

INVASIVE CARP SAMPLING REPORT  
JANUARY – DECEMBER 2021  
MINNESOTA DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF FISH AND WILDLIFE  
SECTION OF FISHERIES



UPPER MISSISSIPPI RIVER, POOLS 1-9  
LOWER ST. CROIX RIVER, BELOW ST. CROIX FALLS  
MINNESOTA RIVER, BELOW GRANITE FALLS

February 22, 2022

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## Introduction

Bighead carp *Hypophthalmichthys nobilis*, Silver Carp *H. molitrix*, Grass Carp *Ctenopharyngodon idella*, and Black Carp *Mylopharyngodon piceus* (hereafter collectively referred to as invasive carp) are invasive species introduced into the United States during the early 1970's as aids in fish aquaculture operations (Henderson 1976). Large flood events allowed these species to escape into the Mississippi River drainage, where they began reproducing and spreading (Freeze and Henderson 1982). Invasive carp have migrated up the Mississippi River and adjoining tributaries, quickly establishing populations in newly invaded areas. In Minnesota, Bighead and Grass carp have been collected in the Minnesota, Mississippi, and St. Croix rivers, while Silver Carp have only been captured in the Mississippi and St. Croix rivers (Figure 1). Black Carp have never been collected in Minnesota or Wisconsin waters. Currently, there is no evidence of invasive carp reproduction in Minnesota waters.

Invasive carp can radically alter local ecosystems by competing with native planktivores and overcrowding other native species. With high fecundity and the ability to disperse great distances, invasive carp can reach substantial populations, sometimes comprising most of the fish biomass in certain systems (MICRA 2002). Bighead and Silver carp have a voracious appetite and coupled with their large size (>70 pounds), have the ability to consume large amounts of food by filtering zooplankton, phytoplankton, and organic particles out of the water column (Jennings 1988; Smith 1989; Voros 1997). If invasive carp populations establish in Minnesota, native planktivores such as Paddlefish *Polyodon spathula*, Bigmouth Buffalo *Ictiobus cyprinellus*, Gizzard Shad *Dorosoma cepedianum*, and the larval stages of many other native fishes may be in direct competition for food resources with invasive carp. Evidence from the Illinois River suggests that competition with invasive carp resulted in reduced condition factors

for Bigmouth Buffalo and Gizzard Shad (Irons et al. 2007). Worldwide, introductions of invasive carp have led to declines in fish species diversity and abundance of commercially desirable species (Spatura and Gophen 1985; Petr 2002).

With the continuing progression of invasive carp up the Mississippi River, Minnesota waters are threatened by a potential invasion. A better understanding to the current status of individual invasive carp and their populations in Minnesota will allow for more effective efforts to prevent their spread and/or eradicating them. Although standard fish sampling assessments have been ongoing in Minnesota's major rivers, and have the potential to catch invasive carp, the gear and methods used in the standard assessments are not the most efficient methods for capturing invasive carp. The purpose of this sampling effort is to use more carp-specific gear and techniques to monitor all life stages of invasive carp and associated native fishes in Minnesota waters.

## Objectives

- Detect and monitor all life stages of invasive carp to:
  - o Inform management efforts in Minnesota.
  - o Provide current information for Upper Mississippi River managers on carp population changes.
- Monitor native fish species that may be affected by the establishment of invasive carp.
- Implement innovative monitoring and removal techniques of invasive carp to increase removal efficiency.

## Sampling Sites

In the Mississippi River, invasive carp sampling occurred in approximately 200 miles of water from St. Anthony Falls Lock and Dam in Minneapolis, MN to Pool 9 near Jefferson

Township, MN on the MN-IA boarder. In the St. Croix River, effort focused on a 52-mile stretch from the dam near Taylors Falls, MN to the confluence with the Mississippi River near Prescott, WI. In the Minnesota River standard effort focused on a 48-mile stretch from Belle Plaine, MN to the confluence with the Mississippi River in St. Paul, MN.

## Sampling Methods

Sampling for invasive carp took place between January 1, 2021 and December 31, 2021.

Gear types, methods, and targeted locations were derived from personal communications with biologists who have been sampling invasive carp (V. Santucci, Illinois Department of Natural Resources, personal communication; J. Lamer, Western Illinois University, personal communication, Duane Chapman, USGS, personal communication) and conducting research on the most efficient gear to sample invasive carp (M. Diana, Illinois Natural History Survey, personal communication), literature review of sampling techniques and habitat preferences (Lohmeyer and Garvey 2009; Williamson and Garvey 2005; Dettmers et al. 2001; DeGrandchamp et al. 2007; Kolar et al. 2007; DeGrandchamp et al. 2008; Wanner and Klumb 2009; ACRCC 2012), and experience from prior field seasons.

## Commercial Fishing

Commercial anglers were contracted to target invasive carp with gill nets and seines for sampling and response efforts. Minnesota Department of Natural Resources (MNDNR) personnel accompanied contracted commercial anglers to direct sampling locations and monitor efforts. The number of fish caught by species was estimated during gill netting operations and total weight harvested was requested from the commercial anglers for both gill netting and seining operations.

## **Invasive Carp Acoustic Tagging and Tracking**

In Minnesota, Statute 84D.05, Subdivision 1 states, “A person may not possess, import, purchase, sell, propagate, transport, or introduce a prohibited invasive species.” In 2017, the legislature passed and the governor signed an amendment to this statute: *Subd. 1a. **Permit for invasive carp.** The commissioner may issue a permit to departmental divisions for tagging bighead, black, grass, or silver carp for research or control. Under the permit, the carp may be released into the water body from which the carp was captured.* As part of the permitting process, MNDNR fisheries developed a protocol to characterize and minimize potential risk while maximizing the amount of information gained. For further information regarding the tagging and tracking procedures, please see the permit issued by the Minnesota Department of Natural Resource’s Division of Ecological and Water Resources.

The MNDNR was permitted to tag invasive carp on a fish by fish basis with acoustic transmitters. The MNDNR utilized both passive telemetry (a stationary receiver array already in place) and active tracking (using a portable receiver) to determine preferred habitats, longitudinal movement patterns, depth preferences, and specific locations for capture efforts.

There are 80 stationary receivers placed throughout the state of Minnesota. They are located on the Mississippi River above the Coon Rapids Dam to Lock and Dam #5, on the St Croix River from the Mississippi River confluence at Prescott, WI to Taylor’s Falls, and on the Minnesota River from the Mississippi River confluence to the County Road 6 bridge north of Delhi, MN (river mile 209). Sixty-one receivers are maintained by the East Metro fisheries office, nine are maintained in the Minnesota River by the Hutchinson fisheries office (from river mile 18.7 to river mile 209), and ten are maintained by the Lake City office in the Chippewa River and Pools 4 and 5 of the Mississippi River. In addition, the U.S. Fish and Wildlife Service

maintains seven receivers in Minnesota waters and 47 additional receivers that extend downstream to Pool 19 near Keokuk, IA. Additional receivers are maintained outside of Minnesota that include, but are not limited to, 11 receivers maintained by the Missouri Department of Conservation from Pool 19 to the confluence with the Ohio River.

By tracking tagged invasive carp, we expect to capture additional invasive carp if they are present. Recapture actions will continue to be taken, including the use of commercial anglers, when tagged fish are in jeopardy of being un-trackable due to tag life nearing completion, leaving the passive array network, or to support removal of other conspecifics. The MNDNR will take all reasonable measures to ensure all tagged fish are tracked and their locations known through active tracking and an extensive passive tracking network.

The impacts of releasing wild-caught invasive carp back into the wild have been considered and are believed to be minimal when compared to the potential information gained from this project. As outlined in this report, MNDNR maintains an extensive monitoring and removal program to ensure populations are adequately sampled and document if reproduction is occurring in Minnesota waters to provide accurate information for Upper Mississippi River managers on carp population changes in the present front. MNDNR is strategic in both the species and locations where tagged invasive carp are released, so as to maximize the information we gain through their tracking. Most captured invasive carp are removed and euthanized.

Based on the tagging results, MNDNR staff have gained a better understanding of movement patterns and habitat preferences, while posing a very low risk to native fish populations or risk of increasing invasive carp populations. Other states have already begun work of this nature in riverine environments and have shown significant results and ability to remove



additional fish with this tagging method. This information will help to improve sampling and removal efforts.

### **Larval Trawling**

Larval trawling was conducted during the 2021 field season. Sampling was conducted in Pool 8 of the Mississippi River. Trawls were conducted on a weekly basis from May-August. Each day of sampling, 12 trawls would be pulled for 5 minutes per trawl 15-20 minutes apart. The samples were then put into plastic containers and transported back to the lab at the East Metro Fisheries office. Fisheries Biologists would then drain the water and put in 10% buffered formalin for 24-48 hours in order to preserve the contents of the trawl. After 24-48 hours the formalin was drained and preserved in Alcohol until the contents could be sorted through for larval fish and eggs in the winter months. Once sorted, the larval eggs and fish will be professionally identified by an outside vendor. That data has not been processed yet, but historic data can be found in Table 3. Sampling locations can be found in Figures 2, 3 & 4.

### **Electrofishing**

Electrofishing occurred in a variety of habitats including backwaters, side channels, main channel borders, and over wing dikes. Sampling locations consisted of eight standardized sampling locations in Pool 2 (Figure 2), the St. Croix River (Figure 3) and Minnesota River (Figure 5), and all other sampling events occurred at non-standardized locations in the aforementioned habitats at the discretion of the sampler. Standardized electrofishing sampling locations were selected based on habitats invasive carp are likely to occupy. Sites averaged 1137 seconds of on-time. At these set sampling locations, all observed fish were collected, identified, measured and weighed. If positive identification was not possible, voucher specimens were kept,

labeled, and preserved in 90% ethanol for later identification. At non-standardized sampling sites, fish were identified in the water and only invasive carp were collected. This reduced unnecessary processing time and allowed for greater sampling effort. Sampling site locations, sampling dates, gear description, effort, habitat type (main channel border, backwater, wing dike, etc.), water depth, and crew details were recorded for each electrofishing run.

### **Seining**

A small 35-foot seine was used to sample shallow water habitats for young fish from July through August on the St. Croix River with 3 seine hauls completed over 1 day. The seine measure 35 ft. long and 6 ft. deep with 3 ft. square bag (3 ft. x 3 ft. x 3 ft.) located at the center of the net, consisting of a knotless "Ace"-type nylon netting 1/8 in. mesh, with a mudline. No invasive carp were captured during 2021 using the shallow seine.

### **Fish Acoustic Tagging Efforts**

Several species of fish in the Mississippi River Pool 2 and the St. Croix River have been tagged according to study guidelines as part of tagging studies. These species included Flathead Catfish *Pylodictis olivaris*, Channel Catfish *Ictalurus punctatus*, Smallmouth Buffalo *Ictiobus bubalus*, and Bigmouth Buffalo in Pool 2. In the St. Croix River, Lake Sturgeon *Acipenser fulvescens*, Muskellunge *Esox masquinongy*, White Bass *Morone chrysops*, Flathead Catfish, and Channel Catfish have been tagged. In both Pool 2 and the St. Croix River, Paddlefish have also been tagged.

### **Gill and Trammel Netting**

Gill netting and trammel netting occurred during multiple sampling events on each system. Large mesh gill nets of depths from 8 to 24 feet and lengths of 150 to 300 feet with bar mesh sizes of 4 to 6 inches were used to target adult invasive carp. Nets were set either short-term or overnight, with short-term sets favored when water temperatures were greater than 60° F. All fish caught were identified.

## Results and Discussion

### Sampling Results

In total, 79 days were spent sampling between January and December 2021 on the Mississippi River Pools 2, 3, 4, 5, 6, 7 and 8, and the Minnesota and St. Croix rivers with gear appropriate for sampling invasive carp (Table 1; Figure 6). A greater amount of effort was focused on Pool 8 in 2021. In early April 2021 we conducted a weeklong multi-agency netting effort in Pool 8 called the Modified Unified Method or MUM. During the Spring MUM 33 Silver Carp were caught. Follow-up sampling was conducted by a contracted commercial angler in Pool 8. Six additional invasive carp were caught during the spring in Pool 8. Capture data and response actions were shared with multiple agencies including the Wisconsin Department of Natural Resources, USGS, and Western Illinois University.

Intensive fall sampling occurred in Pool 8 of the Mississippi River including an additional MUM. Fall sampling resulted in the capture of a total of 13 Silver Carp. These fish were caught by contracted commercial anglers in back waters and side channels. Capture data and response actions were shared with multiple agencies including the Wisconsin Department of Natural Resources, USGS, and Western Illinois University. A total of 71 invasive carp were caught in Minnesota waters and Minnesota-Wisconsin boundary waters in 2021 (Table 2).

Contracted commercial anglers were hired to use large mesh gill nets and seines to sample in the Mississippi River in Pools 2, 3, 4, 5, 6, 7, and 8, and in the St. Croix River from Andersen Bay in Bayport to the confluence with the Mississippi River near Prescott, WI. Contracted commercial anglers set approximately 19,100 feet of gill nets during 29 days of effort and conducted 72 seine hauls between January and December 2021. Gill nets were set short term (2-3 hours) and fish were chased towards the net with boats, typically in large backwater areas. In 2021, nine regular commercial fishing operations were also monitored for the presence of invasive carp.

Both random and standardized electrofishing sampling was conducted on Pool 2 of the Mississippi, the Minnesota and the St. Croix rivers. A total of 1,048 minutes of “on time” over 19 days was spent electrofishing between January and December 2021. In 2021, sixteen standardized electrofishing sites were sampled once, for a total of 303 minutes. Random electrofishing was used to monitor for invasive carp.

Gill nets set by MNDNR personnel were often used to sample behind wing dikes and in smaller side channel and backwater areas where it wasn’t feasible for commercial anglers to target with their larger operations. In 2021, a total of 3,450 feet of gill net were set in Pool 2 over two days, with most net sets being short-term sets (2-5 hours). In 2021, no invasive carp were captured during routine gill netting operations, seining or electrofishing.

Although no new species were added to the list in 2021, numerous unique or rare native fishes were encountered during these sampling events. A complete species list of species caught and observed on Pools 2, 3, and 4, the Minnesota River and the St. Croix River, from January 2013 through December 2021, has been compiled (Table 4).

Determining if invasive carp captured in Minnesota are pioneering individuals or are indicative of established populations is a key question for MNDNR managers. While it is likely there are additional invasive carp present in Minnesota's monitored rivers based on the previously mentioned captures of larger congregations of fish, the degree to which invasive carp populations have change is unclear. The increase in captures could be attributed to a successful year class migrating upstream during extended periods of high water in 2019, but it remains to be seen what the implications will be for the future abundance of invasive carp in Minnesota waters.

### **Invasive Carp Acoustic Tagging and Tracking**

On July 28, 2017 during routine monitoring at the Allen S. King Plant on the St. Croix River, a Bighead Carp was caught by MNDNR staff in a large mesh gill net. The fish was then tagged using a VEMCO V16TP-6H (VEMCO Ltd., Nova Scotia, 69 kHz) coded acoustic transmitter containing sensors to measure pressure (depth) and temperature, transmitting every 60 seconds on average (minimum transmission delay of 30 seconds, maximum delay of 90 seconds) and released. This fish was actively tracked using a VEMCO VR100 every day for a week after release, followed by actively locating the fish once a week every week until September 5, 2017. After September 5, 2017 the fish was located routinely until the last day in the field on November 20, 2017. In 2018, the fish was routinely tracked except when found in areas where sampling was too difficult, at which time tracking resumed within two weeks to ensure the fish did not make large-scale movements or leave the St. Croix River. In addition, this fish was routinely identified and data recorded by the passive VEMCO VR2W receiver array in place, with the last VR2W downloaded on October 20, 2020. The last detection using active tracking with the VR100 occurred on November 6, 2020 (Figure 7). Since the fish was tagged,

we have received an average of 15,000 data points per month with a total of 585,093 data points from July 28, 2017 to October 20, 2020.

This fish was observed on the St. Croix River to range over an extent of 23.3 river miles from Stillwater, MN to the confluence with Pool 3 of the Mississippi River. The tagged fish did not travel into Pool 3 of the Mississippi River in 2020, unlike the last two open-water seasons (Figure 7). In 2018 and 2019, runs downstream coincided with a spike in the hydrograph at Lock & Dam #3 in Hastings, MN. In 2020, the spike in the hydrograph occurred early in the season when temperatures were low (Figure 8) compared to previous years, where spikes coincided with a downstream migration when water temperatures were higher. Over the course of its third field season, the tagged carp continued showing site fidelity within the St. Croix River. In general, the tagged Bighead Carp remained between the Interstate 94 Bridge and Afton, MN (here after referred to as the Lakeland area) from August to April. The tagged fish returned to the King Plant in Bayport, MN and continued upstream to Stillwater, MN in the spring and early summer. The fish then returned downstream to the Lakeland area.

According to temperature and depth data, this fish comes to the water's surface often, inhabits a wider range of depths (0 to 68.6 feet) than believed (Figure 9), and tolerates temperatures ranging from 33 to 88 degrees Fahrenheit (Figure 10). (See MNDNR 2018, MNDNR 2019, and MNDNR 2020 for data collected from the previous three field seasons.) In 2020, due to the Covid-19 pandemic there were no direct recapture efforts during the field season.

From our tagged invasive carp, we have learned of additional areas where this fish has resided for prolonged periods of time, including an overwintering site in the Lakeland area. Therefore, additional VR2Tx receivers were added in the fall of 2020 to the Lakeland area to

investigate how the tagged fish uses the bathymetry in the area for overwintering and feeding, while learning about additional environmental preferences to further inform sampling efforts. Based on information from other areas tracking carp and historic sightings in Minnesota, the hypothesis was this fish would inhabit the King Plant discharge periodically with forays to Lake St. Croix and overwinter near a natural point where flow is constricted on the river (most likely Point Douglas, near Prescott, WI). Based on tracking data, the fish was never observed within the King Plant discharge despite continued monitoring within the discharge. Data from the real-time receiver and main channel receivers showed the tagged carp inhabited the mouth of the King Plant discharge as well as an adjacent bay for several weeks during the spring. Over nearly three full field seasons, the fish has exhibited some site fidelity, inhabiting several key locations for prolonged periods of time.

On May 26, 2020, a Silver Carp was captured in Anderson Bay on the St. Croix River in a contracted commercial gill net. Although the tagged Bighead Carp was not in the bay at the time of the capture, this capture event provides additional habitat information from the tagged fish. The reason that sampling took place at that location and time was because of past movement patterns of our tagged fish. This capture is one of many examples how the tagged Bighead Carp aided in the removal of additional conspecifics.

During the fall of 2020, six Silver Carp were captured in Pool 8 of the Mississippi River, and five of the Silver Carp were tagged and released near the capture site. The three fish tagged on October 13, 2020 were captured by gillnet in a backwater bay, 1.35 miles downstream of Lock & Dam #7. The Silver Carp were released in an adjacent bay, 0.68 miles from the original capture location. The fish were tracked every day for 5 days. One of the fish stayed in the release bay for 4 days then returned to the capture bay, while the other two fish remained in the release

bay for 2 days before traveling downstream to the east of Taylor Island. On October 21<sup>st</sup>, one Silver Carp was captured in Bluff Slough, south of the 7<sup>th</sup> Street landing in La Crosse, WI and was tagged and released at the capture site. The fish stayed in the slough through the first five days of tracking. Additional sampling in Bluff Slough on October 23<sup>rd</sup> resulted in the capture of one additional Silver Carp, which was tagged and released. Crews tracked the fish for 5 consecutive days, the fish remained in Bluff Slough during that time (Figure 11).

During the 2021 field season MNDNR personnel were unable to tag any additional invasive carp. Previously tagged invasive carp were continued to be tracked such as the Bighead Carp in the St. Croix River and the tagged Silver Carp in Pool 8. The tagged Bighead Carp in the St. Croix River showed similar movements to years past. Capture attempts were set in motion during May of 2021 but the low water led to less use by the tagged Bighead Carp.

Of the 5 Silver Carp tagged, only one was found during passive and active tracking in 2021 and that fish was in Pool 8 but never in a vulnerable location for capture. Movement data is still being collected and processed for that fish.

The tagged Bighead Carp was vital in the capture of two Bighead Carp in 2018, four additional invasive carp in 2019, one Silver Carp in 2020, and none in 2021. Without tracking information from the tagged carp, MNDNR personnel would not have fished certain location over the last three years. From previous captures and the understanding of invasive carp movements and biology, MNDNR had focused efforts on relatively few areas (e.g. the Allen S. King Plant, Andersen Bay, and Point Douglas on the St. Croix River), with sporadic sampling in areas considered less suitable to invasive carp. While the data collected only represents the movements of one individual, areas that were considered less suitable may be frequented as often as areas of primary focus in previous years. Because this tagged fish has shown relatively large



movements and has inhabited confined areas suitable for complete sampling for short periods of time, timing of sampling is critical for effective management and removal. The ability to track a tagged individual will allow biologist to better understand additional habitat preferences and the duration of residence preferences.

Tracking methods and field sampling will be adjusted accordingly for 2022. MNDNR staff will continue to track tagged fish while analyzing the data to increase sampling and removal efficiencies.

## Recommendations

Continued monitoring and removal of invasive carp from Minnesota waters is recommended. This project is funded in part by the current Minnesota Environment and Natural Resources Trust Fund grant through June, 2024. We recommend this project continue beyond that grant to ensure invasive carp do not establish spawning populations and adequately document the effects of invasive carp to native fish populations.

Paddlefish are a native planktivore that may compete for food resources with invasive carp. Currently, Paddlefish are a threatened species in Minnesota and populations across their range have suffered due to commercial navigation projects (that impede movement and alter habitats), pollution, and overexploitation (Jennings and Zigler 2000). If invasive carp become established in Minnesota rivers, local Paddlefish populations could be further stressed. Non-lethal means of studying Paddlefish populations are recommended, including continued tagging of encountered Paddlefish using jaw and acoustic tags. Tagging and releasing Paddlefish will inform biologists of their populations and life history, as well as provide a population estimate for management purposes. MNDNR should increase effort to encourage boaters to report any

deceased Paddlefish for age and growth analysis. Other MNDNR offices should collect all deceased Paddlefish for analysis.

## Acknowledgements

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## Tables

**Table 1. Invasive Carp sampling summary for the Mississippi River Pools 2, 3, 5, 6, 7 and 8 and the St. Croix and Minnesota Rivers for January through December 2021. Number of Invasive Carp Captured represents the number of individuals caught by MNDNR, contracted commercial anglers, or monitored commercial fishing.**

Invasive Carp Sampling Summary January – December 2021			Days
<b>Random Sampling Effort</b>			
<b>Gill/Trammel Netting</b>	3,450	feet	2
<b>Electrofishing</b>	744	minutes	11
<b>Small Seine</b>	3	Hauls	1
<b>Standardized Sampling Effort</b>			
<b>Electrofishing</b>	303	minutes	12
<b>Larval Trawl</b>	108	Hauls	
<b>Targeted Commercial Fishing Effort</b>			
<b>Gill Netting</b>	19,100	feet	9
<b>Seining</b>	72	hauls	43
<b>Monitored Commercial Fishing Effort</b>			
<b>Seining</b>	9	hauls	9
<b>Tracking*</b>			
<b>2-person crew</b>	70.5	hours	
<b>Number of Invasive Carp Captured</b>			
	71	fish	
<b>Total Number of Days Sampled</b>			79

\*Does not include tracking by real-time receivers (MNDNR, USFWS) in the St. Croix River and Pool 8.

**Table 2. Invasive Carp caught from January through December 2021 in Minnesota and Wisconsin boundary waters.**

Date	Species	Water Body	Location	State	Length (mm)	Weight (grams)	Sex	Maturity	Capture Method	Captured By
3/5/2021	Silver Carp	Mississippi River	Pool 8	WI	721	3914	Male	Mature	Monitored Comm. Seine	Commercial Angler
3/14/2021	Silver Carp	Lake Bella Outlet	Nobles County	MN	624	2400	Male	Mature	Winterkill	MN DNR Windom
3/14/2021	Silver Carp	Lake Bella Outlet	Nobles County	MN	600	1800	Male	Mature	Winterkill	MN DNR Windom
3/14/2021	Silver Carp	Lake Bella Outlet	Nobles County	MN	666	2690	Female	Mature	Winterkill	MN DNR Windom
3/14/2021	Silver Carp	Lake Bella Outlet	Nobles County	MN	611	2405	Male	Mature	Winterkill	MN DNR Windom
3/14/2021	Silver Carp	Lake Bella Outlet	Nobles County	MN	572	1502	Male	Mature	Winterkill	MN DNR Windom
3/14/2021	Silver Carp	Lake Bella Outlet	Nobles County	MN	605	--	--	Mature	Winterkill	MN DNR Windom
3/16/2021	Silver Carp	Mississippi River	Pool 8	WI	723	5050	Male	Mature	Commercial Seine	Commercial Angler
3/18/2021	Silver Carp	Mississippi River	Pool 8	WI	729	4150	Male	Mature	Commercial Seine	Commercial Angler
3/18/2021	Silver Carp	Mississippi River	Pool 8	WI	768	5990	Female	Mature	Commercial Seine	Commercial Angler
3/18/2021	Silver Carp	Mississippi River	Pool 8	WI	756	4921	Male	Mature	Commercial Seine	Commercial Angler
3/18/2021	Silver Carp	Mississippi River	Pool 8	WI	759	4572	Male	Mature	Commercial Seine	Commercial Angler
3/21/2021	Silver Carp	Mississippi River	Pool 8	WI	763	5350	Male	Mature	Commercial Seine	Commercial Angler
3/21/2021	Hyb Silver-Bighead	Mississippi River	Pool 8	WI	777	6020	Female	Mature	Commercial Seine	Commercial Angler
3/21/2021	Silver Carp	Mississippi River	Pool 8	WI	783	4963	Male	Mature	Commercial Seine	Commercial Angler
3/21/2021	Hyb Silver-Bighead	Mississippi River	Pool 8	WI	720	4009	Male	Mature	Commercial Seine	Commercial Angler
3/21/2021	Silver Carp	Mississippi River	Pool 8	WI	755	4827	Male	Mature	Commercial Seine	Commercial Angler
3/21/2021	Silver Carp	Mississippi River	Pool 8	WI	730	3883	Male	Mature	Commercial Seine	Commercial Angler

**Table 2 (continued). Invasive Carp caught from January through December 2021 in Minnesota and Wisconsin boundary waters.**

<b>Date</b>	<b>Species</b>	<b>Water Body</b>	<b>Location</b>	<b>State</b>	<b>Length (mm)</b>	<b>Weight (grams)</b>	<b>Sex</b>	<b>Maturity</b>	<b>Capture Method</b>	<b>Captured By</b>
<b>3/21/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	750	4665	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	813	6570	Female	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	755	4349	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	800	6905	Female	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	771	5414	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	717	3963	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	771	6806	Female	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	766	4600	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	761	4796	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	760	5084	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	735	4472	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	760	4884	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	769	6413	Female	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	758	5337	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	766	5085	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	777	5002	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	742	5321	Female	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	779	4981	Male	Immature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	757	5263	Male	Mature	Commercial Seine	Commercial Angler

**Table 2 (continued). Invasive Carp caught from January through December 2021 in Minnesota and Wisconsin boundary waters.**

<b>Date</b>	<b>Species</b>	<b>Water Body</b>	<b>Location</b>	<b>State</b>	<b>Length (mm)</b>	<b>Weight (grams)</b>	<b>Sex</b>	<b>Maturity</b>	<b>Capture Method</b>	<b>Captured By</b>
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	770	4620	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	741	4403	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	823	8337	Female	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	726	3971	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	724	4111	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	765	4684	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	742	4705	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	735	5122	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	794	7297	Female	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	724	4124	Male	Mature	Commercial Seine	Commercial Angler
<b>4/7/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	735	4770	Male	Mature	Commercial Seine	Commercial Angler
<b>4/9/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	775	4615	Male	Mature	Commercial Seine	Commercial Angler
<b>4/9/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	815	6579	Female	Mature	Commercial Seine	Commercial Angler
<b>4/15/2021</b>	Silver Carp	St. Croix River	Pt. Douglas	MN	761	6000	Female	Mature	Commercial Seine	Commercial Angler
<b>4/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	773	4857	Male	Mature	Commercial Seine	Commercial Angler
<b>4/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	721	4275	Male	Mature	Commercial Seine	Commercial Angler



**Table 2 (continued). Invasive Carp caught from January through December 2021 in Minnesota and Wisconsin boundary waters.**

<b>Date</b>	<b>Species</b>	<b>Water Body</b>	<b>Location</b>	<b>State</b>	<b>Length (mm)</b>	<b>Weight (grams)</b>	<b>Sex</b>	<b>Maturity</b>	<b>Capture Method</b>	<b>Captured By</b>
<b>4/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	822	7582	Female	Mature	Seine	MNDNR
<b>5/11/2021</b>	Grass Carp	Mississippi River	Pool 8	WI	868	7400	Female	Mature	Seine	MNDNR
<b>5/11/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	840	8445	Female	Mature	Seine	MNDNR
<b>9/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Seine	MNDNR
<b>9/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Seine	MNDNR
<b>9/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Seine	MNDNR
<b>9/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Seine	MNDNR
<b>9/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Seine	MNDNR
<b>9/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Seine	MNDNR
<b>9/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Seine	MNDNR
<b>9/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Seine	MNDNR
<b>9/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Seine	MNDNR
<b>9/15/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Seine	MNDNR
<b>9/23/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	890	10420	Female	Mature	Seine	MNDNR
<b>12/2/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Commercial Seine	Commercial Angler
<b>12/2/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Commercial Seine	Commercial Angler
<b>12/2/2021</b>	Silver Carp	Mississippi River	Pool 8	WI	--	--	--	--	Commercial Seine	Commercial Angler

"--" indicates missing or unavailable data at time of report.

**Table 3. Larval trawl sampling for the St. Croix and Mississippi Rivers from 2013 to 2021.**

<i>Year</i>	<b>Number of Sites</b>		<b>Total number of Samples</b>		<b>Number of Samples with Larval Fish</b>		<b>Number of Larval Invasive carp</b>	
	<i>St. Croix River</i>	<i>Mississippi River</i>	<i>St. Croix River</i>	<i>Mississippi River</i>	<i>St. Croix River</i>	<i>Mississippi River</i>	<i>St. Croix River</i>	<i>Mississippi River</i>
2013	8	8	16	28	6	16	0	0
2014	9	13	28	44	17	28	0	0
2015	8	18	52	253	23	139	0	0
2016	9	16	46	102	25	83	0	0
2017	7	17	20	73	20	73	0	0
2018	8	8	66	68	37	44	0	0
2019	2	4	52	100	37	64	0	0
2020	0	0	0	0	0	0	0	0
2021	0	1	0	108	0	~11	0	--

--Pending results

**Table 4. Species list for the Minnesota, St. Croix and Mississippi (Pool 2, Pool 3 and Pool 4) Rivers from January 2013 through December 2021, including 89 native and invasive species.**

Common Name	Genus Species	Pool 2	Pool 3	Pool 4	St. Croix River	Minnesota River
American Eel	<i>Anguilla rostrata</i>	x				
Bighead Carp	<i>Hypophthalmichthys nobilis</i>	x	x		x	x
Bigmouth Buffalo	<i>Ictiobus cyprinellus</i>	x	x	x	x	x
Bigmouth Shiner	<i>Notropis dorsalis</i>	x				
Black Buffalo	<i>Ictiobus niger</i>	x				
Black Bullhead	<i>Ameiurus melas</i>				x	
Black Crappie	<i>Pomoxis nigromaculatus</i>	x	x		x	x
Black Redhorse	<i>Maoxostoma duquesnei</i>				x	
Blackchin Shiner	<i>Notropis heterodon</i>				x	
Blacknose Shiner	<i>Notropis heterolepis</i>	x				
Blackside Darter	<i>Percina maculata</i>	x			x	
Blue Sucker	<i>Cycleptus elongatus</i>	x			x	x
Bluegill	<i>Lepomis macrochirus</i>	x			x	x
Bluntnose Minnow	<i>Pimephales notatus</i>	x			x	
Bowfin	<i>Amia calva</i>	x		x	x	x
Brassy Minnow	<i>Hybognathus hankinsoni</i>				x	
Brook Silverside	<i>Labidesthes sicculus</i>	x			x	
Brook Stickleback	<i>Culaea inconstans</i>	x				
Brown Trout	<i>Salmo trutta</i>				x	
Bullhead Minnow	<i>Pimephales vigilax</i>	x				
Burbot	<i>Lota lota</i>				x	
Central Mudminnow	<i>Umbra limi</i>	x				
Central Stoneroller	<i>Campostoma anomalum</i>				x	
Channel Catfish	<i>Ictalurus punctatus</i>	x		x	x	x
Channel Shiner	<i>Notropis wickliffi</i>	x				
Common Carp	<i>Cyprinus carpio</i>	x	x	x	x	x
Common Shiner	<i>Luxilus cornutus</i>	x			x	
Creek Chub	<i>Semotilus atromaculatus</i>	x				
Crystal Darter	<i>Crystallaria asprella</i>				x	
Emerald Shiner	<i>Notropis atherinoides</i>	x	x		x	x
Fathead Minnow	<i>Pimephales promelas</i>	x			x	x
Flathead Catfish	<i>Pylodictis olivaris</i>	x	x	x	x	x
Freshwater Drum	<i>Aplodinotus grunniens</i>	x	x	x	x	x
Gilt Darter	<i>Percina evides</i>				x	
Gizzard Shad	<i>Dorosoma cepedianum</i>	x	x		x	x
Golden Redhorse	<i>Moxostoma erythrurum</i>	x			x	x
Golden Shiner	<i>Notemigonus crysoleucas</i>	x			x	
Goldeye	<i>Hiodon alosoides</i>	x	x			x
Grass Carp	<i>Ctenopharyngodon idella</i>	x				
Greater Redhorse	<i>Moxostoma valenciennesi</i>	x			x	
Green Sunfish	<i>Lepomis cyanellus</i>	x			x	x
Highfin Carpsucker	<i>Carpiodes velifer</i>	x			x	x
Hornyhead Chub	<i>Nocomis biguttatus</i>	x			x	
Hybrid Sunfish	<i>Lepomis microlophus</i> x <i>L.</i>	x			x	
Iowa Darter	<i>Etheostoma exile</i>				x	
Johnny Darter	<i>Etheostoma nigrum</i>	x			x	
Lake Sturgeon	<i>Acipenser fulvescens</i>	x	x	x	x	
Largemouth Bass	<i>Micropterus salmoides</i>	x			x	x
Logperch	<i>Percina caprodes</i>	x			x	
Longnose Gar	<i>Lepisosteus osseus</i>	x	x		x	x
Mimic Shiner	<i>Notropis volucellus</i>	x			x	
Mooneye	<i>Hiodon tergisus</i>	x			x	x
Muskellunge	<i>Esox masquinongy</i>	x			x	
Northern Hogsucker	<i>Hypentelium nigricans</i>				x	
Northern Pike	<i>Esox lucius</i>	x	x	x	x	x
Orangespotted Sunfish	<i>Lepomis humilis</i>	x			x	
Paddlefish	<i>Polyodon spathula</i>	x	x	x	x	x

**Table 4 (continued). Species list for the Minnesota, St. Croix and Mississippi (Pool 2, Pool 3 and Pool 4) Rivers from January 2013 through December 2021, including 89 native and invasive species.**

Common Name	Genus Species	Pool 2	Pool 3	Pool 4	St. Croix River	Minnesota River
Pumpkinseed	<i>Lepomis gibbosus</i>	x			x	
Quillback	<i>Carpionodes cyprinus</i>	x	x		x	x
Rainbow Darter	<i>Etheostoma caeruleum</i>				x	
River Carpsucker	<i>Carpionodes carpio</i>	x	x	x	x	x
River Darter	<i>Percina shumardi</i>	x			x	
River Redhorse	<i>Moxostoma carinatum</i>	x			x	
Rock Bass	<i>Ambloplites rupestris</i>	x	x		x	
Sand Shiner	<i>Notropis stramineus</i>	x			x	x
Sauger	<i>Sander canadensis</i>	x	x		x	x
Shoal Chub	<i>Macrhybopsis hyostoma</i>	x				
Shorthead Redhorse	<i>Moxostoma macrolepidotum</i>	x	x	x	x	x
Shortnose Gar/Smallmouth	<i>Lepisosteus platostomus</i>	x	x		x	x
Silver Carp	<i>Hypophthalmichthys molitrix</i>	x		x	x	
Silver Chub	<i>Macrhybopsis storeriana</i>	x			x	
Silver Lamprey	<i>Ichthyomyzon unicuspis</i>	x			x	
Silver Redhorse	<i>Moxostoma anisurum</i>	x	x		x	x
Skipjack Herring	<i>Alosa chrysochloris</i>	x				
Slenderhead Darter	<i>Percina phoxocephala</i>	x			x	
Smallmouth Bass	<i>Micropterus dolomieu</i>	x		x	x	x
Smallmouth Buffalo	<i>Ictiobus bubalus</i>	x	x	x	x	x
Spotfin Shiner	<i>Cyprinella spiloptera</i>	x			x	x
Spottail Shiner	<i>Notropis hudsonius</i>	x			x	x
Spotted Sucker	<i>Minytrema melanops</i>	x			x	
Tadpole Madtom	<i>Noturus gyrinus</i>	x				
Trout Perch	<i>Percopsis omiscomaycus</i>	x			x	
Walleye	<i>Sander vitreus</i>	x	x	x	x	x
Weed Shiner	<i>Notropis texanus</i>	x				
White Bass	<i>Morone chrysops</i>	x	x		x	x
White Crappie	<i>Pomoxis annularis</i>	x			x	x
White Sucker	<i>Catostomus commersonii</i>	x			x	x
Yellow Bullhead	<i>Ameiurus natalis</i>	x				
Yellow Perch	<i>Perca flavescens</i>	x			x	

## Figures

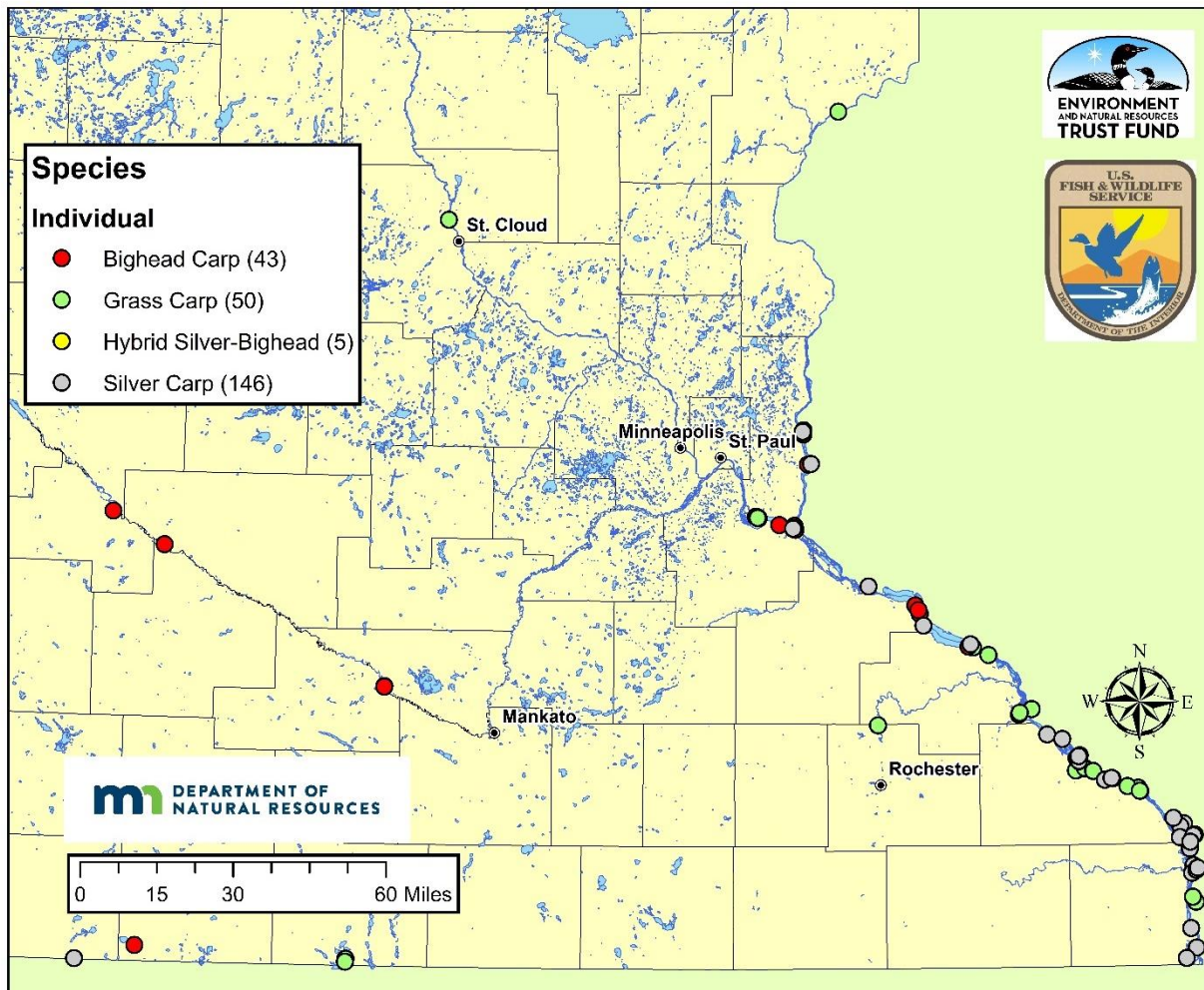
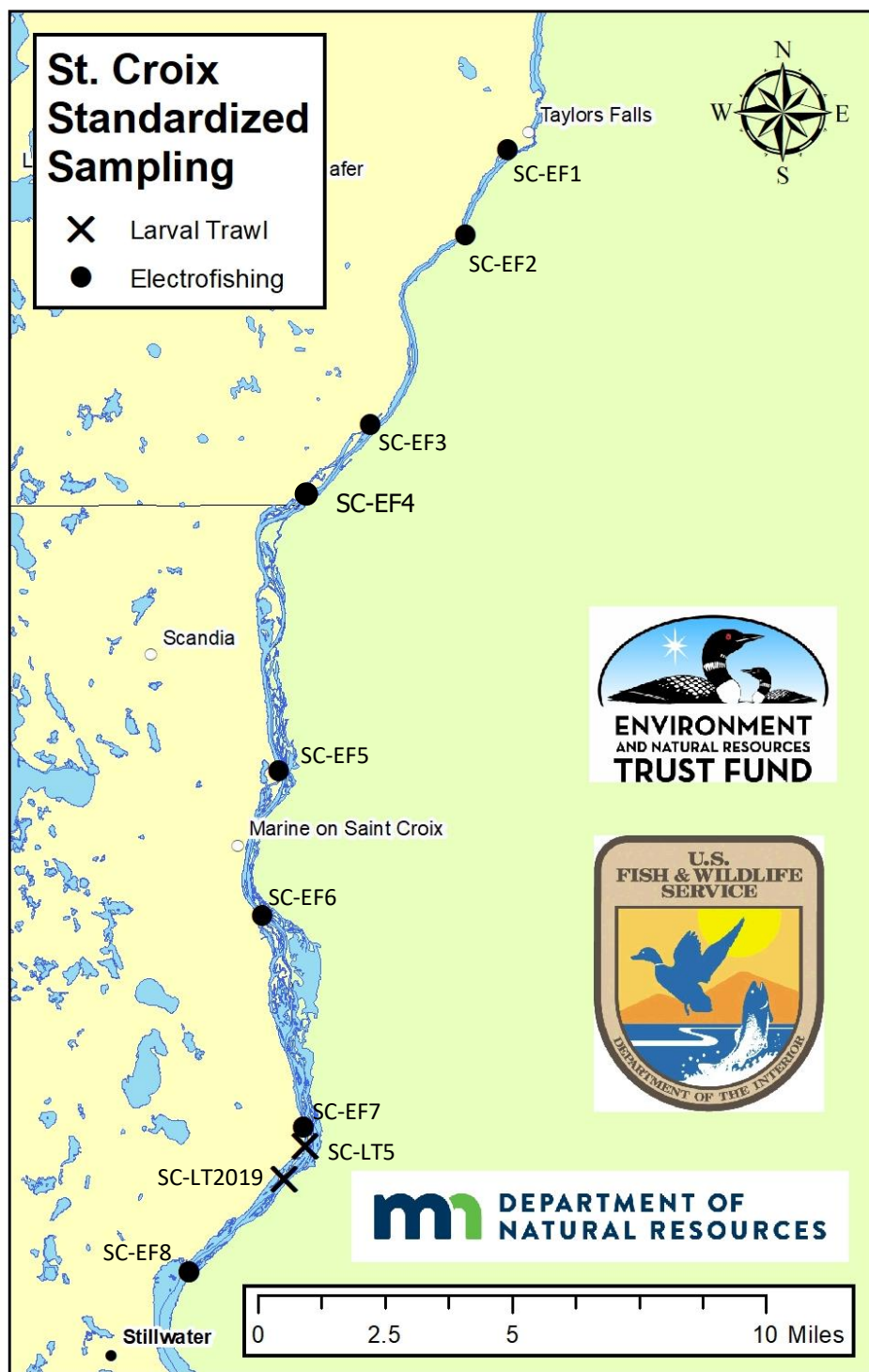


Figure 1. Locations of all known invasive carp captured in Minnesota waters through 2021.

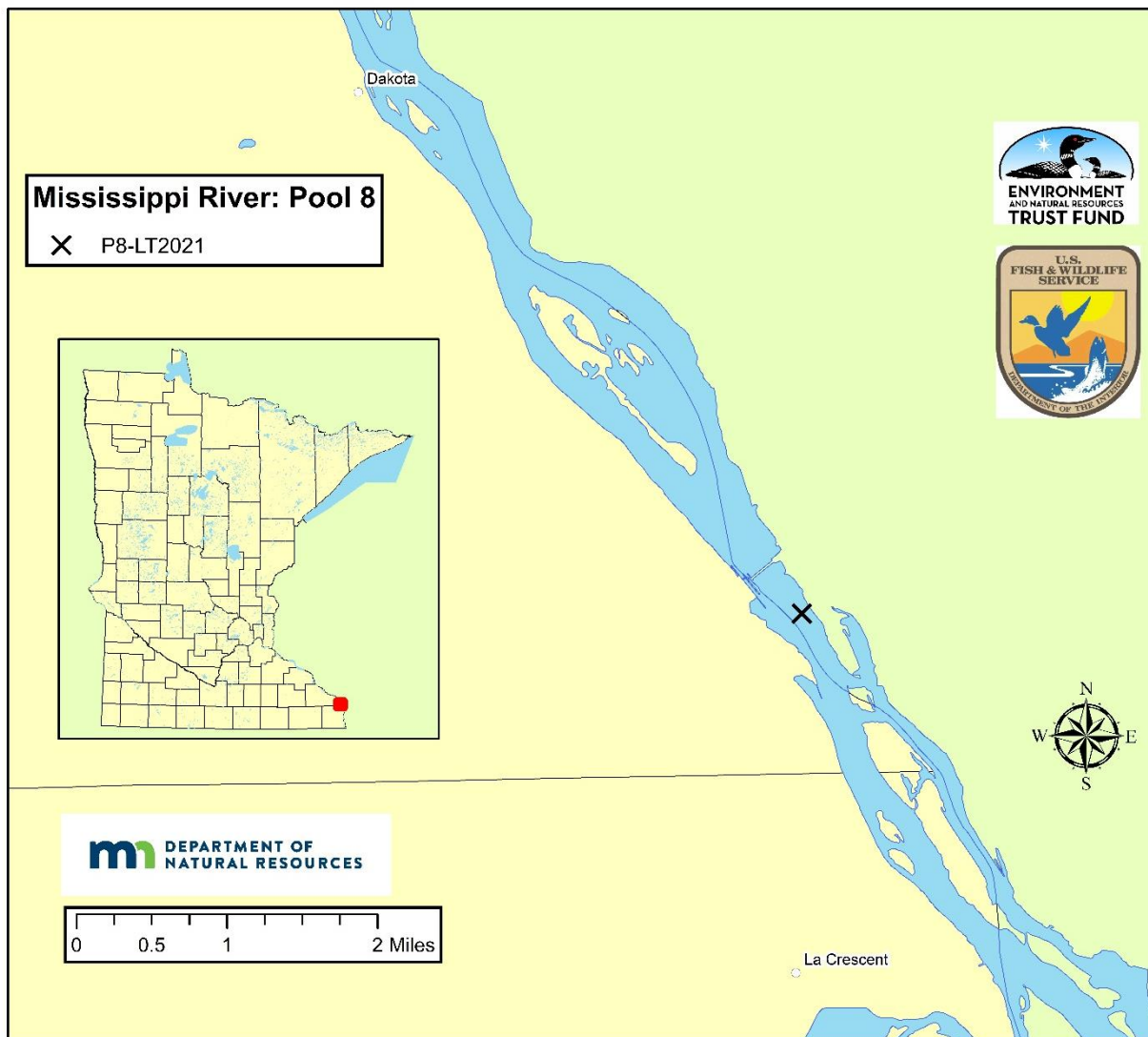


**Figure 2. Standardized electrofishing (dark circle, EF1 – EF8) and larval fish trawling (dark cross, P2-LT6 and P2-LT2019) locations on Pool 2 (P2) and larval fish trawling (dark cross, P3-LT4 and P3-LT2019) locations on Pool 3 (P3) of the Mississippi River.**



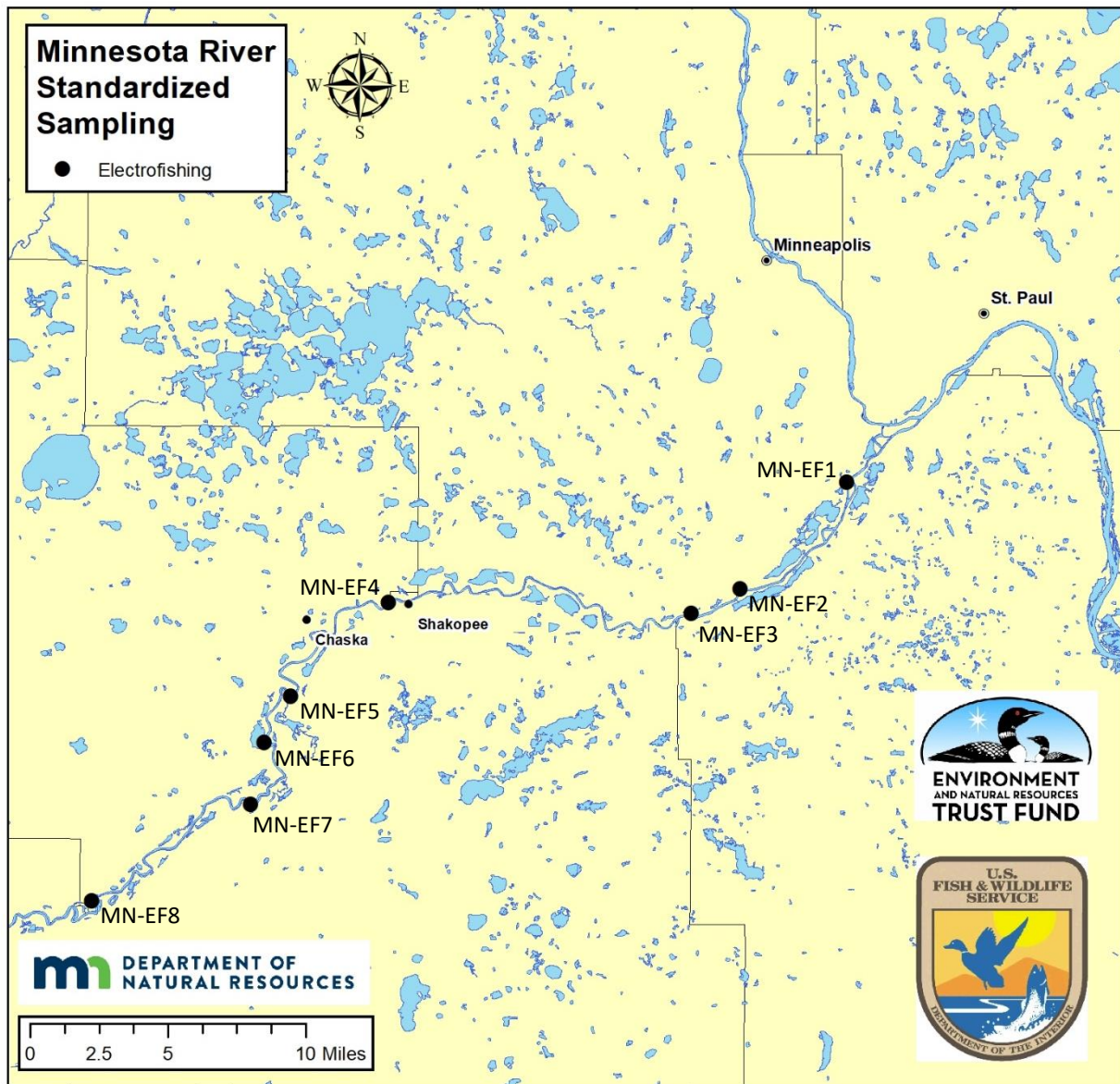
**Figure 3. Standardized electrofishing (dark circle, EF1 – EF8) and larval fish trawling (dark cross, SC-LT5 and SC-LT2019) locations on the St. Croix River (SC).**



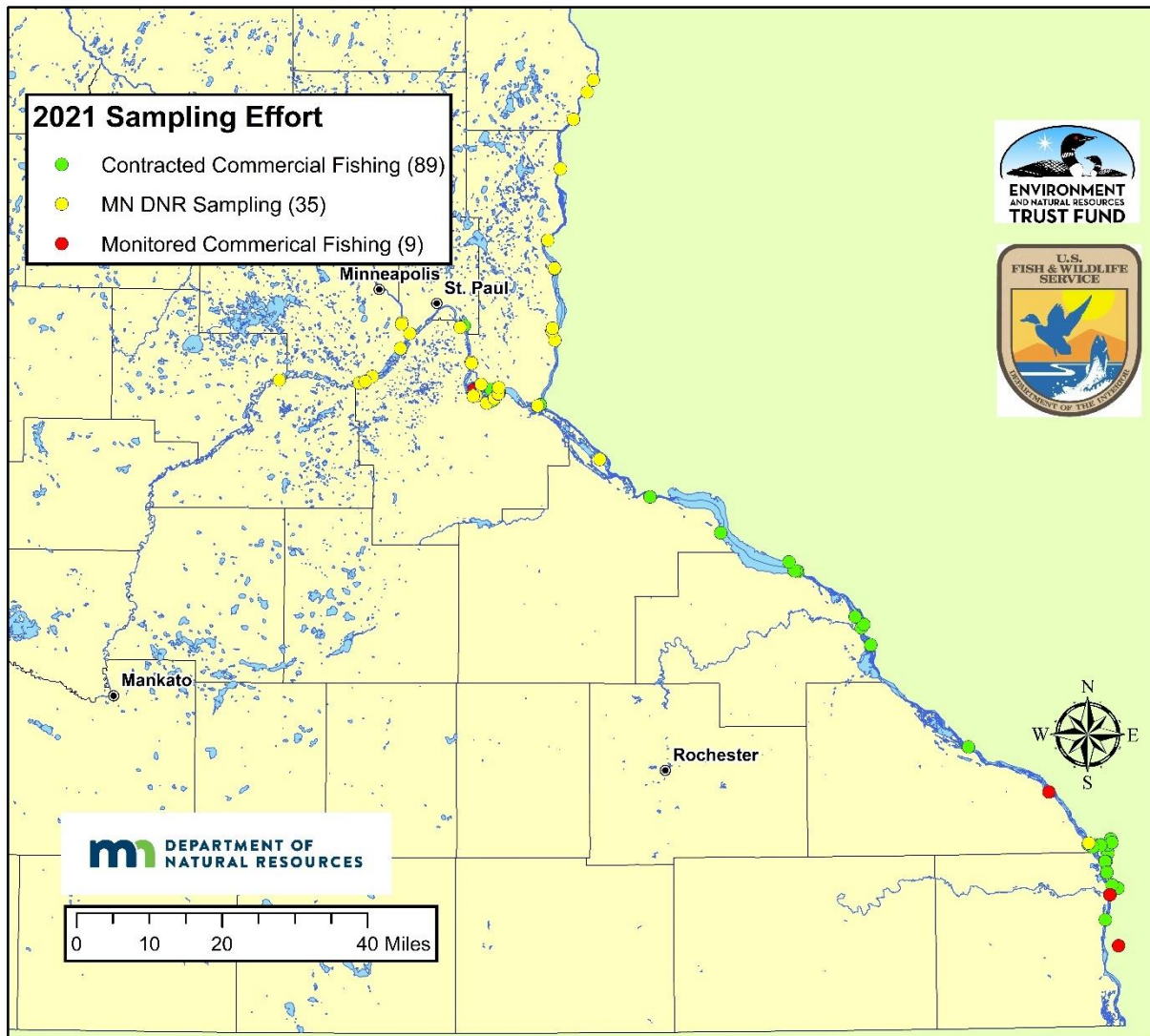


**Figure 4. Standardized larval fish trawling (dark cross, P8-LT2021) locations on the Mississippi River.**

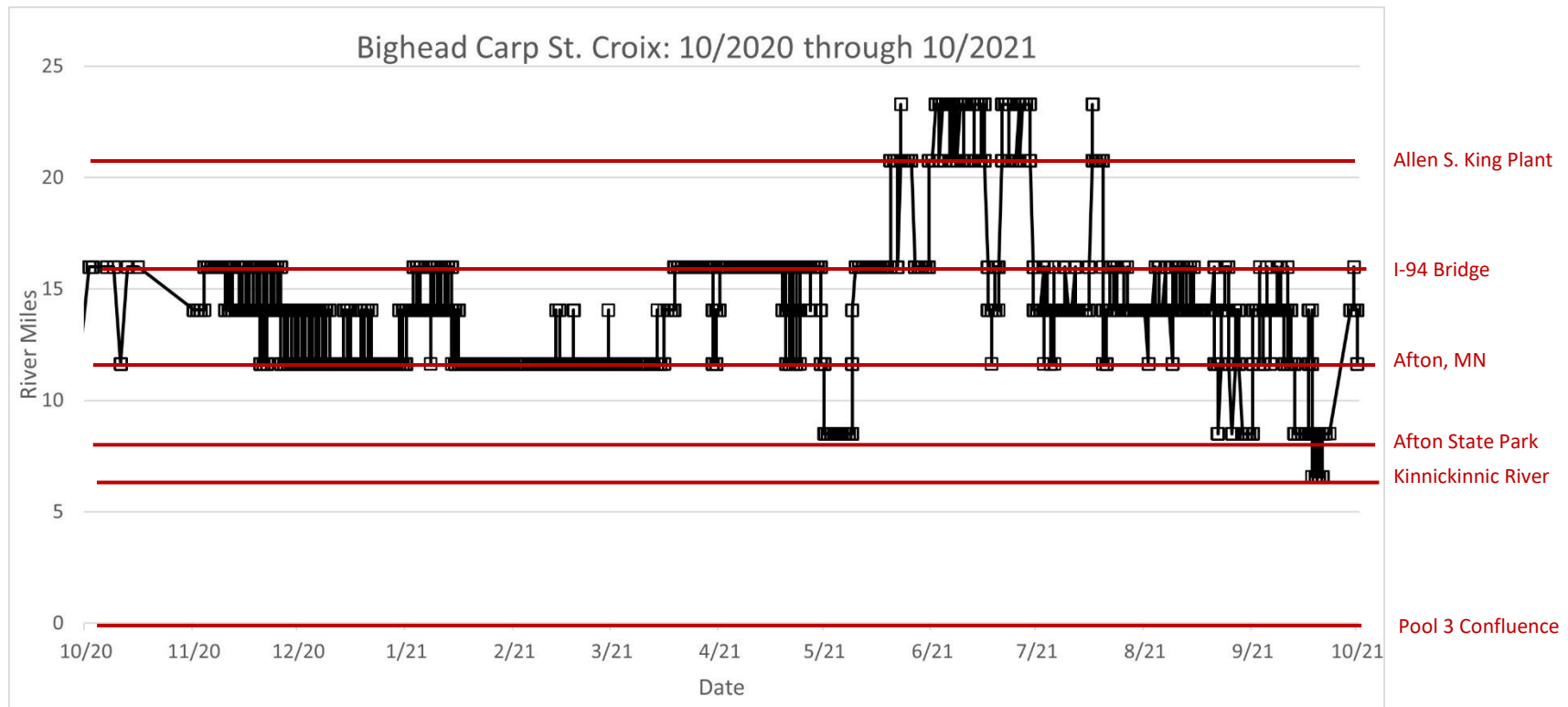




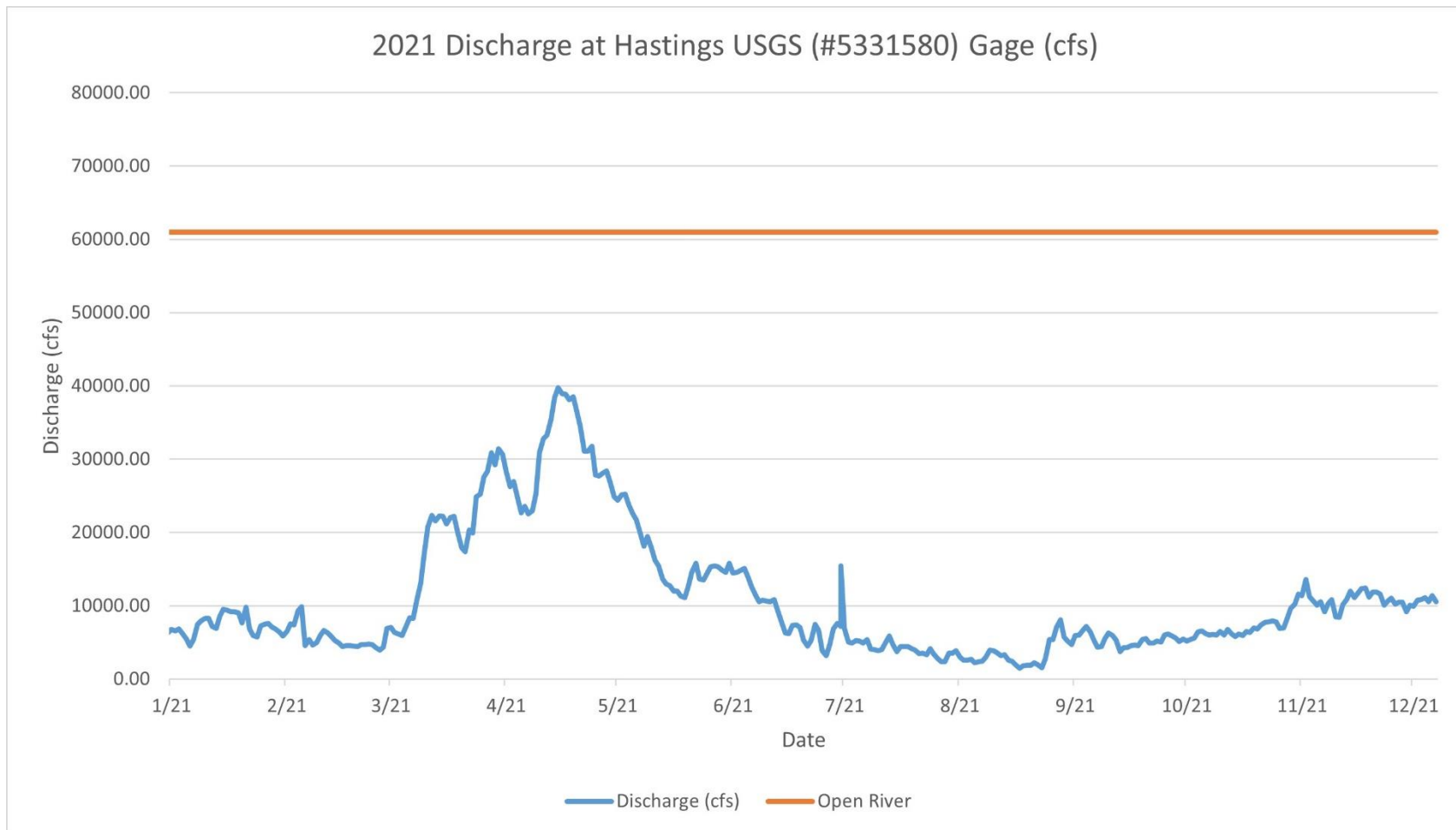
**Figure 5. Standardized electrofishing (dark circle, EF1 – EF8) locations on the Minnesota River.**



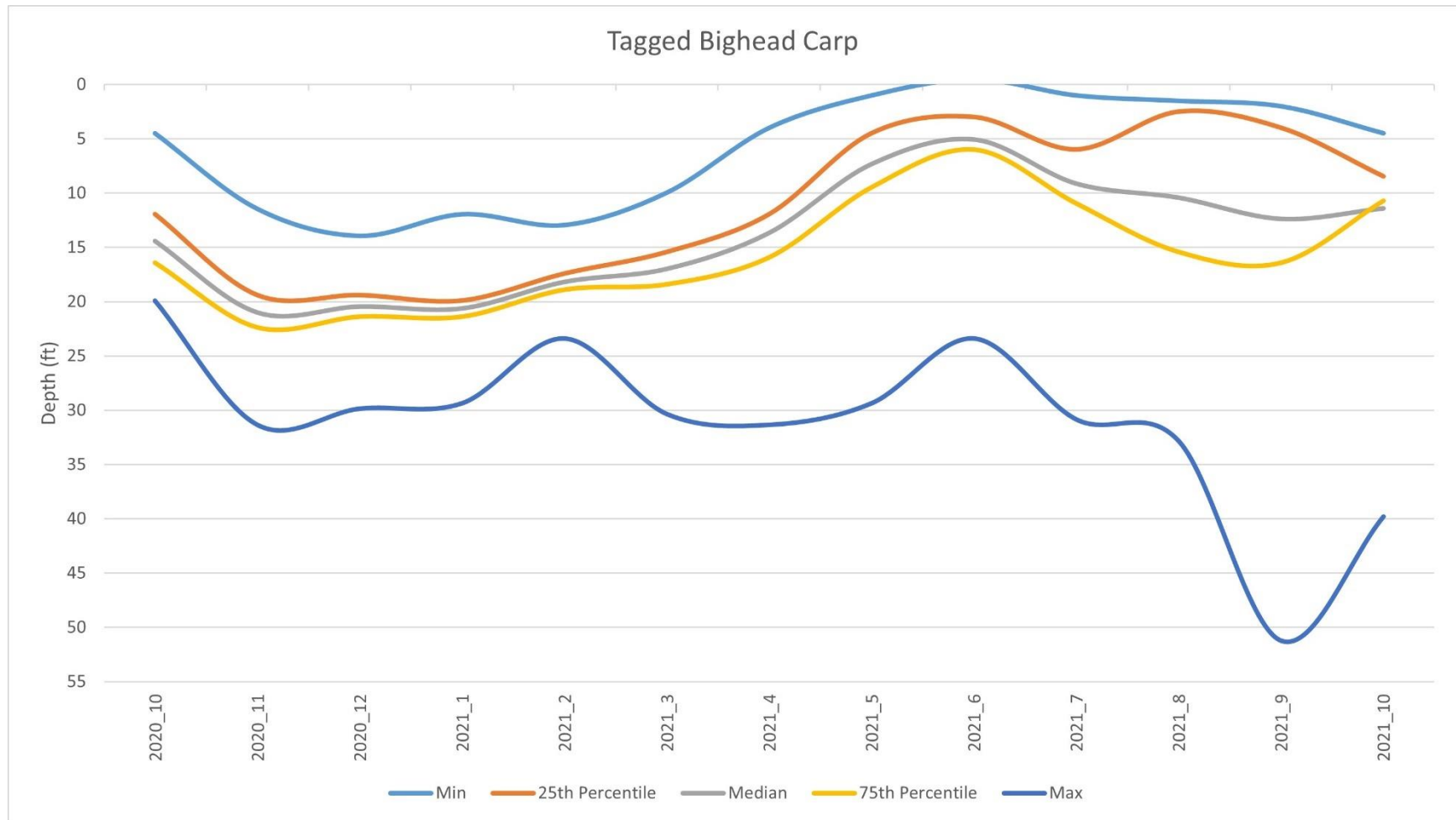
**Figure 6. All sampling locations for contracted commercial sampling and MDNR sampling on the Mississippi, St. Croix, and Minnesota Rivers during 2021.**



**Figure 7. Movement patterns by River Mile over time of a tagged Bighead Carp from October 20, 2020 through the last receiver download for 2021 on October 6, 2021.**



**Figure 8. Discharge patterns of USGS gauge (05331580) at Hastings, MN in Pool 3 of the Mississippi River from January 1, 2021 through December 7, 2021. The tagged Bighead Carp was not detected in the vicinity of the Lock and Dam #2 during this time. The gauge did not reach open river conditions or 61,000 cubic feet per second (cfs) during 2021.**

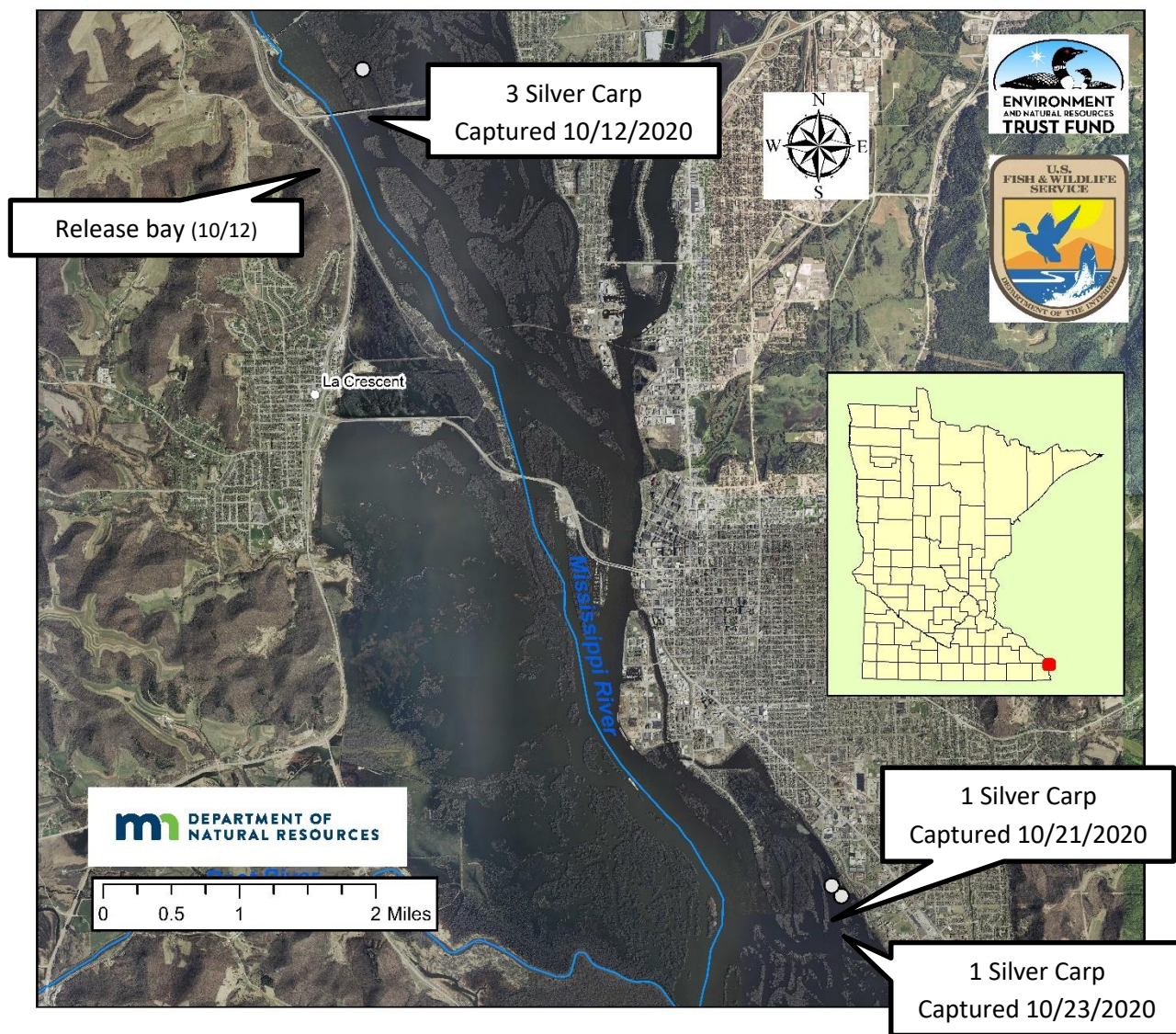


**Figure 9. Depth patterns of tagged Bighead Carp from October 20, 2020 through the last receiver download for 2021 on October 6, 2021. Depths ranged from the surface (0 feet) to a maximum depth of 51.2 feet. Average depth occupied was 13.9 feet below the surface.**



**Figure 10. Temperature patterns of tagged Bighead Carp from October 20, 2020 through the last receiver download for 2021 on October 6, 2021.**





**Figure 11. Capture location of tagged Silver Carp, October 2020.**

Field work and report by:

Ben J. Larson, Invasive Carp Statewide Field Lead

Approved by:

Area Fisheries Supervisor:

/s/ TJ DeBates date: 05/31/2022

Regional Fisheries Supervisor:

/s/ Brian Nerbonne date 05/31/2022

Date: