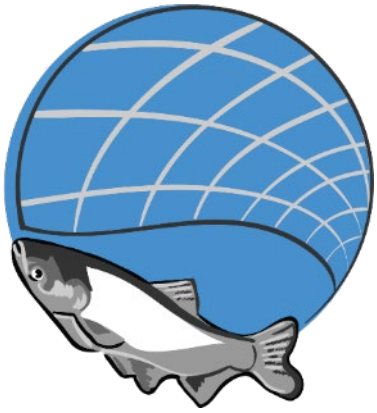
Invasive Carp Action Plan for Fiscal Year 2024

APRIL 2024

Invasive Carp Regional Coordinating Committee



ICRCC Member Agencies:

Illinois Department of Natural Resources
Illinois Environmental Protection Agency
Indiana Department of Natural Resources
Michigan Department of Natural Resources
Michigan Department of Environment, Great Lakes & Energy
Minnesota Department of Natural Resources
New York Department of Environmental Conservation
Ohio Department of Natural Resources
Pennsylvania Department of Environmental Protection
Pennsylvania Fish and Boat Commission
Wisconsin Department of Natural Resources
Grand Traverse Band of Ottawa and Chippewa Indians
Ontario Ministry of Natural Resources and Forestry
Quebec Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs
National Oceanic and Atmospheric Administration
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Department of Transportation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Geological Survey
National Park Service
Fisheries and Oceans Canada
Great Lakes Fishery Commission
Great Lakes Commission
Metropolitan Water Reclamation District of Greater Chicago

Invasive Carp Action Plan: Fiscal Year 2024

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EXECUTIVE SUMMARY

The Invasive Carp Regional Coordinating Committee (ICRCC) is convened by the U.S. Fish and Wildlife Service (USFWS) and the U.S. Environmental Protection Agency (USEPA) to assist ICRCC members in implementing their authorities to reduce and/or eliminate the threats to the Great Lakes posed by Silver Carp, Bighead Carp, Grass Carp, and Black Carp (collectively referred to in this document as "invasive carp"). The ICRCC membership includes 26 U.S. and Canadian federal, state, provincial, tribal, regional, and local agencies.

The central activity of the ICRCC is the annual development and publication of an Invasive Carp Action Plan (Action Plan). The purpose of the ICRCC and the intent of this Action Plan is to prevent the introduction and establishment of invasive carp in the Great Lakes (Figure 1).

The Fiscal Year (FY) 2024 Action Plan outlines a comprehensive management strategy consisting of high-priority prevention, detection, and control projects and includes actions that address potential pathways or vectors for invasive carp movement into the Great Lakes. Projects in the FY 2024 Action Plan are supported by a combination of $26,360,275 in agency funding and $21,000,000 in Great Lakes Restoration Initiative funding provided through federal agency appropriations. These projects help protect the Great Lakes commercial and recreational fishery which is valued at almost seven billion dollars annually.

THE CHALLENGE

Invasive carp – Silver Carp, Bighead Carp, Grass Carp, and Black Carp – have increased in abundance and migrated hundreds of miles upstream through the Mississippi River and its tributaries toward the Great Lakes. Natural resource management agencies in the Great Lakes region are working to prevent further spread of these species. Management of invasive carp at this scale is unprecedented and has required the experimental development and ongoing refinement of many new prevention, detection, and control techniques. Preventing the introduction and establishment of invasive carp in the Great Lakes is a daunting challenge.

The activities conducted by the ICRCC member agencies under the Action Plan are geographically focused to mitigate the risk of introduction and spread at key points, as follows:

- Preventing the introduction of Silver Carp and Bighead Carp into the Great Lakes, with a focus on the State of Illinois' efforts within the Illinois Waterway.
- Preventing the establishment of Grass Carp in the Great Lakes, with a focus on the States of Ohio's and Michigan's efforts within the western basin of Lake Erie and its tributaries.
- Better understanding and preventing the spread of Black Carp toward the Great Lakes, with a focus on populations within the Illinois River.

- Blocking potential migration pathways at other locations, including the State of Ohio's closure of the Little Killbuck Creek connection for the potential transfer of Bighead Carp, Silver Carp, and Black Carp from the Mississippi River basin to the Great Lakes basin, and the ongoing maintenance of previously constructed barriers by the State of Indiana and partners at Eagle Marsh (Fort Wayne, Indiana) and by the State of Ohio at the Ohio & Erie Canal (Akron, Ohio).

Figure 1 — Great Lakes

The ICRCC is convened for the purpose of assisting member agencies in implementing their authorities to reduce and/or eliminate the threats posed by invasive carp to the Great Lakes. Source: SeaWiFS Project, NASA/Goddard Space Flight Center, and ORBIMAGE; https://www.noaa.gov/education/resource-collections/freshwater/great-lakes-ecoregion)

The Action Plan also includes work outside these key areas to further reduce the risk of the introduction and establishment of invasive carp. New control/management technologies are being developed and refined to enhance the effectiveness of comprehensive invasive carp management strategies for the Great Lakes. A multi-agency Contingency Response Plan is ready in the unexpected event of new detections of invasive carp in the Chicago Area Waterway System and the Illinois and Des Plaines rivers upstream of the Starved Rock Lock and Dam. FY 2024 funding also supports the basic coordination and communication activities of the ICRCC, including the development of this Action Plan.

Developed annually since 2010, the Action Plan has incorporated the most current science on invasive carp population status, life history, behavior, and ecological risk, as well as developments in management practices and technologies. The 2024 Action Plan continues to reflect this adaptive approach.

Appendix A includes the FY 2024 Project Funding Matrix.

Appendix B includes FY 2024 agency projects with project descriptions and intended outcomes. Any references to projects in future years are subject to the availability of appropriations. An acronym list is also included in Appendix B.

Appendix C includes the ICRCC Principles of Coordination.

Invasive Carp Action Plan: Fiscal Year 2024

1. INTRODUCTION

The Invasive Carp Regional Coordinating Committee (ICRCC) Fiscal Year (FY) 2024 Invasive Carp Action Plan (Action Plan) contains a portfolio of high-priority prevention, detection, and control projects. These projects constitute a comprehensive and science-based invasive carp management strategy that supports those agencies with jurisdictional authorities to reduce and/or eliminate the threats to the Great Lakes posed by invasive carp. The purpose of the ICRCC and the intent of this FY 2024 Action Plan is to prevent the introduction and establishment of invasive carp in the Great Lakes. The Action Plan serves as a foundation for the work of the ICRCC partnership, a collaboration of U.S. and Canadian federal, state, provincial, tribal, and local agencies.

Projects in the FY 2024 Action Plan are supported by a combination of $26,360,275 in agency funding and $21,000,000 in Great Lakes Restoration Initiative (GLRI) funding**.** These projects help protect the Great Lakes commercial and recreational fishery which is valued at almost seven billion dollars annually.

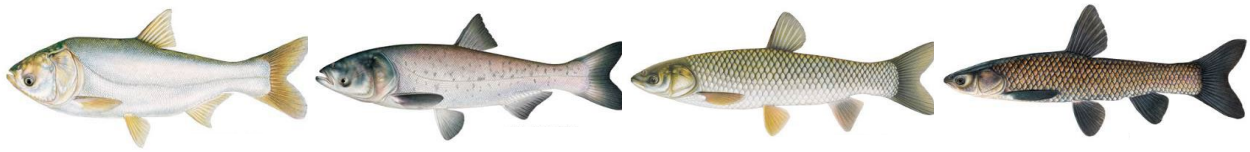
Additional general information on invasive carp can be found at *InvasiveCarp.us*. Information available on the website includes:

- The Invasive Carp Problem (The Invasive Carp Problem | InvasiveCarp.us)
- Frequently Asked Questions about Invasive Carp (FAQs | InvasiveCarp.us)
- What is the ICRCC? (https://www.invasivecarp.us/about-ICRCC.html)
- Partnering Agencies (Partner Agencies | InvasiveCarp.us)
- Specific Invasive Carp Handouts (Printable Handouts | InvasiveCarp.us)
- The Newsroom (Action Plans and Reports | InvasiveCarp.us)

2. INVASIVE CARP AND THE GREAT LAKES — THE THREAT

Invasive carp have posed a growing challenge to North America's aquatic ecosystems and the communities, stakeholders, and economies that depend on healthy aquatic resources since initial unintended introductions into open river systems decades ago. The term "invasive carp" in this document refers to Silver Carp, Bighead Carp, Grass Carp, and Black Carp, the four species addressed by the ICRCC's Action Plan (Figure 2).

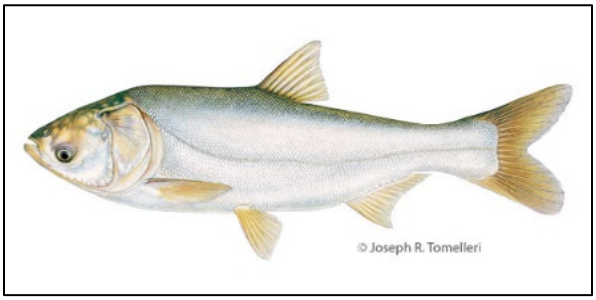
Figure 2 — Invasive Carp



Throughout this document, the term "invasive carp" refers to the following four species: Silver Carp (Hypophthalmichthys molitrix), Bighead Carp (H. nobilis), Grass Carp (Ctenopharyngodon idella), and Black Carp (Mylopharyngodon piceus). Illustration by Joseph R. Tomelleri.

2.1 Silver Carp

Figure 3 — Silver Carp



Silver Carp Photo. Illustration by Joseph R. Tomelleri.

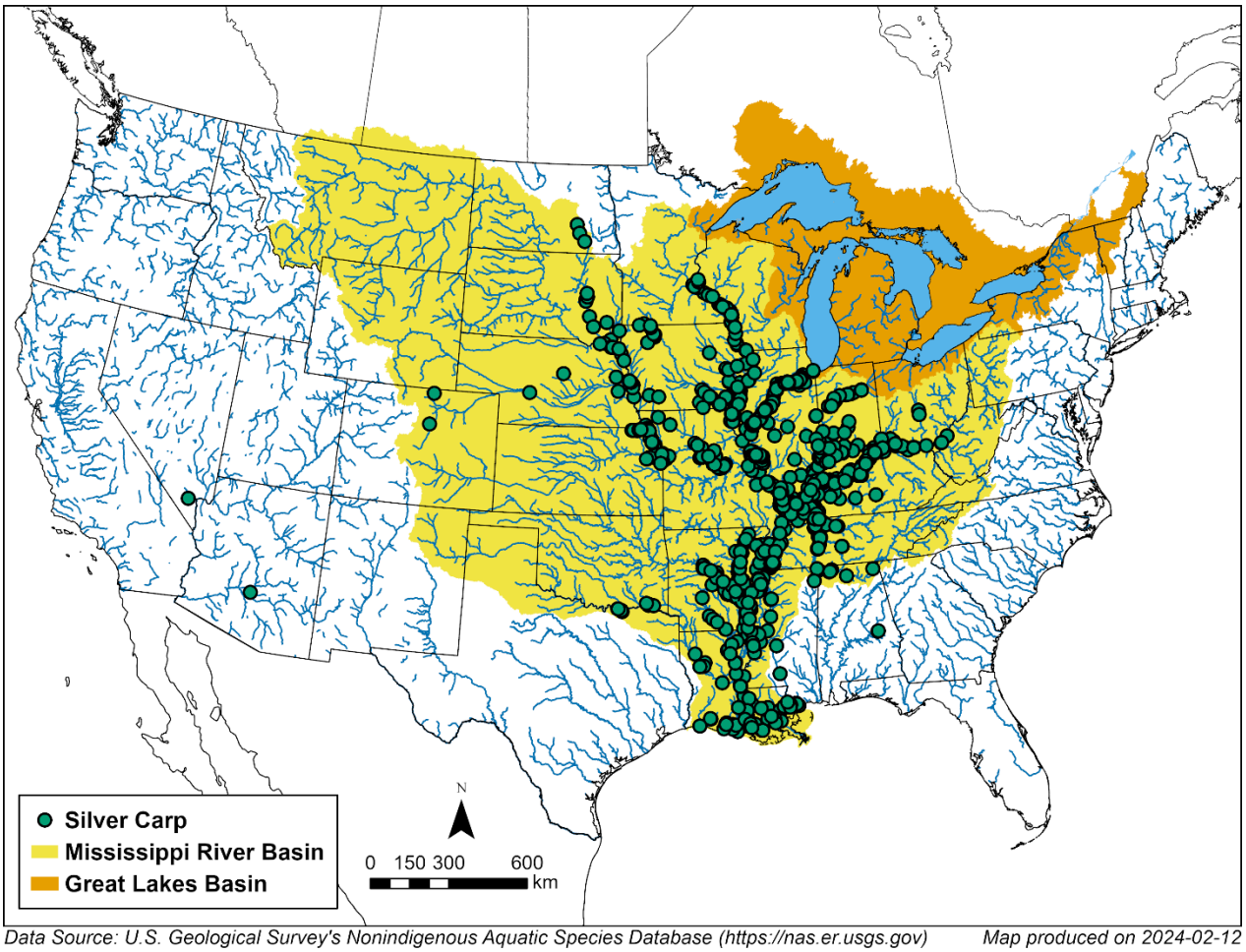
Silver Carp (Figure 3) feed primarily on phytoplankton, as well as zooplankton, invertebrates, detritus, and bacteria. They efficiently filter suspended material from the water with highly specialized gill rakers. Silver Carp adversely affect many native species because they feed on plankton, the primary food source for mussels, larval fish, and certain adult fish. The establishment of large populations of Silver Carp in the Great Lakes could compromise recreational and commercial fishing due to impacts on existing species and pose a threat to human safety due to their jumping behavior when startled. These fish, sometimes referred to as "flying carp," have caused numerous personal injuries and property damage from collisions with people and their boats during recreational boating and fishing.

Silver Carp are now well established throughout much of the Mississippi River basin, including the lower Illinois River. Range expansion has been observed in the Ohio River and other major sub-basins in recent years (Figure 4). Silver Carp can grow to 60 or more pounds and have been collected in the Mississippi River as far north as Lake Pepin in Minnesota. The Silver Carp

population in the Illinois Waterway (IWW) currently poses the greatest threat to the Great Lakes. The population front (or upstream "leading edge") of adult Silver Carp in the IWW remains within Dresden Island Pool, approximately 47 miles and two lock structures from Lake Michigan. This population front has remained unchanged for over 10 years. For more information on Silver Carp, visit Silver Carp | InvasiveCarp.us.

An animated map of the spread of Silver Carp in the United States may be viewed here: https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=549.

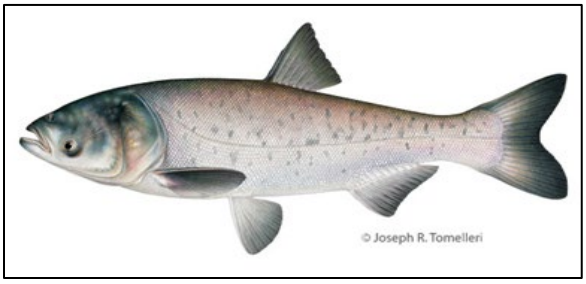
Figure 4 — Documented Occurrence of Silver Carp



Documented occurrence of Silver Carp (reported through February 12, 2024). USGS Nonindigenous Aquatic Species Database). Note: This map represents historical collection records that indicate one or more fish were captured but does not necessarily mean that fish are reproducing or have a population in the area.

2.2 Bighead Carp

Figure 5 — Bighead Carp



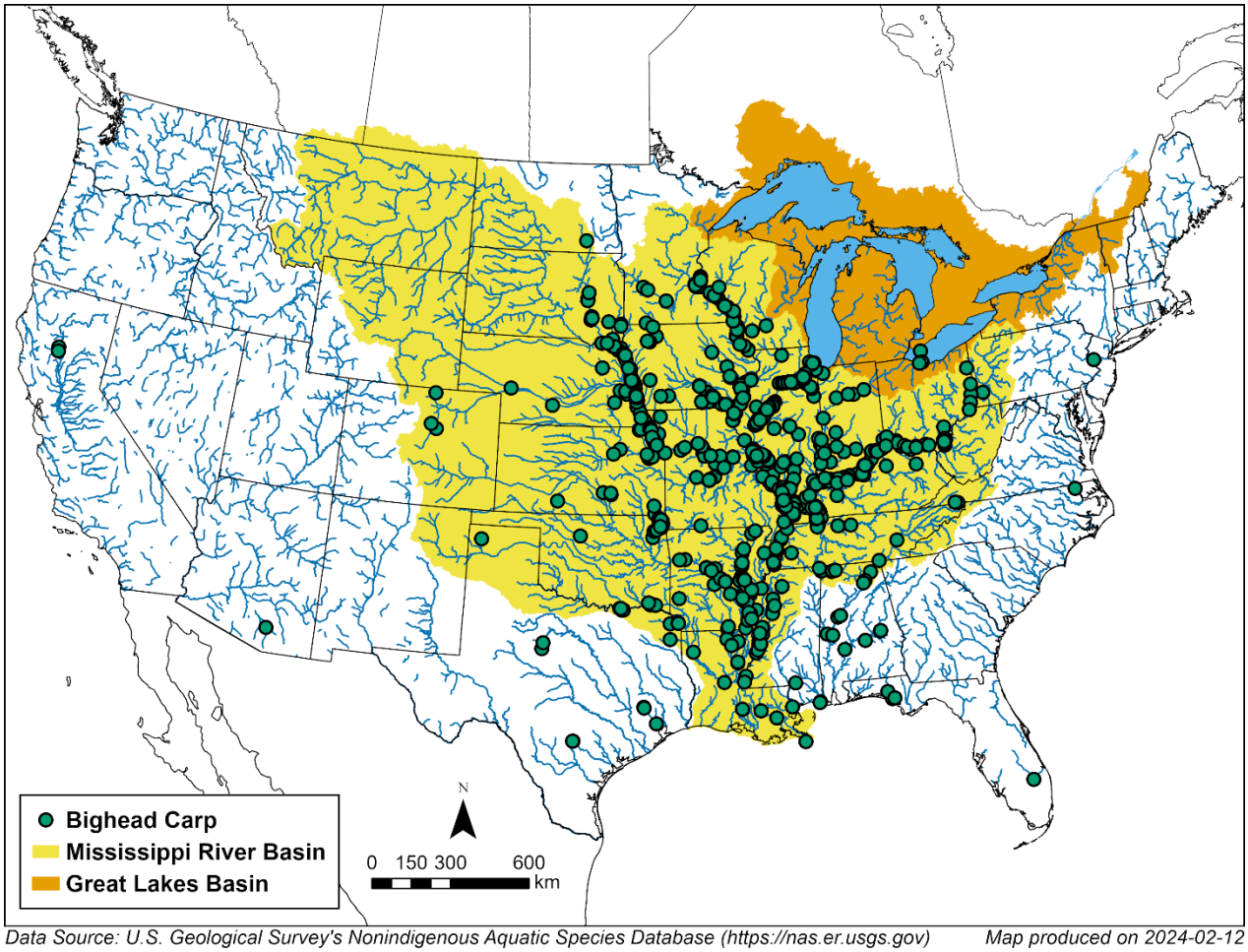
Bighead Carp Photo. Illustration by Joseph R. Tomelleri.

Bighead Carp (Figure 5) feed on or near the surface of the water, as well as in midwater and benthic (bottom) environments, consuming primarily zooplankton, blue-green algae, aquatic insects, and detritus. They efficiently filter suspended material from the water with highly specialized gill rakers. Bighead Carp adversely affect many native species because they feed on plankton, the primary food source for mussels, larval fish, and certain adult fish. The establishment of large populations of Bighead Carp in the Great Lakes could compromise recreational and commercial fishing due to impacts on existing species.

Like Silver Carp, Bighead Carp are now well established throughout much of the Mississippi River basin, with range expansion documented in several river sub-basins (Figure 6). Bighead Carp, which can grow to 100 pounds or more, have since spread through the Mississippi River basin and have been collected as far north as Lake Pepin in Minnesota. The established population in the IWW currently poses the greatest threat for the introduction of Bighead Carp into the Great Lakes. The adult population front of Bighead Carp in the IWW remains within Dresden Island Pool, approximately 47 miles and two lock structures from Lake Michigan. The population front has remained unchanged for over 10 years. For more information on Bighead Carp, visit (Bighead Carp | InvasiveCarp.us).

An animated map of the spread of Bighead Carp in the United States may be viewed here: https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=551.

Figure 6 — Documented Occurrence of Bighead Carp



Data Source: U.S. Geological Survey's Nonindigenous Aquatic Species Database (https://nas.er.usgs.gov) *Map produced on 2024-02-12*

Documented occurrence of Bighead Carp (reported through February 12, 2024). USGS Nonindigenous Aquatic Species Database). Note: This map represents historical collection records that indicate one or more fish were captured but does not necessarily mean that fish are reproducing or have a population in the area.

2.3 Grass Carp

Figure 7 — Grass Carp

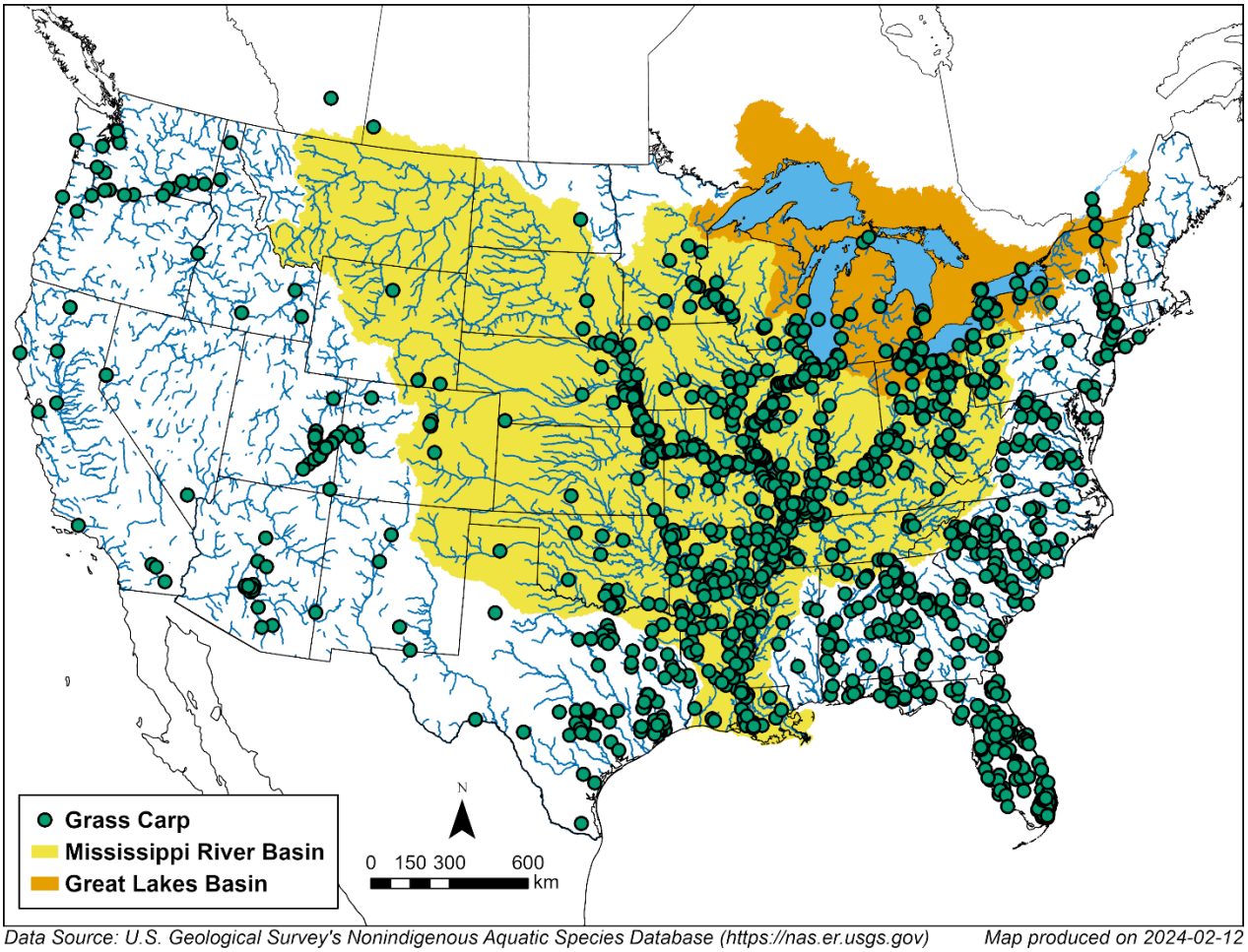
Grass Carp Photo. Illustration by Joseph R. Tomelleri.

Grass Carp (Figure 7) feed primarily on submerged aquatic vegetation and adults can consume over 20 percent of their body weight in vegetation per day. Because of this feeding behavior, Grass Carp have been stocked to control nuisance aquatic plants in small lakes and ponds. Subsequently, infertile adult Grass Carp were produced by aquaculture providers and made widely available for sale. Infertile Grass Carp are referred to as "triploid" because they have three sets of genes rather than the normal two sets, which renders them

reproductively sterile and non-reproducing. Illinois, Indiana, Ohio, Pennsylvania, and New York allow triploid Grass Carp to be used for vegetative control in ponds in compliance with applicable state regulations. Michigan, Wisconsin, and Minnesota prohibit live possession of Grass Carp regardless of ploidy status.

Occurrences of Grass Carp are widely documented throughout much of the contiguous United States. Populations of Grass Carp are now reproducing in major rivers near the Great Lakes, including the Mississippi, Missouri, and Ohio rivers and many other smaller tributaries (Figure 8).

Figure 8 — Documented Occurrence of Grass Carp



Data Source: U.S. Geological Survey's Nonindigenous Aquatic Species Database (https://nas.er.usgs.gov) *Map produced on 2024-02-12*

Documented occurrence of Grass Carp (reported through February 12, 2024). USGS Nonindigenous Aquatic Species Database) Note This map represents historical collection records that indicate one or more fish were captured but does not necessarily mean that fish are reproducing or have a population in the area.

Grass Carp have been detected and captured in all the Great Lakes except Lake Superior. Grass Carp are present within the IWW and are occasionally removed from the Chicago Area Waterway System (CAWS) during Seasonal Intensive Monitoring (SIM) activities. Grass Carp are regularly detected and captured in Lake Erie, with reproduction documented in the Sandusky and Maumee rivers of the lake's western basin. The population in the western basin of Lake Erie currently poses the greatest threat to the Great Lakes from this species. For more information on Grass Carp, visit Grass Carp | InvasiveCarp.us.

An animated map of the spread of Grass Carp in the United States may be viewed here: https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=514.

2.4 Black Carp

Figure 9 — Black Carp

Black Carp Photo. Illustration by Joseph R. Tomelleri.

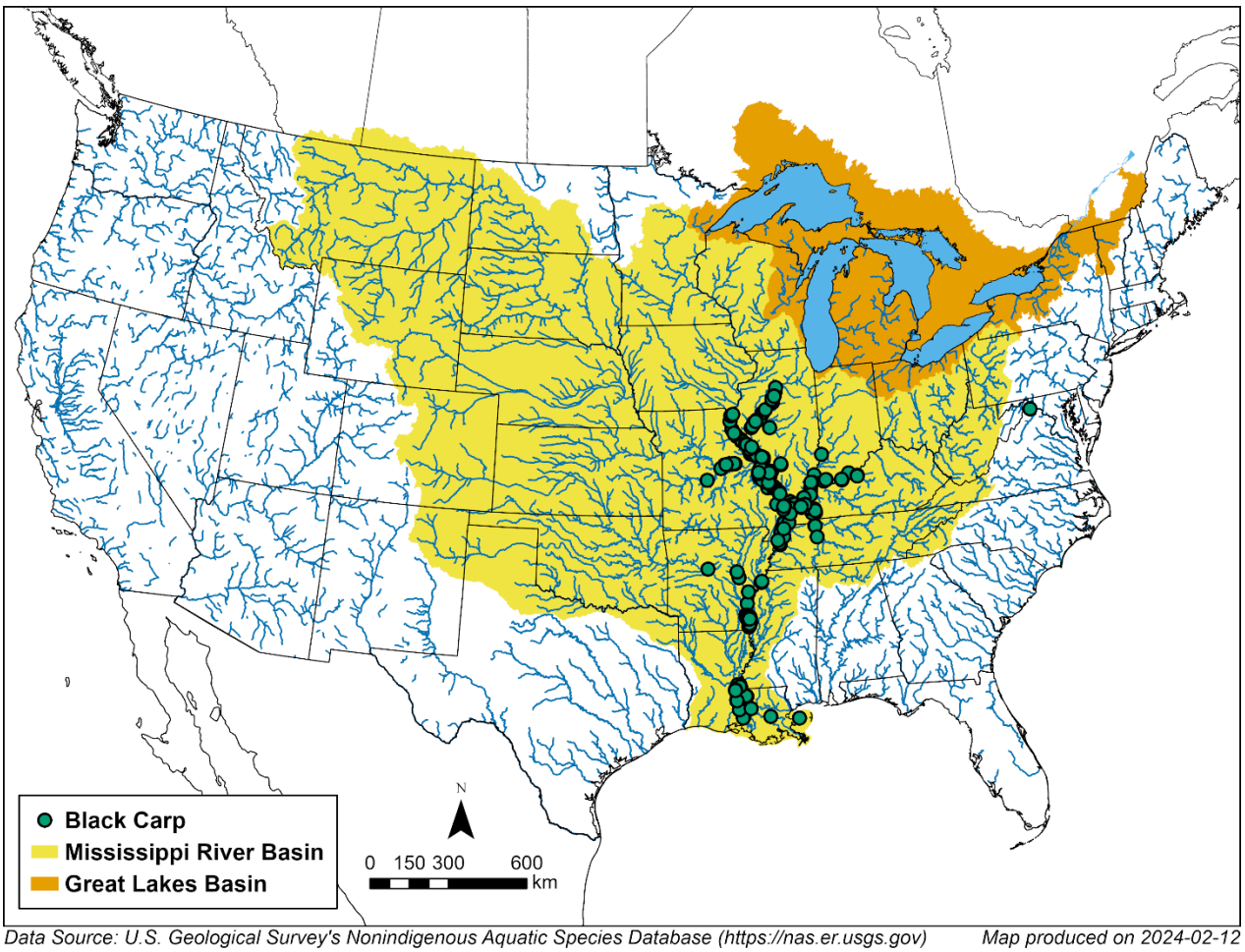
Adult Black Carp (Figure 9) feed primarily on mollusks and snails, using their molar-like pharyngeal teeth to crush the shells. Its preference is to occupy benthic (bottom) areas of rivers. Because of its known feeding ecology, its escape into the Mississippi River raised significant concern among resource managers for the long-term viability of the historical native mussel fauna in the Upper Mississippi River basin, of which over 70 percent are already imperiled or extinct. If Black Carp were to eventually enter the Great Lakes, there would be serious concern for native mollusk populations already impacted by invasive dreissenid mussels (quagga and zebra mussels).

Less is known about the distribution and abundance of Black Carp in the United States compared to Silver Carp, Bighead Carp, and Grass Carp. Black Carp detections are gradually increasing within the Mississippi River basin, including detections in the Illinois and Ohio rivers. In 2022, some expansion in the range of occurrence for Black Carp was observed in certain mainstream rivers within the Mississippi River basin and the Illinois River system, where Black Carp have been captured in the Alton, La Grange, and Peoria reaches of the lower Illinois River (Figure 10). Black Carp can grow to upwards of 150 pounds and live longer than other invasive carp species. The Black Carp population in the Illinois River currently poses the greatest threat to the Great Lakes. Large juvenile and adult Black Carp were initially reported in the Illinois River in 2010. Since 2015, the Illinois Department of Natural Resources (IL DNR) has augmented monitoring of the range expansion of Black Carp within the Upper Mississippi River basin through incentive payments to Black Carp anglers and commercial fishers. Records have increased throughout the lower 183 miles of the Illinois River as a result of these incentives. The furthest upstream captures were in

2023, approximately 8.5 miles upstream of Henry, Illinois, within the Peoria Pool, and approximately 124 river miles and six lock structures away from Lake Michigan. For more information on Black Carp, visit Black Carp | InvasiveCarp.us.

An animated map of the spread of Black Carp in the United States may be viewed here: https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=573.

Figure 10 — Documented Occurrence of Black Carp



Data Source: U.S. Geological Survey's Nonindigenous Aquatic Species Database (https://nas.er.usgs.gov) *Map produced on 2024-02-12*

Documented occurrence of Black Carp (reported through February 12, 2024), USGS Nonindigenous Aquatic Species Database). Note: This map represents historical collection records that indicate one or more fish were captured but does not necessarily mean that fish are reproducing or have a population in the area.

3. SUMMARY OF 2024 ICRCC ACTIONS

The purpose of the ICRCC and the goal of this Action Plan is to prevent the introduction and establishment of invasive carp in the Great Lakes by assisting member agencies in implementing their authorities to reduce and/or eliminate the threats posed by these species. The individual activities in the Action Plan are organized into the following categories:

- **Preventing Invasive Carp Movement through the Illinois Waterway**. This category has three sub-sections:
    - *Illinois Waterway Deterrent Technology Operation and Development.* Projects in this section focus on the operation of the Electric Dispersal Barrier System (EDBS) and the development and testing of migration deterrents for potential use at the Brandon Road Lock and Dam (BRLD), including the underwater acoustic deterrent system (UADS) and Bio-Acoustic Fish Fence (BAFF) technologies.
    - *Removal Actions – Contract Fishing*. These projects include invasive carp removal efforts, focusing on contract fishing and targeted intensive harvest efforts using commercial fishers.
    - *Monitoring and Decision Support.* These actions focus on assessment of the invasive carp population in the lower Illinois River and early detection monitoring in the upper Illinois River and CAWS.
- **Hydrologic Barriers to Prevent Invasive Carp Movement through Intermittent Waterways**. These projects include actions at locations that connect the Mississippi River and the Great Lakes watersheds, including closing the Little Killbuck Creek connection for potential transfer of invasive carp from the Mississippi River basin to the Great Lakes basin, as well as ongoing maintenance of previously constructed barriers at Eagle Marsh (Fort Wayne, Indiana) and the Ohio & Erie Canal (Akron, Ohio).
- **Preventing Establishment of Grass Carp in the Great Lakes.** These actions primarily focus on the detection and removal of Grass Carp from the Lake Erie Western Basin and additional early detection monitoring in Great Lakes tributaries.
- **Understanding Black Carp Population Dynamics to Inform Management Strategies**. These projects include Black Carp monitoring and management strategies, focusing on the Illinois River.
- **ICRCC Communications and Support**. Projects in this section include strategic communication with partners and stakeholders and ICRCC purpose support activities.

3.1 Preventing Invasive Carp Movement through the Illinois Waterway

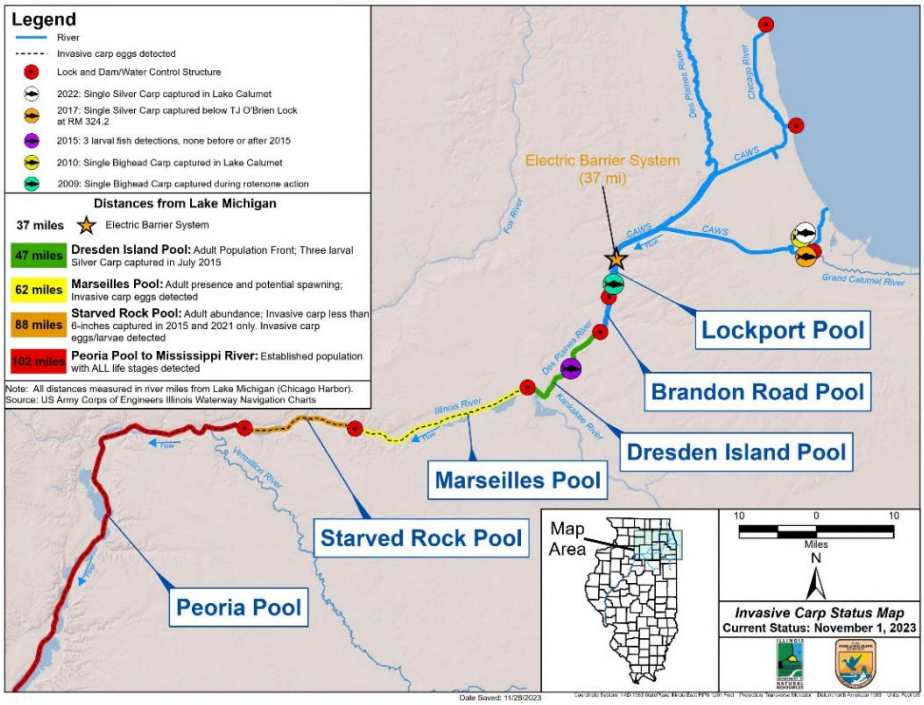
The U.S. Army Corps of Engineers (USACE) Great Lakes and Mississippi River Interbasin Study (GLMRIS) reported Silver Carp and Bighead Carp have caused significant environmental impacts within the IWW and pose a threat to the Great Lakes basin. At the northeast end of the IWW, the CAWS provides a year-round aquatic connection to the Great Lakes. The coordinated interagency effort to address the risk of invasive carp in the IWW began in 2009 with a prevention and fish suppression effort conducted in the CAWS that supported maintenance actions on the USACE EDBS (Figure 11). This was the impetus for creating the ICRCC, which brought together the agencies potentially affected by the expansion of invasive carp into regional waterways. The scope of the Action Plan has since evolved beyond a singular focus on the CAWS; however, controlling invasive carp populations in the IWW to reduce the threat to the Great Lakes remains a major focus.

Figure 11 — CAWS Waterbodies

Map showing the CAWS. Source: Great Lakes Commission

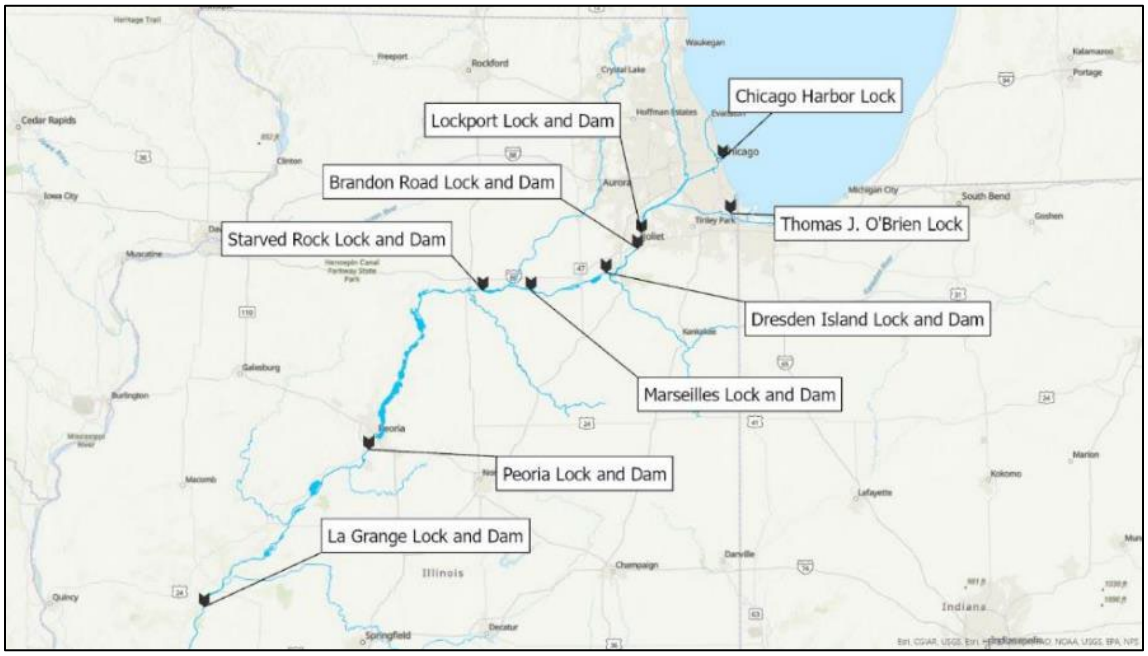
Populations of Silver Carp and Bighead Carp in the IWW are generally characterized by pool. For reference, Figure 12 illustrates the pools in the upper IWW and the stages of invasion for Silver Carp and Bighead Carp. Figure 13 identifies the locks and dams making up the IWW.

Figure 12 — Upper IWW Pools and Stages of Silver Carp and Bighead Carp Invasion



Map showing the Upper IWW pools, distance from Lake Michigan, and where Silver Carp and Bighead Carp are found. Source: IL DNR

Figure 13 — IWW Locks and Dams



Map showing locks and dams along the Illinois Waterway. Source: IL DNR

The Monitoring and Response Work Group (MRWG) is the principal body that supports the extensive coordination needed for work in the IWW. The MRWG is co-chaired by IL DNR and the Great Lakes Fishery Commission (GLFC).

ICRCC actions planned for 2024 include:

Illinois Waterway Deterrent Technology Operation and Development

- Development of deterrents at BRLD and ongoing operation of the EDBS.
- Development and testing of systems using underwater sound as a deterrent to upstream fish migration, use of carbon dioxide at the EDBS, and completion of a technical report summarizing findings of an automated barge clearing deterrent field trial.

Removal Actions – Contract Fishing

- Capture and removal of invasive carp from the upper Illinois River, enhanced harvest where invasive carp are established on the Illinois River to reduce the risk of upstream migration, and refinement of population models to inform future control efforts.

Monitoring and Decision Support

- Characterization of invasive carp populations in the IWW to assess the risk of upstream movement and ensure no invasive carp have moved beyond the EDBS.

3.1.1 Illinois Waterway Deterrent Technology Operation and Development

Migration deterrents and technology development actions are focused on high-risk points of potential introduction and spread and include planning and designing a robust barrier at BRLD (Figure 14), ongoing operation of the EDBS, and enhanced enforcement to prevent unauthorized transport or use of live invasive carp.

The State of Illinois and USACE, with support from the State of Michigan, are actively designing significant prevention measures at the BRLD, with funds to initiate construction from the Bipartisan Infrastructure Law (https://www.mvr.usace.army.mil/Missions/Environmental-Stewardship/BR-Interbasin-Project/). To support this effort, agencies are developing, testing, and refining control technologies that could be used at this location. This project plans to include multiple deterrents, including an electric barrier, acoustic deterrent, bubble curtain, and flushing lock.

The USACE will continue operating the EDBS (Figure 15) in the Chicago Sanitary and Ship Canal (CSSC) and finish installing the second high-field array at Barrier I. Since 2002, several operational and procedural improvements have been implemented to increase the reliability and effectiveness of the EDBS. This effort serves as a key line of defense to prevent invasive carp from becoming established in the Great Lakes by maintaining a constant electrical current in the water of the CSSC to deter fish.

Figure 14 — Recommended Structural Plan – USACE Brandon Road

Note: ABC Deterrent refers to Automated Barge Clearing Deterrent and RDB Guidewall refers to the Right Descending Bank Guidewall. Source: USACE

Figure 15 — USACE EDBS in the CSSC

Schematic of the USACE EDBS in the CSSC Source: USACE

The Action Plan will also support the IL DNR law enforcement efforts in searching for illegal activities (e.g., bait transfer and live fish markets) where invasive carp could be transported or spread by human means. Additional support for key state-led law enforcement activities focused on invasive carp and other aquatic invasive species (AIS) in the Great Lakes basin is provided by the U.S. Fish and Wildlife Service (USFWS) through the GLRI.

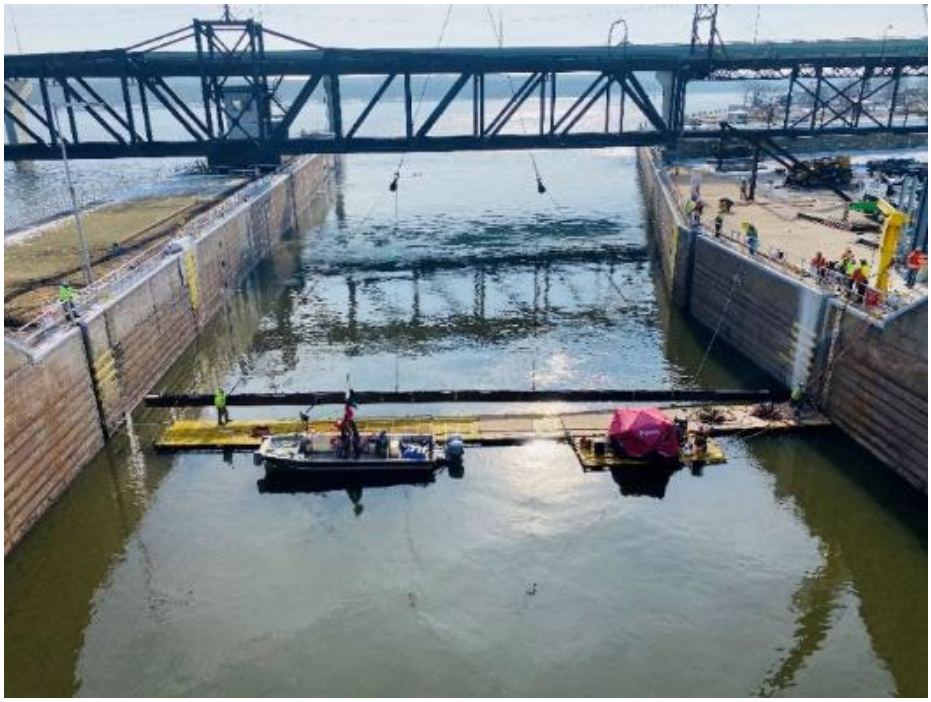
The ICRCC continues to support the development and testing of technology to prevent the movement and spread of invasive carp into the Great Lakes. This work is motivated by the potential use of these technologies to stop Silver Carp and Bighead Carp at the previously mentioned BRLD project. In 2024, the ICRCC member agencies will support work on underwater sound, field deployment of carbon dioxide at the EDBS, and the use of “bubble curtains” (intense concentrations of bubbles) to prevent the accidental entrainment and movement of small fish by shipping barges.

The ICRCC member agencies and partners conducted a multi-year effort to investigate using underwater sound as a potential management technology, including piloting the use of the BAFF and the UADS as two different technologies intended to deter invasive carp. The BAFF project is the large-scale experimental deployment of an integrated sound, bubble, and light deterrent system at Barkley Lock and Dam on the Cumberland River near Grand Rivers, Kentucky. Similarly, the UADS has been installed experimentally in the approach channel at Lock No. 19 near Keokuk, Iowa (Figure 16 and Figure 17). Sixteen underwater speakers play engineered acoustic signals aimed at deterring invasive carp. Both tests are conducted at high-head dam structure sites with no overflow conditions, where acoustic telemetry monitoring infrastructure is in place, and where an established population of invasive carp exists. The results of these studies will reveal the effectiveness of the deterrent technologies and their applicability to protecting the Great Lakes from invasive carp following completion in FY 2024.

Figure 16 — Downbound Tow Traversing UADS – Lock No. 19 (Keokuk, Iowa)

A downbound tow and barges traversing downstream lock approach channel over the UADS at Lock No. 19. Photo credit: Christa Woodley, USACE ERDC

Figure 17 — Soundbar Installation – Lock No. 19 (Keokuk, Iowa)



Installation of the soundbar portion of the underwater acoustic deterrent system in the lock approach channel of Lock No. 19 in February 2021. Photo credit: Marybeth Brey, USGS

Collectively, these projects will result in data to inform future management decisions involving deterrents for invasive carp in rivers, especially at navigation locks. FY 2024 funding will support continued evaluation of the UADS at Lock No. 19, additional analyses of data collected from the BAFF study at Barkley Lock and Dam, and analysis of data collected from an additional small-scale acoustic deterrent study in a backwater of the Illinois River.

The use of carbon dioxide injected into water is being evaluated as a non-lethal behavioral deterrent for invasive carp. In 2019, the U.S. Geological Survey (USGS), USACE, and other partners demonstrated the temporary application of a carbon dioxide infusion system at a navigational lock in Wisconsin. The ICRCC member agencies will support the feasibility testing of using carbon dioxide to clear fish from the EDBS within the CAWS. The EDBS undergoes annual maintenance, presenting an opportunity for fish to move upstream toward Lake Michigan while portions of the system are offline. In 2024, the effort will result in the design, cost estimate, and identification of permit and regulatory requirements associated with implementation.

ICRCC agencies are completing the evaluation of an additional new technology, the Automated Barge Clearing (ABC) Deterrent, to prevent inadvertent entrainment and transport of small fish

through locks and electric barriers by commercial barges. In 2024, the USACE, USFWS, USGS, and partnering agencies will complete the analysis of data collected during a large-scale field trial conducted at Peoria Lock and Dam in 2022. This analysis will identify the efficacy of using directed streams of bubbles for removing small fish from the junctions of commercial barges and discuss the safety of operating both large and small vessels over the ABC Deterrent in the IWW. Results of this project will address known vulnerabilities for the inadvertent entrainment and upstream transport of small fish at the CAWS EDBS and assist in the design of deterrents at BRLD.

Table 1 lists the Illinois Waterway Deterrent Technology Operation and Development projects supported by the 2024 Action Plan.

Table 1 — Illinois Waterway Deterrent Technology Operation and Development Projects

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
ID-1	Operation and Maintenance of the Electric Dispersal Barrier System	USACE
ID-2	USACE Planning for Field Demonstration of Carbon Dioxide Deterrent at the Electric Dispersal Barrier System	USACE
ID-3	USGS Planning for Field Demonstration of Carbon Dioxide Deterrent at the Electric Dispersal Barrier System	USGS
ID-4	Brandon Road Lock and Dam Aquatic Nuisance Species Barrier Project	USACE
ID-5	Further Evaluation of Underwater Acoustics as a Deterrent for Invasive Carp	USACE
ID-6	Summary Evaluation of Bio-Acoustic Fish Fence Deterrent	USFWS
ID-7	Technical Support for Testing of Acoustic Deterrents	USGS
ID-8	Water Quality and Velocity Monitoring in Support of Brandon Road Project	USGS

3.1.2 Removal Actions – Contract Fishing

Removal actions are designed to contain and stop the expansion of populations of invasive carp in the Illinois River and reduce population pressure threatening the EDBS and the Great Lakes basin. This includes the removal of invasive carp in both the upper and lower Illinois River. To reduce the population pressure, the MRWG set a goal of removing three million pounds of invasive carp annually through the Enhanced Contract Fishing Program by contracting with legally licensed Illinois commercial fishers below the Starved Rock Dam. Above Starved Rock Dam in the

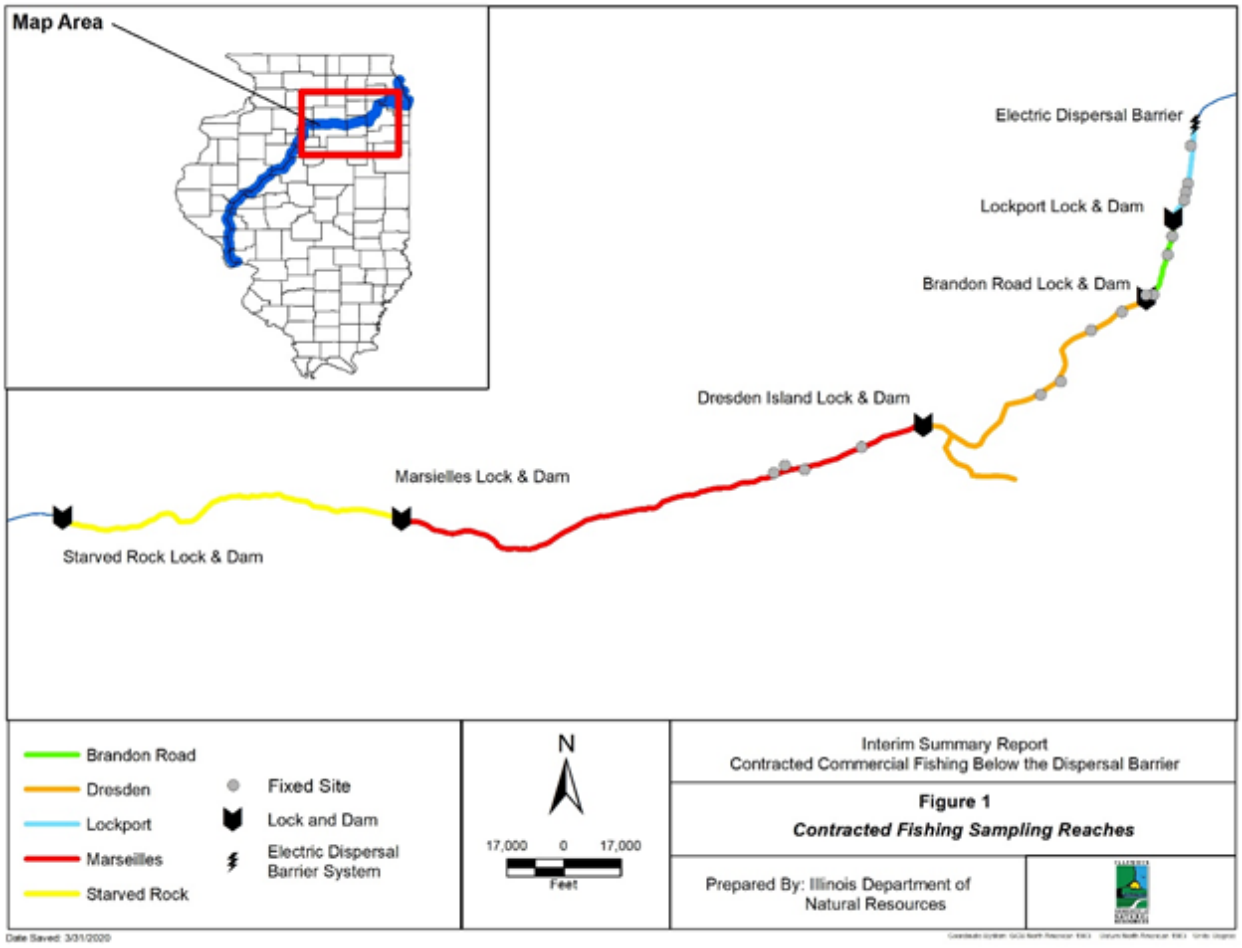
Upper IWW where populations are lower, the goal is to remove at least one million pounds of invasive carp annually with contracted commercial fishing (Figure 18).

Figure 18 — Contract Fishing on the IWW

Photo of contract fishers removing invasive carp from the Illinois River. Source: IL DNR

The Enhanced Contract Fishing Program offers Illinois-licensed commercial fishermen a financial incentive for each pound of invasive carp removed from the Peoria Pool and sold to fish processors or other buyers. This state-led program encourages business development and enhanced contract fishing to increase harvest of invasive carp in the lower IWW (Figure 19).

Figure 19 — Contracted Commercial Fishing Sampling Area



Map of fishing areas used by contracted commercial fishers in the Illinois Waterway. Source: IL DNR

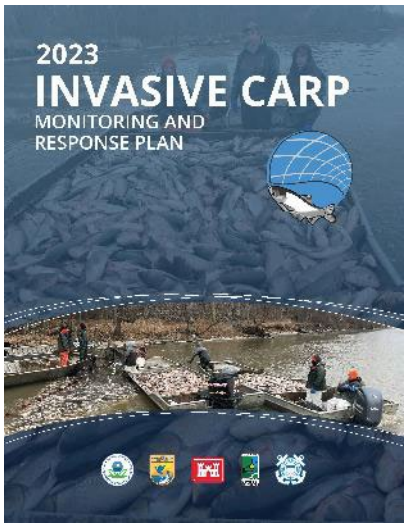
Table 2 lists the Removal Actions – Contract Fishing projects supported by the 2024 Action Plan.

Table 2 — Removal Actions – Contract Fishing Projects

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
IR-1	Contract Fishing for Invasive Carp Removal Near the Electric Dispersal Barrier System	IL DNR
IR-2	Enhanced Invasive Carp Removal in the Lower Illinois River	IL DNR

3.1.3 Monitoring and Decision Support

The continued monitoring and assessment of invasive carp in the IWW is critical for assessing the threat of upstream movement and informing where to target prevention and control actions. Surveillance upstream and downstream of the EDBS ensures no invasive carp have moved beyond this critical control point. The MRWG's Monitoring Response Plan (MRP) is developed annually to evaluate invasive carp status on a pool-by-pool basis within the IWW and target monitoring and control efforts accordingly.



The MRP has been produced annually since 2011.

For more information on the efforts of the MRWG and the MRP, please see the 2023 MRP at (2023 Invasive Carp Monitoring and Response Plan). SIM activities upstream of the EDBS will continue in the upper IWW during the spring and fall of 2024, focusing on detecting and removing invasive carp. This effort will use targeted sampling with a variety of gears, including seines, trammel nets, and hoop nets to detect, capture, and remove any invasive carp from upstream locations. In 2024, USFWS will conduct eDNA monitoring for Bighead Carp and Silver Carp in the CAWS prior to the initiation of the spring and fall SIM traditional fishery gear sampling.

Figure 20 — Commercial Fishing Seine Net

Photo of a commercial fishing seine net. Source: IL DNR

Gear Sampling and Surveillance

The ICRCC member agencies continue to support sampling using a variety of gear types at sites between the Peoria reach of the Illinois River and the EDBS to detect upstream migrations of small and juvenile Silver Carp and Bighead Carp. Downstream of the EDBS, fixed and random site sampling and contracted netting will be implemented at four sites in each of the four pools below the EDBS. This effort provides surveillance in the Lockport, Brandon Road, Dresden Island, and Marseilles pools, utilizing boat electrofishing, electrified dozer trawling, hoop netting, and mini-fyke netting. Upstream of the EDBS, agencies will utilize multiple gear types during the semi-annual SIM events conducted at numerous sampling locations in the CAWS.

In addition, USFWS will continue focused surveillance of small (less than 6 inches in total length) fish in the Marseilles Pool and Dresden Island Pool and targeted effort for detection of both small and large invasive carp in the uppermost pools of the IWW where they are not known to be currently present. This focused effort is intended to further inform the risk of invasion to the Great Lakes by providing additional data for confirmation that invasive carp are not present above BRLD.

eDNA Sampling and Surveillance

USFWS additionally supports environmental deoxyribonucleic acid (eDNA) sampling as an early detection monitoring tool. USFWS maintains program capacity through agency funding to support strategic eDNA surveillance for invasive carp in the Great Lakes and Mississippi River basins. This work includes the continued refinement and development of state-of-the-art tools, field sampling, and laboratory protocols and expanded analytical capacity to support a robust eDNA monitoring program for efficiently sampling high-priority locations for the presence of invasive carp. In 2024, USFWS will conduct eDNA monitoring for Bighead Carp and Silver Carp in the CAWS prior to initiation of the spring and fall SIM traditional fishery gear sampling.

Telemetry Tracking and Hydroacoustics Monitoring

Telemetry tracking and hydroacoustic monitoring of invasive carp in the Alton through Lockport pools of the IWW will continue in 2024. Through the telemetry project, invasive carp are implanted with acoustic transmitters (captured and released in areas where they are already established), and their movement is tracked across an acoustic receiver array (Figure 21). Hydroacoustic sampling will be conducted in the upper Illinois River throughout the Marseilles, Dresden Island, Brandon Road, and Lockport pools to identify areas with high densities of large-bodied fish that could potentially be invasive carp. Hydroacoustic sampling will also occur in Alton to Dresden Island pools in October to quantify pool-wide invasive carp densities for comparison to long-term data collected since 2012. Hydroacoustic sampling will also occur within the EDBS and in the area

immediately downstream (approximately 1.2 miles) of the barrier every two weeks throughout the year. These surveys are intended to identify the presence of any large-bodied fish (fish larger than 12 inches in total length) near the EDBS and help evaluate the potential risk of fish passage in the event of operational changes (e.g., EDBS maintenance).

Figure 21 — Acoustic Transmitter Being Surgically Implanted into an Invasive Carp

Photo shows USGS personnel surgically implanting an acoustic transmitter into an invasive carp. Photo credit: Marybeth Brey, USGS

Contingency Actions

In FY 2024, the ICRCC member agencies will remain prepared to implement contingency (rapid response) actions through the MRWG Contingency Response Plan (CRP) for the Upper IWW and CAWS. The CRP is triggered if a change is detected in the status/risk of invasive carp in the Starved Rock, Marseilles, Dresden Island, Brandon Road, and Lockport pools. An interagency CRP tabletop exercise is planned for FY 2024 to ensure agency personnel are prepared to implement appropriate response actions, if needed. ICRCC member agencies are prepared to shift resources

from other activities to support response actions deemed necessary by the appropriate jurisdictional authority in the event of new invasive carp detections.

Natural resource agencies continue to monitor for invasive carp as part of their standard surveillance activities within the Great Lakes basin. Through USFWS, the ICRCC member agencies support collaborative efforts with U.S. member agencies to implement an ongoing early detection program for AIS, including invasive carp, in the nearshore U.S. waters of the Great Lakes. A wide array of traditional and novel gears is utilized to sample all potential life stages of invasive carp species.

Supporting State Priorities for Basin-Wide Early Detection

In coordination with state partners, USFWS also conducts eDNA sampling as an early detection monitoring tool. USFWS maintains program capacity through agency funding to support strategic eDNA surveillance for invasive carp in the Great Lakes and Mississippi River basins. In 2024, this work will continue to include developing state-of-the-art tools, field sampling, and laboratory protocols. This work will also include expanded analytical capacity to support a comprehensive eDNA monitoring program for efficiently sampling high-priority locations for the presence of invasive carp.

The FY 2024 Action Plan includes support for analytical tools to inform the prioritization, planning, and strategic implementation of the numerous prevention, control, and monitoring actions proposed for the IWW and adjacent waterways. These decision support activities are utilized by the ICRCC to provide objective assessments of potential results achieved by conducting specific invasive carp prevention and control actions under various scenarios. Quantitative fishery analysis tools, including the Spatially Explicit Invasive Carp Population (SEICarP) and Statistical Catch-at-Age models, are being further developed to assess the impacts on invasive carp populations resulting from intensive harvest efforts conducted in specific locations and times within the IWW and to better understand the general demographic trends of the Bighead Carp and Silver Carp populations over time within the IWW. Additional decision support tools are being used to predict the likely timing and locations of invasive carp spawning in mainstem rives and tributaries to inform on-the-water monitoring and capture efforts. Additionally, a structured decision-making approach has been adopted by the Black Carp Work Group (BCWG) to collaboratively identify the highest-priority monitoring and management actions for implementation in the IWW and other waters.

For more information on the efforts of the MRWG and the MRP, please see the 2023 MRP at: 2023 Invasive Carp Monitoring and Response Plan.

Table 3 lists the Monitoring and Decision Support Projects supported by the 2024 Action Plan.

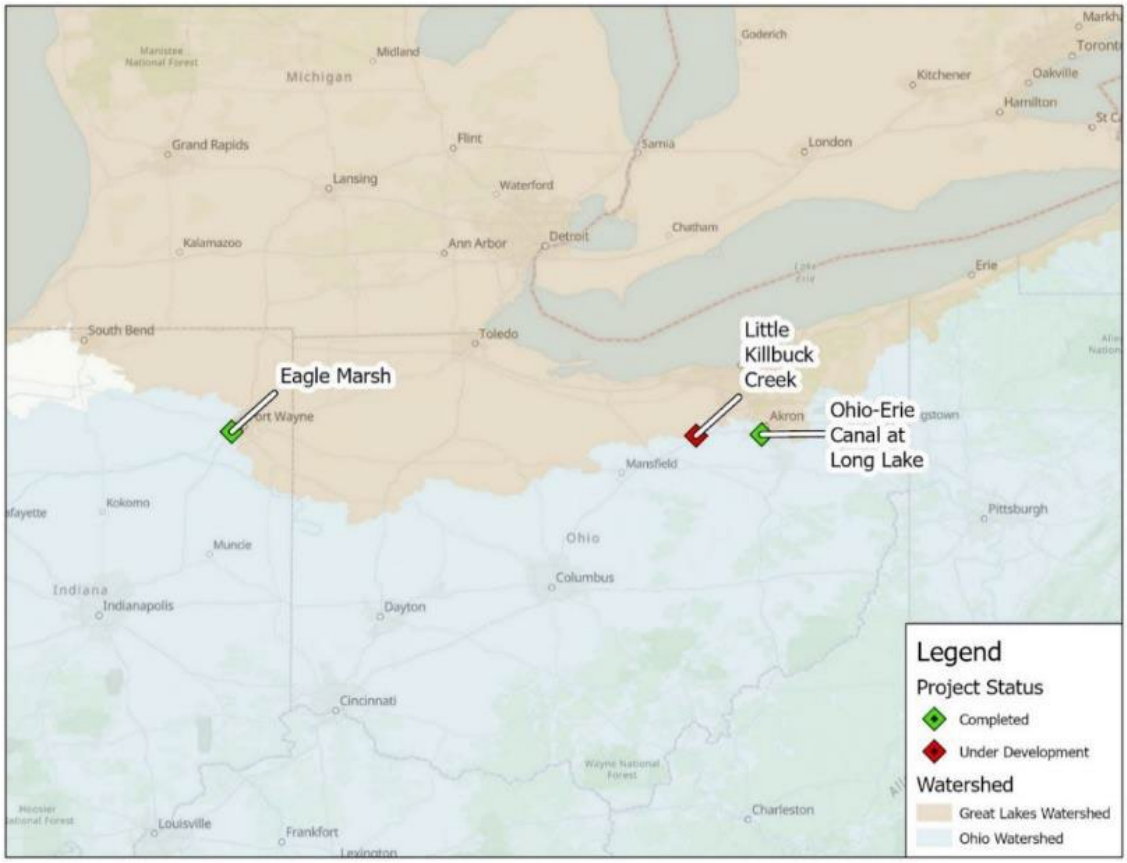
Table 3 — Monitoring and Decision Support Projects

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
IM-1	Early Detection Monitoring and Contingency Response in the Illinois Waterway	IL DNR
IM-2	Support for Early Detection in the Upper Illinois Waterway	USFWS
IM-3	Invasive Carp Stock Assessment in the Illinois River Using Hydroacoustics	IL DNR
IM-4	USFWS Hydroacoustic Surveys of Fish Abundance and Distribution in the Upper Illinois Waterway	USFWS
IM-5	Assessment of Invasive Carp Reproduction and Ecosystem Response in the Illinois Waterway	IL DNR
IM-6	Invasive Carp Demographics in the Illinois Waterway	USFWS
IM-7	Invasive Carp eDNA Sampling and Processing	USFWS
IM-8	Real-Time Telemetry Alert System and Refinement of the Spatially Explicit Invasive Carp Population Model (SEICarP)	USGS
IM-9	Telemetry Tracking in the Illinois Waterway to Support the Spatially Explicit Invasive Carp Population Model (SEICarP)	USFWS
IM-10	Alternate Pathway Surveillance in Illinois	IL DNR
IM-11	Evaluation of Invasive Carp Spawning Dynamics and Collection of Associated Hydrological Data	USGS
IM-12	Invasive Carp Database Management and Integration Support	USGS
IM-13	USGS Support for Invasive Carp Population Modeling in the Illinois River	USGS
IM-14	USFWS Support for Invasive Carp Population Modeling in the Illinois River	USFWS
IM-15	Early Detection Monitoring for Invasive Carp in the Great Lakes	USFWS
IM-16	Evaluation of Fish Transfer System to Promote Native Species Movement and Invasive Carp Harvest	IL DNR

3.2 Hydrologic Barriers to Prevent Invasive Carp Movement through Intermittent Waterways

In 2024, the ICRCC member agencies will continue to support work on pathways identified through the GLMRIS for potential invasive carp introduction and spread. Work will include the project design, real estate negotiations, permitting, and construction (phased over multiple years) to close the pathway on Little Killbuck Creek in northwest Ohio, identified as an intermittent hydrologic connection during periods of high water. Two additional GLMRIS pathways addressed in prior years are Eagle Marsh (Fort Wayne, Indiana) and the Ohio & Erie Canal Aquatic Nuisance Species Barrier project (Akron, Ohio) (Figure 22). Working with local agencies, the Indiana Department of Natural Resources, and Ohio Department of Natural Resources (OH DNR) will continue to maintain those barriers, respectively.

Figure 22 — Alternate Pathways for Potential Interbasin Movement of AIS



Map identifying Great Lakes and Ohio River watersheds and status of interbasin pathways projects. Source: OH DNR

Using previous funding, OH DNR will complete the berm design, permitting, wetland mitigation, and construction of a rock berm that is at highest risk for flooding (Phase 1). The remaining project (Reaches 2 through 7, Phases 2 through 6) will be phased over multiple years and will further stabilize and maintain the current earthen berm and upgrade related infrastructure. Phase 1 of the project will be initiated in the spring of 2024 and will be a new rock berm on Medina County Park District property. Phase 2 of the project will be completed using FY 2024 funding and will address the second highest AIS risk, including purchasing an easement for the current earthen berm, raising two roadways (Franchester and Garden Isle), upgrading a pumping facility to ensure dry conditions, improving the access road for future construction phases, and screening a structure for a culvert. Later phases will include the maintenance of the current earthen berm and additional measures.

Table 4 lists the Hydrologic Barriers to Prevent Invasive Carp Movement through Intermittent Waterways projects supported by the 2024 Action Plan.

Table 4 — Hydrologic Barriers to Prevent Invasive Carp Movement through Intermittent Waterways Projects

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
HB-1	Construction of Structures at Little Killbuck Creek, Ohio, to Prevent Inter-Basin Movement of Invasive Carp	OH DNR
HB-2	Maintenance of Structures at Ohio & Erie Canal to Prevent Inter-Basin Movement of Invasive Carp	OH DNR

3.3 Preventing Establishment of Grass Carp in the Great Lakes

Grass Carp have been detected in Lakes Erie, Huron, Michigan, and Ontario and pose a significant environmental risk, as indicated in the *Ecological Risk Assessment of Grass Carp (Ctenopharyngodon idella) for the Great Lakes Basin*, a binational, peer-reviewed risk assessment published in 2017. The risk assessment indicated that it is "very likely" that Grass Carp will become established in Lakes Erie, Huron, Michigan, and Ontario within 10 years unless a program can be developed that could control the population growth and dispersal. Table 5 provides an estimated timeframe of the likelihood of Grass Carp establishment in the Great Lakes. U.S. and Canadian agencies are actively developing and implementing Grass Carp control programs within their jurisdictional waters.

Table 5 — Likelihood of Grass Carp Establishment in the Great Lakes

Location	Timeframe
Lake Erie	High – by 5 years
Lakes Michigan, Huron, Erie, and Ontario	Very Likely – by 10 years
Lake Superior	Low – at 50 years

Source: Ecological Risk Assessment of Grass Carp (Ctenopharyngodon idella) for the Great Lakes Basin, 2017

The GLFC's Lake Erie Committee (LEC) of fishery managers coordinates efforts to monitor, assess, understand, and control the Grass Carp population in Lake Erie. Actions conducted in 2024 will (1) support the goals and objectives of the LEC's new 5-year Grass Carp adaptive response strategy being developed to guide efforts for 2024 through 2028 and (2) build upon the accomplishments and lessons learned from the implementation of the previous Grass Carp strategy for Lake Erie that spanned 2019 through 2023. The binational LEC, comprised of fishery managers from Michigan, Ohio, Pennsylvania, New York, and Ontario and supported by Canadian and U.S. federal agencies, adopted this 5-year adaptive response strategy to reduce the threat of Grass Carp to Lake Erie through common and coordinated efforts.

The Grass Carp Advisory Committee (GCAC) serves as the instrument of signatory agencies to *A Joint Strategic Plan for Management of Great Lakes Fisheries* (Joint Strategic Plan) and the GLFC for coordinating regional efforts to seek eradication of Grass Carp in Lake Erie, if possible, while also maintaining surveillance where appropriate in other lakes. The GCAC serves to: (1) coordinate actions that address specific LEC priorities associated with its 5-year adaptive response strategy to eradicate Grass Carp, (2) develop coordinated approaches to address critical uncertainties identified by the LEC, (3) provide recommendations about additional uncertainties that should be addressed and whether any LEC priorities should be adjusted based on the effectiveness of priority actions to date and accumulated insights about critical uncertainties that may affect LEC goals, and (4) coordinate surveillance for Grass Carp throughout the Great Lakes basin and provide advice to individual lake committees as appropriate. All signatory agencies to the Joint Strategic Plan have been invited to participate as members of the GCAC.

In 2024, USFWS will continue to implement Grass Carp surveillance and control actions in Lake Michigan, with support from the State of Michigan, the GLFC, and the Lake Michigan Committee. USFWS will also continue Grass Carp surveillance and control efforts in Lake Ontario.

In summary, ICRCC member actions related to Grass Carp that are planned for 2024 include:

- Support Grass Carp removal efforts primarily focused on Lake Erie led by strike teams.
- Identify optimal river conditions for spawning and recruitment of invasive carp in tributaries of the Lake Erie Western Basin to inform future targeted management actions.
- Develop a web-based decision support tool ('SpawnCast') that produces forecasts of potential Grass Carp spawning events to inform targeted control actions.
- Conduct additional exploratory Grass Carp sampling in tributaries of Lake Erie, Lake Michigan, and Lake Ontario.
- Conduct research to predict Grass Carp locations, estimate origin, study movement via telemetry, assess ploidy, evaluate potential baits/attractants, and simulate potential impacts to Great Lakes native species and ecosystems.
- Conduct planning and analyses to determine the feasibility of a barrier to limit Grass Carp spawning on the Sandusky River in Ohio.
- Partner with commercial fishing operations and recreational anglers to promote the removal and reporting of Grass Carp from Lake Erie.

Table 6 lists the Preventing Establishment of Grass Carp in the Great Lakes projects supported by the 2024 Action Plan.

Table 6 — Preventing Establishment of Grass Carp in the Great Lakes Projects

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
GC-1	Removal of Grass Carp in Ohio Waters of the Lake Erie Western Basin and Early Detection Monitoring in Other Lake Erie Tributaries	OH DNR
GC-2	Removal of Grass Carp in the Lake Erie Western Basin and Early Detection Monitoring in Great Lakes Tributaries	MI DNR
GC-3	Support for Removal of Grass Carp in the Lake Erie Western Basin and Early Detection Monitoring in Great Lakes Tributaries	USFWS
GC-4	Invasive Carp Ploidy Analysis to Assess Reproductive Risk of Detected Populations	USFWS
GC-5	Monitoring for Grass Carp Eggs and Larval Fish to Identify Spawning Tributaries and Specific Spawning Areas	USGS
GC-6	Refinement of the Grass Carp Spawning Event Prediction Tool	USGS

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
GC-7	Identification of Optimal River Conditions for Spawning and Recruitment of Invasive Carp in Tributaries of the Lake Erie Western Basin	USGS
GC-8	Using Telemetry to Better Understand Grass Carp Movements and Habitat Use	USGS
GC-9	Characterization of Hydrology and Sediment Mobility to Inform Design and Implementation of a Seasonal Barrier in the Sandusky River	USGS
GC-10	Development and Testing of Deterrent Technologies for Grass Carp	USGS
GC-11	Monitoring Potential Population Growth, Food Web Effects, and Control of Grass Carp in the Lake Erie Western Basin	NOAA

3.4 Understanding Black Carp Population Dynamics to Inform Management Strategies

While Black Carp have not been found in the upper reaches of the Illinois River, they have been found in the lower Illinois River, and there is increased concern for their potential movement toward the Great Lakes. Naturally reproducing populations of Black Carp are now present and increasing their range in the Mississippi River basin. Recognizing the emerging threat, the ICRCC formed an interagency BCWG to collaboratively evaluate the status of the species, identify management needs and objectives, and develop a strategy for implementing high-priority monitoring and control actions to abate the further expansion and establishment in U.S. waters. A focus remains on refining and implementing strategies for effectively sampling Black Carp, a bottom-dwelling species, using traditional fishery gears and eDNA surveillance; collecting and leveraging data from captures of Black Carp reported by commercial fishers; and developing and testing potential management tools for prevention and population control of this species.

In summary, ICRCC member agency actions related to Black Carp that are planned for FY 2024 include:

- Monitoring and assessing population to track upstream movement of Black Carp in the Mississippi and Illinois rivers.
- Conducting traditional fishery gear sampling with experimental baits/attractants to assess the presence, abundance, and potential range expansion of Black Carp and the efficacy of various baits for enhancing Black Carp capture in the lower Illinois River.

- Researching the movement behavior of Black Carp in the wild, as well as evaluating diet composition, reproductive development, population demographics, and larval development.
- Continuing outreach with commercial fishers and anglers to collect additional Black Carp samples for obtaining key demographics and other data through a state-led reward program.

Table 7 lists the Understanding Black Carp Population Dynamics to Inform Management Strategy projects supported by the FY 2024 Action Plan.

Table 7 — Understanding Black Carp Population Dynamics to Inform Management Strategy Projects

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
BC-1	Enhanced Detection of Black Carp in the Lower Illinois River	IL DNR
BC-2	Data Collection from Commercial Fishers and Recreational Angler Captures of Black Carp in the Lower Illinois River	IL DNR
BC-3	Support for Black Carp Monitoring and Population Assessment	USGS
BC-4	Support for Black Carp Monitoring and Interagency Coordination	USFWS

3.5 ICRCC Communications and Support

The FY 2024 Action Plan includes key activities to continue effective communication and partnership coordination efforts in support of the ICRCC's purpose of Great Lakes protection from invasive carp.

The Communication Work Group (CWG), co-chaired by the USFWS and IL DNR, will continue to develop and provide timely and relevant information to the public, government agencies and officials, and other stakeholders. Continuing this outreach and communication approach is a key component of the ICRCC's strategy to promote transparency and accountability and support effective and timely communications on key ongoing and emerging invasive carp issues. A goal of the CWG is to contribute to key audiences' understanding and appreciation for the ICRCC's purpose and ultimately increase stakeholder engagement and support for efforts to protect the Great Lakes from invasive carp. The CWG includes communications expertise from both U.S. and Canadian ICRCC member agencies, serving to coordinate messaging and communications in a

complex multi-agency response and management setting. A primary platform within the ICRCC's communications approach is the partnership's designated website, InvasiveCarp.us. As the site administrator, USFWS will continue to lead efforts to develop and update relevant website content in collaboration with partner agencies.

Additional support for achieving the ICRCC's purpose is provided through the FY 2024 Action Plan for general partnership operational and logistical needs, including contractor staffing capacity, as needed.

In summary, the ICRCC, with its partners, will continue to collaborate to:

- Provide timely and substantive technical information to Congress, the public, the media, and other stakeholders about the status of the invasive carp threat and the coordinated strategic actions undertaken by the ICRCC to address the threat.
- Collaborate with other invasive carp management efforts and partnerships outside the Great Lakes to leverage opportunities, best practices, strategies, and resources on invasive carp prevention and control across multiple basins, in support of the goals of the national *Management and Control Plan for Bighead, Black, Grass, and Silver Carp in the United States* (National Plan).

These collaborative efforts will further support the efforts of partners to identify and leverage expertise, share data, and increase capacity to address the challenge of preventing the introduction and establishment of invasive carp more broadly and holistically on a multi-basin, regional, and national scale.

Table 8 lists the ICRCC Communications and Support projects supported by the FY 2024 Action Plan.

Table 8 — ICRCC Communications and Support Projects

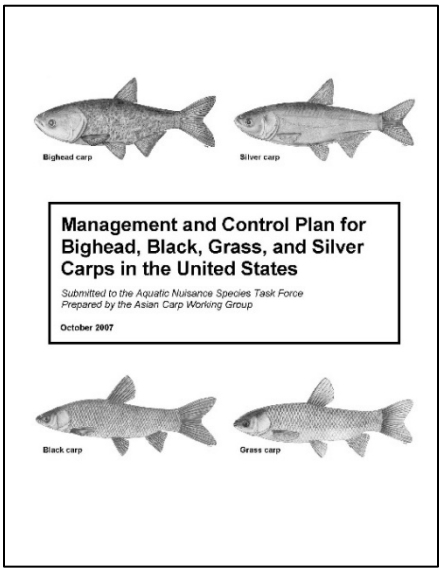
Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
MS-1	ICRCC Strategic Communications with Partners and Stakeholders	USFWS
MS-2	ICRCC Mission Support	USFWS

4. NATIONWIDE AND BINATIONAL INVASIVE CARP MANAGEMENT

The ICRCC's efforts to prevent the introduction and establishment of invasive carp in the Great Lakes take place within a greater nationwide and international context. Invasive carp represent a significant challenge to natural resource managers across much of the U.S. and Canada.

4.1 Nationwide Invasive Carp Management

In the U.S., the river corridors of the Mississippi River basin provide an expansive network of interconnected pathways for the potential movement of invasive carp into the watershed's 31 states. Figure 23 demonstrates the extent of Bighead Carp and Silver Carp populations within the Mississippi River basin's mainstem rivers. Working through the Mississippi Interstate Cooperative Resource Association (MICRA) framework, interagency invasive carp partnerships were initially formed in 2014 to address the threat of invasive carp in the Upper Mississippi River and Ohio River sub-basins and are now operating in all major river sub-basins of the Mississippi River basin (Figure 24). Geographically-focused management strategies are being implemented, stepped down from the national guidance provided in the *Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States.*

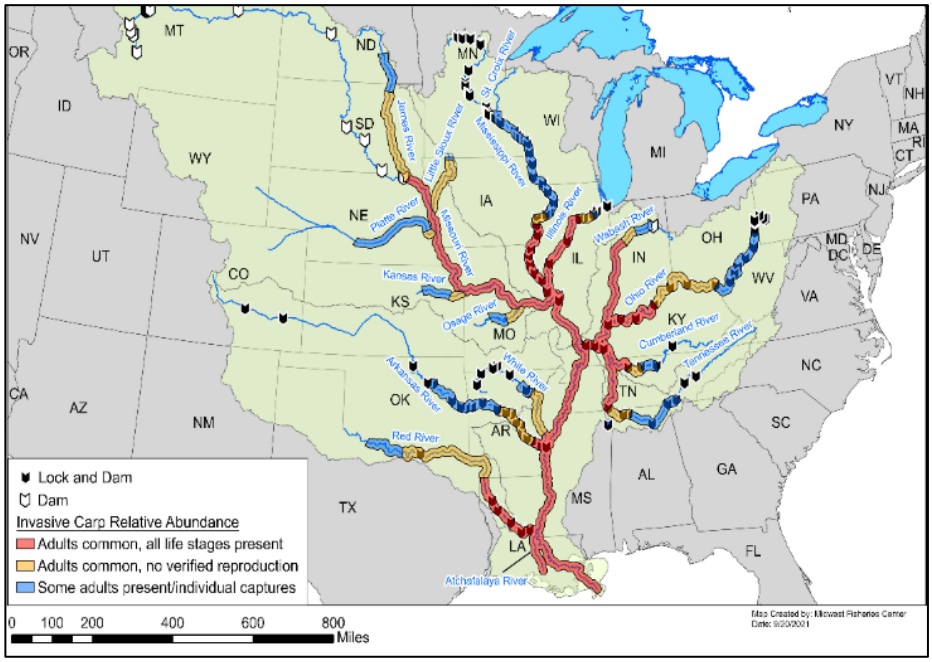


Management and Control Plan developed by the Aquatic Nuisance Species Task Force, Washington, D.C., 2007

(https://invasivecarp.us/Documents/Carps_Management_Plan.pdf).

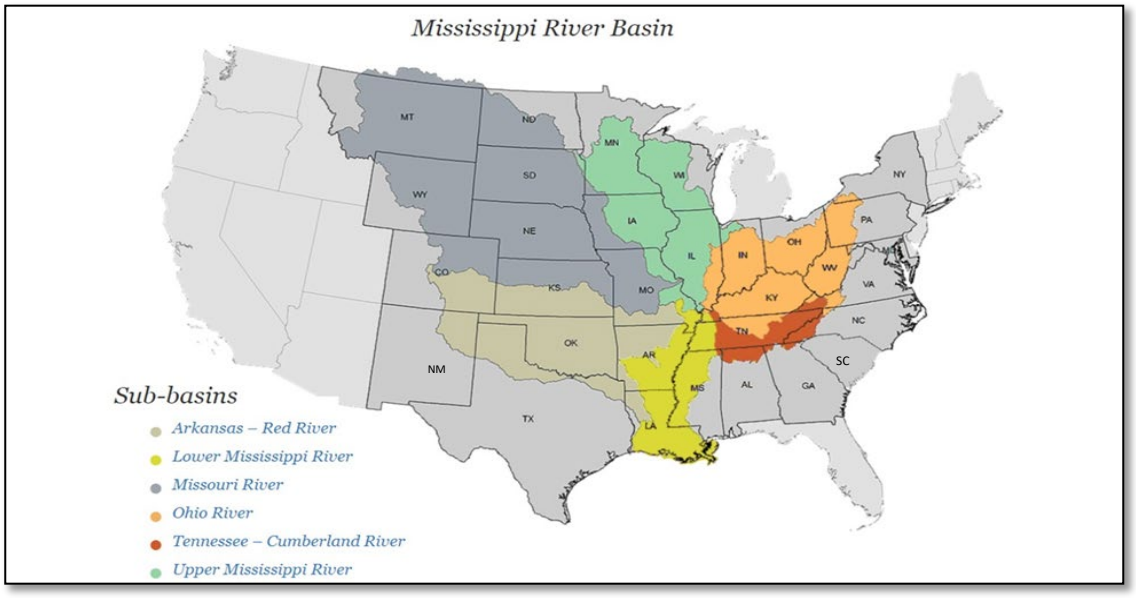
Monitoring, tracking, and managing multiple populations of the four species across large, complex, multi-jurisdictional watersheds underscores the challenging and evolving nature of effectively addressing the threat posed by invasive carp. Accordingly, agencies have developed strategies and approaches to scientifically assess invasive carp and collect critically needed information to inform actions while continuing to focus on aggressive measures to prevent and control further introduction and range expansion. Additional information can be found at: http://micrarivers.org/invasivecarp/.

Figure 23 — Status of Bighead Carp and Silver Carp – Mississippi River Basin



Map showing the status of Bighead Carp and Silver Carp in the Mississippi River basin. Source: USFWS

Figure 24 — Delineation of Mississippi River Sub-Basins with Invasive Carp Partnerships



U.S. map showing states with Mississippi River sub-basin invasive carp partnerships. Source: USFWS

4.2 Canadian Efforts in Support of the ICRCC

Internationally, Fisheries and Oceans Canada (DFO), the Ontario Ministry of Natural Resources and Forestry (OMNRF), and the Québec Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP) are key Canadian Federal and Provincial ICRCC partner agencies working to address the threat of Grass, Bighead, Silver, and Black Carps to the Great Lakes and St. Lawrence River. Their efforts include policy, prevention, early detection surveillance, research, and scientific oversight activities in the Canadian waters of the Great Lakes and St. Lawrence River, representing a critical component to ensuring a basin-wide approach to addressing the threat. More information on these efforts can be found at the following agency websites:

- The official website of Fisheries and Oceans Canada
- The official Quebec website
- Ontario's pamphlet on Asian Carps
- The response plan of Asian Carp Canada

Appendix A

FY 2024 Funding Matrix

Invasive Carp Action Plan: Fiscal Year 2024

Table A-1 – Funding by Project

Action	Lead Agency	Project Title	GLRI Funding	Agency Funding
Preventing Invasive Carp Movement through the Illinois Waterway				
Illinois Waterway Deterrent Technology Operation and Development				
ID-1	USACE	Operation and Maintenance of the Electric Dispersal Barrier System	$0	$15,296,000
ID-2	USACE	USACE Planning for Field Demonstration of Carbon Dioxide Deterrent at the Electric Dispersal Barrier System	$200,000	$0
ID-3	USGS	USGS Planning for Field Demonstration of Carbon Dioxide Deterrent at the Electric Dispersal Barrier System	$300,000	$310,000
ID-4	USACE	Brandon Road Lock and Dam Aquatic Nuisance Species Barrier Project	$0	$0*
ID-5	USACE	Further Evaluation of Underwater Acoustics as a Deterrent for Invasive Carp	$1,070,000	$0
ID-6	USFWS	Summary Evaluation of the Bio-Acoustic Fish Fence Deterrent	$0	$800,000
ID-7	USGS	Technical Support for Testing of Acoustic Deterrents	$1,320,000	$579,000
ID-8	USGS	Water Quality and Velocity Monitoring in Support of Brandon Road Project	$80,000	$0
Removal Actions – Contract Fishing				
IR-1	IL DNR	Contract Fishing for Invasive Carp Removal Near the Electric Dispersal Barrier System	$2,100,000	$0
IR-2	IL DNR	Enhanced Invasive Carp Removal in the Lower Illinois River	$1,250,000	$0
Monitoring and Decision Support				
IM-1	IL DNR	Early Detection Monitoring and Contingency Response in the Illinois Waterway	$4,500,000	$0
IM-2	USFWS	Support for Early Detection in the Upper Illinois Waterway	$640,000	$675,000
IM-3	IL DNR	Invasive Carp Stock Assessment in the Illinois River Using Hydroacoustics	$550,000	$0

Invasive Carp Action Plan: Fiscal Year 2024

Action	Lead Agency	Project Title	GLRI Funding	Agency Funding
IM-4	USFWS	USFWS Hydroacoustic Surveys of Fish Abundance and Distribution in the Upper Illinois Waterway	$100,000	$0
IM-5	IL DNR	Assessment of Invasive Carp Reproduction and Ecosystem Response in the Illinois Waterway	$400,000	$0
IM-6	USFWS	Invasive Carp Demographics in the Illinois Waterway	$414,000	$250,000
IM-7	USFWS	Invasive Carp eDNA Sampling and Processing	$0	$2,400,000
IM-8	USGS	Real-Time Telemetry Alert System and Refinement of the Spatially Explicit Invasive Carp Population Model (SEICarP)	$144,000	$0
IM-9	USFWS	Telemetry Tracking in the Illinois Waterway to Support the Spatially Explicit Invasive Carp Population Model (SEICarP)	$150,000	$400,000
IM-10	IL DNR	Alternate Pathway Surveillance in Illinois	$150,000	$0
IM-11	USGS	Evaluation of Invasive Carp Spawning Dynamics and Collection of Associated Hydrological Data	$80,000	$75,000
IM-12	USGS	Invasive Carp Database Management and Integration Support	$140,000	$436,000
IM-13	USGS	USGS Support for Invasive Carp Population Modeling in the Illinois River	$110,000	$290,000
IM-14	USFWS	USFWS Support for Invasive Carp Population Modeling in the Illinois River	$100,000	$200,000
IM-15	USFWS	Early Detection Monitoring for Invasive Carp in the Great Lakes	$285,000	$1,400,000
IM-16	IL DNR	Evaluation of Fish Transfer System to Promote Native Species Movement and Invasive Carp Harvest	$200,800	$0
Hydrologic Barriers to Prevent Invasive Carp Movement through Intermittent Waterways				
HB-1	OH DNR	Construction of Structures at Little Killbuck Creek, Ohio to Prevent Inter-Basin Movement of Invasive Carp	$2,500,000	$0
HB-2	OH DNR	Maintenance of Structures at Ohio & Erie Canal to Prevent Inter-Basin Movement of Invasive Carp	$20,000	$0

Invasive Carp Action Plan: Fiscal Year 2024

Action	Lead Agency	Project Title	GLRI Funding	Agency Funding
Preventing Establishment of Grass Carp in the Great Lakes				
GC-1	OH DNR	Removal of Grass Carp in Ohio Waters of the Lake Erie Western Basin and Early Detection Monitoring in Other Lake Erie Tributaries	$625,000	$0
GC-2	MI DNR	Removal of Grass Carp in the Lake Erie Western Basin and Early Detection Monitoring in Great Lakes Tributaries	$385,000	$150,000
GC-3	USFWS	Support for Removal of Grass Carp in the Lake Erie Western Basin and Early Detection Monitoring in Great Lakes Tributaries	$1,150,000	$847,590
GC-4	USFWS	Invasive Carp Ploidy Analysis to Assess Reproductive Risk of Detected Populations	$80,000	$40,000
GC-5	USGS	Monitoring for Grass Carp Eggs and Larval Fish to Identify Spawning Tributaries and Specific Spawning Areas	$200,000	$361,885
GC-6	USGS	Refinement of the Grass Carp Spawning Event Prediction Tool	$85,000	$0
GC-7	USGS	Identification of Optimal River Conditions for Spawning and Recruitment of Invasive Carp in Tributaries of the Western Basin of Lake Erie	$40,000	$0
GC-8	USGS	Using Telemetry to Better Understand Grass Carp Movements and Habitat Use	$200,000	$254,800
GC-9	USGS	Characterization of Hydrology and Sediment Mobility to Inform Design and Implementation of a Seasonal Barrier in the Sandusky River	$55,000	$0
GC-10	USGS	Development and Testing of Deterrent Technologies for Grass Carp	$125,000	$280,000
GC-11	NOAA	Monitoring Potential Population Growth, Food Web Effects, and Control of Grass Carp in the Lake Erie Western Basin	$110,800	$65,000
N/A	GLFC	Grass Carp Control in the Lake Erie Basin	$0	$1,000,000

Action	Lead Agency	Project Title	GLRI Funding	Agency Funding
Understanding Black Carp Population Dynamics to Inform Management Strategies				
BC-1	IL DNR	Enhanced Detection of Black Carp in the Lower Illinois River	$228,000	$0
BC-2	IL DNR	Data Collection from Commercial Fishers and Recreational Angler Captures of Black Carp in the Lower Illinois River	$42,000	$0
BC-3	USGS	Support for Black Carp Monitoring and Population Assessment	$475,000	$140,000
BC-4	USFWS	Support for Black Carp Monitoring and Interagency Coordination	$45,400	$10,000
ICRCC Communications and Support				
MS-1	USFWS	ICRCC Strategic Communications with Partners and Stakeholders	$175,000	$100,000
MS-2	USFWS	ICRCC Mission Support	$175,000	$0
Total Funding	--	--	$21,000,000	$26,360,275

* This project will be funded with $225.838 million from the FY 2022 Bipartisan Infrastructure Law and $47.88 million in FY 2023 federal appropriations subject to the execution of a Project Partnership Agreement with the local sponsor.

Table A-2 — Funding Matrix by Agency

Agency	GLRI Funding FY 2024	Agency Funding FY 2024
IL DNR	$9,420,800	$0
OH DNR	$3,145,000	$0
MI DNR	$385,000	$150,000
NOAA	$110,800	$65,000
GLFC	$0	$1,000,000
USACE	$1,270,000	$15,296,000
USFWS	$3,314,400	$7,122,590
USGS	$3,354,000	$2,726,685
TOTALS	**$21,000,000**	**$26,360,275**

Appendix B
FY 2024 Invasive Carp Action Plan Projects

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Acronym List

Acronym	Definition
AIS	Aquatic Invasive Species
ANS	Aquatic Nuisance Species
BAFF	Bio-Acoustic Fish Fence
BCWG	Black Carp Work Group
BRLD	Brandon Road Lock and Dam
CAWS	Chicago Area Waterway System
CO2	Carbon Dioxide
CRP	Contingency Response Plan
CSSC	Chicago Sanitary and Ship Canal
CWG	Communications Work Group
DFO	Department of Fisheries and Oceans Canada
DNR	Department of Natural Resources
EDBS	Electric Dispersal Barrier System
eDNA	Environmental Deoxyribonucleic Acid
EDM	Early Detection Monitory
ERDC	Engineer Research and Development Center
FBC	Fish & Boat Commission
FY	Fiscal Year
GLATOS	Great Lakes Acoustic Telemetry Observation System
GLFC	Great Lakes Fishery Commission
GLMRIS	Great Lakes and Mississippi River Interbasin Study
GLRI	Great Lakes Restoration Initiative
IADNR	Iowa Department of Natural Resources
ICRCC	Invasive Carp Regional Coordinating Committee
IL DNR	Illinois Department of Natural Resources

Acronym	Definition
IN DNR	Indiana Department of Natural Resources
ILRCdb	Illinois River Catch Database
INHS	Illinois Natural History Survey
ISU	Invasive Species Unit
IWW	Illinois Waterway
KDFWR	Kentucky Department of Fish and Wildlife Resources
LTRM	Long-term Resource Monitoring
MAM	Multi-Agency Monitoring
MI DNR	Michigan Department of Natural Resources
MNDNR	Minnesota Department of Natural Resources
MDC	Missouri Department of Conservation
MRWG	Monitoring and Response Work Group
MSU	Michigan State University
NWIS	National Water Information System
NYDEC	New York Department of Environmental Conservation
NOAA	National Oceanic and Atmospheric Administration
OH DNR	Ohio Department of Natural Resources
PVC	Polyvinyl chloride
qPCR	Quantitative polymerase chain reaction
SCAA	Statistical Catch-at-Age
SEICarP	Spatially Explicit Invasive Carp Population
SIM	Seasonal Intensive Monitoring
SIU	Southern Illinois University
SIUC	Southern Illinois University Carbondale
TNWRA	Tennessee Wildlife Resources Agency
TWG	Technology Work Group

Acronym	Definition
U.S.	United States
UADS	Underwater Acoustic Deterrent System
UMN	University of Minnesota
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UT	University of Toledo
WIDNR	Wisconsin Department of Natural Resources

Preventing Invasive Carp Movement through the Illinois Waterway

Illinois Waterway Deterrent Technology Operation and Development

ID-1: Operation and Maintenance of the Electric Dispersal Barrier System

- **Lead Agency:** USACE
- **Agency Collaboration:**
- **GLRI Funding:** $0
- **Agency Funding:** $15,296,000

Project Summary

This project involves the operation of the EDBS on the CSSC in Romeoville, Illinois. This project provides the first line of defense to prevent the establishment of invasive carp in the Great Lakes by maintaining a constant electrical current in the water of the CSSC. FY 2024 funding supports continuous operations as well as efforts to improve the efficacy of the system.

Project Description

The EDBS is in the CSSC, which is a man-made waterway creating the only continuous connection between Lake Michigan and the Mississippi River basin. The EDBS was developed to prevent the spread of invasive fish species between these watersheds. USACE has operated electric barriers in the CSSC since 2002. Over the years, several operational and procedural improvements have been implemented to improve the effectiveness and continuously deliver an uninterrupted flow of electricity to the water to deter fish. In FY 2024, USACE will continue to operate and maintain the barriers and complete currently underway construction efforts.

Figure 1 — USACE EDBS in the CSSC

Map showing the location of EDBS electrodes in the CSSC and supporting facilities. Source: USACE

PREVENTING INVASIVE CARP MOVEMENT THROUGH THE ILLINOIS WATERWAY

Illinois Waterway Deterrent Technology Operation and Development

ID-2: USACE Planning for Field Demonstration of Carbon Dioxide Deterrent at the Electric Dispersal Barrier System

- **Lead Agency:** USACE
- **Agency Collaboration:**
- **GLRI Funding:** $200,000
- **Agency Funding:** $0

Project Summary

This project will complete the planning for implementing a CO2 injection system in the CAWS as an added invasive carp deterrent technology at the EDBS. This project will assess the feasibility of using CO2 as a deterrent to prevent invasive carp from moving into and becoming established in the Great Lakes by clearing fish from the EDBS after maintenance shutdowns. This year's funding will produce field demonstration plans from a collaborative project team, complete permit and regulatory requirements associated with implementation, and develop contract documents.

Project Description

CO2 injected into water is being evaluated as a behavioral deterrent for invasive carp. In 2019, USGS, USACE, and other partners demonstrated the temporary application of a CO2 infusion system at a navigational lock in Wisconsin. This project is focused on assessing the feasibility of CO2 as a potential method to clear fish from the EDBS within the CAWS. The EDBS undergoes regular annual maintenance, which can require portions of the system to be temporarily taken offline (powered down), presenting a potential opportunity for fish to move upstream toward Lake Michigan. This project will determine if CO2 could be applied during or after maintenance events to further reduce the risk of upstream expansion toward the Great Lakes. Also, if successful, CO2 could enhance general safety by eliminating the need to place agency fishing boats and crews within the electrified field to manually remove fish. Activities in 2024 include work by the project team to coordinate with regulatory authorities to identify, complete, and acquire all necessary permits for field testing; validate fluid dynamic models; identify locations and specifications for structural modifications to allow installation of invasive carp deterrents (e.g., identify locations where the canal wall could be modified/notched to allow installation of

invasive carp deterrents without risk for interference with vessels); and develop needed contract documents for field testing.

Preventing Invasive Carp Movement through the Illinois Waterway

Illinois Waterway Deterrent Technology Operation and Development

ID-3: USGS Planning for a Field Demonstration of Carbon Dioxide Deterrent at the Electric Dispersal Barrier System

- **Lead Agency:** USGS
- **Agency Collaboration:** ERDC, USFWS
- **GLRI Funding:** $300,000
- **Agency Funding:** $310,000

Project Summary

This project will complete the planning for implementing a CO2 injection system in the CAWS as an added invasive carp deterrent technology at the EDBS. This project will assess the feasibility of using CO2 as a deterrent to prevent invasive carp from moving into and becoming established in the Great Lakes by clearing fish from the EDBS after maintenance shutdowns. This year's funding will produce field demonstration plans from a collaborative project team, complete permit and regulatory requirements associated with implementation, and develop contract documents.

Project Description

CO2 injected into water is being evaluated as a behavioral deterrent for invasive carp. In 2019, USGS, USACE, and other partners demonstrated the temporary application of a CO2 infusion system at a navigational lock in Wisconsin. This project is focused on assessing the feasibility of CO2 as a potential method to clear fish from the EDBS within the CAWS. The EDBS undergoes regular annual maintenance, which can require portions of the system to be temporarily taken offline (powered down), presenting a potential opportunity for fish to move upstream toward Lake Michigan. This project will determine if CO2 could be applied during or after maintenance events to further reduce the risk of upstream expansion toward the Great Lakes. Also, if successful, CO2 could enhance general safety by eliminating the need to place boats and crews within the electrified field to manually remove fish.

Figure 2 — General Area for Carbon Dioxide Planning and Implementation

Aerial image of the Des Plaines River and Chicago Sanitary and Ship Canal (CAWS) near Romeoville, IL; red dashed box indicates general location of carbon dioxide deterrent project planning and implementation site (adjacent to the Electric Dispersal Barrier System). Source: Google Earth

Preventing Invasive Carp Movement through the Illinois Waterway

Illinois Waterway Deterrent Technology Operation and Development

ID-4: Brandon Road Lock and Dam Aquatic Nuisance Species Barrier Project

- **Lead Agency:** USACE
- **Agency Collaboration:**
- **GLRI Funding:** $0
- **Agency Funding:** This project received $225.838 million from the FY 2022 Bipartisan Infrastructure Law and $47.88 million in FY 2023 federal appropriations.

Project Summary

This project will support the design, construction, and implementation of structural and nonstructural measures near BRLD near Joliet, Illinois, that will prevent, to the maximum extent possible, the upstream transfer of ANS from the Mississippi River basin into the Great Lakes basin while minimizing impacts to waterway uses and users. Plans and specifications and design for Increment I-A have been completed utilizing sponsor funding. Construction of the project is subject to the execution of a Project Partnership Agreement with the local sponsor (State of Illinois). Funds provided in the Bipartisan Infrastructure Law ($225.838 million) and federal appropriations received in FY 2023 ($47.88 million) will be used to complete plans and specifications for Increment I-B and Increment II and complete construction of Increment I-A, which consists of an automated barge clearing deterrent, a bubble deterrent, and an acoustic deterrent.

Project Description

The project includes a layered system of structural controls and non-structural measures. The structural plan includes a new control point at BRLD in addition to the control point that is already provided by the CSSC EDBS in Romeoville, Illinois. The new structural control point would include an acoustic fish deterrent, a bubble deterrent, an engineered channel, an electric deterrent, a flushing lock, and an automated barge clearing (barge entrainment) deterrent. The project includes managing the waterway below the BRLD as a “population reduction zone,” where monitoring and overfishing would occur.

Non-structural measures that may be implemented, primarily by other federal and state agencies, include public education and outreach, non-structural monitoring, integrated pest management, piscicides, manual or mechanical removal of fish, research, and development of two boat launches.

The project is anticipated to be constructed in three increments:

- Increment I-A: bubble deterrent, acoustic deterrent, automated barge clearing (entrainment) deterrent, support facilities, and upstream boat launch.
- Increment I-B: site prep and channel rock excavation.
- Increment II: electric deterrent, large acoustic deterrent, engineered channel floor and wall for electric & large acoustic deterrent, flushing lock, downstream boat launch, and support facilities.
- Increment III: the completion of the engineered channel floor and walls.

The proposed project also includes compensatory mitigation to offset the incremental loss of longitudinal connectivity between the upper and lower Des Plaines River for native fish species. Project performance will be defined by the success of the physical construction that is within the control of USACE and annual operation and maintenance costs upon completing the project.

Preventing Invasive Carp Movement through the Illinois Waterway

Illinois Waterway Deterrent Technology Operation and Development

ID-5: Further Evaluation of Underwater Acoustics as a Deterrent for Invasive Carp

- **Lead Agency:** USACE
- **Agency Collaboration:**
- **GLRI Funding:** $1,070,000
- **Agency Funding:** $0

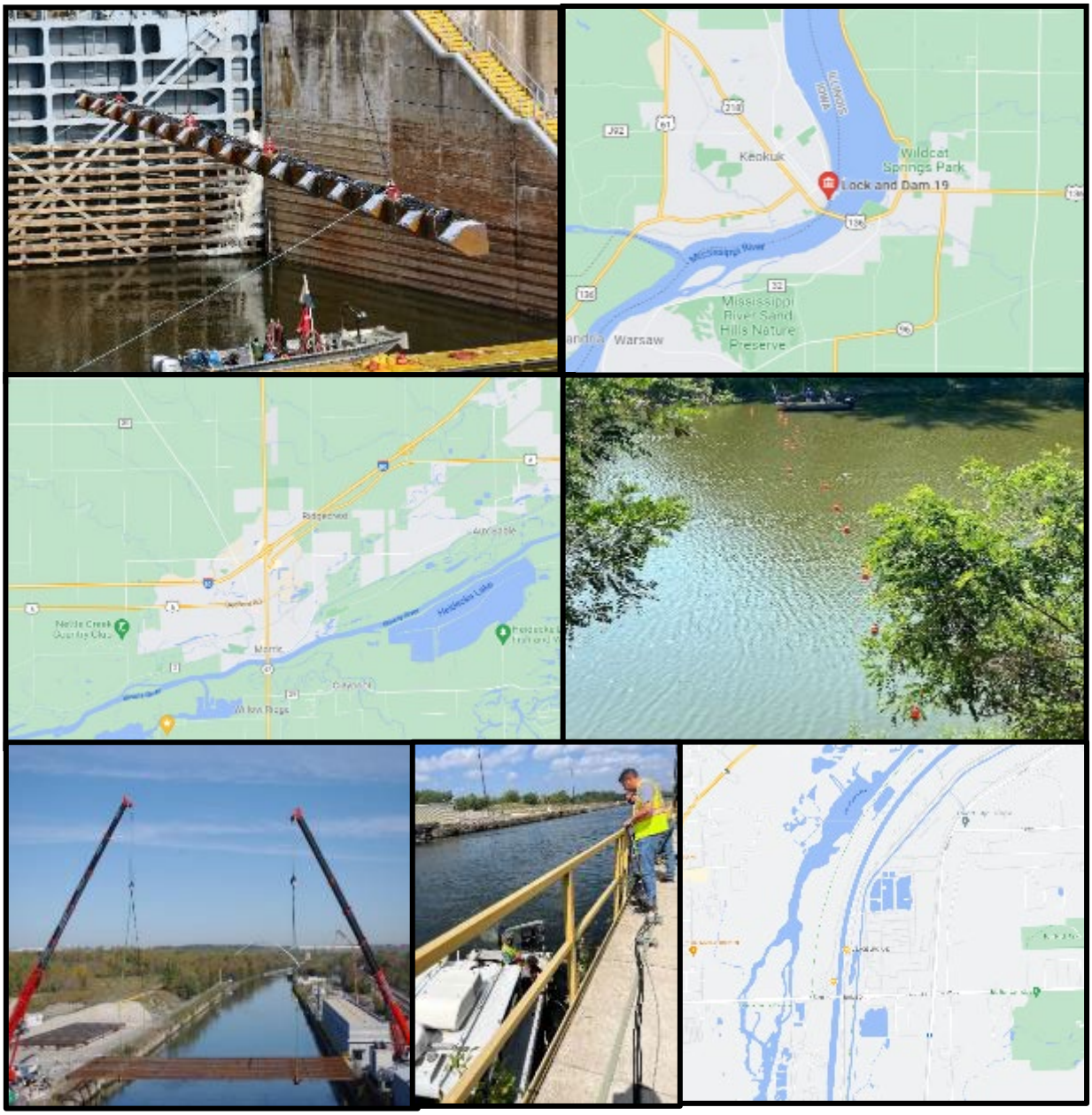
Project Summary

This project will further develop UADS and associated sound signals to reduce the risk of invasive carp upstream movement. This project will evaluate the efficacy of UADS technologies and impacts on native fish species, develop acoustic planning and noise models, and coordinate on technology transfer of underwater acoustic deterrents at (1) Lock No. 19 in the Mississippi River (Keokuk, Iowa); (2) the EDBS, Des Plaines River (Romeoville, Illinois); and (3) the ERDC Behavioral Engineering Laboratory and flume (Vicksburg, Mississippi) where several invasive carp and native fish species are being cultured for use in small-scale studies.

Project Description

This year's funding will produce (1) research, development, testing, software, and evaluation of the UADS deployment at Lock No. 19; (2) analyses of the UADS deployment on the Illinois River at Morris, Illinois; (3) experiments on Silver Carp and Bighead Carp behavior to newly generated sound signals found effective on Grass Carp and Black Carp; (4) a review of the impact of these signals on Bighead Carp, Grass Carp, and Black Carp (response to new engineered sounds); and (5) sampling and monitoring of the impact from UADS exposure to the EBDS (e.g., potential impacts to parasitic array, lower voltages). Additionally, this project will include coordination and support on Lock No. 19 UADS maintenance, development of transition of USACE equipment to stakeholders or districts, and coordination with vendors on engineering for increased resiliency and a detailed examination to the current speaker design.

Figure 3 — Underwater Acoustics Deterrent Systems and Maps



(Upper Left) Photo of the UADS speaker weldment (e.g., soundbar) during deployment (Photo by Mark Cornish, USACE-MVR). (Upper Right) Location of the UADS at Lock No. 19, Keokuk Iowa – Google Maps. (Middle Left) Location of the UADS in the HMS East Pit, Morris, IL – Google Maps. (Middle Right) Photo of the UADS deployment at Morris (Photo by Christa Woodley, ERDC). (Lower Left) Installation of the Parasitic Barrier, Romeoville, IL. (Lower Middle) Installation of the system over the parasitic array, Romeville, IL. (Lower Right) Location of isolation UADS deployed over the Parasitic Array, Romeoville, IL – Google Maps.

Preventing Invasive Carp Movement through the Illinois Waterway

Illinois Waterway Deterrent Technology Operation and Development

ID-6: Summary Evaluation of the Bio-Acoustic Fish Fence Deterrent

- **Lead Agency:** USFWS
- **Agency Collaboration:** USGS, KDFWR, USACE, UMN
- **GLRI Funding:** $0
- **Agency Funding:** $800,000

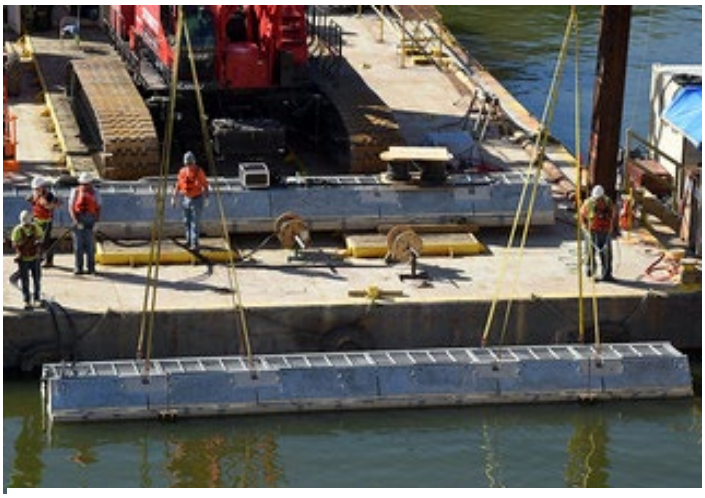
Project Summary

This project will support continued implementation of a large-scale field evaluation of the BAFF acoustic deterrent technology for invasive carp, including system operations, monitoring, and maintenance. The evaluation is being conducted at Barkley Dam on the Tennessee-Cumberland River in Kentucky. This site was selected due to the physical characteristics of the dam (high-head dam with no overflow conditions), the existing monitoring infrastructure in place (telemetry receivers), and the presence of an established population of invasive carp. The evaluation will be completed in 2024. Results of the study will provide key information on the general effectiveness of the BAFF as a fish deterrent in a lock and dam setting and for the potential transfer of this technology to other strategic locations to protect the Great Lakes from invasive carp.

Project Description

For this large-scale deployment, a BAFF Fish Guidance Systems technology has been installed and is being operated at the Barkley Lock and Dam approach channel on the Cumberland River in Kentucky. Silver Carp are being telemetry tagged and translocated each study year in the spring and the fall to track fish passage toward or through the lock in a motivated state. Migration of fish is confined to a single passage point through the lock structure and will continue to be monitored using telemetry and hydroacoustic equipment around the BAFF. The study will conclude following the FY 2024 evaluations.

Figure 4 — Bio-Acoustic Fish Fence Installation



Installation of the Bio-Acoustic Fish Fence at Barkley Lock on the Cumberland River. Source: USFWS

PREVENTING INVASIVE CARP MOVEMENT THROUGH THE ILLINOIS WATERWAY

Illinois Waterway Deterrent Technology Operation and Development

ID-7: Technical Support for Testing of Acoustic Deterrents

- **Lead Agency:** USGS (Lock No. 19), USFWS (Barkley), USACE
- **Agency Collaboration:** USFWS, USACE, IADNR, IL DNR, KDFWR, TNWRA, MDC, MNDNR, UMN-Duluth, UMN, WIDNR
- **GLRI Funding:** $1,320,000
- **Agency Funding:** $579,000

Project Summary

This project will continue the research, deployment, and evaluation of state-of-the-art acoustic deterrent technologies at three locations with established populations of invasive carp, including (1) Kentucky (BAFF in the Cumberland River), (2) Illinois/Iowa (UADS in the Upper Mississippi River), and (3) Illinois (testing engineered signals/playbacks in the Illinois River). This project will result in the continued deployment and testing of experimental deterrents in rivers (specifically locks and dams) and prevent invasive carp from becoming established in the Great Lakes by discouraging upstream movement. This year's funding will produce (1) quantitative measurements of fish movement at Barkley Lock and Dam on the Cumberland River in response to the BAFF over three years and fine-scale analysis of Silver Carp passage/behavior; (2) a three-year summary of fish passage at Lock and Dam 19, including the detailed, fine-scale movement of Silver Carp and bigmouth buffalo (a native fish species); and (3) a summary and peer-reviewed manuscript of Silver Carp movement in response to a small-scale acoustic deterrent deployed in a backwater of the Illinois River to deter motivated fish and assess equipment performance and evaluation of new signals on Black Carp and Grass Carp. These evaluations will inform the ongoing design effort by the USACE for the multi-deterrent engineered channel at BRLD.

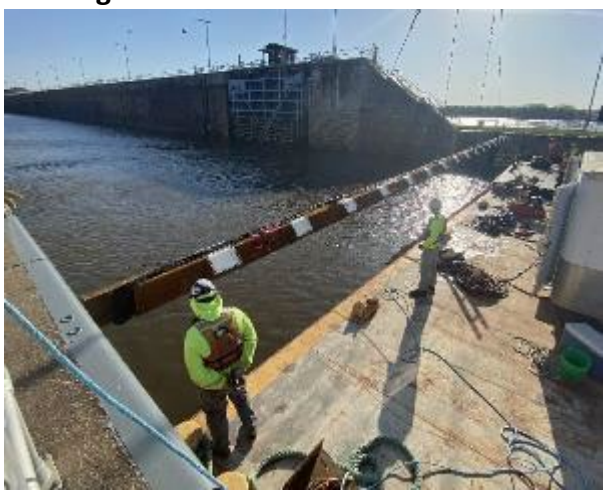
Project Description

Significant work has been conducted to identify and evaluate potential biological and physical deterrent techniques that discourage the movement of Bighead Carp and Silver Carp while allowing the passage of native fish species and commercial and recreational vessels without disruption. One candidate deterrent technique that has demonstrated effectiveness in laboratory and pond settings is underwater sound (acoustics). Previous studies in controlled experimental settings have documented both Bighead Carp and Silver Carp responding negatively to various underwater sound stimuli, while many native fish species responded little to the same sounds. This project will continue collaborative work that was informed by these

earlier studies and deploy large-scale experimental acoustic structures at critical fish passage points in the Ohio River and Upper Mississippi River, where invasive carp populations are already established, allowing for robust evaluation of the technology prior to potential deployment in locations where it may be targeted to prevent upstream migration toward the Great Lakes. For these large-scale deployments, underwater sound equipment has been installed at "pinch points" in the river system where fish are only able to swim upstream through a lock chamber because the height of the dam structure makes it impassable. Migration of fish is then confined to a single passage point and can be monitored using telemetry and hydroacoustic equipment.

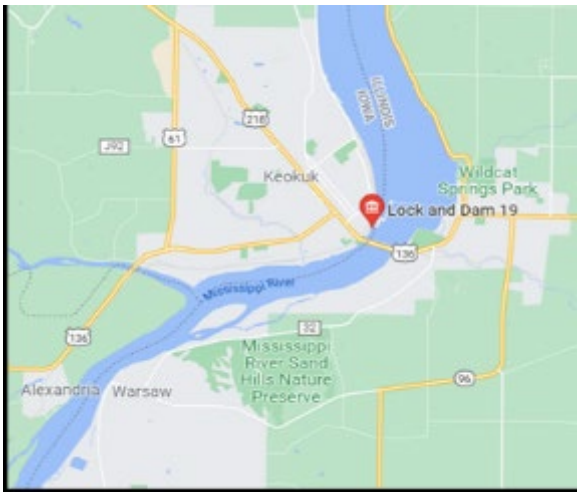
In addition, laboratory research will be conducted to refine and optimize sound frequencies, sound pressure levels, and speaker designs to effectively repel invasive carp while minimizing undesirable effects on native species. Future actions will focus on refining the sound characteristics that elicit the greatest response on invasive carp in biologically motivated states (i.e., hunger, reproduction, etc.). The goal is to limit upstream passage, specifically in areas with access to the Great Lakes.

Figure 5 — Removal of UADS



Temporary removal of the underwater acoustic deterrent system at Lock No. 19 on the Mississippi River for repairs in April 2023. Photo credit: Marybeth Brey, USGS

Figure 6 — Lock and Dam No. 19



Location of Lock and Dam No. 19 at Keokuk, Iowa on the Mississippi River.

Preventing Invasive Carp Movement through the Illinois Waterway

Illinois Waterway Deterrent Technology Operation and Development

ID-8: Water Quality and Velocity Monitoring in Support of the Brandon Road Project

- **Lead Agency:** USGS
- **Agency Collaboration:** USACE
- **GLRI Funding:** $80,000
- **Agency Funding:** $0

Project Summary

This project will support the operation and maintenance of a water velocity and water quality streamgaging station in the downstream approach channel to BRLD on the IWW in the State of Illinois, providing essential data documenting the pre-construction hydrologic, hydrodynamic, and water chemistry conditions in the approach channel and temporal variations associated with the river and lock and dam operations. This project will prevent invasive carp from becoming established in the Great Lakes by informing the USACE and other federal and state partners about potential impacts and engineering challenges associated with deploying barrier technologies in the downstream approach channel to BRLD.

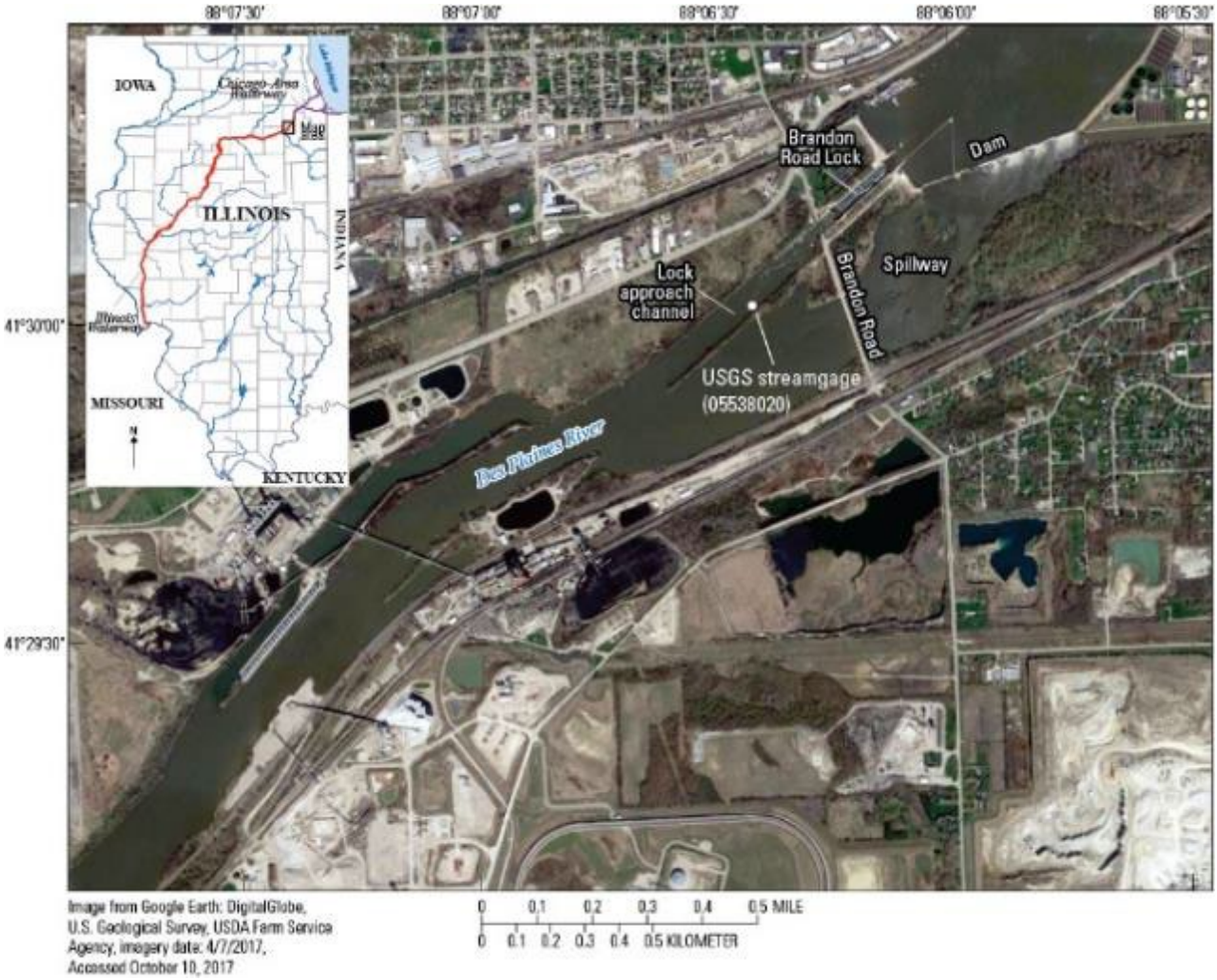
Project Description

In support of the Brandon Road Interbasin Project in FY 2024, the USGS will continue monitoring water velocity and water quality in the downstream approach channel to BRLD (USGS 05538020USGS Current Conditions for USGS 05538020 DES PLAINES RIVER IN LOCK CHANNEL AT ROCKDALE, IL). This USGS streamgaging station was established in 2015 and provides data needed by the USACE for various phases of the project and serves as a record of pre-construction conditions in the approach channel. Data include measurements of water temperature, specific conductance, dissolved oxygen, pH, turbidity, chlorophyll-a, phycocyanin, dissolved carbon dioxide concentration, and water velocity.

Figure 7 – The USGS Streamgage 05538020

USGS streamgage 05538020, Des Plaines River, Illinois near the Brandon Road Lock and Dam
Source: USACE

Figure 8 – USGS Streamgage 05538020 in Des Plaines River near Brandon Road Lock



Aerial image of the Des Plaines River, Illinois at the Brandon Road Lock and Dam; the location of USGS streamgage 05538020 is indicated with an arrow. Source: USACE

REMOVAL – CONTRACT FISHING

IR-1: Contract Fishing for Invasive Carp Removal Near the Electric Dispersal Barrier System

- **Lead Agency:** IL DNR
- **Agency Collaboration:** UT, GLFC, MI DNR, USFWS, USGS
- **GLRI Funding:** $2,100,000
- **Agency Funding:** $0

Project Summary

This project will continue the use of contracted commercial fishing to remove invasive carp from the upper IWW. The goal is to remove approximately one million pounds of invasive carp annually from the upper IWW, especially targeting the Starved Rock and Marseilles pools. The project prevents invasive carp from becoming established in the Great Lakes by reducing the population pressure on the EDBS.

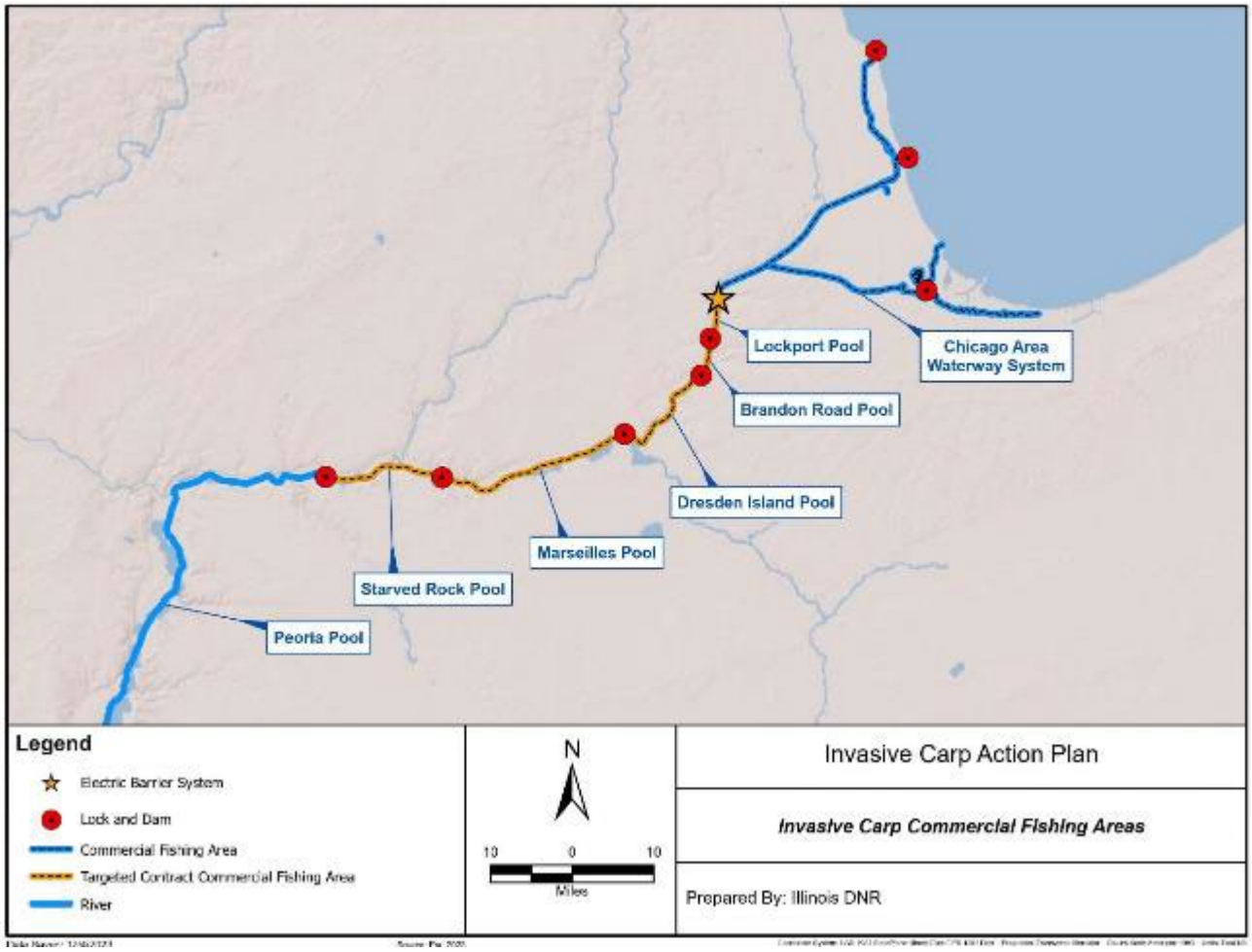
Project Description

Figure 9 – Capturing Invasive Carp

Commercial fishers removing adult invasive carp from gill nets on the Illinois Waterway. Source: IL DNR

Contract commercial fishing will be deployed primarily in the Starved Rock and Marseilles pools to suppress adult populations of invasive carp present in these pools, which are above the reproductive front and present an opportunity to reduce the risk of upstream expansion. Reducing the number of adult fish in this area where small fish have only rarely been found suppresses propagule pressure, reducing the likelihood of upstream migration in the IWW and the risk of invasive carp nearing the EDBS. In 2024, the goal is to remove approximately one million pounds of invasive carp from this portion of the upper IWW through 24 weeks of targeted contracted fishing. Agency biologists develop a harvest schedule in the spring of each year, directing contract commercial fishing effort to maximize removal in the target reaches. Fish removed provide the opportunity to collect valuable biological information on fish condition, age, and demographics.

Figure 10 – Location of Commercial Fishing Areas



Map showing areas on the Illinois Waterway where commercial fishers are utilized for invasive carp capture and removal. Source: IL DNR

REMOVAL – CONTRACT FISHING

IR-2: Enhanced Invasive Carp Removal in the Lower Illinois River

- **Lead Agency:** IL DNR
- **Agency Collaboration:**
- **GLRI Funding:** $1,250,000
- **Agency Funding:** $0

Project Summary

This project will continue the Enhanced Contract Fishing Program in Illinois in the Alton, LaGrange, and Peoria pools of the Illinois River, covering approximately 240 miles of the river from Peoria to Cairo, Illinois. This project will result in the significant removal of invasive carp from these areas and prevent invasive carp from becoming established in the Great Lakes by reducing the number of individual fish reaching the upper Illinois River. This year's funding will support removal of approximately six million pounds of invasive carp from targeted pools with established populations where all life stages are present.

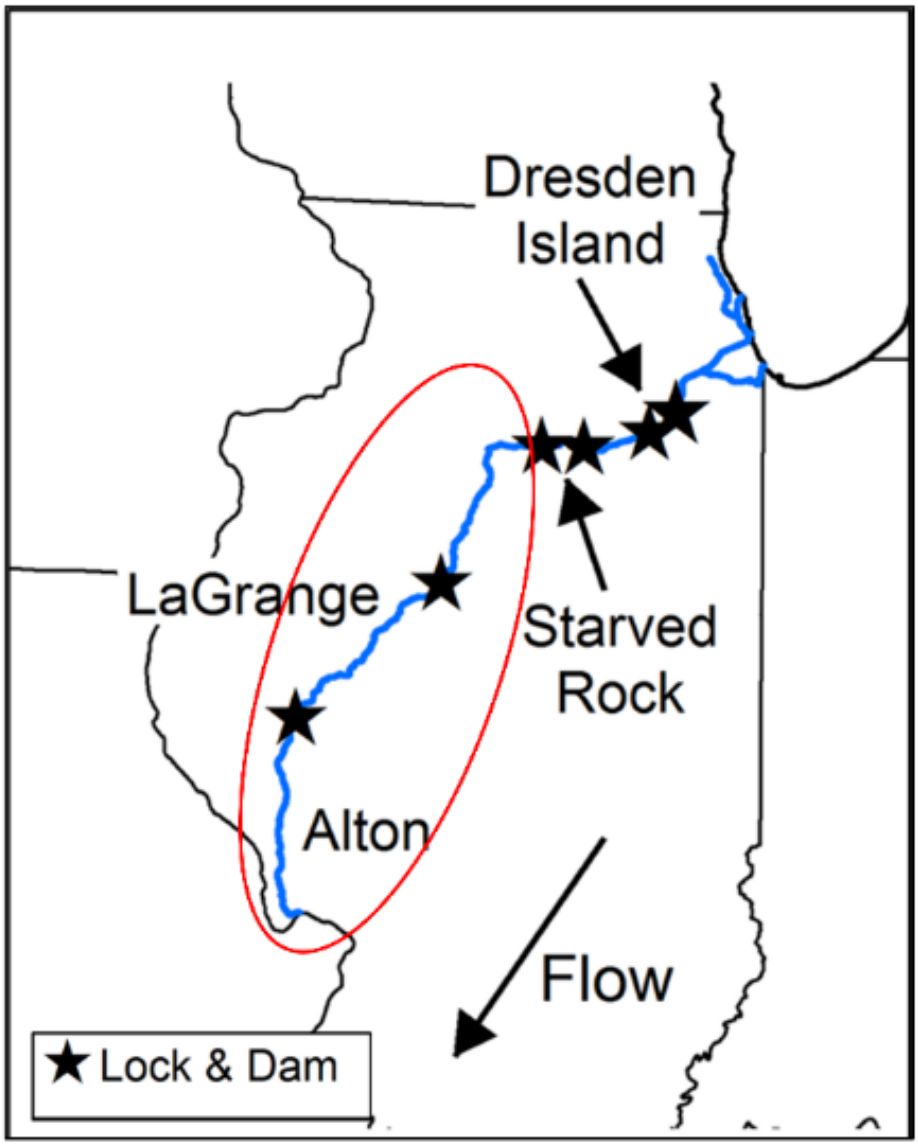
Project Description

This project will continue the Enhanced Contract Fishing Program in Illinois in the Alton, LaGrange, and Peoria pools of the Illinois River. This funding supports using a contractor to subcontract 20 to 30 commercial fishers on behalf of IL DNR. The state-directed contract fishers will be compensated per pound of invasive carp removed and sold to fish processors. This project will result in the removal of approximately six million pounds of invasive carp in the lower Illinois River, subject to market forces, and thus reduce the number of fish reaching the upper Illinois River.

Figure 11 – Invasive Carp Removal on Lower Illinois River

Commercial fishing boat containing harvested invasive carp on the Illinois Waterway. Source: IL DNR

Figure 12 – Lower Illinois River Project Location



Map showing Alton, LaGrange, Starved Rock, and Dresden Island lock and dams. The Enhanced Contract Fishing Program locations are circled in red. Source: IL DNR

PREVENTING INVASIVE CARP MOVEMENT THROUGH THE ILLINOIS WATERWAY

Monitoring and Decision Support

IM-1: Early Detection Monitoring and Contingency Response in the Illinois Waterway

- **Lead Agency:** IL DNR
- **Agency Collaboration:** INHS, USACE, USFWS, USGS
- **GLRI Funding:** $4,500,000
- **Agency Funding:** $0

Project Summary

This project implements an early detection monitoring program to detect and remove invasive carp in the upper IWW. Electrofishing, hoop nets, and mini-fykes will be deployed weekly to monitor for the presence of small invasive carp above the reproductive front and near the EDBS. In addition, SIM will be conducted in the spring and fall above the EDBS in conjunction with agency partners. Each SIM event involves two weeks of intensive sampling effort using electrofishing in conjunction with netting by contracted commercial fishers to detect and remove invasive carp present in the upper IWW. This project will prevent invasive carp from becoming established in the Great Lakes by reducing the risk of their movement through the IWW to Lake Michigan. Contingency planning, rapid response, and training are also supported by this effort.

Project Description

Since 2010, two Silver Carp and one Bighead Carp have been collected above the EDBS in the CAWS. This project supports comprehensive early detection monitoring to detect and remove invasive carp potentially present above the EDBS in coordination with other partner efforts.

Monitoring will occur in Lockport, Brandon, and Dresden Island pools utilizing a variety of gear types and sampling locations. Weekly

Figure 13 – Capturing Silver Carp

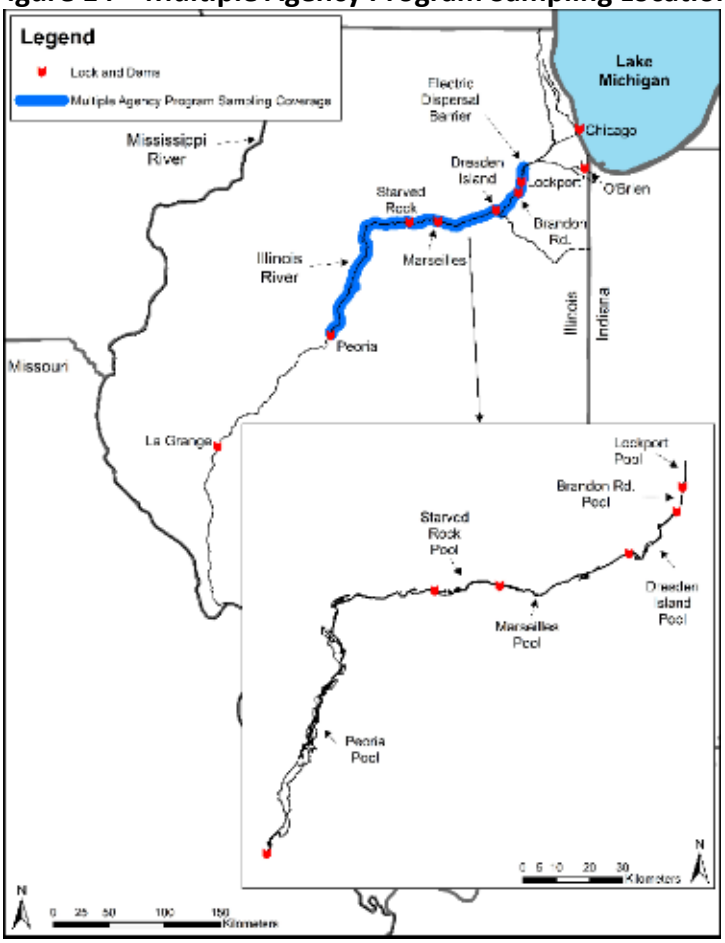
Adult silver carp jumping out of the water during agency electrofishing sampling. Photo credit: ICRCC (InvasiveCarp.us)

surveillance by agency staff in the upper pools of the Illinois River uses hoop nets, electrofishing, and mini-fykes to monitor for the presence of small fish and changes in adult invasive carp demographics. Additional monitoring for invasive carp in the Marseilles, Starved Rock, and Peoria pools of the Illinois River by the INHS Illinois River Biological Station is also supported under this project.

SIM is conducted above the EDBS in coordination with agency partners. The SIM involves two weeks of intensive sampling effort utilizing electrofishing in conjunction with netting by contracted commercial fishers. eDNA monitoring, funded in a separate project, is conducted prior to the SIM to inform sampling. As part of this effort, commercial fishing will be conducted in Lockport and Dresden Island pools to further reduce invasive carp in these two pools.

Contingency planning is also supported by this project. Incident Command System training is planned for FY 2024.

Figure 14 – Multiple Agency Program Sampling Locations



Map showing the sampling locations of the Multiple Agency Monitoring Program in the Illinois Waterway. Source: IL DNR

Preventing Invasive Carp Movement through the Illinois Waterway

Monitoring and Decision Support

IM-2: Support for Early Detection in the Upper Illinois Waterway

Lead Agency: USFWS

Agency Collaboration: IL DNR, USACE-Chicago District, INHS, SIU

GLRI Funding: $640,000

Agency Funding: $675,000

Project Summary

Figure 15 – USFWS Crew Electrofishing on the Des Plaines River

USFWS crew conducting boat electrofishing during targeted monitoring for invasive carp on the Des Plaines River. Photo credit: Jen-Luc Abeln, USFWS

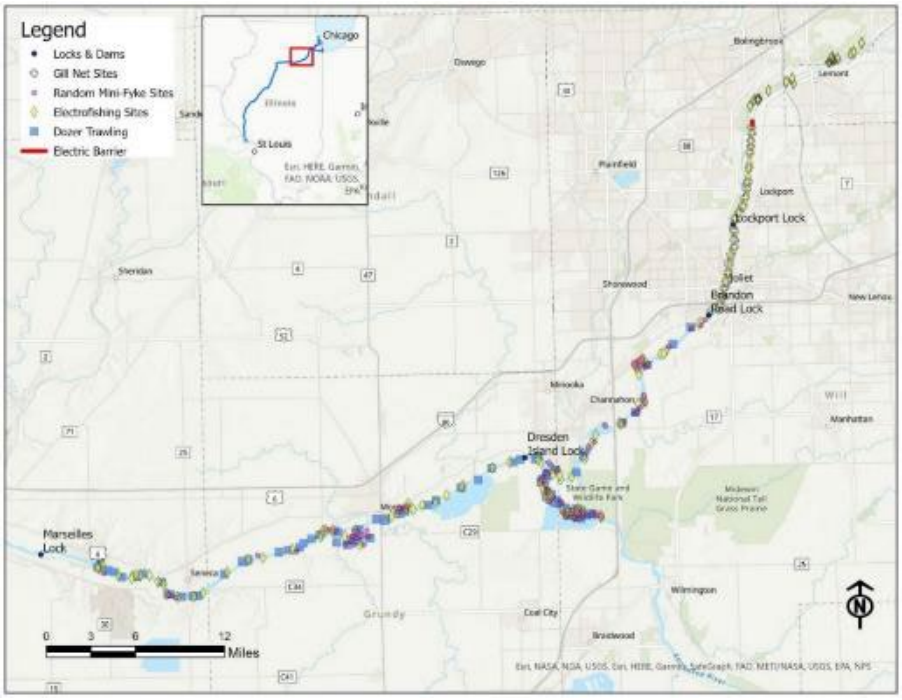
This project will support targeted monitoring activities for early detection and removal of invasive carp in the upper IWW and adjacent waters. This project will focus on additional monitoring effort in the uppermost pools of the IWW to increase the likelihood of detecting potential range expansion and ensure no invasive carp are present upstream of the BRLD. This project will also support early detection monitoring in the Des Plaines River (Illinois) to prevent invasive carp from bypassing the EDBS via movement between the river and the CSSC during high-water events. Additionally, this project will support USFWS field staff participation in the biannual SIM in the CAWS and Unified Method and contingency response efforts in the upper IWW. This project will result in USFWS field support for preventing invasive carp from becoming established in the Great Lakes through early detection monitoring and removal upstream of the EDBS, capture and removal of small and large invasive carp downstream of the EDBS, and rapid contingency response, as needed.

Project Description

This project will support early detection monitoring for invasive carp in targeted upstream locations between the EDBS and Lake Michigan and provide enhanced monitoring for juvenile and adult Bighead Carp and Silver Carp in the Lockport, Brandon Road, Dresden Island, and Marseilles pools and additional sites on the Kankakee River. Data will assist management

agencies in evaluating the current invasion risk to the Great Lakes via the CAWS and inform the IWW CRP. This project increases the coverage of both large and small invasive carp monitoring by sampling each of the uppermost pools monthly (March through November), providing additional data about the presumed invasion front. Sampling will target habitat types known to be occupied by invasive carp in other areas of the IWW and will utilize electrofishing, dozer trawling, gill netting, and mini-fyke netting. Also, USFWS will conduct early detection monitoring in the Des Plaines River, focused on detecting invasive carp that might move into the river prior to overflow events. The purpose is to reduce the risk of invasive carp transfer between the Des Plaines River and the CSSC near the EDBS during high-water events. Sites will be monitored three times during the 2024 field season utilizing boat electrofishing, fyke netting, and gill netting. When Des Plaines River conditions indicate overflows, physical inspections of the barrier between the river and the CSSC will occur, as well as ichthyoplankton sampling. USFWS will be notified of the location of potential overflow events by the USACE so that monitoring teams may be deployed. Biologists will inspect the existing fence structure that serves as the barrier to fish passage between the CSSC and the Des Plaines River at flood-prone locations. Additionally, USFWS will participate in the biannual interagency SIM effort conducted in the CAWS during May and October; assist in the Unified Method in the IWW, as planned by the IL DNR; and continue to maintain readiness if a contingency response action in the IWW/CAWS is needed and requested by the MRWG.

Figure 16 – EDM Sampling Areas



Map of the Illinois River identifying EDM sampling areas. Source: USFWS

PREVENTING INVASIVE CARP MOVEMENT THROUGH THE ILLINOIS WATERWAY

Monitoring and Decision Support

IM-3: Invasive Carp Stock Assessment in the Illinois River Using Hydroacoustics

- **Lead Agency:** IL DNR
- **Agency Collaboration:** SIU, USACE, USGS, INHS
- **GLRI Funding:** $550,000
- **Agency Funding:** $0

Project Summary

This project uses a combination of fisheries hydroacoustics and telemetry tracking to estimate the density and movement of invasive carp in the Alton through Dresden Island pools of the Illinois River. This project will result in the identification of high-density locations of adult invasive carp, a long-term assessment of population trends, and quantification of upstream movements. This project prevents invasive carp from becoming established in the Great Lakes by informing the timing and location of removal actions (harvest) to achieve MRWG management goals, including directing harvest to high-density locations near the invasion front. Results of this project will describe if and when invasive carp move into upstream pools, helping to determine whether contingency response actions are necessary. This year's funding will produce heat maps (illustrating locations where densities are highest) for focused removal. Data from this project will be compared to data collected since 2012 to determine changes in invasive carp densities over that timeframe.

Project Description

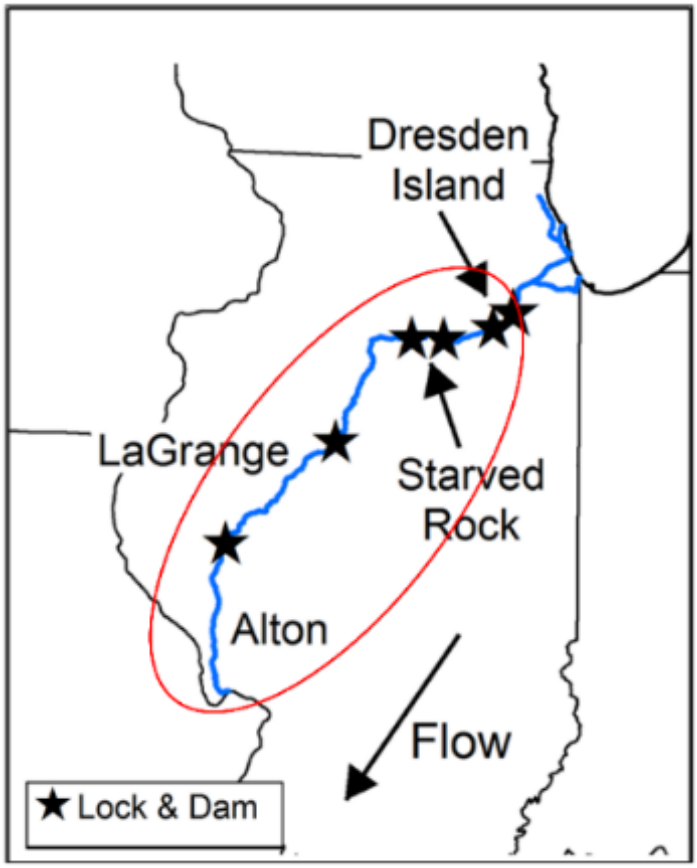
This project will assess invasive carp populations to aid removal and response efforts in the Illinois River. Hydroacoustic sampling will occur monthly in the upper Illinois River throughout the Marseilles and Dresden Island pools from February to October to identify locations of high fish densities. Density heatmaps will be provided to MRWG to inform removal efforts targeting invasive carp aggregations.

Figure 17 – Research Vessel Shovelnose

Southern Illinois University research vessel "Shovelnose" collecting fish density data on the Illinois River. Source: IL DNR

Hydroacoustic sampling and heatmap generation will also occur for each Unified Method mass removal event conducted in the upper Illinois River, and hydroacoustic sampling will be conducted in Alton to Dresden Island pools in October to quantify pool-wide invasive carp densities for comparison to long-term data collected since 2012. Monitoring of acoustically tagged invasive carp will continue from Alton to Dresden Island pools across an array of stationary receivers. The resulting movement data will be used to identify pool-to-pool movement rates for use in the SEICarP model and to assess potential changes in upstream movements by comparing the number of tagged fish in each pool to data from prior years. This year's funding will produce invasive carp density maps every other month in Marseilles and Dresden Island pools, illustrating locations where densities are highest, pool-wide density estimates from Alton to Dresden Island pools for comparisons to annual estimates since 2012, the number of tagged invasive carp occupying each pool, the number of invasive carp moving into other pools through lock and dams, and probability estimates of invasive carp moving among pools to inform harvest response modeling efforts (e.g., SEICarP).

Figure 18 – Project Location Areas



Map showing Alton, LaGrange, Starved Rock, and Dresden Island lock and dams. The hydroacoustic project locations are circled in red Source: IL DNR

Preventing Invasive Carp Movement through the Illinois Waterway

Monitoring and Decision Support

IM-4: USFWS Hydroacoustic Surveys of Fish Abundance and Distribution in the Upper Illinois Waterway

- **Lead Agency:** USFWS
- **Agency Collaboration:** IL DNR, INHS
- **GLRI Funding:** $100,000
- **Agency Funding:** $0

Project Summary

This project will provide estimates of large fish abundance and distribution in the Upper IWW (Lockport Pool) near the EDBS using hydroacoustic surveys. This project will result in risk assessment data that aids managers in preventing invasive carp from becoming established in the Great Lakes by ensuring the abundance of large fish in the Lockport Pool is routinely monitored and changes to EDBS operations are informed by data about current fish presence at that location. Rapid communications to the MRWG on moderate or substantial changes in fish community species composition or fish behavioral observations near the EDBS would continue.

Project Description

Figure 19 – USFWS Research Vessel "Patterson"

USFWS research vessel conducting a hydroacoustic scan of Lockport Pool. Photo credit: Hanna Lavin, USFWS

In 2024, this project will utilize split-beam hydroacoustic and side scan sonar surveys immediately upstream, within, and downstream of the EDBS to assess fish abundance and distribution patterns. Surveys at the EDBS will occur monthly and during any USACE EDBS maintenance events or as requested by partners. The purpose of the hydroacoustic surveys is to aid in assessing the risk of large fish, potentially Bighead Carp or Silver Carp, that may be present near the EDBS during barrier operational changes and/or maintenance. These surveys will utilize split-beam transducers (receivers) deployed to allow for a large portion of the water column to be

ensonified. These surveys will provide information on the abundance and distribution of fish targets approximately 12 inches or greater in total length and fish target depth information. Results will be communicated to partners within 48 hours of survey completion, with notable changes in fish abundance or behavioral status identified. Hydroacoustic scan results will be paired with USGS real-time telemetry summaries from the vicinity for the same dates. Having a greater understanding of the temporally varying densities and spatial distributions of fish near the EDBS will help inform barrier management, allowing operational and maintenance decisions to be made in the context of potential risk factors.

Figure 20 – Hydroacoustic Survey Area Downstream of and within the EDBS

Map highlighting the hydroacoustic survey area downstream and within the EDBS on the IWW at Romeoville, Illinois. Source: USFWS

Preventing Invasive Carp Movement through the Illinois Waterway

Monitoring and Decision Support

IM-5: Assessment of Invasive Carp Reproduction and Ecosystem Response in the Illinois Waterway

- **Lead Agency:** IL DNR
- **Agency Collaboration:** INHS, Eastern Illinois University, SIUC, USGS, and USFWS
- **GLRI Funding:** $400,000
- **Agency Funding:** $0

Project Summary

This project will monitor for invasive carp reproduction in the IWW and select tributaries (Fox, Kankakee, Vermilion, Sangamon, Mackinaw, and Spoon rivers) and quantify relationships between zooplankton abundance and invasive carp density in a sub-set of navigation pools in the Illinois River. FY 2024 funding will produce (1) monitoring for the rapid detection of invasive carp reproduction in the IWW; (2) monitoring for detection of Black Carp reproduction in the IWW; (3) a quantified relationship between reproductive productivity, recruitment, and adult density; and (4) zooplankton-based assessment metrics for evaluating ecosystem response to invasive carp removal. Results from early detection monitoring will be reported to the MRWG. This project will prevent invasive carp from becoming established in the Great Lakes by providing rapid detection monitoring of invasive carp spawning in the IWW and data to inform targeted control actions and assessments of removal levels needed to reduce population growth rates.

Project Description

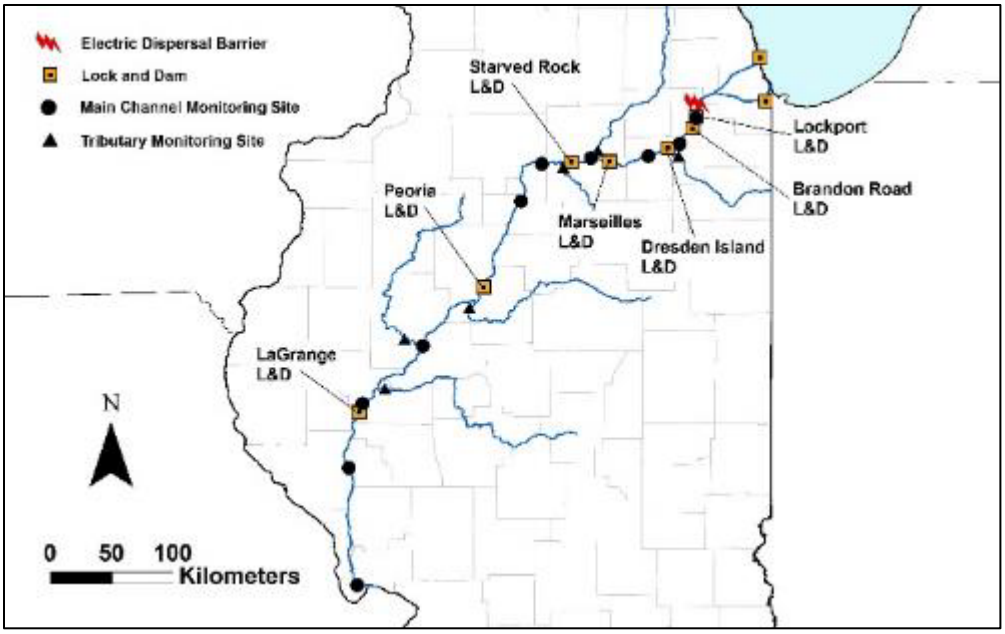
In 2024, ichthyoplankton sampling will be conducted to monitor for the presence of invasive carp eggs and larvae to assess the extent, location, timing, and magnitude of reproduction in the IWW. Samples will be collected from late April through October, with more frequent sampling effort during periods when temperature and flow conditions are thought to be optimal for invasive carp spawning. The potential presence of invasive carp eggs and larvae in each sample will be assessed using qPCR methodology to prioritize samples for rapid processing and provide information on the individual species identity of

Figure 21 – Filtering Water to Collect a Zooplankton Sample

Ichthyoplankton "push net" mounted on the front of sampling boat (the large plastic bin and PVC filter are components of the zooplankton sampling system). Photo credit: IL DNR

invasive carp eggs and larvae present in samples. Microscopy will be used to quantify the overall number of invasive carp eggs and larvae. These data are used as an early detection system for monitoring the upstream extent of bigheaded carp populations and potential reproduction by the newly expanding Black Carp population in Illinois and to quantify relationships between invasive carp adult densities, reproductive output, and subsequent recruitment to assess the level of removal needed to reduce populations. This project uses previous monitoring data on zooplankton communities in the Illinois River to assess which zooplankton taxa are most sensitive to invasive carp abundance to develop performance targets for invasive carp removal from the perspective of diminishing their ecosystem impacts. Targets for ecosystem response to invasive carp harvest will be developed using previous monitoring data to model zooplankton indicators as a function of bigheaded carp abundance and environmental factors influencing zooplankton spatiotemporal dynamics.

Figure 22 – Main Channel and Tributary Monitoring Sites



Map of Illinois River identifying main channel and tributary monitoring sites. Source: IL DNR

PREVENTING INVASIVE CARP MOVEMENT THROUGH THE ILLINOIS WATERWAY

Monitoring and Decision Support

IM-6: Invasive Carp Demographics in the Illinois Waterway

- **Lead Agency:** USFWS
- **Agency Collaboration:** IL DNR, INHS
- **GLRI Funding:** $414,000
- **Agency Funding:** $250,000

Project Summary

This project will provide additional fisheries monitoring capacity for an existing standardized interagency sampling effort utilized by MRWG in the Illinois River and support the collection of key demographic data (e.g., total length, weight, age, sex, and maturity) for invasive carp captured in the lower six pools of the river. Results from the project will inform the development of an SCAA model for assessing Silver Carp abundance and response to management actions in the Illinois River. The electrified dozer trawl will be utilized by USFWS as an additional gear within the MAM program on the Illinois River, augmenting invasive carp detection and capture capability. Age and growth for collected invasive carp will be determined through laboratory analysis of fish otoliths (ear bones) by USFWS. Specimens will include fish collected from the lower Illinois River through the MAM effort ("fishery-independent" data) and by commercial fishers ("fishery-dependent" data). Data will provide age-specific abundance and mortality estimates for use within the SCAA model and other analyses being conducted to inform targeted management actions (including intensive harvest) in the Illinois River to prevent invasive carp introduction and establishment in the Great Lakes.

Figure 23 – Electrified Dozer Trawl

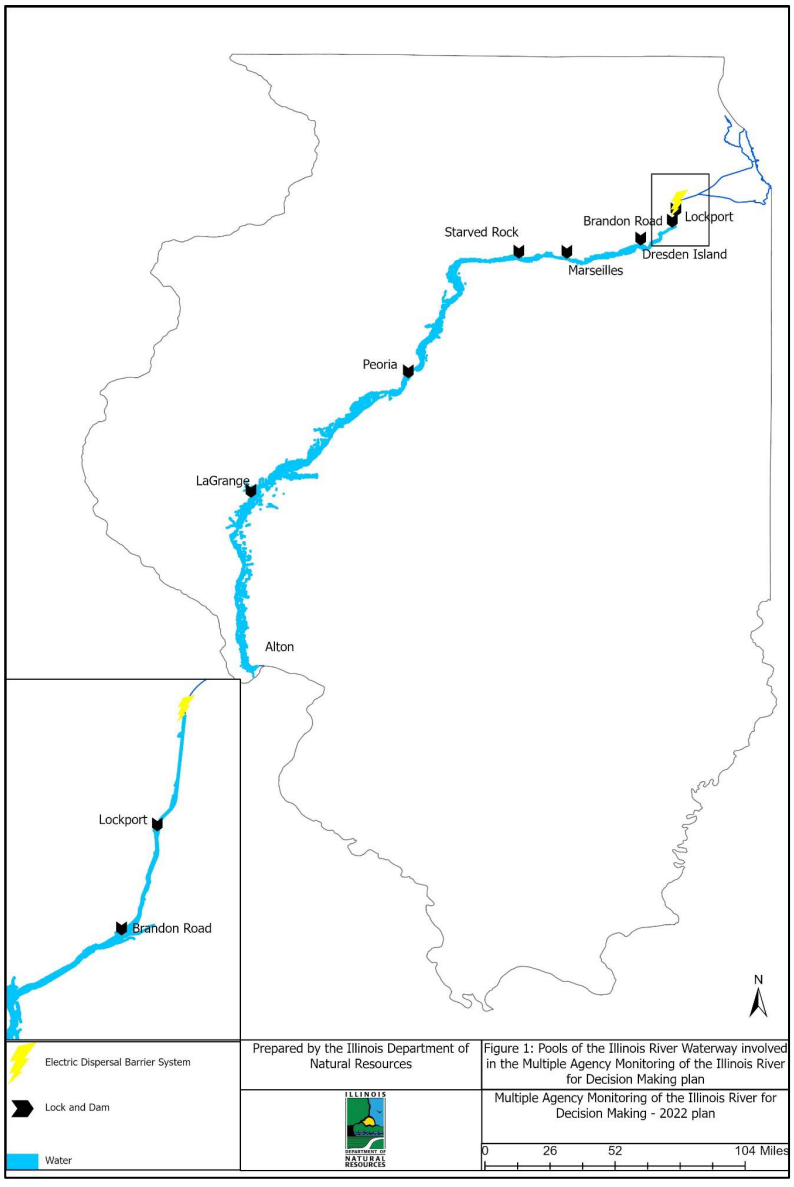
USFWS crew conducting invasive carp monitoring using an electrified "dozer" trawl. Source: USFWS

Project Description

This project provides an additional sampling technique (the electrified dozer trawl) within the existing MAM and supports the acquisition of fishery population information for conducting statistically robust analyses of Silver Carp in the Illinois River. This year's funding will be used to

continue standardized electrified dozer trawl sampling from June through October in eight pools of the Illinois River (Alton, LaGrange, Peoria, Starved Rock, Marseilles, Dresden Island, Brandon Road, and Lockport pools). Age structures (otoliths) will be extracted and analyzed for all fish collected, and age and growth will be determined by the USFWS. Funding will produce data from the analysis of invasive carp collected in the lower six pools (Alton, La Grange, Peoria, Starved Rock, Marseilles, and Dresden Island), and include: (1) fish captured by the agencies through the MAM (up to 200 individual fish per pool), and (2) fish obtained from commercial fishers (up to 200 individual fish per pool). Data will be provided to the MRWG Modeling Work Group to inform the development and use of invasive carp population models, including the SCAA model and evaluations of the relative importance of fishing mortality, fish movement, and natural mortality to observed changes in Silver Carp abundance. This project will support the development of an SCAA model for the Illinois River Silver Carp population by providing key demographic data critical to the development of abundance and mortality estimates for the Illinois River. The results of this project will help managers understand the relative effectiveness of current management actions and make informed decisions regarding targeted interventions, adjustments to existing strategies, or the exploration of novel approaches to ensure a long-term reduction in invasive carp populations for Great Lakes protection.

Figure 24 – Illinois River Waterway Pools



Map showing the pools on the Illinois Waterway. Source: IL DNR

PREVENTING INVASIVE CARP MOVEMENT THROUGH THE ILLINOIS WATERWAY

Monitoring and Decision Support

IM-7: Invasive Carp eDNA Sampling and Processing

- **Lead Agency:** USFWS
- **Agency Collaboration:** States and Tribes
- **GLRI Funding:** $0
- **Agency Funding:** $2,400,000

Project Summary

This project will continue monitoring for the presence of Bighead Carp and Silver Carp in the Great Lakes basin, Upper Mississippi River basin, and Ohio River basin, utilizing the science of eDNA collection and analysis as an early detection tool. Monitoring will include sites in the CAWS sampled prior to traditional fisheries gear surveillance is conducted through the MRWG's biannual SIM effort. USFWS will process water samples collected in collaboration with state and tribal partners to detect the presence of Bighead Carp and Silver carp eDNA in the U.S. Great Lakes tributaries of concern to help provide a warning of species presence prior to establishment. This year's USFWS agency funding will produce results for 9,000 to 10,000 collected and analyzed water samples targeting Bighead Carp and Silver Carp detection. This project will support early detection monitoring efforts for Bighead Carp and Silver carp to prevent their introduction and establishment in the Great Lakes.

Figure 25 – USFWS Personnel Collecting eDNA Water Samples

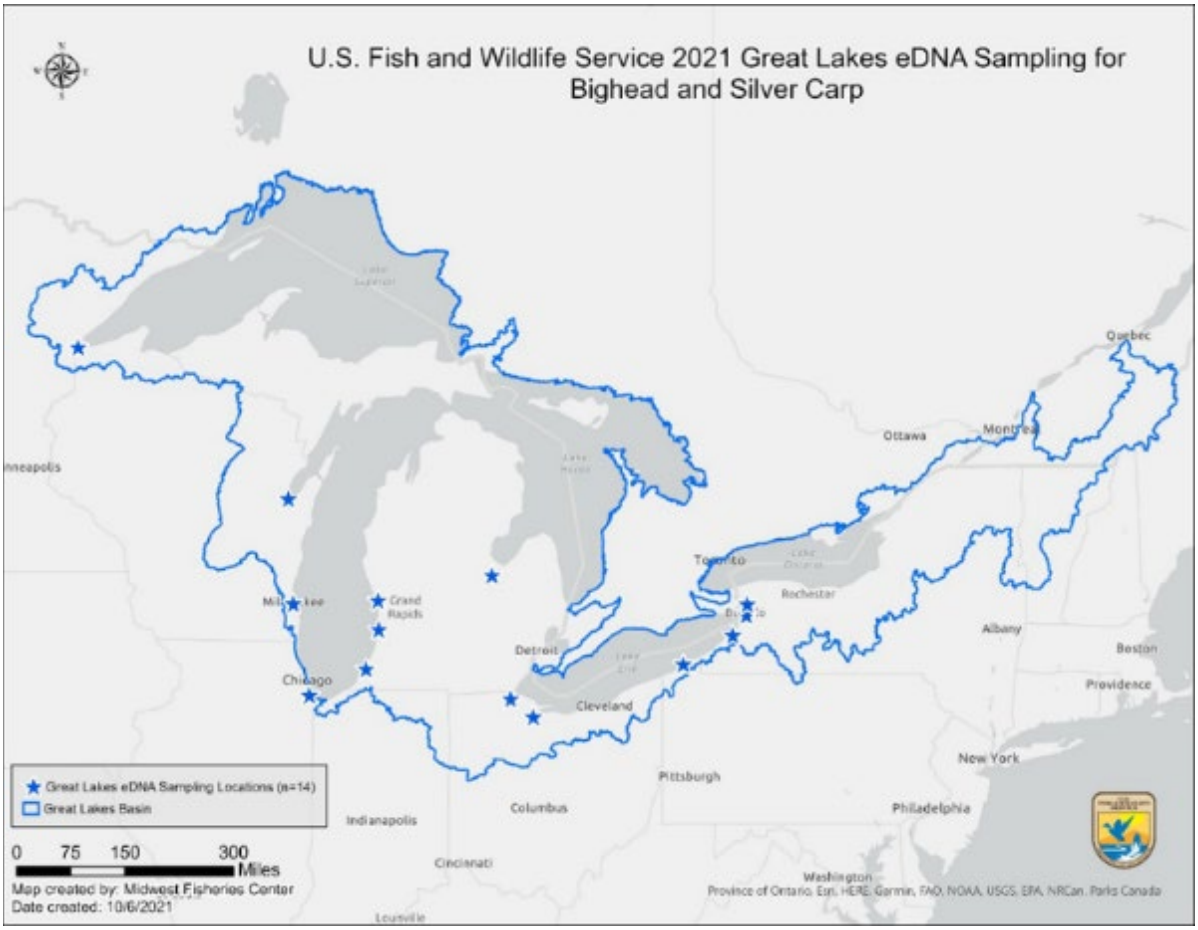
USFWS staff collecting eDNA water samples from a surveillance boat during invasive carp monitoring. Photo credit: USFWS

Project Description

The USFWS applies the science of eDNA as an early detection and monitoring tool in support of the ICRCC's strategic approach for protecting the Great Lakes from invasive carp. This work includes the continued refinement and development of state-of-the-art tools, field sampling and laboratory protocols, and expanded analytical capacity. This project supports a robust eDNA monitoring program for efficiently sampling high-priority locations for the presence of Bighead Carp and Silver Carp within the U.S. waters of the Great Lakes basin and select locations within the Upper Mississippi River and Ohio River basins.

Building upon existing genetics-based work for these species, this project will also continue to support the development of techniques for Grass Carp and Black Carp eDNA surveillance.

Figure 26 – USFWS Great Lakes eDNA Sampling for Bighead and Silver Carp



Map of Great Lakes eDNA sampling areas. Sourcet: USFWS

PREVENTING INVASIVE CARP MOVEMENT THROUGH THE ILLINOIS WATERWAY

Monitoring and Decision Support

IM-8: Real-time Telemetry Alert System and Refinement of the Spatially Explicit Invasive Carp Population Model

- **Lead Agency:** USGS
- **Agency Collaboration:** IL DNR, GLFC, USFWS, USACE, SIU
- **GLRI Funding:** $144,000
- **Agency Funding:** $0

Project Summary

This project will provide data and tools to inform decisions on potential management actions for controlling invasive carp in the Illinois River. This project will result in (1) updated invasive carp transition (movement between pools) estimates from telemetry data for use within the SEICarP model, a scenario planning model to evaluate alternative management actions, (2) maintenance of the real-time alert system for telemetry tagged carp, (3) measurement of immigration/emigration of invasive carp to/from the Illinois River, and (4) development of a framework for using existing telemetry data or planning future studies to refine other model parameters (e.g., fishing mortality) to prevent invasive carp from becoming established in the Great Lakes. This year's funding will support the maintenance of real-time telemetry to inform contingency actions, publish updated transition probability estimates in a peer-reviewed manuscript, review and format additional years of telemetry data for future updates to transition probabilities, provide guidance for efficient distribution of tagging effort and receiver placement in the Illinois River, and develop a framework for estimating/refining additional parameters to the SEICarP model.

Project Description

This project uses acoustic telemetry or acoustic telemetry data to support SEICarP modeling efforts and provide real-time telemetry data in support of barrier evaluations and contingency planning. USGS works with the MRWG TWG and Modeling Work Group to support modeling efforts to inform management actions (e.g., contract fishing, deterrents, etc.).

USGS has published an updated model for estimating transition probabilities from telemetry data coming from a multi-agency network of acoustic receivers in the Illinois River. Transition probability estimates and their associated uncertainty will be updated through 2025 and used to parameterize SEICarP. Additionally, telemetry data will be used to estimate fishing or natural

mortality and immigration or emigration to/from the Illinois River. These data are also actively used by the TWG as decision support guiding tagging plans and receiver placement. Funding will also support the maintenance of a network of real-time telemetry receivers and an alert system to inform contingency actions in the Illinois River.

Preventing Invasive Carp Movement through the Illinois Waterway

Monitoring and Decision Support

IM-9: Telemetry Tracking in the Illinois Waterway to Support the Spatially Explicit Invasive Carp Population Model

- **Lead Agency:** USFWS
- **Agency Collaboration:** SIU, USACE, USGS
- **GLRI Funding:** $150,000
- **Agency Funding:** $400,000

Project Summary

This project will provide telemetry data support and improve the accuracy of the SEICarP model used by fishery managers to run predictive scenarios with simulated outcomes for invasive carp control actions in the Illinois River. This project will result in estimates of the frequency of pool-to-pool invasive carp movement in the IWW and support efforts to prevent invasive carp from becoming established in the Great Lakes. Funding will support the collection of data describing the movement of telemetry-tagged invasive carp in the IWW that will be used to populate and refine the SEICarP model.

Project Description

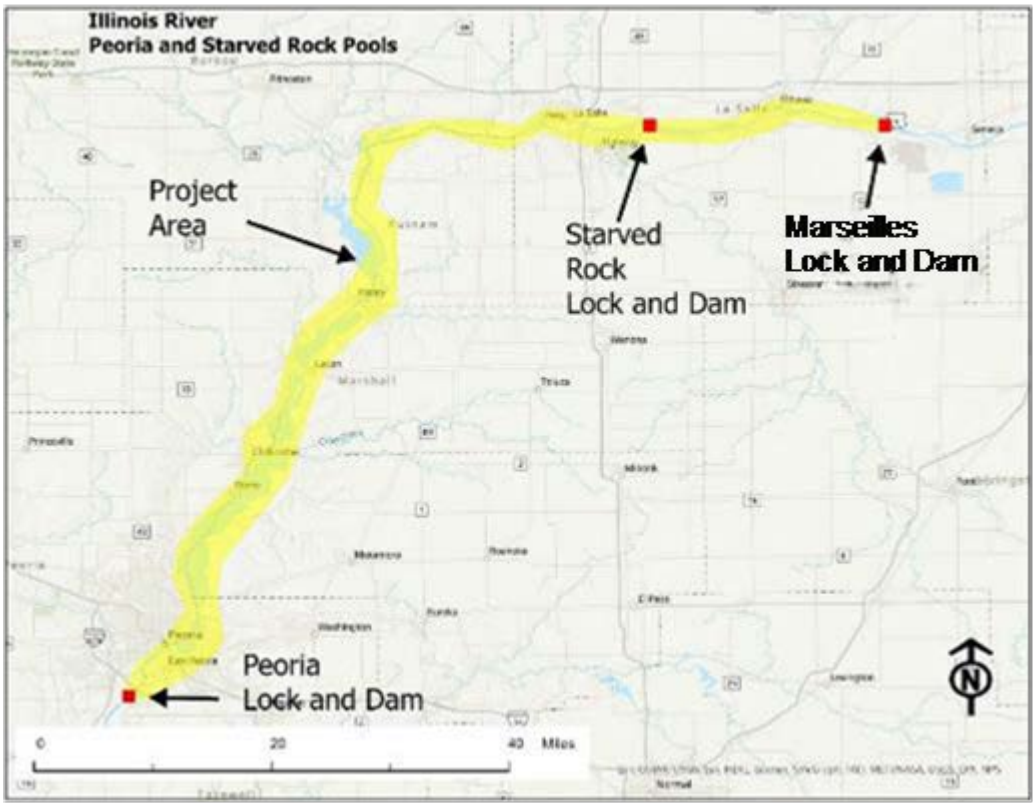
The SEICarP model was developed to provide managers with a tool for predicting the effect of various management strategies to control invasive carp populations in the IWW. In 2024, USFWS crews will tag an additional 150 Silver Carp and Bighead Carp with acoustic transmitters in and around the Peoria and Starved Rock pools. The data gained from the additional tagged fish will improve the accuracy of the SEICarP model, allowing it to better estimate current levels of exploitation and bolster estimates of large-scale pool-to-pool movement. Tagging locations and target lengths will be informed by the TWG. Fish will be tracked using the current acoustic array within the IWW. In consultation with the TWG,

Figure 27 – Technician Recovering Telemetry Receiver

Photo of staff recovering telemetry receiver. Photo credit: Jake Kessel

additional receivers will be placed in areas with reduced coverage. Funding will be used to purchase acoustic transmitters and surgery supplies for implanting transmitters into fish and will support operational costs associated with SEICarP telemetry fieldwork.

Figure 28 – Pools of the Illinois River with Area for Acoustic Receiver Deployments



Map showing pools of the Illinois River with area for acoustic receiver deployments highlighted in yellow. Source: USFWS

Preventing Invasive Carp Movement through the Illinois Waterway

Monitoring and Decision Support

IM-10: Alternate Pathway Surveillance in Illinois

- **Lead Agency:** IL DNR
- **Agency Collaboration:**
- **GLRI Funding:** $150,000
- **Agency Funding:** $0

Project Summary

This project will provide enforcement of laws enacted to prevent the expansion and/or introduction of AIS within the waters of the State of Illinois and jurisdictions throughout the Great Lakes basin. This project will result in the prevention and/or detection of unlawful human activities that increase the likelihood of invasive carp becoming established in the Great Lakes. This year's funding will produce surveillance logistics, support enforcement operations, provide solutions to AIS law enforcement-related issues, and support the training of Conservation Police Officers in aquatic organisms in trade enforcement.

Project Description

The IL DNR ISU specializes in more closely regulating water-related industries that are likely to be a source of future introductions or expansion of AIS into state waters. Industries include sport and commercial fishing, aquaculture, fish transportation, bait, pet, aquarium, fish stocking, and live food markets. ISU efforts to date have identified substantial violations in each of the above-listed industries, with many offenders routinely demonstrating disregard for regulations. A substantial risk to the state's natural resources from these remains for the foreseeable future, mitigated only by the efforts of specialized organisms in trade law enforcement units. ISU coordinates with other state and federal partners to protect this region and can quickly assemble a trained team of officers when necessary. Developing and implementing aquatic organisms in trade law enforcement training is an important element of this project because it creates a force multiplier for detection and prevention. ISU works alongside its non-law enforcement partners within this program to provide any necessary law enforcement support. This year's funding will produce a minimum of 10 organisms in trade industry inspections, a minimum of 5 intelligence-based enforcement operations, and responses to all aquatic invasive species law enforcement-related threats throughout the year. Additionally, training of up to 120 statewide conservation officers in 2024 will further enhance outcomes.

Preventing Invasive Carp Movement through the Illinois Waterway

Monitoring and Decision Support

IM-11: Evaluation of Invasive Carp Spawning Dynamics and Collection of Associated Hydrological Data

- **Lead Agency:** USGS
- **Agency Collaboration:** IL DNR, INHS, USACE, USFWS, NOAA
- **GLRI Funding:** $80,000
- **Agency Funding:** $75,000

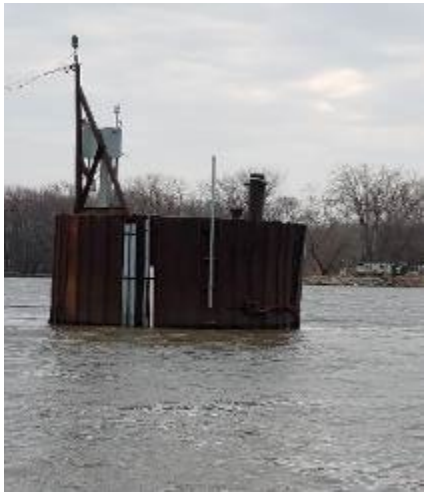
Project Summary

This project will assess the influence of river hydraulics and water quality on the population range, movement, and spawning and recruitment success of invasive carp in the IWW. FY 2024 funding will produce essential real-time and synoptic data in the IWW to support specific partner needs, including assessing seasonal variation in invasive carp spawning locations and modeling analysis of invasive carp egg development and transport (FluEgg) for state and federal agency partners. Results from this project will be used to inform analyses of management options for Great Lakes' protection from invasive carp.

Project Description

This project investigates the influence of habitat stimuli, such as river hydraulics and water quality, on the range, movement, and spawning and recruitment success of invasive carp in the IWW and other priority sites identified by the MRWG. Documenting and understanding how invasive carp interact with the hydraulics and water quality of a river informs efforts to deter invasive carp using novel barrier technologies and control invasive carp through commercial fishing, mass harvest techniques, and management of habitat factors. This project supports operating and maintaining two real-time, continuous water quality monitoring stations in the Marseilles Pool of the IWW; modeling analyses, including application of reverse FluEgg simulations from ichthyoplankton data in the IWW to estimate the most likely spawning locations for sampled eggs and larvae; developing a peer-reviewed journal article evaluating invasive carp spawning areas in the IWW between

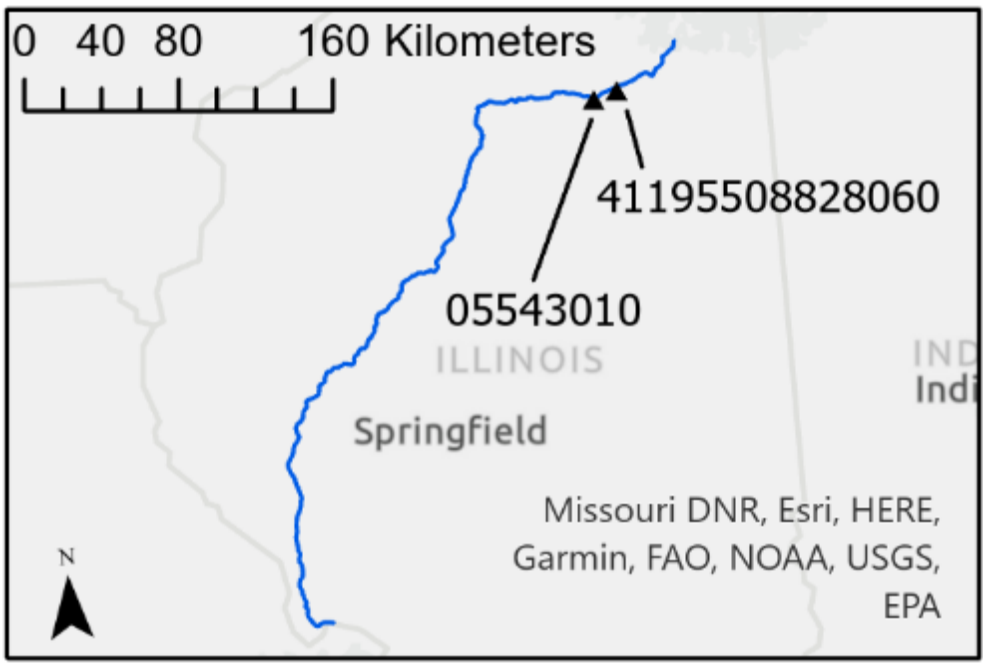
Figure 29 – Water Quality Monitoring Station



Photograph of USGS real-time, continuous water quality monitoring station 05543010 on the Illinois River at Seneca, Illinois. Photo credit: USGS

2015 and 2021; and continued collaboration with NOAA on publishing the results of an Individual-Based Bioenergetics Model for the IWW.

Figure 30 – Water Quality Monitoring Stations in Marseilles Pool



The blue line is the centerline of the Illinois River. The two black triangles show two real-time, continuous water quality monitoring stations in the Marseilles Pool of the IWW (05543010 Illinois River at Seneca and 41195508828060 Hanson West Pit near Morris, IL).

Preventing Invasive Carp Movement through the Illinois Waterway

Monitoring and Decision Support

IM-12: Invasive Carp Database Management and Integration Support

- **Lead Agency:** USGS
- **Agency Collaboration:** USFWS, USACE, IL DNR, IADNR, INHS, SIU, Iowa State University
- **GLRI Funding:** $140,000
- **Agency Funding:** $436,000

Project Summary

This project will provide invasive carp data management and decision support tools for the Illinois River with extensions to connected waters of the Mississippi River basin. This project will result in (1) a shared, multi-agency telemetry database (FishTracks), (2) a catalog and tools for invasive carp data (CarpDAT), and (3) maintenance of the ILRCdb. This project will help prevent invasive carp from becoming established in the Great Lakes by providing partners access to data and tools to analyze, visualize, model, and understand invasive carp movements and life history. This year's funding will support improvements and updates to the FishTracks and deployment of the CarpDAT.

Project Description

This project will provide data management and decision support tools to inform the removal of invasive carp in the Illinois River and reduce the risk of invasive carp reaching the Great Lakes. Funding for this project will be used to develop and maintain several complementary data systems, including (1) FishTracks, a repository for researchers and resource managers who are using acoustic telemetry to track and monitor invasive carp, (2) CarpDAT, a centralized reference for sharing information about invasive carp research, and (3) the ILRCdb, which tracks invasive carp numbers in the Illinois River.

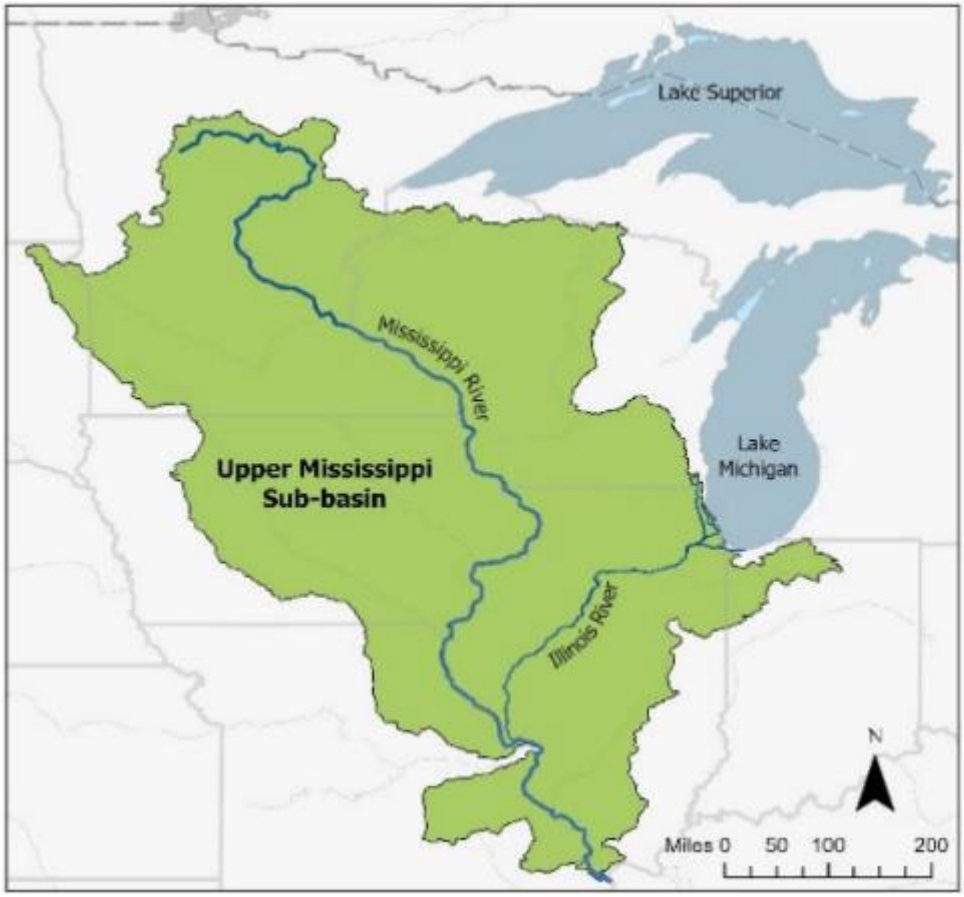
The tools developed will assist researchers in evaluating the impact of different control actions and creating integrated pest management plans for

Figure 31 – Tagging Invasive Carp with Acoustic Transmitter

Invasive carp are tagged with an acoustic transmitter on the Illinois River near Morris, IL. Data is uploaded to the FishTracks Telemetry Database to monitor invasive carp movement in the river.

invasive carp. Data can also be used to inform modeling efforts in the Illinois River and other surrounding basins. FY 2024 funds will be used to upgrade FishTracks, including creating an updated user interface streamlined functionality; initiate the development of invasive carp analysis tools in coordination with partners to meet their needs; coordinate with USFWS to deploy the CarpDAT while ensuring invasive carp information is accessible and useable; improve the efficiency of invasive carp management and research by using CarpDAT to promote coordination and reduce duplication of work; and continue the maintenance of the ILRCdb application.

Figure 32 – Upper Mississippi River Basin Project Area and Illinois River



Map of the Upper Mississippi sub-basin.

Preventing Invasive Carp Movement through the Illinois Waterway

Monitoring and Decision Support

IM-13: USGS Support for Invasive Carp Population Modeling in the Illinois River

- **Lead Agency:** USGS
- **Agency Collaboration:** USFWS, IL DNR, SIU, INHS, MSU
- **GLRI Funding:** $110,000
- **Agency Funding:** $290,000

Project Summary

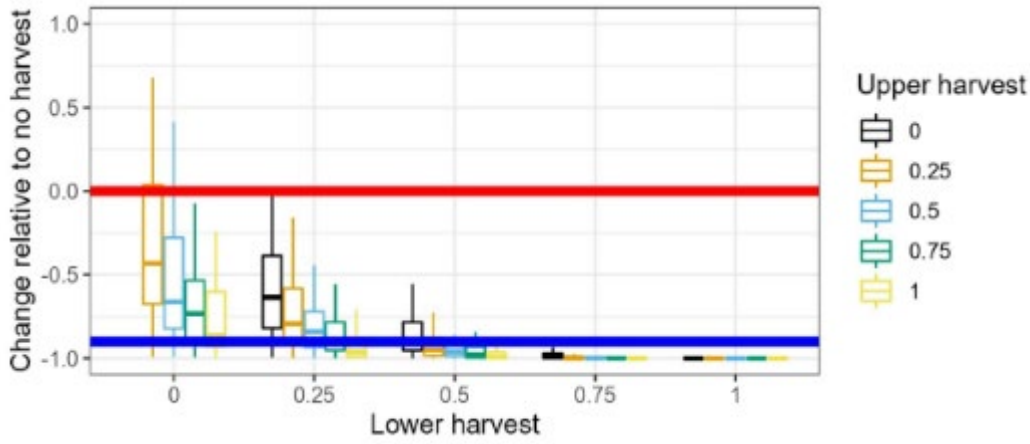
This project will develop objective, data-driven models to inform decisions concerning invasive carp control efforts in the Illinois River. This project will result in population status estimates and identify management recommendations that minimize the number of invasive carp challenging the EDBS. FY 2024 funding will produce advancements to existing decision-support tools and initial population and mortality estimates for invasive carp. This project will prevent invasive carp from becoming established in the Great Lakes by providing recommendations for the magnitude and location of removal and deterrent efforts to reduce invasive carp populations near the EDBS.

Project Description

This project supports ongoing modeling efforts to provide recommendations about the magnitude and spatial allocation of fishing effort and deterrent barriers to reduce the risk of Silver Carp and Bighead Carp introduction and establishment in the Great Lakes. This project will provide estimates of population size and harvest mortality that can be used to determine the effectiveness of current management actions and inform future decision-making regarding the allocation of resources and effort to improve invasive carp management effectiveness in the Illinois River.

Initial management recommendations can be provided from the SEICarP model, which is entering the production phase. To estimate the population size and harvest mortality of Bighead Carp and Silver Carp in the Illinois River, the MRWG Modeling Work Group is using catch statistics, age and growth data, and telemetry-based movement data (e.g., removals, monitoring, telemetry work groups, and the enhanced contract harvest program) to begin developing an SCAA model. Once operational, these models can be used iteratively to set management targets, estimate the effectiveness of management actions, and recalibrate management targets based on this new information.

Figure 33 – Simulated Change in Silver Carp Abundance After 25 Years of Different Harvest Levels



Simulated proportional change in Silver Carp abundance in Dresden Island Pool after 25 years of varying harvest levels in the lower (x-axis) and upper (legend) portions of the Illinois River from the SEICarP model. A harvest rate of one indicates 100% of fish removed annually. A proportional change of zero indicates the same effect as the no-harvest scenario (red line). A proportional decrease of 90% relative to the no-harvest scenario is represented with the blue line. Source: Kallis, et al. 2023

Figure 34 – Illinois River System

Navigational pools are indicated with white rectangles spanning the river, which correspond to the locations of lock and dam structures and are named for the downstream lock and dam structure. Modeling efforts are applied to the Illinois River from its confluence with the Mississippi River to BRLD (i.e., Alton – Dresden Island pools). Source: Kallis et al. 2023.

Preventing Invasive Carp Movement through the Illinois Waterway

Monitoring and Decision Support

IM-14: USFWS Support for Invasive Carp Population Modeling in the Illinois River

- **Lead Agency:** USFWS
- **Agency Collaboration:** USGS, IL DNR, SIU, INHS, MSU
- **GLRI Funding:** $100,000
- **Agency Funding:** $200,000

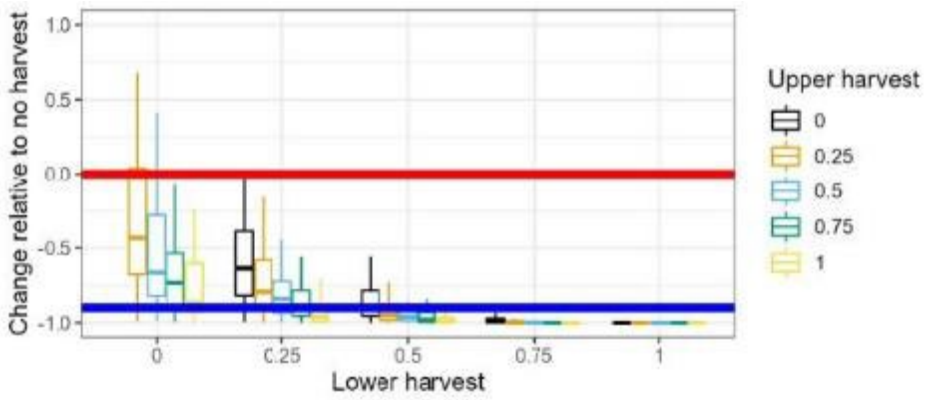
Project Summary

This project will develop objective, data-driven models to inform decisions concerning invasive carp control efforts in the Illinois River. This project will result in population status estimates and identify management recommendations that minimize the number of invasive carp potentially challenging the EDBS. This year's funding will produce advancements to existing decision-support tools and initial population and mortality estimates for invasive carp. This project will prevent invasive carp from becoming established in the Great Lakes by providing recommendations for the magnitude and location of removal and deterrent efforts to reduce invasive carp populations near the EDBS.

Project Description

This project supports ongoing modeling efforts to provide recommendations about the magnitude and spatial allocation of fishing effort and deterrent barriers to reduce the risk of Silver Carp and Bighead Carp introduction and establishment in the Great Lakes. In addition, these efforts will provide estimates of population size and harvest mortality that can be used to determine the effectiveness of current management efforts and inform future decision-making regarding the allocation of additional resources or reallocation of existing resources to improve invasive carp management in the Illinois River. Initial management recommendations can be provided from the SEICarP model, which is entering the production phase. To estimate the population size and harvest mortality of Bighead Carp and Silver Carp in the Illinois River, the MRWG Modeling Work Group is using catch statistics, age and growth data, and telemetry-based movement data (e.g., removals, monitoring, telemetry work groups, and the enhanced contract harvest program) to begin development of an SCAA model. Once operational, these models can be used iteratively to set management targets, estimate the effectiveness of management actions, and recalibrate management targets based on this new information.

Figure 35 – Simulated Change in Silver Carp Abundance After 25 Years of Different Harvest Levels



Simulated proportional change in Silver Carp abundance in Dresden Island Pool after 25 years of varying harvest levels in the lower (x-axis) and upper (legend) portions of the Illinois River from the SEICarP model. A harvest rate of one indicates 100% of fish removed annually. A proportional change of zero indicates the same effect as the no-harvest scenario (red line). A proportional decrease of 90% relative to the no-harvest scenario is represented with the blue line. Source: Kallis et al. 2023.

Figure 36 – Illinois River System

Navigational pools are indicated with white rectangles spanning the river which correspond with the locations of lock and dam structures and are named for the downstream lock and dam structure. Modeling efforts are applied to the Illinois River from its confluence with the Mississippi River to BRLD (i.e., Alton – Dresden Island pools). Source: Kallis et al. 2023.

PREVENTING INVASIVE CARP MOVEMENT THROUGH THE ILLINOIS WATERWAY

Monitoring and Decision Support

IM-15: Early Detection Monitoring for Invasive Carp in the Great Lakes

- **Lead Agency:** USFWS
- **Agency Collaboration:** IL DNR, MI DNR, IN DNR
- **GLRI Funding:** $285,000
- **Agency Funding:** $1,400,000

Project Summary

This project will implement a comprehensive early detection surveillance program for invasive carp species in the Great Lakes at high-risk locations in southern Lake Michigan (Calumet River, Burns Harbor, and Burns Ditch) and western Lake Erie. USFWS biologists will employ an array of fishery sampling gears targeting all life stages of invasive carp to maximize detection probability if invasive carp species are present. This program complements the invasive carp eDNA monitoring program implemented by the USFWS and partners in the U.S. waters of the Great Lakes and key tributaries. This project will prevent invasive carp from becoming established in the Great Lakes by providing targeted, comprehensive early detection monitoring effort to inform potential contingency response actions if needed.

Project Description

USFWS will continue to implement a comprehensive early detection surveillance program for Bighead Carp, Silver Carp, Grass Carp, and Black Carp in and near select locations in the U.S. waters of the Great Lakes. This program complements the invasive carp eDNA and early detection monitoring programs currently implemented by the USFWS and partners in the Great Lakes basin. Sampling will continue to target areas of high concern in the Great Lakes (e.g., southern Lake Michigan, western Lake Erie, areas with past positive eDNA results) and use a wide array of traditional and novel gears to target all

Figure 37 – Using Fyke Net to Survey for Invasive Carp

Biologists from the USFWS Alpena Fish and Wildlife Conservation Office using a fyke net to survey for invasive carp in Lake Erie.
Photo credit: USFWS

potential life stages of invasive carp species (eggs, larvae, juveniles, and adults). This project will be conducted in close coordination with the Great Lakes fishery management agencies of the respective jurisdictions in which sampling is being conducted.

Figure 38 – Great Lakes High-Risk Sampling Locations

Map showing aquatic invasive species sampling surveillance locations in the Great Lakes. Source: USFWS

Preventing Invasive Carp Movement through the Illinois Waterway

Monitoring and Decision Support

IM-16: Evaluation of Fish Transfer System to Promote Native Species Movement and Invasive Carp Harvest

- **Lead Agency:** IL DNR
- **Agency Collaboration:** INHS, USGS, USGS, USACE
- **GLRI Funding:** $200,800
- **Agency Funding:** $0

Project Summary

This project will evaluate a mobile fish transfer system with associated technology to support fish scanning and sorting capabilities. This project may lead to a new tool to attract invasive carp and selectively remove them from the IWW while allowing the passage of native fish. This year's funding will support the operation of the fish transfer system and train the scanning software to identify native and invasive fish to selectively pass or constrain fish depending on their invasive status.

Project Description

Prior work has shown that Silver Carp and Grass Carp will climb a fish ladder, but native fish outperformed the invasive ones in the pilot study. INHS and IL DNR will evaluate using a mobile fish movement system with a fish ladder and associated technology to support fish scanning and sorting capabilities. A floating mobile platform to support the fish ladder will allow for the unit to be evaluated in multiple locations as needed to help determine the optimum height/angle and overcome the limitations of a fixed design and the mobile system. The more flexible design will optimize the fish ladder for invasive carp movement while also assessing the conditions necessary to selectively pass natives. A series of experiments controlling for multiple variables will be conducted, including the angle of the steeppass, the flow rate and depth of water in the steeppass, the

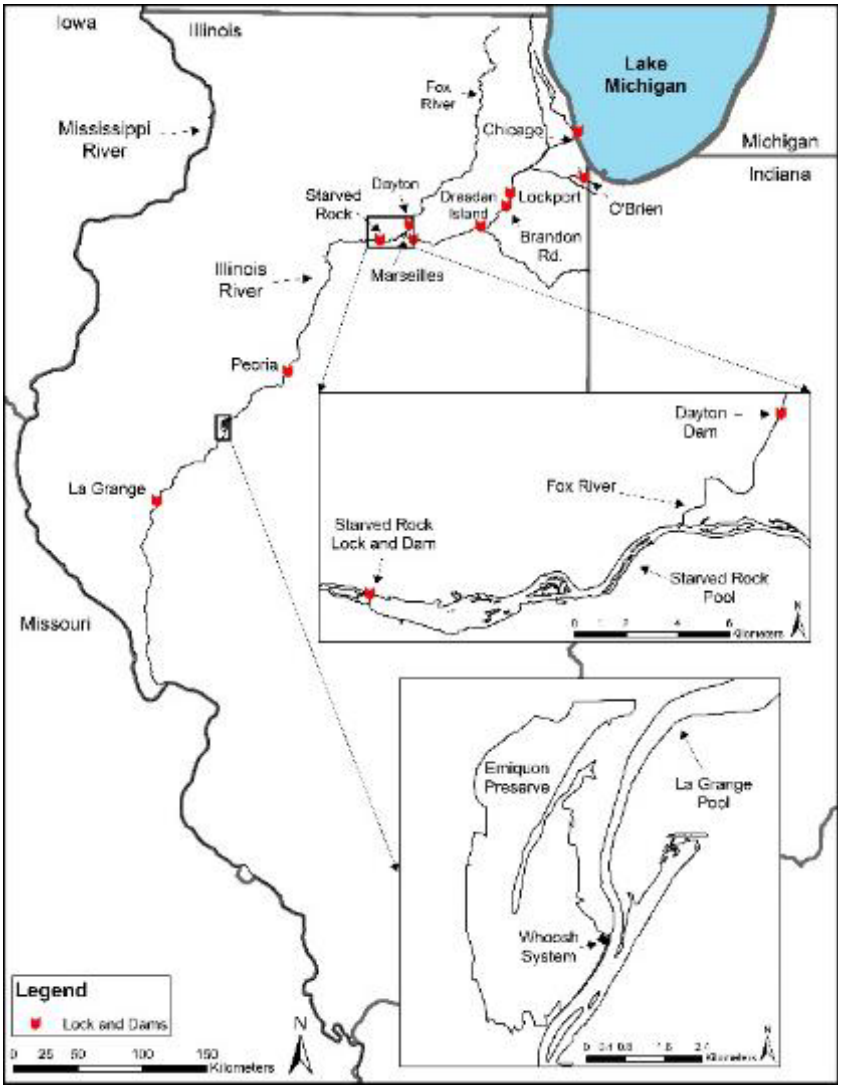
Figure 39 – Alaskan Steeppass Fish Ladder with Scanner

Mobile fish transfer system (Alaskan steeppass fish ladder with scanner/AI species identification software) to promote invasive carp removal and facilitate native fish movement. Photo credit: IL DNR

flow rate and depth of water in the flow box, the elevation of the steeppass distal end to or in the water's surface, invasive carp attractants, and environmental conditions conducive to invasive carp movement.

Scanning technology can likely distinguish multiple invasive species not limited to invasive carp management applications. Collaboration among research agencies will contribute to the evaluation of fish movement technology and advance management tools for invasive carp and native fish in the Illinois River basin.

Figure 40 – Project Location Areas



Map of the State of Illinois, showing mobile fish transfer system project areas (see map insets). Red symbols indicate lock/dam structures. Source: IL DNR

Hydrologic Barriers to Prevent Invasive Carp Movement Through Intermittent Waterways

HB-1: Construction of Structures at Little Killbuck Creek, Ohio, to Prevent Inter-Basin Movement of Invasive Carp

- **Lead Agency:** OH DNR
- **Agency Collaboration:**
- **GLRI Funding:** $2,500,000
- **Agency Funding:** $0

Project Summary

The GLMRIS, completed by USACE in 2014, determined Little Killbuck Creek as a medium-risk connection for the transfer of Bighead Carp, Silver Carp, and Black Carp from the Mississippi River basin (Little Killbuck Creek) to the Great Lakes basin (Black River). The Little Killbuck Creek connection is a low-lying area that supplies a direct water connection between the two watersheds during high-water events. The connection will be closed using a combination of a rock and earthen berm to separate the basins and close this connection through a phased approach that will address the highest risk areas based on flood risk (AIS transfer risk).

Project Description

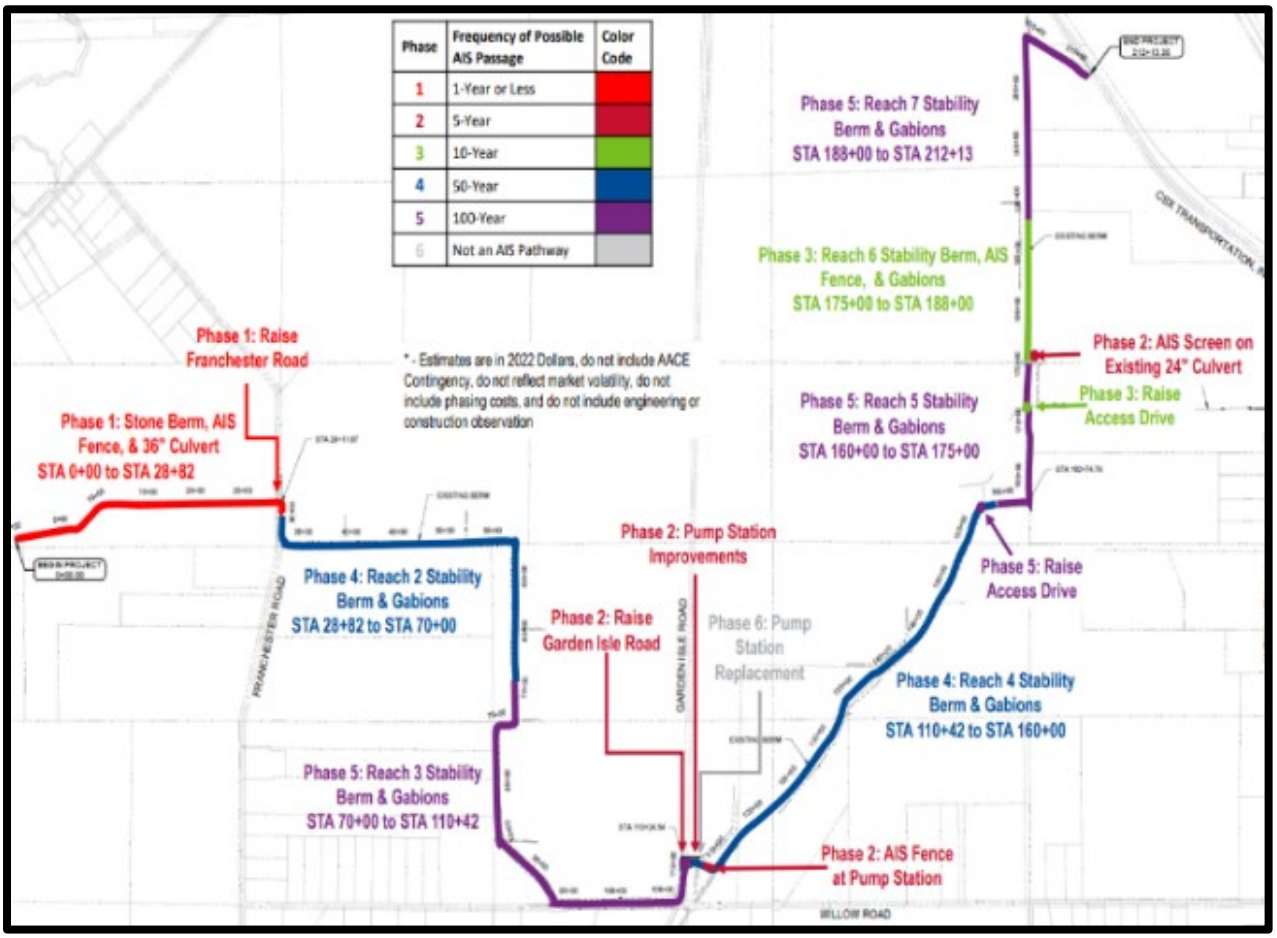
Using previous funding, OH DNR completed the berm design, permitting, wetland mitigation, and construction of a rock berm that is at the highest risk for flooding (Phase 1). The remaining project (Reaches 2 through 7, Phases 2 through 6) will be phased over multiple years and further stabilize and maintain the current earthen berm and upgrade related infrastructure. Phase 1 of the project will be initiated in the spring of 2024 and will include constructing a new rock berm on Medina County Park District property and raising a roadway (Franchester). Later phases will include maintaining the current earthen berm and additional measures on adjacent private property. Phase 2 of the project will be completed using FY 2024 funding and will address the second highest AIS risk, including the purchase of an easement for the current earthen berm, the raising of a second roadway (Garden Isle), the upgrade of a pumping

Figure 41 – Little Killbuck Creek GLMRIS Connection

Map showing the Little Killbuck Creek connection and the Great Lakes and Mississippi River basins. Source: OH DNR

facility to ensure dry conditions, improvements to an access road for future construction phases, and a screening of a structure for a culvert.

Figure 42 – Little Killbuck Creek Barrier – Risk Based Phases



Schematic identifying the risk-based phases for the Little Killbuck Creek barrier project. Source: OH DNR

Hydrologic Barriers to Prevent Invasive Carp Movement Through Intermittent Waterways

HB-2: Maintenance of Structures at Ohio & Erie Canal to Prevent Inter-Basin Movement of Invasive Carp

- **Lead Agency:** OH DNR
- **Agency Collaboration:**
- **GLRI Funding:** $20,000
- **Agency Funding:** $0

Project Summary

This project will help prevent invasive carp from entering Lake Erie via a watershed connection between the Ohio River and Lake Erie at the Ohio & Erie Canal in Akron, Ohio. With the completion of the engineering part of this project, annual maintenance is now necessary to continue effective prevention measures at this area in the Ohio & Erie Canal.

Project Description

Invasive carp, specifically Bighead Carp and Silver Carp, have been confirmed downstream in the Ohio River, and these fish could move upstream toward Lake Erie through a series of tributaries in the coming years. Taking proactive steps helps prepare for what could eventually become a greater threat to the ecology and economy of the Great Lakes. It's important to keep these fish out because they are fast-growing and prolific feeders capable of out-competing native fish for food.

The GLMRIS, completed by USACE in 2014, determined the Ohio & Erie Canal as a medium-risk connection for the transfer of Bighead Carp, Silver Carp, and Black Carp from the Mississippi River basin to the Great Lakes basin. The Ohio & Erie Canal project included the design and construction of various structural measures to prevent or reduce the probability of these invasive ANS moving from the Tuscarawas River Watershed (headwaters of the Muskingum River) into the Cuyahoga River Watershed and eventually Lake Erie via the Ohio & Erie Canal.

The construction of physical barriers was started by USACE in the spring of 2019 using GLRI funding and was completed in

Figure 43 – Little Killbuck Creek GLMRIS Connection

Map showing Little Killbuck Creek connection and the Great Lakes and Mississippi River basins. Source: OHDNR

the spring of 2020. Close coordination of the study, design, and construction was maintained with the OH DNR and Summit County Metro Parks. Once the project was completed in 2020, OH DNR took over the maintenance of the invasive control structures.

Figure 44 – Ohio & Erie Canal – Gabion Basket Barrier

Photo of the Gabion Basket Barrier at the Ohio & Erie Canal. Source: OH DNR

Preventing the Establishment of Grass Carp in the Great Lakes

GC-1: Removal of Grass Carp in Ohio Waters of the Lake Erie Western Basin and Early Detection Monitoring in Other Lake Erie Tributaries

- **Lead Agency:** OH DNR
- **Agency Collaboration:** UT, GLFC, MI DNR, USFWS, USGS
- **GLRI Funding:** $625,000
- **Agency Funding:** $0

Project Summary

This project will conduct aggressive control actions in locations of known Grass Carp spawning in the Sandusky and Maumee rivers in Ohio and other Lake Erie tributaries. Funding will be used for three Grass Carp strike teams and research at the UT that will contribute to the multi-agency goal of removing 373 diploid (fish with two sets of chromosomes and can reproduce) Grass Carp annually from Lake Erie. This project reduces the risk of the spread and establishment of Grass Carp in the Great Lakes by reducing the number of spawning fish while also collecting information to inform future adaptive response actions.

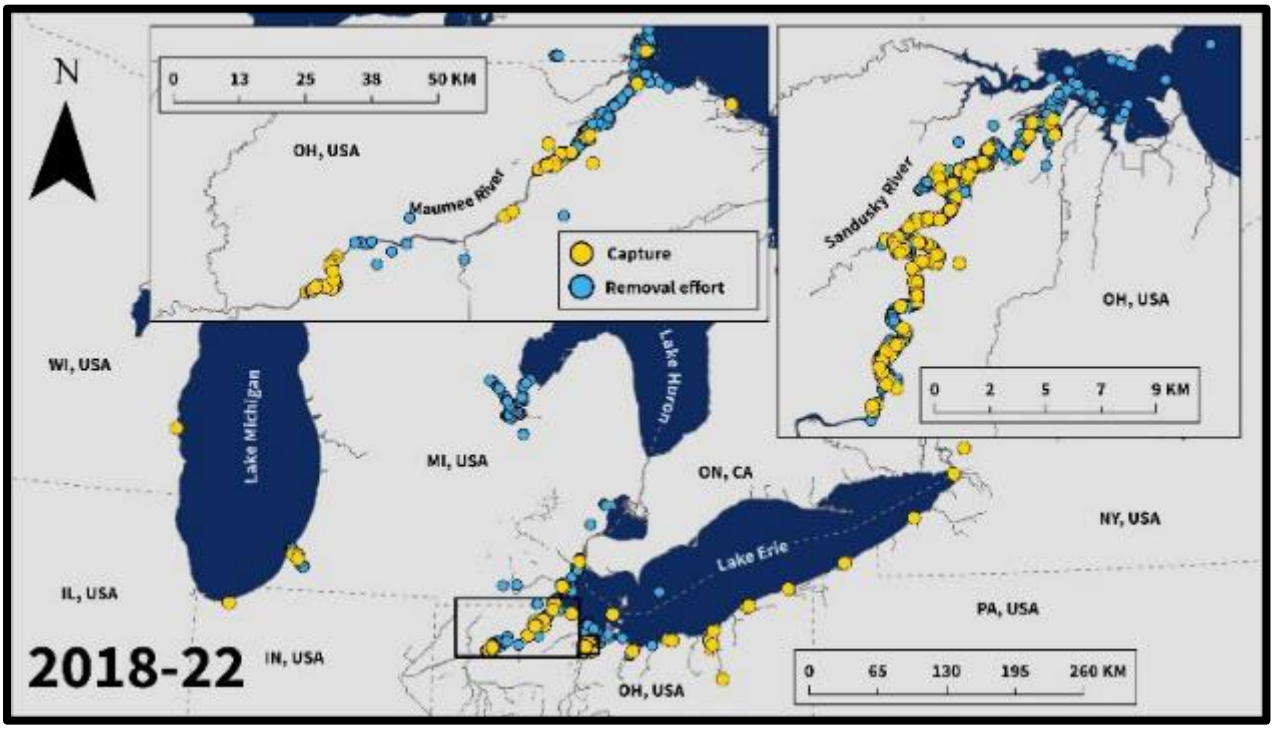
Project Description

Figure 45 – Grass Carp Strike Team

Ohio DNR Grass Carp Strike Team sampling for grass carp in the Sandusky River. Source: OH DNR

This project supports monitoring and control work by field crews to remove Grass Carp from the Lake Erie Western Basin, specifically in the Sandusky and Maumee rivers. Field crews will also conduct reconnaissance on other Lake Erie tributaries to determine if Grass Carp are present and spawning. The goal is to work with agency partners to remove 373 diploid Grass Carp annually from Lake Erie. The effort will be guided by the 2024 to 2028 Lake Erie Grass Carp Response Strategy (under development). Field crews will use real-time telemetry detections to evaluate catchability and capture rates. Data collected will support modeling efforts through UT and MSU to increase collection efficiency, determine effectiveness in removal, and better estimate spawning population size. The long-term goal of this work is to suppress and/or eradicate the Grass Carp population in Lake Erie and prevent this species from becoming established in the Great Lakes.

Figure 46 – Great Lakes Basin Grass Carp Collections



Map showing Grass Carp captures and removal effort at multiple locations in the Great Lakes basin, 2018-2022. Source: OH DNR

Preventing the Establishment of Grass Carp in the Great Lakes

GC-2: Removal of Grass Carp in the Lake Erie Western Basin and Early Detection Monitoring in Great Lakes Tributaries

- **Lead Agency:** MI DNR
- **Agency Collaboration:** OH DNR, USFWS, USGS, GLFC, UT, MSU
- **GLRI Funding:** $385,000
- **Agency Funding:** $150,000

Project Summary

This project will implement Grass Carp response actions in Michigan and Ohio waters of Lake Erie and its connecting waters, as well as early detection monitoring in Great Lake tributaries. This year's funding will provide the support to staff an MI DNR field crew that will contribute to the multi-agency goal of removing 373 Grass Carp from the Lake Erie Western Basin and connecting waters. In addition, surveillance efforts in the tributaries of Lake Huron and Lake Michigan will evaluate potential spread to other Great Lakes. This project will reduce the risk of the spread and establishment of Grass Carp in the Great Lakes by reducing the number of spawning fish while also collecting information to inform future adaptive response actions.

Project Description

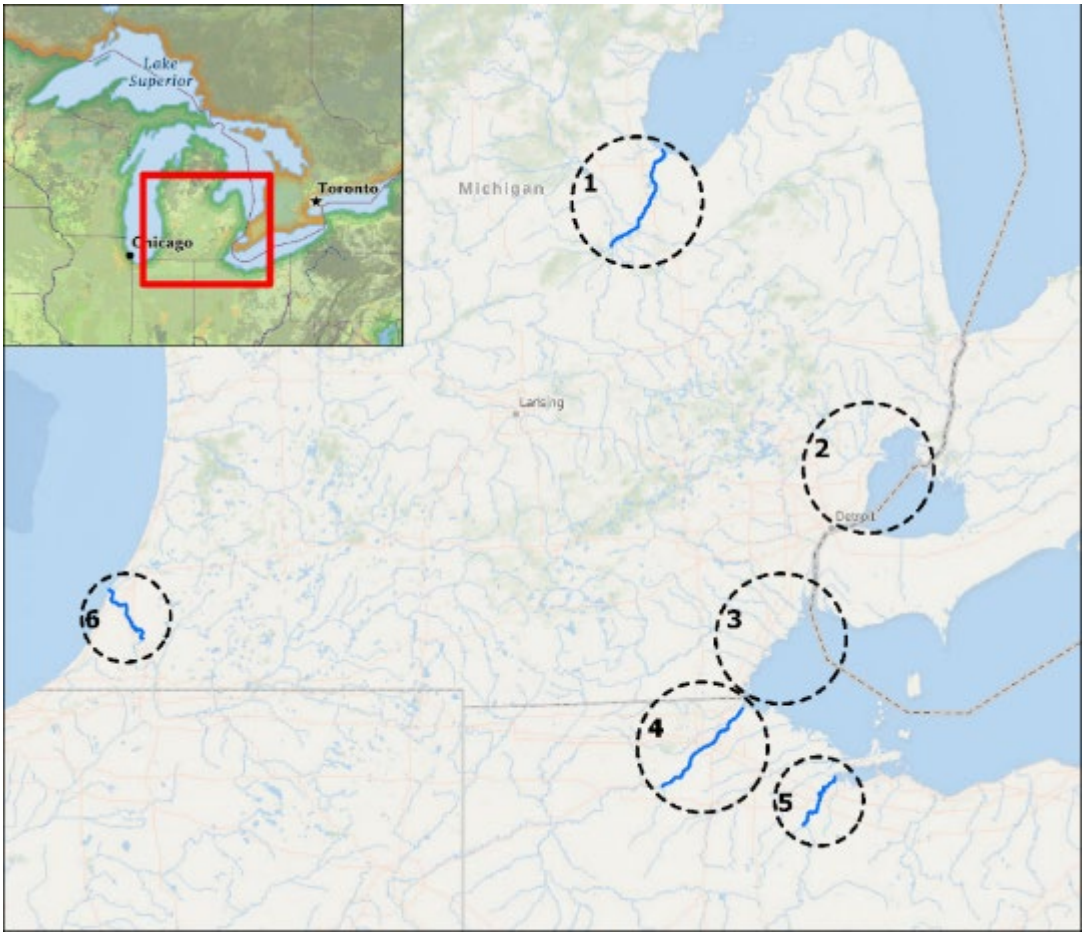
This project will support a field crew that will contribute to the multi-agency goal of removing 373 Grass Carp from the Lake Erie Western Basin and minimizing the likelihood of the establishment of new populations of this species. The effort will be guided by the 2024 to 2028 Lake Erie Grass Carp Response Strategy (under development). Response strategies will be implemented to maximize the removal of Grass Carp while simultaneously collecting important information about Grass Carp relative abundance, movement, distribution, and gear effectiveness. Project partners will integrate information from acoustic telemetry into response strategies, including information about spawning

Figure 47 – Grass Carp Removal Using Electrofishing

MI DNR Grass carp crew conducting electrofishing for Grass Carp removal. Source: MI DNR Fisheries Division

event timing, location of aggregations, and seasonal movements of Grass Carp. Efforts will be focused on the Lake Erie Western Basin and include occasional surveillance in the tributaries of Lake Huron and Lake Michigan to evaluate the potential spread to other Great Lakes. The primary field methods will include paired boat electrofishing and trammel netting; however, collaborations with commercial and recreational fishers will also be leveraged to augment the capacity to remove Grass Carp and collect critical information.

Figure 48 – FY 2024 Areas of Focus for Grass Carp Removal



Map showing the areas of focus for FY 2024, including: (1) the Saginaw River and major tributaries, (2) select areas of Lake St. Clair, (3) the Lake Erie Western Basin, (4) the Maumee River, (5) the Sandusky River, and (6) the St. Joseph River. Source: OH DNR

Preventing the Establishment of Grass Carp in the Great Lakes

GC-3: Support for Removal of Grass Carp in the Lake Erie Western Basin and Early Detection Monitoring in Great Lakes Tributaries

- **Lead Agency:** USFWS
- **Agency Collaboration:** DFO Canada, GLFC, IN DNR, MI DNR, MSU, OH DNR, NY DEC, Pennsylvania FBC, SIU, University at Buffalo, UT, USGS, WIDNR
- **GLRI Funding:** $1,150,000
- **Agency Funding:** $847,590

Project Summary

This project supports the additional capacity needed for Grass Carp removal efforts in the Lake Erie basin and enhances Grass Carp surveillance in Great Lakes tributaries. FY 2024 funding will support the needed capacity to implement Grass Carp response actions in Lake Erie and early detection monitoring at high-priority locations in Lake Michigan and Lake Ontario in support of state-led Grass Carp management strategies. This project will result in increased targeted monitoring and removal of Grass Carp, reducing the threat of this species in the Great Lakes by lessening populations and suppressing reproductive success.

Figure 49 – Adult Grass Carp Jumping from Debris

Adult Grass Carp jumping from submerged woody debris during boat electrofishing on the St. Joseph River, Michigan. Photo credit: USFWS

Project Description

This project will provide field crews, vessel support, and laboratory assistance to project partners that are implementing state-led Grass Carp early detection and removal actions. In Lake Erie, field crews will contribute to the multi-agency goal of removing 373 Grass Carp from the Lake Erie Western Basin and connecting waters. The effort will be guided by the 2024 to 2028 Lake Erie Grass Carp Response Strategy (under development). In addition, assistance will be provided for implementing the mobile VEMCO Positioning System array study (underwater acoustic transmitters and receivers), analyzing samples for estimating ages and mortality rates of Grass Carp, monitoring for the presence of specific viruses in Grass Carp, supporting the Grass Carp early life history project and otolith microchemistry assessments, and surgically implanting acoustic tags for the ongoing Grass Carp telemetry study. In Lakes Michigan and Ontario, USFWS will support state-led early detection and response efforts by providing targeted Grass Carp monitoring, as well as conducting removal actions as requested.

Preventing the Establishment of Grass Carp in the Great Lakes

GC-4: Invasive Carp Ploidy Analysis to Assess Reproductive Risk of Detected Populations

- **Lead Agency:** USFWS
- **Agency Collaboration:** DFO Canada, USGS, MI DNR, IL DNR, OH DNR, Pennsylvania FBC, NY DEC, University of Buffalo, UT
- **GLRI Funding:** $80,000
- **Agency Funding:** $40,000

Project Summary

This project will support laboratory analyses to determine the reproductive capability of captured Grass Carp (capable of reproducing [diplod] or infertile form sold by the aquaculture industry [triploid]). By determining the reproductive viability of Grass Carp, management efforts will be better able to target removal efforts to areas of highest risk for reproduction. Similar analyses will also be used to assess captured Black Carp that threaten to invade the Great Lakes basin via the upper Mississippi River and Ohio River basins. This year's funding will produce analyses of at least 200 Grass Carp specimens to determine the threat for reproduction in Lake Erie and the Great Lakes basin and up to 100 Black Carp from the leading edge of invasion in Great Lakes states.

Project Description

Infertile Grass Carp have been produced by the aquaculture industry for stocking in small lakes and ponds to control nuisance aquatic plants. These infertile fish are referred to as "triploid" because they have three sets of genes, rather than the normal two sets, which renders them reproductively sterile and non-reproducing. Ploidy determination is a genetic analysis of the number of sets of genes using a laboratory analysis called flow cytometry. This project will result in data on the reproductive viability (capability of reproducing in the wild) of collected Grass Carp in Lake Erie and the Great Lakes basin. The analysis will also be performed on Black Carp captured near the invasion front in the Great Lakes States in rivers within the Mississippi River and Ohio River basins.

Figure 50 – Grass Carp Captured in Great Lakes Basin

Photo of personnel holding a Grass Carp captured in the Great Lakes basin. Photo credit: USFWS

Results are used by partner agencies to assess the risk of new population establishment or range expansion and to target invasive carp removal actions. Ploidy determination results, along with collection data and images, are shared with ICRCC member agencies and documented on the USGS Non-indigenous Aquatic Species Database: Nonindigenous Aquatic Species (usgs.gov).

Figure 51 – Black Carp Collected from Mississippi River Basin

Photo of Black Carp collected from the Mississippi River basin. Photo credit: USFWS

PREVENTING THE ESTABLISHMENT OF GRASS CARP IN THE GREAT LAKES

GC-5: Monitoring for Grass Carp Eggs and Larval Fish to Identify Spawning Tributaries and Specific Spawning Areas

- **Lead Agency:** USGS
- **Agency Collaboration:** OH DNR, MI DNR
- **GLRI Funding:** $200,000
- **Agency Funding:** $361,885

Project Summary

This project will monitor Grass Carp spawning in Ohio and Michigan tributaries of the Great Lakes. This project will help prevent invasive carp from becoming established in the Great Lakes by identifying areas where reproduction is occurring to prioritize control efforts. This year's funding will be used to collect Grass Carp eggs and larvae from priority rivers, determine the specific location of spawning areas using modeling, develop insights on spawning cues in relation to hydrology and other environmental factors, and support the implementation of control efforts.

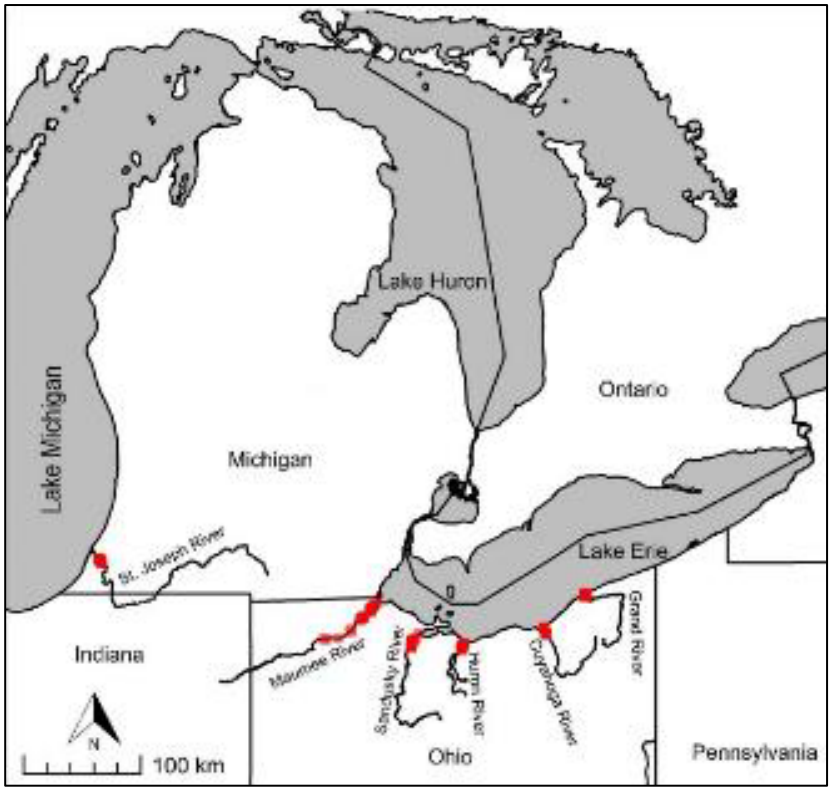
Project Description

This project will sample Grass Carp early life stages (eggs and larvae) in tributaries to the Great Lakes. Ichthyoplankton nets will be used in several tributaries where Grass Carp are either known to spawn, have been identified as high risk of Grass Carp spawning, or have had recent collections of adult Grass Carp. Suspected Grass Carp eggs and larvae will be examined for developmental stage, and all collection data and developmental stages of eggs and larvae will be entered into a database. The data from eggs and larvae sampling will be used in models that estimate specific spawning locations. This project provides the data for managers to target adult Grass Carp removal efforts with identified spawning events. Grass Carp congregate during spawning events, and removal efforts during this time are very effective in reducing the overall population and risk of establishment.

Figure 52 – Sampling with Ichthyoplankton Nets

USGS staff sampling for Grass Carp eggs and larvae using ichthyoplankton nets during a high-flow event in the Huron River (Ohio) in 2023. Photo credit: Corbin Hilling-USGS/Public Domain

Figure 53 – Grass Carp Ichthyoplankton Sampling Locations



Great Lakes tributaries surveyed for Grass Carp eggs and larvae by USGS and University of Toledo in 2023. Sampling sites are shown as red squares. Source: USGS

Preventing the Establishment of Grass Carp in the Great Lakes

GC-6: Refinement of the Grass Carp Spawning Event Prediction Tool

- **Lead Agency:** USGS
- **Agency Collaboration:** NOAA, OH DNR, UT
- **GLRI Funding:** $85,000
- **Agency Funding:** $0

Project Summary

This project will continue the refinement of USGS SpawnCast, a web-based decision support tool that forecasts potential Grass Carp spawning events in select tributaries to the Great Lakes. This project will prevent invasive carp from becoming established in the Great Lakes by providing management agencies with the ability to make informed decisions about when and where to deploy Grass Carp strike teams most effectively. This project provides advanced warning of spawning events and will help inform the planning and implementation of detection and removal actions by the strike teams to achieve the greatest impacts on Grass Carp populations. This year's funding will be used to maintain and operate the USGS SpawnCast webpage for existing forecast sites and deploy a new, interactive dashboard based on the NOAA National Water Model with reach-based Grass Carp spawning forecasts for tributaries throughout the Great Lakes basin.

Project Description

Figure 54 – Grass Carp Strike Team in Action

Photo of Grass Carp Strike Team on the river. Source: UT

The discovery of reproducing populations of invasive Grass Carp in the Great Lakes basin in 2013 led to the development of a multi-agency response and control strategy that includes the removal of adult Grass Carp and monitoring of tributaries for signs of Grass Carp spawning. According to the Great Lakes Grass Carp Advisory Committee, capturing Grass Carp in tributaries during spawning is the most successful and efficient method for strike teams fighting to reduce invasive Grass Carp populations in the Great Lakes. In May 2021, USGS SpawnCast, a Grass Carp spawning prediction tool, went online and has since been a key tool for agency response coordinators.

In its most general form, USGS SpawnCast is a first-generation spawning forecast dashboard for rivers that is broadly applicable to rivers and aquatic species throughout the U.S. USGS SpawnCast uses observed and forecasted discharge and water quality data combined with species-specific spawning requirements to forecast spawning probability for species of interest in select rivers and tributaries to the Great Lakes. USGS SpawnCast currently provides hourly forecasts for Grass Carp spawning in five tributaries to Lake Erie (the Sandusky, Maumee, Cuyahoga, Grand, and Huron rivers). In FY 2024, in addition to the operation and maintenance of the current system, USGS will deploy an interactive dashboard that utilizes output from the NOAA National Water Model to produce reach-based Grass Carp spawning forecasts for tributaries throughout the Great Lakes basin. This expansion of USGS SpawnCast will provide users with detailed Grass Carp spawning forecasts for thousands of river reaches around the Great Lakes, allowing more efficient use of human resources for the collection of ichthyoplankton samples and targeted removal of adult Grass Carp.

Figure 55 – USGS Spawncast Rivers

Map showing Lake Erie tributaries being assessed with USGS SpawnCast modeling.
Source: USGS

Preventing the Establishment of Grass Carp in the Great Lakes

GC-7: Identification of Optimal River Conditions for Spawning and Recruitment of Invasive Carp in Tributaries of the Lake Erie Western Basin

- **Lead Agency:** USGS
- **Agency Collaboration:** NOAA, Brenton Consulting LLC, OH DNR, UT
- **GLRI Funding:** $40,000
- **Agency Funding:** $0

Project Summary

This project will simulate the drift of invasive carp eggs and larvae in the Maumee and Sandusky rivers using the FluEgg model. This project will identify optimal river conditions for spawning and recruitment of Grass Carp in the Lake Erie Western Basin tributaries and prevent invasive carp from becoming established in the Great Lakes by informing control efforts about the conditions that promote recruitment and population growth of Grass Carp. FY 2024 funding will support the completion of a publication on the results of the optimal river conditions analysis for the Sandusky River and a publication of a characterization of the hydraulics at known and suspected spawning locations on the Maumee and Sandusky rivers.

Project Description

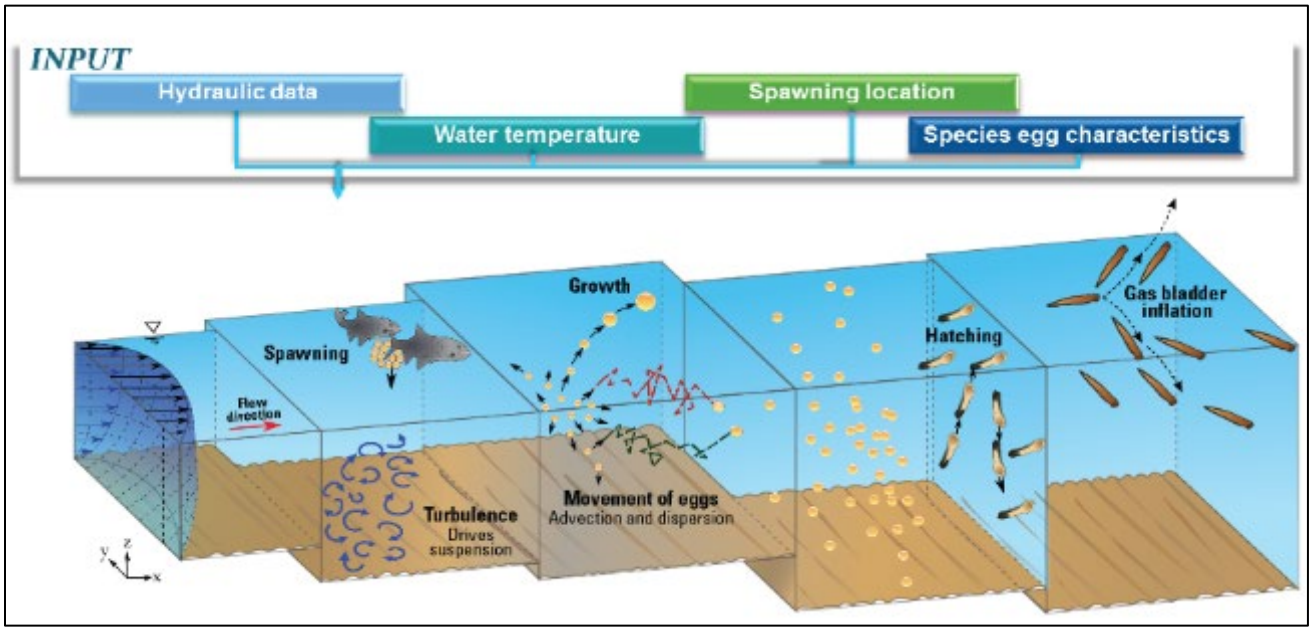
The tributaries of the Lake Erie Western Basin are the focus of intensive Grass Carp control efforts, including harvesting adult fish and egg/larvae sampling efforts aimed at assessing Grass Carp recruitment risk in rivers with both confirmed and hypothesized spawning. Identifying the river conditions (flow and temperature) and spawning sites that have the greatest potential for Grass Carp recruitment is necessary to allow management agencies to prioritize events for response actions and allocate their limited resources effectively and efficiently. USGS will assess the optimal river conditions for spawning and recruitment in the Maumee River by using existing hydraulic and FluEgg models to

Figure 56 – Maumee and Sandusky Rivers

Map highlighting the Maumee and Sandusky rivers. Source: USGS

build a library of egg/larval drift simulations in the Maumee River for a range of water temperatures, discharges (steady flow conditions), and spawning locations.

Figure 57 – Schematic of the Fluvial Egg Drift Simulator (FluEgg)



Schematic of the FluEgg simulator. Source: USGS

PREVENTING THE ESTABLISHMENT OF GRASS CARP IN THE GREAT LAKES

GC-8: Using Telemetry to Better Understand Grass Carp Movements and Habitat Use

- **Lead Agency:** USGS
- **Agency Collaboration:** OH DNR, MI DNR, USFWS, GLFC, MSU
- **GLRI Funding:** $200,000
- **Agency Funding:** $254,800

Project Summary

This project will use telemetry to develop a comprehensive understanding of seasonal movements and habitat use of Grass Carp within Lake Erie and Lake Huron and the tributaries of these lakes. This year's funding will produce a publication examining detailed Grass Carp movement and habitat use during periods when eggs were collected in the Sandusky River, a summary of Grass Carp season movements and locations in lake and tributary habitats, and real-time tracking of Grass Carp movement in spawning tributaries and some nearshore habitats. These detailed observations of Grass Carp spawning, feeding, and overwinter behavior will help prevent Grass Carp from becoming established in the Great Lakes by helping determine when and where eradication efforts would be most effective.

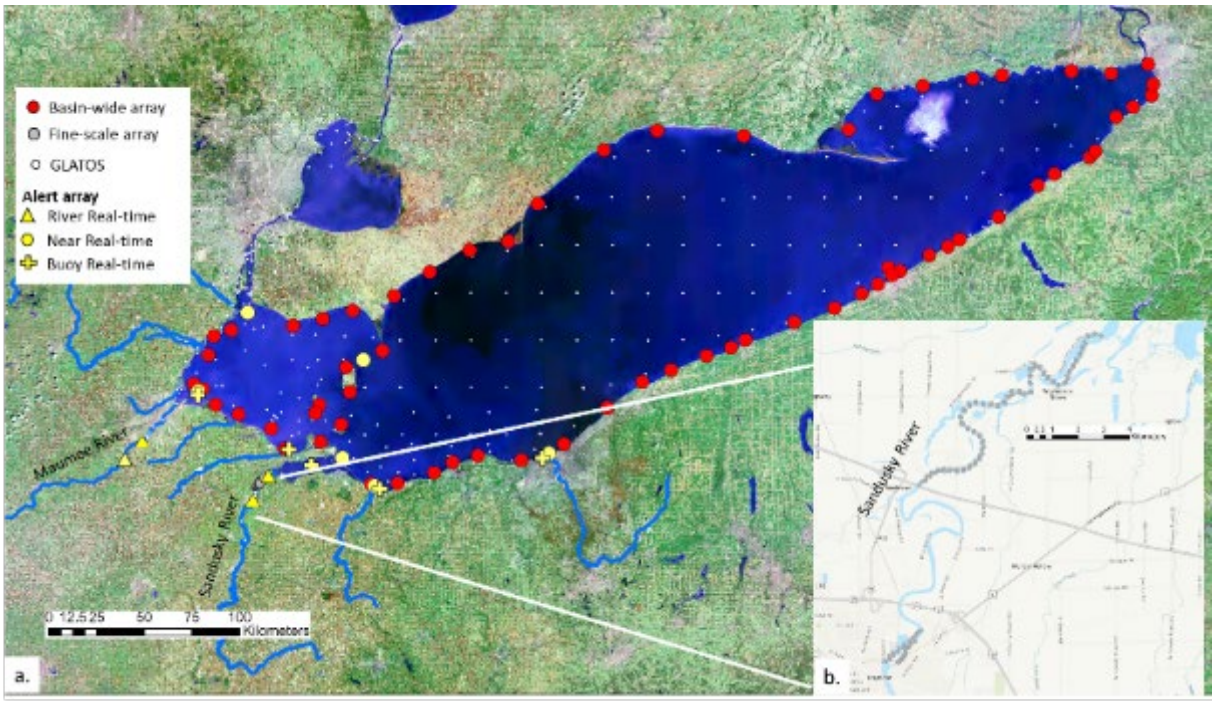
Project Description

Behavioral information on Grass Carp spawning, feeding, and overwinter behavior is highly sought by managers to inform the development of control and eradication (via capture and removal) strategies and efforts. Detailed observations of the location and timing of Grass Carp movements will also be compared to abiotic conditions to explore potential cues to these observed patterns. The approach to address these questions was to create a tiered network of telemetry receivers, leveraging the GLATOS telemetry network. Information from detections of tagged Grass Carp from this array will be used in the analyses of seasonal habitat use, and fine-scale tributary habitat use will inform and improve removal efforts.

Figure 58 – Grass Carp Release

Grass Carp release after being implanted with acoustic telemetry tag in the Sandusky River during the Spring of 2023. Photo credit: USGS

Figure 59 – Lake Erie and Location of Grass Carp Tiered Telemetry Arrays



Lake Erie and the locations of Grass Carp tiered telemetry arrays and a close-up of the fine-scale array. Also shown are the Maumee and Sandusky Rivers, the two known primary spawning tributaries for Grass Carp in the Great Lakes.

Preventing the Establishment of Grass Carp in the Great Lakes

GC-9: Characterization of Hydrology and Sediment Mobility to Inform Design and Implementation of a Seasonal Barrier in the Sandusky River

- **Lead Agency:** USGS
- **Agency Collaboration:** GLFC, OH DNR, UT
- **GLRI Funding:** $55,000
- **Agency Funding:** $0

Project Summary

This project will characterize relevant hydraulic properties and sediment dynamics required for the design, installation, and operation of an invasive carp barrier in the Sandusky River near Brady's Island, Ohio. Products from this project will help to inform the design of a barrier critical to limiting Grass Carp reproduction and recruitment in the Sandusky River. Funding for FY 2024 will produce high-quality, continuous hydraulic and water quality data at the proposed barrier site (water surface elevation, discharge, velocity, and basic water quality parameters), as well as an assessment of sediment dynamics.

Project Description

Using a combination of continuous monitoring and bathymetric surveys, USGS will collect and report information that will inform OH DNR and their engineering representative in the design, installation, and operation of a seasonal invasive carp barrier on the Sandusky River. The proposed investigation will monitor characteristics to report the variability of discharge, stream velocity, water-surface elevation, bathymetry, and suspended sediment at and around the proposed location of the barrier. Each major product provides necessary data to inform an effective design of a behavioral barrier to disrupt Grass Carp reproduction.

All data will be collected, reviewed, and quality assured using standard USGS techniques and methods. All time-series data from the streamgage and water will be made publicly available on the USGS's NWIS website (Water Resources of the United States—National Water Information System (NWIS) Mapper). Synoptic survey data will be published with full metadata as a data release on USGS ScienceBase (ScienceBase | U.S. Geological Survey).

Figure 60 – Shelter for Electronic Equipment

Shelter for electronic equipment used to monitor hydrologic and sediment conditions in the Sandusky River to help inform the design and implementation of a seasonal barrier. Source: USGS

Preventing the Establishment of Grass Carp in the Great Lakes

GC-10: Development and Testing of Deterrent Technologies for Grass Carp

- **Lead Agency:** USGS
- **Agency Collaboration:** USFWS, KDFWR, GLFC, OH DNR, MI DNR
- **GLRI Funding:** $125,000
- **Agency Funding:** $280,000

Project Summary

This project will evaluate Grass Carp response to an experimental BAFF at Barkley Lock and Dam in the Cumberland River near Grand Rivers, Kentucky, and an experimental UADS at Lock No. 19 in the Mississippi River near Keokuk, Iowa. This project will result in a better understanding of fine-scale Grass Carp behavioral response to two experimental deterrent systems. This could assist in preventing invasive carp from becoming established in the Great Lakes by providing data and information to the Great Lakes Grass Carp Advisory Committee to inform the design of a seasonal barrier for the Sandusky River. This year's funding will be used to assess experimental deterrent effectiveness (i.e., BAFF and UADS) for upstream movement and file-scale behavior of Grass Carp.

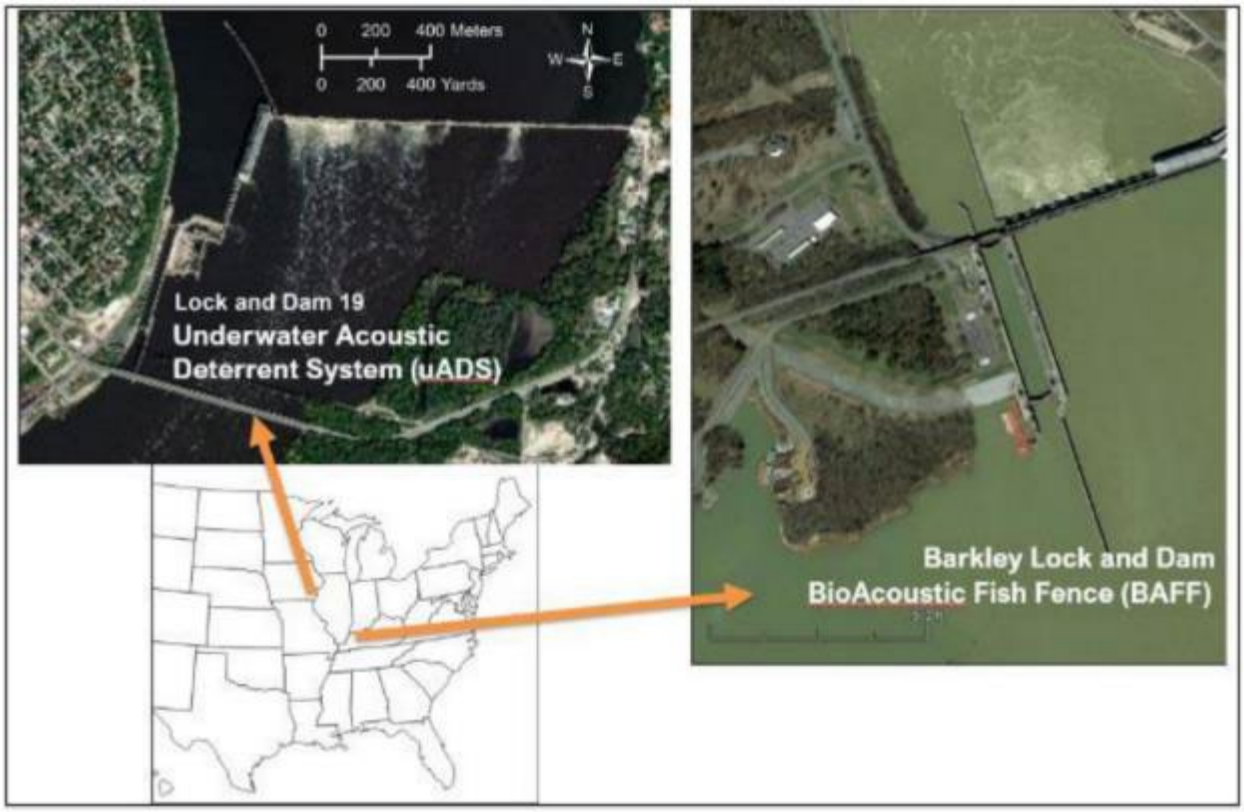
Project Description

Figure 61 – Grass Carp

USGS staff holding a Grass Carp. Source: USGS

This project would leverage the ongoing effort testing the BAFF at Barkley Dam and UADS at Lock No. 19 to gain additional information to inform the design and deployment of a Sandusky River deterrent for Grass Carp. Efforts to date have resulted in successfully tagging translocated and tailwater origin Grass Carp at Barkley Lock and Dam and Lock No. 19 with HTI and VEMCO depth transmitters. This work has shown the feasibility of examining the fine-scale behavior of Grass Carp and the efficacy of the BAFF and UADS for Grass Carp deterrence within dynamic, large-river systems. We will use acoustic telemetry arrays (VEMCO and HTI) to (1) evaluate the effectiveness of the experimental deterrents at preventing upstream movement of Grass Carp under varying environmental and operating (i.e., on/off) conditions and (2) assess the behavior of Grass Carp in the lock approach near the BAFF and UADS. These data will be used to inform the applicability of using a BAFF or UADS as a component of a Grass Carp control program in the Sandusky River.

Figure 62 – Lock and Dam No. 19 and Barkley Lock and Dam



Maps showing the UADS at Lock and Dam No. 19 (left) and the Barkley Lock and Dam BAFF (right). Source: USGS

Preventing the Establishment of Grass Carp in the Great Lakes

GC-11: Monitoring Potential Population Growth, Food Web Effects, and Control of Grass Carp in the Lake Erie Western Basin

- **Lead Agency:** NOAA
- **Agency Collaboration:**
- **GLRI Funding:** $110,800
- **Agency Funding:** $65,000

Project Summary

This project will expand our multispecies, spatially explicit, individual-based bioenergetics model of invasive Grass Carp for Michigan, Ohio, and Ontario waters of Western Lake Erie to include Lake St. Clair, the Thames River, and the Detroit River. The model projections will help assess the risk of Grass Carp establishing a breeding population in Lake St. Clair and affecting key native species and the food web, thereby providing management agencies with better information for implementing targeted monitoring and control efforts. This year's funding will support a developed model of Grass Carp populations in Lake St. Clair and two major tributaries and a technical report that includes the estimated probability of Grass Carp establishment, timing, and effects on key native fish and the food web.

Project Description

Lake St. Clair appears to provide an ideal habitat for Grass Carp and contains at least one major tributary, the Thames River, with strong potential to support successful reproduction. Lake St. Clair is directly connected to Lake Erie, where a reproducing population of invasive Grass Carp currently exists, and there is telemetry evidence of Grass Carp moving through the lake via the Detroit River. To date, there has been limited research specific to Grass Carp in Lake St. Clair.

This proposed project will provide important information to managers in assessing risks and implementing targeted monitoring and control efforts. This will be done by extending our ongoing individual-based modeling of Grass Carp reproduction and food web effects in the Lake Erie Western Basin to include the Detroit River, Lake St. Clair, and the Thames River. Our existing model framework will be recalibrated to include prey groups, macrophytes, and predatory fish species in Lake St. Clair and tributary rivers by leveraging existing data from MI DNR and DFO Canada. Model output will include the probability and projected timing of Grass Carp establishment and potential effects on the food web and select native fish.

Figure 63 – Map of the Model Domain for the Detroit River, Lake St. Clair, and Thames River

Map of the model domain for the Detroit River, Lake St. Clair, and Thames River individual-based bioenergetics model of grass carp and resident food web. Source: NOAA

Understanding Black Carp Population Dynamics to Inform Management Strategies

BC-1: Enhanced Detection of Black Carp in the Lower Illinois River

- **Lead Agency:** IL DNR
- **Agency Collaboration:** INHS, USGS, SIU
- **GLRI Funding:** $228,000
- **Agency Funding:** $0

Project Summary

This project will monitor for invasive Black Carp and determine their abundance in the Illinois River. This project will result in relative abundance estimates that can be used to assess the impacts of management activities. This year's funding will produce estimates of Black Carp relative abundance in the Alton and La Grange reaches of the Illinois River to help direct appropriate management activities.

Project Description

Invasive Black Carp have been detected in portions of the Illinois River system, with recent captures in the Alton, La Grange, and Peoria pools of the lower river. Currently, the invasion of Black Carp is represented by only a few reported individuals, and little is known about the size of the population or the potential scope of ecosystem changes that may result from their introduction. More robust estimates of the current population level are essential to the management and potential control of Black Carp in the Illinois River.

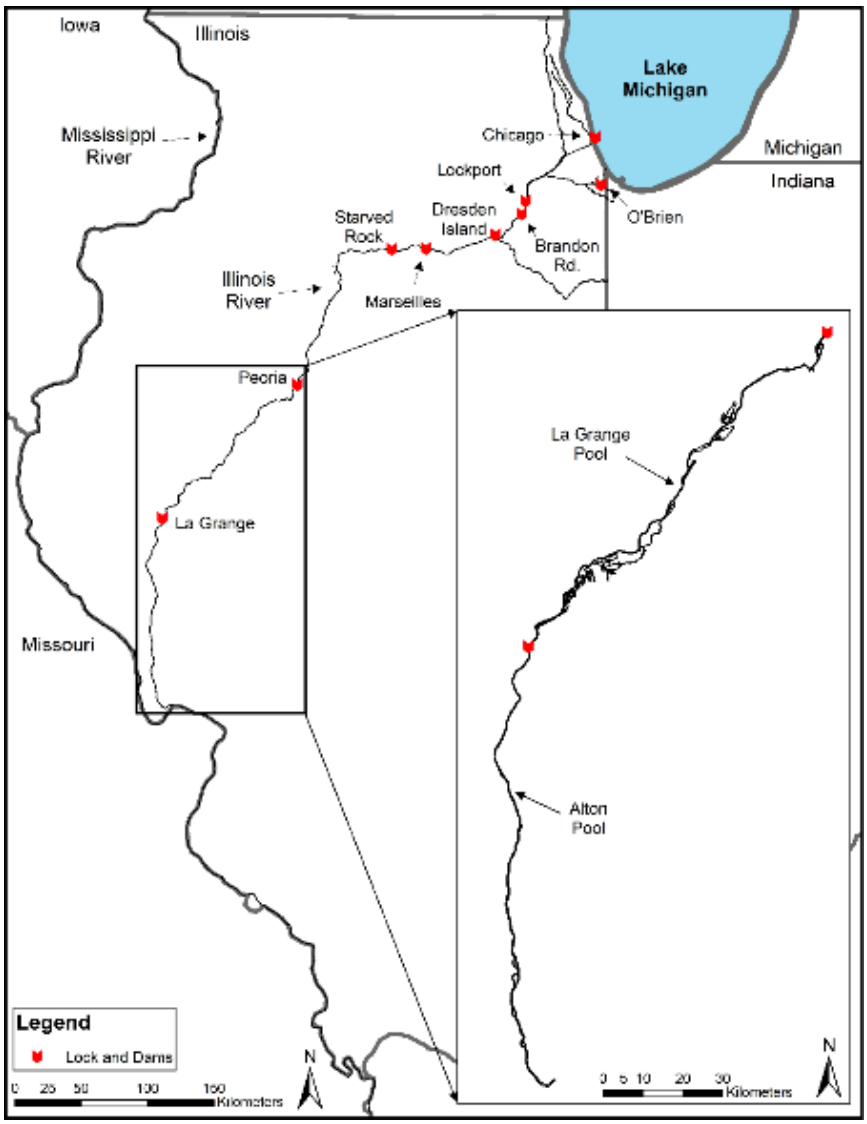
In 2024, IL DNR will continue sampling for Black Carp using hoop nets augmented with experimental baits to assess the Black Carp population in the lower Illinois River and the efficacy of different baits used for collection. Selection of a preferred bait for use in the Illinois River may be further informed by deploying baited nets in known Black Carp populations in Horseshoe Lake (lower Illinois River) and the Mississippi River, where bait comparisons can be evaluated during intensive sampling. Existing LTRM standardized hoop netting efforts in the LaGrange and Alton reaches

Figure 64 – Sampling for Black Carp on the Mississippi River

INHS technician opening a hoop net with a Black Carp and bycatch on the Mississippi River in 2020. Source: INHS

(pools) will be leveraged for Black Carp sampling and will help inform direct comparisons using experimentally baited hoop nets to target this species. Expanded hoop netting efforts will be conducted in main- and side-channel habitats during three sampling periods conducted between June 15 and October 31, similar to ongoing standardized LTRM hoop netting efforts. Fishery-independent Black Carp population abundance estimates in the Illinois River were identified as a priority information need through the BCWG's structured decision-making process. Relative abundance estimates will be used to detect Black Carp population status changes and to help inform and assess management actions.

Figure 65 – Project Locations



Map of the State of Illinois, showing the project areas on the Illinois River. Red symbols indicate lock/dam structures. Source: IL DNR

Understanding Black Carp Population Dynamics to Inform Management Strategies

BC-2: Data Collection from Commercial Fishers and Recreational Angler Captures of Black Carp in the Lower Illinois River

- **Lead Agency:** IL DNR
- **Agency Collaboration:** INHS, USFWS, USGS
- **GLRI Funding:** $42,000
- **Agency Funding:** $0

Project Summary

This project will provide support for incentive payments to recreational anglers and commercial fishers who submit captured Black Carp for agency analysis in the upper Mississippi River basin. This project will result in the acquisition of additional biological information and key data regarding the potential range expansion of Black Carp and prevent invasive carp from becoming established in the Great Lakes by functioning as an early detection and monitoring tool. This year's funding will produce specimens for evaluation and research.

Project Description

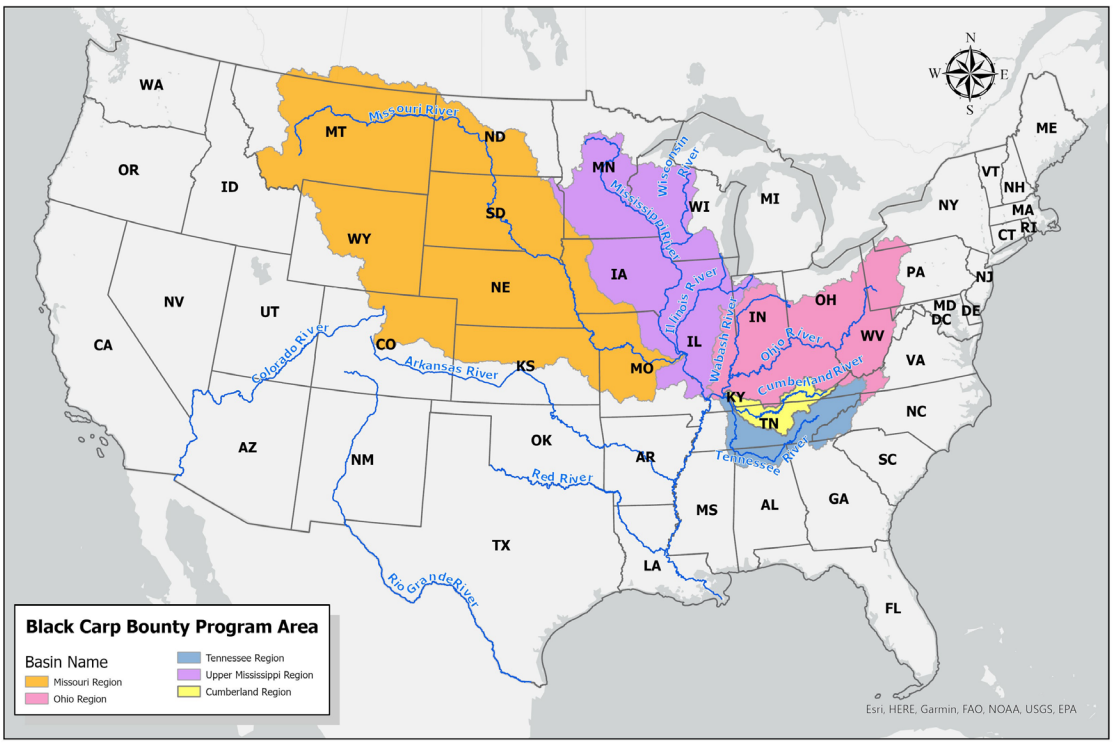
Figure 66 – Captured Black Carp

Photo of captured Black Carp. Source: IL DNR

The IL DNR will continue monitoring the occurrence and potential range expansion of Black Carp within the upper Mississippi River basin (including the Illinois River) through incentive payments to recreational anglers and commercial fishers who submit harvested Black Carp for data collection and analysis. Most Black Carp data points documenting capture in those waters are the result of the collaborative effort with anglers and commercial fishers. This information is vital for monitoring the potential range expansion by this species. Currently, the invasion of Black Carp is represented by a relatively low number of reported sightings, and little is known about the overall size of the population or potential scope of ecosystem changes that may result from their introduction. The geographic scope of the Black Carp reward program will include all waters in the upper Mississippi River basin. A payment of $100 will be provided to anglers and commercial fishers for each wild-caught Black Carp that they report and submit. There is a maximum of $1,000 in reward payments to any individual for Black Carp collected in a given location during a one-week period. Photos of each fish, along with collection information (date, location, and capture method) and

fish length, weight, and ploidy data will be sent to the USGS for inclusion in their Nonindigenous Aquatic Species database.

Figure 67 – Black Carp Bounty Program Area



U.S. map showing Black Carp Bounty Program areas. Source: Midwest Fisheries Center

UNDERSTANDING BLACK CARP POPULATION DYNAMICS TO INFORM MANAGEMENT STRATEGIES

BC-3: Support for Black Carp Monitoring and Population Assessment

- **Lead Agency:** USGS
- **Agency Collaboration:** USFWS, USACE-ERDC, INHS, IL DNR
- **GLRI Funding:** $475,000
- **Agency Funding:** $140,000

Project Summary

This project will study the behavior, development, and capture techniques for Black Carp in the Illinois River and adjacent Mississippi River. The information collected by this project will help prevent Black Carp from becoming established in the Great Lakes by identifying management actions within the species' current range in the Mississippi River and expanding range in the Illinois River. This year's funding will be used to complete analyses on habitat use and movement, capture by hoop nets, site planning and prediction for targeted effort in the Illinois River and adjacent pool of the Mississippi River, and assessment of reproductive development of Black Carp.

Project Description

Figure 68 – Tagged Black Carp

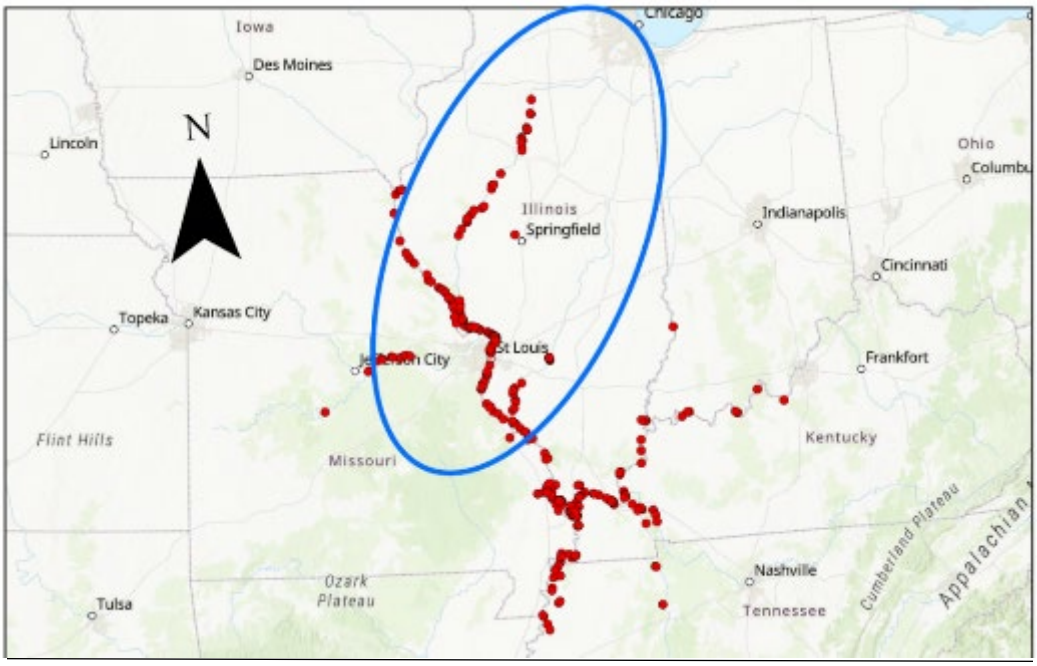
A Black Carp tagged with acoustic and radio transmitters for habitat use and movement research showing abdominal sutures and external radio antenna. Photo credit: Andrea Fitts, USGS

This project addresses several objectives related to the acquisition of Black Carp life history, population status, and behavior information for developing management actions and control strategies within the species' existing and expanding range. Previously tagged Black Carp will be monitored with a passive receiver array to assess long-range movements. Work with INHS scientists will assess Black Carp captures below Mel Price Lock and Dam in summer and at an upstream site in Pool 26 of the Mississippi River in early fall. This effort will use bathymetry data to identify initial sites for capture in both the immediate downstream reach of the upper Mississippi River adjacent to the Illinois River and the lowest reach of the Illinois River. Analyses of reported captured wild Black Carp specimens will provide key information on species life history and reproductive development The size and age at maturation of wild Black Carp have not been described in the

U.S. beyond initial gonadosomatic index values. Additionally, keys for the histological or macroscopic determination of sex for Black Carp are currently unavailable. Maturation data are needed for population modeling to inform developing control tools and for understanding harvest requirements. Reproductive development of Black Carp will be assessed from samples from throughout the Mississippi River, including size and age at maturation and histological and macroscopic keys for the determination of sex and reproductive stage.

Additional assistance with parameterization of the Black Carp decision support model for the Illinois River will also be provided. Results from this project will be shared with state, federal, and university partners and researchers through the BCWG.

Figure 69 – Area of Focused Black Carp Monitoring and Research



Map showing the area of focused Black Carp monitoring and research (blue circle). Source: Andrea Fitts, USGS

Understanding Black Carp Population Dynamics to Inform Management Strategies

BC-4: Support for Black Carp Monitoring and Interagency Coordination

- **Lead Agency:** USFWS
- **Agency Collaboration:** USGS
- **GLRI Funding:** $45,400
- **Agency Funding:** $10,000

Project Summary

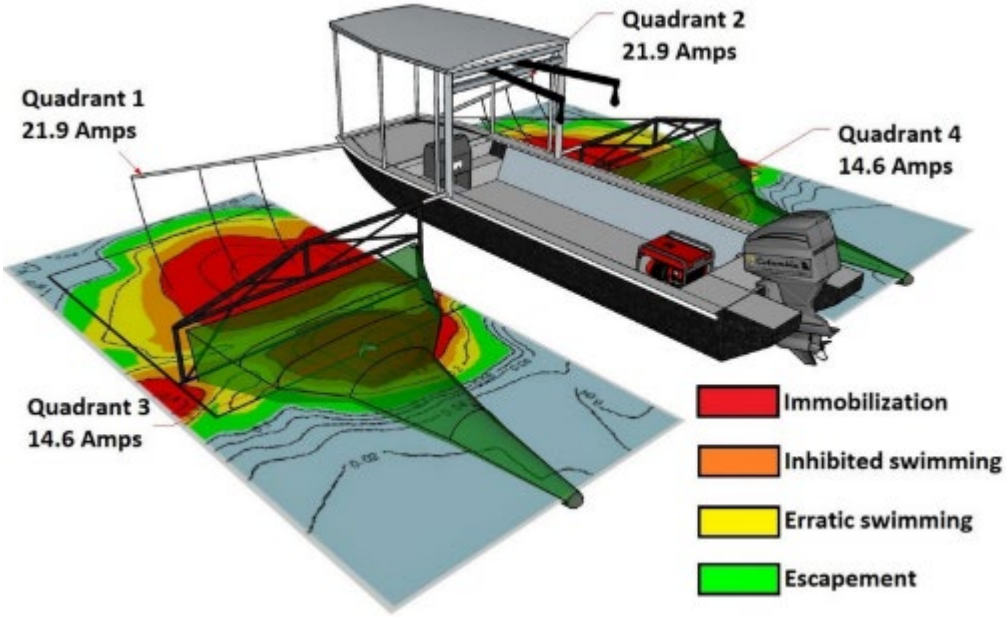
This project will provide general coordination for the interagency BCWG and continue the development of electrified sampling gears to improve agency captures of Black Carp. This project will result in better coordination and identification of management actions and research needs to advance the protection of the Great Lakes from Black Carp, including increasing the likelihood of detecting and capturing Black Carp in the Illinois River to better understand changes in species distribution and abundance. This year's funding will produce a minimum of six BCWG coordination meetings and support an evaluation of depth and range limitations of existing fishery capture gears for Black Carp sampling and develop an electrified sampling approach that addresses the identified limitations.

Project Description

In 2024, the USFWS will continue to coordinate the BCWG, convened approximately every two months to discuss relevant project updates and results, challenges and solutions to collective issues, and Black Carp-focused management and research needs and opportunities, including collaborative development of projects for funding consideration. BCWG efforts are intended to focus and strengthen Black Carp monitoring and control efforts for Great Lakes protection.

Additionally, this project will support efforts to improve the use of electrofishing for Black Carp detection and removal. Electrofishing is currently deployed for invasive carp monitoring in standard boat and backpack methodologies and with electrified framed trawls used within large river monitoring programs or targeted capture/removal events. While these methodologies have generally been effective for invasive carp capture, certain preferred habitats of Black Carp cannot be readily sampled due to depth limitations and/or dangerous and unpredictable water flows exceeding current gear capabilities. This project will initiate the development of an electrified sampling approach capable of addressing these habitat constraints, building off previous lab-based research completed by USFWS and USGS in 2022, with a focus on improving capture of Black Carp at or near the bottom of the water column.

Figure 70 – Example CAD Model



Simulation of in-water electrical field generated by fishery monitoring boat equipped with electrified detection and capture gear, with colors indicating where behavioral responses of invasive carp will occur. Source: USFWS/USGS

ICRCC Communications and Support

MS-1: ICRCC Strategic Communications with Partners and Stakeholders

- **Lead Agency:** USFWS
- **Agency Collaboration:** IL DNR
- **GLRI Funding:** $175,000
- **Agency Funding:** $100,000

Project Summary

This project will support strategic communications and outreach for the ICRCC and result in enhanced communication between the ICRCC member agencies and other partners, the public, and key stakeholders. This project will prevent invasive carp from becoming established in the Great Lakes by ensuring key information is shared efficiently between the ICRCC and other entities involved in invasive carp control efforts. FY 2024 funding will support the management of the ICRCC website, InvasiveCarp.us; facilitate bi-monthly communications meetings between ICRCC member agencies in the CWG (co-chaired by USFWS and IL DNR); ensure targeted media outreach; and coordinate partner responses to public, congressional, and media inquiries.

Project Description

FY 2024 funding will be used by the USFWS to lead the implementation of targeted ICRCC communication efforts to support the protection of the Great Lakes basin from invasive carp. Activities include managing the ICRCC website, InvasiveCarp.us; facilitating bi-monthly communications meetings between ICRCC member agencies in the CWG; ensuring targeted media outreach; coordinating partner responses to public, congressional, and media inquiries; refining ICRCC early detection notification protocols; creating ICRCC branded communication products; and enhancing the ICRCC's image library and ultimately increasing the reach of ICRCC messaging. Communications work will contribute to key audiences having a greater understanding and appreciation for the ICRCC's purpose, function, current actions, and successes. The efforts will continue to assist ICRCC member agencies in implementing their respective authorities to reduce and/or eliminate the threats to the Great Lakes posed by invasive carp.

ICRCC Communications and Support

MS-2: ICRCC Mission Support

- **Lead Agency:** USFWS
- **Agency Collaboration:** USEPA
- **GLRI Funding:** $175,000
- **Agency Funding:** $0

Project Summary

This project will provide staffing and logistical assistance on key coordination, communication, and outreach activities to support the day-to-day operations of the ICRCC in close coordination with the ICRCC co-chairs (USFWS and USEPA). This effort supports the coordinated and timely development and delivery of ICRCC planning and communication products in coordination with participating ICRCC agencies. Staffing provided through this project supports the development of the annual Invasive Carp Action Plan and other strategies and planning documents, the scheduling and convening of regular partnership meetings/communications (in-person and virtual), and other activities led by the ICRCC co-chair team for the effective operation of the ICRCC partnership.

Project Description

This project provides key staffing to support the effective operation of the bi-national ICRCC. Proposed Actions for FY 2024 include:

- Assist in developing and releasing the ICRCC's FY 2024 Invasive Carp Action Plan and initial scoping and planning for the draft FY 2025 Action Plan.
- Assist with convening ICRCC video teleconferences once a month (or as needed) for interagency discussion of relevant updates on invasive carp management.
- Assist in convening ICRCC face-to-face meetings for interagency discussion and coordination of invasive carp research, management, and communications actions.
- Assist in developing informational materials to support interagency congressional briefings as needed and as directed by the ICRCC co-chairs.
- Assist in convening public updates with agencies and stakeholders across the Great Lakes as directed by the ICRCC co-chairs.
- Provide additional support, as needed, to the ICRCC co-chairs on day-to-day partnership operation activities of the ICRCC.

Appendix C
Principles of Coordination

Invasive Carp Regional Coordinating Committee
Principles of Coordination
December 2023

Note: in this document "invasive carp" refers to four species: Silver Carp (Hypophthalmichthys molitrix), Bighead Carp (Hypophthalmichthys nobilis), Grass Carp (Ctenopharyngodon idella), and Black Carp (Mylopharyngodon piceus).

PURPOSE OF THE ICRCC: The Invasive Carp Regional Coordinating Committee (ICRCC) is convened by U.S. Fish and Wildlife Service (USFWS) and U.S. Environmental Protection Agency (USEPA) for the purpose of assisting ICRCC members in implementing their authorities to reduce and/or eliminate the threats posed by invasive carp to the Great Lakes.

ICRCC MEMBERSHIP: Agencies eligible for membership in the ICRCC will: (1) have legal authority or mandate to coordinate and/or implement measures to prevent, control, monitor or assess movement of invasive carp in connection with the Great Lakes and associated water bodies; and (2) must be a federal, state, provincial, local, or federally-recognized tribal governmental agency or organization of tribal governmental agencies. A complete list of member agencies is provided in Attachment 1.

AUTHORITIES: To achieve its purpose, the ICRCC relies on the coordination of activities conducted under the existing authorities of its member agencies. Nothing in this document shall be interpreted to alter existing agency missions or authorities.

ACTIVITIES OF THE ICRCC: The central activity of the ICRCC is the annual development and publication of an Invasive Carp Action Plan (Action Plan) that summarizes planned activities of ICRCC members that address the threats posed by invasive carp to the Great Lakes. The development of the Action Plan helps the ICRCC accomplish its purpose through information sharing, planning and budgeting discussions, and coordination of future implementation activities. Action Plan development is initiated in early fall of each year, which coincides with the end of the field season and the beginning of the U.S. federal fiscal year. This allows agencies to consider the most recent field data and projected available funding levels into the development of the Action Plan. The Action Plan is typically released in the first quarter of the calendar year or when relevant annual Congressional budgetary actions have been completed.

The majority of activities conducted by the ICRCC under the Action Plan are geographically focused to mitigate the most significant threats of invasive carp introduction and/or spread. In addition, technology development, communication, and support for ICRCC coordination and operations are also included in the Action Plan. A brief summary of the main activities follows:

Preventing the introduction of Silver Carp and Bighead Carp into the Great Lakes, with a focus on the efforts led by the State of Illinois within the Illinois Waterway (IWW)

The U.S. Army Corps of Engineers' Great Lakes and Mississippi River Interbasin Study (GLMRIS) identified the IWW as the highest risk potential pathway for invasive carp introduction. The IWW includes the Illinois River and the Chicago Area Waterway System (CAWS). The Action Plan identifies the Monitoring and Response Work Group (MRWG) as the principal body that supports the extensive coordination needed for work in the IWW. The MRWG is co-chaired by the Illinois Department of Natural Resources (ILDNR) and the Great Lakes Fishery Commission (GLFC).

The USACE's Electric Dispersal Barrier System (EDBS) in Romeoville, Illinois is a major component of the effort to stop the upstream migration of invasive carp through the IWW to the Great Lakes. The MRWG co-chairs are regularly updated on operation and status of the EDBS. The MRWG supports USACE's operations of the EDBS by conducting regularly-scheduled monitoring for invasive carp in the IWW. In the event of disruptions to the EDBS, the MRWG co-chairs are consulted on the need for any additional monitoring and/or control activities.

The MRWG implements coordinated invasive carp monitoring, response, control, and management efforts in the IWW and CAWS. Significant removal efforts downstream of the EDBS suppress the number of invasive carp potentially swimming upstream to the barrier system. The MRWG performs Seasonal Intensive Monitoring upstream of the EDBS in the IWW during the spring and fall and also ensures preparedness to implement effective contingency actions through its Contingency Response Plan for the Upper IWW.

Should there be any detections of invasive carp in nearshore waters or open waters of Lake Michigan, the ICRCC relies on the GLFC and its Lake Michigan Committee members to coordinate actions and strategies to address fisheries management and invasive carp in Lake Michigan.

Note: The proposed future construction of structural controls at the Brandon Road Lock and Dam is expected to significantly reduce the risks of upstream migration of invasive carp. This project is led by USACE with the State of Illinois as the cost-sharing agency (non-Federal sponsor). (The State of Illinois has a side agreement with the State of Michigan to partially fund the cost-share for some of the work.) As this project is implemented, future Action Plan development will be informed by the observed effects of this project.

Preventing the establishment of Grass Carp in the Great Lakes, with a focus on the State of Ohio's and the State of Michigan's efforts within the western basin of Lake Erie and its tributaries.

The Action Plan notes that Grass Carp have been captured in low numbers in all of the Great Lakes except Lake Superior; however, Grass Carp in the Western Basin of Lake Erie shows periodic evidence of spawning and is the population of Grass Carp posing the greatest threat to the Great Lakes. The Action Plan identifies the GLFC Lake Erie Committee (LEC) as the principal body that supports the coordination to prevent the establishment of Grass Carp in Lake Erie. This work is guided by the *Lake Erie Grass Carp Adaptive Response Strategy 2019-2023 and the Lake Erie Grass Carp Adaptive Response Strategy 2024-2028 (under development)*. The binational LEC -- comprised of jurisdictional agency fishery managers from Michigan, Ohio, Pennsylvania, New York, and Ontario, and supported by Canadian and U.S. federal agencies -- adopted the *Strategy* to reduce the threat of Grass Carp to Lake Erie through common and coordinated efforts.

Future Action Plans will also be informed by the GLFC's recently established Grass Carp Advisory Committee (GCAC) and its Task Groups that will "undertake and coordinate special focused activities needed to achieve GCAC and individual Lake Committees' objectives." These activities include collecting information from commercial fishers and additional reconnaissance monitoring outside of Lake Erie by State agencies and their federal partners to better understand the distribution of Grass Carp.

Should there be any significant range expansion of Grass Carp within the Great Lakes, the ICRCC relies on the GLFC, its individual Lake Committees, and the GCAC to coordinate actions and strategies to address any such expansion.

Better understanding and preventing the spread of Black Carp toward the Great Lakes, with a focus on populations within the Illinois River

Activities of the ICRCC are focused on evaluating and tracking the status of populations of Black Carp in the Illinois River, including its confluence with the Mississippi River. The lower Illinois River represents the current location of the black carp population closest to the Great Lakes. In recognition of the need to develop and share monitoring and management techniques for this species, the Action Plan identifies the Black Carp Working Group as a primary interagency body to help inform and coordinate future activities.

Blocking potential migration pathways to the Great Lakes

GLMRIS also identified three medium risk locations where flood conditions can temporarily create direct hydraulic connections between the Great Lakes and Mississippi River watershed, thereby providing a potential pathway for invasive carp introduction. Previous state-led work has reduced the pathway risk at two of these locations: Eagle Marsh (Fort Wayne, Indiana) and Ohio & Erie Canal (Akron, Ohio). Work is ongoing at the remaining site at Little Killbuck Creek (near Wooster, OH).

Development of Control Management Technologies

The Action Plan includes projects which relate to the development, refinement, and evaluation of new technologies for invasive carp prevention and control. The goal is to test and identify proven technologies that could further enhance the effectiveness of Great lakes protection strategies.

Multi-Agency Communications

The ICRCC's Communications Work Group (CWG) facilitates communications on key issues among ICRCC members and to stakeholders. The CWG is chaired by the USFWS and co-chaired by an ICRCC member state agency representative (presently ILDNR). The CWG also facilitates the development and dissemination of communication materials to external audiences, including the media. The CWG provides oversight and maintenance of www.invasivecarp.us and coordination with the Canadian website – www.asiancarp.ca.

Ongoing ICRCC Coordination

The ICRCC promotes ongoing coordination of member agency activities through monthly calls and occasional in-person meetings.

FUNDING: ICRCC member agencies are funded through their respective agency budgeting processes, subject to any legislative direction provided as part of appropriations. Enhanced funding of Action Plan activities through the Great Lakes Restoration Initiative (GLRI) is coordinated by USEPA and USFWS, subject to any Congressional direction provided as part of appropriations. Nothing in this document shall be interpreted to alter existing agency or GLRI budgeting processes, nor alter legislative/Congressional

direction. The mention of activities in this document should not be interpreted to be a commitment to future funding nor any specific funding level. Discussions of the ICRCC will help inform, but will not direct, agency decisions on how they allocate their respective funding or resources.

WORKING METHOD: To accomplish its Purpose, the member agencies of the ICRCC will work in a coordinated and collaborative fashion. Consistent with their authorities, policies, and available resources, member agencies will:

- Work to develop the annual Action Plan.
- Participate in teleconferences of the full ICRCC membership in order to: provide for an exchange of relevant information between all member agencies; review progress; and develop recommendations for future ICRCC efforts.
- Attend ICRCC meetings and workgroup meetings, as appropriate. It is acknowledged that member agency participation may be limited due to travel budgets and/or workload.
- Share data and information (including planning documents, monitoring results, response actions, control activities and research) within the course of relevant discussions, consistent with applicable laws and regulations. Members will respect that some information or data may be provisional and should be used only to help inform agency activities.
- All members will strive to provide other ICRCC member agencies at least 10 business days to review and comment on documents/deliverables of ICRCC-wide relevance prior to publication/release.

ROLES OF THE ICRCC CO-CHAIRS: The ICRCC is co-chaired by a representative of the USFWS and the USEPA. The roles of the ICRCC Co-chairs include:

- Oversee and facilitate, in collaboration with member agencies, the development of the annual Action Plan.
- Convene regular teleconferences of the ICRCC to support Action Plan development and implementation and to provide an opportunity for agencies to share other relevant information.
- Coordinate and lead face-to-face ICRCC partnership meetings, as needed.
- Provide *ad hoc* coordination and communication on invasive carp-related issues, as requested and appropriate, to assist ICRCC member agencies' efforts.
- Coordinate and lead Congressional briefings on the Action Plan, as requested.
- Seek opportunities to leverage invasive carp efforts and to share lessons learned with other jurisdictions working on invasive carp, including initiatives under the national *Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States*.

Attachment 1 – Invasive Carp Regional Coordinating Committee Member Agencies

- Illinois Department of Natural Resources
- Illinois Environmental Protection Agency
- Indiana Department of Natural Resources
- Michigan Department of Natural Resources
- Michigan Department of Environmental, Great Lakes and Energy
- Minnesota Department of Natural Resources
- New York Department of Environmental Conservation
- Ohio Department of Natural Resources
- Pennsylvania Department of Environmental Protection
- Pennsylvania Fish and Boat Commission
- Wisconsin Department of Natural Resources
- Grand Traverse Band of Ottawa and Chippewa Indians
- Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry
- Quebec Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs
- National Oceanic and Atmospheric Administration
- U.S. Army Corps of Engineers
- U.S. Coast Guard
- U.S. Department of Transportation
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- National Park Service
- Fisheries and Oceans – Canada
- Great Lakes Fishery Commission
- Great Lakes Commission
- Metropolitan Water and Reclamation District of Greater Chicago