathead Catfish populations with summer hoop net surveys.
- Annually monitor fish community health, fish species diversity, and game fish relative abundance with August index of biotic integrity electrofishing surveys.
- Monitor Flathead Catfish recruitment, growth, and movement patterns with low-frequency electrofishing assessments and PIT tagging studies.
- Conduct targeted surveys for Black Buffalo, Blue Sucker, Lake Sturgeon, and Paddlefish.
- Conduct an angler and creel survey every 5 to 10 years.

Research

- Implement a three-part study to enhance knowledge of Minnesota River fish ecology that is tentatively funded by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources.

    - Part 1: Evaluate seasonal trends of Bigmouth Buffalo, Emerald Shiner, Gizzard Shad, and Spotfin Shiner diets.
    - Part 2: Evaluate the status and distribution of understudied bottom-dwelling fishes with benthic trawl surveys.
    - Part 3: Use acoustic telemetry to describe movement patterns and habitat use of Bigmouth Buffalo, Channel Catfish, and Walleye.
- Surgically implant acoustic transmitters into 15 Paddlefish, 12 Bigmouth Buffalo, 12 Channel Catfish, 12 Walleye, 5 Flathead Catfish, and 5 Blue Suckers.
- Continue annual maintenance of the Minnesota River acoustic receiver array and conduct active tracking surveys to learn about movement patterns and habitat use of acoustic tagged fish species.
- Continue tagging Paddlefish with external jaw tags to learn about movement, growth, and abundance.
- Develop and implement focused research projects to address emerging Minnesota River fisheries concerns.

Other

- Monitor commercial fishing operations and commercial harvest.
- Seek external funding for projects that expand knowledge of the Minnesota River ecosystem and its fish populations.
- Initiate, assist, and support efforts to remove or modify fish passage barriers within the Minnesota River basin.
- Advocate for increased and improved public access for Minnesota River anglers.
- Update the Minnesota River Fisheries Management Plan during winter of 2027–2028.

Pending Regulation Changes

- Although not specific to the Minnesota River, the MNDNR will be separating harvest regulations for Channel Catfish and Flathead Catfish on inland waters. Currently, the possession limit is 5 catfish, no more than 2 can be Flathead Catfish, and only 1 catfish over 24”. The possession limit will be changed to 5 Channel Catfish, only 1 over 24”, and 2 Flathead Catfish, only 1 over 24”.
- The MNDNR will continue to support legislation that would allow for the use of two fishing lines on the Minnesota River downstream of Granite Falls Dam during the open-water fishing season.

Historical Fisheries Management

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).

1980’s

During 1978–1982, a biological survey of the Minnesota River was conducted, which included boat electrofishing surveys at 52 stations (Kirsch et al. 1985). Electrofishing surveys captured

53 different species representing 14 families with Channel Catfish and Walleye being the two most abundant game fish species.

1990's
During 1992, MNDNR fisheries staff conducted fisheries assessments at 55 sites on the Minnesota River using boat electrofishing, gill nets, trap nets, seines, and trotlines (Stauffer et al. 1995). Sixty-four species were collected representing 14 families. Walleye, Channel Catfish, and Flathead Catfish were the most captured game fish species. During 1998, MNDNR fisheries staff conducted fisheries surveys at the same 55 sites that were sampled during 1992 and they captured 68 species representing 15 families (Chapman 2000).

As part of a large-scale "Minnesota River Assessment Project", fish communities were evaluated at 116 stream and river sites throughout the Minnesota River basin during 1993, including several sites on the Minnesota River mainstem (Bailey 1994).

2000–2010
During 2004, MNDNR fisheries staff conducted electrofishing, low-frequency electrofishing, trap net, trotline, gill net, and seine surveys along the Minnesota River (Chapman 2005). Sixty-four species were collected representing 14 families. Since 2010, the MNDNR has conducted annual boat electrofishing assessments at 16 fixed sites (with some exceptions) on the Minnesota River to evaluate fish community health through index of biotic integrity (IBI) scores. Additionally, index of biotic integrity surveys were conducted at sites upstream of Minnesota Falls Dam during 2006–2009.

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" 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 basin including eight sites on the Minnesota River mainstem.

Research

Angler creel survey of a 110-mile segment of the Minnesota River (Chapman 2001)
A stratified-random creel survey was conducted along a 110-mile reach of the Minnesota River between May 1 and October 31, 1998. Total angling effort was estimated at 49,311 hours or 448 hours per 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.

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 direct-current 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 Flathead Catfish length and age data.

Fish communities of Minnesota River floodplain lakes (Schmidt and Polomis 2007)
During 2006, fish were sampled in 21 Minnesota River floodplain 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, Brook 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 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 and September of 2008. However, 17% of fish emigrated from the study reach before the end of September, and all fish emigrated by the end of October. Fourteen of the 18 fish returned to the study reach during August and September of 2009.

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. Recaptured fish exhibited both upstream and downstream movements.

Theses
Minnesota State University, Mankato master's students published two theses about Minnesota River fish populations during the early 2000's. 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.

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 and Smallmouth Buffalo, carpsucker species, Common Carp, and Freshwater Drum 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 pounds of fish.

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. Most 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.

Minnesota Falls Dam Removal
Prior to 2013, the Minnesota Falls Dam at river mile 236.5 was the upstream extent of many large river fish species including Paddlefish and Shovelnose Sturgeon. The Minnesota Falls Dam was removed during 2013 by XCEL Energy with technical assistance from the MNDNR. Since then, more than 10 fish species have recolonized upstream, including game fishes such as Flathead Catfish and Sauger.

Fish Species Highlights

Endangered, Threatened, and Species of Concern

American Eel

American Eel is listed as a species of concern in Minnesota and has 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 nearly 2,000 miles 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. Today, reports of American Eels in the Minnesota River are uncommon, but there are generally several per year. American Eels are also found in the Mississippi River, St. Croix River, their larger tributaries, and Lake Superior. Recreational anglers catch most American Eel captured in the Minnesota River, but some have been caught during MNDNR fisheries surveys.

Black Buffalo

Black Buffalo is listed as a threatened species in Minnesota. 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. Minnesota is on the northern edge of Black Buffalo distribution, and populations are considered low. Very little is known about habitat use, spawning, and migration within Minnesota. Black Buffalo is difficult to distinguish from Smallmouth Buffalo, which complicates understanding of the distribution and status of the species within Minnesota.

Blue Sucker

Blue Sucker is one of the rarest species in Minnesota and therefore is listed as a species of concern, but Blue Suckers are relatively common in the Minnesota River. Historically, Blue Sucker was a prized commercial species and found throughout the Mississippi River drainage. 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 Suckers 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 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 below Granite Falls Dam.

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, St. Louis River, Mississippi River) along with rebounding populations in other lakes and rivers throughout the state. Yet, Lake Sturgeon is still considered a species of concern. In the Minnesota River, Lake Sturgeon were historically present all the way up to Big Stone Lake where historical accounts suggest an abundant population 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. Lock and Dam 2 of the Mississippi River likely limits

important movement of Lake Sturgeon into the Minnesota River from the Mississippi and St. Croix Rivers where Lake Sturgeon are more abundant. During 2015, the Minnesota Department of Natural Resources began a re-introduction program by annually stocking approximately 4,000 fingerling Lake Sturgeon into Big Stone Lake. Although re-introduced Lake Sturgeon are too young to reproduce, survival has been exceptional with an abundance of 30-inch and larger Lake Sturgeon in Big Stone Lake and evidence of fish moving downstream into Marsh Lake, Lac qui Parle, and the Minnesota River downstream of Granite Falls Dam.

Paddlefish

Paddlefish is listed as a threatened species in Minnesota. Paddlefish is a large native planktivore that inhabits large rivers and their backwaters. Similar to other large river species, Paddlefish were once abundant in Minnesota rivers and throughout the Mississippi River drainage. Paddlefish declined in abundance because 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 fishers in backwaters near New Ulm. During 2016 and 2017, MNDNR 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

Skipjack Herring

Skipjack Herring is listed as an endangered species in Minnesota and is functionally extirpated from the Mississippi River drainage upstream of Lock and Dam 19 in Keokuk, Iowa. Skipjack Herring is a highly migratory river species that was once common in the Minnesota and Wisconsin portions of the Mississippi River and its larger tributaries such as the Minnesota River. Construction of dams along the Mississippi River have blocked upstream migrations and infrequent catches of Skipjack Herring in Minnesota waters are considered likely strays. Skipjack Herring is the only known host for Ebonyshell and Elephant-ear Mussels which are both consequently listed as endangered species in Minnesota.

Potentially extirpated species

In addition to the Skipjack Herring which is functionally extirpated from Minnesota, River Redhorse, River Shiner, Spotted Sucker, and Western Sand Darter may be functionally extirpated from the Minnesota River Basin despite being present downstream in the Mississippi River. None of these species have been confirmed present in the Minnesota River within the last 15 years. It is difficult to know how abundant these species may have previously been in the Minnesota River, but historical accounts from the late 1800's suggest that Western Sand Darter were relatively common along sandbars near Mankato. Although not extirpated from the basin, Banded Killifish and Trout-perch are no longer found in upstream reaches of the Minnesota River mainstem where historical accounts suggest they were relatively common.

Game Fishes

Channel Catfish

The Minnesota River has a noteworthy Channel Catfish fishery for both quantity and quality. Downstream of Granite Falls Dam hoop net catch rates are consistently around 4.0 fish per net

with over 15% of captured fish exceeding 24 inches, over 5% of fish exceeding 28 inches, and some fish exceeding 34 inches and 18 pounds. Upstream of Granite Falls Dam hoop net catch rates are much greater with averages around 45.0 fish per net, but only 5% of fish exceed 24 inches and few fish exceed 28 inches. During the 2022 Minnesota River creel survey (Sindt 2023a), Channel Catfish were the most frequently targeted and caught species, and the second most harvested species.

Flathead Catfish

The Minnesota River has a regionally important Flathead Catfish fishery with some fish potentially exceeding 60 pounds. Not only does the Minnesota River have large Flathead Catfish, but it also has a rather abundant population of medium size Flathead Catfish with estimated densities of 90 fish 20 inches or larger per river mile and 13 fish 40 inches or larger per river mile. Flathead Catfish are restricted to areas downstream of Granite Falls Dam, but trophy size fish can be caught anywhere throughout the 240-mile reach 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 (Shroyer 2011). However, Flathead Catfish will migrate great distances for spawning and for over-wintering. Oftentimes Flathead Catfish will return to the same stretch of river each summer and each winter. Population dynamics of Minnesota River Flathead Catfish are indicative of low annual mortality, and the large size structure may be sensitive to increased harvest.

Shovelnose Sturgeon

Shovelnose Sturgeon is the smallest of the ancient sturgeon species in North America and has 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 relatively rare in the Minnesota River, but sampling may have been insufficient. In recent years, Shovelnose Sturgeon have been abundant in MNDNR fisheries assessments conducted on the Minnesota River. Shovelnose Sturgeon are only open to catch-and-release angling in the Minnesota River.

Walleye and Sauger

The Minnesota River has healthy populations of both Walleye and Sauger with some Walleye exceeding 28 inches and Sauger exceeding 20 inches. Both species are difficult to sample from the Minnesota River with traditional fisheries survey gears, but anglers regularly target and catch both species during spring and fall. Natural reproduction by both species is evident but the locations 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. Stocked fish likely contribute to the population, but a recent genetic study indicated that >70% of Walleye downstream of Granite Falls Dam larger than 20 inches were likely from natural reproduction.

Other Game Fish Species

Other game fish species inhabiting the Minnesota River include crappies, Largemouth Bass, Northern Pike, Rock Bass, Smallmouth Bass, sunfish, White Bass, and Yellow Perch. Densities of most of these species are comparatively low and targeted and caught by relatively few anglers. Bluegill, crappies, and Largemouth Bass are more prevalent in backwater lakes, and anglers that find the right backwater 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 Minnesota River backwaters, but preferred habitats are limited in the main river channel. Northern Pike larger than 40 inches have been caught from the Minnesota River, most commonly from upstream of Granite Falls Dam.

Other Species

Common Carp

Common Carp is one of the most widespread and destructive aquatic invasive species. Common Carp were introduced to Minnesota waters during the late-1800's and quickly established populations in lakes, rivers, and wetlands around the state. Common Carp are abundant in the Minnesota River, but likely have a greater negative impact on floodplain lakes than within the main channel. Despite being an invasive species and despised by many anglers, 4% of Minnesota River anglers specifically targeted Common Carp during 2023 (Sindt 2023a). Bow fishers enjoy targeting Common Carp, but bowfishing is uncommon in the Minnesota River because of the typically poor water clarity.

Freshwater Drum

Freshwater Drum are extremely abundant in the Minnesota River and are common in tributary rivers, main stem reservoirs, and connected lakes. Although the Minnesota River population of Freshwater Drum is dominated by smaller fish less than 16 inches, some fish can reach rather large sizes exceeding 30 inches and 20 pounds. During recent history, Freshwater Drum have been perceived as an undesirable "rough fish". More recently, anglers are realizing that Freshwater Drum are excellent for eating and are fun and easy to catch. Minnesota River anglers are increasingly interested in catching Freshwater Drum, with more than a five-fold increase in the proportion of anglers targeting Freshwater Drum from 1998 to 2022 (Sindt 2023a). In fact, Freshwater Drum are the second most frequently caught and the most harvested fish species from the Minnesota River. Thus, Freshwater Drum are now being treated as a Minnesota River "game fish" species.

Longnose and Shortnose Gar

Longnose and Shortnose Gar are prehistoric species that have been around for over 100 million years and have the unique capability of absorbing oxygen by gulping air at the water's surface. Shortnose Gar are more common in the Minnesota River than Longnose Gar, outnumbering them 20 to 1 in MNDNR fisheries surveys. Both Longnose Gar and Shortnose Gar are virtually absent upstream of Granite Falls Dam. Interestingly, there is a poorly understood remnant population of Longnose Gar persisting within the headwaters of the Pomme de Terre River watershed (e.g., Pomme de Terre Lake, Stalker Lake, Ten Mile Lake), despite almost zero records of Longnose Gar within the lower portion of the Pomme de Terre River or within the Minnesota River upstream of Granite Falls Dam. Similarly, there are remnant populations of Shortnose Gar persisting is several headwater lakes of the Chippewa River Watershed and in Big Stone Lake. Few anglers specifically target gar on the Minnesota River, but they are incidentally caught by anglers, especially at night, and often blamed for "stealing" bait.

Challenges

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.

Aquatic Invasive Species
During 2016 and 2017 Zebra Mussels, Grass Carp, and Bighead Carp were confirmed present in the Minnesota River. To date, only one additional invasive carp has 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 veliger's have been detected. The extent to which each of these invasive species will proliferate and impact the Minnesota River ecosystem is unknown.

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. The increased amount of water flowing to the Minnesota River is carrying more pollutants (e.g., nutrients, bacteria, sediment) and increasing erosion. Increases in flood frequency, pollutants, and erosion along with altered hydrologic patterns will have impacts on the entire Minnesota River ecosystem.

Dams and Habitat Fragmentation
Five dams alter the flow of the upper Minnesota River and impact fish species distributions while the lower 240 miles downstream of Granite Falls Dam are completely free flowing. From upstream to downstream, the dams on the Minnesota River mainstem are Big Stone Lake Dam, Big Stone National Wildlife Refuge Hwy 75 Dam, Marsh Lake Dam, Lac qui Parle Dam, and Granite Falls Dam. Most of the dams are associated with impoundments that have independently managed fisheries. Granite Falls Dam is the exception and is a run-of-the-river dam that provides hydropower generation. Many other dams and fish passage barriers (e.g., undersized, or perched culverts) exist throughout the Minnesota River basin.

Granite Falls Dam is the most significant fish passage barrier on the Minnesota River, preventing approximately 20 fish species from inhabiting the river upstream. Most of the impacted species are considered "large-river species" such as American Eel, Flathead Catfish, Paddlefish, Sauger, and Shovelnose Sturgeon. Lac qui Parle Dam is the next dam upstream, and it also serves as a significant barrier to upstream fish passage and is the upstream extent of Fantail Darter and Smallmouth Bass (except populations in headwater lakes of the Pomme de Terre River and Oliver Lake in Swift County) within the Minnesota River Basin. Marsh Lake Dam was a significant fish passage barrier until recent construction of a rock-arch rapids fishway that was part of the Marsh Lake Restoration Project. The Hwy 75 bridge is a significant fish passage barrier and is the upstream extent of Logperch and Silver Redhorse. Big Stone Dam is passable by most fish species during high flows, but neither Bowfin nor Central Mudminnow are found upstream of the dam.

Barriers on tributary rivers and streams also restrict the distribution of many fish species in the basin and prevent access to potentially important spawning and nursery habitat. Rapidan Dam is the most significant fish passage barrier in the Minnesota River basin that is not on the mainstem, and it likely restricts the distribution of nearly 30 fish species from inhabiting the Blue Earth River and its tributaries (e.g., Watonwan River) upstream of the dam. Approximately 40 species are prevented from accessing the Redwood River upstream of Redwood Falls Dam, but

the natural falls were historically a complete barrier to fish passage. Several other low-head dams in the Minnesota River basin have noticeable impacts of fish species distributions (e.g., Crissy Lake Dam on the Pomme de Terre River, Lake Emily Diversion Dam on the Chippewa River, Swift Falls Dam on the East Branch Chippewa River). For instance, over a dozen species are absent in the Pomme de Terre River upstream of the Crissy Lake Dam in Morris, MN that are present immediately downstream of the dam.

Downstream of the Minnesota River Basin, lock and dams on the Mississippi River also have impacts on Minnesota River fish populations. Particularly relevant to the Minnesota River, lock and dam 2 near Hastings, MN has been shown to prevent important upstream migrations of Lake Sturgeon and Paddlefish (among other fish species) into the Minnesota River from the Mississippi and St. Croix Rivers during low flow conditions.

Monitoring Walleye, Sauger, and Freshwater Drum populations
Freshwater Drum, Walleye, and Sauger are among the most targeted, caught, and harvested species by Minnesota River anglers. Gill nets and night-time boat electrofishing are two common methods for capturing and assessing populations of these species. Unfortunately, in a complex river system like the Minnesota River, it is nearly impossible to conduct gill net assessments and night-time electrofishing is especially challenging and dangerous. Currently, these three species are being monitored through day-time electrofishing surveys conducted during summer for the primary purpose of evaluating fish community health. Catch rates of these three species are relatively low during these day-time electrofishing surveys, and size biases are likely significant. Therefore, novel methods for indexing relative abundances and describing age and size structures are being explored.

Floodplain Connectivity

Lateral connectivity with the floodplain is important for riverine ecosystems and provides an important source of organic matter, macroinvertebrates, and plankton that fuel the rivers food chain. Connectivity with floodplain lakes or “backwaters” is particularly important as they enhance biological productivity and promote a healthy and diverse fish community. When rivers connect with floodplain lakes, they replenish nutrients and oxygen, which facilitates phytoplankton, zooplankton, and macroinvertebrate production. As floodwaters recede and flow back into the river, they carry phytoplankton, zooplankton, macroinvertebrates, organic matter, and often 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, Northern Pike, Orangespotted Sunfish). Unfortunately, wetland drainage, habitat encroachment, landscape alterations, and changes to the hydrologic flow regime negatively affect floodplain 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 temporarily 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.

References

Bailey, P. A., J. W. Enblom, S. R. Hanson, P. A. Rendard, and K. Schmidt. 1994. A fish community analysis of the Minnesota River basin. Minnesota River Action Plan v.3, St. Paul, MN.

Biological Survey Unit. 1960. A biological survey of the Minnesota River (1958 and 1959), Mankato to Mouth.

Chapman, B. 2000. Assessment of the fish populations of the Minnesota River, 1998. Federal aid completion report number 501. Minnesota Department of Natural Resources, Section of Fisheries, St. Paul, MN.

Chapman, B. 2001. Angler creel survey of a 110 mile segment of the Minnesota River 1998. Federal aid completion job number 466. Hutchinson, MN.

Chapman, B. 2002. Special sampling of Flathead Catfish in the Minnesota River. Federal aid completion study four job number 543. Hutchinson, MN.

Chapman, B. 2005. Assessment of the fish populations of the Minnesota River, 2004. Federal aid completion report, Minnesota Department of Natural Resources section of Fisheries, St. Paul, MN.

Huber, E. 1971. A fish and Wildlife survey of the Minnesota River near New Ulm. Minnesota Department of Natural Resources, Division of Fish and Game, Section of Technical Services. Special Publication 84.

Kirsch, N. A., S. A. Hanson, P. A. Renard, and J. W. Enblom. 1985. Biological survey of the Minnesota River. Federal Aid Completion Report 139. St. Paul, MN.

Lederman, N. J., A. R. Sindt, D. J. Dieterman, J. D. Krenz, and S. J. Fisher. 2020. Evaluation of four larval fish sampling methods in a large midwestern river. The Prairie Naturalist 52:21–30.

MNDNR. 2013. Minnesota River fisheries management plan 2013-2017. Minnesota Department of Natural Resources.

MNDNR. 2018. Minnesota River fisheries management plan 2018-2022. Minnesota Department of Natural Resources.

Nelson, B. D. 2015. Hydrologic and temperature regime influence on growth and recruitment of fishes in an upper Midwest riverine ecosystem. Master’s thesis. Minnesota State University, Mankato.

Nickel, A. D. 2014. An investigation of connectivity relationships with abiotic conditions and community dynamics in Minnesota River backwater lakes. Master’s thesis. Minnesota State University, Mankato.

Schneider, J. A. 1966. A biological reconnaissance of the Minnesota River from Lac qui Parle Dam to Mankato. Minnesota Conservation Department, St. Paul, MN.

Schmidt, K. P. 2004. Paddlefish (*Polyodon Spathula*) survey results in the Mississippi River from St. Paul to Red Wing. Minnesota Department of Natural Resources, Division of Ecological Services.

Schmidt, K., and T. Polomis. 2007. Fish communities of Minnesota River floodplain lakes. Minnesota Department of Natural Resources, Division of Ecological Services.

Shroyer, S. M. 2011. Movement and site fidelity of Flathead Catfish in the Minnesota River. Pages 473–483 *in* P. H. Michaletz and V. H. Travnichek, editors. Conservation, ecology and management of catfish: the second international symposium. American Fisheries Society, Symposium 77, Bethesda, Maryland.

Shroyer, S. M. 2018. Population dynamics of Flathead Catfish in the lower Minnesota River. Minnesota Department of Natural Resources investigational report 564.

Sindt, A. R. 2018. Evaluation of unbaited hoop nets for simultaneously assessing Channel Catfish and Flathead Catfish populations in the Minnesota River. North American Journal of Fisheries Management 38:538–548.

Sindt, A. R. 2021. Comparing Channel Catfish populations in the fragmented Minnesota River. North American Journal of Fisheries Management, Special Issue 1 41:S146-S155.

Sindt, A. R. 2023a. Minnesota River creel survey April 27–October 31, 2022. Minnesota Department of Natural Resources federal aid completion report, job 1156.

Sindt, A. R. 2023b. Standardized procedures for Minnesota River fisheries assessments. Minnesota Department of Natural Resources special publication XXX.

Sindt, A. R., and M. C. Wolf. 2021. Spatial and temporal trends of Minnesota River phytoplankton and zooplankton. River Research and Applications 37:776–795.

Sindt, A. R., M. Vaske, M. Wolf, E. Katzenmeyer, and K. Stampfle. 2019a. Minnesota River Shovelnose Sturgeon: population dynamics and movement patterns. Minnesota Department of Natural Resources. Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Sindt, A. R., M. Vaske, M. Wolf, E. Katzenmeyer, and K. Stampfle. 2019b. Paddlefish inhabiting the Minnesota River. Minnesota Department of Natural Resources. Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Stauffer, K., B. Carlson, T. Jones, T. Kolander, J. Malzhan, T. Polomis, and B. Schultz. 1995. Minnesota Department of Natural Resources Completion Report: A survey of the fish populations of the Minnesota River, 1992. Federal aid completion report, Hutchinson, MN.

Stauffer, K. W., and B. D. Koenen. 1999. Comparison of methods for sampling Flathead Catfish in the Minnesota River. Pages 329–333 *in* E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr., and T. Coon, editors. Catfish 2000: proceedings of the International Ictalurid Symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Vaske, M., A. Sindt, M. Wolf, K. Stampfl, and E. Katzenmeyer. 2019a. Evaluation of Minnesota River Physical Habitat Features. Minnesota Department of Natural Resources. Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Vaske, M., A. Sindt, M. Wolf, K. Stampfl, and E. Katzenmeyer. 2019b. Minnesota River Backwater Fish Communities. Minnesota Department of Natural Resources. Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Figures

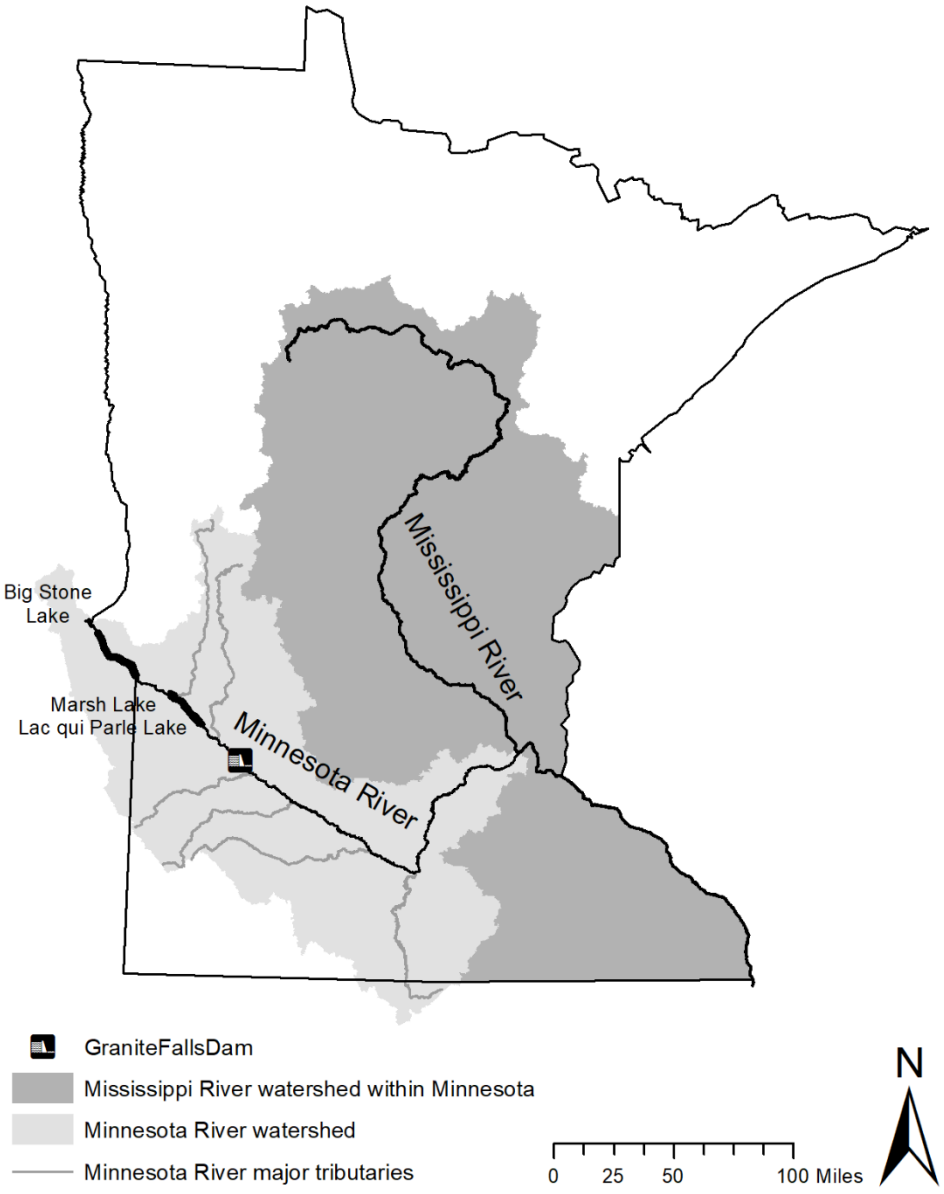

Figure 1. A map of the Minnesota River, including major tributaries, impoundments, and Granite Falls Dam.

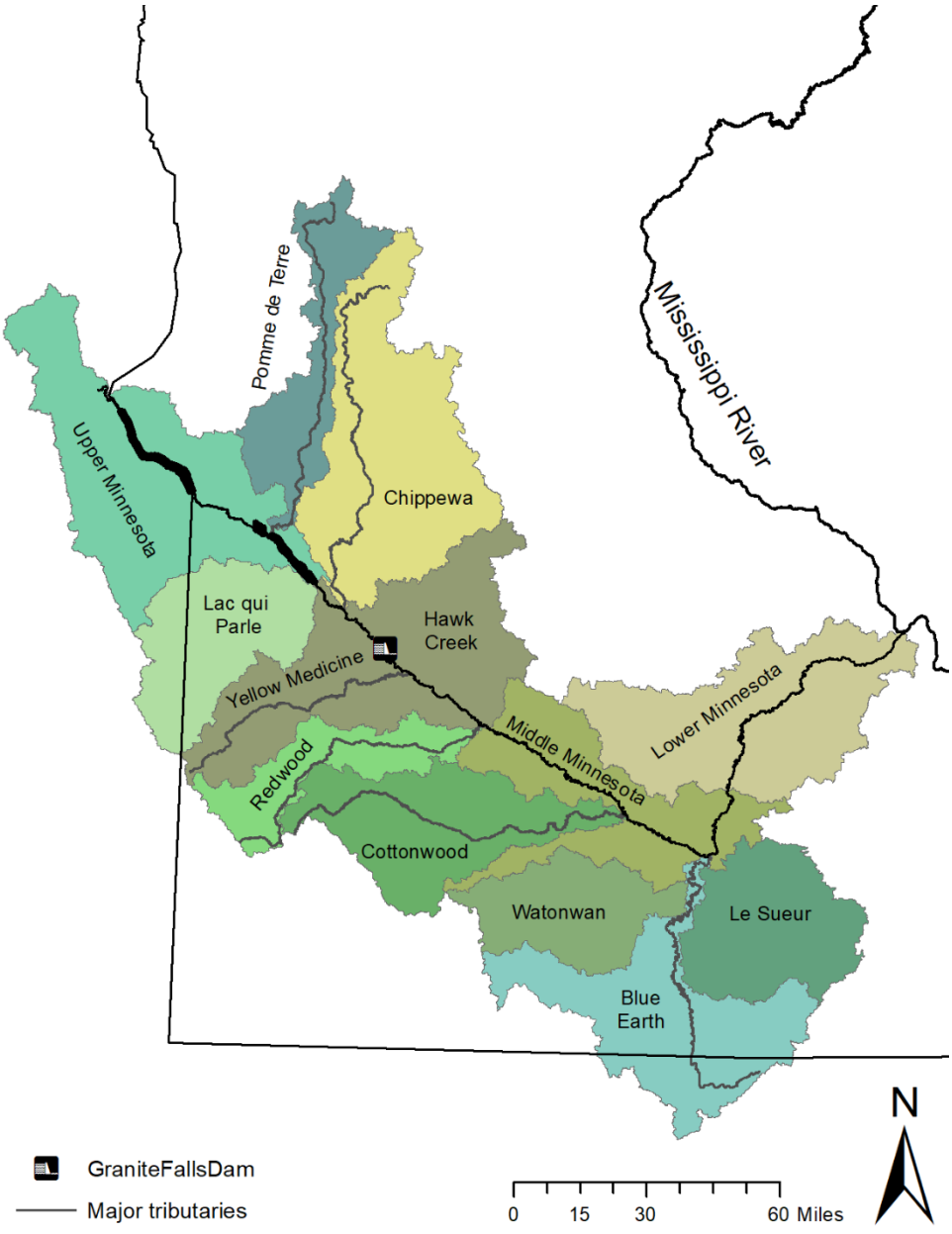

Figure 2. A map of the sub-watersheds of the Minnesota River basin.

Tables

Table 1. Fish species of the Minnesota River basin.

Species	Occurrence in mainstem	Found in mainstem upstream of Granite Falls Dam	Non-native	"Game fish"	Potentially extirpated
American Brook Lamprey	absent				
American Eel	rare			X	
Banded Darter	rare				
Banded Killifish	absent				
Bighead Carp	rare		X		
Bigmouth Buffalo	common	X			
Bigmouth Shiner	incidental	X			
Black Buffalo	rare				
Black Bullhead	locally abundant	X			
Black Crappie	common	X		X	
Blackchin Shiner	absent				
Blacknose Dace	incidental	X			
Blacknose Shiner	absent				
Blackside Darter	common	X			
Blue Sucker	present				
Bluegill	common	X		X	
Bluntnose Minnow	common	X			
Bowfin	rare	X			
Brassy Minnow	present	X			
Brook Silverside	rare				
Brook Stickleback	incidental	X			
Brown Bullhead	incidental	X			
Brown Trout	absent		X	X	
Bullhead Minnow	common				
Burbot	rare			X	
Carmine Shiner	rare	X			
Central Mudminnow	incidental	X			
Central Stoneroller	incidental	X			
Channel Catfish	common	X		X	
Channel Shiner	common				
Chestnut Lamprey	rare				
Cisco	absent			X	
Common Carp	common	X	X		
Common Shiner	present	X			
Creek Chub	incidental	X			
Emerald Shiner	common	X			
Fantail Darter	incidental	X			

Fathead Minnow	common	X			
Flathead Catfish	common			X	
Freshwater Drum	common	X			
Gizzard Shad	common				
Golden Redhorse	common	X			
Golden Shiner	incidental	X			
Goldeye	rare				
Goldfish	rare		X		
Grass Carp	rare		X		
Greater Redhorse	rare	X			
Green Sunfish	common	X		X	
Highfin Carpsucker	present				
Hornyhead Chub	incidental	X			
Iowa Darter	incidental	X			
Johnny Darter	common	X			
Lake Sturgeon	rare	X		X	
Largemouth Bass	common	X		X	
Largescale Stoneroller	incidental				
Least Darter	absent				
Logperch	common	X			
Longnose Gar	present				
Mimic Shiner	incidental				
Mooneye	common				
Muskellunge	rare			X	
Northern Hog Sucker	incidental				
Northern Pike	locally abundant	X		X	
Northern Redbelly Dace	absent				
Orangespotted Sunfish	present	X		X	
Paddlefish	present			X	
Pugnose Shiner	absent				
Pumpkinseed	incidental	X		X	
Quillback	common	X			
Rainbow Darter	absent				
Rainbow Trout	absent		X	X	
River Carpsucker	common	?			
River Darter	locally abundant				
River Redhorse	rare				X
River Shiner	absent				X
Rock Bass	rare	X		X	
Sand Shiner	common	X			
Sauger	common			X	
Shoal Chub	common				
Shorthead Redhorse	common	X			

Shortnose Gar	common				
Shovelnose Sturgeon	common			X	
Silver Chub	common				
Silver Lamprey	rare				
Silver Redhorse	common	X			
Skipjack Herring	absent				X
Slenderhead Darter	common	X			
Smallmouth Bass	present	X		X	
Smallmouth Buffalo	common				
Spotfin Shiner	common	X			
Spottail Shiner	locally abundant	X			
Spotted Sucker	absent				X
Stonecat	incidental	X			
Tadpole Madtom	rare	X			
Tiger Muskellunge (hybrid)	absent		X	X	
Trout-perch	absent				
Walleye	common	X		X	
Weed Shiner	incidental				
Western Sand Darter	absent				X
White Bass	common	X		X	
White Crappie	rare	X		X	
White Sucker	locally abundant	X			
Yellow Bass	absent		X	X	
Yellow Bullhead	incidental	X			
Yellow Perch	locally abundant	X		X	

Table 2. Channel Catfish and Flathead Catfish catch per hoop net (SE) during Minnesota River catfish assessments 2017–2022.

				Channel Catfish				Flathead Catfish		
Year	Hoop net reach	Reach description	Hoop nets	Catch rate	≥ 24 inch catch rate	≥ 28 inch catch rate		Catch rate	≥ 34 inch catch rate	≥ 40 inch catch rate
2017	A	Lac qui Parle Dam downstream to Granite Falls Dam	63	42.2 (37.9)	1.5 (2.0)	0.1 (0.2)		NA	NA	NA
2018	Flood Conditions									
2019	B	Redwood River confluence downstream to Cottonwood River confluence	107	4.8 (10.7)	1.7 (4.1)	0.6 (1.6)		1.3 (2.3)	0.5 (1.0)	0.2 (0.5)
2020	COVID-19 Pandemic									
2021	C	Carver Rapids downstream to Hwy 169 bridge	129	4.2 (5.0)	1.3 (2.4)	0.4 (0.9)		1.4 (2.4)	0.6 (1.4)	0.2 (0.6)
2022	D	Granite Falls Dam downstream to Hawk Creek confluence	102	26.1 (48.3)	1.3 (2.2)	0.5 (1.1)		1.7 (3.2)	0.7 (1.7)	0.2 (0.7)

Table 3. Index of biotic integrity (IBI) scores from Minnesota River boat electrofishing surveys 2010–2022. Asterisks indicate IBI scores between the impairment threshold and upper confidence value.

	Minnesota River			Upstream of Granite Falls Dam			Downstream of Granite Falls Dam	
Year	Stations electrofished	Mean IBI score		Stations electrofished	Mean IBI score		Stations electrofished	Mean IBI score
2010	16	60		5	56*		11	63
2011	16	62		5	64		11	61
2012	13	69		5	68		8	70
2013	16	58		5	56*		11	58
2014	16	64		5	63		11	65
2015	16	65		5	61		11	66
2016	15	60		5	57*		10	61
2017	16	61		5	52*		11	65
2018	16	64		5	53*		11	65
2019	16	71		5	68		11	72
2020	COVID-19 Pandemic							
2021	10	75		3	72		7	76
2022	14	63		4	71		9	60

Table 4. Low-frequency electrofishing catch per hour (total catch) of < 400 mm Flathead Catfish at nine sample stations during 2018–2022.

Station name	2018	2019	2021
Memorial Park	2.7 (1)		
Hazel Creek			46.7 (7)
North Redwood	3.6 (1)	0.0 (0)	
Highway 71	46.2 (10)	18.0 (3)	
Mankato			
7 Mile	56.1 (12)		
Le Sueur			
Shakopee	30.8 (5)		60.0 (10)
I-35	43.4 (10)		106.0 (18)

Table 2. Summary results from the 2022 Minnesota River angler survey (Sindt 2023a).

Species	Percent targeted	Caught per river mile	Percent of total catch	Harvested per river mile	Percent of total harvest
Channel Catfish	43	71	36	16	30
Flathead Catfish	39	6	3	1	3
Walleye (and Sauger)	23	32	17	12	23
Freshwater Drum	5	50	25	20	37
Common Carp	4	10	5	2	4
Shovelnose Sturgeon	<1	5	3	0	0

Appendix A. Seasonal movement patterns of Minnesota River Flathead Catfish.

Spring migration

During spring, Flathead Catfish leave their overwintering habitat and begin migrating upstream sometime between early April and early May when the water temperature is 50–60°F (Figure 3). Upstream migration distances range from as little as 10 miles up to 200 miles and can last several days up to two months. Upstream migrations are hypothesized as dispersal away from overwintering congregations in search of spawning and foraging habitat. Spring migrations are relatively slow, with fish traveling an average of 2–3 miles per day. In contrast, some Flathead Catfish will exhibit additional upstream migrations during early summer (late-June to early-July), covering 5-15 miles per day and lasting less than 1 week. Although most adult Flathead Catfish in the Minnesota River exhibit obvious seasonal migrations and large home ranges (50–200 miles), a subset of Flathead Catfish likely over-winter, spawn, and summer within a small area and thus exhibit relatively small home ranges (< 25 miles).

Spawning season

In the Minnesota River, Flathead Catfish generally spawn during summer when water temperature exceeds 70°F. Flathead Catfish are cavity nesters. The males select and guard secluded spawning sites—in undercut banks, hollow logs, or under rocks—where they prepare a nest by fanning out fine sediments and other debris. Females select a suitable nest and mate, and after eggs are deposited and fertilized the males defend the nest until the young hatch and disperse.

Summer

Most Flathead Catfish exhibit a relatively small home range for an extended duration (1–4 months between mid-spring and early fall) following their spring migration and prior to their fall migration. Summer home ranges are often restricted to a several mile reach of river, but some fish exhibit more frequent excursions up to 30 miles. Additionally, a subset of the Flathead Catfish migrate >30 miles downstream during late-July or early-August, which likely corresponds with the post-spawn period. Fish exhibiting late-summer migrations may be females leaving spawning habitats while males continue to guard the eggs and fry. After completing the late-summer migration, the fish again occupy a relatively small home range for 1–2 months prior to the final downstream migration to an overwintering habitat.

Fall migration

Most Flathead Catfish complete downstream migrations to overwintering habitats during October before the water temperature reaches 50°F, but some fish begin migrating as early as mid-September while some fish don’t reach their overwintering habitat until early November. Downstream migrations to overwintering habitats vary from 5 miles to more than 100 miles and can last from 1 day up to 1 month. Downstream migrations are generally faster than upstream spring migrations with fish traveling up to 25 miles per day.

Overwintering

From mid-September through October Flathead Catfish congregate in overwintering habitats where they generally remain for approximately 5 months until water temperatures begin increasing past 50°F during early-April through early-May the following spring. Flathead Catfish generally overwinter in deep holes with gentle current that have an abundance of woody debris or rocky habitat. Most Flathead Catfish overwinter within the Minnesota River, but a non-trivial

number overwinter further downstream in the Mississippi River. During the overwintering period, Flathead Catfish enter a state of hibernation—called torpor—and have been shown to exhibit almost zero movement. The large concentrations of hibernating Flathead Catfish are often likened to “stacks of cordwood”. Although many reaches of the Minnesota River contain what observationally appears to be suitable overwintering habitat, most Flathead Catfish travel large distances to congregate in very specific habitats. Currently, only five significant overwintering concentrations of Flathead Catfish have been identified in the Minnesota River along with several in the Mississippi River.

Site fidelity

Most Flathead Catfish in the Minnesota River exhibit high site fidelity, regularly returning to the same summer and overwinter habitats year after year.

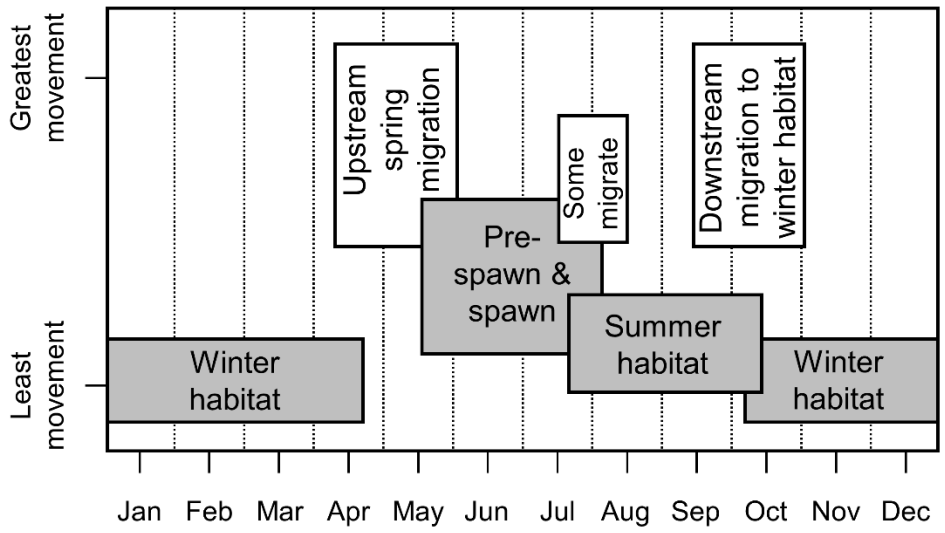

Figure 3. Conceptual diagram of Flathead Catfish movement patterns and behavior in the Minnesota River.