

ASIAN CARP

Control Strategy Framework

June 2014

Asian Carp Control Strategy Framework

June 2014

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U.S. Army Corps of Engineers
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U.S. Department of Transportation/Maritime Administration
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Geological Survey
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EXECUTIVE SUMMARY

Asian carp, particularly bighead and silver carp, pose a significant threat to the waters they invade. One of the most severe aquatic invasive species (AIS) threats facing the Great Lakes today is movement of Asian carp species through the Chicago Area Waterway System (CAWS) and other pathways that can connect the Great Lakes and the Mississippi River Basin.

Asian Carp Impact

<p>Phytoplankton Photosynthetic primary producers. Act as the main energy input to the Great Lakes ecosystem. Composed of green algae, blue-green algae, and diatoms. Currently, populations are in decline and species composition is shifting, leaving them particularly vulnerable</p>	<p>Consumption: Asian carp are voracious consumers of phytoplankton. They have highly developed physiology tailored to consuming microscopic organisms. Given the weakened state of primary producers in the Great Lakes, additional stress on phytoplankton could be devastating</p>
<p>Zooplankton Large group of microorganisms with high varied feeding habits. Act as a major food source within the Great Lakes, including for fish in early life-stages</p>	<p>Consumption and Competition: Asian carp are voracious consumers of zooplankton. Zooplankton, which primarily feed on phytoplankton and other zooplankton, would also be forced to directly compete with Asian carp for food sources. These coupled pressures of predation and competition could have a large impact on zooplankton populations.</p>
<p>Macroinvertebrates Wide ranging group of organisms that primarily live in lake sediment. Includes many larval insects, and so has ties to terrestrial ecosystems. Feed primarily on detritus and plankton, and act as food source to foraging fish</p>	<p>Consumption and Competition: Asian carp impact on macroinvertebrates would vary on a species-by-species basis, dependent on food source. For macroinvertebrates that depend primarily on plankton as a food source (mussels, shrimp, mollusks) Asian carp would be in direct competition. For those that depend on detritus for food, there would be less direct competition, but these macroinvertebrates could still be effected by the overall reduction in energy in the ecosystem. Asian carp would also likely consume early life-stage macroinvertebrates</p>
<p>Foraging Fish Large group of fish, including commercially/recreationally important species: Yellow perch, bloaters, whitefish, etc. Utilize variety of food sources, including plankton and macroinvertebrates</p>	<p>Competition and Food Source Reduction: Asian carp impact on foraging fish would be dependent on food source. Foraging fish that consume plankton would suffer from the impacts of direct competition with Asian carp. All foraging fish would likely experience food source reductions, as Asian carp impact on primary producers would decrease the total energy in the ecosystem.</p>
<p>Piscivorous Fish Group of predatory fish which feed primarily on other fish, although other food sources are utilized in early life-stages. Include commercially and recreationally important species: bass, trout, walleye, salmon</p>	<p>Food Source Reduction: Asian carp impact on predatorial fish would largely be a result of decreased energy in the ecosystem and decreased food sources. Asian carp would also likely impact the recruitment process of early life-stage fish, as at this stage of development the fish would be in direct competition with Asian carp for plankton-based food sources.</p>

The Obama Administration is implementing an unprecedented and comprehensive set of actions to prevent the introduction and establishment of bighead and silver carp populations in the Great Lakes. These actions are being carried out by the Asian Carp Regional Coordinating Committee (ACRCC), with support from federal, state, provincial, and local agencies, and from private stakeholders and citizens. The ACRCC implements actions for protecting and maintaining the Great Lakes ecosystem from an Asian carp invasion via all viable aquatic pathways. The ACRCC management strategy and current and future

actions are reported annually in the Asian Carp Control Strategy Framework (Framework) using the best science available. The Framework is accessible online at www.asiancarp.us.

The Framework's strategy is to perform activities that will directly prevent bighead and silver carp dispersal towards the Great Lakes. Each Framework action item is categorized within a component of the Framework strategy and addresses specific management actions. The Asian carp control strategy features the following new initiatives:

- Expanded harvesting of silver and bighead carp downstream of the electric barriers
- New electric barrier construction
- Water gun testing and the evaluation of other potential control technologies at Brandon Road Lock and Dam approach site to determine whether fish can be kept out of locks
- Field testing of a fish toxicant (microparticle)
- Construction of Eagle Marsh berm to stop Asian carp threatening Lake Erie
- Identifying options for blocking carp pathways at Killbuck Creek and the Ohio-Erie Canal in Ohio
- Development of a hand-held real-time deoxyribonucleic acid (DNA) detection kit
- Further work on the future of water transport in the CAWS

Since 2009, when bighead and silver carp environmental DNA (eDNA) appeared in the CAWS, the Asian carp control efforts focused on CAWS fish population monitoring and frequent eDNA sampling, which triggered repeated response actions that found only one live bighead carp. Critical risk reduction efforts with improvements in the electrical barrier system and research into potential control technologies were investment priorities. After 4 years of dedicating significant resources to monitoring and other activities, Asian carp assessment efforts have shown that the Asian carp situation has stabilized from the exigencies of 2009.

The 2014 Asian Carp Framework outlines efforts to support activities that will directly prevent bighead and silver carp dispersal towards the Great Lakes. For example, the U.S. Fish and Wildlife Service (USFWS) now has a better understanding of the bighead and silver carp population dynamics and has refined its assessment techniques. USACE has made significant investments to upgrade the electrical barrier system and improve its effectiveness, and is developing and testing control tools (water gun), chemical tools (microparticle/selective toxin), and pheromone attractants to increase the efficacy of the barriers.

The 2014 Framework will focus on developing interim solutions for preventing the transfer of carp into the Great Lakes through the CAWS and field deployment of carp control tools currently under development. In 2014, the ACRC will focus on efforts needed to further accelerate the identification, evaluation, design, and implementation of carp control measures in both the CAWS and other pathways including Eagle Marsh, Little Killbuck Creek, and the Ohio-Erie Canal. This new direction will include support for positioning key agencies to continue refinement and assessment of both structural and non-structural Asian carp control technologies in the CAWS.

Critical efforts that are underway and planned as part of this 2014 Framework include the following:

Targeted Monitoring and Assessment - In 2014, the monitoring efforts will increase below the electrical barrier system to strengthen ACRCC's ability to evaluate the bighead and silver carp population. The effort will ensure that bighead and silver carp, including larval stages (small fish), are not approaching the electrical barrier system. In addition, intensive surveys will be undertaken in the CAWS (Lake Calumet and the North Channel). USFWS will continue development and implementation of a comprehensive and complementary early detection and rapid assessment surveillance program for bighead, silver, grass, and black carp in and near the Great Lakes, using a combination of conventional and novel sampling techniques and equipment in strategic locations.

Commercial Harvesting and Removal Actions - In 2013, a total of 56,435 bighead carp, 94,071 silver carp, and 799 grass carp were removed from the upper Illinois and lower Des Plaines rivers, downstream of the electrical dispersal barrier system by contracted netting. In 2014, contracted commercial fishing crews will reduce the numbers of bighead and silver carp in the upper Illinois and lower Des Plaines rivers. Crews will implement lessons learned from previous years shifting their efforts to spring and fall to increase the number of fish harvested. Commercial harvest will increase in the areas downstream of the electric barrier system.

GLMRIS and Other Pathway Closures - U.S. Army Corps of Engineers (USACE) recently completed the Great Lakes and Mississippi River Interbasin Study (GLMRIS) Report, which laid out an array of alternatives—at a conceptual level—to prevent the transmission of invasive species between the Mississippi River and Great Lakes basins, but did not recommend a particular plan or project. Currently the Great Lakes region is evaluating the alternatives identified in the report in an effort to select a regional recommendation for moving forward.

The GLMRIS Other Pathways report identified a number of potential pathways of concern for the transfer of aquatic invasive species between the Great Lakes and Mississippi River basins. The actions under the 2014 Framework will pursue closing of those pathways of concern for bighead and silver carp. Those pathways presently include, and are limited to, Eagle Marsh (Indiana), Killbuck Creek (Ohio), and Ohio Erie Canal (Ohio).

Control Activities - Redundancy provided by additional control activities will improve the efficacy of the electrical barrier system. A third new electric barrier will be completed by 2016. Two barriers will be on constantly and the third in warm standby. In 2014, carbon dioxide gas (CO₂) and water guns will be field tested as barriers that generate noxious water conditions preventing Asian carp from entering locks and approaching an electric barrier.

Interim actions being considered in the Framework will have an impact on commercial transportation in the CAWS. To better understand this, transportation impacts will be evaluated through developing a better understanding of the current commercial transportation status, projected trends, and infrastructure and related needs to support the long-term economic viability of commercial

transportation on the CAWS, including opportunities for improved multi-modal connectivity. This study will be conducted in collaboration with the US Department of Transportation, other federal agencies, the Great Lakes states, existing users of the CAWS, and other interested parties.

Control Technology Development - Because long-term solutions for controlling carp have projected timelines of at least 10 years, interim solutions to the control of bighead and silver carp in the CAWS will be further defined, designed, and implemented, where technically and financially feasible. The ACRCC has concluded that adding interim measures at Brandon Road Lock and Dam has the opportunity to provide significant risk reduction. The Framework focuses on technologies such as carbon dioxide as a repellent, ozonation, fish toxicants, water guns, attractants, and other related technologies. Actions will include development of environmental assessments; registration of chemical or biological pesticides, where necessary; and moving the developed tools to fisheries' management agencies in the CAWS as well as across the Great Lakes basin. In addition field deployment of the water gun, will be undertaken and an assessment of hydraulic and water-quality influences on bighead and silver carp movement, spawning and recruitment will be completed.

Control Technologies – Brandon Road - The GLMRIS report identified the Brandon Road Lock and Dam area as a potential location for future measures to control the movement of bighead and silver carp. As such much of the effort will focus on this area. The 2014 efforts will include:

- Understanding of the impacts of boats locking through structures and other influences that could constrain the deployment of the technologies
- Understanding fish presence and movement (bighead and silver carp and native fishes) around and through these structures
- Additional studies on water quality and quantity effects on structure design, construction, and operation

eDNA - Early detection and monitoring is a vital part of managing any invasive species, including bighead and silver carp. Significant efforts have been made in the CAWS to detect the bighead and silver carp invasion front. However, Asian carp are highly successful at avoiding traditional capture gear, thereby providing limited utility in finding bighead and silver carp at low density using this technique. The ACRCC will continue to support the application and use of eDNA monitoring in the CAWS as an early detection tool for bighead and silver carp DNA.

In addition, the USGS will be developing a hand-held, real-time eDNA field detection kit. This kit will be a field-deployable and cost-effective hand-held device for the detection of bighead and silver carp DNA in as little as 12 minutes.

USACE will also be undertaking research to use eDNA as a stock assessment tool to better understand bighead and silver carp populations and for tracking impacts of control measures. The goal is to take the

basic eDNA approach to provide information on populations that otherwise are unattainable without significant hands-on efforts to capture and process fish, such as age, health, and gender.

Enforcement - Although transfer of bighead and silver carp is currently illegal, the 2014 Framework will provide funding for stricter enforcement to mitigate the risk of transfer. USFWS and Illinois DNR have expanded surveillance and enforcement and increased their efforts to target and interdict federally listed invasive species at border locations, and pursue prosecution of individuals involved in illegally importing or transporting federally listed injurious species in interstate commerce.

Outreach/Education/Training - In 2014, The ACRCC will continue efforts to expand outreach, education, and training efforts. The USFWS website, www.asiancarp.us will continue to be the ACRCC's central platform for public outreach and education. The Framework will include funding for a new video project focusing on the new or enhanced Asian carp assessment techniques supported by the ACRCC.

Asian Carp Control Toolkit - An important communication tool of the ACRCC that was recently developed is the Asian Carp Control Technology Toolkit. The ACRCC directs funding to numerous projects to develop new technologies for the control and assessment of Asian carp in the Great Lakes. The toolkit is an on-line tool providing basic information to resource managers on the process of development of:

- Control technologies
- Assessment technologies
- Communication efforts

The toolkit contains resources designed to assist in the efforts to control, plan, and communicate actions to control Asian carp in the CAWS, the Great Lakes, and across the United States and Canada, where necessary. The toolkit is intended to be simple and, to the extent possible, uses links to agency websites where additional information on each tool is available. The toolkit is directed to fisheries resource managers and identifies where and when specific technologies would be appropriate for use. The toolkit will be a living document, with current information added as it becomes available. The toolkit can be found online at www.asiancarp.us.

1.0 INTRODUCTION

Species of carp not native to the United States, specifically Asian carp (bighead and silver carp), represent one of the greatest aquatic invasive species (AIS) threats to the waters of the Great Lakes and other aquatic ecosystems. Grass carp have already spread into the Great Lakes, and black carp are currently found in the Mississippi River basin, including the Illinois Waterway. Bighead and silver carp may be introduced into the Great Lakes through many various pathways, such as connecting waterways, accidental or willful human release of live fish, bait bucket transfer, ballast water exchange, and others.

This 2014 Asian Carp Control Strategy Framework (Framework) has been prepared by the Asian Carp Regional Coordinating Committee's (ACRCC) participating agencies, states, and stakeholders to specify actions for preventing and controlling bighead and silver carp movement. The actions described in this document are intended to address and control each of the pathways through which Asian carp could be introduced to the Great Lakes to the greatest extent feasible, while employing the latest in scientific advances and technology.

For the purposes of this Framework, Asian carp refers to bighead and silver carp; grass and black carp are not specifically included in this document. However, efforts to contain black and grass carp, species of increasing concern, will also benefit from actions specified in the Framework. Additionally, the action items presented in the Framework are limited to the Chicago Area Waterway System (CAWS) and the Great Lakes Basin.

With support from United States and Canadian federal, state/provincial, and local agencies, and from other private stakeholder entities, the ACRCC will create a sustainable Asian carp control program for protecting the Great Lakes ecosystem by preventing the introduction and establishment of an Asian carp population in the Great Lakes via all viable pathways. This Framework describes the strategies and proposed action items necessary to achieve that goal.

What's New in 2014

The Asian Carp Control Strategy Framework features the following new initiatives in 2014:

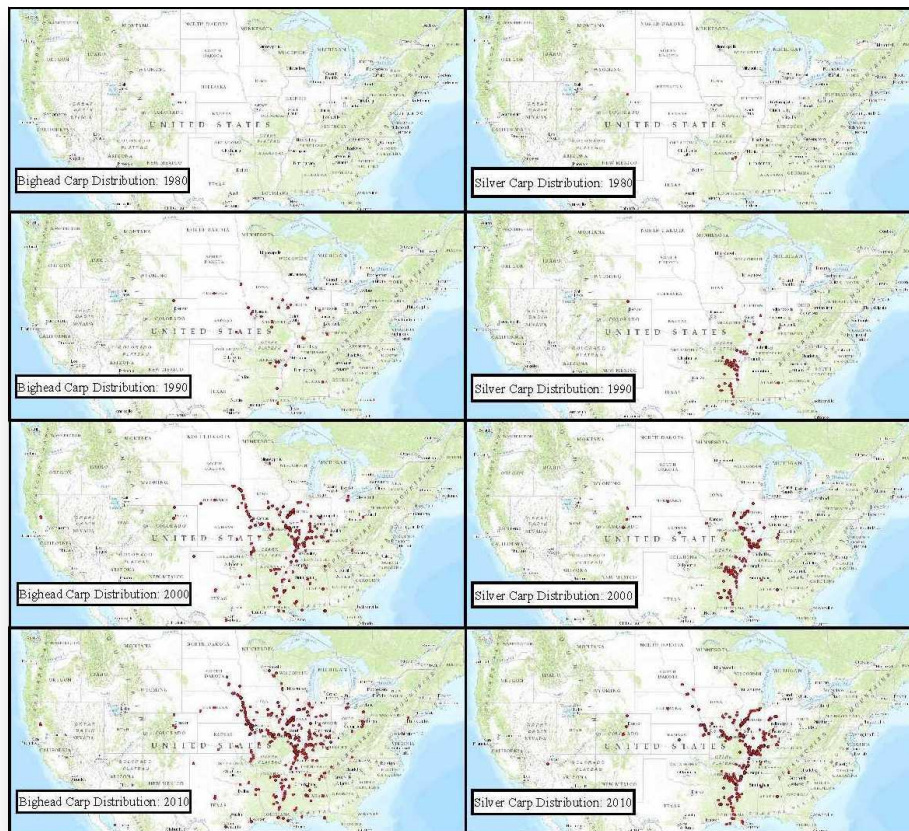
- Expanded harvesting of silver and bighead carp downstream of the electric barriers
- New electric barrier construction to replace the old demonstration barrier
- Water gun testing and evaluation of other control technologies at Brandon Road Lock and Dam approach site to determine whether fish can be kept out of locks
- Field testing of a fish toxicant (microparticle)
- Construction of Eagle Marsh berm to stop Asian carp threatening Lake Erie
- Identifying options for blocking carp pathways at Little Killbuck Creek and the Ohio-Erie Canal in Ohio
- Development of a hand-held, real-time deoxyribonucleic acid (DNA) detection kit
- Further work on the future of water transport in the Chicago area

This Framework provides an introduction, background information, and the ACRCC program focus in Section 1.0. Section 2.0 presents the ACRCC strategy for Asian carp management. Section 3.0 presents many of the specific efforts underway and planned for by involved stakeholder agencies under this iteration of the Framework. The ACRCC organizational structure is presented in Section 4.0 and additional stakeholder coordination is discussed in Section 5.0.

1.1 Situation

The geographic range of bighead and silver carp species is expanding in the Mississippi River Basin and threatening invasion into the Great Lakes. Since the beginning of the 19th century, more than 180 non-native species have been introduced into the Great Lakes, and some species have become invasive, causing ecological or economic damage, and threatening human health. These invasive fish, invertebrates, viruses, bacteria, and parasites can devastate native communities and cause great economic damage to the Great Lakes' commercial, sport, and tribal fisheries. The potential invasion of bighead and silver carp is one of the most serious invasive species threats facing the Great Lakes today. Figure 1 below shows the increase of silver and bighead carp in distribution throughout the United States since 1980.

Figure 1. Bighead and Silver Carp Distribution Since 1980



The ecological and economic damage in the Mississippi River watershed that followed the bighead and silver carp invasion is a forewarning of potential impacts of bighead and silver carp on the Great Lakes. The damage in the Mississippi River watershed has inspired extensive mobilization of local, state, and federal agencies, and the creation of the Asian Carp Regional Coordinating Committee (ACRCC)—a unified team responsible for coordinating and conducting activities to prevent a bighead and silver carp invasion into the Great Lakes.

Establishment of bighead and silver carp in the Great Lakes would have potentially long-lasting and negative effects on both the economic and social value of the lakes. The potential impact of bighead and silver carp on the Great Lakes would be multifaceted, affecting the ecology, biology, and economic and social function of the Great Lakes region. Each wide-ranging impact is interrelated, with complex relationships and feedback mechanisms. As a result, it is necessary to create an active, multi-disciplinary approach to understand, address, and prevent bighead and silver carp introduction into the Great Lakes.

Current conditions within the Great Lakes and their tributaries and estuaries are suitable for bighead and silver carp survival and reproduction. In particular, water temperature, food abundance, area for expansion, lack of natural predators, and flow regimes and wetland areas in tributaries and estuaries of the lakes may allow for the rapid establishment and propagation of bighead and silver carp throughout the lakes. The sections below detail the ecological and biological, social, and financial risks associated with Asian carp invasion in the Great Lakes.

1.1.1 Ecological and Biological Risk

The threat to the Great Lakes ecosystem represented by bighead and silver carp invasion is the foundational element that also impacts all other systems (financial, recreational, social, etc.). Aquatic invasive species, from sea lamprey to zebra mussel, have already had significant impacts on the Great Lakes ecosystem. These impacts have rippled out through multiple levels of the ecosystem, affecting commercial, recreational, and social practices in the entire region. The potential impact of bighead and silver carp is similar to the impact seen from past aquatic invasive species.

The Binational Ecological Risk Assessment of Bigheaded Carps (*Hypophthalmichthys* spp.) for the Great Lakes Basin¹ suggests that the major ecological consequence resulting from the establishment and spread of Asian carp into the Great Lakes would likely be an overall decline in certain native fish species, including some commercially and recreationally important ones. Such declines could occur because Asian carp would compete with prey fish that primarily eat plankton. This could lead to reduced growth rates and declines in abundance of prey fish species, and thus predatory fish would also likely decline. Asian carp also reduce survival of open-water fish larvae -- like those of walleye and yellow perch -- most likely through competition for plankton or by preying on the larvae.

The Great Lakes and their associated tributaries represent a viable habitat for the fish because carp can tolerate the climate of the Great Lakes; bighead carp tolerate mean annual air temperatures between 28° Fahrenheit (-2°Celsius) and 72° Fahrenheit (22°Celsius), and silver carp between 21° Fahrenheit (-

¹ Cudmore, B., N.E. Mandrak, J. Dettmers, D.C. Chapman, and C.S. Kolar. Binational ecological risk assessment of bigheaded carps (*Hypophthalmichthys* spp.) for the Great Lakes Basin. Fisheries and Oceans Canada. 2012.

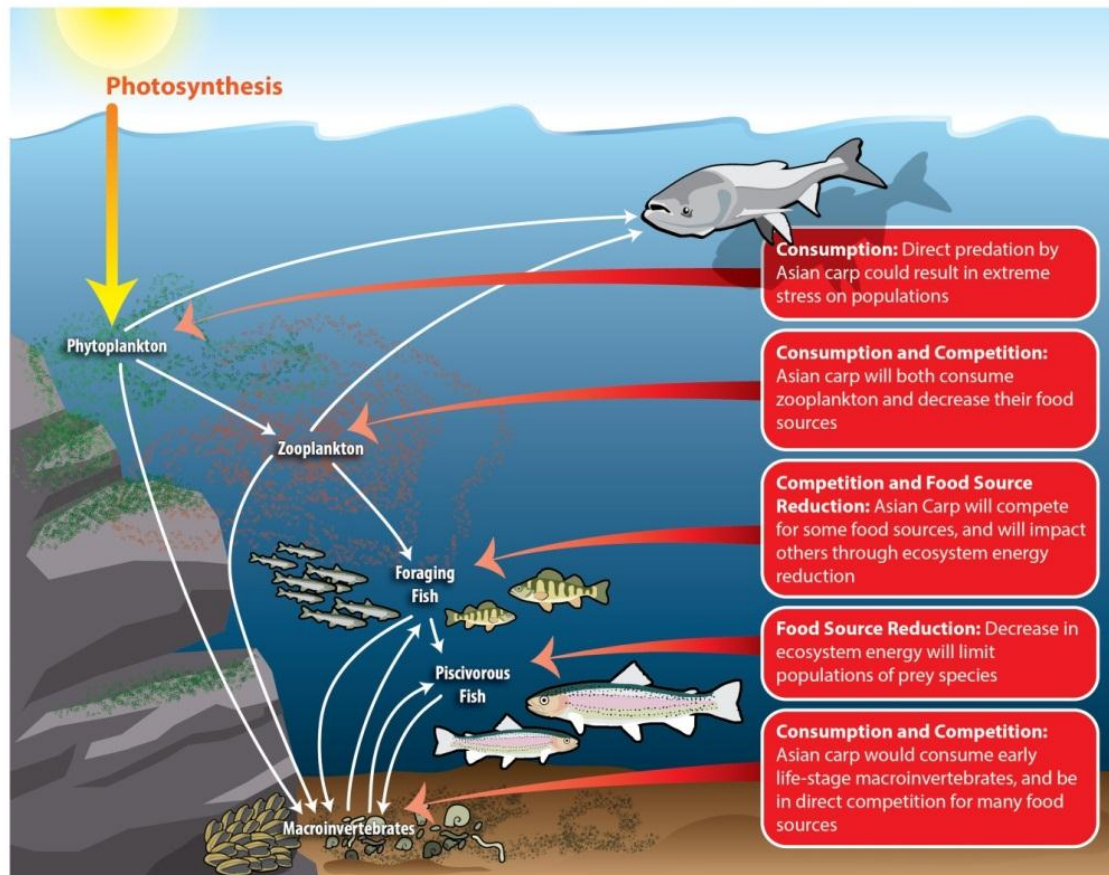
6°Celsius) -and 75° Fahrenheit (24°Celsius). This climate range covers much of the United States and Canada, including the Great Lakes region². The wetland areas surrounding the Great Lakes would provide habitat well suited to young bighead and silver carp, allowing them to develop in somewhat protected areas with ample food sources, which would support their invasion, propagation, and spread. Bighead and silver carp are primarily filter feeders, with specialized physiology particularly suited to removing extremely fine particles and organisms from water; however, research has indicated that bighead and silver carp can support themselves on other food sources when plankton is not plentiful. This indicates that they could spread throughout the Great Lakes, including areas with relatively low amounts of plankton available for feeding.

Bighead and silver carp are equipped to greatly out-compete native species within the Great Lakes. These Asian carp are at a distinct advantage because they grow extremely quickly and reach large sizes. Silver carp have been observed to grow to 12 pounds within their first year of life, and reach weights of approximately 60 pounds. Bighead carp can reach weights of approximately 110 pounds³. Figure 2 illustrates the current structure of a Great Lakes ecosystem, and outlines the potential impacts of bighead and silver carp introduction on various feeding guilds.

² Hansen, M. 2010. The Asian Carp Threat to the Great Lakes. Accessed September 18, 2011. On-line address: http://www.glf.org/fishmgmt/Hansen_testimony_aisancarp.pdf. Great Lakes Fisheries Committee, Ann Arbor, Michigan..

³ U.S. Fish and Wildlife Service. “Asian Carp – Aquatic Invasive Species. Issues, Program Accomplishments, and Program Needs.” On-line Address: <http://www.fws.gov/midwest/fisheries/library/fact-aisancarp.pdf>. Accessed on March 22, 2014.

Figure 2. Asian Carp Impact on Great Lakes Ecosystem



1.1.2 Social Risk

The social implications of a bighead and silver carp invasion within the Great lakes range from indirect (outcompeting and thus impacting native sport fish populations) to direct (physical harm to people). The Great Lakes Commission (GLC) estimates that nearly 1 million boats and personal watercraft operate on the lakes⁴, thereby placing more than a million people in potential contact with the silver carp, a projectile fish. The social risk that bighead and silver carp represent to the Great Lakes is directly relevant to the financial risk as well. If bighead and silver carp do make their way into the Great Lakes, recreational activities could be significantly affected, directly impacting revenue based on those activities.

1.1.3 Financial Risk

As Great Lakes leaders know from experience, dealing with invasive species after they have become established is difficult and expensive, and eradication is unlikely. For example, the United States and

⁴ Hansen, M. 2010. The Asian Carp Threat to the Great Lakes. Accessed September 18, 2011. On-line address: http://www.glf.org/fishmgmt/Hansen_testimony_aisancarp.pdf. Great Lakes Fisheries Committee, Ann Arbor, Michigan..

Canadian governments have spent over \$300 million since 1956 to control sea lampreys, an invasive species to the Great Lakes.

Existing AIS have an expansive impact on the economy of the Great Lakes region. A study commissioned by The Nature Conservancy analyzed the economic impact of AIS. While the study did not provide a specific dollar-amount impact, it did discover an annual cost of significantly more than \$100 million⁵. Also, this estimate only considers the current state and extent of invasive species within the Great Lakes region. If bighead and silver carp were to spread through the Great Lakes, costs induced could increase.

Numerous industries are currently affected by AIS, and it can be assumed that these same industries would bear the brunt of economic costs associated with bighead and silver carp invasion of the Great Lakes. The main industries impacted by AIS include:

- **Sport and Commercial Fishing:** AIS change the composition and availability of species within an impacted water body.
- **Power Generation:** AIS can impact the water intake infrastructure of power generation facilities, which is especially relevant with zebra and quagga mussels. Bighead and silver carp would likely not directly impact these facilities, but could contribute to problems through ecosystem disruption and compete with native species that do not affect power generation.
- **Shipping Industry:** AIS may impact shipping businesses primarily by making it necessary to institute alternative practices, routes, or shipping methodology to avoid enabling movement or introduction of AIS into new areas.
- **Tourism and Recreation:** AIS primarily impact the tourism and recreation industries through ecosystem disruption. This disruption affects both the main attractions for tourism and recreation (fishing, boating) and public perception of the quality of the Great Lakes. Bighead and silver carp could have a huge impact, including lower-quality fisheries, potential danger from leaping silver carp, and the perception of carp as an undesirable fish.

Commercial and recreational fishing in the Great Lakes is an industry estimated to generate billions of dollars of revenue to the economies of both the United States and Canada⁶. An invasion of bighead and silver carp to the Great Lakes would be detrimental to the fishing industry and those financial assets.

1.2 Framework Background

Development of this Asian Carp Control Strategy Framework (Framework) began in 2009 when bighead and silver carp were observed in the Chicago and Sanitary Shipping Canal (CSSC) roughly 43 miles from Lake Michigan and downstream of the U.S. Army Corps of Engineers (USACE) electric barrier system. The original framework was provided in fiscal year (FY) 2010 to establish the mission of the ACRC and set forth a series of short-term and long-term actions to control the spread of bighead and silver carp and prevent establishment of a bighead and silver carp population within the Great Lakes. The goal was

⁵ Anderson Economic Group. 2012. "The Costs of Aquatic Invasive Species to Great Lakes States".

⁶ Barnhart, Gerald A. "The Threat Posed to the Great Lakes Basin by Asian Carp". House Subcommittee on Fisheries and Oceans. November 3, 2005.

to create a systematic multi-tiered defensive approach against Asian carp beyond relying solely on the USACE electric barriers in place in the CSSC. Since that time, the ACRCC has released yearly iterations of the Framework to focus the strategy amongst each of the participating stakeholder agencies, increase agency collaboration, and communicate new or existing actions plans to further control species movement and establishment into new waterways of the Great Lakes Basin.

The 2013 Framework marked a programmatic shift toward sustainable agency efforts. New and sustained efforts in 2013 focused on the expansion of control and assessment strategies within the United States and Canada. New efforts undertaken in 2013 included the following:

- Bi-national expansion of efforts with Canada (Department of Fishery and Oceans – Canada and Ontario Ministry of Natural Resources) joining the ACRCC to improve collaboration and the announcement of the Canadian 5-year Asian carp program
- ACRCC support for United States' national approach to Asian carp control and management as set forth under the Aquatic Nuisance Species Task Force (ANSTF)-approved Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States (National Asian Carp Management Plan)
- Transition operations and processing of environmental deoxyribonucleic acid (eDNA) from USACE to U.S. Fish and Wildlife Service (USFWS) where a sustainable program was created
- Expansion of bighead and silver carp monitoring efforts to southern Lake Michigan, western Lake Erie, and other potential invasion hotspots
- Design of a mobile electric dispersal barrier that can be deployed to move fish for containment and removal
- Mitigative efforts at locations outside of the CAWS identified as potential introduction points for invasive species between the Great Lakes and Mississippi River basins

1.3 ACRCC Transition

This Framework is the fifth Framework developed by the ACRCC and builds off the previous Frameworks. The strategy for moving forward identified in the Framework is based on lessons learned over the previous 4 years and has identified efficiencies based on these lessons learned. Each Federal and state partner agency identified a list of priority actions for their contribution to the 2014 Framework. These projects were then discussed with the project review team of CEQ and EPA staff. Some modifications were made and a project list was the circulated to the entire ACRCC team that includes state and federal agency partners. A workshop was held in April to review all projects in person and some adjustments were made to include multi agency coordination and participation to expand the scope of the projects and eliminate duplication of effort. Then a final project list was again circulated to the ACRCC for review and comments.

As mentioned above, the Framework has evolved and includes efficiencies based on lessons learned. These include:

- In previous years rapid response actions based on positive DNA finding for bighead and silver carp triggered response actions of intensive electrofishing and commercial fishing. These actions resulted in the finding of only one bighead carp in 2010. These actions are now scheduled and not in direct response to eDNA positives for bighead and silver carp.
- eDNA monitoring in the Chicago Area Waterway has been significantly reduced due to the conclusions realized through the eDNA calibration study. The study has concluded that eDNA could be from live fish or it could also be transported by barges, boats, birds and other sources into the CAWS.
- Control technologies, such as water guns and CO₂, have the potential to be significantly less costly than current technologies.
- Netting technologies, developed through previous Frameworks, have improved our effectiveness in catching bighead and silver carp in areas downstream of the electrical barrier.
- Commercial fishing is being shifted to fall and spring to be more efficient and effective in catching bighead and silver carp.
- The Framework is investing in registration of an effective toxicant specific to bighead and silver carp. This will provide a more efficient tool for removing Asian carp while not impacting the native fish populations.

As seen in Framework documents from previous years, the focus was on short and long-term controls to effectively reduce the risk of Asian carp invasion to the Great Lakes Basin. Through both agency base funding and the Great Lakes restoration Initiative (GLRI), supporting agencies have been able to develop, implement, and refine a wide variety of monitoring techniques and technologies for the control and management of bighead and silver carp

1.3.1 Strategic Program Focus

In 2013, the ACRCC began efforts to move towards program sustainability, and will continue these efforts. To advance the level of Asian carp management over the next several years, bighead and silver carp populations need to be reduced regionally and nationally rather than locally (Illinois Waterways). This will aid in the further protection of the Great Lakes as populations of bighead and silver carp are reduced in the areas where there are currently significant bighead and silver carp populations. To effectuate these actions, increased emphasis will be placed on implementing the recommendations of the National Carp Control Plan⁷.

The ACRCC will transition to focus on field testing and implementation of control technologies and long-term controls. In 2014, the ACRCC will focus its resources on the following areas:

⁷ U.S. Fish and Wildlife Service. 2007. Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States. November.

- Because the Great Lakes and Mississippi River Interbasin Study (GLMRIS) provides an array of alternatives that includes long-term solutions, interim solutions to the control of Asian carp in the CAWS will also be further defined, designed, and implemented where technically and financially feasible.
- ACRCC will support agencies' work to implement control and risk-reduction technologies that have been developed and refined over the past several years. The purpose of this would be to prepare agencies to utilize these control technologies later under agencies' base budgets. This effort would include technologies such as using a carbon dioxide barrier, fish toxicants, water guns, seismic technology, attractants, and other related technologies. Actions could include development of environmental assessments; registration, where necessary; and moving the tools that have been developed to management efforts to ensure fisheries management agencies across the Great Lakes basin are prepared to use such technologies, should it become necessary.

2.0 FRAMEWORK STRATEGY FOR ASIAN CARP CONTROL

This 2014 Framework marks a shift in the long-term strategy for the ACRCC. This section of the Framework provides the overview and strategic approach for Asian carp management as adopted by the ACRCC and each of the member agencies.

Since 2009, when bighead and silver carp eDNA appeared where the agencies did not expect to find it in the CAWS, the Asian carp control efforts focused on CAWS fish population monitoring and frequent eDNA sampling, triggering repeated response actions that found only one live bighead carp. Currently, an interagency eDNA Calibration Study (ECALS) is being conducted by USACE, USGS and USFWS to improve the understanding and interpretation of eDNA results. The study is:

- investigating potential alternative viable sources and pathways for DNA (other than a live fish),
- developing more efficient markers, decreasing the processing time for eDNA samples,
- determining the relationship between the number and distribution of positive eDNA samples with the number of Asian carp in the CAWS,
- determining the effect of environmental variables (light, temperature, water velocity) on the persistence and degradation of DNA in water,
- modeling eDNA transport in the CAWS,
- improving existing genetic markers, and
- Investigating ways we can make the eDNA process more efficient (decrease processing time and cost).

Critical risk reduction with improvements in the electrical barrier system and research into potential control technologies were investment priorities. After 4 years of dedicating significant GLRI resources to monitoring, bighead and silver carp assessment efforts have shown that the Asian carp situation has stabilized from the exigencies of 2009.

The USACE recently completed the GLMRIS report that identified an array of alternatives for preventing the transfer of aquatic invasive species between the Mississippi River and Great Lakes basins, which included options ranging from nonstructural measures to hydrological separation. The report also incorporated conceptual information on costs, impacts, and implementation timelines for the alternatives considered.

The 2014 Framework outlines efforts to support activities that will directly prevent bighead and silver carp dispersal towards the Great Lakes. For example, the ACRCC now has a better understanding of the bighead and silver carp population dynamics and has refined its assessment techniques; USACE has invested in upgrading the electrical barrier system and determining its effectiveness; and USGS is developing and testing control tools (water gun), chemical tools (microparticle/selective toxin), and pheromone attractants.

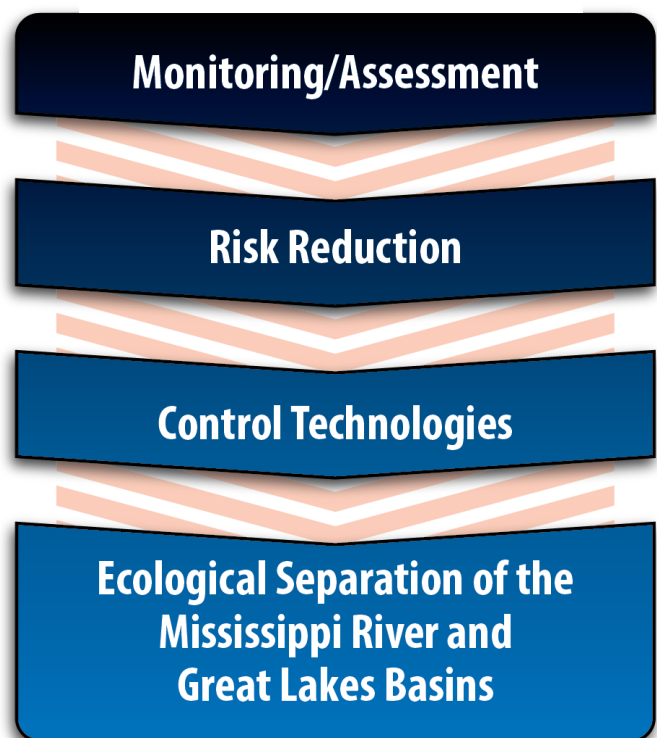
Because long-term solutions for controlling carp have projected timelines of at least 10 years, interim solutions to the control of bighead and silver carp in the CAWS will be further defined, designed and implemented, where technically and financially feasible. This effort would include technologies such as carbon dioxide as a repellent, fish toxicants, water guns, attractants, and other related technologies. Actions would include development of environmental assessments; registration, where necessary; and moving the developed tools to fisheries' management agencies in the CAWS as well as across the Great Lakes basin.

The GLMRIS Other Pathways report identified a number of potential aquatic pathways of concern for the transfer of aquatic invasive species between the Great Lakes and Mississippi River basins. The actions under the 2014 Framework will pursue closing of those pathways of concern for Asian carp. Those pathways include Eagle Marsh (Indiana), Killbuck Creek (Ohio), and Ohio Erie Canal (Ohio). These potential aquatic pathways were identified in the GLMRIS Focus Area 2 Other Aquatic Pathways assessment reports. Each pathway received overall ratings of medium or high for risk of transfer of bighead or silver carp.

GLMRIS was a multi-year investigation, undertaken by USACE, studying the range of options and technologies available and suitable given the target areas to prevent AIS between the Great Lakes and Mississippi River basins through existing aquatic connections. Bighead and silver carp were considered amongst the AIS analyzed. The outcome of the study was an array of eight alternatives, including a conceptual level of design, cost, and evaluation information on each, to prevent the transfer of AIS between the basins. A detailed discussion of GLMRIS is provided below in Section 3.1.5 of this Framework.

Immediate efforts will also focus on Alternative 2 of GLRMIS, which calls for nonstructural control technologies. The U.S. Fish and Wildlife Service (USFWS) is currently working with the Great Lakes States on addressing specific actions for GLMRIS-identified high-risk species in the state AIS plans for use of GLRI funds in FY2014. Many of these control technologies are already being used throughout the CAWS and the Great Lakes to prevent Asian carp movement and control and the ACRCC believes it is essential that these actions continue. Based on recommendations of the ACRCC's Monitoring and Response Work Group members, the area immediately downstream of the Brandon Road Lock and Dam was identified as a focus for interim risk reduction measures. It may be

Figure 3. ACRCC Path Forward



appropriate to examine the feasibility of another electric barrier at this location. Figure 3 highlights the overall strategy of the ACRCC in the control and management of Asian carp.

The aquatic connection that forms across the Wabash – Maumee Pathway (a.k.a. Eagle Marsh) in Fort Wayne, Indiana, was identified in 2010 as the highest-risk aquatic pathway within GLMRIS Focus Area 2 Other Aquatic Pathways assessment reports. The risk posed by AIS at this location prompted Indiana Department of Natural Resources (IN DNR)—supported by the U.S. Environmental Protection Agency (EPA), National Resource Conservation Service (NRCS), USGS, USACE, Allen County, and the Little River Wetlands Project—to complete construction of a temporary barrier fence to prevent adult Asian carp movement across the marsh during flood events. As part of the Focus Area 2 effort, USACE has completed an Aquatic Nuisance Species Controls report for this pathway assessing the action or set of actions that could best attain a long-term solution to prevent inter-basin transfer of AIS across the Eagle Marsh in Fort Wayne, Indiana. Included in the report are identifications of structural and non-structural measures and a systematic evaluation of the completeness, effectiveness, efficiency, and acceptability of each measure. Working with NRCS and the USACE, the DNR is finalizing the plans for closure of this potential pathway and expects closure action to be initiated in late 2014.

In addition to reducing risk of transfer through the CAWS, the Great Lakes and Mississippi River watershed divide was assessed under the USACE GLMRIS to determine whether there were viable pathways for the transfer of AIS. The GLMRIS Aquatic Pathway Assessment Report developed by the USACE for the Little Killbuck Creek and the Ohio Erie Canal connections determined the risk for the transfer of AIS between both the Mississippi River and the Great Lakes basins. The Little Killbuck Creek and Ohio Erie Canal connections were rated a medium risk for the transfer of silver carp, bighead carp, and black carp. For Little Killbuck Creek, the Ohio Department of Natural Resources (Ohio DNR) is in the process of developing alternatives for closure of this potential pathway. Because these pathways are high-or medium risk of transfer for Asian carp they are being addressed in the Framework. All low risk sites have been referred to the appropriate state agency and are being addressed through the states' aquatic invasive species management plans. .

BRANDON ROAD LOCK AND DAM AREA

New to the Framework in 2014, the ACRCC is also supporting the formation of a Brandon Road Workgroup to focus efforts on the Brandon Road Lock and Dam. The Workgroup is considering the Brandon Road Lock and Dam and downstream approach channel as a potential location to halt the movement of bighead and silver carp through new or existing technologies. New technologies may include a refined electric barrier system with a specifically engineered channel to increase electric field efficiency, water guns to exclude fish from entry into the approach channel and locks, and carbon dioxide barriers in the approach channel to provide a redundant fish repellent to the new electric barrier protecting the lock from Asian carp entry.

The Brandon Road Workgroup will have the following purposes:

- Interagency coordination of the development of risk reduction measures for bighead and silver carp at Brandon Road vicinity

- Coordinate and integrated pest management approach at Brandon Road area
- Facilitate fisheries management agencies' involvement in risk-reduction approaches
- Identify potential environmental concerns, permitting challenges, and registration
- Communicate and coordinate with the other interested agencies

Moving forward, the key concepts that the Workgroup will be addressing include:

- Further development of the controls currently under development (carbon dioxide gas [CO₂], water guns, etc.) including evaluating:
 - Effects on civil structures
 - Risk to general safety and human health concerns
 - Environmental and water quality concerns
 - Potential impact on native fisheries and wildlife
- Evaluation of a new or improved lock including:
 - The flushing approach presented in GLMRIS
 - Further evaluation and modeling to determine effectiveness, feasibility, impacts, and cost
- Determination of dam improvements to ensure no movement of bighead and silver carp through the dam structure
- Evaluation of potential impacts on barge traffic and lock operation
- Assistance in evaluation of potential roles and resource needs in scoping, funding, and executing recommended investigations

3.0 ORGANIZATIONAL CONTRIBUTIONS TO THE STRATEGY

This section describes critical efforts underway, control efforts outside the Great Lakes Basin (specifically, Quebec), and non-Framework-related Asian Carp control efforts.

3.1 Critical Efforts Underway

The following sections provide an overview of ongoing efforts by ACRC contributing agencies. A general overview of the 2013 actions is provided. Each of the specific action items contributing to the FY2014 Framework are provided in Appendix A of this document along with a thorough discussion of actions taken to date and the projected actions for the next 3 years.

3.1.1 Targeted Monitoring and Assessment

Numerous agencies and stakeholders are collaborating to institute an effective, comprehensive, and manageable monitoring and assessment system throughout the Great Lakes region, including Canada. The multiple components of these monitoring plans are in varying stages of development, usually linked to the immediacy of the threat of bighead and silver carp invasion in each specific region. Multiple technologies are used to monitor and assess electrofishing, traditional fishing and harvesting methods, and eDNA sampling. This section describes specific monitoring and assessment efforts in various locations throughout the Great Lakes region.

3.1.1.1 Monitoring within the CAWS

Monitoring efforts within the CAWS are well developed and comprehensive, because of the importance of understanding bighead and silver carp movement near, and potentially within, the CAWS. Because the CAWS is the only permanent hydrologic link between the Mississippi River and Great Lakes basins, monitoring efforts within the CAWS are crucial for tracking the threat of invasion to the Great Lakes. As such, the monitoring and assessment efforts within the CAWS are designed to detect the presence of bighead and silver carp, as well as determine the significance of any potential invasions. These efforts are described in the sections below.

ELECTROFISHING

From 2010-2013, Illinois DNR, USFWS, and USACE have collaborated to create a coordinated electrofishing plan within the CAWS. Five fixed sites are sampled regularly to monitor for the presence of Asian carp, and to understand the composition of existing fish populations within the CAWS. Additional sites are randomly selected and sampled using electrofishing. The data collected during these sampling efforts, focused on monitoring for the presence of Asian carp, are being used to design a fishery-statistical model to quantify the potential of Asian carp presence or absence within the CAWS. Additional electrofishing has been conducted near the electrical barrier system to determine the presence or absence of Asian carp near the barrier system, and to determine whether Asian carp are possibly passing through the barrier into the CAWS.

With current information of few or no Asian carp above the electrical barrier system, the future electrofishing plan will intensify below the barrier and decrease above (or lakeward) of the barrier. Seasonal events (spring and fall) will include electrofishing efforts throughout the CAWS above the barrier at the historical fixed sights, random sites, and areas most likely to have Asian carp. The majority of the effort, as in past years, is distributed below the electrical barrier system to inform on the leading edge and risk of Asian carp approaching it.

NETTING AND COMMERCIAL FISHING

Additional monitoring and assessment within the CAWS has been conducted through contracted commercial fish harvesting and other netting efforts. Illinois DNR has a commercial harvest program in place both within the CAWS and in other areas with known Asian carp populations. By collecting information via contracted commercial fishers, this program aims to reduce Asian carp population where present, and to aid in monitoring for Asian carp in areas where they have not yet spread in significant numbers, such as the CAWS. This program is discussed in more detail in Section 3.1.3.

Within the CAWS, extensive monitoring is conducted by analyzing the harvest of commercial fishing vessels and dedicated netting efforts. Sampling efforts are conducted at multiple fixed sites and at random locations throughout the CAWS. Two 4-day planned intensive surveillance events are conducted in accordance with the Monitoring Response Plan for Asian Carp in the Upper Illinois River and Chicago Area Waterway System. These events are designed to provide a thorough and detailed assessment of fish populations in locations of particular importance based on their connectivity to the CAWS or Lake Michigan and are intended as a supplement to past rapid response events.

The first event was conducted in Lake Calumet. Sampling efforts utilized electrofishing, seines, gill nets, experimental deep gill nets, hoop nets, and fyke nets over the course of 4 days. A total of 11,222 fish were collected; however, no Asian carp were collected. The second intensive surveillance event took place in the North Shore Channel and Chicago River. This event employed electrofishing, gill netting, and experimental deep gill netting harvesting techniques. A total of 11,367 fish were collected but no Asian carp were collected. A consortium of agencies, including Indiana DNR, USACE, USFWS, U.S. Coast Guard (USCG), and Fisheries and Oceans (DFO) Canada, conducted both of these events.

With current information of few or no Asian carp above the electrical barrier system, the future contracted commercial fishing plan will intensify below the barrier and decrease effort above or lakeward of the barrier (as with electrofishing effort). Seasonal events (spring and fall) will look throughout the CAWS above the barrier at the historical fixed sights, random sites, and areas most likely to have Asian carp. The majority of the commercial fishing efforts, as in past years, is distributed below the electrical barrier system to inform on the leading edge and risk of Asian carp approaching it. This balance of efforts above and below the electric barrier system will further allow intensive removal efforts to occur below the electrical barrier system.

3.1.1.2 Monitoring Below Electric Barrier System

Monitoring efforts below the CAWS electric barrier system have been dedicated to determining three primary factors: (1) the Asian carp population in areas where they are known to exist, (2) the leading

edge of Asian carp invasion (including the leading edge of active reproduction), and (3) the stress applied to the electric barrier system by Asian carp. Efforts to monitor and assess the population of Asian carp and the location of the leading edge of invasion are primarily conducted through commercial harvest and dedicated netting efforts (discussed in further detail in Section 3.1.3).

The stress applied to the electric barrier system is primarily determined through electrofishing conducted near the barrier system. This sampling attempts to determine the population of Asian carp present near the electric barrier system by monitoring how often the electric barrier system is tested by Asian carp attempting to pass through it. Additional monitoring is conducted in the area below the electric barrier system as a component of numerous research efforts to better understand Asian carp habits, reproduction, and control strategies. These research activities are further discussed in Section 3.1.7.

On May 22, 2013, representatives of Illinois DNR observed silver carp spawning activity in the Marseilles Pool area of the Illinois River, below the Dresden Lock and Dam. Monitoring efforts were quickly initiated, hydroacoustic scans were performed to better understand spawning behavior, and ichthyoplankton samples were collected to study early life-stage Asian carp and to reduce the likelihood of successful recruitment of this particular spawning event.

3.1.1.3 Monitoring in Des Plaines River

Monitoring efforts within the Des Plaines River are dedicated to understanding the extent of Asian carp invasion of the river (especially reproduction and spawning activities) and determining the possibility/likelihood of Asian carp being introduced to the Chicago Sanitary and Ship Canal (CSSC) through Des Plaines River flooding. Monitoring and assessment efforts geared towards understanding Asian carp invasion and reproduction within the Des Plaines are primarily focused near Hoffman Dam, near Lyons, Illinois. To determine the potential for Asian carp introduction to the CAWS directly from the Des Plaines River, monitoring activities have been focused in areas where flooding occasionally provides a direct link between the Des Plaines and the CSSC. A 13-mile long steel and concrete-reinforced fence has been constructed in this area to prevent Asian carp passage from the Des Plaines into the CSSC when the water bodies are hydrologically linked through flooding.

3.1.1.4 Lake Erie Rapid Assessment and Monitoring

Regular eDNA sampling has been conducted within the western basin of Lake Erie. The extent of this monitoring and assessment program is a response to sampling events in 2012. During routine eDNA sampling in Maumee and Sandusky Bays, multiple samples tested positive for Asian carp DNA. In Ohio's Sandusky Bay, four samples tested positive for bighead carp DNA. In Ohio and Michigan's Maumee Bay, two samples tested positive for silver carp DNA. To more accurately determine the presence of Asian carp DNA in eDNA samples, a rapid assessment action was taken, during which a total of 417 eDNA samples were collected from the Sandusky River/Bay and Maumee River/Bay areas. In addition, physical monitoring was conducted using electrofishing equipment to drive fish into gillnetting. No physical specimens of Asian carp were collected during this rapid assessment action. In the Maumee Bay area, 20 of 150 eDNA samples tested positive for silver carp DNA. In the Sandusky Bay area, three of 350 eDNA samples tested positive for silver carp DNA.

3.1.1.5 Canadian Monitoring and Assessment Efforts

Following the positive eDNA samples of 2012, the Ontario Ministry of Natural Resources (OMNR) increased its monitoring activities in the Great Lakes area in Canada. Efforts were devoted to monitoring and assessing Lake Erie and its tributaries; regular monitoring is now conducted in Lake Erie, Lake St. Clair, the Detroit River, the St. Clair River, and the Thames River. eDNA is the primary technique used for monitoring in these locations. OMNR also conducts electrofishing in these locations both to monitor for Asian carp presence and to better understand the composition of fish species currently present. OMNR has also begun eDNA sampling within southern Lake Huron. Additionally, OMNR collects samples from commercial fishing harvests within Lake Erie, and has instituted a trawling program in the eastern and western basins of Lake Erie to monitor for Asian carp. A seining program has also been instituted in Lake St. Clair, also to monitor for Asian carp presence. These programs did not produce evidence of Asian carp in any sampled locations during 2013.

3.1.1.6 Inland Lakes and Ponds Monitoring and Assessment

As part of the alternate pathway monitoring and assessment plan, Illinois DNR crews and local agencies conducted sampling events in several inland urban lakes and ponds. Depending on the specific body of water, a combination of electrofishing and gill netting was used to capture fish. Sampling was conducted at the following locations during summer 2013:

- Humboldt Park Lagoon, Chicago: Electrofishing was used to capture five bighead carp.
- Flatfoot Lake, Chicago: Electrofishing and gill netting were used to capture one bighead carp.
- Powderhorn Lake, Chicago: Gill netting was used; no carp were captured.
- Lake Shermerville, Northbrook: Gill netting was used; no carp were captured.

Neither Humboldt Park Lagoon nor Flatfoot Lake (the locations where carp were captured) has any connection to Lake Michigan.

In all, 32 bighead carp have been removed from five Chicago-area ponds using electrofishing and trammel/gill nets since 2011. A replica of the largest of the bighead carp removed from Flatfoot Lake (82 pounds) has been made for use in outreach education efforts. Efforts will continue to investigate new ponds by working with the public and local/state management agencies and to resample the water bodies already visited to minimize any movement from isolated ponds to other waters.

3.1.2 Response Activities

The overarching goal of the ACRCC's Monitoring and Response Plan (MRP) is to prevent Asian carp from establishing self-sustaining populations in the CAWS and Lake Michigan. The five strategic objectives to accomplish the overall goal are:

1. Determination of the distribution and abundance of any Asian carp in the CAWS, and use this information to inform response removal actions;
2. Removal of any Asian carp found in the CAWS to the maximum extent practicable;
3. Identification, assessment, and reaction to any vulnerability in the electric dispersal barrier to prevent Asian carp from moving into the CAWS;

4. Determination of the leading edge of major Asian carp populations in the Illinois River and the reproductive success of those populations; and
5. Improvement of our understanding of factors behind the likelihood that Asian carp could become established in the Great Lakes.

This plan is available on the ACRCC website at www.asiancarp.us. Other agencies throughout the basin can utilize the MRP or set parameters for response.

Since late 2009, several rapid response operations have been conducted within the CAWS to halt the Asian carp progress toward the Great Lakes. No triggered response operations were initiated in 2013. Seasonally, the MRP outlines a schedule for intensive sampling events at the most likely places Asian carp may appear in the CAWS; this is additional to sampling that took place across the CAWS in 2013. These actions in the areas of Lake Calumet and the North Shore Channel last several days and are intense. No bighead or silver carp have been captured during these events in 2013.

3.1.3 Commercial Harvesting and Removal Actions

Illinois DNR has implemented a commercial harvesting program in the CAWS and below the electric barrier system. This program acts as the primary means of Asian carp population control immediately below the electric barrier system and as an important monitoring method. Monitoring efforts below the electric barrier system are focused on determining Asian carp population levels and movements, while monitoring efforts within the CAWS are focused on monitoring the presence of Asian carp and determining the effectiveness of the electric barrier system.

Illinois DNR has contracted with numerous commercial riverine fishing vessels to employ mass-harvest techniques and equipment. Fishing efforts are focused on areas with large documented carp populations in order to maximize the amount of fish harvested. This increases the effectiveness of harvest as a population control and provides for optimal catch rates, ensuring that the commercial harvest program is an attractive option for commercial vessels. The main goal of population control efforts is to reduce the number of Asian carp that could potentially attempt to pass through the electrical barrier system. Reducing the number of Asian carp attempting to pass would lower stress on the barrier system, potentially optimizing performance and decreasing the chances of Asian carp making it past the barrier.

To date, commercial harvesting efforts have been focused in the area between the Starved Rock Lock and Dam and the electric barrier system near Romeoville, Illinois, specifically in four large pools located immediately below the electric barrier system. From 2010 to 2013, commercial harvests have deployed over 1,055 miles of netting, removing over 59,000 bighead carp and over 100,000 silver carp from the area between Starved Rock Lock and Dam and the electric barrier system. Catch rates for Asian carp have been declining on a year-to-year basis, likely indicating that removal efforts are limiting population expansion in the upper Illinois Waterway.

Catch rates from monitoring efforts focused between Starved Rock Lock and Dam, and above the electric barrier system indicate that Asian carp populations are not expanding within the target harvest area. It also appears that the leading edge of the Asian carp population has not advanced closer to Lake

Michigan since commercial harvesting efforts began in 2010. Harvesting practices above the electric barrier system have not captured any Asian carp, indicating that the electric barrier system is an effective means of preventing Asian carp passage. This also indicates that Asian carp have not reached Lake Michigan.

Future commercial harvesting efforts will continue to focus on the areas between Starved Rock Lock and Dam and the electric barrier system, and above the electric barrier system within the CAWS. Based on current trends, catch rates and overall removal rates of Asian carp are expected to continue to decrease with time, presumably as Asian carp populations decrease because of harvest and other control measures. Research is currently underway to develop more effective harvesting methods. DIDSON technology is being used to analyze net-avoidance behavior in Asian carp, and thus far, two different avoidance behaviors have been documented. These avoidance behaviors, as well as Asian carp reactions to different types of netting and harvesting techniques, will continue to be observed and documented and the information will be used to develop nets and harvesting with increased effectiveness at harvesting Asian carp.

3.1.4 Electrical Barrier and Support Activities

The CAWS electric barrier system is currently in place in the CSSC, which is part of the CAWS near Romeoville, Illinois. This location was selected for the electric barrier system because the CAWS remains the only continuous link between the Great Lakes and the Mississippi River, making it the most likely route of Asian carp invasion. The electric barrier system is made up of several separate electric barriers, which are created by steel electrodes secured to the bottom of the canal. These electrodes emit an electric field that stimulates an active avoidance response in fish, preventing the passage of fish past the barriers. The barrier electrodes do not inhibit waterway vessel traffic, and are controlled from a building located adjacent to the CSSC. Equipment in the control building generates a direct current (DC) pulse through the electrodes, creating an electric field in the water that discourages fish from crossing, as depicted in Figures 4 and 5 below.



Figure 4. Electric Barrier System Location

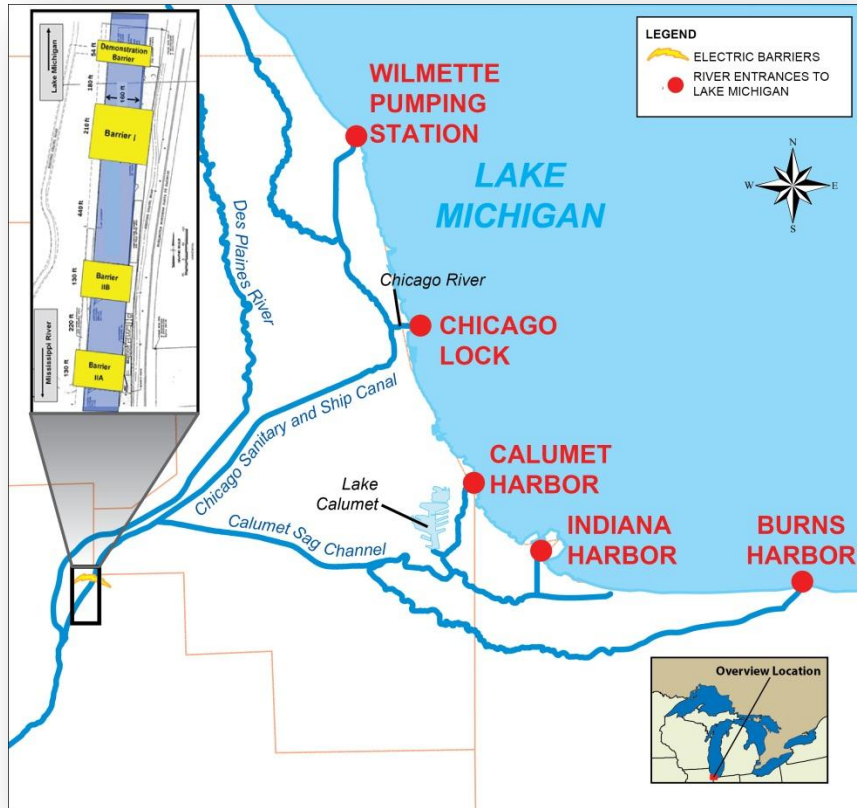
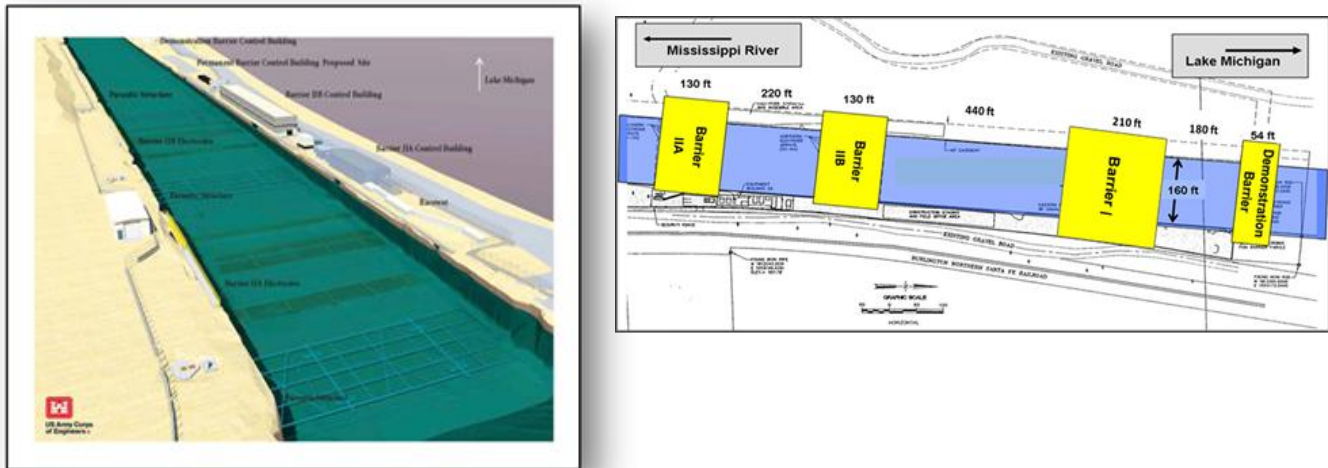


Figure 5. Electric Barrier Design



Based on the findings of laboratory research, the operational settings of Barrier II were changed in October 2011 to those believed to be more effective at deterring very small fish. USACE continues to provide operation and maintenance to the CAWS electric barrier system, which will continue in FY 2014.

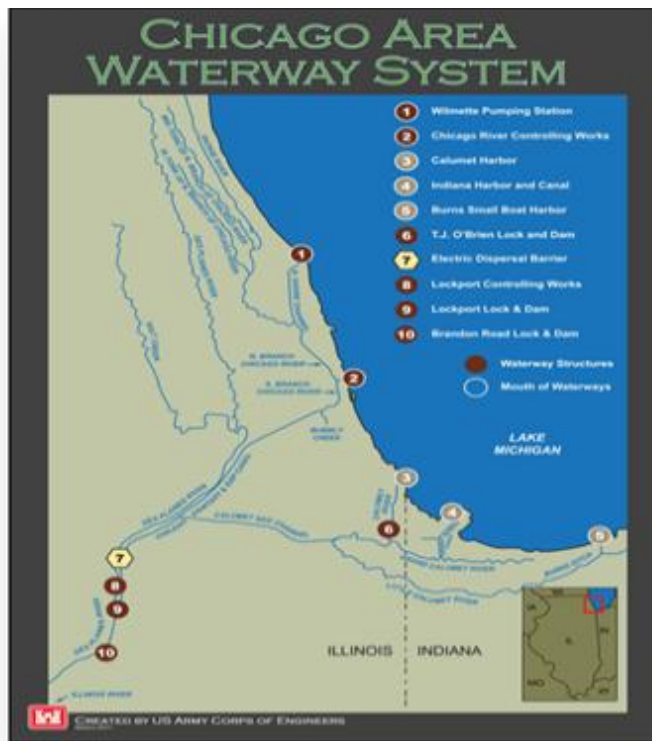
Outside of the CAWS, the state of Minnesota funding the design phase of a new “sweeping” electric barrier within the upper Mississippi River. Based on the river characteristics at the proposed location, the barrier is intended to discourage Asian carp from gathering in the fore-bay, and to detect and sweep them downstream before the lower lock gate is opened so that fish do not enter the lock. The barrier will be designed to operate for all water levels at which the lock is operational and the gates may be opened. This complete fish barrier is designed to use far less power on a cumulative basis than other electric barriers that have been deployed in the past (e.g., the Chicago Sanitary and Ship Canal). It is also designed to be far safer in the event that a human being enters the water when the electrodes are energized.

3.1.5 GLMRIS and Other Pathways

GLMRIS is a study authorized in the Water Resources Development Act (WRDA) of 2007. The study directed USACE to evaluate the range of options and technologies available to prevent spread of AIS (WRDA uses the terminology Aquatic Nuisance Species [ANS]; within this document AIS and ANS are used interchangeably) between the Great Lakes and the Mississippi River basins through the CSSC and other aquatic pathways, in consultation with appropriate federal, state, and local agencies and non-governmental organizations (NGO). The study identified potential hydrologic connections between the two basins, explored existing and potential AIS of concern, and assessed AIS control technologies. These control technologies included but were not limited to physical or hydrologic separation.

The study is divided into two focus areas based on differences (in nature and complexity) between the hydrologic connection at the CAWS and the remainder of the interbasin divide. Focus Area 1 consists of the CAWS, and Focus Area 2 encompasses all aquatic pathways outside the CAWS, commonly referred to as the Other Pathways. Figure 6 shows the CAWS as the connection between the Mississippi River Basin and Lake Michigan while Figure 7 below shows the complete GLMRIS study area.

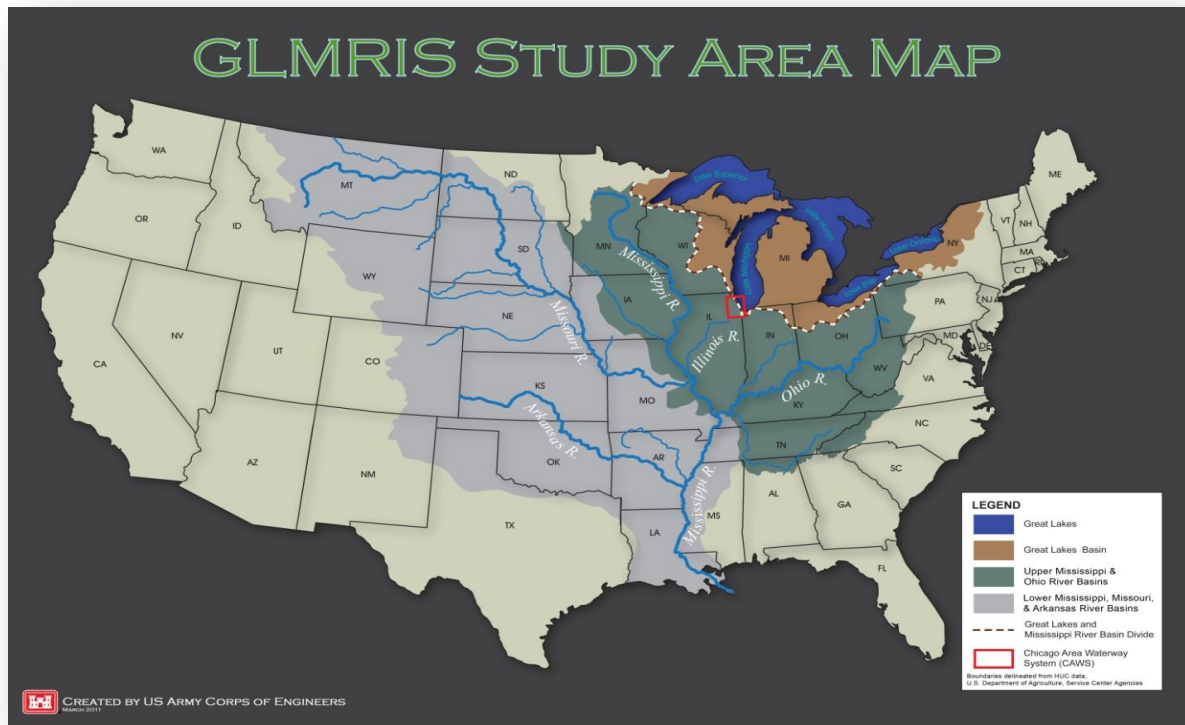
Figure 6. Chicago Area Waterway System



Language in Section 1538(b)(5) of Public Law 112-141 (Moving Ahead for Progress in the 21st Century Act or MAP-21) directed expedited completion of the GLMRIS Report no later than 18 months from enactment and further authorized the Secretary of the Army to proceed directly to project preconstruction, engineering, and design (PED) if he or she determines a project evaluated in the completed GLMRIS report is justified. In an October 2012 Interim Report to Congress, USACE described its strategy for completing GLMRIS within the congressionally mandated timeframe. To date, 24 interim reports have been released and posted to the study website as the effort has progressed across the entire 1,500-mile basin.

The purpose of the final GLMRIS Report was to identify an array of alternatives for preventing inter-basin transfer of AIS via aquatic pathways. While not focused solely on Asian carp, some alternatives identified in the Report would likely reduce the risk of Asian carp movement into the Great Lakes via the CAWS or other aquatic pathways where Asian carp are a threat. In its final report, the USACE developed eight alternatives focused on addressing the CAWS. The alternatives include a wide spectrum of preventative measures ranging from the continuation of current activities to the complete hydrologic

Figure 7. GLMRIS Study Area Map



separation of the Great Lakes and Mississippi River basins. The GLMRIS Report also includes an analysis of potential impacts to uses and users of the CAWS, and corresponding mitigation requirements for adverse impacts to functions such as flood risk management, natural resources, water quality, and navigation. The eight alternatives presented in the GLMRIS Report include:

1. Continuing current efforts (i.e., the electric barriers) with “No New Federal Action — Sustained Activities”
2. Nonstructural control technologies (i.e., education, monitoring, herbicides, ballast water management)
3. A technology concept involving a specialized lock, lock channel, electric barriers, and ANS treatment plants at two mid-system locations in the CAWS
4. A technology concept (CAWS buffer zone) using the same technologies as number 3, preventing downstream passage from Lake Michigan at five separate points and preventing upstream passage at a single point at Brandon Road Lock and Dam
5. Lakefront hydrologic separation with physical barriers separating the basins at four locations along the lakefront of Lake Michigan
6. Mid-system hydrologic separation with physical barriers separating the basins at two mid-system locations
7. A hybrid of technology and physical barriers at four mid-system locations, leaving the Cal-Sag channel open
8. A hybrid of technology and physical barriers at four mid-system locations, leaving the CSSC open

As part of GLMRIS, USACE conducted a comprehensive analysis of AIS controls, and analyzed the effects of each AIS control, or combination of controls, on current uses of the CAWS and Other Pathways. AIS control studies include: (1) the CAWS, a continuous aquatic pathway between the Great Lakes and Mississippi River Basins; and (2) other aquatic pathways between these basins, as applicable. USACE included the following:

- Inventory current conditions and forecast future conditions within the study area
- Identify aquatic pathways that exist or may form between the Great Lakes and Mississippi River Basins from up to a 1-percent annual recurrence interval flood event
- Inventory current and future potential AIS of concern at applicable pathways
- Analyze possible AIS controls to prevent AIS transfer, to include hydrologic separation of the basins
- Analyze the impacts each AIS control may have on the environment and on existing and forecasted uses of the lakes and waterways within the study area

Important considerations of GLMRIS include, but are not limited to:

- Significant natural resources such as ecosystems and threatened and endangered species
- Commercial and recreational fisheries
- Current recreational uses of the lakes and waterways
- AIS effects on water users
- Effects of potential AIS controls on current waterway uses such as flood risk management, commercial and recreational navigation, recreation, water supply, hydropower, and conveyance of effluent from wastewater treatment plants and other industries
- Statutory and legal responsibilities relative to the lakes and waterways

The full GLMRIS Report and a discussion of each alternative can be found online at [www.http://glmr.is.anl.gov](http://glmr.is.anl.gov). Future work done by USACE as part of GLMRIS will be dependent on direction by the Secretary of the Army or Congress.

3.1.6 eDNA Monitoring and Technology Refinement

This section describes general eDNA monitoring activities, and eDNA monitoring activities specifically associated with the Environmental DNA Calibration Study (ECALS).

3.1.6.1 General eDNA Monitoring Activities

eDNA is a surveillance method used to detect the genetic material of bighead and silver carp, and its high sensitivity makes it ideal to apply as an early detection monitoring tool. Since 2010, USFWS and Illinois DNR have collected eDNA samples from the CAWS on an ongoing basis. Processing efforts began with USACE in 2009 and transitioned to USFWS in 2013. Construction of the new Whitney Genetics Laboratory (WGL) was completed in November 2012 at the USFWS La Crosse Fish Health Center in Wisconsin. Field collection of eDNA has been used as an early detection surveillance tool since 2009 and is specified for use by the ACRCC in the Monitoring and Response Plan (MRP). This technique yields

Asian carp “presence/absence” data for bighead and silver carp DNA for the reaches of the waterway sampled.

In 2010 through 2013, eDNA was used as a regular weekly monitoring tool to help inform response decisions, including additional intensive and focused sampling, as specified in the MRP. In 2014, eDNA will continue to be used in the CAWS as well as other regions of the Midwest (Great Lakes, Upper Mississippi River and Ohio River) as part of a comprehensive regional monitoring effort for bighead and silver carp invasion. Results from eDNA testing are posted regularly on the USFWS Midwest Region website at <http://www.fws.gov/midwest/fisheries/eDNA.html>.

Between 2009 and 2013, over 8,500 water samples were analyzed for bighead and silver carp DNA. In 2014, eDNA monitoring and surveillance in the CAWS will be maintaining the same number of eDNA samples in the CAWS. The sampling will occur in four strategic sites, twice a year. The USFWS’s comprehensive basin-wide eDNA monitoring program spans the entire Midwest region to include the CAWS, Great Lakes, Upper Mississippi River, and Ohio River. The USFWS now has the capacity to process that 9,000. This highlights the success of the Whitney Genetics laboratory and efficiencies realized through the Environmental DNA Calibration Study (ECALS).

eDNA sampling in the basin will follow the standard protocols outlined in the Quality Assurance Project Plan (QAPP): eDNA Monitoring of Bighead and Silver Carps (<http://www.fws.gov/midwest/fisheries/eDNA.html>). The QAPP is now maintained by USFWS, including developments from the eDNA calibration study and other efforts from our interagency laboratory network (USACE, USGS, USFWS). USFWS will work with the states, provinces, and other members of the Council of Great Lakes Fishery Agencies to identify where efforts should be focused to ensure sampling occurs within areas with the highest probabilities of Asian carp presence (including spawning), based on habitat preferences and availability, and other factors (e.g., Maumee River/Bay, Sandusky River/Bay, and southern Lake Michigan). Sampling at these locations will follow a probabilistic design targeting areas of eDNA accumulation. The USFWS Whitney Genetics Laboratory will process samples.

3.1.6.2 eDNA Calibration Study (ECALS)

ECALS is a multi-year study to improve the understanding and interpretation of the detection of Asian carp DNA in environmental samples (eDNA) used in early detection monitoring. eDNA surveillance programs seek to detect the presence of genetic material (DNA in cells sloughed off in slime, feces, urine, etc.) extracted from water samples; the detection of genetic material is linked to the possible presence of Asian carp. The study involves collaboration between USACE, USGS, and USFWS (referred to as “the team”). The sections below summarize ECALS efforts to date.

ASIAN CARP eDNA VECTORS

In addition to DNA shed by live Asian carp, vectors of Asian carp eDNA could transfer eDNA into the CAWS. Initial ECALS work on potential eDNA vectors included studies of storm sewer transport, fish-based fertilizers, fisheries gear, bird transport and deposition of eDNA, fish carcasses and transport on barges, and sediment eDNA. In 2013, ECALS further investigated vessel hulls, fishing nets, and sediment eDNA. The vessel hull and fishing net trials in 2013 confirmed the presence of very large quantities of

eDNA potentially transported by these vectors. Sediment studies confirmed that eDNA sorption on sediments can take place, and low-level, long-term eDNA releases are possible from undisturbed and re-suspended sediment (based on 21-day study). Results from the study indicated that sediment eDNA contributions to water samples are likely minimal unless turbidity is high or particulate matter is captured on the filter (current practice is to analyze filtered solids rather than the dissolved filtrate fraction).

ASIAN CARP eDNA GENETIC MARKER DEVELOPMENT

The current eDNA markers for both bighead and silver carp are comprised of short segments of the mitochondrial DNA (mtDNA) control region (or “D-loop”) and primarily provide information on presence or absence of that DNA in a sample. The team’s aim is to develop a suite of different markers that provide different capabilities, including (1) improved detection probabilities by increasing the number of markers simultaneously assayed, (2) more efficient processing by reducing background non-target polymerase chain reaction (PCR) amplification, (3) real-time quantitative PCR (qPCR) estimates of DNA abundance (qPCR has added benefit of increased efficiency by eliminating gel electrophoresis and reducing or eliminating the need for sequencing), (4) data on allelic variability (or “polymorphism”) to a degree that will allow at least broad estimation or corroboration of Asian carp abundance, and (5) some indication of the nature or time since deposition of an eDNA sample.

The haplotype sequences generated in this study allowed the team to develop markers that were better tailored for detecting individuals from the Asian carp populations found in North America. Because of the limited sequence variation between species across the mitochondrial genomes, design of effective species-specific conventional PCR (cPCR) and qPCR markers was difficult. The markers designed for this study were chosen from mitochondrial DNA (mtDNA) regions that were the most divergent between species, which should correspond to markers with the highest likelihood of being species-specific. However, in initial trials, amplification of DNA from at least one non-target species was observed for most markers. Further testing of cPCR and qPCR assays is needed to adequately evaluate the efficacy of the markers developed in this study. Optimization of PCR is needed, followed by assessment of method sensitivity, and finally further field-testing.

Complimentary to ECALS work, USGS initiated studies in 2013 to correlate fish movement and spawning activities of Asian carp in the Wabash River, Indiana, with eDNA detections through collaboration with Purdue University. Temporal and spatial differences in eDNA detections and quantities were determined. In this same line of work, “stair-step” markers were used to detect DNA fragments specific to live fish genetic material (>800 base pair) that would not have been transmitted to waters by fish-eating birds. USGS research on the Wabash River with Purdue University shed light on the importance of marker design for eDNA analysis. USGS scientists are also collecting DNA samples from select cyprinids in the Upper Midwest to further refine and develop unique and robust markers for detection of silver and bighead carp DNA. Microbial source markers are being developed in collaboration with researchers at the University of Illinois, Champaign-Urbana to further expand the usefulness of eDNA in detecting live fish.

In 2014, the USFWS, USGS, and USACE will complete the validation trials on these new markers for implementation into the 2014 eDNA monitoring program. Work is also being conducted to investigate the affects of inhibitors, which may cause false negative detections in the field. A workshop is planned for June 2014 to present the findings of this marker research to fisheries managers using eDNA as a surveillance method in their jurisdictional waters.

INCREASING EFFICIENCY

Presently, the time from field sampling to analytical results for eDNA can take as long as 2 weeks. Even before laboratory analysis, several hours of very intensive fieldwork followed by laborious sample filtering is required. ECALS has evaluated ways to reduce time and effort for this process. Identification of the most cost and time-efficient extraction approach and most robust cross-platform qPCR approach will benefit future monitoring efforts. Initial ECALS work compared different DNA extraction kits, evaluated different field sampling protocols (filtration, centrifugation, sieve cloth), and compared sampling from different depths in the CAWS. Based on these efforts, changes to the QAPP have been made.

CALIBRATION STUDIES

Calibration studies seek to examine eDNA release (i.e. shedding) rates and degradation rates under laboratory conditions to inform hydrodynamic modeling of how deposited eDNA may be distributed by water flow in the CAWS. The team designed experiments to determine how fish size, number, behavior, as well as water temperature and diet influence eDNA loading (or shedding) by Asian carp. The team also investigated sperm as a source of eDNA over time in static water conditions.

LOADING/SHEDDING STUDIES

Loading studies have shown that eDNA shedding rates are consistent over different water flow rates. The team found no correlation between water temperature and eDNA shedding rates. The team observed a correlation between eDNA loading and fish density. Studies of eDNA from sperm in water showed that eDNA was detectable for at least 17 days. Sperm degradation studies will be completed in 2014 by USGS. Water samples can be quantified for carp eDNA using qPCR. The sensitivity of the assay will depend on time-consuming but necessary optimization of the analysis (temperature, reagent amounts). The eDNA signal can be highly variable, likely reflecting clumped eDNA distribution. Fish shed eDNA at higher rates when fed, likely because cells are sloughed off in the excrement. Non-fed fish still shed detectable amounts of eDNA but at approximately 10-fold lower rates compared to the fed fish (especially those fed algae). Non-fed silver carp juveniles and bighead sub-adults shed lower amounts of eDNA relative to algae-fed fish, but differences were not statistically significant. For the bighead sub-adults, shedding rates trended similarly to the bighead juveniles and sub-adult silvers, but did not show significant pairwise differences in shedding rates. Sample collection to assess eDNA correlations with spawning, and for attempted validation of stair-step markers to estimate the time since eDNA was shed from a live fish, will occur in spring and early summer 2014.

DEGRADATION STUDIES

Trials assessing the influence of environmental factors on the degradation rate of eDNA were conducted for temperature, pH, microbial loads, and water turbulence. The majority of eDNA in these trials degraded either rapidly or very rapidly over a few days, but in all cases a small portion of eDNA persisted beyond 2 to 4 weeks. Higher water temperatures and pH levels were found to increase the degradation rate of eDNA, while microbial load and turbulence did not show a significant effect. Remaining studies include the influence of light, organic matter, dissolved oxygen, and extreme environmental conditions on eDNA degradation rates.

HYDRODYNAMIC MODEL

The hydrodynamic grid for the area to be modeled has been completed, and protocols have been established to enable passing of information back and forth between the hydrodynamic and eDNA transport (i.e. water quality) parts of the model. Results from other ECALS investigations (e.g. eDNA degradation studies) will be incorporated into the eDNA transport model when available. Three-dimensional simulations of the hydrodynamics of the barrier area are also underway, and the electrical field modeling is in preliminary development at present.

PROBABILISTIC MODEL

To integrate information gathered through ECALS and other ACRCC studies, a conceptual model has been developed to provide a structured visualization of the potential eDNA inputs (e.g. presence of a live fish vs. vectors of eDNA) as well as the factors or variables that influence release, transport, persistence, and detection of eDNA in the CAWS. Parameterization of the model is presently underway, building upon the conceptual model previously developed. Information from other ECALS tasks and other sources are being used to parameterize the model.

3.1.7 Research Activities

In keeping with the ACRCC's strategic focus toward the development of new control technologies and long-term strategies, the Framework science strategy focuses on development of approaches, methods, and tools for detection, prevention, attraction, and removal of invasive Asian carp. Numerous historical examples demonstrate the difficulty of eradicating or controlling populations of AIS (e.g., sea lamprey, zebra mussels, and common carp). Extirpation is rarely accomplished, and achieving persistent population control is challenging and expensive, requiring long-term, dedicated effort. Based on these limitations, the Framework outlines several projects intended toward preventing introduction of Asian carp into the Great Lakes. However, fishery management tools are needed if prevention projects fail, and to further reduce propagule pressure (i.e., lower population densities) where Asian carp are already established.

Developing and determining the effectiveness of control strategies requires continued information not only on effectiveness and efficiency of control methods, but also on (1) invasive species life history and types of habitats needed for growth, (2) best use of attractants and repellants to concentrate Asian carp within areas for control or removal, (3) hydrologic conditions for control application and monitoring activities, (4) effects of controls on native organisms, and (5) other important factors.

An Integrated Pest Management (IPM) approach, currently being used to address Asian carp, will provide managers with a range of options for addressing and controlling invasive species. No single tool, technology, or method will suffice for all situations or species. Therefore, a suite of control options must be created—requiring the breadth of information gathered and knowledge gained from scientific activity under the Framework. While focused on Asian carp at this time, most detection, prevention, attraction, and removal methods are designed for application to a wide range of AIS.

This section describes research activities related to understanding Asian carp life cycles and habitat; and hydrology, hydraulics, and water quality.

3.1.7.1 Asian Carp Life Cycle and Habitat

An understanding of the life cycle of Asian carp and the types of habitat they require for each phase of their development and reproductive success is essential for developing effective control strategies and tools. Asian carp recruitment success and year class strength are highly variable. Given their extremely high fecundity (ability to produce offspring), survival of the early life stages appears to be the greatest weakness of Asian carps. In some years, most recently 2010 on the Illinois River, recruitment failed despite successful spawns. Asian carp larvae were briefly ubiquitous in off-channel habitats, but the larvae did not recruit (develop) to the fingerling stage. The exact combination of environmental conditions that causes recruitment failure in some years is not clear, but a reasonable assumption is that with a more complete understanding of Asian carp larval and juvenile behavior and habitat selection, control mechanisms can be devised that take advantage of these strong drivers of recruitment success or failure.

Access to shallow lentic (still water) environments seems to be important in the early life of Asian carp, but beyond that, little is known. It is not clear how environmental parameters such as depth, presence and density of terrestrial or aquatic vegetation, turbidity, temperature, availability of planktonic or detrital food, degree of accessibility to the spawning river, and predator types and densities affect habitat selection and survival of young Asian carp. USGS research presumably will provide this knowledge, which should in turn offer opportunities to develop mechanisms for controlling this life stage that sets year class strength and controls population density. When these requirements are understood, future threats from Asian carp can be reduced. Also, habitats can be created that are highly attractive to young Asian carp, but where the fish could be easily harvested or targeted with directed toxicants. Directed toxicant formulations would likely be much more effective in the shallow water habitats selected by juvenile bighead and silver carp than in the deep pelagic habitats selected by adult fish, because less water would have to be treated. Introductions of predators such as largemouth bass, catfish, or bowfin might be appropriate strategies if the correct habitats can be identified and targeted.

USGS plans to conduct a number of projects that focus on determining the life cycle of and habitat uses by Asian carp. For example, despite some research and anecdotal information, locations of Asian carp nurseries in the Illinois, Mississippi, Missouri, and Wabash Rivers, and in other rivers, are unknown. Some of these studies will occur necessarily where Asian carp are already established (e.g., sections of the Illinois, Missouri, and the Mississippi Rivers). Regardless of where this research occurs, all systems

(including the Great Lakes region and Ohio River) will benefit from information resulting from these efforts.

3.1.7.2 Hydrology, Hydraulics, and Water Quality

An understanding of the interaction between Asian carp and the hydrology and hydraulics of their river habitat is crucial in both risk assessment and application of control measures. Scientists have advanced the characterization of Asian carp egg transport in streams, rivers, and lakes to gain a greater understanding of what river velocities and lengths are needed to keep eggs suspended until they hatch. This information, along with identification of nursery habitat and spawning locations, will be helpful in understanding what makes a river a likely spawning and recruitment habitat. Hydraulic assessments of rivers will also be needed to support control measures. These assessments will allow researchers to identify possible “choke points” in rivers where control might be the most feasible.

Hydraulic data are also required for optimal application of other technologies such as attractant or repellent substances or oral-delivery toxins. To transition these technologies from the laboratory to field testing and application necessitates confidence in prediction of how far the introduced substance will travel and what flow conditions it will encounter. For example, areas of the CAWS occasionally reverse flow. Additionally, the Illinois River main channel has water velocities larger than those in the adjacent flood plain or side channels. Such conditions could cause false estimates of travel time and dispersal if an assumption of a simple flow condition is used.

Hydraulic or geochemical analyses may also be needed to identify conditions when encapsulated toxins become isolated as sediment on stream bank areas, or become re-suspended and are delivered during non-targeted times because of post-deployment changes in stream flow. USGS experience in acquisition and assessment of water-quality data, from either fixed stations or field surveys, will be important to the success of these field applications to complement its biological expertise in Asian carp recruitment and control measures. USGS data on stream flow, water quality, and bathymetry, as well as USGS expertise in hydrologic simulation and climate change science, can help optimize the design of hydraulic separation measures and preserve prior hydraulic and ecologic functions of the proposed separated basins, as practicable.

Water quality is an important component of habitat, and understanding this is crucial for success of potential control measures. Asian carp sensitivity to conditions affecting water quality such as temperature and turbidity may impact spawning and recruitment. Similarly, performance of carp pheromone attractants to optimize other control measures may be affected by availability of other nutrients and food. Understanding effects of water-quality factors such as pH and dissolved oxygen may be important in devising successful Asian carp attractant or repellent substances, or oral-delivery toxins.

Application of emerging types of water-quality data—such as from field-based measurements of chlorophyll, organic matter, and other water quality characteristics (e.g., turbidity)—could assist in identifying precursor conditions affecting field pheromone use of algal and pheromone attractants for Asian carp control.

USGS has already secured and deployed equipment for two real-time water-quality stations (one in the main channel of the Illinois River and one in a backwater area) and one streamflow only station (at the main entrance to the backwater area), used to correlate movement of Asian carp population front relative to water quality and other factors. Scientists have also collected site-specific data including bathymetric surveys, velocity mapping, and fluorometer deployments for dye monitoring of algal feeding attractants, and have completed initial water velocity and temperature surveys of the Marseilles and Dresden Island Pools of the Illinois River. Scientists will continue to use dye tracer studies to analyze water flow and velocity to assist in the effective application of control tools.

In 2013, USGS also announced some very important findings from the Tributary Assessment Tool project, which was focused on assessing suitability of rivers for Asian carp spawning. Final results of field assessments of the water data collected on two Lake Michigan and two Lake Erie rivers were very significant. Scientists found that river reaches as short as 16 miles may allow sufficient time for Asian carp eggs to develop and hatch. This means that more Great Lakes tributaries than previously thought would be suitable for Asian carp spawning. This is valuable information for managers to determine potential actions to address Asian carp and reinforces the importance this work in the overall Asian carp control efforts.

Another major accomplishment under this project was the final development of the Tributary Assessment Tool (called FluEgg). FluEgg is a model that incorporates biological (fish egg density, developmental rate, buoyancy, etc.) and hydraulic data to assess risk of successful Asian carp spawning in a river. It will help managers target locations in Great Lakes tributaries where eggs may settle to the river bottom and die. Publications on these two efforts can be found at asiancarp.us.

In 2014, USGS will be preparing a report/fact sheet on procedure for data collection for spawning and egg-transport characterization to provide managers with information they need on the uses and of this tool and the information it can provide. Scientists will also begin efforts to incorporate successful recruitment criteria (juvenile habitat, etc.) with existing egg transport characterization methods to determine which rivers may pose a greater probability for the establishment of sustainable populations of Asian carp, including investigating the use of remote sensing for increased efficiency. Data on development of grass carp eggs and density will also be completed and added to the model. In addition, a publication is being developed based on the results of the use of the Tributary Tool on the Wabash River in Indiana, in collaboration with Purdue University.

3.1.8 Risk Assessment

National Oceanic and Atmospheric Administration (NOAA) continues its efforts with Great Lakes management agencies to develop cost-effective strategies to prevent or respond to invasions from likely new aquatic nuisance species, including Asian carp. This work has centered on the development of risk assessments, models, and forecasts that can be used to determine the potential ecological and economic impacts of new invaders. NOAA's work combines scientific, economic, risk analysis, and management expertise to determine the likelihood that a set of key species could invade through multiple pathways (shipping, canals, trade) and become established in the Great Lakes basin.

Food web models are being used to forecast the impact a new invader could have in select ecosystems within both Lake Michigan and Lake Erie. A multi-sector economic model is being used to determine potential disruptions to the economy of Lake Erie specifically as well as the entire basin. The ecological and economic models are also being coupled in order to predict the overall impact were any of the selected species to invade and become established. The ecological data are also being used to help state agencies inform the development and implementation of monitoring and response strategies. An important part of NOAA's effort will continue to be to quantify the uncertainty inherent in the models being used in order to reduce the uncertainty around the forecasts being produced.

In 2010-2013, USGS undertook the project titled, Great Lakes' Tributary Assessment for Asian Carp Habitat Suitability, focusing on four Great Lakes tributaries—Milwaukee River in Wisconsin, St. Joseph River in Michigan, and Maumee and Sandusky Rivers in Ohio. The outcomes of this project included the following:

- Determination of a more exact timeline for Asian carp to achieve required key developmental stages
- Determination of the minimum velocities (0.5-0.82 feet per second) needed to keep Asian carp in early, non-swimming life stages suspended in the water column
- A new estimate for minimum length of rivers for Asian carp spawning (16 miles rather than 62 miles)
- In cooperation with the University of Illinois at Urbana-Champaign, development of a tributary assessment tool (FluEgg) to simulate transport of Asian carp eggs to assess spawning habitat suitability.

A USGS report describing data acquisition and analysis from the Milwaukee, St. Joseph, Maumee, and Sandusky Rivers was published in 2013 and a journal article on the FluEgg model was published in *Ecological Modeling* in 2013.

3.1.9 Enforcement

At the federal level, enforcement of illegal trade and interstate transit of Asian carp is carried out by the USFWS under the Lacey Act, which prohibits interstate movement of live organisms that are on a recognized list of injurious species. Currently, silver, large-scale silver, bighead, and black carp are listed as injurious wildlife. Bighead carp were most recently added to the list of injurious species in 2011. Although the Lacey Act prohibits movement of live Asian carp across state lines, it does not prohibit Asian carp aquaculture or possession of live Asian carp. Each of the Great Lakes states and the province of Ontario has made it illegal to possess live Asian carp within their jurisdictions; however Asian carp aquaculture facilities (fish farms) in parts of the southern United States remain active.

In spite of the federal and state laws, live Asian carp remain highly valued at fish markets, and the illegal movement of Asian carp and non-compliant fish dealers persists. Enforcement of U.S. and Canadian laws regulating movement and/or possession of live fish is essential to prevent establishment of Asian carp in the Great Lakes Basin. For example, the Great Lakes Fishery Commission's Lake Erie Committee believes that prevention efforts are the most important investment for protecting Lake Erie from

potential effects of Asian carp. The Great Lakes Law Enforcement Committee has consistently advocated better enforcement and tougher laws governing interstate movement of live Asian carp, and has facilitated training of officers to identify Asian carp and other key invasive fishes.

The USFWS continues to expand surveillance and enforcement of the illegal transportation of Asian carp and other federally listed invasive species. Border locations are of particular concern and targeted surveillance actions, including the use of a deployable x-ray van, are being expanded in areas of known activity. The USFWS is working closely with Great Lakes State partners to control the spread of invasive species, including Asian carp. In 2013, USFWS increased training of law enforcement personnel and partner agencies using video and informational brochures to assist law enforcement officials in identifying Asian carp and transport vehicles used in moving these fish across state lines.

Illinois DNR has increased officer presence and friendly enforcement activities related to Asian carp, which has proven successful in promoting open dialogue among store owners, the public, and enforcement officials. Throughout 2013, Illinois DNR staff and Conservation Police officers performed on-site enforcement through informal site visits at fish processors, fish markets, and retail food establishments.

The State of New York updated their state regulations to restrict possession, transportation, and the sale of Asian carp and other fish dangerous to indigenous fish populations. The most recent revisions to the regulations ban the importation, possession, and sale of live bighead carp in the entire state of New York. These new regulations are consistent with federal actions that ban all interstate transportation of live bighead carp.

3.1.10 Outreach and Education

Actions that support Asian carp management include those that increase public awareness of the threat from introduction of Asian carp. ACRC continues to inform and engage the public, stakeholder organizations, and governmental organizations in this regard. This is an unprecedented effort to disseminate information about preventing the spread of invasive species, through meetings, press events, and communications. Moreover, education and outreach can lead to behavior changes that may prevent release of the species through various pathways including the bait or the live food-fish trade.

Training and Exercise

EPA has developed an Incident Command System (ICS) training course for invasive species response efforts. This 1- to 2-day course provides the knowledge required for service as lead response or support personnel in an invasive species response that may require multi-jurisdictional resources and agency coordination. The course is intended for agencies and groups that participate in an AIS-specific rapid response and may or may not have previous experience with ICS. The group exercise as part of the class promotes effective communication and collaboration, which are essential during rapid response incidents. Team training with multiple agencies is ideal to simulate the complexity of most incidents.

The goals of this course are to:

- Gain a general understanding of the ICS organizational and operational framework through a brief ICS instructional presentation
- Demonstrate the ability to effectively conduct internal notifications, coordinate across agencies, and use resources from multiple entities
- Gain an understanding of the importance of jurisdictional authority based on agencies' missions/mandates and species location
- Organize and initiate a successful small-scale, on-water AIS assessment through group discussion and course exercises
- Discuss the differences in operations and resources for various types of AIS rapid response efforts

EPA has combined this course with a tabletop exercise using an AIS scenario to introduce agencies to response-related situations and inter-agency coordination. This course offering will continue on an as-requested basis. Additional, more in-depth ICS trainings are available if requested, depending on group size and trainer availability.

In January 2010, the State of New York published a statewide Rapid Response Framework for Invasive Species.⁸ New York also participated in a Great Lakes rapid response training exercise in 2008 in Erie, Pennsylvania, sponsored by Pennsylvania Department of Environmental Protection (PADEP), EPA, Pennsylvania Sea Grant, and Save Our Native Species (SONS).

Several state and provincial jurisdictions have Asian carp response plans at various stages of completion. For example, Ontario MNR has developed a provincial Asian Carp Response Plan in partnership with Fisheries and Oceans Canada. The Asian Carp Response Plan outlines procedures for implementation of a rapid 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 2013, the province continued its efforts to improve the plan based on new science, and improved coordination with U.S. partners.

EPA facilitated a rapid response exercise between Ohio and Indiana in Fort Wayne, Indiana, in August 2012. State and federal agencies, universities, and NGOs participated in this exercise that included instruction in ICS and a mock planning exercise at Eagle Marsh, Indiana.

Illinois DNR has supported all rapid responses in the CAWS since 2010 under ICS, and has two complete ICS teams that train annually with Illinois State Emergency Management teams in conjunction with the National Incident Management Organization's (NIMO) national type III response team from Phoenix, Arizona. Team members have attended various EPA training events, as well as ICS position-specific training. In addition, Illinois DNR staff members have participated in statewide emergency management teams, and have supported wildfire teams in the western United States.

⁸ Eric J. Kasza. 2010. Rapid Response Framework for Invasive Species. New York State (NYS) Department of Environmental Control (DEC), Office of Invasive Species Coordination, Albany, New York 12233-1052. January.

The Michigan Department of Natural Resources, in collaboration with Michigan Out-of-Doors TV has developed an education and outreach video that focuses on identification of juvenile Asian carp. The overall message of the video is to increase awareness of a potential pathway for the introduction of these detrimental invasive species that the common angler can relate with. The video has been posted to www.AsianCarp.us and the Michigan DNR's Asian carp webpage (http://www.michigan.gov/dnr/0,1607,7-153-10364_18958-248641--,00.html).

Canada will begin development of in-agency capacity for rapid response activities to be implemented if Asian carp are discovered in Canadian waters. A national rapid response framework, and work conducted in collaboration with the province of Ontario, will form the basis of this preparedness. Fisheries and Oceans Canada will conduct business continuity planning and develop a database of available equipment that would be useful for a response action.

3.1.11 Control Technologies

Numerous control technologies have been developed to aid in managing Asian carp populations. These technologies vary in stages of development from those currently in active use to those still being researched in laboratories. Control technologies also employ numerous different strategies in order to control Asian carp populations. Some technologies aim to eradicate the carp, others attempt to control their movements, and still others are developed as tools to aid in understanding Asian carp behaviors. This section includes discussions of some of major control technologies.

3.1.11.1 Carbon Dioxide Barrier

The carbon dioxide barrier is a control technology that involves dosing gaseous carbon dioxide at the water surface or within the water column in order to elevate carbon dioxide levels within the body of water in question. Past experiments have suggested that carbon dioxide is an effective chemical deterrent to Asian carp, inciting behavioral, physiological, and physical disturbances in the fish, and triggering active avoidance. Fish have specialized receptors in the gills that are used to detect carbon dioxide and will avoid elevated concentrations of it. Carbon dioxide dosing could be used to create a chemical barrier to Asian carp, preventing their spread toward Lake Michigan. It would most likely be used in controlled environments, such as within locks systems, and as a level of redundancy for the current electric barrier system.

Possible problems with carbon dioxide barrier technology include its efficacy in field conditions and its impact on non-target organisms and infrastructure. The variable, dynamic flow conditions found in the actual environments that would employ a carbon dioxide barrier would make it difficult to uniformly disperse carbon dioxide throughout the water column. Efforts are underway to understand how this could limit its effectiveness. The impact of elevated carbon dioxide levels on non-target organisms is also being investigated, as well as its potential impact on infrastructure because carbon dioxide can potentially accelerate the breakdown of concrete.

To establish a carbon dioxide barrier, a carbon dioxide infusion system will be used that is capable of achieving concentrations of carbon dioxide necessary to deter fish movement. USGS and University of Illinois Champaign/Urbana are collaborating on this effort. This unit has been engineered specifically to

infuse gas into liquid – it is not a typical pond aerator. The unit has an efficiency of over 90 percent (compared to 20 to 30-percent efficiency for a standard aerators), and is designed specifically for fish barrier applications. The unit establishes a CO₂ barrier by infusing micro-bubbles of gas into the water, and stationary sensors in the water regulate output by automatically turning the system on and off when needed.

Scientists completed a large-scale evaluation of the behavioral response of bighead carp and silver carp to the deployment of a CO₂ barrier in 2013, successfully using the infusion system. Behavioral responses of non-target fishes (bigmouth buffalo, channel catfish, paddlefish and yellow perch) were also assessed. Tests were conducted in both laboratory experiments and outdoor study ponds. Promising preliminary results indicate that both young and adult fish detected and avoided areas of elevated carbon dioxide.

Plans for 2014 include completing a large-scale, open-water field evaluation of a CO₂ barrier to deter Asian carp as a part of the Integrated Pest Management (IPM) strategy to be conducted in the Illinois River backwater location where testing occurred in 2013. Scientists will also be evaluating the response of native mussels to carbon dioxide. USGS and USACE will be working together to evaluate injection of CO₂ into a lock chamber to determine feasibility to create a barrier to Asian carp under scaled conditions.

3.1.11.2 Chemical Attractants

Chemical attractants are a control technology that makes use of chemical stimuli in the natural life of Asian carp. Asian carp, like many fish, rely on chemical stimuli to obtain information on essential life functions such as location of food, habitat quality, schooling, avoidance of predators, and synchronization of sexual functions with the rest of the population. The chemical attractant control strategy focuses on using positive chemical stimuli to attract Asian carp to a specific location. Research is focusing on two categories of attractants: those using compounds released by algae to stimulate a feeding response, and those using pheromones released by Asian carp themselves to stimulate a sexual response. These stimulants could be deployed within rivers in locations where Asian carp are known to exist and would attract a large number of Asian carp to a specific location, where they could then be efficiently destroyed. Alarm pheromones, generated by Asian carp when in danger and used as a signal to avoid a specific area, are also being investigated for use as a repellent. In this scenario, the alarm pheromones could be used in order to keep carp away from a specific location, such as a lock system, or to drive carp to a specific location for harvest or other means of destruction.

Tests of the attraction to algal stimulus solutions were conducted in study ponds using tagged juvenile Asian carp. The response of the carp was verified using digital video imaging with underwater cameras that revealed active feeding responses among the fish attracted to the targeted area of release where the algal stimulus was presented. The response elicited by this stimulus was robust relative to the number of fish attracted to the area and the duration of time fish remained in the immediate vicinity of the algal plume. Fish began to move from the area as the algal stimulus dissipated as a result of consumption by the carp and dilution. The response was highly consistent among the 12 trials

conducted. A high degree of turbidity was present during these tests as a result of ambient native algal blooms; however, the presence of these algae did not diminish the response to the algal stimulus.

Studies were also conducted to determine if wild carp could be conditioned to feeding stations in the Missouri River. Several sites of varying complexity relative to width, depth, flow, and cover were identified along the Missouri River for these studies with the intention of repeating the study at sites of increasing complexity as this approach proved successful. Initial observations using DIDSON imagery indicated the attraction for fish including carp to this feeding. Studies expanded to habitats behind box dike structures along the Missouri River consistently document attraction of Asian carp to the algal stimulus.

In 2014, scientists will accelerate field observations of the feeding response of wild free-ranging carp to the algal stimulus in the Missouri River using the feeding station approach and optimize application of the feeding stimulus to enhance attraction. Scientists will also evaluate the response of other species, including grass carp, to the algal attractant and initiate trapping procedures with applications of the feeding stimulus to facilitate fish harvest. Physiological and behavioral studies of sex pheromones in Asian carp will continue. Investigations are also beginning on the use of algal attractants in combination with microparticles to enhance their effectiveness.

Potential problems with this control technology are mainly centered on isolating a maximally effective chemical compound for use. It is also necessary to determine the practicality of deploying this technology in field conditions, and the impact of dispersal on effectiveness.

3.1.11.3 Integrated Pest Management (IPM)

The IPM Program uses available technologies to manage Asian carp populations as effectively as possible. The aim of the program is to take advantage of the strengths of each individual control technology by developing integrated management techniques and plans. For example, in 2013 an Asian carp removal event used chemical attractants (derived from algae) to lure the carp to a specific area, water guns prevented the fish from escaping the area, and commercial harvesting was used to remove and destroy the fish. During the removal effort, hydroacoustics and side-scan sonar were used to assess the population in order to gain valuable knowledge on the propagation of Asian carp and the effectiveness of the removal effort.

An IPM approach was used in field testing in 2013 in a backwater of the Illinois River that included algal attractants, waterguns, hydroacoustic technology, and commercial fishing. Testing was performed as collaboration between USGS, Illinois DNR, and Southern Illinois University and included a demonstration of all the components for state and federal partners that attended. Based on preliminary results, the combination of these tools proved very effective in increasing the number of Asian carp captured by the commercial fishermen. Field work is planned for 2014 to refine these methods and test methods for use of carbon dioxide as a barrier within this IPM approach.

The IPM Program is continually evolving and attempting to utilize more and different control strategies. A potential difficulty in implementing the program involves the amount of time it takes for new control technologies to be developed and approved for use. As more technologies become available for

deployment, the IPM Program will be able to tailor protocols and methods for each individual Asian carp management action.

3.1.11.4 Seismic Technology

Seismic Technology (primarily water guns) is a control technology designed to manage the movement of Asian carp. The technology is based on past research that demonstrated that many fish species, including Asian carp, display avoidance behaviors when they encounter a high-pressure underwater wave generated by sound energy. Water guns are currently the most common means of creating these pressure waves. The water guns operate by driving a shuttle through a chamber using pressurized air. As the shuttle moves through the chamber, it leaves behind a void that is quickly filled by water, generating a high-pressure wave of sound energy in the frequency of 20 to 1,500 Hz. These waves can be used to repulse Asian carp, either driving them away or trapping them in a specific area.

Potential problems with the use of seismic technology center on its impact on infrastructure, and the ability to create uniform pressure fields within a dynamic body of water. It is not currently known whether the repeated application of these pressure waves could be detrimental to infrastructure such as dams or lock structures. Further testing is also needed to determine whether it is possible to create a uniform field of pressure waves in order to create a complete barrier to fish passage.

Data has been collected to assess the distribution of seismic energy from the water guns so that engineers can determine potential impacts on the structures and canal walls. Pressure maps have been developed under different water gun operating pressures and configurations to determine safe operating distances from sensitive navigational structures. Scientists also collected background pressure readings from barge traffic downstream of the Brandon Road Lock and Dam in the approach channel to compare with watergun pressure data to assess effects. USGS will collaborate with USACE to complete the needed structural trials. In 2014, scientists will continue work on development of a model to predict potential strengths of the seismic signals produced by the water guns on structures and pressure mapping depending on varying waterway channel configurations.

Previously, behavioral responses of several fish species, including bighead carp and silver carp, were characterized under controlled settings in USGS study ponds during operation of water guns under static deployment conditions. Though behavioral responses of fish to operation of water guns in field settings were characterized, repeated studies were needed to confirm the results of initial trials under differing field conditions. So scientists took the waterguns out to the field in a backwater of the Illinois River to evaluate their potential use as an area clearing tool or as a mechanism to drive fish towards commercial fishing nets or into areas where other control techniques could be applied. This effort was part of the IPM field effort in collaboration with the Illinois DNR and Southern Illinois University. Preliminary results showed that the waterguns substantially reduced the number of large fish to a distance of ~25 meters

In 2014, scientists will complete one or more deployment trials of a static water gun barrier and a mobile water gun system including the use of acoustic telemetry tagged fish to determine behavioral responses of fish to water gun operation. While some non-target effects data have been collected, the

potential negative effects of water gun discharge are generally unknown in native mussels. Work will also be initiated to evaluate the potential negative effects of water gun deployment on native mussels.

3.1.11.5 Targeted Piscicides

Targeted piscicides are a control technology involving the development of lethal compounds and delivery systems that would specifically target Asian carp, without affecting non-target organisms, including native species. Currently, known piscicides affect all organisms they come into contact with, if they are dosed throughout the water column, it leads to the destruction of all species of fish in a targeted area. This control strategy of targeted piscicides attempts to avoid this wholesale destruction of fish by tailoring the piscicide to selectively impact Asian carp. Researchers are attempting to accomplish this primarily in one of two ways: (1) developing a piscicide that is uniquely lethal to Asian carp only or (2) developing a delivery system for known piscicides that specifically targets Asian carp. Species-specific piscicides would target unique physiological characteristics of Asian carp, such as gill structure or digestive system. Tailored delivery systems would likely target Asian carp's behavioral characteristics, such as preferred food particle size, reactions to chemical attractants, and preferred habitat.

Possible issues with this control technology are primarily related to the early stage of development of target piscicides, and obtaining approval for use of any effective piscicides that may be developed. Extensive research was conducted by USGS over the last few years, focused on developing a microparticle that was targeted as specifically as possible to target Asian carp and avoid harming natives species. Scientists identified antimycin as the selective toxin; determined that the intestines of the Asian carp are the best place for release of the toxin and that an enzyme called trypsin would trigger that release; and identified the preferred food size of Asian carp. The microparticle was designed based on these and other factors, including comparisons with native filter-feeding fish species. The next phase was the actual microparticle development that began in 2013 and is going through various testing phases to ensure stability and effectiveness.

In 2014, scientists will evaluate the toxicity of a selective targeted delivery system of antimycin in order to determine field exposure rates for controlling bighead and silver carp. They will also determine degradation characteristics of the microparticles so we know how long they take to break down. Testing of effects on non-target native species will also be conducted. On-site field evaluations of the antimycin microparticles will also be conducted this year using the USGS mobile laboratory.

Several chemical controls are being evaluated for the potential to control populations of Asian carp. These tools, however, must complete a rigorous registration process before they may be used within IPM control programs of federal or state natural resource agencies. For the microparticles, USGS has already initiated formulation review with EPA to determine registration data requirements of antimycin-incorporated microparticles, and with USFWS to determine Section 7 ESA-consultation data requirements. These efforts will continue to move forward.

3.1.12 Program Support

EPA program support oversees and facilitates a variety of actions and activities for the ACRCC and greater control of bighead and silver carp. Through the years EPA support has included emergency funding to support rapid response against bighead and silver carp introductions; separation of newly discovered potential pathways of dispersal and fish suppression activities if new populations are found in the Great Lakes basin; contractor support to the agencies in developing reports, tracking activities, and providing field support as necessary; development and deployment of training and exercises throughout the basin to enhance agencies' rapid response capabilities; continued support of the Asian Carp Director and deputy to enhance collaborations among the federal, state, local, and tribal agency partners; and provision to senior executives and the ACRCC of continued communication and outreach support activities. Support in 2014 will continue with many of these items.

3.2 Asian Carp Control Efforts Outside the Great Lakes Basin: Quebec

While efforts to control Asian carp outside of the Great Lakes Basin are not within the scope of the ACRCC and not discussed within the action items of this Framework, they are equally critical to controlling the Asian carp population throughout the United States and Canada and can ultimately impact the efforts taken within the basin. Some of the many efforts being undertaken and the federal and state level are discussed below. For example, outreach tools and materials developed for managing Asian carp in the Great Lakes Basin and provided through the Asiancarp.org website also directly support efforts to manage for the threats of Asian carp species in other watersheds in the United States, including the Upper Mississippi River and Ohio River basins. Additionally, field-based monitoring and rapid response strategies, tactics, and tools being developed through the leadership of the ACRCC and focused on protecting the Great Lakes watersheds may, ultimately, be applicable to managing the threat of Asian carp in other watershed throughout the United States, including those contiguous with the Great Lakes.

In Quebec, Ministère des Forêts, de la Faune et des Parcs (MFFP) is responsible for managing fishing activities on freshwater and anadromous fishes both in the freshwater portion of the St. Lawrence River and Inland Waters. MFFP also works in collaboration with other departments, agencies, governments and partners to protect, restore, and sustain the fish populations and their habitats. The conservation and integrity of aquatic animal biodiversity and health are also responsibilities that are under the jurisdiction of the MFFP. MFFP fulfills these mandates through planning, regulation, enforcement, scientific study, stocking and stewardships.

MFFP has the provincial leading role to prevent introduction, establishment, and spread of AIS in freshwaters including in Inland Waters and parts of the St. Lawrence River. MFFP responsibilities include leadership and coordination of interagency activities to prevent and manage the threat of AIS, development and enforcement of provincial legislation and policy, response planning, monitoring and science, development of management measures and communications/outreach to the public. Specific MFFP activities are summarized in the sections below.

3.2.1 eDNA Sampling

eDNA sampling and analyses protocols have been tested since 2013 as a future Ministerial tool for endangered species early detection. In 2013, water samples were collected in several zones of the St. Lawrence River freshwater portions, including fluvial lakes (e.g. lakes St-François, St-Louis and St-Pierre). Asian carp were targeted in those analyses as well as other AIS (e.g. Round goby and Tench). In 2014, the same areas will be sampled, as will additional inland bodies of water.

3.2.2 Rapid Response Plan

An Interministerial rapid response plan on aquatic invasive species is currently being drafted. The two Ministries involved in this plan are the MFFP and the Ministère du Développement durable, de l'Environnement et de la Lutte Contre les Changements Climatiques (MDDELCC). This rapid response plan will help the ministries' responders to react quickly when a new AIS is detected or when an AIS already present is detected in a new area in the St. Lawrence River or inland waters. Silver and bighead carps are among the AIS targeted by the Interministerial rapid response plan. This plan is part of the St. Lawrence Action Plan 2011-2026. This action plan pools efforts and resources of multiple departments, ministries and agencies of the governments of Canada and Québec as well as various stakeholders that share common objectives of conservation, restoration, protection et development of the St. Lawrence.

3.2.3 Action Plan

An Interministerial Action Plan on exotic invasive species (EIS) is currently being drafted. The two Ministries involved in this plan are the MFFP and the MDDELCC. This action plan will help the ministries' responders fight effectively against EIS, prevent their introduction and propagation, acquire more information and conduct risks analyses and outreach activities on EIS, and promote collaboration with other jurisdictions and ministries, as well as non governmental organizations. The Action Plan arises from the Interministerial Strategy on exotic invasive species and will target silver and bighead carps, as well as other exotic invasive aquatic and terrestrial animals and plants.

Some of the actions targeted by the Action Plan will be (1) developing a Code of Practice to prevent EIS introduction and propagation during field work, (2) promoting the Code of practice to external partners and the public in general, (3) putting in place a network of information sharing on EIS, (4) establishing ministerial EIS early detection and surveillance tools, (5) developing environmental and economic risk analyses, (6) evaluating the feasibility of intervention analyses tools on EIS, and (7) developing EIS interventions protocols.

3.2.4 Strategy

An Interministerial Strategy on EIS is currently being drafted. The two Ministries involved in this plan are the MFFP and the MDDELCC. Five issues related to EIS and nine orientations compose the Strategy. The Interministerial Strategy will target silver and Bighead carps, as well as other exotic invasive aquatic and terrestrial animals and plants. Prevention of EIS introduction and propagation, EIS surveillance and rapid response are among the issues presented in the Interministerial Strategy. Fostering collaboration and information between governments and agencies, other jurisdictions and non-governments partners,

acquisition of new knowledge, public outreach activities and adaptation of the current regulatory framework will be part of the orientations also presented in the Strategy.

3.2.5 Monitoring: Commercial Fisheries

Since 2007, an AIS early detection network, composed of 40 volunteer commercial fishers, works in collaboration with the MFFP. They declare any exotic, unknown or suspicious fishes caught in their nets. The network operates over a 600 km stretch in the St. Lawrence River, and the fish caught are sent to the Ministry's experts for identification if necessary. The fishermen have been informed and trained to identify Asian carps. They are aware about the risks and the threat that these species represent, and we make sure that if a specimen of these species is caught in their nets, they will immediately contact the Ministry. Since the beginning of this network, two Chinese mitten crabs (*Eriocheir sinensi*), one blueback herring (*Alosa aestivalis*), more than 60 round gobies (*Neogobius melanostomus*) and 2000 tench (*Tinca tinca*) have been declared to the Ministry by this AIS early detection network.

3.2.6 Outreach Activities

Many outreach activities have been undertaken by the MFFP over the years. Among others, a poster on AIS, produced in collaboration with the MDDELCC, with information on how to clean your boat and gear to prevent AIS introduction and propagation between two body of waters, information on what to do when you want to get rid of pet fish and other aquatic organisms was made available to municipalities, marinas, provincial and regional parks, and other non-governmental organisms involved in AIS outreach activities. Silver and bighead carp, as well as grass and black carps are part of the AIS presented during outreach activities as threats to Québec's aquatic ecosystems.

3.2.7 Sport Fishing and Boat Cleaning Activities

Since 2012, outreach activities targeting sport fishing activities and anglers and even ice fishing activities, are conducted all year long to inform on the risk of AIS introduction and propagation by fishing activities. These outreach activities were conducted by teams led by MFFP staff together with nongovernmental partners (such as Watershed organizations). These teams present outreach activities promoting boat and gear cleaning before accessing a new water body. Information is also given on vectors of introduction and propagation (e.g. releasing live bait, as well as pet fish and other aquatic organisms in the wild), and on organisms that can be transported by boats and gear (e.g. fish, plants, pathogens, eggs, larvae, etc.) and on the Regulation controlling possession, transport, and exploitation of AIS. Threats represented by Asian carp in general are part of the outreach activities. Even if no Asian carp species are present in Québec's water, the great majority of anglers met during these activities were concerned about the possible propagation of Asian carp in the St. Lawrence River.

3.2.8 Ministry's Website

Information on exotic invasive species and their environmental and economic impacts, and instructions on how to prevent their introduction and propagation can be found on the Ministry's website at <http://www.mddep.gouv.qc.ca/faune/especes/envahissantes/index.htm>. Specific information on Asian

carp is also available at <http://www.mddep.gouv.qc.ca/faune/especes/envahissantes/carps-asiatiques.htm>.

Information on other animal exotic invasive species, aquatic and terrestrial, as well as some exotic pathogens, can also be found on the website. However, information is available only in French.

3.2.9 Regulations

Two regulations exist in Québec as a means to control and prevention against the threat that represents AIS in general and includes some specific species. These regulations respect the conservation and development of wildlife. The two related regulations are described below:

- **Règlement sur l'aquaculture et la vente de poisson / Regulation respecting aquaculture and the sale of fish:** Includes a list of prohibited freshwater fish and aquatic species. This regulation prohibits owning as a pet, keeping in captivity, transport, farming, breeding, sale or purchase of live specimen of listed species. The prohibited species are Asian carps (black, grass, silver, bighead, and big-scale silver), all the Channidae family (snakehead fish), non-indigenous eel and sturgeons, Blueback herring, Eurasian ruff, Round and Tubenose gobies, Eurasian perch, Zander, Tench, Wels catfish, Common rudd, Chinese mitten crab, and Rusty crayfish.
- **Règlement sur les poissons appâts / Regulation on baitfish:** This new regulation came into force April 1, 2013, and is applied in sport fishing activities only. The use of live baitfish is prohibited in summer. In 2017, no baitfish will be allowed, dead or alive, during the summer. The use of baitfish during ice fishing activities is tolerated, and is permitted in restricted zones only, including the St. Lawrence River. There is no ban on the use of invertebrate (e.g. earthworm and leech) as bait.

3.2.10 Ministerial Asian Carp Scientific Task Force

Because of the Asian carp threats and their possible propagation to the St. Lawrence River and its watershed, the Ministry is in the process of creating an Asian carp Scientific Task Force. The Scientific Task Force will be under the coordination of the already existing Ministerial Exotic Invasive Animal Species Committee. The Task Force will conduct analysis to help the Committee make informed decisions about prevention, early detection, control, and research on Asian carp species. For example, the Task Force will conduct analysis on the possible impacts of Asian carp on aquatic biodiversity and ecosystems, as well as on economic activities such as fisheries and tourism, on the implications of hydrological connectivity on the propagation of Asian carp to Inland Waters, and on costs and feasibility of interventions. Collaboration between the Task Force and research facilities, universities, and other ministries and jurisdictions will also be possible and important once the task force is functional.

3.3 Non-Framework-Related Asian Carp Efforts

State and federal agencies in both the United States and Canada are undertaking additional work related to Asian carp that is not discussed within this Framework. The focus of the Framework is on bighead and silver carp. The non-Framework efforts pertain to grass carp or black carp, or are not funded under

U.S. Asian carp program dollars. Although grass carp and black carp are invasive species that are of great concern, they are not currently covered under the ACRCC mission. Some of the work being done throughout the Great Lakes Basin, but not otherwise discussed in the Framework is highlighted below.

With the aid of funding provided by Fisheries and Oceans Canada, the Great Lakes Fishery Commission will coordinate a grass carp risk assessment for the Great Lakes set to begin in 2014. Partners will include Fisheries and Oceans Canada, USFWS, and USGS. Similar to Binational Ecological Risk Assessment of Bigheaded Carps (*Hypophthalmichthys* spp.) for the Great Lakes Basin (http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2011/2011_071-eng.pdf) released in 2011 for bighead and silver carp, project leaders will consult with state and provincial fishery managers and policy makers on key information to be incorporated in the grass carp assessment. The grass carp assessment will include a socio-economic component.

With the aid of funding provided by Fisheries and Oceans Canada (DFO), the Great Lakes Fishery Commission will coordinate a bi-national grass carp risk assessment for the Great Lakes. Partners will include DFO, USFWS, and USGS. Similar to the bigheaded carps risk assessment conducted during 2010-2012, project leaders will consult with state, provincial, and federal fisheries managers, scientists, and policy makers on key information to be incorporated in the ecological risk assessment for grass carp. The grass carp assessment will include a socio-economic component that will follow completion of the ecological risk assessment for grass carp. The ecological risk assessment will begin with scoping meetings of managers and scientists in June 2014, with an expected completion date by the end of 2015.

USFWS and USGS developed a protocol whereby black carp caught anywhere in North America and grass carp captured in locations where they are not believed to be established are processed for ploidy (fertility), genetics, age, maturation and reproductive status, otolith microchemistry (for birth location and movement), and diet. These factors are being used to understand the current status of the invasion, and to assess locations where spawning is currently occurring.

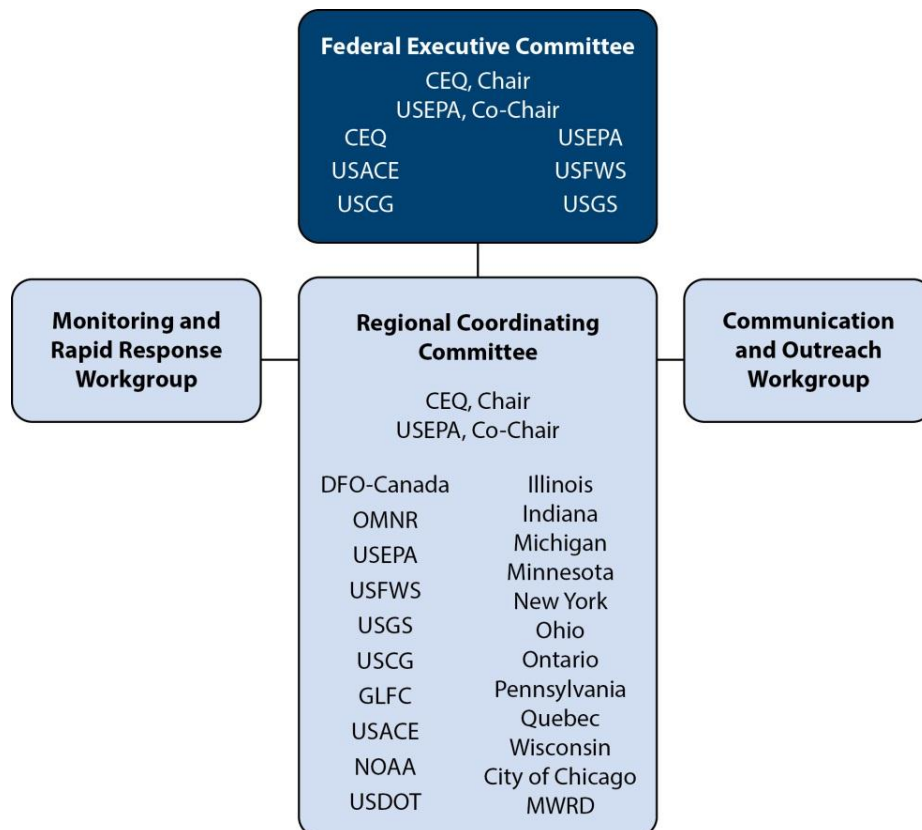
USGS continues to study aspects of Asian carp biology in the Mississippi River Basin that were begun over 2 decades ago and that have provided the foundation for the current Great Lakes Asian carp control efforts. These studies provide basic life history and habitat use information to help guide further study, improve the science of Asian carp research (e.g., determining optimal structures of Asian carp to be used for aging individuals), contribute toward our understanding of invasive species, determine and document the effects of Asian carp on native species, and help guide management and control efforts.

Additionally, USFWS has worked with its partners to develop a draft National Asian Carp Surveillance Plan, focused on sampling for Asian carp in areas outside of the waters of the Great Lakes, the Chicago Area Waterways System, and other Great Lakes pathways. The plan builds upon the protocols and strategies previously developed under the ACRCC's leadership and focused on the Great Lakes. The Plan is currently under review by federal, state, and non-governmental partners invested in managing the Asian carp threat in the United States.

4.0 THE ASIAN CARP REGIONAL COORDINATING COMMITTEE

In 2009, federal, state, provincial, and local agencies, as well as stakeholder organizations, with jurisdictional authority and/or a vested interest in defending the Great Lakes against the introduction and establishment of bighead and silver carp came together to form the ACRCC. The ACRCC has gone through a number of transitions in both composition and leadership since its original inception. The initial composition included only the directly affected federal agencies, the State of Illinois, MWRD, and the City of Chicago. EPA initially led this effort with support from the White House Council on Environmental Quality (CEQ) to address the perceived emergency response needed in the CAWS. In 2010, CEQ took the primary lead of the ACRCC and expanded the membership to include the Great Lakes states and the Great Lakes Fishery Commission (GLFC) to better engage the United State’s portion of the Great Lakes basin. In 2012, the ACRCC was once again expanded to include the federal government of Canada (through Fisheries and Oceans Canada) and the provincial government of Ontario (through the Ontario Ministry of Natural Resources) to engage the Canadian portion of the Great Lakes basin. Recently the provincial government of Quebec (Ministère de la Forêt, de la Faune et des Parcs) has joined the ACRCC. The ACRCC organization chart is found in Figure 8. Information on the Jurisdiction, Authority and Role of the other agencies that are members of the ACRCC can be found in the 2103 Asian Carp Control Strategy Framework.

Figure 8. ACRCC Organization



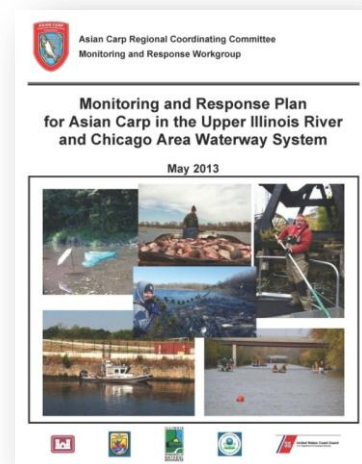
The Council on Environmental Quality and EPA have shared the responsibility for development of the annual Framework. With the addition of several agencies from the United States and Canada and a comprehensive outlook, the ACRC represents a coordinated and collaborative effort among the involved organizations to prevent bighead and silver carp from entering the Great Lakes, and to control and manage their invasion.

The goal of the ACRC is to execute an aggressive, multi-tiered strategy to prevent an Asian carp invasion into the Great Lakes, and to ensure vigilant monitoring for necessary response actions within the CAWS and other areas of probable early detection of expansion. The ACRC does not dictate management of fishery issues to individual states or provincial authorities, and does not discourage or reject management principles, techniques, or actions. While the ACRC does not directly implement activities, with input from each member, it develops the overall strategy for control and management of Asian carp and relies on each member agency to implement actions, which carry out the mission of the ACRC and its members.

This section describes CAWS monitoring and response workgroup, and communications and outreach workgroup (CWG).

4.1 CAWS Monitoring and Response Workgroup

The CAWS Monitoring and Response Workgroup (MRWG) of the ACRC is tasked with monitoring and response efforts within the CAWS and at the leading edge of current Asian carp boundaries. This MRWG is generally composed of fisheries biologists and scientific experts from GLFC, Illinois DNR, Illinois Environmental Protection Agency, Indiana DNR, USFWS, and USACE. In 2012, all of the Great Lakes states fisheries chiefs were also asked to participate in MRWG. Since 2010, MRWG 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 plan 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 to the maximum extent practicable
- Identify, assess, and react to any vulnerability in the current system of electrical barrier system that excludes Asian carp from moving into the CAWS
- Determine the leading edge of major Asian carp populations and reproductive success of those populations
- Improve understanding of the likeliness of establishment of Asian carp in the Great Lakes.

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

4.2 Communications and Outreach Workgroup

The purpose of the Communications and Outreach Workgroup (CWG) is to facilitate internal and external communication on Asian carp prevention and control efforts of the ACRCC. Audiences receiving this communication include elected officials and the public, with special attention to key constituents, media, internal ACRCC members, and ACRCC Workgroups, Framework Science Coordination groups, and other relevant groups outside the ACRCC.

Communication efforts support the ACRCC as it develops and executes short- and long-term strategies for preventing Asian carp movement above the electric barrier system in the CAWS, as well as other monitoring and control activities in other areas of the Great Lakes Basin. CWG does not intend to supplant or supersede actions of ACRCC members.

CWG has communication representatives from CEQ, USFWS, EPA, USACE, USCG, USGS, the Great Lakes states, the province of Ontario, GLFC, and DFO-Canada. All members of the ACRCC are invited to establish representation on CWG.

CWG is currently co-chaired by two representatives—one each from USFWS and Illinois DNR. The chair has primary responsibility for the group's management, organization, and operation, but the work is shared among CWG members. One or both co-chair positions may be filled by a CWG member from another agency deemed appropriate by CWG.

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 to reach the general public
- Distribute to appropriate response agencies comments, concerns, and questions received from external audiences, including the public and key stakeholders
- Respond to media requests or filter to appropriate response agency
- 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 Critical Efforts programs
- Develop other outreach products for public use

Another important communication tool of the ACRCC that was recently developed is the Asian Carp Toolkit. The ACRCC directs funding to numerous projects to develop new technologies for the control and assessment of Asian carp in the Great Lakes. The toolkit can be found at www.asiancarp.us. The toolkit is an on-line resource to provide basic information to resource managers on the development of:

- Control technologies, including seismic technology (water guns), attractants, fish toxicants, and deterrents
- Assessment/response technologies
- Contract commercial fishing
- Monitoring and response actions including eDNA sampling, analyses, and calibration; telemetry, acoustic/side scan sonar
- Barrier Technologies including the CAWS electrical barrier system, bubble-acoustic barrier, development at Eagle Marsh, Des Plaines River bypass barrier, the new mobile electrical barrier, and the closure assessments at Little Killbuck Creek and Ohio Erie Canal
- Waterway traffic management and safety risk assessment
- Communication efforts

The toolkit contains resources designed to assist in the efforts to control, plan, and communicate actions in the Great Lakes and across the United States and Canada, where necessary. The toolkit is intended to be simple and, to the extent possible, uses links to agency websites where additional information on the tool is available. The toolkit is directed to fisheries resource managers and identifies where and when specific technologies would be appropriate for use. The toolkit will be a living document, with current information added as it becomes available.

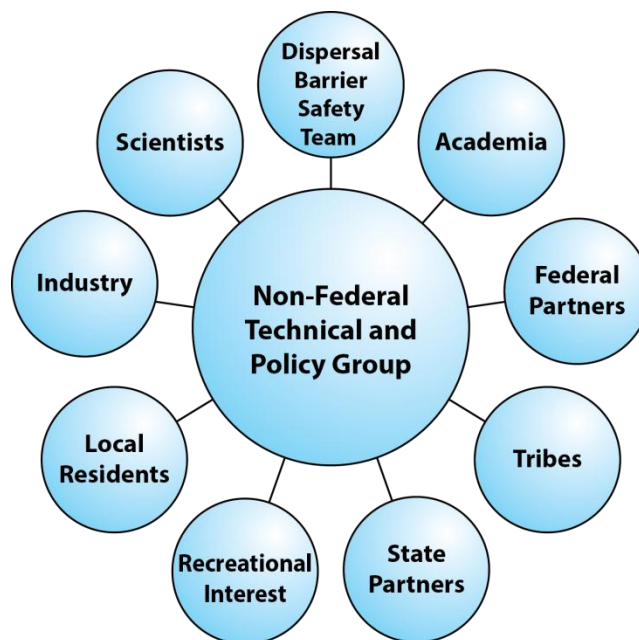
5.0 STAKEHOLDER PARTICIPATION

Stakeholder participation is essential to the continued success of efforts to further control the spread of Asian carp and prevent their establishment throughout the Great Lakes basin. The ACRCC considers stakeholder participation and engagement key components in the strategy for control. The ACRCC will continue efforts to ensure that there are strong participation and stakeholder interest (public, industry, environmental organizations, tribes/First Nations, Congressional) in preventing Asian carp from becoming established in the Great Lakes through Framework action items, public meetings, and interagency collaborative efforts. In addition, the ACRCC will continue regular public forums around the Great Lakes, including Canada, to ensure a common understanding of the risks posed by Asian carp and efforts to prevent and control them.

TECHNICAL AND POLICY WORKGROUP

The Technical and Policy Workgroup is a non-federal, advisory entity that is comprised of members from stakeholder organizations, public sector agencies, the scientific community, academia, and others. Figure 10 below shows the diverse membership of the group. While the Technical and Policy Workgroup is not part of the ACRCC organization, they consult with and provide feedback to the ACRCC and other agencies on invasive species matters.

Figure 9. Technical and Policy Workgroup



Appendix A
2014 Asian Carp Control Strategy Matrix – Funding by Agency

FY 2014 Funding by Agency and Action Area

June 2014

Action Item	Title	USACE		USEPA		USFWS		USGS		USFWS-IL DNR		USFWS-IN DNR		USFWS-OH DNR	
		GLRI	Base	GLRI	Base	GLRI	Base	GLRI	Base	GLRI	Base	GLRI	Base	GLRI	Base
1.0 Monitoring and Species Assessment															
1.1	Enhanced Monitoring Efforts Above and Below the Electric Barrier System									\$1,750,000	\$0				
1.2	Great Lakes Asian Carp Monitoring Program	\$20,400	\$0			\$350,000	\$1,190,094								
1.3	Monitoring and Field Team Support in the CAWS	\$39,000	\$0			\$520,000	\$300,000								
1.4	Illinois River Stock Assessment/Management Alternatives									\$400,000	\$0				
1.5	Barge Entrainment and Asian Carp Interaction Project	\$7,800	\$0			\$580,000	\$0								
2.0 Control and Eradication															
2.1	Development of Control Technologies for Grass Carp in the Great Lakes							\$0	\$230,000						
2.2	Contract Fishing for Asian Carp Detection and Removal									\$1,200,000	\$0				
3.0 Brandon Road Area Activities															
3.1	Characterization of Brandon Road Lock for Implementation of Novel Barriers Against Asian Carp Movement	\$167,200	\$0					\$370,000	\$0						
3.2	Investigation of Interim and Long-term Actions by the Brandon Road Workgroup	\$98,700	\$0							\$200,000					
3.3	Applying Improved Gears and Designs at the Brandon Road Pool of CAWS to Reduce Risk of Asian Carp Movement									\$150,000	\$0				
3.4	Use of Seismic Technology to Divert and Eradicate Asian Carp	\$36,240	\$0					\$570,000	\$300,000						
3.5	Field deployment of Carbon Dioxide Barrier to deter Asian Carp	\$865,000	\$0					\$756,732	\$50,000						
3.6	Hydro-Acoustic Assessment of Lock mediated Fish Passage in the Upper Illinois River					\$293,000	\$0								
4.0 Barrier and Pathway Closure Activities															
4.1	Eagle Marsh Barrier Mitigation and Maintenance											\$700,000	\$0		
4.2	Operation and Maintenance of Electric Barriers	\$0	\$11,800,000												
4.3	Electric Barrier 1 Construction	\$0	\$24,000,000												
4.4	Telemetry - Barrier Efficacy Evaluation	\$0	\$200,000												
4.5	Great Lakes & Mississippi River Interbasin Study (GLMRIS)	\$0	\$3,000,000												
4.6	Hydrologic Support at Wabash/Maumee Connection (Eagle March Barrier) to Prevent Interbasin Transfer of Asian Carp							\$0	\$6,000						
4.7	Little Killbuck Creek Closure Assessment													\$686,028	\$0
4.8	Ohio Erie Canal Closure Assessment													\$0	\$0
5.0 Research Activities															
5.1	Developing Targeted Microparticle and Piscicide Control Systems for Asian Carp							\$200,000	\$450,000						
5.2	Field Evaluation of Chemical Attractants to Control Asian Carp and Development of Protocols for Field Verification of Response							\$200,000	\$190,000						
5.3	Waterway Assessment of Hydraulic and Water-quality Influences on Asian Carp Movement, Spawning, and Recruitment	\$6,600	\$0					\$100,000	\$200,000						
5.4	Assessment of Asian Carp Life History Traits in Established and Emerging Populations to Identify and Characterize Vulnerabilities for Control							\$0	\$200,000						
5.5	Asian Carp Net Avoidance Behavior Study Using Acoustic Technology							\$0	\$100,000						
5.6	Improving Molecular Techniques to Support Integrated Asian Carp Control							\$0	\$700,000						
6.0 eDNA Technology Refinement															
6.1	USFWS Fisheries Program Capacity for eDNA Sampling and Early Detection					\$650,000	\$400,000								

FY 2014 Funding by Agency and Action Area

June 2014

6.2	USFWS Midwest Region Fisheries Program Capacity for eDNA Sample Processing and Technique Refinement					\$900,000	\$900,000								
6.3	Development of a Hand-held, Real-time DNA Detection Kit							\$100,000	\$0						
6.4	Making eDNA a Tool for Better Understanding Carp Populations and for Tracking Impacts of Control Measures	\$385,500													
7.0 Enforcement and Outreach															
7.1	Increased Lacey Act Enforcement of Illegal Transport of Injurious Wildlife					\$400,000	\$0								
7.2	Community Action Initiatives to Increase Awareness, Surveillance, and Enforcement of Unlawful Live Asian Carp									\$300,000	\$0				
7.3	Agency and Public Outreach through Website Development					\$50,000	\$0								
7.4	Public Outreach Video - Enhancements in Asian Carp Assessment Techniques					\$10,000	\$0								
8.0 Asian Carp Program Support															
8.1	Integrated Pest Management Program for Asian Carp							\$926,500	\$773,942						
8.2	Communication and Demonstration of New Technologies for Asian Carp Monitoring and Control							\$100,000	\$15,000						
8.3	Registration of Control Strategies					\$250,000	\$0	\$200,000	\$50,000						
8.4	Investigation of Certification Requirements for Asian Carp Usage									\$0	\$0				
8.5	CAWS Transportation Study	\$13,300	\$0							\$500,000	\$0				
8.6	Facilitation and Mediation Support for the Advisory Committee on Actions for the CAWS									\$200,000	\$0				
8.7	USEPA Support for Asian Carp Activities			\$748,000	\$0										
Agency Total: GLRI and Base Funding		\$1,639,740	\$39,000,000	\$748,000	\$0	\$4,003,000	\$2,790,094	\$3,523,232	\$3,264,942	\$4,700,000	\$0	\$700,000	\$0	\$686,028	\$0

Monitoring and Species Assessment Totals	\$3,667,200	\$1,490,094
Control and Eradication Totals	\$1,200,000	\$230,000
Brandon Road Area Activities	\$3,506,872	\$350,000
Barrier and Pathway Closure Activities Totals	\$1,386,028	\$39,006,000
Research Action Totals	\$506,600	\$1,140,000
eDNA Technology Refinement Totals	\$1,650,000	\$1,300,000
Enforcement and Outreach Totals	\$760,000	\$0
Program Support for Asian Carp Activities Totals	\$2,937,800	\$838,942
Total FY 2014 Agency Base funding planned	\$45,055,036	
Total Fy 2014 GLRI funding requested	\$16,000,000	
Total Planned FY 2014 Funding: GLRI and Base	\$61,055,036	

Appendix B
2014 Asian Carp Control Strategy Framework Action
Items

Framework Action Items

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INTRODUCTION

This package contains the action items (submitted to the ACRC by member agencies) in accordance with the ACRC strategy, as set forth in the body of this Framework. Action items are listed for FY 2014 and are numbered for ease in tracking and according to the various categories for which they pertain. In some cases, action items include milestones expected beyond 2014; these do not represent funding commitments, and will be subject to future budget decision-making. The Framework Funding Matrix (Appendix A) and this document will be organized in the same way with the following categories:

- 1.0 Monitoring and Species Assessment
- 2.0 Control and Eradication
- 3.0 Brandon Road Area Activities
- 4.0 Barrier and Pathway Closure
- 5.0 Research Activities
- 6.0 eDNA Technology Refinement
- 7.0 Enforcement and Outreach
- 8.0 Asian Carp Program Support

Each of the action items below provides a project description including project justification, project milestones, outcomes, and potential hurdles to completion.

1.0 Monitoring and Species Assessment

1.1 Enhanced Monitoring Efforts Above and Below the Electric Barrier System

Lead Agency: Illinois Department of Natural Resources (IL DNR)

Agency Collaboration: United States Army Corps of Engineers (USACE) and United States Fish and Wildlife Service (USFWS)

Funding Table

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$1,750,000	\$0

Project Explanation: This work is a continuation of the extensive monitoring efforts in elevated risk areas to detect the presence of Asian carp and remove them, as necessary. These areas have been previously identified through waterway characterization as preferable Asian carp habitat, extensive sampling, or where previous eDNA sampling indicated the presence and persistence of Asian carp DNA in the area at the time of sample collection. Monitoring of these elevated areas includes eDNA testing and convention monitoring through electrofishing and netting. A detailed discussion of all related monitoring efforts is found in the Asian Carp Regional Coordinating Committee (ACRCC) 2014 Monitoring and Response Plan for Asian Carp in the Upper Illinois River and Chicago Area Waterway System April 2014 (MRP). This plan is located online at www.asiancarp.us. Summaries of generated data and all scheduled activities are also found on the Asian carp website.

Data gathered as part of this effort will inform IL DNR and the ACRCC about potential “choke points” along the Chicago Area Waterway System (CAWS) such as Brandon Road, Lockport, and Starved Rock locks and dams, and will support the decision process to further prevent upstream movement.

Summary of Actions to Date:

Fixed Site Monitoring Upstream of the Dispersal Barrier – This part of the project included standardized monitoring with pulsed-DC electrofishing gear and contracted commercial fishers at fixed and random sites in the CAWS upstream of the electrical dispersal Barrier.

- Estimated over 12,030 person-hours spent sampling at fixed sites upstream of the Electric Dispersal Barrier in 2010 – 2013.
- 636.5 hours spent electrofishing and 420 km (261.1 miles) of trammel/gill net deployed at fixed sites in 2010 – 2013 and random areas in 2012 – 2013.
- Sampled 227,181 fish representing 72 species and two hybrid groups during electrofishing and trammel/gill netting at fixed sites in 2010 – 2013 and random sites in 2012 – 2013.
- 103.5 hours spent electrofishing and 153.2 km (95.2 miles) of trammel/gill net deployed at fixed sites and random areas in 2013.

- Sampled 34,418 fish representing 57 species and two hybrid groups during fixed and random electrofishing and trammel/gill netting in 2013.
- No bighead carp or silver carp captured or observed during fixed site and random area electrofishing and netting in 2013.

Fixed Site Monitoring Downstream of the Dispersal Barrier – This part of the project included monthly standardized monitoring with pulsed-DC electrofishing gear and contracted commercial fishers at four fixed sites downstream of the electrical dispersal barrier in the Lockport pool, and downstream from the Lockport, Brandon Road, and Dresden Island locks and dams. It provides information on the location of the Asian carp detectable population front and upstream progression of populations over time.

- Estimated 7696.5 person-hours spent sampling at fixed, random, and additional sites and netting locations downstream of the electric dispersal barrier from 2010-2013.
- 222.5 hours spent electrofishing and 236 km (146.7 miles) of trammel/gill net deployed.
- Sampled 105,466 fish, representing 92 species and seven hybrid groups.
- No bighead carp or silver carp were captured by electrofishing or netting in Lockport and Brandon Road pools.
- Thirty bighead carp and two silver carp were collected in the Dresden Island pool during fixed, random, and additional commercial netting from 2010-2013.
- One bighead carp and no silver carp were captured at Dresden Island pool while electrofishing from 2010-2013.
- Eighteen bighead carp and 293 silver carp were captured by electrofishing in Marseilles pool from 2010-2013.
- Detectable population front of mostly bighead carp located just north of I-55 Bridge at river mile 280 (76 km (47 miles) from Lake Michigan). No appreciable change in upstream location of the population front in past seven years.

Asian carp spawning activity was observed on May 22, 2013, in the Marseilles pool. However, Asian carp larvae and juveniles were not detected upstream of Peoria pool or less than 161 km (100 miles) downstream of the electric barrier system and 220 km (137 miles) from Lake Michigan.

Young-of-Year and Juvenile Asian Carp Monitoring – This part of the project consists of monitoring for the presence of young-of-year Asian carp in the Illinois River, Des Plaines River, and CAWS occurred through sampling planned by other projects in the MRP and targeted a segment of the Asian carp population typically missed with adult sampling gears.

- Sampled for young Asian carp from 2010 to 2013 throughout the CAWS, Des Plaines River, and Illinois River between river miles 83 and 334 by incorporating sampling from several existing monitoring projects.
- Sampled with active gears (pulsed DC electrofishing, small mesh purse seine, and beach seine) and passive gears (small mesh gill nets, mini-fyke nets, and pound nets) in 2013.
- Completed 1,107 hours of electrofishing across all years and sites.
- Examined 102,590 Gizzard Shad <152 mm (6 in) long in the CAWS and Illinois Waterway upstream of Starved Rock Lock and Dam and found no young Asian carp.
- Low catches of young Asian carp at all sites suggested poor recruitment years.
- Farthest upstream catch was a post larval Asian carp in the Peoria pool near Henry, Illinois (river mile 190) in 2012, over 100 downstream from the electric dispersal barrier.

Response Actions in the CAWS – This part of the project uses a threshold framework to support decisions for response actions to remove any Asian carp from the CAWS upstream of the electrical dispersal barrier with conventional gear or rotenone.

- No response actions in 2013.
- Completed three planned intensive surveillance events with conventional gears in the CAWS upstream of the electric dispersal barrier and collected eDNA samples during 2013.
- Results from “Planned Intensive Surveillance in the CAWS” and “Strategy for eDNA Monitoring” are located in their respective sections.

Planned Intensive Surveillance in the CAWS – This part of the project represents a modification to response actions in the CAWS, and surveillance events that will target areas previously monitored through response actions. These efforts will have the benefit of advanced planning and will occur in locations where the repeated detection of eDNA in previous years indicates the potential presence of Asian carp in the waterway.

- Completed three planned intensive surveillance events with conventional gears in the CAWS upstream of the electric dispersal barrier during 2013.
- Estimated 1,165 person-hours were spent to complete 45.8 hours of electrofishing, set 14.6 km (9.1 miles) of trammel/gill net and 1.1 km (0.7 miles) of deep water gill net, make three 800-yd (732 m) long commercial seine hauls, and deploy three tandem trap nets and eight hoop nets equal to 25.2 net-days of effort.
- Across all response actions and gears, sampled 22,896 fish representing 50 species and 3 hybrid groups.
- Examined 4,757 young of the year (YOY) Gizzard Shad and found no Asian carp YOY.
- No bighead carp or silver carp were captured or observed during response actions.

Barrier Maintenance Fish Suppression – This part of the project provides a fish suppression plan to support U.S. Army Corps of Engineers (USACE) maintenance operations and outages at the Dispersal Barrier. The plan includes fish sampling to detect juvenile or adult Asian Carp presence in the Lockport pool downstream of the barrier, surveillance of the barrier zone with split-beam hydro-acoustics, side-scan sonar and DIDSON imaging sonar, and operations to clear fish from between barriers by mechanical or chemical means.

- Multiple agencies and stakeholders cooperated in successfully removing fish between electrical dispersal barrier 1 and 2A for necessary barrier fish suppression on 3 separate operations. (June 17, August 26 to 27 and November 4)
- A total of 115 fish were removed using pulsed DC-electrofishing and 9 m (30 ft) deep gill nets, with 27 fish > 305 mm (12 in) in length.
- A total of 2 hours and 20 minutes of split-beam hydro-acoustics and side-scan sonar were used to assess the success of the fish clearing operation by surveying the area in and near the barrier.
- No Asian carp were captured or observed during fish suppression operations

2014 Actions:

Fixed Site Monitoring Upstream of the Dispersal Barrier – These activities will continue throughout 2014, but in a reduced capacity. Seasonal Intensive Monitoring (as it will be called in the 2014-16 MRP) is a modified continuation of fixed and random site monitoring upstream of the electrical dispersal barrier and planned intensive surveillance in the CAWS. A variety of gears will be used during seasonal intensive monitoring activities, including pulsed DC-electrofishing, trammel and gill nets, deep water gill nets, a commercial seine, trap nets, hoop nets and Great Lake pound nets to capture and remove any Asian carp present in areas where eDNA has been found to accumulate. Sampling will occur both in Spring (June) and Fall (September) when carp catches in other areas are notably higher. Fixed and random sites throughout the CAWS above the electric barriers will be sampled at these times with electrofishing and contracted netting as in past years. Additional intensive monitoring with those gears and others listed above will occur: Lake Calumet will be sampled in the spring, and the North Shore channel in the fall.

Fixed Site Monitoring Downstream of the Electric Dispersal Barrier – Fixed and random electrofishing and contracted netting will be increased in 2014 below the electric barrier system. This is facilitated by a reduction in fixed and random electrofishing and contracted netting above the barriers. The sample design includes intensive electrofishing and netting at four fixed sites and will increase from 4 to 12 random sites in each of the four pools below the electrical dispersal barrier (Figure 6). 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 4 fixed sites, and 13, 13, and 24 random sites in the Lockport, Brandon Road, and Dresden Island pools, respectively. Contracted commercial netting in the Marseilles pool will occur at 4 fixed sites and four random sites. Effort in the Marseilles pool will remain the same as effort in 2013, to better evaluate the leading edge of the Asian carp population front in the Dresden Island Pool.

Young-of-Year and Juvenile Asian Carp Monitoring – As in the past, 2014 sampling for young-of-year and juvenile Asian carp will take place through netting and electrofishing operations. Projects will include larval fish and productivity monitoring, fixed and random site monitoring upstream of the electrical dispersal barrier, fixed site monitoring downstream of the electrical dispersal barrier, gear efficiency and detection probability study, rapid response actions in the CAWS, seasonal intensive monitoring, barrier maintenance fish suppression project, and the Des Plaines River and overflow monitoring project. The collection of small fish in the Upper Illinois Waterway would suggest an increased risk of Asian carp movement toward Lake Michigan and this remains one of the primary foci of monitoring.

Response Actions in the CAWS – A decision tree is described in prior MRPs and conventional gears, experimental gears and/or rotenone will be used to capture and remove Asian carp from the CAWS upstream of the Lockport Lock and Dam as information and remedy suggest. Each response action will be unique to location, perceived severity of the threat, and likelihood of successfully capturing,

removing, or stopping Asian carp. Agency personnel and contracted netters may be used for initial responses.

IL DNR contracts with a small set of commercial fishing crews as responders. These responders will fish during Seasonal Intensive Monitoring events, but also can be deployed to maximize removal efforts with any of the commercial tools, including seines up to ¾ mile long (if directed by IL DNR and is practicable), outlined in 2013 MRP and subsequent plans.

Detection and response efficiency is important for appropriate and effective invasive species control. Exercises to increase or improve upon responses in challenging, multijurisdictional areas will be identified where appropriate to facilitate future response capacities and partnerships.

Barrier Maintenance Fish Suppression – The IL DNR will work with federal and local partners to remove fish more than 12 inches long between Barrier 2A and 2B before maintenance operations are initiated. Fish removal will take place by collecting or driving fish into the net or from the area with mechanical technologies (surface noise, surface pulsed DC-electrofishing and surface to bottom gill nets) or, if needed, a small-scale rotenone action; and assess the success of fish clearing operations by surveying the area between Barrier 2A and 2B with remote sensing gear (split-beam hydro-acoustics and side-scan sonar). Success is defined as having no fish over 12 inches long remaining in the between-barrier area, as determined with remote sensing gear or MRWG deems the remaining fish in the barrier as a low risk.

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 electric barrier system.
- Application of new gear into surveillance as warranted.
- Monthly reporting of monitoring results to 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.

Outcomes:

- Prevention of Asian carp establishment in CAWS through an active and adaptive monitoring and management program.
- Coordination and summary of sampling and response efforts
- Share expertise and lessons learned with other agencies and programs wanting to remove/control aquatic nuisance species.

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 in the vicinity of the barrier

would challenge ability of current plan to further restrict lakeward movement of Asian carp populations (implementation of additional or other control techniques would be necessary).

1.2 Great Lakes Asian Carp Monitoring Program

Lead Agency: USFWS

Agency Collaboration: Great Lakes States, United States Geological Survey (USGS), USACE, academic institutions

Funding Table:

Funding	Base Funding		Asian Carp GLRI		Other Funding
	USFWS	USACE	USFWS	USACE	
FY 2014	\$1,190,094	\$0	\$350,000	\$20,400	\$0

Project Explanation: USFWS will continue development and implementation of 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 eDNA sampling and monitoring programs implemented by the USFWS, 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), and use a diverse array of traditional and novel gears to sample all potential life stages. USACE funding will support participating in conference and meetings.

Summary of Actions to Date: The USFWS continues to work with partners to refine a Great Lakes basin-wide early detection protocol for Asian carp and other AIS. USFWS convened a meeting with Great Lakes Basin partners in February 2013 to identify 2013 sampling locations (areas of concern), further develop 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. From May through November 2013, USFWS collected 2,240 eDNA water samples, electrofished, and set nets to assess presence or absence of Asian carp. No Asian carp were captured, but positive eDNA results were obtained from USFWS sampling in 3 locations.

FY 2014 Actions: USFWS will work with partners to continue developing and refining standard sampling protocols for the Great Lakes, and will continue implementing the protocol. 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. By the end of 2014, 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 detect new invasions of Asian carp.

Expected Milestones:

- Fully implement a comprehensive and coordinated Great Lakes basin-wide early detection and monitoring program for Asian carp and other AIS species

- Complete early detection surveys in suspected “hot spots” for AIS, in cooperation with partner agencies, as needed
- Continue to refine standard operating procedures (SOP) for basin-wide AIS monitoring with partner agencies

Outcomes/Outputs:

- Ongoing early detection, rapid assessment, and rapid response program for the Great Lakes
- Information that will build upon existing knowledge of distribution and habitat requirements for bighead, silver, grass, and black carp

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

1.3 Monitoring and Field Team Support in the CAWS

Lead Agency: USFWS

Agency Collaboration: IL DNR, USACE

Funding Table:

Funding	Base Funding		Asian Carp GLRI Funding		Other Funding
	USFWS	USACE	USFWS	USACE	
FY 2014	\$300,000	\$0	\$520,000	\$39,000	\$0

Project Explanation: This task encompasses long-term monitoring and rapid response activities regarding Asian carp throughout the CAWS, both above and below the electric barrier system. Enhanced sampling with both conventional (electrofishing, netting, side-scan sonar, hydro-acoustics, rotenone) and novel gears (eDNA, DIDSON, Paupier net) will be used to document Asian carp population dynamics within the canal system and connecting waterways, provide data for modeling potential population movements (range expansion), document fish behavior in and around the barriers, and determine life stages of Asian carp potentially present. Response activities may be implemented where specific evidence indicates presence of Asian carp above the electric barriers, or if a catastrophic event necessitates immediate action.

Summary of Actions to Date: IL DNR, USFWS, and USACE conducted extensive sampling efforts in search of Asian carp above and below the barriers following implementation of the ACRCC Monitoring and Response Workgroup’s (MRWG) updated 2013 MRP—which included additional and novel sampling gear types, a juvenile distribution study, additional telemetry and DIDSON evaluations, an evaluation of the impact of contract commercial fishing on Asian carp abundance, and a survey program of urban fishing ponds. Through June 2013, staff completed 400 electrofishing runs for a total of 100 hours. No Asian carp were observed through electrofishing. USFWS staff also conducted fish behavior studies (wild

and caged) at the electric barriers. USFWS staff also participated in 5 responses, including Lake Calumet intensive surveillance, or barrier clearing exercises in 2013.

2014 Actions: USFWS will support Asian carp monitoring and response activities throughout the region as necessary, and help implement actions called for under the annually updated MRP. USACE will participate in select field work including DIDSON and Telemetry.

Expected Milestones:

- Annual updating, approval, and implementation of the MRP
- Attainment of goals and objectives set by the MRP
- Completion of necessary monitoring with conventional and novel gears to determine the distribution and abundance of Asian carp in the CAWS
- Participation in response efforts, as needed
- Participation in necessary barrier clearing

Outcomes/Outputs:

- Continued development of ACRCC’s MRP, as needed to monitor the leading edge of the Asian carp expansion
- Support of Incident Command System (ICS) response operations as needed
- Provision of staff, equipment, supplies, and ICS team members as needed

Potential Hurdles:

- Weather conditions
- Staff availability
- Possible negative impacts on commercial vessel traffic movement, recreational uses, and resident aquatic life (other than Asian carp) from activities associated with this template
- Possible public resistance to continuing monitoring and response efforts

1.4 Illinois River Stock Assessment and Management Alternatives

Lead Agency: IL DNR

Agency Collaboration: Southern Illinois University, Feeding Illinois

Funding Table

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$400,000	\$0

Project Explanation: IL DNR will advance its work monitoring and developing insights into the strategies for addressing Asian carp in the Illinois River. The primary objective is to understand population dynamics of Asian carp that would give insight into ability of directed harvest and other control measures to reduce overall populations within waters connecting to the Great Lakes, and reduce movement of Asian carp upstream toward the CAWS. Population-level effects and capabilities of harvest

as a control strategy are outlined in the Management and Control Plan for Bighead, Black, Grass, and Silver Carp in the United States. Using best science and understanding the harvest and stock/recruitment variables in the upper Illinois River, IL DNR is further developing dynamic models to forecast and predict effects of harvest, other control efforts, and breadth of Asian carp populations. This will provide science based direction for harvest and control strategies and regional regulatory oversight to achieve goals for (1) prevention of spread toward the CAWS and (2) further reduction of Asian carp populations.

This project encompasses multiple studies with the goal of determining estimates of Asian carp abundance, biomass, size structure, demographics (e.g., growth and mortality), natal origin, and rates of hybridization in the Alton, LaGrange, Peoria, Starved Rock, Marseilles, Dresden Island, and Brandon Road pools of the Illinois and Des Plaines rivers.

As with other projects, beginning in 2014 the project will specifically gather information around several known bottlenecks (Brandon Road, Lockport, and Starved Rock lock and dams) to prevent upstream movement as noted in prior years' work, and in part identified in the Great Lakes/Mississippi River Inter-basin Study (GLMRIS) and support decision making processes in developments of alternative and/or additional measures

Summary of Actions to Date:

The following information can be found in full detail in the 2013 Interim Summary Report, a product of the MRWG at www.asiancarp.us:

- Demographics in the Illinois River
 - Catch per unit of effort estimates in late summer 2013 suggest that densities of Asian carp are lower than in 2011 and 2012. Apparent densities are highest in Peoria Pool. This may be due to the large amount of shallow-water areas and higher catch rates rather than actual density in this reach.
 - Significant recruitment leading to a strong year class was not detected for over 6 years.
 - Sampling in the lower reaches revealed some production of age-0 Asian carp in 2013.
 - In 2013, the predominant "2008" year-class declined.
 - Age distributions of Asian carp from the lower three reaches show no recruitment and declining older fish.
 - Sex ratio did not deviate from 1:1 in 2013, although it was skewed toward males in 2012.
- Hybridization
 - 394 putative Asian carp were genotyped in 2012.
 - Of these fish, 196 were pure silver carp, 4 were pure bighead carp; the rest were hybrids.
- Harvest in Upper Illinois River
 - Modeling using recapture rates of Asian carp revealed that harvest in the Hanson Materials Service area is very effective, contributing to mortality of nearly 100%. However, fish density increased during both years and tag return declined, suggesting net immigration into the backwater.
- Movement

- In 2013, 337 Asian carp were implanted with acoustic transmitters.
- Fish were distributed from Dresden Pool to the Mississippi River. Thirty-eight Asian carp were caught and tagged in Dresden Pool, the furthest location for tagging Asian carp to date.
- Acoustic receiver network was expanded, particularly in the pools above Starved Rock Lock and Dam.
- In 2010-2011, flooding in the Illinois River led to a 30% immigration rate of Asian carp from the Mississippi River. With the low water in 2012, average immigration dropped to 8.1%.
- Net movement of Asian carp was downstream in 2012-2013.
- Spawning behavior of Asian carp was quantified by IDNR personnel in Marseilles Pool. These events corresponded with movements of Asian carp out of the HMS with elevated main-channel discharge.
- Acoustics
 - Acoustics conducted during 2010 through 2011 provided a conservation estimate for the three lower reaches of the Illinois River (main channel only with downlooking hydro acoustics only); 1,413 metric tonnes were estimated. Asian carp comprised greater than 60% of biomass.
 - During 2012 through 2013, completion of surveys from Dresden down to the confluence, which allowed entry into the backwaters
 - 70 plus 200 kHz, side-looking transducers
 - 2012 – 2,306 miles of survey were completed.
 - 2013 – 2,029 miles of survey were completed.
- Recruitment Sources—Otolith microchemistry
 - Water chemistry data continue to indicate that Sr:Ca is consistently higher in the middle Mississippi and Missouri rivers compared to the Illinois River, thus enabling the use of this marker as an indicator of fish that have immigrated into the Illinois River from these other rivers.
 - Using otolith core Sr:Ca data, we estimated that 28-53% of adult silver carp and 26-48% of hybrids in the Illinois River were immigrants that originated in the middle Mississippi or Missouri Rivers.
 - Only 5% of the fish analyzed had otolith core $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ signatures indicative of use of floodplain lake habitats during early life, consistent with data from prior years.
 - Among silver carp and hybrids that were immigrants to the Illinois River, the vast majority originated in the middle Mississippi River; only 2-8% of the total number of silver carp and hybrids captured in the Illinois River originated in the Missouri River.
 - In contrast to silver carp and hybrids, otolith core Sr:Ca indicated that 91-98% of bighead carp analyzed originated in the Illinois River, with 2% originating in the middle Mississippi River, consistent with data from prior years.
- Ecosystem Responses
 - Reduction of Asian carp through controlled commercial fishing did not significantly influence zooplankton densities, gizzard shad relative weight, or gizzard shad catch-per-unit effort.
 - Rotifers are proportionally dominant in terms of abundance in both upper and lower river sections.
 - Primary productivity (i.e., chlorophyll-*a* concentration) decreased from downstream to upstream.

- Total phosphorus (mg/L) decreased from upstream to downstream
- Modeling
 - A paper on population responses of Asian carp to harvest is now published in Fisheries magazine.
 - In 2013, we convened a group of modeling experts in fish ecology. This group provided an outline for a spatially explicit model of movement of Asian carp as a function of density, demographics, and environmental conditions.
 - This model is currently in development.

2014 Actions

- Gather and share (communicate) basic information regarding ongoing market driven economy, industry developments, and carp populations to decision makers and managers to understand existing effort to prevent upstream migration and to facilitate information of ongoing efforts to public sector.
- Although data processing is ongoing, Asian carp abundance appears to be at a low level in 2012-2013. Poor recruitment and natural mortality, perhaps coupled with harvest, contributes to this pattern in Upper Illinois River. Evaluation of this data throughout 2014 will highlight areas in need of further targeted efforts to further goal of contracting population of fish away from sensitive areas or pathways toward Lake Michigan.
- Specifically gather information around several known bottlenecks (Brandon Road, Lockport, and Starved Rock lock and dams) to prevent upstream movement, in part identified in the GLMRIS and support decision making processes in developments of alternative and/or additional measures. These efforts will include:
 - Telemetry efforts
 - Hydroacoustic/side scan sonar efforts
 - Traditional and contracted monitoring efforts

Information from these efforts can inform harvest strategies and inform managers on potential for infrastructure modification, operations, or design at or near lock chambers or other locations where fish may by-passing bottlenecks.

Expected Milestones:

- Population estimate for all Illinois populations of Asian carp for use by program to maximize efficiency in reducing numbers and retracting range of Asian carp
- Dynamic movement and multi pool models for entire Illinois River
- Identify areas of control
- Identify areas to restrict fish passage

Outcomes:

- Ability to transfer knowledge, management actions, and control technologies obtained from Asian carp activities to national or international levels
- Conveyance of information to the ACRCR regarding control efforts to reduce the density of Asian carp approaching the Great Lakes
- Prediction of effects of harvest and other control efforts on movement of Asian carp populations toward the Great Lakes
- Determination of potential impact of Asian carp on native fish and other ecosystem parameters if the carp invades the Great Lakes

- Reduced upstream passage of Asian carp
- Overall reduced populations of Asian carp in upper Illinois Waterway
- Reduced risk of Asian carp at or near electric barrier system

Potential Hurdles:

- Variation in feral carp populations due to reproduction and or movements may exceed ability to detect changes due to harvest/control efforts
- Hydrological effects on removal efforts and implementation of surveillance

1.5 Barge Entrainment and Asian Carp Interaction Project

Lead Agency: USFWS

Agency Collaboration: USACE

Funding Table:

Funding	Base Funding		Asian Carp GLRI Funding		Other Funding
	USFWS	USACE	USFWS	USACE	
FY 2014	\$0	\$0	\$580,000	\$7,800	\$0

Project Explanation: This task encompasses follow up investigations to laboratory work conducted by USACE and field work completed by USFWS in 2012 and 2013 which showed that live fish could be entrained across the electrical barriers in the CAWS by passing barges to varying degrees depending on barge configuration. The proposed work also aims to address questions raised by the recently formed Government/Barge Workgroup regarding behavior of fish in barge void spaces and distances fish may be entrained.

Specific study objectives are to: (1) evaluate behavior of fish near and in the void spaces of barges as they traverse the electrical barriers; and (2) determine the length of time and distance fish may be entrained in areas and void spaces of barges. Studies of this nature have not been conducted before to the best of our knowledge. Therefore, it is unclear what methods (i.e. DIDSON, video camera, underwater camera, etc.) might be best suited for these studies. It is also unknown how turbulence from barge movements and water clarity may impact our abilities to monitor fish in and around barges with video equipment, so we will use several methods to attempt this work. To answer questions related to the possibility of wild fish (free swimming, non-tethered) entering areas around barges, nets will be designed and deployed in the void spaces between the barges while barges traverse the barriers. USFWS will attempt to deploy DIDSON (Dual-frequency identification sonar) units or video cameras around barges. The images from the DIDSON or Underwater cameras will be used to view and count wild fish in barge junctions over time and distance traveled. Additional data on temperature, flow, speed of the barges, location, electrical measurements, and distances traveled by the barges will also be collected and compared to the images collected. Surrogate live, untethered fish may also be collected and dropped into the areas in order to collect additional images of fish behavior under simulated entrainment conditions if warranted.

The majority of project costs will be used to contract with barge companies to provide barges, time, and crews to conduct this work (estimated at 4 weeks of field work at approximately \$100,000 per week). Costs of this project could be reduced if barge operators were willing to provide barge platforms as an in-kind contribution.

Summary of Actions to Date: in 2013, USACE completed a laboratory-based model study using a scaled-down flume version of the CAWS electrical barrier system and model fish and barges at its ERDC lab. This study showed that model fish assumed to be incapacitated by the barriers could be entrained beyond the barriers in void spaces between the barges. Further USACE studies of electric field strength around barges traversing the barriers showed distortion of the electric field and weakening of the electric field in some cases, particularly in the void space of a rake-to-box barge configuration. Field studies conducted by USFWS in 2012 and 2013 used tethered and wild surrogate fishes to test if barges would entrain these fish and propel them through the barrier system. Two general methods were used, one where fish were placed directly in the spaces around barges as they traversed the barrier, and another where fish were placed across the canal in front of north-bound barges crossing the barrier. These studies (<http://www.fws.gov/midwest/fisheries/carterville/didson-barge.html>) found that live fish were entrained across the barriers by passing barges, to varying degrees depending barge configuration.

2014 Actions: USFWS will conduct studies of fish behavior in and around barges traversing the CAWS electrical barriers as described above in an attempt to: (1) evaluate behavior of fish near and in the void spaces of barges as they traverse the electrical barriers; and (2) determine the length of time and distance fish may be entrained in areas and void spaces of barges. Work would be attempted in late summer or early fall, pending availability of barges.

Expected Milestones:

- Data allowing agencies to determine the relative frequency of wild fish entering void spaces of barge tows
- Data allowing agencies to determine the relative time spent and distance traveled by fish in void spaces of barge tows
- Written project report(s) describing project results

Outcomes/Outputs:

- Enhanced knowledge of behavior of fishes near barges and in void spaces of barge tows that could influence future operations in a manner that minimizes fish entrainment
- Support of Government/Barge Workgroup
- Satisfaction of USFWS partners in addressing potential entrainment issues at the barriers

Potential Hurdles:

- Weather conditions
- Staff availability
- Turbulence and water clarity in and around barges may obscure systems used to monitor fish behavior
- Possible issues regarding sampling site logistics

- Potential difficulties in contracting or scheduling participation with barge operators

2.0 Control and Eradication Efforts

2.1 Development of Control Technologies for Grass Carp in the Great Lakes

Lead Agency: USGS

Agency Collaboration: Ohio Department of Natural Resources (OH DNR) and Bowling Green State University

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$230,000	\$0	\$0

*Assume flat line funding for base funding.

Project Explanation: With the recent discovery of grass carp in Lake Erie, there is an increased interest in developing a strategic research plan that would focus on grass carp in the Great Lakes as well as other areas of the United States. USGS has documented that grass carp have spawned in the Sandusky River and that some of the young have survived. Six 1-year-old grass carp were captured in the Sandusky River in 2012, and USGS has determined that the six fish had no overlapping parentage, indicating a potentially large population of spawning fish. However, the extent of the grass carp population beyond these few fish is unknown. Understanding the extent of the invasion and whether grass carp are self-sustaining or growing is critical in understanding where and how to address the issue of grass carp in the Great Lakes. USGS scientists have already begun to determine grass carp spawning habitat and investigate egg survival concurrently with bighead and silver studies. USGS will take an integrated pest management approach in addressing grass carp control, informed by adequate biological information as needed and researching a variety of complementary potential control mechanisms.

The presence of grass carp in the Great Lakes, while undesirable, does offer an opportunity to research the biology of Asian carp in the unique Great Lakes system. As adults, grass carp differ in behavior and physiology from their relatives, bighead and silver carp; however, they are very similar in their spawning and early life history requirements. Grass carp are often seen spawning together with silver carp, the eggs and larvae drift similarly, and their young are often captured together in the same type of habitat. Where grass carp can successfully spawn and recruit, it reasonable to suppose that bighead and silver carp also would be successful. Thus, a study of grass carp in the Great Lakes may affect future efforts with bighead and silver carp. What is learned in grass carp studies may be transferable to bighead and silver carp and be useful in planning rapid response and control methods if those fish access the Great Lakes. USGS has already begun some research efforts on grass carp and these activities are not necessarily mutually exclusive of our efforts to understand and control bighead and silver carp. These efforts would have application to the Great Lakes Region as well as other areas of the United States that are concerned with the potential spread of Asian carp. Furthermore, current research on the biology and control of bighead and silver carp may be useful in responding to grass carp invasions. Integration of research and control plans for all Asian carp may be advantageous.

This project will build on past and current efforts associated with Asian carp and follow the same strategy as other USGS research efforts. That is, studies will focus on understanding the role of life history and behavior, hydrology, early detection, and control methods as part of an Integrated Pest Management approach.

Summary of Actions to Date: NA

2014 Actions:

- Analyze and disseminate research conducted in 2013 on grass carp early life history and developmental rate, sinking rate and size of eggs, survival and hatching of settled eggs, and behavior of larvae.
- Update the FluEgg tributary assessment model to incorporate grass carp, to be used in predicting adequacy of rivers for grass carp reproduction and recruitment.
- Collect hydraulic and water-quality data on two Lake Erie tributaries (Grand and Cuyahoga rivers are proposed).
- Continue to receive grass carp collected by federal and state collaborators from the Great Lakes or other areas of North America where grass carp are not known to be established. Collect aging parts, genetic material (for studies of parentage and spawning populations), otoliths (for microchemistry determination of sources and locations where the fish have lived, or for oxygen isotope determination of temperatures), gut contents (to determine food consumed) and muscle plugs (for genetic analyses), gonad material (for determination of reproductive status and age at maturity) and eyes (for determination of ploidy and thus fertility). Samples will be archived until a sufficient number of fish are collected to proceed effectively with the different technologies.
- If possible, initiate egg and larval fish sampling on the Sandusky River to determine if grass carp successfully spawn in 2014.

Expected Milestones:

- May 2014: Completion of the genetic analysis of the 12 Raisin River grass carp
- September 2014: Assess the combination of genetic data, aging data, and otolith data of these and fish from the Sandusky River to inform us on the movements and interrelatedness of these fish
- Summer 2014: Add the capability to predict grass carp egg survival to the Fluegg model
- Fall 2014: Egg and larvae collections on the Sandusky June and July (2014), and samples picked and Asian carp (grass carp) eggs and larvae identified

Outcomes/Outputs:

- Manuscripts of USGS Series reports are to be produced as a result of 2013-2014 efforts. Future products will be delivered as efforts increase and additional information is collected.

Potential Hurdles:

- Logistical and resource challenges associated with field sampling in a large system.
- Partnering with other resource agencies and universities to develop a comprehensive research strategy.

2.2 Contract Fishing for Asian Carp Detection and Removal

Lead Agency: IL DNR

Agency Collaboration: USGS during Integrated Pest Management field trials.

Funding Table

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	1,200,000	\$0

Project Explanation: This program was established to reduce the numbers of Asian carp below the Electric Barrier System through controlled and contracted fishing efforts, thereby reducing the opportunity for carp to test the barrier and decreasing the possibility of Asian carp moving across the barrier and gaining access to waters upstream of the electrical barrier system. Refocus of efforts in 2014 can further remove more fish from the Illinois River from the most populated reaches. This program also allows for monitoring population densities of Asian carp over time in the CAWS down to the Starved Rock pool.

Summary of Actions to date:

- Contracted commercial fishers and assisting IL DNR biologists deployed 1585 km (985 miles) of net in the upper Illinois Waterway from 2010- 2013.
- A total of 56,435 bighead carp, 94,071 silver carp, and 799 grass carp were removed by contracted netting. The total weight of Asian carp removed was 1006.72 tons (62.41 tons in 2010, 351.78 tons in 2011, 284.53 tons in 2012 and 308 tons in 2013).
- Identification of sink populations in upper waterway facilitate removal
- Asian carp populations have not significantly moved lake ward since 2006

2014 Actions:

Contracted commercial fishing crews will be used to reduce the numbers of Asian carp in the upper Illinois and lower Des Plaines Rivers downstream of the electrical dispersal barrier. Ten commercial fishers will be employed to harvest as many Asian carp as possible in the Starved Rock and Marseilles pools. Harvested fish will then be picked up and utilized by private industry for purposes other than human consumption, as well as to gather information on Asian carp population abundance and movement in the Illinois Waterway downstream of the electrical barrier system as a supplement to fixed site monitoring by contracted netters. Many of the same contracted netters will work in teams of two to detect and remove Asian carp in the CAWS (seasonally) from the electrical barrier system down to the Dresden Island pool (bi-weekly). , These contactors may also serve as responders.

Expected Milestones:

- Throughout 2014 - Annual observance of reduction of biomass of Asian carp detected in river reaches below the electric barrier system thus reducing the threat of challenges to electric barrier system and lower threat to Great Lakes.
- A minimum of 350 tons of Asian carp removed from upper Illinois Waterway annually.
- Deploy seines to maximize removal at least twice annually.

Outcomes:

- Ability to assess these populations and adjust efforts to optimize impacts
- Population reduction
- Reduce opportunities for Asian carp to challenge electric barrier system
- Apply multiple control and detection techniques to maximize control on an invasive species
- Monitor leading front of Asian carp length and weight and general biological condition
- Have significant resources contracted for implementation over a short response time for rapid responses
- Significant personnel with experience fishing multiple gears in riverine conditions to respond rapidly for early detection and rapid responses
- Assessment of efficacy of removal efforts by reference to added telemetry data (other projects) is expected to indicate success of removal efforts on a pool by pool basis and thus success in prohibiting upstream movement of Asian carp
- Additional removal using contracted netting (both seining and gill/trammel netting) with efficient deployment of fishers as informed by telemetry and remote sensing (concurrent projects with results communicated to fishers should improve removal rates).

Potential Hurdles:

- Increased immigration from out-populations could outpace removal efforts (being investigated by stock assessment, population estimates, and comparing catch rates)
- Removal efforts can be affected by weather and river levels. Effort will be scheduled to minimize these factors or rescheduled in case efforts need to be canceled for safety concerns
- Without sufficient immigration and/or recruitment, removal efforts could drive population down without immigration (as designed) which could preclude removal of 350 tons annually. In this case removal efforts can be optimized at new levels

3.0 Brandon Road Area Activities

3.1 Characterization of Brandon Road Lock for Implementation of Novel Barriers against Asian Carp Movement

Lead Agency: USGS

Agency Collaboration: USACE, USFWS, MWRD, IDNR

Funding Table:

Funding	Base Funding		Asian Carp GLRI Funding		Other Funding
	USGS	USACE	USGS	USACE	
FY 2014	\$0	\$0	\$370,000	\$167,200	\$0

Project Explanation: To help prevent the movement of Asian carp from the Mississippi River basin to the Great Lakes basin, additional barriers to the CAWS have been proposed at Brandon Road as a component of the GLMRIS Report developed by the U.S. Army Corps of Engineers (USACE) in 3 of the 8 alternative plans. The plans outlined by the USACE suggested the implementation of a combination of new electric barriers and a “GLMRIS Lock” with an estimated timeline of 10 years or longer. Newer barrier technologies such as water guns or carbon dioxide to drive fish away have been suggested as approaches that could be implemented relatively quickly.

To implement the use of these technologies at the Brandon Road location would require a better understanding of the impacts of locks, structures, and other influences that could constrain the deployment of these technologies. The USACE is concerned about the potential impacts associated with the deployment of these technologies on or near their structures, such as water guns on the canal walls, carbon dioxide on lock chambers, etc. Furthermore, the deployment of these technologies could impact the movement of barges and other vessels.

The success of the project will depend on the collaboration with partners on potential barriers, and the availability of existing data. This template is designed on the assumption that potential barriers and data gaps will be identified in the project meeting and that subsequent field characterization and other studies will not be necessary after the first efforts. If additional follow-up studies are necessary, expectations for future efforts will need to be revised.

Summary of Actions to Date (completed under previous templates):

- Testing of CO2 barriers in ponds has shown that fish move away from the barrier.
- Water guns have been shown to drive away fish in pond studies and data analysis is underway for the fish response to the water guns at an application in a backwater pond of the Illinois River.
- The pressure wave created by the water guns has been measured and mapped during pond studies.

2014 Actions:

- Meet with the USACE and other parties at Brandon Road to discuss project goals and potential technologies and solicit input. Other activities described below will be subject to modification depending on the outcome of this meeting. Work plan will be developed and sent to parties for comment.
- Perform synoptic velocity field mapping (intensive collection of water velocities in a short timeframe) at a range of low, medium, and high flows in the lock and the exit channel downstream.
- Measure downstream boundary conditions to examine the effects of backwater in the Dresden Pool on hydrodynamics in the Brandon Road tailwater.
- Document the range of mixing environments present due to the expected range of hydrologic/hydraulic variation near the lock and downstream. Dye will be applied under normal flow conditions and tracked through the lock to document mixing zones and rates both within the lock and downstream of the lock.
- Collect water-quality data under various hydrologic conditions (locking, seasonal, high and low flows) to provide the information needed for the design of the system that will include basic field parameters in addition to major ions, including alkalinity and calcium, that will be needed to assess season variability and hydrologic extremes. The USGS will coordinate with MWRD with their ongoing data collection efforts.
- Collect data on the potential effects of pressure waves generated during watergun operation on locks and other structures based on different watergun configurations and to identify the most effective deployment methods. Collect fish behavior response with hydro-acoustic monitoring.
- Assess potential effects of CO₂ on structures, including potential assessment of current conditions of existing structures in conjunction with the USACE.
- Complete flood inundation mapping in the vicinity of the Brandon Road Lock and Dam to determine if flooding could provide a pathway around the proposed barriers at certain flood conditions.
- Complete native mussel survey if needed, to assess potential impact of CO₂ use.
- Install fish telemetry receivers and begin data collection.
- USACE will provide engineering/navigation technical expertise.
- USACE will provide engineering/navigation technical expertise.

Expected Milestones:

- Spring 2014: Meeting with USACE and other parties
- May 2014: Structural testing with waterguns (completed under other project)
- Summer 2014: Velocity mapping
- Fall 2014: Flood inundation mapping

Outcomes/Outputs:

- A better understanding of how potential new barrier technologies could be used at the Brandon Road Lock and Dam to prevent the movement of Asian carp

Potential Hurdles:

- Field work components are subject to weather conditions
- Overall project completion and field activities heavily dependent on timing of funding

3.2 Investigation of Interim and Long-term Actions by the Brandon Road Working Group

Lead Agency: EPA and IL DNR

Other Collaborators Involved: University of Illinois, SIU, USACE, USGS

Funding Table

Funding	Base Funding		Asian Carp GLRI Funding		Other Funding
	ILDNR	USACE	ILDNR	USACE	
2014	\$0	\$0	\$200,000	\$98,700	\$0

Project Explanation:

Long-term success of keeping Asian carp from expanding into the Great Lakes basin will take consistent and long-term action. Currently the spread of Asian carp has stalled, affording more time for action, these actions should exploit bottlenecks that already exist to be most efficient and time sensitive to enforce. Several studies by Great Lakes Commission and USACE have suggested one of these bottlenecks may be the Brandon Road lock and dam. To further inform control efforts, studies focused on this location and other potential bottlenecks (Starved Rock and Lockport locks and dams) can expedite future actions.

Studies will focus initially on fish presence/movement (Asian carp and native fishes) around and through these structures. Blocking fish passage is a concern in fish management with removing structures even when invasive species exist, to allow the native fish habitat they would otherwise not have access to. The dilemma is that such a structure may be important in managing an Asian carp threat to the Great Lakes, thus information on both nuisance species and native species behavior is necessary.

Further and additional studies are recognized for other biota, water quality effects of structures design, construction, and operation. IL DNR will seek support for needed data mining and studies to be conducted by Illinois agencies, research organizations, and contractors as needed to keep progressing in long-term solutions. Currently, specific needs are not identified and thus budgets for additional work will be highly collaborative. A State and Federal Workgroup is being proposed to help manage needs, and identify expertise needed to accomplish project goals.

Tagging and telemetry studies identified in other projects will further confirm potential efficacy of the barriers. This study will evolve further as future directions become clear; such as the need to involve contractors to further investigate certain areas.

2014 Actions:

- Increase mark-recapture studies to capture fish (Asian carp and native fishes) near to Brandon Road Lock and Dam

- Support Brandon Road Workgroup, and other agency activities when applying technologies in and around Brandon Road Lock and Dam
- Investigate historical and archived data that informs on history of fish movement in upper Illinois Waterway, and specifically Brandon Road Lock and Dam
- Assist applying technology to slow or examine fish movement near other bottleneck structures as practicable.
- USACE will provide engineering/navigation technical expertise.

Expected Outcomes:

- Improved understanding of the efficacy of current lock and dam structures in Illinois Waterway to stop fish movement
- Knowledge of the cost, feasibility & logistic challenges associated with the use of locks and dams as a fish deterrent in a real-world scenario
- Begin assessment of the non-target impacts of lock and dam barriers on biota, abiotic parameters, and existing infrastructure (i.e., existing cement locks) if alternative technologies are utilized (CO2, waterguns, other) to stop fish movement
- Capturing tagged fishes that will inform on efficacy of existing structures to fish passage with information on species, size, and season of passage
- Insights into fish staging locations around existing structures
- Create a decision support framework that will gather needed fish and fish community information needed in evaluation of long term strategy to prevent carp passage
- Interim measures Workgroup development to bring needed expertise into close communication with projects (will inform interim measures and long term solutions as identified by IL DNR, federal, state, and NGO studies, e.g. GLMRIS and GLC Divide proposals)

Potential Hurdles:

- Timely permitting and permissions to allow technologies to be used as a deterrent in a ecologically important location (trials)
- Lack of appropriate data or information to inform on impacts
- Tagging numbers need to be high, therefore to augment telemetry we will use external and numbered floy tags. Because fish with these tags must be recaptured, both the numbers of tags deployed and effort to recapture them needs to be significant. This study will rely on the increased monitoring efforts for recapture. If amount of fish passage is low, it could be unobserved, thus requiring even additional efforts (floy tags and telemetry) in future to fully understand.
- Permitting timelines could slow development of emerging technologies
- Construction of physical needs takes time and weather/river-level dependent

3.3 Applying Improved Gears and Designs at the Brandon Road Pool of CAWS to Reduce Risk of Asian Carp Movement

Lead Agency: IL DNR

Funding Table

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$150,000	\$0

Project Explanation: Current studies are evaluating technologies that can capture or increase capture efficiencies within the CAWS or specific habitats within the CAWS. A working group of net makers, fishery biologists, Great Lakes and riverine commercial fishers, and hydro-acoustic and pheromone experts has developed several tools/items to use in the CAWS and Illinois Waterway. Deep panel gill nets, large hoop nets (6 feet), and Great Lakes style pound nets are currently being evaluated as appropriate gears that increase our ability to detect Asian carp in the CAWS and upper Illinois Waterway. Additional locations and gears, as well as combination of gears and fine-tuning, is ongoing to further increase detection rates of Asian carp. Pheromone research by cooperating agencies has identified some baits and lures that also may aid in carp capture; these tools may be implemented as available. Through these efforts, gears can be fine-tuned and recommended for full implementation and inclusion in response, removal, or monitoring efforts. In particular, downstream of Brandon Road lock and dam has been identified as a location where increased efforts should be focused. This project will assist in further customizing gears for this specific area as well as other areas to fully implement gears with highest efficiency throughout MRP areas and activities, as appropriate. This may also replenish appropriate gears as needed to achieve MRP objectives.

Summary of Actions to Date:

Asian Carp Gear Efficiency and Detection Probability Study – This project assessed efficiency and detection probability of gears currently used for Asian carp monitoring (e.g., pulsed-DC electrofishing, gill nets, and trammel nets) and other potential gears (e.g., mini-fyke nets, hoop nets, trap nets, seines, and cast nets) by sampling at 10 sites in the Illinois River, lower Des Plaines River, and CAWS that have varying carp population densities. Results were used to inform decisions on appropriate levels of sampling effort and monitoring regimes and ultimately improve Asian carp monitoring and control efforts.

- Pulsed-DC electrofishing was the most effective gear for capturing silver carp, whereas hoop nets were the most effective gear for capturing bighead carp. Hybrid Asian carp were vulnerable to both electrofishing and hoop nets.
- Hoop nets outperformed gill/trammel nets in experimental deployments at fixed sites. Gill and trammel nets have been seen to outperform hoop nets in MRP removal efforts, thus comparison of contracted netters and experimental deployments need further evaluation.

- Asian carp were most abundant in the LaGrange and Peoria pools; abundance declined at upstream sites, and no Asian carp were observed upstream of the electrical barrier in the CAWS.
- No age-0 Asian carp were observed in 2013. Possible age-1 Asian carp (< 500 mm) were most abundant in the Peoria pool, but were relatively scarce elsewhere, suggesting populations consisting primarily of larger, older fish.
- Tributary sites were sampled with pulsed-DC electrofishing gear in the Spoon, Sangamon, Mackinaw, and Kankakee Rivers during 2013. No Asian carp were observed in the Kankakee (major tributary closest to the electric barrier system), whereas 513 Asian carp were captured from the other three tributaries.

Detection probabilities for Asian carp were lower at upstream sites than at downstream sites. Given the lowest estimates of detection probability for sites where Asian carp were captured, a minimum of 17 pulsed-DC electrofishing transects (15-minute duration) are necessary to achieve a 95 percent probability of capturing at least one silver carp, whereas a minimum of 42 hoop net-nights would be required to achieve this same cumulative detection probability for bighead carp. Even higher sampling efforts are likely necessary to achieve these same levels of confidence at sites with lower Asian carp abundance.

Unconventional Gear Development Project –The goal of the project was to develop an effective trap or netting method capable of capturing low densities of Asian carp in the deep-draft canal and river habitats of the CAWS, lower Des Plaines River, upper Illinois River, and possible Great Lakes spawning rivers.

- Large (2 m) hoop nets captured fewer fish of all taxa, and fewer Asian carp than standard (1.2 m diameter) hoop nets.
- Surface-to-bottom gill nets captured more Asian carp than traditional gill nets during 4-hour sets.
- Driving fish into surface-to-bottom gill nets with pulsed-DC electrofishing gear captured more Asian carp than drives using traditional pounding methods or control sets.
- Pound nets were effective at capturing large numbers of fish, including a high proportion of Asian carp, at Materials Service Pit (Marseilles pool) and at Lilly Lake (LaGrange pool).

FY 2014 Actions:

- Contracting with a net builder we will re-design/tweak 2-m hoop nets to optimize catch rates.
- Will fish pound nets in new locations and deploy in novel ways to increase catches where carp are present
- Pound nets designed for new areas will be evaluated.
- Maintaining novel gears
- Testing USFWS novel gears (Mamou and Paupier nets) in Illinois Waterway. Compare efficacy with other experimental gears.
- Evaluate hydro-acoustic data to compare efficacy of catch versus standing stock

Expected Milestones:

- Demonstrate additional gears to use in upper Illinois Waterway where fish are rare
- Demonstrate additional gears to use in lower Illinois Waterway where fish abundance is high
- Construct total list of gears, specifications, and sources to share with partner agencies

Outcomes/Output:

- Further development of new gears and fine tuning of existing ones to maximize detection and removal of Asian carp
- Additional tools for detecting, stopping, and eliminating Asian carp from the waterway and elsewhere
- Additional tools to be utilized wherever Asian carp exist to increase likelihood of capture
- Additional tools for rapid responses which can be deployed to maximize chances of capturing rare fish in deep channels or Great Lakes habitats
- Additional tools to fish habitats that are hard to sample with more conventional gears
- Develop tools that will be able to fish water more effectively and cost effective while minimizing mortality to native species

Potential Hurdles:

- Cost of applying new technology may not have cost savings over existing methods
- New technologies may not improve upon sampling efficiencies when actually deployed
- New gears may be more expensive and require additional equipment to deploy as compared to traditional fisheries gear
- Gears may catch fish where they are abundant, but may not increase ability to catch fish significantly where they are very rare

3.4 Use of Seismic Technology to Divert and Eradicate Asian Carp

Lead Agency: USGS

Other Agencies Involved: IL DNR, USACE, USFWS, Northern Illinois University, Southern Illinois University, University of Illinois Urbana-Champaign, University of Minnesota-Duluth

Funding Table:

Funding	Base Funding		Asian Carp GLRI Funding		Other Funding
	USGS	USACE	USGS	USACE	
FY 2014	\$300,000	\$0	\$570,000	\$36,240	\$0

Project Description: Currently, preventing the movement of Asian carp from the Mississippi watershed into the Great Lakes rests on a set of electric barriers installed in the Chicago Sanitary and Ship Canal (CSSC). Additional barriers and/or supplements to the electric barriers would improve the efficacy of deterring Asian carp movement into the Great Lakes and elsewhere. Seismic technologies used in oil exploration create high-pressure underwater sound energy waves that may deter the movement of Asian carp. These sound energy waves may be produced by a variety of means ranging from chemical explosives to high-pressure air. Two pneumatic techniques, both involving high-pressure air, are the air guns and water guns. Air guns release on command a specified volume of high-pressure air which produces a steep-fronted shock wave with several oscillations caused by the repeated collapse and expansion of the air bubble. Water guns use high-pressure air to drive a shuttle through the lower chamber of the water gun. The rapid expulsion of the water in the lower chamber by the shuttle creates a void which is rapidly filled by the collapse of water back into the void – the collapse of water into this

void creates a pulsed sound/pressure wave in the frequency range from 20 to 1,500 Hz. Seismic technologies employed as a barrier could deter movement of or drive Asian carp from an area, effectively supplementing existing barriers or provide a standalone deterrent in other locations (e.g., locks, connecting waterways, etc.).

Using water guns to modify carp behavior may have a potential impact on structures (controlling works, electric barrier, etc.) and canal walls; however, that impact is unknown. Water guns have been used during the maintenance cycle on the electric fish dispersal barrier to help remove fish from the area between Electric Barriers 2A and 2B. Potential use of water guns in downstream lock and dams, such as Brandon Road or Lockport could keep more Asian carp downstream, potentially reducing the population pressure moving toward the electric barrier. To assess the distribution of seismic energy from the water guns, data collection is needed when the water guns are used within the CSSC, and other parts of the CAWS, such as near O'Brien or Brandon Road locks and dams, so that engineers can determine potential impacts on the structures and canal walls. Pressure maps under different water gun operating pressures and configurations are needed prior to deployment to ensure appropriate pressure coverage to prevent fish passage and to determine safe operating distances from sensitive navigational structures. The project will begin to develop a model to predict potential strengths of the seismic signals produced by the water guns on structures and pressure mapping depending on varying waterway channel configurations.

Behavioral responses of several fish species, including bighead carp and silver carp, have been characterized under controlled settings during operation of water guns under static deployment conditions. Though behavioral responses of fish to operation of water guns in field settings were characterized, repeated studies are needed to confirm the results of initial trials under differing field conditions. Categorization of the response of Asian carp to mobile deployments of water gun configurations will also be evaluated to evaluate potential use as an area clearing tool or as a mechanism to drive fish toward commercial fishing nets or into areas where other control techniques could be applied. While some non-target effects data have been collected, the potential negative effects of water gun discharge are generally unknown in native mussels. Work will be initiated to evaluate the potential negative effects of water gun deployment on native mussels.

FY 2013 Actions Undertaken:

- Completed 6 trials (October-November 2012) to begin to characterize the movement of silver carp in a USGS experimental pond. Behavioral observations identified needed changes in study design to more accurately categorize the response of Asian carp to water gun operation
- Completed detailed acoustic tag evaluation study to identify the best methods to attach acoustic telemetry tags to juvenile Asian carp
- Developed detailed acoustic telemetry study plan for the conduct of behavioral assessment trials in a USGS experimental ponds
- Conducted 7 behavioral response trials with silver carp and bighead carp. Four trials evaluated the response of silver carp and bighead carp to water gun operation after fish had been allowed to acclimate to the experimental pond. Three trials evaluated the behavioral response of bighead carp and silver carp and 4 non-target species (bigmouth buffalo, channel catfish,

paddlefish and yellow perch) following introduction to the research pond in which the water guns were operating as a barrier before fish introduction to the research pond

- Deployed a water gun barrier on 3 separate trials on a ~100-m wide channel connecting the Illinois River to a privately-owned sand mining operation near Morris, IL. Behavioral responses were recorded using split-beam hydro-acoustics (USGS) near the water gun barrier and by split-beam hydro-acoustics and side-scan sonar (SIU) within the connecting channel and in the pool within the sand mining area.
- Completed pressure testing in USGS pond for both a single and dual 80-in3 water guns
- Completed pressure testing in approach channel at Hanson Materials, Morris, IL site
- Worked on a data report from the first water gun testing along the Illinois Sanitary and Ship Canal
- Collected background pressure readings from barge traffic downstream of the Brandon Road Lock and Dam in the approach channel

FY 2014 Actions

- Lemont test area pressure gradient mapping.
- Data report completion following Lemont data acquisition.
- Brandon Road (downstream of lock) testing – pending USACE approval.
- Discussions with U.S. Coast Guard on scope of issue with ship hulls and equipment.
- Begin scoping and development of predictive pressure model.
- Assess the effects of water gun exposure on three native mussel species.
- Complete one or more deployment trials of a static water gun barrier and a mobile water gun system including the use of acoustic telemetry tagged fish to determine behavioral responses of fish to water gun operation.
- Initiate purchase actions to acquire additional underwater seismic sound generation systems (air and water guns).
- USACE will provide engineering/navigation technical expertise.

Expected Milestones:

- July 2014: Descriptions of the behavioral response of fish to water gun operation in an experimental pond
- September 2014: Descriptions of the behavioral responses of fish to operation of a water gun barrier under field conditions
- May 2014: Complete pressure mapping of water gun operation in the CAWS/CSSC and structural testing and pressure gradient mapping of different boundary conditions outside of the Brandon Road Lock and Dam, pending USACE permission.
- June 2014: Pressure gradient mapping at the 25 feet deep channel of the CSSC-Lemont test site (near river mile 301.6, approximately 5 miles upstream of the electric fish barrier and 2 miles downstream of Sag Junction) and additional different data collection at the rock/water interface
- June 2014: Begin activities on developing a predictive model for water gun pressures on structures

Outcomes:

- Understanding of the minimum gun size, operating pressure and gun discharge frequency needed to alter the behavior of Asian carp

- Recommendations to management agencies on the minimum gun size and operating conditions to establish static deterrent barriers or mobile herding systems.
- Data report summarizing data collection methods, background data and data collected with water guns
- Journal publication of review and interpretations of studies summarizing the seismic energy imparted on structures
- Geophysical model for predictions of seismic energy imparted on structures

Potential Hurdles:

- The current configuration of the air compressor restricts operation to temperatures above 41°F (5°C) unless heated storage is available for the compressor prior to operation. A mobile compressor configuration capable of placement onto a barge/boat is needed to allow operation in all weather conditions.
- A limited number of water guns are available and replacement parts are similarly in limited supply
- Inability to conduct work in Illinois Waterway (most importantly the CSSC and Brandon Road Lock and Dam area) is greatly increasing time and money needed to complete data collection work at Brandon Road Lock and Dam and other areas
- Publication schedule is affected by the length of time required by reviewers and data acquisition completion

3.5 Field Deployment of Carbon Dioxide Barrier to Deter Asian Carp

Lead Agency: USGS/IL DNR

Other Agencies Involved: University of Illinois Urbana-Champaign (UIUC), USACE, USFWS, Southern Illinois University

Funding Table:

Funding	Base Funding		Asian Carp GLRI Funding		Other Funding
	USGS	USACE	USGS ¹	USACE ²	
FY 2014	\$50,000	\$0	\$756,732	\$865,000	\$0

1 Includes funding for UIUC to work collaboratively with USGS and USACE. Funding to UIUC will flow through USGS.

2 Includes funding for USACE Rock Island District

Project Description: Currently, preventing the movement of Asian carp from the Mississippi watershed into the Great Lakes rests on a single electric barrier located in the CAWS. Additional barriers and/or supplements to the electric barriers would improve the efficacy of deterring Asian carp movement into the Great Lakes through redundancy and ‘safety nets,’ and offer greater confidence in their containment. For example, development of a chemical barrier that generated noxious water conditions might repel Asian carp, preventing them from approaching the electric barrier.

The GLMRIS Report did not evaluate CO₂ as an alternative control technology because it was not a proven technology at the time the report was prepared. However, the ACRCC believes it has great potential as a fish deterrent. USGS is working directly with the USACE to ensure any work is within current authorities to conduct the associated activities. This project is being developed outside the GLMRIS process.

Previous work from our research group has defined biological limits and potential benchmarks for candidate chemicals that may serve as a non-physical barrier to deter the movement of Asian carp. One candidate barrier chemical that has received a great deal of attention from our group has been carbon dioxide gas (CO₂). Adding CO₂ to water has two main effects: (1) a reduction in pH due to the formation of carbonic acid (a weak acid), and (2) elevation of dissolved CO₂. While the exact mechanism that induces avoidance for fish following CO₂ exposure has not yet been defined, it is believed that CO₂ functions by ‘irritating’ the gills of aquatic organisms. It is important to note that additions of CO₂ do not function as a ‘bubble curtain’ (i.e., not a physical obstruction), CO₂ does not deter movement by causing hypoxia, and the inevitable change in pH associated with elevated CO₂ is not sufficient to cause fish to move. Rather, it is believed that fish have CO₂ receptors in their gills and are able to sense CO₂ in the water, and it is the presence of a concentration of CO₂ that is physiologically unacceptable, causing intolerable gill irritation that likely induces avoidance as fish seek water containing near normal concentrations of CO₂. Additionally, CO₂ does not appear to be species specific, with all fishes impacted in a similar fashion; a CO₂ barrier would therefore likely prevent the movements of non-target fish as well. Subsequent work by UIUC built upon this finding and examined the impacts of elevated CO₂ on small fish (eggs, larvae, fingerlings). This series of subsequent experiments has produced results

currently being studied, but preliminary findings suggest that (a) small fish experience significant physiological disturbances when exposed to elevated CO₂ similar to adult fishes, and (b) small fish will swim away from areas of elevated CO₂. Together, results to date have documented a strong propensity for elevated CO₂ environments to act as a non-physical barrier to deter the movement of fish (ranging from small fingerlings to adults).

The proposed location for this work will be in a backwater within a privately-owned sand mine connected to the Illinois River near Morris, Illinois. The site has a number of characteristics that make it ideal for this study.

To establish a carbon dioxide barrier, a carbon dioxide infusion system will be used, which will be capable of achieving concentrations of carbon dioxide necessary to deter fish movement; this system is currently owned by UIUC. This unit has been engineered specifically to infuse gas into liquid – it is *not* a typical pond aerator. The unit has an efficiency of over 90 percent (compared to 20-30 percent efficiency for a standard aerators), and is designed specifically for fish barrier applications. The unit establishes a CO₂ barrier by infusing micro-bubbles of gas into the water, and stationary sensors in the water regulate output by automatically turning the system on and off when needed.

To monitor the movement of fish within the test site, two separate but complementary tools will be used: acoustic telemetry and split beam hydro-acoustics. This combination of receivers and transmitters deployed in the test site described above will allow monitoring of fish positions in three dimensions in almost real time.

The project will also include assessments of water chemistry changes or impacts from potential CO₂ barrier operation. USACE ERDC will assess these potential changes or impacts by developing data to characterize operational factors (e.g. distribution, nature, and rate of CO₂ injection), temporal variables (temperature, pH, CO₂, dissolved oxygen) and background water chemistry changes (e.g. surface-water discharges and associated water quality/chemistry, groundwater flux [if substantial]; general water chemistry [e.g. TDS, conductivity, volatile or semivolatile contaminants]).

Operation of a CO₂ barrier within a confined waterway has the potential to impact navigation structures. The forced introduction of CO₂ into aquatic systems would certainly tend to suppress pH through the formation and dissociation of carbonic acid, H₂CO₃. Any acidification generated by a CO₂ barrier could conceivably have a corrosive impact on in-water concrete structures. CO₂ affects concrete primarily by carbonation of the calcium hydroxide phase present in hardened concrete, which reduces its buffering capacity, and ultimately leads to concern for corrosion of embedded reinforcing steel. Carbonation-induced corrosion (~1 mm/year for structural concretes) from atmospheric CO₂ is typically not a concern until well into the service life of a structure. However, artificially elevated CO₂ concentrations from a CO₂ barrier could accelerate the carbonation of submerged concrete, especially those well into its service life. Acidification of the water to a pH well below 7 could also lead to deterioration of the paste fraction of the concrete and any limestone aggregates present in the concrete. A pH of 4-5 would be of significant concern for concrete stability, though CO₂ barriers will likely operate at much lower concentrations than required to depress pH to <5.

Though field trials to assess the operation of a CO₂ barrier are planned, there is a need to assess the behavioral component associated with exposure in advective (flowing) environments/conditions. Studies will be conducted to assess and quantify the behavioral response of fish exposed to a CO₂ barrier in a flowing environment. Similarly the behavior of the CO₂ plume in advective environments also needs to be described to accurately predict downstream dispersion of CO₂ during barrier operation. This will determine the effective area from which fish will be excluded and where non-target effects (on aquatic animals or in-water structures) might be expected.

2013 Actions Undertaken:

- Completed a large-scale evaluation of the behavioral response of bighead carp and silver carp to the deployment of a CO₂ barrier. Behavioral responses of non-target fishes (bigmouth buffalo, channel catfish, paddlefish and yellow perch) were also assessed.
- Began discussions with EPA regarding regulatory framework for research applications of CO₂ in open water applications including barrier operations.

2014 Actions

- Obtain Experimental Use Permit to allow field evaluation in open-water application and lock chamber application.
- Complete large-scale open-water field evaluation of a CO₂ barrier to deter Asian carp
- Evaluate the response of native mussels to CO₂.
- Evaluate injection of CO₂ into a lock chamber to determine feasibility to create a barrier to Asian carp under scaled conditions.
- Evaluate injection of CO₂ into a lock chamber to determine feasibility to create a barrier to Asian carp.
- Initiate registration review with EPA to determine registration data requirements of a CO₂ barrier or the use of a CO₂ as a control agent in limited open-water application sites.
- Initiate review with USFWS to determine Section 7 ESA-consultation data requirements of a CO₂ barrier or the use of a CO₂ as a control agent in limited open-water application sites.
- Develop CO₂ barrier scenarios
- Develop hydraulic model for Brandon Road Lock and Dam
- Develop CO₂ plume model
- Initiate laboratory studies to assess CO₂ barrier effects on concrete structural integrity
- Initiate field water chemistry and concrete structural effects data collection
- Advective environment fish behavioral assessments
- Initiate animal care and use permitting
- Acquire fish/telemetry equipment; initiate preliminary experimental studies
- USACE will provide engineering/navigation technical expertise.

Expected Milestones:

- October 2014: Complete field evaluation of a CO₂ barrier to deter Asian carp
- Ongoing: Completion of USFWS Section 7-ESA consultation
- Assessment of the operation of a CO₂ barrier on potential structural effects on in-water concrete structures

- Assessment of the operation of a CO₂ barrier on water chemistry/quality and models to predict the downstream plume associated with CO₂ barrier operation
- Assessment of the behavior of fish associated with CO₂ barrier operation in advective systems

Outcomes:

- Define the ability of a CO₂ barrier, when deployed in the field at ‘real world’ scales, to impede the movement of free-swimming Asian carp
- Recommendations to management agencies on the operating conditions to establish a static deterrent barrier

Potential Hurdles:

- Capacity of the CO₂ infusion system to evenly disperse CO₂-infused water within an uncontrolled flow environment to maintain an effective deterrent barrier
- Potential effects of carbonic acid on in-water navigation/control structures

3.6 Hydro-Acoustic Assessment of Lock-mediated Fish Passage in the Upper Illinois River

Lead Agency: USFWS

Agency Collaboration: USACE

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$293,000	\$0

Project Explanation: There is great concern about upstream dispersal of Asian carp within the upper Illinois waterway and the effects this dispersal could have on the ecosystems of the Great Lakes. The Brandon Road lock may presently act, or provide opportunity to be modified, to serve as a barrier to fish movement within the upper Illinois water way. Preliminary results of USFWS hydro-acoustic surveys within the Brandon Road and Dresden Island pools suggest that fish density is greater below the Brandon Road lock in the Dresden Island pool than above the lock. Asian carp are known to inhabit the Dresden Island pool.

Because of these considerations, efforts are currently underway by partner agencies (IL DNR, SIU, USGS, and USFWS) to understand different aspects of fish passage at the Brandon Road lock by utilizing complimentary techniques. SIU is undertaking sonar and telemetry work on both a river-wide and a fine-scale basis to understand and predict current and potential habitat use by Asian carp and other fish. USGS is undertaking stationary split-beam hydro-acoustics below the Brandon Road lock to assess fish abundance and behavior below the structure and is testing novel fish passage deterrent mechanisms. IL DNR has proposed intensive mark recapture studies to generate an understanding of cumulative fish passage by several species. USFWS has work currently underway that is explaining 24-hour cycles and

seasonal patterns of fish in Lockport, Brandon Road., and Dresden Island pools. Fine-scale real-time observations within the lock and examining variables that affect fish passage (such as commercial shipping) to further understand fish passage at the Brandon Road Lock lock-mediated upstream dispersal by Asian carp has been proposed.

Specific study objectives include the following:

1. Quantify the amount of upstream fish passage that occurs between the Dresden Island and Brandon Road pools through the Brandon Road Lock.
2. Assess fish behavior within the Brandon Road lock before, during, and after lockage operations.
3. Compare fish passage at Brandon Road with Lockport Lock and Dam.
4. Determine if interactions between fish and commercial barge traffic, upon entry or exit from the Brandon Road lock, are a significant factor in fish passage dynamics.
5. Understand lock-mediated upstream dispersal dynamics of Asian carp.

The objectives of this project will be attained by using several of the following methods described below.

1. Mobile split beam hydro-acoustic assessments of fish abundance and location within and near the Brandon Road lock structure will be conducted under a variety of operational conditions in an attempt to determine the number and size frequency distribution of fish that are making upstream passage via the lock.
2. Dual Frequency Identification Sonar (DIDSON) acoustic cameras will be deployed within the lock chamber at different operational conditions to assess the movement and behavior patterns of fish within the lock chamber.
3. A comparison of fish passage rates will be made between Brandon Road and Lockport Lock and Dam using the above methods.
4. An Asian carp lock-mediated dispersal behavior study utilizing all of the above techniques will be performed at Starved Rock Lock and Dam (a lock on the Illinois River where abundances of Asian carp are high).

2014 Actions: USFWS will conduct studies of fish behavior in and around the Brandon Road lock by deploying a split beam hydro-acoustic equipped research vessel into the lock to survey fish abundance and size distribution before, during, and after lock operation. Work will be attempted in late summer or early fall. Preliminary trials of DIDSON deployment will be attempted to better understand the most appropriate methods for deployment within the lock chamber. Asian carp behavior will be examined at a downstream lock using split beam hydro-acoustic and DIDSON techniques. Due to the late start of the project, some work may need to occur in 2015.

Expected Milestones:

- Data allowing the Brandon Road Workgroup and other collaborating agencies to determine the relative frequency and size structure of wild fish attaining passage from the Dresden Island pool upstream through the Brandon Road lock structure
- Data allowing agencies to determine the fine scale spatial movement patterns of wild fish within and near the lock structure
- Data that informs agencies and industry partners about potential fish passage vulnerabilities associated with commercial traffic

- Data that describes lock mediated dispersal behavior of Asian carp
- Written project report(s) and peer reviewed publication(s) describing project results

Outcomes/Outputs:

- Enhanced knowledge of behavior of fishes near the Brandon Road lock and fish interactions with barge tows that could influence future operations in a manner that minimizes fish passage
- Enhanced knowledge of lock mediated dispersal behavior of Asian carp
- Collaboration with partner agencies (USGS, IDNR) to enhance value of individual research projects

Potential Hurdles:

- Commercial traffic through the lock structure
- Weather
- Staff availability
- Turbulence and air bubbles in and around the lock may obscure systems used to monitor fish behavior
- Possible issues regarding sampling site logistics

4.0 Barrier and Pathway Closure Activities

4.1 Eagle Marsh Barrier Mitigation and Maintenance

Lead Agency: Indiana DNR

Agency Collaboration: Indiana DNR, NRCS, Little River Wetlands Project

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$700,000	\$0

*Assume flat line funding for base funding.

Project Explanation: Up to this time, there has been no money budgeted for the mitigation required as a result of rebuilding the Graham-McCulloch berm that will act as a watershed separator between the upper Wabash watershed and the Maumee watershed. Wetlands will be disturbed, also requiring mitigation. The berm project will create a small amount of flooding onto private property, requiring the purchase of a flood easement. Finally, there is no budget for long-term maintenance of the berm to ensure its integrity is maintained

Summary of Actions to Date: The Graham-McCulloch berm is scheduled for reconstruction in the summer/fall of 2014. Some cursory effort has been made to identify potential wetland mitigation property. Off-site flooding areas resulting from this project have been identified.

2014 Actions:

- 12 acres of wetlands will be disturbed when the Graham-McCulloch berm is replaced and these wetland acres will have to be replaced off-site.
- Flood easements will have to be purchased as a result of the reconstruction of the Graham-McCulloch berm.
- Routine maintenance will be required in perpetuity on the berm to protect its integrity. This maintenance will be performed by Little River Wetlands Project since they are part owner (along with Indiana DNR) and the care-taker of Eagle Marsh.

Expected Milestones:

- 4th Quarter FY 2014: Identify wetland mitigation site, develop mitigation plan, and hire wetlands consultant
- 4th Quarter FY 2014: Determine flood easement property and develop agreement with affected property owners
- 4th Quarter FY 2014: Determine routine berm maintenance needs and develop maintenance action plan

Outcomes/Outputs:

- 12 acres of wetlands disturbed at Eagle Marsh replaced with at minimum 12 acres within the Little River valley
- Graham-McCulloch berm will be maintained

Potential Hurdles:

- Find willing seller for wetland mitigation property
- Come to financial agreement with property owners requiring flood easements
- Little River Wetlands Project may have limited ability to care for the berm with their current equipment

4.2 Operation and Maintenance of Electric Barriers

Lead Agency: USACE

Agency Collaboration:

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$11,800,000	\$0	\$0

*Assume flat line funding for base funding.

Project Explanation:

USACE operates three different types of fish deterrent measures throughout the CAWS. Each is designed to prevent migration of Asian carp toward the Great Lakes in a different manner as described below.

1. The Bypass barrier physically blocks known bypasses around the electric barriers from the Des Plaines River and the Illinois and Michigan (I&M) Canal caused by flooding. The barriers placed in these locations are intended to stop juvenile and adult Asian carp.
2. The Electric barriers operate by creating a waterborne pulsed direct current electric field in the Chicago Sanitary and Ship Canal. 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 (Demo, IIA, and IIB) have been constructed.
3. Bar screens on sluice gates at Thomas J. O’Brien Lock and Dam were installed to impede entry of Asian carp to Lake Michigan. All potential impacts were considered to ensure public health and safety, and the purposes of these structures must be maintained as authorized by law.

Summary of Actions to Date:

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.

The Des Plaines River Bypass Barrier was erected in 2010. Portions of the barrier were damaged during the record flood of April 2013. Subsequently, the fence fabric was reinforced through the placement of riprap at the base of the structure, and later through the construction of a berm comprised of overburden material from the McCook Reservoir.

2014 Actions: Operation and maintenance of the barriers will continue, including regularly scheduled maintenance of the electric barriers.

Expected Milestones:

- May/June: annual maintenance
- Quarterly: other maintenance

Outcomes/Outputs:

- The barriers will perform as designed, thereby minimizing the risk of Asian carp movement toward Lake Michigan through the CAWS

Potential Hurdles: None

4.3 Permanent Electric Barrier I Construction

Lead Agency: USACE

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$24,000,000	\$0	N/A

Project Explanation: Congress authorized USACE to upgrade the demonstration barrier to a public facility in the Water Resources Development Act of 2007. Once completed, the permanent barrier 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 upward movement of Asian carp within the CAWS.

Summary of Actions to Date: Site work began in 2013. Contracts were awarded for fabrication and placement of the in-water structures, and for acquisition of the new barrier’s electrical equipment.

2014 Actions: Design of the building to house the electrical building is scheduled for completion in FY2014, to be followed by the award of a construction contract.

Expected Milestones:

- 4th Quarter 2014: Award building contract

Outcomes/Outputs: Once completed, Barrier I is expected to be capable of delivering power necessary to deter fish with sufficient redundancy to significantly reduce the potential for system outages.

Potential Hurdles: None

4.4 Telemetry – Barrier Efficacy Evaluation

Lead Agency: USACE

Agency Collaboration: USFWS, SIUC, IDNR

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$200,000	\$0	\$0

Project Explanation: USACE has led the telemetry efforts in the Illinois Waterway and CAWS since 2010 with a primary objective of assessing the efficacy of the barriers as identified in the ACRCC Monitoring and Response Plan. By surgically implanting transmitters into fish species (both Asian carp and surrogate species), we have empirical data to demonstrate the barriers are effective in preventing fish passage in the upstream direction. This funding request is to continue the work in assessing the efficacy of Barriers IIA and IIB, as well as adding an array at the site of the new permanent Barrier I. Additionally, funding will also include procurement of depth sensor transmitters to provide further insight into barrier challenges by surrogate species as well as how tagged fishes react to passing barge traffic. Further refinement of the stationary receiver network is an ongoing activity within the project which increases efficiency and coverage within the system. By combining the array established by USACE with the new arrays established by SIUC and USFWS, we are also able to monitor long-term movement of Asian carp in the entire waterway, including localized movements through lock structures and at the area of the population’s leading edge. Future downstream activities will focus 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: Since 2010, USACE researchers have successfully established an acoustic network of receivers positioned at over 30 strategic locations from the Upper Illinois Waterway into the CAWS. A Vemco Positioning System (VPS) was also established around Barriers IIB and IIA, which is capable of providing two- dimensional fish movements in relation to the barrier fields. Transmitters have been surgically implanted into 315 fish released throughout the system and mobile tracking and receiver downloads have occurred monthly to ensure up-to-date data is provided to decision makers regarding the efficacy of the barrier system. Some of the interim studies of the project have been completed, including small fish barrier efficacy and barge interaction trials. These studies have provided valuable results to USACE management and have also been shared with partner agencies in support of

external study development. Interim summary reports of work completed have been prepared annually and included within the Monitoring and Response Plan annual summary report.

2014 Actions:

- Implant depth sensor tags into surrogate species at the barriers
- Continue analysis of barge interactions taking advantage of any barge research in the area
- Detailed investigation into the Brandon Road Lock and Dam for fish passage
- Increase transmitter density within Brandon Road Pool (surrogates and Asian carp)
- Coordinate with USGS, SIUC and INHS in assessing Brandon Road passage during CO2 deterrent demo
- Bi-monthly downloads with monthly mobile tracking during late spring/early summer
- Increase transmitter density within the Dresden Island Pool
- Increase receiver coverage within the Dresden Island Pool and Kankakee River tributary
- Maintain baseline level of active transmitters in the system

Expected Milestones:

- April 2014: Modify acoustic receiver network appropriately to account for Asian carp leading edge movements and to focus efforts surrounding Brandon Road Lock
- September 2014: Surgically implant an additional 100 fishes to increase transmitter density and replace expired transmitters
- November 2014: Surgically implant an additional 50 fishes to maintain current level of transmitter density within each pool of the study area

Outcomes/Outputs:

Goal 1: *Determine if fish are able to approach and/or penetrate the Barrier (Barrier Efficacy)*

- **Objective** Monitor the movements of tagged fish (large and small) in the vicinity of the Barrier using receivers placed immediately upstream, within, and immediately downstream of the Barrier, in addition to mobile tracking
- **Objective** Implant surrogate fishes near the barriers with depth sensor transmitters
- **Objective** Analyze behavior and movement patterns of fish near the barriers as they interact with barge traffic

Goal 2: *Determine if and how Asian carp pass through navigation locks in the Upper Illinois Waterway*

- **Objective** Monitor the movements of tagged fish at Dresden Island, Brandon Road, and Lockport Locks and Dams using stationary receivers placed above and below each dam and within the lock chamber
- **Objective** Determine if there is adequate detection coverage to effectively assess fish passage through lock structures or other bypass pathways

Goal 3: *Determine the leading edge of the Asian carp population and habitat use*

- **Objective** Determine if the leading edge of Asian carp invasion; currently, RM 281.5 is the upstream location of Asian carp population

- **Objective** Describe habitat use and movement in the areas of the Upper IWW and tributaries where Asian carp have been captured and relay information to the population reduction program undertaken by IDNR and commercial fishermen

Potential Hurdles:

- Receiver deployment, retrieval and protection within the electrified water of the barriers could present a challenge in the future
- Floating debris and canal industry traffic could dislocate or damage submerged equipment which would require mitigation

4.5 Great Lakes and Mississippi River Interbasin Study (GLMRIS)

Lead Agency: USACE

Agency Collaboration: EPA, USFWS, USCG, NOAA, USGS, USDOT, USDA, MWRD, State DNRs & EPAs, local governments including the City of Chicago

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$3,000,000	\$0	N/A

Project Explanation: The USACE has conducted GLMRIS pursuant to the terms of the authority provided in Section 3061(d) of the Water Resources Development Act (WRDA) of 2007 (Public Law 110–114; 121 Stat. 1121), and in accordance with prevailing policies, guidance and regulations. In GLMRIS, USACE evaluated the range of options and technologies available to prevent the spread of aquatic nuisance species between the Great Lakes and Mississippi River Basins through aquatic pathways.

GLMRIS has been conducted in two Focus Areas (FA1 & FA2). In FA1, study efforts are concentrated on evaluating prevention measures for the potential threat of ANS transfer via the CAWS. In FA2, an investigation of potential surface-water connections has been conducted along the remainder of the boundary between the two basins in order to evaluate the relative probability of ANS transfer via these pathways.

In July 2012 a transportation reauthorization bill, titled Moving Ahead for Progress in the 21st Century Act (MAP-21) was enacted. Section 1538 of MAP-21 is specific to GLMRIS, providing additional direction for the study. Section 1538 requires USACE to expedite the study and submit a report on its findings not later than January 6, 2014.

Summary of Actions to Date: FA1 – In January 2014, the GLMRIS Report was sent to Congress fulfilling the directive in the Moving Ahead for Progress in the 21st Century Act (MAP-21). The report included a range of options and technologies to prevent the spread of ANS between the two basins through the CAWS (FA1).

FA2 – Completed FA2 pathway assessments are located on the GLMRIS website. For both focus areas, the study teams coordinate regularly with other Federal, state, and local agencies, as well as regional stakeholders.

2014 Actions: FA1 – Complete and submit the GLMRIS Report to Congress. Conduct a comprehensive rollout of the GLMRIS Report to engage congressional, agency, non-governmental, and public stakeholders.

To date, the Corps has conducted eleven public and eight state agency meetings, as well as briefings for Congressional staff, regional organizations and local interest groups. A report summarizing rollout activities is anticipated to be released in May 2014.

As ANS control is a shared responsibility among federal, state, regional and non-governmental organizations, continued engagement toward building a collaborative path forward is a critical element of identifying a consensus-based solution to existing ANS control concerns and issues. Input obtained from the public, agency partners, and other stakeholders during the comment period will help inform future decisions regarding opportunities for further study. Until a clear consensus can be identified, the Corps will await further instruction from the Secretary of the Army or legislative direction from Congress prior to conducting additional study efforts.

FA2 – Complete feasibility-level technical design input to possible ANS controls for connections at Eagle Marsh, Little Killbuck Creek and Ohio/Erie Canal.

Expected Milestones: N/A

Outcomes/Outputs: N/A

Potential Hurdles: N/A

4.6 Hydrologic Support at Wabash/Maumee Connection to Prevent Interbasin Asian Carp Transfer

Lead Agency: USGS

Agency Collaboration: USACE, U.S. Department of Agriculture (Natural Resource Conservation Service), Indiana Department of Natural Resources IN DNR), Little River Wetlands Project, Maumee River Basin Commission (MRBC), City of Fort Wayne, Indiana (FW); Aqua America, Inc./Ohio River Basin Water Sanitary Commission

Funding Table:

Funding	Base Funding	Asian Carp GLRI	Other Funding
FY 2014	\$6,000	\$0	\$0

*Assume flat line funding for base funding.

Project Explanation: Adult bighead carp have been a confirmed presence in the Wabash River basin for at least 15 years. The Wabash River basin intermittently connects with the Maumee Basin (Lake Erie) through a former glacial channel at Eagle Marsh in northeast Indiana during flood stage. This effort to date has provided hydrologic data to support development and validation of flow models by the USACE to develop feasible plans to separate the basins to migration of Aquatic Nuisance Species while maintaining the marsh as viable flood relief for Fort Wayne, Indiana.

Since 2011 the USGS, through GLRI and the USGS invasive species program has installed and operated water level gages at the adult carp barrier fence in Eagle Marsh. That site has identified several events during spring months in 2011 and 2013 after large precipitation events (>3 in./24 hrs) when water levels were sufficiently high to indicate to potential for fish to be at the fence.

Since 2012, the USGS through GLRI has also operated streamflow and temperature gages on tributaries to the Wabash River (Graham-McCulloch Ditch or G-M Ditch) and the Maumee River (Junk Ditch) to understand flow conditions that lead to flooding in the marsh at the adult carp barrier fence. In 2013, the USGS/GLRI streamgages identified flow conditions when Asian carp could bypass barrier fence/levee design. For example, the G-M gage indicated flow conditions when the G-M Ditch reached a stage of about 14 feet and flowed around the existing berm at its upstream end and temporarily connected the Wabash-Maumee basins at Eagle Marsh. The Junk Ditch gage indicated conditions when Junk Ditch reversed flow and floods Eagle Marsh due to flood stages in the St. Mary's River, at a tributary that empties into the Maumee River at Fort Wayne. The Junk Ditch gage also indicated when localized high precipitation amounts cause Junk Ditch water levels to rise sufficiently to contribute to flooding and basin interconnection in Eagle Marsh.

2014 Actions/Milestones: Current plans are for stakeholders to improve and expand a berm system along the eastern and southern banks of Graham-McCulloch Ditch to separate the Wabash and Maumee basins to the 1 percent flood frequency. The adult Asian carp barrier fence is expected to be removed

as part of the final basin separation design. Funding is in place through GLRI to complete engineering designs and construction for basin separation through external contracts.

Milestones:

- Operate Junk Ditch and Graham McCulloch Ditch stream flow and temperature gages with cooperator and USGS CWP funds through September 30, 2014. The stream flow and temperature data are needed:
 - As part of local observations to demonstrate that separation of the Wabash and Maumee basins is effective prevent migration of ANS such as Asian carp and the round goby and
 - To verify that the final implemented barrier has no adverse impact on area flooding.
- Operate of Eagle Marsh water level gages and webcam to activate response of USACE, IDNR, and Little River Wetland Project through September 30, 2014
- Publish provisional data to USGS NWIS-Web and provide information to USACE and IDNR partners for effective use in hydraulic simulation of ANS separation alternatives

The USGS, Indiana WSC has successfully enlisted cooperation from the MRBC, FW and Aqua America/ORSANCO to partially fund operation of the Junk Ditch and G-M Ditch hydro-acoustic stream flow and temperature gages for up to three years.

Potential Hurdles: USACE and Indiana DNR asked whether USGS could continue to financially support and operate water level gages at barrier fence. Design change has restored barrier fence to final Eagle Marsh Carp barrier design, as of February 2014.

4.7 Little Killbuck Creek Closure Assessment

Lead Agency: Ohio Department of Natural Resources (OH DNR) Division of Wildlife (DOW)

Agencies Collaboration: USACE, Natural Resources Conservation Service (NRCS), Medina County Soil and Water Conservation District (SWCD)

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$686,028	\$0

Project Explanation: Closure of the AIS pathway at Little Killbuck Creek

Summary of Actions to Date: The Great Lakes and Mississippi River watershed divide was assessed under the USACE Great Lakes Mississippi River Interbasin Study (GLMRIS) to determine if there were viable pathways for the transfer of AIS. The GLMRIS Aquatic Pathway Assessment Report developed by the USACE for the Little Killbuck Creek connection determined the risk for the transfer of AIS between both the Mississippi River and the Great Lakes basins. For the movement of AIS between the Mississippi River Basin and the Great Lakes Basin, this connection was rated a medium risk for the transfer of silver carp, bighead carp, black carp, inland silverside, and northern snakehead and a low risk for the transfer of skipjack herring. For the movement of AIS between the Great Lakes Basin and the Mississippi River Basin, this connection was rated a medium risk for the transfer of three spine stickleback, ruffe, tubenose goby, parasitic copepod, and viral hemorrhagic septicemia and a low risk for the transfer of European fingernail clam and European stream valvata. In addition, the Ohio DNR recently found Asian carp eDNA in the Muskingum River which is tributary to Little Killbuck Creek. The OH DNR has facilitated numerous meetings with the Medina SWCD, NRCS, and the main landowner. The following is the timeline:

- November 19, 2012: ODNR met with the Medina SWCD and the local NRCS representative to discuss the Little Killbuck GLMRIS study.
- September 19, 2013: ODNR, Medina SWCD, and NRCS met with the primary landowner (Dewey Hall) to discuss the Little Killbuck GLMRIS study and the alternatives for closure (Other land uses, non-structural alternatives, and structural alternatives).
- November 25, 2013: ODNR met with the Medina SWCD, the local NRCS representative, and representatives from the NRCS central office staff. A decision was made to have NRCS provide design assistance for structural alternatives.
- February 14, 2014: NRCS developed preliminary alternatives for structural closure. These alternatives will be discussed on March 17th. The two alternatives are to improve the current dike system or construction of a new dike along the historical watershed boundary.
- February 24, 2014: As part of the Governors State-of-the-State speech in Medina County, Ohio; the ODNR Director met with the primary landowner and media to discuss the project.
- March 17, 2014: OH DNR met with Medina SWCD and NRCS to discuss the NRCS alternatives. We will then set up a meeting with the primary landowner to discuss the preferred alternative,

how this alternative will impact his farming operation, and mitigation that can be implemented to ensure his continued operation.

2014: OH DNR, Medina SWCD, and NRCS (with input from the local landowners) will determine the preferred alternative for closure. This alternative will be based on cost and potential impacts to local landowners. NRCS will develop final design plans for closure, including mitigation of impacts to the local landowners (ex. loss of production, changes to irrigation). Final plans developed by September 30, 2014. No funds will be required for this component of the project.

Expected Milestones:

- October 1st, 2014 – September 30th, 2016: Based on input from OH DNR, NRCS, local landowners, and other principally affected interests, implement the preferred closure alternative

Outcomes/Outputs:

- Final design for implementation of separation of the basins at the Little Killbuck Creek in FY2014.

Potential Hurdles:

- The ability to develop a separation option that prevents the movement of AIS across the basin divide while allowing for landowner-desire to continue agriculture operation

4.8 Ohio Erie Canal Closure Assessment

Lead Agency: USACE and Ohio Department of Natural Resources (OH DNR) Division of Wildlife (DOW)

Agencies Collaboration: ODNR Division of Soil and Water Resources (DSWR), ODNR Division of Engineering, ODNR Division of Parks and Recreation, and City of Akron

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$0	\$0

Project Explanation: Closure of the AIS pathway at the Ohio Erie Canal.

Summary of Actions to Date: The Great Lakes and Mississippi River watershed divide was assessed under the USACE Great Lakes Mississippi River Inter-basin Study (GLMRIS) to determine if there were viable pathways for the transfer of AIS. The GLMRIS Aquatic Pathway Assessment Report developed for the Ohio Erie Canal connection determined the risk for the transfer of AIS from the Mississippi River Basin to the Great Lakes Basin as a medium risk for the transfer of silver carp, bighead carp, black carp, and northern snakehead and low for skipjack herring. In addition, the Ohio DNR recently found Asian carp eDNA in the Muskingum River which is tributary to the Ohio Erie Canal.

1. The OH DNR Division of Wildlife met with the City of Akron to discuss the Aquatic Pathway Assessment Report. The OH DNR Division of Wildlife and the DSWR discussed the two primary areas of concern:
 - The direct transfer of water from the Mississippi River Basin to the Great Lakes Basin at the feeder gates that transfer water from Long Lake to the Ohio Erie Canal.
 - Flooding at the tow path that allows water to move from the Mississippi River Basin to the Great Lakes Basin
2. The OH DNR Division of Wildlife has met with USACE on numerous occasions to determine a path forward.

2014 Actions: USACE received FY2013 GLRI funding to assess closure options and the 50% design plans will be completed by September 30th, 2014.

Expected Milestones:

- September 30th 2014: Completion of 50% design plans for closure alternatives
- January 15th 2015: Present options to PAIs including the preferred alternative
- September 30th 2015: USACE will develop final design for the preferred alternative for basin separation

Outcomes/Outputs:

- Final design for implementation of separation of the basins at the Ohio Erie Canal

Potential Hurdles:

- The ability to develop a separation option that prevents the movement of AIS across the basin divide while allowing the City of Akron to fulfill obligations related to the inter-basin transfer of water as dictated by the Great Lakes Compact

5.0 Research Activities

5.1 Developing Targeted Microparticle and Piscicide Control Systems for Asian Carp

Lead Agency: USGS

Other Agencies Involved: USFWS, Advanced BioNutrition, Purdue University, South Dakota State University, University of Wisconsin-La Crosse, Viterbo University

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$450,000	\$200,000	\$0

Project Description: No current technology can specifically target bighead or silver carp for control within aquatic ecosystems. Available toxicants used in AIS control programs are non-selective and are applied throughout the entire water column, resulting in equal exposures of native and invasive species alike. Developing targeted delivery systems with high specificity for bighead and silver carp would increase the ability of management agencies to control or limit Asian carp while minimizing potential impacts on native species. Targeted selectivity can be achieved by understanding the habits and physiological characteristics of the target organism, and incorporating technologies into a delivery system that will exploit those characteristics. Considerations such as food particle size, digestive physiology, feeding attractants/stimulants, and identification of species-selective chemicals can be brought together to develop a targeted delivery system.

The current lack of registered piscicides limits the tools that aquatic resources managers have available to control invasive fish. Developing a new suite of chemical tools specifically toxic to bighead or silver carp 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. This project will analyze structures and activities of chemicals with known piscicidal capabilities described in a variety of industrial, pesticide, and pharmaceutical libraries. Chemicals similar in structure or activities to known piscicides will be evaluated for potential use in controlling bighead or silver carp.

FY 2013 Actions Undertaken:

- Completed a database of chemicals with known piscicidal activity of over 400.
- Evaluation of the database, in progress, to identify common structural features that can be used in structure-activity correlations for review and assessment of pharmaceutical and pesticide databases to identify candidate fish toxicants.
- Contacts made with two agrichemical/chemical companies to gain access to chemical databases. Access to databases of additional agrichemical/chemical/pharmaceutical companies is being pursued.

- In collaboration with the USFWS La Crosse Fish Health Center, sources of native fish cell lines suitable for use in cytotoxicity (cell toxicity) assays have been identified. The native cell lines are being maintained for use in cellular assays currently under development and validation.
- Digestive enzymes were analyzed from fish captured from the Illinois (IL), Wabash (IN) and James Rivers (SD), and a manuscript describing these data is under development for publication in a peer-review journal. Additionally, mean pore sizes of gill rakers of silver carp and inter-raker spacing of gill rakers of gizzard shad have been compared seasonally in the Illinois River and among the Illinois, Wabash, and James Rivers. Drafts of two manuscripts are nearing completion. Complete work to evaluate toxicity of a selective targeted delivery system of rotenone in order to determine field exposure rates for controlling bighead and silver carp
- Research comparing the oral toxicity of rotenone and antimycin to microparticle ingestion by bighead and silver carp resulted in an active ingredient formulation specification change from rotenone to antimycin. Studies completed to determine digestive enzyme kinetics, gastric evacuation rates and the digestibility of food (and thus microparticles) by bighead and silver carp at three temperatures (12, 19, and 25°C). Drafts of two manuscripts are nearing completion.
- Sample batches of second generation microparticles containing antimycin or asthaxanthin (a non-toxic marker dye) were received in July. Work was completed to assess microparticle buoyancy, size and leaching rates prior to production of final batches of second generation microparticles. Information describing particle characteristics were provided to the manufacturer to modify the formulation prior to subsequent product preparations.

2014 Actions

- Continue in vitro cytotoxicity assays and initiate in vivo fish assays.
- Evaluate the toxicity of a selective targeted delivery system of antimycin in order to determine field exposure rates for controlling bighead and silver carp.
 - Particle characterization (i.e. size, stability, leaching, buoyancy)
 - Target animal efficacy
 - Optimize particle delivery
- Initiate assays to determine which components of algal diets deter feeding in native species.
- Initiate aerobic aquatic metabolism study to determine degradation characteristics of toxicant-incorporated microparticle technology.
- Complete non-target testing of a selective targeted delivery system of antimycin to non-target native filter feeding species.
- Conduct on-site field evaluations (either in UMESC mobile laboratory or in situ pending permitting) of microparticles containing antimycin.
- Initiate formulation review with EPA to determine registration data requirements of antimycin-incorporated microparticles
- Initiate formulation review with USFWS to determine Section 7 ESA-consultation data requirements of antimycin-incorporated microparticles
- Initiate studies to determine biologically-derived controls of Asian carp

Expected Milestones:

- In vitro cytotoxicity assays to assess chemical toxicity for Asian carp and native fish
- A selective targeted delivery system of antimycin to Asian carp

- Aerobic aquatic metabolism study to determine degradation characteristics of toxicant-incorporated microparticle technology
- Non-target testing of a selective targeted delivery system of antimycin to non-target native filter feeding species
- On-site field evaluations (either in UMESC mobile laboratory or *in situ* pending permitting) of microparticles containing antimycin

Outcomes:

- Approximately one dozen candidate fish toxicants identified for further testing
- Development of a selective targeted delivery system of antimycin for selective control of bighead and silver carp
- Development of a selective targeted delivery system of another chemical control agent or a biologically-derived control agent for selective control of bighead and silver carp

Potential Hurdles:

- Access to candidate fish toxicants from private chemical libraries
- Establishment of contracts with industry to prepare microparticles or deliver biocides for incorporation into the microparticles

5.2 Field Evaluation of Chemical Attractants to Control Asian Carp and Development of Protocols for Field Verification of Response

Lead Agency: USGS

Agency Collaboration: State agencies, FWS

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$190,000	\$200,000	\$0

Project Explanation:

Chemical stimuli play a critical role in the performance of essential life functions in many fish, including Asian carp, where chemical stimuli provide important information to seek favorable habitats, locate food, and find conspecifics for schooling, avoid predators, and synchronize sexual readiness within the population and induce specific behaviors such as attraction and spawning behaviors. Sex pheromones can be induced through hormonal treatments. Repellant alarm pheromones offer carp protection from predation and aggregating pheromones attract carp to schools. Selection and location of planktonic food sources are largely based on chemical cues.

Field studies are required to evaluate the effectiveness of chemical stimuli as an attractant and repellant to aid in the capture of wild carp. Technologies need to be identified for observing the response of wild carp to attractive and repellant stimuli in the field.

FY 2013 Actions Undertaken:

Tests of the attraction to algal stimulus solutions were conducted in the mesocosm pit tag array using tagged juvenile Asian carp. The response of the Asian carp was verified using digital video imaging with underwater GoPro cameras revealed active feeding among the fish attracted to the targeted area of release where the algal stimulus was presented. The response elicited by this stimulus was robust relative to the number of fish attracted to the area and the duration of time fish remained in the immediate vicinity of the algal plume. Fish began to move from the area as the algal stimulus dissipated as a result of consumption by the carp and dilution. The response was highly consistent among the 12 trials conducted. There was a high degree of turbidity present during these tests as a result of ambient native algal blooms; however the presence of this algae did not diminish the response to the algal stimulus. Laboratory evaluations of algae from cultures of other algal species were initiated. Studies were initiated to determine if wild carp could be conditioned to feeding stations in the Missouri River. Several sites of varying complexity relative to width, depth, flow and cover were identified along the Missouri River for these studies with the intention of repeating the study at sites of increasing complexity as this approach proved successful. Studies initiated on Moniteau Creek about 0.5 miles upstream of the Missouri River near Rocheport, Missouri. Apparatus and procedures were developed

for applying the algal stimulus each day and initial observations using DIDSON imagery indicated the attraction for fish, including carp, to this feeding. Studies then expanded to habitats behind box dike structures along the Missouri River consistently document attraction of Asian carp to the algal stimulus.

During the IPM field actions in 2013, an array of detection technology including DIDSON, side-scan sonar, pit tag surveillance, and telemetry were used to document fish response to the algal treatment. Pit tag surveillance during mesocosm tests has proven to be effective for documenting the behavioral response of free-range carp to feeding attractants, and enabled interspecies comparisons. Underwater GoPro cameras proved effective imagery when visibility was at least 1 meter and enabled documentation of attempts to feed. A consumer grade side-scan sonar instrument operating from a stationary position was effective in documenting present/absence of fish during feeding studies, and protocols are presently being developed for quantifying the response.

Studies were initiated at the University of Minnesota to determine the physiological taste sensitivity of Asian carp to components of the algal stimulus. These efforts included neuroanatomical studies of the epibranchial organ and physiological recordings. The studies revealed abundant sensory receptors in the epibranchial organ, and stimulation of these with the algal stimulus resulted in sensory nerve responses as well as a reflexive release of mucus that is part of the feeding response. Additionally, analysis of amino acid was made of the algal stimulus to identify the effective chemical stimulus, and a feeding behavior assay based on frequency of buccal pumps. The University of Minnesota continues to investigate potential sex pheromone attractants, using various combinations of hormone treatments to stimulate sex pheromone production.

2014 Actions Proposed:

Accelerate field observations of the feeding response of wild free-range carp to the algal stimulus in the Missouri River using the feeding station approach. Develop protocols for quantifying the response of wild fish to the feeding stimulus in the river and other locations to feeding stimulus. Optimize application of feeding stimulus to enhance attraction. Evaluate the response of other species, including grass carp, to the algal attractant. Initiate trapping procedures with applications of the feeding stimulus to facilitate fish harvest.

Continue physiological and behavioral studies with component amino acids found in the algal stimulus to facilitate development of an attractant for micro particle poison bait.

Continue physiological and behavioral studies of sex pheromones in Asian carp.

Outcomes:

- Develop protocols for conducting behavioral observation of free-ranging fish to focal stimuli
- Draft protocols for use of chemical stimuli as lures to assist in the capture of free-ranging fish
- Report on feasibility of the use of chemical attractants and repellants in the capture and harvest of Asian carp
- Create expanded protocol for application of chemical attractants
- Merge chemical attractant and harvesting methodologies

- Merge chemical attractant and micro-particle bait methodologies
- Transfer of technology to state agencies

Expected Milestones:

- October 2013 - March 2014: Conduct feeding station trials at four locations on the Missouri River to determine effect of temperature on the response in an effort to determine optimal seasons or conditions for attracting Asian carp.
- March 31- September 31: Replicate studies conducted to assess attraction of free-ranging carp to feeding and pheromonal stimuli. Evaluate the effectiveness of various trapping approaches for harvesting carp at feeding stations.
- March 2014 - September 2014: Conduct multiple agency interdisciplinary demonstration projects to evaluate the effectiveness of proposed control strategies, and to confirm accuracy of monitoring technologies in the field. Manuscript on the behavioral response to the algal stimulus in lab and mesocosm studies prepared.
- Determine chemical identity of attractants in the algal feeding stimulus to facilitate incorporation in the microparticle formulation.

Potential Hurdles:

- Lack of sufficient staff to facilitate accelerated field study schedule
- Lack of study sites that provide sufficient access and structure to conduct replicated field trials with free-range Asian carp

5.3 Waterway Assessment of Hydraulic and Water-quality Influences on Asian Carp Movement, Spawning and Recruitment

Lead Agency: USGS

Agency Collaboration: IL DNR, USFWS, MWRD, SIU, USACE, University of Illinois, and Purdue

Funding Table:

Funding	Base Funding		Asian Carp GLRI Funding		Other Funding
	USGS	USACE	USGS	USACE	
FY 2014	\$200,000	\$0	\$100,000	\$6,600	\$0

Project Explanation: The upstream movement of Asian carp through the Illinois River has been documented by the IL DNR, the USFW) and the USACE. These efforts have documented the distribution of the Asian carp population within the pools of the Illinois River and have identified habitats favorable for Asian carp. Since 2006, the upstream expansion of the carp population has stalled in the Marseilles and Dresden Island pools. Sharp contrasts in habitat, flow conditions, water quality, and food supply between these pools and the CAWS may be acting as controlling factors to the stalled migration. A major objective of this project is to determine the controlling factor(s), with the possibility that one or more of these factor(s) could be used to prevent future migration or to reduce Asian carp populations.

Several techniques will be used to characterize these potential controlling factors, and data collection will be coordinated with the other agencies efforts to provide maximum complementary data collection and analysis. Flow, velocity, and a suite of water-quality parameters (water temperature, pH, dissolved oxygen, specific conductance, chlorophyll-a, blue-green algae, nitrate and turbidity) will be collected in the main channel and backwater areas of the river. Plankton sampling data will be used to characterize the available food supply in this reach of the river. Existing data, including long-term water-quality sampling by the Metropolitan Water Reclamation District (MWRD) of Greater Chicago will be reviewed. In addition to a greater understanding of why Asian carp have not moved further upstream, the velocity and flow data will be evaluated to determine optimum locations (channel constrictions, pinch points, backwater areas, etc.) within the river that may be suitable for the testing of Asian carp control strategies. The applicability of this methodology will be evaluated for the downstream sections of the Illinois River.

In addition to the Illinois River, other rivers, such as the Wabash River in Indiana and reservoir tributaries in Missouri, provide an opportunity to examine factors that influence Asian carp movement, spawning, and recruitment. These rivers represent the lower end of the size range thought to be used by Asian carp for spawning and would provide an ideal setting to test the tributary assessment tool (FluEgg) developed in a previous template project. FluEgg simulates egg transport and can help in determining the reach length required for successful egg hatching. For successful recruitment, egg hatching must take place in close proximity to larval habitat, so FluEgg results will need to be linked with habitat data for a more complete picture of likely population growth in a river. Laboratory testing of eggs (or

surrogates) will also be completed to verify the transport properties and further refinement of FluEgg. Once FluEgg has been verified with data from these experiments and spawning rivers, it can be more widely disseminated to states with Asian carp populations and Great Lakes states for planning purposes. The next evolution in tools for the partner agencies will be developed to include the evaluation of habitat for small fry as an addition to the tributary assessment tool.

FY 2013 Actions Undertaken:

Hydraulic and water quality data collection and analysis:

- Secured and deployed equipment for two real-time water-quality stations on the Illinois River; one station is located in the main channel (at Seneca), and one in a backwater (Hanson backwater at west culvert pits). Also deployed one stream-flow only station (at the main entrance at the Hanson backwater), used to correlate movement of Asian carp population relative to water-quality and other factors.
- Collected site-specific data for demonstration activities in mid-August 2013 including bathymetric surveys, velocity mapping, and fluorometer deployments for dye monitoring of algal feeding attractants.
- Completed initial water velocity and temperature surveys of the Marseilles and Dresden Island pools of the Illinois River.
- Coordinated water velocity and water temperature mapping of Marseilles Pool spawning activity (April 2013) with IL DNR/SIU.

Reference Materials on Spawning and Recruitment

- USGS Scientific Investigations Report Hydraulic and Water-Quality Data Collection for the Investigation of Great Lakes Tributaries for Asian Carp Spawning and Egg-Transport by Murphy, E.A. and Jackson, P.R. published
- “Development of a Fluvial Egg Drift Simulator to evaluate the transport and dispersion of Asian carp eggs in rivers” by Garcia, T., Jackson, P.R., Murphy, E.A., Valocchi, A.J., and Garcia, M.H. published in Ecological Modelling
- Hydraulic and water quality characterization on the Wabash River completed jointly with Purdue University egg collection
- “Aspects of embryonic and larval development in bighead carp *Hypophthalmichthys nobilis* and silver carp *Hypophthalmichthys molitrix*” by George, A.E. and Chapman, D.C. published in PLOS ONE
- Grass carp developmental series work completed
- Contributed to journal article on grass carp spawning in Sandusky River

2014 Actions:

Hydraulic and water quality data collection and analysis:

- Continue mapping of water velocity and water quality in the Upper Illinois River with emphasis on boundary condition inflows/outflows (Brandon Road and Marseilles locks and dams).
- Compute continuous water-quality records for two Illinois River stations (main channel and backwater with eight parameters at each station).
- Publish 2013 Water Year water-quality data for Illinois River main channel and backwater sites.

- Summarize water velocity and temperature mapping for the April 2013 documented spawning event in the Marseilles pool.
- Meet with USACE to discuss potential GLMRIS impacts.
- USACE will provide engineering/navigation technical expertise.

Spawning and Recruitment:

- Publish journal article on FluEgg user interface and example application.
- Work with states to apply FluEgg and hydraulic/water quality characterization methodology to help determine what rivers may be capable of successful spawning.
- Complete flume experiments using pseudo-eggs.
- Develop and submit a Wabash River spawning and transport characterization journal article in collaboration with Purdue University.
- Prepare report/fact sheet on procedure for data collection for spawning and egg-transport characterization.
- Begin efforts to incorporate successful recruitment criteria (juvenile habitat, etc.) with existing egg transport characterization methodologies to determine which rivers may pose a greater probability for the establishment of sustainable populations including investigating the use of remote sensing for increased efficiency.
- Submit publication of egg size and buoyancy and for developmental rate and behavior of grass carp early life stages.
- Evaluate reservoir tributaries for presence of Asian carp eggs and larvae during the peak spawning season.

Expected Milestones:

- Publish Annual Water Year data of main channel and backwater water quality.
- January 2014: Presentations at Midwest Fish and Wildlife conference on 1) the hydraulic and water quality data collected in the Illinois River and 2) an assessment of four Great Lakes tributaries for risk of Asian carp spawning and recruitment
- Summer 2016: Publish Scientific Investigations Report on hydraulic and water quality factors controlling movement of Asian carp in the upper Illinois River
- Summer 2014: Publish journal article on FluEgg graphical user interface and example application
- Fall 2014: Perform flume experiments on Asian carp pseudo-eggs
- Summer 2014: Collect egg and larvae data in reservoir tributaries
- Summer 2014: Publish grass carp early life stages

Outcomes/Outputs:

- Greater understanding of Asian carp preferred habitat with regards to hydraulic and water-quality characteristics and insight into how habitat may be altered to deter them from spreading into new areas
- Incorporate successful recruitment criteria (juvenile habitat, etc.) with existing egg transport characterization methodologies to determine which rivers may pose a greater probability for the establishment of sustainable populations
- Increase the robustness of the FluEgg egg transport and dispersal model and disseminate it to the states to assist in the identification of rivers that pose elevated risk for reproduction of Asian carp by using hydraulic characteristics to simulate egg travel times and likelihood of staying in suspension until hatching

Potential Hurdles:

- The project has a large field data collection component which is subject to weather delays during the year
- Publication schedule is affected by length of time various reviewers need which is beyond the control of project personnel

5.4 Assessment of Asian Carp Life History Traits in Established and Emerging Populations to Identify and Characterize Vulnerabilities for Control

Lead Agency: USGS

Agency Collaboration: Columbia River Research Laboratory, USGS, Western Illinois University, Illinois Department of Conservation, Illinois Natural History Survey, Iowa State University and Iowa Department of Natural Resources, USFWS, and Minnesota Department of Natural Resources

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$200K	\$0	\$0

Project Explanation: To obtain a better understanding the life history traits and population dynamics of Asian carp in areas with established (e.g., Illinois River) and emerging populations, it is necessary to identify vulnerabilities that can be exploited for control using an integrated pest management approach. In particular, a better understanding of seasonal movements, habitat use, predators, and behaviors of adult and juvenile Asian carp and native fish planktivores is needed for safe and effective application of species-specific toxicants, selective removal by fishing, predator stocking, habitat manipulation and barriers. In addition, understanding the feeding behaviors and diet selectivity (i.e., plankton food particle size and composition) of Asian carp and native planktivores is necessary to identify, develop, and then apply species-specific microparticle-toxicants. Finally, using a “Judas fish” approach as a test to detect of Asian carp in areas newly invaded will determine its effectiveness as a rapid response tool. When using a “Judas fish” approach, the test determines whether sterile Asian carp tagged with a transmitter and released into novel areas will seek out their own kind (i.e., species or genus) so that removal efforts can be targeted to these areas. To achieve a better understanding of these life history traits, USGS will conduct a series of field and laboratory (i.e., pond) studies aimed at assessing habitat use, “Judas fish” response, feeding behavior and recruitment constraints (i.e., juvenile habitat, adult spawning requirements, and predation) of Asian carp in areas with established and emerging populations.

Summary of Actions to Date:

Collaborations were established including formal and informal cooperative agreements with state agencies and universities in Iowa and Illinois and federal entities needed to conduct the studies. Appropriate methods and equipment were determined, necessary acquisition or requests for

acquisitions were completed and training was conducted for capturing and monitoring adult, juvenile and egg/larvae forms of Asian carp (AC) and bigmouth buffalo.

In the first field season of 2013, USGS completed the following: 1) collected ichthyoplankton samples for AC eggs and larvae at 14 sites in the Mississippi River and major tributaries to assess spawning requirements and the influence of mainstem navigation dams on spawning; 2) sampled ambient plankton from 4 macro habitats during 5 time periods and stomach samples from AC and bigmouth buffalo in these same areas to assess diet selectivity base on particle size and composition; 3) collected fish samples at 80 randomly selected sites with standardized electrofishing to assess abundance and composition of adult and juvenile Asian carp and native fishes by macro habitat type; 4) collected gut content samples from 1,436 native fish “predators” in Pools 19 and 20 of the Mississippi River to assess their potential as predators of AC larvae and juveniles; 5) used triploid bighead carp as part of a “Judas fish” assessment; 6) completed a PIT tagging study to assess habitat selection and predators of juvenile bighead, silver, and grass carp in two regulated Missouri River wetlands; purchased and outfitted a boat to be used as a landing craft for an amphibious vehicle; and 8) performed acoustic work to assess juvenile habitat and the Judas fish approach.

2014 Actions:

- Process egg/larvae, plankton and gut samples from the first field season to assess habitat, feeding behavior and recruitment constraints (i.e., juvenile habitat, adult spawning requirements, and predation).
- Complete analysis and summary of first year data on habitat, feeding behavior and recruitment constraint (i.e., juvenile habitat, adult spawning requirements, and predation) studies.
- Present findings from first year sampling on habitat, feeding behavior and recruitment constraint (i.e., juvenile habitat, adult spawning requirements, and predation) studies to managers and the control development groups at UMESC, CERC and other research facilities.
- Complete second year of field sampling for habitat, feeding behavior and recruitment constraint (i.e., juvenile habitat, adult spawning requirements, and predation) studies.
- Initiate pond studies at CERC to evaluate predator effectiveness under differing environmental conditions. Also assess tolerance of Asian Carp juveniles to low oxygen concentrations.

Expected Milestones:

- September 2014: Present findings from first field season to assess habitat, feeding behavior and recruitment constraints (i.e., juvenile habitat, adult spawning requirements, and predation) to managers and the control development groups at UMESC, CERC and other research facilities.
- December 2014: Complete second field season of sampling to assess habitat, feeding behavior and recruitment constraints (i.e., juvenile habitat, adult spawning requirements, and predation).
- December 2014: Complete first year of pond studies to evaluate predator effectiveness under differing environmental conditions.
- September 2015: Present findings from second field season to assess habitat, feeding behavior and recruitment constraints (i.e., juvenile habitat, adult spawning requirements, and predation) to managers and the control development groups at UMESC, CERC and other research facilities.
- December 2015: Complete final field season of sampling to assess habitat, feeding behavior and recruitment constraints (i.e., juvenile habitat, adult spawning requirements, and predation).

- December 2015: Complete second year of pond studies to evaluate predator effectiveness under gradients of environmental conditions including predator species and density, water column depth, turbidity, and aquatic vegetation coverage.

Outcomes/Outputs:

- Compile information on the movement, habitat selection, and behaviors of Asian carp and native planktivores that will be used to develop and implement effective and safe control measures for Asian carp with established and emerging populations.
- Compile information on the spatial and temporal prey selection of Asian carp and native planktivores that will be used to develop and implement effective and safe control measures for Asian carp with established and emerging populations.
- Compile information on the spatial and temporal habitat selection of post-drift larval and juvenile Asian carp that will be used to develop and implement effective and safe control measures for Asian carp in areas with established and emerging populations.
- Obtain information on Asian carp predator effectiveness under natural and controlled conditions that will be used to develop and implement effective and safe control measures for Asian carp in areas with established and emerging populations.
- Determine the feasibility of deploying telemetered fish to locate Asian carp so that control measures can be taken while avoiding the addition of fertile individuals to invasive population and complication of eDNA studies (i.e., assessment of Judas fish approach).
- Evaluate the effectiveness of triploidy and surgical sterilization will indicate whether these methods could be used to stock Judas bigheaded carp without fear of reproduction by these fish. In addition, sufficient triploid fish will be produced that they could be deployed as early as 2016.

Potential Hurdles:

- Delays in funding allocations, purchasing or hiring could result in commensurate delays in project actions and associated milestones
- Adverse environmental conditions such as floods could delay project actions and associated milestones

5.5 Asian Carp Net Avoidance Behavior Study Using Acoustic Technology

Lead Agency: USGS

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$100,000	\$0	\$0

Project Explanation:

Asian carp have been expanding their range in North America since they were introduced in the early 1970s. They are now abundant in the Mississippi, Illinois, and Missouri River drainages and threaten to enter the Great Lakes. These fish are skittish when approached by boat and are known to leap out of

the water when stressed by boat noise or when confronted with barriers (such as the shoreline, wing dikes, and gill nets). In many cases, Asian carp are seen simply leaping over nets and avoiding catch.

Dual-Frequency Identification Sonar (DIDSON) is a high-frequency sonar camera that produces images at a high enough rate observe fish swimming patterns, and guilds of fish species based on crude body shape and behavior. DIDSON sonar has been used in the past to conduct fish counts of salmonids passing specific areas in a river; investigate spawning behavior, and trawl net avoidance. With this tool USGS can accurately observe fish with minor interference. The ability of the DIDSON to discretely observe *in situ* Asian carp's behavior at night or in turbid water will broaden the understanding their behavior.

Asian carp are believed to have highly developed net avoidance behavior, which inhibits control methods based on harvest. However, simply comparing catch rates between different net types to assess their efficiency of carp harvest is hampered because different sets will be tested by different and unknown numbers of carp. Furthermore, improvement of harvest gear design is hampered due the lack of knowledge of the types of behaviors that allow Asian carp to avoid nets. We plan to assess the behavior of Asian carp in relation to different gear types and propose gear modifications that might enhance harvest efficiency.

Thousands of silver carp and bighead carp have been caught with traditional gear; however, preliminary observations with the DIDSON have shown strong avoidance of the most common gear types by Asian carp. DIDSON images show hundreds of Asian carp, singly and in groups, approaching nets and then rebounding from them and quickly swimming away. In this study, fish behavior, in association with traditional gear, will be classified and quantified. Water quality will be measured at each site, especially including water temperature, velocity, and turbidity, parameters which may influence avoidance behavior or net detection.

The goal of the project is to observe and quantify Asian carp behavior that results in net avoidance and form testable hypothesis regarding gear modifications that ameliorate or negate such behaviors.

Summary of Actions to Date:

On July 11, 2013, an older model DIDSON sonar (Model 300m) was tested and used to train personnel on the equipment. The test location was Moniteau Creek near Marion, Missouri. Fish reactions were recorded when encountering trammel nets, and when the DIDSON data was reviewed, distinct behaviors were observed that were previously unknown.

Behavior 1: Instant Reversal or Bounce Back

This striking behavior was noted dozens of times for each net set. Carp of many sizes were observed swimming toward the trammel net. When nearing the net the caudal fin appeared to stop its swimming motion and the fish would drift for approximately a meter or so until they either contact the net or approach extremely close to it. At that time, the fish reversed course sharply and swam rapidly away from the net (Figure 1).

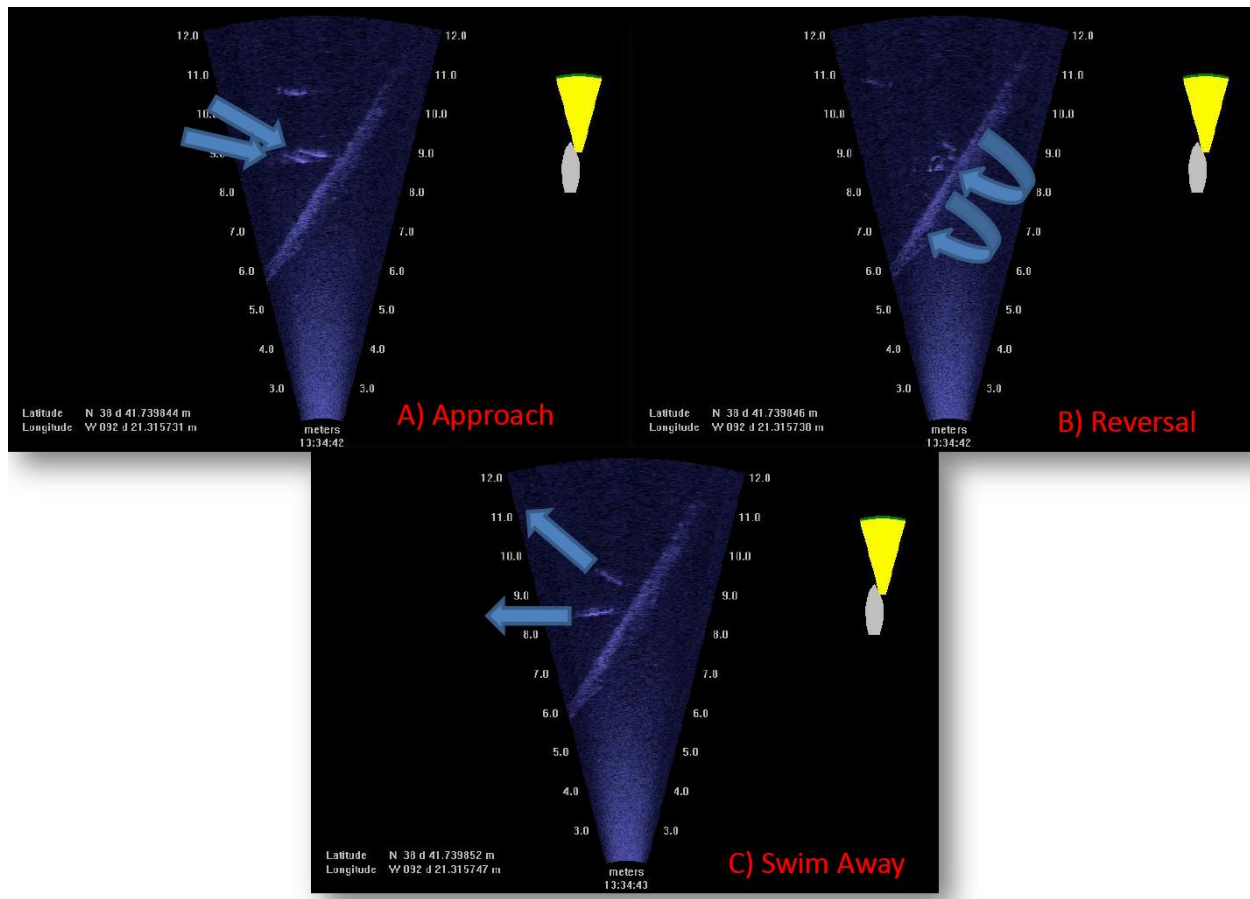


Figure 1: Screenshots of DIDSON footage showing the “bounce back” behavior of silver carp when approaching a trammel net. A) silver carp approach the trammel net at 13:34:42. B) Silver carp sense the trammel net and reverse course C) silver carp are swimming away from the trammel net at 13:34:43.

Behavior 2: Bounce Along

On a few occasions, silver carp would be seen encountering the trammel net then doing a bounce back in an arch only to encounter the net again a few meters away and bounce back again. In this case the fish appears to be searching for an opening to pass the net.

2014 Actions:

- Determine site locations
- Begin data collection with multiple gear types to compare gear types and catch efficiencies
- Develop testable hypotheses regarding net design improvement and design studies to test those hypotheses

Expected Milestones:

- Summer 2014: complete first round of data collection. Some data analysis and hypothesis generation

- Fall 2014: data analysis and new hypothesis generation, and, if appropriate, construct gear with modifications for hypothesis testing
- Winter 2014/2015: Begin data collection to test new hypotheses, and prepare manuscript describing behavior of Asian carp encountering nets

Outcomes/Outputs:

- Description of behaviors of Asian carp encountering the different harvest gears. These behaviors will be quantified and the effect of gear type on behavior and capture efficiency will be assessed
- New gear types or deployment methods that could enhance harvest will be designed and tested

Potential Hurdles:

- Scheduling conflicts between groups at CERC on DIDSON use given the center currently has only two DIDSON units, of differing capabilities
- Weather may lead to delays and damage to nets will need time to repair if not replaced

5.6 Improving Molecular techniques to Support Integrated Asian Carp Control

Lead Agency: USGS

Agency Collaboration: USACE, USDA, USFWS, Purdue University, Minnesota Department of Natural Resources (MNDNR) and Wisconsin Department of Natural Resources (WIDNR) for field assistance and University of Minnesota (UM), University of Missouri at Columbia (UMC), University of Wisconsin (UW), Illinois Natural History Survey, South Dakota State University, University of Illinois at Urbana-Champaign

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$700,000	\$0	\$0

Project Description: Early detection and monitoring is a vital part of managing any invasive species, including Asian carp. Significant efforts have been made to detect Asian carp at low abundances and identify their invasion front, but since Asian carp avoid traditional capture gear, traditional gear have limited utility in finding Asian carp at low density. An alternative method for monitoring the fish is the detection of molecular signals (such as mitochondrial DNA – often termed eDNA) in samples taken from a body of water. Monitoring via eDNA can not only be used as an early warning sign for potential invasions and new colorization events, but may be the only way to ultimately track the continuing impacts of control strategies for small populations and to ultimately demonstrate eradication (if achievable).

Improvements in current methods to detect eDNA (such as the development of new mitochondrial markers for conventional or quantitative polymerase chain reaction (qPCR) and the development of alternative molecular signal detection methods (such as microbial source tracking of Asian carp) will enhance the interpretation of eDNA detection and its application to management actions. Further

characterization of the quality of eDNA, including the spatial and temporal distribution of differing length DNA sequences will help us understand the origins of the sampled DNA, the time since deposition or shedding, the likely deposition locales, and the population density of the source population. The proposed work, building on results from the ECALS studies and other recent reports, allows the unique properties of the initial, rapidly degraded eDNA to be distinguished from recently deposited eDNA. Validation of methods to exclude vectors and fomites of eDNA, including improvements in markers (e.g. validation of “stair-step” markers that amplify progressively longer AC DNA sequences, development/validation of allelic discriminatory markers, development/validation of multiplex qPCR markers, etc.), development of new marker targets (e.g. bacteria unique to Asian carp), and better understanding of the genetic constituents of an environmental sample will lead to better interpretation of eDNA detections and enable USGS to determine if a link exists between detected DNA in environmental samples and the presence of live fish – critical tools for gauging both growing invasion fronts or populations in decline following control efforts.

This project will develop methods to avoid and reduce the effect of PCR inhibitors in environmental samples, validate new mitochondrial DNA markers to identify and exclude eDNA detections caused by vectors/fomites, and validate new molecular signals of the presence of Asian carp. The project, building on its success in 2013 to correlate eDNA signals with Asian carp spawning in the Wabash River, will expand its efforts to correlate eDNA and other molecular signals with the presence of Asian carp to better inform future management actions.

FY 2013 Actions Undertaken:

- Initiated study to correlate movement of Asian carp with eDNA detection through a collaboration with Purdue University (Purdue is currently tracking telemetered fish in the Wabash River). Sampling was initiated on the Wabash River in June 2013.
- Identified significant spike in Asian carp eDNA correlated with spawning event in Wabash River.
- Applied “stair-step” markers to eDNA samples from the Wabash River and detected Asian carp sequences (i.e., sequences >800-base pairs) that would not have been transmitted by fish-eating birds.
- Initiated collection of DNA samples (i.e., fin clips) of selected species of cyprinids
- Developed initial markers to detect selected bacteria unique to Asian carp, initiated validation of microbial markers.
- Initiated trials to couple the ECALS eDNA loading studies with quantification of Asian carp-specific microbe sequences under controlled conditions.
- Published one manuscript in a peer-review journal.
- Described the relationship between fish population density and eDNA shedding rate under controlled laboratory conditions.
- Identified effects of temperature and feeding on eDNA shedding rate under controlled laboratory conditions.
- Described degradation curve of eDNA from sperm under controlled laboratory conditions.

FY 2014 Actions

- Develop qPCR method to detect Asian carp-specific microbial populations and determine how microbial populations change seasonally; initiate validation of Asian carp-specific microbial communities to detect the fish.
- Identify restriction enzyme sites that can be used to design qPCR assays from Asian carp DNA that may be useful for tracking live fish.
- Screen for inhibitors in eDNA samples from river water.
- Complete mitochondrial sequencing of select native cyprinids whose mitochondrial DNA sequences are underrepresented in GenBank.
- Expand temporal sampling of locations with known Asian carp populations before, during and after spawning to characterize eDNA quantity, quality (DNA fragment length), and presence of inhibitors with the age of fish eggs and larvae in matched samples.
- Validate new conventional and qPCR markers for Asian carp mitochondrial DNA to allow incorporation into USFWS eDNA monitoring program.
- Design and optimize markers to incorporate into a rapid, portable DNA/RNA detection kit for use in the field to screen samples (e.g. water of baitfish transport containers) for the presence of the DNA of Asian carp (e.g., DNA of Asian carp in baitfish shipments could mean that AC are present in the baitfish shipment). Commercial, handheld DNA detection kits are available but lack properly designed and optimized markers.

Expected Milestones:

- September 2016: Development of assays linked to the presence of live fish
- September 2016: Validation and transition of new markers to monitoring programs
- September 2015: Identification of methods to minimize inhibition of PCR for eDNA analysis
- September 2016: Development of molecular monitoring protocols that extend beyond just determining the absence or presence of Asian carp.
- September 2016: Characterization of the quality and quantity of DNA in environmental samples to inform response actions to eDNA findings
- Ongoing: Transfer technological and methodological advancements to Asian carp monitoring programs

Outcomes:

- Multiple validated methods to detect a variety of Asian carp molecular signals including mitochondrial DNA (target of current eDNA surveillance programs)
- Tools to accurately identify the route of entry of Asian carp molecular signals (such as eDNA) into a water body to discriminate between potential vectors (piscivorous birds) and the presence of live fish
- Enhanced tools to identify the leading edges of juvenile Asian carp
- The ability to use molecular signals (e.g. eDNA) to determine specific critical life history characteristics of populations of Asian carp
- Characterization of eDNA signals associated with spawning events

Potential Hurdles:

- Identification of native species with similar DNA sequences
- Collection of rare species for mitochondrial screening, though access to museum specimens may negate this hurdle

- Collection of samples through winter months

6.0 eDNA Technology Refinement

6.1 USFWS Fisheries Program Capacity for eDNA Sampling and Early Detection

Lead Agency: USFWS

Agency Collaboration: Great Lakes States, USACE

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$400,000	\$650,000	\$0

*Assume flat line funding for base funding.

Project Explanation: USFWS Great Lakes Fish and Wildlife Conservation Offices are uniquely poised to collect samples from around the Great Lakes basin to be analyzed for Asian carp eDNA at the Midwest Fisheries Center, Whitney Genetics Laboratory. In FY13, USFWS began implementing a comprehensive, effective, and efficient program in the Great Lakes to detect incipient invasions. This provided USFWS facilities with resources and expertise to conduct integrated, long-term early detection activities in areas outside of the CAWS using eDNA. Funding received under this action item supported water sample collection around the Great Lakes Basin, and samples were analyzed for eDNA at the Midwest Fisheries Center, Whitney Genetics Laboratory.

Summary of Actions to Date: The USFWS continues to work with partners to refine a Great Lakes basin-wide early detection protocol for Asian carp, and potentially other AIS species, using eDNA. 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. From May-November 2013, USFWS collected 2,240 eDNA water samples. Positive eDNA results were obtained from USFWS sampling in three locations.

2014 Actions: The USFWS, in cooperation with our partners, will continue to monitor for the presence of Asian carp eDNA in the Great Lakes basin utilizing a statistically tenable sampling protocol. The USFWS will continue to upgrade its field sampling infrastructure (e.g. mobile eDNA processing trailers) 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 southern Lake Michigan and other potential hotspots for Asian carp invasions

Outcomes/Outputs:

- Continued eDNA sampling in areas of concern by USFWS Fish and Wildlife Conservation Offices, conducted in close coordination with partners
- Continued updating of the Quality Assurance Project Plan to include any necessary updates for collection, handling, and processing of water samples

Potential Hurdles:

- Possible issues with eDNA calibration outcomes/output
- Limitations due to weather and difficulties accessing sites
- Maintaining QA/QC process regarding sample contamination in the field

6.2 USFWS Midwest Region Fisheries Program Capacity for eDNA Sample Processing and Technique Refinement

Lead Agency: USFWS

Agency Collaboration: USACE, USGS, Great Lakes States,

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$900,000	\$900,000	\$0

*Assume flat line funding for base funding.

Project Explanation: GLRI will partially fund the processing of eDNA samples for Asian carp at the Service’s Midwest Fisheries Center, Whitney Genetics Laboratory. This funding will enable processing of at least 120 water samples per week from the CAWS and other Great Lakes hotspots. Use of eDNA as a monitoring tool for Asian carp and other AIS is still in early development stages, and is rapidly being improved through research efforts within federal agencies and academic institutions. In order to implement new techniques and methods as they are published, new methods and techniques must be tested and validated to be included in the Quality Assurance Project Plan (QAPP), and then implemented in official monitoring programs. Adaptations from the methods must be researched and then validated in at least three different labs. Furthermore, as the Great Lakes monitoring program commences and additional monitoring sites are added, the lab will be required to increase capacity and efficiency. Higher throughput can be realized with modifications to current procedures and methods, all of which require testing and validation in three labs in order to be adopted into the QAPP.

Summary of Actions to Date: The Service’s Whitney Genetics Laboratory was constructed and staffed in 2012, and newly hired staff engaged USACE to transfer processing operations from ERDC to USFWS. A transition plan from USACE to the USFWS was implemented, and the USFWS assumed a lead role for processing eDNA samples from the CAWS and from additional invasional hotspots in the Great Lakes basin. Working with partners, Service staff reviewed and updated the eDNA Quality Assurance Plan (QAPP) as necessary. In 2013, the Whitney Genetics Lab processed 2,240 eDNA water samples collected by Service offices, and sampling will likely expand in 2014.

2014 Actions: The USFWS will continue to process water samples collected by our USFWS Conservation Offices, in collaboration with our partners, to detect the presence of Asian carp DNA in areas of concern. The USFWS will continue to evaluate and implement new collection and processing techniques for eDNA surveillance, to identify factors that may influence test results (e.g. detection capability of various sampling and processing techniques; environmental inhibitors) and to increase lab throughput.

Expected Milestones:

- Continued processing of water samples for Asian carp eDNA sampling from areas of concern
- Continued updating of the QAPP to include additional information on collection, handling, and processing of water samples
- Increased throughput of samples processed at the Whitney Genetics Laboratory due to procedural modifications, where possible

Outcomes/Outputs:

- USFWS eDNA sample processing and analysis at a rate of at least 120 samples per week at the Whitney Genetics Laboratory

Potential Hurdles:

- Possible uncertainty in eDNA calibration outcomes

6.3 Development of a Hand-held, Real-time DNA Detection Kit

Lead Agency: USGS

Other Agencies Involved: USFWS

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$100,000	\$0

Project Description: Amplification of environmental deoxyribonucleic acid (eDNA) by polymerase chain reaction (PCR) has been used to monitor for the presence of carp (bighead carp [*Hypophthalmichthys nobilis*] and silver carp [*H. molitrix*]) DNA throughout the Chicago Area Waterway System (CAWS), Des Plaines River, near shore waters of Lake Michigan and Upper Mississippi River. This PCR technique has been useful for early detection and identification of distribution patterns of the DNA of bighead carp because it can presumably detect the presence of DNA in water when fish populations are at very low abundance (Jerde et al. 2011). A positive PCR result indicates the presence of the DNA of bighead carp and the possible presence of live fish.

Although laboratory-based methods are an effective and efficient method to detect the presence of bighead carp or silver carp eDNA for surveillance and monitoring programs, they do not provide the real-time information required by field or law enforcement personnel working in time-sensitive settings. One potential use for a field-deployable test kit is the detection of the DNA of bighead carp or silver carp in fish distribution tanks. Juvenile bighead carp and silver carp are often difficult to distinguish from

baitfish species, especially when held in large baitfish distribution tanks (containing up to ~160 kg [~350 lbs] of baitfish in a single ~680-L [~175-gallon] tank). Physical inspection of these distribution tanks (commercial transport trucks often have more than six distribution tanks loaded with baitfish) and the fish source tanks are practically impossible given the sheer number and mass of baitfish present. The development of a hand-held, field deployable, real-time eDNA detection kit could simplify the inspection process and prioritize those tanks that are in need of greater scrutiny, allowing precious resources to be directed at the highest-risk risk systems thereby reducing the risk of bighead carp and silver carp transfer through baitfish movement. A field-deployable rapid eDNA detection kit could be used to quickly assess whether the DNA of bighead carp or silver carp are present (e.g., to guide sample collection for refined laboratory-based monitoring).

Lucigen® Corporation is currently combining loop-mediated isothermal amplification (LAMP) with a lateral-flow strip to produce cost-effective hand-held devices for the detection of various types of pathogens in both human and animal clinical settings in as little as 12 minutes (Figure 1) with detection capacity reportedly equivalent to laboratory-based PCR systems. Development of this technology for detection of the DNA of bighead carp and silver carp, could allow its integration into inspection and surveillance programs to provide near real-time monitoring for the absence or presence of bighead carp or silver carp or other invasive species. The device will make use of several markers presently being developed with funding from the U.S. Environmental Protection Agency's Great Lakes Restoration Initiative (e.g., eDNA Calibration Study [ECALS]; microbial source tracking project). If successful, prototype field-deployable devices (which require minimal training) will be developed and provided to biologists/technicians/conservation officers/etc. Prototype field-deployable devices could be available in early 2015. If successful, this project would enable resource managers to implement an appropriate management strategy in a time-sensitive environment to respond to the detected presence of Asian carp.

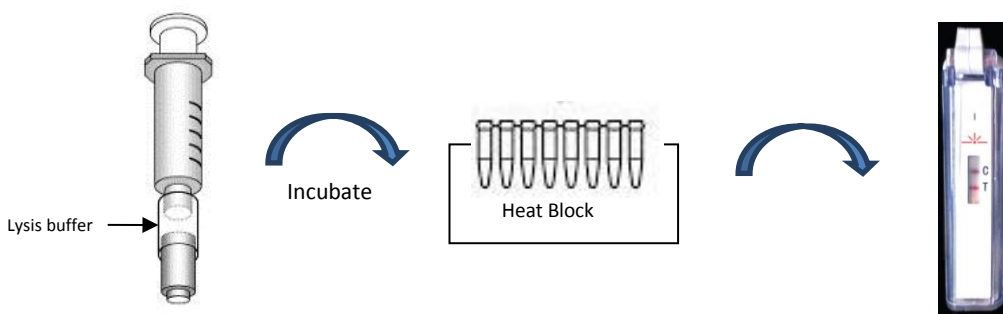


Figure 1. Flow diagram of the loop-mediated isothermal amplification process used in the hand-held, field-deployable rapid DNA detection kits being developed by Lucigen® Corporation. Time from sample collection to DNA detection is <30 minutes.

The development of a field-deployable, hand-held, real-time DNA detection kit does not negate the need for laboratory-based eDNA monitoring and surveillance efforts. Current and next generation field-deployable, real-time DNA detection kits will likely target a limited number of DNA sequences whereas laboratory-based DNA surveillance programs will have the potential to amplify and detect multiple DNA

targets – making laboratory-based DNA detection more robust, efficient, and accurate within the conduct of a large-scale monitoring program. The principal advantage of current and next generation field-deployable, real-time DNA detection kits will be the portability and immediate, near real-time results these kits offer to detect the presence of the DNA of bighead carp or silver carp.

2014 Actions

- Develop a cooperative research and development agreement between USGS and Lucigen®
- Develop appropriate markers (from existing markers designed as part of ECALS) and optimize LAMP assay
- Optimize sample collection and preparation methods
- Validate LAMP assay performance on lateral-flow detection cartridge of bighead carp or silver carp
- Validate LAMP assay and lateral-flow detection cartridge in hand-held kit to detect the DNA of bighead carp or silver carp
- Assess the concordance of the LAMP assay with real-time PCR methods to detect the DNA of bighead carp or silver carp

Expected Milestones:

- Development of a hand-held, real-time DNA detection kit for use by trained field personnel to detect bighead carp DNA to reduce the risk of the transfer of bighead carp with baitfish or in other live fish transport
- Validation of a hand-held, real-time kit to detect the DNA of bighead carp in environmental samples
- Training of field crews on the use of a hand-held, real-time DNA detection kit to detect the DNA of bighead carp in environmental samples and in baitfish transport tanks

Outcomes:

- A hand-held, real-time DNA detection kit for use by field personnel to detect the DNA of bighead carp to reduce the risk of the transfer of bighead carp with baitfish or in other live fish transport systems

Potential Hurdles:

- Selection of DNA markers that can be optimized for use in the LAMP assay and which correlate to the presence of a live bighead carp or silver carp
- Lateral-flow detection cartridge technology in current generation hand-held detection kits limits the number of DNA sequences that can be detected in a single assay

6.4 Making eDNA a Tool for Better Understanding Asian Carp Populations and for Tracking Impacts of Control Measures

Lead Agency: USACE - ERDC

Funding Table:

Year	Task/Product	Base Funding	GLRI Funding
FY2014	Support for USFWS Monitoring Program	\$0	\$125,000
	Sex Determination and Detection Trials		\$100,500
	Population Estimate Validation Trials		\$100,000
	Age/Health Determination Trials		\$60,000
	Total		\$385,500

Project Description: USACE’s goal is to take the basic eDNA approach and make it into a stock assessment tool that provides more than an early detection assay for invasive carp. Particularly, the potential for combining basic eDNA sampling with advanced technologies to provide information on carp populations that otherwise are unattainable without significant “hands on” efforts to capture and process fish should be explored. The proposed DNA tools would rely on our ability to use qPCR and next generation sequencing to detect and characterize markers that are only found in one or a few locations (= “limited copy markers”) in the genome of a fish. These markers include sex-linked markers for determining population sex ratios, mitochondrial and microsatellite markers that provide diversity indices that may be used to cross-validate other methods for estimating population sizes, and telomeric markers that potentially reflect fish age, stress, or health.

With a shift in GLRI funding emphasis toward Asian carp control technologies, USACE hopes to provide these eDNA tools as means for understanding the population-level impacts of control measures that kill invasive carp or evict/repel them from large stretches of waterway. Population characteristics that are of particular interest that we may be able to discern with environmental samples include sex ratios, population estimate cross-validation, and age ratios or general health indices.

There are currently no established methods for obtaining data on the effectiveness of control measures, other than gear surveys and follow-up surgical and laboratory investigations for sex determination, aging, etc. Fish capture efforts, however, become increasingly inefficient as fish populations dwindle, and follow-up procedures are costly and time-consuming. If the procedures we test prove successful they can be adopted by the Whitney Genetics Laboratory and other labs, and these helpful data can be generated along with more established assays for detection and population estimation of invasive carp.

2014 USACE (ERDC) actions

- Conduct trials to determine if sex-linked DNA markers in bighead and silver carp can be reliably characterized using qPCR and next-generation sequencing.
- Conduct trials to determine if genetic diversity in multiple-copy and limited-copy markers can be accurately and easily determined from eDNA samples.
- Conduct trials to determine if the relative amounts of telomeric sequence in individual invasive carp strongly correlate with fish age (as determined by otolith aging methods) or general carp body index conditions.

Potential Hurdles:

The proposed tools will rely on the detection and characterization of DNA markers found in only one or a few locations in a genome (e.g. limited copy markers). Current invasive carp markers have been designed to detect DNA markers that can be found in anywhere from a small number to large numbers of copies in each cell of a fish (e.g. mitochondrial DNA loci). Using next-generation sequencing technologies should allow for detection of limited copy markers in eDNA samples, but the approach is *experimental*. Furthermore, the strength of the relationship between telomerase DNA and aging or individual health has been found to be unreliable in many species and may not work for invasive carp. Finally, approaches for characterizing mixed-individual samples of telomere markers have not been established and may not provide desired levels of accuracy.

7.0 Enforcement and Outreach

7.1 Increased Lacey Act Enforcement of Illegal Transport

Lead Agency: USFWS

Agency Collaboration: Great Lakes States

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$400,000	\$0

*Assume flat line funding for base funding.

Project Explanation: Although transfer of aquatic invasive species (AIS) is currently illegal, stricter enforcement is necessary to mitigate the risk of transfer. Specific activities cannot be revealed, because disclosing those details will jeopardize law enforcement investigations underway.

Summary of Actions to Date: USFWS, Office of Law Enforcement expanded surveillance and enforcement of illegal transportation of federally listed invasive species. USFWS wildlife inspectors increased their efforts to target and interdict federally listed invasive species at border locations. In addition, USFWS has acquired a van to remotely scan containers and vehicles, and that can be deployed at all international ports of entry. This van will allow USFWS wildlife inspectors to be more effective and efficient in their search for invasive species. In addition, the Office of Law Enforcement is working with state partners to control the spread of invasive species (including Asian carp) through investigations here in the United States. Specifics are considered law enforcement sensitive.

2014 Actions: Investigative and inspection work will continue and expand, where necessary, in 2014. Specifics are considered law enforcement sensitive.

Expected Milestones: NA—specifics are considered law enforcement sensitive.

Outcomes/Outputs:

- Prosecutions of individuals involved in illegally importing or transporting federally listed injurious species in interstate commerce

Potential Hurdles: None

7.2 Community Action Initiatives to Increase Awareness, Surveillance, and Enforcement of Unlawful Live Asian Carp

Lead Agency: IL DNR

Agency Collaboration: USFWS, state and federal law enforcement agencies, DFO/Canadian enforcement as necessary, Illinois Natural History Survey-IL/IN Seagrant

Funding Table

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	300,000	\$0

Project Explanation: While both bighead and silver carp are listed under the Lacey Act as illegal to transport alive, many local communities and/or markets continue to buy and sell live Asian carp for consumption and/or release into the wild according to ethnic customs or traditions. IL DNR proposes to increase officer presence and friendly enforcement activities related to Asian carp in a manner similar to the bait shop visits (Action Item 2.7.1). This has proved successful in promoting open dialogue between store owners, the public, and enforcement officials. Community involvement would focus on fish processors, retail food establishments where live Asian carp are (or were) likely to have been, and markets known for having a preference for live fish for release or food preparation.

IL DNR staff and Conservation Police Officers will perform education and outreach activities, as well as on-site enforcement, if necessary, through informal site visits at fish processors, fish markets, and retail food establishments. In addition, import and export audits and inspections will be performed to ensure compliance with both the federal Lacey Act and Illinois Injurious Species Rule. Conservation Police officers (CPOs) will also be tasked with ensuring adherence to other laws and regulations by commercial fisherman.

Interpretive materials will be developed for distribution to increase awareness of enforcement and additional outreach materials will be important for non-English speaking business owners and consumers.

Because unintentional contamination has been suspected in other ANS, fish transportation and import for food or stocking will also be investigated. Increased officer presence, education, and communication will enhance understanding. The following activities will occur:

Summary of Actions to Date:

Law Enforcement

- At least four investigations of live fish in markets per year, regionally.
- Coordinate outreach and education for best management practices and regulations.
- Develop techniques to share information across language/cultural barriers.
- Increase surveillance of live fish haulers to prevent spread of ANS and specifically live Asian carp.
- Develop recommendations for policy or regulatory changes to address any identified gaps in control or management of Asian carp and of other ANS.
- Hold discussions with City of Chicago-Department of the Environment to coordinate regulations
- Coordinate with Conservation Police Officers (CPOs) to coordinate enforcement efforts in Chicago area restaurants and market places.
- Visit restaurants and markets in the greater Chicago area.
- Investigate live fish haulers moving through Illinois.
- Investigate live fish in markets, regionally.
- Coordinate outreach and education for best management practices and regulations.

- Begin interactions with local business to develop techniques to share across language/cultural barriers.
- Increase surveillance on live fish haulers.
- Evaluate live grass carp sales in Chicago area and clarified rules that now will only permit live triploid grass carp to be sold as food (fish are dispatched upon sale).
- Produce educational materials to facilitate training in invasive species enforcement.
- Participate in leadership role in Asian Carp Task Force.
- Arrest any aquatic life dealer illegally stocking and selling invasive species in Illinois.
- Examine plea agreements pending in court totaling over \$24,000 in fines for aquatic life code violations.
- Arrest bait dealer for VHS, restricted species permits, and aquatic life dealer's license violations.
- Seize and dispose of two shipments of illegal aquatic life.
- Discover any illegal sale of aquatic life parts in fish markets.

Urban Fishing Pond Surveys

- Removed 32 bighead carp from five Chicago area ponds using electrofishing and trammel/gill nets since 2011.
- Sampled four ponds with electrofishing and trammel/gill nets during 2013.
- Estimated 165 person-hours were spent sampling Chicago area ponds in 2013.
- Sampled 179 fish representing 5 species and 1 hybrid group.
- Removed 6 bighead carp from Humboldt Park and Flatfoot Lake; a replica of the carp from Flatfoot Lake has been made for outreach and educational events.

2014 Actions:

In 2014 and subsequent years, IL DNR will continue with the efforts started in 2012 in working throughout the greater Chicago Area and expand the program to statewide site visits and surveillance, working with multijurisdictional teams when appropriate. Additional areas where live Asian carp may be moving within the state intentionally or unintentionally will be identified.

To expand these efforts, IL DNR will coordinate efforts with the USFWS along with local and regional jurisdictions.

Expected Milestones:

- Develop outreach and interpretive materials for businesses and consumers for awareness
- Increase enforcement and establish expectations regarding live fish sales in Illinois
- Establish consistent enforcement and understanding in Illinois and train surrounding states in same consistent enforcement techniques
- Increase coordination with City of Chicago, and USFWS in these issues

Outcomes:

- Develop outreach and interpretive materials for businesses and consumers for awareness
- Increase enforcement and establish expectations regarding live fish sales in Illinois
- Increase coordination with multijurisdictional and regional fish hauling and movement of fish

- Increase awareness and education by December 2012 and then build upon in 2013 to ensure compliance
- Decrease or eliminate any illicit transportation of Asian carp within or across Illinois
- Educate law enforcement that is not regularly involved with resource conservation in the Asian carp issues and further increase ability to stop illicit ANS movement and enforce regulations

Potential Hurdles:

- Difficult to inspect non-registered locations, or black market dealers
- Activity in other states/jurisdictions may affect Illinois commerce and activity

7.3 Agency and Public Outreach through Website Development

Lead Agency: U.S. Fish and Wildlife Service

Agency Collaboration: Web content will be supplied by all members of the ACRCC

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$50,000	NA

*Assume flat line funding for base funding.

Project Explanation:

The ability to provide information in a timely and accessible format is a critical component in the ACRCC’s stakeholder participation efforts. The ongoing maintenance and continued expansion of AsianCarp.us as both a window into the ACRCC actions and source of trusted information on Asian carp requires extensive staff support.

FY 2013 Actions Undertaken: In 2013, www.asiancarp.us website continued to be the ACRCC’s central platform for public outreach and education. As the site administrator, USFWS maintained and developed the website, working toward increased visitation. In 2013 the website was viewed by 59,000 unique users. Since www.asiancarp.us launched in 2011, the site has reached more than 152,000 people. Website highlights from the last year include the addition of two educational videos; one on the science of eDNA and the other on the identification juvenile Asian carp. The homepage was also modified to include a “Partner’s Update” section on the homepage, where on a monthly rotation ACRCC members post a message to the public about their agency’s work and accomplishments related to Asian carp.

2014 Actions: Recent research and subsequent media attention has placed new attention on grass carp, a species of Asian carp. A primary goal for the website in 2014 will be to enhance public understanding and awareness of grass carp issues. The website will also be improved by the creation of the Asian Carp Toolkit, which will serve as a resource for fisheries managers on the new tools and techniques developed by ACRCC partners in the assessment and control of Asian carp populations.

Expected Milestones:

- The website will be enhanced with new information and outreach products from 2014-2016. Enhancement will take advantage of new and updated social media tools as appropriate.

Outcomes/Outputs:

- Fostering public understanding regarding the role of the ACRC and the actions it undertakes
- Identification of information gaps to better target outreach and communication activities

Potential Hurdles: NA

7.4 Public Outreach Video – Enhancement in Assessment Techniques

Lead Agency: USFWS

Agency Collaboration: NA

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$10,000	NA

*Assume flat line funding for base funding.

Project Explanation:

Brief educational videos (available to the public on YouTube) are an important outreach and communication tool. The proposed video project will focus on the new or enhanced Asian carp assessment techniques supported by the Asian Carp Control Strategy Framework. The video would highlight USFWS projects such as the Whitney Genetics Lab, DIDSON, and net improvements.

FY 2013 Actions Undertaken: In 2013, the USFWS released the video, *Using eDNA in the Fight Against Asian Carp*. The year before, the USFWS released the video, *How to Identify an Asian Carp*. Collectively, the videos have garnered nearly 20,000 views. In the process of developing these videos, some of the necessary footage for the proposed video has already been collected.

2014 Actions: In 2014, a video script would be developed, narration written and recorded, additional footage collected as needed and the video editing completed. After the video is complete, the USFWS will launch it through social media, partner listservs, agency websites and AsianCarp.us.

Expected Milestones:

- Spring 2014: Script is drafted and finalized
- Spring/Summer 2014: Additional footage is collected during field season as needed
- Summer 2014: Video editing begins
- Fall/Winter: Video is completed

Outcomes/Outputs:

- Fostering public understanding regarding the role of the ACRCC and the USFWS in enhancing the tools and techniques used in assessment activities
- A product that complements the proposed Asian Carp Toolkit, a resource for fisheries managers

Potential Hurdles: NA

8.0 Asian Carp Program Support

8.1 Integrated Pest Management Program

Lead Agency: USGS

Other Agencies Involved: IL DNR, USACE, USFWS, Southern Illinois University, University of Illinois Urbana-Champaign, University of Minnesota-Duluth

Funding Table:

Funding	Base Funding	Asian Carp GLRI	Other Funding
FY 2014	\$773,942	\$926,500	\$0

Project Description: Many potential tools, including chemical controls, are being evaluated for use within integrated pest management control programs of federal or state natural resource agencies. In general, those tools are being evaluated separately, not as part of an integrated strategy to reduce populations of Asian carp. In 2013, USGS, the IL DNR and Southern Illinois University (SIU) completed a collaborative effort to evaluate the integration of multiple tools to control Asian carp. The 2013 effort integrated feeding attractants of Asian carp, water guns to block fish escape, and commercial fishing to deplete local populations of Asian carp. The goal of the 2014 work will be to extend the evaluation of integrating multiple tools, such as those used in 2013, to multiple locations in the Illinois River and other water sheds near the Great Lakes where Asian carp are present. This project integrates the products of several larger projects that are developing tools to control Asian carp to evaluate if integrating these tools increases the ability to reduce Asian carp populations.

The USGS, IL DNR, SIU and other collaborators will identify potential locations where multiple control tools may be used to assess whether integration (1) increases removal of Asian carp by commercial fishing, (2) decreases spawning success or (3) denies Asian carp access to critical habitat. Two or more sites will be identified where feeding attractants, water guns, and commercial fishing may be used (or combinations thereof). Feeding attractants will be applied to attract Asian carp, and then water guns will be positioned to block their escape during commercial fishing. Studies will be designed to assess whether catch by commercial fishing increases when combined with feeding attractants or water guns, or both.

FY 2013 Actions Undertaken:

An integrated pest management action near Morris, Illinois was completed during August 3-16, 2013 in a backwater area in a privately-owned sand mine. The backwater is connected to the Illinois River and is fished by commercial fisherman under contract with IL DNR. Fish distribution and population assessments were completed throughout the study area daily during the trial using split-beam hydro-acoustics and side-scan sonar. Algal feeding attractants were applied daily at six application sites in the closed end of the backwater from August 4-15, 2013. A static water gun barrier was emplaced beginning at 1900 h on August 12 and operated continuously (except for 1 hour for unanticipated gun

maintenance) for 66 h. Commercial fishing commenced with five separate commercial fishers under contract by IL DNR. Commercial fishers were assigned to separate zones identified within the backwater and fished, using similar gear, 2,400 yards of gill net (equal lengths of 3.5- and 4-inch mesh) on three consecutive days. A total of >14,800 lbs of bighead carp and silver carp were removed from the backwater.

2014 Actions

- Identify locations to complete two or more integrated pest management evaluations. Barriers techniques will focus on the use of water guns and/or CO₂. Additional techniques (e.g. sound, etc.,) may also be evaluated.
- Complete a report describing the integrated pest management operation conducted in August 2013.

Expected Milestones:

- Identification of critical life stages or critical or limiting habitat on which to focus integrated control efforts
- Identification/demonstration of approaches to apply integrated pest management techniques to control Asian carp
- Field evaluations of the integration of multiple techniques to control Asian carp

Outcomes:

- Understanding of how to integrate multiple technologies to alter the behavior of Asian carp and to control/deplete localized populations of
- Recommendations to management agencies on operating conditions to establish static deterrent barriers or mobile herding systems

Potential Hurdles:

- Scaling of evaluated technologies to use in field trials
- A limited number of available water guns and replacement parts
- Obtaining needed permits/access to conduct field trials

8.2 Communication and Demonstration of New Technologies for Asian carp Monitoring and Control

Lead Agency: USGS

Agency Collaboration: USACE, USFWS, Southern Illinois University, University of Illinois Urbana-Champaign, Purdue University, State Departments of Natural Resources or Fisheries

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$15,000	\$100,000	\$0

*Assume flat line funding for base funding.

Project Explanation:

As new control technologies have been and will be developed to control and monitor the Asian carp, (such as pheromones, carbon dioxide barriers, food cues, and targeted oral-delivery platforms), results will need to be communicated to managers responsible for implementing the control technologies. The USGS will communicate these results through coordinating site visits to demonstrate how technologies are applied and production of fact sheets and other publications to share new technologies with stakeholders and managers. Information will need to be presented in a straightforward manner and detail how to apply the new technology in a field setting. USGS will coordinate the communication approach across multiple projects to most efficiently demonstrate technologies and get the information to the stakeholders and managers.

FY 2013 Actions Undertaken:

- Control technologies demonstrated during an August event near Morris, Illinois. This was located at an Illinois River backwater area for State and Federal partners.
- Video footage collected for use at talks and inform a wider audience about new technologies

2014 Actions:

- Coordination with USACE on potential communications during testing of the water guns at Brandon Road lock and dam in May and potential work in the fall of 2014.
- Demonstration of a field deployment of a carbon dioxide barrier in Morris, Illinois in August.
- Integrated pest management (IPM) demonstrations planned for Morris, Illinois, in August to demonstrate this approach to a wider audience beyond the ACRC group who attended last year, including states outside of the Great Lakes basin.
- Development of videos from IPM events for wider distribution
- Development of a list of stakeholders and their stated priorities to more effectively target dissemination of new technologies
- Ongoing technology transfers to state and other partners through webinars and/or workshops.

Expected Milestones:

- May 2014: Communication of Brandon Road Lock and Dam water gun work (pending agreement of USACE)
- August 2014: Demonstration of carbon dioxide barrier technology
- August 2014: Demonstration of IPM for additional interested stakeholders outside the ACRC
- Spring 2014: Video of Summer 2013 IPM demonstration available
- Throughout 2015: Collection of additional video from summer 2014 for development of additional podcasts

Outcomes/Outputs:

- Communication to the public on progress toward additional barrier technology to keep the Chicago Area Waterway System separate from the Mississippi River Basin at Brandon Road lock and dam
- Greater understanding of Asian carp control technology for the management community
- Interaction between scientists developing technologies and the expected technology users

Potential Hurdles:

- Partners have limited travel budgets to travel to on-site demonstrations
- The water gun work at Brandon Road will be scheduled to coincide with a closure to barge traffic and we may not have a lot of prior notice on the dates
- Delay in GLRI funding availability could affect implementation of planned activities

8.3 Registration of Control Strategies

Lead Agency: USGS and USFWS

Other Agencies Involved: IL DNR, USACE, Southern Illinois University, University of Illinois Urbana-Champaign, University of Minnesota-Duluth

Funding Table:

FY	Base Funding			Asian Carp GLRI Funding		
	USGS	USFWS	Total	USGS	USFWS	Total
2014	\$50,000	\$0	\$50,000	\$200,000	\$250,000	\$450,000

Project Description: This project will complete work to support the registration of chemical or biological pesticides to control Asian carp and will conduct trials designed to evaluate the integration of multiple technologies to control Asian carp. Several chemical controls are being evaluated for the potential to control Asian carp populations; however, these tools must go through a rigorous registration process before they may be used within integrated pest management control programs of federal or state natural resource agencies. The goals of this work will be to 1) provide regulatory affairs support for the registration of chemical controls of Asian carp and 2) develop registration-specific data to support the registration of micro-particle controls and other chemical or biological pesticide controls of Asian carp. This project supports several larger projects that are evaluating several potential chemical controls of Asian carp.

The USGS Upper Midwest Environmental Sciences Center (UMESC) will provide regulatory affairs support to the USFWS in the development of biological and chemical pesticide controls of Asian carp. Regulatory affairs support will include compiling data and reports for submission to regulatory agencies (e.g. EPA), identifying data required to attain chemical registration, coordinating experimental use permits, and providing other regulatory support as needed to attain and maintain chemical registrations of tools to control Asian carp. The UMESC will also develop specific data required to attain registration of micro-particles to control Asian carp, including studies to describe product chemistry, physical/chemical properties and EPA Group A acute toxicity (acute oral, dermal, and inhalation toxicity, eye and dermal irritation, skin sensitization).

The USFWS will provide support in preparing any needed Section 7 consultations to ensure that all actions taken regarding testing and implementation of Asian carp control technologies are compliant with the Endangered Species Act (ESA). The ESA directs all Federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the Act. Section 7 of the Act, called "Interagency Cooperation," is the mechanism by which Federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any listed species. 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 finding of "likely to adversely affect" a listed species. The USFWS will also work with USGS and partners to prepare any needed incidental take permits or exemptions, if

required under the ESA. Staff from our Ecological Services Program will assist with completing any requirements under the ESA.

USFWS will also partner with USGS to complete the EPA registration processes required for new toxicants under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). USFWS will work with USGS to compile the required health and safety information and complete procedural requirements needed for EPA to evaluate proposed control techniques and assure they will not pose unreasonable risks of harm to human health and the environment. The USFWS will also provide staff to assist with developing use manuals and labeling requirements for control technologies developed under this template, and liaise with USGS, EPA, and other partners to fulfill other requirements of the EPA registration process. Where possible, the USFWS will serve as eventual registrant of Asian carp control technologies developed under this template.

The USFWS will also work with USGS to ensure that any applications, including experimental or test applications, of control technologies developed under this template are compliant with the National Environmental Policy Act (NEPA).

FY 2013 Actions Undertaken:

- Completed preliminary review of data and registration status for antimycin for potential inclusion in a micro-particle delivery system
- Provided regulatory affairs guidance focused on understanding registration requirements for carbon dioxide

2014 Actions

- Complete formulation review with EPA to determine registration data requirements of antimycin-incorporated micro-particles
- Complete formulation review with USFWS to determine Section 7 ESA-consultation data requirements of antimycin-incorporated micro-particles
- Complete registration review with EPA to determine registration data requirements of a CO₂ barrier or the use of a CO₂ as a control agent in limited open-water application sites
- Complete review with USFWS to determine Section 7 ESA-consultation data requirements of a CO₂ barrier or the use of a CO₂ as a control agent in limited open-water application sites
- Begin preparation of Section 7 review and NEPA documentation
- Prepare use manual for CO₂ as a barrier/control agent

Expected Milestones:

- Determination of EPA registration and Section 7-ESA consultation data requirements for use of CO₂ as a barrier or the use of a CO₂ as a control agent in limited open-water application sites to control Asian carp
- Determination of EPA registration and Section 7-ESA consultation data requirements for antimycin-incorporated micro-particle registration
- Acquisition of Experimental Use Permits to allow experimental use antimycin-incorporated microparticles or use of CO₂ as a barrier or as a control agent in limited open-water application sites to control Asian carp

- Registration of an antimycin-incorporated microparticle formulation
- Registration of CO₂ as a barrier or as a control agent in limited open-water application sites to control Asian carp

Outcomes:

- Evaluation of the regulatory requirements to attain and maintain registration of potential chemical or biological control agents
- Registered chemical or biological controls for Asian carp for inclusion as part of integrated pest management programs

Potential Hurdles:

- Limited access to proprietary data to support registrations
- Negative impacts to endangered species
- Public concerns regarding use of chemical control agents

8.4 Investigation of Certification Requirements for Asian Carp Usage

Lead Agency: IL DNR

Agency Collaboration: USAID, IL DNR-Target Hunger Now, SIU

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$0	\$0

Project Explanation: There is a potential that Asian carp could be used as a human food source, but certification procedures that document the suitability of Asian carp from the Illinois River and Mississippi River and used for human consumption have not yet been assessed.

Summary of Actions to Date:

- IL DNR identified requirements necessary for certification. The major requirement is completion of current contaminant studies. Currently, efforts to communicate findings, and identify pathways for fish into international relief efforts are underway.
- IL DNR has results from Illinois EPA fish contaminant analysis which allowed a letter from the fish advisory board to promote the use of Asian carp for humanitarian aid.
- Southern Illinois University has further results regarding contaminant and compositional analysis to further support findings that these fish are a healthy choice of high quality protein for human consumption. This information is needed by industry for international trade.
- Communicated information to national and global organizations with compositional and contaminant information in hand.
- Build upon state, local, regional promotions of Asian carp as high quality food to garner support for Aid investigation.
- Demonstrated Asian carp food products at Illinois State Fair with overwhelming acceptance.
- Completed USDA-requested fact sheet for product lists, availability, and quantities.

- Numerous discussions with leaders in national and international AID organizations.
- Routinely provided private or not-for-profit agencies and organizations with state of industry to promote similar developments to governmental AID organizations and product development.

Expected Milestones:

- Contaminant analysis and report is complete
- Additional letter may allow further listing of Asian carp for global use
- Putting supply and health certifications together will promote the good use of this protein for humanitarian uses
- Private development of markets and industry which further allow for significantly increasing use of Asian carp in United States and export markets

Outcomes/Outputs:

- Identify partners and workable pathways to get packaged product into the international aid or domestic aid pipeline

Potential Hurdles:

- Ability to supply fish in quantities desired
- Ability to support both domestic and international needs
- Identify and provide proper and suitable packaging for fish to be welcome and used in USAID
- Logistics/transportations increase cost of even an over abundant supply of high quality protein
- Increase in need for quality protein and fish products
- Continued need for quality fish meal, feeds, and oils

8.5 CAWS Transportation Study

Lead Agency: IL DNR

Agency Collaboration: U.S. Department of Transportation, Illinois River waterway users, USCG, EPA, CEQ, MWRD, City of Chicago, USACE, Illinois Department of Transportation, Illinois Chamber of Commerce, MAP21, Northwest Indiana Forum

Funding Table:

Funding	Base Funding		Asian Carp GLRI		Other Funding
	ILDNR	USACE	ILDNR	USACE	
FY 2014	\$0	\$0	\$500,000	\$13,300	\$0

Project Explanation: IL DNR, working with CAWS waterway stakeholders, the Chicago Waterways Advisory Group and other Great Lakes and Mississippi River basin groups, will conduct a study on the current status, projected trends, and infrastructure and related needs to support the long-term economic viability of commercial transportation on the CAWS, including opportunities for improved multi-modal connectivity.

This study will investigate solutions for AIS prevention, taking a broad view, thinking big picture and creatively about how solutions can be design that harmonize the various parts of the waterways system to achieve a number of goals while protecting the ecological (and so economic) health of the Great Lakes and Mississippi River Basin.

This study will be conducted in collaboration with other federal agencies, the Great Lakes states, existing users of the CAWS and other interested parties.

The study will:

- Identify efforts to partner with stakeholders to develop plans to stop AIS while better addressing cargo and non-cargo traffic.
- Further develop a broadly shared desire to re-envision the CAWS for multiple uses, increasing public access and amenities.
- Provide a better understanding of the current conditions and future needs of the CAWS.
- Assess what a broad range of interests would like to see happen in terms of uses of and changes along the CAWS, including a survey of communities or interests outside of shipping and other commercial users regarding what these groups would like to see happen with their waterways to generate benefits above the current uses.
- Identify mechanisms to bring the CAWS into the current century and integrate it into the larger freight movement system, including freight movement on other modes throughout the region.
- Identify necessary mitigation actions necessary (if action is to be taken), considering a significant amount of the opposition AIS transfer prevention options comes from the cargo and non-cargo users of the CAWS.
- Identify potential shifts of business along the CAWS not accounted for in the data used in the current analyses of waterways goods movement.
- Assess GLMRIS alternatives and their impacts to waterway transportation.

Summary of Actions to Date: The USACE has completed the Great Lakes and Mississippi River Inter-basin Study. This study has been recommended by many interest groups and agencies to clarify the impacts of recommendation presented in GLMRIS.

2014 Actions: The following action will be taken:

- IL DNR will work with Illinois River waterway user groups and others to develop a scope of work for the contract.
- Bid solicitation will be held soliciting bid from qualified consultants, evaluated, and awarded.
- IL DNR will award the project contract to the selected bidder.
- Selected consultant will create a project advisory committee.

Expected Milestones:

- June 2014: Project is expected to be awarded
- July 2014: The contract will be awarded
- December 2014: Interim report will be provided to IL DNR
- June 2015: Final report will be provided to IL DNR

Outcomes/Outputs:

- This project will produce a study on the current status, projected trends, and infrastructure and related needs to support the long-term economic viability of commercial transportation on the Chicago Area Waterway System, including opportunities for improved multi-modal connectivity.

Potential Hurdles: None

8.6 Facilitation and Mediation Support for the Advisory Committee on Actions for the CAWS

Lead Agency: IL DNR

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding	Other Funding
FY 2014	\$0	\$200,000	Joyce Foundation

Project Explanation: Long term success of keeping Asian carp from expanding into the Great Lakes basin will take a consistency in both interim and long-term actions. Currently the spread of Asian carp has stalled, affording more time for action and in order to be efficient and enforceable, these actions should exploit bottlenecks that already exist. Several studies by Great Lakes Commission (GLC) and USACE have suggested one of these bottlenecks may be Brandon Road lock and dam. To further inform control efforts, studies focused on this location and other potential bottlenecks (Starved Rock and Lockport locks and dams) can expedite future actions.

With the release of the GLMRIS report in 2014, there significant desire now exists in the region to move forward with specific measures to prevent the introduction of Asian carp and other invasive species. However, GLMRIS does not recommend a preferred solution. Building on previous work, IL DNR with the GLC and the Great Lakes and St. Lawrence Cities Initiative (Cities Initiative), are well positioned to facilitate consensus and provide input on next steps. The members of the Advisory Committee have expressed a strong desire to continue meeting and help identify and advance solutions to the threat of invasive species passing through the CAWS. Moving forward, the committee is focused on near-term actions that can be taken quickly while still pursuing long-term solutions.

The already established Advisory Committee is comprised of a diverse array of stakeholders from the greater Chicago and Northwest Indiana area and the Great Lakes region. It includes approximately 30 members, roughly two-thirds from the Chicago/Northwest Indiana area and the remainder from regional organizations or entities. The advisory committee is a forum where industry, environmental groups and other non-governmental organizations can share insights and collaborate on this problem. State and federal partners, as participants, regularly attend meetings of the Advisory Committee to hear discussions and report on agency efforts.

The overall goal of the Advisory Committee is to prevent Asian carp and other invasive species from moving between the Mississippi River and Great Lakes basins through the CAWS and improve waterborne transportation, flood control, and water quality.

Summary of Actions to Date: Over the past 3 years, outside of the Framework, GLC and the Cities Initiative, embarked on a study to investigate ecological separation in the CAWS to prevent interbasin movement of aquatic invasive species (AIS), including Asian carp. The final report, *Restoring the Natural Divide: Separating the Great Lakes and Mississippi River Basins in the Chicago Area Waterway System*, also examines potential improvements to the Chicago waterway's roles in commercial navigation, recreational boating, flood and stormwater management, and water quality.

Since the release of the report in January 2012, efforts have continued to prevent the inter-basin transfer of aquatic invasive species through the CAWS. The GLC and Cities Initiative committees have also been working closely with the U.S. Army Corps of Engineers to provide information and feedback related GLMRIS.

2014 Actions Proposed: The IL DNR is proposing to hire a facilitator with mediation skills to help manage a consensus building process around the following six-point strategy:

1. Continue all current actions to keep Asian carp from reaching the Great Lakes through the CAWS;
2. Initiate additional near-term actions to reduce the risk of Asian carp reaching the Great Lakes through the CAWS;
3. Conduct additional evaluation of the feasibility and efficacy of a GLMRIS lock;
4. Evaluate the possibility of near and mid-term actions at the Brandon Road lock and dam that can reduce the risk of Asian carp reaching the Great Lakes through the CAWS in the interim while a long-term solution is pursued;
5. Reach consensus on a long-term solution that will achieve the above goal; and
6. Develop a cost-sharing approach for funding near, mid, and long term solutions.

The selected facilitator would plan and facilitate quarterly meeting of the Advisory Committee to further gather information and select actions to control Asian carp in the CAWS. Throughout the process the facilitator would also conduct mediation sessions with industry and agency representatives as necessary to resolve issues that may arise.

Expected Milestones:

- Early 2014: Select and hire facilitator
- March 2014: Advisory Committee Meeting 1
- May 2014: Information gathering on control actions

Outcomes/Outputs:

- Consensus on interim and long term actions that should be implemented to control the movement of Asian carp through the CAWS into the Great Lakes among industry and agency representatives

Potential Hurdles: Unknown

8.7 Program Support for Asian Carp Activities

Lead Agency: EPA

Funding Table:

Funding	Base Funding	Asian Carp GLRI Funding*	Other Funding
FY 2014	\$0	\$748,000	NA

*\$348,000 – CEQ for Asian carp program support; \$100,000 – USFWS-ILDNR (contractor support); \$300,000 – Agency contingency response support.

Project Description: Support for Great Lakes National Program Office, CEQ, and federal agency activities. The threat of Asian carp introduction into the Great Lakes directly affects the Great Lakes ecosystem, the eight Great Lakes states, and the economics of several associated industries. A variety of actions and activities are contained in this Framework item. These include emergency funding to support rapid response against Asian carp introductions; separation of newly discovered potential pathways of migration and fish suppression activities if new populations are found in the Great Lakes basin; contractor support to the agencies in developing reports, tracking activities, and providing field support as necessary; development and deployment of training and exercises throughout the basin to enhance agencies’ rapid response capabilities; continued support of USEPA’s Asian carp director and deputy to enhance collaborations among the federal, state, local, and tribal agency partners; and provision to senior executives and the ACRCC of continued communication and outreach support activities.

Actions Undertaken to Date: EPA has continued to work closely with its Asian carp stakeholder partners since 2009 to mitigate the effects that Asian carp may have on local ecosystems and to decrease potential for the species to spread to new waterways. With GLRI funding, EPA has supported ACRCC activities and worked closely with CEQ to ensure agency collaboration and program support for Asian carp-related activities, including the following:

- Development and refinement of the Asian Carp Control Strategy Framework since 2010.
- Development and delivery of rapid-response training courses and exercises for increased agency capability.
- Contractor support to provide technical expertise and services.
- Facilitation of meetings and outreach activities to keep the public and ACRCC member agencies aware and engaged in the control process.
- Expansion of the monitoring and response support program to allow for increased capacity and for response activities by USFWS, Great Lakes’ States, USGS, and other ACRCC partners.
- Facilitation of research and development and of additional field studies to test alternative methods to capture, control, identification, or eradicate Asian carp.

- Procurement of equipment to accelerate calibration studies and provide additional tools for field detections and quantification surveys of both bighead and silver carp.
- Funding to enhance Lacey Act enforcement activities by developing outreach and training tools for increased vigilance and interdiction of illegal live shipments of Asian carp.
- Acceleration of GLMRIS efforts for waterway separation and support for increasing USACE capacity to meet the congressional mandates of completion.
- Funding to allow continuation of engagement of White House-appointed staff in these efforts.

2014 Actions: Funding will be used for Asian carp efforts to include the following:

- Federal Executive Committee and ACRC support
- Contractor support
- Contingency support for Asian carp response related activities throughout the Basin
- Delivery of training and exercises throughout the Great Lakes Basin
- CEQ personnel support.

Expected Milestones: None

Outcomes: None

Potential Hurdles: None