2020

Asian Carp Action Plan

Asian Carp Regional Coordinating Committee

February 2020

Asian Carp Action Plan for Fiscal Year 2020

February 2020

Asian Carp Regional Coordinating Committee

Contributing Members:

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
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Great Lakes Fishery Commission
Great Lakes Commission
Metropolitan Water Reclamation District of Greater Chicago
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EXECUTIVE SUMMARY

The Asian Carp Regional Coordinating Committee's (ACRCC) 2020 Asian Carp Action Plan (Action Plan) contains a portfolio of high-priority detection, prevention, and control projects developed to support a comprehensive, multi-pronged, and science-based Asian carp management strategy. The Action Plan serves as a foundation for the work of the ACRCC partnership — a collaboration of 28 United States (U.S.) and Canadian federal, state, provincial, tribal, and local agencies— to achieve its mission to prevent the introduction and establishment of Asian carp in the Great Lakes.

Projects in the 2020 Action Plan are supported by a combination of $24,757,250 in agency funding and $21,000,000 in Great Lakes Restoration Initiative (GLRI) funding provided through fiscal year (FY) 2020 appropriations. *All FY 2020 funding projections are based on appropriations provided by Public Law number 116-94. FY 2020 funding amounts identified for U.S. Fish and Wildlife Service and U.S. Geological Survey are estimates and do not reflect final allocations.*

Developed annually since 2010, the Action Plan has continually evolved by incorporating advances in the most current science on Asian carp population status, life history, behavior, and risk assessment; and in management practices and technologies for early detection, prevention, and long-term control for Asian carp and other aquatic invasive species (AIS). The 2020 Action Plan builds upon prior efforts by applying lessons learned and using data and science to inform an adaptive management approach under which strategic enhancements are incorporated, when and where needed, to further reduce the threat to the Great Lakes from Asian carp. Many individual Action Plan projects target the control or assessment of specific Asian carp life stages or behaviors, with the full portfolio of agency activities designed to be complementary to achieve the maximum collective impact to control fish population numbers across key geographic locations. The Action Plan again includes key projects to address identified potential pathways or vectors for Asian carp movement and range expansion.

Building on 2019 efforts, the 2020 Action Plan provides an increasingly proactive approach to Asian carp control within the comprehensive strategy. This includes a goal of further reducing Asian carp populations in the Illinois Waterway (IWW) through intense removal to more aggressively address the potential threat of fish movement upstream towards the Great Lakes.

A key line of Great Lakes defense is the U.S. Army Corps of Engineers' (USACE) operation of the Electric Dispersal Barrier System (EDBS) in the Chicago Sanitary and Ship Canal (CSSC). The Des Plaines River Bypass Barrier and screens placed on sluice gate adjacent to the Chicago and T.J. O'Brien Locks are additional measures in place to address potential issues with the efficacy of the electric barriers. The EDBS is intended to stop the movement of juvenile and adult Asian carp towards the Great Lakes. In 2020, USACE will continue improvements to the EDBS, with full-time operation of the system scheduled for 2021, and continue to operate and maintain these three different types of fish deterrent measures (bypass barrier, electric barriers, and bar

screens on sluice gates) in the Chicago Area Waterway System (CAWS), each designed to prevent movement of Asian carp toward the Great Lakes in a different manner.

The ACRCC recognizes the value of increased harvest of Asian carp in the Illinois River informed by current fishery stock assessment data. A goal has been set of removing 15 million pounds annually by 2022 below the Starved Rock Dam. This enhanced removal is currently targeting the most upstream river reach first, the Peoria pool. This pilot project initiated in 2019 will continue to explore potential opportunities to make greater market use of adult Asian carp captured through commercial removal efforts conducted in support of the ACRCC's long-term population management goals and objectives for the Illinois River. Removal efforts will be informed by agency assessments of Asian carp population status and movement within the focused geographic range, most notably characterized by the density of fish at the population front within the Dresden Island pool.

An additional focus of the ACRCC is the development of underwater sound as a potential prevention and control technology. There are three basic components of the work being undertaken. The first component is the Barkley bio-acoustic fish fence (BAFF) Deployment Project. This component is a large-scale experimental deployment of the BAFF system at Barkley Dam near Grand Rivers, Kentucky. The recently installed system includes operations and initiation of a demonstration for Barkley BAFF evaluation. The second component is the Lock and Dam 19 Acoustic Deterrent System (ADS) Deployment Project. This effort will continue coordination among a multi-agency science and evaluation team to determine feasibility for a large-scale experimental deployment in the Upper Mississippi River at Lock and Dam 19 near Keokuk, Iowa. The third component is the ongoing research and development related to acoustic deterrents, including engineering of new acoustic signals and testing of signals in ponds and/or in the field on Asian carp and native fishes as well as acoustic deterrent designs.

The ACRCC is increasing focus on phasing potential control tools with demonstrated success into broader strategies, when and where possible, to achieve its mission. One of these control tools is carbon dioxide (CO_2), which is being investigated as a potential deterrent to Asian carp. The concept is to introduce CO_2 into water to deter or immobilize Asian carp from moving upstream. Several published studies at laboratory, mesocosm, and field settings have demonstrated that Asian carp and other fishes are repelled from areas with elevated CO_2 concentrations. This avoidance mechanism could be useful for management agencies to restrict movement through key pinch-points (e.g. navigation structures) and better control range expansion towards the Great Lakes and other large river basins. In 2019, the U.S. Geological Survey (USGS) and the U.S. Fish and Wildlife Service (USFWS) obtained a Section 3 registration from the U.S. Environmental Protection Agency (USEPA) for Carbon Dioxide-Carp as a new aquatic pesticide. Approved uses included are as an Asian carp deterrent and as a non-selective under-ice lethal control for aquatic nuisance species (ANS). Also, an economic engineering feasibility study was conducted within a navigation lock in Kaukauna, Wisconsin. This study demonstrated the installation and operation of a large-scale CO_2 infusion system and collected

data on operational costs, fish behavior, non-target organisms, human health risk assessment, and water quality. Proposed next steps focus on transitioning CO_2 from research to implementation for management use and will finalize work that began in FY 2019.

The ACRCC will increase focus on phasing potential control tools with demonstrated success into broader strategies, when and where possible, to achieve its mission.

In 2020, the Action Plan again features key baseline interagency surveillance efforts, including telemetry; electrofishing and netting; environmental deoxyribonucleic acid (eDNA) monitoring; and interagency contingency response plans developed specifically for potential rapid-response in the event of new detections of Asian carp of all life stages in the CAWS and the Illinois and Des Plaines Rivers upstream of the Starved Rock Lock and Dam.

The ACRCC is continuing to develop and refine the Spatially Explicit Asian Carp Model (SEAcarP) population model to help maximize fishing harvest effectiveness with the goal of reducing numbers of adult Asian carp in targeted areas of the Illinois River. The SEAcarP model serves as a decision support tool to inform the optional location and timing of fishing efforts on the water, and to help identify additional key Asian carp population and life history data collection needs. In FY 2020 the following efforts will be undertaken:

- Provide demographic information annually to the SEAcarP model.
- Complete sensitivity analyses and develop a prioritized list of data and research needs based on results thereof.
- Transition the SEAcarP model to a multi-basin framework to take advantage of combined Upper Mississippi River and Illinois River telemetry modeling – accounting for complex source-sink dynamics will improve Illinois River SEAcarP model predictions.
- Implement Statistical Catch at Length modeling to estimate vulnerability to fishing as a function of fish size, exploitation rates, and immigration into the upper Illinois River Waterway.

The portfolio of FY 2020 initiatives are summarized below under the following complementary Action Plan focus areas:

1. PREVENTION ACTIONS

- **Current Barrier System in the CAWS** – USACE will continue to operate three different types of fish deterrent measures (bypass barrier, electric barriers, and bar screens on sluice gates) in the CAWS; each designed to prevent movement of Asian carp toward the Great Lakes in a different manner.
- **Construction of a New Electric Barrier** – Construction of an upgrade to the Demonstration Barrier I to a permanent facility is being completed in stages via multiple contracts. Completion of this barrier, known as Permanent Barrier I, will signal the completion of construction on the CSSC EDBS. Construction of the new control building,

utility connections, and backup power systems were completed in 2018. The Demonstration Barrier electrodes were replaced in 2019. Work on the remaining two major contracts, installation of the specialized pulse-generating system, is underway. Permanent Barrier I is scheduled for full time operation in 2021.

- **Closure Actions at Little Killbuck Creek Pathway** – In FY 2018, the Ohio Department of Natural Resources (DNR) worked with the local landowner and completed the 25 percent design of the proposed construction effort, determined the proposed berm alignment, developed additional hydraulic modeling to assess potential flooding, acquired easements on four parcels for the construction of the berm, and facilitated a meeting with the Potentially Affected Interests. In FY 2019, USACE completed a peer review of Ohio DNR's findings and recommended alternative designs for the project. Ohio DNR selected an alternative design and is completing appraisals and acquiring easements for the properties needed for berm construction. In FY 2020, Ohio DNR will be completing the 100% design for the construction of the berm.

  Closure Actions at Ohio-Erie Canal Pathway – This project will prevent or reduce the probability of ANS (e.g. Asian carp) being able to move from the Tuscarawas River Watershed (Mississippi River basin) into the Cuyahoga River Watershed (Great Lakes basin) via the Ohio-Erie Canal. The canal towpath that forms the basin divide between Mississippi River and Great Lakes basins is now a trail prized for its recreational value and historical significance. At most locations, hydrologic separation of the two basins is being accomplished by raising the ground surfaces in low areas. In other locations where separation is not practical, fences or screens are being installed. While the actual pathway was closed in December 2019, the project will be completed in early 2020.

2. CONTROL MEASURES

- **Contract Fishing, Seining, and Netting** – Contracted commercial fishing will be used to reduce the numbers of Asian carp in the upper Illinois and lower Des Plaines rivers downstream of the EDBS. Commercial fishers will be employed to harvest as many Asian carp as possible in the Starved Rock and Marseilles pools. Harvested fish will be utilized by private industry for purposes other than human consumption. In 2019, over 1.5 million pounds of Asian carp were removed from this portion of the Upper IWW.
- Control efforts have contributed to significant reductions in carp densities in Dresden Island pool (2018 levels approximately 4% of the Asian carp density found in 2012). Efforts in 2020 will continue as enhanced in 2019 and will include utilizing nine contracted commercial fishers to conduct directed contracted fishing projects described in the 2020 Monitoring Response Plan (MRP) as follows:
  - Manage and control through removal in Starved Rock, Marseilles, and Dresden Island pools.

  - Detection between current Asian carp population front and EDBS in Brandon Road and Lockport pools.
  - Detection in the CAWS within the Seasonal Intensive Monitoring program.
  - Deployment of prescribed netting efforts such as seines, or needs requiring short notice.
  - Contingency response measures at various locations, as needed.

- **Asian Carp Enhanced Contract Removal Program Development (Peoria pool)** – The primary goal is to increase removal of Asian carp from the Lower IWW, targeting Peoria pool, then considering other Illinois River pools. This effort will continue implementation of two key impactful recommendations identified in a comprehensive Business Analysis Plan. One key recommendation of the Business Analysis Plan is creation of the Enhanced Contract Fishing Program, initiated in September 2019. Over the first 6 weeks of the program, 16 contracts were executed with Illinois-licensed commercial fishermen and over 100,000 pounds of Asian carp removed from the Peoria pool. The goal of removing 4.5 million pounds is anticipated to be achieved prior to year-end 2020. To measure removal effects, Southern Illinois University (SIU) also has begun an analysis using data from the Enhanced Contract Fishing Program to conduct a fish population study.

  Other recommendations made in the Business Analysis Plan pertain to marketing, to support the creation of a positive brand for Asian carp that will help product-makers and processors better utilize potential markets, ultimately to support increased removal and risk reduction. Work to initiate a brand development process is underway along with the start of the Market Value Program to provide small-sized, matched grant funding to processors and product makers to defray the costs of travel and trade-show attendance that support efforts to increase sales of Asian carp products and ultimately support the directed removal and control efforts in the IWW.

  Proposed actions for FY 2020 will continue to build on successes of 2019:

  - Removal goal under the Enhanced Contract Fishing Program will be increased to 8 million pounds in the Peoria pool. At this volume, it is expected that additional processing capability will enter Illinois in 2020 and that the number and/or efficiency of fishermen will grow, increasing supply of Asian carp to reliably support growth of Asian carp products and sustained removal.
  - Production of ice is a key component of preserving freshness and improving distances over which Asian carp (harvested fish product) can be transported. Having ice available to cool fish immediately following removal from the water is essential to their ability to be used for human consumption. This effort may include added capacity and increased access to readily-available bulk ice for use by commercial fishers in advance of harvesting Asian carp in the Peoria pool. Increase harvest is expected with this component as it effectively lengthens the

fishing season by preventing spoilage as well as increasing value and quality of harvested fish throughout most of the year.

- To support interest among fish processors and to satisfy application requests, efforts will continue to make available small grant funds to assist processors and product makers to market their products. To receive reimbursement under the program, the applicant must provide a 20% match and use Illinois-caught Asian carp to make their products.
- Continued implementation of the new Asian carp brand and marketing strategy currently under development is important to support fish processors and product makers to increase Asian carp product sales.

- **Asian Carp Population Model and Demographics** – In 2020, the SEAcarP model will again be used to inform potential combinations of management actions needed to achieve the maximum net impact on Asian carp population levels for specific locations in the IWW. The expanded model will incorporate key data with a focus on Asian carp control in the six lower pools in the IWW (Alton, La Grange, Peoria, Starved Rock, Marseilles, and Dresden Island), while also providing critical information on growth and year-class strength and informing our understanding of the risk of upstream migration using the most current data. The model and resulting management recommendations will be annually updated and improved based on expert feedback and new information gathered from ongoing monitoring for population changes.

3. TECHNOLOGY DEVELOPMENT

The ACRCC is developing control technologies to improve the overall efficacy of the defense of the Great Lakes by providing layered defenses and additional safety nets, ultimately offering greater confidence in their containment ability. The following are summaries of the control measures that will be undertaken in 2020:

- **Use of Underwater Sound** – There are three basic components to the work being undertaken in FY 2020. The first component is the Barkley BAFF Deployment Project. This component will be a large-scale experimental deployment of the BAFF system at Barkley Dam near Grand Rivers, Kentucky. The recently installed system includes operations and initiation of a demonstration for Barkley BAFF evaluation. The second component is the Lock and Dam 19 ADS Deployment Project. This component will continue coordination among a multi-agency science and evaluation team to determine feasibility for a large-scale experimental deployment in the Upper Mississippi River at Lock and Dam 19 near Keokuk, Iowa. The third component is the ongoing research and development related to acoustic deterrents, including engineering of new acoustic signals and testing of signals in ponds and/or in the field on Asian carp and native fishes as well as acoustic deterrent designs.

- **Carbon Dioxide (CO_2)** – Increased efforts have been undertaken to field test underwater sound and CO_2 as a potential technology for Asian carp control. The ACRCC is increasing focus on phasing potential control tools with demonstrated success into broader strategies, when and where possible, to achieve its mission. CO_2 is being investigated as a potential deterrent to Asian carp. The concept is to introduce CO_2 into water to deter or immobilize Asian carp from moving upstream. Several published studies at laboratory, mesocosm and field settings have demonstrated that Asian carp and other fishes are repelled from areas with elevated CO_2 concentrations. This avoidance mechanism could be useful for management agencies to restrict movement through key pinch-points (e.g. navigation structures) and better control range expansion towards the Great Lakes and other large river basins.

  State and federal partners completed several important milestones in 2019. The USGS and USFWS obtained a Section 3 registration from USEPA for Carbon Dioxide-Carp as a new aquatic pesticide. Approved uses included deployment as a non-lethal Asian carp deterrent, and as a non-selective lethal control for use under ice for ANS. Also, an economic and engineering feasibility study was conducted within a navigation lock in Wisconsin. This study demonstrated the installation and operation of a large-scale CO_2 infusion system and collected data on operational costs, fish behavior, non-target organisms, human health risk assessment, and water quality. Proposed next steps are intended to transition CO_2 from research to management and will finalize work that was completed in FY 2019.

- **Microparticle** – No current technology can specifically target Asian carp for control within aquatic ecosystems. Available toxicants used in aquatic invasive species control programs are non-selective and are applied throughout the entire water column, resulting in equal exposures of native and invasive species alike. Developing delivery systems that target feeding strategies of specific organisms, like an Asian carp, would increase the ability of management agencies to control or limit a species like Asian carp, while minimizing potential impacts on native species. In 2020, USGS will be consulting with USEPA to identify which studies would likely be accepted and which studies will need to be redone for registration of an Asian carp toxicant and will submit registration packet for antimycin-A in a Fintrol formulation. USGS will also finalize environmental fate studies for microparticle.
- **Barge Entrainment** – USFWS, USACE, and USGS have conducted several years of studies showing that small fish can become inadvertently entrained within junction gaps of commercial tows and transported over long distances (at least 15.5 kilometers through locks, and through the EDBS; herein referred to as barge entrainment). In 2017, a scale physical model and a proof-of-concept field study showed that water jets and water jets with compressed air could achieve some level of efficacy in mitigating barge entrainment by clearing fish from tows. These findings led to the hypothesis that

compressed air bubble curtains may be used in place of water jets to clear fish from tows. The agencies are trying to determine if existing compressed air systems in lock structures on the Illinois River, specifically sill bubble curtains designed for ice removal, have potential to mitigate for small Asian carp entrainment.

In 2020, the USACE Engineer and Research Development Center (ERDC) is using a physical model of the CSSC with remote control tow and barges to (1) test the efficacy of compressed air bubble curtains to remove entrained neutrally buoyant fish surrogates from tows, and to (2) quantify changes in flow dynamics within the hydraulic recesses during passage over a bubble curtain. USGS conducted hydraulic surveys of the lower sill bubble curtain at Peoria Lock and Dam in September 2019. This lock is representative of navigation locks from around the country including other areas where Asian carp are found such as Barkley Lock and Dam and Pickwick Lock and Dam in Kentucky and Tennessee, respectively. This data will be used to validate results from the physical model and to inform planned field trials.

- In 2020, the agencies will test the efficacy of a sill bubble curtain in mitigating barge entrainment at the field scale. Planning and contracting for these field tests will occur in 2020 and the field tests are planned at Peoria Lock and Dam in 2021. Field scale testing will entail a mark and recapture study in which live fish are marked with unique fin clips and placed in the junction gap of a tow. A barge tow will enter the lock chamber, passing over the bubble curtain, and the number of fish remaining in the junction gap will be determined through a combination of recapture attempts and sonar observations. The planned field tests will also include hydroacoustic water velocity measurements in the junction gap space, around the tow, and in the lock chamber.

4. EARLY DETECTION, MONITORING AND ASSESSMENT

Continued monitoring and assessment of the Asian carp population in the Upper Illinois River are critical to the ACRCC's ability to assess the threat of Asian carp upstream movement and range expansion. The following describes the early detection, monitoring, and assessment activities being undertaken under these methods in 2020:

- **Monitoring Upstream of the EDBS** – In 2020, a variety of gears will be used during seasonal intensive monitoring activities as in past years, including pulsed Direct Current (DC)-electrofishing, trammel and gill nets, deep water gill nets, a commercial seine, trap nets, hoop nets and Great Lake pound nets to detect, capture and subsequently remove any Asian carp present. Additional intensive monitoring will occur in Lake Calumet (spring 2020) and the North Shore channel (fall 2020). Bi-annual eDNA assessments will assist informing detection strategies, see below Comprehensive Interagency eDNA Monitoring Program.
- **Monitoring Downstream of the EDBS** –Multiple ACRCC agencies will contribute to initiation of the Multiple Agency Monitoring of the Illinois River for Decision Making

project in 2020, which will provide a robust, unbiased, and statistically powerful dataset that is comparable over time, among multiple agencies, and across river basins. Utilizing a stratified random approach to data collection in reaches of the Illinois River should provide unbiased estimates of Asian carp population demographics capable of being extrapolated among strata, pools, and time increasing the understanding of Asian carp population demographics below the EDBS, and the threat of possible Asian carp invasion upstream the EDBS. Appropriate fixed sites will be sampled to augment the standardized program as needed.

- **Comprehensive Interagency eDNA Monitoring Program** – USFWS, in cooperation with state partners, will continue to monitor for the presence of Asian carp eDNA in the Great Lakes, Upper Mississippi River, and Ohio River basins. USFWS will continue to process water samples collected, in collaboration with our state and tribal partners, to detect the presence of Asian carp DNA in areas of concern. This will include the CAWS of the IWW and will include two sampling events in 2020. USFWS will continue to upgrade its field sampling infrastructure and its collection and sample processing techniques as new technologies emerge.
- **Asian Carp Stock Assessment in the Upper Illinois River** – Hydroacoustic sampling will occur for multiple purposes, including whole-pool sampling in Marseilles and Dresden Island pools every other month from February through October. Hydroacoustic sampling will also take place before and after any Unified Method events in spring and fall to provide density heatmaps (maps of Asian carp density) to inform harvest events and to assess effectiveness of harvest at reducing densities. Finally, hydroacoustic sampling will be conducted in October at standardized locations from Alton to Dresden Island pools in order to quantify pool-wide bigheaded carp (Bighead Carp and Silver Carp) densities that will be compared to long-term (since 2012) density trends. A program of enhanced fishing of bigheaded carp in the Peoria pool began in September 2019. Hydroacoustic surveys will be conducted at select sites in Peoria pool every other month from February to October. The resulting data will allow for a better ability to assess effects on bigheaded carp densities, size distributions, and spatial distributions, and to relate these potential changes to harvest from the enhanced fishing program.
- **Great Lakes Monitoring** – In 2020, USFWS will work with partners to continue developing and adapting standard sampling protocols targeting AIS in the Great Lakes. Working in coordination with State partners, USFWS will be prepared, and may be mobilized, to respond to any Bighead or Silver Carp detected (using either traditional gear or eDNA) in the Great Lakes. USFWS and partner agencies will fully implement a comprehensive Great Lakes basin wide early detection and monitoring program for Asian carp and other AIS. Efforts will continue on an annual basis to monitor the movement.

5. RESPONSE ACTIONS

The ACRCC will be prepared to shift monitoring resources as needed informed by the most current data on Asian carp location and status. As in past years, if new findings indicate an increased risk within a specific location, resources will be available to transition to the involved areas, as necessary. Enhanced monitoring, analysis, and decision-support tools would be utilized to provide additional key data. In 2020, the ACRCC will be prepared to address contingency actions through the Monitoring and Response Work Group's (MRWG) Contingency Response Plan (CRP) in the event a change is detected in the status/risk considering all life stages of Asian carp in the Starved Rock, Marseilles, Dresden Island, Brandon Road, and Lockport pools. The ACRCC will be prepared to respond rapidly and shift monitoring resources as new information becomes available.

6. BLACK CARP

Black Carp is an invasive species that is undergoing rapid expansion in the U.S. commercial fishers and fishery biologists have collectively reported over 700 captures of Black Carp since 1994, with the majority of fish collected in the last 5 years.

In 2020, efforts to continue monitoring of Black Carp will continue to take advantage of an Illinois DNR-funded bounty program to encourage reporting of fish commonly caught in commercial gears or by public by way of bow fishing or other similar activities. Additional sampling for all life stages will continue, with the evidence of natural reproduction identified for the last several years around Cape Girardeau, Missouri. Development of a species-specific bait by USGS is underway, as well as refinement of genetic surveillance tools, including eDNA, and telemetry in Missouri will be initiated to understand the habitat use and movement of this species in the Mississippi River.

The ACRCC monitors for Black Carp and other Asian carp in the Upper Illinois River. To date, no Black Carp have been found upstream of Starved Rock Lock and Dam.

7. GRASS CARP

U.S. and Canadian resource agencies in the Lake Erie basin have identified the threat of invasive Grass Carp as a high priority requiring focused and aggressive assessment and control action. Member agencies have developed a suite of proposed actions for implementation, building off existing efforts within the Lake Erie basin. Planning is being conducted in collaboration with the Great Lakes Fishery Commission's (GLFC) Council of Great Lakes Fishery Agencies, Invasive Fishes Executive Committee, and the Lake Erie Committee (LEC).

Because the spawning and early life history requirements of Grass Carp are similar to Bighead Carp and Silver Carp, USGS scientists have built on their existing knowledge base to identify two Lake Erie tributaries where Grass Carp are spawning.

State, provincial, and federal agencies from both Canada and the U.S. have collaborated to develop and implement Grass Carp removal techniques for river systems under differing flow

regimes. Michigan and Ohio expect to increase their removal activity in FY 2020 with support from the GLRI funding and assistance from USFWS, USGS, and GLFC. This increased removal effort, coupled with research into additional control strategies, should increase the ability of agencies to control the Grass Carp population in the short term and allow for continued progress toward eventual eradication of Grass Carp in Lake Erie. Research conducted by USGS will provide additional assistance to ongoing management activities.

For the last two years, three strike teams, one each from USFWS, Michigan DNR, and Ohio DNR, have operated in the Lake Erie basin. In 2020, two additional strike teams will be available through GLRI funding, plus two more teams through funding to the GLFC. For FY 2020, the LEC believes that substantially increasing the number of strike teams is its highest priority, as it seeks to meet its objective of removing 390 Grass Carp annually. In 2020, four additional strike teams will be available, increasing the number to seven strike teams.

A second priority, to evaluate the feasibility of a seasonal barrier in the Sandusky River, has funding in hand to complete that work. Additional funding may be needed pending the results of the feasibility study. The third priority of the LEC is to reduce critical uncertainties. Key activities that will help the LEC reduce uncertainties about where and when to target removal include maintaining support for real-time fish telemetry receivers, additional sampling for eggs in Ohio tributaries, and expanding telemetry coverage to improve its understanding of Grass Carp movement patterns.

Illinois River efforts continue to detect and remove Grass Carp throughout all pools where they are present and are managed as an Asian carp in the MRP.

8. COMMUNICATION/EDUCATION/STAKEHOLDER ENGAGEMENT

In 2020, USFWS will continue to lead the implementation of targeted ACRCC communication efforts, including managing the ACRCC website, www.AsianCarp.us; organizing public listening sessions; developing targeted media outreach; coordinating partner responses to public, congressional and media inquiries; refining, as needed, ACRCC early detection notification protocols; creating ACRCC branded communication products; enhancing the ACRCC's image library and ultimately increasing the reach of ACRCC messaging. These efforts will be conducted in coordination with the ACRCC Communication Work Group, co-chaired by USFWS and Illinois DNR. Communications work will contribute to key audiences having a greater understanding and appreciation for the ACRCC's purpose, function, current actions and successes. Efforts will include:

- Building upon the new logo and the rebuilt website, USFWS will lead the effort to continue to grow and reinforce the ACRCC's brand.
- Enhancing Teacher Resources on www.AsianCarp.us.
- Developing a Grass Carp Identification Video.

9. ACRCC PARTNERSHIP OPERATIONS

In 2020 the ACRCC will continue to collaborate with our partners to:

- Coordinate meetings and communications of the ACRCC and its subcommittees and work groups to ensure effective development and implementation of the annual Action Plan, the MRP, and other related strategic plans; and to ensure ongoing interagency information-sharing and dialogue in support of the partnership mission.
- Provide timely and substantive technical information to Congress, the public, media, and other stakeholders on the status of the Asian carp threat, and the coordinated strategic actions undertaken by the ACRCC to address the threat.
- Collaborate with other Asian carp management efforts and partnerships outside the Great Lakes to leverage opportunities, best practices, strategies, and resources on Asian 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). This includes continuing to seek opportunities to leverage key developments and lessons learned to benefit the ACRCC mission of Great Lakes protection and provide additional benefits to other basinwide Asian carp partnerships.
- Continue to work with the CAWS AIS Stakeholder Advisory Group and the Great Lakes and Mississippi River Interbasin Study (GLMRIS) Executive Steering Committee to engage stakeholders on potential solutions to prevent Asian carp from moving through the CAWS and establishing self-sustaining populations.
- Continue working with the Technical and Policy Work Group (TPWG), a non-federal entity composed of members from stakeholder organizations, public-sector agencies, the scientific community, academia, and others. While the TPWG is not part of the ACRCC organization, it consults with the ACRCC and other agencies on invasive species matters. The current TPWG is chaired by a representative of the Chemical Industry Council of Illinois.

These collaborative efforts will further allow partners to identify expertise, share data, and increase capacity to more broadly address the threat region-wide, across multiple basins, where possible.

In support of the strategy, two appendices are included with this Action Plan:

- Appendix A includes the FY 2020 Project Funding Matrix. *All FY 2020 funding projections are based on appropriations provided by Public Law Number 116-94.*
- Appendix B provides a full listing of FY 2020 action items, project descriptions, and intended outcomes.

1.0 INTRODUCTION

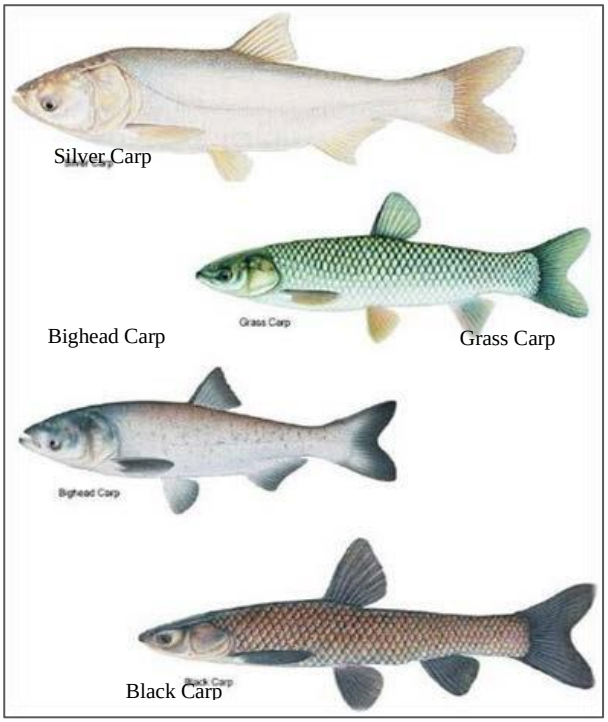
This section provides the reader with an explanation of the strategy and purpose of the Asian Carp Regional Coordinating Committee (ACRCC) Action Plan, the role and mission of the ACRCC, the ways in which this Action Plan drives efforts to reduce the threat of Asian carp, and background information to understand the threat of Asian carp.

1.1 ABOUT THIS STRATEGY

The ACRCC's mission is to prevent the introduction and establishment of Asian carp in the Great Lakes.

The ACRCC's 2020 Action Plan contains a portfolio of high priority detection, prevention, and control projects developed to support a comprehensive, multi-pronged, and science-based Asian carp management strategy. The Action Plan serves as a foundation for the work of the ACRCC partnership — a collaboration of 28 United States (U.S.) and Canadian federal, state, provincial, tribal, and local agencies— to achieve its mission to prevent the introduction and establishment of Asian carp in the Great Lakes.

Developed annually since 2010, the Action Plan has continually evolved by incorporating advances in the most current science on Asian carp population status, life history, behavior, and risk assessment, and in management practices and technologies for early detection, prevention, and long-term control for Asian carp and other aquatic invasive species (AIS). The 2020 Action Plan builds upon prior approaches by applying lessons learned using data and science to inform an adaptive management approach under which strategic enhancements are incorporated, when and where needed, for increased effectiveness at reducing the risk from Asian carp. Many individual Action Plan projects target the control or assessment of specific Asian carp life stages or behaviors, with the full portfolio of agency activities designed to be complementary to achieve the maximum collective impact to control fish population numbers and geographic range. A primary goal



Throughout this document, the term Asian carp refers to the following four species: Silver Carp (H. molitrix), Grass Carp (Ctenopharyngodon idella), Bighead Carp (Hypophthalmichthys nobilis), and Black Carp (Mylopharyngodon piceus).

of a subset of 2020 Action Plan activities is to dramatically reduce Asian carp populations in the Illinois River, resulting in a reduced threat of fish movement upstream towards the Great Lakes.

The 2020 Action Plan continues to provide an increasingly aggressive approach to Asian carp control. This includes a goal of further reducing Asian carp populations in the Illinois Waterway (IWW) to more proactively address the potential threat of fish movement upstream towards the Great Lakes.

A principal line of defense for protection the Great Lakes from Asian carp is the U.S. Army Corps of Engineers (USACE) operation of the Electrical Dispersal Barrier System (EDBS) in the Chicago Sanitary and Ship Canal (CSSC). Installation of the specialized pulse-generating system for Permanent Barrier I continues, with full time operation of the new system scheduled for 2021.

The Des Plaines River Bypass Barrier and screens placed on sluice gates adjacent to the Chicago and T.J. O'Brien Locks are additional measures in place to address potential issues with the efficacy of the electric barriers. The EDBS is intended to stop the movement of juvenile and adult Asian carp towards the Great Lakes. In 2020, USACE will continue to operate and maintain these three different types of fish deterrent measures (bypass barrier, electric barriers, and bar screens on sluice gates) in the Chicago Area Waterway System (CAWS), each designed to prevent movement of Asian carp toward the Great Lakes in a different manner.

The ACRCC recognizes the value of increased harvest of Asian carp in the Illinois River informed by current fishery stock assessment data. A goal has been set of removing 15 million pounds annually by 2022 below the Starved Rock Dam. This enhanced removal is currently targeting the most upstream river reach first, the Peoria pool. In 2019 the directed use of contract commercial fishing will again be increased to achieve even greater annual harvest of adult Asian carp in key locations in the upper Illinois River to support ACRCC management goals. Also, in 2019, a project was initiated to explore potential opportunities to make greater market use of adult Asian carp captured through commercial removal efforts conducted in support of the ACRCC's long-term population management goals and objectives for the Illinois River. This effort will continue in 2020. Removal efforts will be informed by agency assessments of Asian carp population status and movement within the focused geographic range, most notably characterized by the density of Asian carp at the population front within Dresden Island pool.

A component of the 2020 ACRCC efforts includes the use of underwater sound as a potential control technology. There are three basic components to the work being undertaken. The first component is the Barkley Bio-Acoustic Fish Fence (BAFF) Deployment Project. This component is a large-scale experimental deployment of the BAFF system at Barkley Dam near Grand Rivers, Kentucky. This includes the recently completed system installation, operation and evaluation of the demonstration of the Barkley BAFF system. The second component is the Lock and Dam 19 Acoustic Deterrent System (ADS) Deployment Project. This component will continue coordination among a multi-agency science and evaluation team to determine feasibility for a large-scale experimental deployment in the Upper Mississippi River at Lock and Dam 19 near Keokuk, Iowa. The third component is the ongoing research and development related to

acoustic deterrents, including engineering of new acoustic signals and testing of signals in ponds and/or the field on Asian carp and native fishes as well as acoustic deterrent designs.

Increased efforts have been undertaken to field test underwater sound and carbon dioxide (CO_2) as a potential technology for Asian carp control. CO_2 is being investigated as a potential deterrent to Asian carp. The concept is to introduce CO_2 into water to deter or immobilize Asian carp from moving upstream. Several published studies at laboratory, mesocosm and field settings have demonstrated that Asian carp and other fishes are repelled from areas with elevated CO_2 concentrations. This avoidance mechanism could be useful for management agencies to restrict movement through key pinch-points (e.g. navigation structures) and better control range expansion towards the Great Lakes and other large river basins.

State and federal partners completed several important milestones in 2019. The U.S. Geological Survey (USGS) and U.S. Fish and Wildlife Service (USFWS) obtained a Section 3 registration from the U.S. Environmental Protection Agency (USEPA) for Carbon Dioxide-Carp as a new aquatic pesticide. Approved uses included as an Asian carp deterrent and as a non-selective under-ice lethal control for aquatic nuisance species (ANS). Also, an economic and engineering feasibility study was conducted within a navigation lock in Wisconsin. This study demonstrated the installation and operation of a large-scale CO_2 infusion system and collected data on operational costs, fish behavior, non-target organisms, human health risk assessment, and water quality.

Proposed next steps are intended to transition CO_2 from research to management and will finalize work that was completed in Fiscal Year (FY) 2019. Actions that will be taken in 2020 include:

- Complete data analysis and report writing from FY 2019 toxicity trials.
- Complete data analysis and report writing from FY 2019 navigation lock field trials.
- Conduct studies to support Carbon Dioxide-Carp registration within individual states.
- Develop a Carbon Dioxide-Carp pesticide reporting system.
- Initiate Section 3 registration of dry ice (solid state CO_2) for lethal control applications.

No current technology can specifically target Asian carp for control within aquatic ecosystems. Available toxicants used in aquatic invasive species control programs are non-selective and are applied throughout the entire water column, resulting in equal exposures of native and invasive species alike. Developing delivery systems that target feeding strategies of specific organisms, like an Asian carp, would increase the ability of management agencies to control or limit a species like Asian carp, while minimizing potential impacts on native species. In 2020, USGS will consult with USEPA to identify which studies would likely be accepted and which studies will need to be redone for registration of an Asian carp toxicant and will submit registration packet for antimycin-A in a Fintrol formulation. USGS will also finalize environmental fate studies for microparticle.

In 2020, the Action Plan will again feature key baseline interagency surveillance efforts, including telemetry, electrofishing and netting, and environmental deoxyribonucleic acid (eDNA)

monitoring; and interagency contingency response plans developed specifically for potential rapid-response in the event of new detections of Asian carp of all life stages in the CAWS and the Illinois and Des Plaines Rivers, upstream of the Starved Rock Lock and Dam.

The ACRCC is continuing the development and refinement of the Spatially Explicit Asian Carp Model (SEAcarP) population model that will be used to maximize fishing harvest effectiveness to reduce numbers of adult Asian carp in the Illinois River by optimizing location and timing of effort on the water. The SEAcarP model may assist decision support for prioritizing Asian carp research and data collections. In FY 2020 the following efforts will be undertaken:

- Provide demographic information annually to the SEAcarP model.
- Complete sensitivity analyses and develop a prioritized list of data and research needs based on results thereof.
- Transition the SEAcarP model to a multi-basin framework to take advantage of combined Upper Mississippi River and Illinois River telemetry modeling – accounting for complex source-sink dynamics will improve Illinois River SEAcarP model predictions.
- Implement Statistical Catch at Length modeling to estimate vulnerability to fishing as a function of fish size, exploitation rates, and immigration into the upper Illinois River Waterway.

In support of the strategy, Appendices A and B of this Action Plan include a funding matrix and a description of each proposed action item. All federal funding estimates included in this Action Plan are subject to final appropriations decisions.

The 2020 Action Plan has been prepared by members of the ACRCC, including federal, state, provincial, tribal, and local agencies, to develop and strategically implement targeted actions for preventing and controlling the movement of Asian carp. The primary focus is on preventing the introduction of Bighead and Silver Carp into the Great Lakes basin. Such actions will be strategically deployed using the most current scientific advances and technology available. Work to anticipate the migration of Black Carp and control the spread of Grass Carp continues under this Action Plan.

1.2 Purpose of this Strategy

This Action Plan describes the strategies and proposed action items collaboratively developed to achieve the mission of the ACRCC and identifies the objectives and organizational structure of the binational partnership, including its work groups. It focuses heavily on efforts taken within the CAWS and Illinois Waterway (IWW), but also captures efforts outside the CAWS that indirectly assist the efforts of the ACRCC. Additionally, the Action Plan now includes actions to address Grass and Black Carp, both demonstrated to be additional emerging threats to native aquatic ecosystems. This approach will be further informed by findings from binational (U.S. and Canadian) ecological risk assessments for Grass and Black Carp in the Great Lakes, and results from related evaluations of species occurrence and life history.

In addition, the Action Plan supports the goals, strategies, and recommendations of the national *Management and Control Plan for Bighead, Black, Grass, and Silver Carp in the U.S.*[1] The Action Plan also serves to inform, though does not include, Asian carp prevention strategies being developed for other basins, such as the Upper Mississippi and Ohio River basins.

1.3 THE ROLE OF THE ACRCC

Through the Action Plan, the ACRCC coordinates annual interagency planning for members to strategically execute projects to achieve the mission of protecting the Great Lakes from Asian carp introduction and establishment. The ACRCC's objectives are to:

- Support all efforts to prevent the introduction, establishment, and spread of Asian carp in the Great Lakes.
- Support development of technologies and methods that will result in the control and management of Asian carp and the transferability of these new tools for use in the control of other invasive species, where possible.
- Promote collection of biological information on Asian carp, its impacts, preferred habitats, and biological and ecological requirements.
- Identify additional research, technology, and data needed to effectively inform and support Asian carp management strategies.
- Encourage the exchange of information between member agencies and stakeholders and, seek opportunities to transfer and further leverage control technologies developed as part of the Action Plan to other areas of the U.S. and Canada. Work under this objective by the ACRCC fulfills the coordination and notification requirements of the U.S.-Canada Great Lakes Water Quality Agreement.
- Coordinate implementation and evaluate the effectiveness of collaborative Asian carp assessment, prevention, and control measures as described in the Action Plan.

The organizational structure of the ACRCC and its work groups is highlighted in Figure 1 on the next page.

The ACRCC Federal Executive Committee is charged with coordinating federal efforts in meeting the goals and objectives of the Action Plan and works collectively on any inherently U.S. federal issues related to control, response, or federal policy and legal issues associated with the Asian carp efforts to prevent the establishment of Asian carp in the Great Lakes. As co-chairs of the ACRCC, USFWS and USEPA lead the Federal Executive Committee. Other members include USACE, U.S. Coast Guard (USCG), National Oceanic and Atmospheric Administration (NOAA), the U.S. Department of Transportation (DOT), and USGS.

[1] Conover, G., R. Simmonds, and M. Whalen, editors. 2007. Management and control plan for bighead, black, grass, and silver carp in the United States. Asian Carp Working Group, Aquatic Nuisance Species Task Force, Washington, D.C. 223 pp.
http://www.anstaskforce.gov/Documents/Carps_Management_Plan.pdf.
http://www.anstaskforce.gov/Documents/CO2_Management_Plan.pdf.

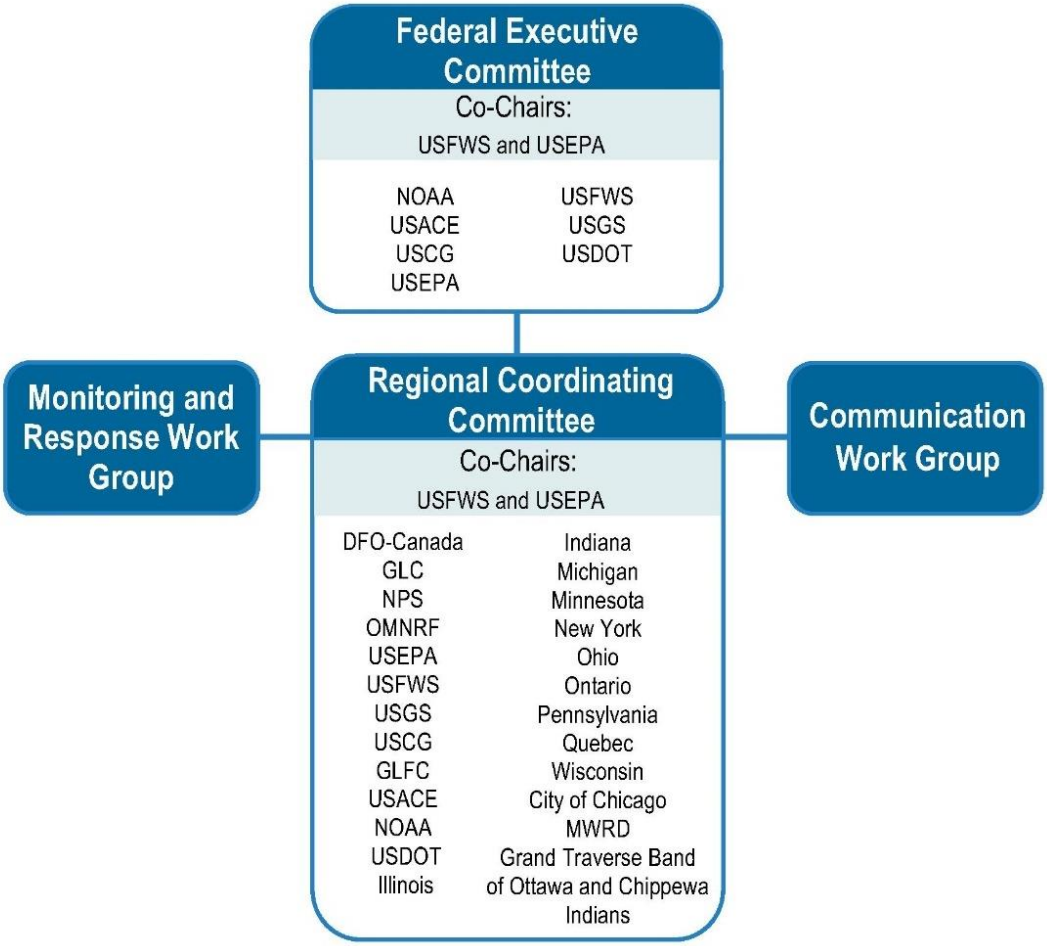


Figure 1. *ACRCC Organizational Structure.*

While coordination among federal, state, provincial, tribal, and local agencies is essential to ensuring the most effective strategy and actions necessary to combat the spread of Asian carp, coordination among the federal agencies is equally important to ensure a coordinated, collaborative federal approach to the issue.

1.3.1 CAWS Monitoring and Response Group

The Monitoring and Response Work Group (MRWG) of the ACRCC, co-chaired by Illinois Department of Natural Resources (DNR) and the Great Lakes Fishery Commission (GLFC), is tasked with monitoring and response efforts within the Illinois River and the CAWS. The MRWG is composed of fisheries biologists and scientific experts from GLFC, Illinois DNR, Illinois Environmental Protection Agency, Indiana DNR, USFWS, USGS, and USACE. In 2012, all of the Great Lakes states fisheries chiefs were invited to participate in the MRWG. Since 2010, MRWG has created an annual Monitoring and Response Plan (MRP) for the CAWS and revises this plan annually with the overall goal of preventing Asian carp from establishing self-sustaining populations in the CAWS and subsequently in Lake Michigan.

Five strategic objectives are specified in the MRP to accomplish the overall goal:

- Determine the distribution and abundance of Asian carp in the CAWS and use this information to inform response removal actions.
- Remove Asian carp from the CAWS.
- Identify, assess, and react to any vulnerability in the EDBS.
- Determine the leading edge of major Asian carp populations and reproductive success of those populations.
- Improve understanding of the risk for the establishment of Asian carp in the Great Lakes.

The MRWG carries out these objectives through collective efforts by member agencies. The MRWG coordinated monitoring within the CAWS, including commercial fishing, netting, electrofishing, and other collection operations, and interprets the data obtained to offer informed recommendations to the ACRCC.

1.3.2 Communication Work Group

The purpose of the Communication Work Group (CWG) is to facilitate internal and external communication on Asian carp prevention and control efforts of the ACRCC. The audiences include elected officials the public, key constituents, the media, ACRCC members, ACRCC CWG members, and other interested stakeholder groups outside the ACRCC.

Communication efforts support the ACRCC as it develops and executes short- and long-term strategies for preventing Asian carp movement as well as other monitoring and control activities in other areas of the Great Lakes basin. The CWG is not intended to supplant or supersede agency-specific communications actions of the individual ACRCC members.

The CWG, currently co-chaired by USFWS and Illinois DNR, includes representatives from USFWS, USEPA, USACE, USCG, USGS, NOAA, National Park Service (NPS), Great Lakes States, the Province of Ontario, GLFC, Great Lakes Commission (GLC), and Fisheries and Oceans Canada (DFO).

The CWG co-chairs have primary responsibility for the group's management, organization, and operation, with the work activities shared among CWG members. Specific efforts of CWG include, but are not limited to, the following:

- Work in collaboration with ACRCC members to foster internal communications among ACRCC members.
- Update and maintain the website at www.AsianCarp.us and other social media.
- Distribute to appropriate agencies comments, concerns, and questions received from external audiences, including the public and key stakeholders.
- Respond to media requests.
- Provide video and photographic materials to members of the media, the ACRCC, and the public.

- Coordinate on-site or telephonic media events, including press announcements, regarding new Asian carp control efforts and new detections of Asian carp.
- Coordinate public forums and meetings.
- Provide outreach to municipal leaders, tribal leaders, and other interested parties.
- Serve in advisory capacity to the ACRCC regarding communication needs for the ACRCC's efforts.
- Develop other outreach products for public use.

1.3.3 Technical and Policy Work Group

The Technical and Policy Work Group (TPWG) is a non-federal, advisory entity that is comprised of members from stakeholder organizations, public sector agencies, the scientific community, academia, and others. Figure 2 on the next page shows the diverse membership of the group. While the TPWG is not part of the ACRCC organization, they consult with and provide feedback to the ACRCC and other agencies on invasive species matters.

The TPWG grew out of the Barrier Work Group (BWG), initially convened to discuss alternatives and issues regarding the original electrical barrier installed by the USACE in 2002. The BWG provided input into the design of the original barrier and worked on issues such as barrier alternative, barrier impacts on the barge industry, safety surrounding the employment of electricity in the CAWS, impacts on local residents, businesses, and governments, etc.

The TPWG calls on federal, state, provincial, tribal and local agencies to identify the best ways to move forward with controlling AIS in the CAWS. Figure 2 below depicts the issues addressed by the TPWG.

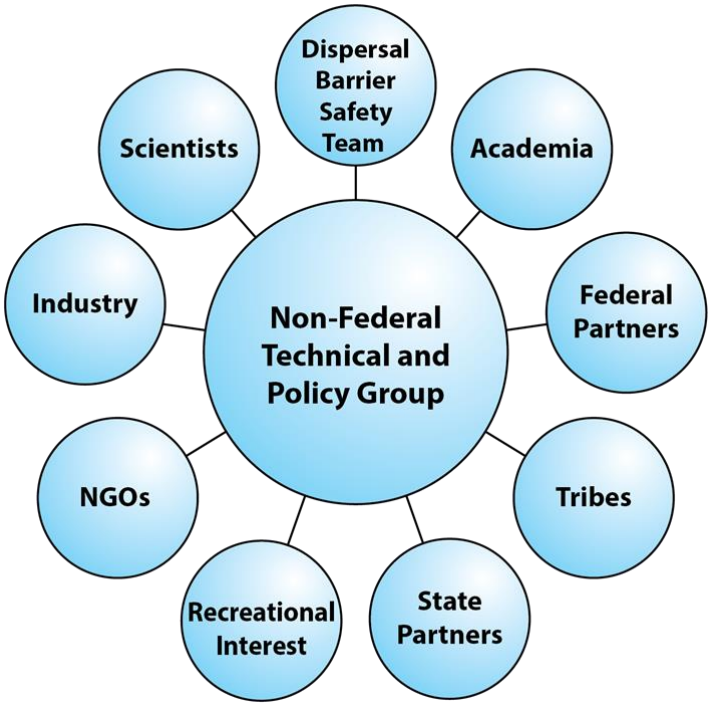


Figure 2. *Non-Federal Technical and Policy Group.*

1.4 Mission of the ACRCC

The ACRCC coordinates planning and execution of efforts of its members to prevent the introduction, establishment, and spread of Bighead, Black, Grass, and Silver Carp populations in the Great Lakes. The ACRCC, a collaborative team of federal, state, provincial, tribal, and local agencies, provides oversight and coordination of multijurisdictional prevention activities through development and implementation of an annual Asian Carp Action Plan.

THE CHALLENGE

Addressing the threat of Asian carp represents one of the greatest challenges to protecting the Great Lakes and adjacent aquatic ecosystems from AIS.

1.5 Background on Asian Carp

While Asian carp remain a significant threat to North America's aquatic resources, no Bighead, Silver, or Black Carp have been collected or observed in the Great Lakes since 2000. Historical data document two separate occasions when adult Bighead Carp were collected from the western basin of Lake Erie (1995 – one fish; 2000 – two fish). These fish represent the only documented collections of Bighead, Silver, or Black Carp in the Great Lakes. Since that time, intensive sampling has been regularly conducted by resource agencies in targeted locations in the Great Lakes and yielded no additional collections of these three species. Collections of a fourth Asian carp species, Grass Carp, have been documented in the Great Lakes and other North American watersheds for decades. Recent data demonstrate reproducing Grass Carp populations in Lake Erie's western basin triggering focused collaborative State-led management response actions further described in this Action Plan.

Outside of the Great Lakes basin, data from Asian carp monitoring and surveillance demonstrate that new occurrences of Bighead and Silver Carp continue to be detected in progressively further upstream locations, specifically within portions of the Mississippi River and Ohio River basins. Also, data demonstrate the establishment of a self-sustaining population of Black Carp in the middle Mississippi River as well as range expansion of this species into the Ohio River basin and into the Peoria pool of the IWW.

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 Asian carp. Accordingly, agencies are developing strategies and approaches to further address emerging threats posed by additional species while continuing to focus on prevention of Bighead and Silver Carp population expansion and introduction.

Silver Carp were first imported into the U.S. in the early 1970s to control phytoplankton blooms in sewage lagoons and as a potential addition to fish production ponds. By 1975, Silver Carp were collected from Bayou Meto and the White River, Arkansas, and by 1981 collected from the White, Arkansas, and Mississippi Rivers in Arkansas.

Silver Carp are now well established throughout much of the Mississippi River basin and are expanding in the Ohio River and other basins. In addition to concerns over ecological and related economic impacts, Silver Carp pose an additional threat to human safety, as they regularly jump out of the water when disturbed, particularly in response to outboard motors. Silver Carp was listed as Injurious under the Lacey Act in 2007, making it illegal to import live fish, gametes, viable eggs, or hybrids of the species, or to transport them between the listed jurisdictions in the shipment clause (the continental U.S., the District of Columbia, Hawaii, the Commonwealth of Puerto Rico, and any possession of the U.S). The statute does not prohibit transport of injurious wildlife between States within the continental United States. Permits may be granted for zoological, educational, medical, or scientific purposes.

Silver Carp jump from the water when startled. Because moving boats can frighten the Silver Carp, they often jump into boats, sometimes injuring boaters or damaging equipment.

Bighead Carp were imported from eastern China to Arkansas in the 1970s to improve water quality in aquaculture ponds and sewage treatment lagoons. The fish, which can grow to 60 or more pounds, have since spread through the Mississippi River basin and have been collected as far north as Lake Pepin in Minnesota. The species was listed as Injurious under the Lacey Act in 2011. Current records indicate Bighead Carp collections from at least 27 states.

Grass Carp caught in neighborhood lake in northwest Illinois in July 2018.

Grass Carp have historically been used by resource managers as a means of combating nuisance aquatic vegetation in ponds and lakes in the U.S. Records indicate that, by the mid-1970s, this species had been stocked in at least 45 states. Although not considered widely established outside of the Mississippi River Valley (except in Texas), Grass Carp are now the most widespread species of Asian carp in North America (currently documented in at least 45 states and Puerto Rico, and the Provinces of Ontario and Québec).

In addition, more recent monitoring data provides evidence of Grass Carp reproduction in the Sandusky River and Maumee River, a major tributary of the western basin of Lake Erie in Ohio.

Adult Black Carp. Photo credit: www.asiancarp.us.

Black Carp represent the fourth species of Asian carp imported into the U.S. in the early 1970s, likely in conjunction with the importation of one or more other Asian carp species. Black Carp grow to relatively large sizes and are longer lived than other species of Asian carp. As a molluscivore (feeds on mollusks and snails), its preference is to occupy benthic areas of rivers, making it suited for use as a desired biological control agent of snail populations in aquaculture ponds. 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 already extinct. Black Carp remains a preferred method of snail control in states with an established aquaculture industry. Requirements governing their management, use, and intrastate transportation vary from state to state. Since 2007, they have been listed as an Injurious species under the Lacey Act. A notable rise in Black Carp captures was seen in 2017-2018, with a total of 81 captures in 2017 and 133 captures in 2018. Current records indicate Black Carp collections from at least seven states, and several occurrences of natural reproduction.

Geographically-focused Asian carp management strategies are directly informed by the most current and accurate data on species distribution and range expansion over time. Figure 3 on the next page illustrates the distribution of Bighead, Silver, Black, and Grass Carp throughout the waters of the Midwest U.S. as of December 2019. Monitoring and catch data are critical to informing the focused use of specific strategies for early detection, response, prevention and control actions, underscoring the need for comprehensive and consistent Asian carp surveillance across the basins.

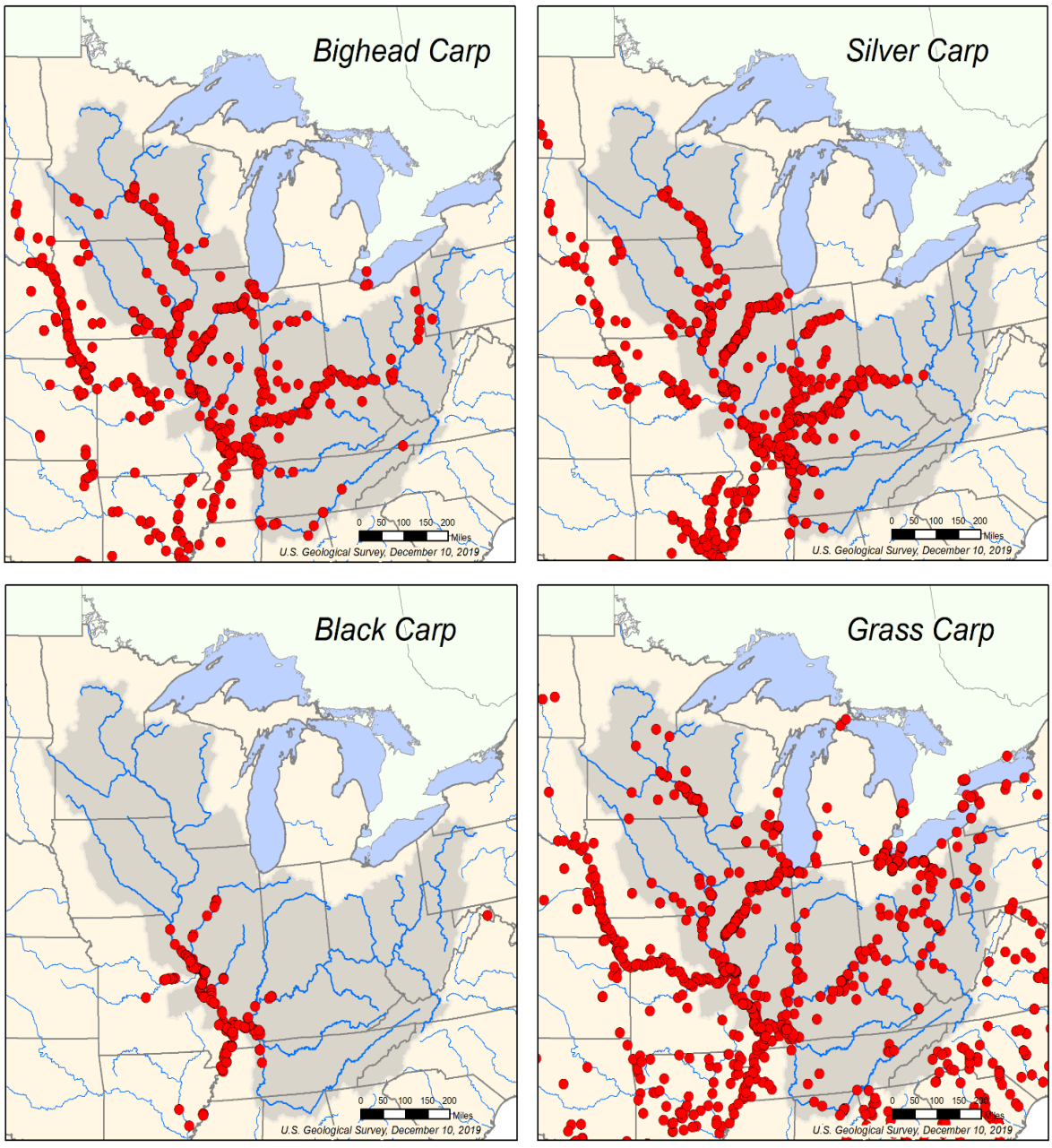


Figure 3. *Distribution maps of all four species of Asian carp in the Midwest United States.*

The mapping data generally illustrate the higher densities of Asian carp initially present in the middle Mississippi River following establishment in the wild, and increasingly in the adjacent major river reaches and tributaries, including the upper Mississippi River, Ohio River, Illinois River, and Missouri River. The range of each of the four species has steadily increased over time in the major river basins since initial introduction and establishment.

Figure 4 below illustrates the relative abundance and general population status of Bighead and Silver Carp in Midwest U.S. river basins, showing fish densities and evidence of reproduction (including larval fish) progressively reduced toward the upstream boundaries of range of occurrence.

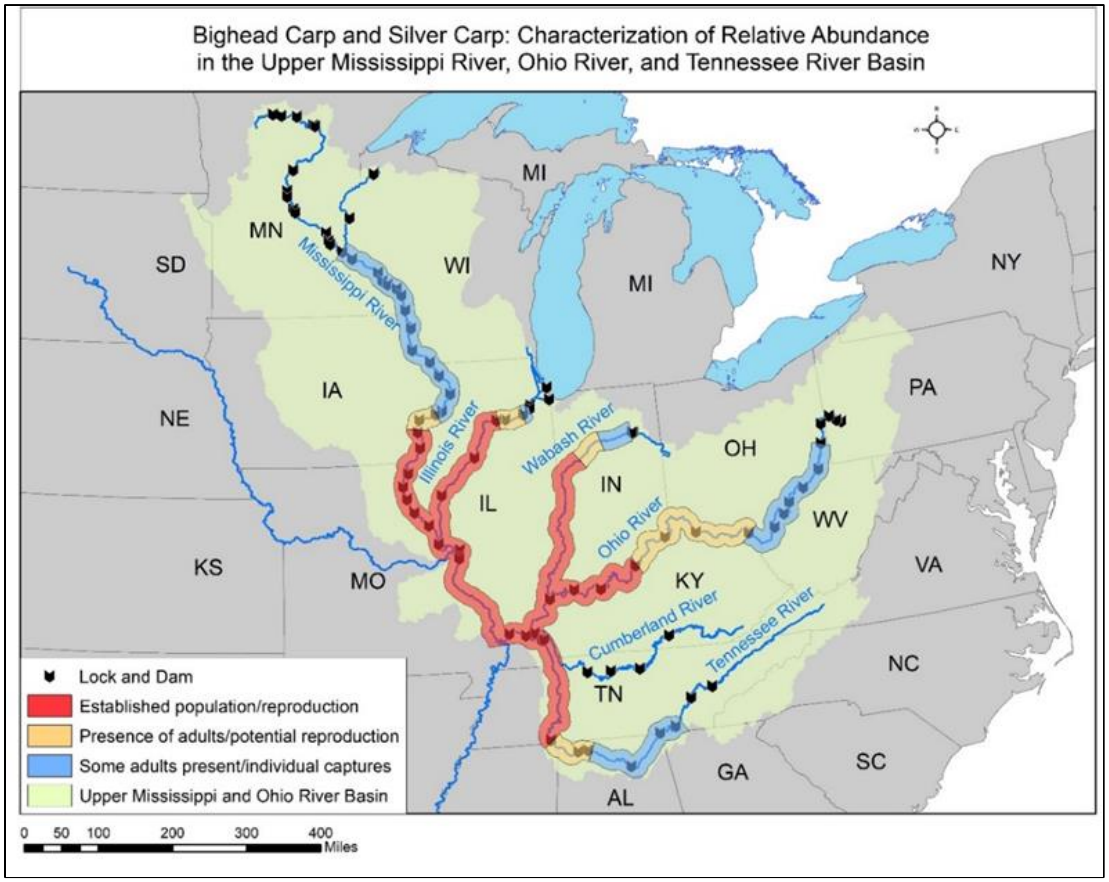


Figure 4. *Characterization of relative abundance of Bighead Carp and Silver Carp in the Upper Mississippi River Basin, Ohio River Basin, and IWW/CAWS.*

Accordingly, species assessments and mapping at a broader, regional scale are warranted to comprehensively evaluate the status and movement of Asian carp populations within and between basins - including identifying likely source populations - to best inform the strategic implementation of focused and complementary prevention and control actions by the ACRCC and other basinwide partnerships (See Section 4.0 Collaborative Actions within the Upper Mississippi and Ohio River Basins).

Within the Illinois River, ACRCC agencies conduct intensive ongoing monitoring for Asian carp using a combination of fishery sampling gears and techniques to ensure a comprehensive sampling approach. Traditional fishery sampling gears, including boat electrofishing and netting; remote sensing, including telemetry tracking and sonar;, and eDNA sampling are conducted in targeted locations to best inform the understanding of Asian carp occurrence and population status. Based on the proximity of established populations of Bighead and Silver Carp in the lower (downstream) segments of the Illinois River, intensive ongoing monitoring and control efforts have been focused on the CAWS to improve the understanding of the population dynamics and lower the level of risk from fish moving upstream toward the Great Lakes.

Populations of Bighead and Silver Carp in the Illinois River are generally characterized by pool. For reference, Figure 5 below illustrates the pools in the upper Illinois River, and the stages of invasion for Bighead and Silver Carp within the IWW. As of December 2019, the MRWG concluded that the adult population front of Bighead and Silver carp remained approximately 47 miles and two lock structures from Lake Michigan in the Dresden Island pool. No small Bighead or Silver Carp (less than 6 inches) have been detected in Dresden Island, Marseilles, or Starved Rock pools by MRWG efforts in 2019. While spawning of Asian carp and eggs have been noted in both Marseilles and Starved Rock pools, no larval fish have been detected in these pools. All life stages (eggs, larval, small Asian carp, and juvenile/adult Asian carp) have been detected in the lower three IWW pools of Peoria, LaGrange, and Alton. These pools are over 100 miles away from Lake Michigan.

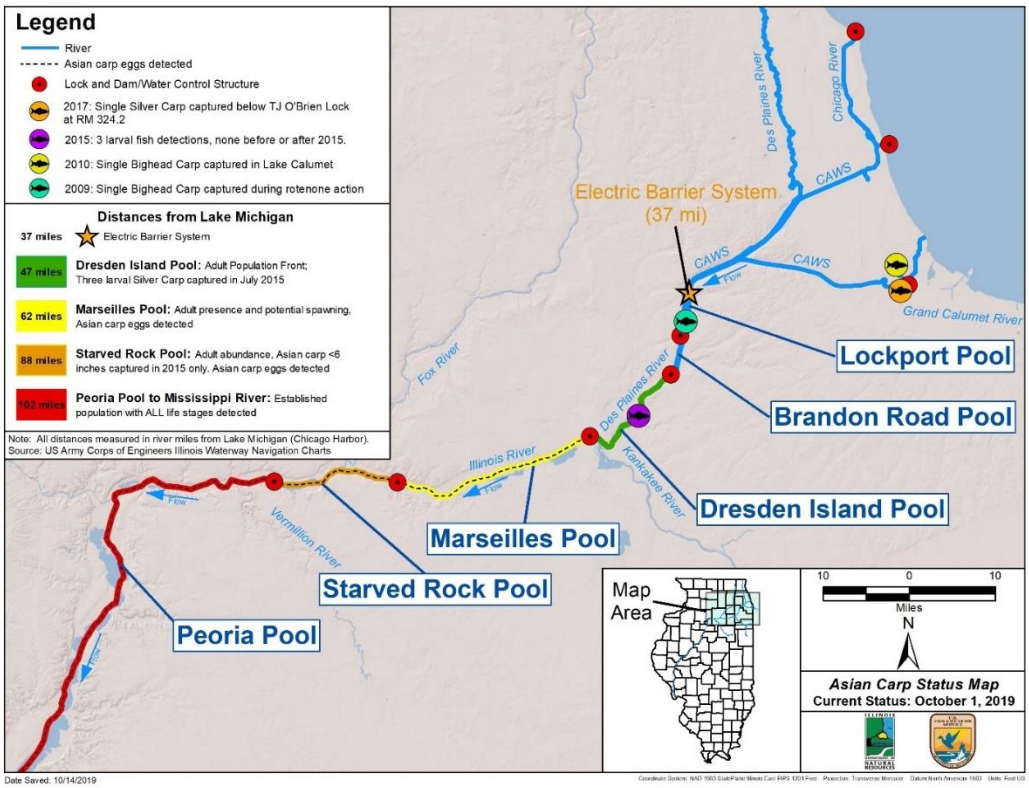


Figure 5. *Bighead and Silver Carp Status in the Upper Illinois River.*

2.0 Monitoring and Response Work Group Efforts

The MRWG of the ACRCC is tasked with deploying monitoring, response, control and management efforts in the IWW and CAWS. The MRP evaluates status by pool within the Illinois River, prescribing effort to minimize populations in each, as practicable.

This MRWG is generally composed of fisheries biologists and scientific experts from state and federal agencies involved in monitoring and response activities in the CAWS. In 2012, all Great Lakes states fisheries chiefs were invited to participate in the MRWG. Since 2010, MRWG has created an annual MRP for the CAWS and revises this plan annually with the overall goal of preventing Asian carp from establishing self-sustaining populations in the CAWS and subsequently in Lake Michigan.

The MRWG carries out its actions through collective efforts by member agencies. The MRWG oversees contracted fishing, netting, electrofishing, and other collection operations, and then interprets the data obtained to offer informed recommendations to the ACRCC.

The MRWG formed discipline-specific work groups to assist in developing the MRPs in the future. Work groups are also useful to focus expertise for further evaluation, assist in decision making, or otherwise provide MRWG Co-chairs, agencies, and ACRCC with insights as technical experts on a range of subjects. The work groups are listed below:

- Contingency Planning.
- Removal.
- Hydroacoustic Assessments.
- Telemetry.
- Modeling.
- Behavioral Deterrent Technologies.

The efforts undertaken by the MRWG are designed to address three primary objectives for preventing the spread of Asian carp to Lake Michigan. These objectives are:

- **Detection:** Determine the distribution and abundance of Asian carp to guide response and control actions.
- **Management and Control:** Prevent upstream passage of Asian carp towards Lake Michigan via use of barriers, mass removal, and understanding best methods for preventing passage.
- **Response:** Establish comprehensive procedures for responding to changes in Asian carp population status, test these procedures through exercises, and implement if necessary.

2.1 MRWG Strategic Vision

The MRWG has developed a short-term (2018-2022) and long-term (2022 and beyond) vision to strategically guide Asian carp detection, prevention, control, and response actions. The goals under the vision are annually reviewed and updated, as needed, informed by the most current data on the Asian carp population status in the IWW and CAWS.

2.1.1 Short-Term (5-year) MRWG Strategic Vision: 2018 – 2022

Detection

- Ensure sufficient surveillance effort is deployed throughout upper IWW, Des Plaines and Kankakee rivers to inform management and control, or response needs, including:
    - Adult fish, small fish, and larval/egg assessment.
    - Population changes and movements.

Management and Control

- Remove at least 1 million pounds of Asian carp annually from between Starved Rock Lock and Dam and the population front, e.g. downstream of Brandon Road Lock and Dam, to reduce upstream migratory pressure at the leading edge of the population (biomass observed in 2015). Broadly meeting the goals, MRWG will consider how to maintain and establish new targets.
- Prevent the movement into or sustained presence of Asian carp between the Brandon Road Lock and Dam and the Lockport Lock and Dam.
- Utilize technical expertise and recommendations provided by discipline-specific work groups to determine whether algal attractants, complex noise generation, and use of CO_2 to herd fish can be effectively incorporated into MRWG actions.
- Evaluate ongoing management efforts to measure the effectiveness of management actions, adjust activities to improve effectiveness, and adapt to future changes.
- Assist in developing an enhanced market for Asian carp harvested out of the lower three pools of the Illinois River.
    - Use established business development techniques to provide guidance and information to agency, industry, and entrepreneurs to improve ability of business establishment and success.
- Increase harvest by expanding the commercial fishery in Peoria pool to 8 million pounds by end of 2020 and 15 million pounds annually by 2022.

Response

- Ensure that response readiness is maintained and responsive to detected changes.
- Enable rapid deployment of needed assets as needed.
- Review EDBS operations and operational changes.

2.1.2 Long-Term (5+-year) MRWG Strategic Vision: 2022 and Beyond

Detection

- Implement an effective, efficient, and sustainable detection program to inform ongoing adaptive management and contingency response planning.

Management and Control

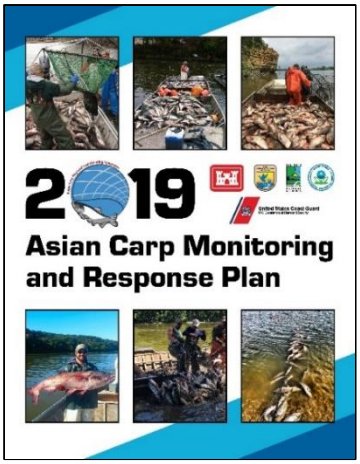
- Sustain management and control effort of Asian carp with continued population reduction using a baseline of Dresden Island pool densities in 2015 levels as a standard for comparison.
- Provide guidance to minimize Asian carp populations in the upper IWW with no impacts on native fish or mussel populations, human health and safety, recreational use, or industrial uses of the waterway.
- Have in place a dynamic economic business strategy in the lower IWW to remove 20-50 million pounds of Asian carp annually.
- Support development of management and control strategies in other river basins, as requested

Response

- Provide for contingency plan and response in less than 48 hours for all contingency response measures.

2.2 Monitoring and Response Plan

MRWG prepares annual workplans built from previous years' work. Specifically, the MRP is a compilation of individual project plans, each of which plays an important role in preventing the expansion of the range of Asian carp, and in furthering the understanding of Asian carp location, population dynamics, behavior, and the efficacy of control and capture methods. Each individual plan outlines specific actions, including project objectives, methodology, and highlights of previous work. The MRP clearly sets pool-by-pool targets for population removal. The five-year and long-term plans articulate the vision for control moving downstream with private sector partnership removal at 5-15 times the historic harvest level.



Draft 2019 Asian Carp Monitoring Response Plan

The Action Plan supports the MRP, including a section on contingency response actions. This MRP uses the best available science on Asian carp to help ACRCC members make the most effective management decisions in support of the Action Plan.

For example, science-based predictive models and risk assessments are critical for informing managers and scientists on locations at highest-risk for potential invasion, exploitation, or colonization by Asian carp. The various risk characterizations efforts and assessments that have

been completed or are currently under way by the ACRCC member agencies are described in Section 3.4.6. These efforts are evaluating the ecological risk of establishment of Asian carp in the Great Lakes and the social and financial risks associated with establishment.

2.3 Multiple Agency Monitoring of the Illinois River for Decision Making

The Multiple Agency Monitoring of the Illinois River for Decision Making project will provide a robust, unbiased, and statistically powerful dataset that is comparable over time among multiple agencies and across river basins. Utilizing a stratified random approach to data collection in reaches of the Illinois River should provide unbiased estimates of Asian carp population demographics capable of being extrapolated among strata, pools, and time increasing the understanding of Asian carp population demographics below the EDBS and the threat of possible Asian carp invasion upstream the EDBS.

Agencies participating in the Multiple Agency Monitoring of the Illinois River for Decision Making project include Illinois DNR and Illinois Natural History Survey (co-leads), USFWS – Wilmington and Columbia Fish and Wildlife Conservation Offices and USACE – Chicago District (field support). Monitoring efforts will occur in all pools of the Illinois River below the EDBS to the confluence of the Upper Mississippi River near Alton, Illinois. Specifically, agencies will collaborate to sample: Lockport, Brandon Road, Dresden Island, Marseilles, Starved Rock, Peoria, LaGrange, and Alton pools (Figure 6 on the next page).

The objectives of the Multiple Agency Monitoring of the Illinois River for Decision Making project effort are:

- Monitor adult and juvenile Asian carp population demographics (i.e., presence/absence, distribution, and abundance) in pools below the EDBS with a standardized design.
- Provide relevant data to detect changes to the native fish community affected by Asian carp overtime throughout the entire Illinois River below the Electric Dispersal Barrier.
- Inform other projects (i.e., Contracted Asian Carp Removal, Telemetry Monitoring, SEAcarP model, etc.) with Asian carp demographic and fish community assemblage data necessary for making management decisions.
- Provide a standardized, robust, and statistically powerful monitoring comparable spatially and temporally throughout the entire Illinois River below the EDBS.

The Fixed Site Monitoring Downstream of the EDBS and Juvenile Asian carp monitoring projects (2010-2018) had been collecting Asian carp demographic data to meet MRP objectives. This project focused on the Starved Rock, Marseilles, Dresden Island, Brandon Road, and Lockport pools utilizing electrofishing, hoop netting, and mini fyke netting sampling. Transitioning to the Multiple Agency Monitoring of the Illinois River for Decision Making project will use a proven standardized multi-gear approach that should provide robust results that increase the ability to monitor Asian carp as well as native fish communities throughout the various pools of the Illinois River below the EDBS. Additionally, these methods will facilitate comparisons to river systems outside of the program, giving context to observations that do not currently exist.

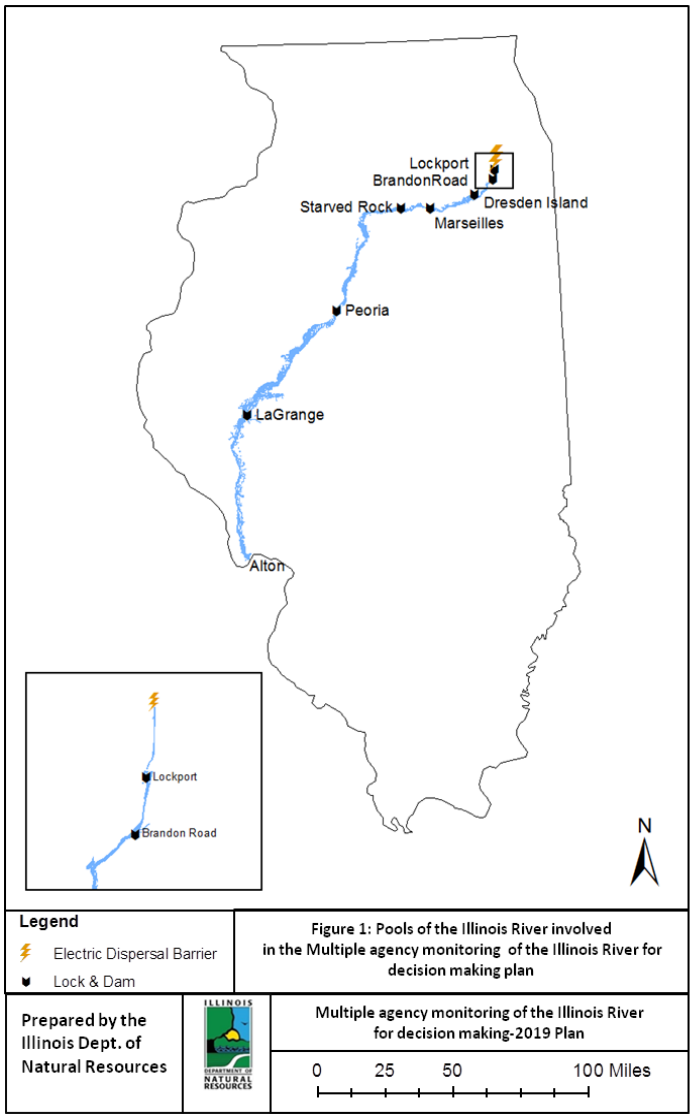


Figure 6. *Map of the sampling reaches of the Illinois River below the Electric Dispersal Barrier to the confluence of the Upper Mississippi River involved in the Multiple Agency Monitoring of the Illinois River for Decision Making plan: Lockport, Brandon Road, Dresden Island, Marseilles, Starved Rock, Peoria, LaGrange, and Alton pools.*

In 2019 and extending into 2020, this monitoring effort includes daytime pulsed Direct Current (DC) boat electrofishing, paired hoop netting, fyke netting, and minnow fyke netting gear types to assess Asian carp population demographics and native fish assemblages spatially and temporally. Effort will occur in all pools of the Illinois River below the EDBS to the confluence of the Upper Mississippi River (Figure 7 on the next page). Fish will be collected during three-time intervals in 2020: June 15 to July 31, August 1 to September 15, and September 16 to October 31. Sampling sites will be randomly generated using a stratified random design among all specific habitat type within each pool (i.e., main channel borders-shoreline [MCB-S], main channel border-open water [MCB-O], side channel borders [SCB], and backwater [BWC] habitats), designated by Wilcox 1993. Figure 7 on the next page is provided as an example.

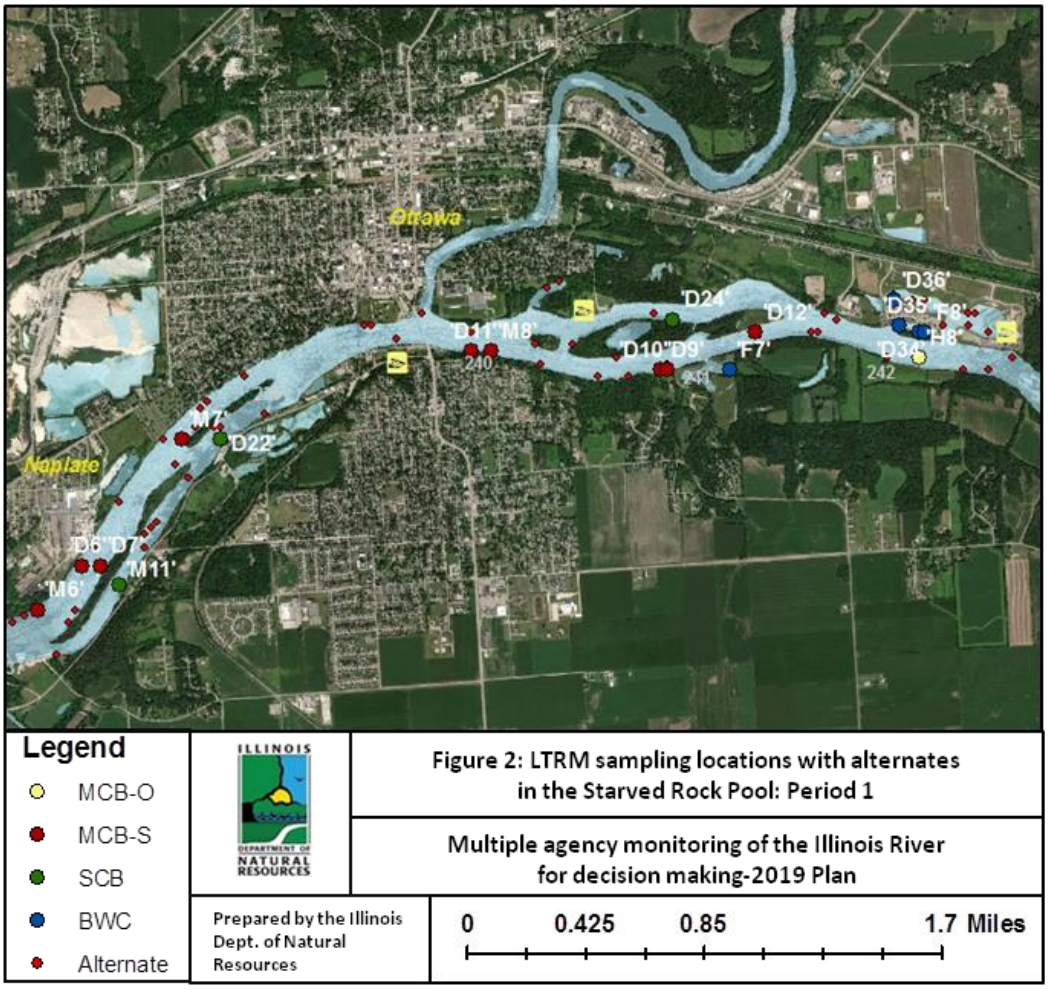


Figure 7. *Minnow fyke net ('M'), Daytime electrofishing ('D'), Paired Hoop Net ('H'), and Fyke net ('F') stratified random sampling locations: main channel border (MCB), side channel border (SCB), and backwater (BWC) habitats with alternate locations in the Starved Rock pool of the Illinois River for Period 1 from river mile 242 to 237.*

The number of sites generated per strata and pool will be dependent on availability within each pool (Ratcliff *et al.* 2014). If physical site characteristics prevent gear deployment (e.g., insufficient water depth, overly vegetated, other obstructions), the site interferes with public usage or a low likelihood gear will be recovered exists, the randomly generated site will be replaced with the nearest randomly generated alternative site.

Fixed sites of exceptional interest to MRWG within Brandon Road pool and Lockport pool from the Fixed Site Monitoring Downstream of the Dispersal Barrier project will also be sampled in this project. These fixed sites necessitate a higher frequency and lengthier temporal range of sampling then the randomized sampling design as a result of the proximity to the dispersal barrier and will be sampled biweekly from March to December. Fixed sites are established in habitats where Asian carp (Bighead Carp, Black Carp, Grass Carp, and Silver Carp) have been

historically found to congregate in other pools (backwaters, side channel habitats, and tailwater areas below lock and dam structures). This effort will include:

- *Day Electrofishing:* Daytime pulsed DC boat electrofishing will be used to collect standardization and comparable fish catch rates within each pool.
- *Paired Hoop Netting:* Paired deployment of a large 4-foot (1.2 meter) hoop with 1.5-inch bar mesh (3.7 centimeter), and a small 2-foot (0.6 meter) hoop with 3/4-inch bar mesh (1.8 centimeter) net will be placed at each random sample site.
- *Fyke Netting:* Fyke nets (3.0 feet [0.9 meter] x 6.0 foot [1.8 meter] frame) will be deployed in areas where water depth is sufficient to submerge the throats of the nets.
- *Minnow Fyke Netting:* Minnow fyke nets (2.0 feet [0.6 meter] x 4.0 foot [1.2 meter] frame) will be deployed following the same criteria and exceptions as those used for fyke nets.

2.4 Contingency Response Plan

Despite current activities, it is understood that Asian carp populations may respond in unpredictable ways. Based on this realization, the MRP is designed to respond to unforeseen developments in Asian carp detections. The purpose of the additional Contingency Response Plan (CRP) component is to outline the process and procedures the MRWG and ACRCC member agencies will follow in response to the change in Asian carp conditions in any given pool of the upper IWW and how to communicate results. There are three primary functions of the upper Illinois CRP, which include: (1) direct support of potential response actions, (2) work group review and updates to the CRP, and (3) continued training of action agencies and stakeholders through actual annual or tabletop exercises. The CRP can be found on www.asiancarp.us.

The CRP describes specific actions within the CAWS and the five navigation pools of the Upper IWW, which include the Lockport, Brandon Road, Dresden Island, Marseilles, and Starved Rock pools. In the event a change is detected in the status of Asian carp in those pools indicating an increase in risk level, this plan will be implemented to carry out response actions. The MRWG has maintained a robust and comprehensive Asian carp monitoring program in the CRP area and will continue these efforts as the foundation for early detection capability in the IWW. Annual interim summary reports describing these efforts, including extent of monitoring and Asian carp detection probabilities, can be found at www.asiancarp.us. Based on this experience, MRWG is confident in its ability to detect changes to Asian carp status in the navigation pools in the upper IWW.

The results of ongoing surveillance and management efforts have been used to establish the current status of Asian carp populations in each pool of the IWW, as described below:

- Lake Michigan: No established Asian carp population.
- CAWS: No established Asian carp population.
- Lockport pool: No established Asian carp population.
- Brandon Road pool: No established Asian carp population.

- Dresden Island pool: Adult Asian carp consistently present. Larval Asian carp observed for the first time in 2015 and have not been observed since (source unknown).
- Marseilles pool: Adult Asian carp consistently present, and Asian carp eggs have been detected. Spawning has been observed.
- Starved Rock pool: Abundance of adult Asian carp present, and Asian carp eggs have been detected. Early life-stage Asian carp (<6 inches total length) were observed in 2015 and have not been observed since.
- Peoria pool (downstream to confluence with Mississippi River): Established population with all life stages of Asian carp has been observed.

The toolbox of potential response actions will be a primary focus area for reviews to ensure the most up-to-date information is available to the MRWG when the need for a response arises. The CRP not only provides quick guidance for agencies' actions, but also strategies for inter-agency communication, outreach and education with partners and the public.

3.0 INTERAGENCY CAWS ASIAN CARP PROGRAM

The interagency CAWS Asian Carp Program began in 2009 with efforts to support electric barrier maintenance within the CAWS. The formation of the ACRCC initially brought together the agencies potentially affected by the expansion of Asian carp into new waterway systems. The scope of effort has since evolved beyond a singular focus on the CAWS to now include other potential pathways for Asian carp introduction, including secondary pathways of AIS introduction as indicated in the Great Lakes and Mississippi River Interbasin Study (GLMRIS) report. The ACRCC's efforts are now binational and Great Lakes basin-wide in scope, encompassing 28 agencies and organizations in the U.S. and Canada. The ACRCC's efforts and mission are complementary to other interagency resource governance initiatives to address AIS threats in the Great Lakes, and the partnership strives to coordinate broadly and regularly with all entities.

Numerous key initiatives were addressed through the 2019 Asian Carp Action Plan and many will continue in 2020. ACRCC initiatives for 2020 include efforts for detection of Asian carp of various life stages using comprehensive and targeted sampling, continued development of control technologies, and identification of opportunities for their field implementation. The ACRCC will also emphasize coordination of collaborative interagency efforts within and between basins, and program support. In addition, ACRCC continues its focus on development of control alternatives at Brandon Road Lock and Dam to further explore pathway closure opportunities. Accomplishments achieved in 2019 and initiatives planned for 2020 are highlighted below.

3.1. PREVENTION ACTIONS

The ACRCC is undertaking several prevention actions to address existing pathways to the Great Lakes. These efforts include:

3.1.1 Operate and Maintain Current Barrier System in the CAWS

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 to continuously deliver an uninterrupted flow of electricity to the water to deter fish.

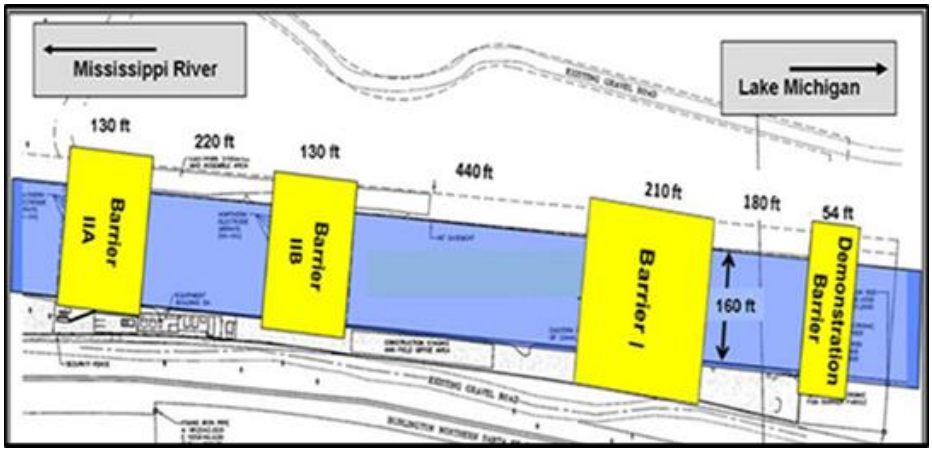


Figure 8. *USACE Electric Dispersal Barrier System.*

In 2020, the USACE will continue routine operation and maintenance of the existing barriers, including a dive inspection of the underwater structures.

Permanent Barrier I. Photo credit: USACE

3.1.2 Construction of a New Electric Barrier

USACE is completing construction of an upgrade to the Demonstration Barrier I to a permanent facility, as authorized in the Water Resources Development Act of 2007. Completion of this barrier, known as Permanent Barrier I, will signal the completion of construction on the CSSC EDBS. Site work for the Permanent Barrier I and installation of underwater components were completed in 2014. Construction of the new control building, utility connections, and backup power systems was completed in 2018. Replacement of the Demonstration Barrier's electrodes was completed in 2019. Work on the remaining major contract, installation of the specialized pulse-generating system will continue in 2020. Permanent Barrier I is scheduled for full-time operation in 2021.

3.1.3 Development of Potential Future Actions at Brandon Road

In FY 2019, USACE completed the evaluation of potential control options and technologies at Brandon Road Lock and Dam to prevent the upstream interbasin transfer of ANS while minimizing impacts to IWW uses and users. This effort, known as the Brandon Road Study, resulted in a recommended plan presented in a Chief's Report signed on May 23, 2019 and sent to Congress, to construct an over $830 million project that would serve as a new control point at Brandon Road Lock and Dam to reinforce the existing control point provided by the EDBS in the CSSC. The plan consists of structural measures to be carried out by USACE including an acoustic fish deterrent, bubble curtain, engineered channel, electric barrier, and flushing lock. It also includes non-structural measures to be carried out by other agencies through management of the waterway below the Brandon Road Lock as a 'population reduction zone' where monitoring and overfishing would occur. Non-structural measures include manual or mechanical removal, monitoring, integrated pest management, pesticides, research and development, public education and outreach and two boat launches. Implementation of the recommended plan requires congressional authorization and a non-Federal sponsor willing to provide 35 percent of the total cost of the proposed project.

3.1.4 Closure Actions at Little Killbuck Creek Pathway

In FY 2018, Ohio DNR worked with the local landowner and completed the 25 percent design of the proposed construction effort, determined the proposed berm alignment, developed additional hydraulic modeling to assess potential flooding, acquired easements on four parcels for the construction of the berm, and facilitated a meeting with the Potentially Affected Interests. In FY 2019, USACE completed a peer review of Ohio DNR's findings and recommended alternative designs for the project. Ohio DNR selected an alternative design and is completing

appraisals and acquiring easements for the properties needed for berm construction. In FY 2020, Ohio DNR will be completing the 100% design for the construction of the berm.

3.1.5 Closure Actions at Ohio-Erie Canal Pathway

In 2018, the Ohio DNR and USACE identified two primary areas of concern: (1) the direct transfer of AIS from the Mississippi River basin to the Great Lakes basin at the Long Lake flood gates and the feeder gates to the canal that transfer water from Long Lake to the Lake Erie watershed and (2) flooding along the tow path and along sections of Long Lake that allows water to move from the Mississippi River basin to the Great Lakes basin. This project will prevent or reduce the probability of ANS (e.g. Asian carp) being able to move from the Tuscarawas River Watershed into the Cuyahoga River Watershed via the Ohio-Erie Canal. The canal towpath that forms the basin divide between Mississippi River and Great Lakes watersheds is now a trail prized for its recreational value and historical significance. At most locations, hydrologic separation of the two basins is being accomplished by raising the ground surfaces in low areas. In other locations where separation isn't practical, fences or screens are being installed. Construction that began in 2019 is targeted for completion in early 2020.

3.1.6 Alternate Pathway Surveillance in Illinois – Law Enforcement

The Illinois DNR Invasive Species Unit (ISU) was created in 2012 as a special law enforcement component to overall Asian carp control effort. It consists of Conservation Police Officers who are fully dedicated to searching for illegal activities within the commercial fishing, aquaculture, transportation, bait, pet, aquarium, and live fish market industries. The ISU focuses its energies and resources on the likely pathways Asian carp could spread by human means. ISU has exposed the risks human activities bring to the entire Asian carp project by making significant arrests in almost every industry it has examined. The capabilities and knowledge of the ISU advance significantly each year.

3.2 Control Measures

The mission of the ACRCC is to prevent the introduction, establishment, and spread of Asian carp in the Great Lakes. In support of this long-term goal, the ACRCC recognizes the need to scientifically assess the movement of Asian carp and undertake control actions, where necessary. The following efforts have been or will be undertaken to address these potential concerns.

3.2.1 Contract Fishing for Asian Carp Detection and Removal

Contracted commercial fishing (annually and nearly continually) will be used to reduce the numbers of Asian carp in the upper Illinois and lower Des Plaines rivers downstream of the EDBS. Commercial fishers will be employed to harvest as many Asian carp as possible in the Starved Rock and Marseilles pools. Harvested fish will be picked up and utilized by private industry for purposes other than human consumption. Efforts in 2019 removed over 1.5 million pounds of Asian carp from Starved Rock, Marseilles, and Dresden Island pools.

Commercial fishers will gather information on Asian carp population abundance and movement in the IWW downstream of the EDBS as a supplement to fixed site monitoring by contracted netters. In the CAWS (seasonally) and from barrier downstream through Lockport pool, Brandon Island pool, and Dresden Island pool (bi- weekly), many of the same contracted netters will work in teams of two or more to detect and remove Asian carp while serving as responders.

Efforts were heightened in 2019 to prescribe more effort to maintain lower populations of Asian carp (as observed by hydroacoustic and corroborating information) while further removing and reducing Asian carp densities in the Upper IWW. These priorities will continue in 2020.

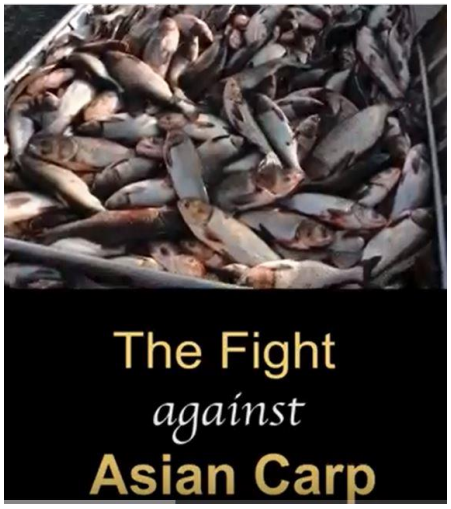
These efforts will include:

- A goal of at least 1 million pounds of Asian carp removed remains for 2020.
- Utilizing nine contracted fishers to achieve contracted fishing projects described in the 2020 MRP which include:
    - Management and control through removal in Starved Rock, Marseilles, and Dresden Island pools.
    - Detection between population front and EDBS in Brandon Road and Lockport pools.
    - Detection in the CAWS within the Seasonal Intensive Monitoring program.
    - Deployment of prescribed netting efforts such as seines or needs requiring short notice.
    - Contingency measures at various locations, as needed.

While increased surveillance efforts from the EDBS to Dresden Island pool had been modified in prior years (most recently in 2018), increased removal efforts farther downstream will continue, as in 2019, in Starved Rock and Marseilles pools where higher densities of Asian carp exist.

3.2.2 Asian Carp Enhanced Contract Removal Program Development

The ACRCC recognizes the value of increased harvest of Asian carp in the Illinois River informed by current fishery stock assessment data. A goal has been set of removing 8 million pounds per year in the Peoria pool. The use of targeted contract fishing in the Illinois River is a key component of the multipronged strategy. Concurrent recommendations for increased harvest are identified in a comprehensive Business Analysis Plan and corroborated by SEAcarP model output. The Business Analysis Plan recommends actions to accommodate increased commercial harvest as a control option and expand alternative uses of Asian carp to increase fishing by identifying end-users for fish. The long-term goal is removal of 20 to 50 million pounds of Asian carp per year from the IWW to reduce the population and risk of their spread to the Great Lakes.



The ACRCC and partners, including contract fishers, continue the fight against Asian carp.

One key recommendation of the Business Analysis Plan is creation of the Enhanced Contract Fishing Program which was initiated in September of 2019. Over the first 6 weeks of the program, 16 contracts were executed with Illinois-licensed commercial fishermen and over 100,000 pounds were removed from the Peoria pool toward a goal of 4.5 million pounds annually. To measure removal effects, Southern Illinois University (SIU) also has begun an analysis using data from the Enhanced Contract Fishing Program to conduct a fish population study. This study will measure changes in fish size, abundance and other characteristics to evaluate effectiveness of concentrated fishing in the Peoria pool. Results of that analysis will be available in 2020.

Other recommendations made in the Business Analysis Plan pertain to marketing, to support the creation of a positive brand for Asian carp that will help product-makers and processors grow their markets. Market growth and increased sales have a direct impact on increased removal. Work to initiate a brand development process is underway along with the start of the Market Value Program to provide small-sized, matched grant funding of a maximum of $8,000 to processors and product makers to defray the costs of travel and trade-show attendance to support their efforts to increase sales of Asian carp products.

Proposed actions for FY 2020 will continue to build on successes of 2019 and include:

- **Enhanced Contract Fishing Program.** Removal under the Enhanced Contract Fishing Program is increased to 8 million pounds (up from 2019/2020 goal of 4.5 million pounds) in the Peoria pool. At this volume, it is expected that additional processing capability will enter Illinois in 2020 and that the number and/or efficiency of fishermen will grow, increasing supply of Asian carp to reliably support growth of Asian carp products and sustained removal. Additional efforts to coordinate fishers and processors will increase cooperation and coordination to begin to scale removal to satisfy larger Asian carp orders.
- **Ice Production and Equipment.** Production of ice is a key component of preserving freshness and improving distances over which Asian carp can be transported. Having ice available to cool fish immediately following removal from the water is essential to their ability to be used for human consumption. At present, however, no capacity exists near or close to the water that provides ice in volume for this purpose. Funds for this item will provide bulk ice capacity for fishermen to stock their boats with ice prior to going out on the water. Costs include securing 1 - 3 ice machines that produce at least 5,000 pounds of ice per day. These efforts increase the length of the fishing season by minimizing spoilage.
- **Targeted Use of Commercial Fishers.** Assistance also is needed to support increasing targeted use of commercial fishers to achieve larger Asian carp hauls, and to support entry of new fishermen to the trade in Illinois in support of ACRCC management and control goals. Such equipment as netting and related fishing equipment and gear, along with transportation support, will remove high cost items that currently limit expansion of current fishermen to increase fishing and inhibit entry of new fishermen into the Illinois

marketplace. In particular, new fishermen are needed to enter the market not only to increase removal, but also to replace attrition among existing fishermen in the state that is expected to occur due to high median age. Removal goals will be hampered without further assistance.

- **Market Value Program.** To support interest among fish processors and to satisfy application requests, continuation of funding for the Market Value Program will continue to make available up to small grant funds to assist processors and product makers to market their products. To receive reimbursement under the program, the applicant must provide a 20% match and use Illinois-caught Asian carp to make their products. Funding supports growth in sales of Asian carp products by defraying costs of travel, attending trade shows, and costs related to meeting with potential buyers for the purpose of promoting the processor's or product-makers sales.
- **Asian Carp Brand Marketing.** Continued implementation of the new Asian carp brand and marketing strategy currently under development is important to support fish processors and product makers to increase Asian carp product sales. A strong, positive brand that countermands negative perceptions of Asian carp will support existing carp-related businesses. Activities under this item includes creation of marketing collateral, distribution of brand imagery, attendance at trade shows and other events, writing press releases and other earned media, and holding events with early adopters. Positive branding helps a range of product makers to promote and sell their Asian carp products, which supports removal by increasing sales of Asian carp products.

3.2.3 Asian Carp Population Model and Demographics

The SEAcarP model describes our current understanding of Silver and Bighead Carp population dynamics in the Illinois River. It is a simulation-based model that includes spatially explicit components (i.e., river pools) of the Illinois River system and produces probability-based predictions. The model is being used to evaluate the effectiveness of different management strategies – spatial allocation and intensity of harvest and upstream movement deterrence between Starved Rock Lock and Dam and Brandon Road Lock and Dam. Determining ways to maximize return on investment of management actions was an area of increased emphasis in 2018 and 2019. Efforts were directed to the refinement (improved the accuracy and precision), expansion, and strategic use of an Asian carp population model SEAcarP, including: (1) the optimal location(s) and times for adult harvest in downstream navigation pools in the IWW relative to upstream navigation pools, and (2) potential locations for implementing deterrents to prevent the continuous upstream movement of Asian carp from source self-sustaining populations established farther downstream.

In 2020, the model will be used to assess control scenarios for achieving the maximum net impact on Asian carp population levels for specific locations in the IWW. The model identifies scenarios for spatially explicit components of the Illinois River system and will be expanded to: (1) recommend mortality benchmarks, or harvest quotas, and fish passage deterrent locations with efficacy requirements relative to percent of blocked passage, (2) incorporate updated Asian

carp demographic rates using the most current data available, and (3) evaluate the feasibility to estimate immigration into the upper Illinois River using indirect methods from harvest information. The expanded model will incorporate key data with a focus on Asian carp control in the six lower pools of the IWW (Alton, La Grange, Peoria, Starved Rock, Marseilles, and Dresden Island), while also providing critical information on growth and year-class strength and informing our understanding of the risk of upstream migration using the most current data. The model and resulting management recommendations will be annually updated and improved based on expert feedback and new information gathered from ongoing monitoring for population changes, ultimately providing a robust tool to inform ACRCC interagency management actions. In 2020 the following efforts will be addressed:

- Estimate demographic rates using the most current data available and incorporate results into the SEAcarP model.
- Conduct sensitivity analyses and develop a prioritized list of data and research needs based on results thereof.
- Recommend mortality benchmarks and fish passage deterrent locations with efficacy requirements.
- Use statistical catch-at-length models to estimate vulnerability to fishing as a function of fish size, exploitation rates, and immigration into the upper Illinois River Waterway.
- Modify the length-based structure of the model; use integral projection models to define populations by a continuous variable instead of discrete length classes.

3.3 TECHNOLOGY DEVELOPMENT

Currently, the primary permanent control tool for preventing the movement of Asian carp from the Mississippi watershed into the Great Lakes is the USACE EDBS located in the CAWS. Additional barriers or control technologies to augment the EDBS would improve the overall efficacy of the defense of the Great Lakes by providing redundancy and additional safety nets, ultimately offering greater confidence in their containment ability. For example, development of a chemical barrier that generates noxious water conditions might repel Asian carp, preventing them from approaching the EDBS; however, impacts on other fauna need to be assessed carefully. Some work has been done to define biological limits and potential benchmarks for candidate chemicals that may serve as a non-physical barrier to deter the movement of Asian carp.

An interagency team consisting of USGS, USFWS, Illinois DNR, USACE, and other partner agencies will continue to explore options for potential implementation of new Asian carp prevention and control tools, including complex sound, CO_2, and microparticles.

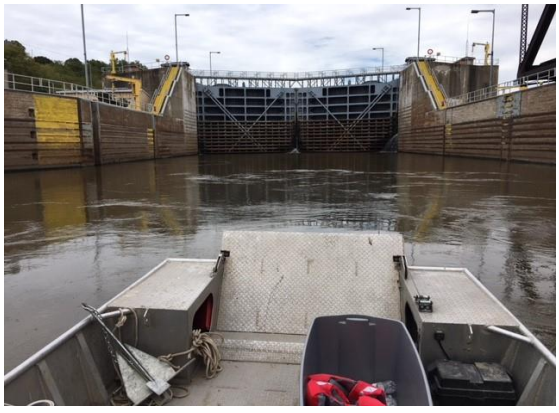
3.3.1 Use of Acoustic Deterrents

Significant work has been done to identify potential biological and physical deterrent techniques that discourage the movement of Asian carp, while allowing 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 have documented both

Downstream approach at Barkley Lock and Dam at Grand River, Kentucky. Photo credit: USFWS

Bighead and Silver Carp responding negatively to various underwater sound stimuli while many native fish species responded little to that same sound. Building off these studies and deploying large-scale experimental acoustic structures at critical passage points in the Ohio River and Upper Mississippi Basins will help in the understanding of the effectiveness of acoustic deterrents where Asian 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. For these large-scale pilot studies, underwater sound systems are being deployed pinch points in the river reaches where Asian carp are only able to swim upstream through a lock chamber because the head height of the dam structure prevents passage. 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 acoustic deterrent systems, research efforts in the lab will continue to refine and optimize sound frequencies, sound pressure levels, and speaker design to repel Asian carp while preventing injury to native species. Studies will also measure the efficacy of sound as a way to contain, herd, and capture Asian carp, as well as test their behavioral responses to underwater sound stimuli. 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.).



Downstream Approach at Lock and Dam 19 at Keokuk, Iowa. Photo credit: USFWS

Large-scale deployment of acoustic technologies will continue at two locations in FY 2020. At the BAFF system at Barkley Dam near Grand Rivers, Kentucky, telemetry studies will begin in FY 2020 and data will inform managers as to how the technology is performing with respect to deterring Asian carp. Design and construction of the Lock and Dam 19 ADS Deployment Project in Keokuk, Iowa, is also underway in FY 2020.

Proposed actions for FY 2020 at the Barkley BAFF Deployment Project include:

- Deploy and evaluate the BAFF system.
- Continue coordination among multi-agency science and evaluation team.
- Implement the study plan for Barkley BAFF evaluation.

Proposed actions for FY 2020 at Lock and Dam 19 (Mississippi River) ADS Deployment Project include:

- Develop, implement, and assess an ADS at Lock and Dam 19 or a surrogate location.
- Continue coordination among multi-agency science and evaluation team.
- Continue research and development related to acoustic deterrents, including engineering of new acoustic signals and testing of signals in ponds and/or the field on Asian carp and native fishes.

It is hoped that the results of these studies can further inform development of underwater sound as a potential control alternative.

3.3.2 Carbon Dioxide

CO_2 is being investigated as a potential deterrent to Asian carp. The concept is to introduce CO_2 into water to deter or immobilize Asian carp from moving upstream. Several published studies at laboratory, mesocosm, and field settings have demonstrated that Asian carp and other fishes are repelled from areas with elevated CO_2 concentrations. This avoidance mechanism could be useful for management agencies to restrict movement through key pinch-points (e.g. navigation structures) and better control range expansion towards the Great Lakes and other large river basins.

Scientists monitored movements of Asian carp and other fish in relation to carbon dioxide in a research pond in Wisconsin. Photo credit: USGS

State and federal partners completed several important milestones in 2019. First, USGS and USFWS obtained a Section 3 registration from USEPA for Carbon Dioxide-Carp as a new aquatic pesticide. Approved uses included as an Asian carp deterrent and as a non-selective under-ice lethal control for all ANS. Next, an economic and engineering feasibility study was conducted within a navigation lock in Wisconsin. This study demonstrated the installation and operation of a large-scale CO_2 infusion system and collected data on operational costs, fish behavior, non-target organisms, human health risk assessment, and water quality.

Proposed next steps are intended to transition CO_2 from research to management and will finalize work that was completed in FY 2019. Actions that will be taken in 2020 include:

- Complete data analysis and report writing from FY 2019 toxicity trials.
- Complete data analysis and report writing from FY 2019 navigation lock field trials.
- Conduct studies to support Carbon Dioxide-Carp registration within individual states.

- Develop a Carbon Dioxide-Carp pesticide reporting system.
- Initiate Section 3 registration of dry ice (solid state CO_2) for lethal control applications.

3.3.3 Microparticles

No current technology can specifically target Asian carp for control within aquatic ecosystems. Available toxicants used in aquatic invasive species control programs are non-selective and are applied throughout the entire water column, resulting in equal exposures of native and invasive species alike. Developing delivery systems that target feeding strategies of specific organisms, like an Asian carp, would increase the ability of management agencies to control or limit a species like Asian carp, while minimizing potential impacts on native species. In 2020, USGS will be consulting with USEPA to identify which studies would likely be accepted and which studies will need to be redone for registration of an Asian carp toxicant and will submit a registration packet for antimycin-A in a Fintrol formulation. USGS will also finalize environmental fate studies for microparticle.

3.3.4 Barge Entrainment

In 2019-2020, the USACE Engineer Research and Development Center (ERDC) facility in Vicksburg, Mississippi is using a 1:16.6 scale physical model of the CSSC with remote control tow and barges to (1) test the efficacy of compressed air bubble curtains to remove entrained neutrally buoyant fish surrogates from tows, and to (2) quantify changes in flow dynamics within the hydraulic recesses during passage over a bubble curtain. The physical model enables a controlled and detailed evaluation of the interaction between barges, fluid motions, and nearly neutral buoyant objects under a variety of vessel speeds and barge configurations typical of a navigation lock.

The USGS conducted hydraulic surveys of the lower sill bubble curtain at Peoria Lock and Dam in September 2019. This lock is representative of navigations locks from around the country including other areas where Asian carp are found such as Barkley Lock and Dam and Pickwick Lock and Dam in Kentucky and Tennessee, respectively. These surveys included hydroacoustic water velocity measurements (acoustic Doppler current profiler and acoustic Doppler velocimeter), video recordings of the water surface for estimation of surface velocities using image processing techniques, and acoustic imaging of the bubble curtain in the water column (Multibeam Echosounder). This data will be used to validate results from the physical model and to inform planned field trials.

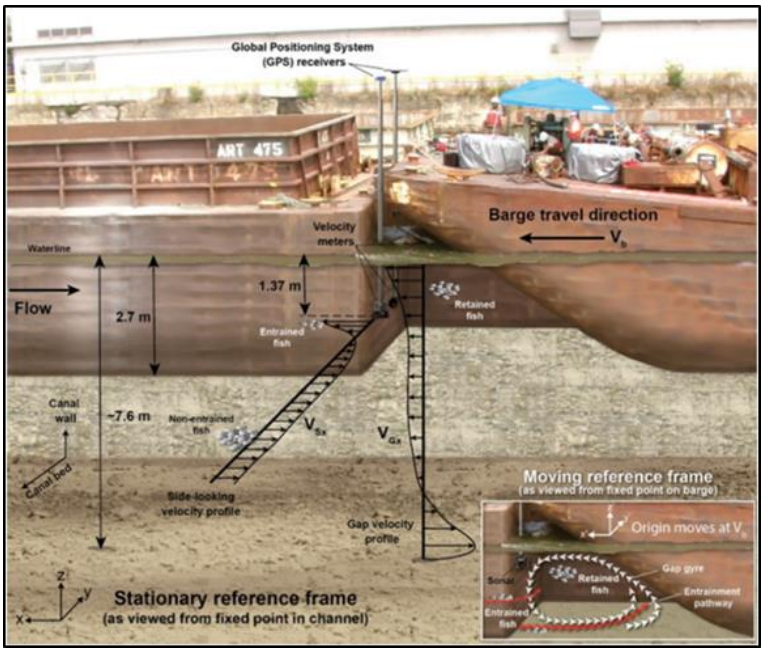


Figure 9. *Rake to box junction between barges (from Davis et al. 2016).*

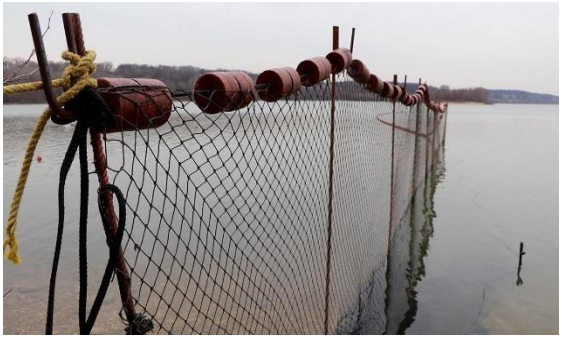
In 2020, the agencies will test the efficacy of a sill bubble curtain in mitigating barge entrainment at the field scale. Planning and contracting for these field tests will occur in 2020 and the field tests are planned at Peoria Lock and Dam in 2021. The proposed field scale testing will entail a mark and recapture study in which live fish are marked with unique fin clips and placed in the junction gap of a tow. The barge tow will enter the lock chamber, passing over the bubble curtain, and the number of fish remaining in the junction gap will be determined through a combination of recapture attempts and sonar observations. The planned field tests will also include hydroacoustic water velocity measurements in the junction gap space, around the tow, and in the lock chamber. The results of the ERDC physical modeling and the interagency field testing will inform the design of proposed bubble curtain barriers on the IWW, Upper Mississippi River or elsewhere (e.g. as a potential seasonal barrier on the Sandusky River), as well as the strategic use of existing bubbler systems at Lockport, Dresden, Marseilles, and Peoria Locks to minimize the upstream movement of bigheaded carp.

3.4 Early Detection, Monitoring, and Assessment

Continued monitoring and assessment of the Asian carp population in the Upper Illinois River are critical to the ACRCC's ability to assess the threat of Asian carp upstream movement and range expansion. In addition, monitoring above the EDBS is important to ensure no Asian carp have moved beyond the barrier.

3.4.1 Monitoring Upstream and Downstream of the Dispersal Barrier

Seasonal Intensive Monitoring continued in 2019. A variety of gears were used during monitoring activities, including pulsed DC-electrofishing, trammel and gill nets, deep water gill nets, a commercial seine, trap nets, hoop nets, and Great Lakes pound nets to detect, capture, and subsequently remove any Asian carp present.



The seine net is lifted to keep any fish from escaping. Photo credit: Evan Garcia /Chicago Tonight.

Fixed and random site intensive electrofishing efforts and contracted netting at four fixed sites in each of the four pools below the EDBS are used for this effort. In 2020, contracted commercial netting will take place bi-weekly from March through December in the Lockport, Brandon Road, and Dresden Island pools. Contracted commercial netting in the Marseilles pool will also occur. An intense removal effort, or Barrier Defense, occurs in the Starved Rock, Marseilles, Dresden Island, Brandon Road, and Lockport pools.

Fixed Site Monitoring Upstream of the Dispersal Barrier. In 2020, a variety of gears will be used during seasonal intensive monitoring activities, including pulsed Direct Current (DC) - electrofishing, trammel and gill nets, deep water gill nets, a commercial seine, trap nets, hoop nets and Great Lake pound nets to detect, capture and subsequently remove any Asian carp

present. Additional intensive monitoring will occur in Lake Calumet and the North Shore channel.

Fixed Site Monitoring Downstream of the EDBS. Fixed and random electrofishing and contracted netting has been increased since 2014 and will continue in 2020 at these elevated levels below the EBDS. The effort will include intensive electrofishing and netting at four fixed sites and will increase from four to 12 random sites in each of the four pools below the EDBS. Fixed and random site electrofishing will take place bi-weekly from March through November.

Contracted commercial netting will take place bi-weekly from March through December, except during June and September, and will include four fixed sites and random sites in the Lockport, Brandon Road, and Dresden Island pools, respectively. Also, the lower Kankakee River, which drains into Dresden Island pool, will be monitored to provide information on life stages within the river. Contracted commercial netting in the Marseilles pool will occur at four fixed sites and four random sites.

Also, 2020 sampling for young-of-year and juvenile Asian carp will take place through netting and electrofishing operations in coordination with additional projects. The collection of small fish, in context of their relative abundance in the Upper IWW may suggest an increased risk of Asian carp movement toward Lake Michigan and this remains one of the primary foci of monitoring.

3.4.2 Distribution and Movement of Small Asian Carp in the IWW

Small Silver and Bighead Carp pose a unique threat to invading the Great Lakes because of the potential electrical limitations of the EDBS at immobilizing fish less than 6 inches in total length. Therefore, it is important to carry out sampling using a variety of gear at sites between the Peoria reach of the Illinois River and the EDBS throughout the year to detect upstream migrations of small and juvenile Silver and Bighead Carp. Any successful capture of juvenile or small Asian carp is immediately communicated to the MWRG if it is new for the year or further upstream than prior captures.

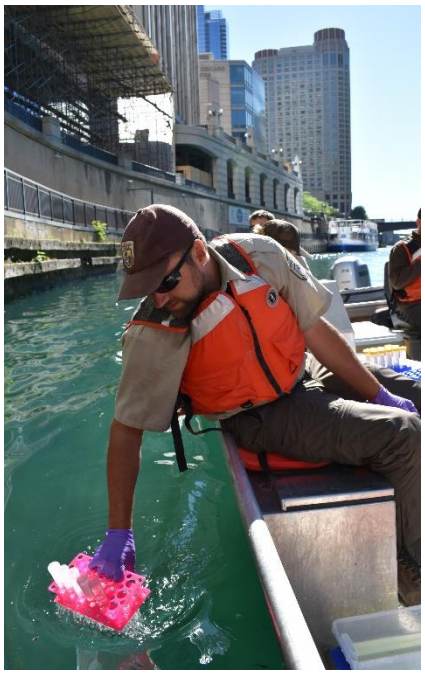
In 2020, sites within the various pools (Lockport, Brandon Road, Dresden Island, Marseilles, and Starved Rock) of the Upper IWW will be sampled using a suite of gears intended to capture juvenile Asian carp, to include fish <152 millimeters total length (6 inches).

3.4.3 Comprehensive Interagency eDNA Monitoring Program

Throughout 2019, USFWS, in cooperation with agency partners, continued to monitor for the presence of Asian carp eDNA in the Great Lakes basin utilizing a statistically tenable sampling protocol. In addition, USFWS continued to upgrade its field sampling infrastructure and its collection and sample processing techniques as new technologies emerged.

eDNA analysis in the laboratory.

In 2020, USFWS, in cooperation with state and tribal partners, will continue to monitor for the presence of Bighead and Silver Carp eDNA in the Great Lakes basin, as well as the Upper Mississippi River and Ohio River basins. Actions include program coordination and oversight and processing collected water samples to detect the presence of Asian carp DNA in areas of concern. This will include the CAWS of the IWW and will include two sampling events in 2020.



USFWS collects water for eDNA surveillance in the CAWS.

3.4.4 Asian Carp Stock Assessment in the Upper Illinois River

Hydroacoustic sampling will occur for multiple purposes, including whole-pool sampling in Marseilles and Dresden Island pools every other month from February through October. This sampling results in bigheaded carp density heatmaps displaying spatial distributions of fish throughout the year that will be provided to MRWG members to target contracted harvest to maximize harvest efficiency. Hydroacoustic sampling will also take place before and after any Unified Method Asian carp removal events in spring and fall to provide density heatmaps to inform harvest actions, and to assess effectiveness of harvest at reducing densities. Finally, hydroacoustic sampling will be conducted in October at standardized locations from Alton to Dresden Island pools in order to quantify pool-wide bigheaded carp densities that will be compared to long-term (since 2012) density trends.

Acoustic telemetry surveillance of the movement of telemetry-tagged bigheaded carp throughout the Illinois River using an array of over 70 stationary receivers (distributed from Alton through Dresden Island pools) will continue. Data will be processed to identify dam passages by tagged fish, including the route of passage (i.e., dam vs. lock) when possible. Bigheaded carp movement data are used to improve estimates of movement rates among pools, an essential component of the SEAcarP population model. Additionally, this receiver array is compatible with acoustic telemetry tags from other groups/studies, including tags in bigheaded carp in the Mississippi and Ohio rivers so that data can be included in inter-river movements for future expansion of the SEAcarP model.

By the end of 2020, SIU will have deployed 100 active acoustic telemetry tags in Alton pool and 100 tags in La Grange pool to continue efforts to estimate pool-to-pool transition probabilities under changing management strategies. These efforts are coordinated through the Telemetry Work Group of the MRWG. Illinois DNR will work collaboratively with USACE to compare the behavior (movements, home range, and dam passage) of Common Carp to Silver Carp to assess the appropriateness of using Common Carp as a surrogate species in telemetry studies conducted in areas where Asian carp are not currently established. This study will help to

improve inferences from Common Carp telemetry data upstream from Brandon Road Lock and Dam regarding the behavior of Silver Carp.

A program of enhanced fishing of Asian carp in the Peoria pool began in September 2019. Assessing effects of this new enhanced fishing program on bigheaded carp in Peoria pool is necessary to determine effectiveness of this program and to improve program success. One method for determining effects of enhanced fishing on bigheaded carp is comparing fall densities from hydroacoustic sampling in years after implementation of enhanced fishing versus prior years. In 2020, hydroacoustic surveys will be conducted of select sites (same sites as fall standardized sampling) in Peoria pool every other month from February to October. The resulting data will allow for a better ability to assess effects on bigheaded carp densities, size distributions, and spatial distributions, and to relate these potential changes to harvest from the enhanced fishing program.

3.4.5 Great Lakes Monitoring

The USFWS continues to work with partners to refine a Great Lakes basinwide early detection protocol for Asian carp and other AIS. Sampling gears used and locations sampled are tailored each year to match conditions and agency needs, as well as to leverage new sampling technologies for AIS species of interest. The USFWS continues to coordinate with federal, state, and provincial partners to annually identify priority sampling locations, further develop and refine protocols, share information, and discuss ways to coordinate agency sampling efforts. Since 2013, USFWS worked with partners to conduct coordinated and complementary sampling efforts in the Great Lakes basin with both emerging and traditional gears. In 2019, USFWS continued to expand its overall sampling efforts and collected over 7,000 eDNA water samples, electrofished, trawled, sampled ichthyoplankton, and set a variety of nets to survey for Asian carp. No Bighead or Silver Carp were captured or observed.

In FY 2020, USFWS and partner agencies will continue to implement a comprehensive Great Lakes basin wide early detection and monitoring program for Asian carp and other AIS. USFWS staff/teams will be prepared, and may be mobilized, to respond to any Asian carp detected (using either traditional gear or eDNA) in the Great Lakes. Efforts will continue on an annual basis focused on detecting new invasions of Asian carp.

3.4.6 Binational Ecosystem Risk Assessments

A binational ecological risk assessment on Bighead and Silver Carp was completed in 2012 to provide scientifically defensible advice for managers and decision-makers in Canada and the U.S. This risk assessment looked at the likelihood of arrival, survival, establishment, and spread of bigheaded carp to obtain an overall probability of introduction. Arrival routes assessed were physical connections and human-mediated releases. The risk assessment ranked physical connections (specifically the CAWS) as the most likely route for arrival into the Great Lakes basin. Results of the risk assessment show that there is enough food and habitat for bigheaded carp survival in the Great Lakes, especially in Lake Erie and productive embayments in the other lakes. Analyses of tributaries around the Canadian Great Lakes and the American waters of Lake

Erie indicate that there are many suitable tributaries for bigheaded carp spawning. Should bigheaded carp establish in the Great Lakes, their spread would not likely be limited and several ecological consequences can be expected to occur. These consequences include competition for planktonic food leading to reduced growth rates, recruitment and abundance of planktivores. Subsequently this would lead to reduced stocks of piscivores and abundance of fishes with pelagic, early life stages. Overall risk was determined to be highest for lakes Michigan, Huron, and Erie, followed by Lake Ontario then Lake Superior. To avoid the trajectory of the invasion process and prevent or minimize anticipated consequences, it is important to continue to focus efforts on reducing the probability of introduction of these species at either the arrival, survival, establishment, or spread stage (depending on location).

A binational ecological risk assessment for Grass Carp in the Great Lakes basin was released in January 2017. The document explains that Grass Carp have been found in Lakes Michigan, Erie, and Ontario, and summarizes the potential ecological consequences over the next 50 years, which in most of the Great Lakes basin could be extreme. Should Grass Carp become established, wetlands in the Great Lakes basin are particularly vulnerable. The study's findings will inform management and policy decisions with an objective of preventing the survival, establishment and spread of Grass Carp in the Great Lakes basin on both sides of the border, as well as activities related to prevention, early detection or monitoring, response, and management.

In close collaboration with subject matter experts from DFO, GLFC, and Ontario Ministry of Natural Resources and Forestry (OMNRF), Central and Arctic Region - DFO finalized a binational socio-economic risk assessment in 2018 as a companion piece to the binational ecological risk assessment released in January 2017. The study found that, in the absence of additional measures to prevent Grass Carp, starting in 2024, the present value of impact on Great Lakes commercial and recreational fishing industry in Canada would be around $590 million and $3.9 billion in 10 years and 40 years, respectively. The present value of impact on Great Lakes commercial and recreational fishing industry in the US would be around $2.5 and $15.28 billion in 10 years and 40 years starting 2024, respectively. The study found that the presence of Grass Carp in the Great Lakes would decrease lake front use, wildlife viewing, recreational hunting opportunities and associated benefits and might benefit the recreational boating activities. Other services expected to be at risk were ecosystem services, non-use values, future use values, and subsistence, social, and cultural values.

The results of the study may be used to communicate to the public, resource managers, and decision makers in both Canada and the U.S., and help set the priorities for mitigation measures and/or prevention of Grass Carp in the Great Lakes basin. Moreover, the study will greatly inform any cost-benefit analysis to facilitate developing options and/or support any regulatory initiatives under the DFO AIS Program. The study is now awaiting approval and once approved will be distributed to GLFC and OMNRF. Following the distribution of the final report to GLFC and OMNRF, any further distribution will be considered collaboratively with our partners.

A Black Carp ecological risk assessment for the Great Lakes is currently ongoing. The risk assessment will evaluate the probability of introduction (assessing the likelihood of arrival, survival, establishment, and spread) as well as the magnitude of the ecological consequences for each lake, projected out for 50 years. Input into the assessments will include research and ecological modeling conducted in both Canada and the U.S. The writing team for both assessments consists of DFO, GLFC, USGS, and the USFWS.

3.4.7 Great Lakes Food Web Assessments

NOAA will continue to model the potential risk of Asian carp to Great Lakes food webs. NOAA accomplishes this by modeling how Asian carp may affect the food webs of the Great Lakes ecosystem. NOAA has applied the Ecopath with Ecosim model to simulate effects of bigheaded carp on the food webs of Lakes Erie, Huron, Michigan and Ontario, and Illinois River. In FY 2020, NOAA will apply the model to simulate Black Carp effects on the Lake Erie and Lake Michigan food webs. The potential risk of Black Carp to food webs in the Great Lakes is highly uncertain. For example, it is unknown whether Black Carp will prefer to eat *Dreissena* mussels, a readily available and abundant prey resource, over other benthic taxa in the Great Lakes. If Black Carp do consume *Dreissena* mussels, it is uncertain whether their thermal preference for warmer waters will significantly restrict their consumption of mussels to nearshore areas, thereby limiting their impacts on *Dreissena mussels* and Great Lakes food webs.

3.5 Response Actions

The ACRCC will be prepared to shift monitoring resources as new information becomes available. As in past years, if new findings indicate an increased risk, resources will be available to transition to the involved areas, as necessary. Evaluations and enhanced monitoring decision tools will provide additional details as warranted.

In 2020, the ACRCC will be addressing contingency actions through the MRWG's CRP once again in the event a change is detected in the status/risk considering all life stages of Asian carp in those pools. The goal of the CRP is to provide a process to consider appropriate and specific response actions that fully consider available tools and the authorities of member agencies to implement actions. The ACRCC will be prepared to respond rapidly and shift monitoring resources as new information becomes available.

The CRP will continue to be used by the MRWG to direct response actions in the event a change is detected in the status/risk considering all life stages of Asian carp in those pools or in the event of Asian carp detection above the EDBS. The CRP will also provide for open and transparent communication with the public and special stakeholder groups. Command and control of an Asian carp response in the IWW will be implemented under the MRWG. The Incident Command System (ICS) is a management system designed to enable effective and efficient incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure.

3.6 Black and Grass Carp Monitoring, Assessment, and Control

USFWS, USGS, Michigan DNR, Ohio DNR, Ontario Ministry of Natural Resources and Forests, DFO-Canada, and other partners continued to assess Grass Carp populations in Lake Erie and other locations in the Great Lakes to better understand their status, and to target capture and removal. In addition, Illinois DNR and USFWS conduct sampling targeting all life stages of Black Carp.

The Action Plan includes numerous monitoring and control activities focused on Black and Grass Carp. Below are collaborative approaches undertaken by the ACRCC to address these species:

3.6.1 Addressing the Threat of Black Carp

Black Carp Captured, Southern Illinois University.

Black Carp, one of the four species of invasive Asian carp, have population numbers that have been increasing in the Upper Mississippi River basin since 1994. Over 700 specimens have been collected in the U.S., since 1994 with 196 collected in 2019 alone reported to the USGS Nonindigenous Aquatic Species (NAS) database. Most of these specimens were collected by commercial fishers. To leverage existing ongoing commercial fishing efforts and opportunistically collect critical data on Black Carp, SIU administers a bounty funded by the Illinois DNR to encourage reporting and provide specimens for research. Reports from commercial fishers revealed that Black Carp have spread to the Illinois River (Peoria pool) and Ohio River. Increased captures in recent years, including a February 2018 capture of a 115-pound adult female (aged to be about 13 years old) near Cape Girardeau, Missouri, and evidence of reproduction across multiple years, indicate that Black Carp are established in the Mississippi River basin and are expanding their range.

Recognizing the emerging threat, the ACRCC formed an interagency Black Carp Work Group (BCWG) to scientifically evaluate the status of the now-established species, identify clear 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. The BCWG is comprised of fishery scientists and managers from State and Federal agencies and academic institutions with technical expertise on Asian carp life history and management. The addition of the Black Carp Strategy within the 2017 ACRCC Asian Carp Action Plan underscored the partnership's concern for this growing threat. Through this effort, the ACRCC is identifying the data needs and highest priority management and control actions in response to the significant increases in documented occurrence and upstream range expansion in recent years.

In order to effectively target Black Carp and control their spread, there is a strong need for critical data on the species' biology, ecology, and current population status. The establishment

of the BCWG began to address these knowledge gaps. This interagency effort is part of a comprehensive approach to coordinate research, monitoring, and development of control technologies. The Black Carp Strategy prioritizes monitoring and surveillance of this species in its invaded range of the Mississippi River, focusing on all life stages. Development of a species-specific bait is underway, as well as refinement of genetic surveillance tools, including eDNA. In addition, the BCWG has also recommended telemetry for this species, as a tool to fill an information gap on movement and habitat use. Currently, all captured specimens are removed from waters and key demographic and biological data is gathered (sexual maturity, age, diet, ploidy). However, there is minimal data on their range of or triggers for movement, or species habitat preference.

Specific Black Carp efforts in 2020 include:

- Determine habitat selection and movements of Black Carp using acoustic telemetry.
- Spawn Black Carp and generate needed early life history data.
- Continue to receive Black Carp specimens from across the invaded range to track expansion and changes in demographics, and to acquire sufficient gonad for determination of spawning periods.
- Generate a model of size of representative unionid mussel species that could be consumed by a given size Black Carp.
- Continue diet analysis, increasing sample size and focusing on better determining the types of native mollusks consumed.
- Assess whether the eDNA markers and protocols developed in earlier work (in combination with field portable, user friendly instrumentation) can be used to efficiently detect populations of juvenile Black Carp.
- Determine juvenile Black Carp diets using DNA metabarcoding.
- Undertake diet comparisons among juvenile Black Carp to those of co-occurring species (based on early fall captures) in order to determine whether juvenile Black Carp are selective or opportunistic foragers.
- Continue to provide sequence confirmation of visual identified young-of-year (YOY) (larvae)
- Conduct relatedness and/or parentage analysis of wild-caught Black Carp age classes and estimate effective number of breeders or effective population size.
- Continue to improve eDNA collection methods. Upon optimization of eDNA methods, develop specific Standard Operating Procedure for Black Carp eDNA monitoring program.
- Provide ploidy analysis support.
- Expand hoop netting efforts to target Black Carp to better detect their presence and expansion up the lower Illinois River.
- Apply the model to simulate Black Carp effects on the Lake Erie and Lake Michigan food webs. The potential risk of Black Carp to food webs in the Great Lakes is highly uncertain. For example, it is unknown whether Black Carp will prefer to eat *Dreissena* mussels, a readily available and abundant prey resource, over other benthic taxa in the Great Lakes.

3.6.2 Addressing the Threat of Grass Carp

U.S. and Canadian resource agencies in the Lake Erie basin have identified the threat of invasive Grass Carp as a high priority requiring focused and aggressive assessment and control action. Member agencies have developed a suite of proposed actions for implementation, building off existing efforts within the Lake Erie basin. Planning is being conducted in collaboration with the GLFC's Council of Great Lakes Fishery Agencies, Invasive Fishes Executive Committee, and the Lake Erie Committee (LEC).

In recent years, the ACRCC has funded actions to address the threat that Grass Carp pose to the Great Lakes, broadening from the initial focus on Bighead Carp and Silver Carp. Because the spawning and early life history requirements of Grass Carp are similar to Bighead Carp and Silver Carp, USGS scientists have built on their existing knowledge base to identify two Lake Erie tributaries where Grass Carp are spawning. Investments by Michigan and Ohio, along with USGS and USFWS, have led to a better understanding of Grass Carp movements that led to improved action strategies. In 2016, Michigan DNR, collaborating with Ohio DNR, OMNRF, Fisheries and Oceans Canada, USGS, and USFWS, initiated development of an Adaptive Management Framework for Grass Carp Control in Lake Erie to inform the identification, prioritization, selection, and sequencing of key strategic actions. This information has led the binational LEC, comprised of fishery managers from Michigan, Ohio, Pennsylvania, New York, and Ontario, and supported by Canadian and U.S. federal agencies, to adopt a 5-year adaptive response strategy to reduce the threat of Grass Carp to Lake Erie through common and coordinated efforts.

Efforts to respond to Grass Carp threats support the coordinated and cooperative fishery management conducted by agencies signatory to *A Joint Strategic Plan for Management of Great Lakes Fisheries*, and the goals and objectives of the Management and Control Plan for Bighead, Black, Grass, and Silver Carp in the U.S. These efforts are further supported by the Great Lakes AIS Early Detection program, conducted by USFWS in collaboration with State and Federal agency partners to provide targeted surveillance for non-native species (including Grass Carp) in the highest risk locations within the basin. Since 2016, a combination of research and agency removal actions has identified key areas on which to focus to best reduce the threat of Grass Carp to Lake Erie, while also increasing agency understanding that should improve future response efforts. Based on this experience and increased information about Grass Carp, the LEC recognizes that dramatically increasing the number of strike (or response) teams to target removal of adult Grass Carp, and adding an additional egg sampling team to assess the risk of reproduction in other Ohio tributaries are essential elements of its 5-year adaptive response strategy.

State, provincial, and federal agencies from both Canada and the U.S. have collaborated to develop and implement Grass Carp techniques for removal of Grass Carp in Lake Erie. For the last two years, three strike teams, one each from USFWS, Michigan DNR, and Ohio DNR, have operated in the Lake Erie basin. In 2020, two additional strike teams will be available through GLRI funding, plus two more teams through a Congressional appropriation to the GLFC for $1 million in FY 2020. These seven strike teams will help in reaching the removal goals developed

through the Adaptive Management Framework. The LEC believes that substantially increasing the number of strike teams is its highest priority as it seeks to meet its goal of removing 390 Grass Carp annually.

A second priority, to evaluate the feasibility of a seasonal barrier in the Sandusky River, is currently underway. The third priority of the LEC is to reduce critical uncertainties. Key activities that will help the LEC reduce uncertainties about where and when to target removal include maintaining support for real-time receivers, additional sampling for eggs in Ohio tributaries, and expanding telemetry coverage to improve its understanding of Grass carp movement patterns.

The increased removal effort, coupled with research into additional control strategies, should increase the ability of agencies to control the Grass Carp population in the short term and allow for continued progress toward eventual eradication of Grass Carp in Lake Erie. Research conducted by USGS will provide additional assistance to ongoing management activities.

In 2019, Ohio DNR undertook the following actions aimed at Grass Carp population reduction/eradication.

- Continuation of the University of Toledo (UT) study on the application of detection probability estimates to Grass Carp population estimates and catchability.
- Refinement of Grass Carp science to improve removal efforts that included a dedicated Grass Carp strike teams focused on removal and comparison of removal techniques. The Strike Team worked in cooperation with staff from Michigan DNR and USFWS.
- Partnership with commercial fishing operations for Grass Carp removal.
- Continuation of efforts to evaluate the feasibility of a temporary or permanent barrier to prevent Grass Carp movement into spawning or high use areas.

In collaboration with partner agencies, Michigan DNR began implementing adaptive management actions in 2018 while continuing to support efforts to obtain information to reduce key uncertainties. As part of the response plan, Michigan DNR has implemented sustained response actions with a standardized random sampling approach to provide time series data. Adaptive response actions including fishing with setlines, baiting methods, and night-time responses have also been evaluated with the goal of improving removal strategies. Starting in 2019, Michigan DNR began implementing a Judas Fish study with USFWS, Ohio DNR, and Michigan State University (MSU) to assess the ability of real-time telemetry receivers to increase capture rates. These studies utilize Grass Carp that are captured, telemetry tagged, and then released live into the lake for the purpose of their movement eventually revealing the preferred location of larger aggregations of adult fish. Three of the five Grass Carp captured in Michigan waters of Lake Erie by agency effort in 2019 were the direct result of responding to real-time detections. Although the results are still preliminary, they suggest that the Judas fish approach increases the effectiveness of response actions.

The following are actions that will be completed in 2020:

USGS

- Sampling for early life history stages of Grass Carp in key Lake Erie tributaries and modeling egg and larval drift to identify spawning locations and inform control efforts focusing on the Cuyahoga River and other tributaries identified by past research as potentially suitable for Grass Carp spawning.
- Evaluation of bait and attractants to increased aggregation and harvest of Grass Carp in the Lake Erie Basin.
- Evaluation of nearshore and tributary movements and habitat use of Lake Erie Grass Carp.
- Completion of an extended hydraulic model for the Sandusky River will allow FluEgg modeling using eggs and larvae captured in 2018 and 2019 to locate new spawning areas upstream of the former Ballville Dam and verify continued use of previously identified spawning areas.
- Conduct field trials using Grass Carp baits and attractants in Plum Creek (hot ponds) and North Maumee Bay in collaboration with the Michigan DNR.
- Sampling for early life history stages will be expanded to other rivers if telemetry data identifies other potential spawning rivers where adults are detected.

USFWS

USFWS will continue to provide field crews, including strike teams, and vessel support to state, federal, and university partners working to implement Grass Carp response actions in Lake Erie. Grass Carp response priorities include:

- USFWS teams will conduct exploratory monitoring in high priority rivers and tributaries to Lake Erie (e.g., Grand River, Huron River, Portage River, and Vermilion River).
- Collect blood for ploidy analysis and assist with lab processing of samples (eggs, larvae, and adults).
- Conduct exploratory Grass Carp monitoring in rivers and tributaries to Lake Erie.

Grass Carp research priorities include: (1) assist with implementation of Grass Carp bait/attractant aggregation study, (2) assist with implementation of mobile VPS array study to track fine-scale movements of Grass Carp during response actions, and (3) implement a study aimed at determining the optimal parameters for inducing a capture-prone response of adult Grass Carp using “Midwest Lake Electrofishing Units”.

Ohio DNR

Ohio DNR will combine previous knowledge with additional information gained to further refine when and where Grass Carp response actions can be most effective for control/eradication through the following:

- In partnership with the UT, deploy Grass Carp strike teams.
- Use real-time telemetry detections to evaluate catchability and capture rates.
- Continue to support modeling efforts through UT and MSU to increase collection efficiency, determine effectiveness in removal, and better estimate population size.
- Continue to determine barrier feasibility on the Sandusky River (current funding).

Michigan DNR

Michigan DNR will implement response strategies for Grass Carp in Lake Erie, based on the 5-year response plan (2017-2022). The specific goal of the Michigan response plan is to work with other states and federal agencies to eradicate or significantly reduce reproducing Grass Carp in Lake Erie within 5 years as defined by occasional commercial occurrences of triploid fish similar to those prior to 2012. This effort will support a Michigan Grass Carp response team that will implement the following actions:

- Conduct random and fixed site monitoring to track population trends.
- Use real-time telemetry detections to evaluate catchability of tagged fish and capture rates of untagged fish (i.e., Judas fish approach).
- Implement strategic response actions in Ohio waters, as requested by Ohio DNR.
- Partner with commercial fishing operations for Grass Carp removal.
- Outreach with bow-fishers to promote removal.

3.7 Communication/Education/Stakeholder Engagement

ACRCC communication efforts are organized by the partnership's CWG, which is co-chaired by USFWS and Illinois DNR. The CWG is comprised of communication specialists from each partner agency and serves the essential function of coordinating messaging and communications in a complex multi-agency response and management setting.

A primary component of the ACRCC's communications approach is the website, AsianCarp.us. As the site administrator, USFWS organizes content and leads website development efforts. In 2019, efforts continued to make website content compliant with Section 508 of the U.S. Workforce Rehabilitation Act (1973). New content included announcements provided by ACRCC partners and the release of a Black Carp identification video. Created by USFWS, it is the first educational video that teaches public audiences how to identify Black Carp using Grass Carp as a point of comparison. Overall, the website continues to consistently generate traffic and attract new users interested in the Asian carp issue.

Targeted ACRCC communications will continue in 2020 with the ongoing coordination of partner responses to public, congressional and media inquiries; continued refinement of the ACRCC's early detection notification protocols; creation of ACRCC branded communication products; and sharing lessons-learned with groups outside of the ACRCC interested in learning more about how to structure communications in multi-agency response and management settings focused on high profile invasive species. Communication efforts will also continue to expand around

federal and state actions in the Upper Mississippi River and Ohio River basins, as outlined in the Water Resources Reform and Development Act (2014). Overall, communications work will contribute to key audiences having a greater understanding and appreciation for the ACRCC's purpose, function, current actions and successes.

In 2019, the USFWS released the first Black Carp identification video (http://www.asiancarp.us/News/Black-carp-ID-video.html) to be made widely available to the public. Image above provided by USFWS.

3.8 ACCRC Partnership Operations

In 2020, the USFWS and other ACCRC members will continue to seek opportunities for additional collaboration with inter-agency partnerships conducting Asian carp prevention efforts in the Upper Mississippi River and Ohio River basins. While these activities are outside of the purview and geographic scope of the ACRCC, they represent potential opportunities to further leverage resources including expertise, data, and capacity to more broadly address the threat region-wide, across multiple basins, where possible.

4.0 COLLABORATIVE ACTIONS WITHIN THE UPPER MISSISSIPPI AND OHIO RIVER BASINS

In support of a national approach to Asian carp management, Federal and State agencies and non-governmental partners work collaboratively across jurisdictional and basin watershed boundaries to address the threat of Asian carp on a landscape-scale. With a focus on increasing cooperative management, Congress provided direction in the Water Resources Reform and Development Act of 2014, Public Law 113-121 (WRRDA) authorizing the Director of USFWS to coordinate with the Secretary of the Army, the Director of the NPS, and the Director of the USGS to lead a multiagency effort to address the spread of Asian carp in the Upper Mississippi River basin (UMRB) and Ohio River basin (ORB). Those actions include technical assistance, coordination, and support provided by federal agencies to state and local governments in carrying out activities designed to slow, and eventually eliminate, the threat posed by Asian carp. Following the direction in WRRDA, agencies are leveraging and applying advances in detection, prevention and control technologies and implementation strategies realized through the ACRCC, UMRB and ORB partnerships across multiple basins to more comprehensively address the risk of Asian carp at the broader landscape scale.

Since 2015, the Mississippi Interstate Cooperative Resource Association (MICRA) has coordinated Asian carp management actions through partnerships of state, federal and nongovernmental organizations in the UMRB and ORB. These efforts are supported, in part, by additional USFWS resources made available since 2015 to support enhanced coordination, as well as implementation of key projects to address highest-priority management needs (monitoring and assessment, containment, and control), as identified by the partnerships and in support of basin wide strategies as provided below.

In FY 2019, USFWS continued to collaborate closely with state and federal partners in support of the management goals and objectives in the UMRB and ORB basin-wide management strategies, including an increased emphasis on the strategic use of contract fishing for Asian carp control, and the development and testing of fish migration deterrent barrier technologies.

The increased deployment of scientifically-informed and directed contract fishing and in-water deterrent technologies will further support collaborative efforts to protect interconnected watersheds from the risk of Asian carp by addressing potential source populations established in large river systems of the Midwest. Technological developments and lessons-learned will be leveraged for use across the basins for a more robust and coordinated approach in support of the national *Management and Control Plan for Bighead, Black, Grass, and Silver Carp in the United States* (National Plan).

For more detailed information on annual Asian carp project coordination and implementation in the Upper Mississippi River and Ohio River basins, see the 2018 MRP for Asian Carp in the Mississippi River Basin at http://micrarivers.org/asian-carp-plans-and-reports/ or http://www.micrarivers.org/wp-content/uploads/2018/10/2018-Monitoring-and-Response-Plan-for-Asian-carp-in-the-Mississippi-River-Basin.pdf.

Priority efforts in the UMRB and ORB include:

- Defining distribution of reproduction, recruitment, juveniles, and adults of all four species – fundamental information to make informed management decisions.
- Early detection surveillance and removal of Asian carp in upper reaches to prevent the establishment of reproducing populations.
- Preventing the spread of Asian carp through evaluation of deterrence technologies (e.g. complex sound, manipulation of hydrology at dams) at priority locations.
- Decreasing propagule pressure and reducing impacts of Asian carp by removing Asian carp (commercial fishing, contract fishing) and evaluating Asian carp removal methods.
- Improving management decisions by evaluating the impacts of harvest on Asian carp populations.
- Expanding collaborative interagency partnerships in the UMRB and ORB to include the Missouri River and Lower Mississippi River for Mississippi River basin wide approaches to managing the threat of Asian carp across multiple jurisdictions.
- Enhancing inter-basin collaboration between the Mississippi River basin and the Great Lakes basin.

Collaborative Asian carp management projects supported with additional USFWS resources include the following:

Upper Mississippi River Basin

- **Surveillance and Evaluation.** Implementation of a comprehensive early detection program to define distribution, abundance, and movement of all life stages of Asian carp to inform control and containment efforts and subsequent evaluation of management actions.
- **Containment.** Collection of baseline fish movement data for evaluation of Asian carp deterrence technologies; as part of an integrated control strategy to prevent upstream spread while minimizing impacts to native species.
- **Control.** Expansion of contract fishing to reduce propagule pressure, reduce impacts, and characterize adult Asian carp populations. The partnership has identified an intensive management zone (between Lock and Dam 19 and Lock and Dam 14) where most removal effort is focused and continually refined using up to date telemetry information.

Ohio River Basin

- **Surveillance and Evaluation**. Implementation of a comprehensive early detection program to define distribution, abundance, and movement of all life stages of Asian carp to inform control and containment efforts and subsequent evaluation of management actions.
- **Containment.** Collection of baseline movement data for evaluation of Asian carp deterrence technologies; and planning future deterrence needs as part of an integrated control strategy to prevent upstream spread while minimizing impacts to native species.

- **Control.** Deployment of contract fishing to reduce propagule pressure, reduce impacts, and characterize adult Asian carp populations. The partnership has identified priority locations in the Ohio, Tennessee and Cumberland rivers where most removal efforts are focused and continually refined.

A growing number of technologies are now under development or have been proposed for use in controlling or preventing the spread of Asian carp. While the immediate focus of many of these technologies is on managing Asian carp populations in the IWW and the CAWS to prevent establishment in the Great Lakes, advancements can potentially be leveraged and applied to partnership prevention and control strategies in other basins. Interbasin coordination of Asian carp control and management (including technology development) between the UMRB, ORB and Great Lakes partnerships supports an integrated, landscape-scale approach to addressing the threat, furthering the mission of the ACRCC and the goals of the National Plan.

The Asian carp problem is present throughout the Mississippi River basin and additional coordination is now underway within the Missouri River and Lower Mississippi River basins. The Missouri River Asian Carp Control Strategy Framework (http://www.micrarivers.org/wp-content/uploads/2018/08/Missouri-River-Basin-Asian-Carp-Framework_180313.pdf) guides the development of multi-year action plans within the Missouri River Natural Resources Committee Asian Carp Team. The Lower Mississippi River framework (http://www.micrarivers.org/wp-content/uploads/2019/08/LMR-AR-Red-Basin-Asian-Carp-Control-Strategy-Framework-FINAL_AUGUST2019.pdf) was finalized in August of 2019 and follow up meetings are planned to begin development of multiyear action plans.

Strong coordination within and between the Mississippi River basin and Great Lakes basin interagency partnerships is supporting more effective strategic and tactical planning and leveraging of the limited resources available for broad-scale Asian carp management efforts, working toward shared regional and national goals and objectives.

5.0 Canadian Asian Carp Prevention and Early Warning Efforts

Fisheries and Oceans Canada (DFO), the OMNRF, and the Québec Ministère des Forêts, de la Faune et des Parcs (MFFP) are key Canadian Federal and Provincial ACRCC partner agencies working to address the threat of Asian carp to the Great Lakes. Their efforts include policy, management, and scientific oversight of Asian carp actions in the Canadian waters of the Great Lakes and tributaries and represent a critical component to ensuring a basinwide approach to addressing the threat.

5.1 Fisheries and Oceans Canada

Fisheries and Oceans Canada has undertaken a wide variety of efforts to prevent the introduction and establishment of Asian carp (Grass, Black, Bighead, and Silver Carp) in the Canadian waters of the Great Lakes under its Asian Carp Program, which began in 2012. Presented here is a summary of activities conducted in 2019.

5.1.1 Targeted Traditional Gear for Early Warning Surveillance

Since 2013, DFO has implemented an early detection surveillance program for the Canadian side of the Great Lakes and has continued these operations through the 2019 field season (May through November). Selection of sites was based on those identified as at-risk in Canadian tributaries in the 2011 Binational Ecological Risk Assessment for Bigheaded Carp in the Great Lakes, followed by verification. A reassessment of the sites visited in previous years resulted in the inclusion of 37 sites in total, however, for the 2019 surveillance program, 35 of those sites were surveilled, which included 12 sites in Lake Huron, 8 sites in the Huron-Erie corridor, 8 sites in Lake Erie, and 7 sites in Lake Ontario.

The early warning surveillance field program uses a variety of traditional field gear, including bag seine, boat electrofishing, fyke nets, tied-down gill nets, trammel nets, 4-foot trap nets, and 5-foot and 3-foot hoop nets. New cooperative targeted sampling using gill nets or trammel nets, and electrofishing techniques was incorporated to improve sampling efficiency in blocked off areas. In 2019, the program continued its use of bongo nets and larval light traps to sample for eggs and larval fishes. Field work plans extend into the 2020 season and beyond; and new gears will continue to be introduced to the program to complement those currently deployed.

The Asian Carp Program continues to conduct extensive early detection surveillance efforts each year. In 2019, 1,143 sites have been completed (additional sampling continues). A total of 52,431 fishes have been detected, representing 86 species. Egg and larval sampling was conducted in the Grand River, Sydenham River, and Thames River. A total of 45 bongo net hauls, and 60 light trap sets were completed, capturing 18,551 larval fishes. Species identification will be completed by genetic analysis.

5.1.2 Response

The responsibility for taking action with regard to Asian carp in the Canadian waters of the Great Lakes is shared between DFO and OMNRF. Detections of a live Asian carp triggers ICS led by DFO; OMNRF may participate in the response as deemed necessary. Both agencies work co-operatively to continuously improve response activities and will continue to update protocols based on the experience gained through past responses. An Asian Carp Response Plan was developed using the ICS framework. DFO has also developed the capacity in the Asian carp laboratory for rapid ploidy testing of captured Asian carp in Canada. This capacity allows the program to better understand the level of threat posed by captured individuals and to respond quickly and accordingly. A total of 28 Grass Carp have been captured in Canadian waters of the Great Lakes since 2013. In addition to the three Grass Carp captured during DFO's early detection surveillance efforts (one in 2013, 2014, and 2015, respectively), 12 more were captured by DFO during response activities and 13 others were detected during this time by commercial fishers, recreational anglers and other agencies. These Grass Carp captures occurred over 16 events for which response efforts were initiated; nine of these responses involved on-water operations.

Despite similar levels of effort as previous years of targeted surveillance and non-target sampling and fishing, no Asian carp were captured in Canadian waters of the Great Lakes in 2019.

Throughout 2020, DFO will continue to respond, in conjunction with its partners, to Asian carp captures in Canadian waters. Response triggers, actions, protocols and a response database continue to be refined as DFO's experience with responses increases. ICS and response training for DFO included intensive in-class training and on-water training exercises in April 2017 with partners in Ontario and in April-May 2018 with Québec partners. These exercises served to test DFO's Asian Carp Response Plan with partners and observers from other agencies that were present. Future exercises and other training opportunities involving other partner agencies are being explored.

5.1.3 Research Activities

DFO's Asian Carp Program focuses mainly on research related to prevention, early warning and preparedness for response to potential Asian carp detections in Canadian waters. DFO has partnered with the University of Toronto (Scarborough) to conduct additional research activities. Such work in 2019 has included the following studies:

Native Fish Population Structure. To determine the potential for fishes to move between Lake Erie and Lake Ontario, and thereby bypass Niagara Falls, it was investigated whether populations of seven native fishes are genetically differentiated in habitats above versus below the falls. A state-of-the-art ddRAD method was used for sequencing thousands of loci (range: 6,988–29,421) from throughout the genome of each species and identified from these loci hundreds to

thousands (range: 810–13,617) of single nucleotide polymorphisms. These data were used to quantify genetic distinctiveness of populations above versus below Niagara Falls and to test for the magnitude and direction of gene flow past Niagara Falls. Populations of all species (*Ameiurus nebulosus*, *Ambloplites rupestris*, *Catostomus commersonii*, *Micropterus salmoides*, *Moxostoma macrolepidotum*, *Moxostoma valenciennesi*, Perca flavescens) were significantly genomically differentiated above versus below Niagara Falls (Hudson's Fst range: 0.055 in A. nebulosus to 0.359 in *C. commersonii*). Models assuming unidirectional upstream migration past Niagara Falls were supported in all six species investigated (*A. rupestris*, *A. nebulosus*, *C. commersonii*, *M. salmoides*, *M. macrolepidotum*, and *P. flavescens*), although this support was indifferentiable from a no migration model in four species (*A. rupestris*, *C. commersonii*, *M. salmoides*, and *M. macrolepidotum*). Models in which fish migration was restricted to the last 186 years since the first navigation canal past Niagara Falls was completed were universally rejected, suggesting that all signal of gene flow past Niagara Falls is the result of still poorly understood prehistoric hydrologic connections between the Great Lakes. A manuscript reporting results of this research was submitted to the journal Molecular Ecology in February 2019 where it received overall positive reviews.

Metabarcoding of Fish Eggs and Larvae. Early life stages of AIS are more numerous and broadly dispersed in the environment than adults – making them ideal targets for early detection – yet precisely identifying freshwater fish eggs and larvae is often impossible using morphology-based methods and traditional molecular identification methods are slow, expensive, and labor intensive. To address these methodological shortcomings, a metabarcoding protocol was developed in which mixed species samples of fish eggs and larvae can be bulk processed with the mitochondrial DNA 'barcode' region being sequenced from all individuals in parallel. Bioinformatics processing allows the resulting DNA sequence data to be matched to a reference alignment of all potential species in the region, and a list of species present in a given sample to be generated. In 2018, work included: improving upon the previously successful test of this metabarcoding pipeline by developing and testing new primers tailored more specifically to Great Lakes native, invasive, and potentially invasive fishes; and the extraction, sequencing and identification of DNA from approximately 1,200 egg and larval samples. Work currently underway involves finishing the bioinformatics from the first batch of samples in order to perfect the pipeline before sequencing the next batch of samples. All samples are anticipated to be sequenced by the end of 2019 with preliminary figures and results by January 2020.

Control Technologies. Recent occurrences of Asian carp in the Great Lakes emphasize the urgent need to identify methods to prevent Asian carp establishment and spread. In 2019, field research was conducted in collaboration with the Royal Botanical Gardens to investigate the efficacy of carbon dioxide deterrents in preventing the dispersal of carp into wetland areas. This was the first study to investigate the effects of carbon dioxide on the movement of target and non-target fishes within a realistic environment.

River Modeling. A 3-D hydrodynamic model coupled with a Lagrangian Particle Tracker to simulate Asian carp egg movement in the water column, was completed for the Don River. The model was calibrated and validated using the data collected in 2017. Different constant flow scenarios were run to test changes in hatching success across scenarios. Results show that hatching is possible under a wide variety of flow and temperature scenarios. The research has been submitted to a peer-reviewed journal and is expected to be accepted and published in 2020.

A separate model was developed on the Sandusky River in Ohio, where Grass Carp have been observed to be spawning. The model used data collected by the USGS to calibrate and validate water level and velocity throughout the river. The completed model is being validated using 2017 Grass Carp egg capture data provided by the USGS. The model successfully re-creates spawning scenarios that match the egg capture locations and developmental stage of the eggs at the time of capture. Model results indicate that some eggs may be settling in low velocity areas and becoming re-suspended in the water column, which potentially shortens the required distance for spawning and indicates that eggs could successfully hatch in the Lower Sandusky River. This research has been submitted to a peer-reviewed journal and is expected to be accepted and published in 2020.

Temperature Model. The Sandusky River hydrodynamic model was linked with a temperature model able to incorporate spatial and temporal variation in water temperature. This model was run to test changes in hatching rates due to variations in temperature. The results of the model are currently under analysis and should be completed in early 2020.

Spawning Suitability. A preliminary assessment of the suitability to Asian carp spawning of eight Great Lake tributaries in the Toronto area was completed in 2017. Mean daily temperature and velocity from 2009-2014 was provided by the Toronto and Region Conservation Authority (TRCA), which informed a decision tree to determine suitability. Suitability was determined based on estimates of spawning time, distance of spawning, and minimum flow spikes required for spawning. Six of the eight tributaries were found to be suitable in at least one year over the study period and two tributaries were suitable on average. This highlighted previously unexplored interannual variation in suitability and provided tributaries to further investigate using river modelling. The method can be used on other tributaries where suitable data exist. A manuscript has been prepared. It was recently accepted (in press) and posted online; anticipated to be in the December 2019 issue of the Journal of Great Lakes Research.

5.1.4 Ecological Risk Assessment for Grass Carp

A binational ecological risk assessment for Grass Carp in the Great Lakes basin was released in January 2017. The document explains that Grass Carp have been found in Lakes Michigan, Erie, and Ontario, and summarizes the potential ecological consequences over the next 50 years, which in most of the Great Lakes basin could be extreme. Should Grass Carp become established, wetlands in the Great Lakes basin are particularly vulnerable. The study's findings will inform management and policy decisions with an objective of preventing the survival,

establishment and spread of Grass Carp in the Great Lakes basin on both sides of the border, as well as activities related to prevention, early detection or monitoring, response, and management.

5.1.5 Research to Inform Ecological Risk Assessment for Black Carp

As part of the binational ecological Black Carp risk assessment, DFO conducted research on the potential arrival, survival, establishment, spread, and impact of Black Carp in the Great Lakes. A movement model was used to assess the likely timeline of spread through the Mississippi basin to entry points near the Great Lakes. A temperature- and size-based model was developed to assess the overwinter survival of young-of-the-year Black Carp, as well as the suitability of spawning tributaries throughout the basin. A population model was used to understand the relationship between propagule pressure and establishment, including the likely timeframes of spread among suitable tributaries and lake basins. The model predicted the extent of spread in the Great Lakes within 1, 5, 10, 20, 35 and 50 years using the CAWS and the Maumee River as arrival points. A series of prey layers were developed that incorporated native unionids, gastropods, and dreissenids, which were used to develop a Black Carp bioenergetics model to evaluate where Black Carp could establish populations, based on food availability. The magnitude of impact of different densities of Black Carp on the Great Lakes fish community and native unionids was assessed using a food web approach and linear inverse models. Together, this research provides scientific information to inform the Black Carp risk assessment (described below) that will be completed spring 2020.

5.1.6 Ecological Risk Assessment for Black Carp

A binational ecological risk assessment for Black Carp in the Great Lakes basin is nearing completion, with modelling and writing complete. Research and other data are being used to inform a risk assessment team composed of DFO, GLFC, USGS, and USFWS. The draft risk assessment was presented at a Canadian Science Advisory Secretariat meeting for a face-to-face peer review by a variety of invited binational experts, with a peer-review date of December 4-6, 2018. The risk assessment will also be in the U.S. federal review process within the USGS. When it is finalized, the risk assessment results and information will be presented to Great Lakes managers on both sides of the border and will form valuable science advice for prevention, early detection or monitoring, response, and management activities.

5.1.7 Outreach and Education

DFO has undertaken a variety of outreach activities to prevent the introduction and establishment of Asian carp in Canadian waters. In 2019, DFO has engaged with some of Ontario's Indigenous communities, including setting up an information booth at a Pow Wow and delivering Asian carp identification training to Indigenous commercial fishers. In terms of general public outreach, DFO participated in two Asian carp public information sessions (Sarnia, Ontario, and Point Pelee National Park), engaged with high school and college students, and presented at

Fishing Club meetings. Finally, DFO has contracted a company to create a short documentary-style film about the most immediate threat to the Great Lakes, Grass Carp (expected completion: early 2020), and contracted a communications firm to complete a gap analysis on its outreach activities, which was completed in the spring of 2019 and which will guide the activities of DFO and its partners moving forward.

In partnership with two non-governmental organizations, Ontario Federation of Anglers and Hunters (OFAH) and the Invasive Species Centre (ISC), DFO is implementing outreach and education to stakeholders and the public in Canada. Contribution Agreements between DFO and the ISC and OFAH were in place throughout 2019. The current Contribution Agreements are in place for four consecutive years to avoid yearly lapses in public outreach activities.

In 2019, the ISC continued to manage the asiancarp.ca website as well as carpeasiatique.ca, its French language counterpart. ISC also hosted two public information sessions (as mentioned above), hosted two partnership meetings with the Asian carp Canada partners (one in-person and one over the telephone), ran several social media campaigns, hosted three informational webinars, helped to organize and host International Conference on Aquatic Invasive Species 2019, and pursued some of the recommendations of the gap analysis, including collaborating with a social media influencer and fishing website/mobile application.

The OFAH has also conducted a significant amount of outreach and education activities related to Asian carp in 2019. This includes: running a print public service announcement in three issues of Ontario Out of Doors magazine and a web banner from May-August; producing one article on the topic of Asian carp; continuing their billboard campaign at four locations near border crossings; attending seven trade shows and other key events including the Owen Sound Salmon Spectacular and Canadian National Exhibition. OFAH staff also participated in panel discussions during the two public open houses this year. From January to October inclusive, their on-staff educator traveled to 12 school boards to deliver 163 presentations about invasive species, including Asian carp, to 4,621 students. Based on the results of the gap analysis, OFAH is increasing its focus on Great Lakes communities, especially areas considered high risk for Grass Carp invasion. In addition, the OFAH distributed an e-blast to over 47,000 members and worked with the Ontario Chinese Anglers Association to distribute factsheets and engage the Chinese angling community. OFAH also contributed regularly to their social media campaigns reaching approximately 125,200 people on Facebook, approximately 76,650 people on Twitter, and approximately 16,700 people on Instagram, based on 30 posts across all platforms. Finally, OFAH continues to run and monitor the centralized reporting system in Ontario that consists of the Invading Species Hotline and Early Detection and Distribution Mapping System (EDDMapS); as of October 25, 2019, OFAH received 31 reports of Asian carp in 2019.

Since December 2015, the Biodiversity Gallery at the Royal Ontario Museum (ROM) has educated the public through information provided through a display, video and touchables (such as a rubberized Grass Carp, pharyngeal teeth, and skeletons) which are geared toward educating children on the threat of Asian carp. The ROM sees 7,000 to 8,000 daily visitors.

In August 2019, the Program signed a Contribution Agreement with a new partner, the TRCA. Although the main purpose of this agreement is to conduct field sampling for Asian carp in the Toronto region of Lake Ontario, it also includes education and outreach activities. TRCA staff attended the Highland Creek Salmon Festival, where they educated the public on Asian carp, and are working on developing their own outreach materials related to Asian carp.

5.1.8 Enforcement

The Canadian Federal Government's national AIS regulations came into effect in the summer of 2015. These regulations prohibit the import, transport, possession, sale, and control of high-risk AIS. These regulations complement provincial regulations and strengthen Canada's collaborative ability, along with the U.S., to protect the Canadian waters of the Great Lakes from AIS, including Asian carp. DFO continues to gather data on current live trade of Asian carp through a newly implemented joint project (Single Window Initiative) between DFO and the Canada Border Services Agency. This information will be used to provide support to enforcement agencies in both Canada and the U.S. to prevent movement of live Asian carp through trade, and potential introduction into the Great Lakes. In April 2019, new resources were provided within DFO for more on the ground enforcement of the AIS regulations.

5.2 ONTARIO

OMNRF has the lead provincial role to prevent the introduction, establishment, and spread of AIS and their negative effects on Ontario's environment, economy, and society. OMNRF's responsibilities include:

5.2.1 Surveillance and Monitoring

OMNRF continued its monitoring activities in 2019 for the Canadian waters of the Great Lakes and their tributaries. Efforts focused on monitoring and assessment on Lake Erie and its tributaries, Lake St. Clair, and southern Lake Huron. eDNA is a key technique used for monitoring in these locations. In 2019, 90 sites were sampled in the Great Lakes watershed for eDNA. Many sites were sampled on multiple dates, for a total of 162 sampling events. Over 486 water samples were collected by OMNRF field staff and analyzed by the OMNRF Aquatic Genetics Laboratory, located at Trent University. There were no positive detections for any Asian carp species in 2019. Surveillance plans for 2020 are currently being developed by OMNRF.

OMNRF also conducts a variety of fisheries assessment programs throughout the Canadian waters of the Great Lakes and their tributaries. These programs are used to assess the status of sport and commercial species as well as the prey fish that these fisheries rely on. Asian carp may be encountered through the course of these activities if they are present. In addition, OMNRF has a close relationship with commercial and sport fishers. These stakeholders are well informed of concerns regarding Asian carp and contact OMNRF and its partner agencies when they encounter suspect fish.

5.2.2 eDNA Research

OMNRF eDNA research has focused on quantifying sensitivity and specificity of eDNA assays, discriminating between detection failure and true absence, as well as testing and validating other eDNA markers and systems. Experimental eDNA trials with noninvasive species are being used to confirm taxonomic specificity and the spatial, temporal, and quantitative sensitivity of eDNA detection. OMNRF research has validated markers for all four species of Asian carp, enabling surveillance for Black, Bighead, Silver, and Grass Carp. A 'round-robin' blind validation of Grass Carp primers and probes with Quebec and USFWS labs is assessing the repeatability and sensitivity of each group's detection assay. Ongoing eDNA research is assessing the sensitivity and cost-effectiveness of community metabarcoding for species detection, testing several assay target regions for taxonomic breadth and sensitivity.

5.2.3 Asian Carp Response Plan

OMNRF has developed a provincial Asian Carp Response Plan in partnership with DFO. The Asian Carp Response Plan outlines procedures for implementation of an agency response if Asian carp are detected in Ontario waters. The province has undertaken several simulation exercises to test the plan and improve agency-wide preparedness. In April 2016, OMNRF participated in the on-water response exercise led by DFO to test coordination between the agencies. OMNRF and DFO have also field tested the plan, in conjunction with other partners, in response to actual captures of Grass Carp in the Ontario portions of Lakes Ontario, Erie, and Huron. Based on additional field experience, new science, and continued coordination with U.S. partners, OMNRF and DFO meet annually to review, and if necessary, refine and improve this response plan.

5.2.4 Outreach Activities

The Ontario-wide Invading Species Awareness Program has been a partnership initiative of the OMNRF and OFAH since 1992. The program focuses on the promotion of public awareness and prevention of the spread of invasive species. The program is also designed to track and monitor the occurrence and distribution of invasive species, including Asian carp. The program includes a toll-free hotline (1-800-563-7711) and website (www.invadingspecies.com) hosted by OFAH, as well as a web-based reporting and tracking system called EDDMapS Ontario, which also has a mobile app for Apple and Android devices. EDDMapS Ontario is designed to allow users to quickly view and report invasive species sightings. All potential reports of Asian carp received by OFAH or through EDDMapS Ontario are sent to OMNRF and DFO for identification and possible response. OFAH conducts extensive outreach with anglers and provides materials that help anglers discriminate between Asian carp and other native species.

As part of the province's cooperative efforts with commercial fishers, specific Asian carp outreach materials have been provided to commercial fishers to assist in identification and reporting. OMNRF has received several Grass Carp captured by commercial fishers the past few years as a result of this additional outreach. As well, reports of other non-native species captures have been received through this valuable partnership.

OMNRF has developed additional partnerships, including the Invasive Species Centre, to deliver various AIS programs across the province, including outreach, communications, and development of best management practices. OMNRF partnered with the Canadian federal government in 2009 to establish the Invasive Species Centre as a hub of collaboration and knowledge sharing. The mission of the Invasive Species Centre is to connect stakeholders, knowledge and technology to prevent and reduce the spread of invasive species. The Invasive Species Centre supports research, management and policy for a wide range of invasive species, including invasive fishes such as Asian carp.

5.2.5 Regulations

In 2005, Ontario made it illegal to possess live Asian carp. In 2015, Ontario enacted standalone invasive species legislation, the Invasive Species Act, which came into force on November 3, 2016. This Act regulated all four species of Asian carp. Possessing, transporting, propagating, buying, selling, leasing, trading, and bringing Asian carp into Ontario is prohibited, unless the fish are dead and eviscerated. At the same time, Ontario also regulated four other species of fishes, three aquatic invertebrates, nine plants, and one family of fishes. The Act provides a suite of provincial tools that will allow Ontario to take action, while continuing to work with partners and complementing the role of the Canadian federal government, including:

- Providing a strong legislative framework to better prevent, detect, rapidly respond to, and, where feasible, eradicate invasive species.
- Promoting shared accountability for managing invasive species.
- Holding those responsible accountable for costs of control and eradication through strong penalties and cost recovery of expenses for managing invasive species.
- Using a risk-based approach that considers the full range of threats, costs, and benefits to the environment, society, and the economy.

5.3 QUÉBEC

Among its mandates, the Québec MFFP is responsible for the development and conservation of aquatic wildlife resources. It includes prevention, monitoring and control of AIS. To fulfill these mandates, the Québec Government initiated an Asian carp Program in April 2016. The main objectives of this provincial program are to develop an expertise on Asian carp, to create and maintain collaborative works with DFO, OMNRF and American governmental agencies. In addition, important efforts are dedicated within the province of Québec toward surveillance, research, risk assessment, outreach and regulation/law enforcement.

5.3.1 Asian Carp Status in Québec

In May 2016, a commercial fisherman targeting common carp caught a Grass Carp in the St. Lawrence River near Contrecoeur (45°50'59.82"N, -73°14'57.25"O) using large mesh-sized gillnets (11.5 inches stretched mesh). The Grass Carp captured was a 9-year old diploid female measuring 1.26 meters and weighting 29 kilograms. Analyses of otolith chemistry revealed that

this fish was likely born in the wild (the otolith core has a lower oxygen isotope signature than that of a specimen born in aquaculture facilities) and according to the strontium (Sr) to calcium (Ca) ratios, the fish lived its first 4 years of life in a relatively stable habitat before making numerous movements between water masses with contrasting chemistry. In addition, stable isotopes analyses in the otolith as well as different parts of the fish (vertebrae, muscle, liver, blood, scale) indicate the Contrecoeur Grass Carp appears to have been born and lived in the Great Lakes water mass. Environmental DNA surveys conducted in 2015 and 2016 revealed the presence of Grass Carp genetic material in 16 out of the 110 sites sampled throughout the St. Lawrence River and some of its tributaries. No positive signals were detected for the Silver Carp and Bighead Carp. Based on the capture of one specimen and the recurrent presence of positive eDNA signals throughout the St. Lawrence, the Grass Carp is considered to be present in the system. Two main colonization routes provided by the hydrological connections are considered (1) the St. Lawrence River and the Great Lakes, and (2) the connected Richelieu River / Lake Champlain / Hudson River systems. However, since Grass Carp eDNA has been observed in a lake unconnected to the St. Lawrence River or its tributaries, other vectors of introduction are present and their importance has to be assessed.

5.3.2 Regulation

Since 2012, the possession of live individuals from the four species composing the Asian carp species complex is illegal in Québec. The commerce of dead individuals or products derived from these species is still allowed. Regulation respecting aquaculture and the sale of fish (http://legisquebec.gouv.qc.ca/en/ShowDoc/cr/C-61.1,%20r.%207) render illegal aquarium fish keeping, production, keeping in captivity, breeding, stocking, transport, sale and purchase all live fish listed in the schedule IV (http://legisquebec.gouv.qc.ca/en/ShowDoc/cr/C-61.1,%20r.%207). Grass, Silver, Bighead and Black Carp are among the 17 fish and aquatic invertebrate species listed so far. To prevent further spread of Asian carp or other invasive species, the MFFP has recently amended the provincial baitfish regulation. Since April 2017, it is now completely forbidden to use live fish as bait throughout the province of Québec. Only dead baitfish are permitted during winter fishing in some specific regions (https://mffp.gouv.qc.ca/english/publications/online/wildlife/fishing-regulations/general-regulations/bait-fish.asp).

5.3.3 Surveillance Activities

eDNA Monitoring: Annual eDNA surveys are conducted over a 230 kilometer stretch of the St. Lawrence River, from Lake Saint Francis downstream to Lake Saint-Pierre. Surveys also target the Richelieu River, a tributary connecting the St. Lawrence River to Lake Champlain. In 2015 and 2016, a total of 110 stations were sampled, and sampling effort has increased to reach 480 stations per year in 2019. Sampling sites are determined according to the presence of potential habitats for Grass Carp, areas where positive detections occurred in previous years. In addition to the 16 positive sites for 2015-2016, Grass Carp DNA was detected at 11 sites out of 323 in 2017 and 2 out of 360 in 2018. Analysis of samples taken in 2019 is still underway.

Traditional Gear Sampling Surveys: A dedicated survey targeting Grass Carp is in place since May 2017. The major technique employed is herding fish in gillnets or trammel nets using one electrofishing boat (similar as in Marson et al., 2016) and using electrofishing transects. Approximately 30 days per year are dedicated to the capture of Grass Carp between May and September. No Grass Carp have been caught to date during fishing surveys; the MFFP is working to improve the fishing techniques employed as well as better selecting sampling sites and periods targeted for fishing. A part of these actions is conducted in collaboration with agencies working on Grass Carp surveillance and monitoring surveys.

Ichthyological Surveys as a Surveillance Tool: All MFFP crews working in lakes and fluvial sections of the St. Lawrence River are briefed about the possibility that they may catch Grass Carp and other Asian carp. Identification keys and standardized protocols following the capture of Asian carp species were distributed and explained to all MFFP staff. Each year since 1995, the MFFP has implemented a standardized ichthyological survey allowing monitoring of fish diversity, distribution and abundance throughout the St. Lawrence or the Richelieu River (see Foubert et al. 2018). Field work dedicated for this survey spans over six weeks each year and fish are captured using multi-mesh gillnets and standardized seine nets.

Network for Detection of AIS by Commercial Fishermen: In addition to governmental surveys, commercial fishermen are also contributing to the surveillance of AIS through a volunteer network coordinated by the MFFP since 2003. All the members of the Network for Detection of AIS by Commercial Fishermen annually receive protocols related to Grass Carp, identification keys and other relevant information. The utility of such a collaborative effort has been proven by the fact that the only wild specimen of Asian carp caught in Québec waters was reported by a member of this network (see Asian carp status in Québec above). Since 2019, a bounty is offered for Grass Carp captured by fishermen who are members of the network.

Citizen Collaboration: A provincial protocol to manage public sightings was created in 2017. Every public sighting follows the same standardized process of validation and, if needed, a rapid response. In 2017 and 2018, 46 and 23 observations were reported to the MFFP respectively. Citizens contacted the MFFP mostly through e-mail. The two species misidentified the most frequently as Asian carp were the Common Carp and the Fallfish (*Semotilus corporalis*). However, one valid observation which was reported resulted in the seizure of three live Grass Carp kept illegally in an establishment of Montreal (July 2017). A second, highly likely, observation led to a field operation in May 2018 in order to validate the presence of live Grass Carp in an inland lake. The response action has been realized in collaboration with DFO for the benefit of any future joint action and served as an invaluable opportunity to directly transfer expertise between both agencies in the context of a real-life event.

5.3.4 Outreach

MFFP developed outreach tools with the objective of helping to identify Asian carp and inviting citizens to report their sightings. A flyer presents the four species of Asian carp with identification criteria and facts regarding their biology. Additional species frequently

misidentified as Asian carp were included: Common Carp, Fallfish, and Copper Redhorse (*Moxostoma hubbsi*). The latter species is endemic to the Province of Québec and is listed under the federal Species at Risk Act. Citizens are invited to take care to not harm or kill such fish. Flyers and stickers are available in both French and English and are distributed throughout the Province. Information about the Asian carp biology and their impact is also available on the MFFP website (https://mffp.gouv.qc.ca/english/wildlife/fishing/species/asian-carps.jsp).

The MFFP is also collaborating with the Stratégies Saint-Laurent, a local non-governmental organization conducting outreach activities in all administrative regions where Asian carp may be observed by citizens. Information and awareness campaigns are conducted targeting various audiences, with the objective of educating the public on identifying Asian carp, their biology, the ongoing North American invasion and understanding their impacts on the ecosystems.

5.3.5 Research on Persistence and Spread of eDNA in Natural Systems

MFFP is conducting research in collaboration with Laval University (Québec) to test *in situ* the persistence and spread of eDNA in relation with water masses of St. Lawrence River: brown water from the Ottawa River and blue water from the Great Lakes are flowing side by side with little mixing. Retention cages containing Brown Trout (*Salmo trutta*) or Rainbow Trout (*Oncorhynchus mykiss*), which are unlikely to be found in the system, are used as proxies for assessing the potential for positively detecting eDNA at various distances from cages (up to 5000 meters downstream). A study assessing the performance of the various water sampling strategies has also been done: 1) 950 milliliters (mL) of surface water centrifugated, 2) 250 mL of surface water filtered with a syringe, 3) 250 mL of an integrated water column filtered with a syringe and 4) 2000 mL of an integrated water column filtered with a drill pump. More experiments are planned over the next 3 years to test the capacity to detect Asian carp eDNA under different weather conditions and timespans.

5.3.6 Analysis on Risk of Spread in Inland Waters

An analysis of potential dispersal of Asian carp from the St. Lawrence River toward Québec inland waters is underway. Aerial photography and satellite imaging were used for the identification and mapping of existing barriers restricting upstream movements. These analyses will allow the determination of tributaries at risk of invasion by Asian carp from the St. Lawrence River. The ability to pass nearly 300 potential barriers was assessed by examining the size, the geographical position, and the presence of structures favoring passage of fish (e.g., fish ladders, canals, and locks). The resulting maps cover an area extending from Ontario to the Saguenay River. In a second step, field assessment has been done on around 100 barriers identified in the first analysis in collaboration with local watershed associations. The objective was to validate barrier specifications on-site (e.g. barrier width, length, height) and other variables quantified under natural conditions. An evaluation grid has been developed to quantify the barrier potential to restrain Asian carp dispersal. This grid could be adapted for other AIS or native fishes. This

assessment is still ongoing. This analysis will be an important management tool, helping in the planning and prioritizing of monitoring activities as well as in identifying possible sites for implementing mitigation measures such as selective or repulsive barriers.

5.3.7 Actions Planned for 2020

The following activities are planned for 2020:

- Pursuing surveillance activities, outreach and *in situ* experiments on eDNA persistence and spread.
- Refining of the dispersal analysis using habitat data to include the likelihood for local establishment.
- Identifying tributaries and areas within the St. Lawrence River itself with habitat characteristics suitable for Grass Carp reproduction and priority sites for early detection.
- Assessing the legal and illegal markets where Asian carp are distributed and sold in Québec. The release of live fish is recognized as an important vector of AIS introduction and this risk is presently unknown in the Province of Québec. This work will be realized in collaboration with MFFP's Wildlife officers and investigators.

Appendix A

FY 2020 Funding Matrix

FY 2020 Asian Carp Action Plan Funding

	No.	Agency	Project Title	GLRI Funding FY2020 ($)	Agency Funding FY2020 ($)
Prevention	P-1	USACE	Electric Dispersal Barriers	$0	$14,243,000
	P-2	USCG	Electric Dispersal Barriers and Barrier Operational Risk Assessment	$10,000	$5,000
	P-3	USGS	Support of Brandon Road Study	$79,000	$0
	P-4	USCG	Brandon Roak Lock and Dam Operational Risk Assessment	$10,000	$5,000
	P-5	USACE	Ohio-Erie Canal ANS Barrier Project	$20,000	$0
		Ohio DNR	Ohio-Erie Canal ANS Barrier Project	$15,000	$0
	P-6	Ohio DNR	Closure and Monitoring of the Potential Pathay at Little Killbuck Creek	$1,628,000	$0
	P-7	Illinois DNR	Alternate Pathway Surveillance in Illinois – Law Enforcement	$150,000	$0
	P-8	Indiana DNR	Stabilize Crest of Existing ANS Barrier at Eagle Marsh	$250,000	$0
Control	C-1	Illinois DNR	Contract Fishing for Asian Carp Detection and Removal	$1,500,000	$0
	C-2	Illinois DNR	Enchanced Contract Removal of Asian Carp in the Peoria Pool of the Illinois River	$1,286,883	$0
	C-3	USFWS	Asian Carp Population Modeling to Support an Adaptive Managment Framework (moved to Decision Support)	$162,000	$100,000
		USGS	Asian Carp Population Modeling to Support an Adaptive Management Framework	$100,000	$140,000

FY 2020 Asian Carp Action Plan Funding

(Continued)

	No.	Agency	Project Title	GLRI Funding FY2020 ($)	Agency Funding FY2020 ($)
Early Detection, Monitoring, and Evaluation	M-1	USFWS	Great Lakes Asian Carp Monitoring Program	$350,000	$1,400,000
	M-2	USFWS	Asian Carp Demographics	$365,000	$100,000
	M-3	USFWS	Des Plaines River and Overflow Monitoring	$15,000	$0
	M-4	USFWS	Illinois River Monitoring and Response Team Support	$113,000	$275,000
	M-5	USFWS	Habitat Use and Movement of Juvenile Silver Carp in the Illinois River	$225,000	$300,000
	M-6	USFWS	Distribution and Movement of Small Asian Carp in the Illinois Waterway	$170,000	$300,000
	M-7	USGS	USGS Illinois River Monitoring and Evaluation Project	$365,000	$225,000
	M-8	Illinois DNR	Enhanced Detection, Management, Control and Contingency Planning Above and Below Electric Barriers	$3,600,000	$0
	M-9	Illinois DNR	Ecosystem Assessment – Eggs, Larvae, Plankton for Risk and Population Assessment	$443,000	$0
	M-10	Illinois DNR	Illinois River Stock Assessment/Management Alternatives	$550,000	$0
	M-11	USFWS	eDNA: USFWS Midwest Region Fisheries Program Capacity for eDNA Sampling and eDNA Sample Processing	$0	$2,400,000
	M-12	USACE	Telemetry in the Upper Illinois River	$0	$200,000
	M-13	USFWS	Telemetry support for the spatially explicit Asian carp population model (SEACarP)	$140,000	$0
	M-14	USFWS	USFWS Illinois River Hydroacoustics	$135,000	$0
	M-15	USGS	USGS Telemetry Project	$299,000	$142,250

FY 2020 Asian Carp Action Plan Funding

(Continued)

	No.	Agency	Project Title	GLRI Funding FY2020 ($)	Agency Funding FY2020 ($)
Technology Development	T-1	USACE	Acoustic Deterrents for Asian Carp	$1,053,817	$0
		USFWS	Acoustic Deterrents for Asian Carp	$1,310,000	$800,000
		USGS	Acoustic Deterrents for Asian Carp	$1,822,000	$355,000
	T-2	USACE	Carbon Dioxide Deterrence for Asian Carp	$300,000	$0
	T-3	USGS	Implementation and Planning for Carbon Dioxide Deployment	$375,000	$0
	T-4	USGS	Carbon Dioxide Deterrence for Asian Carp	$100,000	$420,000
	T-5	USGS	Developing Species-Specific Control Systems for Asian Carp	$250,000	$650,000
	T-6	USACE	Experimental Testing of Sill Bubble Curtains for Barge Entrainment Mitigation	$175,000	$0
		USFWS	Experimental Testing of Sill Bubble Curtains for Barge Entrainment Mitigation	$15,000	$5,000
	T-7	USGS	Prevention of Barge-Induced Transport of Aquatic Nuisance Species	$100,000	$0
	T-8	USGS	Science Support for Control Efforts in the Illinois Waterway and Other Priority Sites	$50,000	$95,000
	T-9	USFWS	Technology Registration and Environmental Review	$150,000	$15,000
	T-10	USGS	Developing of Tailwater Removal Techniques for Bigheaded Carp	$100,000	$100,000
Response	R-1	USFWS and USGS	ACRCC Contingency Actions in the Upper Illinois River	$0	$0

FY 2020 Asian Carp Action Plan Funding

(Continued)

	No.	Agency	Project Title	GLRI Funding FY2020 ($)	Agency Funding FY2020 ($)
Black Carp	BC-1	USFWS	Black Carp Monitoring, Assessment and Control	$50,000	$114,000
		USGS	Black Carp Monitoring, Assessment and Control	$450,000	$95,000
		Illinois DNR	Black Carp Monitoring, Assessment and Control	$175,000	$0
		USACE-ERDC	Obtaining Critical Data on Black Carp Populations using Cutting-edge Genetic Capabilities	$150,000	$0
		NOAA	Modeling Potential Effects of Black Carp on the Food Webs and Fisheries of the Illinois River and Lake Michigan	$105,000	$17,000
Grass Carp	GC-1	USFWS	Adaptive Grass Carp Response and Monitoring in Lake Erie	$570,000	$450,000
		USGS	Adaptive Grass Carp Response and Monitoring in Lake Erie	$525,000	$0
		GLFC	Adaptive Grass Carp Response and Monitoring in Lake Erie	$0	$1,000,000
		Ohio DNR	Adaptive Grass Carp Response and Monitoring in Lake Erie	$535,000	$0
		Michigan DNR	Implementation of an Adaptive Management Framework for Grass Carp in Lake Erie	$300,000	$350,000
Communi-caton	Comm-1	USFWS	ACRCC Strategic Communications	$250,000	$100,000
Partnership Opertions	PO-1	USFWS	ACRCC Partnership Operations Assistance	$41,000	$41,000
	PO-2	USFWS	Administrative and Facilitation Support for the Chicago Area Waterway System Aquatic Invasive Species Stakeholder Group	$67,300	$0
	PO-3	USACE	Great Lakes Mississippi River Interbasin Study (GLMRIS)	$0	$315,000
TOTAL FUNDING				$21,000,000	$24,757,250

Asian Carp Action Plan Funding by Agency

Agency	GLRI Funding FY 2020 ($)	Agency Funding FY 2020 ($)
Illinois DNR	$7,704,883	$0
Indiana DNR	$250,000	$0
Michigan DNR	$300,000	$350,000
NOAA	$105,000	$17,000
Ohio DNR	$2,178,000	$0
GLFC	$0	$1,000,000
USACE	$1,698,817	$14,758,000
USCG	$20,000	$10,000
USFWS	$4,128,300	$6,400,000
USGS	$4,615,000	$2,222,250
TOTALS	**$21,000,000**	**$24,757,250**

FY 2020 funding amounts identified for USFWS and USGS are estimates and do not reflect final allocations. The agency funding amounts will be revised once finalized.

Appendix B

FY 2020 Asian Carp* Action Plan Action Items

** Throughout this document, the term Asian carp refers to the following four species: Silver Carp (H. molitrix), Grass Carp (Ctenopharyngodon idella), Bighead Carp (Hypophthalmichthys nobilis), and Black Carp (Mylopharyngodon piceus).*

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P-1 Electric Dispersal Barriers

Lead Agency: U.S. Army Corps of Engineers (USACE)

Agency Collaboration: None

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$14,243,000	$0

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

USACE has operated electric barriers in the Chicago Sanitary and Ship Canal (CSSC) since 2002. The electric barriers operate by creating a waterborne pulsed direct current electric field in the CSSC. Fish penetrating the electric field are exposed to electrical stimuli which act as a deterrent. As fish swim into the field they feel increasingly uncomfortable. When the sensation is too intense, the fish is either immobilized or is deterred from progressing further into the field. Three barriers (I, IIA and IIB) are currently operated by USACE (Barrier IIA, Barrier IIB, and a Demonstration Barrier). Over the years, several operational and procedural improvements have been implemented to improve the effectiveness and to continuously deliver an uninterrupted flow of electricity to the water to deter fish.

Summary of Actions to Date: In 2004, USACE initiated construction of Barrier II. Barrier II, which is located 800 to 1,300 feet downstream of Barrier I, also uses a pulsed electric field, but includes several design improvements identified during monitoring and testing of Barrier I, including the use of 5”x5” steel billets for the electrodes instead of cables. The steel billets were projected to have a life span of 25 years. Barrier II is able to generate a more powerful electric field over a larger area and was implemented in two halves, known as Barriers IIA and IIB. Barrier IIA began full-time operation in 2009. Barrier IIB became fully operational in 2011.

Barrier I was constructed in 2002 as a demonstration barrier and is currently being upgraded to a permanent status. Site work for the upgraded barrier, known as Permanent Barrier I, and installation of underwater components were completed in 2014. Construction of the new control building, utility connections, and backup power systems were completed in 2018. Replacement of the Demonstration Barrier electrodes was completed in 2019. Work on the remaining major contract, installation of the specialized pulse-generating system, is underway. Permanent Barrier I is scheduled for full time operation in 2021. Once completed, Permanent Barrier I will be capable of running at voltage levels high enough to repel smaller fish, similar to Barriers IIA and IIB, thereby providing additional protection against upstream movement of Asian Carp within the Chicago Area Waterway System

Prevention Action Item 1

Proposed Actions for FY 2020:

- Routine operation and maintenance of existing barriers, including a dive inspection of the underwater structures.
- Continue construction of Permanent Barrier I.

Expected Milestones: None.

What Is Deliverable for this Funding:

- Routine operations and maintenance of the system.
- Permanent Barrier I completion in FY 2021.

Expected Completion Date for Project: Not applicable.

Potential Hurdles:

- Coordination of scheduled traffic restrictions with the navigation industry.

How will the results of this project be disseminated?

- Targeted stakeholder notifications.
- USACE webpage.

P-2 Electric Dispersal Barriers and Barrier Operational Risk Assessment

Lead Agency: U.S. Coast Guard (USCG)

Agency Collaboration: U.S. Army Corps of Engineers (USACE)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$5,000	$10,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Electric Dispersal Barriers (USACE): The electric dispersal barriers described in P-1 are located in the Chicago Sanitary and Ship Canal (CSSC), which is a man-made waterway creating the only continuous connection between Lake Michigan and the Mississippi River basin.

Managing Waterway Traffic in Support of Asian Carp Control Activities (USCG): When operations associated with the electric fish barrier, rapid response actions, research projects, or any other Asian carp activity will impact the flow of traffic on a navigable waterway, the USCG issues safety zone and provides notice to the public and mariners to inform them of the planned activities and expected impact on navigation. If a partial or full waterway closure is required, the USCG or other agencies may need to deploy small boats, personnel and/or obtain resources (i.e. temporary mobile command post) and/or mission support services on scene to enforce the waterway closure. For extended closures, the USCG acquires additional resources to establish a temporary vessel traffic service that tracks delayed vessels and facilitates the orderly resumption of traffic after the closure is lifted. Sector Lake Michigan and Marine Safety Unit (MSU) Chicago are the primary field units of the Ninth District engaged in local Asian carp activities. Sector Lake Michigan and MSU Chicago support the management of waterway traffic in support of Asian carp control activities with industry outreach, conducting Regulated Navigation Areas (RNA) and safety zone enforcements and attending Asian Carp Regional Coordinating Committee (ACRCC) meetings and teleconferences.

Barrier Operational Risk Assessment: To combat invasive species, particularly Asian carp, the USACE installed electrified barrier systems at Romeoville, Illinois on the CSSC. These barriers create a significant electric field in the water and along the shore (an “electrified zone”) that presents hazards for vessel navigation and human activity. The Coast Guard Research and Development Center (CGRDC) to work with USACE Engineer Research and Development Center (ERDC) Construction Engineering Research Lab (CERL) to maximize commonality in safety test development and field measurement research to minimize separate USACE and USCG tests and experiments. This includes field test design and conduct to determine changes in the electric field associated with the CSSC barrier system, and the implicit change in marine safety risk.

Summary of Actions to Date:

- In 2010, the USCG put in place a Temporary Interim Rule (33 CFR 165.930) that established a 77-mile-long safety zone from Brandon Road Lock to Lake Michigan in Chicago, Illinois, including segments of the navigable waters of the Des Plaines River, the CSSC, branches of the Chicago River, and the Calumet-Saganashkee Channel. The purpose of the safety zone was to provide the USCG Captain of the Port with the ability to take targeted and quick action to protect vessels and persons from the hazards associated with any federal and state efforts to control aquatic nuisance species. The USCG also put in place a Temporary Interim Rule that established an RNA (33 CFR 165.923) on the waters located adjacent to, and over, the electric fish barrier. The RNA prescribes requirements for vessels passing over the barrier to protect them from hazards associated with the barrier. This Temporary Interim Rule also established a safety zone that restricts vessels from transporting non-potable water across the barrier with the intention of discharging the water on the other side.
- In 2011, the USCG put in a place a Final Rule that established a permanent safety zone covering the same 77 miles of waterways covered by the Temporary Interim Rule issued in 2010 (33 CFR 165.930) and issued a Final Rule to make the safety zone and RNA, created under the Temporary Interim Rule issued in December 2010, permanent (33 CFR 165.923).
- In 2013, the USCG issued an Interim Rule amending the RNA (33 CFR 165.923) to restrict vessels 20 feet or less in length, and personal or human-powered watercraft of any kind, from crossing the electric fish barrier. Also, in 2013 the USCG RDC delivered a report titled "Chicago Sanitary and Ship Canal (CSSC) Marine Safety Risk Assessment." This report categorized risks to mariners and shore personnel in the vicinity of the CSSC electrified barriers near Romeoville, Illinois.
- In August 20, 2018, the final rule come into effect and updated the current restrictions listed under 33CFR 165.923. In particular, the proposed Notice of Public Rule Making (NPRM) removes current requirements that have been deemed unnecessary or ineffective from the RNA. They also clarify discrepancies between sections .923 and .930, harmonizing the boundary limits for the Safety zone and RNA to alleviate boundary confusion. These changes reflect information collected from field units, industry, and the USCG research and development marine safety risk assessment in 2013. Selected items included in the RNA which are listed under section .923 instead of the Safety Zone are:
    - Removing bow boat requirements for flammable liquid cargoes. Facility handling such cargoes ceased operations in 2012.
    - Reclassifying the restrictions on "non-potable" water discharge under Section 923 with the RNA.
    - Potential removal of wire rope to prevent electrical arcing and considering other means of maintaining electrical connectivity between tows.
    - Establishing a no wake zone to all vessels in RNA.

Between 2002 and 2009, the USACE installed a system of electrified fish barriers in the CSSC near Romeoville, Illinois. The purpose of the barriers is to limit the spread of various nuisance

species, with a more-recent emphasis on preventing the "lake-ward" migration of Silver and Bighead Carp, which could have a significant impact on sport and commercial fishing industries on the Great Lakes.

From the outset, USACE and the USCG were aware the actual effects of high-voltage barriers on vessel traffic and marine safety were not well known. Before getting USCG agreement that waterway navigation could safely continue during barrier operation, the ERDC/CERL conducted a series of engineering tests to determine the physical effects of vessel traffic interaction with electrified water near the barriers. USACE also funded research by the Navy Experimental Diving Unit (NEDU) to research effects the barriers would have on a person in the water. As USACE completed construction on the second and third barriers in the system, they continued engineering tests to document effects of the electrified water on vessel traffic.

In 2009, USCG field commands requested CGRDC support initially to provide an independent analysis of existing studies, to characterize knowledge gaps regarding USCG concerns, and assist in developing search and rescue policy near the barriers. At the same time, after test observation and discussion with field commands, the USCG Office of Design and Engineering Standards (CG-521) compiled a list of potential hazards, tests to investigate the potential hazards, relative degree of the hazard, and mitigation measures should the hazard exist.

These elements all became the basis for various provisions in 33 CFR §165.923 as the rule developed. In 2010 and 2011, CGRDC conducted tests to identify the hazards associated with rescue of a person in electrified water, with operating guidance and recommendations for rescuer safety. In 2013, CGRDC completed a formal, quantitatively based marine safety risk assessment related to operation of the barriers.

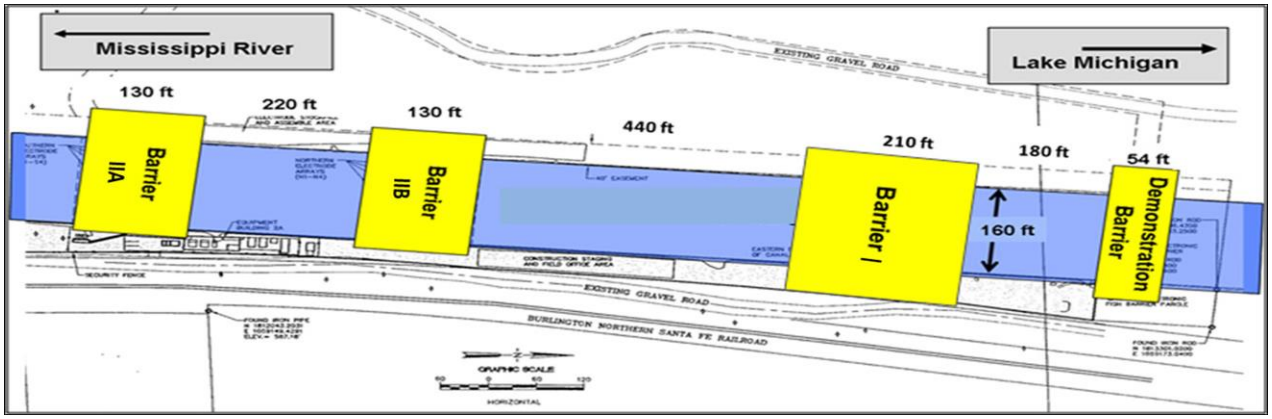
USACE has begun construction on a permanent barrier that will replace the initial demonstration barrier. The new barrier, referred to as "Permanent Barrier I," will be able to operate at higher voltages than the existing demonstration barrier it replaces, which operates at one volt per inch (V/in). Adding a new higher voltage barrier to the existing series of barriers may change the risk profile to the extent existing provisions in 33 CFR §165.923 must change to address risk to vessels and mariners in the vicinity of the barriers.

A 15-barge tow transiting in the CSSC can reach up to 1,145 feet in length. The dispersal barrier's overall length is 1,364 feet. The addition of Barrier I will reduce the length between Barrier IIA and Barrier I by 234 feet and make the overall three-barrier length 1,130 feet. Furthermore, Barrier I will operate at a stronger electric field, likely 2.3 V/in.

With the new configuration, it will be possible for a 15-barge tow to cross all three electric barriers simultaneously. The impacts of this waterway condition to mariner safety and tug/barge operations are unknown and must be examined to determine if the CG needs to develop additional measures to mitigate the increased risk.

Prevention Action Item 2

Once Barrier 1 is complete (estimated early FY 2021) the USACE intends to conduct a series of engineering and safety tests to determine the physical effects of vessel traffic interaction with the electrified waters near the barrier system. The local Captain of the Port and Ninth USCG District lack the knowledge to determine if these tests are sufficient to accurately identify risks to vessels and mariners transiting the CSSC or interpret the results of the tests to determine the adequacy of existing mitigation measures.



USACE Electric Dispersal Barrier System

Proposed Actions for FY 2020:

- USCG will issue and enforce a series of full and partial waterway closures as necessary to support electric fish barrier maintenance, barrier construction, barrier testing, and any other ANS control activities that may affect the safety of vessels and mariners on federally navigable waterways throughout FY 2020.
- USCG may also develop new safety zones or RNAs to support new aquatic nuisance species initiatives.
- Develop coordinated USCG and USACE safety testing for "new" CSSC Barrier I at Romeoville, Illinois.
- With ERDC CERL, develop test plan to maximize commonality in electric field test development and electric field measurement research to minimize separate USACE and USCG tests and experiments. This includes field test design and execution to advance technical knowledge about electrical field hazards and the implicit change in marine safety risk once new electrical barriers are energized.
- With ERDC CERL, study electrical field measurements.
- Conduct additional test measurement research as needed.
- Develop recommendations for marine safety risk mitigation.

Expected Milestones:

Barrier Operational Risk Assessment:

FY 2020 Q2:

- Safety Testing completion.

FY 2020 Q3:

- Test Report.

What Is Deliverable for this Funding

- Barrier Operational Risk Assessment: FY 2020-Safety Testing Report.

Expected Completion Date for Project

- Electrode Replacement: To be determined.
- Barrier Operational Risk Assessment: FY 2021.

Potential Hurdles: None.

P-3 USGS Support of the GLMRIS Brandon Road Project

Lead Agency: U.S. Geological Survey (USGS)

Agency Collaboration: U.S. Army Corps of Engineers (USACE) and USGS

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$79,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Work includes all efforts to evaluate options and technologies available to prevent the spread of aquatic nuisance species in either direction between the Great Lakes and Mississippi River basins through the Chicago Sanitary and Ship Canal (CSSC), and other aquatic pathways. In the context of this study, USACE has interpreted the term "prevent" to mean the reduction of risk to the maximum extent possible, because it may not be technologically feasible to achieve an absolute solution. Specifically, this includes: (1) Great Lakes and Mississippi River Interbasin Study (GLMRIS) Program Management (USACE), (2) Characterization of Brandon Road Lock and Approach Channel for Barrier Implementation (USGS), and (3) Brandon Road Lock and Dam Risk Assessment (USCG).

Summary of Actions to Date:

To provide additional information concerning the flow hydraulics and mixing characteristics of the lock and downstream approach channel, the USGS performed a detailed study of the site between December 2014 and October 2015, which included the collection and analysis of bathymetric, hydrodynamic, and dye tracer data. Synthesis of these data, combined with long-term continuous monitoring in the approach channel, allowed a characterization of the site for future use in feasibility studies of potential aquatic nuisance species (ANS) control technologies. The data and results of this study were published in FY 2018 (see Engel et al. 2018 to access the report and 8 data releases).

Proposed Actions for FY 2020: Assessment of hydrologic and water chemistry conditions and temporal variations associated with the river and lock and dam operation will help the USACE identify the potential impacts associated with the deployment of barrier technologies in the downstream approach channel to Brandon Road Lock and Dam. An understanding of the hydrologic and water chemistry conditions also provides background information about how deployment of these new technologies could be designed to maximize efficacy as an aquatic invasive species barrier while minimizing the impact on movement of barges and other vessels through the lock and approach channel.

In FY 2020, USGS will continue to monitor velocity and water quality in the downstream approach channel to Brandon Road Lock (USGS 05538020). This gaging station was established in 2015 and provides valuable data needed by the USACE for various phases of the project. Data

include water temperature, specific conductance, dissolved oxygen, pH, turbidity, chlorophyll a, and carbon dioxide concentration and water velocity measured in nine cells across the downstream approach channel.

What's New in FY 2020: No new additions to this project in FY 2020; continued operation of the USGS gaging station in the downstream approach channel to Brandon Road Lock (USGS 05538020).

Expected Milestones:

FY 2020 Q1

- Perform site visits, service gage instrumentation, calibrate sensors, and work/publish data records.
- Attend GLMRIS-Brandon Road Lock and Dam meetings, calls.
- Respond to data requests from partner agencies.

FY 2020 Q2

- Perform site visits, service gage instrumentation, calibrate sensors, and work/publish data records.
- Attend GLMRIS-Brandon Road Lock and Dam meetings, calls.
- Respond to data requests from partner agencies.

FY 2020 Q3

- Perform site visits, service gage instrumentation, calibrate sensors, and work/publish data records.
- Attend GLMRIS-Brandon Road Lock and Dam meetings, calls.
- Respond to data requests from partner agencies.

FY 2020 Q4

- Perform site visits, service gage instrumentation, calibrate sensors, and work/publish data records.
- Attend GLMRIS-Brandon Road Lock and Dam meetings, calls.
- Respond to data requests from partner agencies.

What Is Deliverable for this Funding:

- Real-time and historic velocity and water-quality data in the approach channel to Brandon Road Lock (USGS 05538020) and historic water-quality data just upstream of the lock chamber (USGS 05538010) served via USGS National Water Information System (NWIS).
- Related deliverable: Engel, F.L., Jackson, P.R., and Murphy, E.A., 2018, Flow hydraulics and mixing characteristics in and downstream from Brandon Road Lock, Joliet, Illinois: U.S. Geological Survey Scientific Investigations Report 2018–5094, 32 p., https://doi.org/10.3133/sir20185094.

Expected Completion Date for Project:

- Continuous monitoring for federal and state partners is expected to continue annually as determined by the ACRCC and MRWG.

Potential Hurdles:

- Stream gages are subject to damage from lightning, flooding, and vandalism.
- Data outages may occur until repairs can be made.

How will the results of this project be disseminated?

- All publications associated with this project will be publicly accessible through the USGS Publications Warehouse (search keyword: Brandon Road) and links to articles will be posted on relevant websites (GLRI.us, asiancarp.us). Press releases will accompany publications when appropriate.
- Data releases associated with this project including full metadata are publicly accessible on the USGS ScienceBase web portal (https://www.sciencebase.gov) (search keyword: Brandon Road).
- Real-time and historic velocity and water-quality data in the approach channel to Brandon Road Lock (USGS 05538020) and historic water-quality data just upstream of the lock chamber (USGS 05538010) served via USGS National Water Information System (NWIS).

What National Asian Carp Plan goals and recommendations does this project support:

Goal 1: Prevent accidental and deliberate unauthorized introductions of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.1.7.1. Investigate fully the risks associated with ballast water transfers or other means of water transfer by commercial vessels and recreational watercraft.

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.2.1.1. Develop a Decision Support System to assist natural resources managers in prioritizing specific locations for the construction, maintenance, monitoring, or removal of barriers to carp dispersal.

Strategy 3.2.1.2 Evaluate the effectiveness afforded by alternative technical containment measures (i.e., physical and behavioral barriers).

Strategy 3.2.1.3. Promote, support, and provide technical analysis and comment for the field testing of novel containment methods.

Strategy 3.2.2.2. Develop and implement reasonable and effective measures that prevent the spread of Asian carp via canals, water ways, or other water diversions between basins.

Strategy 3.2.6. Develop an information exchange network for agencies, organizations, and partners to communicate and share “real time” data to facilitate early detection and rapid response programs.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

3.6.3.1. Develop effective physical and behavioral barriers for controlling the movement of Asian carp.

P-4 Brandon Road Lock and Dam Operational Risk Assessment

Lead Agency: U.S. Coast Guard (USCG)

Agency Collaboration: U.S. Army Corps of Engineers (USACE)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$5,000	$10,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

To address invasive-species control-measure changes, USCG operational commander requested the CG Research & Development Center (CGRDC) support for research to develop scientific and technical knowledge into how species control technologies could influence possible navigation safety hazards, extent of hazardous areas, interaction of hazards and operational procedures, and risk mitigation alternatives associated with the control-measure changes.

CGRDC research includes how new species control technologies can influence the scope of potential risk-loss opportunities at the Brandon Road Lock and Dam before new control measure installation (preliminary risk assessment).

Research vessel-traffic density and vessel operations near anticipated barrier location.

1. Conduct in-depth, data collection and analysis to determine scope of potential risk opportunities, regarding each of the different possible invasive species control measures.
2. Observe and analyze vessel and vessel-crew activity in the downstream channel during and after locking through, with and without barge cuts, before, during, and after lock-chamber draining.
3. Investigate whether control measures or potential changes to present operational procedures lead to marine-safety risk scenarios that need further evaluation.
4. Research results will be provided to USACE to develop and tabulate risk scenario matrices in coordination with USCG operational commander.

Summary of Actions to Date:

Aquatic nuisance species (ANS) control technologies, especially electric barriers, can pose major safety risks to commercial and recreation vessels transiting the area as well as shore side personnel that come in contact with the water near ANS control measures. The risk of a person falling into the water at Brandon Road is significantly different than at the existing electric fish dispersal barrier (located 10 miles upstream of Brandon Road) since mariners must be out on deck for work in conjunction with lock operations.

The USCG operational commander requested CGRDC help in shaping USACE's formal evaluation to include associated risks to vessels and mariners, analyzing USACE results, and identifying mitigation strategies for safety risks associated with ANS controls at Brandon Road.

CGRDT completed a Preliminary Marine Safety Risk Assessment for Brandon Road Lock and Dam Invasive Species Control Measures. The report addresses control technology as far as hazardous operating environment, potentially hazardous effects on vessel operations, personnel safety, or hazardous environmental interactions near anticipated barrier location. Additionally, CGRDC developed a baseline risk matrix that identifies scenarios and potential consequences based on the interactions with the prospective control measure technologies.

Proposed Actions for FY 2020: The USCG operational commander seeks CGRDC assistance in the following areas:

- Early identification of USACE and safety tests that, in addition to evaluating ANS control technologies, also examine associated risks to vessels and mariners transiting Brandon Road Lock and Dam. Technologies to include carbon dioxide (CO_2) concentration testing and acoustic deterrence program.
- Reviewing USACE evaluation of potential ANS control technologies for Brandon Road Lock and Dam to advise D9, Sector Lake Michigan, and MSU Chicago on associated risks to vessels and mariners.

Timeline for Major Actions: Participation in planning and execution of CO_2 testing site. Liaison and test attendance with USACE on acoustic deterrence. Participation in entrainment/non-entrainment research.

Expected Milestones:

- Participation in planning and execution of CO_2 testing site.
- Liaison and test attendance with USACE on acoustic deterrence.
- Participation in entrainment/non-entrainment research.

What Is Deliverable for this Funding:

- Participation in planning and execution of CO_2 testing site.
- Liaison and test attendance with USACE on acoustic deterrence.
- Participation in entrainment/non-entrainment research.

Expected Completion Date for Project: On-going.

Potential Hurdles:

As part of GLMRIS, a Commercial Cargo Navigation Team was tasked with assessing the impacts to commercial cargo navigation within the CAWS associated with the potential implementation of a GLMRIS alternative plan. This assessment is included here to quantify the commercial vessel traffic within the requested study area. Note that the CAWS includes the deep draft ports on Lake Michigan, and not just the CSSC. Here is a summary of their findings (See GLMRIS Appendix D – Economic Analyses, D.10 Commercial Cargo Navigation, D.10.1.3 Key Findings).

“Since a spike to 25 million tons in 1994, traffic on the CAWS has remained flat to declining. After achieving a five-year low in recession year 2010 at 13.2 million tons, CAWS shallow draft traffic, vessels with a draft less than fifteen feet, experienced a slight increase to 13.6 million tons. However, deep draft traffic, vessels with a draft of fifteen feet or greater, increased from 6.5

million tons in 2010 to 8.4 million tons in 2011. Over the last ten years, the CAWS has averaged 17.2 million tons of shallow draft traffic and 6.6 million tons of deep draft tonnage."

"In 2011, the total traffic was 22.0 million tons with the three main shallow draft commodities in the CAWS being coal (33 percent), iron and steel (15 percent), and aggregates (12 percent) and the three main deep draft commodities being coal (45 percent), ores and minerals (19 percent), and all other group (13 percent)."

"In 2011, approximately 73 percent of CAWS shallow draft commercial cargo traffic is traveling towards Lake Michigan. However, deep draft tonnage was almost evenly split with 56 percent traveling upbound and 44 percent moving downbound."

At this time, beyond a preliminary risk assessment, there are too many variables and uncertainties to accurately quantify risk. Each of the variables associated with the proposed control measures need individualized examinations before combining them into an assessment that evaluates them as a system. A full-scale qualitative risk assessment would not be possible until barrier testing (at this time USACE estimates to be in 2022), based on the need to accurately identify the extent of the electrical field in the modified waterway.

P-5 Ohio-Erie Canal ANS Barrier Project-USACE

Lead Agency: U.S. Army Corps of Engineers (USACE)

Agency Collaboration: U.S. Environmental Protection Agency (USEPA), Ohio Department of Natural Resource (DNR), Summit County Metro Parks

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$20,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

The goal of the project is preventing or reducing the probability of aquatic nuisance species (e.g. Asian carp) being able to move from the Tuscarawas River Watershed into the Cuyahoga River Watershed via the Ohio-Erie Canal. Construction that began in 2019 is targeted for completion by calendar year end, contingent on brine line relocations by others and the weather. The canal towpath that forms the basin divide between Mississippi River and Great Lakes watersheds is now a trail prized for its recreational value and historical significance. At most locations, hydrologic separation of the two basins is being accomplished by raising the ground surfaces in low areas. In other locations where separation isn't practical, fences or screens are being installed.

Proposed Actions for FY 2020:

- Complete construction of all remaining barrier measures in FY 2020 and provide all necessary construction supervision and administration.
- Conduct all monitoring and reporting per the agreement with the State Historic Preservation Office (SHPO).
- Prepare an operation and maintenance (O&M) manual for long-term maintenance by Ohio DNR.
- Make all final payments and fiscally close out of the project.

Expected Milestones:

FY 2020 Q2:

- Substantial completion.

FY2020 Q4:

- Completion of O&M Manual and project closeout.

What Is Deliverable for this Funding: Project turnover for O&M by Ohio DNR.

Expected Completion Date for Project: FY 2020 Q4

Potential Hurdles: Uncertainties at this stage that may result in hurdles include:

- Differing site conditions at remaining barrier locations and possible change orders.
- Possible delays with brine line relocation activities and resuming work at Areas F & G.
- Adverse weather conditions that interfere with completing work this calendar year.

How will the results of this project be disseminated?

There are various possible means for disseminating information, including:

- USACE fact sheet.
- Congressional updates.
- Press releases.
- GLRI.US website updates.
- ACRCC presentations.
- Facebook posts – USACE, Ohio DNR and Summit Metro Parks.
- Other social media.

P-5 Ohio-Erie Canal ANS Barrier Project-Ohio DNR

Lead Agency(s): Ohio Department of Natural Resources (DNR)

Agency Collaboration: U.S. Army Corp of Engineers (USACE)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$15,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

The Great Lakes Mississippi River Interbasin Study determined that the Ohio Erie Canal is a medium risk pathway for transfer of Silver Carp, Bighead Carp, Black Carp, northern snakehead, and skipjack herring from the to the Mississippi River Basin to the Great Lakes Basin.

Proposed Actions for FY 2020:

- The pathway was closed in December 2019.
- With current funding, the Ohio DNR Division of Wildlife will complete State Historic Preservation Office (SHPO) negotiations for required mitigation, implement SHPO measures, determine expected long-term maintenance of the connection.
- Develop an Operation and Maintenance (O&M) manual for long-term maintenance.
- Maintenance of the closure will start in calendar year 2020.

What's New in FY 2020:

- FY 2020 funding will cover personnel to provide long-term maintenance of the closure.

What Is Deliverable for this Funding:

- Annual maintenance of the Ohio Erie Canal closure.

P-6 Closure and Monitoring of the Potential Pathway at Little Killbuck Creek

Lead Agency: Ohio Department of Natural Resources (DNR)

Agency Collaboration:

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$1,628,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

The Great Lakes Mississippi River Interbasin Study (GLMRIS) determined that Little Killbuck Creek is a medium risk connection for transfer of Silver Carp, Bighead Carp, Black Carp, and inland silverside from the Mississippi River basin to the Great Lakes basin for the transfer of threespine stickleback and viral hemorrhagic septicemia (VHS) from the Great Lakes basin to the Mississippi River basin.

Summary of Actions to Date:

- NTH completed 25 Percent design (Study and Report).
- U.S. Army Corps of Engineers (USACE) conducted peer review (value engineering) of the NTH Study and Report.
- Ohio DNR worked with NTH to finalize Study and Report.
- Using the finalized Study and Report, Ohio DNR determined preferred berm design and alignment.
- With current funds, Ohio DNR will complete appraisal values for the three properties needed for berm construction to allow for owner negotiations.
- With current funds, Ohio DNR will acquire easements on three parcels for the construction of the berm.
- With current funds, Ohio DNR will facilitate a meeting with the Potentially Affected Interests.

Proposed Actions for FY 2020:

- FY 2020 funding will be used to complete 100% design for the construction of the berm which will be phased over a three-year period starting in 2021.

What's New in FY 2020:

- Final design will be completed with FY 2020 funds.

Expected Milestones:

FY 2020 Q3:

- Complete property appraisals for landowner negotiations.

FY 2020 Q4:

- Berm easement negotiation with the three property owners.

What Is Deliverable for this Funding:

- Completion of final design for the project.

Expected Completion Date for Project:

- FY 2024

Potential Hurdles:

- Landowner negotiations.
- Potential for localized flooding.
- Local opposition.

How will the results of this project be disseminated?

- Congressional updates.
- Project initiation/completion press releases.
- Ohio DNR and GLRI.US website updates.
- Asian Carp Regional Coordinating Committee notifications.
- Facebook posts.
- Project completion dedication .

What National Asian Carp Plan goals and recommendations does this project support:

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass and Silver Carp in the United States.

Strategy 3.2.2. Take immediate actions to prevent interbasin transfers and limit intrabasin movements of feral Asian carp populations.

Strategy 3.2.2.2. Develop and implement reasonable and effective measures that prevent the spread of Asian carp via canals, water ways, or other water diversions between basins.

P-7 Alternate Pathway Surveillance in Illinois – Law Enforcement

Lead Agency: Illinois Department of Natural Resources (DNR)

Agency Collaboration: U.S. Fish and Wildlife Service (USFWS), Great Lakes Fishery Commission (GLFC) and partner states and provinces

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$150,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

The Illinois DNR Invasive Species Unit (ISU) was created in 2012 as a special law enforcement component to overall Asian Carp project. It consists of two Conservation Police Officers with a combined 30+ years of law enforcement experience who are fully dedicated to searching for illegal activities within the commercial fishing, aquaculture, transportation, bait, pet, aquarium, and live fish market industries. The ISU focuses its energies and resources on the likely pathways Asian carp could spread by human means. ISU has exposed the risks human activities bring to the entire Asian carp project by making significant arrests in almost every industry it has looked at. ISU proved it a critical piece of the puzzle among many others working diligently to protect our waterways. The capabilities and knowledge of the Unit advance significantly each year. This effort will be the equivalent of one officer-year but may contribute to portions of several officer's time dedicated to the below and similar efforts during the project period.

Objectives:

1. Educate and train Conservation Police Officers in the field of aquatic invasive species enforcement.
2. Implement a strategy to inspect shipments of live species being imported into Illinois through the Chicago O'Hare airport.
3. Conduct an advanced search for injurious species within the pet/aquarium trade.
4. Seek out training relevant to ISU enforcement priorities.
5. Conduct surveillance operations.
6. Widen the scope of commercial inspections within the aquatic life industry.
7. Participate in pertinent conferences associated with aquatic invasive species issues.
8. Utilize the Great Lakes Detector of Invasive Aquatics in Trade (GLDIATR) web monitoring tool to monitor the Internet trade of AIS.

Summary of Actions to Date:

- ISU developed and implemented a strategy to inspect Illinois aquaculture facilities for illegal species and activities. Eight facility inspections revealed three unpermitted operations and yielded substantial intelligence for future actions. No Asian carp were

being raised at the facilities, but ISU was able to convey the importance of invasive species laws and compliance within the industry.

- ISU exposed the significant risk of invasive species being spread through electronic commerce and package delivery or mail services. Records inspections identified at least five non-resident aquatic life dealers offering to sell and ship live tilapia, an Illinois restricted species, overnight through package delivery services directly to customers or to pick up locations at major airports. ISU created a standardized notification letter explaining Illinois license and permit regulations pertaining to shipping and selling aquatic life in Illinois and sent it to all known dealers. ISU followed up with all the dealers to ensure they understood and followed Illinois law. This pathway is a major threat to preventing the spread of Asian carp if regulatory agencies don't take the initiative to monitor it for illegal activities and take quick actions on those who use it for unlawful purposes.
- ISU developed a system to ensure aquatic life dealers are complying with Illinois aquatic species transportation laws. Covert contact was made with a non-resident dealer suspected of illegally shipping live restricted species into Illinois after the owner was made aware of Illinois regulations. ISU developed enough probable cause that the company was shipping fish into Illinois illegally to obtain a search warrant for the business. ISU and the USFWS successfully executed the search warrant to obtain additional evidence of the crimes. The case is currently pending.
- An Illinois fish processing plant that processed and sold Asian carp pled guilty in court to criminal disposal of waste-open dumping after ISU conducted an extensive investigation and executed a search warrant on the business. The owner also pled guilty to selling roe-bearing species without a commercial roe dealer permit. A total of $50,000 in fines was ordered by the court.
- ISU helped develop and is an active member of a multi-agency task force that focuses on crimes related to the commercial fishing industry. The task force identifies individuals or businesses believed to be or known to be committing crimes within the industry and develops strategies to take actions against offenders.

Methods: ISU generated enforcement activity based upon public complaints and tips, surveillance operations, on-site facility inspections, fish truck inspections, record audits, permit reviews, Internet investigations and assistance from other agencies.

Results and Discussion:

- ISU developed lesson plans to teach the new Conservation Police Officer recruits enforcement techniques for the following topics: Aquaculture, Aquatic Life Dealers, Injurious Species, Fish Truck Inspections. ISU provided training to District 4 Conservation Police Officers on fish truck inspections, commercial inspections, and invasive species enforcement techniques.
- ISU met with the Supervisory USFW Inspector at the Chicago O'Hare airport to discuss what live species are prohibited from being imported into to State and the objectives of the Unit. ISU worked alongside USFW Inspectors at the airport searching for contraband and

were granted permission to return in the future to look for invasive species in air cargo shipments.

- ISU assisted with the voluntarily relinquishment of a snakehead by a member of the public who no longer wanted the fish as a pet. The snakehead was given to the Aurora Zoo after ISU helped the curator obtain an injurious species permit. No other injurious fish species were detected during searches within the pet/aquarium trade.
- ISU attended a 36-hour Advanced Undercover Tactics and Survival Course. ISU completed a training course on Search Warrant and Major Case Management. ISU received training on aquatic invasive species enforcement techniques at the Great Lakes Fishery Commission (GLFC) Law Enforcement Committee meeting.
- An extensive surveillance operation in Chicago's Chinatown neighborhood was successful in identifying a reported illegal fish producer and transporter delivering fish to local fish markets. The business owners failed to submit the proper documents to the Illinois DNR to report their annual activity and they allowed their aquaculture permit for their facility expire. The investigation did not find any evidence of live Asian carp being sold or transported.
- Commercial inspections within the aquatic life industry were expanded to 6 additional counties not previously inspected by the ISU to include Winnebago, Boone, Dekalb, La Salle, Bureau, and Putnam counties.
- ISU attended the Aquatic Resources Task Force meetings in Illinois, Tennessee and Indiana. ISU attended the Great Lakes Aquatic Nuisance Species Panel Meeting in Chicago and gave a presentation on the Invasive Species Unit formation and enforcement activities. The ISU attended the Great Lakes Fishery Commission Law Enforcement Committee in Toronto, Ontario. ISU participated in quarterly Illinois Environmental Crimes Task Force meetings.
- ISU could not use the GLDIATR web monitoring tool because of the existing system stopped running new searches to facilitate the deployment of a cloud-based system to replace the old server-based system.

Proposed Actions for FY 2020:

- ISU will continue to generate enforcement activity based upon public complaints and tips, surveillance operations, on-site facility inspections, fish truck inspections, record audits, permit reviews, Internet investigations and assistance from other agencies. These efforts ensure that risk for Asian carp movement does not increase and any remaining inappropriate use or illegal activity is identified. Such detection is significantly reduced with unfocused enforcement activities.
- ISU needs to continuously stay updated with technology advances and trends within the AIS field. Laws need to be clear, concise and readily available to the public. ISU emphasis needs to focus on the likely pathways that humans could sabotage the overall Asian carp project and not on specific species. Those who are willing to violate the laws for profit or selfish reasons will do so whether the species is listed as prohibited, restricted or injurious. Regulatory agencies need to demonstrate strict enforcement of their laws and the presence of dedicated personnel making sure everyone is following them.

What's New in FY 2020:

- Illinois will be continuing the efforts in 2020 but funding may reduce activities devoted specifically to this topic as compared to prior years. This funding strategy may then use portions of several officers to get the geographical coverage and support when necessary.

Expected Milestones:

- ISU will update the Monitoring and Response Work Group (MRWG) and Asian Carp Regional Coordinating Committee (ACRCC) with any new information as early as practicable and able in law enforcement cases.
- Annual Interim summary reports and reporting of significant actions will be reported on a case by case basis.

What Is Deliverable for this Funding:

- With confidence that no Asian carp are being transported alive, support for increasing harvest and removal can be increasingly supported, thus further protecting the Great Lakes. Much of the removal efforts are focused in the Illinois and lower portions of Kentucky. With projected decreased populations it is also important to consider any movement of fish from other areas, not as regulated in appropriate transfer of these species. Continued inspections of this commerce also reduce risk of inadvertent spread.
- This project increases communication and abilities of enforcement agencies across the Great Lakes. These communications lead to a multi-jurisdictional web of protection greater than any one jurisdiction alone. Increased coordination activities are likely to leverage state-wide Conservation Police Officers in the role of managing Asian carp and invasive species transfer to the Great Lakes basin and within Illinois.

Expected Completion Date for Project:

- While each state does have limited capacity for enforcement, only though this project and coordination with USFWS law enforcement are we assured to have Asian carp focused upon. This infrastructure does allow for additional efficiencies to investigate other aquatic life and invasive species issues which have proven to be beneficial specifically to reduce spread of Asian carp.
- Unless Asian carp are extirpated, enforcement will be a necessary focus to protect the Great Lakes.

Potential Hurdles:

- Enforcement efforts do depend on compliance with appropriate rules and regulations. ISU works closely with state and regional bodies to review and clarify rules as needed to make sure necessary rules support the mission of preventing invasive species transfer/release.
- Enforcement is not designed to monitor everything, therefore a strategy to have significant and ample effort is necessary. While increased education amongst duty officers has been delivered in prior years, a reduction in the project during 2020 could provide for open opportunities for illegal activity.

- With lower direct funding of the effort, other enforcement initiatives could take priority on staff not funded or directed by ISU.

How will the results of this project be disseminated? As enforcement and legal requirements allow activities will be reported in the following ways:

- Annual interim summary reports.
- Agency web sites and social media.
- Formal and informal reporting to ACRCC and partner agencies.
- GLFC Law Enforcement Committee and other appropriate peer groups as prudent/requested.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 1: Prevent accidental and deliberate unauthorized introductions of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 4: Minimize potential adverse effects of feral Bighead, Black, Grass, and Silver Carp in the United States.

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United.

Goal 7: Effectively plan, implement, and evaluate management and control efforts for Bighead, Black, Grass, and Silver Carp in the United States.

P-8 Stabilize Crest of Existing ANS Barrier at Eagle Marsh

Lead Agency(s): Indiana Department of Natural Resources (DNR) Division of Fish and Wildlife

Agency Collaboration: NRCS and Little River Wetlands Project (LRWP)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$250,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Eagle Marsh in Ft. Wayne, Indiana was identified as a high-risk aquatic nuisance species (ANS) pathway in 2010. Within just a few months a temporary Asian carp barrier fence was installed on the Eagle Marsh property while a more permanent solution was being investigated.

In 2015, a 9,000-foot berm separating the upper Wabash River watershed (Ohio River basin) from the Maumee River drainage (Great Lakes basin) was constructed on the Eagle Marsh property. In the years since its construction it has performed exceptionally well in preventing the transfer of ANS between the two basins as there have been no water connections that have occurred.

Proposed Actions for FY 2020:

- Required berm inspection and maintenance activities in the past especially during wet periods have resulted in rutting on the top of the berm. The full length of the crest of the berm (approximately 9,000 feet) will be improved using a combination of geosynthetic erosion control material, topsoil, and seed to improve load support, erosion control, and crest stability.
- NRCS Wetland Reserve and Enhancement funding will be used to install a blind inlet to facilitate better drainage through the berm to reduce flooding during periods of high rainfall. NRCS funding and LRWP in-kind will be used to revegetate areas where vegetation and trees have died due to past flooding. These components are valued at approximately $75,000 but are separate from the GLRI request.

What's New in FY 2020:

- This is a new project.

Expected Milestones:

- Installation of a system to provide a stable crest of the Eagle Marsh ANS berm.

What Is Deliverable for this Funding:

- Installation of a system to provide a stable crest of the Eagle Marsh ANS berm.

Expected Completion Date for Project: November 1, 2020

Potential Hurdles:

- The project must be completed in a relatively dry weather window so a wet summer and fall in 2020 could delay completion of the project.

How will the results of this project be disseminated?

- Little River Wetlands Project will have to close the berm to public use while the crest stabilization project is occurring. They will use their newsletter and social media to alert their users. They will use the same means in notifying the public when the berm is again available for public use.

What National Asian Carp Plan goals and recommendations does this project support:

Strategy 3.2.2.2. Develop and implement reasonable and effective measures that prevent the spread of Asian carp via canals, water ways, or other water diversions between basins.

C-1 Contract Fishing for Asian Carp Detection and Removal

Lead Agency: Illinois Department of Natural Resources (DNR)

Agency Collaboration: U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$1,500,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation:

This project uses contracted commercial fishing (annually and nearly continually) to reduce the numbers of Asian carp in the upper Illinois and lower Des Plaines rivers downstream of the Electric Dispersal Barrier System (EDBS). Commercial fishers will be employed to harvest as many Asian carp as possible in the Starved Rock and Marseilles pools. Harvested fish will be picked up and utilized by private industry for purposes other than human consumption.

Commercial fishers will gather information on Asian carp population abundance and movement in the Illinois Waterway (IWW) downstream of the EDBS as a supplement to fixed site monitoring by contracted netters. In the Chicago Area Waterway System (CAWS) (seasonally) and from the EDBS downstream through Lockport pool, Brandon Road pool, and Dresden Island pool (bi-weekly), many of the same contracted netters will work in teams of two or more to detect and remove Asian carp. Many of these contractors also serve as responders. This project allows for personnel services, equipment/gear and commodities for agency support, and contracts for fishing as well as any necessary contracts for fish removal.

Efforts were heightened in 2019 to prescribe more effort to maintain lower populations of Asian carp (as observed by hydroacoustic and corroborating information) while further removing and further reducing Asian carp densities in the Upper IWW these priorities will continue in 2020:

- Continue additional crew/weeks scheduled in removal efforts as implemented in 2019 (+30% as compared to 2018).
- Specialty gears and unified methods including gear such as seines and trap nets will be deployed when most prudent.
- Continue adaptive netting dimensions, as carp population has changed nets will be set to optimize removal efforts. (Fishing efforts have removed the largest individuals in the upper river therefore smaller meshed nets will be used to also optimize for the smaller fish).
- While increased surveillance efforts from the EDBS to Dresden Island pool had been modified in prior years (most recently in 2018) increased removal efforts farther downstream will continue, as in 2019, in Starved Rock and Marseilles pools where larger densities of Asian carp exist. Spatially Explicit Asian Carp Population (SEAcarP) models

suggest the removal of fish where more plentiful/dense increase ability to manage and control spread.
- Coordination with hydroacoustic and telemetry projects will continue
- 2019 efforts removed over 1.5 million pounds of Asian carp from Starved Rock, Marseilles, and Dresden Island pools.

Proposed Actions for FY 2020:

- A goal of at least 1 million pounds of Asian carp removed remains for 2020 for Starved Rock, Marseilles, and Dresden Island pools.
- Utilizing 9 contracted fishers to achieve contracted fishing projects described in the 2020 Monitoring Response Plan (MRP) which include:
    - Management and Control through removal in Starved Rock, Marseilles, and Dresden Island pools.
    - Detection between population front and EDBS in Brandon Road and Lockport pools.
    - Detection in the CAWS within the Seasonal Intensive Monitoring.
    - Deployment of prescribed netting efforts such as seines or needs requiring short notice.
    - Contingency measures at various locations as needed.

What's New in FY 2020:

- Evaluation of methods and strategies are continually evolving, minor modifications in gear and locations within target pools and in response to intel from hydroacoustic and telemetry will be ongoing.
- 2020 will be the first full year of removal in the Upper IWW with downstream enhanced contracted fishing program ongoing.
- Effects of downstream enhanced removal could change the abundance or movement of upstream populations, but no significant effect is expected.

Expected Milestones:

- Contracted Removal efforts are ongoing throughout year.
- First deployment will be in Q1 (scheduling for February 2020).
- Last deployments will be in Q4 (scheduling for December 2020).
- Contributing to other science and models as necessary.
- Data will be shared through a database supported by USGS.

What Is Deliverable for this Funding:

- Even though 2019 removed over 1.5 million pounds of Asian carp, a goal of 1 million pounds annually from Starved Rock, Marseilles, and Dresden Island pools continues to be the target through 2020.
- Evaluations with non-fisheries dependent gears is necessary to infer confidence and value of removal annually and as needed.

Expected Completion Date for Project:

- This project is expected to continue to provide annual evaluation and advice to the Asian Carp Regional Coordinating Committee (ACRCC) and Monitoring Response Work Group (MRWG) as long as Asian carp management and control is a priority. This project could be modified on an annual basis to provide managers needed information and may be modified as new techniques or technologies inform this work. Continued modification to fishing, e.g. Unified methods, will be identified to become more efficient. Total effort can be modified as risk is identified (more or less).

Potential Hurdles:

- These budget numbers relate to a state enforced bid process, which is currently on a 5-year cycle for rebidding fall 2020. It is a competitive process and we expect costs to stay similar; however, future costs could be impacted by these bids and future years prescribed effort.
- Efforts are weather dependent and contingency dependence. ACRCC will coordinate efforts between agencies and projects to best implement the 2020 plan.

How will the results of this project be disseminated?

- www.asiancarp.us and GLRI.us have been utilized in the past and will be in the future for sharing updates.
- Monthly summaries will be shared with partners both via email, scheduled phone updates, and posted to www.asiancarp.us.
- ACRCC and Illinois DNR readily makes themselves available to update interested parties on status, removal, marketing efforts to further coordinate and find efficiencies with ACRCC strategies.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 1: Prevent accidental and deliberate unauthorized introductions of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 4: Minimize potential adverse effects of feral Bighead, Black, Grass, and Silver Carp in the United States.

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 7: Effectively plan, implement, and evaluate management and control efforts for Bighead, Black, Grass, and Silver Carp in the United States.

C-2 Enhanced Contract Fishing & Marketing

Lead Agency: Illinois Department of Natural Resources (DNR)

Agency Collaboration: Southern Illinois University (SIU)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$1,236,883

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

On-going Monitoring and Response Plans (MRP) recognize the value of increased harvest of Asian carp in the lower Illinois River by setting a goal of removing 8 million pounds by end of 2020 and a short term (5-year) vision to achieve 15 million pounds removed annually by 2022. The strategy is supported by the success and observed reduced relative abundance in those areas generally attributed to contracted removal in the upper Illinois River. Currently, harvest/removal of Asian carp through contracted commercial fishing results in approximately 3.5 million pounds of Asian carp removed annually.

Additionally, a model has been developed that recognizes the significant management effects that increasing downstream harvest provides. Also, concurrent recommendations for increased harvest are identified in a comprehensive "2018 Asian Carp Business Process Analysis" (Report). This Report recommends actions to remove barriers to expand alternative uses of Asian carp as a means to increase fishing. The end goal is removal of 20 to 50 million pounds of Asian carp per year from Illinois waterways to reduce the population and risk of their spread to the Great Lakes.

Summary of Actions to Date:

- One key recommendation of the Report is creation of the Enhanced Contract Fishing Program which was initiated in September of 2019. Over the first 6 weeks of the program, 16 contracts were executed with Illinois-licensed commercial fishermen and over 100,000 pounds were removed from the Peoria pool toward a goal of 4.5 million pounds anticipated to be achieved prior to established goal achievement timeframe of year-end 2020. To measure removal effects, SIU also has begun an analysis using data from the Enhanced Contract Fishing Program to conduct a fish population study. This study will measure changes in fish size, abundance and other characteristics to evaluate effectiveness of concentrated fishing in the Peoria pool. Results of that analysis will be available in 2020.
- Other recommendations made in the Report pertain to marketing, to support the creation of a positive brand for Asian carp that will help product-makers and processors grow their markets. Market growth and increased sales have a direct impact on increased removal. Work to initiate a brand development process is underway along with the start of the Market Value Program to provide small-sized, matched grant funding of a maximum of

$8,000 to processors and product makers to defray the costs of travel and trade-show attendance to support their efforts to increase sales of Asian carp products.

Proposed Actions for FY 2020:

- **Enhanced Contract Fishing Program.** Removal goals under the Enhanced Contract Fishing Program is increased to 8 million pounds. Current funding levels preclude full contracting in 2020; however, just over 4.5 million pounds can be added to the contracted fishing initiative with this effort. Combined with roll-over from 2018 funding efforts fully implemented in fall of 2019, enhanced contracting could remove over 8 million pounds, thus approaching the 8-million-pound goal and effectively raising the 2019/2020 goal of 4.5 million pounds. At this volume, it is expected that new and additional processing capability will enter Illinois in 2020 and that the number and/or efficiency of fishermen will grow, increasing supply of Asian carp to reliably support growth of Asian carp products and sustained removal. Additional efforts to coordinate fishers and processors will increase cooperation and coordination to begin to scale removal to satisfy larger Asian carp orders.
- **Ice Production and Equipment.** Production of ice is a key component of preserving freshness and improving distances over which Asian carp can be transported. Having ice available to cool fish immediately following removal from the water is essential to their ability to be used for human consumption. At present, however, no capacity exists near or close to the water that provides ice in volume for this purpose. Funds for this item will provide bulk ice capacity for fishermen to stock their boats with ice prior to going out on the water. Costs include securing 1 - 3 ice machines that produce at least 5,000 pounds of ice per day. These efforts increase the length of the fishing season by minimizing spoilage.
- **Expansion of Existing Fisherman.** Assistance also is needed to support expansion of existing fishermen to achieve larger Asian carp hauls and to support entry of new fishermen to the trade in Illinois. Such equipment as netting and related fishing equipment and gear, along with transportation support will remove high cost items that currently limit expansion of current fishermen to increase fishing and inhibit entry of new fishermen into the Illinois marketplace. In particular, new fishermen are needed to enter the market not only to increase removal, but also to replace attrition among existing fishermen in the state that is expected to occur due to high median age. Removal goals will be hampered without further assistance.
- **Market Value Program**. To support interest among fish processors and to satisfy application requests, continuation of funding for the Market Value Program will continue to make available up to $8,000 in grant funds to assist processors and product makers to market their products. To receive reimbursement under the program, the applicant must provide a 20% match and use Illinois-caught Asian carp to make their products. Funding supports growth in sales of Asian carp products by defraying costs of travel, attending trade shows, and costs related to meeting with potential buyers for the purpose of promoting the processor’s or product-makers sales.
- **Asian Carp Brand Marketing.** Continued implementation of the new Asian carp brand and marketing strategy currently under development is important to support fish

processors and product makers to increase Asian carp product sales. A strong, positive brand that countermands negative perceptions of Asian carp will support existing carp-related businesses. Activities under this item includes creation of marketing collateral, distribution of brand imagery, attendance at trade shows and other events, writing press releases and other earned media, holding events with early adopters, and similar. Positive branding helps a range of product makers to promote and sell their Asian carp products, which supports removal by increasing sales of Asian carp products.

- **Program Status and Evaluation.** SIU will assess effects of the Enhanced Contract Fishing Program on bigheaded carp (Black Carp and Silver Carp) in Peoria pool to determine effectiveness of the program and to improve program success. SIU will measure the effects of the Enhanced Contract Fishing Program on bigheaded carp by comparing densities from fall hydroacoustic sampling, collect demographics and assemble data from other efforts, markets, and fishers in years following program implementation with sampling from years prior to the program. SIU will conduct hydroacoustic surveys of select sites in Peoria pool every other month from Feb – October (other project funding sources). The evaluation of and in concert with removal efforts data will improve the ability to assess effects on bigheaded carp densities, size distributions, and spatial distributions, and to relate these potential changes to harvest from the Enhanced Contract Fishing Program. Close coordination between project and contracted fishers by sharing bi-monthly hydroacoustic spatial distribution maps (i.e., density heatmaps) of bigheaded carp at the selected sampling sites will aid in focusing removal efforts to areas of high densities. Similar maps have been used since 2016 in Marseilles and Dresden Island pools in directing contracted removal efforts to high-density locations and has proven successful in maintaining harvest efficiency. Further communication and coordination of efforts will provide increased information with fishing industry, markets, and science information.

What's New in FY 2020: Ice Production and Equipment, and the Hydroacoustic Population Analysis are new items to FY 2020. While existing programs, the following changes occur in the remaining three programs. The Enhanced Contract Fishing Program increases removal from 4.5 million pounds to 10 million pounds in FY 2020. The Market Value Program supports additional promotion of Asian carp products through existing and new processors and product-makers' attendance at annual trade shows, and their efforts to expand and find new markets for their products. Asian Carp Brand Marketing supports increased awareness of the new brand and change in perception of Asian carp in support of processors and product-makers sales growth.

What Is Deliverable for this Funding:

- Removal of 4.5 million pounds of Asian carp from the Peoria pool.
- Purchase, installation and operation of one to three ice machines along the Illinois River, and establishing fishermen's and processors' assistance to purchase or lend netting. equipment, and support transportation of Asian carp.
- Support of at least three processors or product makers to attend trade shows or other travel and related expenditure to promote Asian carp product sales.
- Promote Asian carp brand in at least three venues, events or outlets.
- Communication of results of Asian carp removal effort for the Peoria pool.

Expected Completion Date for Project: End FY 2022

Potential Hurdles:

- Increased market volume for Asian carp products is hard to predict.
- Added enhanced contracted fishing *may* take time to gain capacity and require more than 12 months to fully utilize the full funding.
- Concern of increased fishing activity to reduce catchability in confined areas.
- Ability to enforce fishing areas.
- Ability to assess relative abundances and fishing mortality/effects in large river pools.
- Public opinion reluctance to accept positive brand influence.

How will the results of this project be disseminated?

- Public (GLRI.us, GLIN Announce).
- Technical audience(s).
- Media.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

C-3 Asian Carp Population Modeling to Support an Adaptive Management Framework

Lead Agency: U.S. Fish and Wildlife Service (USFWS) and U.S. Geological Survey (USGS)

Agency Collaboration: Illinois Department of Natural Resources (DNR), Southern Illinois University (SIU)

FY 2020 Funding Table:

Agency Funding Expected		Asian Carp GLRI Funding Requested	
USFWS	**USGS**	**USFWS**	**USGS**
$100,000	$140,000	$162,000	$100,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Modeling is a critical component of the Adaptive Management framework and is essential for developing Asian carp control strategies and evaluating control success. The Spatially Explicit Asian Carp Population (SEAcarP) model is a simulation-based mathematical representation of Silver and Bighead Carp population dynamics used to generate model-based evaluations of differing Illinois River Asian carp control strategies (i.e., different levels and spatial allocations of mortality and upstream movement deterrence). Additive mortality through contracted fishing efforts remains the primary tool for controlling Asian carp and minimizing propagule pressure at the electric dispersal barrier system (EDBS). Model results provided support for the continuation of upstream (i.e., above Starved Rock Lock & Dam [L&D]) removal efforts. However, model results also predicted strong long-term control effects associated with increased downstream (i.e., below Starved Rock L&D) removals. Implemented in 2019, the Enhanced Contract Removal of Asian Carp in the Peoria pool of the Illinois River represents the first sustained harvest downstream of Starved Rock L&D.

The SEAcarP model was also used to evaluate effects associated with proposed upstream movement deterrence technologies. Although Illinois River lock and dam infrastructure managed by the U.S. Army Corps of Engineers (USACE) likely influences upstream migration rates, technologies designed to deter upstream movement have not been deployed in Illinois waters – the effectiveness of deterrence technologies on Asian carp movement and impacts to native fish passage represent important considerations, which remain largely unknown. Nevertheless, SEAcarP model results comparing reductions in upstream movement rates revealed that deterrents, though imperfect, can have strong containment effects that are maximized when deterrents are located immediately upstream of source populations.

The SEAcarP model is also used as a decision support tool for prioritizing Asian carp research and data collections. Prioritizing in this way improves model predictions and contributes to general understanding of Asian carp population dynamics. Model development revealed a need to

increase tagging efforts on small immature fish located below Starved Rock L&D. In addition, conversations between the Modeling and Telemetry Work Groups stimulated development of an updated movement model that will be parameterized using Upper Mississippi River and Illinois River data. Accounting for movement between these two basins will increase the accuracy of SEAcarP model predictions, including Illinois River results used to inform Asian Carp Regional Coordinating Committee (ACRCC) decision makers. SEAcarP model development also revealed a paucity of growth data from small fish (< 300 mm Total Length) and variation associated with systematic aging errors as key sources of uncertainty in the SEAcarP model. To address these and other demographic data gaps (e.g, size at maturity, sex ratios), USGS and USFWS collaborated on an Illinois River laboratory and field effort.

There remains a need to get critical feedback on the SEAcarP model using peer review, disseminate model results in the primary literature and support annual model updates. This will help inform future developments designed to address model limitations and assumptions (e.g., development of a multi-basin model) and achieve management goals and objectives for Asian carp in the Illinois River. Additionally, there remains a need to complete Statistical Catch at Length modeling (Sullivan et al. 1999), a distinct yet complementary modeling effort. The purpose is to leverage commercial harvest data to address current knowledge gaps such as fishing mortality and vulnerability to fishing as a function of fish length and to provide an independent and secondary source of demographic information (e.g., growth) for comparison. To expedite this effort, we propose using a post-doctoral researcher coordinated through USGS to support the modeling and analysis. Lastly, there is a need to develop the Modeling Work Group into a multi-institutional quantitative science team. Incorporating members from Federal, state, and academic institutions will improve future iterations of SEAcarP and other data-driven decision support tools. This team would meet in a series of semi-annual statistical workshops to update the model and distribute the work necessary to maintain these efforts.

Summary of Actions to Date:

- Asian carp simulation model developed by Tsehaye et al. (2013) using support from Illinois DNR. The model treated the Illinois River system as a single spatial unit and estimated the level of fishing mortality required to collapse the fishery.
- A meeting attended by modeling experts and coordinated by Illinois DNR convened to address assumptions and limitations associated with the Tsehaye et al. (2013) model. The panel recommended a new version of the model that included spatial components (i.e., river pools) and changing the objective function from fishery induced collapse to elimination of Silver Carp in the vicinity of the EDBS.
- Using support from Illinois DNR, researchers at Ohio State University and SIU compiled Asian carp demographic data from multiple universities and state and federal agencies. Parameterization and coding of the SEAcarP model completed during 2016.
- Researchers at SIU developed a telemetry-based model describing movement in the lower six pools of Illinois River (Coulter et al. 2018) allowing for implementation of a spatially explicit population model
- Deployment of model supported control efforts and data collections and research projects.

- SEAcarP results presented during the January 2017 Monitoring and Response Work Group (MRWG) meeting by Ohio State researchers
- Annually updated parameter estimates using methods described by Erickson et al. (*in review*)
- Management recommendations disseminated, including mortality levels, required upstream movement effectiveness, and data collections and research.
- Ongoing development of a combined Illinois River and Upper Mississippi River movement model.

Proposed Actions for FY 2020:

- Estimate demographic rates on a recurring annual basis using the most current data available and incorporate results into the SEAcarP model.
- Complete sensitivity analyses and develop a prioritized list of data and research needs based on results thereof.
- Subject the SEAcarP model to peer review by collecting critical feedback from three separate quantitative researchers. Guidelines describing the review process will be developed in collaboration with the MRWG co-chairs and attached to the formal review request along with the SEAcarP model code. The review will include both biological (e.g., the biological assumptions of the model) as well as technical (e.g., verification of model code) aspects of the modeling effort.
- Incorporate results from Action's 1 – 3 and prepare a manuscript for publication in a peer reviewed journal using results from sensitivity analyses and population control (i.e., additive mortality, upstream movement deterrence) simulations.
- Transition the SEAcarP model to a multi-basin framework to take advantage of combined Upper Mississippi River and Illinois River telemetry modeling – accounting for complex source-sink dynamics will improve Illinois River SEAcarP model predictions.
- Implement Statistical Catch at Length modeling to estimate vulnerability to fishing as a function of fish size, exploitation rates, and immigration into the upper Illinois River Waterway.
- Develop the Modeling Work Group into a multi-institutional quantitative science team to guide the development and maintenance of future iterations of SEAcarP and other data-driven decision support tools.
- Hold an in-person meeting of the Modeling Work Group and identify data needs and knowledge gaps.
- Develop a detailed communications strategy that outlines how the Modeling Work Group will provide timely updates to MRWG chairs on progress and setbacks.

Expected Milestones:

FY 2020 Q1

- Incorporate new data and update demographic statistical analyses, finalize sensitivity analyses, complete peer review of the model.

FY 2020 Q2

- Modeling Work Group Coordination meeting.

FY 2020 Q1-Q3

- Prepare manuscript for publication in a peer reviewed journal, manuscript will include simulation results, sensitivity analyses, and prioritized data collections and research.

FY 2020 Q1-Q4

- Coordinate with the MRWG to develop a quantitative science team to guide population modeling efforts.

FY 2020 Q2

- Update management scenario simulations – specific scenarios coordinated with the MRWG.
- Prepare reports and presentations.

FY 2020 Q3

- Start date for USGS post-doctoral researcher that will focus on statistical catch-at-length modeling.

FY 2020 Q3-Q4

- Implement statistical catch-at-length model.

What Is Deliverable for this Funding:

- A tool to inform Asian carp control and management in the Upper Illinois Waterway, in support of keeping Asian carp out of the Great Lakes.
- Sensitivity analysis results including a prioritized list of research and data needs designed to address model limitations and increase confidence in model predictions.
- Annually updated model predications.
- SEAcarP model manuscript.
- Increased model flexibility to allow for the seamless transition to a multi-basin framework.

Expected Completion Date for Project:

- Population modeling is an important component of the Adaptive Management framework. Consequently, development of new model-based tools and maintenance of existing ones should remain a priority in the fight against invasive Asian carp.

Potential Hurdles:

- Timeline may be negatively influenced by unanticipated challenges, which are often associated with doing novel work.

How will the results of this project be disseminated?

- Conferences and meetings.
- GLRI summaries and reports.
- Peer-reviewed publications.

M-1 Great Lakes Asian Carp Monitoring Program

Lead Agency: U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: Great Lakes States

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$1,400,000	$350,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

The USFWS will continue to implement and refine, with input from our partners, a comprehensive and complementary early detection and rapid assessment surveillance program for Bighead, Silver, Grass, and Black Carp in and near the Great Lakes. This program would complement the environmental DNA (eDNA) sampling and monitoring programs implemented by the USFWS, U.S. Army Corps of Engineers (USACE), academia, and other partners. 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 diverse array of traditional and novel gears to sample all potential life stages of Asian carp species.

Summary of Actions to Date: USFWS continues to work with partners to refine a Great Lakes basinwide early detection protocol for Asian carp and other aquatic invasive species (AIS). Sampling gears used and locations sampled are tailored each year to match conditions and agency needs, as well as to leverage new sampling technologies for species of interest. USFWS continues to coordinate with federal, state, and provincial partners to annually identify priority sampling locations, further develop and refine protocols, share information, and discuss ways to coordinate agency sampling efforts. In 2013, USFWS worked with our partners to conduct coordinated and complementary sampling efforts in the Great Lakes basin with both emerging and traditional gears. In 2019, the Service continued to expand its overall sampling efforts and collected over 7,000 eDNA water samples, electrofished, trawled, sampled ichthyoplankton, and set a variety of nets to survey for Asian carp. No Bighead or Silver Carp were captured or observed. Asian carp

Proposed Actions for FY 2020: USFWS and partner agencies will continue to implement a comprehensive Great Lakes basin wide early detection and monitoring program for Asian carp and other AIS. USFWS staff/teams will be prepared, and may be mobilized, to respond to any Asian carp detected (using either traditional gear or eDNA) in the Great Lakes. Efforts will continue on an annual basis to detect new invasions of Asian carp.

Expected Milestones:

FY 2020:

- Implement a comprehensive and coordinated Great Lakes basinwide early detection and monitoring program for Asian carp and other AIS species.

FY 2020 Q2:

- Continue to refine standard operating procedures (SOP) for basinwide AIS monitoring with partner agencies.

FY 2020 Q3-Q4:

- Complete early detection surveys in suspected "hot spots" for AIS, in cooperation with partner agencies, as needed.

2020 Schedule:

February 2020

Gear preparation, planning field logistics, and crew scheduling

March – November 2020

Sampling, identification, and data entry

November – December 2020

Complete fish identification (preserved specimens as needed), data entry, and verification

December 2020 – January 2021

Data analyses, prepare report and presentation

What Is Deliverable for this Funding:

- Information regarding any new Asian carp observations/occurrences that will be provided to management agencies for potential action.
- Annual agency reports summarizing sampling efforts and findings.
- Presentations at conferences, to partner agencies, and to the public.
- A uniform, long-term data set of sampling efforts and sample collections.

Expected Completion Date for Project:

- Ongoing to maintain vigilance regarding potential new observations/occurrences of Asian carp in the Great Lakes or tributaries.

Potential Hurdles:

- Coordination among numerous agencies on a large landscape such as the Great Lakes basin.
- Attainment of agreement regarding sampling gears and sampling design among diverse partners.
- Possible issues regarding sampling site logistics.

- Inefficiency of traditional sampling gear, particularly in large, voluminous water bodies.

How will the results of this project be disseminated?

- Public (GLRI.us, GLIN Announce) and technical audience(s).

What National Asian Carp Plan goals and recommendations does this project support:

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.6.2. Assemble information about the distribution, biology, life history, and population dynamics of Bighead, Black, Grass, and Silver Carp.

M-2 Asian Carp Demographics

Lead Agency: U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: Southern Illinois University (SIU), State and Federal Partners

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$100,000	$365,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

The effects of control measures on the abundance and distribution of Illinois River Asian carp is determined by the extent to which demographic rates (i.e., growth, recruitment, mortality, movement) are altered. To evaluate control success and predict population level responses to different control scenarios requires robust data sets and analyses. Examples include demographic data to test for predicted control effects (e.g., changes in sex ratio, growth, condition) and to parameterize decision support tools such as the simulation based Spatially Explicit Asian carp Population (SEAcarP) model. The proposed 2020 work described herein is a continuation of 2019 efforts and includes field collections, laboratory processing, and data analysis. Project results will supplement existing size at age data (i.e., growth) collected through the current Long-Term Resource Monitoring (LTRM)-based sampling program and address data gaps identified by the Monitoring and Response Work Group (MRWG) Modeling Work Group including length at maturity and sex structure data derived from Asian carp captured from the lower three pools of the Illinois River (i.e., Alton, La Grange, Peoria). Lastly, this project will provide data and analysis needed to evaluate the benefits and limitations associated with adding the dozer trawl to the set of capture gears currently used to inform Illinois River hydroacoustics data.

Summary of Actions to Date:

- Completed gear evaluation study to determine sample size needed to assess Asian carp populations.
- Trained with U.S. Geological Survey (USGS)-Columbia Environmental Research Center (CERC) staff to correctly assign maturity status of small bodied Asian carp.
- Collected aging structures from the lower six pools of the Illinois River during fall 2019 sampling.
- Previous spring collections yielded few immature fish needed to address Proposed Action 1. However, large numbers of age-0 fish captured during fall 2019 sampling suggests they will be available during spring 2020.

Proposed Actions for FY 2020:

- Fall sampling and laboratory processing (i.e., otolith preparation and aging) to describe population length and age structure in pools of the Illinois River.

- Spring field sampling designed to provide length at maturity and sex structure data in the pools of the Illinois River.
- Data analysis and report writing.
- Coordination with existing Asian carp sampling programs.

Expected Milestones:

FY 2020 Q2:

- Report or manuscript characterizing age, size, and sex structure of Illinois River bigheaded carp (Black Carp and Silver Carp).

FY 2020 Q3:

- Inform population models by providing a statistical analysis describing the relationship between fish length and maturity.

FY 2020 Q4:

- Complete laboratory processing of fall 2019 aging structures.

What Is Deliverable for this Funding:

- Underlying demographic data (i.e., age, length, and sex structure, length at maturity) needed to parameterize decision support tools such as the SEAcarP model and test for control effects (e.g., spatial or temporal demographic effects associated with control actions).

Expected Completion Date for Project:

Annually updated demographic status and trend data collected through this effort is crucial for assessing control effects and informing development of management alternatives. Therefore, ongoing sampling to collect key data is recommended.

Potential Hurdles:

- Coordination among agencies.
- Issues regarding sampling gear, sample size, and logistics.
- Weather conditions.

How will the results of this project be disseminated?

- Conferences and meetings.
- GLRI summaries and reports.
- Peer-reviewed publications.

M-3 Des Plaines River Overflow Monitoring

Lead Agency: U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: U.S. Army Corps of Engineers (USACE) Chicago District, Metropolitan Water Reclamation District of Greater Chicago (MWRD), Illinois Department of Natural Resources (DNR)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$15,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

In 2010 and 2011, Asian carp environmental DNA (eDNA) was detected in the upper Des Plaines River. No Asian carp eDNA sampling has been conducted in the Des Plaines River since 2011. It is possible that Asian carp present in the upper Des Plaines River could gain access to the Chicago Sanitary and Ship Canal (CSSC) upstream of the Electric Dispersal Barrier System during high water events when water flows laterally from the upper Des Plaines River into the CSSC. The construction of a physical barrier to reduce the likelihood of this movement was completed in the fall of 2010. The physical barrier was constructed by the USACE and consists of concrete barriers and 0.25 inch mesh fencing built along 13.5 miles of the upper Des Plaines River where it runs adjacent to the CSSC. It is designed to stop adult and juvenile Asian carp from infiltrating the CSSC, but it will likely allow Asian carp eggs and fry in the drift to pass.

Opportunites for fish to pass occurred during high discharge events in 2011 and 2013 when water breached the physical barrier. USACE reinforced these and other low lying areas to prevent scouring during future lateral water transfers. These reinforcements have withstood several high flow events. Understanding the population status of Asian carp in the Des Plaines River, monitoring for potential spawning events, and determining the effectiveness of the physical barrier are all necessary to inform management decisions and assess risk of Asian carp bypassing the dispersal barrier.

Since the inception of this project in 2011, no Bighead or Silver Carp have been collected or observed. Seven Grass Carp have been collected. Six of these were submitted for ploidy analysis and all six were determined to be triploid (sterile).

Proposed Actions for FY 2020: Fixed sites will be sampled three times throughout the field season for population monitoring. Additional sampling will be scheduled if: (1) population status in Brandon Road pool significantly increases, or (2) there are credible reports of Asian carp sightings in the upper Des Plaines River. Physical barrier inspections and ichthyoplankton sampling will occur when USACE personnel indicate overflow conditions are likely or occurring. This project consists of two different efforts, Population Monitoring and Overflow Monitoring. Population monitoring will include electrofishing and gill netting. The project will utilize pulsed-

DC electrofishing. One or two dippers will attempt to dip all visible fish, with the exception of Common Carp. Any Bighead or Silver Carp collected will be kept for further study, and the Monitoring and Response Work Group (MRWG) will be notified. Grass Carp will be tested for ploidy.

USACE personnel will monitor water levels for potential overflow events. USFWS (Carterville Fish and Wildlife Conservation Office) will be notified of potential overflow events and location. Biologists will inspect the fence for areas of flow through and potential breaches. When it is safe and practical to do so, block nets may be used to temporarily close any breaches until repairs can be made by USACE. Depending on conditions, multiple gears may be used to document fish species and sizes moving through the physical barrier.

What's New in FY 2020: USFWS will continue this effort in 2020.

Expected Milestones:

- May 2020 – Staff will conduct population monitoring.
- July 2020 – Staff will conduct population monitoring.
- August 2020 – Staff will conduct population monitoring.
- Overflow monitoring will be conducted as needed.
- November 2020 – Reports will be generated.

What Is Deliverable for this Funding:

- Early detection of Asian carp breach in the Des Plaines River and above the confluence with the CSSC. Results of each sampling event will be reported for monthly sampling summaries. Asian carp captures (excluding Grass Carp) will be reported to MRWG immediately.
- Data will be summarized for an annual interim report and presented at the annual MRWG winter meeting.

Expected Completion Date for Project: This project will continue as long as Asian carp remain a threat to the upper Des Plaines River.

Potential Hurdles:

- Flow of river.
- Access to fence line.

How will the results of this project be disseminated?

- Public and technical audiences.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.6.2. Assemble information about the distribution, biology, life history, and population dynamics of Bighead, Black, Grass, and Silver Carp.

M-4 Illinois River Monitoring and Response Team Support

Lead Agency: U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: U.S. Army Corps of Engineers (USACE) Chicago District, Metropolitan Water Reclamation District of Greater Chicago (MWRD), Illinois Department of Natural Resources (DNR)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$275,000	$113,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

This work encompasses all monitoring and response support provided by USFWS throughout the Illinois River. This effort is led by the Illinois DNR and the USFWS provides support with staff and vessels during scheduled and unscheduled events. The individual efforts are:

- Fixed and Random Sites Monitoring.
- Seasonal Intensive Monitoring.
- Unified Method.
- Response Actions.

USFWS has been assisting with these efforts since 2015.

Proposed Actions for FY 2020:

- Fixed and random sites monitoring events are conducted by USFWS six times a year from April through September.
- Seasonal Intensive Monitoring is conducted by the USFWS during two events a year, one in June and one in September.
- USFWS assists with the Unified Method as planned by Illinois DNR each year.
- USFWS is on call if a Response Action is requested by the Asian Carp Regional Coordinating Committee (ACRCC). Please see the Contingency Response Plan for further information.

Expected Milestones:

- April – September: Fixed and Random Sites (six).
- June & September: Seasonal Intensive Monitoring.
- October: Unified Method.

What Is Deliverable for this Funding:

- Staff will provide requested support for Illinois DNR projects throughout the Illinois River.
- Data will be summarized and reported to the Illinois DNR after each event.

Expected Completion Date for Project: Fixed and Random Site Monitoring, Seasonal Intensive Monitoring, Unified Method, and Response Support will continue as long as Asian carp remain a threat to the Great Lakes. USFWS staff will continue to provide support during these efforts as requested.

Potential Hurdles:

- Weather.
- Equipment failure.

How will the results of this project be disseminated?

- Public and technical audiences.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.6.2. Assemble information about the distribution, biology, life history, and population dynamics of Bighead, Black, Grass, and Silver Carp.

M-5 Habitat Use and Movement of Juvenile Silver Carp in the Illinois River

Lead Agency: U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: None

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$300,000	$225,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

In an effort to collect needed data on the movement of sub-adult Asian carp in the Illinois River, total of 72 juvenile Silver Carp were tagged in the Peoria Reach during 2017. Twelve of these fish were tagged using both acoustic V5 tags and NTQ radio tags and were active as of October 2018. Mean total length of tagged fish was 320 millimeters and the smallest total length of a tagged Silver Carp was 174 millimeters. In 2018, an additional 52 juvenile Silver Carp were tagged. Fish are tracked using 10 radio monitoring stations and 19 hydro-acoustic receivers are deployed in the Peoria pool. Data through 2018 have been analyzed and are being used to inform efforts focused on monitoring the status and distribution of small Silver or Bighead Carp in upstream pools.

In 2019, efforts included downloading and maintaining stationary telemetry receivers and capturing juvenile Silver Carp for tagging. As of the end of October 2019, 36 additional juvenile Silver Carp have been tagged with 180kHz acoustic and VHF radio tags. All of the tagged juvenile Silver Carp were captured between October 9-11 and October 28-29 and ranged in total length between 120 millimeters and 306 millimeters. Further tagging efforts were planned for November with a goal of 50 total fish tagged.

Proposed Actions for FY 2020:

- Use telemetry methods to quantify mean movement distance, short-range movement frequency, and long-range movement frequency of juvenile Silver Carp.
- Estimate macro-habitat selection based on periods of residency by juvenile Silver Carp.
- Test for correlations in movement and macro-habitat selection to a variety of river conditions both temporally and spatially including temperature, current velocity, dissolved oxygen, chlorophyll-A levels and average depth in each habitat type.
- In conjunction with the Distribution and Movement of small Asian Carp project, telemetry data will be used to direct sampling efforts in future years in an attempt to increase sampling efficiency.

The projected actions for 2020 will build on 2019 efforts. USFWS will attempt to deploy approximately 50 more tags (in addition to the 40 during the fall/winter of 2019) into juvenile Silver Carp to increase the numbers of active tags in the water. The majority of work for 2020

will be tagging fish, maintaining telemetry equipment, downloading data, actively tracking fish, and measuring environmental parameters.

Expected Milestones:

November 2019 – December 2019

- Tag 40 more juvenile Silver Carp, data downloads, removal of gear that may be damaged over winter.

December 2019 – February 2020

- Data analyses, prepare report and presentation, next year field work planning, deployed equipment maintenance, data downloads, active tracking.

March – November 2020

- Fish tagging, re-deploy any equipment taken in for winter, deployed equipment maintenance, active tracking, data downloads.

November – December 2020

- Deployed equipment maintenance, removal of gear that may be damaged over winter.

What Is Deliverable for this Funding:

- The results from this study will be used to inform small Silver and Bighead Carp monitoring efforts throughout 2019 and for future years and fill in a critical knowledge gap about the behavior of this life stage of Silver Carp.
- Habitat usage and movement data is important to improving knowledge of juvenile stages of Silver Carp and subsequently will make monitoring efforts more efficient.
- Data will be analyzed and results summarized into a Monitoring and Response Work Group (MWRG) summary report/presentation, as well a peer-reviewed paper publication(s) and presentation(s) at the conclusion of this study.
- In addition to the data from this study, tagging efforts result in fish tagged for the for the Spatially Explicit Asian Carp Population (SEAcarP) model telemetry supplement (350 millimeters to 500 millimeters, and greater than 500 millimeters). Also, adults captured during tagging efforts will be measured for demographics data to support the model.

Expected Completion Date for Project: This project is set to continue throughout 2020 and into 2021, depending on the success of tagging juvenile Silver Carp and the lifespan of tags that are deployed. Project completion is anticipated by the end of 2021.

Potential Hurdles:

- Weather delays.
- Lack of suitable size fish to tag.
- Extreme weather/river conditions damaging equipment. In 2018 several receivers went offline due to storm damaging the solar panels maintaining the batteries in the telemetry stations. Additionally, suitable size fish for tagging have been hard to capture. These

issues will likely arise during the next year as well, although attempts to mitigate issues are being made.

How will the results of this project be disseminated?

- Public and technical audience(s), media, etc.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.6.2. Assemble information about the distribution, biology, life history, and population dynamics of Bighead, Black, Grass, and Silver Carp.

M-6 Distribution and Movement of Small Asian Carp in the Illinois Waterway

Lead Agency: U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration:

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$300,000	$170,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Small Silver and Bighead Carp pose a unique threat to invading the Great Lakes because of the potential electrical limitations of the Electric Dispersal Barrier System (EDBS) at immobilizing fish less than 6 inches in total length. This project involves sampling using a variety of gear at sites between the Peoria reach of the Illinois River and the EDBS throughout the year to detect upstream migrations of small and juvenile Silver and Bighead Carp. Any successful capture of small or juvenile Asian carp will be immediately communicated to the Monitoring and Response Work Group (MRWG) if it is a new finding for the sampling year, or further upstream than prior noted captures.

Summary of Actions to Date: Known populations of adult Asian carp exist in all pools of the Illinois Waterway downstream of Brandon Road Lock and Dam. In 2016, USFWS personnel surveyed for small Asian carp within the Lockport, Brandon Road, Dresden Island, Marseilles, and Starved Rock pools. Three small (109 - 115 millimeters Total Length) Silver Carp were captured in near Henry, Illinois (River Mile 194) in the Peoria pool during 2017. As of October 2018, the farthest upstream record of juvenile Asian carp (≤400 millimeters Total Length) was in Moody Bayou (Gundy County) at Illinois River Mile 256.4, where two Silver Carp (168 and 171 millimeters) were collected on October 22, 2015.

During 2018, a total of 22 crew weeks of sampling effort was conducted targeting juvenile Silver and Bighead Carp in Starved Rock, Marseilles, Dresden Island, Brandon Road and Lockport pools. A combination of gear types was utilized including electrofishing, electrified dozer trawls, and mini-fyke nets. The furthest upstream capture of a juvenile Silver Carp was in lower Starved Rock pool (Total Length, 222 millimeters) on May 14, 2018. Although this fish was above the 6-inch category, it was likely in the same year class (age) as the size of juvenile fish being targeted. No other juveniles in this age class were captured. Multiple juvenile Silver Carp in this age class were captured in the Peoria pool during 2018, indicating that the likely distribution front of age-0 Silver Carp is lower Starved Rock or upper Peoria pool.

In 2019, targeted sampling in support of this project was limited due to obligations requested in support of newly implemented a Long-Term Resource Monitoring (LTRM)-style of sampling under the Illinois River Monitoring and Response project. Approximately 2.5 weeks (compared to

22 weeks in 2018) of targeted effort in the form of fyke net sets and boat electrofishing were expended in the Starved Rock, Marseilles and Dresden Island pools of the Illinois River. No age-0 Asian carp were captured during this effort.

Proposed Actions for FY 2020: A combination of targeted and random sampling sites within the various pools (Lockport, Brandon Road, Dresden Island, Marseilles, and Starved Rock) of the Upper IWW will be sampled using a suite of gears intended to maximize the capture probability of juvenile Asian carp, to include fish <152 millimeters Total Length (6 inches). The timing of, gears used during, and specific locations for these targeted juvenile Asian carp surveys will expand beyond the scale and scope of, and be supplementary to, other Illinois River fish community monitoring efforts. In addition to collected data pertaining to distribution and movement of small Asian carp, physical characteristics and water quality measurements of the habitats sampled will be measured and recorded at each collection site.

What's New in FY 2020: USFWS will continue this effort in 2020.

Expected Milestones:

February 2020

- Gear preparation, planning field logistics, and crew scheduling.

March – November 2020

- Fish sampling, identification, and data entry.

November – December 2020

- Complete fish identification (preserved specimens), data entry, and verification.

December 2020 – January 2021

- Data analyses, prepare report and presentation.

What Is Deliverable for this Funding:

- An annual MRWG report and presentation with maps highlighting capture locations and data will be provided at MRWG meetings, as scheduled.
- Recorded length and weight data for all Asian carp collected will be provided to support the Spatially Explicit Asian Carp Population (SEAcarP) model. These data also support Asian carp hydroacoustics population monitoring conducted by Southern Illinois University.

Expected Completion Date for Project: This project is projected to continue annually due to the potential electrical limitations of the EDBS at immobilizing small Silver or Bighead Carp, as well as natural or human influenced movements of juvenile Silver and Bighead Carp throughout the year. For these reasons it is critical to continuously monitor for the upstream most location of small Silver or Bighead Carp. Each year, sampling will begin downstream again to detect the smallest year class and move upstream to determine the upstream extent of that year class.

Potential Hurdles:

- Weather.
- Equipment failure.

How will the results of this project be disseminated?

- Public and technical audiences.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.6.2. Assemble information about the distribution, biology, life history, and population dynamics of Bighead, Black, Grass, and Silver Carp.

M-7 USGS Illinois River Monitoring and Evaluation Project

Lead Agency(s): U.S. Geological Survey (USGS)

Agency Collaboration: Illinois Department of Natural Resources (DNR), U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), Southern Illinois University (SIU),

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$225,000	$365,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

The overarching goal of this project is to provide informational products and decision support tools to aid and inform the management and removal of bigheaded carp (Black Carp and Silver Carp) in the upper Illinois River waterway system. The objectives to accomplish this goal include:

- Continued maintenance of the Illinois River Catch database (ILRCdb) to facilitate objectives 3 and 4 via data summarization, visualization, and modeling.
- Providing geospatial support (mapping and analysis) to inform implementations of the Unified Method by the Illinois DNR.
- Furthering understanding of bigheaded carp life history and other factors that might influence the efficacy and efficiency of contract removal or other control approaches (e.g., deterrents) and facilitate risk assessment.
- Incorporating understandings from Objective 3 into informational products and decision support tools to inform management decisions to control bigheaded carp.

Specific products resulting from these objectives include:

- Maintenance and improvement of the ILRCdb, including analysis of data from the ILRCdb and other sources to better predict the spatial and temporal distribution of bigheaded carp at various seasons, discharges, and temperatures.
- Addition of the demographics data (being collected by the partnership in support of the Spatially Explicit Asian Carp Population [SEAcarP] model) to the ILRCdb.
- Decision support tool (i.e., web mapping service for identifying similar areas of bigheaded carp habitat/distribution models) for informing and directing removal, other management actions, and risk assessment in the Illinois River waterway system.
- High resolution benthic classification system of the upper Illinois River with a focus on high priority removal areas.
- Visual assessment of actions (e.g., blocking, driving, capturing) taken during Unified Method events in relation to catch and bigheaded carp movements derived from telemetry data.

- An assessment of the sensory development of larval bigheaded carp and how that interacts with behavioral, habitat preference, and hydrology to influence dispersal and recruitment.

Summary of Actions to Date:

- Development and deployment of the ILRCdb containing query-able, downloadable catch data for the Illinois River and customized data reports has been completed. The ILRCdb provides centralized access to standardized monitoring and removal data from Illinois DNR to facilitate data sharing, use, and analysis to aid in removal efforts for Asian carp. Additional automated monthly data reports and standardized data Quality Assurance/Quality Control checks during the data upload process have been implemented, along with testing the use of a standardized collection dataset for agency monitoring efforts. Coding for an interactive tool for the spatial and temporal analysis of catch data in support removal and other management actions has been completed and will be integrated with the ILRCdb in FY 2020.
- Development of web mapping service for invasive carp habitat suitability that includes benthic and environmental data for managers to identify and examine geographic areas of similar conditions of input areas has begun and will be incorporated as a tool in the 'Asian carp operations dashboard' to be compiled in FY 2020.
- Post-processed previously collected benthic data and collected systematic random samples from Brandon Road, Dresden Island, Marseilles, and Starved Rock pools of the Illinois River to be used as validation of processed benthic data layers, in conjunction with the development of a benthic habitat classification system for the Illinois River waterway system.
- Data (e.g., GPS tracking, telemetry, and catch data) collected during the fall of 2018 Unified Method event in Dresden Island has been post-processed into visual summaries (i.e., videos) of the event that informed the development of a methodology for timely post-Unified Method event data processing for Unified Method teams to assess and improve coordination during future implementations.
- Completed lab studies of larval Asian carp sensory development; reported on these studies in appropriate management and science outlets.

Proposed Actions for FY 2020:

- Continue maintenance of and incorporate new catch data collected by partner agencies into the ILRCdb; expand database functionality and/or add additional customized report based on partner needs; incorporate spatial/temporal analysis tool functionality with the ILRCdb to support removal and other management actions through interactive visualization of collected commercial catch and agency monitoring data.
- Integrate previously developed decision support tools and databases into 'Asian carp operations dashboard' as centralized location for managers to access and utilize Asian carp-related data and tools, including the similar areas tool and other reporting tools (e.g., monthly catch reports by pool, tracking/reporting weekly agency activities by location of work, or other tools identified by management agency needs).

- Apply and validate benthic habitat classification system to previously collected and post-processed high-resolution benthic data from priority removal areas of the Illinois River waterway system; incorporate into web mapping services.
- Continue geospatial support for the Unified Method event assessments to help improve future implementations in high priority areas identified by the Illinois DNR; report on feasibility and estimated cost of real-time geospatial support during Unified Method events.
- Publish results from Asian carp sensory development studies.

What's New in FY 2020: No new objectives.

Expected Milestones:

FY 2020 Q1:

- Report on feasibility and estimated cost of real-time geospatial support during Unified Method events.

FY 2020 Q3:

- Apply and validate benthic habitat classification system to previously collected and post-processed high-resolution benthic data.

FY 2020 Q4:

- Continue maintenance of and incorporate new catch data into the ILRCdb
- Incorporate spatial/temporal analysis tool functionality with the ILRCdb.
- Integrate previously developed decision support tools (e.g., similar areas tool) and databases into 'Asian carp operations dashboard.'
- Incorporate benthic classification layers into web mapping services.
- Continue geospatial support for the Unified Method events.
- Publish results from Asian carp sensory development studies.

What Is Deliverable for this Funding:

- ILRCdb with customized data reports, query and visualization tools (including spatial/temporal analysis functionality), and data upload and download functionality for data sharing among partner agencies.
- Web mapping service for Asian carp habitat suitability/distribution, incorporating collected and processed benthic coverages, catch data, and environmental condition variables (e.g. water depth, classified aquatic areas, etc.) with functionality to identify similar areas to user-identified areas of interest (e.g., similar water conditions and benthic characteristics), as part of an 'Asian carp operations dashboard' (online location for resource managers to access decision support tools and databases related to Asian carp management activities in the Illinois River waterway system).
- Processed benthic Geographic Information System (GIS) layers (sidescan mosaics and multibeam bathymetry) for priority areas of Peoria pool of the Illinois River and benthic

habitat classification system applied to previously collected and post-processed pools of the Illinois River.

- Methodology and support for data collection during Unified Method events and visualizations (e.g., videos) for post-event assessment; report of estimated cost, feasibility, and effort required to implement real-time geospatial support during future Unified Method events.
- Reports on larval Asian carp sensory development studies including implications for management actions and risk assessment.

Expected Completion Date for Project: FY 2020 for decision support projects. ILRCdb and 'Asian carp operations dashboard' maintenance will continue past development indefinitely at the discretion of the MRWG.

Potential Hurdles: Delays in funding or purchasing.

How will the results of this project be disseminated?

- ILRCdb and associated functionality will be available online to partner agencies through a USGS UMESC-hosted server application.
- Web mapping habitat suitability service and similar areas tool will be available online through an 'Asian carp operations dashboard' application, hosted in ArcGIS Online.
- Processed benthic GIS layers for the Illinois River are available through the USGS ScienceBase Catalog.
- Visual summaries (i.e., videos) of completed Unified Method events will be distributed to participating Unified Method agencies.
- Study results from larval Asian carp sensory development studies will be disseminated as reports including recommendations for management and risk assessment application.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 6: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

M-8 Enhanced Detection, Management, Control and Contingency Planning Above and Below Electric Barriers

Lead Agency: Illinois Department of Natural Resources (DNR)

Agency Collaboration: U.S. Army Corp of Engineers (USACE), U.S. Geological Survey (USGS), and U.S. Fish and Wildlife Service (USFWS), Illinois Natural History Survey, U.S. Coast Guard (USCG), and others will be utilized as outlined in MRP, as needed.

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$3,600,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Enhanced Prevention and Control are key elements in support of the 2020 Asian Carp Action Plan. To support the Action Plan and monitoring and response needs, Illinois DNR coordinates and collaborates with federal, state, regional, and local, and international agencies to provide the most informed efforts to prevent Asian carp from entering Lake Michigan. Staffing to implement the coordination, communication, and collaboration of this Plan falls to Illinois DNR in part and generally found in this project. Several key elements identified in the Monitoring Response Plan (MRP) of detection, management and control, and contingency actions are necessary to carry out these endeavors within the annual monitoring plan and summarized below:

Detection

The overall goal is to prevent the establishment of Asian carp in the Great Lakes by preventing the movement through the Chicago Area Waterway System (CAWS). A rigorous detection protocol is in place, based upon active roles in these waters to assure Asian carp are not thriving in waters between the Electric Dispersal Barrier System (EDBS) and Lake Michigan. Currently, seasonal and intensive efforts have been identified as a robust way to accomplish this in concert with information from environmental deoxyribonucleic acid (eDNA) surveillance. While eDNA alone cannot determine presence of live fish, the Asian Carp Regional Coordinating Committee (ACRCC) agencies want to leave nothing to chance in regard to information in the Chicago Area. Those 2020 actions supported by Illinois DNR under this project will include:

- Seasonal (Spring and Fall) Intensive Monitoring (SIM) in the CAWS.
    - Coordination of multi-agency, multi-gear efforts as found in the MRP.
- Communication of the results of SIM to agency partners.
- Review and modify efforts as cooperating agencies and science recommends.
- Any capture of Bighead or Silver Carp in these events will trigger contingency actions protocols identified in MRP.

Management and Control

A key component of management and control of Asian carp in the upper Illinois Waterway (IWW) has been removal by contracted commercial fishing. Reduced Asian carp populations in the upper IWW have been observed demonstrating lower propagule pressure and reducing the chances of Asian carp gaining access to waters near the EDBS. Informed by modeling outputs and observations this adaptive process has shown success as the observed decline in densities in Dresden Island pool has been reduced by 96% since 2012 as noted by hydroacoustic surveys and correlative data. Primary areas fished include Dresden Island, Marseilles, and Starved Rock pools.

- Fixed/Random Site Monitoring Upstream of the EDBS.
- Standardized Monitoring Downstream of the EDBS (fixed sites where prudent) integrating young of year (YOY) and juvenile monitoring into plan.
- Illinois DNR support and management of contracted fishing program.
- Barrier Maintenance Fish Surveillance/Suppression.
- Coordination and Communication of MRP activities and provide Action Plan Support and Planning expertise.

Contingency Response Actions

Contingency actions and management are identified in the annual monitoring and response plan. This response allows heightened and more coordinated responses. Annual table-top exercises have proven to be helpful and allows for evaluation of the new plan with recommended clarifications and edits being implemented. While the hope is that this plan should not be used, it is our goal to have the best plan at the ready if indeed it is needed. A table-top exercise will be planned for in 2020.

In summary, this project enables Illinois DNR to work on Asian carp detection, management and control, as well as contingency actions as necessary in the Upper IWW and CAWS.

- Contingency Planning.
- Response Actions Planning in the CAWS.
- Tabletop exercises.
- Updated MRP.

Implementation

- Administration of state efforts including staffing, contracting, necessary travel and equipment to meet annual goals.
- Support necessary efforts to meet MRP, and science needs through agency, contracts, or cooperative actions.
- Close coordination between ACRCC partners, state, federal, provincial, and Canadian federal agencies.
- Contributions to update Asian Carp Action Plan, lead annual MRP development, provide constituent briefings as needed.
- Co-chair of Monitoring and Response Work Group (MRWG).
- Coordination of communication needs (co-chair of Communication Work Group).

Proposed Actions for FY 2020: Continued high level of detection, management and control, and prepared contingency measures will persist with 2020 support. The efforts below are recommended to continue at 2019 levels which were elevated from 2018 by approximately 25% in contracted fishing/harvest activities and transitioning to a scientifically based monitoring program across all agencies for heightened monitoring efforts. While minor review and modifications may take place, field needs are not expected to be reduced in upcoming years until data suggests it is prudent. While a 96% reduction in Dresden Island pool is an encouraging observation, efforts at this location will continue. Future efficacy of enhanced contracted fishing (downstream of Starved Rock Lock and Dam) is yet unknown but may allow for modifications of both level of upstream harvest, locations, and needed monitoring presence. During 2020, efforts will be maintained to implement prevention measures, monitor and evaluate current and future efforts, inform contingency needs/actions, as well as assess risk of Asian carp to the Great Lakes.

- Fixed/Random Site Monitoring Upstream of the EDBS.
- Standardized Monitoring Downstream of the EDBS (fixed sites where prudent) integrating YOY and juvenile monitoring into plan.
- Illinois DNR support and management of contracted fishing program.
- Barrier Maintenance Fish Surveillance/Suppression.
- Coordination and Communication of MRP activities and provide Action Plan Support and Planning expertise.

What's New in FY 2020: Status/presence of Asian carp has not significantly changed in the upper river as compared to the baseline year of 2015 except for the continued decline in relative abundance, most notably in Dresden Island pool. Consistent or even heightened efforts must be maintained to further remove fish under these circumstances. After increasing efforts in 2019, it is not believed to be necessary to increase efforts in 2020, however, efforts conducted through the fall of 2019 must still be evaluated . Expected results would not indicate any significant increase in abundance of Asian carp in the upper IWW.

These baseline efforts are the focus of the annual Asian carp Action Plan and supported MRP and no significant new action is neither recommended nor suggested. Continued communication and collaboration will seek efficiencies and coordination through face to face, coordination calls, email schedule planning, monthly report outs, and digital data collection.

It is a goal to have all crews collecting data and reporting in a timely manner through a USGS supported data portal.

Expected Milestones:

- Evaluation of threat in CAWS both above and below the electric barrier system.
- Maintain high level of surveillance and increase efficiency and information from surveillance efforts.
- Contract commercial fishing surveillance in the CAWS both above and below the EDBS, with a goal of 1 million pounds of Asian carp removed upstream of Starved Rock Lock and Dam.

- Monthly reporting of monitoring results to www.asiancarp.us and informing ACRCC partners.
- MRWG meeting to share and communicate significant findings as well as identifying needs to modify or update current monitoring plans as needed. Quarterly updates via teleconference or face-to-face.
- Support and facilitate Action Plan development and 2020 MRP development and implementation.
- Support and inform Contingency Response Plan as needed.

What Is Deliverable for this Funding:

- Increased protection of the Great Lakes by identifying risk, reducing propagule pressure and supporting contingency measures.
- Providing oversight for safe and efficient monitoring and evaluation of Asian carp threat with high confidence of results.
- Coordinate with other agencies on the most effective and efficient Asian carp MRP.
- Provide partners with needed information on status and risk, protecting Great Lakes and Illinois waters.

Expected Completion Date for Project: This is an ongoing project.

Potential Hurdles:

- Unidentified pathways for expansion of Asian carp.
- Timeline of funding and prevention of timely allocation of resources.
- Very large system to find very rare fish.
- Changes in population dynamics (significant increases in abundances of Asian carp moving close to or toward the barrier; or presence of small (< 4 inch) Asian carp near the barrier would challenge ability of current plan to further restrict lake-ward movement of Asian carp populations (would need to implement additional or other control techniques).
- Administrative challenges to maintain full staffing at all times.

How will the results of this project be disseminated?

- Public (GLRI.us, GLIN Announce), technical audience(s), media, etc.
- Illinois DNR works closely with ACRCC and partners through the Communications Work Group.
- Provide timely updates to ACRCC and MRWG directly to share observations and sampling results.
- Continue to work with Illinois agency communication team to provide information through public or agency outlets, coordinate as appropriate with media inquiries, provide briefs at various scientific and technical forums and media.

What National Asian Carp Plan goals and recommendations does this project support

Goal 1: Prevent accidental and deliberate unauthorized introductions of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 4: Minimize potential adverse effects of feral Bighead, Black, Grass, and Silver Carp in the United States.

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 7: Effectively plan, implement, and evaluate management and control efforts for Bighead, Black, Grass, and Silver Carp in the United States.

M-9 Ecosystem Assessment – Eggs, Larvae, Plankton for Risk and Population Assessment

Lead Agency: Illinois Department of Natural Resources (DNR)

Agency Collaboration: Illinois Natural History Survey (INHS), University of Illinois (UI)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$443,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Ichthyoplankton sampling to monitor for the eggs and larvae of four invasive carp species (Bighead Carp *Hypophthalmichthys nobilis*, Silver Carp *H. molitrix*, Grass Carp *Ctenopharyngodon idella*, and Black Carp *Mylopharyngodon piceus*) is used to assess the extent and timing of invasive carp reproduction in the Illinois Waterway (IWW). These data are critical as an early detection system for monitoring the upstream expansion of bigheaded carp (Black Carp and Silver Carp) populations and potential reproduction by the newly expanding Black Carp population in Illinois. Limited numbers of adult Black Carp have been found in the lower Illinois River (Kroboth et al. 2019); however, presence of pre-adult life stages is largely unknown. Early detection and rapid response can be the cornerstones of effective eradication and control of aquatic invasive species; however, detecting invasive species present at low densities, such as at the edges of their invasion front (e.g., Upper Illinois River) or early in the invasion process (e.g., Black Carp in Illinois), is particularly challenging. Integrating two detection methods, environmental deoxyribonucleic acid (eDNA) quantification and ichthyoplankton sampling, has the potential to produce a very rapid, reliable approach for detecting low-density spawning events.

Monitoring for larval Asian carp is needed to determine the timing and spatial extent of Asian carp reproduction in the IWW. Larval Asian carp have previously been collected in the Alton, LaGrange, and Peoria pools of the Illinois River (DeGrandchamp et al. 2007, Butler et al. 2016), and small juvenile Asian carp (≤ 152 millimeters) have been captured in the LaGrange, Peoria, and Starved Rock pools (Irons et al. 2011, Butler et al. 2019, Monitoring and Response Work Group [MRWG] 2018). However, recent collections of Asian carp eggs in the upper pools (Starved Rock and Marseilles) and the capture of a small number of Asian carp larvae in the Dresden Island pool (Butler et al. 2019) highlight the need for continued monitoring for early life stages of Asian carp throughout the IWW. Reproduction and recruitment are also known to be highly variable among years in the Illinois River (DeGrandchamp et al. 2007, Irons et al. 2011, Gibson-Reinmer et al. 2017, Butler et al. 2019), but a system-wide assessment is needed to evaluate relationships among environmental variables and recruitment of young Asian carp. Assessing the timing and spatial distribution of the ichthyoplankton drift and evaluating factors affecting Asian carp reproduction and recruitment in different sections of the IWW will help to

improve our understanding of Asian carp population dynamics and potentially aid in development of management strategies targeting early life stages.

Simple relationships between stock abundance and reproductive potential are often lacking (Marshall et al. 2003), in part because of spatial and temporal variability in spawning conditions, stock composition, and first-year survival (Köster et al. 2001; Köster et al. 2005). Quantifying the relationship between adult stock abundance and reproductive productivity, and the influence of environmental conditions on this relationship, will help to refine our understanding of the conditions and level of removal that reduce population growth rate. Zooplankton are useful performance indicators because they are known to be impacted by Asian carp (Sass et al. 2014), are a rapid index of ecosystem response, are distributed throughout the Illinois River, and are critical food web components for larval and adult native fishes. Ultimately, these assessments will benefit the Great Lakes region as well as any other aquatic systems that Asian carp may also invade.

The proposed studies are aimed at providing information required by multiple state and federal agencies to more effectively control Asian carp populations. These needs have been identified through discussions with biologists and other decision makers at meetings of the MRWG of the Asian Carp Regional Coordinating Committee (ACRCC), and through consultation with staff within the Division of Fisheries, Illinois DNR.

In this segment of the project, we propose to continue our existing sampling programs for Asian carp reproduction and ecosystem responses in the IWW to (1) better understand spatial and temporal patterns of Asian carp reproduction, (2) provide rapid detection of carp reproduction, (3) assess the level of adult removal needed to degrade the reproductive productivity of Asian carp, and (4) develop zooplankton metrics that assess the performance of removals in diminishing the ecosystem impacts of bigheaded carp. Due to the extensive effort, large spatial coverage, and the emphasis on multiple life stages of Asian carp, this project will also provide a substantial contribution to the ongoing monitoring efforts for Asian carp in the IWW.

Proposed Actions for FY 2020: The purposes of this project are to evaluate the spatial and temporal extent of Asian carp reproduction in the IWW and its tributaries, enhance the efficiency of detection of carp reproduction, quantify the relationship between carp stock abundance and reproductive productivity, and assess current ecosystem response to Asian carp removals. The sampling required to achieve these goals will also supplement Asian carp monitoring activities conducted by other agencies, particularly in areas where the presence of Asian carp is of highest concern. This project is divided into two jobs with the following objectives:

- Illinois DNR will identify the spatial and temporal extent of Asian carp reproduction in the IWW and its tributaries through frequent sampling with ichthyoplankton push-nets and drift nets. Our objectives include: (1) monitoring for potential changes in the reproductive front of Asian carp populations within the IWW and its tributaries, (2) provide early detection of any Black Carp reproduction, (3) transfer the methods developed in Fritts et al. (2018) and Guan et al. (2019) to enhance our ability for early detection of carp reproduction, and (4) quantify the relationship between Asian carp stock abundance and reproductive output. Illinois DNR will conduct statistical analyses of environmental

factors that contribute to successful Asian carp spawning and assess the level of removal needed to degrade the ability of Asian carp to perpetuate themselves through reproduction. We will field-test the method that integrates our push-net collections with eDNA techniques to assess its potential to produce a more rapid method for detecting invasive carp reproduction than either method alone. This work will be used to inform management agencies regarding Asian carp spawning events, spawning locations, and areas of larval settlement through weekly updates, monthly summaries, annual reports, and annual updates to the MRWG's Interim Summary Report.

- We will combine historical and current monitoring data on zooplankton communities in the Illinois River to develop dynamic targets for diminishing the ecological impact of Asian carp. Assessments of ecosystem response will be based on comparisons between current zooplankton abundances and targets derived from models developed from pre-invasion conditions. A stoplight assessment report card will be developed based on deviation of zooplankton performance measures from management targets. The report card approach will categorize locations by the level of Asian carp impact on zooplankton, from strong, moderate, to weak/no impact. This work will be used to inform management agencies regarding ecosystem response to Asian carp removals and explicit targets for evaluating the outcome of Asian carp control and removal efforts. These results will be disseminated through weekly updates, monthly summaries, annual reports, and annual updates to the MRWG's Interim Summary Report.

What's New in FY 2020:

Implementing qualitative polymerase chain reaction (qPCR) techniques developed by USGS builds upon previously funded work and implements recommendations in order to project future efficiencies.

Expected Milestones: The timeline for this project is the calendar year 2020 for data collection, analyses, and reporting as noted below.

	2020											
Job	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
1. Asian Carp Reproduction Monitoring												
Field Sampling				X	X	X	X	X	X	X		
Sample Processing					X	X	X	X	X	X	X	
Data Processing	X	X	X	X	X	X	X	X	X	X	X	X
Reporting	X			X			X			X		X
2. Zooplankton as Assessment Targets												
Field Sampling				X	X	X	X	X	X	X		
Sample Processing					X	X	X	X	X	X	X	
Data Processing	X	X	X	X	X	X	X	X	X	X	X	X
Reporting	X			X			X			X		X

What Is Deliverable for this Funding: Targets for ecosystem response to Asian carp removals will be developed by using monitoring data from the pre-assessment time period to model zooplankton indicators as a function of Asian carp abundance and the seasonal environmental variation driving their spatiotemporal dynamics (e.g., discharge, temperature, total phosphorus, chlorophyll *a*). Models of zooplankton indicators will be parameterized over conditions including pre- or early-invasion time periods, when bigheaded carp were absent or at very low abundance. Environmental values from the assessment time period will be entered into these models while holding carp abundance at zero to produce target values for zooplankton metrics (i.e., zooplankton values in the absence of carp but still under control of seasonal environmental conditions). A second set of predicted zooplankton values will be generated using observed carp abundances in combination with observed environmental values (i.e., full set of observed conditions during assessment period).

A stoplight assessment report card will be developed for locations throughout the IWW based on deviation of zooplankton performance measures from predicted management targets. The stoplight report will code locations as impacted by Asian carp (red light) if the deviation (± 2 standard error) between observed and target predictions of zooplankton metrics falls outside of the deviation (± 2 standard error) between observed zooplankton values and predictions based on the full set of observed conditions (this deviation interval is known as the control limits of a given metric). Locations will be coded as warranting caution (yellow light) if zooplankton target intervals fall outside of the ± 1.5 standard error control limit. Locations where zooplankton targets fall within the ± 1.5 standard error control limit will be considered as not having an impact of carp and will be coded as a green light.

Expected Completion Date for Project: Final report with metrics as stated above by December 2021.

Potential Hurdles:

- Annual sampling in the field is weather dependent.
- Collaboration with field data and availability of such may impact this project timeline.

How will the results of this project be disseminated?

- Data will be disseminated to ACRCC audience through written and in person presentations as needed.
- Written reports, peer review manuscripts and web driven content will be developed.
- Coordination through ACRCC Communications Work Group and Illinois DNR as needed.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 4: Minimize potential adverse effects of feral Bighead, Black, Grass, and Silver Carp in the United States.

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 7: Effectively plan, implement, and evaluate management and control efforts for Bighead, Black, Grass, and Silver Carp in the United States.

M-10 Illinois River Stock Assessment/Management Alternatives

Lead Agency: Illinois Department of Natural Resources (DNR)

Agency Collaboration: U.S. Army Corps of Engineers (USACE), U.S. Geological Survey (USGS), and U.S. Fish and Wildlife Service (USFWS) worked continually and extensively on the creation of the Monitoring Response Plan (MRP) and monitoring efforts and plans and funded under separate projects. Illinois Natural History Survey (INHS), U.S. Coast Guard (USCG), and others will be utilized as outlined in MRP and as needed.

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$550,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Summary of Actions to Date: Hydroacoustic sampling will occur for multiple purposes, including whole-pool sampling in Marseilles and Dresden Island pools every other month from Feb. – Oct. This sampling results in bigheaded carp (Black Carp and Silver Carp) density heatmaps displaying spatial distributions of fish throughout the year that will be provided to Monitoring Response Work Group (MRWG) members to target contracted harvest to maximize harvest efficiency. Hydroacoustic sampling will also take place before and after any Unified Method events in spring and fall to provide density heatmaps to inform harvest events and to assess effectiveness of harvest at reducing densities. Finally, hydroacoustic sampling will be conducted in October at standardized locations from Alton – Dresden Island pools in order to quantify pool-wide bigheaded carp densities that will be compared to long-term (since 2012) density trends. Funds will also support the continued surveillance of the movement of bigheaded carp throughout the Illinois River using an array of 70+ stationary receivers (distributed from Alton through Dresden Island pools). Funds cover downloads of stationary receivers, data quality assurance/quality control (QA/QC), data upload to FishTracks, analyses, and maintenance of the receiver array (batteries, replacement stands). Data will be processed to identify dam passages, including the route of passage (i.e., dam vs. lock) when possible. Bigheaded carp movement data are used to improve estimates of movement rates among pools, an essential component of the Spatially Explicit Asian carp Population (SEAcarP) model. Additionally, this receiver array is compatible with acoustic telemetry tags from other groups/studies, including tags in bigheaded carp in the Mississippi and Ohio rivers so that data can be included in inter-river movements for future expansion of the SEAcarP model. Stationary receiver information is also utilized to assess Unified Method harvest (i.e., assess herding effectiveness), and to inform the timing of management actions through the observation of the mass movements of bigheaded carp.

A program of enhanced fishing of bigheaded carp in the Peoria pool began in September 2019. Assessing effects of this new enhanced fishing program on bigheaded carp in Peoria pool is

necessary to determine effectiveness of this program and to improve program success. One method for determining effects of enhanced fishing on bigheaded carp is comparing fall densities from Southern Illinois University's (SIU) fall hydroacoustic sampling in years after implementation of enhanced fishing versus prior years. However, such annual comparisons will be difficult, at least initially, to quantitatively attribute to enhanced fishing. We propose conducting hydroacoustic surveys of select sites (same sites as fall standardized sampling) in Peoria pool every other month from Feb – October. The resulting data will allow for a better ability to assess effects on bigheaded carp densities, size distributions, and spatial distributions, and to relate these potential changes to harvest from the enhanced fishing program. These efforts will need to be repeated in subsequent year to evaluate enhanced contract removal from downstream pools.

This project supports implantation of 100 acoustic telemetry tags into bigheaded carp in the Illinois River, with 50 tags placed in Alton pool and 50 tags into LaGrange pool. As of the end of 2019, only 50 active tags will be in each of these two river pools. This is an incredibly small proportion of the population in these pools that reduces our ability of detecting inter-pool movement. Increasing the number of active tags by an additional 100 individuals in 2020 will (1) increase the likelihood of detecting inter-pool movements and (2) bring numbers of tags for Alton and La Grange pools more in-line with Peoria pool (150 telemetry tags in bigheaded carp in 2019). These efforts are coordinated through the Telemetry Work Group of the MRWG and only found in the 2020 request. Future efforts may require refreshing and coordinated through the Telemetry Work Group prior to future request.

Funding to complete the second (and final) year of a collaborative project with USACE to compare the behavior (movements, home range, dam passage) of Common Carp to Silver Carp to assess the appropriateness of Common Carp as a surrogate species. This study will help to improve inferences from Common Carp telemetry data upstream from Brandon Road Lock and Dam regarding the behavior of Silver Carp. The requested amount is slightly higher than last year by $2,014. Work in 2019 revealed that (1) more trips than previously estimated are needed to field sites for retrieving stationary telemetry receivers and to actively track fish and (2) the student needs more assistance in the field than can be provided by existing staff (in the form of hourly, short-term help). USACE will provide 50 acoustic telemetry tags (as they also provided in 2019) for use in Common Carp in 2020. These funds will not be required in future years.

Proposed Actions for FY 2020: Continued pool-wide and event driven hydroacoustic assessments will occur annually and more frequent in targeted areas to assess status of relative abundance and inform on observed relative abundance changes over baseline values. Such efforts are necessary to inform the MRP annually as well as providing critical information for the SEAcarP model.

Support of telemetry in collaboration with Telemetry Work Group partners provides a cost-efficient use of agency time which also informs removal efforts, biological modeling, and risk.

Activities limited to just 2020 include: (1) implanting 100 acoustic telemetry tags throughout Illinois Waterway, and (2) providing surrogate species telemetry support with USACE

cooperation with provided tags. Neither of these efforts are currently expected to continue into 2021 with current information.

What's New in FY 2020: SIU is collaborating with other agencies to refresh the telemetry resources that are used in model development, fishing responses, and evaluation within the Illinois Waterway. These efforts need to occur occasionally as tags expire from the population over time. Increased emphasis in the lower Illinois Waterway, specifically Peoria pool commensurate with increased harvest, is prudent. An investment as suggested by the SEAcarP model in lower river removals can provide heightened protection of the Great Lakes. To gage response and adequacy of removal, increased resolution is necessary in pools where enhanced contracted removal is ongoing, while also maintaining up-steam efforts (to detect further and expected change upstream).

Expected Milestones:

Goal: Document spatial and temporal variation in Asian carp densities in Marseilles and Dresden Island pools to inform harvest and control efforts.

Specific objectives are:

- Quantify Asian carp densities every other month in Dresden Island and Marseilles pools in 2020 using mobile hydroacoustic surveys to pinpoint high density areas that can be targeted during contracted removal. Surveys will also document how distributions of Asian carp change through time which can better inform targeted removal and could provide an indication of the effectiveness of harvest efforts. Data collection will occur bi-monthly as long as conditions allow and results will be available one month after the survey.

Goal: Estimate density and biomass of Asian carp in the Illinois River.

Specific Objectives are:

- Hydroacoustic surveys will be completed in fall 2020 and Asian carp densities, biomass, and size structure in Alton – Dresden Island pools will be determined. Density, biomass, and size structure estimates will be compared across habitats, pools, and through time to compare 2020 densities to past trends. Results will be included in the final project report and communicated in MRWG communications.
- Increase precision in Peoria pool as a target of enhanced contracted fishing by conducting hydroacoustic surveys of select sites (same sites as fall standardized sampling) in Peoria pool every other month from Feb – October.
- Collect fish via electrofishing and gill netting in 2020 in the Alton, La Grange, and Peoria pools to determine species-specific densities from hydroacoustic surveys. Catch data will also help determine population characteristics including catch-per-unit-effort, length-weight relationships, and size structure of Asian carp. These data will be used to update the spatially explicit population model and results will be included in the project's final report.

Goal: Monitor passage of Asian carp through Illinois River Lock and Dams

Specific Objectives are:

- Maintain and download SIU's extensive acoustic telemetry array currently in place in the Illinois River by replacing batteries, lost stationary receivers, and deploying additional acoustic telemetry tags in 2020. Quality check data, merge data with existing telemetry database, and supply data to the Modeling Work Group in order to update the SEAcarP model. Documented dam passages will be included in the final report.

Goal: Compare movement patterns of surrogate species to Asian carp to improve inferences from surrogate fish movement data near the electric barriers.

Specific Objectives are:

- Continue to compare dam passage rates and timing among surrogate species and Asian carp.
- Continue to identify patterns and environmental correlates of the movements of surrogate species and Asian carp to improve the utility of surrogate fish movement data from near the electric barriers. This is year 2 of 2 for surrogate fish efforts.

What Is Deliverable for this Funding:

- Increased protection of the Great Lakes by identifying risk, reducing propagule pressure and supporting contingency measures.
- Evaluation of enhanced removal is necessary to optimize future efforts.
- Providing oversight for safe and efficient monitoring and evaluation of Asian carp threat with high confidence of results.
- Coordinate with other agencies on the most effective and efficient Asian carp MRP.
- Provide partners with needed information on status and risk, protecting GLs and Illinois waters.

Expected Completion Date for Project: This project is expected to continue to provide annual evaluation and advice to the ACRCC and MRWG if Asian carp management and control is a priority. This project could be modified on an annual basis to provide managers needed information and may be modified as new techniques or technologies inform this work.

Potential Hurdles: The working groups of the MRWG have suggested the current methodology is appropriate for management considerations but are developing standard operating procedures. Such procedures may require future modifications of techniques or suggest errors or oversights of current methods. Such review may provide insights or needed modifications to properly assess populations and movements.

How will the results of this project be disseminated?

- Monthly summaries of activities provided to MRWG.
- Annual summaries provided in the Interim summary reports.
- Coordination with Communication Work Group.

- When needed, and at least annually provide a briefing to ACRCC on status of Asian carp populations and observations. Upon request will provide summaries for online content of www.asiancarp.us, www.glri.us, or other.
- Illinois DNR works closely with ACRCC and partners through the communications work group.
- Provide timely updates to ACRCC and MRWG directly to share observations and sampling results.
- Continue to work with Illinois agency communication team to provide information through public or agency outlets, coordinate as appropriate with media inquiries, provide briefs at various scientific and technical forums and media.

What National Asian Carp Plan goals and recommendations does this project support

Goal 1: Prevent accidental and deliberate unauthorized introductions of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 4: Minimize potential adverse effects of feral Bighead, Black, Grass, and Silver Carp in the United States.

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 7: Effectively plan, implement, and evaluate management and control efforts for Bighead, Black, Grass, and Silver Carp in the United States.

M-11 eDNA: USFWS Midwest Region Fisheries Program Capacity for eDNA Sampling and eDNA Sample Processing

Lead Agency(s): U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: States/Tribes of Great Lakes, Ohio River, Upper Mississippi River

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$2,400,000	$0

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Summary of Actions to Date: The USFWS applies the science of environmental deoxyribonucleic acid (eDNA) as an early detection monitoring tool in support the Asian Carp Regional Coordinating Committee's (ACRCC) strategic approach for protecting the Great Lakes from Asian carp. 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 Bighead and Silver Carp. USFWS has identified the need to maintain program capacity for eDNA surveillance in the Great Lakes, Upper Mississippi, and Ohio River basins. Building on prior work to improve Bighead and Silver Carp genetic markers, field collection and extraction protocols, USFWS will continue support for Grass and Black Carp surveillance for Great Lakes protection as part of this monitoring program.

Use of eDNA as a monitoring tool for Asian carp and other aquatic invasive species (AIS) has been successfully implemented since 2013, coordinated through the USFWS Midwest Fisheries Center - Whitney Genetics Lab. Improvements through eDNA research efforts within federal agencies and academic institutions has resulted in efficiencies in field and laboratory techniques and processes allowing for analytical capacity to expand each year. Higher throughput (sample processing) has been realized with modifications to current procedures and methods, all of which have been tested and validated in three labs in order to be adopted into the Quality Assurance Project Plan (QAPP). Lab capacity has expanded from ~2,500 to 8,500 samples per year.

Proposed Actions for FY 2020:

USFWS, in cooperation with partners, will continue to monitor for the presence of Bighead and Silver Carp eDNA in the Great Lakes, Upper Mississippi River, and Ohio River basins. USFWS will continue to process water samples collected, in collaboration with state and tribal partners, to detect the presence of Asian carp DNA in areas of concern. This will include the Chicago Area Waterway System (CAWS) through two sampling events in 2020. USFWS will continue to upgrade its field sampling infrastructure and its collection and sample processing techniques as new technologies emerge.

Expected Milestones:

- Continued development of capacity for implementing an eDNA sampling program at USFWS Great Lakes Fish and Wildlife Conservation Offices.
- Continued implementation and refinement of an eDNA sampling protocol for other areas of concern, with particular focus on potential hotspots for Asian carp invasions.
- Continued processing of water samples for Asian carp eDNA sampling from areas of concern.
- Continued updating of the QAPP to include any necessary updates for collection, handling, and processing of water samples.
- Increased throughput of samples processed at the USFWS Whitney Genetics Lab due to procedural modifications, where possible.

What Is Deliverable for this Funding:

- Continued eDNA sampling in areas of concern by USFWS Fish and Wildlife Conservation Offices, conducted in close coordination with partners.
- Continued updating of the QAPP to include any necessary updates for collection, handling, and processing of water samples.
- USFWS eDNA sample processing and analysis; providing results to state partners within one month of when samples were received at the Whitney Genetics Lab.
- Posting of eDNA results on USFWS eDNA website.

Expected Completion Date for Project:

- Ongoing; annual implementation.

Potential Hurdles:

- Limitations due to weather and difficulties accessing sites.

How will the results of this project be disseminated?

- USFWS eDNA website.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 1: Prevent accidental and deliberate unauthorized introductions of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

M-12 Telemetry in the Upper Illinois Waterway

Lead Agency: U.S. Army Corps of Engineers (USACE)

Agency Collaboration: U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS), Illinois Department of Natural Resources (DNR), Southern Illinois University (SIU)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$200,000	$0

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

USACE has led telemetry efforts in the Chicago Area Waterway System (CAWS) since 2010 with a primary objective of assessing the efficacy of the barriers as identified in the Asian Carp Regional Coordinating Committee (ACRCC) Monitoring and Response Plan (MRP). By surgically implanting transmitters into fish species (both Asian carp and surrogate species), USACE has empirical data to demonstrate the barriers are effective in preventing large fish passage in the upstream direction. This funding request is to continue the work in assessing the efficacy of Barriers IIA and IIB, and Permanent Barrier I. Future work will combine the historical acoustic telemetry monitoring with alternative monitoring systems at the barrier site such as hydroacoustics in cooperation with partner agencies. Additionally, continual refinement of the stationary receiver network will occur which increases efficiency and coverage within the system. Further downstream, the combined receiver array established by USACE and the receiver arrays established by SIU and USFWS, have been able to monitor long term movement of Asian carp in the entire Illinois Waterway (IWW), including localized movements through lock structures and at the area of the population's leading edge. Future downstream activities have focused on inter-pool movement across the Brandon Road Lock and Dam and finer scale movement detection of Asian carp within the Dresden Island pool.

Summary of Actions to Date: USACE researchers have successfully established an acoustic network of receivers positioned at 29 strategic locations from the Upper IWW into the CAWS. A Vemco Positioning System (VPS) was also established around Barriers IIB and IIA that was capable of providing 2D fish movements in relation to the barriers from 2011 through 2016. Transmitters have been surgically implanted into a total of 650 fishes to date. Mobile tracking and receiver downloads have occurred bi-monthly to ensure up-to-date data are provided to decision makers regarding the efficacy of the barrier system. Interim summary reports of work completed have been prepared annually and included within the Monitoring and Response Plan annual summary reports.

- Winter receiver network was recovered and full receiver network was deployed.

- Receiver downloads were completed every other month throughout FY 2019 with monthly summaries provided to the Monitoring and Response Work Group (MRWG) for distribution.
- Participation in the Telemetry Work Group for MRWG support.
- Integration of USACE telemetry with USGS online telemetry networking tool.
- Supplemental transmitter surgery implants to maintain transmitter densities in 1st and 3rd quarters of FY 2019.
- Support of the Unified Fishing Method in the Dresden Island pool.
- Continued range testing and habitat mapping throughout the focus area.
- Real-time receiver monitoring above the Barriers and Brandon Road lock.
- Continued integration of USACE telemetry with USGS online telemetry networking tool
- Work with USGS to refine receiver network in Dresden Island to reduce coverage while maintaining support to MRWG monitoring and modeling efforts.
- Commence surrogate comparison study in the Upper IWW in cooperation with SIU (see write up from Illinois DNR or SIU for further details).
- Establish additional baseline fish passage rates at locks and dams in the upper Illinois River by using site fidelity to increase motivation for movement upstream and downstream.
- 2019 Interim Summary report completed.
- 2020 MRP for telemetry developed.

Proposed Actions for FY 2020

- Continued monitoring of tagged fishes within the study area.
- Supplemental transmitter surgery implants to maintain transmitter densities.
- Refinement of telemetered and hydroacoustic monitoring at the dispersal barriers with emphasis on assessing Permanent Barrier I as it is commissioned.
- Analyze and report on data from the surrogate comparison study in the Upper IWW.

Timeline for Major Actions: The receiver network is generally deployed by early 3rd Quarter of each fiscal year and stripped to a bare-bones essential network for winter by late 1st Quarter each fiscal year. An interim summary report for the previous field season and projected plan for the upcoming field season is prepared in the 1st to 2nd Quarter each fiscal year. Monitoring specific to Permanent Barrier I will be implemented concurrent to its commissioning.

Expected Milestones:

FY2020 Q3:

- Establish 2020 receiver network in study area.

FY2020 Q4:

- Supplemental transmitter deployment in all upper IWW pools.

What Is Deliverable for this Funding:

- Real-time updates and alarms for tagged fish passage at the EDBS to continue the work of assessing the efficacy of Barriers IIA, IIB, and Permanent Barrier I.
- Annual Interim Summary Reports.
- Monthly summary reports.
- Tracking reports in support of harvest efforts and special monitoring events as needed.

Expected Completion Date for Project: To be determined.

Potential Hurdles:

- Weather related delays to field work implementation.
- Equipment long-lead delays of custom transmitters.
- Potential technical difficulties with equipment or network arrays.
- Vandalism, theft, barge strike damage, or siltation of receivers.

How will the results of this project be disseminated?

- Public (www.asiancarp.us).
- Technical audience(s).
- Media, etc.

M-13 Telemetry Support for the SEAcarP Population Model

Lead Agency: U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: Southern Illinois University (SIU), U.S. Army Corps of Engineers (USACE) Chicago District

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$140,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

In addition to the USFWS juvenile Asian carp habitat project Habitat Use and Movement of Juvenile Silver Carp in the Illinois River (focused on tagging and tracking fish up to 300mm in length), staff will also tag all Asian carp collected that are between 300mm and 500mm in length. Work conducted in support of the Spatially Explicit Asian Carp Population (SEAcarP) model under this project will use Vemco fish telemetry tags at 69 kHz, the frequency aligning with the receiver array currently dispersed throughout the Illinois River. This will give biologists a better understanding of the more large-scale movement of smaller (300-500 millmeters) individuals that are assumed to move at the same rates as larger, sexually mature individuals within the population model (see the SEAcarP Model project for more information).

Summary of Actions to Date: In 2018, staff tagged 154 Asian carp throughout the Peoria pool as was agreed upon by the Monitoring and Response Work Group (MRWG) Telemetry Work Group. Of the 154 fish tagged, 8 were smaller than 350mm and 146 were greater than 350 millimeters but smaller than 500 millimeters. Additional smaller fish were tagged as part of the USFWS Small Fish Habitat Project . All fish were also fin clipped, and samples sent to Western Illinois University to determine if fish were hybrids. All fish were marked with external loop tags to show that they have been acoustically tagged. All tag numbers and individual fish information were distributed to the Telemetry Work Group and will be uploaded into the FishTracks database.

In 2019, an additional 123 Asian carp were tagged throughout the Peoria pool, as was agreed upon by the MRWG Telemetry Work Group. Similar to 2018, additional smaller fish were tagged as part of the USFWS Small Fish Habitat Project. All fish were fin clipped to determine if fish were hybrids. All fish were marked with external loop tags/floy tags to indicate that they have been acoustically tagged. All tag numbers and individual fish information were distributed to the Telemetry Work Group and will be uploaded into FishTracks. Acoustic receivers were maintained and data were downloaded on several occasions in 2019.

Proposed Actions for FY 2020: USFWS crews will tag an additional 150 Asian carp in and around the Peoria and Starved Rock pools. This large-scale tagging of adult and juvenile Asian carp will provide more information for the model to better estimate current levels of exploitation and to bolster estimates of large-scale, pool-to-pool movement. Fish will be tracked using the

current acoustic array within the Illinois River. Additional receivers will be placed in areas with reduced coverage and the MRWG Telemetry Work Group will be consulted prior to deployment.

Expected Milestones:

- January-December – Data from receivers will be downloaded each month.
- February – Additional equipment purchased.
- July-September – Fish tagging will begin and continue until all tags are used.
- November – Data analysis.
- December – Report generation.

What Is Deliverable for this Funding: This project will provide information as to large-scale pool-to-pool movement of Asian carp within the Illinois River. This data will be used to bolster the SEAcarP Model effectiveness for informing the timing and location of Asian carp harvest for maximum impacts.

Expected Completion Date for Project: This project will be re-evaluated at the end of 2020 to determine if further tagging is needed in 2021.

Potential Hurdles: Contracting delays, weather delays, staffing, equipment.

How will the results of this project be disseminated?

- Public and technical audiences.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.6.2. Assemble information about the distribution, biology, life history, and population dynamics of Bighead, Black, Grass, and Silver Carp.

M-14 USFWS Illinois River Hydroacoustics

Lead Agency: U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: Southern Illinois University (SIU), U.S. Army Corps of Engineers (USACE)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$135,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Since 2012, the USFWS has utilized a wide range of technologies to collect data under this comprehensive monitoring, assessment, and barrier efficacy program. Split beam sonar, side scan sonar, and multi beam sonar imaging systems have been used extensively to monitor fish behavior and abundance near the Electric Dispersal Barrier System (EDBS) over varying temporal and spatial scales. Initial work conducted during the 2012 and 2013 field seasons showed that fish abundance near the barrier varies throughout the year (Parker et al. 2015). During summer, large schools of small fish (non-Asian carp) congregated directly below the operational barrier where fish were observed to demonstrate a "challenging" behavior. In some cases, schools of small fish penetrated the entirety of Barrier IIB which has the greatest electrical field strength (Parker and Finney 2013).

Summary of Actions to Date: Since 2015, hydroacoustic surveys have been completed on a bi-weekly to monthly basis to gain greater temporal resolution on fish community dynamics. An additional component to this work was furthering the understanding of complexities introduced at the EDBS concurrent with passage of commercial barge traffic. Trials conducted during 2015 demonstrated that freely swimming small fish could be entrained and transported over the entire EDBS in junction gaps between barges (Davis et al. 2016). Additional trials conducted during 2016 demonstrated that small wild fish could also be transported upstream across the EDBS in return current flows associated with downstream barge transits at the EDBS (USFWS 2016). Standard operating procedures were updated and put into place at the end of 2017. During 2018, staff conducted bi-weekly scans at the barrier system and notified USACE and the Monitoring and Response Work Group (MRWG) as to any concerns based on the scan results.

Proposed Actions for FY 2020: Side-looking split beam hydroacoustic and side scan sonar surveys will be conducted above and below the Chicago Sanitary and Ship Canal (CSSC) EDBS to assess fish abundance, density, and distribution patterns near the EDBS on a fine temporal scale. Surveys at the EDBS will take place on a bi-weekly (barrier surveys) to bi-monthly (pool surveys) beginning in January. The hydroacoustic survey equipment utilized for these surveys consists of a pair of Biosonics® 200 kHz split-beam transducers as well as a 4125 Edge Tech ultra-high-resolution side scan unit. The two split-beam transducers are mounted in parallel on the

starboard side of the research vessel 0.15 m below the water surface on Biosonics® dual axis automatic rotators. The side scan unit is attached to a davit and is lowered less than a meter into the water. This approach, using both systems, will allow a large portion of the water column to be ensonified by the survey vessel during each survey. These surveys will provide information on size frequency distributions of fish targets as well as spatial orientation information. Results of biweekly surveys will be communicated to partners as changes in fish abundance or behavioral status are detected. In addition, several scans will be conducted in conjunction with SIU throughout the summer to ensure that both agencies are collecting data in a consistent and comparable manner.

What's New in FY 2020: USFWS will continue this effort in 2020.

Expected Milestones:

- Mobile hydroacoustic fish surveys at the EDBS: Biweekly- January 2020-December 2020.
- Mobile hydroacoustic fish surveys; Dresden Island, Brandon Road and Lockport pools: Bi-monthly May 2020-September 2020.
- Additional surveys as needed or requested based on distribution changes or barrier shutdown or maintenance.

What Is Deliverable for this Funding: Biweekly report on fish density and spatial distribution near the EDBS to the Asian Carp Regional Coordinating Committee (ACRCC). Annual reports and presentations outlining significant findings of all program study areas. Rapid communications to the ACRCC on moderate or significant changes in fish community species composition or fish behavioral observations at the EDBS.

Expected Completion Date for Project: This project should continue as long as Asian carp pose a risk to the EDBS and the Great Lakes.

Potential Hurdles: Weather, barge traffic, equipment failure.

How will the results of this project be disseminated?

- Public and technical audience.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.6.2. Assemble information about the distribution, biology, life history, and population dynamics of Bighead, Black, Grass, and Silver Carp.

M-15 USGS Telemetry Project

Lead Agency: U.S. Geological Survey (USGS)

Agency Collaboration: Illinois Department of Natural Resources (DNR), U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), WIU, Southern Illinois University (SIU)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$142,250	$299,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Bigheaded carp life history is complex with each life stage from egg through adult, and even male and female adults, potentially exhibiting season- and environmental condition-dependent habitat use and movement patterns. These variable patterns make targeting bigheaded carp (Black Carp and Silver Carp) for removal and containment challenging and costly. Acoustic telemetry and modeling to understand these complex lateral and longitudinal movements and distribution by bigheaded carp can be useful for (1) informing removal efforts, (2) planning contingency actions for threshold movements (e.g., past barriers), and (3) parameterizing population models for scenario planning and adaptive management.

Telemetry projects in support of removal and contingency planning. USGS will work with partners via the Monitoring and Response Work Group (MRWG) Telemetry Work Group to inform removal and contingency actions for bigheaded carp by (1) conducting telemetry, data management, visualization and analyses to understand bigheaded carp distribution and movements in strategic areas to inform Illinois DNR-directed contract and agency fishing, (2) deploying real-time acoustic receivers at strategic locations, and serving that data via the internet, text messaging, and email to inform contingency planning and removal, and (3) completing testing of new technologies (i.e., satellite tags) for real-time tracking of bigheaded carp. Specific products include telemetry database and visualization tools; real-time acoustic receiver network with remote data serving and alert options; assessment of existing and new telemetry and catch data to determine strategic locations to place real-time receivers to inform removal; assessment of bigheaded carp movement in response to the Unified Method in Dresden Island pool; and a final assessment of satellite tags and recommendations regarding their use for tracking bigheaded carp in the upper Illinois River to inform removal.

Telemetry projects in support of Spatially Explicit Asian carp Population (SEAcarP) modeling. USGS will work with the Telemetry Work Group and other MRWG work groups in support of the SEAcarP model for scenario planning and adaptive management of bigheaded carp by analyzing the telemetry data to (1) determine optimal receiver placement and tagging schemes and (2) model movement and survival probabilities for parameterizing SEAcarP. Specific

products include geospatial models/tools to inform receiver placement and tagging schemes, and a Bayesian multi-state model for parameterizing the SEAcarP model.

Summary of Actions to Date:

Development and deployment of the FishTracks Telemetry database containing query-able, downloadable telemetry data for the Upper Mississippi River basin (i.e., Upper Mississippi River, Illinois River, Ohio River) has been completed. FishTracks provides centralized access to standardized acoustic and real-time telemetry data from the Upper Mississippi River basin to facilitate data sharing, use, and analysis to aid in parameterizing transition probability models, monitoring, contingency planning, and removal efforts for Asian carp. Incorporated real-time receiver data into FishTracks Telemetry database, including monthly real-time summary reports to the MRWG, and implemented standardized data Quality Assurance/Quality Control checks during the database data upload process. Coding for the summarization/compression of receiver data, to identify potential gaps in the receiver network and duplicate areas covered by multiple receivers, has been completed and will be integrated with FishTracks in FY 2020. Telemetry data collected by the Telemetry Work Group in Dresden Island pool to help assess bigheaded carp movement during the fall 2018 Dresden Island Unified Method event was downloaded from FishTracks database and analyses of fish movement relative to driving and fishing efforts are ongoing.

Analysis of habitat, movement, and distribution of bigheaded carp in the Starved Rock pool as part of an approved thesis at SIU was completed. This information has been presented at several conferences and a manuscript is being prepared for publication. The real-time receiver network in the upper Illinois River waterway was maintained and incorporated into FishTracks telemetry database. Archiving, serving and incorporating real time data into an email/text messaging alert system and monthly summaries was continued to inform contingency planning and removal efforts. Field testing of satellite tags testing continued, with the release of 22 bigheaded carp were dual tagged in Dresden Island pool with final-design satellite tags and VEMCO 69kHz tags in June of 2019. Satellite and manual tracking of bigheaded carp is ongoing for comparison to assess feasibility of satellite tags for tracking movements and distribution in upper Illinois River pools. Real time data from these satellite tags, along with weekly manual tracking data, was made available to agency personnel directing removal efforts. An initial Bayesian multi-state model was parameterized with independent states for fish survival and battery condition. The model was run for Silver Carp in six pools in the Illinois River with data from 2012 – 2015, with pool specific transition and detection probabilities and global survival and battery operation parameters. The initial model was modified based on feedback from the SEAcarP modeling group to incorporate and compare various seasonal sampling frequencies including monthly, 4-season, 3-season, and 2-season ‘sampling frequency’.

Proposed Actions for FY 2020:

- Continue maintenance of and incorporate new telemetry data (including real-time receivers) collected by partner agencies into the FishTracks Telemetry database; improve database backend for efficiency of user queries and data accessibility; incorporate receiver

summarization functionality into FishTracks to inform receiver placement for optimal network coverage and effective tagging schemes.

- Continue work on the Bayesian multi-state model to estimate transition probabilities including parameterizing additional configurations of model (time dependent transitions/detections, pool dependent survival) as advised by the MRWG Telemetry and Modeling Work Groups to resolve optimal construction for informing SEAcarP model. Acquire and clean additional years of data (2016-2019) for inclusion in the model. Run the model on existing and additional data. Generate code to facilitate updating model as additional data becomes available in FishTracks.
- Modify and add receivers to the real-time receiver network to facilitate removal and contingency planning for bigheaded carp; continue to archive, serve and incorporate data from the real-time network into an email/text messaging alert system, monthly MRWG summaries, and the FishTracks database for informing contingency planning and removal efforts; in coordination with Illinois DNR and the Telemetry Work Group place additional receivers and conduct analyses with telemetry and catch data to optimize the location of real-time receivers to inform removal; conduct annual range testing and maintenance and repair on the real-time receiver network.
- In collaboration with WIU, complete work on development of satellite tags for bigheaded carp. Field work will end in about November 2019. Analysis and reporting will be completed by September 2020.
- Complete preparation of manuscripts for lateral (Starved Rock backwater study) and longitudinal (fish passage through high-head dams) movement studies.

What's New in FY 2020: No new studies or tasks are being initiated.

Expected Milestones:

- Incorporate new telemetry and receiver data collected by partner agencies into FishTracks Telemetry database (throughout FY 2020).
- Complete annual range testing and maintenance and repair on the real-time receiver network (Q1-Q4 2020).

FY2020 Q1:

- Complete field work on development of satellite tags for bigheaded carp.

FY2020 Q2:

- Integrate code for receiver network summarization functionality.
- Complete preparation of manuscripts longitudinal (fish passage through high-head dams) movement studies.

FY2020 Q3:

- Focus database development efforts on optimizing database query efficiency.
- Delivery of final recommendations for configuration of Bayesian multi-state model (e.g. seasonal versus monthly) and pool to pool transition rates for use in population models.

- Complete preparation of manuscripts for lateral (Starved Rock backwater study) movement studies.

FY2020 Q4:

- Prepare manuscript describing methodology for adding battery condition parameter to multistate mark recapture models.
- Oral/poster presentation at one large (national or international) conference and at least one small/regional conference.
- Complete analyses of telemetry detections vs catch to inform real-time receiver placement and discuss with Illinois DNR.
- Complete analysis and initial reporting.

What Is Deliverable for this Funding: Data, databases, reports, presentations, and models.

Expected Completion Date for Project: FY 2022 for research/modeling projects. FishTracks Telemetry database maintenance will continue past development indefinitely at the discretion of the MRWG. See milestones and outyear actions for specifics.

Potential Hurdles: Delays in funding or hiring.

How will the results of this project be disseminated?

- FishTracks Telemetry database and associated functionality will be available online to partner agencies through a USGS UMESC-hosted server application, including receiver network summarization functionality.
- Movement studies, satellite tag development and multi-state modeling work will be reported at management meetings, and in reports and peer-review publications.

What National Asian Carp Plan goals and recommendations does this project:

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 4: Minimize potential adverse effects of feral Bighead, Black, Grass, and Silver Carp in the United States.

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

T-1 Acoustic Deterrents for Asian Carp

Lead Agency: U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS), U.S. Army Corps of Engineers (USACE)

Agency Collaboration: USACE Districts of Chicago, Nashville, Rock Island and the US Army Engineer Research and Development Center [EDRC]), Iowa Department of Natural Resources (DNR), Illinois DNR, Indiana DNR, Kentucky Department of Fish and Wildlife (DFW), Tennessee Wildlife Resources Agency (WRA), Missouri Department of Conservation (MDC), Western Kentucky University (WKU), Purdue University, University of Minnesota Duluth (UMN-Duluth), UMN, U.S. Coast Guard (USCG)

FY 2020 Funding Table:

Agency Funding Expected			Asian Carp GLRI Funding Requested		
USFWS	USGS	USACE	USFWS	USGS	USACE
$800,000	$355,000	$0	$1,310,000	$1,822,000	$1,053,817

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Description

Significant work has been done to identify potential biological and physical deterrent techniques that discourage the movement of Bighead Carp (*Hypophthalmichthys nobilis*), and Silver Carp (*H. molitrix*), while allowing 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 have documented both Bighead and Silver Carp responding negatively to various underwater sound stimuli while many native fish species responded little to that same sound. Building off of 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 where Asian 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. For this large-scale deployment, underwater sound equipment will be installed at "pinch points" in the river system where Asian 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 thus confined to a single passage point and can be monitored with the use of telemetry and hydroacoustic equipment.

In addition to field-testing acoustic deterrent systems, research efforts in the lab will continue to refine and optimize sound frequencies, sound pressure levels, and speaker design to repel Asian carp while preventing injury to native species. Studies will also measure the efficacy of sound as a way to contain, herd, and capture Asian carp, as well as test their behavioral responses to underwater sound stimuli. 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.).

Proposed Actions for FY 2020:

Barkley Bio-Acoustic Fish Fence (BAFF) Deployment Project

- Continue coordination among multi-agency science and evaluation team for large-scale experimental deployments at Barkley Dam (Cumberland River, Kentucky)(USFWS, USGS, USACE).
- Implement study plan for Barkley BAFF evaluation (USFWS, UMN, Kentucky DFW, USGS, USACE LRN).

Lock and Dam 19 ADS Deployment Project

- Continue coordination among multi-agency science and evaluation team to implement a large-scale experimental deployment at Lock and Dam 19 (Mississippi River, Iowa) (USGS, USACE, USFWS).
- Collect bathymetry, substrate, water quality, and fish passage data from desired deployment locations (USGS, USACE).
- Finalize a study plan including agency roles, timelines, and deliverables (USGS, USACE, USFWS, Illinois DNR, Iowa DNR).
- Develop design plan, including engineering review (USGS, USACE, USFWS).
- Develop acoustic propagation model for site (USGS, USACE).
- Contract with appropriate vendors for acquisition of speaker equipment (USFWS, USGS).
- Complete an assessment/monitoring plan (USFWS, USGS, Illinois DNR, Iowa DNR).
- Develop long-term equipment maintenance, monitoring, and communication plan (USFWS, USGS).

Research and Development (lab/field testing at multiple locations)

- Conduct additional hearing tests (Auditory Evoked Potential [AEP]) on native fish species.
- Test engineered sounds on Black Carp and Grass Carp (behavioral lab/pond testing).
- Assist Engineer Research and Development Center (ERDC), as needed, with development and testing of newly engineered sounds.
- Initiate additional deployments at targeted locations as appropriate and coordinated among the interagency planning team (USFWS, USGS, USACE and states).

USGS

Funding by Year	Sub-project (in alphabetical order)	USGS Base Funding Expected	Asian Carp GLRI Funding Requested
FY 2020	Barkley Lock and Dam of BAFF	$30,000	$95,000
	Lock and Dam #19 (or Alt. Loc.) of ADS	$175,000	$914,000
	Research & Development of ADS	$150,000	$260,000

USGS will work to accomplish three separate sub-projects under this interagency project:

1. Deployment and evaluation of a BAFF system at Barkley Lock and Dam, led by the USFWS, and includes USGS participation costs.
2. Development, implementation, assessment of an Acoustic Deterrent System (ADS) at Lock and Dam 19 (Mississippi River) or surrogate location, is a sub-project led by the USGS includes personnel costs and projected USGS costs for this project for FY 2019 include all equipment purchases, engineering, design, operation, and maintenance for the first year.
3. Ongoing research and development related to acoustic deterrents This sub-project is led by ERDC and includes engineering of new acoustic signals and testing of signals in ponds and/or the field on Asian carp and native fishes.

Summary of USGS Actions to Date:

Prior to 2020, significant lab and pond testing was completed to assess the potential of underwater sounds to deter Bighead and Silver Carp. Pure tones (a suite of five specific tones tested independently) were found to be less effective than the use of a broadband 100hp boat motor acoustic stimulus. Further testing using the 100hp boat motor was completed at Morris, Illinois and in ponds at USGS UMESC. Over the past year, additional actions from USGS included:

- Finished AEP testing and follow-up behavioral tests on Silver Carp and Bighead Carp, and AEPs for Black Carp and Grass Carp to determine efficacy of sound as potential deterrents for these fishes (USGS).
- Supported screening and selection a new set of acoustic signals and tested those at USGS CERC ponds with Silver Carp (USGS and ERDC).
- Participated in multi-agency workgroup to assess implementation of a BAFF system at Barkley Lock and assisted in deployment of an HTI telemetry system.
- Study Plan developed for implementation of an Acoustic Deterrent System (ADS) on the Wabash River. This project was cancelled due to landowner not signing a site access agreement with USGS. This study was redesigned for implementation in the Illinois River (Morris, Illinois) is planned for late 2019/2020.
- Developed a study plan, multi-agency science team, and communication group for large-scale ADS deployment at Lock and Dam 19 (Keokuk, Iowa), in the Mississippi River basin.

Proposed Actions for FY 2020:
Barkley Lock and Dam Bio-Acoustic Fish Fence (BAFF) Deployment (LEAD: USFWS)

- Continue coordination among multi-agency science and evaluation team for large-scale experimental deployments at Barkley Dam (Cumberland River, Kentucky).
    - Participate in the science and evaluation team.
    - Develop and distribute science team study plan.
    - Conduct ARIS camera surveys (if deemed useful).
    - Assist with deployment, coordination, and summary of acoustic telemetry data.

- Lead time-to-event analysis for HTI telemetry data during system operation.
- Assist in writing final report or peer-reviewed publication.

Lock and Dam 19: ADS Deployment (LEAD: USGS)

- Lead multi-agency effort to deploy an acoustic deterrent system at Lock and Dam 19.
  - Hold bi-weekly multi-agency coordination calls.
  - Lead contracting for speaker array engineering/design, construction, and permitting (with representatives from the USACE).
  - Complete permitting to fulfill NEPA requirements and state (Illinois and Iowa) permitting.
- Collect or provide data relevant to ADS deployment (including, but not limited to bathymetry, discharge/flow, or assistance to ERDC for completion of the sound propagation model).
- Continue to summarize and communicate fish passage data with USFWS (and partner states) relevant to ADS deployment. Publish results in peer-reviewed journals.
- Deploy and test HTI telemetry array to monitor additional fish behavior and passage.
- Communicate with USACE on progress related to design plan, including engineering review.
- Contract with appropriate vendors for acquisition of acoustic equipment.

Research and Development (lab/field testing, or applicable to multiple locations; LEAD: ERDC)

- Conduct additional AEP tests on native fishes of concern (e.g., catfish, buffalo, sturgeon).
- Test engineered sounds on Black Carp and Grass Carp (behavioral lab/pond testing).
- Assist ERDC, as needed, with development and testing of newly engineered sounds.
  - In-pond testing of new engineered sounds on motivated fish.
  - In-river testing of new engineered sounds on wild fish (move original Wabash River study to Illinois River; additional site possible).
- Initiate additional deployments at targeted locations, as appropriate, and coordinate among the interagency planning team (USFWS, USGS, USACE and states).

Expected Milestones:

Barkley Lock and Dam BAFF Deployment (LEAD: USFWS)

- Continue coordination among multi-agency science and evaluation team for large-scale experimental deployment of the Bio-Acoustic Fish Fence at Barkley Lock and Dam (Cumberland River, KY) (2019-2022).
- Support USFWS and collaborating agencies with analysis of fish movement and behavior.

Lock and Dam 19 for ADS Deployment (LEAD: USGS)

- Continue coordination among multi-agency team for large-scale experimental deployments at Lock and Dam 19 or alternative location.
- Construction and deployment of ADS.

- Assist with equipment monitoring and implementation (system operation changes with use, navigation, temporal variation (discharge, water quality etc.)).
- Initiate long-term ambient acoustic recording for monitoring purposes.
- Summarize and communicate fish passage data with USFWS relevant to ADS deployment.
- Monitor equipment (system operations changes with use, navigation, and temporal variation).
- Analyses of ADS operational changes.
- Final project assessment and wrap-up meeting.
- Analyze fish passage data (USGS and USFWS) for final report.

Research and Development (lab/field testing, or applicable to multiple locations; LEAD: USACE)

- Assist ERDC, as needed, with development and testing of newly engineered sounds.
  - In-river testing of newly engineered sounds on wild fish.
  - Finish analyses of pond work and develop publications/report.
- Initiate 2-D predictive movement model of fish in response to sound using large scale field test location (Brandon Road Lock and Dam, Lock and Dam 19, etc.) as case study for use at other deployment sites (with ERDC).
- Develop long-term remote performance monitoring of fish and acoustics to support federal and state agencies.
- Initiate additional deployments at targeted locations as appropriate and coordinated among the interagency planning team.

What Is Deliverable for this Funding:

- Study Plan for installing an ADS at Lock and Dam 19 (or surrogate location
- Full deployment and evaluation of an ADS at Lock and Dam 19.
- Peer reviewed publication or report on fish movement and passage at sites where acoustic deterrents are deployed.
- Peer reviewed publication or report on additional testing of acoustic signal on Asian carp and native fish in a field setting.

Expected Completion Date for Project: Completion of large-scale deployments estimated for 2023.

Potential Hurdles: Multi-agency communication, receiving adequate funding to fulfill contracts for large scale deployments, permitting timelines, river flooding.

How will the results of this project be disseminated?

- Peer-reviewed reports and/or publications.
- Public Asian Carp Regional Coordinating Committee (ACRCC) announcements and web articles as necessary.
- Webinars to partners.

USFWS

Funding Table:

Funding by Year	Sub-project (in alphabetical order)	USFWS Funding (FY19*)	Asian Carp GLRI Funding Requested
FY 2020	**Barkley Lock and Dam BAFF**	$ 800,000	$1,300,000
	Lock and Dam 19 (or alternate location) ADS	$0	$10,000
	Research & Development of ADS	$0	$0

Project Explanation

Summary of USFWS Actions to Date: The USFWS continues to work closely with USGS, USACE, and state partners to further understand how underwater sound can be successfully applied in the field as a deterrent for Asian carp. In FY 2018, a contract was awarded to Fish Guidance Systems, Ltd. (FGS) to design, build, install and operate a BAFF at the lock approach of Barkley Lock on the Cumberland River in Kentucky. The BAFF system will be evaluated beginning in FY 2020, and state and federal agencies, along with the UMN, have formed a research team to develop and implement a Study Plan Design. Extensive collaboration with the USACE Nashville District is ongoing throughout the design, install, and operational phases of the project.

Installation of the Barkley Lock ADS, slated for June 2019, was delayed until October 2019 due to record high water levels at the site. Construction was completed late October 2019 and the system is currently in operation. A telemetry array has been installed at the site to track tagged Asian carp through the area and additional fish will be tagged this winter.

Proposed USFWS Actions for FY 2020:

- Deployment of the BAFF system at Barkley Lock and Dam, Kentucky will be completed in the first quarter of FY 2020 (target October 2019). The system is expected to be fully operational by December, following 4-6 weeks of performance testing.
- 250-300 additional fish will be tagged by the Barkley Research Team and evaluated using the HTI/Vemco telemetry array system, combined with hydroacoustic monitoring and ARIS imaging sonars.
- Monitoring of the system performance and its effect on Asian carp and native fish per the research study plan will continue throughout the year.
- Maintenance of the system will be performed (est.) monthly with diver assistance and repairs made as appropriate.
- USFWS will assist USGS in planning for deployment of an ADS at Lock and Dam 19 in the UMR.

What's New in FY 2020:

Now that the system has been installed, the Barkley Research Team will initiate the monitoring protocol to assess fish passage and behavior at the BAFF. Preliminary analysis will be conducted following spring 2020 translocation studies where motivated Asian carp are collected above the system in Barkley Lake and placed below the BAFF in the Cumberland River.

Early maintenance inspections (Nov-Dec 2019) will provide important information on operational costs into year two and three of the study.

Expected Milestones:

- Continued coordination among multi-agency teams for Barkley and Lock and Dam 19 tests - Ongoing (FY 2020, Q1-4).
- Purchase of additional monitoring equipment (Barkley Dam) to support expanded hydroacoustic surveillance – January 2020 (FY 2020, Q2).
- Barkley BAFF system maintenance and operation (routine) – Monthly, throughout the year (FY 2020, Q1-4).
- Initiation of Research Monitoring Plan – December 2020 (FY 2020, Q1).
- Data analysis – December 2020-September 2021. (FY 2020).

What Is Deliverable for this Funding: Proof-of-concept field test of a particular acoustic deterrent technology (BAFF); performance information of such system at a lock where Asian carp are established. Research outcome will be significant to continued acoustic testing.

- Early funds ($800K) will be necessary to complete installation in FY 2020 Q1 and continue monthly obligations for leasing, operation and maintenance through the end of the calendar year.
- Funds for the BAFF will support continuation of monthly lease payments for the equipment (owned by FGS); operations and maintenance of the system including power; acquisition of additional fish tags (200 ct.) and tagging crews (4-person crew – 2 weeks) to obtain fish for tagging and translocation.
- FY 2020 funds for Lock and Dam 19 will fund USFWS support role in the Lock and Dam 19 field test led by USGS and, include bi-monthly calls/meetings for 4 months, project plan review, hydroacoustic survey for 1 week, and tagging for 1 week (2 person crew).

Expected Completion Date for Project: May 2022.

Potential Hurdles: Technical complexity, equipment integrity and performance, and locational challenges (lock environment) that will constrain access for surveillance and maintenance. Discharge ports along river wall of lock will be evaluated for potential fish passage during Year 1 and may require additional acoustic deterrent equipment for testing, pending results.

How will the results of this project be disseminated?

- Public and stakeholder meetings, media, congressional communication coordinated via federal and state channels. Kentucky DFW is primary local dissemination lead.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

USACE

Funding Table:

Funding by Year	Sub-project (in alphabetical order)	USACE Base Funding Expected	Asian Carp GLRI Funding Requested
FY 2020	Barkley Lock and Dam of BAFF	$0	$127,456
	Lock and Dam #19 (or Alt. Loc.) of ADS	$0	$425,107
	Research & Development of ADS	$0	$501,254

Summary of USACE Actions to Date:

- Collaborated with USGS on lab and pond testing, see "USGS Actions to Date."
- Participated on a multi-agency science team for large-scale deployment of the BAFF at Barkley Lock.
- Oversight and technical assistance with construction of BAFF System - installation completed November 4, 2019.
- Several media events organized, including July 30, 2019 with technical representatives from USFWS, USGS and USACE. Approximately 31 million Internet views of video footage documented as of August 6, 2019.

Proposed Actions for FY 2020:
Barkley Lock and Dam BAFF Deployment (LEAD: USFWS)

- Continue coordination among multi-agency science and evaluation team for large-scale experimental deployment of the BAFF at Barkley Lock and Dam (Cumberland River, Kentucky)
- Continue environmental assessment and compliance.
- Continue science and evaluation of BAFF study plan; disseminate to partner agencies and stakeholders.
- Coordinate navigation operations and support of the maintenance of the installed equipment.
- Overview of engineering design and installment.
- 100% Construction of BAFF System scheduled completion November 4, 2019 (technically FY 2020).
- Equipment monitoring (system operations changes with use, navigation, and temporal variation).

- Support multi-agency team (USFWS et al.) as needed.

Lock and Dam 19 (or alternative location) for ADS Deployment (LEAD: USGS)

- Continue coordination among multi-agency science and evaluation team for large-scale experimental deployments at Lock and Dam 19 (Mississippi River, IA) (multi-agency)
- Develop 3-year study plan including agency roles, timelines, and deliverables:
  - Permitting inclusive of Section 408 and interagency coordination.
  - Communication.
  - ADS efficacy, fish passage.
- Collect or provide data relevant to ADS deployment:
  - Ambient acoustic monitoring.
  - Sound propagation model.
  - Lock operations by season and daily.
- Develop acoustic array design.
- Provide engineering review of construction design.

Research and Development (lab/field testing, or applicable to multiple locations; LEAD: USACE)

- Develop new engineered sounds, specifically designed to deter AC and limit impacts on native fishes.
- In-pond testing of new engineered sounds on motivated AC and native species.
- In-river testing of new engineered sounds on wild AC and native species.
- Development of underwater acoustic deterrent systems for various deployment scenarios.
- Initiate stress testing of proposed underwater acoustics equipment.
- Initiate 2-D predictive movement model of fish in response to sound using large-scale field test location (Brandon Road Lock and Dam, Lock and Dam 19, etc.) as case study for use at other deployment sites (with ERDC).
- Development of long-term remote performance monitoring of fish and acoustics to support federal and state agencies.
- Support multi-agency team (USGS et al.) as needed.

Expected Milestones:

What Is Deliverable for this Funding:

- Study and Project Plan for installing an ADS at Lock and Dam 19 (or surrogate location.
- Full deployment and evaluation of an ADS at Lock and Dam 19.
- Peer reviewed publication or report on fish movement and passage at sites where acoustic deterrents are deployed.
- Peer reviewed publication or report on additional testing of acoustic signal on Asian carp and native fish in a field setting.

Expected Completion Date for Project: Completion of large-scale deployments is estimated for 2023.

Potential Hurdles: Multi-agency communication, receiving adequate funding to fulfill contracts for large scale deployments, permitting timelines.

How will the results of this project be disseminated?

- Peer-reviewed reports and/or publications.
- Public ACRCC announcements and web articles as necessary.
- Webinars to partners.

T-2 Carbon Dioxide Deterrence for Asian Carp

Lead Agency: U.S. Army Corps of Engineers (USACE)

Agency Collaboration: U.S. Geological Survey **(**USGS), University of Illinois (UI), University of Wisconsin Platteville

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$300,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Summary of Actions to Date: A series of laboratory-based fish behavior studies has been completed. The work suggested that carbon dioxide (CO_2) has great potential to be a deterrence but that flowing water changes the fish's response to CO_2. Because CO_2 is now registered by USEPA for use as a fish deterrent, feasibility of the approach in an operational setting remains to be determined. To this end, a field-scale demonstration was planned for FY 2018 at Lock and Dam 14 auxiliary lock. The field test was designed to measure cost, safety and efficacy of the barrier in a full-scale operational environment. However, the field test as Lock and Dam 14 auxiliary lock had to be abandoned since the necessary water quality standard permit could not be issued by the state lead agency. Documents produced include:

- Investigating the Mixing Efficiencies of Liquid-to-Liquid Chemical Injection Manifolds for Aquatic Invasive Species Management - Journal of Fluids Engineering (in press).
- Effects of Free Carbon Dioxide on the Shoaling Behavior of Bighead Carp (*Hypopthalmichthus nobilis*) – University of California at Davis/Engineer Research and Development Center-(ERDC) University supported master's thesis- submitted to *Biological Invasions.*
- Avoidance of carbon dioxide in flowing water by Bighead Carp - Canadian Journal of Fisheries and Aquatic Sciences (in press).
- Water Quality Model of the Brandon Road Approach Channel – ERDC Technical Report (in review).
- Field Scale Demonstration Engineering Design (100%) Documents Lock and Dam 14 Auxiliary lock (USGS/USACE co leads).

FY 2019 saw the completion of a large-scale demonstration of this technology was conducted at Lock #2 on the Fox River near Kaukauna, Wisconsin. This feasibility study designed, constructed, and operated a temporary CO_2 infusion system to collect data on water quality, air quality (human health), system optimization, fish behavior, and non-target toxicity. The system was designed using widely available components from the wastewater treatment industry. Preliminary results from this study demonstrated that it is possible to treat large volumes of water (i.e. navigational lock) with CO_2 to target concentrations and suggested that management

agencies could utilize this technology to deter fish movement. The study also provided valuable information on the extent to which water quality parameters are affected.

Proposed Actions for FY 2020:

- Analyze FY 2019 field trial data with USGS and write reports and papers.
- Model fish behavior at Lock and Dam 2 to develop an engineering tool suitable for evaluating carp behavior with CO_2 barriers.
- Participate with a team of state and federal researchers, managers, operations and regulatory personnel to identify key management locations (e.g. Chicago Area Water System (CAWS), Brandon Road Lock and Dam, Nickajack, Pickwick) and provide specifications for CO_2 diffusion system designs that could meet management objectives
- Support development and award of architectural and engineering (A&E) services contract for portable and fixed CO_2 infusion systems designed for specific management locations (e.g. CAWS, Brandon Road Lock and Dam, Nickajack, Pickwick)

Expected Milestones:

FY 2020 Q1:

- Coordinate and organize a CO_2 development team.

FY 2020 Q2:

- Develop, advertise, and award an architectural and engineering (A&E) services contract.

FY 2020 Q3:

- Initiate A&E process.
- Finalize fish behavior engineering tool.

FY 2020 Q4:

- Continue A&E process (35%, 65%, 95%, 100% design development).

What Is Deliverable for this Funding: Incorporation of CO_2 into Asian carp response and control practices needs to be tailored for specific locations. The final deliverable will describe what expected startup costs and construction drawings for management agencies to consider and potentially move forward as part of their management plans. This project is expected to facilitate the transfer of CO_2 from research to management.

- Field trial completion report/papers.
- Feasibility Report for CO_2 in navigation environments.

Expected Completion Date for Project: FY 2021

Potential Hurdles: CO_2 is a new technology and if the field trial suggest low feasibility on either cost, safety and/or efficacy further work is unwarranted

How will the results of this project be disseminated?

- Reports.
- Conferences.
- Monthly coordination calls.
- Peer reviewed publications.

T-3 Implementation and Planning for Carbon Dioxide Deployment

Lead Agency: U.S. Geological Survey (USGS)

Agency Collaboration: U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (USEPA), U.S. Coast Guard (USCG), Wisconsin Department of Natural Resources (DNR), University of Wisconsin Platteville, University of Illinois, Illinois DNR

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$375,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Carbon dioxide (CO_2) injected into water is being evaluated as a non-physical deterrent for invasive Asian carp. In 2019, the USGS, USACE, and other partners demonstrated the temporary installment of a CO_2 infusion system at a navigational lock in Wisconsin. The next step to translate this technology from research into management is to develop more permanent CO_2 diffusion systems that can be utilized for management actions. More specifically, management agencies need well-defined startup costs and engineering designs for CO_2 infusion systems at key management points that can be deployed to keep Asian carp from moving into new areas.

Proposed Actions for FY 2020:

- Assemble a team of state and federal researchers, managers, operations and regulatory personnel to identify management location and provide specifications for system designs that could meet management objectives.
- Develop and award an architectural and engineering (A&E) services contract for CO_2 infusion system designed for a specific location.
- Initiate A&E process between design services contractor and CO_2 team.

What's New in FY 2020:

- Management locations will be identified for a CO_2 deterrent.
- A&E and cost estimates for installation or use of CO_2 at identified locations (into FY 2021).
- Construction drawings delivered to project managers (into FY 2021).

Expected Milestones:

FY 2020 Q1:

- Assemble team of partners and stakeholders.
- Draft Scope of Work (SOW) for A&E contract.

FY 2020 Q2:

- Finalize SOW.
- Continue team coordination to identify management location and system specifications.
- Begin contracting process.

FY 2020 Q3:

- Complete contracting process.
- Continue team coordination with regulatory authorities.

FY 2020 Q4:

- Award A&E contract.
- Contractor and team begin A&E development process.

What Is Deliverable for this Funding: Develop a template to transition CO_2 into Asian carp response and control practices needs to be tailored for specific locations. The final deliverable will describe expected startup cost estimates and construction drawings for management agencies to consider and potentially move forward as part of their management plans. This project is expected to facilitate the transition of CO_2 from research into management.

Expected Completion Date for Project: Final construction drawings and opinion of probable construction costs (OPCC) are expected to be completed in FY 2021/22. Project could continue transition into construction (pending funding availability) if agencies decided to proceed with management action at identified location(s).

Potential Hurdles:

- Contracting process.
- Management location characteristics.

How will the results of this project be disseminated? Results from this project are being disseminated as final reports, construction drawings, cost estimates, presentations at scientific and public meetings, inter-agency coordination to support integration into Asian carp control plans.

What National Asian Carp Plan goals and recommendations does this project:

Strategy 3.2.1. Develop a national strategy and guidelines for science-based decision making concerning the need for continued and additional containment measures.

Strategy 3.2.1.2 Evaluate the effectiveness afforded by alternative technical containment measures (i.e., physical and behavioral barriers).

Strategy 3.2.1.3. Promote, support, and provide technical analysis and comment for the field testing of novel containment methods.

Strategy 3.2.2.1. Develop and implement redundant barrier systems within the Chicago Sanitary and Ship Canal to limit the unrestricted access of Asian carp to Lake Michigan.

Strategy 3.2.2.2. Develop and implement reasonable and effective measures that prevent the spread of Asian carp via canals, water ways, or other water diversions between basins.

Strategy 3.2.2.4. Identify additional containment measures needed to limit intrabasin movements of feral populations of Asian carp within the Mississippi River and other basins where established.

T-4 Carbon Dioxide Deterrence for Asian Carp

Lead Agency: U.S. Geological Survey (USGS)

Agency Collaboration: U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (USEPA), U.S. Coast Guard (USCG), Wisconsin Department of Natural Resources (DNR), University of Wisconsin Platteville, University of Illinois (UoI)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$420,000	$100,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Carbon dioxide (CO_2) is currently registered by USEPA as a fish deterrent/piscicide and is being investigated as a potential deterrent to Asian carp. The concept is to introduce CO_2 into water to deter or prevent Asian carp from moving upstream. Several published studies at the laboratory, mesocosm and field level have demonstrated that Asian carp and other fishes are repelled from areas with elevated CO_2 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 towards the Great Lakes and other large river basins.

Summary of Actions to Date: State and federal partners completed several important milestones in 2019. First, USGS and USFWS obtained a Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Section 3 registration from USEPA for CO_2 as a new aquatic pesticide. Approved uses included as an Asian carp deterrent and as a non-selective under-ice lethal control (i.e., piscicide) for all nuisance fishes. Next, an engineering feasibility study was conducted within a navigational lock in Wisconsin. This study demonstrated the installation and operation of a large-scale CO_2 infusion system and collected data on operational costs, fish behavior, non-target organisms, human health risk assessment, and water quality.

Proposed next steps are intended to transition CO_2 from research to management and will finalize work that was completed in FY 2019.

Proposed Actions for FY 2020:

- Complete data analysis and report writing from FY 2019 toxicity trials.
- Complete data analysis and report writing from FY 2019 navigational lock field trials.
- Conduct studies to support Carbon Dioxide–Carp registration within individual states.
- Develop a Carbon Dioxide–Carp pesticide reporting system.
- Initiate Section 3 registration of dry ice (solid state CO_2) for lethal control applications.

What's New in FY 2020:

- Data to support registration of Carbon Dioxide–Carp with individual states.
- Carbon Dioxide–Carp reporting system for use by management agencies.
- Section 3 registration of dry ice (solid state CO_2) for lethal applications.
- Completion reports and dissemination of FY 2019 studies.

Expected Milestones:

FY 2020 Q1:

- Field trial data processing and preliminary analyses.
- Toxicity trials data analyses.
- Agency coordination for pesticide reporting system.

FY 2020 Q2:

- Field trial data analyses.
- Initiate toxicity study report writing.
- Agency coordination for pesticide reporting system.

FY 2020 Q3:

- Complete field trial analyses and initiate report drafting.
- Complete toxicity trials final report.
- Continue coordination for reporting system development.
- Conduct toxicity studies as needed to satisfy state registration needs.
- Initiate discussions with USEPA for dry ice registration.

FY 2020 Q4:

- Complete field trial final report.
- Complete toxicity trials final report.
- Make pesticide reporting system available.
- Continue toxicity studies as needed.
- Prepare required documents to USEPA for dry ice registration.

What Is Deliverable for this Funding: The overall deliverable from this funding is a new Asian carp control tool that could reduce the risk of Asian carp spreading into new areas. Specific deliverables include final study reports, publications in scientific journals, on-site technology demonstrations, presentations at meetings and conferences, and inter-agency coordination to support permanent implementation.

Expected Completion Date for Project: Completion reports are expected to be drafted in FY 2020 with publication to follow. Pesticide reporting is expected to continue into outyears as needed to maintain registration. Other research needs are anticipated and will depend on state or federal agencies that implement CO_2 long-term for Asian carp control.

Potential Hurdles:

- Start-up and equipment costs.
- Regulatory permits.

- CO_2 supplier.

How will the results of this project be disseminated? Results from this project are being disseminated as final study reports, publications in scientific journals, on-site technology demonstrations, presentations at scientific and public meetings, inter-agency coordination to support integration into Asian carp control plans.

What National Asian Carp Plan goals and recommendations does this project support:

Strategy 3.2.1. Develop a national strategy and guidelines for science-based decision making concerning the need for continued and additional containment measures.

Strategy 3.2.1.2 Evaluate the effectiveness afforded by alternative technical containment measures (i.e., physical and behavioral barriers).

Strategy 3.2.1.3. Promote, support, and provide technical analysis and comment for the field testing of novel containment methods.

Strategy 3.2.2.1. Develop and implement redundant barrier systems within the Chicago Sanitary and Ship Canal to limit the unrestricted access of Asian carp to Lake Michigan.

Strategy 3.2.2.2. Develop and implement reasonable and effective measures that prevent the spread of Asian carp via canals, water ways, or other water diversions between basins.

Strategy 3.2.2.4. Identify additional containment measures needed to limit intrabasin movements of feral populations of Asian carp within the Mississippi River and other basins where established.

T-5 Developing Species-Specific Control Systems for Asian Carp

Lead Agency: U.S. Geological Survey (USGS)

Agency Collaboration: U.S. Fish and Wildlife Service (USFWS), Viterbo University, University of Wisconsin - La Crosse, U.S. Department of Agriculture, Iowa Department of Natural Resources (DNR), Iowa Department of Agriculture and Land Conservation

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$650,000	$250,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

No current technology can specifically target Asian carp for control within aquatic ecosystems. Available toxicants used in aquatic invasive species control programs are non-selective and are applied throughout the entire water column, resulting in equal exposures of native and invasive species alike. Developing delivery systems that target feeding strategies of specific organisms, like an Asian carp, would increase the ability of management agencies to control or limit a species like Asian carp, while minimizing potential impacts on native species. Increased selectivity can be achieved by understanding the habits and physiological attributes of target organisms and incorporating them into a delivery system technology to exploit unique feeding characteristics. Considerations such as food particle size, digestive physiology and feeding attractants/stimulants can be brought together with more selective control agents, whether chemical, biological or genetic, into a single species-specific control tool. Therefore, this project consists of two main foci: (1) development of a delivery tool and (2) identification of control agents that are more specific to Asian carp.

Development of an oral delivery formulation is the first step in the establishment of a species-specific control. Technologies developed for the pharmaceutical and agricultural industries can be used to encapsulate a control agent into a microparticle that can be used to increase the selectivity of non-selective control agents currently available to natural resource managers. A microparticle will allow for the delivery of a control agent to a select group of fishes that have similar feeding habits. Further, the microparticle can later be combined with new control agents that have selectivity towards targeted species; thus, making a highly selective control tool.

Progress has been made in the past several years to identify a formulation of a spray-atomized particle that does not leach the control agent, is readily consumed by both Silver Carp and Bighead Carp and is easily scalable for commercial production. Both controlled laboratory and pond trials have been completed that demonstrate effectiveness of this new delivery tool. In both lab and pond studies, Silver Carp and Bighead Carp died following particle exposure while native fishes, such as largemouth bass, appeared unaffected. The first field study conducted with the particle used a marker, yttrium, to determine potential non-targeted impacts. This study suggested

that primarily the filter-feeding bigheaded carp (Black Carp and Silver Carp) and Gizzard Shad would be impacted from a microparticle application and demonstrated potential increased selectivity. The first field deployment of this microparticle formulation was implemented in a backwater of the Wabash River near Lafayette, Indiana. During this trial, only three filter-feeding fish species were impacted by the microparticle application (Silver Carp, Gizzard Shad, and River Carpsucker), even though more than 20 fish species were identified at the test site. This trial demonstrated increased selectivity of a broad spectrum piscicide, using microparticles, may result in decreased negative impacts to many fishes of commercial and recreational importance.

Results from this field study suggest improvements in microparticle application could increase impacts to targeted Silver Carp. Because no Bighead Carp were detected at the Wabash River site, further research is necessary to assess potential impacts on Bighead Carp. Additional field trials will be required to determine the best application method as well as assess specificity to Bighead Carp.

Currently, of the four USEPA-registered piscicides for use by aquatic resource managers to control aquatic invasive fish, two are commonly used for controlling sea lamprey and are less toxic to the bony fishes and rotenone is a piscicide that generally impact all fishes equally. The fourth is carbon dioxide and is used strictly as a deterrent for Asian carp or as an alternative to rotenone to renovate a pond's fish population only in those ponds that are covered in ice. Unfortunately, rotenone is broken down into non-toxic degradants within the gastrointestinal tract. Although not currently registered by USEPA, antimycin-A was previously registered as a piscicide and it represents the only viable control agent for delivery with the microparticle. USGS is currently using antimycin-A delivered orally through the microparticle to test specificity of the microparticle. USGS will work toward registering the piscicidal use of liquid antimycin-A while developing the necessary data to also support the registration of microparticles to orally deliver antimycin-A as a new control tool.

Beyond the delivery, specificity can be added through the identification of control agents that are more toxic to the targeted fishes than to non-target species. Ideally, these new control agents can easily be incorporated into the microparticle, which in turn will increase the specificity of the control tool. The identification of new control agents would provide a management option within an integrated pest management program designed to control populations of Asian carp and is essential to successful management of these nuisance species. Progress has been made in the identification of new chemical control agents. A large chemical database has been established and machine learning models that estimate toxicity from chemical properties have been developed. These models are based solely on mortality and chemical properties, not on mode of action. Mortality can be achieved through many pathways, including blocking cellular respiration, stimulate apoptosis, and etcetera. Improvements in these models can be made by better understanding the mode-of-action (MOA) of various classes of toxicants, unfortunately this information is lacking for most chemicals. Regardless, USGS has been able to identify more than 30 potential new piscicides from this database. Six chemicals have passed through the initial cytotoxicity trials; three of which have been found to have some selectivity to cyprinids in *in vivo* toxicity tests; four chemicals require further investigation. The initial evaluation of one of these chemicals as a piscicide is currently underway.

One promising new technology for species-specific control is the use of genetic tools. Two technologies that have garnered considerable interests in the use of clustered regularly interspaced short palindromic repeats (CRISPR) as a gene drive system and RNA interference (RNAi) to knock-down key processes for the survival of the animal. One advantage of CRISPR is that an inheritable trait can be generated that is detrimental to the animal and rapidly spreads through a population, via natural reproduction, using only a few animals. One can then use this trait to eradicate all animals of the population. However once released, this trait can easily be passed from one population to another and ultimately become and "invasive" trait. Before developing CRISPR as a tool for controlling invasive species, USGS must determine the risk of this "invasive" trait to native populations. The other technology, RNAi, simply targets only those individuals that are exposed. A properly designed RNAi will knock down a key regulatory process within the animal and can be extremely specific. RNAi has been designed to target transcriptional control at the sub-species level in fruit flies and therefore has significant potential as a control of Asian carp. However, first a description of the transcriptome of Asian carp is needed so that a target gene can be identified. Once a target sequence has been identified, RNAi can be designed, purchased from a commercial provider and tested for efficacy.

The development and registration of these new control agents is dependent upon the regulatory process, which includes state and federal permitting required for testing to support the registration of a new piscicide. Novel tools used to mitigate a pest must complete a rigorous registration process before it can be used within integrated pest management control programs of state and federal natural resource agencies. Specifically, the registration component of this project will (1) provide regulatory affairs support for the registration of microparticle controls and (2) develop registration-specific data to support the registration of microparticle controls for bigheaded carp. Results from this project will include the development of comprehensive, Standard Operating Procedures (SOPs) and institutional guidance for use by approved state or federal agencies when implementing control agents in prevention actions. The SOPs will be developed based on the model of the bi-national Sea Lamprey Control Program field protocols, currently in use in the Great Lakes basin, and tailored to each specific microparticle control formulation. The control SOPs will serve as core components of the registration application documentation, and include protocols on safe transport, handling, storage, and dispersal of control agents and equipment; treatment site selection and management (including security and environmental monitoring); employee health and safety training and monitoring; and process for approval and compliance with all requisite Federal, State and local environmental regulations (including Endangered Species Act (ESA) Section 7 consultation, National Environmental Policy Act (NEPA) and Migratory Bird Treaty Act compliance, and other regulatory requirements).

The USGS's Upper Midwest Environmental Sciences Center (UMESC) will provide regulatory affairs support to the USFWS in the development of biological and chemical pesticide controls of bigheaded carp. Regulatory affairs support will include compilation of data and reports for submission to regulatory agencies (e.g. USEPA), identification of required data to attain chemical registration, coordination of experimental use permits and other regulatory support as needed to attain and maintain chemical registrations of tools to control bigheaded carp. The UMESC will also develop specific data required to attain registration of microparticles to control bigheaded

carp including studies to describe product chemistry, physical/chemical properties and USEPA Group A acute toxicity (acute oral, dermal, and inhalation toxicity, eye and dermal irritation, skin sensitization).

USFWS, which serves as the technical registrant, will partner with USGS to complete the USEPA registration processes required for new pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and lead development of the multiple SOPs for implementation of the control techniques. The USFWS will provide support in preparing any needed Section 7 consultations necessary to ensure that all actions taken regarding testing and implementation of bigheaded carp control technologies are compliant with federal action agency responsibilities under the Endangered Species Act (ESA). USFWS staff will provide site specific consultations for potential field test sites and wider consultations as appropriate for planned control/chemical application areas, which could include multiple states and multiple USFWS regions. The USFWS will prepare any necessary biological opinions, if consultation processes yield a determination of "likely to adversely affect" a listed species, and work with USGS and partners to prepare any needed incidental take permits or exemptions, if required under the ESA. The USFWS will work with USGS to compile the required health and safety information and complete procedural requirements needed for USEPA to evaluate proposed control techniques and ensure that they will not pose unreasonable risks to human health and the environment. In addition, the USFWS will assist with developing use manuals and labeling requirements for control technologies developed under this project, and liaise with USGS, USEPA, and other partners to fulfill other requirements of the EPA registration process. The USFWS will serve as eventual technical registrant of bigheaded carp control technologies developed under this project and will work with USGS to ensure that any applications, including experimental or test applications, of control technologies developed under this project are compliant with NEPA and other relevant statutes.

Summary of Actions to Date:

USGS has acquired ownership of antimycin-A and is developing a microparticle formulation for oral delivery that can stabilize and deliver antimycin-A to Silver Carp and Bighead Carp. Laboratory and highly controlled pond studies indicate that this oral delivery formulation (ODF) can selectively deliver antimycin-A to the two target species while having minimal impact on recreationally important species, e.g., Bluegill and Largemouth Bass. The first field trials on wild fish, using the lethal microparticle, were conducted in Indiana and Iowa during 2018 after USEPA waived the need to have an Experimental Use Permit given the limited scope of the studies. Results from these trials indicate that the antimycin-A microparticle is highly selective in terms of its lethality. However, improvements in the time-of-year for application and methods to increase dispersal during microparticle application may result in greater numbers of dead bigheaded carp.

Currently, a non-toxic method for quantifying particle and bait consumption is being developed. A dye used in histology imparts a blue color to fish tissues upon consumption and can be extracted from fish tissues for a quantitative assessment of bait and microparticle ingestion. This alternative method to test oral delivery tools will aid in lethal bait development by increasing the ability to test formulations, palatability, and selectivity on wild fish populations prior to the

registration of new piscicides. In 2019, this method has proven to dye Rainbow Trout, Grass Carp, Yellow Perch, and Bighead Carp through consumption of developed baits.

Additionally, USGS has developed a high-throughput screening tool to identify new control agents that can be used by fishery resource managers to control Asian carp. A model that uses quantitative structure activity relationship (QSAR) analysis of a chemical to predict toxicity to a wide variety of taxa has been developed. Once a chemical has been Identified, specificity of the chemical can be quickly assessed using cell-lines for Asian carp and native fishes. Lastly, all chemicals that demonstrate high selectivity to Asian carp can then be validated *in vivo*. The USGS toxicity model has identified 11 chemicals that may be selective to Asian carp. Seven of these chemicals have been screened through cytotoxicity trials, while the remaining four still need to be tested. Three of the chemicals screened to date demonstrate selective toxicity to Asian carp cells. These three chemicals and any others of the six yet to be tested need to be validated with *in vivo* toxicity tests. USGS has acquired, through co-operative agreement, enough quantities of the three chemicals to initiate the in vivo tests.

Proposed Actions for FY 2020:

- Consult with USEPA to identify which studies would likely be accepted and which studies will need to be redone for registration of Fintrol.
    - May need a contract lab to conduct certain types of studies like mammalian toxicity tests.
- Submit registration packet for antimycin-A in the Fintrol formulation.
- Finalize environmental fate studies for microparticle.
- Complete Product Chemistry section of registration for microparticle.
- Assessment of potential biocides that have been identified as selective to Asian Carp.
    - Conduct in vivo trails for potential biocides that have been identified as potentially selective during cytotoxicity tests during 2018-19.
- Increase palatability and selectivity of toxic bait for Bigheaded Carp.
- Optimize load of control agent for Bigheaded Carp.
- Optimize methods for testing oral delivery of microparticles and bait on wild fish.
- Assess *in vivo* efficacy of newly developed control agents.
- Conduct pond trials to assess selectively of bait formulations.
- Assess effectiveness of oral toxicant developed by MJSTI Corp, from Overland KS.
- Initiate studies to identify genetic-based controls, specifically RNA interference (RNAi) .at critical development stages for single species of Asian carp.
- Initiate studies to identify viable Bigheaded Carp feeding strategies, habitat selection, and seasonal locations for species specific bait application.

What's New in FY 2020:

- Submission of registration packet.
- Establishment of stable supply of antimycin.
- Development of SOP for field application of microparticles.

- Initial discussion with USEPA have indicated potential need for conducting mammalian toxicity tests.

Expected Milestones:

FY 2020 Q1:

- Assess effectiveness of oral toxicant developed by MJSTI Corp, from Overland, Kansas.

FY 2020 Q2:

- Initiate palatability and loading studies for microparticle.
- Complete Product Chemistry section of registration for microparticle.

FY 2020 Q3:

- Complete assessment of three potential biocides that have been identified as potentially selective to Asian carp.
- Initiate studies to identify genetic-based controls, specifically RNA interference (RNAi) at critical development stages for bigheaded carp.
- Review environmental fate studies of antimycin-A incorporated microparticles.

FY 2020 Q4:

- Increase palatability and selectivity of toxic bait for bigheaded carp.
- Obtain contracts to conduct studies needed for registration of antimycin-A, if necessary.
- Submit registration packet for registration of antimycin-A in the Fintrol formulation.
- Complete laboratory and field trials to assess the use of Sudan Black dye as a tool for estimating bait and microparticle consumption.
- Initiate studies to support registration of antimycin-A encapsulated microparticles (i.e. leaching and environmental fate).
- Respond to USFWS review of data submitted to address Section 7 ESA-consultation of the use of antimycin-A incorporated microparticles in limited open-water application sites to control bigheaded carp.

What Is Deliverable for this Funding:

- Stable supply of antimycin-A (2020).
- Registration of antimycin-A (2021).
- Publication on the development and testing of the microparticle. This manuscript will include the development of the formulations, laboratory efficacy trials and the pond trials as well as the field studies (2020).
- USGS will submit a manuscript on the results of the *in vivo* toxicity trials for the identification of a cyprinid-specific control (2020).
- Submission of EPA registration application package (2020).
- Publication on the biological response models used for the identification of new biocides.
- Publication on the development of a Bighead Carp specific bait.

Expected Completion Date for Project:

- Studies on the registration of antimycin-A microparticle will likely need to continue beyond 2020.
- Studies to support the use of microparticles by natural resource agencies will be continued beyond 2022.
- Testing and registration of new potential biocides beyond 2023.
- New necromone or modified pheromone antagonists will be identified by 2022. Once the chemical has been identified, USGS will initiate registration of the chemical as a behavioral deterrent.
- Conduct a large-scale field application of antimycin-A encapsulated microparticle by 2022.

Potential Hurdles:

- Obtaining access to candidate fish toxicants from private chemical libraries.
- Establishment of contracts to produce antimycin-A and other potential biocides.
- Regulatory permitting.

How will the results of this project be disseminated? Results from this project will be disseminated in reports, peer-reviewed publications, technology transfer workshops/demonstrations, and presentations at scientific and public meetings.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.3.9.1. Determine effectiveness of registered piscicides to control Asian carp.

Strategy 3.3.9.2. Identify conditions where rotenone or antimycin could be used to control populations of Asian carp.

Strategy 3.3.9.3. Determine potential of other chemicals to control Asian carp.

Strategy 3.3.9.5. Determine registration needs, if any, for the use of piscicides to control Asian carp and ensure that piscicides are available for appropriate uses.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.6.2. Assemble information about the distribution, biology, life history, and population dynamics of Bighead, Black, Grass, and Silver Carp.

Strategy 3.6.2.3. Describe diets, evaluate food selection and availability, estimate food consumption, and assess feeding interactions (i.e., predation and competition) with native biota (trophic ecology).

Strategy 3.6.4. Develop an integrated management strategy to extirpate or reduce abundances of feral Asian carp.

Strategy 3.6.4.1. Develop and evaluate effective attractants and repellents.

Strategy 3.6.4.2. Evaluate existing piscicides and, if necessary, develop new piscicides that are selective for Asian carp.

T-6 Experimental Testing of Sill Bubble Curtains for Barge Entrainment Mitigation

Lead Agency: U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE)

Agency Collaboration: U.S. Geological Survey (USGS), USACE Engineer and Research Development Center (ERDC) and Rock Island District, USGS Central Midwest WSC

FY 2020 Funding Table:

Agency Funding Expected		Asian Carp GLRI Funding Requested	
USACE	**USFWS**	**USACE**	**USFWS**
$0	$5,000	$175,000	$15,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

USFWS, USACE, and USGS have conducted several years of studies showing that small fish can become entrained within junction gaps of commercial tows and transported over long distances (at least 15.5 kilometers), through locks, and through the Electric Dispersal Barrier System (EDBS) (herein referred to as "barge entrainment"). In 2017, a scale physical model (Bryant et al., 2016 & 2018) and a proof-of-concept field study showed that water jets and water jets with compressed air could achieve some level of efficacy in mitigating barge entrainment by clearing fish from tows. These findings led to the hypothesis that compressed air bubble curtains may be used in place of water jets to clear fish from tows. Therefore, the project goal is to determine if existing compressed air systems in lock structures on the Illinois River, specifically sill bubble curtains designed for ice removal, have potential to mitigate for small Asian carp entrainment.

Summary of Actions to Date: In 2019-2020 (FY 2019 funds), the ERDC facility in Vicksburg, Mississippi is using a 1:16.6 scale physical model of the Chicago Sanitary and Ship Canal with remote control tow and barges to 1) test the efficacy of compressed air bubble curtains to remove entrained neutrally buoyant fish surrogates from tows, and to 2) quantify changes in flow dynamics within the hydraulic recesses during passage over a bubble curtain. The physical model enables a controlled and detailed evaluation of the interaction between barges, fluid motions, and nearly neutral buoyant objects under a variety of vessel speeds and barge configurations typical of a navigation lock.

USGS conducted hydraulic surveys of the lower sill bubble curtain at Peoria Lock and Dam in September 2019 (FY 2019 funds). This lock is representative of navigations locks from around the country including other areas where Asian carp are found such as Barkley Lock and Dam and Pickwick Lock and Dam in Kentucky and Tennessee respectively. These surveys included hydroacoustic water velocity measurements (acoustic Doppler current profiler and acoustic Doppler velocimeter), video recordings of the water surface for estimation of surface velocities

using image processing techniques, and acoustic imaging of the bubble curtain in the water column (Multibeam Echosounder). This data will be used to validate results from the physical model and to inform planned field trials.

Proposed Actions for FY 2020: FY 2020 funds will be used to test the efficacy of a sill bubble curtain in mitigating barge entrainment at the field scale. Planning and contracting for these field tests will occur in 2020 and the field tests will take place at Peoria Lock and Dam in 2021. Field scale testing will entail a mark and recapture study in which live fish are marked with unique fin clips and placed in the junction gap of a tow (e.g. Davis et al., 2016 & 2017). The tow will then enter the lock chamber, passing over the bubble curtain, and the number of fish remaining in the junction gap will be determined through a combination of recapture attempts and sonar observations. The field tests will also include hydroacoustic water velocity measurements in the junction gap space, around the tow, and in the lock chamber* (Note that funding for the velocity measurement component of the study is requested in the USGS barge entrainment GLRI project). The results of the ERDC physical modeling and the interagency field testing will inform the design of proposed bubble curtain barriers on the IWW, UMR or elsewhere (e.g. as a potential seasonal barrier on the Sandusky River) as well as the strategic use of existing bubbler systems at Lockport, Dresden, Marseilles, and Peoria Locks to minimize the upstream movement of bigheaded carp (Black Carp and Silver Carp).

What's New in FY 2020: Entrainment mitigation technology refinement - field testing using a commercial tow to examine the efficacy of compressed air to disrupt vessel-induced eddies testing of box to rake junction.

Expected Milestones:

To be completed in 2020-2021 using FY 2020 funds:

FY2020 Q1-Q2:

- Planning, contracting, gather/purchase equipment, prepare barges, and calibrate air entrainment bubblers with regard to discharge or momentum flux.
- Planning meetings with stakeholders, complete study design, assemble field trial and evaluate compressed air via existing structures.

FY2020 Q3-Q4:

- Evaluate mitigation potential: Conduct full barge experiment at standard entrance speed, then evaluate different vessel speeds and exposure time configurations. Analysis and report preparation.
- Test compressed air efficacy for removing small fish from barge gaps in the lock chamber. Evaluate impact of exposure time and tow speeds on effectiveness.

What Is Deliverable for this Funding: Completion of field testing and an interim report documenting the findings of the barge entrainment trials.

Expected Completion Date for Project: September 30, 2022.

Potential Hurdles:

- The scheduled closure of Peoria Lock and Dam is currently from mid-July 2020 to mid-September 2020. If this closure is delayed it could impact the schedule for planned field tests.
- Contracting the commercial tows is a lengthy/difficult process.
- Field tests could potentially be delayed by excessively high or low water on the Illinois River.
- Field tests are contingent on receiving any necessary approvals for live fish testing.
- Field tests are contingent on securing weekday closures of Peoria Lock to commercial and recreational vessel traffic for a period of up to four weeks (similar studies at the EDBS entailed daily closures from 8am-12pm and 2pm-6pm CST).

How will the results of this project be disseminated? Results will be documented in a report. USGS data will be published as a data release.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 4: Minimize potential adverse effects of feral Bighead, Black, Grass, and Silver Carp in the United States.

T-7 Prevention of Barge-Induced Transport of Aquatic Nuisance Species

Lead Agency(s): U.S. Geological Survey (USGS)

Agency Collaboration: U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$100,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

Previous work under this project has shown that commercial vessels pushing barges (hereafter referred to as tows) can induce transport of fish, including aquatic nuisance species such as Bigheaded carps. Field studies in FY 2015 and FY 2016 examined two pathways for tow-induced fish passage through the through the Electric Dispersal Barrier System (EDBS) on the Chicago Sanitary and Ship Canal (CSSC): (1) entrainment pathway: small fish can become entrained within junction gaps and transported over long distances (at least 15.5 km), through navigation locks, and through the EDBS (Davis et al. 2016), and (2) non-entrainment pathway: large schools of small fish were observed crossing the high-field array of Barrier IIB concurrent with downstream-bound loaded tows, which cause a decrease in the voltage gradient of the barrier of up to 88% and can cause water to flow upstream (return flows) in the EDBS (Davis et al. 2017).

In FY 2017, the interagency team began two field studies to test strategies to mitigate entrainment and non-entrainment fish passage through the EDBS during tow passage: (1) the water jet mitigation study (entrainment pathway), and (2) the return flow mitigation study (non-entrainment pathway). A briefing report and presentation on these two mitigation studies was completed in FY 2018. A USACE report on the water jet mitigation study is under agency review as of Sept 2019. The hydraulic data from the return flow mitigation study was published as a USGS data release in FY 2018 (LeRoy et al. 2017) and a journal article on this study was accepted for publication in the Journal of Great Lakes Research in FY 2019 (LeRoy et al. 2019).

An additional proposed mitigation strategy for the entrainment pathway is to use the sill bubbler systems installed in many navigation locks on the Illinois River to reduce the overall upstream movement of fish between navigation pools. FY 2019 activities included planning discussions for an ERDC lab study to test whether sill bubblers, designed to keep ice from forming around lock gates, are effective in reducing the number of fish that enter a lock with an upbound tow as well as a planning discussions for a field study at Peoria Lock and Dam and a reconnaissance visit to the site. Additionally, measurements of water velocities around the Peoria Lock sill bubbler and acoustic images of the bubble curtain were collected in September 2019.

This project also includes an egg/larvae entrainment risk assessment, which entails a combined analysis of commercial vessel shiptrack data from the Nationwide Automatic Identification

System (NAIS) with results from FluEgg model runs for six spawning events in the Illinois River in 2015. The results will be used to determine if entrainment risk "hot spots" exist by identifying when and where upstream-moving tows crossed through drifting plumes of eggs and larvae. FY 2018 and FY 2019 activities for the egg/larvae entrainment risk assessment involved running the FluEgg model, writing scripts to process the results, and preliminary analysis of the output data.

Proposed Actions for FY 2020:

Egg/larvae entrainment risk assessment

- USGS will finish the data analysis, draft a manuscript, and submit manuscript to a peer-reviewed journal for publication.

Sill bubbler study

- Measurements of water velocities around the Peoria Lock sill bubbler and acoustic images of the bubble curtain were collected in September 2019. Following preliminary processing, if additional field data needs are identified by ERDC collaborators, USGS will collect those data in Q2 of FY 2020. USGS will publish the results from Peoria Lock as a data release for ERDC collaborators to use as validation data for their lab experiments. USGS will also be involved in planning these lab experiments and out-year field trials testing the sill bubblers. In addition to validating the lab experiments, the results of the field data collection will inform the design of proposed bubble curtain barriers below Brandon Road Lock and Dam or elsewhere (e.g. as a potential seasonal barrier on the Sandusky River) as well as the strategic use of existing bubbler systems at Lockport, Dresden, Marseilles, and Peoria Locks to minimize the upstream movement of bigheaded carp (Black Carp and Silver Carp).

Hydrodynamics of tow lockages

- An upcoming publication from researchers at USGS—UMESC shows that adult Bighead and Silver Carp pass upstream through Lock and Dam 19 on the Mississippi River when tows lock upstream. A better understanding of how tows facilitate the upstream movement of fish through locks is needed to mitigate this pathway for transfer of ANS between navigation pools. Furthermore, an understanding of the hydrodynamics of tow lockages is needed to support future efforts to install deterrents and barriers in and near locks (e.g. the GLMRIS—Brandon Road project, Barkley Lock on the Cumberland River, Kentucky). Therefore, we propose an analysis of an existing dataset of velocity measurements collected alongside a tow during lockages at Brandon Road Lock and Dam (collected during the FY 2015/2016 entrainment study but not yet published) to characterize the flows generated by tows as they enter/exit the lock chamber (USGS). The results of this study will be published as a journal article with an associated data release. The study will inform the design of proposed barrier/control technologies at Brandon Road Lock and Dam and the development of mitigation strategies for the movement of ANS through locks.

Prevention of Barge-Induced Fish Passage at the Electric Dispersal Barrier System (EDBS)

- USGS will participate in calls and meetings with USACE and USFWS collaborators to develop ideas for preventing barge-induced fish passages at the EDBS and plan out-year mitigation efforts.

What's New in FY 2020: The hydrodynamics of tow lockages is a new component of this project.

Expected Milestones:

FY 2020 Q1:

- Process sill bubbler velocity measurements (validation data) and prepare data release.
- Participate in sill bubbler planning calls.

FY 2020 Q2:

- Finish egg/larvae entrainment risk analysis and write first draft of publication.
- USGS peer review of sill bubbler velocity measurements (validation data) data release, revision, and publication.
- Participate in sill bubbler planning calls and ERDC lab experiments (if funding and time permits).
- Processing and analysis of velocity data for hydrodynamics of tow lockages study.
- Prepare data release for hydrodynamics of tow lockages study.

FY 2020 Q3:

- Co-author revisions of egg/larvae entrainment risk publication and submit to journal/USGS peer reviews.
- Revisions of egg/larvae entrainment risk publication based on journal/USGS reviews.
- Write first draft of hydrodynamics of tow lockages publication and begin co-author revisions.
- USGS peer review of hydrodynamics of tow lockages data release, revision, and publication.
- Participate in sill bubbler planning calls.

FY 2020 Q4:

- Complete egg/larvae entrainment risk publication.
- Finalize and submit hydrodynamics of tow lockages publication to journal and USGS peer reviews.
- Participate in sill bubbler planning calls.

What Is Deliverable for this Funding:

- Journal article on mitigation of barge-induced return flows (LeRoy et al. 2019).
- Journal article on egg/larvae entrainment risk modeling (e.g. the combined analysis of NAIS shiptrack data and FluEgg runs).
- Data release on velocity measurements around Peoria Lock and Dam sill bubbler .

- Report on use of sill bubblers to mitigate barge entrainment.
- Data releases for any new data collected under this project.

Expected Completion Date for Project: This project is anticipated to end in FY 2022 or as determined by partner agencies, the MRWG, and the ACRCC.

Potential Hurdles:

- Publication schedule is affected by length of time various reviewers need which is beyond the control of project personnel
- Collaborative publications with other federal agencies subject to each agency's publication policies and internal review process
- USGS funding for sill bubbler study is dependent on USACE receiving funding for lab experiments and field tests (USACE project titled "Experimental Testing of Sill Bubble Curtains for Barge Entrainment Mitigation")

How will the results of this project be disseminated?

- All journal articles will be publicly accessible through the USGS Publications Warehouse and links to articles will be posted on relevant websites (GLRI.us, asiancarp.us). Press releases will accompany publications when appropriate.
- Data releases with full metadata and made accessible on the USGS ScienceBase web portal (https://www.sciencebase.gov)

What National Asian Carp Plan goals and recommendations does this project support:

Goal 1: Prevent accidental and deliberate unauthorized introductions of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.1.7.1. Investigate fully the risks associated with ballast water transfers or other means of water transfer by commercial vessels and recreational watercraft.

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.2.1.2. Evaluate the effectiveness afforded by alternative technical containment measures (i.e., physical and behavioral barriers).

Strategy 3.2.1.3. Promote, support, and provide technical analysis and comment for the field testing of novel containment methods.

Strategy 3.2.2.1. Develop and implement redundant barrier systems within the Chicago Sanitary and Ship Canal to limit the unrestricted access of Asian carp to Lake Michigan.

Strategy 3.2.2.2. Develop and implement reasonable and effective measures that prevent the spread of Asian carp via canals, water ways, or other water diversions between basins.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

3.6.3.1. Develop effective physical and behavioral barriers for controlling the movement of Asian carp.

T-8 Science Support for Control Efforts in the Illinois Waterway and Other Priority Sites

Lead Agency: U.S. Geological Survey (USGS)

Agency Collaboration: Illinois Department of Natural Resources (DNR), Illinois Natural History Survey (INHS), U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$95,000	$50,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

This project investigates the influence of habitat stimuli, such as river hydraulics and water-quality, on the population range, movement, and spawning and recruitment success of Asian carp in the Illinois Waterway (IWW) and other priority sites identified by the Asian Carp Regional Coordinating Committee (ACRCC). Documenting and understanding how Asian carp interact with the hydraulics and water quality of a river informs efforts to control Asian carp through commercial fishing, mass harvest techniques, and management of habitat factors.

A previous component of this project identified a correlation between the location of the stalled Asian carp population front in the IWW and chemicals present in the effluent-dominated water at the population front. The water chemistry data from this study was published as a USGS ScienceBase data release (Duncker et al. 2017) with updates in 2019. In collaboration with the University of Illinois, this work was extended to include sampling of tissue from bigheaded carp (Black Carp and Silver Carp) near the population front for comparison to tissue samples from fish further downriver. Tissue samples were analyzed for a range of chemicals identified to be correlated with the population front and known to impact the physiology of fish. The initial results of this work were published in FY 2019 (Jeffery et al. 2019). The water chemistry and fish tissue work have led to an FY 2020 collaborative proposal for an expanded analysis of the impacts of water quality on the apparent stalling of the bigheaded carp population front in the Dresden Island pool of the IWW (separate project entitled “Contaminants as a deterrent”).

Ongoing components of this project include continuous monitoring and geospatial mapping to support Asian carp control in the IWW and other priority sites. Along with flow data, continuous monitoring of water quality in the main channel and backwaters of IWW provides information on waterway conditions used to predict fish movement and spawning activity and guide targeted commercial fishing activities and mass removal harvest techniques. Additionally, the continuous monitoring and geospatial mapping supports site selection and field testing of an acoustic deterrent system in a backwater of the IWW. Geospatial mapping of flow, water quality, and bathymetry supports control efforts of state and federal partners and provides critical habitat

information that can be used in designing and testing control methods and modelling hydrodynamics, population dynamics, and spawning and recruitment in the IWW and other priority sites.

Proposed Actions for FY 2020:

Continuous Water-Quality Monitoring to Support Control Efforts and Deterrent Testing – Control & Technology Development

Supports the operation and maintenance of two real-time, continuous water-quality monitoring stations in the Marseilles pool of the IWW, one in the main channel (05543010 Illinois River at Seneca) and one in a backwater (41195508828060 Hanson West Pit near Morris, Illinois).

- Real-time data from these USGS gages provide waterway conditions used to predict fish movement and spawning activity and guide targeted commercial fishing and mass removal harvest techniques (e.g. unified method) by our state and federal partners. Acoustic deterrent system (ADS) testing is scheduled for the Hanson backwater and the project lead (USGS-UMESC) has requested that these gages remain operational along with co-located real-time fish telemetry receivers.
- Data from these gages (in operation since 2013) enables assessment of seasonal and yearly variation in carp response to changes in water quality both in the main channel and in a highly-utilized backwater refuge

Hydrographic Surveys and Geospatial Mapping to Support Control Efforts and Deterrent Testing – Control & Technology Development (Agency funded)

Hydrographic surveys of bathymetry and geospatial mapping of water velocity and water quality supports control efforts of state and federal partners and provides critical habitat information that can be used in designing and evaluating control methods (e.g. unified method), barrier development and testing (e.g. ADS), and modelling hydrodynamics, population dynamics, and spawning and recruitment in the IWW.

- Requests for these support services come from both state and federal partners (Illinois DNR, INHS, USACE, USFWS, and USGS—UMESC & CERC)
- These funds allow the USGS CMWSC to respond to federal and state partner requests in a timely manner and without project-specific funding

Fluvial Egg Drift Simulation (FluEgg) Model Maintenance and User Support – Prevention (Agency funded)

Funding supports FluEgg model maintenance (e.g. bug fixes, etc.) and user support, but no development of new features or applications of FluEgg to new rivers. Beginning in FY 2020, we also plan to offer an annual 3-day FluEgg training course for state and federal partners (on-demand) to increase tech transfer.

What's New in FY 2020: The "FluEgg model maintenance and user support" is a new component of this project in FY 2020 (agency funds requested).

Expected Milestones:

FY 2020 Q1:

- Perform site visits, service continuous water-quality gages, and work/publish data records; complete geospatial surveys on an as-needed basis (determined by partner requests) and publish associated data releases in USGS ScienceBase; maintain FluEgg model and provide user support.

FY 2020 Q2:

- Perform site visits, service continuous water-quality gages, and work/publish data records; complete geospatial surveys on an as-needed basis (determined by partner requests) and publish associated data releases in USGS ScienceBase; maintain FluEgg model and provide user support; survey partner interest for FluEgg training and update training materials.

FY 2020 Q3:

- Perform site visits, service continuous water-quality gages, and work/publish data records; complete geospatial surveys on an as-needed basis (determined by partner requests) and publish associated data releases in USGS ScienceBase; maintain FluEgg model and provide user support; schedule and complete FluEgg training for partners.

FY 2020 Q4:

- Perform site visits, service continuous water-quality gages, and work/publish data records; complete geospatial surveys on an as-needed basis (determined by partner requests) and publish associated data releases in USGS ScienceBase; maintain FluEgg model and provide user support.

What Is Deliverable for this Funding:

- Real-time continuous water-quality data in the main channel and backwaters of the Illinois Waterway served via USGS National Water Information System (NWIS).
- Data releases for new hydrographic data collected in FY 2020.
- FluEgg model maintenance, user support, and 3-day on-demand training for partners.

Expected Completion Date for Project: Continuous monitoring and hydrographic surveying in support of state and federal partners is expected to continue annually as determined by the ACRCC and MRWG. FluEgg maintenance, user support, and annual 3-day training course contingent upon availability of agency funds.

Potential Hurdles:

- Stream gages are subject to damage from lightning, flooding, and vandalism. Data outages may occur until repairs can be made.

How will the results of this project be disseminated?

- Data releases containing geospatial data with full metadata will be publicly accessible on the USGS ScienceBase web portal (https://www.sciencebase.gov).
- Real-time and historic water-quality data in the main channel (USGS 05543010) and backwater (USGS 411955088280601; seasonal) of the Illinois Waterway served via USGS National Water Information System (NWIS).
- FluEgg users will receive direct support and training from USGS staff.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.2.1.2. Evaluate the effectiveness afforded by alternative technical containment measures (i.e., physical and behavioral barriers).

Strategy 3.2.1.3. Promote, support, and provide technical analysis and comment for the field testing of novel containment methods.

Strategy 3.2.2.2. Develop and implement reasonable and effective measures that prevent the spread of Asian carp via canals, water ways, or other water diversions between basins.

Strategy 3.2.4.1. Develop an early detection Decision Support System to: 1) identify high risk locations susceptible to introductions or range expansions of Asian carp, 2) identify watersheds of special concern, 3) prioritize specific locations for implementing comprehensive early detection monitoring programs.

Strategy 3.2.6. Develop an information exchange network for agencies, organizations, and partners to communicate and share “real time” data to facilitate early detection and rapid response programs.

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.3.1.2. Create population, biomass, and recruitment models for Asian carp.

Strategy 3.3.2. Increase the commercial harvest of Asian carp.

Strategy 3.3.4. Physical removal by natural resources management agencies.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.6.2.2. Describe movements and distribution of Asian carp in waters of the United States (e.g., habitat preference, habitat selection, and habitats used).

Strategy 3.6.3.1. Develop effective physical and behavioral barriers for controlling the movement of Asian carp.

T-9 Technology Registration and Environmental Review

Lead Agency: U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: U.S. Geological Survey (USGS), U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency (USEPA), U.S. Coast Guard (USCG), Wisconsin Department of Natural Resources (DNR), University of Wisconsin Plattville, University of Illinois, Kentucky Department of Fish and Wildlife Resources, Iowa DNR, Illinois DNR

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$15,000	$150,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

This project supports the development, registration and use of various emerging technologies to control Asian carp, including carbon dioxide (CO_2), microparticles, and acoustic deterrents. In the past, USFWS registration and permitting efforts were funded separately on a deterrent-by-deterrent basis. However, since multiple related deliverables overlap (registration, Endangered Species Act (ESA) Section 7 consultation and other permitting, and development of Standard Operating Procedures (SOPs)), all Technology Registration and Environmental Review efforts have been combined into one Action Plan project.

Summary of Actions to Date: To date, ESA Section 7 consultation requirements were completed for a proposed CO_2 test deployment site at auxiliary Lock and Dam 14 near Bettendorf, IA (postponed in 2018 due to NPDES permitting concerns). The registration packet for CO_2 was submitted to USEPA in September 2018 and was subsequently approved under the registered label Carbon Dioxide-Carp in April 2019. A comprehensive list of SOPs was developed for use with CO_2 deterrents, and a subset of these SOPs have been written at the request of Wisconsin DNR for a test deployment conducted in the summer of 2019 at Kaukauna Lock #2 in the Lower Fox River lock system in Wisconsin. Currently the results of this study are being analyzed by USGS and research partners.

After USACE completed the Environmental Assessment for the BAFF project at Barkley Dam in Grand River, Kentucky, an Intra-Service Consultation was completed and used to finalize the USFWS Biological Opinion for the project. In response to the identification of an ESA-listed mussel species (fat pocketbook) in the proposed dredging area for BAFF installation, Tennessee Wildlife Resources Agency staff relocated mussels from the proposed dredging and excavation area for the BAFF installation. As part of the relocation, USFWS paid a mitigation fee ($500 per ESA-listed mussel) to the Kentucky Aquatic Resources Fund as outlined in the USFWS Biological Opinion for the project.

In 2018, USEPA registration of the piscicide antimycin-A lapsed. This is one of the control agents that USGS has been testing with microparticle delivery technology as a species-specific control system for Asian carp. USGS researchers have since acquired the license for antimycin-A and are working to complete the (re)registration documents required by USEPA. Actions covered by the USFWS under this project to date include review of the USFS antimycin-A SOPs and writing of additional content to increase the stringency of these protocols based on a request from USEPA.

Proposed Actions for FY 2020: Proposed actions include developing an online reporting system so state and federal partners can register to use Carbon Dioxide-Carp and request a label for specific applications. The USFWS and USGS will use this system to track the label, ensure state registrations and other necessary permits (for example, NPDES permits) are obtained prior to receiving the label, and collect data to report back to USEPA in order to maintain product registration. The initial Carbon Dioxide-Carp SOPs cover lethal under ice application as a piscicide and we will work to expand the label later in 2020 for lock chamber applications. This will occur once the data from the Kaukauna Lock study conducted on the Fox River in Wisconsin has been analyzed. Additionally, the reporting system will be designed so additional Asian carp deterrents can be added using a modular update once new deterrents (for example, antimycin-A) are registered for use. The USFWS will also work with the USGS to complete a registration package to USEPA in 2020 and serve as the registrant.

For the acoustic deterrent research study planned at Lock and Dam 19 (LD19), the USFWS will determine what level of ESA Section 7 consultation is required to support the project and will work with project partners to ensure compliance with all requisite Federal, State and local environmental regulations including ESA Section 7 consultation, National Environmental Policy Act, Migratory Bird Treaty Act, and other regulatory requirements. This will be completed by USFWS staff from the Midwest Fisheries Center and the Illinois/Iowa Ecological Services Field Office.

What's New in FY 2020:

- Develop an online request and data management system (Registered Deterrent Program Management System) for Carbon Dioxide-Carp for state and federal partners to request the label, ensure that all required state registration and National Permit Discharge Elimination System requirements have been met, describe locations for proposed use, and collect data to report to USEPA.
- Additional SOPs for registered use of Carbon Dioxide-Carp for under ice use as a piscicide.
- Incorporate data from the Kaukauna Lock #2 CO_2 study to develop SOPs for lock chamber application of Carbon Dioxide-Carp for the deterrence of Asian carp as described on the registration label.
- Respond to USEPA and state regulatory agency review of data submitted to register Antimycin A with a targeted registration date in 2020.
- ESA Section 7 consultation at acoustic deterrent demonstration site (LD19).

- Continue coordination among the multi-agency teams involved in developing and testing sound, CO_2, and microparticle deterrent technology for registration and regulatory permitting.

Expected Milestones:

- Registered Deterrent Program Management System will "go live" online.
- Completion of Standard Operating Procedures for a CO_2 delivery system for use in a lock chamber.
- Completion of ESA Section 7 consultation at Lock and Dam 19.
- Completion of ESA Section 7 consultation supporting field trial(s) using antimycin-incorporated microparticles.
- Determination of USEPA registration and Section 7 consultation data requirements for antimycin-incorporated microparticle registration.
- Acquisition of Experimental Use Permits to allow use of antimycin-incorporated microparticles in limited open-water application sites.
- Submission of registration packet for antimycin-incorporated microparticle formulation
- Facilitation of State regulatory agency review for deterrent field deployment sites.

What Is Deliverable for this Funding:

- Standard Operating Procedures for Carbon Dioxide-Carp for under ice lethal control of fish.
- Online Carbon Dioxide-Carp (Registered Deterrent) Program Management System for users/applicators.
- Review of Antimycin A registration application decision and response actions.
- Standard Operating Procedures for antimycin-incorporated microparticles.
- Safety and training programs and protocols for agency staff for implementation of USEPA registered Asian carp control technologies in the field.
- ESA Section 7 consultation and other regulatory permits necessary for registration and use of Asian carp deterrents.

Expected Completion Date for Project: Contingent on projected completion dates for development of CO_2 and species-specific Asian carp deterrents, registration of these deterrents by USEPA, and all Section 7/regulatory needs for field study sites involving CO_2, microparticles, and acoustic deterrent technologies covered by this Action Plan.

Potential Hurdles:

- Regulatory permitting.
- Potential impacts on non-target species, including ESA-listed species.
- Limitations to producing antimycin-A.
- Failure to meet USEPA registration requirements.
- Engineering and operational challenges associated with deploying/installing deterrents in a lock and dam environment.
- NPDES permit process could be resource intensive.

How will the results of this project be disseminated? Public outreach (GLRI.us, GLIN Announce, Asiancarp.us), presentations to technical audiences, partnership meetings, coordination meetings, media releases, USEPA registration notices, peer reviewed publications

What National Asian Carp Plan goals and recommendations does this project support:

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.2.1.1. Develop a Decision Support System to assist natural resource managers in prioritizing specific locations for the construction, maintenance, monitoring, or removal of barriers to carp dispersal.

Strategy 3.2.1.4. Anticipate and address consequences of specific containment actions on native biological communities.

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.3.9.5. Determine registration needs, if any, for the use of piscicides to control Asian carp and ensure that piscicides are available for appropriate uses.

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of bighead, black.5.

Strategy 3.5.2.6. Develop an information module on Hazard Analysis and Critical Control Point planning procedures.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.6.4.2. Evaluate existing piscicides and, if necessary, develop new piscicides that are selective for Asian carp.

T-10 USGS Development of Tailwater Removal Techniques for Bigheaded Carp

Lead Agency: U.S. Geological Survey (USGS)

Agency Collaboration: Illinois Department of Natural Resources (DNR), U.S. Fish and Wildlife Service (USFWS), TVA, Kentucky Department of Fish and Wildlife Resources, Tennessee Wildlife Resources Agency

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$100,000	$100,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

During part of the growing season, bigheaded carp (Black Carp and Silver Carp) congregate in mass in tailwaters of some dams on large rivers (e.g., Fox River Dayton Dam in the Illinois River basin, Barkley Dam on the Cumberland River, and Pickwick Dam on the Tennessee River). These congregations are often visible on the surface or at times of disturbance by flow, sampling, or boats. We hypothesize that these fish are spending significant amounts of time in these tailwaters to exploit relatively concentrated food resources in favorable hydraulic conditions. Several factors might be contributing to concentrating food resources for bigheaded carp including an abundant source of plankton produced in the reservoirs above these dams, hydraulic conditions like eddies that concentrate food, and maceration of food sources including zooplankton and fish by spillway gates, power plant turbines or barge propellers. Effectively targeting these large congregations of bigheaded carp for removal at strategic dams would likely contribute to management objectives to control spread and reduce impacts to native fishes. The objectives of this project would be to identify (Objective 1) strategic dams that typically concentrate bigheaded carp, (Objective 2) large scale environmental factors that influence when bigheaded carp congregate in tailwaters (e.g., discharge, lift, temperature, and seston), (Objective 3) small scale hydraulic and operational factors (i.e., turbulence, eddy formations, water release from spillway gates, lock discharge, and power plant turbines) that influence the location of these congregations in tailwaters. In parallel with the above objectives aimed at understanding factors that influence when and where large congregations occur, this project would also (Objective 4) develop effective removal techniques and gears for these large congregations.

Summary of Actions to Date: Meetings and calls with state and federal partners to discuss objectives and feasibility.

Proposed Actions for FY 2020:

- Meet with managers to identify strategic tailwaters that hold large congregations of bigheaded carp to determine priority and feasible tailwaters for this work (Objective 1).

- Hold a workshop or interact with commercial fishers, private entities and fishery managers/scientists to identify potential gears or techniques that might be effective at removing fish in tailwater environments (Objective 4).
- Initiate the development of sampling techniques, experimental designs (environmental and fish) and study plans (Objective 2-3).
- Initiate pilot testing of promising removal gears at priority tailwater sites or at other field sites or UMESC ponds where experimental or environmental conditions can be better controlled. (Objective 4).

What's New in FY 2020: This entire project is new.

Expected Milestones:

FY 2020 Q3:

- List of priority tailwater sites for conducting work derived from interactions with managers and site visits.
- List of potential experimental gears derived from interactions with commercial fishers, private entities and fishery managers/scientists.

FY 2020 Q4:

- Develop sampling techniques, experimental design, and study plan for understanding tailwater congregations of bigheaded carp.
- Develop study plan to test promising gears and techniques.

What Is Deliverable for this Funding: Reports and presentations that include (1) list of priority dams, (2) list of potential techniques and gears to target congregations, and (3) results of analyses of large- and small-scale environmental factors influencing congregations of bigheaded carp and (4) results of tests of promising experimental gears and techniques.

Expected Completion Date for Project: To be determined.

Potential Hurdles: Delays in funding, contracting, hiring, and permitting. Delays related to high water or adverse weather.

How will the results of this project be disseminated?

- Presentations at management and scientific meetings.
- Published in MRWG interim summary reports and in peer-review publications.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 4: Minimize potential adverse effects of feral Bighead, Black, Grass, and Silver Carp in the United States.

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 7: Effectively plan, implement, and evaluate management and control efforts for Bighead, Black, Grass, and Silver Carp in the United States.

R-1 Contingency Response Plan

Lead Agency(s): U.S. Fish and Wildlife Service (USFWS); U.S. Army Corps of Engineers (USACE) co-lead

Agency Collaboration: Great Lakes Fishery Commission (GLFC); Illinois Department of Natural Resources (DNR); U.S. Geological Survey (USGS), U.S. Coast Guard (USCG), Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), and all other supporting Asian Carp Regional Coordinating Committee (ACRCC) stakeholders

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$0

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

The purpose of the Contingency Response Plan (CRP) is to outline the process and procedures the Monitoring and Response Work Group (MRWG) and the Asian Carp Regional Coordinating Committee (ACRCC) member agencies will follow in response to the change in Asian Carp conditions in any given pool of the upper Illinois Waterway (IWW). In the event a change is detected in the status of Asian carp in the project location indicating an increase in risk level, this plan will be implemented to carry out response actions. The interagency MRWG has maintained a robust and comprehensive Asian carp monitoring program in the CRP area and will continue these efforts as the foundation for early detection capability in the IWW.

Summary of Actions to Date: The CRP was formally adopted into the Monitoring and Response Plan (MRP) in 2016 with alternative response actions identified in previous plans which only covered the Chicago Area Waterway System (CAWS) upstream of the Electric Dispersal Barrier System (EDBS). Illinois DNR and the ACRCC announced the finding of one Silver Carp in the IWW below T.J. O'Brien Lock and Dam, approximately nine miles away from Lake Michigan on June 26, 2017. The Silver Carp capture triggered two additional weeks of intense sampling in the area, as outlined in the ACRCC's 2017 CRP beginning June 26, 2017 and ending July 7, 2017. In addition, multiple positive environmental deoxyribonucleic acid (eDNA) water samples in the CAWS triggered two weeks of intensive monitoring actions (November 11-14 and 18-28), in 2019.

The MRWG continues to refine and improve the CRP through annual table-top exercises with response agencies and stakeholders. A two-day, multi-agency table-top exercise was hosted on 23-24 September 2019. These exercises review the existing CRP and work through hypothetical scenarios that would likely trigger a response action. This allows the MRWG to elicit feedback on appropriate response actions and potential impacts.

Proposed Actions for FY 2020: This project will continue annually in association with other MRP projects in order to maintain a standard response structure, communication plan, and

management strategy for the collaboration of multiple resource agencies. This plan will evolve over time as information changes and additional tools are developed. A tabletop exercise will be a planned action for FY 2020 and annually thereafter. The CRP outlines specific triggers that may be realized in any given sampling season which may result in a range of response actions tailored to the relative risk identified through collaborative discussion between action resource agencies and the ACRCC. In addition to the tabletop exercise, the CRP will also be updated with lessons learned for the 2020 MRP and any response actions summarized in the 2019 Interim Summary Report.

All efforts under this project will be covered by funding from other projects. projects.

Expected Milestones:

FY2020 Q1:

- Intensive response to multiple positive environmental deoxyribonucleic acid (eDNA) findings.

FY2020 Q2:

- CRP drafted for 2019 MRP.

FY2020 Q2 and Q3:

- Tabletop exercise planned.

FY2020 Q3:

- CRP 2020 Interim Summary Report Drafted.

What Is Deliverable for this Funding: Minimal funding has been identified as a requirement for those planned actions in support of the tabletop exercise and to develop the annual MRP and Interim Summary Reports. Request and identification of the funding in support of these activities may be accounted for through alternative Action Plan projects on an agency-by-agency basis.

Expected Completion Date for Project: The CRP is anticipated to be an ongoing part of the MRP until such a time as Asian carp and like invasive species are no longer a threat to the ecology and economy of the Great Lakes Region.

Potential Hurdles:

- Timely response is the key to a successful response action.
- Inclement weather, interference with commercial or recreational marine navigation, and/or resource distribution may present hurdles to implementing an action quickly.
- Communication between agencies and successful approval to implement actions may also restrict some immediate response actions.
- Certain developing technologies identified for potential use during response may require specific regulatory approval prior to field implementation.

Identified hurdles may be overcome with sufficient planning and justify strong coordination through continual communication and actively engaging on these topics at the annual tabletop exercise.

Additionally, efficient funding is required to ensure each individual agency is resourced correctly to take action when required. This hurdle is mitigated to some degree by allowing individual agency projects to include funding which would cover some of the response tools outlined within the CRP. However, this Action Plan project also serves as an additional mechanism to distribute funding as appropriate to supplement individual agency budgets.

How will the results of this project be disseminated?

- Annual Interim Summary Reports of the MRP.
- Asiancarp.us posted updates on significant findings and subsequent response actions.
- Teleconference communication as necessary during and after response actions between action agencies (MRWG) and ACRCC members.

BC-1 Black Carp, Monitoring, Assessment, and Control

Lead Agency(s): U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: U.S. Geological Survey (USGS) Columbia Environmental Research Center (CERC), U.S. Army Corps of Engineers (USACE) Engineering Research and Development Center (ERDC), Illinois Natural History Survey (INHS), Illinois Department of Natural Resources (DNR), Southern Illinois University (SIU), Missouri Department of Conservation (MDC), National Oceanic and Atmospheric Agency

FY 2020 Funding Table:

Agency Funding Expected				
USFWS	**USGS (CERC)**	**USACE-ERDC**	**Illinois DNR**	**NOAA**
$114,000	$95,000	$0	$0	$17,000
Asian Carp GLRI Funding to be Requested				
USFWS	**USGS (CERC)**	**USACE-ERDC***	**Illinois DNR**	**NOAA**
$50,000	$450,000	$150,000	$175,000	$105,000

*****USACE-ERDC funds to be included USACE-EPA interagency agreement

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

To effectively target Black Carp and control their spread, there is a strong need for baseline data on the biology, ecology, and current population status of the species. This combined project is a collection of several agency and academia projects to support the monitoring, assessment, and control of Black Carp in the Midwest, in support of Great Lakes protection. The collaborative projects are part of coordinated research, monitoring, and development of control technologies:

- Enhanced Detection of Black Carp in the Lower Illinois River (ILNHS/Illinois DNR).
- Black Carp Biology, Ecology, Early Life History, and Habitat Use (USGS CERC with support for habitat use from USFWS).
- Black Carp Genetic Support (USFWS- Midwest Fisheries Center).
- Genetic Studies to Assist in Surveillance and Control of Invasive Black Carp Populations (ERDC).

Overview of Proposed Actions for FY 2020:

- Determine habitat selection and movements of Black Carp using acoustic telemetry. Two to three years of field work to begin in October 2019 (USGS CERC).
- Spawn Black Carp and generate needed early life history data. (USGS CERC)
- Continue to receive collected Black Carp from across the invaded range to track expansion and changes in demographics, and to acquire sufficient gonad for determination of spawning periods. Provide specimen eyes to USFWS according to Black Carp Work Group (BCWG) specifications. (USGS CERC)
- Based on corbicula data, collaborate with Missouri State University to generate model of size of representative unionid mussel species that could be consumed by a given size Black Carp/ Black Carp gape. (USGS CERC)
- Submit manuscripts on demographics and origin of Black Carp, on bait development to date, required lethal dose of piscicide. (USGS CERC)
- Continue diet analysis, increasing sample size and focusing on better determining the types of native mollusks consumed. (USGS CERC)
- Reporting on Improved eDNA Capture and Collection - complete any remaining analytical tasks and write, submit, and shepherd two peer-reviewed articles through the publication process. (ERDC)
- eDNA-enhanced Discovery and Validation of Juvenile Black Carp Populations and Nursery Locales; exploring whether the eDNA markers and protocols developed in earlier work, in combination with field portable, user friendly instrumentation, can be used to efficiently detect populations of juvenile Black Carp (in locales where adults are unlikely). (ERDC)
- Determination of juvenile Black Carp Diets using DNA metabarcoding. (ERDC)
- Diet comparisons among juvenile Black Carp to those of co-occurring species (based on early fall captures) in order to determine whether juvenile Black Carp are selective or opportunistic foragers. (ERDC)
- Continue to provide sequence confirmation of visual identified YOY. (USFWS)
- Conduct relatedness and/or parentage analysis of wild-caught Black Carp age classes. Estimate effective number of breeders or effective population size. (USFWS)
- Collaborate as needed with USACE as they continue to improve eDNA collection methods. Upon optimization of eDNA methods by USACE, develop specific Standard Operating Procedure for Black Carp eDNA monitoring program. (USFWS)
- Provide ploidy analysis support (USFWS)
- Expand the existing Upper Mississippi River Restoration Program's Long-Term Resource Monitoring (LTRM) element hoop netting efforts to target Black Carp to better detect their presence and expansion up the lower Illinois River. (Illinois DNR, ILNHS)
- Development of an Ecopath with Ecosim model to simulate Black Carp effects on the Lake Erie (LE) and Lake Michigan (LM) food webs. It is unknown whether Black Carp will prefer to eat Dreissena mussels, and it is uncertain whether their thermal preference for warmer waters will significantly restrict their consumption of mussels to nearshore

areas, thereby limiting their impacts on Dreissena mussels and Great Lakes food webs. (NOAA GLERL)

USGS - CERC

Summary of USGS Actions to Date:

- USGS serves as the deposition point for nearly all wild caught fish. More than 475 Black Carp captured in the US have been processed for diet assessment, and analyses of reproductive stage, ploidy, age, growth, stable isotopes, and genetics. Genetic material has been archived with samples provided to USACE, eyes for ploidy to USFWS, and lapilli otoliths to Southern Illinois University for oxygen stable isotopes and microchemistry to determine fish origin. Also, muscle tissue for analyses of trophic status by stable isotope has been archived and samples provided to SIU. Length, weight, and gonadosomatic index are recorded for each fish.
- USGS has aged Black Carp caught from 2011 through 2018, and 2019 fish parts are currently being processed for aging. Working with SIU and USFWS, a manuscript is currently in draft form describing demographic results, fish origin from stable isotopes and microchemistry, ploidy, and size and age of maturation. This manuscript shows that most captured fish are the result of reproduction in the wild, and that Black Carp are clearly established in the Midwest U.S.
- The first analysis of diets of wild Black Carp in North America (and the only analysis of diets of wild Black Carp numbering more than 10 individuals) was completed and published. Over a hundred fish (fish captured through 2017) were examined.
- Poulton, B. C., P. T. Kroboth, J. Bailey, A. E. George, S. E. McMurray, J. S. Faiman, and D. C. Chapman. 2019. First examination of diet items consumed by wild-caught Black Carp (*Mylopharyngodon piceus*) in the U.S. American Midland Naturalist 182(1):89-108.
- A manuscript of the morphometric analysis comparing Black Carp and Grass Carp is currently in press. This work is important because the two species can be difficult to differentiate, especially by those who have not previously encountered Black Carp, and because of their expanding range and frequency of capture, more people are encountering Black Carp.
- Kroboth, P.T., D.C. Chapman, R. A. Hrabik, and D.A. Neely. 2019. Characteristics for the external identification of Black Carp (*Mylopharyngodon piceus*) from Grass Carp (*Ctenopharyngodon idella*). Journal of Fish and Wildlife Management. On-line first: https://www.fwspubs.org/doi/pdf/10.3996/112018-JFWM-102
- A manuscript describing reported captures of Black Carp is now in press.
- Kroboth, P.T., C.L. Cox, D.C. Chapman, and G.W. Whitledge. 2019. Black Carp in North America: a description of range, habitats, timing, and methods of reported captures. North American Journal of Fisheries Management. On-line first: https://afspubs.onlinelibrary.wiley.com/doi/epdf/10.1002/nafm.10340
- USGS identified the frequent presence of flukes that are parasitic on mollusks residing in the guts of Black Carp. Because many captured fish had no food in their guts when captured, but did contain flukes, this is an indication that the diet study underestimated the

proportion of Black Carp feeding on mollusks. Furthermore, it is an indication that Black Carp are likely vectors for this common mollusk parasite. Manuscript currently in review.

- Equipment for telemetry has been purchased, and boats modified for telemetry use. Telemetry to begin October 2019. High water has delayed the initiation of field deployment.
- Early life history: Brood stock have not been available for this work, which would define the early life history of Black Carp eggs and larvae (similar to work with Bighead, Silver, and Grass Carp), so that Black Carp can be included in drift models, and identification of larval Black Carp improved and validated. In 2019 several wild fish were captured by commercial fishers and transported to USGS, but of the females of spawning size, only one survived capture and transport. A spawn was attempted but the single female brood stock died before eggs could be acquired.
- Selective Bait development: USGS determined the lethal oral dose of antimycin-A for Black Carp, developed a delivery method using glass vials attached to prey items, and tested several concentrations of antimycin-A in solvents.
- Using Corbicula clams as a surrogate, USGS determined maximum size and size preference of diet items for Black Carp.

Proposed Actions for FY 2020:

- Determine habitat selection and movements of Black Carp using acoustic telemetry. Two to three years of field work to begin in October 2019
- Spawn Black Carp and generate needed early life history data.
- Continue to receive Black Carp from across the invaded range to track expansion and changes in demographics, and to acquire sufficient gonad for determination of spawning periods. Provide eyes to USFWS according to Black Carp Work Group (BCWG) specifications.
- Based on corbicula data, collaborate with Missouri State University to generate model of size of representative unionid mussel species that could be consumed by a given size Black Carp/ Black Carp gape.
- Submit manuscripts on demographics and origin of Black Carp, on bait development to date, and required lethal dose of piscicide.
- Continued diet analysis, increasing sample size and focusing on better determining the types of native mollusks consumed.

What's New in FY 2020: Publish, with SIU, information on otolith microchemistry and demographics that indicates that Black Carp are well-established in the Midwest US. Publish data on selective bait trials, and on oral toxicity of antimycin-A to Black Carp. Publish on mollusk-parasite trematodes found in the digestive tract of Black Carp that are evidence that existing data underestimates Black Carp consumption of mollusks, and that Black Carp can be vectors for these parasites. Publish existing data on fish/gape size on preference for different sizes of bivalve and ability to consume different bivalve sizes. Begin implantation and active tracking of Black Carp and on early development of Black Carp.

Expected Milestones:

FY 2020 Q1:

- Telemeter the first Black Carp for the telemetry study, adaptively develop tracking program depending on activity and habitats selected.
- Submit journal manuscript on sources, demographics, age at maturation, and establishment of Black Carp.

FY 2020 Q2:

- Continue tracking Black Carp. If individuals remain in an appropriate area, install 2-D monitoring system to monitor daily movements within the area during cold water conditions.
- Submit manuscript(s) on bait and toxicology work.

FY 2020 Q3:

- Continue Black Carp telemetry and habitat selection determination
- Spawn Black Carp in the laboratory and gather information on developmental rate, pictorial developmental series for larval identification, egg sinking rate, egg size, and basic larval behavior.
- Submit manuscript on gape and prey size preference, if not included in bait and toxicology manuscripts.

FY 2020 Q4:

- Continue telemetry work.

What Is Deliverable for this Funding:

- Journal manuscripts and reports and presentations on new biological information and potential controls for Black Carp.
- Journal manuscript on diets of Black Carp and quantification of the threat to native mollusks.

Expected Completion Date for Project: To be determined.

Potential Hurdles: Ability to capture brood stock and appropriate-sized fish for telemetry research, unwanted mortality of captured fish for telemetry or brood stock, flooding or other variables that reduce the ability to detect and locate telemetered fish, susceptibility of Black Carp to piscicides.

How will the results of this project be disseminated?

- Reports to ACRCC and journal publications.

USACE - ERDC

Summary of USACE Actions to Date: Over the course of 2017 through 2019, ERDC-EL developed and tested the first set of highly-validated, efficient eDNA markers. This work was conducted in collaboration with the Whitney Genetics Laboratory (USFWS) and Northeast Fish

Laboratory (USFWS), and supports the Whitney Genetics Laboratory Upper Mississippi River, Chicago Area Waterway System, and Great Lakes Asian carp monitoring mission. A scientific journal article describing the new markers and associated testing was recently published in the Transactions of the American Fisheries Society. From 2018-2019, ERDC-EL work has focused on further parameterizing the nature of Black Carp eDNA and identifying optimal methods for collecting it (e.g. filtering versus grab samples, water versus sediment samples) for detecting it. The last set of samples for this task was obtained in September 2019 and a paper on this topic is expected in FY 2020.

ERDC-EL has genotyped over 300 of Black Carp that were captured and/or submitted to USGS, SIU, and USFWS from 2011- April 2019. Many of these Black Carp are submissions to the Illinois DNR bounty program for commercial captures in Illinois and contiguous states. Analyses of these data will be used to assess the level of migratory (and gene flow) connectivity among different Black Carp populations, to estimate effective population size changes over time, and to estimate parental stock sizes in different reaches of the Black Carp invaded region and to assess changes in this parameter over time. The study further represents a largely unprecedented opportunity to track how genetic patterns change in an emerging invasive species and to observe how future control efforts may impact gene pools (e.g., inbreeding rates). Genotyping of the remaining and recently obtained samples held by ERDC will be competed in FY 2020 and a journal article submission on the findings of this task is also expected in FY 2020.

What's New in FY 2020:

Tasks expand efforts to develop Black Carp eDNA markers and to optimize eDNA sampling and processing for this species.

Expected Milestones:

FY 2020 Q1:

- Complete Black Carp eDNA Optimal Sample Type Tests and Analysis.

FY 2020 Q2:

- Submit journal article on Optimal eDNA Sample Types for Black Carp.
- Complete Black Carp genotyping and analysis.

FY 2020 Q3:

- Submit journal article on Black Carp genetics and breeding pool estimates.

What Is Deliverable for this Funding:

- Enhanced capabilities for detecting Black Carp eDNA and tracking the spread and population growth of this invasive species.
- Enhanced capabilities for detecting populations of juvenile Black Carp and nursery locales.
- Enhanced capabilities for determining critical habitat associations for of juvenile Black Carp.

- New data and information on juvenile Black Carp trophic ecology, and, potentially, key dietary items that may be manipulated to control or eradicate populations of juvenile Black Carp.
- An enhanced understanding of the impacts of Black Carp on aquatic systems by adding new data on juvenile Black Carp ecology and impacts.
- Improved DNA barcode databases for some components of regional plankton community.
- At least four peer-reviewed publications.

Expected Completion Date for Project: All current efforts and proposed studies for FY 2021 will be completed by the close of 2022.

Potential Hurdles: That juvenile Black Carp reside in more locales in the Cape Girardeau region than just the previously identified reaches of Dutchtown Ditch. Without additional populations of juvenile Black Carp, proposed work becomes very limited.

How will the results of this project be disseminated?

- Peer-reviewed publications (4 or more)
- Webinars
- Conference and workshop presentations
- Social media (GLIN-announce, @eDNAresources)

Illinois DNR/Illinois NHS

Summary of Illinois DNR/ILNHS Actions to Date:

Enhanced detection of Black Carp in the lower Illinois River-

Monitoring for Black Carp by the Illinois DNR and ILNHS has been part of the comprehensive Asian carp monitoring strategy already in place in the annual Monitoring and Response Plan. However, there has been specific focus on targeting Black Carp during removal events. Illinois DNR also continues to implement the Black Carp bounty program.

Expected Milestones:

- Ongoing early detection field monitoring using LTRM approach.

What Is Deliverable for this Funding: Improvement in detection capabilities for Black Carp and estimates of the current population size in the La Grange pool. Data from any collected Black Carp will also greatly enhance knowledge of the species' life history.

Expected Completion Date for Project: When monitoring efforts by the ACRCC end and no further effort to catch Black Carp is ongoing, or if other monitoring and surveillance programs can meet the needs for Black Carp capture in the Illinois River.

Potential Hurdles: Funding limitations, timing.

How will the results of this project be disseminated?

- Results will be shared with other ACRCC agencies via the Black Carp Work Group, MRWG, and associated meetings or publications.

USFWS

Summary of USFWS Actions to Date:

- Continued marker validation building on prior work (e.g. evaluation of Black Carp from Dutchtown Ditch, Missouri), in collaboration with USACE; Collected field samples in four marker validation attempts.
- Continued sampling of Dutchtown Ditch for young-of-year (YOY) Black Carp.
- Genetic sequence validation of species identification for YOY and two of the adult fish tested for ploidy conducted for partners. Genetic microsatellite analysis conducted on YOY to evaluate the number of adults that may have contributed to the YOY captured in 2016. There were no YOY captured in 2017, but 30 captured in 2018 were analyzed. Data provided estimates on the minimum number of parents contributing to the cohort.
- Whole genome data generated, and genomes assembled for publication.
- Provided technical assistance to the ERDC lab to use consistent microsatellite techniques to analyze all adult Black Carp captured to date.
- As part of a monitoring project with SIU, MDC and the assistance of KDFWR, USFWS sampled the Ohio River, Missouri River, and several lakes with traditional gears.
- Placed water level loggers at strategic points in Dutchtown Ditch where YOY have historically been captured, to estimate relationship between Mississippi River gauge height and ditch connectivity to help inform understanding of potential spawning location.
- Produced handouts to promote the Illinois DNR Black Carp bounty and encouraged reporting by the public and other agencies.
- Updated the Black Carp collection protocol and distributed collection kits to interested agencies.
- Collected hydroacoustic habitat data in Alton, Illinois, and Greenville, Mississippi, where many Black Carp have been captured by commercial fishermen.
- Sampled for Black Carp in the Ohio River, Missouri River, Lake Barkley, Kentucky Lake, and several floodplain lakes as part of a larger monitoring project with SIU and MDC. Sampling effort was over twice FY 2017 levels, and included assistance by KDFWR.
- Determining water fraction in which Black Carp eDNA largely resides and trade-offs among filter pore sizes in water volume processed vs. % DNA captured – which pore size gives us the largest number of Black Carp DNA.
- Testing sediment eDNA for a stronger Black Carp signal.

Expected Milestones:

- Field sample collection, ploidy analysis (FY 2020 Q2-FY 2021 Q4); genomic surveillance will align with ERDC milestones, *see above*.

What Is Deliverable for this Funding:

Black Carp genetic support-

- Confirmation of identification of YOY Black Carp. This allows for further downstream analysis including population genetics and diet analysis.

- Estimates for the minimum number of parents contributing to reproduction each year.
- Early detection eDNA program specific to Black Carp. Monitoring could provide information on the identification of spawning habitats, nursery habitats and further clarification on the overall population size.
- Genomic surveillance in coordination with ERDC will identify key outcomes including location of juvenile populations and knowledge of juvenile population habitat features; determination of juvenile Black Carp diet and potential ecological impacts of these fish on local ecologies; optimized methodology for DNA-based analysis of juvenile fish studies; and, scales of dispersal and emigration, population origins, population effective sizes, and minimum breeding pair estimates.

Expected Completion Date for Project:

- When monitoring efforts by the ACRCC end and no further effort to capture Black Carp is conducted.

Potential Hurdles:

- Availability of Black Carp for testing**.**

How will the results of this project be disseminated?

- Technical reports confirming species identification are provided to agencies that captured the fish.
- Technical reports on the population genetics and minimum number of parents contributing to YOY cohorts are provided to the Black Carp Work Group.
- eDNA results will be shared with partners and ACRCC in a fashion similar to the current eDNA program for Bighead and Silver Carp.

NOAA

Summary of NOAA Actions to Date: This is a new component proposed under the Black Carp combined agency project.

Expected Milestones:

FY 2020 Q4:

- Meet with collaborators to review model domain and simulation objectives. Acquire input data needed for the Lake Erie EwE and Lake Michigan EwE models.
- Revise the EwE models to include Black Carp.

What Is Deliverable for this Funding:

- Estimates of potential Black Carp population growth and equilibrium population size in Lake Erie and Lake Michigan.
- Potential effects of Black Carp on the food webs and fish communities in Lake Erie and Lake Michigan under scenarios of diet preference and thermal tolerance.

Expected Completion Date for Project: September 30, 2021.

Potential Hurdles:

- A delay in receipt of funds will result in a delay in achievement of milestones.

How will the results of this project be disseminated?

- Results of this project will be disseminated through reports at ACRCC meetings and presentations at scientific conferences (e.g., IAGLR, AFS), and via peer-reviewed scientific publications.
- Results will also be disseminated through social media at NOAA GLERL.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.3.9: Investigate the sensitivity of Asian carp to piscicides and examine the feasibility of chemical Asian carp control in specific habitats.

Strategy 3.5.2 Prepare science-based materials based on key audience needs that can be used to develop curricula for effective education and outreach programs

Strategy 3.6.2. Assemble information about the distribution, biology, life history, and population dynamics of Bighead, Black, Grass, and Silver Carp.

Strategy 3.6.5. Determine the demonstrated and probable ecological and economic effects of Asian carp in the United States and determine the degree to which these effects are negative.

Goal 4: Minimize potential adverse effects of feral Bighead, Black, Grass, and Silver Carp in the United States.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

GC-1 Implementation of Adaptive Management Framework for Grass Carp in Lake Erie

Lead Agency(s): U.S. Fish and Wildlife Service (USFWS) and U.S. Geological Survey (USGS)

Agency Collaboration: Ohio Department of Natural Resources (DNR), Michigan DNR, Ontario Ministry of Natural Resources and Forestry (MNRF), Department of Fisheries and Oceans Canada, Great Lakes Fishery Commission (GLFC), New York Department of Environmental Conservation, Pennsylvania Boat and Fish Commission, University of Toledo, Michigan State University, Bowling Green State University, University of Illinois, and Central Michigan University

FY 2020 Funding Table:

Agency Funding Expected				
USFWS	**USGS**	**Ohio DNR**	**Michigan DNR**	**GLFC**
$450,000	$0	$0	$350,000	$1,000,000
Asian Carp GLRI Funding Requested				
USFWS	**USGS (CERC)**	**Ohio DNR**	**Michigan DNR**	
$570,000	$525,000	$535,000	$300,000	

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

U.S. and Canadian resource agencies in the Lake Erie basin have identified the growing threat of invasive Grass Carp as a high priority requiring focused and aggressive monitoring and control action. Member agencies have developed a suite of proposed actions for implementation, building off existing efforts within the Lake Erie basin. Planning is being conducted in collaboration with the GLFC's Council of Great Lakes Fishery Agencies, Invasive Fishes Executive Committee, and the Lake Erie Committee (LEC).

Grass Carp is recognized as one of the four Asian carp species threatening the Great Lakes basin. Unlike Bighead Carp, Silver Carp, and Black Carp, Grass Carp has been present in the Great Lakes since the 1980s. A recent binational risk assessment, Ecological Risk Assessment of Grass Carp (*Ctenopharyngodon idella*) for the Great Lakes Basin, noted that the invasion process for Grass Carp has begun in the Great Lakes, with Lake Erie being especially at risk if no further actions are taken. Grass Carp have the potential to exert their greatest ecological impacts on Great Lakes coastal wetlands, which provide essential ecosystem functions and are critical habitat areas for many life stages of native fish, waterfowl and wildlife that sustain the economic and ecological viability of this unique freshwater ecosystem.

In recent years, the Asian Carp Regional Coordinating Committee (ACRCC) has funded actions to address the threat that Grass Carp pose to the Great Lakes, broadening from the initial focus on Bighead Carp and Silver Carp. Because the spawning and early life history requirements of Grass Carp are similar to Bighead Carp and Silver Carp, USGS scientists have built on their existing knowledge base to identify two Lake Erie tributaries where Grass Carp are spawning. Investments by Michigan and Ohio, along with USGS and USFWS, have led to a better understanding of Grass Carp movements that lead to improved action strategies. In 2016, Michigan DNR, collaborating with Ohio DNR, OMNRF, Fisheries and Oceans Canada, USGS, and USFWS, initiated development of an Adaptive Management Framework for Grass Carp Control in Lake Erie to inform the identification, prioritization, selection, and sequencing of key strategic actions. This information has led the binational Lake Erie Committee, comprised of fishery managers from Michigan, Ohio, Pennsylvania, New York, and Ontario, and supported by Canadian and U.S. federal agencies, to adopt a 5-year adaptive response strategy to reduce the threat of Grass Carp to Lake Erie through common and coordinated efforts. Efforts to respond to Grass Carp threats support the coordinated and cooperative fishery management conducted by agencies signatory to A Joint Strategic Plan for Management of Great Lakes Fisheries, and the goals and objectives of the Management and Control Plan for Bighead, Black, Grass, and Silver Carp in the U.S. These efforts are further supported by the Great Lakes Aquatic Invasive Species (AIS) Early Detection program, conducted by USFWS in collaboration with State and Federal agency partners to provide targeted surveillance for non-native species (including Grass Carp) in the highest risk locations within the basin. Since 2016, a combination of research and agency removal actions has identified key areas on which to focus to best reduce the threat of Grass Carp to Lake Erie, while also increasing agency understanding that should improve future response efforts. Based on this experience and increased information about Grass Carp, the LEC recognizes that dramatically increasing the number of so-called “strike teams” to target removal of adult Grass Carp and adding an additional egg sampling team to assess the risk of reproduction in other Ohio tributaries are essential elements of its 5-year adaptive response strategy.

For the last two years, three strike teams, one each from USFWS, Michigan DNR, and Ohio DNR, have operated in the Lake Erie basin. In 2020, two additional strike teams will be available through GLRI funding, plus two more teams through a Congressional appropriation to the GLFC for $1 million in FY 2020. These seven strike teams will help in reaching the removal goals developed through the Adaptive Management Framework. The LEC believes that substantially increasing the number of strike teams is its highest priority as it seeks to meet its goal of removing 390 Grass Carp annually.

A second priority, to evaluate the feasibility of a seasonal barrier in the Sandusky River, is currently underway. The third priority of the LEC is to reduce critical uncertainties. Key activities that will help the LEC reduce uncertainties about where and when to target removal include maintaining support for real-time receivers, additional sampling for eggs in Ohio tributaries, and expanding telemetry coverage to improve its understanding of Grass Carp movement patterns.

Theses increased removal effort, coupled with research into additional control strategies, should increase the ability of agencies to control the Grass Carp population in the short term and allow

for continued progress toward eventual eradication of Grass Carp in Lake Erie. Research conducted by USGS will provide additional assistance to ongoing management activities.

Summary of Actions to Date

In 2017 and 2018, state, provincial, and federal agencies from both Canada and the U.S. collaborated to develop and implement Grass Carp removal techniques for river systems under differing flow regimes. Michigan and Ohio expect to increase their removal activity in FY 2019 with support from this Grass Carp project and assistance from USFWS and USGS. This increased removal effort, coupled with research into additional control strategies, should increase the ability of agencies to control the Grass Carp population in the short term and allow for continued progress toward eventual reduction/eradication of Grass Carp in Lake Erie. Research conducted by USGS that is detailed in the 2019 project will provide additional assistance to ongoing management activities.

In 2018, Ohio hosted a week-long targeted removal action under the Mutual Aid Agreement for Combating Aquatic Invasive Species Threats to the Great Lakes - St. Lawrence River Basin for Grass Carp in the Sandusky River during the week of June 11. State, provincial and federal government agencies from both Canada and the U.S. participated. Agencies captured 31 Grass Carp during this event, 28 from the Sandusky River and 3 from the Maumee River.

In 2019, Ohio DNR undertook the following actions aimed at Grass Carp population reduction/eradication:

- Continued the University of Toledo (UT) study on the application of detection probability estimates to Grass Carp population estimates and catchability.
- Refinement of Grass Carp science to improve removal efforts that included a dedicated Grass Carp Strike Teams focused on removal and comparison of removal techniques. The Strike Team worked in cooperation with staff from Michigan DNR and USFWS.
- Partnered with commercial fishing operations for Grass Carp removal.
- Continued efforts to evaluate the feasibility of a temporary or permanent barrier to prevent Grass Carp movement into spawning or high use areas.

In 2016, a Structured Decision-Making (SDM) process was initiated to strategically address regional concerns and knowledge gaps. Michigan DNR partnered with Michigan State University's Quantitative Fisheries Center, partner agencies (e.g., Lake Erie Committee and Fisheries and Oceans Canada), and subject matter experts to determine a regional and science-based approach for eradicating Grass Carp in Lake Erie. Subsequent response plans in 2017-2019 have been focused on implementing the recommended outcomes from the SDM process that link directly with implementation of the Lake Erie Committee's adaptive management framework for the eradication of Grass Carp in Lake Erie. Michigan DNR developed a Grass Carp response plan designed for 5-years at which point it will be re-assessed and future management direction will be determined.

In collaboration with partner agencies, Michigan DNR began implementing adaptive management actions in 2018 while continuing to support efforts to obtain information to reduce key uncertainties that were identified during the SDM workshops. As part of the response plan,

Michigan DNR has implemented "sustained response actions" with a standardized random sampling approach to provide time series data. "Adaptive response actions" including fishing with setlines, baiting methods, and night-time responses have also been evaluated with the goal of improving removal strategies. Starting in 2019, Michigan DNR began implementing a "Judas Fish" study with USFWS, Ohio DNR, and Michigan State University (MSU) to assess the ability of real-time telemetry receivers to increase capture rates. Three of the five Grass Carp captured in Michigan waters of Lake Erie by agency effort in 2019 were the direct result of responding to real-time detections. Although the results are still preliminary, they suggest that the "Judas fish" approach increases the effectiveness of response actions.

During all response actions, Michigan DNR collaborates with project partners on fish collected to determine sex, along with collecting blood samples and/or eyes for ploidy analysis, a fin clip for potential genetic analyses, and aging structures to refine our knowledge of population dynamics that will be used in future statistical models and subsequent response strategies. In addition, partnerships with commercial fishers have increased targeted sampling efforts using large seines (approx. 3000'), which have been an effective capture gear for Grass Carp in Lake Erie to date.

Proposed Actions for FY 2020:

USGS

Sampling for early life history stages of Grass Carp in key Lake Erie tributaries and modeling egg and larval drift to identify spawning locations and inform control efforts.

USGS will be continuing support of egg-sampling efforts in conjunction with the University of Toledo and for completion of modeling required for identifying spawning locations on the Sandusky River upstream of former Ballville Dam.

This work will continue USGS-led efforts since 2015 that identified spawning tributaries and specific spawning areas of Grass Carp. The USGS and the University of Toledo will focus most egg sampling effort on the Cuyahoga River based on capture of fertile adults in 2019 and results from a 2014 study that concluded the Cuyahoga has suitable hydrodynamics and water quality to support Grass Carp spawning. Developmental stages of captured eggs will be determined to calculate fertilization time, which will provide baseline data for eventual modeling of spawning locations and conditions at which Grass Carp spawn (contingent on development, calibration, and validation of a hydraulic model for the Cuyahoga River in subsequent years).

Modeling efforts will focus on completing the hydraulic model for the Sandusky River upstream of former Ballville Dam and then using it within the FluEgg model to verify past spawning locations and identify new spawning locations. Information on spawning rivers and specific spawning locations is required by managers to inform removal efforts and assess the feasibility and potential locations of seasonal barriers.

Evaluation of bait and attractants to increased aggregation and harvest of Grass Carp in the Lake Erie Basin.

This collaborative project will assess potential attractants for Grass Carp, including spawning-related chemicals (pheromones) and food-based attractants, to support development of control strategies. Efforts related to this research will focus on the use of baits and attractants to increase aggregation of Grass Carp in key locations to aid in the harvest and removal of Grass Carp in the Lake Erie Basin. A suite of amino acids has been identified that can elicit an involuntary feeding response in fish, at certain concentrations, by keeping olfactory neuroreceptors open. These amino acids can also be used as food enhancers to increase effectiveness of the attractive qualities of newly developed baits.

While the development of Grass Carp attractants and baits have been independently tested and refined, utilization of both techniques to attract, aggregate, and keep fish localized for extended periods has not been examined. Our goal is to determine if species specific baits, fish attractants, and/or combination of the two can increase capture of Grass Carp, with traditional gears, during seasonal sampling and harvest tactics currently employed by state management agencies in Michigan and Ohio.

Nearshore and Tributary Movements and Habitat Use of Lake Erie Grass Carp.

This action leverages the existing Great Lakes Acoustic Telemetry Observation System (GLATOS), which is an infrastructure tool providing unprecedented insights to movements of Grass Carp in Lake Erie and tributaries. The goal is to improve control efficiency through better understanding of Grass Carp movements and habitat use. Acoustic telemetry is a key tool being utilized by management agencies in Lake Erie. Behavioral information on Grass Carp movements will inform future efforts to identify spawning, feeding, and overwintering locations.

USFWS

USFWS will continue to provide field crews and vessel support to state, federal, and university partners working to implement Grass Carp response actions in Lake Erie. Grass Carp response priorities will be to: (1) support modeling and telemetry efforts under the Lake Erie Grass Carp Workgroup; (2) use real-time telemetry detections to inform planning/implementation of response actions; (3) implement/evaluate innovative and strategic response actions; (4) collect/provide environmental data during response actions; (5) collect blood for ploidy analysis and assist with lab processing of samples (eggs, larvae, and adults); (6) provide representation at regional and national conferences/meetings; and (7) conduct exploratory Grass Carp monitoring in rivers and tributaries to Lake Erie.

Grass Carp research priorities will be to: (1) assist with implementation of Grass Carp bait/attractant aggregation study; (2) assist with implementation of mobile VPS array study to track fine-scale movements of Grass Carp during response actions; and (3) implement a study aimed at determining the optimal parameters for inducing a capture-prone response of adult Grass Carp using Midwest Lake Electrofishing Units.

Ohio DNR

Ohio DNR will combine previous knowledge with additional information gained to further refine when and where Grass Carp response actions can be most effective for control/eradication through the following:

- In partnership with the UT, deploy Grass Carp Strike Teams.
- Use real-time telemetry detections to evaluate catchability and capture rates.
- Continue to support modeling efforts through UT and MSU to increase collection efficiency, determine effectiveness in removal, and better estimate population size.
- Continue to determine barrier feasibility on the Sandusky River (current funding).

Michigan DNR

Michigan DNR will implement response strategies for Grass Carp in Lake Erie, based on the 5-year response plan (2017-2022). The specific goal of the Michigan response plan is to "work with other states and federal agencies to eradicate or significantly reduce reproducing Grass Carp in Lake Erie within 5 years as defined by occasional commercial occurrences of triploid fish similar to those prior to 2012". This project represents strategies that were collaboratively determined by the Lake Erie Grass Carp Workgroup that participated in a Structured Decision-Making process facilitated by MSU in 2016 and finalized in 2017. The project funding will be used to support a Michigan Grass Carp response team that will implement the following actions:

- Implement and evaluate innovative control actions for Grass Carp.
- Conduct random and fixed site monitoring to track population trends.
- Use real-time telemetry detections to evaluate catchability of tagged fish and capture rates of untagged fish (i.e., "Judas fish" approach).
- Participate in the population Modeling and Telemetry sub-workgroups under the Lake Erie Grass Carp Work Group.
- Implement strategic response actions in Ohio waters, as requested by Ohio DNR.
- Partner with commercial fishing operations for Grass Carp removal.
- Outreach with bow-fishers to promote removal.
- Represent Michigan during regional and international invasive species meetings to communicate Grass Carp eradication efforts to interested partners and stakeholders.

What's New in FY 2020:

The requested GLRI funding will allow agencies to fund five strike teams. In addition, The GLFC funding will allow for an additional two strike teams, bringing the total number of strike teams to seven. This increase in capacity is expected to bring agencies much closer to their goal of removing 390 Grass Carp annually from Lake Erie and its tributaries.

USGS

- Sampling will focus on the Cuyahoga River where reproductively viable adults were captured in 2019.
- USGS will be adaptive and sample other rivers if telemetry data identifies other potential spawning rivers were adults are detected.

- Completion of an extended HEC-RAS model for the Sandusky River will allow FluEgg modeling using eggs and larvae captured in 2018 and 2019 to locate new spawning areas upstream of the former Ballville Dam and verify continued use of previously identified spawning areas.
- Optimize methods for testing oral delivery of bait on wild fish.
- Conduct field trials using Grass Carp baits and attractants in Plum Creek (hot ponds) and North Maumee Bay in collaboration with the Michigan DNR.
- In FY 2020, USGS will deploy and maintain new receivers in the Cuyahoga River and in several near-shore locations of Lake Erie following the needs as established by Lake Erie partner agencies. USGS will operate and maintain the five existing real-time receivers deployed in known Grass Carp spawning rivers and overwintering locations that inform control efforts.

USFWS

- USFWS teams will conduct exploratory monitoring in high priority rivers and tributaries to Lake Erie (e.g., Grand River, Huron River, Portage River, and Vermilion River).
- Grass Carp baiting, mobile VPS array, and electrofishing studies will commence with partners.

Ohio DNR

- Refinement of removal techniques and a shift towards a more aggressive removal strategy with multiple strike teams. Assessment of the currently funded barrier feasibility study being facilitated by the GLFC to determine applicability.

Michigan DNR

Michigan DNR team will collaborate with regional partners (Ohio DNR, USFWS, USGS, MSU, UT) to evaluate innovative response strategies. Real-time telemetry will be used to expand the "Judas fish" study with the goals of increasing the capture of non-tagged fish and evaluating capture probability. Additionally, the Michigan DNR team is planning to conduct response efforts in coordination with fine-scale variable positioning system (VPS) telemetry arrays, which will provide information about fish behavioral responses during field efforts that will be used to develop better strategies in the future. The Grass Carp team also plans to incorporate attractants developed by USGS into standardized response efforts to assess the effectiveness of bait to increase Grass Carp captures.

During the 2018-2019 field seasons, the Michigan DNR Grass Carp response team participated in a collaborative study with Michigan State University to evaluate Grass Carp detection probability in Michigan waters of Lake Erie. Due to the conclusion of the field component, the Michigan DNR Grass Carp response team will have additional capacity to direct efforts towards high priority locations such as the Maumee and Sandusky Rivers in Ohio. The Michigan DNR team will participate in collaborative response efforts in Ohio tributaries upon request from Ohio Department of Natural Resources. Allocating additional efforts to high priority locations will increase the likelihood of reaching targeted Grass Carp removal goals for Lake Erie and, will also

increase the potential to determine the effectiveness of control strategies as part of the adaptive management framework.

What Is Deliverable for this Funding:

USGS

- Sampling of Lake Erie tributaries that are known to be or are suspected of being spawning rivers for Grass Carp to determine if and when spawning occurs and data sets on egg developmental stages and capture locations.
- Following completion of extension of the HEC-RAS hydraulic model for the Sandusky River to Tiffin, Ohio, USGS will use existing egg data from 2019 and the FluEgg model to verify previously identified spawning areas and determine if there are new spawning areas upstream of the site of the former Ballville Dam.
- A manuscript verifying previously identified spawning areas on the Sandusky River and reporting there are/are not new spawning areas upstream of the site of the former Ballville Dam will be prepared for a peer-reviewed journal.
- Partnership with state management agencies.
- A characterization of Grass Carp behavior in response to conspecific feeding sounds will be drafted.
- Report describing the effectiveness of baits and attractants to increase aggregation of fish and Grass Carp harvest rates through traditional capture methods.
- Grass Carp movement and habitat use data will be obtained through USGS field support of the GLATOS network of receivers in Lake Erie.
- Operate and maintain the existing (5) real-time acoustic telemetry receivers deployed in known spawning rivers (Sandusky, Maumee) and areas of potential aggregation (Plum Creek mouth near Monroe, MI).
- Maintain the real-time data server (displays last 24 hours of data) and associated email and text alert system for strike teams.
- Nearshore receivers will be deployed in fall of 2019 and spring of 2020. Tributary and seasonal receivers will be serviced and downloaded on multiple occasions.
- By mid-summer 2020, open lake receivers will be serviced and downloaded.
- The complete data will undergo preliminary analysis in FY 2020 for reporting out during subsequent fall and winter planning meetings.

USFWS

This project will support research and management needs for Grass Carp in Lake Erie (e.g., ploidy analysis, population modeling, and telemetry). Funding with allow USFWS to increase the capacity (e.g., field staff and equipment) necessary to accomplish goals/objectives identified through the Structured Decision Making (SDM) process. Reports/presentations will be prepared and circulated to the Lake Erie Grass Carp Work Group, managers, and key partners. Targeted removal activities will increase in areas where Grass Carp are known to exist and additional surveillance activities will be implemented in tributaries throughout the basin.

Ohio DNR

Increased removal of Grass Carp with the goal of population suppression/eradication to reach the goals set out by the SDM process. Assessment of the Grass Carp Barrier Feasibility Study to determine applicability for the Sandusky River. Suppress/eradicate Grass Carp from the Sandusky and Maumee Rivers.

Michigan DNR

The implementation of the collaborative adaptive management strategy will provide data that will continue to improve the understanding of control strategies for Grass Carp. The information gained through the sampling efforts and data analyses will be synthesized and written up to meet reporting milestones and will be provided at Grass Carp Work Group meetings and other information exchange venues, upon request (e.g. quarterly reporting through ACRCC; annual reporting per requirements, presentations at appropriate venues). The deliverables for this funding are as follows:

- Reduction of Grass Carp in Lake Erie.
- Reduced risk of spread and impacts of Grass Carp throughout Lake Erie.
- Early detection and monitoring of other aquatic invasive species in Lake Erie.
- Monitoring population trends of Grass Carp in Michigan waters of Lake Erie.
- Final assessment and report on control actions, including estimates of catchability and control effectiveness.
- Recommendations for future control actions.

Expected Milestones:

USGS

- Identify key locations for testing baits and attractants that coincide with state management agencies Grass Carp strike teams (Winter – Spring 2020).
- Rapid assessment of current technologies to identify multiple bait formulations to be tested in the field (Winter – Spring 2020).
- Work with feed manufacture to produce large quantities of bait for field trials (Winter – Spring 2020).
- Develop secure baiting stations that will be protected during long-term deployment in publicly accessible field locations (Winter – Spring 2020).
- Initiate field deployment of bait and attractants at identified sites, using multi-beam imaging sonars to monitor changes in fish activity near feeding stations (Summer – Fall 2020).

USFWS

- Provide two response teams dedicated to the removal of Grass Carp from rivers and tributaries to Lake Erie.
- Provide assistance to partners working to accomplish goals/objectives identified through the SDM process under the Lake Erie Grass Carp Work Group.

Ohio DNR

- Develop Grass Carp Strike Teams through the UT dedicated to the removal of Grass Carp from the Sandusky and Maumee Rivers. This dedicated crew will collaborate with Ohio DNR, Michigan DNR, and USFWS for targeted removal.
- Work with experienced contractor to conduct a barrier feasibility study to determine how and where hydrological barriers might be used to block movements of Grass Carp and/or support population reduction actions in the Sandusky and Maumee Rivers.
- Continue to develop space and time bound predictions of adult Grass Carp spawning aggregations.
- Refine the UT's Grass Carp detection probability model using information from the Grass Carp removal actions.
- Continue to refine the UT study on the application of detection probability estimates to Grass Carp population estimates and catchability.

Michigan DNR

- Conduct "sustained" and "adaptive" response actions.
- Collect information to address critical uncertainties (e.g. bait evaluation, Judas fish study, etc.).
- Analyze data from response actions and adapt response strategies as needed to improve effectiveness.
- Refine Grass Carp control model developed during SDM process.

Expected Completion Date for Project

USGS

- Pilot field trials in Plum Creek (hot ponds) and North Maumee Bay by the end of 2020.
- Pilot field trial in Sandusky River by the end of 2020.

USFWS

- Publish assessment results for collaborative electrofishing study in a peer-reviewed scientific journal.

Ohio DNR

- This will be an ongoing effort to control/eradication Grass Carp populations in Lake Erie and improve long-term opportunities for eradication. As specified in the Lake Erie Grass Carp Response Strategy (2019-2023), program success will be assessed in 2023.

Michigan DNR

- The project will be completed as required through Federal contract requirements with USFWS. The expected contract deadline is Sept. 30, 2021.

Potential Hurdles

USGS

- Flooding and severe weather events can cause high river stages that hinder research due to unsafe conditions and can delay fieldwork.
- Low water can also negatively impact our ability to access sites.
- Water quality and temperature may affect bait performance.

USFWS

- Reduced effectiveness of typical gear types used during high flow conditions.
- Limited number of acoustic telemetry tags available for fish discovered in exploratory rivers and tributaries.

Ohio DNR

- The largest potential hurdle for the proposed project is low sample size and episodic reproduction. The development of an effective control plan is dependent upon gaining information on life history characteristics, which can only be gained through collecting and analyzing enough individuals to determine if consistent spatial and temporal patterns emerge that can aid control efforts.

Michigan DNR

- The largest potential hurdle for the proposed project is low sample size. The adaptive management strategy is an iterative process that emphasizes evaluating and improving the response strategies over time. Refining the response plan is dependent upon gaining information on life history characteristics, which can only be gained through collecting and analyzing enough individuals to determine if consistent spatial and temporal patterns emerge that can aid response efforts. This conundrum is paradoxical with the beginning of an invasion process where Michigan DNR have the greatest likelihood of eradication actions having long-term effectiveness, but the effort is can be hindered by difficulty in gaining information on populations at low abundance. This project will work with regional partners to take advantage of available information to reduce remaining critical uncertainties about Grass Carp in Lake Erie.

How will the results of this project be disseminated?

USGS

- Public (GLRI.us, GLIN Announce), technical audience(s), media, peer-reviewed publications and USGS reports, etc.
- Direct communication with state and federal management agencies.
- Peer-reviewed data releases.
- Presentations at various national conferences.

USFWS

- Direct communication with partners.

- Data requests with partners.
- Presentations at regional and national meetings/conferences.
- Journal articles or other reporting mechanisms.
- Presentations at station outreach efforts for the general public and congressional members.
- Provide activities/accomplishments to the station's Facebook page in accordance to Department of the Interior/USFWS policies.

Ohio DNR

- Congressional updates.
- Project initiation/completion press releases.
- Ohio DNR and GLRI.US website updates.
- ACRCC notifications.
- Facebook posts.
- Project completion dedication.

Michigan DNR

- Results will be shared through news releases and the Michigan DNR website as well as Asiancarp.us. Presentations and updates will be provided to project partners and the broader scientific community at state, regional, and international meetings.

What National Asian Carp Plan goals and recommendations does this project support

Goal 2: Contain and control the expansion of feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Strategy 3.2.3. Minimize the range expansion and ecological effects of feral populations of Asian carp in conjunction with management actions to enhance aquatic environments for the sustainability of native biological communities.

Goal 3: Extirpate, or reduce to levels of insignificant effect, feral populations of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 4: Minimize potential adverse effects of feral Bighead, Black, Grass, and Silver Carp in the United States.

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 6: Conduct research to provide accurate and scientifically valid information necessary for the effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 7: Effectively plan, implement, and evaluate management and control efforts for Bighead, Black, Grass, and Silver Carp in the United States.

Comm - 1 ACRCC Strategic Communications

Lead Agency: U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: All Asian Carp Regional Coordinating Committee (ACRCC) Partners

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$100,000	$250,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

USFWS has served as co-chair of the Communication Work Group (CWG) since the inception of the ACRCC, coordinating internal communications across the partnership, as well as external communications with key audiences, including elected officials and the media. Duties include routinely engaging and helping organize communication efforts related to ACRCC actions, which includes the creation of common messaging across ACRCC partner agencies.

Summary of Actions to Date: In FY 2019, work continued on the newly rebuilt www.AsianCarp.us, the partnership's primary communication platform. Work focused largely on compliance with section 508 of the U.S. Workforce Rehabilitation Act (1973) and posting announcements. Other enhancements to the website include the creation and posting of a Black Carp identification video. This is the first Black Carp identification video that has been created and shared widely with the public. Other Communication Work Group accomplishments include supporting burgeoning coordinated communication efforts in the Ohio River Basin and Upper Mississippi River Basin.

Finally, the value of CWG communication efforts has been noticed by agencies across the nation. USFWS receives invitations from organizations to share the ACRCC communications model to help guide others with large-scale, multi-agency early detection and response efforts.

Proposed Actions for FY 2020: USFWS will lead the implementation of targeted ACRCC communication efforts. Work includes management of the ACRCC website, AsianCarp.us; organizing public listening sessions; targeted media outreach; coordinating partner responses to public, congressional and media inquiries; refinement of ACRCC early detection notification protocols; creating ACRCC branded communication products; enhancing the ACRCC's image library and ultimately increasing the reach of ACRCC messaging. Communications work will contribute to key audiences having a greater understanding and appreciation for the ACRCC's purpose, function, current actions and successes.

What's New in FY 2020:

- ACRCC Graphic and Design Standards Project - Building upon the new logo and the rebuilt website, USFWS will lead an effort to continue to grow and reinforce the ACRCC's brand. In 2020, USFWS will build projects that incorporate the updated logo to give ACRCC products a consistent look and feel.
- Enhance Teacher Resources on www.AsianCarp.us – Various teacher resources have been created, but many are not 508 compliant or in a format that is conducive to web-based delivery. Work will focus on making more resources available to teachers on www.asiancarp.us.
- Grass Carp Identification Video – Following up on the Black Carp identification video, we will make an identification video that focuses on just Grass Carp.

Expected Milestones:

- ACRCC Graphic and Design Standards toolkit that includes press release, PPT, and other related communication product templates. (FY 2020, completed by Q4).
- New or updated content on AsianCarp.us that is targeted to the needs and interests of teachers. (Ongoing, initial updates made by Q4).
- A Grass Carp identification video. (FY 2020, completed by Q4).

What Is Deliverable for this Funding:

- Coordination of an ACRCC Communication Work Group that supports ACRCC. announcements, presentations and related communication products.
- Coordination of media, congressional and public inquiries.
- Ongoing management of web content for www.asiancarp.us.
- Section 508 compliant Grass Carp identification video.
- Enhanced teacher resources on www.AsianCarp.us.
- ACRCC Graphic and Design Standards toolkit that includes press release, PPT, and other related communication product templates.

Expected Completion Date for Project:

- The coordination of ACRCC communications, across the partnership and to external audiences, is ongoing.

Potential Hurdles: None

How will the results of this project be disseminated?

- GLRI.us, GLIN Announce, media and AsianCarp.us.

What National Asian Carp Plan goals and recommendations does this project support

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

PO-1 ACRCC Partnership Operations

Lead Agency: U.S. Fish and Wildlife Service (USFWS)

Agency Collaboration: U.S. Environmental Protection Agency (USEPA)

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$41,000	$41,000

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

ACRCC Partnership Operations includes contract program staff support to the ACRCC agencies in developing reports, tracking activities; providing field support as necessary; and continued support of the ACRCC's efforts to enhance collaborations among the federal, state, and local partners.

ACRCC program support staff works closely with the Asian carp stakeholder partners and assists ACRCC activities to ensure effective interagency collaboration including the following:

- Development and refinement of the annual Asian Carp Action Plan.
- Facilitation of meetings and outreach activities to keep the public and ACRCC member agencies aware and engaged in the partnership's mission to protect the Great Lakes from Asian carp.

Proposed Actions for FY 2020:

The ACRCC program support provides assistance through the following primary efforts:

- Development of the annual Asian Carp Action Plan, including interagency and intergovernmental coordination; and communication and outreach.
- Working with the ACRCC and other stakeholders both in the Great Lakes and in the Mississippi River basins.
- Assists in ensuring bi-national (U.S. and Canada) coordination in sharing of Asian carp control information, including efforts under the national Asian carp control plans.
- Assists the USFWS in the development of the annual report identified in WRRDA 2014.

In FY 2020, the ACRCC program support will work with the ACRCC and interested stakeholder and be actively involved in the following:

- Provide support to the ACRCC co-chairs to support the activities of the ACRCC.
- Convening ACRCC calls once a month to discuss progress made on control activities.
- Assist in convening twice a year ACRCC face-to-face meetings to discuss agency input, as directed by the ACRCC co-chairs.
- Provide support for preparation of Congressional briefings by the ACRCC, as needed and as directed by the ACRCC co-chairs.

- Support the stakeholder consensus building process for long-term solutions to address aquatic nuisance species transfer between the Great Lakes and Mississippi River basins as directed by the ACRCC co-chairs.
- Assist in convening public updates with agencies and stakeholders across the Great Lakes as directed by the ACRCC co-chairs.
- Assist the MRWG in the development and release of the MRP and work with the MRWG to help coordinate the extensive monitoring under the MRP for the CAWS and the Illinois River.
- Attend CAWS AIS Stakeholder Committee and Technical and Policy Work Group meetings, as directed by the ACRCC co-chairs.

The ACRCC program support will assist the USFWS in the development of the Asian carp annual WRRDA report. This may include assisting with the following:

- Soliciting and collating necessary information and data (annual expenditures, accomplishments, planned research, etc.).
- Compiling, editing, and drafting narrative summaries.

Additional duties to be completed by the ACRCC program support will include providing support to the USFWS on development and execution of outreach and engagement efforts on the WRRDA Report conclusions and recommendations with appropriate State and nongovernmental partners, following delivery of the WRRDA Report to the designated Congressional committees by the USFWS.

The ACRCC program support staff will assist in the efforts to share information on Asian carp control plans. This will include working with states both within Great Lakes basin and in the Mississippi River basin.

In FY 2020, the ACRCC program support staff will assist the ACRCC co-chairs and the ACRCC members in the identification and development of projects for the 2021 Action Plan. The ACRCC program support staff will assist in the effort to coordinate and support agencies in their efforts to work together to implement efforts that prevent invasive Asian carp from establishing in the Great Lakes.

The ACRCC program support staff will also work with the USFWS and Illinois DNR to continue the coordination of Great Lakes Asian carp prevention communication effort by engaging Federal, state, and local governmental units; stakeholders in both the private and public sectors; Congressional committees, subcommittees, and staff; and media contacts. The ACRCC program support staff will also work with the Communication Work Group on the release of the Asian Carp Action Plan and will work with the MRWG on development and release of the MRP.

What's New in 2020: This project has been reduced in scope and in funding requested.

Expected Milestones: Milestones will be dependent on work requested by USFWS and the ACRCC.

What Is Deliverable for this Funding:

- Assist in the development of the 2021 Asian Carp Action Plan, including interagency and intergovernmental coordination, and communication and outreach.
- Assist in the development of the annual WRRDA report.
- Support to the ACRCC co-chairs in support of activities of the ACRCC.
- Assist in convening twice a year ACRCC face-to-face meetings to discuss agency input, as directed by the ACRCC co-chairs.
- Assist in convening Congressional briefings, as needed and as directed by the ACRCC co-chairs.
- As directed by ACRCC co-chairs, support the stakeholder consensus building process for long-term solutions to address aquatic nuisance species transfer between the Great Lakes and Mississippi River basins.
- Assist in convening public updates with agencies and stakeholders across the Great Lakes, as directed by the ACRCC co-chairs.
- Attend CAWS AIS Stakeholder Committee and Technical and Policy Work Group meetings, as directed by the ACRCC co-chairs.

Expected Completion Date for Project: September 2021

Potential Hurdles: None

How will the results of this project be disseminated? There are no direct results related to this project. However, this effort will assist other ACRCC agencies with project dissemination.

What National Asian Carp Plan goals and recommendations does this project support: This effort supports:

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 7: Effectively plan, implement, and evaluate management and control efforts for Bighead, Black, Grass, and Silver Carp in the United States.

PO-2 Administrative and Facilitation Support for the Chicago Area Waterway System Aquatic Invasive Species Stakeholder Group

Lead Agency: Northwestern Indiana Regional Planning Commission (NIRPC)

Agency Collaboration: The Chicago Area Waterway System (CAWS) Aquatic Invasive Species (AIS) Stakeholder Group includes approximately 30 public and private stakeholders that benefit from and have responsibilities related to the CAWS, as well as regional stakeholder groups representing commercial, recreational, and environmental interests. The City of Chicago, Illinois Department of Natural Resources (DNR), Illinois Department of Transportation, Illinois Environmental Protection Agency (EPA), Indiana Department of Environmental Management (IDEM), Indiana Department of Transportation, Michigan DNR, U.S. Army Corps of Engineers (USACE), U.S. Department of Transportation, the Great Lakes Commission (GLC) and the Indiana Wildlife Federation are ex officio members of the committee. The committee's resource group includes U.S. and Canadian federal, state and provincial agencies, tribal authorities, and regional agencies.

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$0	$67,300

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

The NIRPC began administration activities for the CAWS AIS Stakeholder Group (Stakeholder Group), as a sub-grantee of the Great Lakes Commission in January of 2019. The members are committed to maintaining the Group and continuing to focus on both near-term and long-term solutions to preventing AIS transfer through the CAWS. In 2018, the group adopted new operating principles and a workplan that NIRPC is charged with helping them to implement.

Summary of Actions to Date: During the first 3 quarters of 2019 NIRPC staff created a new website home for AIS and the Stakeholder Group, https://www.nirpc.org/invasive-species-and-the-chicago-area-waterway-system/, built new constant contact distribution lists of the 97 individuals representing Stakeholder Group members, resource people, and observers, became familiar with the Brandon Road Project, and got to know the Steering Committee members through monthly conference calls.

The Stakeholder Group is the only stakeholder forum in place to receive reports from, and provide input to, federal and state agencies. While the group's dynamics have been challenging, it continues to play a valuable role in ensuring the transparent exchange of information and perspectives on options for preventing AIS movement through the CAWS. It has a particularly important role to play in building stakeholder support for high-profile investments, such as the proposed Brandon Road Project.

Proposed Actions for FY 2020: The Stakeholder Group's primary focus in 2020 will be on advancing the proposed plan for control actions at the Brandon Road Lock and Dam, coordinating with non-federal sponsor(s) on options for the non-federal cost share, and exploring options for long-term operations and maintenance.

The Stakeholder Group is currently monitoring and supporting research into efficacy and scalability of newer AIS control measures proposed in the long-term Brandon Road Selected Plan as well as the negotiation of a non-federal sponsor agreement with the State of Illinois for Preliminary Engineering and Design. There is significant regional and Congressional interest in the Brandon Road Selected Plan, and the Stakeholder Group is an important forum for exchanging information and receiving updates from the USACE, USFWS, the State of Illinois, and other federal and state agencies.

The Stakeholder Group provides an ongoing well-informed and broadly representative forum for coordinating with state leaders. This will continue to be a critical function to ensure broad understanding of state and federal perspectives, and support for the project.

Beyond potential control actions at Brandon Road, the Stakeholder Group will continue to provide input on prevention and control actions being led by federal and state agencies; the work of the ACRCC; AIS lock treatment concepts; outcomes from hydrology and hydraulic investigations of impacts from AIS controls in the CAWS; cost-share options for new control actions; impacts to maritime transportation in the CAWS; and general review of the status, impacts and trends of AIS in the Great Lakes and Mississippi River basins.

What's New in FY 2020: The 2020 effort is specifically focused on proposed control actions at Brandon Road and implementation of the final Chief's Report. Other activities in the Stakeholder Group workplan that NIRPC plans to start is a small work group to explore near-term and longer-term efforts to prevent two-way AIS movement through the CAWS.

Expected Milestones: The following are general milestones anticipated during the project period. Exact dates for meetings may vary based on the needs of the Group and other factors.

Project Oversight	Ongoing
Steering Committee	Monthly
CAWS Group and Workgroup Meetings and Webinars	
CAWS Group meeting #1	FY2020 Q4
CAWS Group meeting #2	FY 2021 Q1
CAWS Group meeting #3	FY 2021 Q3
Work Group Meetings (as needed)	To be convened as needed
Webinars (as needed)	To be convened as needed
Mediation of Specific Issues	Ongoing
Communications & Logistical Support	Ongoing

What Is Deliverable for this Funding:

- Planning and facilitation support for a minimum of three CAWS group meetings.
- Convening monthly calls with the steering committee for the CAWS group.
- Planning and facilitation of workgroup meetings and webinars, as needed.
- Coordination with relevant agencies and organizations to secure information and speakers for CAWS group meetings and webinars.
- Preparation of correspondence and statements from the CAWS group, as requested.
- Mediation of key issues with CAWS group members.
- Development of technical presentations and reports, as requested.
- Coordination and communication with the ACRCC, Technical and Policy Work Group, and other relevant groups, as needed.

Expected Completion Date for Project: The requested funding is for administrative and facilitation support to the Stakeholder Group for approximately one year.

Potential Hurdles:

- Continue strengthening the overall effectiveness of the group, trust, and a common focus.
- Complete and timely reporting from federal agencies on relevant work.

How will the results of this project be disseminated?

Project results will be disseminated primarily through the members of the Stakeholder Group and via their membership and communications mechanisms. A website will be maintained for the Stakeholder Group for its materials, and the administrative support organization will report out to appropriate forums, such as the ACRCC, GLC meetings, etc.

What National Asian Carp Plan goals and recommendations does this project support:

Goal 5: Provide information to the public, commercial entities, and government agencies to improve effective management and control of Bighead, Black, Grass, and Silver Carp in the United States.

Goal 7: Effectively plan, implement, and evaluate management and control efforts for Bighead, Black, Grass, and Silver Carp in the United States.

PO-3 Great Lakes and Mississippi River Interbasin Study (GLMRIS)

Lead Agency: U.S. Army Corps of Engineers (USACE)

Agency Collaboration: None

FY 2020 Funding Table:

Agency Funding Expected	Asian Carp GLRI Funding Requested
$315,000	$0

**All FY 2020 funding projections are based on appropriations provided by Public Law 116-94.*

Project Explanation

The proposed work includes vertical team coordination, stakeholder coordination and engagement, budget development and defense, public outreach, Asian Carp Regional Coordinating Committee (ACRCC) and Chicago Area Waterway System (CAWS) Aquatic Invasive Species (AIS) (Stakeholder Group) related activities, and response to Congressional and media inquiries.

Summary of Actions to Date: USACE completed the Great Lakes and Mississippi River Interbasin Study (GLMRIS) Report in January 2014, which evaluated options and technologies available to prevent the spread of aquatic nuisance species in either direction between the Great Lakes and Mississippi River basins through the Chicago Sanitary and Ship Canal (CSSC), and other aquatic pathways. The Report identified multiple alternatives including alternatives at the Brandon Road Lock and Dam, which were evaluated in a separate, stand-alone feasibility study. The Brandon Road Study was completed when the Chief's Report was signed on May 23, 2019 and sent to Congress.

Proposed Actions for FY 2020: Continue vertical team coordination, stakeholder coordination and engagement, budget development and defense, public outreach, ACRCC, and Stakeholder Group related activities, and response to Congressional and media inquiries.

What's New in FY 2020:

Expected Milestones: To be determined.

What Is Deliverable for this Funding: Vertical team coordination, stakeholder coordination and engagement, budget development and defense, public outreach, ACRCC and Stakeholder Group related activities, and response to Congressional and media inquiries.

Expected Completion Date for Project: Not applicable.

Potential Hurdles: None.

How will the results of this project be disseminated? Not applicable.