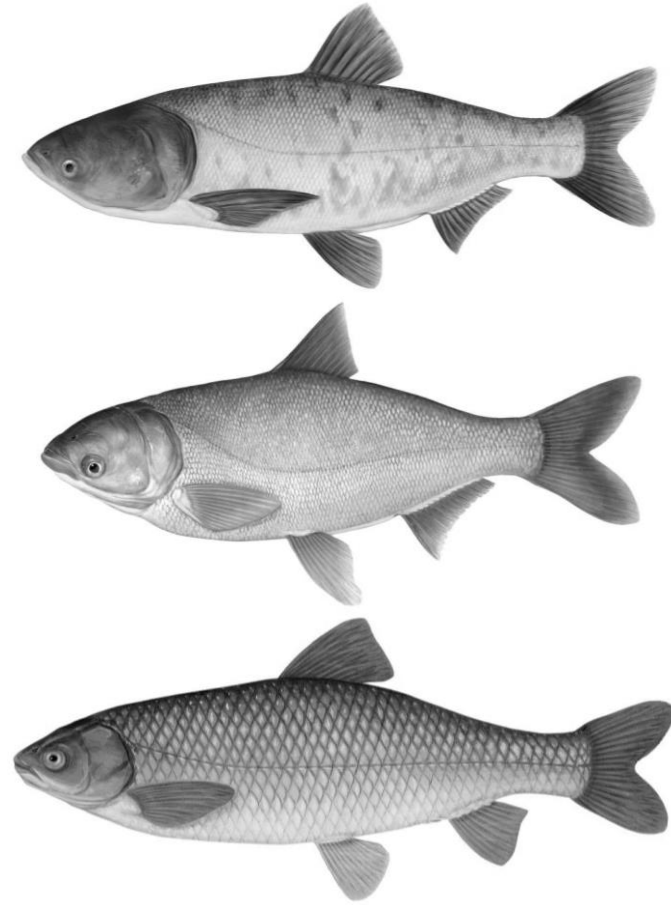


INVASIVE CARP SAMPLING REPORT
JANUARY – DECEMBER 2023
MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
SECTION OF FISHERIES



UPPER MISSISSIPPI RIVER, POOLS 1-8
LOWER ST. CROIX RIVER, BELOW ST. CROIX FALLS
MINNESOTA RIVER, BELOW GRANITE FALLS

February 26, 2024

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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 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 of the current status of invasive carp in Minnesota will allow for more effective efforts to prevent spread and impacts. 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:
 - Inform management prioritization of efforts in Minnesota.
 - 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 capture techniques of invasive carp to increase removal efficiency.

Sampling Sites

In the Mississippi River, invasive carp sampling occurred across approximately 200 river miles from St. Anthony Falls Lock and Dam in Minneapolis, MN to Pool 8 near Brownsville Township, MN. 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, effort was throughout the 370-mile stretch from Granite Falls, MN to the confluence with the Mississippi River in St. Paul, MN.

Sampling Methods

Sampling for invasive carp took place between January 1, 2023 and December 31, 2023. 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, Jesse Fischer, USGS, personal communication), telemetry data from tagged invasive carp (Mark Fritts, USFWS, personal communication; Joel Stiras, MNDNR personal communication), 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 native 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. All invasive carp captured were counted, total length measured, weighed, and a subsample processed for otoliths to be aged.

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 in 2023 to tag two invasive carp per river pool, and ten in Pools 5A and 8, with acoustic transmitters. The MNDNR utilized both passive telemetry (a stationary receiver array already in place) and active tracking (using a portable receiver and real-time floating receivers) to determine preferred habitats, longitudinal movement patterns, depth preferences, and specific locations for capture efforts. In 2023, a total of eight invasive carp received transmitters with the assistance of the U.S. Fish and Wildlife Service. Over 50 invasive carp tagged by USFWS in Pools 14-16 moved upstream into Minnesota during spring 2023 (Fritts et al. in press). Invasive carp tagged in Minnesota in previous years and those that migrated into Minnesota were all used to collect data on invasive carp movements.

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. Invasive carp tend to school together during spring and late fall/winter, when tagged carp can be used as “traitor fish” 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, to maximize the information we gain through their tracking. Any invasive carp that are captured are surgically implanted with a transmitter if conditions and permitting allow or 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 continue 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 Sampling

Larval trawling was not feasible during ideal spawning conditions due to the highwater event in April and May. DNR personnel safety remains a top priority and high-water conditions did not allow for safe access to the river during this time. Light traps were set overnight in Pool 5A backwaters at the lower end of the pool. Sites were chosen at random based on accessibility by boat and water current conditions in backwaters. During the 2023 field season 60 larval light traps were set in Pool 5A. Each set consisted of 5 floating traps, each equipped with a flashing green light, attached 5 feet apart and anchored on both ends. Orientation line, current, depth, set/pull time, and water temp were recorded. Traps were set out overnight in a line of 5 traps. The samples were then collected the following morning and placed in plastic containers to be transported back to the East Metro Fisheries office where the water was drained and replaced with 90% ethanol for preservation. After 24-48 hours the ethanol was then drained from the sample and replaced with 90% ethanol. The samples were then stored for the remainder of the field season. The ethanol samples are then sent for visual identification of invasive carp larval fish. That data has been sent in for processing, but results have not been received and historic data can be found in Table 3. Sampling locations can be found in Figure 4. This sampling has been conducted with the aid and support of the USFWS La Crosse Office.

eDNA

MNDNR partners with USFWS to help direct sampling locations. USFWS and Whitney Genetics lab collect grab samples and process the samples using qPCR amplification. Three genetic markers are tested for: a silver carp marker, a bighead carp marker, and a marker that applies to both bighead and silver carp. The results are then publicly posted on the USFWS eDNA portal. eDNA sites for spring 2023 include several high priority capture sites in Pool 8 (commonly referred to as the Condo Site, NSP,

Airport Site, I-90 Scour, and Hospital Bay); Andersen Bay and the Boom Site in the St. Croix River; and below Granite Falls in the Minnesota River. Fall 2023 sites included the Condo Site in Pool 8, above the Dam 7 spillway in Pool 7, and Fisherman's Bay in Pool 7.

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 30 feet and lengths of 150 to 1000 feet with bar mesh sizes of 3.5 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 to species.

Results and Discussion

Sampling Results

In total, 100 days were spent sampling between January and December 2023 on the Mississippi River Pools 2, 3, 4, 5, 5A, 6, 7, and 8, and the Minnesota and St. Croix rivers with gear appropriate for sampling invasive carp (Table 1; Figure 5). A greater amount of effort was focused on Pools 5A and 8 in 2023 in response to recent captures, sightings, and telemetry data. In early March 2023, we conducted a contracted commercial fishing effort in pool 6. During that seine haul, 30 invasive carp were captured and was the largest capture upstream of Pool 8 in MN at the time.

Intensive fall sampling occurred in Pools 5A-8 of the Mississippi River including a multi-agency capture event (previously called a Modified Unified Method or MUM). A spring event was not able to be conducted due to extensive flooding. On the first day of the fall event 5 invasive carp jumped over the net while pulling in the seine. In response, anti-jump nets were added to block nets going forward. These nets are intended to entangle escaping invasive carp. Later in the week, multiple tagged fish were

detected at the lower end of pool 8 and we directed our effort to that location. After gill nets and block nets were set, boat motors, speakers, and an electrofishing boat were used to stimulate movement. This effort resulted in 6 captures in which the fish were surgically implanted with acoustic transmitters and were released. One silver carp was captured by electrofishing, one silver carp was removed from a jumping net, and 3 silver carp and a grass carp were captured in the gill nets. This was the first grass carp tagged by Minnesota DNR and the most invasive carp tagged in one day. Capture data and response actions were shared with multiple agencies including the WDNR, USGS, NPS, and USFWS.

In late November, a commercial fishing seining operation was conducted in pool 6 after WDNR had located 6 tagged invasive carp in the area and commercial fishermen utilized side imaging to locate a large school, resulting in the largest single capture of IC in Minnesota/Wisconsin boundary waters. Follow up sampling was conducted the following week and an additional 77 invasive carp were captured and removed. None of the tagged invasive carp tracked in the area were captured. A total of 466 invasive carp were caught in Minnesota and Minnesota-Wisconsin boundary waters in 2023 (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, 5A, 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 and the Minnesota River near New Ulm. Contracted commercial anglers set approximately 32,050 feet of gill nets during 16 days of effort and conducted 25 seine hauls between January and December 2023. Short term gill nets (.5-1.5 hours) were prioritized over overnight sets due to the silver carp's ability to escape from the nets. After gill nets were set, fish were chased towards the net with boats and underwater speakers, typically in large backwater areas. Unlike previous years, nets were pulled shortly after fish were driven towards the net. In 2023, one regular commercial fishing operation not under contract was also monitored for the presence of invasive carp.

Random electrofishing sampling was conducted on the Minnesota and St Croix River, as well as Pools 2, 3, 5A, 7, and 8 of the Mississippi River. A total of 1,192 minutes of “on time” over 19 days was spent electrofishing between January and December 2023. 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 2022, a total of 3,400 feet of gill net were set in Pool 2 over five days, with most net sets being short-term sets (2-5 hours). In 2023, no invasive carp were captured during routine gill netting operations, seining or electrofishing.

Although no new or notable species were added to the list in 2023, 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 2023, 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 changed is unclear. Captures are too limited to allow for an estimate of invasive carp abundance in Minnesota waters. The recent increase in captures could be attributed to a successful year class migrating upstream during extended periods of high water in 2019 and 2023, but it remains to be seen what the implications will be for the future abundance of invasive carp in Minnesota waters.

Spring eDNA sampling was conducted by the USFWS in Pool 8 during the week of April 10th, 2023, which resulted in 12 positive detections out of 495 total samples. The St. Croix sites were

sampled during the week of May 23, 2023, which resulted in 7 positive detections out of 213 total samples. The Minnesota River site was sampled the week of May 22, 2023, and none of the 84 samples were positive for invasive carp eDNA. Results were consistent with past years' data, with limited detections (<10% positive) in the Condo Site, Airport Site, I-90 Scour, Hospital Bay, and Andersen Bay; and no detections at the NSP site, Boom Site, and below Granite Falls. Fall sampling occurred during the week of October 3rd, and 14 of 206 samples were positive for invasive carp eDNA. Approximately 10% of samples were positive for invasive carp eDNA at the Condo Site, 5% were positive at Fisherman's Bay, and no invasive carp eDNA was detected above the spillway. These detections are all within the known range of invasive carp captured and does not equate to range expansion or suggest a change in abundance.

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, released, and tracked. For information from previous years on the tagged Bighead Carp, refer to the Minnesota Department of Natural Resources 2021 Sampling Report (MNDNR 2022), this tag is set to expire in February of 2024.

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. In the past 7 years, the tagged bighead traveled into Pool 3 of the Mississippi River multiple times. These downstream runs occasionally coincide with open water at Lock & Dam #3 in Hastings, MN. Please see figure 6 for hydrologic conditions at Lock & Dam #3 during 2023.

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 8), and tolerates temperatures ranging

from 33 to 88 degrees Fahrenheit (Figure 9). (See MNDNR 2018, MNDNR 2019, MNDNR 2020, MNDNR 2021 and MNDNR 2022 for data collected from the previous field seasons.) In 2023, recapture efforts were limited due to higher priority sampling efforts in lower pools.

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 2022 and 2023 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. This data is still being processed. Additionally, in one of the sites the tagged bighead had shown high site fidelity a short-term array was deployed to track the tagged bighead carp's interaction with an algae pellet attractant station during May 2023. This VPS array is a scaled back version of what has been deployed in Lakeland for the 2 winters and will provide critical information on the use of algae-based attractants to lure bighead carp into an area suitable for removal. An attractant station study is currently being developed with USGS for the 2024 field season.

On April 23, 2023, a Silver Carp was captured at Point Douglas on the St. Croix River in a commercial seine. Past sampling at this location has resulted in the capture of multiple silver carp. Conditions were appropriate to tag the carp with an acoustic tag. The carp stayed in the St. Croix River throughout the summer.

During the 2023 field season MNDNR staff, alongside contracted commercial fisherman, USFWS, and WDNR, 16 additional invasive carp captured received acoustic tags. One Silver Carp was captured in the St. Croix River by a commercial seine, 7 silver carp were captured in gill nets on pool 5a, and 8 other invasive carp were caught in a commercial gill net in pool 8. Previously tagged invasive carp were continued to be tracked such as the Bighead Carp in the St. Croix River and another Silver Carp tagged in

Pool 8. The tagged Bighead Carp in the St. Croix River showed similar movements to years past. Please refer to Figure 6, 7, 8, & 9 for movement data, Hastings Lock & Dam 2 discharge data, depth data and temperature data from the tagged Bighead Carp.

Of the 23 Silver Carp tagged in previous years, only one was detected marking a large upstream run during 2023. This fish was tagged in partnership with USFWS. During the 2022/2023 hard water season the fish overwintered at the lower end of pool 5a. During the spring flooding the fish made a run upstream to Pool 3 and the St. Croix River. Movement data is still being collected and processed for that fish since it moved through several networks maintained by partnering agencies.

High water during April and May allowed for open river conditions throughout most of the UMR (Upper Mississippi River). During this time, more than 50 tagged invasive carp moved upstream from Pools 14, 15 and 16. Some of these fish along with silvers tagged in Pool 5A in May 2023 were tracked throughout the field season and lead to the capture of 6 carp in Pool 8 that were tagged and 410 carp that were removed in Pool 6.

The traitor fish method has been vital in the capture of multiple invasive carp since the first tagged carp in 2017. The tagged silver in has led to new areas that had previously not been sampled throughout the last few years. Without tracking information from these tagged carp, MNDNR personnel would not have fished certain locations. Because the tagged fish exhibit 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 tagged individuals will continue to allow biologists to better understand additional habitat preferences and the duration of residence preferences.

Tracking methods and field sampling will be adjusted accordingly for 2024. 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 to adequately document the effects of invasive carp to native fish populations. Monitoring should focus on activities that inform removal and monitor for changes in the population to inform management actions.

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.

Contracted commercial fishing has produced the bulk of recent invasive carp captures in Minnesota. The 2023 decision-making process to inform the 2024 update of the Minnesota Invasive Carp Action Plan identified maximizing commercial fishing as an important action to reducing impacts from invasive carp. Commercial fishing should be continued and expanded to reduce invasive carp abundance in the state.

Multi-agency netting events have continued to result in captures and sightings. As we continue to develop this capture technique for use in low-density populations, netting events will continue to adapt. MNDNR will work with partnering agencies towards a more streamlined method that can be deployed by MNDNR staff for rapid response.

Continued eDNA sampling is important as a monitoring tool. Captures of invasive carp are limited, and eDNA detection data can help supplement the available capture data to inform management. Minnesota DNR partners with USFWS and USGS on eDNA sampling in Minnesota.

The invasive carp action plan was first developed in 2011 and updated in 2014 and in January of 2024. The updated plan includes a suite of management actions to address the increase in invasive carp captures and availability of new management options. The update was informed by a comprehensive structured decision-making process to identify the best management options for Minnesota. The updated plan is available online on the DNR invasive carp website.

Deterrents and barriers have been useful for keeping invasive carp out of lakes in southwest Minnesota. The deterrents and barriers to movement were installed after a watershed breach analysis identified vulnerable connections. Additional watershed breach studies in Minnesota will be important to identifying locations for monitoring and management and are recommended in future funding to reassess Minnesota's changing waterways. A deterrent at Lock and Dam 19 was also prioritized in the updated Action Plan and could reduce the number of invasive carp migrating upstream to Minnesota. Deterrents in Minnesota, such as at Lock and Dam 5, are also under consideration.

As invasive carp captures increase in Minnesota, the risk of reproduction also increases. Invasive carp require sufficient length of flowing water for their eggs to hatch and larvae to begin swimming, and the larvae require nursery habitat to survive. FluEgg is a model that can be used to predict whether a location is suitable for invasive carp to reproduce. FluEgg modeling has been conducted on the Lower St.

Croix River; further modeling is underway to evaluate pools 1-9 of the Mississippi River. Identifying locations where recruitment is possible will help focus management efforts to prevent reproduction and monitor for potential spawning events.

Acknowledgements

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Tables

Table 1. Invasive carp sampling summary for the Mississippi River Pools 2, 3, 4, 5, 5A, 6, 7 and 8 and the St. Croix and Minnesota rivers for January through December 2023. 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 2023			Days
Random Sampling Effort			
Gill/Trammel Netting	8,200	feet	8
Electrofishing	1,196	minutes	19
Beach Seine	0	Hauls	0
Standardized Sampling Effort			
Electrofishing	0	minutes	0
Larval Trawl	0	Hauls	0
Larval Light Traps	60	Traps	4
Targeted Commercial Fishing Effort			
Gill Netting	32,050	feet	16
Seining	25	hauls	22
Monitored Commercial Fishing Effort			
Seining	1	hauls	1
Tracking*			
2-person crew		days	30
Number of Invasive Carp Captured			
	466	fish	
Total Number of Days Sampled			100

*Does not include tracking by real-time receivers (MNDNR, USFWS) in the St. Croix River, Pool 5A and Pool 8.

Table 2. Invasive carp caught from January through December 2023 in Minnesota and Wisconsin boundary waters.

Date	Species	Quantity	Sex	Water Body	Location	Method	Captured By
3/15/2023	Silver Carp	1	Female	Miss. River	Pool 5A	Commercial Seine	Commercial Fisher
3/20/2023	Silver Carp	9	Female	Miss. River	Pool 6	Commercial Seine	Commercial Fisher
3/20/2023	Silver Carp	20	Male	Miss. River	Pool 6	Commercial Seine	Commercial Fisher
3/27/2023	Silver Carp	1	Female	Miss. River	Pool 5A	Commercial Seine	Commercial Fisher
3/28/2023	Grass Carp	1	Male	Miss. River	Pool 5A	Commercial Seine	Commercial Fisher
4/7/2023	Silver Carp	1	Female	Miss. River	Pool 8	Commercial Seine	Commercial Fisher
4/7/2023	Silver Carp	3	Male	Miss. River	Pool 8	Commercial Seine	Commercial Fisher
4/12/2023	Silver Carp	1	Female	St. Croix River	Pt. Douglas	Commercial Seine	Commercial Fisher
4/25/2023	Grass Carp	1	Female	Bright Lake	Martin County	Commercial Seine	Commercial Fisher
5/22/2023	Grass Carp	2	Unknown	Miss. River	Pool 5A	Commercial Seine	Commercial Fisher
5/22/2023	Silver Carp	1	Female	Miss. River	Pool 5A	Commercial Seine	Commercial Fisher
5/22/2023	Silver Carp	4	Male	Miss. River	Pool 5A	Commercial Seine	Commercial Fisher
5/23/2023	Silver Carp	2	Male	Miss. River	Pool 5A	Commercial Seine	Commercial Fisher
5/25/2023	Silver Carp	1	Female	Miss. River	Pool 5A	Snagged	MN DNR
6/1/2023	Silver Carp	1	Female	Miss. River	Pool 8	Commercial Seine	Commercial Fisher
6/14/2023	Grass Carp	1	Female	Root River	Fillmore County	Electrofishing	MN DNR
6/22/2023	Silver Carp	2	Unknown	Miss. River	Pool 5A	Commercial Gillnet	Commercial Fisher
10/11/2023	Silver Carp	1	Male	Miss. River	Pool 8	Electrofishing	MN DNR
10/11/2023	Grass Carp	1	Unknown	Miss. River	Pool 8	Gillnet	MN DNR
10/11/2023	Silver Carp	2	Female	Miss. River	Pool 8	Gillnet	MN DNR
10/11/2023	Silver Carp	2	Male	Miss. River	Pool 8	Gillnet	MN DNR
11/30/2023	Bighead Carp	1	Female	Miss. River	Pool 6	Commercial Seine	Commercial Fisher
11/30/2023	Bighead Carp	2	Male	Miss. River	Pool 6	Commercial Seine	Commercial Fisher
11/30/2023	Grass Carp	3	Female	Miss. River	Pool 6	Commercial Seine	Commercial Fisher
11/30/2023	Grass Carp	8	Male	Miss. River	Pool 6	Commercial Seine	Commercial Fisher
11/30/2023	Silver Carp	97	Female	Miss. River	Pool 6	Commercial Seine	Commercial Fisher
11/30/2023	Silver Carp	192	Male	Miss. River	Pool 6	Commercial Seine	Commercial Fisher

Table 2 (continued). Invasive carp caught from January through December 2023 in Minnesota and Wisconsin boundary waters.

Date	Species	Quantity	Sex	Water Body	Location	Method	Captured By
12/4/2023	Bighead Carp	2	Male	Miss. River	Pool 6	Commercial Seine	Commercial Fisher
12/4/2023	Grass Carp	3	Female	Miss. River	Pool 6	Commercial Seine	Commercial Fisher
12/4/2023	Grass Carp	10	Male	Miss. River	Pool 6	Commercial Seine	Commercial Fisher
12/4/2023	Silver Carp	41	Female	Miss. River	Pool 6	Commercial Seine	Commercial Fisher
12/4/2023	Silver Carp	21	Male	Miss. River	Pool 6	Commercial Seine	Commercial Fisher

Table 3. Larval sampling for the St. Croix and Mississippi rivers from 2013 to 2023.

<i>Year</i>	<i>Number of Sites</i>		<i>Total number of samples</i>		<i>Number of samples with larval fish</i>		<i>Number of larval invasive carp</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>	<i>St. Croix River</i>	<i>Mississippi River</i>
<i>2013</i>	8	8	16	28	6	16	0	0
<i>2014</i>	9	13	28	44	17	28	0	0
<i>2015</i>	8	18	52	253	23	139	0	0
<i>2016</i>	9	16	46	102	25	83	0	0
<i>2017</i>	7	17	20	73	20	73	0	0
<i>2018</i>	8	8	66	68	37	44	0	0
<i>2019</i>	2	4	52	100	37	64	0	0
<i>2020</i>	0	0	0	0	0	0	0	0
<i>2021*</i>	0	1	0	108	0	11	0	0
<i>2022*</i>	0	6	0	72	0	72	0	0
<i>2023*</i>	0	60	0	60	0	24	0	--

--Pending results.

* Genetic testing was preformed on one or all the samples either as the main method of identification or as a verification.

Table 4. Species list for the Minnesota, St. Croix and Mississippi (Pool 2, Pool 3 and Pool 4) rivers from January 2013 through December 2023, 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>Moxostoma duquesnei</i>				x	
Blackchin Shiner	<i>Notropis heterodon</i>				x	
Blacknose Shiner	<i>Notropis heterolepis</i>	x			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	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	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>Carpodes 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	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			x	
Northern Pike	<i>Esox lucius</i>	x	x	x	x	x
Orangespotted Sunfish	<i>Lepomis humilis</i>	x			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 2023, 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>Carpiodes cyprinus</i>	x	x	x	x	x
Rainbow Darter	<i>Etheostoma caeruleum</i>				x	
River Carpsucker	<i>Carpiodes 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	<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	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

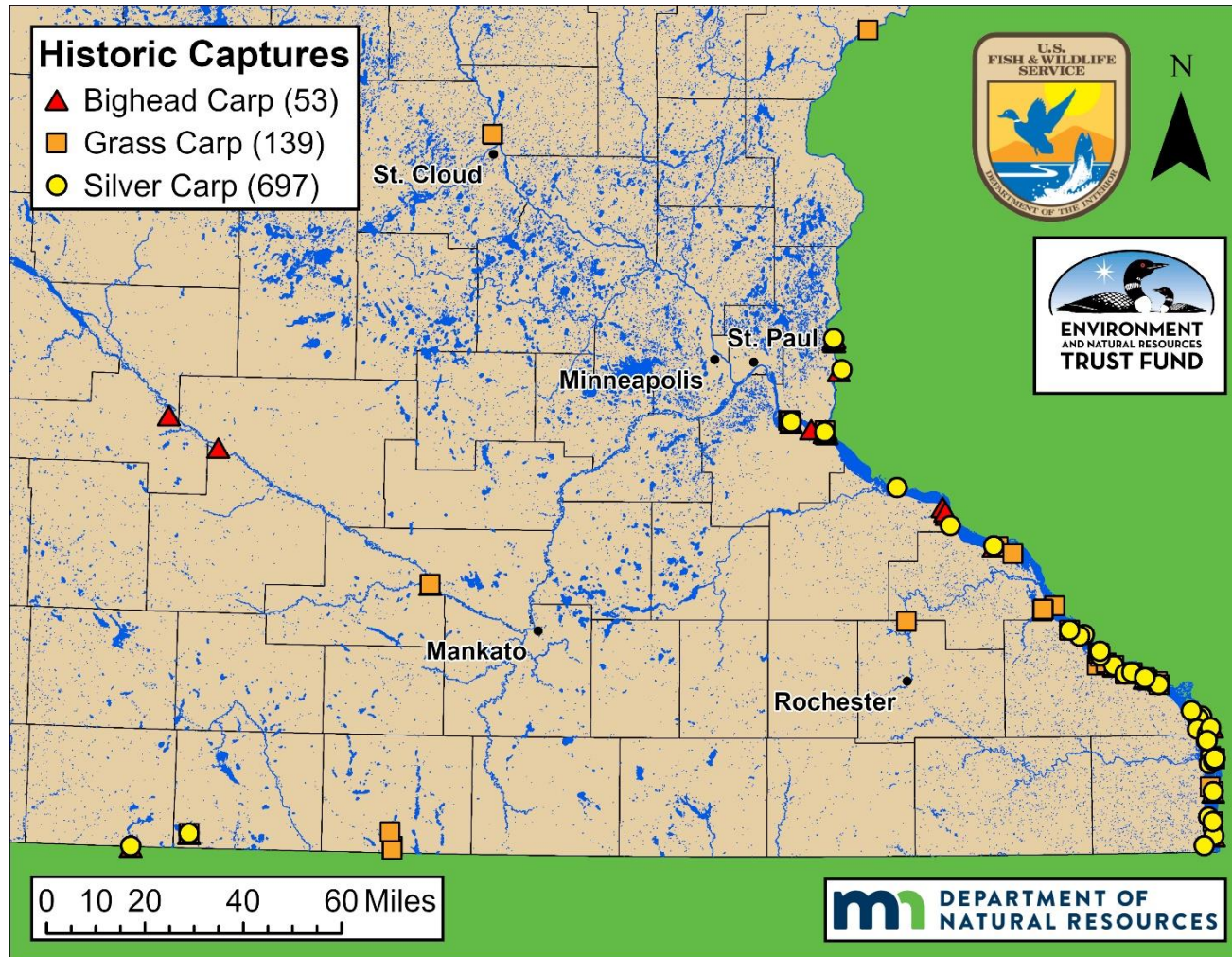


Figure 1. Locations of all known invasive carp captured in Minnesota waters through 2023.

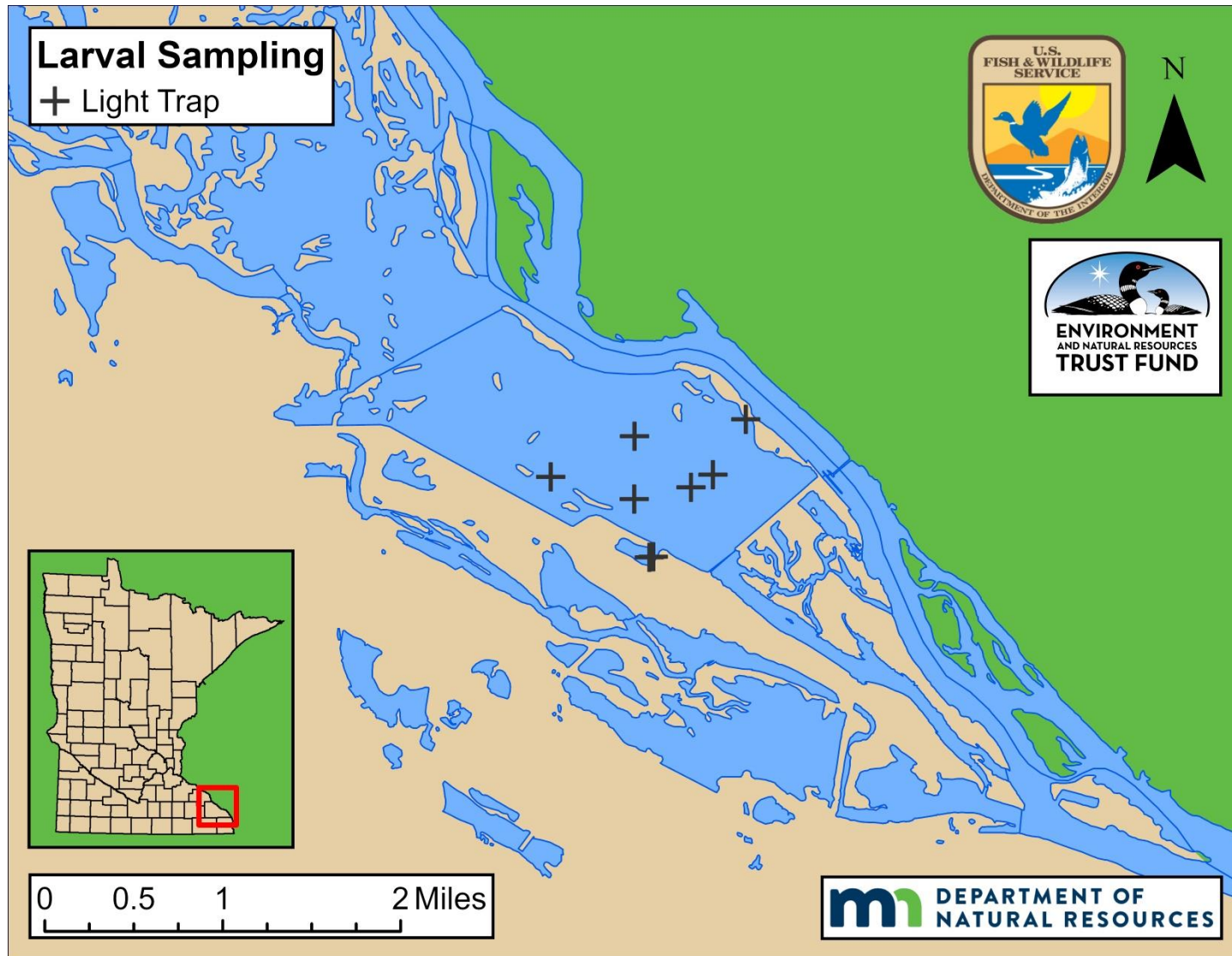


Figure 2. Standardized larval light trap locations on the Mississippi River in pool 5a.

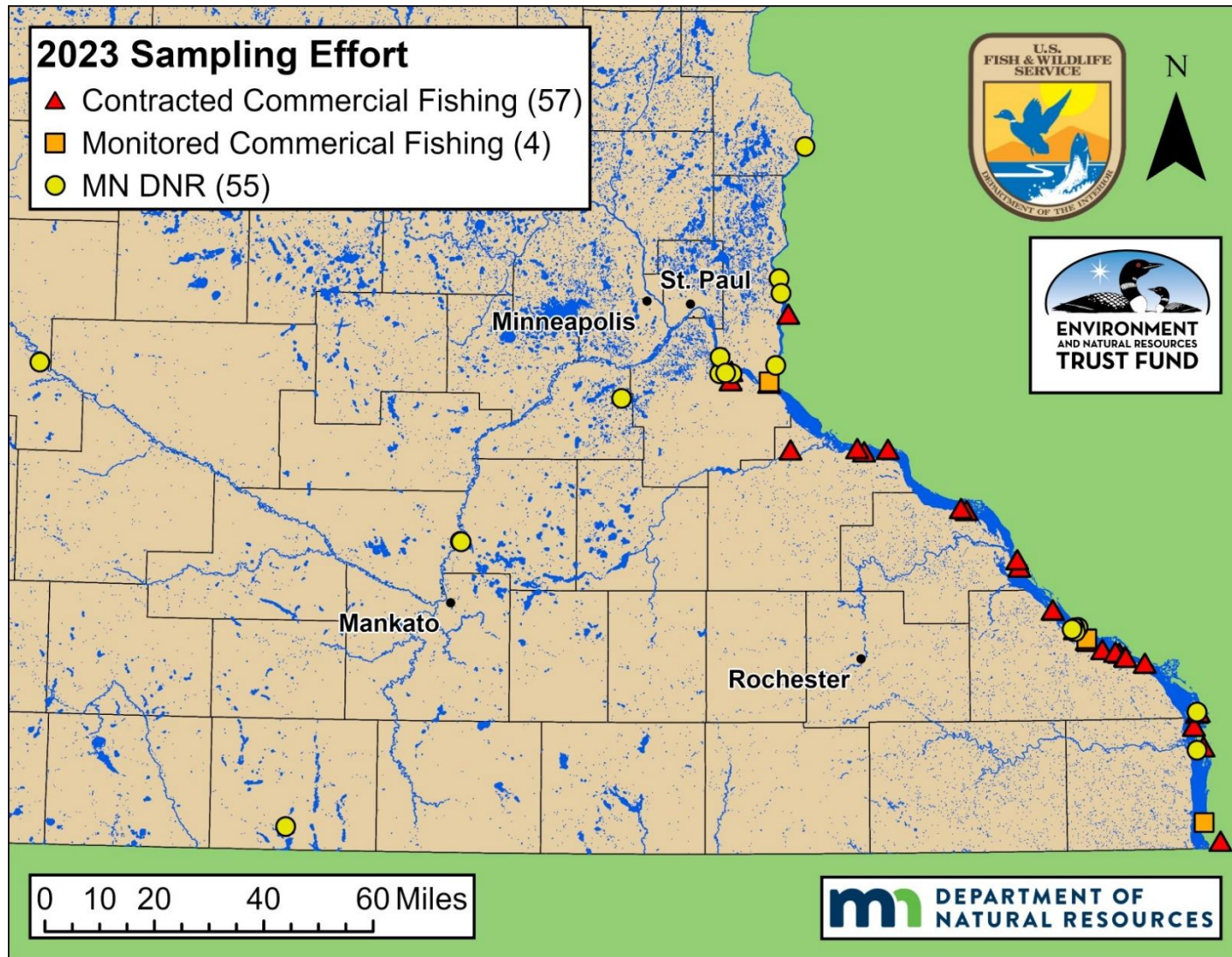


Figure 3. All sampling locations for contracted commercial sampling and MDNR sampling on the Mississippi, St. Croix, and Minnesota rivers during 2023.

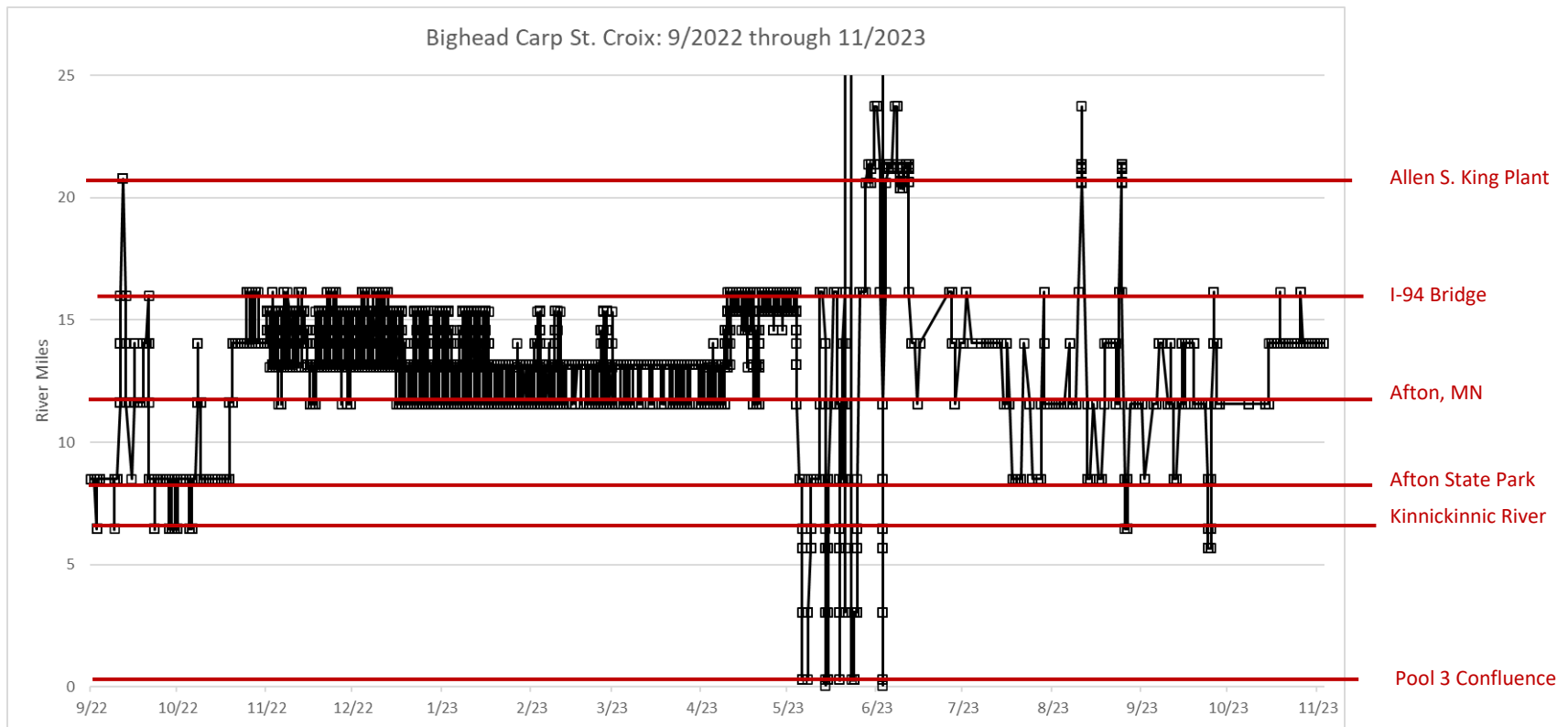


Figure 6. Movement patterns by River Mile over time of a tagged Bighead Carp from September 3, 2022 through the last receiver download for 2023 on November 3, 2023. The tagged bighead carp moved from the St. Croix River to Pool 3 on the Mississippi River below the Hastings Lock and Dam from May 23, 2023, and again on June 3, 2023.

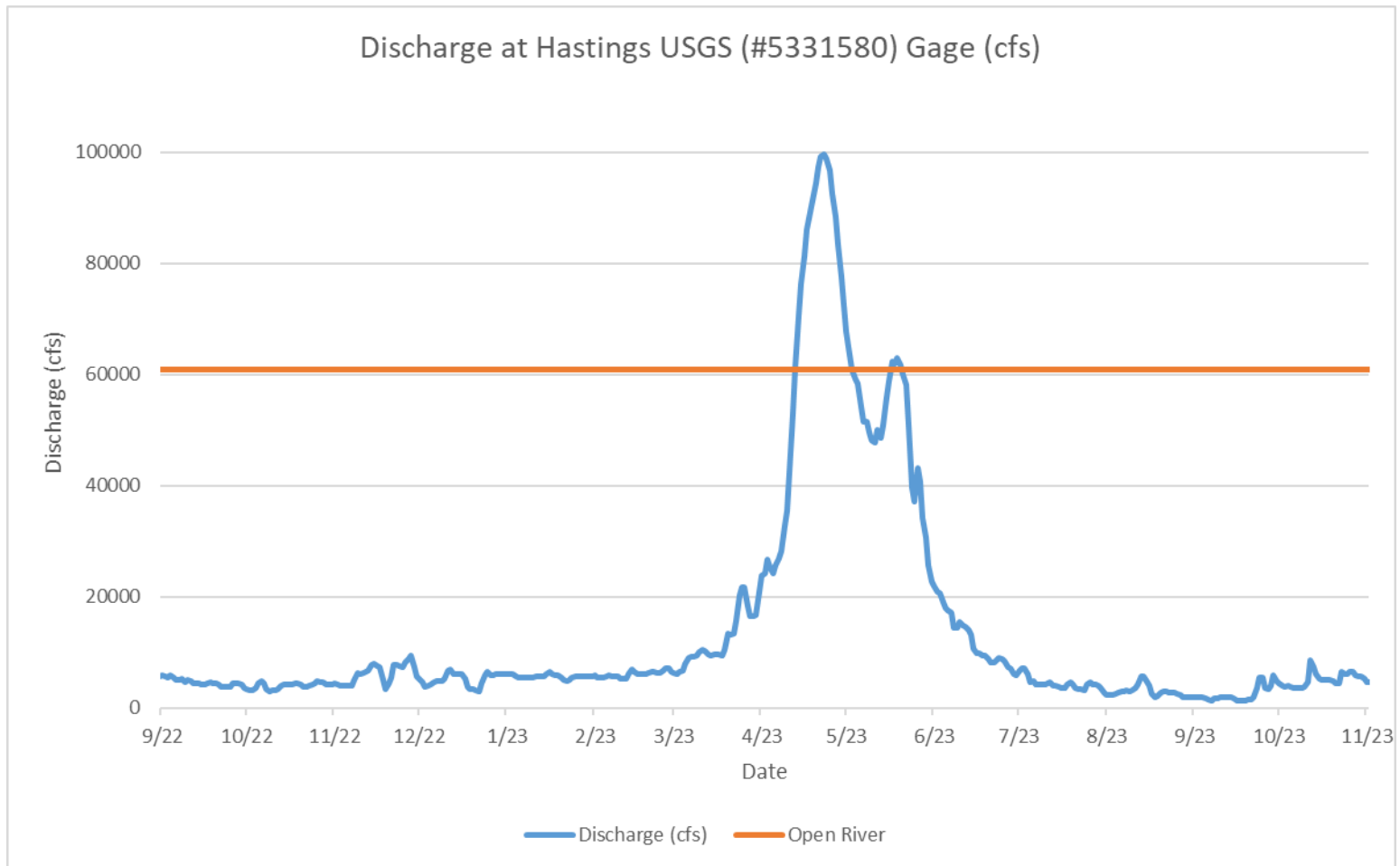


Figure 7. Discharge patterns of USGS gauge (05331580) at Hastings, MN in Pool 3 of the Mississippi River from September 2022 through November 2023. The tagged Bighead Carp was detected in the vicinity of the Lock and Dam #2 from May 22-May 23, 2023 and entered Pool 3 but did not approach L&D#2 on June 6, 2023. The gauge reached open river conditions, or 61,000 cubic feet per second (cfs) from April 15, 2023 – May 4, 2023, and again from May 19, 2023 – May 22, 2023.

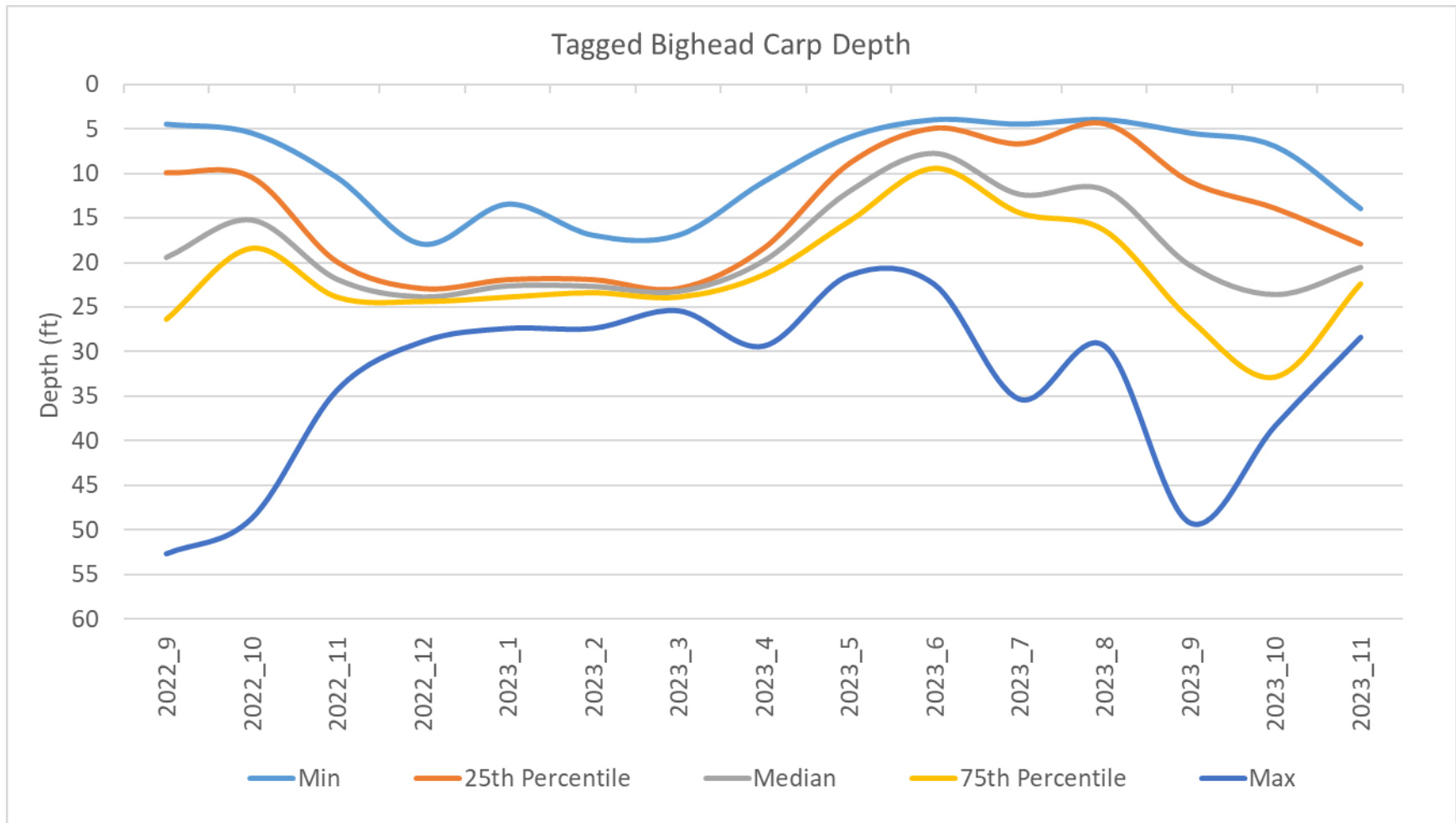


Figure 8. Depth patterns of tagged Bighead Carp from September 3, 2022 through the last receiver download for 2023 on November 3, 2023. Depths ranged from the surface (0 feet) to a maximum depth of 52.7 feet. Average depth occupied was 18.45 feet below the surface.

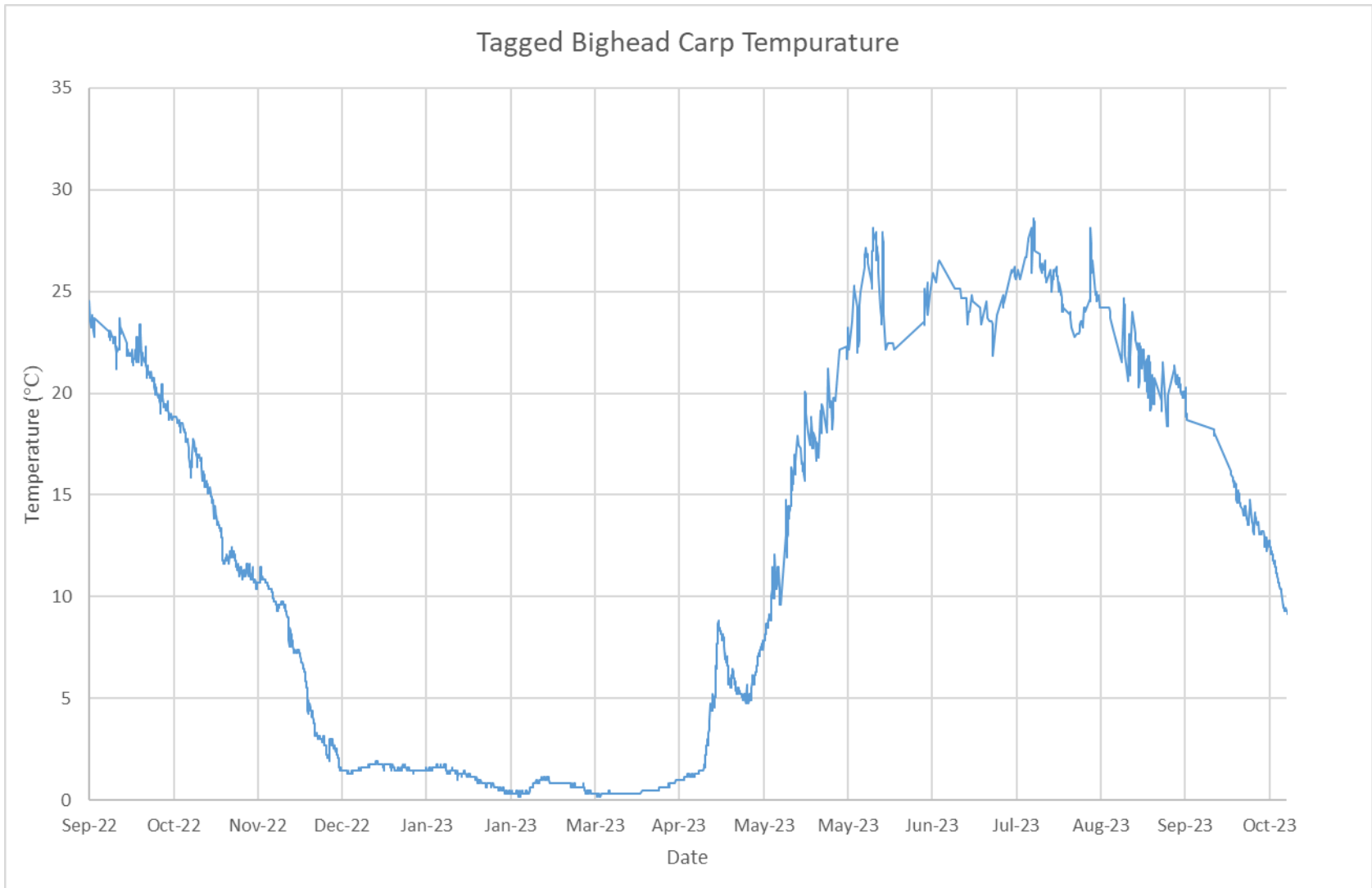


Figure 9. Temperature patterns of tagged Bighead Carp from September 3, 2022 through the last receiver download for 2023 on November 3, 2023.

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Area Fisheries Supervisor:

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Date: