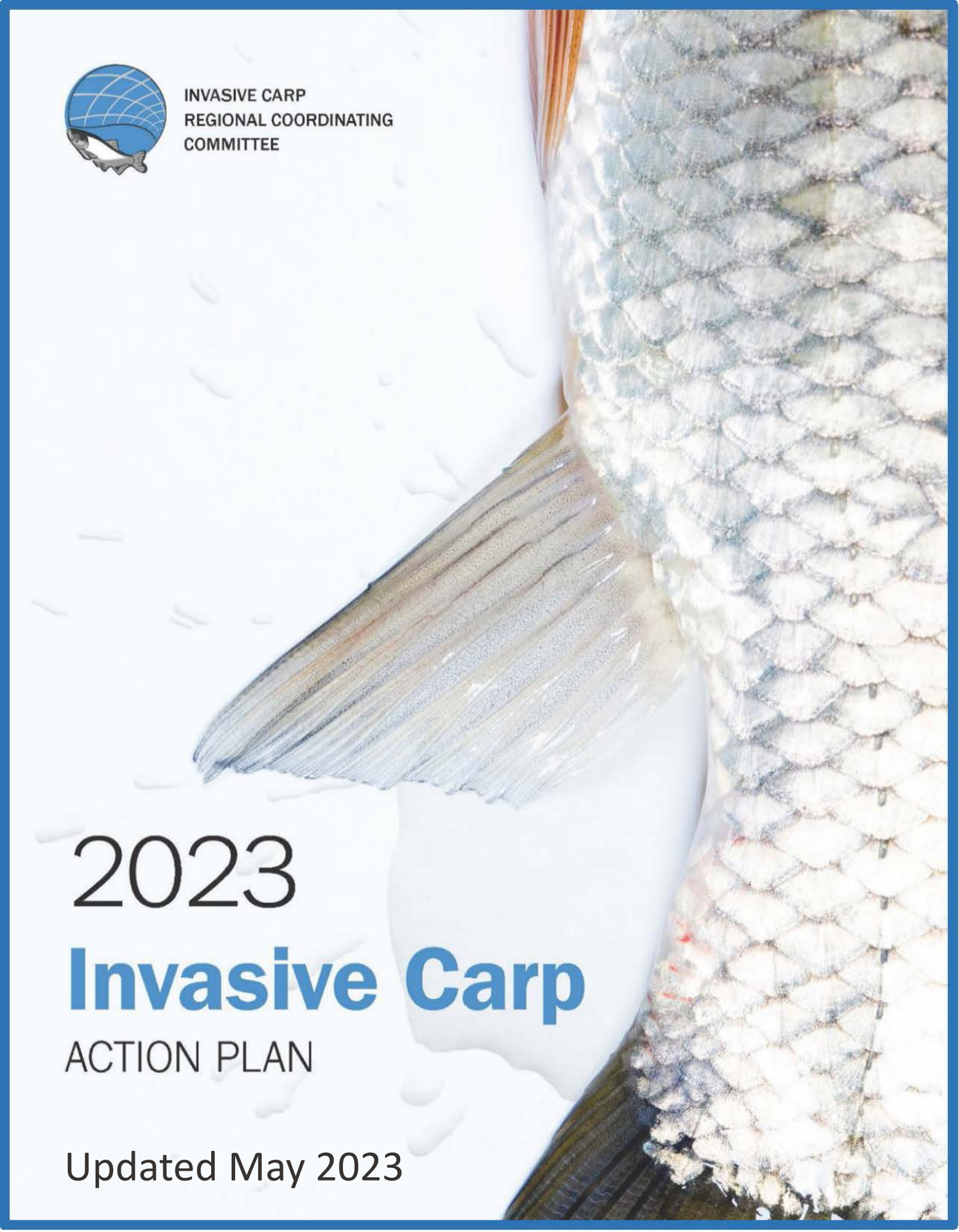
INVASIVE CARP
REGIONAL COORDINATING
COMMITTEE



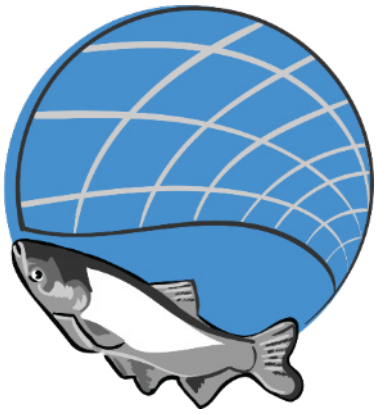
2023 Invasive Carp ACTION PLAN

Updated May 2023

Invasive Carp Action Plan for Fiscal Year 2023

Updated May 2023

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
Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs
U.S Department of Commerce - National Oceanic and Atmospheric Administration
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Department of Transportation/Maritime Administration
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 2023

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APPENDICES

Invasive Carp Action Plan: Fiscal Year 2023

EXECUTIVE SUMMARY

The Invasive Carp Regional Coordinating Committee (ICRCC) is convened by U.S. Fish and Wildlife Service (USFWS) and 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 consists of 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 mission of the ICRCC member agencies and the intent of this Action Plan is to prevent the introduction and establishment of invasive carp in the Great Lakes.

The Fiscal Year (FY) 2023 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 2023 Action Plan are supported by a combination of $75,040,720 in agency funding and $21,000,000 in Great Lakes Restoration Initiative funding provided through federal agency appropriations. FY 2023 appropriations are provided to the U.S. federal agencies through the "Consolidated Appropriations Act, 2023".

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 preventing the 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 efforts are geographically focused to mitigate 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 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 constructed barriers by the State of Indiana and partners at Eagle Marsh (Fort Wayne, Indiana) and by Ohio at the Ohio & Erie Canal (Akron, Ohio).

The Action Plan also includes work outside these key areas to further reduce the risk of introducing and establishing 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 2023 funding also supports the basic coordination and communication activities of the ICRCC, including the annual 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 and behavior, ecological risk, as well as developments in management practices and technologies. The 2023 Action Plan continues to reflect this adaptive approach.

Appendix A includes the FY 2023 Project Funding Matrix.

Appendix B fully lists FY 2023 Actions (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.

Invasive Carp Action Plan: Fiscal Year 2023

1. INTRODUCTION

The Invasive Carp Regional Coordinating Committee (ICRCC) Fiscal Year (FY) 2023 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 mission of the ICRCC and the intent of this FY 2023 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 2023 Action Plan are supported by a combination of $75,040,720 in agency funding and $21,000,000 in Great Lakes Restoration Initiative (GLRI) funding**.**

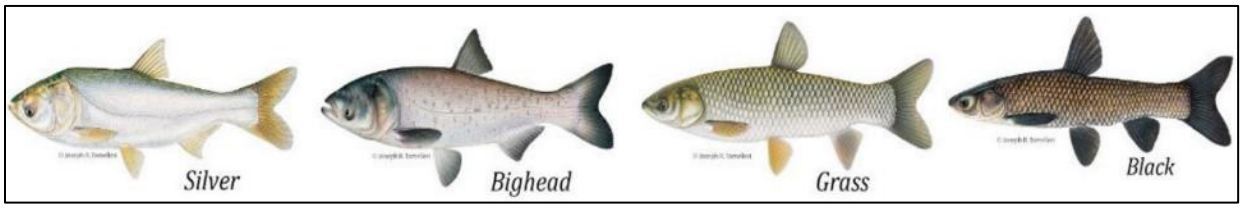
Additional general information on invasive carp can be found at *InvasiveCarp.us*. Information available at the website includes:

- The Invasive Carp Problem (The Invasive Carp Problem | InvasiveCarp.us)
- Frequently Asked Questions about Invasive Carp (FAQs | InvasiveCarp.us)
- Descriptions/pictures of Invasive Carp (Bighead Carp | 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 to the communities, stakeholders, and economies that depend upon 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.

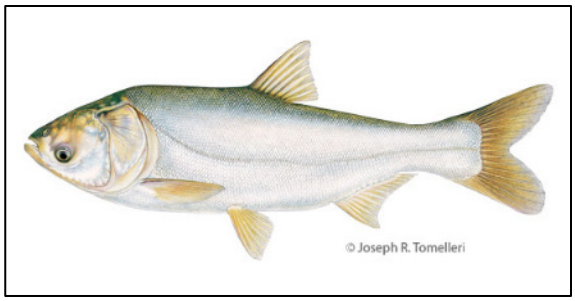
Figure 1 — Invasive Carp



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 2 — Silver Carp



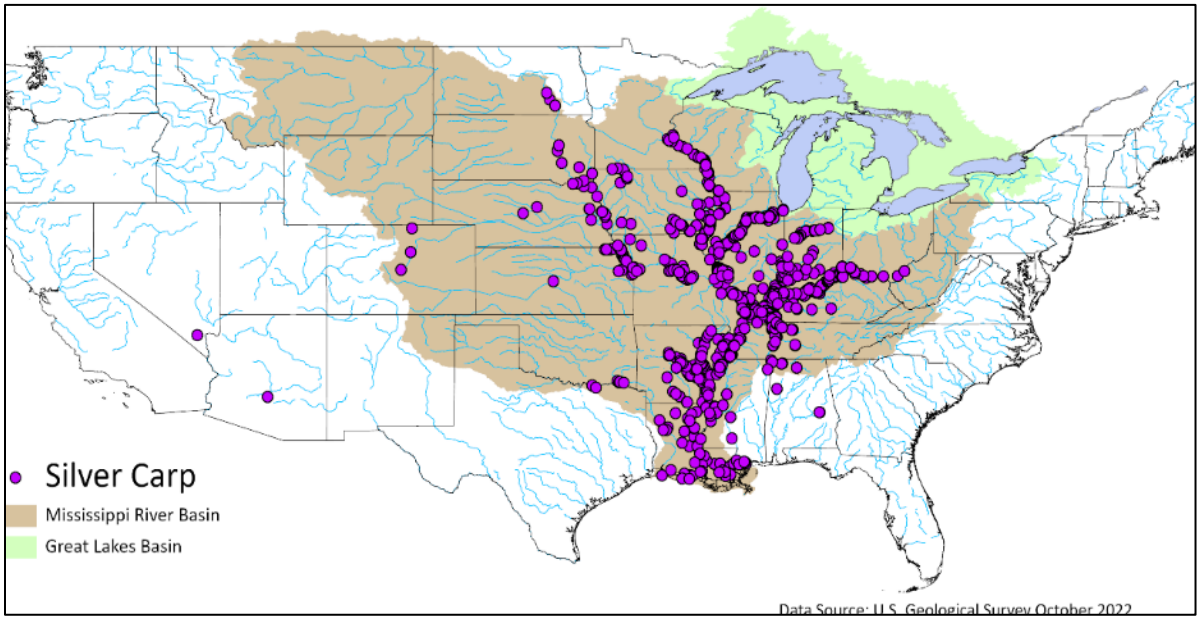
Silver Carp feed primarily on phytoplankton, as well as zooplankton, invertebrates, detritus, and bacteria. They efficiently filter suspended material from the water with highly specialized gill rakers. Silver Carp adversely affect many native species because they feed on plankton, the primary food source 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 due to 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 3). Silver Carp can grow to 60 or more pounds and have been

collected 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. The population front has remained unchanged for over 10 years.

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 3 — Documented Occurrence of Silver Carp – Midwest United States



Documented occurrence of Silver Carp in the Midwest United States (reported through October 2022) (USGS Nonindigenous Aquatic Species Database). Note: These maps represent historical collection records only indicating 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 4 — Bighead Carp

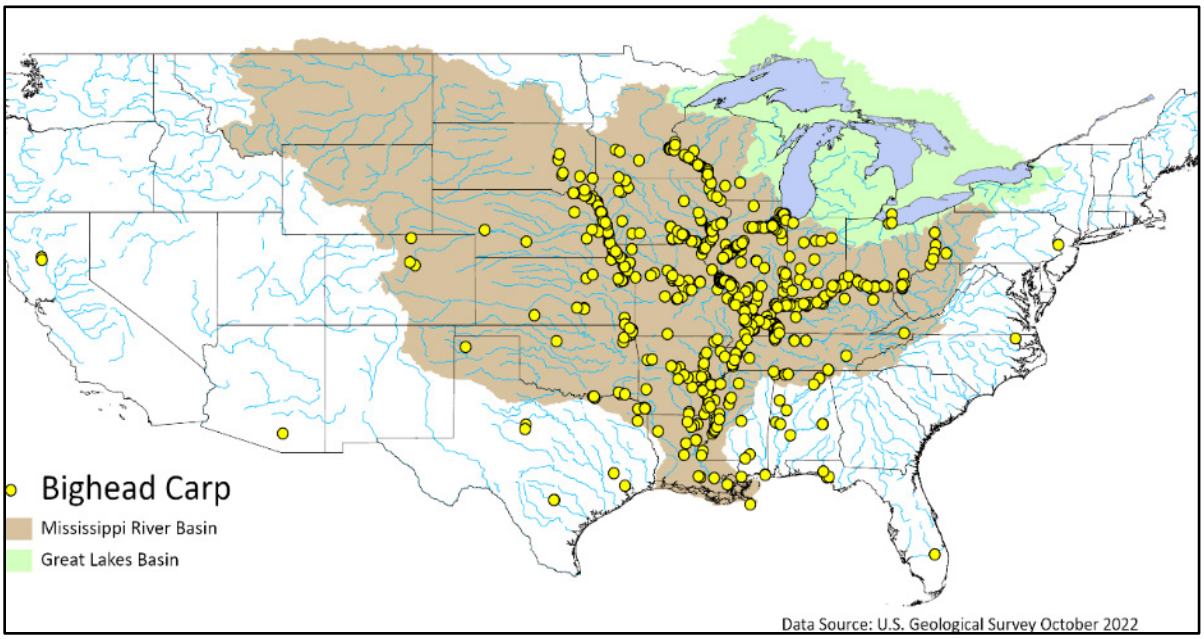
Bighead Carp feed on or near the surface of the water, as well as in midwater and benthic (bottom) environments, consuming primarily zooplankton, blue-green algae, aquatic insects, and detritus. They efficiently filter suspended material from the water with highly specialized gill rakers. Bighead Carp adversely affect many native species because they feed on plankton, the primary food source for mussels, larval fish, and certain adult fishes.

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 5). 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.

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 5 — Documented Occurrence of Bighead Carp – Midwest United States



Documented occurrence of Bighead Carp in the Midwest United States (reported through October 2022) (USGS Nonindigenous Aquatic Species Database). Note: These maps represent historical collection records only indicating one or more fish were captured but does not necessarily mean that fish are reproducing or have a population in the area.

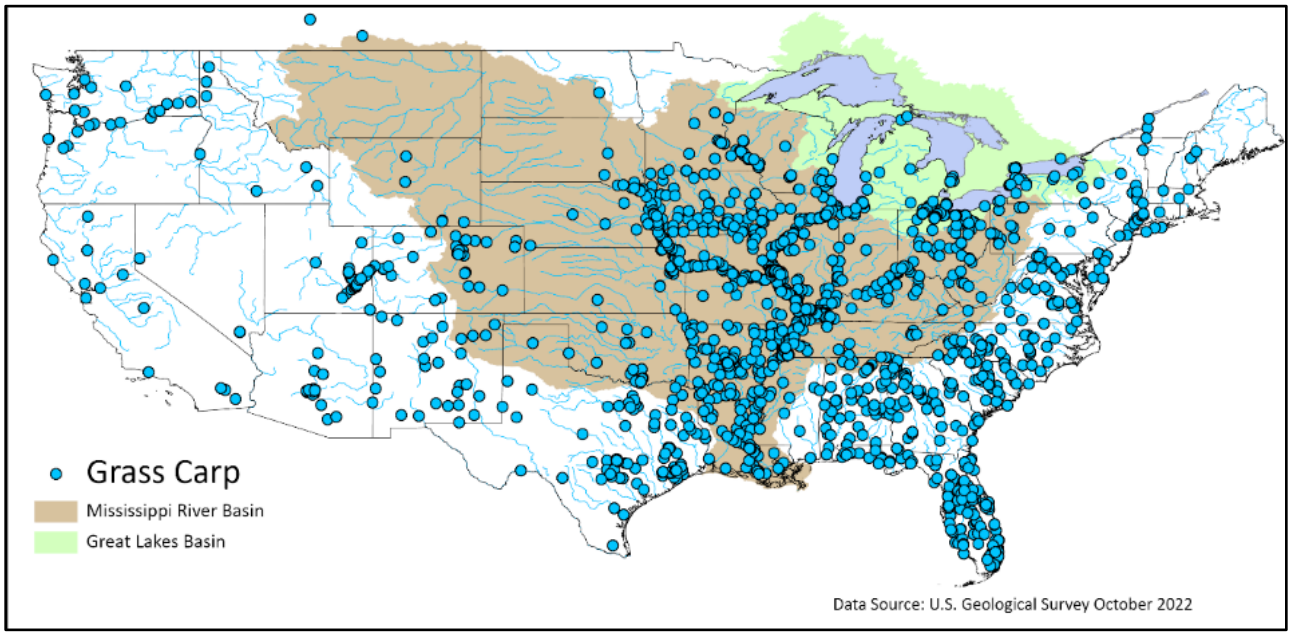
2.3 Grass Carp

Figure 6 — Grass Carp

Grass Carp feed primarily on submerged aquatic vegetation and are able to consume over 20 percent of their body weight in vegetation per day. Because of this feeding behavior, infertile adult Grass Carp were historically produced and made widely available for sale by aquaculture providers for stocking to control nuisance aquatic plants in small lakes and ponds. 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 all allow triploid Grass Carp to be used for vegetative control in ponds. 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 7).

Figure 7 — Documented Occurrence of Grass Carp – Midwest United States



Documented occurrence of Grass Carp in the Midwest United States (reported through October 2022). (USGS Nonindigenous Aquatic Species Database) Note These maps represent historical collection records only indicating 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.

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

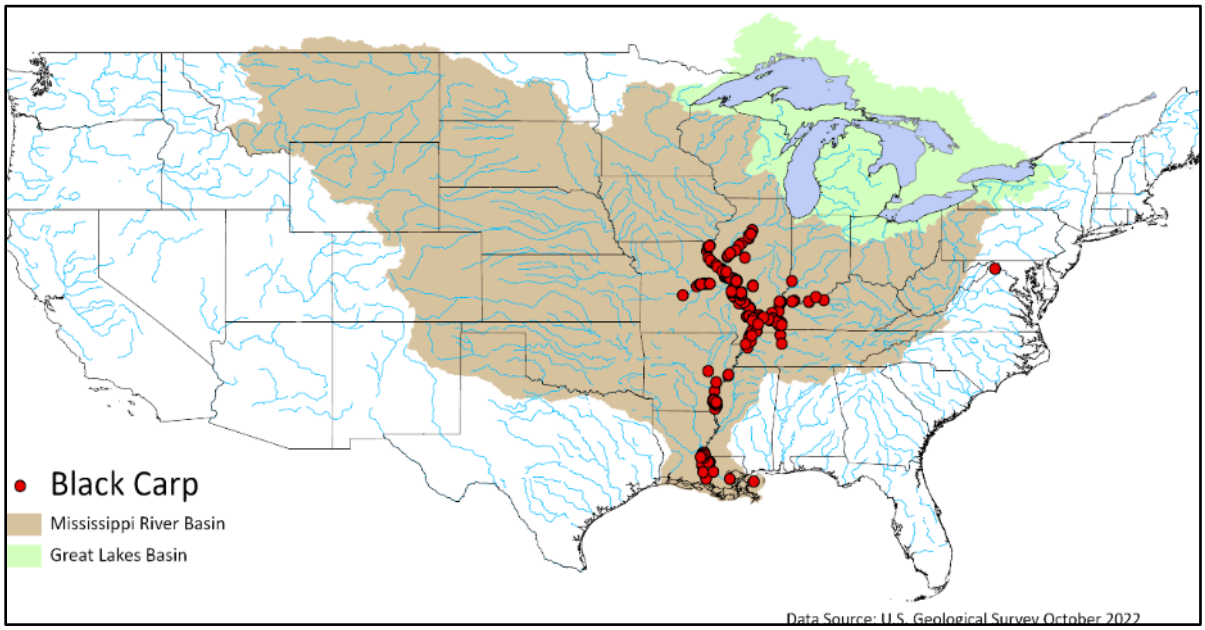
Figure 8 — Black Carp

Adult Black Carp 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. Some expansion in the range of occurrence for Black Carp was observed in certain mainstream rivers within the Mississippi River Basin in 2021. Black Carp can grow to 150 or more pounds and live longer than other invasive carp species (Figure 9). 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, 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/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 2021, approximately 2.5 miles downstream of Henry, Illinois, within the Peoria Pool, and approximately 135 river miles and six lock structures away from Lake Michigan.

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 9 — Documented Occurrence of Black Carp in the Midwest



Documented occurrence of Black Carp in the Midwest United States (reported through October 2022) (USGS Nonindigenous Aquatic Species Database). Note: These maps represent historical collection records only indicating 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 2023 ICRCC ACTIONS

The ICRCC mission and the goal of this Action Plan are 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 ICRCC's monitoring and control activities focus on key geographic areas of highest risk. Additionally, support is provided for technology development, interagency coordination, and communication and outreach activities of the ICRCC. In this Action Plan, ICRCC actions are organized into six categories:

- Preventing the introduction of Silver Carp and Bighead Carp into the Great Lakes, with a focus on the IWW.
- Preventing the establishment of Grass Carp in the Great Lakes, with a primary focus on detection and removal from the western basin of Lake Erie and additional early detection monitoring in the eastern basin of Lake Erie, Lake Ontario, Lake Huron, and Lake Michigan.
- Assessing and preventing the spread of Black Carp toward the Great Lakes, with a focus on the Illinois River.
- Blocking potential migration pathways at other locations, including closing the Little Killbuck Creek connection for potential transfer of invasive carp from the Mississippi River Basin to the Great Lakes Basin and ongoing maintenance of previously constructed barriers at Eagle Marsh (Fort Wayne, Indiana) and the Ohio & Erie Canal (Akron, Ohio).
- Supporting state-led efforts in the Great Lakes basin focused on the early detection of invasive carp.
- Communicating and coordinating efforts in support of the ICRCC.

3.1 Preventing the Introduction of Silver Carp and Bighead Carp into the Great Lakes, with a Focus on the Illinois Waterway

The U.S. Army Corps of Engineers (USACE) Great Lakes and Mississippi River Interbasin Study (GLMRIS) reported that Bighead Carp and Silver 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 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 electric dispersal barrier system (EDBS) (Figure 10). 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 populations of invasive carp in the IWW to reduce the threat to the Great Lakes remains a major focus.

Figure 10 — CAWS Waterbodies

Source: Great Lakes Commission

Populations of Bighead Carp and Silver Carp in the IWW are generally characterized by pool. For reference, Figure 11 illustrates the pools in the upper IWW and the stages of invasion for Bighead Carp and Silver Carp, and Figure 12 identifies the waterbodies making up the IWW.

Figure 11 — Upper IWW Pools and Stages of Bighead Carp and Silver Carp Invasion

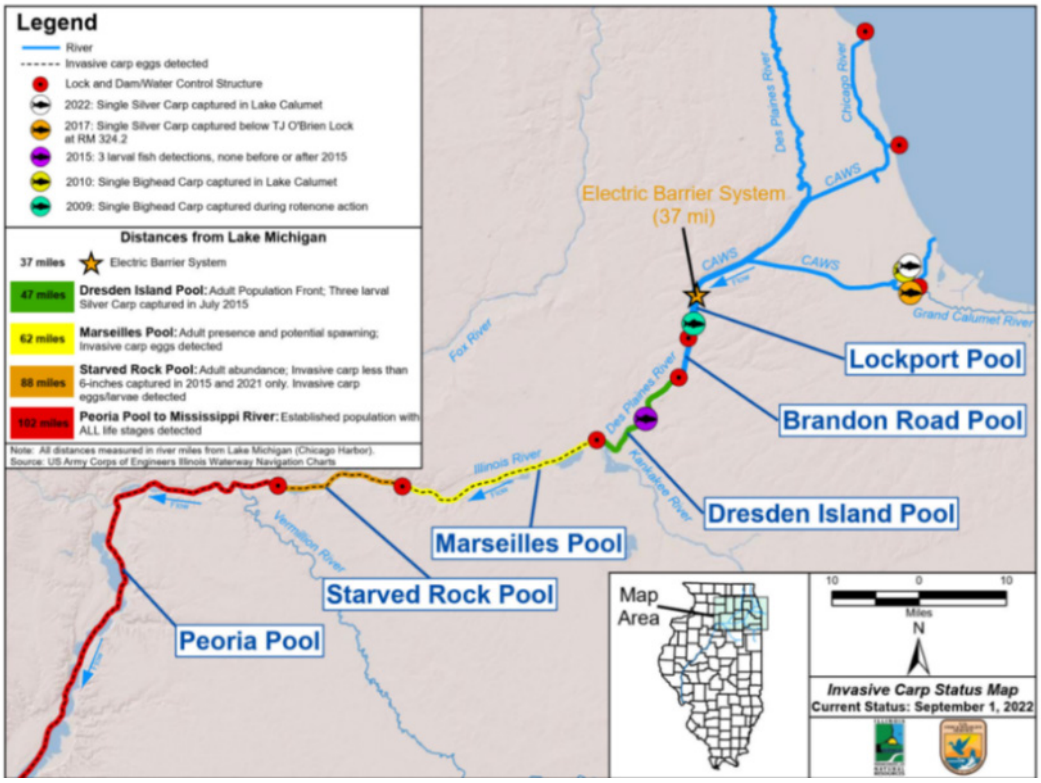
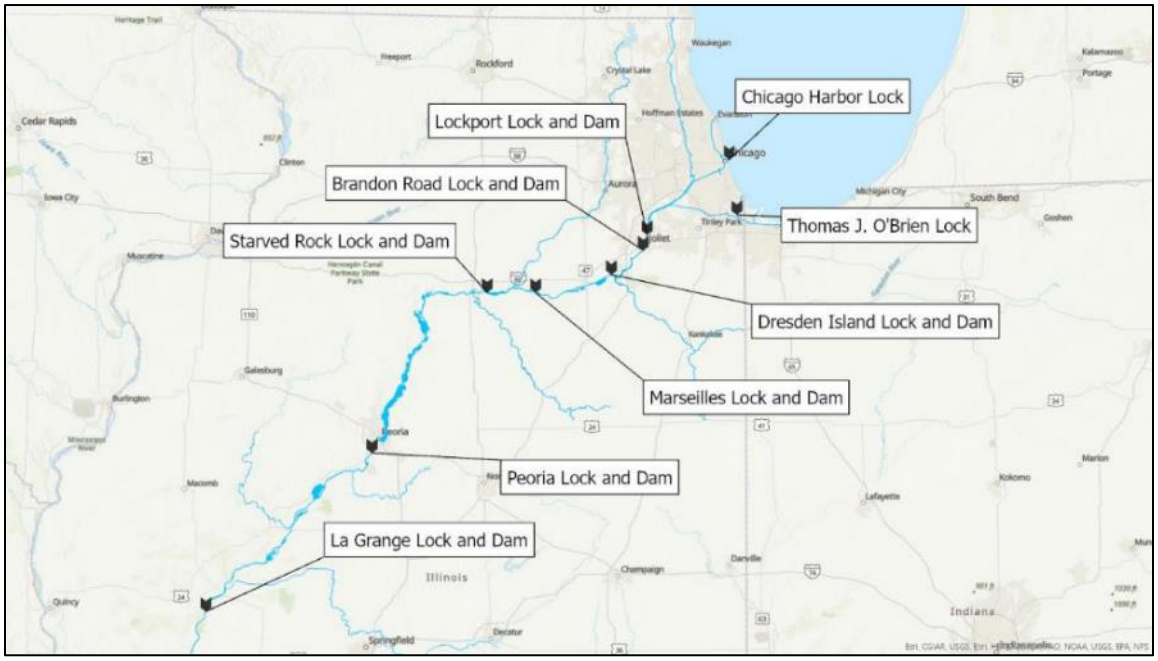


Figure 12 — IWW Locks and Dams



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).

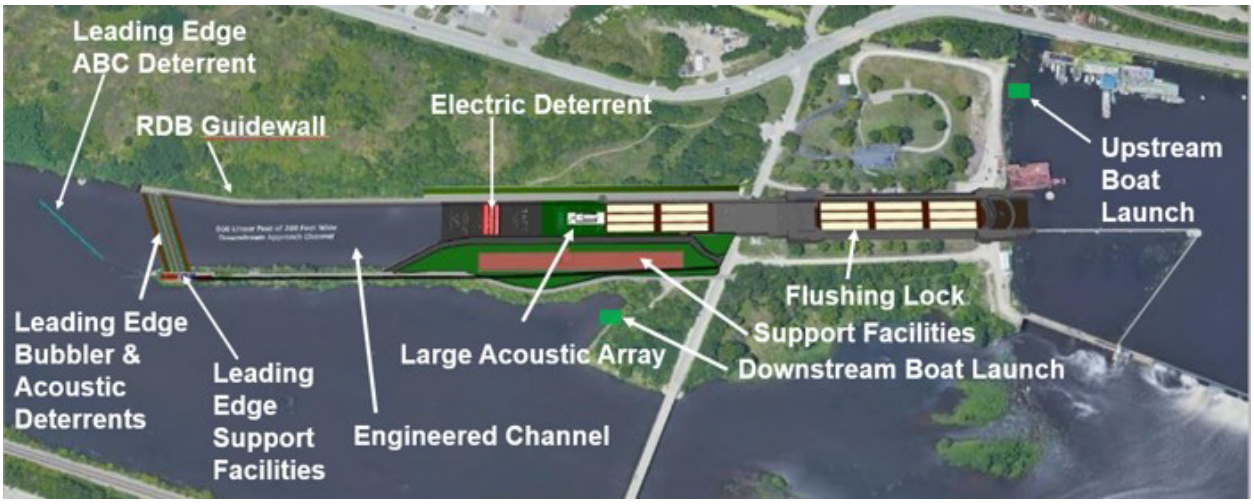
ICRCC actions planned for 2023 include:

- **Prevention:** Development of deterrents at Brandon Road Lock and Dam (BRLD), ongoing operation of the EDBS, enhanced enforcement activity to prevent unauthorized transport of live invasive carp, and closure of the high-priority area of the Little Killbuck Creek connection for potential transfer of Bighead Carp, Silver Carp, and Black Carp from the Mississippi River Basin to the Great Lakes Basin.
- **Technology Development:** Development and testing of systems that use underwater sound as a deterrent to upstream fish migration, use of carbon dioxide at the EDBS, and completion of a technical report that summarizes findings of an automated barge clearing deterrent field trial.
- **Monitoring and Population Assessment**: Characterization of invasive carp populations in the IWW to assess risk of upstream movement and ensure no invasive carp have moved beyond the EDBS.
- **Control:** Capture and remove invasive carp from the upper Illinois River, enhancement of harvest where invasive carp are established on the Illinois River to reduce risk of upstream migration, and refinement of population models to inform future control efforts.

3.1.1 Prevention Actions

Prevention actions are focused on high-risk points of potential introduction and spread and include planning and designing a robust barrier at BRLD (Figure 13), ongoing operation of the EDBS, and enhanced enforcement to prevent unauthorized transport or use of live invasive carp.

Figure 13 — 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.

The State of Illinois and USACE, with support from the State of Michigan, are actively designing significant prevention measures at the BRLD, and the Bipartisan Infrastructure Law included funds to initiate construction (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 will consider structural barriers and deterrents, including an electric barrier, acoustic deterrent, bubble curtain, and flushing lock.

The USACE will continue to operate the EDBS (Figure 14) in the Chicago Sanitary and Ship Canal (CSSC) and construct the second high-field array at Barrier I. Since 2002, several operational and procedural improvements have been implemented to improve the effectiveness of the EDBS and continuously deliver an uninterrupted flow of electricity to the water to deter fish. This effort is the first 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.

Figure 14 — USACE EDBS in the CSSC

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 U.S. Fish and Wildlife Service (USFWS) through the GLRI.

Table 1 lists the Prevention Actions supported by the 2023 Action Plan.

Table 1 — Prevention Project Actions

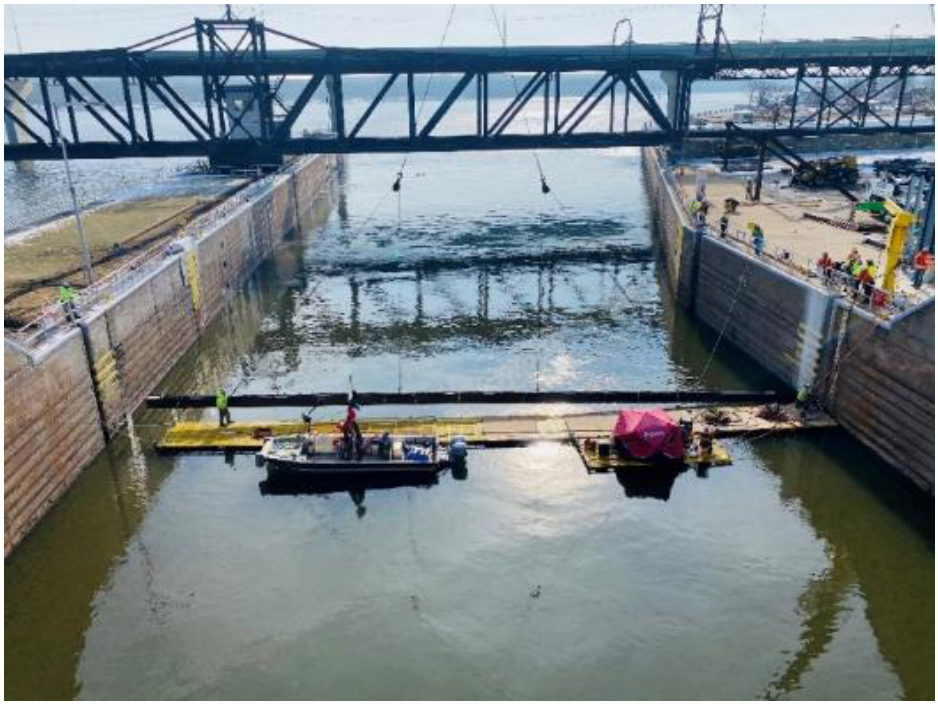
Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
P-1	Alternate Pathway Surveillance in Illinois	IL DNR
P-2	Operation and Maintenance of the Electric Dispersal Barrier System	USACE
P-3	Water-Velocity/Quality Monitoring Station in Support of the Brandon Road Project	USGS
P-4	Design and Construction of the Brandon Road Lock and Dam Aquatic Nuisance Species Barrier Project	USACE

3.1.2 Technology Development Actions

The ICRCC continues to support the development and testing of technology to assist in preventing 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 2023, the ICRCC member agencies will support work on underwater sound, field deployment of carbon dioxide at the EDBS, and other toxicants, and

the use of “bubble curtains” (intense concentrations of bubbles) to prevent the accidental entrainment and movement of small fish by shipping barges.

Figure 15 — Soundbar Installation – Lock 19 (Keokuk, Iowa)



The ICRCC has led a multi-year effort to investigate the use of underwater sound as a potential management technology, including piloting the use of the Bioacoustic Fish Fence (BAFF) and the underwater Acoustic Deterrent System (uADS) as two different technologies intended to deter invasive carp. The BAFF project is the large-scale experimental deployment of an integrated sound and bubble deterrent system at Barkley Dam on the Tennessee-Cumberland River near Grand Rivers, Kentucky. The test is being conducted at this site due to the high-head dam structure with no overflow conditions, telemetry monitoring infrastructure in place, as well as the presence of an established population of invasive carp. Once completed in 2023, the results of the study will reveal the effectiveness of the BAFF technology and its applicability to protect the Great Lakes from invasive carp. Similarly, the uADS has been installed experimentally to test the efficacy of acoustic signals in deterring invasive carp at Lock 19 near Keokuk, Iowa.

Figure 16 — Downbound Tow Traversing uADS – Lock 19 (Keokuk, Iowa)

Collectively these projects will result in data that can inform future management decisions involving deterrents for invasive carp in rivers with locks and dams. FY 2023 funding will continue evaluating the uADS at Lock 19 and additional evaluation of a small-scale acoustic deterrent 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, which could present an opportunity for fish to move upstream toward Lake Michigan while portions of the system are offline. In 2023, 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 2023, the USACE, USFWS, USGS, and partnering agencies will complete the analysis of data collected during a large-scale field

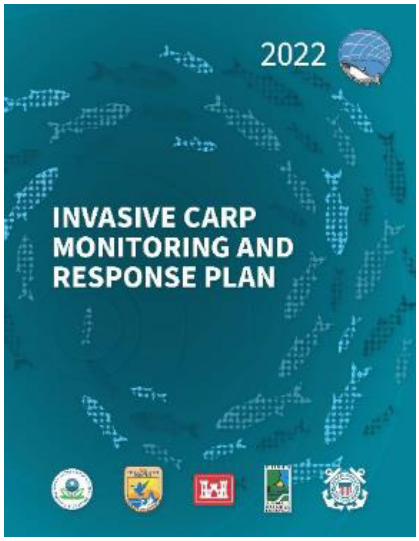
trial conducted at Peoria Lock and Dam in 2022. This analysis will identify the efficacy of using directed streams of bubbles for removing small fish from the rake-box junction of commercial barges and discuss the safety of operating both large and small vessels over the ABC Deterrent in the IWW. Results 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 2 lists the Technology Development Project Actions supported by the 2023 Action Plan.

Table 2 — Technology Development Project Actions

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
T-1	Experimental Testing of Automated Barge Clearing Deterrent for Barge Entrainment Mitigation	USACE
T-2	Further Develop the Use and Efficacy of Underwater Acoustics as a Deterrent for Invasive Carp and Impacts on Native Species	USACE
T-3	Field Testing of Acoustic Deterrents for Invasive Carp	USGS
T-4	Implementation and Planning for a Carbon Dioxide Deployment at the EDBS	USACE
T-5	Planning for a Field Demonstration of Carbon Dioxide Deployment at the EDBS	USGS
T-6	Research and Development of Carbon Dioxide as a Deterrent	USGS
T-7	Impacts of Water Characteristics on the Population Range, Movement, and Spawning/Recruitment Success in the Illinois Waterway	USGS
T-8	Acoustic Deterrents for Invasive Carp Bio-Acoustic Fish Fence	USFWS

3.1.3 Monitoring, Population Assessment, and Contingency Planning



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.

SIM activities upstream of the EDBS will continue in the upper IWW during spring and fall of 2023, 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.

Figure 17 — Example Seine Net

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.

In addition, USFWS will increase focused surveillance of small (less than 6 inches in total length) fish in the Marseilles Pool and Dresden Island Pool and will increase targeted effort focused on 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 increased 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.

USFWS also offers additional support for 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

Figure 18 — Example Surgical Implanting – Acoustic Transmitter

to support a robust eDNA monitoring program for efficiently sampling high-priority locations for the presence of invasive carp.

Telemetry tracking and hydroacoustic monitoring of invasive carp in the Alton through Lockport pools of the IWW will continue in 2023. 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. Hydroacoustic sampling will also 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 (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) within proximity to the EDBS and help evaluate potential risk of fish passage in the event of operational changes (e.g., EDBS maintenance).

In FY 2023, the ICRCC member agencies will remain prepared to implement contingency (rapid response) actions through the MRWG Contingency Response Plan (CRP) for the Upper IWW. 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 2023 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 response to new invasive carp detections.

For more information on the efforts of the MRWG and the MRP, please see the 2022 MRP at: 2022 Invasive Carp Monitoring and Response Plan.

Table 3 lists the Early Detection, Monitoring, and Evaluation Project Actions supported by the 2023 Action Plan.

Table 3 — Early Detection, Monitoring, and Evaluation Project Actions

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
M-1	Early Detection, Management and Control, and Contingency Response in the Illinois Waterway	IL DNR
M-2	Assessment of Invasive Carp Reproduction and Ecosystem Response in the Illinois Waterway	IL DNR
M-3	Invasive Carp Stock Assessment in the Illinois River/Management Alternatives	IL DNR
M-4	Early Detection Monitoring for Invasive Carp in the Great Lakes	USFWS
M-5	Invasive Carp Demographics – Multiple Agency Monitoring Support	USFWS
M-6	Des Plaines River Overflow Monitoring for Invasive Carp	USFWS
M-7	Illinois River Invasive Carp Monitoring and Response Team Support	USFWS
M-8	Midwest Region Fisheries Program Capacity for eDNA Sampling and eDNA Processing for Invasive Carp Monitoring	USFWS
M-9	Tracking the Movement of Invasive Carp in the Upper Illinois Waterway through Telemetry	USACE
M-10	Telemetry tracking in the Illinois Waterway to support the Spatially Explicit Invasive Carp Population Model (SEICarP)	USFWS
M-11	Hydroacoustic Surveys of Fish Abundance and Distribution in the Illinois River	USFWS
M-12	Maintain a Real-Time Telemetry Alert System and Continued Support of the SEICarP Model	USGS
M-13	Small Fish Distribution and Early Detection of Invasive Carp in the Upper Illinois Waterway	USFWS

3.1.4 Control

Control actions are designed to contain and stop the expansion of populations of invasive carp in the Illinois River to 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 annually removing 15 million pounds of invasive carp through the Enhanced Contract Fishing Program by contracting with legally licensed Illinois commercial fishers below the Starved Rock Dam and removing at least 1 million pounds of invasive carp annually from the upper IWW (Figure 10).

Figure 19 — Contract Fishing on the IWW

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 20 — Contracted Commercial Fishing Sampling Area

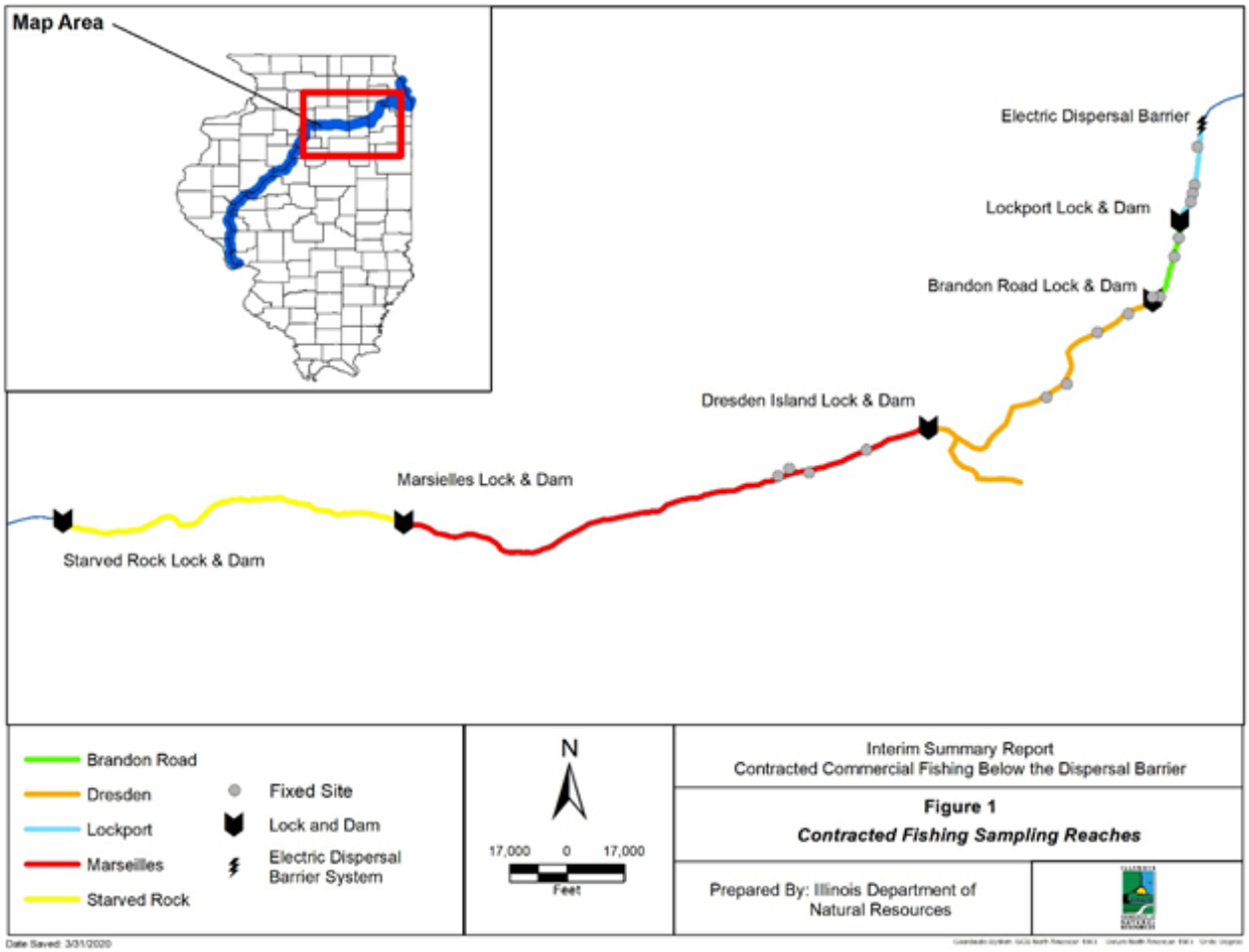


Table 4 lists the Control Project Actions supported by the 2023 Action Plan.

Table 4 — Control Project Actions

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

3.2 Preventing the Establishment of Grass Carp in the Great Lakes, with a Focus on the Western Basin of Lake Erie

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. 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, better understand, and control the Grass Carp population in Lake Erie as articulated in the *Lake Erie Grass Carp Adaptive Response Strategy 2019-2023*. 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 2023, 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 planned for 2023 include:

- Support Grass Carp removal efforts primarily focused on Lake Erie led by 11 strike teams.
- Identify optimal river conditions for spawning and recruitment of invasive carp in tributaries of the western basin of Lake Erie 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 research to predict Grass Carp locations, estimate origin, study movement via telemetry, assess ploidy, and evaluate potential baits/attractants.
- Conduct additional exploratory Grass Carp sampling in tributaries of Lake Erie, Lake Michigan, and Lake Ontario.

Table 6 lists the Grass Carp Project Actions supported by the 2023 Action Plan.

Table 6 — Grass Carp Project Actions

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
GC-1	Monitoring, Removal, and Control of Grass Carp in Ohio Waters of the Lake Erie Western Basin	OH DNR
GC-2	Monitoring, Removal, and Control of Grass Carp in Michigan and Ohio Waters of the Lake Erie Western Basin	MI DNR
GC-3	Implementation of an Adaptive Management Framework for Grass Carp for the Great Lakes	USFWS
GC-4	Continued Deployment of the Grass Carp Spawning Event Prediction Tool	USGS
GC-5	Identifying Optimal River Conditions for Spawning and Recruitment of Invasive Carp in Tributaries of the Western Basin of Lake Erie	USGS
GC-6	Information and Tools to Support the Removal and Deterrents of Grass Carp	USGS
GC-7	Laboratory Testing to Determine the Efficacy of an Oblique Bubble Screen System as a Two-Way Dispersal Barrier for Grass Carp	USGS
GC-8	Improve Control Efficiency through Better Understanding of Grass Carp Movements and Habitat Use	USGS
GC-9	Identifying Spawning Tributaries and Specific Spawning Areas of Grass Carp	USGS
GC-10	Characterization of Hydrology and Sediment Mobility to Inform Design and Implementation of a Seasonal Barrier in the Sandusky River	USGS
GC-11	Development and Testing of Deterrent Technologies for Grass Carp	USGS
GC-12	Grass Carp Ploidy Analysis to Assess Reproductive Risk of Detected Populations	USFWS
	Grass Carp Control in the Lake Erie Basin	GLFC

3.3 Assessing the Spread of Black Carp Toward the Great Lakes, with a Focus on the Illinois River

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 Black Carp Work Group (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.

In summary, ICRCC member agency actions planned for FY 2023 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.
- Developing a Structured Decision-Making (SDM) process to incorporate new information from existing research and identify new potential Black Carp management actions.

Table 7 lists the Black Carp Project Actions supported by the 2023 Action Plan.

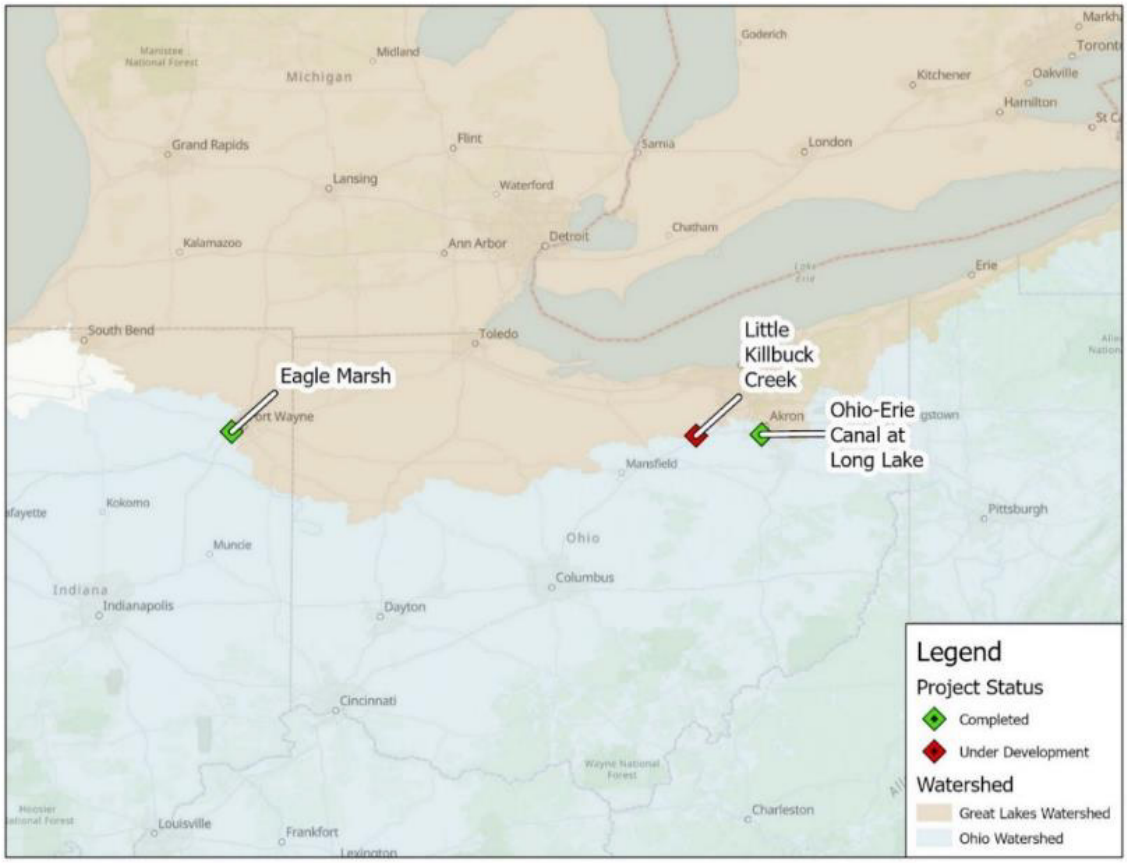
Table 7 — Black Carp Project Actions

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
B-1	Enhanced Detection of Black Carp in the Lower Illinois River	IL DNR
B-2	Angler/Commercial Fisher Black Carp Data Collection	IL DNR
B-3	Black Carp Management and Control-Coordination and Support	USFWS
B-4	Black Carp Monitoring, Assessment, and Control	USGS

3.4 Blocking Potential Migration Pathways at Other Locations

In 2023, 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, for efforts 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 21). Working with local agencies, Indiana Department of Natural Resources and Ohio Department of Natural Resources (OH DNR) will also continue to maintain those barriers, respectively.

Figure 21 — Alternate Pathways



Source: OH DNR

In FY 2023, OH DNR will complete Phase 1 construction and other infrastructure upgrades on the Little Killbuck Creek pathway project, closing the highest-risk section, which has a 1-year inundation frequency. The remaining project will be phased over multiple years and require the current earthen berm to stabilize.

Table 8 lists the Blocking Potential Migration Pathways Project Action supported by the 2023 Action Plan.

Table 8 — Blocking Potential Migration Pathways Project Action

Project Number	Project Title (*Click on Project Title to go to the Project*)	Lead Agency
MP-1	Closure of Connection between the Mississippi River Watershed and Great Lakes Watershed at Little Killbuck Creek, Ohio	OH DNR

3.5 Supporting State-led Efforts in Basin-Wide Early Detection

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

USFWS also offers additional support for 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 2022, 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.

3.6 Decision Support Efforts Assisting the ICRCC

The FY 2023 Action Plan includes activities to support the prioritization, planning, and implementation of the numerous invasive carp detection, prevention, and control actions proposed for the IWW and adjacent waterways. These activities provide relevant data and analyses to support collaborative decision-making and objectively assess the impacts and effectiveness of specific prevention and control actions. These efforts include assessing commercial harvest efforts, developing the SEICarP model and other fishery models, and collecting and managing invasive carp catch and demographics data.

Table 9 lists the Decision Support Project Actions supported by the 2023 Action Plan.

Table 9 — Decision Support Project Actions

Project Number	Project Title *(Click on Project Title to go to the Project)*	Lead Agency
DS-1	Assessment of Enhanced Commercial Harvest Efforts	IL DNR
DS-2	Modeling Potential Population Growth, Food Web Effects, and Control of Grass Carp in Lake Erie's Western Basin	NOAA
DS-3	Invasive Carp Population Modeling to Support an Adaptive Management Framework for the Illinois River	USFWS
DS-4	Invasive Carp Population Modeling to Support an Adaptive Management Framework for the Illinois River	USGS
DS-5	Invasive Carp Database Management and Integration Support	USGS

3.7 ICRCC Communication and Mission Support

The FY 2023 Action Plan includes key activities to continue effective communication and partnership coordination efforts in support of the ICRCC's mission 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 mission is provided through the FY 2023 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 10 lists the Communication and Mission Support Project Actions supported by the FY 2023 Action Plan.

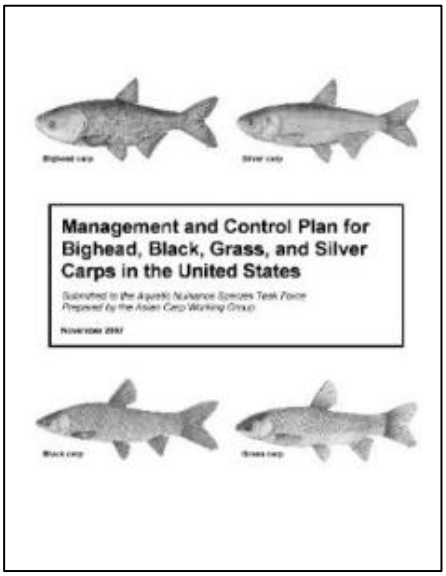
Table 10 — Communication and Mission Support Project Actions

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

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 United States 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 12 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. 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.* (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.

Figure 22 — Abundance of Bighead Carp and Silver Carp – Mississippi River Basin

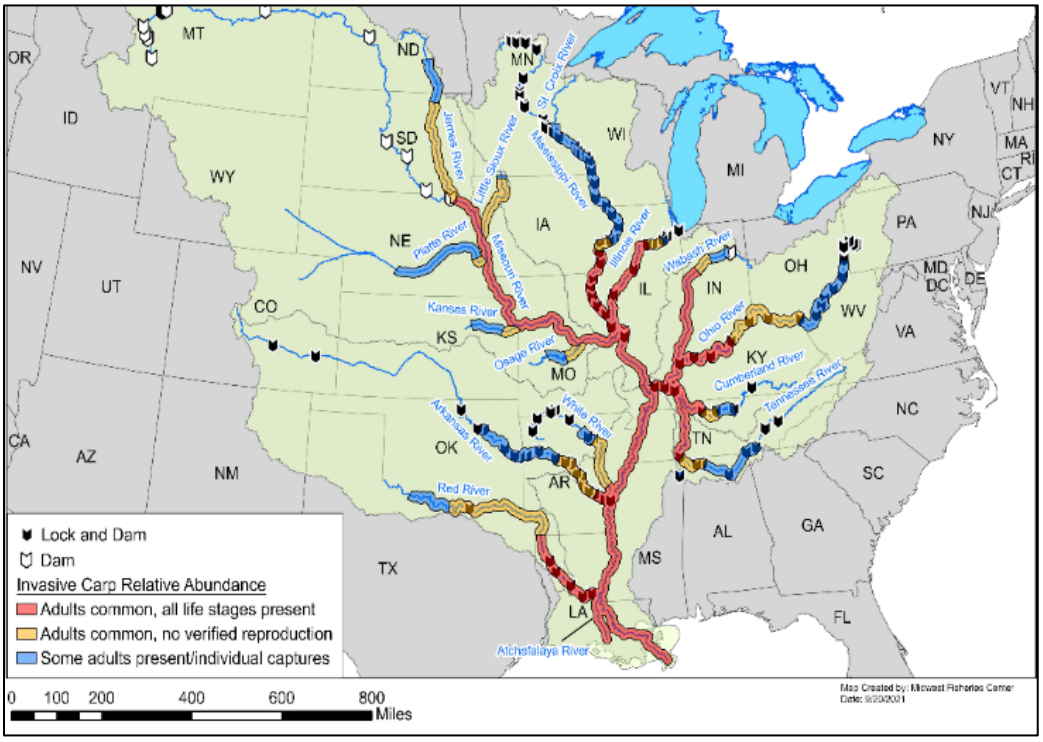
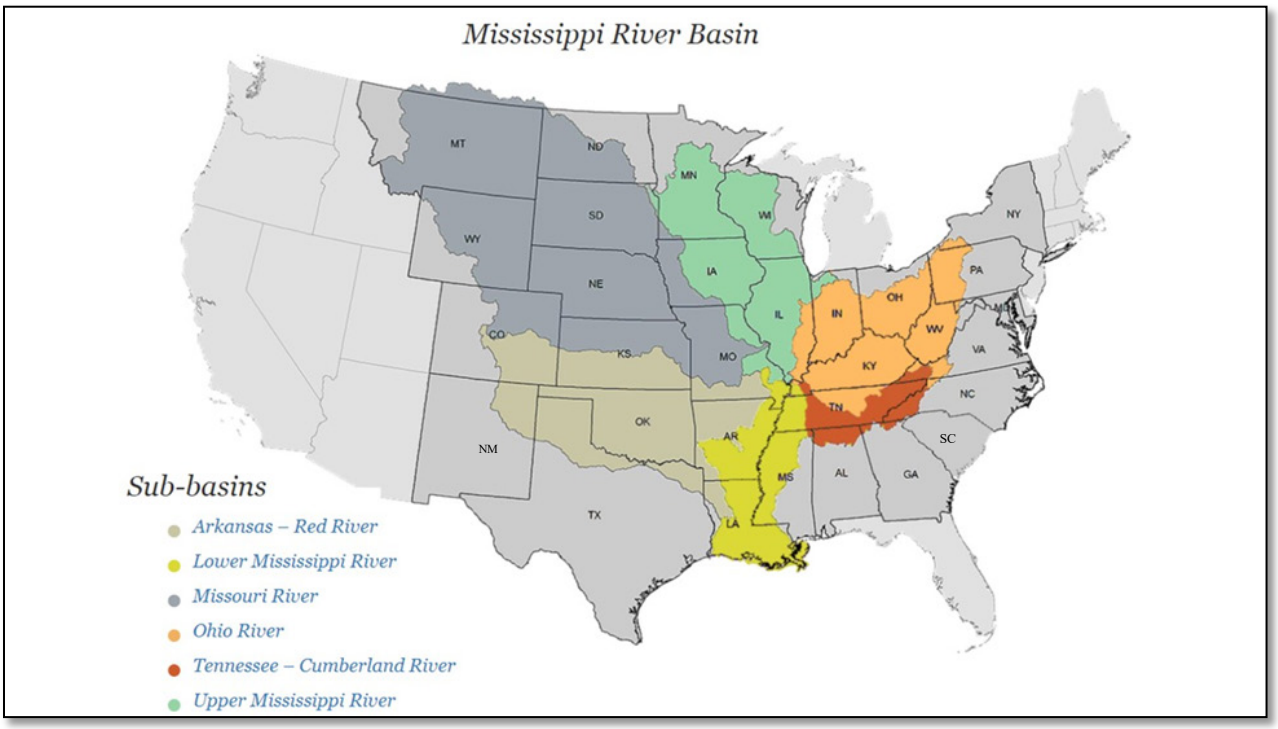


Figure 23 — Delineation of Sub-Basin Invasive Carp Partnerships



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 2023 Funding Matrix

Table A-1 — Funding Matrix by Action

Action	Lead Agency	Project Title	GLRI Funding	Agency Funding
Prevention Action P-1	IL DNR	Alternate Pathway Surveillance in Illinois	$150,000	$0
Prevention Action P-2	USACE	Operation and Maintenance of the Electric Dispersal Barrier System	$0	$14,129,000
Prevention Action P-3	USGS	Water-Velocity/Quality Monitoring Station in Support of the Brandon Road Project	$80,000	$0
Prevention Action P-4	USACE	Design and Construction of the Brandon Road Lock and Dam Aquatic Nuisance Species Barrier Project	$0	$47,880,500
Technology Action T-1	USACE	Experimental Testing of Automated Barge Clearing Deterrent for Barge Entrainment Mitigation	$150,000	$0
Technology Action T-2	USACE	Further Develop the Use and Efficacy of Underwater Acoustics as a Deterrent for Invasive Carp and Impacts on Native Species	$1,351,000	$0
Technology Action T-3	USGS	Field Testing of Acoustic Deterrents for Invasive Carp	$1,577,000	$451,739
Technology Action T-4	USACE	USACE Implementation and Planning for a Carbon Dioxide Deployment at the EDBS	$350,000	$0
Technology Action T-5	USGS	Planning for a Field Demonstration of Carbon Dioxide Deployment at the EDBS	$200,000	$0
Technology Action T-6	USGS	Research and Development of Carbon Dioxide as a Deterrent	$0	$338,746
Technology Action T-7	USGS	Impacts of Water Characteristics on the Population Range, Movement, and Spawning/Recruitment Success in the Illinois Waterway	$90,000	$74,534
Technology Action T-8	USFWS	Acoustic Deterrents for Invasive Carp Bio-Acoustic Fish Fence	$0	$800,000
Monitoring Action M-1	Illinois DNR	Early Detection, Management, and Control and Contingency Response in the Illinois Waterway	$4,400,000	$0
Monitoring Action M-2	Illinois DNR	Assessment of Invasive Carp Reproduction and Ecosystem Response in the Illinois Waterway	$477,400	$0

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Action	Lead Agency	Project Title	GLRI Funding	Agency Funding
Monitoring Action M-3	Illinois DNR	Invasive Carp Stock Assessment in the Illinois River/Management Alternatives	$550,000	$0
Monitoring Action M-4	USFWS	Early Detection Monitoring for Invasive Carp in the Great Lakes	$350,000	$1,400,000
Monitoring Action M-5	USFWS	Invasive Carp Demographics – Multiple Agency Monitoring Support	$315,000	$226,590
Monitoring Action M-6	USFWS	Des Plaines River Overflow Monitoring for Invasive Carp	$15,000	$0
Monitoring Action M-7	USFWS	Illinois River Invasive Carp Monitoring and Response Team Support	$70,000	$275,000
Monitoring Action M-8	USFWS	Midwest Region Fisheries Program Capacity for eDNA Sampling and eDNA Processing for Invasive Carp Monitoring	$0	$2,400,000
Monitoring Action M-9	USACE	Tracking the Movement of Invasive Carp in the Upper Illinois Waterway Through Telemetry	$0	$200,000
Monitoring Action M-10	USFWS	Telemetry Tracking in the Illinois Waterway to Support the Spatially Explicit Invasive Carp Population Model (SEICarP)	$110,000	$400,000
Monitoring Action M-11	USFWS	Hydroacoustic Surveys of Fish Abundance and Distribution in the Illinois River	$120,000	$0
Monitoring Action M-12	USGS	Maintain a Real-Time Telemetry Alert System and Continued Support of the SEICarP Model	$125,000	$0
Monitoring Action M-13	USFWS	Small Fish Distribution and Early Detection of Invasive Carp in the Upper Illinois Waterway	$400,000	$400,000
Control Action C-1	IL DNR	Contract Fishing for Invasive Carp Removal near the Electric Dispersal Barrier System	$2,000,000	$0
Control Action C-2	IL DNR	Enhanced Contract Fishing for Invasive Carp Removal in the Lower Illinois River	$1,292,000	$0
Grass Carp Action GC-1	Ohio DNR	Monitoring, Removal, and Control of Grass Carp in Ohio Waters of the Lake Erie Western Basin	$600,000	$0
Grass Carp Action GC-2	MI DNR	Monitoring, Removal, and Control of Grass Carp in Michigan and Ohio Waters of the Lake Erie Western Basin	$325,000	$150,000

Invasive Carp Action Plan: Fiscal Year 2023

Action	Lead Agency	Project Title	GLRI Funding	Agency Funding
Grass Carp Action GC-3	USFWS	Implementation of an Adaptive Management Framework for Grass Carp for the Great Lakes	$1,250,000	$800,000
Grass Carp Action GC4	USGS	Continued Deployment of the Grass Carp Spawning Event Prediction Tool	$90,000	$0
Grass Carp Action GC-5	USGS	Identifying Optimal River Conditions for Spawning and Recruitment of Invasive Carp in Tributaries of the Western Basin of Lake Erie	$85,000	$0
Grass Carp Action GC-6	USGS	Information and Tools to Support the Removal and Deterrents of Grass Carp	$0	$1,024,672
Grass Carp Action GC-7	USGS	Laboratory Testing to Determine the Efficacy of an Oblique Bubble Screen System as a Two-Way Dispersal Barrier for Grass Carp	$0	$205,000
Grass Carp Action GC-8	USGS	Improve Control Efficiency Through Better Understanding of Grass Carp Movements and Habitat Use	$200,000	$619,162
Grass Carp Action GC-9	USGS	Identifying Spawning Tributaries and Specific Spawning Areas of Grass Carp	$200,000	$455,875
Grass Carp Action GC-10	USGS	Characterization of Hydrology and Sediment Mobility to Inform Design and Implementation of a Seasonal Barrier in the Sandusky River	$145,000	$0
Grass Carp Action GC-11	USGS	Development and Testing of Deterrent Technologies for Grass Carp	$195,000	$280,000
Grass Carp Action GC-12	USFWS	Grass Carp Ploidy Analysis to Assess Reproductive Risk of Detected Populations	$65,000	$40,000
N/A	GLFC	Grass Carp Control in the Lake Erie Basin	$0	$1,000,000
Black Carp Action BC-1	IL DNR	Enhanced Detection of Black Carp in the Lower Illinois River	$188,000	$0
Black Carp Action BC-2	IL DNR	Angler/Commercial Fisher Black Carp Data Collection	$41,000	$0
Black Carp Action BC-3	USFWS	Black Carp Management and Control – Coordination and Support	$43,500	$40,000
Black Carp Action BC-4	USGS	Black Carp Monitoring, Assessment, and Control	$475,000	$120,000

Invasive Carp Action Plan: Fiscal Year 2023

Action	Lead Agency	Project Title	GLRI Funding	Agency Funding
Decision Support Action DS-1	IL DNR	Assessment of Enhanced Commercial Harvest Efforts	$200,000	$0
Decision Support Action DS-2	NOAA GLERL	Monitoring Potential Population Growth, Food Web Effects, and Control of Grass Carp in Lake Erie's Western Basin	$110,800	$65,000
Decision Support Action DS-3	USFWS	Invasive Carp Population Modeling to Support an Adaptive Management Framework for the Illinois River	$100,000	$200,000
Decision Support Action DS-4	USGS	Invasive Carp Population Modeling to Support an Adaptive Management Framework for the Illinois River	$55,000	$289,069
Decision Support Action DS-5	USGS	Invasive Carp Database Management and Integration Support	$70,000	$434,833
Migration Pathway Action MP-1	OH DNR	Closure of Connection Between the Mississippi River Watershed and Great Lakes Watershed at Little Killbuck Creek, Ohio	$2,000,000	$0
Communication Action CM-1	USFWS	ICRCC Strategic Communications with Partners and Stakeholders	$175,000	$100,000
Mission Support Action MS-1	USFWS	ICRCC Mission Support	$214,300	$41,000
Mission Support Action MS-2	USACE	GLMRIS Program Management	$0	$200,000
Total Funding			$21,000,000	$75,040,720

Note: Agency funding is subject to final appropriation. All FY 2023 funding appropriations are provided to U.S. federal agencies through the "Consolidated Appropriations Act, 2023."

Table A-1 — Funding Matrix by Agency

Agency	GLRI Funding FY 2023	Agency Funding FY 2023
IL DNR	$9,298,400	$0
OH DNR	$2,600,000	$0
MI DNR	$325,000	$150,000
NOAA	$110,800	$65,000
GLFC	$0	$1,000,000
USACE	$1,851,000	$62,409,500
USFWS	$3,227,800	$7,122,590
USGS	$3,587,000	$4,293,630
Total	**$21,000,000**	**$75,040,720**

Appendix B

Action Plan Actions

Invasive Carp Action Plan: Fiscal Year 2023

CONTENTS

FIGURES

LIST OF ACRONYMS

Acronym	Definition
ABC	Automated Barge Clearing
AIS	Aquatic Invasive Species
ANS	Aquatic Native Species
BAFF	Bio-Acoustic Fish Fence
BCWG	Black Carp Work Group
BRLD	Brandon Road Lock and Dam
Cal-Sag	Calumet-Saganashkee
CAWS	Chicago-Area Waterway System
CRP	Contingency Response Plan
CSSC	Chicago Sanitary and Ship Canal
DC	Department of Conservation
DFO	Department of Fisheries and Oceans Canada
DFWR	Department of Fish and Wildlife Resources
DNR	Department of Natural Resources
DWF&P	Department of Wildlife, Fisheries, and Parks
EDBS	Electric Dispersal Barrier System
eDNA	Environmental Deoxyribonucleic Acid
EEL	Ecohydraulics and Ecomorphodynamics Laboratory
ERDC	Engineer Research and Development Center
FWCO	Fish and Wildlife Conservation Office
FY	Fiscal Year
GCAC	Grass Carp Advisory Committee
GLATOS	Great Lakes Acoustic Telemetry Observation System
GLERL	Great Lakes Environmental Research Laboratory
GLFC	Great Lakes Fishery Commission
GLMRIS	Great Lates and Mississippi River Inter-Basin Study
GLRI	Great Lakes Restoration Initiative
IA DNR	Iowa Department of Natural Resources
IBM	Individual-Based Biogenetics Model

Acronym	Definition
ICRCC	Invasive Carp Regional Coordinating Committee
IL DNR	Illinois Department of Natural Resources
IN DEN	Indiana Department of Natural Resources
INHS	Illinois Natural History Survey
ISU	Invasive Species Unit
IWW	Illinois Waterway
KY DFWR	Kentucky Department of Fish and Wildlife Resources
LEC	Lake Erie Committee
LTRM	Long-Term Resource Monitoring
MAM	Multi-Agency Monitoring
MELCCFP	Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs
MI DNR	Michigan Department of Natural Resources
MN DNR	Minnesota Department of Natural Resources
MS DWF&P	Mississippi Department of Wildlife, Fisheries, and Parks
MDC	Missouri Department of Conservations
MRWG	Monitoring and Response Work Group
NY DEC	New York Department of Environmental Conservation
NOAA	National Oceanic and Atmospheric Administration
OBS	Oblique Bubble Screen
OH DNR	Ohio Department of Natural Resources
OMNRF	Ontario Ministry of Natural Resources
R&D	Research and Development
SDM	Structured Decision Making
SEICarP	Spatially Explicit Invasive Carp Population
SIM	Seasonal Intensive Monitoring
SIU	Southern Illinois University
SIUC	Southern Illinois University Carbondale
TN WRA	Tennessee Wildlife Resources Agency
TWG	Telemetry Working Group
U.S.	United States

Acronym	Definition
uADS	Underwater Acoustic Deterrent System
UMN	University of Minnesota
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VPS	VIMCO Positioning System
WI DNR	Wisconsin Department of Natural Resources
WRA	Wildlife Resources Agency

Invasive Carp Action Plan: Fiscal Year 2023

PREVENTION ACTIONS

P-1: Alternate Pathway Surveillance in Illinois

- **Lead Agency:** IL DNR
- **Agency Collaboration:** None
- **GLRI Funding:** $150,000
- **Agency Funding:** $0

Project Summary

This project will provide enforcement of legislation enacted to prevent the distribution and/or introduction of invasive species within the waters of the State of Illinois and jurisdictions throughout the Great Lakes region. 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. FY 2023 funding will produce surveillance details, enforcement operations, project law enforcement support, responses to AIS concerns, and training in AIS enforcement.

Project Description

The IL DNR ISU is fully dedicated to searching for illegal activities within the commercial fishing, aquaculture, transportation, bait, pet, aquarium, and live fish market industries. ISU focuses its time and resources on the likely pathways invasive carp can spread by human means as past enforcement objective results demonstrate human activities pose credible risks in every industry ISU enforces. ISU coordinates with other state and federal partners to protect the region and can assemble a team of Conservation Police Officers to address any threats or concerns that arise. ISU works alongside its non-law enforcement partners to further reduce the risk of invasive carp and other invasive species present in the Great Lakes region.

P-2: Operation and Maintenance of the Electric Dispersal Barrier System

- **Lead Agency:** USACE
- **Agency Collaboration:** None
- **GLRI Funding:** $0
- **Agency Funding:** $14,129,000

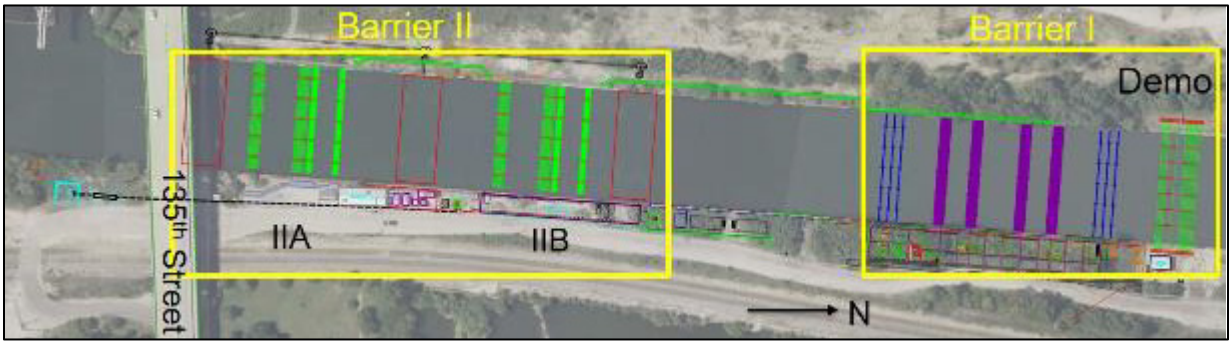
Project Summary

This project involves 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 2023 funding supports continuous operations as well as efforts to improve efficacy of the system.

Project Description

The EDBS is located in the CSSC, which is a man-made waterway creating the only continuous connection between Lake Michigan and the Mississippi River Basin. The dispersal barrier system 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 2023, USACE will continue to operate and maintain the barriers, continue to construct the Barrier I southern array, and complete currently underway construction efforts.

Figure B-1 — USACE EDBS in the CSSC



P-3: Water-Velocity/Quality Monitoring Station in Support of the Brandon Road Project

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

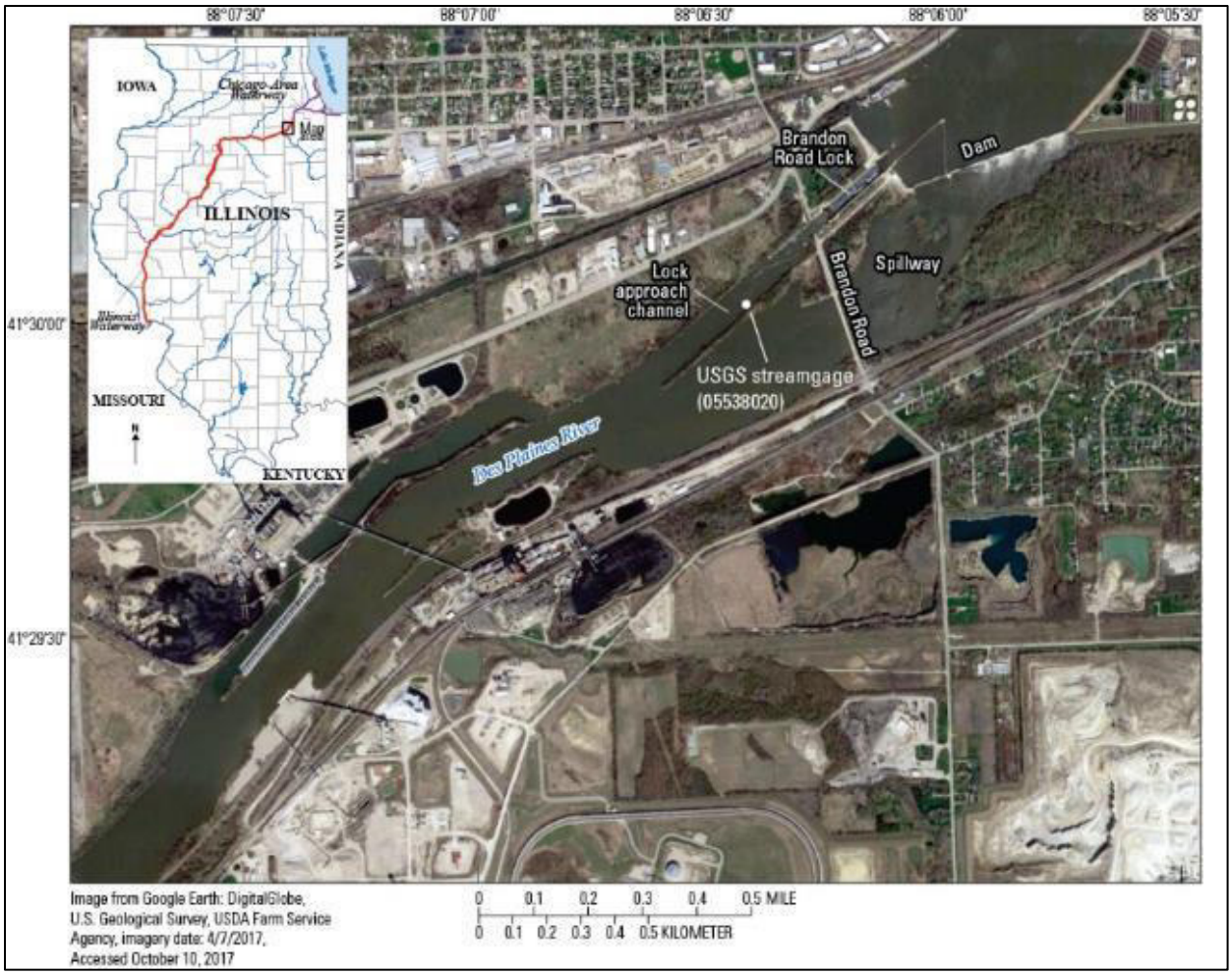
Project Summary

This project will support the operation and maintenance of a real-time, continuous water-velocity and water-quality monitoring station in the downstream approach channel to Brandon Road Lock in the IWW in the State of Illinois. This project will result in essential data documenting the pre-construction hydrologic, hydrodynamic, and water chemistry conditions in the approach channel and temporal variations. FY 2023 findings will produce real-time and historic water-velocity and water-quality data in the downstream approach channel to Brandon Road Lock served via the USGS National Water Information System.

Project Description

In support of the GLMRIS-Brandon Road project in FY 2023, the USGS will continue monitoring water velocity and water quality in the downstream approach channel to Brandon Road Lock. This USGS streamgaging station provides data needed by USACE for various phases of the project and serves as a record of pre-construction conditions in the approach channel.

Figure B-2 — Des Plaines River (Illinois) near BRLD and USGS Streamgage 05538020



Source: Modified from Engel et al. (2017)

P-4: Design and Construction of the Brandon Road Lock and Dam Aquatic Nuisance Species Barrier Project

- **Lead Agency:** USACE
- **Agency Collaboration:** None
- **GLRI Funding:** $0
- **Agency Funding:** $47,880,500[1]

Project Summary

This project will support the design, construction, and implementation of structural and nonstructural measures in the vicinity of the 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. Subject to execution of a Project Partnership Agreement with the local sponsor, the State of Illinois FY 2023 funds and the $225.838 million provided in the Bipartisan Infrastructure Law will be used to complete plans and specifications for Increment I-A, Increment I-B, and Increment II, and complete construction of Increment I-A, the first layer of risk reduction measures.

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 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, nonstructural monitoring, integrated pest management, piscicides, manual or mechanical removal of fish, research and development and two boat launches.

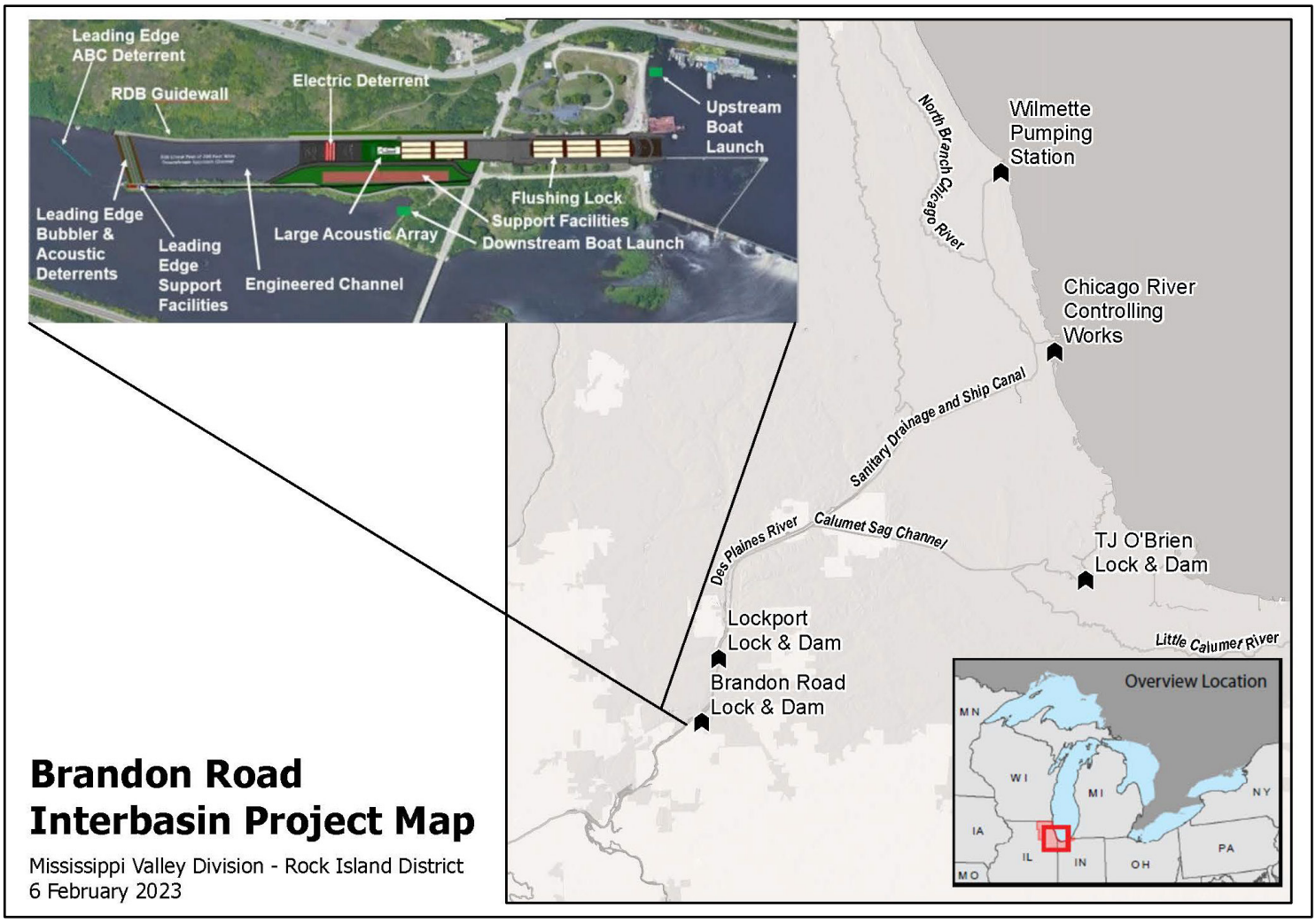
The project is anticipated to be constructed in three increments:

[1] Construction funds can be used once a project partnership agreement is signed.

- **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 & 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 that will include trapping native fish downstream and transporting them upstream, post construction monitoring, and adaptive management for a period of up to ten years to ensure project performance. 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 completion of the project.

Figure B-3 — Brandon Road Inter-Basin Project Map



TECHNOLOGY DEVELOPMENT ACTIONS

T-1: Experimental Testing of Automated Barge Clearing Deterrent for Barge Entrainment Mitigation

- **Lead Agency:** USACE
- **Agency Collaboration:** USACE Rock Island District and ERDC; USGS, Illinois Water Science Center, USFWS
- **GLRI Funding:** $150,000
- **Agency Funding:** $0

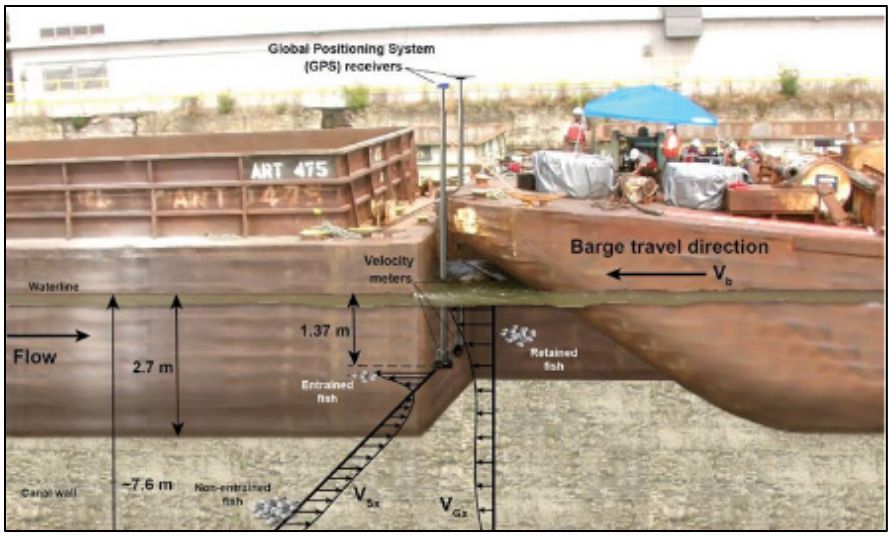
Project Summary

This project will complete previous studies that investigated small fish entrainment, retainment, and upstream transport by commercial barge tows in the IWW. FY 2023 funding will produce a technical report summarizing the findings of field trials conducted in the summer of 2022. This project will result in the completion of ABC Deterrent prototype field test write-ups and prevent invasive carp from becoming established in the Great Lakes by incorporating lessons learned from this fieldwork into the design of Brandon Road Interagency Project's array of fish deterrents.

Project Description

This project is a continuation of previous studies that investigated small fish entrainment, retainment, and upstream transport by commercial barge tows. The interagency team, including USFWS, USGS, and USACE, working with the IL DNR, have conducted several years of barge entrainment studies that demonstrate that small fish can become entrained and retained in the box to rake junction of commercial tows.

Figure B-4 — Rake-to-Box Junction Between Barges



Source: Davis et al. (2016)

Figure B-5 — ABC Deterrent Prototype in Operation at Peoria Lock and Dam

Photograph taken in September 2022

T-2: Further Develop the Use and Efficacy of Underwater Acoustics as a Deterrent for Invasive Carp and Impacts on Native Species

- **Lead Agency:** USACE
- **Agency Collaboration:** USFWS, USGS, U.S. Navy, USBR, Auburn University, IL DNR, IA DNR, KY DFWR, MI DNR, MN DNR, MDC, MS DWF&P, TN WRA, University of Illinois, University of Maryland, UMN-Twin Cities, UMN-Duluth, University of South Florida, University of Wisconsin
- **GLRI Funding:** $1,351,000[1]
- **Agency Funding:** $0

Project Summary

This project will further develop the use and efficacy of underwater acoustics in (1) Lock 19 on the Mississippi River (Keokuk, Iowa and Hamilton, Illinois), (2) the Hanson Material Service, East Pit, Marseilles Pool (Morris, Illinois), and (3) support laboratory work focused on testing new species, size ranges, and signals to develop several signals for use depending on species and environment uADS deployed (ERDC, Vicksburg, Mississippi). This project, in an effort with funding on low-head locks, will develop an acoustic deterrent planning model for future efforts and interests given the success thus far at Lock 19. This project will result in the efficacy of underwater acoustics as a method to prevent invasive carp from becoming established in the Great Lakes by generating a series of underwater signals that engage the lateral line and hearing sensory systems of invasive carp.

Project Description

Over the past 5 years, some biological and physic-based underwater acoustic deterrent technological aspects were identified that discourage the movement of invasive carp while allowing passage of native fish and recreational and commercial vessel passage to continue. uADS have demonstrated effectiveness in the laboratory and at Lock 19 (stakeholder identified pinch-point in the highly refractive environment). Results from pond studies were used to inform

[1] Decreased request based on FY 2022 lessons learned and ability to leverage funding to support broadscale underwater acoustics research, development, testing, and evaluation.

changes to increase the impact at Lock 19 and Morris (soft-bottom, sound-absorbing environment) with the ultimate goal of supporting the installations of uADS at critical passage points in the Ohio River and Upper Mississippi River basins to help managers understand the effectiveness of acoustic deterrents on invasive carp populations.

FY 2023 funding will produce (1) a review of analyses from the BAFF effort, (2) analyses from the uADS deployment at Lock 19, (3) analyses of the uADs deployment at Morris, and (4) experiments on Silver Carp behavior to new signals and a review of the impact on Bighead Carp, Grass Carp, and Black Carp response to new engineered sounds deployed at Lock 19 and new engineered signals based on species-specific hearing ranges. FY 2023 efforts will include the development of a maintenance plan for Lock 19 uADS and deployment of second-generation speakers (projectors) that are ERDC- and vendor-engineered to be more resilient and detailed examination of the current speaker design.

Figure B-6 — BAFF Location

Figure B-7 — BAFF Installation

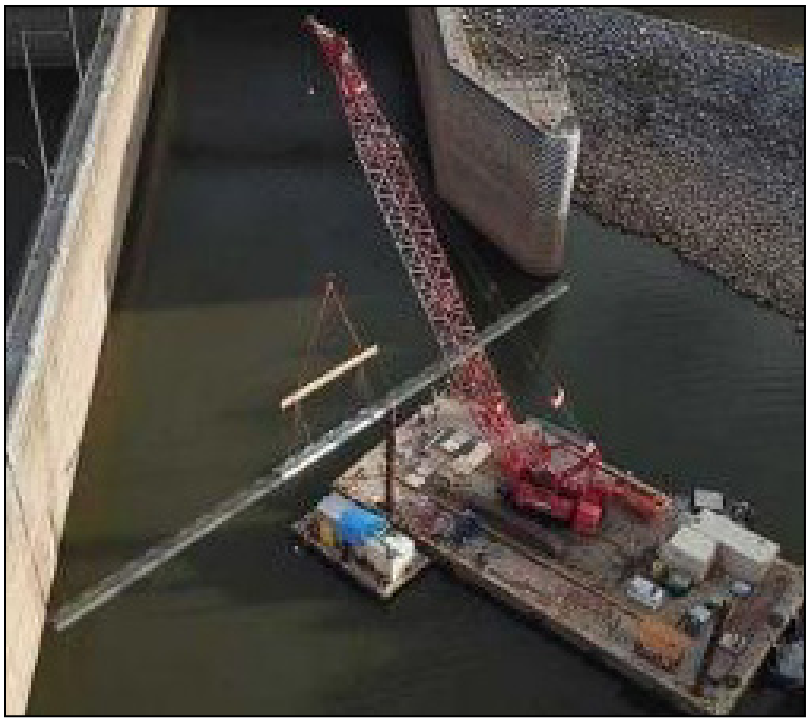


Figure B-8 — uADS Location

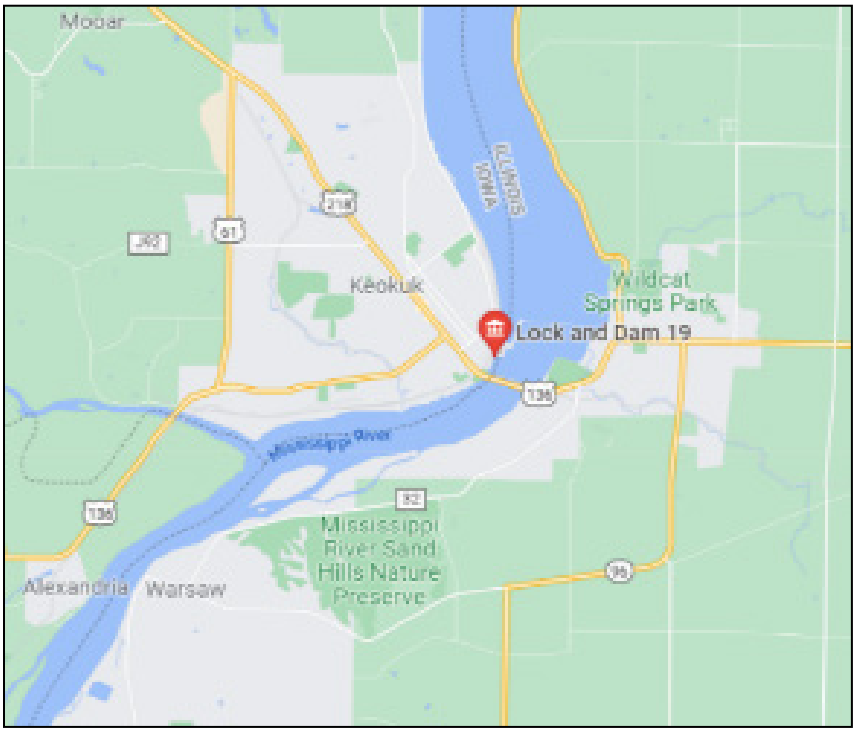


Figure B-9 — uADS Installation

T-3: Field Testing of Acoustic Deterrents for Invasive Carp

- **Lead Agency:** USGS
- **Agency Collaboration:** USFWS, USACE (includes ERDC), IA DNR, IL DNR, KY DFWR, TN WRA, MDC, MN DNR, UMN-Duluth, UMN, WI DNR
- **GLRI Funding:** $1,577,000
- **Agency Funding:** $451,739

Project Summary

This project will research, deploy, and evaluate acoustic deterrents in Kentucky (BAFF in the Cumberland River), Illinois/Iowa (uADS in the Upper Mississippi River), and Illinois (testing engineered signals/playbacks in the Illinois River). This project will result in deployments and rigorous 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. FY 2023 funding will produce (1) quantitative measurements of fish movement at Barkley Lock and Dam in response to the BAFF, (2) continue evaluation of the uADS at Lock 19, and (3) continued evaluation of a small-scale acoustic deterrent in a backwater of the Illinois River to deter motivated fish and assess equipment performance. Efforts will complement ongoing design for the multi-deterrent engineered channel at BRLD.

Project Description

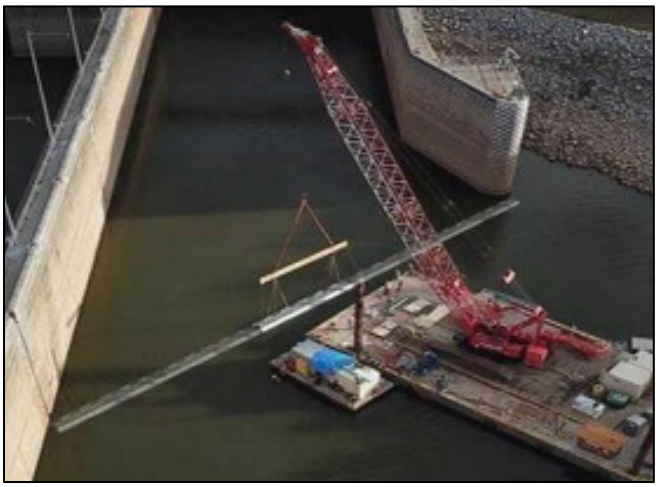
Significant work has been done to identify potential biological and physical deterrent techniques that discourage the movement of Bighead Carp and Silver Carp while allowing the passage of native fish and shipping to continue. One candidate deterrent technique that has demonstrated effectiveness in laboratory and pond settings is underwater sound. Previous studies in controlled experimental settings have documented both Bighead and Silver Carp responding negatively to various underwater sound stimuli, while many native fish species responded little to the same sounds. Building off these studies and deploying large-scale experimental acoustic structures at critical passage points in the Ohio River and Upper Mississippi River basins will help managers understand the effectiveness of acoustic deterrents in natural settings where invasive carp populations are already established and allow for the evaluation of the technology prior to deployment in other locations where it might help prevent upstream migration to the Great Lakes. For this large-scale deployment, underwater sound equipment will be installed at “pinch points” in

the river system where carp are only able to swim upstream through a lock chamber because the head height of the dam structure is impassable. Migration of fish is then confined to a single passage point and can be monitored with the use of telemetry and hydroacoustic equipment.

In addition to field-testing uADS, research efforts in the lab will continue to refine and optimize sound frequencies, sound pressure levels, and speaker designs to repel invasive carp while limiting or eliminating undesirable effects on native species. Future actions will focus on refining the sound characteristics that elicit the greatest response in these species in biologically motivated states (i.e., hunger, reproduction, etc.). The ultimate goal is to limit upstream passage, specifically in areas with access to the Great Lakes.

Figure B-10 — BAFF Location – Barkley Lock and Dam (Grand Rivers, Kentucky)

Figure B-11 — BAFF Deployment



Source: FWS.gov, by KY DFWR

Figure B-12 — uADS Location – Lock 19 (Keokuk, Iowa)

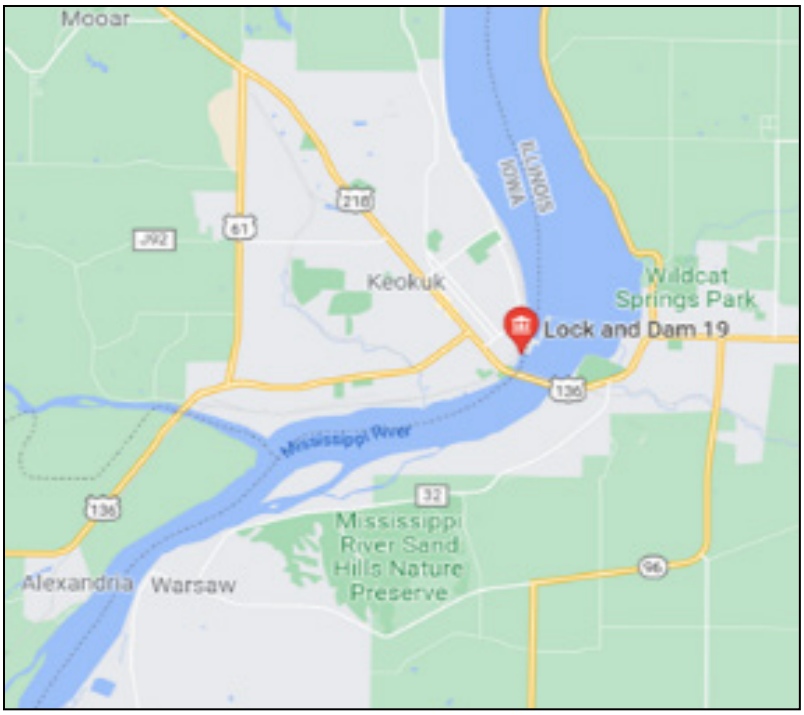
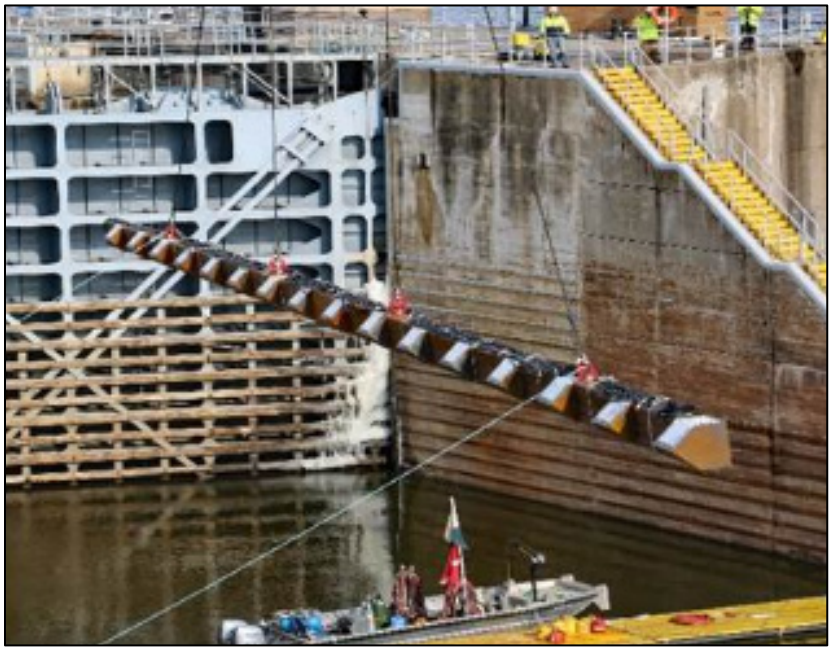


Figure B-13 — uADS Speaker Weldment During Deployment



Source: Mark Cornish, USACE

Figure B-14 — uADS Location – Hanson Material Service East Pit (Morris, Illinois)

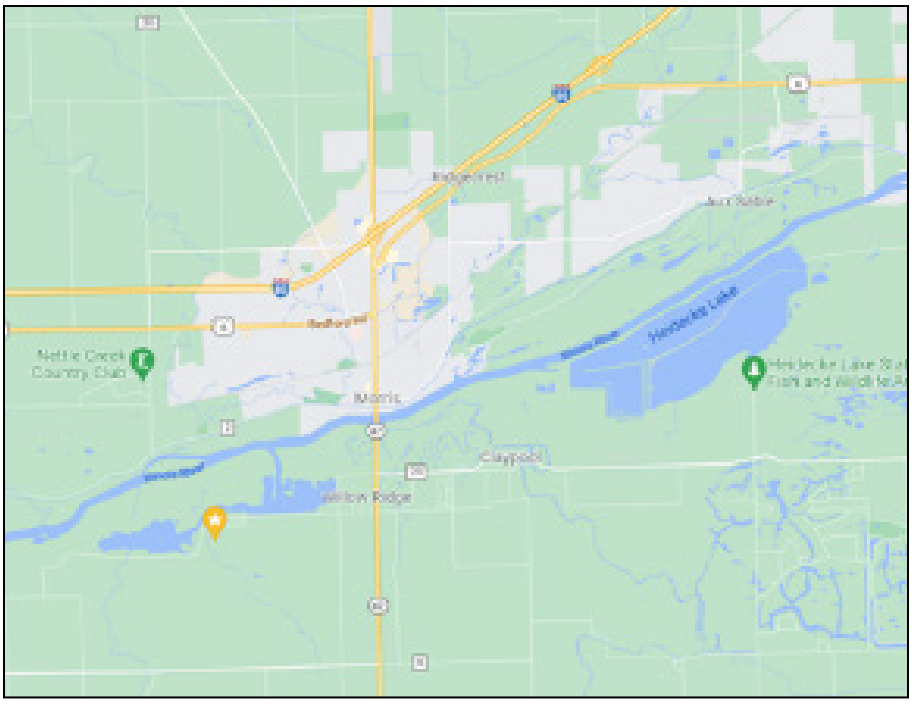


Figure B-15 — uADS Deployment

Source: Christa Woodley, ERDC

T-4: Implementation and Planning for a Carbon Dioxide Deployment at the EDBS

- **Lead Agency:** USACE
- **Agency Collaboration:** USGS, USFWS, IL DNR, IL EPA
- **GLRI Funding:** $350,000
- **Agency Funding:** $0

Project Summary

This project will complete the planning for the implementation of a carbon dioxide injection system in the CAWS as an additional invasive carp deterrent at the electric fish dispersal barrier. FY 2023 funding will produce field demonstration plans from a collaborative project team, complete permit and regulatory requirements associated with implementation, and develop contract documents. The project will assess the feasibility of carbon dioxide as a deterrent to prevent invasive carp from becoming established in the Great Lakes by clearing fish from the EDBS after maintenance shutdowns.

Project Description

Carbon dioxide injected into water is being evaluated as a behavioral deterrent for invasive carp. Management agencies need well-defined startup costs and engineering designs for carbon dioxide infusion systems that can be deployed at key management points to keep invasive carp from moving into new areas. This project is focused on assessing the feasibility of carbon dioxide as a potential method to clear fish from the EDBS within the CAWS. This project will determine if carbon dioxide could be applied during or after maintenance to further reduce the risk of upstream expansion towards the Great Lakes. Additionally, if successful, the use of carbon dioxide could enhance general safety by eliminating the need to place boats within the electrified field to manually remove fish.

Figure B-16 — Carbon Dioxide Planning and Implementation (T-4)

Note: Red, dotted box indicates general area for carbon dioxide planning and implementation, which is adjacent to the current EDBS in the CAWS.

T-5: Planning for a Field Demonstration of Carbon Dioxide Deployment at the EDBS

- **Lead Agency:** USGS
- **Agency Collaboration:** USACE, USFWS, IL DNR, IL EPA
- **GLRI Funding:** $200,000
- **Agency Funding:** $0

Project Summary

This project will complete the planning for the implementation of a carbon dioxide injection system in the CAWS as an additional carp deterrent at the EDBS. This project will assess the feasibility of carbon dioxide as a deterrent to prevent invasive carp from becoming established in the Great Lakes by clearing fish from the EDBS after maintenance shutdowns. FY 2023 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

Carbon dioxide injected into water is being evaluated as a behavioral deterrent for invasive carp. Management agencies need well-defined startup costs and engineering designs for carbon dioxide infusion systems at key management points that can be deployed to keep invasive carp from moving into new areas. This project is focused on assessing the feasibility of carbon dioxide as a potential method to clear fish from the EDBS within the CAWS. The EDBS undergoes annual maintenance, which could present an opportunity for fish to move upstream toward Lake Michigan. This project will determine if carbon dioxide could be applied during or after maintenance to further reduce the risk of upstream expansion towards the Great Lakes. Additionally, if successful, the use of carbon dioxide could enhance general safety by eliminating the need to place boats within the electrified field to manually remove fish.

Figure B-17 — Carbon Dioxide Planning and Implementation (T-5)

Note: Red, dotted box indicates general area for carbon dioxide planning and implementation, which is adjacent to the current EDBS in the CAWS.

T-6: Research and Development of Carbon Dioxide as a Deterrent

- **Lead Agency:** USGS
- **Agency Collaboration:** USACE, USFWS
- **GLRI Funding:** $0
- **Agency Funding:** $338,746

Project Summary

This project will develop a control tool option for use by natural resource management agencies throughout the Great Lakes Basin. This project will result in efficacy, engineering, human health, and regulatory compliance for carbon dioxide as a deterrent barrier and help support efforts to prevent invasive carp from becoming established in the Great Lakes by reducing the risk of upstream expansion at migratory pinch-points throughout the Great Lakes Basin. FY 2023 funding will produce deliverables that describe the effectiveness and regulatory compliance of this control tool.

Project Description

Carbon dioxide is being investigated as a potential deterrent to invasive carp. The concept is to introduce carbon dioxide into the water to deter or prevent invasive carp from moving upstream. Several published studies in laboratory, mesocosm, and field settings have demonstrated invasive carp and other fish are repelled from areas with elevated carbon dioxide concentrations. This avoidance mechanism could be useful for management agencies to restrict movement through key pinch-points (e.g., navigational structures) and better control range expansion toward the Great Lakes and other large river basins.

State and federal partners recently completed several important milestones. The USGS and USFWS obtained a Section 3 registration from USEPA for carbon dioxide as a new aquatic pesticide. Approved uses are as an invasive carp deterrent and as a non-selective lethal control for all nuisance fishes. An engineering feasibility study was also conducted within a navigational lock in Wisconsin. This study demonstrated the installation and operation of a large-scale carbon dioxide infusion system and collected data on operational costs, fish behavior, non-target organisms, human health risk assessment, and water quality. Lastly, regulatory steps to transition from research into management have been completed with the registration of carbon dioxide within individual states.

T-7: Impacts of Water Characteristics on the Population Range, Movement, and Spawning/Recruitment Success in the Illinois Waterway

- **Lead Agency:** USGS
- **Agency Collaboration:** IL DNR, INHS, USACE, USFWS, NOAA
- **GLRI Funding:** $90,000
- **Agency Funding:** $74,534

Project Summary

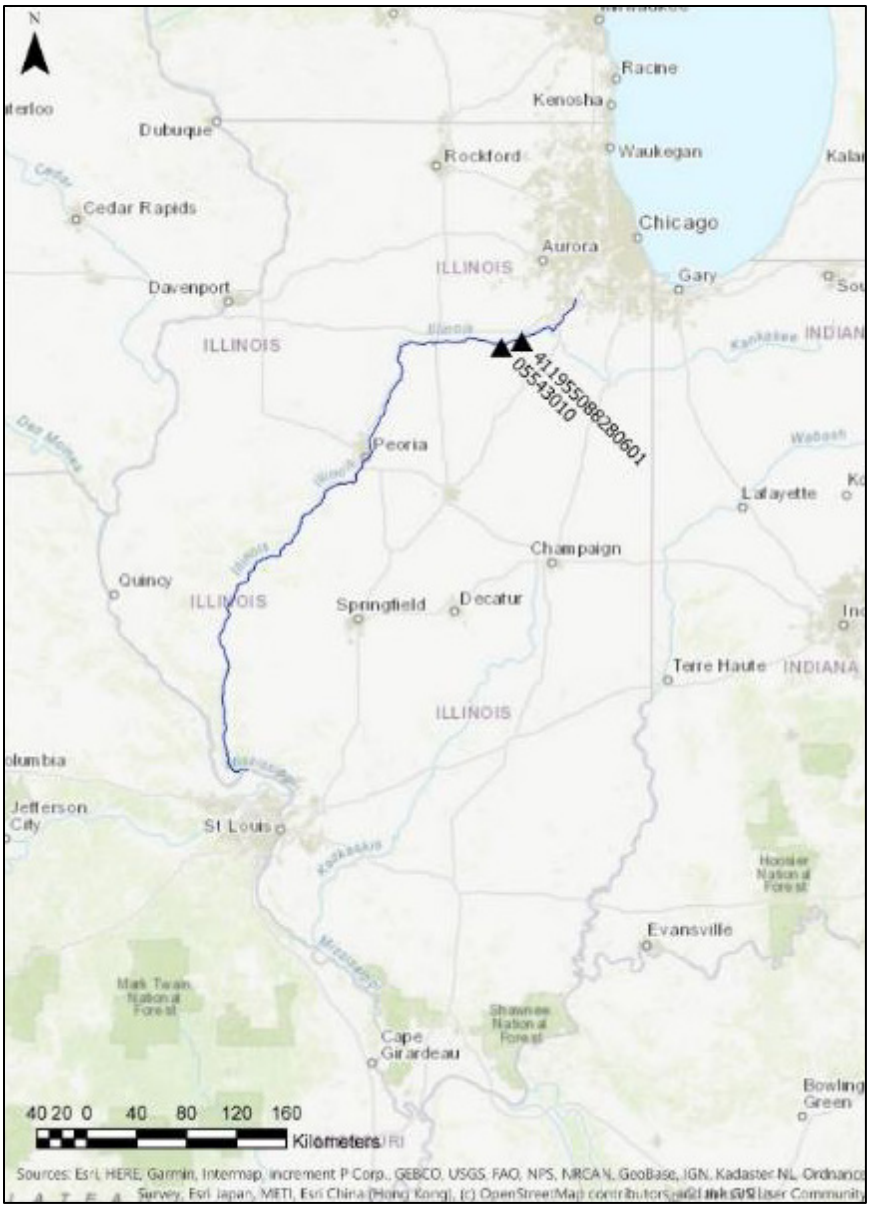
This project will assess the influence of river hydraulics and water quality on the population range, movement, and spawning/recruitment success of invasive carp in the IWW of the State of Illinois and other priority areas. FY 2023 funding will produce essential real-time and synoptic data in the IWW to support specific partner needs, assess seasonal variation in invasive carp spawning locations in the IWW, and FluEgg modeling support for state and federal partners.

Project Description

This project investigates the influence of habitat stimuli, such as river hydraulics and water quality, on the population range, movement, and spawning/recruitment success of invasive carp in the IWW and other priority areas. Proposed actions for FY 2023 include:

- Continuous water quality monitoring to support control efforts and deterrent testing.
- Application of reverse FluEgg simulations to identify spawning locations from Ichthyoplankton data in the IWW.
- FluEgg Model maintenance and user support.

Figure B-18 — Study Area (T-7)



Note: 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 411955088280601 Hanson West Pit near Morris, IL). Source: USACE

T-8: Acoustic Deterrents for Invasive Carp Bio-Acoustic Fish Fence

- **Lead Agency:** USFWS
- **Agency Collaboration:** USGS, KY DFWR, USACE Nashville District, UMN
- **GLRI Funding:** $0
- **Agency Funding:** $800,000

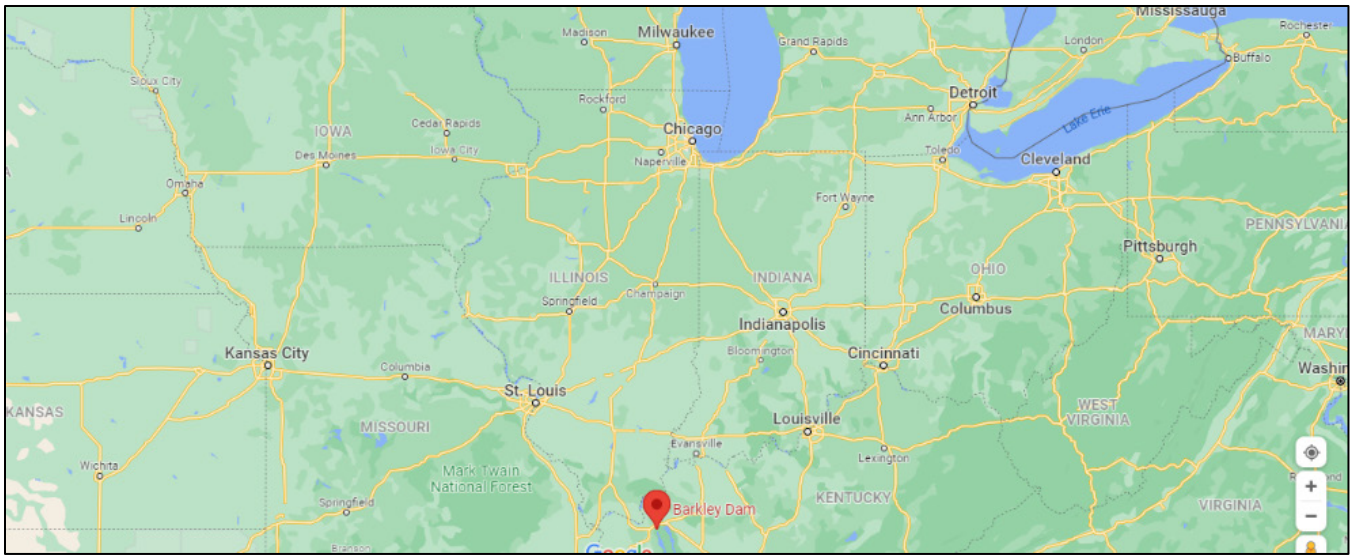
Project Summary

This project will support implementation of a large-scale field study of the BAFF acoustic deterrent for invasive carp, including operations and maintenance of the BAFF system. The test is being conducted at Barkley Dam on the Tennessee-Cumberland River in the State of Kentucky. Once completed in 2023, the results of the study will reveal the effectiveness of the BAFF so that this technology may be transferred to other locations to protect the Great Lakes from invasive carp.

Project Description

One candidate deterrent technique that has demonstrated effectiveness in laboratory and pond settings is underwater sound. Building off previous studies and deploying large-scale experimental acoustic structures at critical passage points will help managers understand the effectiveness of acoustic deterrents where invasive carp populations are established and will evaluate potential for the technology to be transferred and deployed in other locations to prevent upstream migration to the Great Lakes. The system will be evaluated by an interagency research team. Silver Carp will be tagged and translocated each study year in the spring and the fall to track fish passage in a motivated state and will be monitored with the use of telemetry and hydroacoustic equipment around the BAFF.

Figure B-19 — Barkley Dam Map



MONITORING ACTIONS

M-1: Early Detection, Management and Control, and Contingency Response in the Illinois Waterway

- **Lead Agency:** IL DNR
- **Agency Collaboration:** USACE, INHS, USGS, USFWS
- **GLRI Funding:** $4,400,000
- **Agency Funding:** $0

Project Summary

This project will implement a multi-pronged approach to early detection, monitoring, and control of invasive carp in the upper Illinois River. Intensive monitoring will occur in the spring and fall using conventional and eDNA monitoring in the CAWS above the EDBS. This sampling is focused on any potential movement of individual invasive carp past the EDBS. Monitoring and removal of invasive carp will be conducted below the EDBS where adult invasive carp are present, utilizing a semi-annual unified method approach, as well as deployment of contract commercial fishers in conjunction with agency staff. Contingency planning, rapid response, and training are also supported by this effort. This plan supports agency efforts to rapidly deploy staff, equipment, and contract fishers should an invasive carp be reported above the EDBS. Electrofishing, hoop nets, and mini-fykes will be deployed weekly to monitor for the presence of small invasive carp above the reproductive front. This project will address the risk of invasive carp from becoming established in the Great Lakes by preventing the movement of invasive carp through the CAWS to Lake Michigan.

Project Description

SIM will be conducted in the CAWS above the EDBS in conjunction with agency partners. The SIM will involve two weeks of intensive sampling utilizing electrofishing in conjunction with contracted commercial fishers using a combination of fixed and random sample sites in the CAWS above the barrier. The SIM will be informed by eDNA monitoring that is conducted a few weeks before, providing the opportunity to direct the effort to hotspots of invasive carp eDNA detections if present. Below the barrier, semi-annual modified unified method removal efforts will

be conducted in Lockport and Dresden Island pools to keep invasive carp in these two pools at low/reduced levels. This sampling involves agency biologist electrofishing in conjunction with contracted commercial fishers in a systematic downstream approach to remove invasive carp. Three six-week periods of MAM consistent with MAM protocol will occur in Lockport, Brandon, and Dresden Island pools utilizing a variety of gear types and sampling locations. This weekly surveillance by agency staff in the upper pools of the Illinois River will utilize hoop nets, electrofishing, and mini-fykes to monitor for the presence of small fish and changes in adult invasive carp demographics. Many of these locations are targeted due to their shallow nature and are unreachable to many of the other sampling techniques deployed. The MAM conducted by INHS is also supported in the lower river pools, Marseilles, Starved Rock, and Peoria under this project. This standardized sampling approach provides data on invasive carp population demographics and impacts on native fish populations.

The general purpose of this project is to prevent the establishment of invasive carp in the Great Lakes by preventing the movement through the CAWS through a variety of IL DNR actions supported and outlined in the ICRCC MRP. Contingency planning for communication and response activities is identified in the annual monitoring and response plan. This planning allows heightened and more coordinated responses. Annual tabletop exercises have proven to be helpful and allow for evaluation of the CRP, helping to identify any needed updates/clarifications both by utilizing agency staff and those interested partners as necessary. A tabletop exercise will be planned for 2023. This project enables IL DNR to provide contractual support, updates working with ICRCC/MRWG partners, and communications planning if a response action or incident is needed.

M-2: Assessment of Invasive Carp Reproduction and Ecosystem Response in the Illinois Waterway

- **Lead Agency:** IL DNR
- **Agency Collaboration:** INHS, Eastern Illinois University, SIU-C, USGS
- **GLRI Funding:** $477,400
- **Agency Funding:** $0

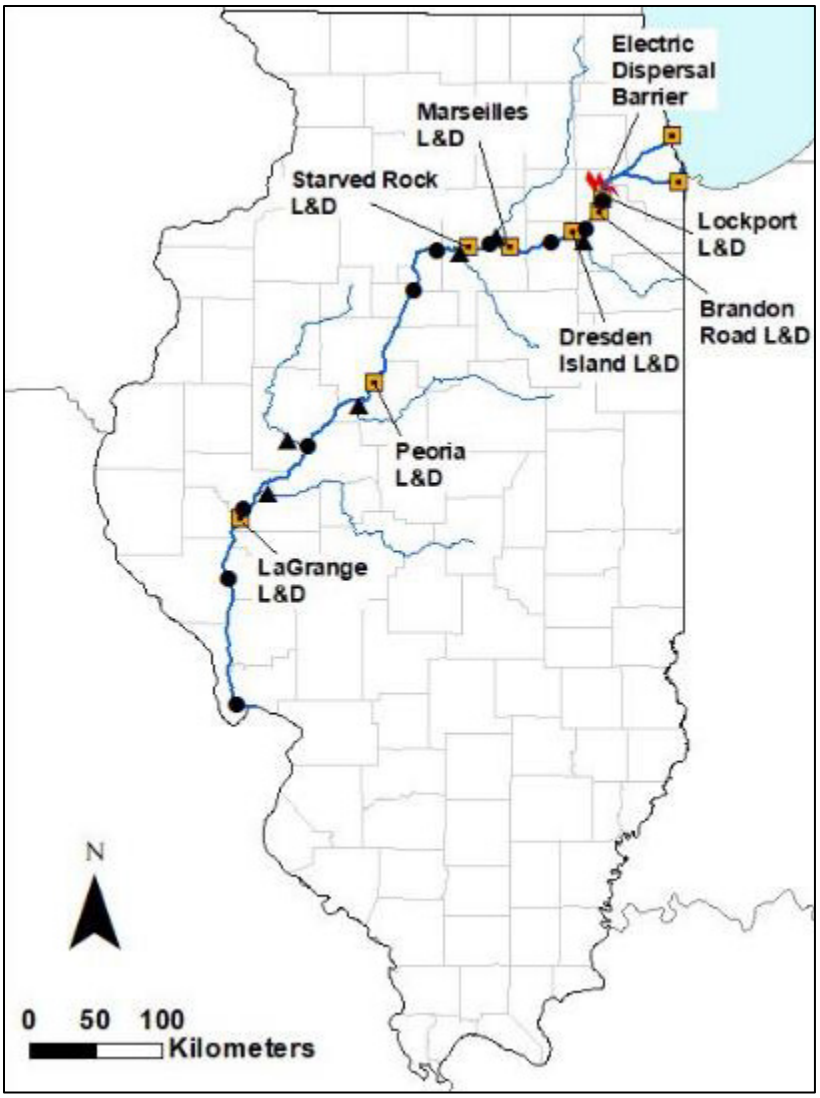
Project Summary

This project will monitor for invasive carp reproduction in the IWW (Illinois River, Des Plaines River, and CSSC) and select tributaries of the IWW (Fox River, Kankakee River, Vermilion River, Sangamon River, Mackinaw River, and Spoon River) and quantify the relationship between zooplankton abundance and invasive carp density in a sub-set of navigation pools in the Illinois River.

Project Description

This project will result in (1) the detection of any invasive carp reproduction in the Upper Illinois River, (2) the early detection of Black Carp reproduction in the Illinois River, (3) an evaluation of the spatial and temporal extent and magnitude of invasive carp reproduction in the IWW and its tributaries, (4) quantification of the relationship between the density of adult invasive carp, reproductive productivity, and subsequent recruitment, (5) an assessment of zooplankton response to invasive carp removals, and (5) prevention of invasive carp from becoming established in the Great Lakes through rapid detection of invasive carp spawning in the IWW.

Figure B-20 — EDBS, Lock, and Dam Locations Along IWW



M-3: Invasive Carp Stock Assessment in the Illinois River/Management Alternatives

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

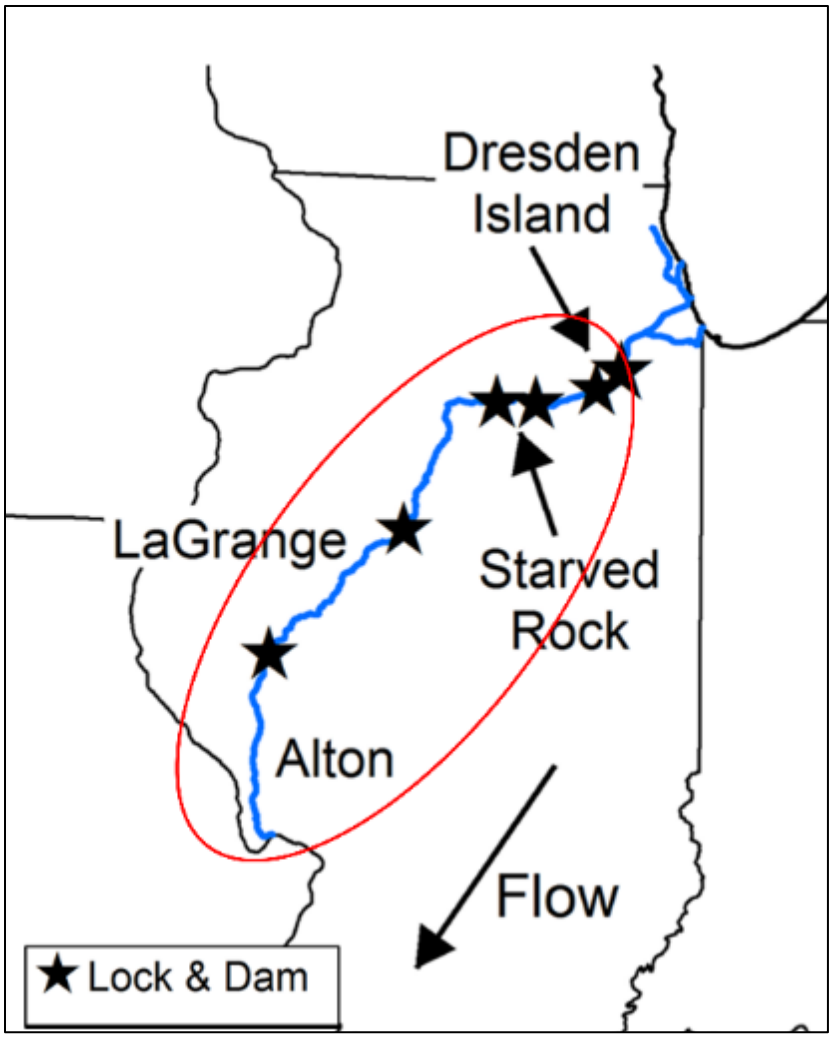
Project Summary

This project will involve hydroacoustic sampling, implanting invasive carp with acoustic transmitters, and maintaining an acoustic receiver array in Illinois, specifically the Alton – Dresden Island pools of the Illinois River. This project will result in the identification of high-density locations of invasive carp, a long-term assessment of population trends, and quantification of upstream movements. FY 2023 funding will produce invasive carp density maps every other month in Marseilles and Dresden Island pools, illustrating locations where densities are highest.

Project Description

Hydroacoustic sampling will occur in the upper Illinois River throughout the Marseilles and Dresden Island pools to identify locations of high invasive carp densities. The resulting density heatmaps (illustrating locations where densities are highest) will be provided to MRWG members so that removal efforts can be targeted as fish aggregations within each pool change throughout the year. 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. Monitoring of acoustically tagged invasive carp will continue from Alton to Dresden Island pools across an array of 70 stationary receivers. Seventy-five invasive carp will be implanted with acoustic transmitters in Alton and LaGrange pools and 50 in Starved Rock and Marseilles pools to supplement the existing number of acoustically tagged individuals.

Figure B-21 — Project Location Throughout Illinois River



M-4: Early Detection Monitoring for Invasive Carp in the Great Lakes

- **Lead Agency:** USFWS
- **Agency Collaboration:** MI DNR, IL DNR, IN DNR
- **GLRI Funding:** $350,000
- **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 a wide 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.

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

Figure B-22 — Chicago – Southern Lake Michigan

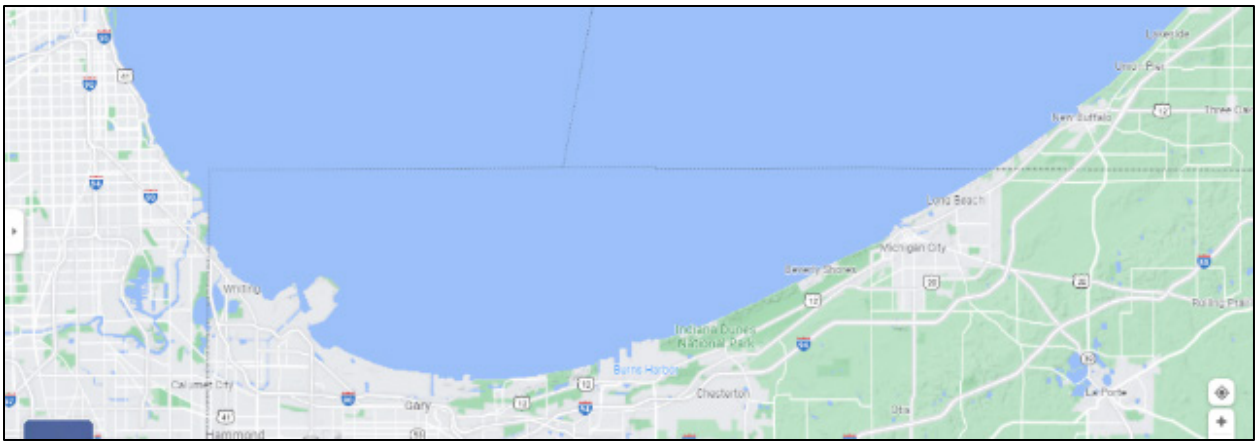


Figure B-23 — Western Lake Erie

M-5: Invasive Carp Demographics – Multiple Agency Monitoring Support

- **Lead Agency:** USFWS
- **Agency Collaboration:** IL DNR, INHS
- **GLRI Funding:** $315,000
- **Agency Funding:** $226,590

Project Summary

This project supports the interagency standardized sampling approach used to monitor for Bighead Carp and Silver Carp and assess native fish communities in the Illinois River implemented through the interagency MAM program by providing key information to managers on the geographic distribution and relative abundance of juvenile and adult invasive carp populations in pools below the EDBS and data for detecting changes in invasive carp and native fish populations throughout the Illinois River. This project will also better inform the SEICarP and statistical catch-at-age stock assessment models. This project will support the expanded effort with the addition of a new gear type (the electrified dozer trawl) into the standardized sampling protocols outlined by the MAM program. FY 2023 funding will be used to implement electrified dozer trawl sampling in up to three periods during June through October 2023 in seven pools of the Illinois River (LaGrange, Peoria, Starved Rock, Marseilles, Dresden Island, Brandon Road, and Lockport pools) and acquire additional key demographic data for Bighead Carp and Silver carp to inform the fishery population models, including analyses of the age and growth of approximately 1,200 Silver Carp collected from the lower six pools of the Illinois River during the fall period.

Project Description

This project will provide an additional gear type (the electrified dozer trawl) to the existing standardized sampling protocol used within the MAM program and support the acquisition of additional demographic information describing Silver Carp sizes and ages for use in fishery population models for the Illinois River. The MAM and LTRM programs in the Illinois River provide important trend data to managers regarding the integrity of fish communities utilizing standardized fish sampling approaches. MAM sampling is based on LTRM methodologies and utilizes a

multiple-gear approach deployed across three time periods. Prior work suggested the relative efficiency of the dozer trawl for capturing invasive carp and its use to complement the existing MAM multi-gear fishery sampling approach, especially for pelagic fishes. This project will support increased catch rates of Silver and Bighead Carp and other pelagic fishes and provide key fisheries independent data collected by USFWS and transferred through the MAM program into the MRWG central database. The USFWS will also process invasive carp age structures (i.e., lapilli otoliths) from MAM program collections in the lower six pools of the Illinois River (approximately 1,200 Silver Carp) and provide age and growth data to the MRWG Modeling Work Group to inform invasive carp population models in the Illinois River. These models will be used to evaluate the relative importance of fishing mortality, fish movement, and natural mortality to observed changes in Silver Carp abundance, informing invasive carp harvest and other management options focused on preventing upstream migration into the Great Lakes.

Figure B-24 — Illinois River Map

M-6: Des Plaines River Overflow Monitoring for Invasive Carp

- **Lead Agency:** USFWS
- **Agency Collaboration:** USACE, IL DNR
- **GLRI Funding:** $15,000
- **Agency Funding:** $0

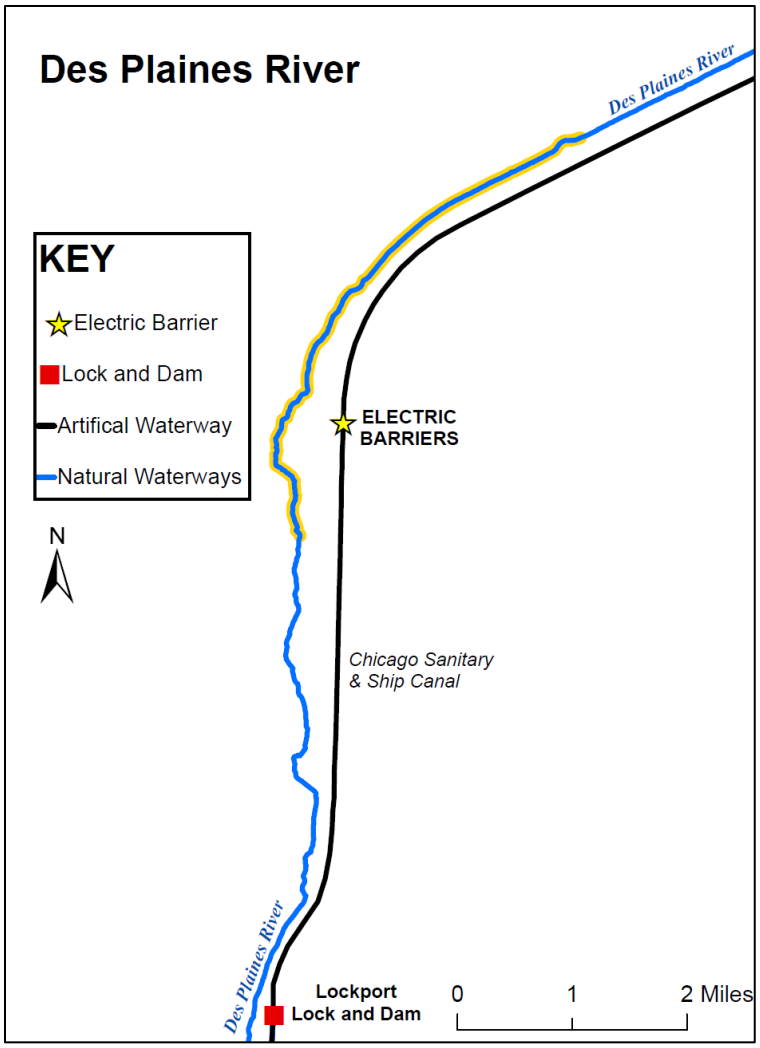
Project Summary

This project will continue invasive carp early detection in the Des Plaines River, Illinois. This project will result in invasive carp early detection and prevent invasive carp from becoming established in the Great Lakes by helping to prevent fish from bypassing the EDBS through movement between the Des Plaines River and the CSSC during high water events. FY 2023 funding will support fishery monitoring efforts in the Des Plaines River and produce data regarding any potential invasive carp breaches, as well as an annual Interim Summary Report detailing the results of the sampling.

Project Description

Routine early detection monitoring of the Des Plaines River increases the likelihood of detecting any invasive carp that move into the river prior to the occurrence of any overflow events thus reducing the risk of invasive carp transfer between the Des Plaines River and the CSSC in the vicinity of the EDBS. To support early detection, fixed sites will be monitored three times throughout the 2023 field season for invasive carp. Additional sampling will be scheduled if (1) invasive carp population status in Brandon Road pool significantly increases or (2) there are credible reports of invasive carp sightings in the upper Des Plaines River. Physical barrier inspections and ichthyoplankton sampling will occur when USACE indicates overflow conditions are occurring. Population monitoring will include boat electrofishing and gill netting. Any Bighead Carp or Silver Carp collected will be kept for further study, and MRWG will be immediately notified. Any Grass Carp captured during sampling will be kept and tested for ploidy. Overflow monitoring will occur each time an overflow event occurs. USACE personnel will monitor water levels for potential overflow events. USFWS will be notified of potential overflow events and locations so that monitoring teams may be deployed for sampling. 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.

Figure B-25 — Project Area Map (M-6)



M-7: Illinois River Invasive Carp Monitoring and Response Team Support

- **Lead Agency:** USFWS
- **Agency Collaboration:** IL DNR, USACE, SIU
- **GLRI Funding:** $70,000
- **Agency Funding:** $275,000

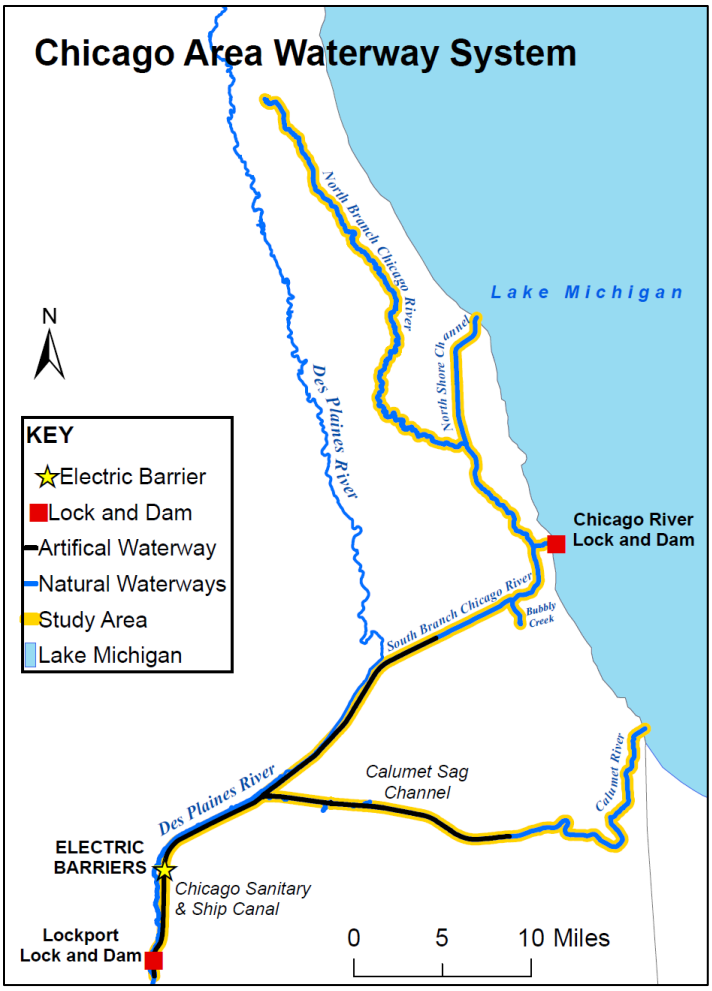
Project Summary

This project will provide USFWS field support for the implementation of the biannual SIM program in the CAWS, the Unified Method for capturing invasive carp, and contingency response (rapid response) actions, as needed, in the upper IWW. This project will result in USFWS support for IL DNR-led actions and prevent invasive carp from becoming established in the Great Lakes through support for early detection upstream of the EDBS, population control downstream of the EDBS, and interagency contingency response. FY 2023 funding will support USFWS staff involvement in priority invasive carp detection and control actions in the IWW and produce summarized data provided to IL DNR for all sampling events.

Project Description

USFWS will assist the IL DNR-led SIM during biannual sampling (spring and fall). Additionally, USFWS assists with the Unified Method to capture invasive carp in the IWW, as planned by the IL DNR each year. USFWS will assist if a response action is requested by the ICRCC (please see the Upper IWW CRP). SIM supports invasive carp early detection in the CAWS upstream of the EDBS, therefore aiding the prevention of invasive carp population establishment upstream of the EDBS. The Unified Method strategy is used to control invasive carp population abundance in specific locations downstream of the EDBS, reducing propagule pressure on the EDBS. Contingency response actions are aimed at tactically minimizing eminent threats of invasive carp introduction and establishment in the Great Lakes.

Figure B-26 — Study Area Along CAWS (M-7)



M-8: Midwest Region Fisheries Program Capacity for eDNA Sampling and eDNA Processing for Invasive Carp Monitoring

- **Lead Agency:** USFWS
- **Agency Collaboration:** States, Tribes of the Great Lakes, Upper Mississippi River, Ohio River
- **GLRI Funding:** $0
- **Agency Funding:** $2,400,000

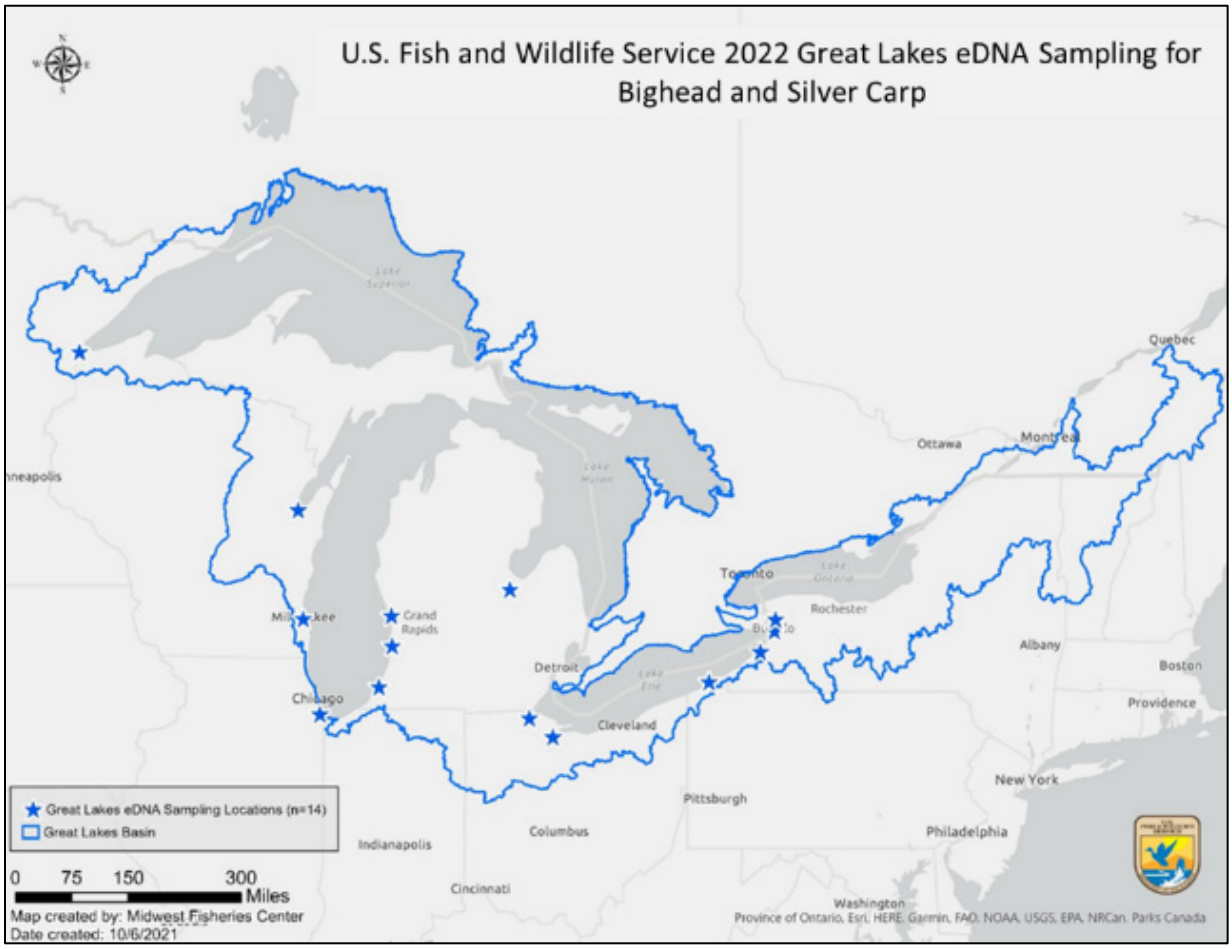
Project Summary

This project will continue monitoring the presence of Bighead Carp and Silver Carp eDNA in the Great Lakes. USFWS will process water samples collected by our field offices, in collaboration with state and tribal partners, to monitor for the presence of Bighead Carp and Silver Carp eDNA in Great Lakes tributaries, supporting early detection of species presence prior to establishment. USFWS FY 2023 funding will produce results for 6,000 to 7,000 collected and analyzed water samples for the U.S. waters of the Great Lakes Basin.

Project Description

The USFWS applies the science of eDNA as an early detection and monitoring tool in support of the ICRCC's comprehensive and strategic approach to protecting the Great Lakes from invasive carp. USFWS will build upon prior work to improve Bighead and Silver Carp genetic markers, field collection, and extraction protocols and will continue developing genomic sampling methodologies for Grass Carp as part of this monitoring program.

Figure B-27 — USFWS 2022 Great Lakes eDNA Sampling Locations – Bighead Carp and Silver Carp



M-9: Tracking the Movement of Invasive Carp in the Upper Illinois Waterway Through Telemetry

- **Lead Agency:** USACE
- **Agency Collaboration:** USFWS, USGS, SIU, IL DNR, INHS
- **GLRI Funding:** $0
- **Agency Funding:** $200,000

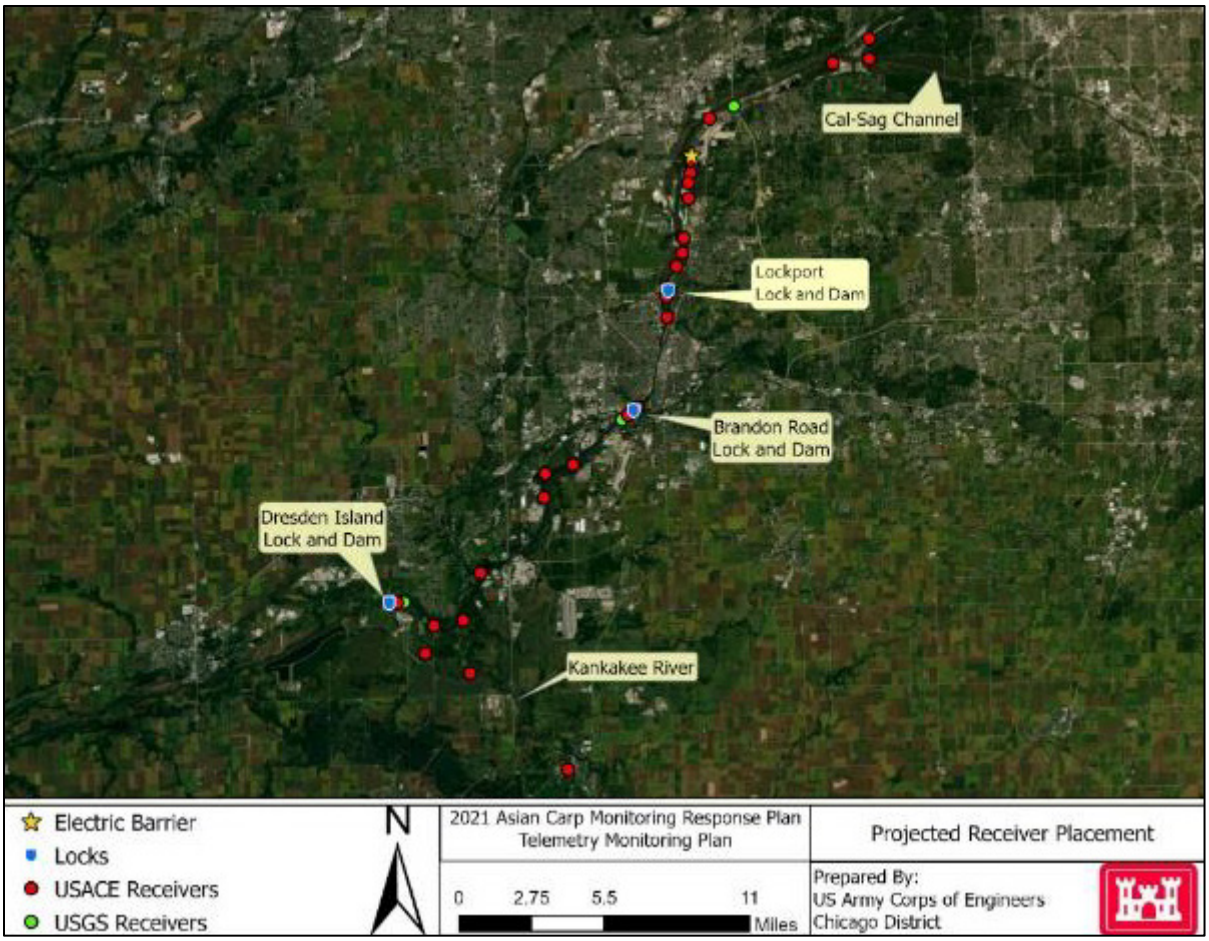
Project Summary

This project will track and monitor the movement of invasive carp and surrogate species in the upper Illinois River from Dresden Island Lock and Dam through to the confluence of the CSSC and Cal-Sag Channel in Illinois. FY 2023 efforts will produce monthly summaries and a year-end analysis of telemetry data tracking the movement of invasive carp in the IWW. This project will result in a greater understanding of surrogate fish movements and interactions with locks and dams and the EDBS.

Project Description

Telemetry goals in the upper Illinois River consist of tracking and monitoring fish from Dresden Island to the confluence of the CSSC and the Cal-Sag. These goals consist of monitoring the EDBS for upstream passage of large fishes, assessing the risk of Bighead Carp and Silver Carp presence, identifying lock operations and vessel characteristics that may contribute to the passage of Bighead Carp and Silver Carp and surrogate species through navigation locks in the Upper IWW, and evaluating temporal and spatial patterns of habitat use at the leading edge of the Bighead Carp and Silver Carp invasion front. FY 2023 funding will continue the work in assessing the efficacy of the EDBS.

Figure B-28 — Invasive Carp Projected Telemetry Receiver Placement (Upper Illinois River)



M-10: Telemetry Tracking in the Illinois Waterway to Support the Spatially Explicit Invasive Carp Population Model (SEICarP)

- **Lead Agency:** USFWS
- **Agency Collaboration:** SIU, USACE, USGS
- **GLRI Funding:** $110,000
- **Agency Funding:** $400,000

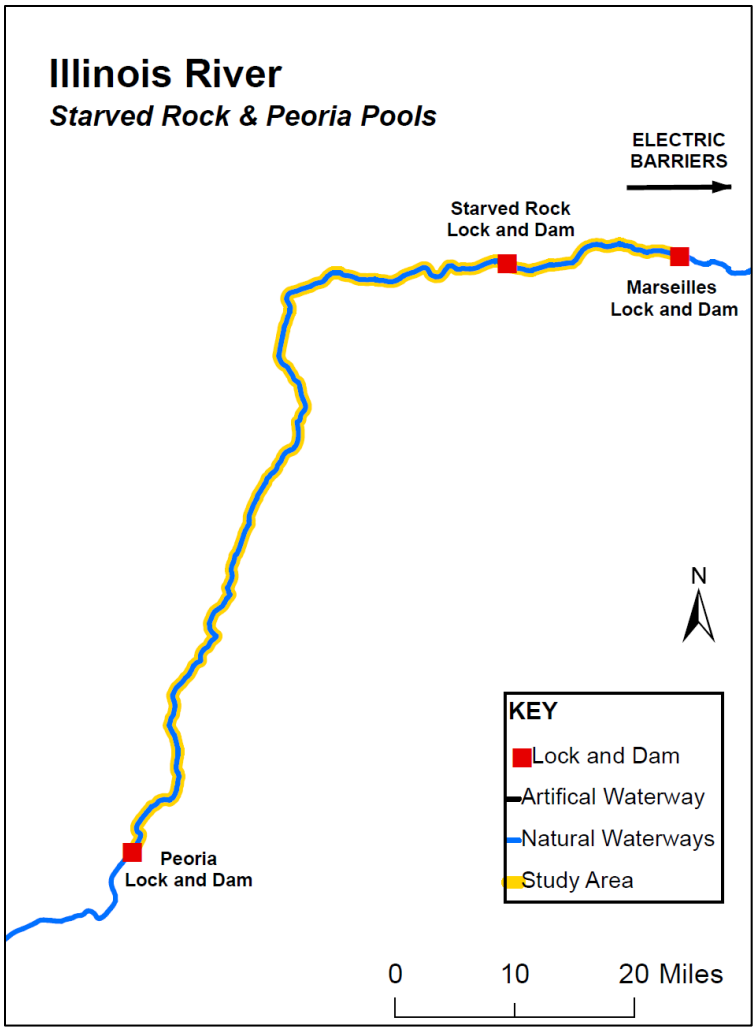
Project Summary

This project will provide telemetry data support for the SEICarP model that estimates invasive carp population status in the IWW. 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 by improving the accuracy of SEICarP model predictions used to inform agencies on potential management options. FY 2023 funding will support actions to collect robust data on the movement of telemetered (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 assess invasive carp population status in the IWW. In 2023, 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 MRWG TWG. Fish will be tracked using the current acoustic array within the IWW. Additional receivers will be placed in areas with reduced coverage, and the TWG will be consulted prior to deployment. FY 2023 funding will be used to purchase acoustic transmitters and surgery supplies and will support operational costs associated with SEICarP telemetry fieldwork.

Figure B-29 — Study Area (M-10)



M-11: Hydroacoustic Surveys of Fish Abundance and Distribution in the Illinois River

- **Lead Agency:** USFWS
- **Agency Collaboration:** SIU, USACE
- **GLRI Funding:** $120,000
- **Agency Funding:** $0

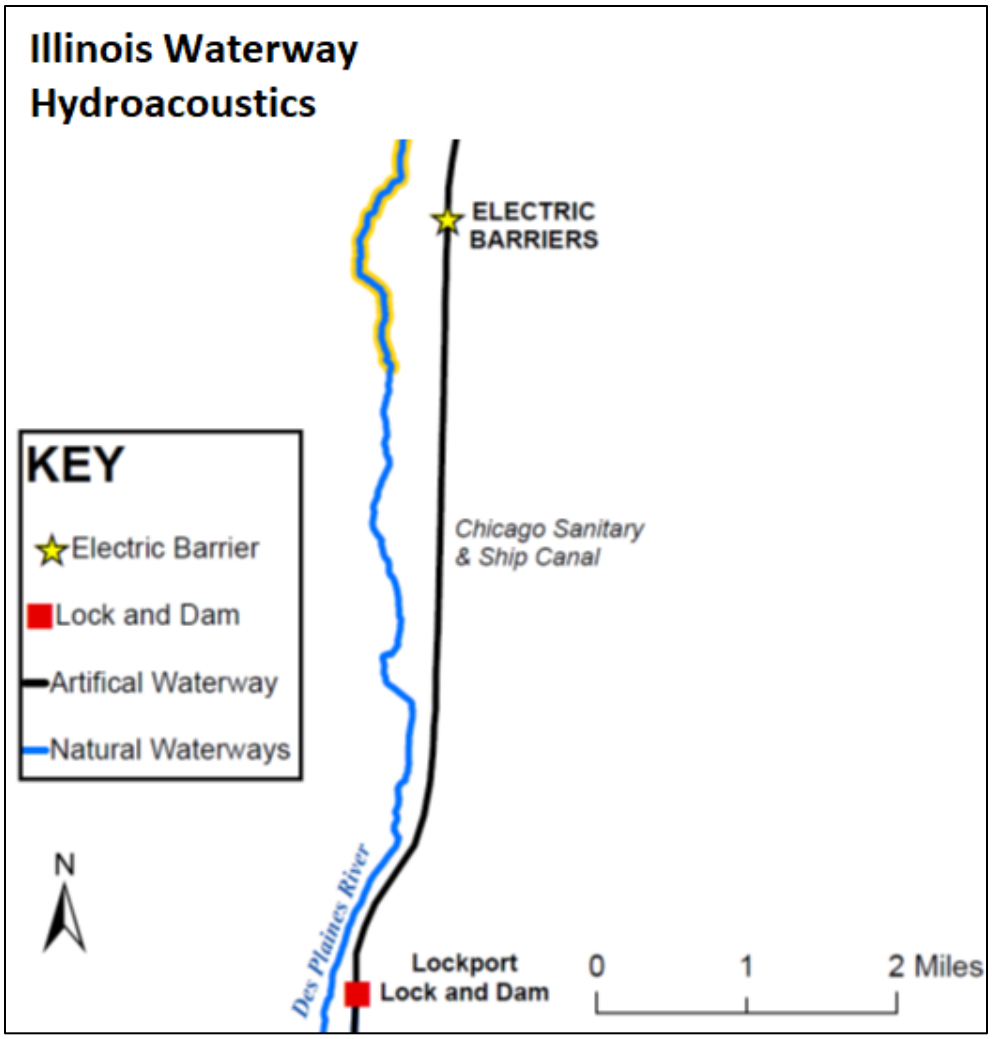
Project Summary

This project will provide hydroacoustic estimates of the abundance and distribution of large fish (greater than 12 inches in total length) in the upper IWW in the vicinity of the EDBS. This project will result in data that aids managers in assessing the risk and implementing efforts to prevent invasive carp from becoming established in the Great Lakes by ensuring that abundances of large fish upstream of the invasion front in the Dresden Island Pool are monitored. FY 2023 funding will produce bi-weekly hydroacoustic surveys and reports about fish abundance and distribution near the EDBS.

Project Description

Side-looking split-beam hydroacoustic and side scan sonar surveys will be conducted above and below the CSSC EDBS to assess fish abundance and distribution patterns on a fine temporal scale. Barrier surveys at the EDBS will take place bi-weekly beginning in January 2023 to aid in assessing the risk of large fish (potentially Bighead Carp or Silver Carp) passing through the EDBS during barrier operational changes and/or maintenance. The hydroacoustic surveys will utilize two split-beam transducers as well as an ultra-high-resolution side scan unit. These surveys will provide information on the abundance of fish targets larger than 12 inches in length, as well as collect information on fish spatial distribution. Upon completion of surveys, USFWS would rapidly communicate to the MRWG co-chairs regarding any moderate or substantial changes in fish community species composition or fish behavioral observations near the EDBS.

Figure B-30 — Study Area (M-11)



M-12: Maintain a Real-Time Telemetry Alert System and Continued Support of the SEICarP Model

- **Lead Agency:** USGS
- **Agency Collaboration:** IL DNR, GLFC, SIUC, USACE, USFWS
- **GLRI Funding:** $125,000
- **Agency Funding:** $0

Project Summary

This project will support SEICarP model development and continue to track invasive carp movements to inform decisions on management actions to control the abundance of invasive carp in the upper Illinois River system in the state of Illinois. This project will result in (1) transition probability estimates (multi-state model) from telemetry data to parameterize the SEICarP model used to evaluate alternative management actions, (2) maintenance of the real-time alert system for tagged carp, and (3) development of a framework for using either existing telemetry data or planning future studies to refine other SEICarP model parameters (such as fishing mortality).

Project Description

FY 2023 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 or refining additional parameters to the SEICarP model.

- USGS will work with MRWG TWG and Modeling Work Group in support of the SEICarP model.
- USGS is developing frameworks for designing field studies for estimating fishing mortality (F) in various pools of the upper Mississippi River from mark-recovery tags.
- USGS, in coordination with the developers of the SEICarP model, will continue to explore the feasibility of including additional parameters and predictor variables in a comprehensive invasive carp movement model.
- USGS will work with partners via the MRWG TWG to inform decisions on contingency actions for invasive carp by operating real-time acoustic receivers at strategic locations. Specific products include a real-time acoustic receiver network with remote data serving and detection alert and summary options.

M-13: Small Fish Distribution and Early Detection of Invasive Carp in the Upper Illinois Waterway

- **Lead Agency:** USFWS
- **Agency Collaboration:** USACE, INHS, IL DNR
- **GLRI Funding:** $400,000
- **Agency Funding:** $400,000

Project Summary

This project supports monitoring for invasive carp in select areas of the IWW, providing increased focused surveillance for small (less than 6 inches, or 153 millimeters total length) fish in the Marseilles and Dresden Island pools, and increases sampling for both small and large invasive carp in the uppermost pools of the IWW where they are not currently known to be present. This increased effort will provide new monitoring data from targeted areas to further inform awareness of the risk of invasion to the Great Lakes and increase the likelihood of detecting any range expansion of invasive carp at the earliest possible time. FY 2023 funding will support activities that are complementary to ongoing partner agency monitoring efforts and closely coordinate with the MRWG, providing information and reports on the spatial distribution of invasive carp in the upper IWW.

Project Description

In FY 2023, this project will conduct targeted electrofishing for invasive carp to assess the risk of upstream range expansion of both small and adult fish in the upper IWW. The project will assess the distribution of small fish (less than 6 inches total length) through increased targeted effort in the area believed to be the current invasion front for this smaller life stage within the IWW. A specific objective is to detect if small Silver Carp and Bighead Carp are present upstream of the Marseilles Lock and Dam in the IWW. This increased targeted sampling effort seeks to support the CRP by providing additional confirmation of the distribution of small invasive carp above the Marseilles Lock and Dam. An additional component of this project will increase targeted early detection sampling of both small and large Silver Carp and Bighead Carp in the upper IWW. Early detection sampling in the upper IWW will utilize both fixed and random site sampling, consisting of approximately one crew week of effort per gear per pool per month. Site selection will target

habitat types and areas that are known to be occupied by invasive carp in other areas of the IWW. Sampling strategies (including gear types and time of deployment) will be selected to increase the likelihood of capture of target species and size classes. USFWS will continue to coordinate with the MRWG to further refine the sampling plan to include additional surveillance efforts aimed at addressing any knowledge gaps revealed during initial sampling.

CONTROL ACTIONS

C-1: Contract Fishing for Invasive Carp Removal near the Electric Dispersal Barrier System

- **Lead Agency:** IL DNR
- **Agency Collaboration:** None
- **GLRI Funding:** $2,000,000
- **Agency Funding:** $0

Project Summary

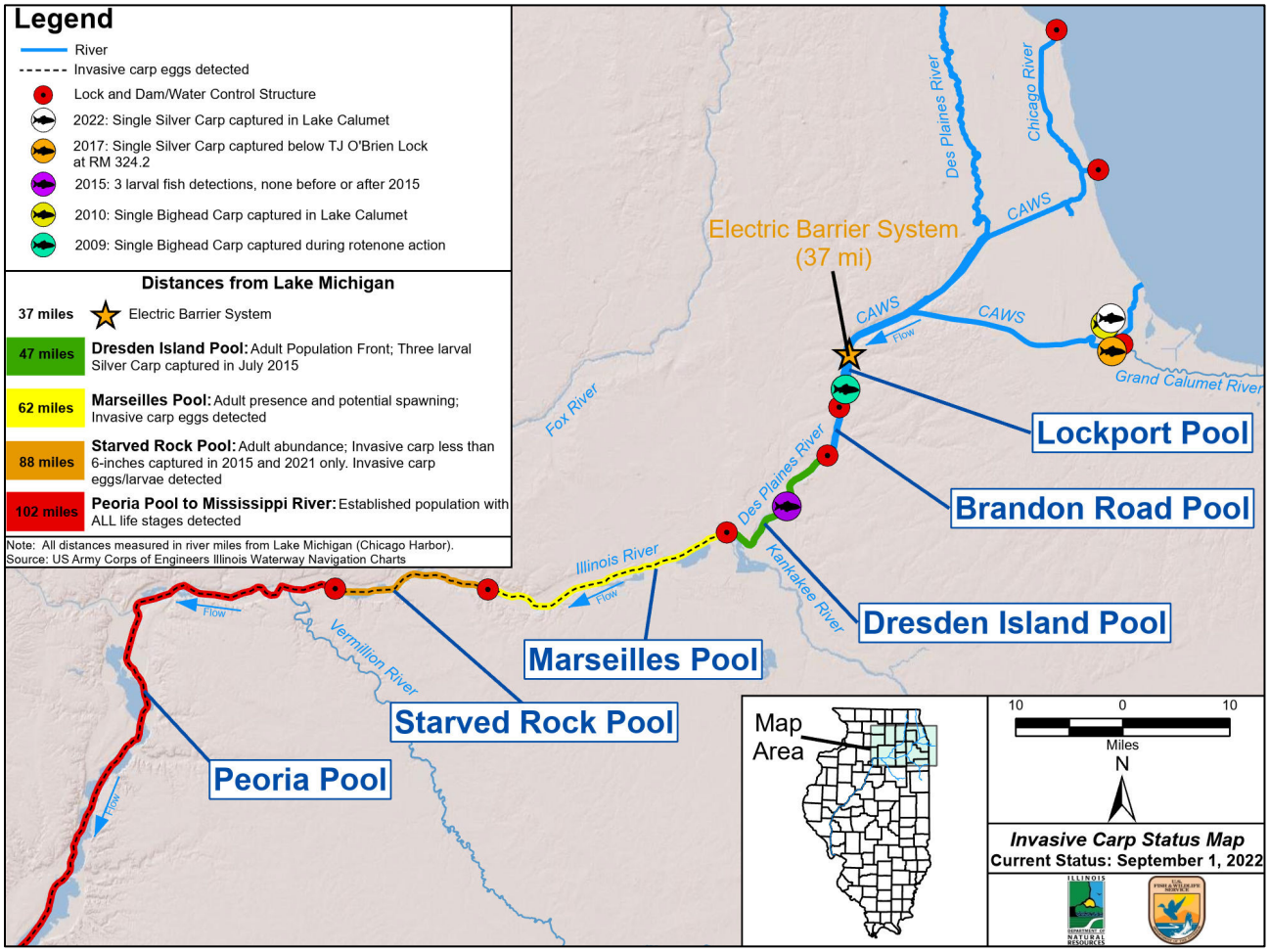
This project will continue the use of contracted commercial fishing to remove invasive carp from the upper IWW. The goal is to remove at least one million pounds of invasive carp from the upper IWW annually, especially targeting the Starved Rock and Marseilles pools. The project prevents invasive carp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

Project Description

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 that 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 toward upstream migration, reducing the risk of invasive carp nearing the EDBS. Twenty-four weeks of contracted removal in these pools is scheduled annually, resulting in roughly one million pounds of invasive carp removed per year. Contract commercial fishing begins in the spring following ice-out and continues to mid-summer when temperatures become too warm to harvest fish effectively. Effort resumes in September until freeze up. Agency staff develop a harvest schedule in the spring of each year. Agency biologists direct the contract commercial fishing effort to maximize removal in the target reaches. Removed fish provide the opportunity to collect valuable biological information on fish condition, age, and demographics. This harvest is expected to result in populations in the Dresden Island Pool that are below 90 percent of levels observed in 2015 using advanced hydroacoustics.

The contracted fishers are also available as rapid responders. These fishers can be called up in response to information that requires investigation or if additional harvest is needed. A typical rapid response scenario would be similar to the rapid response action taken based on a verified angler report of a Silver Carp observation in Lake Calumet above the EDBS in August 2022.

Figure B-31 — Approximate Coverage of Contract Fishing – Starved Rock Through CAWS



C-2: Enhanced Contract Fishing for Invasive Carp Removal in the Lower Illinois River

- **Lead Agency:** IL DNR
- **Agency Collaboration:** None
- **GLRI Funding:** $1,292,000
- **Agency Funding:** $0

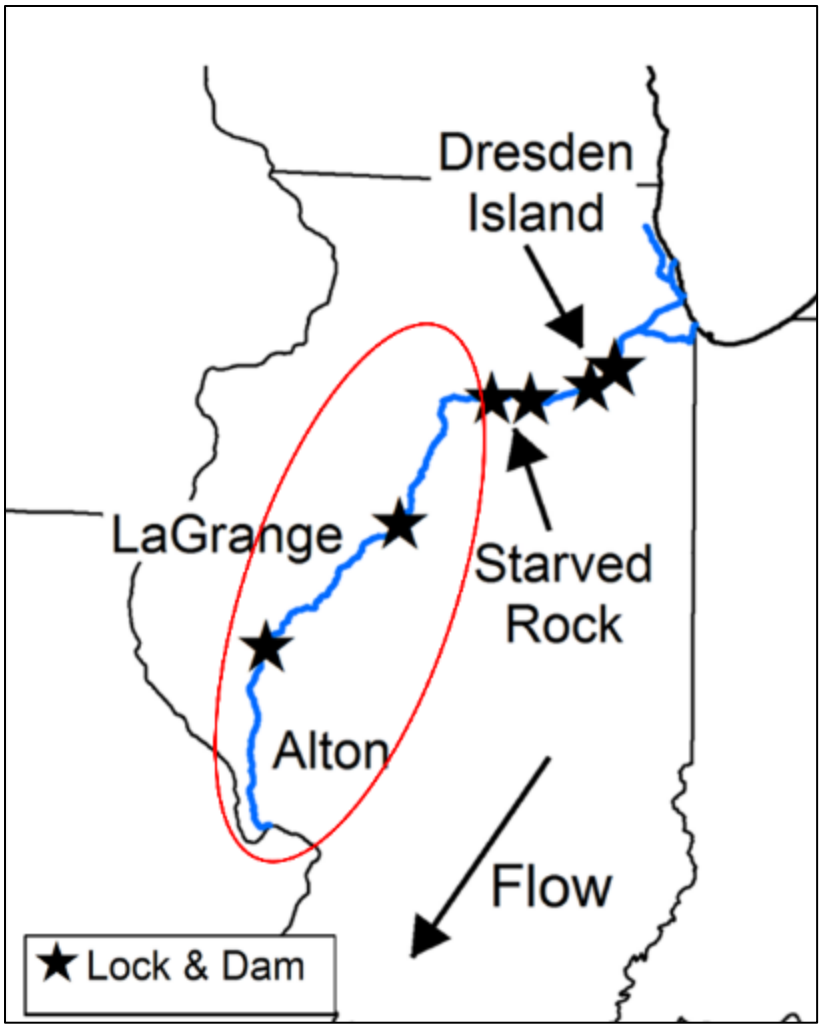
Project Summary

This project will continue the Enhanced Contract Fishing Program in Illinois in the Alton, LaGrange, and Peoria pools of the Illinois River. The goal is to remove 8 to 10 million pounds of invasive carp from these areas. This project prevents invasive carp from becoming established in the Great Lakes by reducing the number of fish reaching the upper Illinois River.

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 the use of a contractor to develop and implement management strategies for enhanced removal of invasive carp. The contractor will subcontract on behalf of IL DNR to hire 20 to 30 contract fishers who fish several days per week, weekly, or seasonally, typically removing an aggregate average total of approximately 400,000 pounds per week. Fishing locations vary but originate from approximately 10 boat launch locations throughout the three-pool area. In coordination with SIU (funded separately), the contractor will collect and provide data from the harvested fish and contracted removal effort and analyze the efficacy of removal, the status of populations, and support the development of recommendations for future contracted removal efforts to meet management goals both in the upper and lower IWW. This project will result in the removal of 8 to 10 million pounds of invasive carp in the lower Illinois River and thus reduce the number of fish reaching the upper Illinois River.

Figure B-32 — Project Location (C-2)



GRASS CARP ACTIONS

GC-1: Monitoring, Removal, and Control of Grass Carp in Ohio Waters of the Lake Erie Western Basin

- **Lead Agency:** OH DNR
- **Agency Collaboration:** University of Toledo, GLFC, MI DNR, USFWS, USGS
- **GLRI Funding:** $600,000
- **Agency Funding:** $0

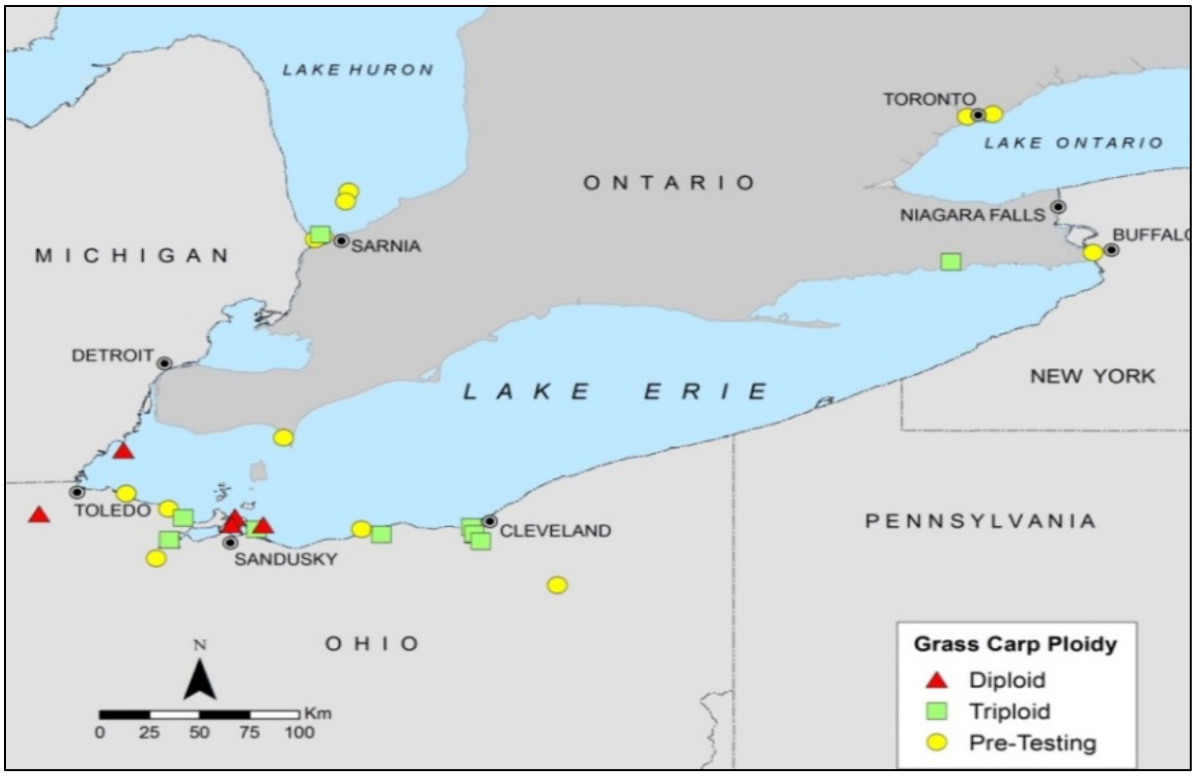
Project Summary

This project will conduct aggressive control actions in locations of known Grass Carp spawning in the Sandusky and Maumee Rivers in Ohio, as well as other Lake Erie tributaries. Funding will be used for four Grass Carp strike teams that will contribute to the multi-agency goal of removing 373 diploid Grass Carp annually from Lake Erie. This project reduces the risk of 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 supports monitoring and control work to remove Grass Carp in the western basin of Lake Erie, specifically in the Sandusky and Maumee Rivers, as well as other Lake Erie tributaries. The goal is to work with agency partners to remove 373 diploid Grass Carp annually from Lake Erie. The project will also help coordinate with the USACE on the feasibility of a Sandusky River Grass Carp behavioral barrier to disrupt Grass Carp spawning. This coordination includes facilitating the Grass Carp Barrier/Deterrents Work Group and determining the potential impact of the barrier on native fish. The long-term goal of this work is to suppress and/or eradicate the Grass Carp population in Lake Erie and prevent this member of the invasive carp family from becoming established in the Great Lakes.

Figure B-33 — Diploid and Triploid Grass Carp Ploidy and Pre-Testing Areas



GC-2: Monitoring, Removal, and Control of Grass Carp in Michigan and Ohio Waters of the Lake Erie Western Basin

- **Lead Agency:** MI DNR
- **Agency Collaboration:** OH DNR, USFWS, USGS
- **GLRI Funding:** $325,000
- **Agency Funding:** $150,000

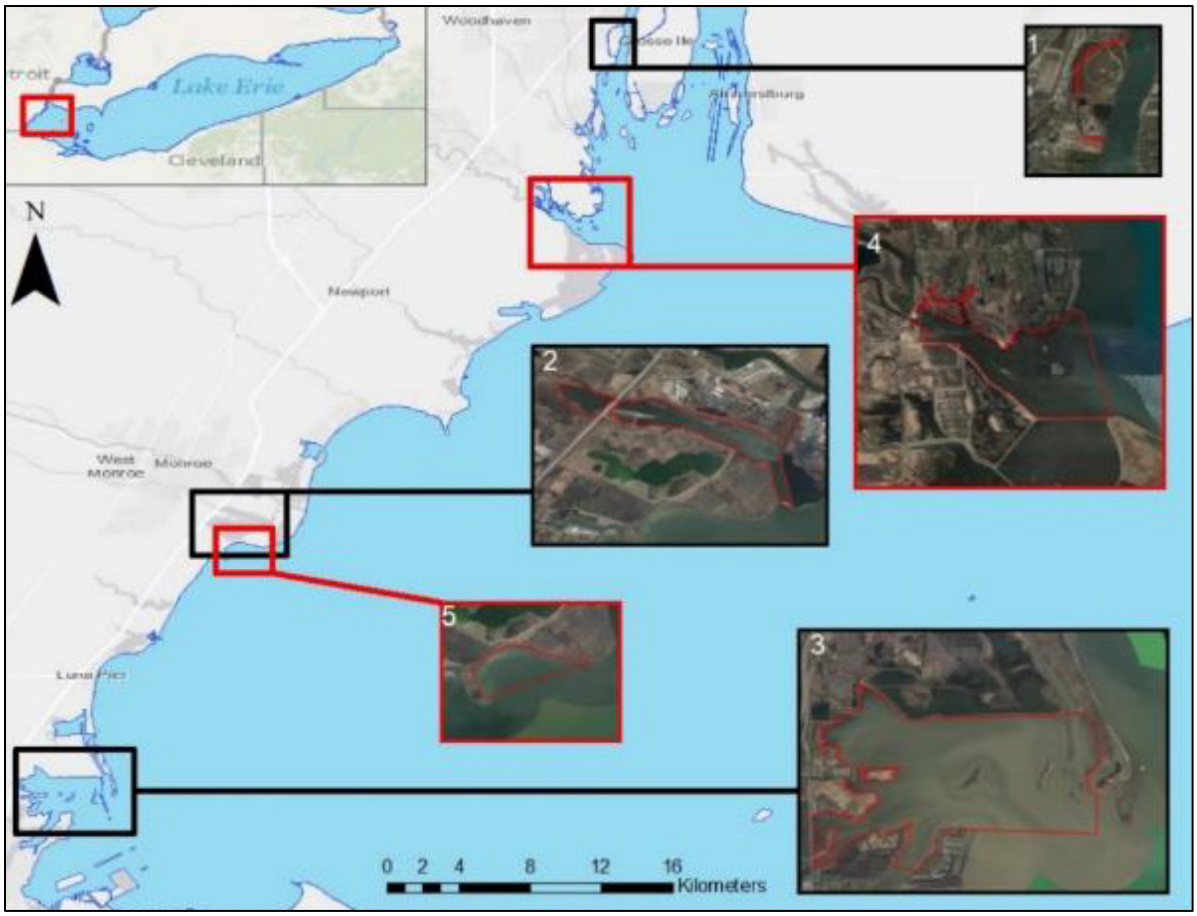
Project Summary

This project will implement Grass Carp response actions in Michigan and Ohio waters of Lake Erie and connecting waters. FY 2023 funding will provide the support to staff a MI DNR field crew that will contribute to the multi-agency goal of removing 373 Grass Carp from the Western Basin of Lake Erie and connecting waters. 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 funding will be used to support a Michigan Grass Carp response team that will implement the following actions: (1) implement targeted removal efforts during spawning events, (2) conduct sustained response efforts to track population trends over time, (3) conduct surveillance efforts to evaluate potential spread to new locations, (4) maintain telemetry arrays, tag fish, and use telemetry detections to inform removal efforts, and (5) partner with commercial fishing operations and recreational anglers to promote removal and reporting of Grass Carp.

Figure B-34 — Grass Carp Nearshore (a) and VPS (b) Acoustic Receiver Arrays



Note: The two known spawning tributaries for Grass Carp in the Great Lakes (Maumee and Sandusky Rivers) are also shown with the locations of the VPS and real-time receivers. The Grass Carp receivers and arrays are shown in red and other existing strategically located GLATOS receivers are shown in white.

GC-3: Implementation of an Adaptive Management Framework for Grass Carp in the Great Lakes

- **Lead Agency:** USFWS
- **Agency Collaboration:** Fisheries and Oceans Canada, GLFC, IN DNR, MI DNR, Michigan State University, OH DNR, NY DEC, Pennsylvania Fish and Boat Commission, SIU, University at Buffalo, University of Toledo, USGS, WI DNR
- **GLRI Funding:** $1,250,000
- **Agency Funding:** $800,000

Project Summary

This project provides support for the additional capacity needed to expand enhanced Grass Carp surveillance and capture effort in the U.S. waters of the Lake Erie basin and additional lake basins where management agencies feel further targeted effort for Grass Carp is warranted (Lake Michigan, Lake Huron, and Lake Ontario). This project will result in increased targeted monitoring and the capture/removal of diploid (fertile) and triploid (sterile) Grass Carp, when detected, reducing the threat of diploid Grass Carp establishing self-sustaining populations in the Great Lakes by suppressing reproductive success. FY 2023 funding will support the needed capacity to implement Grass Carp response actions at high-priority locations in U.S. waters of the Great Lakes in support of state-led Grass Carp management strategies.

Project Description

The following USFWS FWCOs will support the Grass Carp surveillance, response, and removal efforts in the U.S. waters of the identified lake basins.

Lake Huron, Lake Erie Western, and Central Basins

- USFWS will provide field crews, vessel support, and laboratory assistance to project partners working to implement state-led Grass Carp response actions in Lake Erie, Lake Huron, and connecting waters. USFWS will support the research/management needs of the LEC, identified by the GCAC, described in the Lake Erie Grass Carp Response Strategy (2019-2023).
- Response priorities will be to (1) maintain support for two Grass Carp field crews and vessels, (2) implement and evaluate innovative control actions for Grass Carp, (3) use real-time telemetry detections of Grass Carp to inform planning/implementation of response

actions, and (4) contribute to efforts to remove 373 Grass Carp annually from the Lake Erie basin.

- Research priorities will be: (1) maintain support for the modeling/telemetry (GLATOS) project, (2) maintain support for the otolith microchemistry/stable isotope analysis project, (3) maintain support for USFWS ploidy analysis of Grass Carp, (4) continue to assist with implementation of mobile VPS array study to track fine-scale movements of Grass Carp during response actions, (5) continue to serve as a second reader to verify Grass Carp age estimates, and (6) provide representation, as needed, at relevant regional or national conferences and meetings to support coordination and information-sharing related to Grass Carp management.

Lake Erie Eastern Basin, Lake Ontario

- USFWS will provide field crews and vessel support to project partners implementing state-led Grass Carp response actions in Lake Erie and connecting waters. USFWS will support the research/management needs of the LEC, identified by the GCAC, described in the Lake Erie Grass Carp Response Strategy (2019-2023). Additionally, in response to partner priorities, USFWS will continue to develop the capacity to implement targeted Grass Carp monitoring and removal in Lake Ontario.
- Response priorities will be: (1) maintain support for one Grass Carp field crew and vessel, (2) implement and evaluate innovative control actions for Grass Carp, (3) use real-time telemetry detections of Grass Carp to inform planning/implementation of response actions, (4) remove all Grass Carp collected and process for ploidy (unless an individual fish is tagged, pending approval by the LEC), and (5) provide representation, as needed, at local and regional meetings to support coordination, information sharing, and improved awareness related to Grass Carp management.

Lake Michigan

- In response to a request from the MI DNR, the GLFC, and the Lake Michigan Committee, USFWS will continue to develop the capacity to implement targeted Grass Carp monitoring and removal in Lake Michigan.
- Response priorities will be: (1) maintain support for one Grass Carp field crew and vessel, (2) implement and evaluate innovative control actions for Grass Carp, (3) remove all Grass Carp collected and process for ploidy (unless an individual fish is tagged, pending approval by the LEC), and (4) explore locations not previously sampled for Grass carp in the Lake Michigan Basin.

GC-4: Continued Deployment of the Grass Carp Spawning Event Prediction Tool

- **Lead Agency:** USGS
- **Agency Collaboration:** USGS – Great Lakes Science Center, OH DNR, University of Toledo
- **GLRI Funding:** $90,000
- **Agency Funding:** $0

Project Summary

This project will continue the development of USGS SpawnCast to provide forecasts of potential Grass Carp spawning events in select tributaries to the western basin of Lake Erie. This project will result in the ability of management agencies to make informed decisions about when and where to deploy Grass Carp strike teams and prevent invasive carp from becoming established in the Great Lakes by providing advanced warning of spawning events and identifying events and locations where strike teams can have the greatest impact on Grass Carp populations in western Lake Erie.

Project Description

In FY 2023, Grass Carp spawning forecast dashboards will be developed and added to USGS SpawnCast for two additional Great Lakes tributaries prior to the 2023 spawning season. Work will be done to improve the user experience with the web interface, including operation and maintenance of the existing site as well as potential improvements to the interactivity of the dashboards. In addition, integration of the National Water Model into USGS SpawnCast for reach-based forecasts will be explored as a potential for increasing the efficacy of the tool to better assist the collection of ichthyoplankton and harvesting of adult Grass Carp in response to real-time spawning events. Once fully developed, the techniques and methods employed by this tool will undergo formal peer review and approval for public dissemination.

Figure B-35 — USGS SpawnCast Deployment Locations

GC-5: Identifying Optimal River Conditions for Spawning and Recruitment of Invasive Carp in Tributaries of the Western Basin of Lake Erie

- **Lead Agency:** USGS
- **Agency Collaboration:** NOAA GLERL, Brenton Consulting LLC, OH DNR, University of Toledo
- **GLRI Funding:** $85,000
- **Agency Funding:** $0

Project Summary

This project will simulate the drift of invasive carp eggs and larvae in the Maumee and Sandusky Rivers. This project will identify optimal river conditions for spawning and recruitment of Grass Carp in the western Lake Erie 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 2023 funding will support the publication of results of the optimal river conditions analysis on the Sandusky River and a new, in-depth characterization of the hydraulics at known and suspected spawning locations on the Maumee and Sandusky Rivers based on results from existing hydraulic models.

Project Description

It is necessary to identify the river conditions (flow and temperature) and spawning sites with the greatest potential for Grass Carp recruitment to allow management agencies to prioritize events for response actions and allocate their limited resources effectively and efficiently. Proposed work for FY 2023 funding includes:

- Publishing a USGS data release containing Sandusky River FluEgg simulation outputs.
- Publishing the results of the Sandusky River optimal river conditions and hindcasting analyses in a peer-reviewed journal article.
- A detailed characterization of the hydraulics of known and suspected spawning areas on the Maumee and Sandusky Rivers.

Figure B-36 — Project Study Area (GC-5)

GC-6: Information and Tools to Support the Removal and Deterrents of Grass Carp

- **Lead Agency:** USGS
- **Agency Collaboration:** MI DNR, OH DNR, UFWS, University of Toledo, Ohio, Sandusky River Watershed Coalition, Michigan State University
- **GLRI Funding:** $0
- **Agency Funding:** $1,024,672

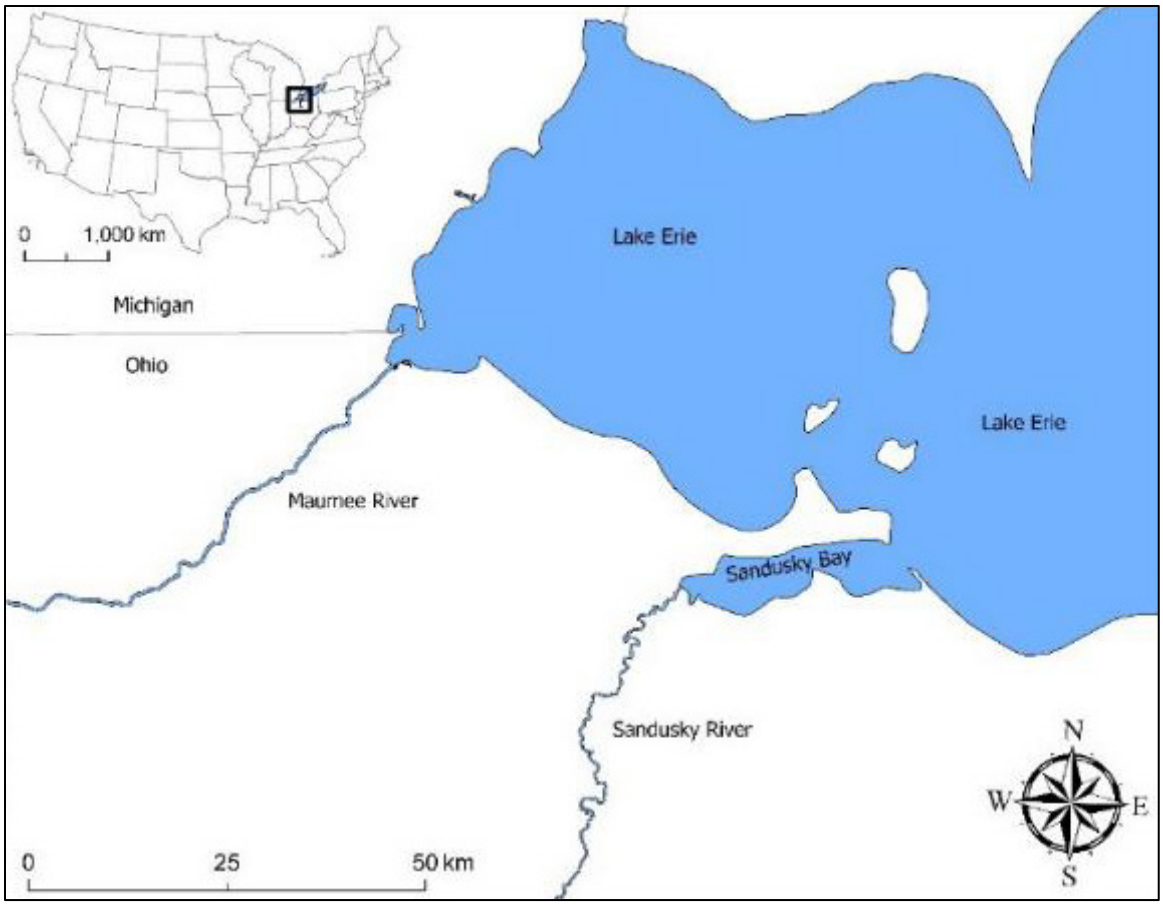
Project Summary

This project will provide information and tools related to the removal and deterrents of Grass Carp needed to inform management decisions in Western Lake Erie and relevant tributaries. These projects will result in data that will (1) optimize gear to maximize capture efficiency, (2) establish baseline fish assemblages, (3) identify behavioral responses to baits and attractants, and (4) provide detailed movement information. This project will prevent invasive carp from becoming established in the Great Lakes by better informing Grass Carp control and removal efforts.

Project Description

FY 203 funding will: (1) identify the most efficient gear combination to optimize removal efficiency, (2) evaluate fish assemblages and establish baseline conditions in preparation for a behavioral barrier, (3) continue evaluation of bait and attractants to congregate and increase capture of Grass Carp, and (4) provide continued telemetry information on Grass Carp movements.

Figure B-37 — Western Lake Erie Basin – Proposed Project Area (GC-6)



GC-7: Laboratory Testing to Determine the Efficacy of an Oblique Bubble Screen System as a Two-Way Dispersal Barrier for Grass Carp

- **Lead Agency:** USGS
- **Agency Collaboration:** University of Illinois at Urbana-Champaign, OH DNR, GLFC, MI DNR, University of Toledo
- **GLRI Funding:** $0
- **Agency Funding:** $205,000

Project Summary

This project will assess and optimize the efficacy of an OBS system as a two-way, seasonally operated dispersal barrier to disrupt the spawning and recruitment of Grass Carp in known spawning tributaries to the Great Lakes. FY 2023 funding will produce the design of such a barrier for flow conditions typical of Grass Carp spawning events and a two-way efficacy of at least 50 percent in both directions, following a process-based characterization to allow scaling-up for near-field scale testing in subsequent years.

Project Description

USGS will answer three fundamental research questions: (1) How do OBS systems alter stream flows, and how can an OBS system be tuned to optimize efficacy in redirecting and trapping Grass Carp eggs and larvae in streams? (2) Can an OBS system be simultaneously optimized to also deter the upstream movement of motivated adult Grass Carp? and (3) How will a seasonally operated OBS system impact native species, along with sediment and oxygen dynamics in streams? USGS will refine the OBS prototype design through extensive testing and experimentation. The refined OBS design will be tested with live Grass Carp eggs and larvae to determine the capture efficiency across developmental stages and flow conditions. A third experimental series will assess the efficacy of the refined OBS configuration in deterring upstream passage of sub-adult Grass Carp.

Figure B-38 — EEL and EEL Racetrack Flume Experimental Facility

GC-8: Improve Control Efficiency Through Better Understanding of Grass Carp Movements and Habitat Use

- **Lead Agency:** USGS
- **Agency Collaboration:** OH DNR, MI DNR, USFWS, GLFC, MSU
- **GLRI Funding:** $200,000
- **Agency Funding:** $619,162

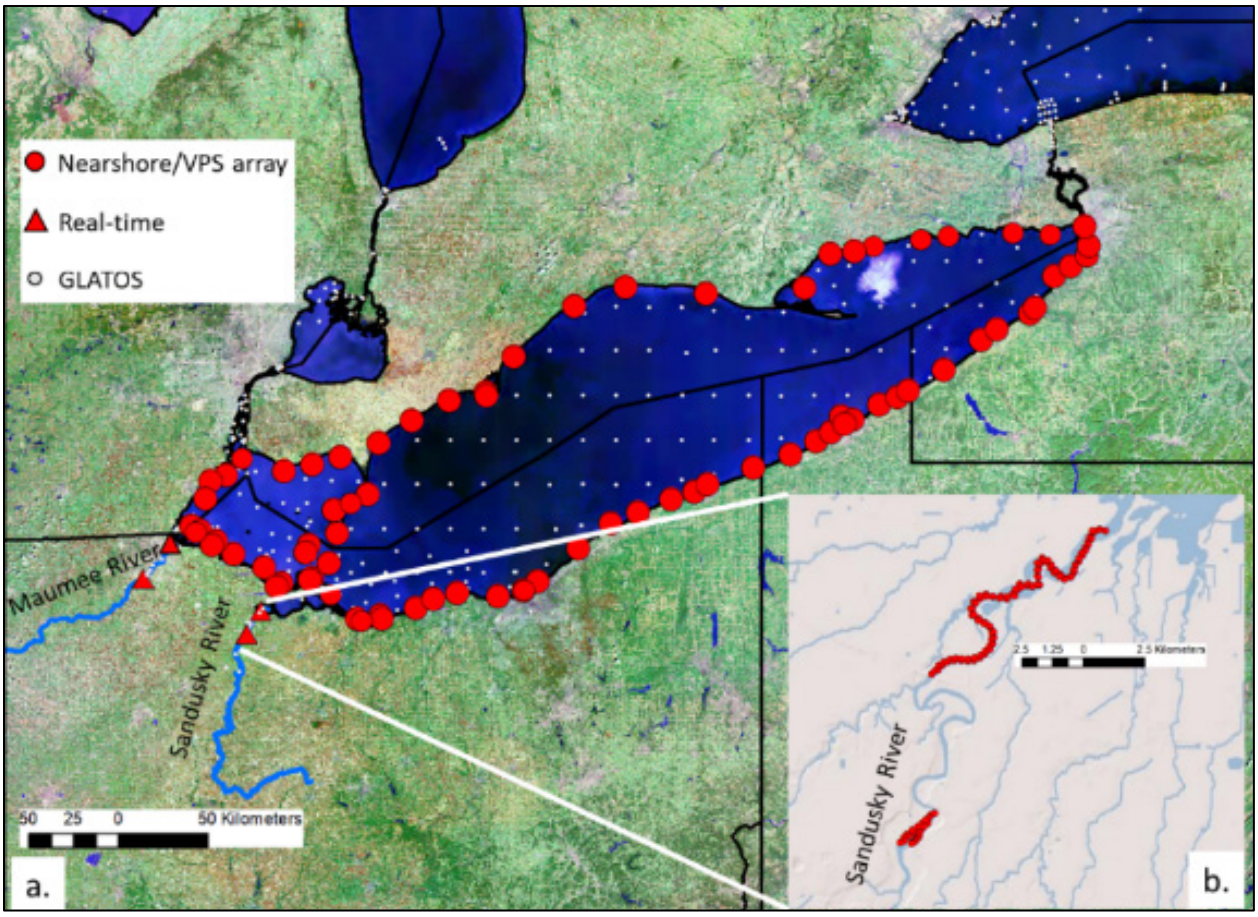
Project Summary

This project will address the threat of invasive Grass Carp by developing a comprehensive understanding of seasonal movements and habitat use to determine when and where eradication efforts would be most effective in Lakes Erie and Lake Huron and tributaries to these lakes. This project will result in detailed observations of Grass Carp spawning, feeding, and overwinter behavior and prevent invasive carp from becoming established in the Great Lakes by determining when and where eradication efforts would be most effective. FY 2023 funding will produce a publication on Grass Carp spawning behavior 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.

Project Description

The goal of this project is to address the threat of invasive Grass Carp by developing a comprehensive understanding of seasonal movements and habitat use to determine when and where eradication efforts would be most effective. The work will be accomplished with acoustic telemetry, leveraging the GLATOS. Detailed observations of the location and timing of Grass Carp movements will be compared to conditions to explore potential cues to these observed patterns.

Figure B-39 — Project Area (GC-8) with Telemetry Station Locations



GC-9: Identifying Spawning Tributaries and Specific Spawning Areas of Grass Carp

- **Lead Agency:** USGS
- **Agency Collaboration:** MI DNR, OH DNR
- **GLRI Funding:** $200,000
- **Agency Funding:** $455,875

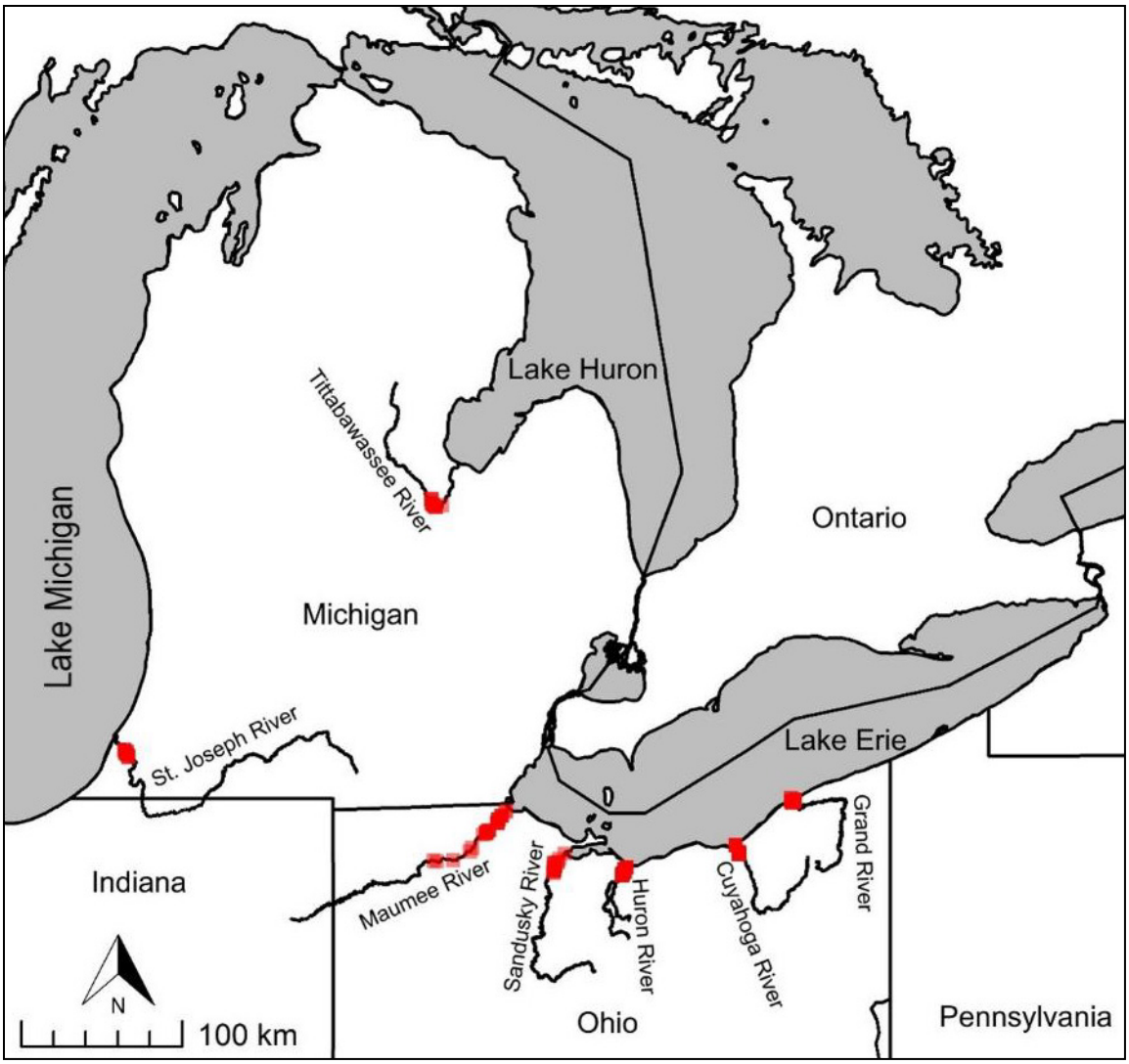
Project Summary

This project will monitor Grass Carp spawning in Michigan and Ohio tributaries of the Great Lakes. This project will result in an improved understanding of Grass Carp spawning and reproductive ecology and help prevent invasive carp from becoming established in the Great Lakes by identifying areas where successful reproduction is occurring to aid prioritization of control efforts. FY 2023 funding will produce an updated detection history of priority sampling rivers, input data for modeling spawning locations, insights on spawning cues in relation to hydrology and other environmental factors, and data to support the estimation of detection probabilities for spawning events.

Project Description

This project will sample for Grass Carp early life stages (eggs and larvae). Suspected Grass Carp eggs and larvae will be examined for developmental stages, and all collected data and developmental stages of eggs and larvae will be entered into a database. USGS will use data from eggs and larvae in models that identify specific spawning locations. This information will be provided to managers to inform their efforts to remove and eradicate Grass Carp from the Great Lakes. To date, this effort has produced high catches of adult Grass Carp. Second, it has identified new spawning rivers and spawning locations within rivers, which has directed where control efforts were targeted, reducing the risk of establishment.

Figure B-40 — Grass Carp Egg and Larvae Monitoring Locations



Note: Monitoring locations are shown in red.

GC-10: 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, University of Toledo
- **GLRI Funding:** $145,000
- **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 inform the design of a barrier and will help prevent Grass Carp establishment in the Great Lakes by limiting reproduction and recruitment in the Sandusky River. Funding for FY 2023 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) and an assessment of sediment dynamics.

Project Description

Using a combination of continuous monitoring and synoptic surveys, the USGS will collect and report information that will inform OH DNR and their engineering representative in the design and later 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.

GC-11: Development and Testing of Deterrent Technologies for Grass Carp

- **Lead Agency:** USGS
- **Agency Collaboration:** KY DFWR, USFWS, GLFC, Sandusky Grass Carp Barrier Team, OH DNR, MI DNR
- **GLRI Funding:** $195,000
- **Agency Funding:** $280,000

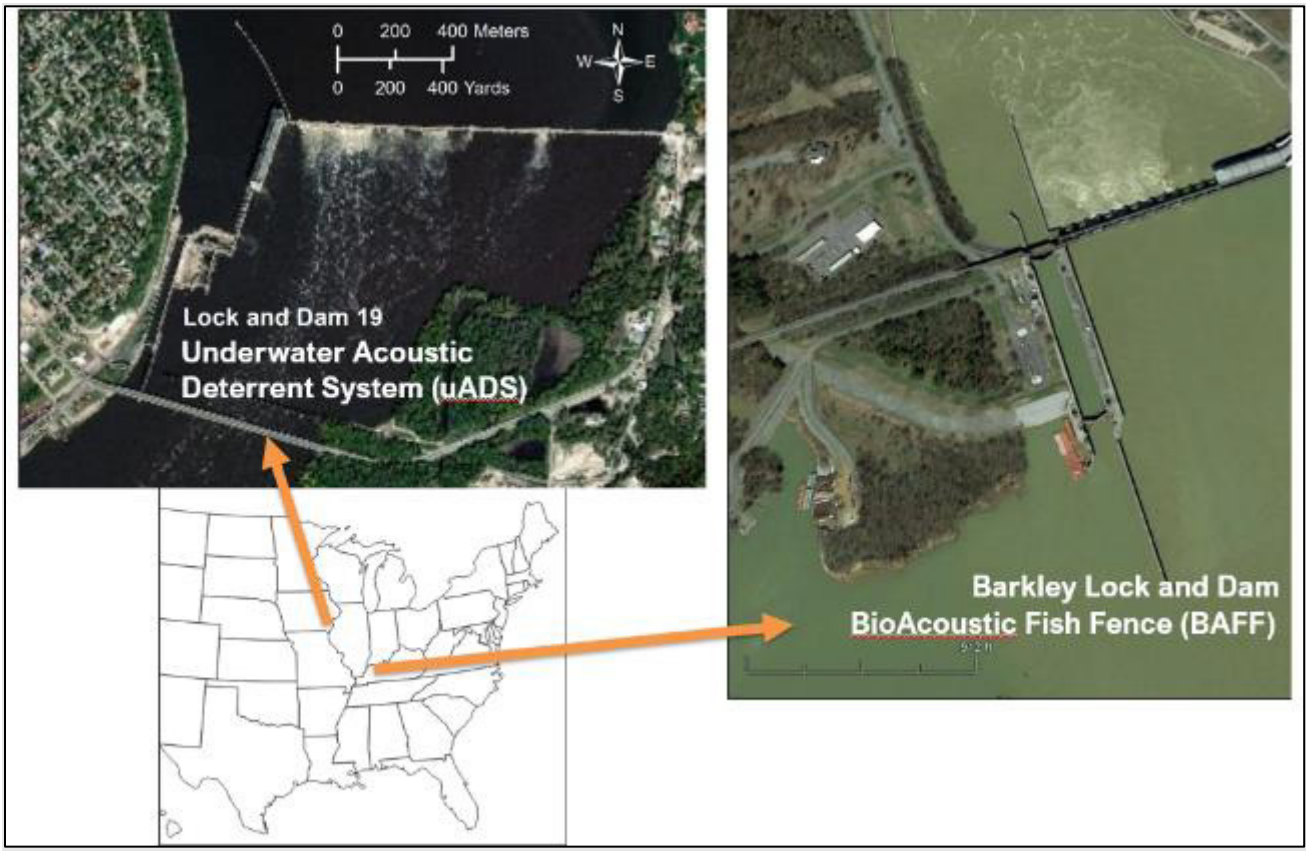
Project Summary

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 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. FY 2023 funding will be used to assess acoustic deterrent effectiveness for upstream movement of Grass Carp.

Project Description

This project will leverage the ongoing testing of the BAFF at Barkley Dam and uADS at Lock 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 Grass Carp at Barkley Lock and Dam with acoustic tags and dual tagging Grass Carp at Lock 19. USGS will use acoustic telemetry arrays 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 (e.g., swim direction, speed, tortuosity, depth) 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 and other tributaries of the Great Lakes.

Figure B-41 — Experimental BAFF and uADS for Grass Carp Response



GC-12: Grass Carp Ploidy Analysis to Assess Reproductive Risk of Detected Populations

- **Lead Agency:** USFWS
- **Agency Collaboration:** USGS, SIU, University of Toledo, DFO, OH DNR, MI DNR, IL DNR, NY DEC, University at Buffalo
- **GLRI Funding:** $65,000
- **Agency Funding:** $40,000

Project Summary

This project will use state-of-the-art analytical techniques (flow cytometry) to determine the ploidy status (reproductive diploid or non-reproductive triploid) of Grass Carp captured in the Great Lakes and tributaries. This project will result in data on the reproductive viability (capability of reproducing in the wild) of collected Grass Carp, increasing awareness of the level of risk of Grass Carp natural reproduction and informing management plans to control populations detected in the Great Lakes Basin. FY 2023 funding will provide key results to partner agencies with capture, location, and other associated data compiled in the USGS-Nonindigenous Aquatic Species Database for searchable results to inform management planning and research efforts.

Project Description

Captures of Grass Carp from the Great Lakes and tributaries have steadily increased in the last 10 years. Recently, Great Lakes management partners have coordinated and expanded efforts to control existing Grass Carp and prevent populations from becoming established. The USFWS, USGS, DFO, and Great Lakes state management agencies collect samples during targeted removal and research efforts in the Great Lakes. Ploidy analysis for chromosomal content of the sampled fish can help determine if captured Grass Carp were escaped triploids (no threat) or reproductive diploids (threat of reproducing). Results can help managers focus removal and control efforts on areas where reproductive diploids have been found to prevent the establishment of a breeding population. The technology using flow cytometry to determine the ploidy status of invasive carp was developed by USGS (Wetland and Aquatic Resource Center) and is performed at USFWS (La Crosse Fish Health Center-Midwest Fisheries Center) laboratories. Ploidy results from captured fish are provided to agency partners and inform their management actions. Ploidy results, along with capture data and images, are submitted to the USGS-Nonindigenous Aquatic Species Database for searchable information managers and researchers can use to inform actions to control and manage Grass Carp in the Great Lakes Basin.

BLACK CARP ACTIONS

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

- **Lead Agency:** IL DNR
- **Agency Collaboration:** INHS, USGS, SIU
- **GLRI Funding:** $188,000
- **Agency Funding:** $0

Project Summary

This project will use baited hoop nets in the lower Illinois River and side channel habitats. This project will result in increased knowledge of Black Carp population size and distribution and prevent invasive carp from becoming established in the Great Lakes by adding to our knowledge of this species. FY 2023 funding will produce data on Black Carp locations and densities and refine techniques for their capture.

Project Description

IL DNR will continue sampling using hoop nets baited with experimental baits to assess the population of Black Carp in the lower Illinois River and the efficacy of different baits to collect them. The bait of choice to be used in Illinois River monitoring will be guided by targeted efforts of known Black Carp populations (Horseshoe Lake and Mississippi River) where bait comparisons can be evaluated during intensive sampling. In the La Grange Reach of the Illinois River, IL DNR will expand upon the existing Upper Mississippi River Restoration Program's LTRM standardized hoop netting efforts and make direct comparisons using experimentally baited hoop nets to target Black Carp to better detect their presence, abundance, and expansion up the lower Illinois River. While LTRM hoop netting uses a soybean-based bait, this proposed expansion will include the use of clam-based and cottonseed-based baits deployed in around 100 paired hoop net sets each (around 200 hoops total) in main- and side-channel habitats of the La Grange Reach. Expanded hoop netting efforts will be randomly fished in main- and side-channel border habitats in three time periods (Period 1, June 15 to July 31; Period 2, August 1 to September 15; and Period 3, September 16 to October 31) similar to ongoing standardized LTRM hoop netting efforts.

BC-2: Angler/Commercial Fisher Black Carp Data Collection

- **Lead Agency:** IL DNR
- **Agency Collaboration:** INHS, USFWS, USGS, Tetra Tech
- **GLRI Funding:** $41,000
- **Agency Funding:** $0

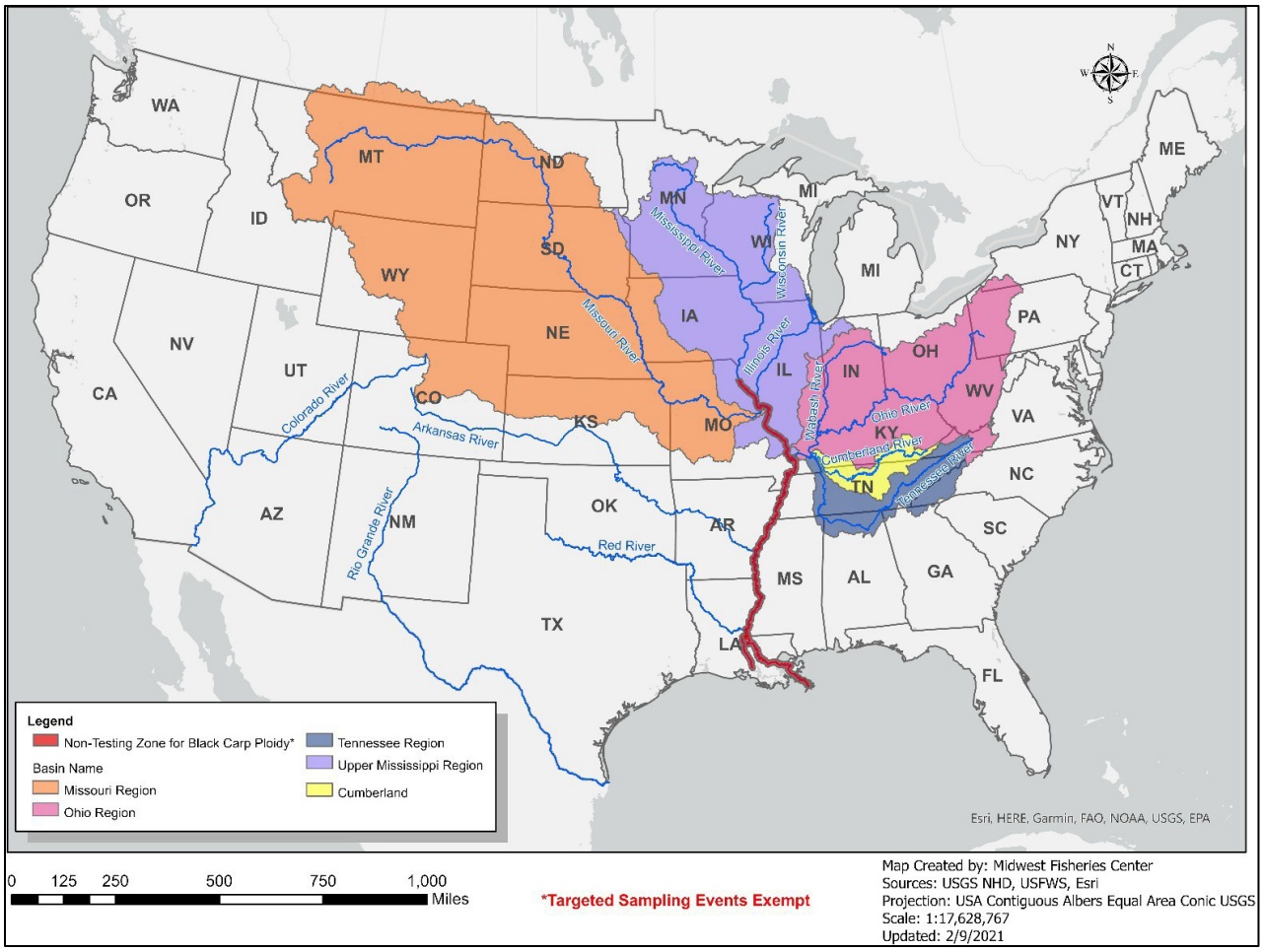
Project Summary

This project will fund incentive payments to sport and commercial anglers who submit captured Black Carp for agency analysis in the upper Mississippi River Basin. This project will result in valuable information regarding the 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. FY 2023 funding will produce specimens for evaluation and research.

Project Description

IL DNR will continue monitoring the range expansion of Black Carp within the upper Mississippi River Basin through incentive payments to anglers/commercial fishers to submit harvested Black Carp for data collection and analysis. A $100 reward will be provided to anglers/commercial fishermen for each wild-caught Black Carp that they report and donate to the project as an incentive for fishermen to target Black Carp and report any Black Carp that they catch (maximum of $1,000 in reward payments to any individual for Black Carp collected in a location during a one-week period).

Figure B-42 — Geographic Area of Black Carp Reward Program



BC-3: Black Carp Management and Control – Coordination and Support

- **Lead Agency:** USFWS
- **Agency Collaboration:** USGS, IL DNR
- **GLRI Funding:** $43,500
- **Agency Funding:** $40,000

Project Summary

This project will provide coordination to the BCWG, support the development of an SDM process, continue genetic-based identification of suspect Black Carp eggs/larvae, and determine ploidy (reproductive viability) of Black Carp captured in select waters of Illinois and surrounding states. This project will result in enhanced coordination and identification of priority management actions and data and research needs to support the protection of the Great Lakes from Black Carp. FY 2023 funding will support regular Black Carp interagency coordination meetings, contribute to the completion of a Black Carp SDM model, and provide species identification and/or ploidy determination of collected Black Carp specimens.

Project Description

The USFWS continues to coordinate the interagency BCWG convened every two months to discuss relevant Black Carp projects and results, identify future Black Carp management and research needs, and identify and coordinate priority projects for potential funding consideration. The overall goal of the BCWG is to improve coordination and communication for Black Carp management, control, and monitoring efforts for Great Lakes protection. FY 2023 funding will support interagency coordination and continued development and refinement of the SDM model.

USFWS will continue to provide support for genetics-based identification of suspect larval (age 0) Black Carp to BCWG partners to identify any potential range expansion. USFWS will continue to consult with partners about ways to improve Black Carp eDNA sampling protocols, detection sensitivity, and assay validation. Finally, USFWS staff will continue to provide Black Carp ploidy analysis technical support.

BCWG coordination effort focuses primarily on the Illinois River corridor but also includes additional discussion of and support for activities in other areas where Black Carp are an emerging concern, especially along areas of range expansion. Genetic identification and ploidy testing will be conducted on fish that are collected in and around the state of Illinois.

BC-4: Black Carp Monitoring, Assessment, and Control

- **Lead Agency:** USGS
- **Agency Collaboration:** USFWS, USACE-ERDC, INHS, SIU-C, MDC, KY FWR
- **GLRI Funding:** $475,000
- **Agency Funding:** $120,000

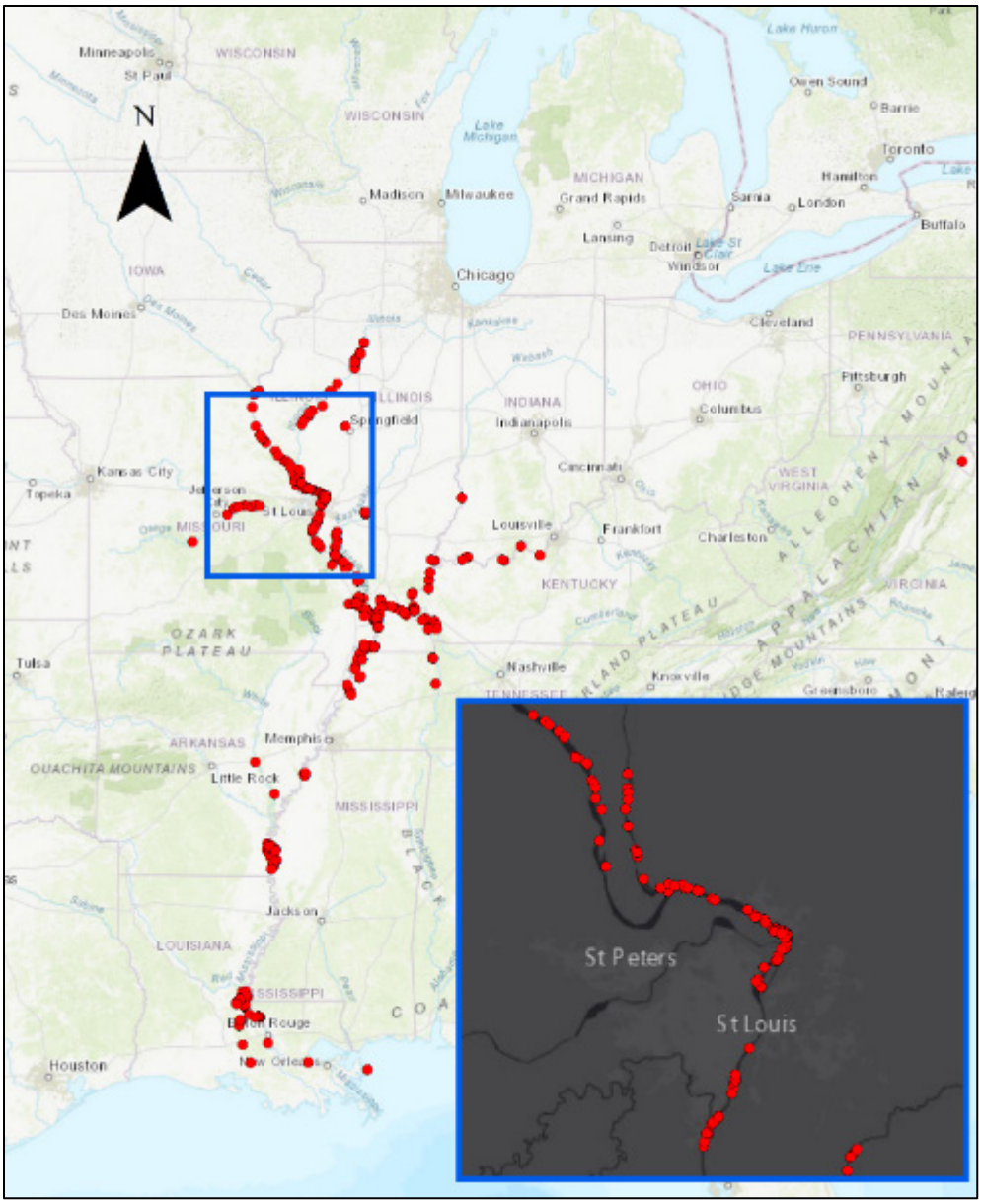
Project Summary

This project will assess the habitat use and movement, capture, aging methods, and development of Black Carp and will prevent invasive carp from becoming established in the Great Lakes by developing management actions and controls within the species' existing and expanding range prior to potential dispersal in the Great Lakes. FY 2023 funding will be used to complete telemetry data collection on habitat use and movement; allow continuation of research into the population demographics, reproductive development, and capture methods; and aid state and federal partners through the collection and distribution of samples, data, and support needed for R&D of management actions.

Project Description

FY 2023 efforts will include an additional year of telemetry to describe habitat use and movement within and among these systems using the existing pool of 40 tagged individuals. In 2023, analysis of post-tagging movements from initial weekly relocations of Black Carp will continue. Further analyses on the habitat use and long-range movements of tagged Black Carp will also continue. Continued analysis of presence-absence data in 2023 will be used to assess timing and conditions that optimize Black Carp collections. Specifically in 2023, analysis will be completed on factors associated with the capture of Black Carp by agencies and commercial methods to identify optimal sampling timing and conditions for Black Carp. Field sampling in 2023 for Black Carp will focus on model validation. In 2023, USGS will continue to support commercial captures through the receipt and processing of samples for demographics, diet, and genetics. Additionally, eyeballs will be processed and sent to the USFWS for ploidy determination. Lab experiments for the development of a single-dose species-specific piscicide bait to control wild Black Carp and protect high-value mussel populations were previously completed. A summary of analyses and a report based on these previous efforts will be completed in FY 2023.

Figure B-43 — Distribution of Black Carp as of September 2022



Note: Red circles represent reports of Black Carp collections. The blue box and adjacent gray-scale map represent the extent of focused field research on the capture, movement, and habitat use of Black Carp in the Mississippi River.

DECISION SUPPORT ACTIONS

DS-1: Assessment of Enhanced Commercial Harvest Efforts

- **Lead Agency:** IL DNR
- **Agency Collaboration:** SIU
- **GLRI Funding:** $200,000
- **Agency Funding:** $0

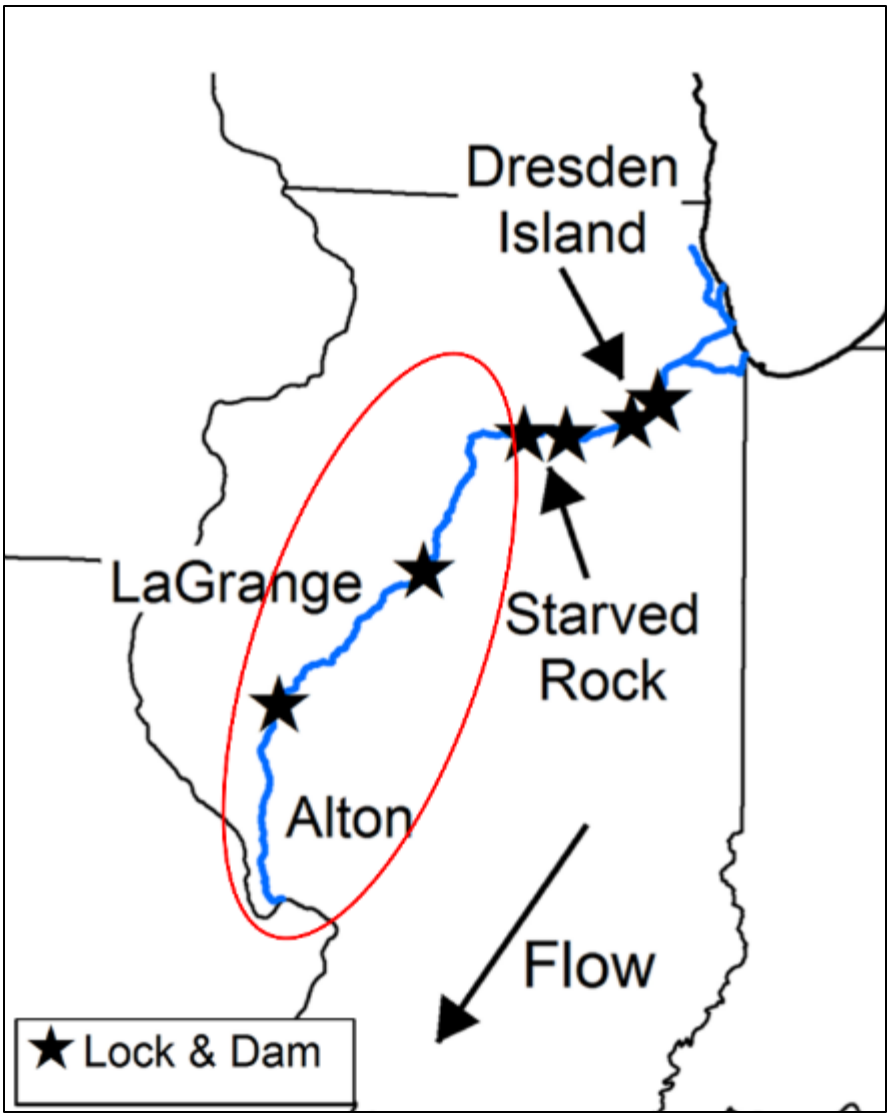
Project Summary

This project will assess the success of enhanced contract removal efforts and aid directed harvest in the lower Illinois River of the State of Illinois. This project will result in information about the success of harvest and prevent invasive carp from becoming established in the Great Lakes by reducing the number of fish moving upstream into the upper Illinois River as predicted by SEICarP modeling. FY 2023 funding will provide heat maps and trends in density and size distributions of invasive carp in the lower Illinois River to aid contracted harvest and assess the effect of harvest on the densities of invasive carp.

Project Description

SEICarP modeling using telemetry and demographics data predicts that the removal of invasive carp in the lower Illinois River may reduce the migration of fish upstream, further reducing the possibility of invasion into the Great Lakes. This project will evaluate the effects of harvest by assessing changes in invasive carp spatial distributions (hotspots), densities, and population demographics in the lower Illinois River to develop management strategies for enhanced removal through harvest. These efforts are required to provide detailed and comprehensive analyses about the efficacy of removal, the status of populations, and recommendations for future removal efforts, considering the spatial extent of removal and formulation of contracts and effort to meet management goals.

Figure B-44 — Project Location (DS-1)



DS-2: Monitoring Potential Population Growth, Food Web Effects, and Control of Grass Carp in Lake Erie's Western Basin

- **Lead Agency:** NOAA GLERL
- **Agency Collaboration:** Brenton Consulting LLC, USGS, Michigan State University Quantitative Fisheries Center
- **GLRI Funding:** $110,800
- **Agency Funding:** $65,000

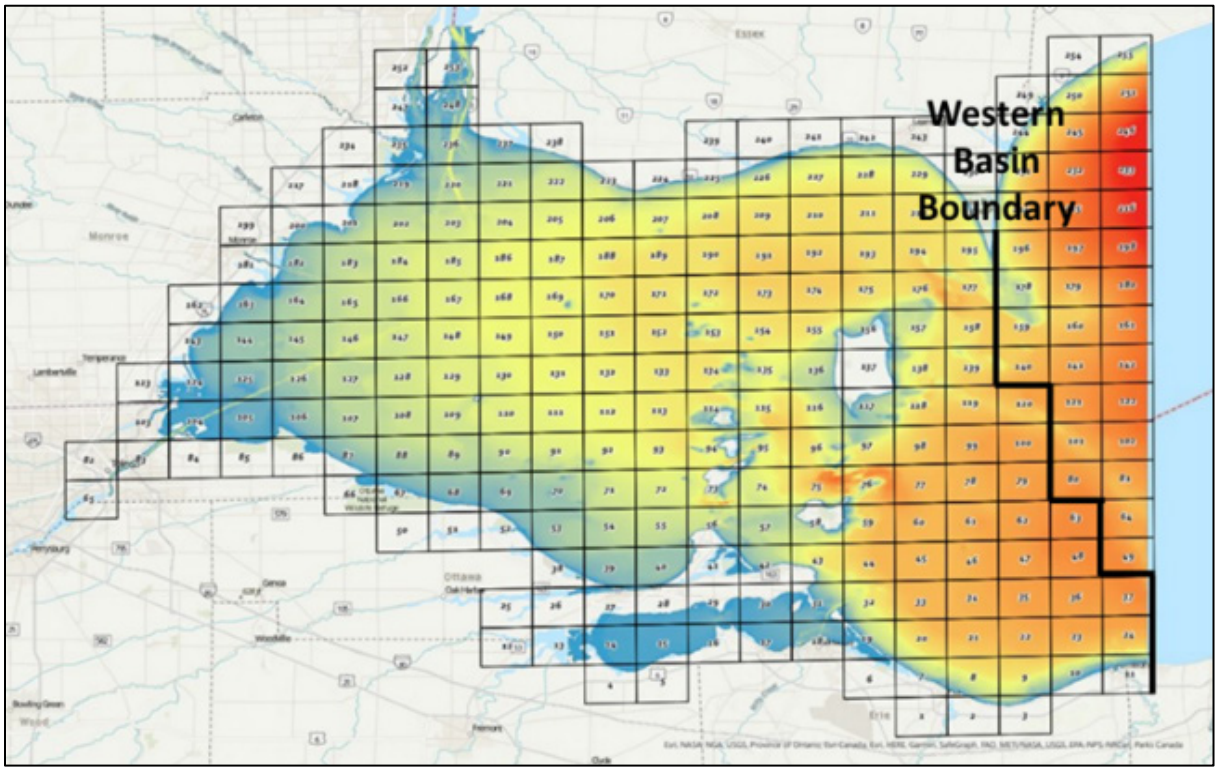
Project Summary

This project will revise, update, and expand our existing bioenergetics model of Grass Carp, Bighead Carp, Silver Carp, and four key resident fishes for the Maumee River and western Lake Erie. NOAA will add and explicitly model: (1) spawning success of Grass Carp in Sandusky River, (2) uncertainties associated with key recruitment parameters (e.g., egg and larval mortality), diet, movement, and habitat use, (3) simulate consequences of model uncertainties for Grass Carp population growth and harvest control, and (4) run scenarios as requested by the managers. These efforts will result in better-informed estimates of drivers of Grass Carp recruitment, population growth, food web effects, and relative effectiveness of current and proposed control measures for western Lake Erie.

Project Description

NOAA will collaborate with the FluEgg team to simulate Grass Carp and invasive carp spawning, reproductive success, and foraging in the Sandusky River watershed and combine this information with our Maumee River simulations to expand the spatial scope of modeled carp dynamics in the western basin. In FY 2023, NOAA will run simulations that vary the survival of Grass Carp eggs and larvae in nearshore waters of Lake Erie by applying a probability distribution to cover a range of possible scenarios for Grass Carp egg and larval survival. NOAA will revise the IBM to include scenarios of Grass Carp habitat preferences, movements, and macrophyte consumption in rivers from the latest telemetry results.

Figure B-45 — Model Domain for Western Basin of Lake Erie IBM of Grass Carp and Resident Food Web



DS-3: Invasive Carp Population Modeling to Support an Adaptive Management Framework for the Illinois River

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

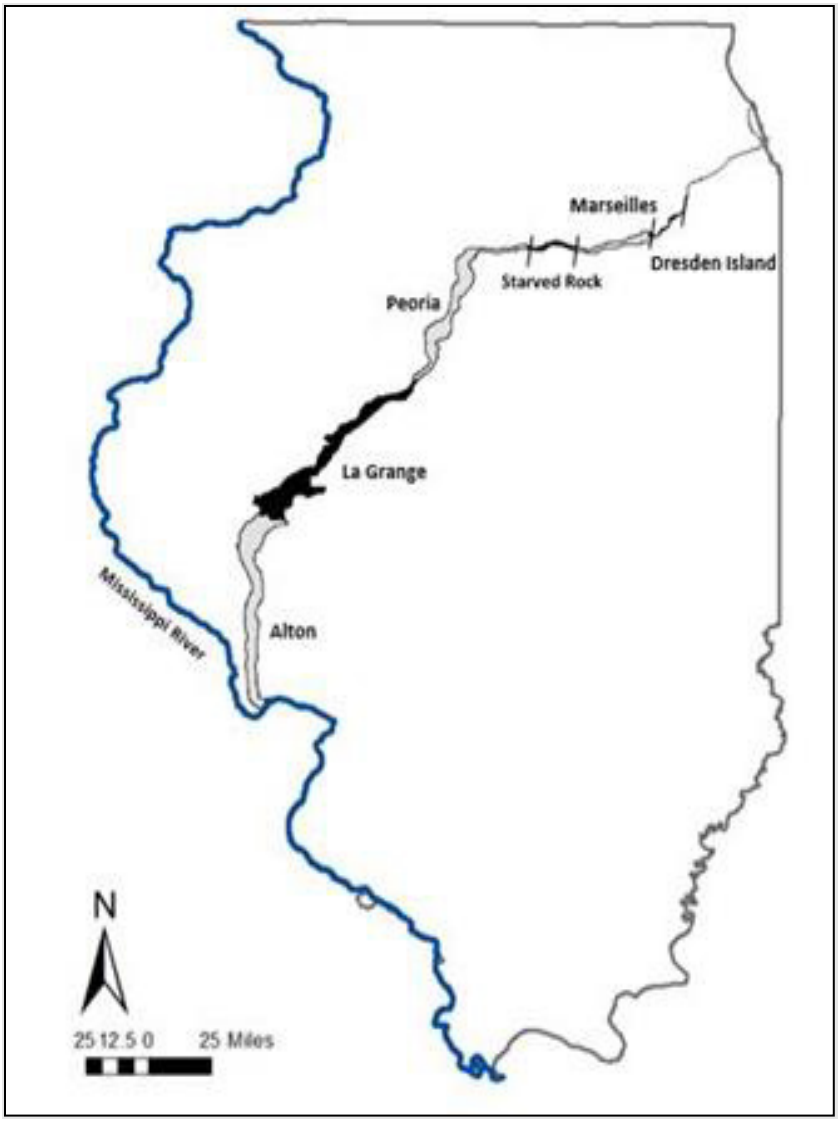
Project Summary

This project will develop objective fishery management models to inform agency decisions concerning invasive carp control efforts in the Illinois River (Alton, La Grange, Peoria, Starved Rock, Marseilles, and Dresden Island pools). This project will result in population models designed to identify management options that minimize the number of invasive carp advancing upriver and potentially challenging the EDBS. FY 2023 funding will produce advancements to existing decision-support tools and develop additional analytical models to address emerging management questions and assess the effectiveness of current management efforts.

Project Description

This project will continue ongoing efforts to develop and implement the SEICarP model. The SEICarP model simulates Silver Carp and Bighead Carp population dynamics and is used to support management in the Illinois River by informing (1) the required amounts and optimal locations of removal by harvest and scenarios for deterrence of upstream movement and (2) data collection and research needs to inform further model development to increase capabilities and reduce uncertainty. This project will continue to develop an invasive carp stock-recruitment relationship to determine how recruitment rates will respond to reductions in biomass from control actions. This project will also support efforts to estimate the rate at which individual fish in a given pool contribute to pools located above Starved Rock Lock and Dam. Lastly, this project will begin the development of a statistical catch-at-age model to estimate population characteristics and current mortality rates. Current estimates of fishing mortality can then be compared with harvest recommendations from the SEICarP model to better inform future management actions.

Figure B-46 — Project Area (DS-3)



DS-4: Invasive Carp Population Modeling to Support an Adaptive Management Framework for the Illinois River

- **Lead Agency:** USGS
- **Agency Collaboration:** USFWS, IL DNR, SIU, MSU
- **GLRI Funding:** $55,000
- **Agency Funding:** $289,069

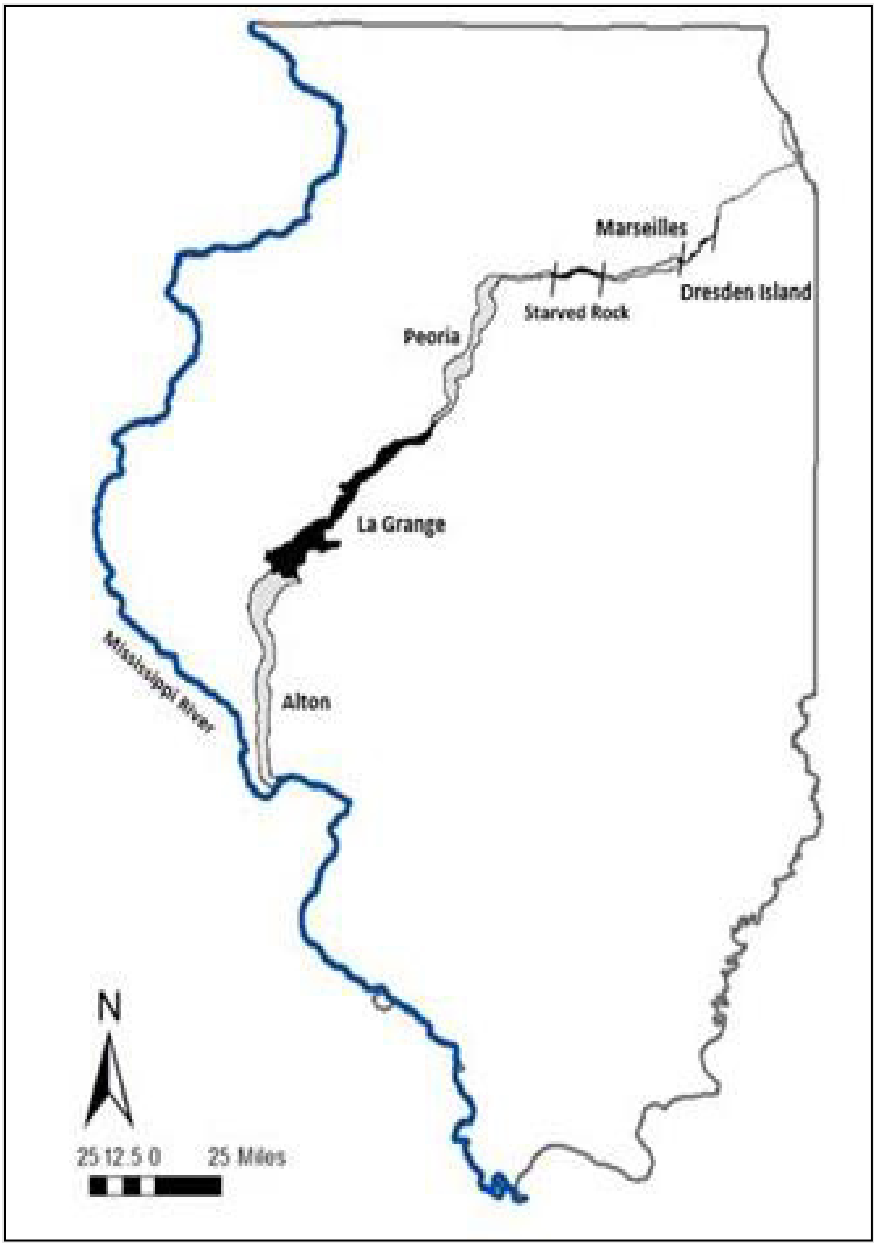
Project Summary

This project will develop objective data-driven models to inform decisions concerning invasive carp control efforts in the Alton, La Grange, Peoria, Starved Rock, Marseilles, and Dresden Island pools of the Illinois River in Illinois. This project will result in quantitative population models designed to help prevent invasive carp from becoming established in the Great Lakes by identifying management recommendations that minimize the number of invasive carp challenging the electrical dispersal barriers. FY 2023 funding will produce advancements in existing decision-support tools leading to better long-term management outcomes and developed novel models to address emerging management questions and the effectiveness of current management efforts.

Project Description

To address the limitations of the SEICarP model, this project will coordinate with the MRWG TWG to deliver an updated movement model with greater spatial coverage and finer spatial resolution. In addition, this project would recode the SEICarP model as needed to accept the updated movement model. To allow for the exploration of management scenarios that are of interest to management agencies, a workflow for operating the SEICarP model will also be developed. A fourth area of ongoing development involves using a metapopulation model to estimate the rate at which individuals in a given pool contribute to pools located above Starved Rock Lock and Dam. During FY 2023, this modeling effort will be extended to examine various fish movement barrier scenarios. Specifically, these modeling efforts will explore how the placement of a single or multiple barrier(s) will affect individual fish contributions to subpopulations at the leading edge of the invasive carp distribution.

Figure B-47 — Project Area (DS-4)



DS-5: Invasive Carp Database Management and Integration Support

- **Lead Agency:** USGS
- **Agency Collaboration:** USFWS, USACE, IL DNR, IA DNR, INHS, SIU, Iowa State University
- **GLRI Funding:** $70,000
- **Agency Funding:** $434,833

Project Summary

This project will provide data management and decision support tools in the upper Mississippi, Ohio, and lower Missouri subbasins. FY 2023 funding will produce a telemetry and catch dataset, a geographically expanded FishTracks database, an initial fish demographics database, a CarpDAT data catalog (hub) deployment, and enhanced telemetry and catch decision support tools.

Project Description

The overarching goal of this project is to provide data management, informational products, and decision support tools to aid and inform the management and removal of invasive carp in the Upper Mississippi, Ohio, and lower Missouri subbasins. Integrating and transforming invasive carp-related data sets into actionable information includes the following objectives:

- Maintaining the FishTracks Telemetry Database and ILRCdb applications, geographical expansion of FishTracks, and initial FishDemographics Database (FishTracks expansion).
- Furthering understanding of invasive carp life history and other factors that influence the efficacy and efficiency of contract removal and control (e.g., deterrents) and facilitate risk assessment.
- Incorporating understandings into analyses, informational products, and decision support tools to inform modeling efforts and management decisions to control invasive carp.
- Developing CarpDAT data catalog.

Figure B-48 — Project Study Area (DS-5)

MIGRATION PATHWAY ACTION

MP-1: Closure of Connection Between the Mississippi River Watershed and Great Lakes Watershed at Little Killbuck Creek, Ohio

- **Lead Agency:** OH DNR
- **Agency Collaboration:** None
- **GLRI Funding:** $2,000,000
- **Agency Funding:** $0

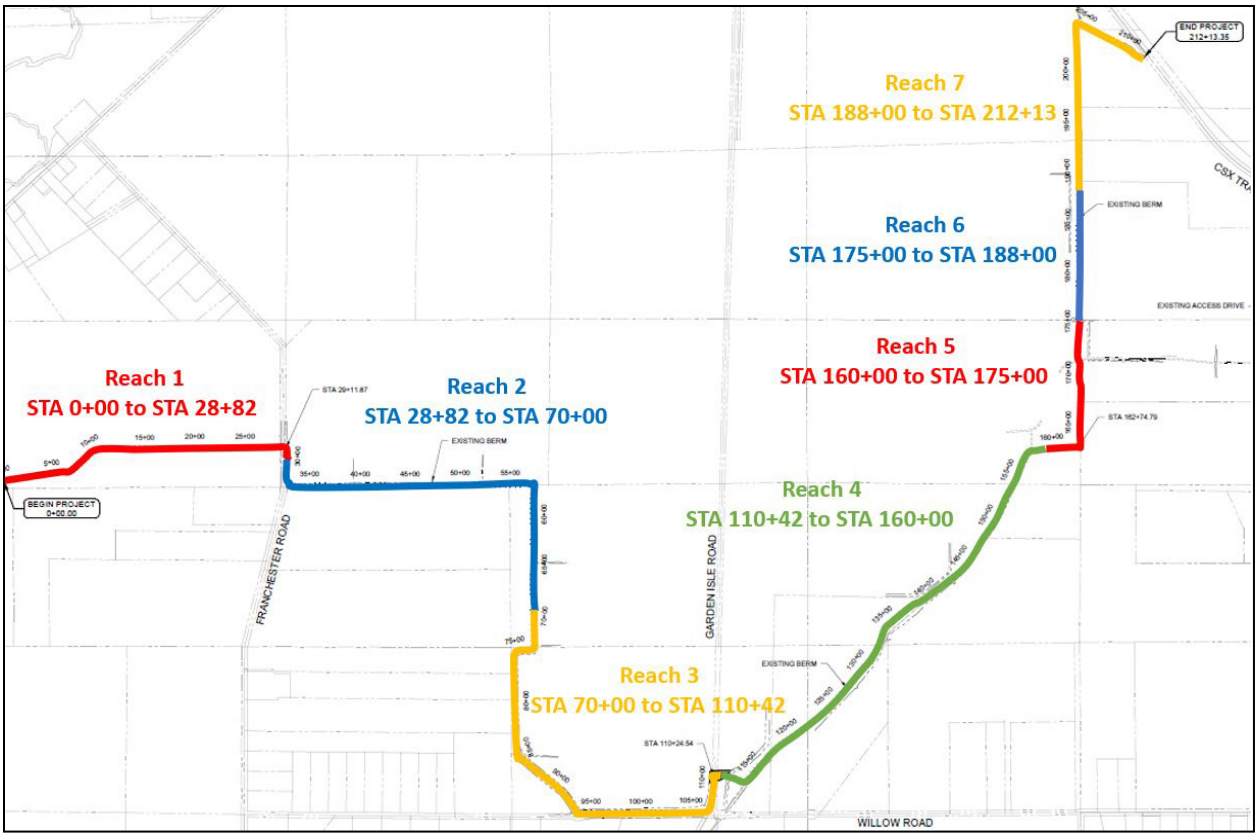
Project Summary

The GLMRIS determined that Little Killbuck Creek in Ohio is 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 goal of this project is to separate the basins and close this connection using an earthen berm. FY 2023 funding initiates construction in the location of Little Killbuck Creek, which has the highest current risk of flooding.

Project Description

The Little Killbuck Creek connection is a low-lying area that provides a direct water connection between the Mississippi River watershed (via the Ohio River) and the Lake Erie watershed during high-water events. The connection will be closed using a combination of a rock and earthen berm. Using previous funding, OH DNR will complete the berm design, secure easements, and complete permitting. FY 2023 funding will complete construction at the section upgrades. The remaining project will be phased over multiple years and will require completion of upgrades to sections of the berm currently at highest risk for flooding (Reach 1) and stabilization of other infrastructure in the remaining portion of the earthen berm at the Little Killbuck Creek site (Reaches 2-7).

Figure B-49 — Little Killbuck Creek Berm by Reach



COMMUNICATION ACTION

CM-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 2023 funding will create efficiencies in the ICRCC's strategic communication efforts and enable the development of new products that amplify the critically needed messaging identified by ICRCC members.

Project Description

FY 2023 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 management of the ICRCC website, InvasiveCarp.us; facilitating bi-monthly communications meetings between ICRCC member agencies in the Communications Work Group (co-chaired by USFWS and IL DNR); 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.

MISSION SUPPORT ACTION

MS-1: ICRCC Mission Support

- **Lead Agency:** USFWS
- **Agency Collaboration:** USEPA
- **GLRI Funding:** $214,300
- **Agency Funding:** $41,000

Project Summary

This project will provide staffing and logistical assistance on key coordination, communication, and outreach activities to support 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 prompt and accurate 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, 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 2023 include:

- Provide support to the ICRCC co-chairs on day-to-day activities of the ICRCC.
- Assist with convening ICRCC video teleconferences once a month (or as needed) for interagency discussion of relevant updates on invasive carp management.
- Assist in the development and release of the ICRCC's FY 2023 Invasive Carp Action Plan and initial scoping and planning for the development of the draft FY 2024 Action Plan.
- 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.
- Assist the ICRCC's MRWG in the development and release of the annual Monitoring Response Plan and Interim Summary Report as needed.

MS-2: GLMRIS Program Management

- **Lead Agency:** USACE
- **Agency Collaborators:** None
- **Agency Funding: $200,000**

Project Summary:

This project supports USACE coordination and communication with the ICRCC and the CAWS-AIS stakeholder group as efforts continue to prevent the spread of aquatic nuisance species in either direction between the Great Lakes and Mississippi River basins through the CSSC, and other aquatic pathways.

Project Description:

Proposed actions for FY 2023 include:

- Internal coordination, coordination with other agencies, coordination among and support to project elements within the geographical boundaries of the GLMRIS study area (see map below).
- Budget development and defense.
- Public outreach and stakeholder engagement.
- Response to Congressional and media inquiries.