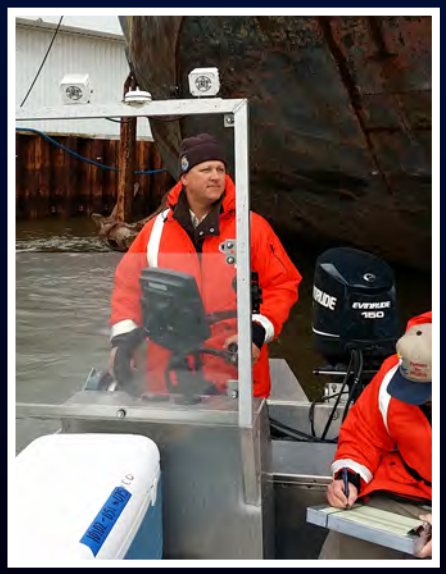
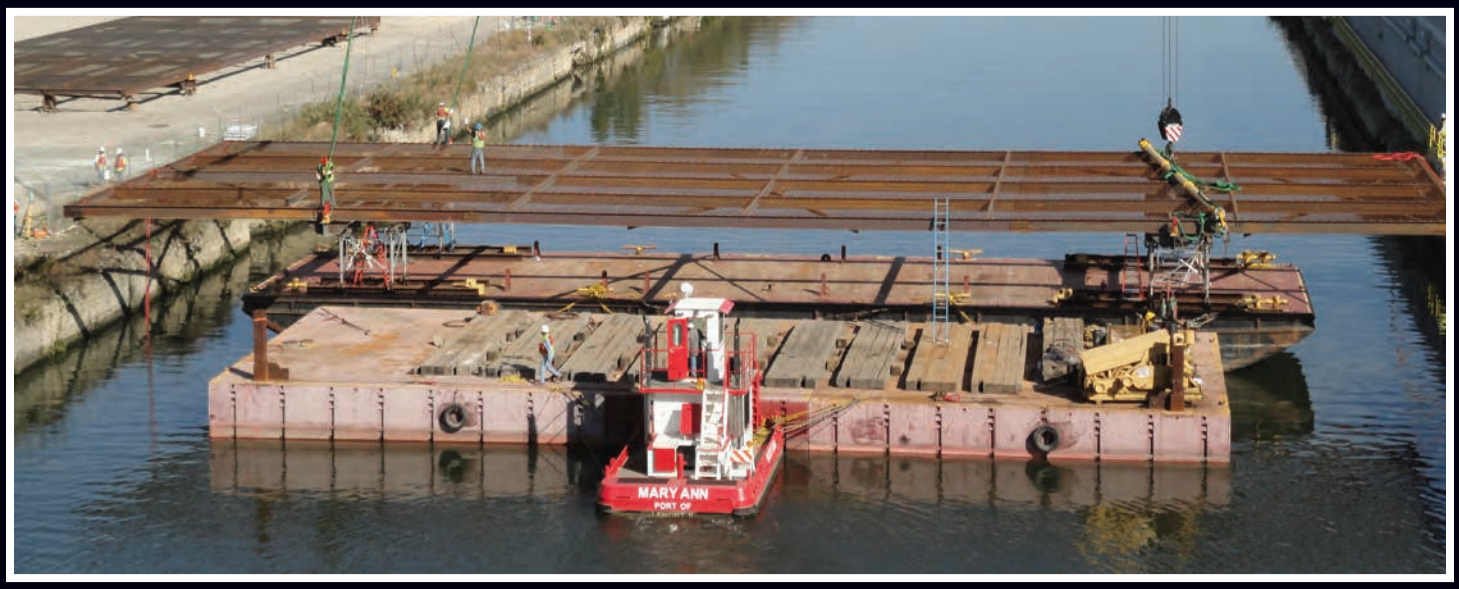
The First

Annual Report to Congress

Summary of Activities and Expenditures to Manage the Threat of Asian Carp in the Upper Mississippi and Ohio River Basins

June 2012 to June 2014





A Report to Congress Pursuant to the Water Resources Reform and Development Act of 2014 (PL 113-121)

Report to Congress

Summary of Activities and Expenditures to Manage the Threat of Asian Carp in the Upper Mississippi and Ohio River Basins: June 2012 to June 2014

December 2014

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Executive Summary

Background

On June 10, 2014, the President signed into law the Water Resources Reform and Development Act of 2014 (WRRDA), Public Law 113-121, authorizing completion of a broad array of agency actions and public projects across the United States. As a part of WRRDA, the United States Fish and Wildlife Service (USFWS) is authorized, in collaboration with the National Parks Service (NPS) and United States Geological Survey (USGS), to take actions to slow, and eventually eliminate, the spread of Asian carp in the Upper Mississippi River Basin (UMRB) and Ohio River Basin (ORB) and tributaries. Those actions include provision of technical assistance, coordination, best practices, and support to state and local governments engaged in activities to decrease and eventually eliminate that threat. Section 1039 of WRRDA includes, in part, language requiring the Director of the USFWS to provide a Report to the U.S. Congress (Report) by December 31, 2014, summarizing strategies, expenditures, and progress in addressing the threat of Asian carp in the UMRB and ORB and their tributaries over the 2-year timeframe preceding enactment of the legislation.

Specific content required in the Report per WRRDA 2014 includes:

i. "Any observed changes in the range of Asian carp in the upper Mississippi and Ohio River basins and tributaries during the 2-year period preceding submission of the report;

ii. A summary of federal agency efforts, including cooperative efforts with non-federal partners, to control the spread of Asian carp in the UMRB and ORB and their tributaries;

iii. Any research that the Director determines could improve ability to control the spread of Asian carp;

iv. Any quantitative measures that the Director intends to use to document progress in controlling the spread of Asian carp; and

v. A cross-cut accounting of federal and non-federal expenditures to control the spread of Asian carp."

The USFWS, working in close coordination with the Secretary of the Army and over 20 federal, state, Canadian, and non-governmental partners, developed this Report, as specified in WRRDA. This Report is a summary of efforts preceding the date on which WRRDA was signed (June 10, 2014), with a strong focus on the UMRB and ORB, but also addresses effort focused on Asian carp management elsewhere in the U.S. As directed by Congress, the Report summarizes activities and expenditures over the previous two years, and includes data acquired by both federal and non-federal partners. Sections of the Report are devoted to efforts of the partners within the UMRB and ORB. This document will be available to the public, and will serve as a model for subsequent annual summary reports to be submitted to Congress, as directed by WRRDA 2014.

The Challenge

Aquatic invasive species (AIS) represent a primary threat to the health of aquatic systems and their related economies in the United States, often having significant impacts in areas where they become established. AIS pose significant challenges to the sustainability of native species and the ability of state and federal

agencies and their partners to achieve their respective conservation missions. For several decades, the large river systems of the Midwest have been increasingly threatened by impacts from introduced aquatic species. During the past two decades, Asian carp (including Bighead Carp (*Hypophthalmichthys nobilis*), Silver Carp (*H. molitrix*), Grass Carp (*Ctenopharyngodon idella*), and Black Carp (*Mylopharyngodon piceus*)) have increased their range through portions of the Mississippi River and Ohio River basins, as well as the Illinois Waterway and Chicago Area Waterway Systems (CAWS), posing a threat to the rich biodiversity and related economies of the UMRB and ORB, as well as those of the Great Lakes. In total, AIS have cost our nation's economy billions of dollars per year (Pimental 1999). Significant portions of America's interior river systems are now occupied by one or more Asian carp species, resulting in further threats of range expansion into other connecting watersheds, including the UMRB, the ORB, and the Great Lakes. One or more of these four species of Asian carp now occur in 45 states. In the UMRB, upstream range expansions were observed for all four Asian carp species between June 2012 and June 2014. In the ORB, range expansion was noted for three of the four species (no detectable expansion of range was noted for Black Carp in the ORB).

Current Prevention and Control Efforts

To address the threat, resource management agency efforts now focus heavily on enhancing the ability to quickly detect presence of Asian carp using state-of-the-art science, and on developing the capacity to quickly and effectively implement subsequent actions to prevent further geographic spread, including the containment of existing populations (barriers). State and federal agencies, non-governmental organizations, academia, industry, and stakeholders are partnering to reduce Asian carp populations where established, and to develop and deploy new tools and techniques to prevent spread and to control and potentially eradicate Asian carp in waters of the United States. These efforts are consistent with legislation at the federal and state levels that address the broader issue of AIS in waters of the United States, and more specifically, prevention and control of unwanted presence of Asian carp. Between 2012 and 2014, state and federal agencies conducted a broad suite of prevention activities in both basins, including: field-based early detection and population monitoring for Asian carp; rapid response (specific discrete and intensive detection/eradication/containment efforts based on indications of elevated potential for Asian carp presence); risk assessment for Asian carp; interagency coordination; active prevention (e.g. implementation or assessment of dispersal barriers, targeted fishing to reduce Asian carp populations, focused containment activities); outreach with industry or the public/stakeholder participation focused on Asian carp prevention; law enforcement/regulatory actions focused on Asian carp prevention; research focused on development of new tools/techniques for Asian carp prevention; and financial support to partner agency/organizations to support Asian carp prevention

In both the UMRB and ORB, state, federal, and non-governmental agency partnerships have been developing holistic strategies to address Asian carp and other AIS, building, in part, off of the *Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States* (National Plan), and other existing strategies and mechanisms. These efforts being conducted in the respective basins leverage the resources of each partner organization and are used to inform budgets and workplans focused on addressing the threat of AIS. For example, the Upper Mississippi River Basin Association, a coalition of state and federal agencies, local governments, NGOs, and other interested stakeholder groups formed a Task Force to address the issue of Asian carp advancement toward Minnesota waters. The Task Force developed the *Minnesota Asian Carp Action Plan,* to assess the threat

posed by Asian carp and actions needed to minimize their impact in Minnesota, focusing on the Mississippi, St. Croix, and Minnesota Rivers. Additionally, the USFWS is working with the federal and state partners to draft an *Action Plan for Management of Asian Carp in the Upper Mississippi River Basin*, which will complement the Minnesota efforts and other regional state and basin strategies such as the multi-agency Asian Carp Regional Coordinating Committee's (ACRCC) *Asian Carp Control Strategy Framework*.

In the ORB, the *Ohio River Basin Asian Carp Control Strategy Framework* was prepared by the Ohio River Fishery Management Team, which includes the states of Illinois, Indiana, Ohio, Pennsylvania, Kentucky, and West Virginia who collaboratively manage fishery resources in the main stem Ohio River under the auspices of the Ohio River Fisheries Management Team (ORFMT). The Ohio River Basin Asian Carp Control Strategy Framework identifies tactics and projects by state and federal agencies necessary to prevent continued spread, reduce abundance of established populations, and minimize impacts of Asian carp populations in the ORB. The framework includes specific recommendations for early detection, rapid response, prevention and deterrence, population control, and communication and coordination of ORB Asian carp populations.

A query of state and federal agencies for all expenditures incurred for Asian carp prevention and control in the UMRB and ORB between June 2012 and June 2014 yielded a cost of approximately $94.5 M, of which $12.2 M was expended on prevention and control actions outside of the CAWS (Table 1). While the majority of agency fiscal expenditures were realized within the CAWS during the reporting timeframe and largely attributed to GLRI funding, the Report identifies numerous opportunities to leverage and build upon existing partnerships, strategies, and research for the purposes of bringing significant additional capacity and expertise to augment Asian carp prevention efforts in the UMRB and ORB. This expanded and strengthened collaboration will be facilitated by increased and ongoing interagency coordination, as prescribed in WRRDA, with partners bringing their collective resources to bear on the common challenge of Asian carp prevention in the waters of the upper Midwest United States.

Applying Lessons-Learned, and Transferring Technology

A growing number of technologies are under development or have been proposed for use in controlling or preventing spread of Asian carp in waters of the United States. While the immediate focus of many of these activities has been on the challenge of managing Asian carp populations in the Illinois Waterway (IWW) and the CAWS in order to prevent Asian carp establishment in the Great Lakes, many tools that may prove successful also have promise for use in other waterways (including the ORB and UMRB) threatened by AIS. Working closely with federal and state partners, the USGS is the primary federal agency spearheading research and development of new and emerging technologies in the United States. Additionally, the U.S. Army Corps of Engineers, through its Engineer Research and Development Center, and other facilities, has contributed significant advancements to the science and capacity for managing Asian carp, including development and refinement of tools for early detection. Further research being conducted by other agencies and academic institutions will produce new and emerging technologies that may prove beneficial in UMRB and ORB strategies. Opportunities to apply the lessons-learned from this research will be identified and incorporated.

Establishing Measures of Effectiveness for Asian Carp Prevention Efforts

As required by WRRDA, USFWS has developed draft performance measures for evaluating collective progress in controlling spread of Asian carp in the Ohio and Upper Mississippi River Basins. Identified below is a subset of proposed measures for potential use in evaluating effectiveness toward achieving the long-term goals of controlling Asian carp populations in the UMRB and ORB and tributaries:

- Changes in movement in the current verified adult Asian carp population front in both the Ohio and Mississippi River basins and tributaries
- Changes in numbers or range of current verified spawning areas in the rivers and tributaries
- Changes in eDNA positive findings within areas upstream of the known adult population front
- Miles of streams excluded or protected from Asian carp movement
- Number of stream miles assessed for presence of Asian carp
- Number of state and federal agencies with response plans in place
- Number of control technologies proven to control or eradicate Asian carp that are ready for in-the-field use
- Number of agencies with model regulations or ordinances focused on Asian carp prevention in place

In addition, qualitative measures will be developed for use as indicators in gauging progress in the development and implementation of the various activities needed for effective basin-wide prevention programs, including (but not limited to) the following:

- Developing collaborative basin-wide or stepped-down strategies for Asian carp prevention
- Planning and conducting early detection monitoring and assessment
- Identifying and addressing potential introduction pathways
- Planning for rapid response
- Promoting/conducting collaborative research
- Developing effective information materials and implementing education programs
- Implementing comprehensive, complementary, and effective regulations and laws
- Ensuring sufficient resource availability

Recommendations

The USFWS will continue to provide leadership among the federal agencies in coordinating efforts to prevent the spread of Asian carp, with enhanced effort in the ORB and UMRB. In addition to leveraging the existing resource management partnerships, the model of the Asian Carp Regional Coordinating Committee (ACRCC) partnership currently in use to protect the Great Lakes from Asian carp will be considered for use in convening the breadth of state and federal agencies, and non-governmental partners addressing the issue within the two basins.

Priority actions will focus on convening basin-specific partnerships to develop common strategies and objectives, and expand current efforts in order to ensure the highest level of coordination and collaboration moving forward, including:

- Development of an ORB and an UMRB formal institutional arrangement, including a network similar to the ACRCC, to facilitate interagency coordination, collaboration, and plan implementation;
- Development of an operational agreement (memorandum of understanding or operation principles) to identify roles and responsibilities of all participating agencies for each basin-wide partnership;
- Development of a short-term (annual) and prospective (multi-year) project plan identifying collaborative decision-making/management structure and required resources;
- Development of a process to ensure actions are strategically prioritized and properly sequenced;
- Preparation of an annual report which includes an evaluation of effectiveness of completed actions and recommendations for strategically implementing subsequent priority actions to ensure progress, including identification of costs for future actions; and,
- Identification of federal, state, and non-governmental resources potentially available for implementing highest-priority strategic prevention actions.

Additionally, the USFWS and USGS will lead interagency coordination to ensure that lessons-learned and technologies developed and successfully applied to Asian carp prevention and control in areas outside of the UMRB and ORB are effectively documented, communicated and considered for incorporation into basin-wide strategies, and for active implementation, as appropriate and with adequate resources.

Acknowledgments

The writers would like to acknowledge the many state, federal, and non-governmental partners whose valuable input and collaboration made this Report possible. This includes the following federal (8) and state (13) agencies: U.S. Geological Survey, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, National Park Service, U.S. Department of Agriculture – Forest Service, National Oceanic and Atmospheric Administration, U.S. Coast Guard, White House Council on Environmental Quality, Iowa Department of Natural Resources, Illinois Department of Natural Resources, Indiana Department of Natural Resources, Kentucky Department of Natural Resources, Missouri Department of Conservation, Minnesota Department of Natural Resources, North Carolina Wildlife Resources Commission, New York State Department of Environmental Conservation, Ohio Department of Natural Resources, Pennsylvania Fish and Boat Commission, Tennessee Wildlife Resources Agency, Wisconsin Department of Natural Resources, and West Virginia Division of Natural Resources. Their efforts included acquiring, analyzing, and summarizing fiscal and biological data; generating and providing descriptions of project accomplishments; and continually engaging with the USFWS Report development team to ensure accuracy and completeness in our collective communication of Asian carp management efforts within the UMRB and ORB.

1.0 Introduction

1.1 WRRDA

On June 10, 2014, the President signed into law the Water Resources Reform and Development Act of 2014 (WRRDA), Public Law 113-121, authorizing completion of a broad array of agency actions and public projects across the United States. As a part of WRRDA, the United States Fish and Wildlife Service (USFWS) is authorized, in collaboration with the National Parks Service (NPS) and United States Geological Survey (USGS), to take actions to slow, and eventually eliminate, the spread of Asian carp in the upper Mississippi River Basin (UMRB) and Ohio River Basin (ORB) and tributaries. Those actions include provision of technical assistance, coordination, best practices, and support to state and local governments engaged in activities to decrease and eventually eliminate that threat. Section 1039 of WRRDA includes, in part, language requiring the Director of the USFWS to provide a report to the U.S. Congress (Report) and the public by December 31, 2014, describing coordinated strategies established and progress made toward the goal of controlling and eliminating Asian carp in the UMRB and ORB and tributaries.

Specific content required in the Report includes:

i. "Any observed changes in the range of Asian carp in the upper Mississippi and Ohio River basins and tributaries during the 2-year period preceding submission of the report;

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1.2 The Asian Carp Challenge

Aquatic invasive species (AIS) are primary threats to the health of aquatic systems in the United States, having caused severe ecological and economic impacts in many locations across our nation. AIS have cost our nation's economy billions of dollars per year (Pimental 1999). Introduction and establishment of non-native invasive species have jeopardized many aquatic ecosystems of native species and intact habitat, as well as communities, ways of life, and industries that depend directly on those ecosystems. Well-known examples of these non-native invasive species include the Zebra Mussel, Quagga Mussel, Sea Lamprey, Eurasian Watermilfoil, Chinese Mitten Crab, and (more recently) Asian carp.

For the purposes of this Report, "Asian carp" refers exclusively to the following four species of fish native to Asia and introduced into the United States: Bighead Carp (*Hypophthalmichthys nobilis*), Silver Carp (*H. molitrix*), Grass Carp (*Ctenopharyngodon idella*), and Black Carp (*Mylopharyngodon piceus*).

Introduction and expansion of range of Asian carp is one of the most serious current challenges posed by AIS to North American waters. As with many non-native animal and plant species now established in the U.S., Asian carp were imported into the country for specific purposes to benefit aquaculture, other industries, and other human uses; each species was selected for a specific intended purpose based on feeding preferences and ecology. Over the decades, however, releases and escapements into open river and lake systems have resulted in establishment of self-sustaining populations where conditions were optimal for feeding, spawning, rearing, and overwintering. Introduction of Asian carp into the wild may have occurred from a variety of inadvertent and intentional release, including overland flooding and transport and release from stocking activities associated with the harvest and sale of bait. In invaded open water systems, the feeding and reproductive characteristics of Asian carp provide advantages over native fish that include the ability to avoid predators by achieving large body size early in life, spawning strategies, and efficient feeding regimes. Uses, means of introduction, and biological characteristics of each species are discussed in the next section.

Unfortunately, significant portions of America's interior river systems are now occupied by one or more Asian carp species, resulting in further threats of range expansion into other connecting watersheds, including the Upper Mississippi River Basin (UMRB), the Ohio River Basin (ORB), and the Great Lakes. Bighead Carp occur in at least 26 states, Silver Carp in 20 states, Black Carp in 5 states, and Grass Carp in 45 states. Grass Carp and Silver Carp also occur in Puerto Rico. As populations have become established, impacts on native species and related fisheries have become more pronounced. For example, commercial fishing harvests in the UMRB from 2000 to 2005 declined by 13% from historical average levels from 1989 to 2005.

To address this issue, efforts now focus on enhancing ability to quickly detect presence of Asian carp and on taking subsequent action to prevent further geographic spread. Resource management agencies and organizations, academia, industry, and stakeholders are partnering to reduce Asian carp populations where established, and to develop and deploy new tools and techniques to prevent spread of Asian carp in waters of the U.S. These efforts are consistent with legislation at the federal and state levels that address the broader issue of AIS in waters of the U.S., and more specifically, prevention and control of unwanted presence of Asian carp. Congress passed the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA), which called for establishment of a comprehensive new federal effort to prevent

introduction, establishment, and proliferation of introduced aquatic nuisance species, and assigned primary responsibilities for coordination to the USFWS, U.S. Coast Guard (USCG), U.S. Environmental Protection Agency (USEPA), U.S. Army Corps of Engineers (USACE), and the National Oceanic and Atmospheric Administration (NOAA). In 1996, the National Invasive Species Act (NISA) subsequently re-authorized NANPCA (with amendment, to include ballast water prevention measures for the Great Lakes). NANPCA's encouragement of a broad collaborative strategy to prevent, monitor, and control AIS is complemented by other federal and state laws and regulations that address risks posed by AIS. These include the Lacey Act (passed in 1900, amended in 2008), which specifies regulations to prevent importation or interstate transport of non-native species listed as injurious, and serves as an increasingly important tool in preventing further spread of Asian carp and other AIS in the United States. Bighead Carp, Silver Carp, and Black Carp are all listed as injurious species under the Lacey Act. In addition to WRRDA, other recent federal and state legislative acts underscore the need for cross-jurisdictional assessment and coordination (both organizational and geographic) to most effectively address invasive species prevention and control. For example, the Great Lakes and Mississippi River Interbasin Study (GLMRIS), authorized by Congress, identified a range of options and technologies that could prevent movements of AIS between the Great Lakes and Mississippi River basins via aquatic pathways; but that also depend on increased coordination to succeed.

These authorities and sources, as well as lessons learned from resource management agency and grass-roots collaborative partnerships across the United States, have encouraged and guided the development of a model of cross-jurisdictional collaboration with clear and common goals to address the threat of invasive species. Primary examples of this include the development of the *Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States* (National Plan, Conover et al. 2007), the first national framework for managing the threat of Asian carp; and the 2009 formation of the Asian Carp Regional Coordinating Committee (ACRCC), a federal and state partnership to prevent establishment of Asian carp, specifically Bighead Carp and Silver Carp, in the Great Lakes, which was co-led at its inception by the by the White House Council Environmental Quality (CEQ) and USEPA. The ACRCC executes an aggressive, multi-tiered partnership strategy to prevent an Asian carp invasion into the Great Lakes through implementation of a vigilant, standardized monitoring program focused on early detection to inform and trigger necessary rapid response actions within the Chicago Area Waterway System (CAWS), which is part of the Illinois Waterway (IWW), and other areas at risk of expanded Asian carp presence. This strategy uses the National Plan as guidance, and has built upon many of its recommendations through intensive research and field implementation. The ACRCC publishes an annual summary of activities titled *Asian Carp Control Strategy Framework* (Framework, ACRCC 2014a). This document is a compendium of strategies developed and implemented for control of Asian carp, and is a means of national dissemination of lessons learned by the ACRCC in its attempts to prevent Asian carp from reaching the Great Lakes. The ACRCC Monitoring and Response Work Group also produces an annual Monitoring and Response Plan, as well as annual Interim Summary reports (ACRCC 2014b and c). The collaborative model is underscored in WRRDA, which provides direction to federal agencies for implementation of a coordinated and focused effort to prevent spread of Asian carp populations in the UMRB and ORB.

More recently, the growing threat of Asian carp introduction and establishment into additional waterway systems has become a primary focus of resource management agendas of other regional and national organizations, and is now a high priority of Canadian conservation agencies and policy makers.

Today, the challenge of Asian carp prevention and control is addressed by an increasingly broad array of agencies, organizations, and stakeholders, working at varying scales and in different, sometimes disparate watersheds and jurisdictions, but toward a commonly-shared goal of ecological and economic resource protection. Coordination and communication among these parties is facilitated, enhanced, and more formally codified, but requires additional focused effort to better integrate the myriad of activities across the landscape, leverage available resources and expertise, and further develop strategies to prevent and control the spread of Asian carp.

For the purposes of this report, the UMRB is defined consistent with the USGS Hydrologic delineations of the upper Mississippi Region (Regional Code 7): the drainage of the Mississippi River Basin above the confluence with the Ohio River, excluding the Missouri River Basin. This also includes the CAWS, up to River Mile (RM) 333 of the IWW, where it ends at the entrance to Lake Michigan. This includes parts of Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, South Dakota, and Wisconsin. The ORB is defined consistent with the USGS Hydrologic delineations of the Ohio River Basin (Regional Code 5): the drainage of the Ohio River Basin, excluding the Tennessee River Basin. This includes parts of Illinois, Indiana, Kentucky, Maryland, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. For the 2-year time period of reporting included the two years preceding the date on which WRRDA was signed: June 2012 through June 2014.

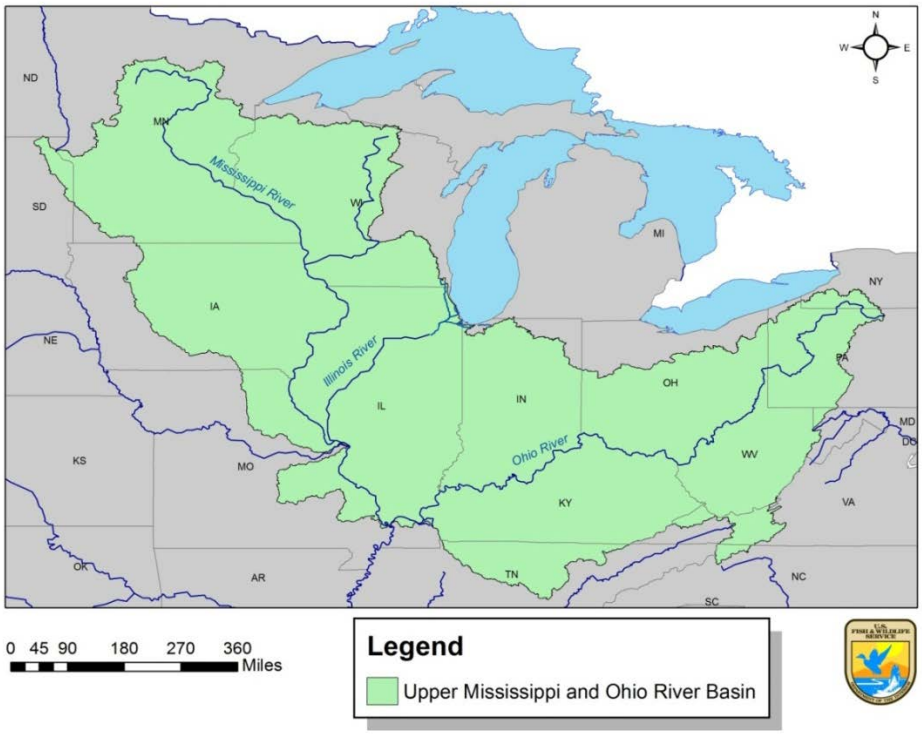

Figure 1. Upper Mississippi River Basin and Ohio River Basin (shaded green): geographic areas covered in this Report.

2.0 Changes in the Range of Asian Carp in the Upper Mississippi and Ohio River Basins and Tributaries: June 2012 to June 2014

Originally introduced to North America for aquaculture purposes, Asian carp are successful invaders, and possess life history characteristics that have allowed them to thrive in our large river ecosystems in the United States. Bighead Carp and Silver Carp were introduced at locations within the Mississippi River watershed approximately 40 years ago to improve water quality in aquaculture and wastewater treatment facilities due to their preference for consuming large quantities of algae. Silver Carp, introduced into sewage lagoons and aquaculture ponds in the early 1970s, have since become established following escapement to 20 surrounding states, reaching as far north as South Dakota and Minnesota and as far east as Ohio and West Virginia. The Illinois Waterway, a tributary to the Mississippi River and connecting water body to the Great Lakes, currently holds the highest biomass of Bighead Carp and Silver Carp in the world. Black Carp were introduced to control a fish parasite in aquaculture facilities, while Grass Carp were initially introduced as early as the 1960's to control growth of nuisance aquatic vegetation in water treatment lagoons.

An analysis of Asian carp occurrence data in the Nonindigenous Aquatic Species (NAS) database was conducted over the 2-year period of this Report to gain insight into recent changes in the ranges of Asian carp species. The NAS, maintained by the U.S. Geological Survey, is a repository for spatially-referenced biogeographic accounts of introduced aquatic species across the United States. In addition to scientific information on introduced aquatic species, the database also includes locality data acquired from many sources, including scientific literature; state, federal and tribal resource agencies; non-governmental organizations; academic institutions; and private citizens. This database aids efforts to verify presence of species and includes a number of parameters from each collection or sighting such as date, collector, location, and habitat type.

For this Report, the farthest known distribution points (both upstream and downstream) were determined for each mainstream river and major tributary. The change in range expansion of each species between June 2012 and June 2014 was determined for the UMRB and ORB. Data regarding occurrence of a species do not infer species abundance at a particular site. Occurrence data of Grass Carp includes information about the reproductive status (viable, sterile, undetermined) of collected specimens. Data were divided into two groups: Pre-2012 and 2012-2014. Potential change in distribution was assessed by comparing the furthest distance upstream an individual was captured in 2012-2014 with the documented leading edge of the invasion pre-2012 data.

2.1 Silver Carp

Silver Carp are produced in aquaculture more than any other fish worldwide. Brought to the United States in the early 1970s to control phytoplankton (algae) in municipal waste water and aquaculture ponds, they eventually spread into the Mississippi River as a result of escapement from hatcheries and research projects that used these fish in municipal sewage systems, and their accidental inclusion in shipments of other non-detrimental fish species. Silver Carp are unique in that, unlike other species of Asian carp, they have a tendency to jump out of the water when disturbed. They thrive in large river systems with high phytoplankton productivity, and have been found in waters of 20 states and Puerto

Rico. By the early 2000s, the middle and lower Illinois River was estimated to have the highest density of Silver Carp worldwide.

Silver Carp can exceed 3.5 feet and 60 pounds, and are typically more short lived at around 5 to 7 years of age. Silver Carp reach sexual maturity between 2 and 4 years of age, and multiple spawning events during a single year have been documented. Silver Carp are planktivorous, generally consuming microorganisms at the base of the food web, but can be opportunistic and consume a variety of food sources, based on availability. Their dietary patterns may allow them to out-compete both small and large native fish for this important forage resource by quickly and effectively filtering large amounts of plankton from the water column.

From 2012-2014, Silver Carp expanded their range upriver in the upper Mississippi River approximately 118 miles into the State of Minnesota (Figure 2). In the Ohio River, they moved approximately 56 miles upriver in the States of Ohio and Kentucky. Reported individual occurrences of Silver Carp in the UMRB after 2012 included 33 captures, indicating bypass of seven navigational dams on the Mississippi River (Lock and Dams 2, 3, 4, 5, 5a, 6, and 7).

There were 42 captures reported in the NAS database in the ORB during this timeframe, but no additional lock and dam structures were bypassed. Although no estimates of population size are available, Silver Carp appear to be the most abundant species of Asian carp in the UMRB and ORB. Population estimates are available for the lower Illinois River, a tributary to the Mississippi River and the connecting water body from the UMRB to the Great Lakes. It was estimated that the three lower reaches of the Illinois River (the first 231 miles of the IWW, up to Starved Rock Lock and Dam about 100 miles from Lake Michigan) contained approximately 3.1 million pounds of Asian carp, of which Silver Carp made up about 90% of the population density and 70% of the biomass relative to Bighead Carp (Garvey et al. 2012).

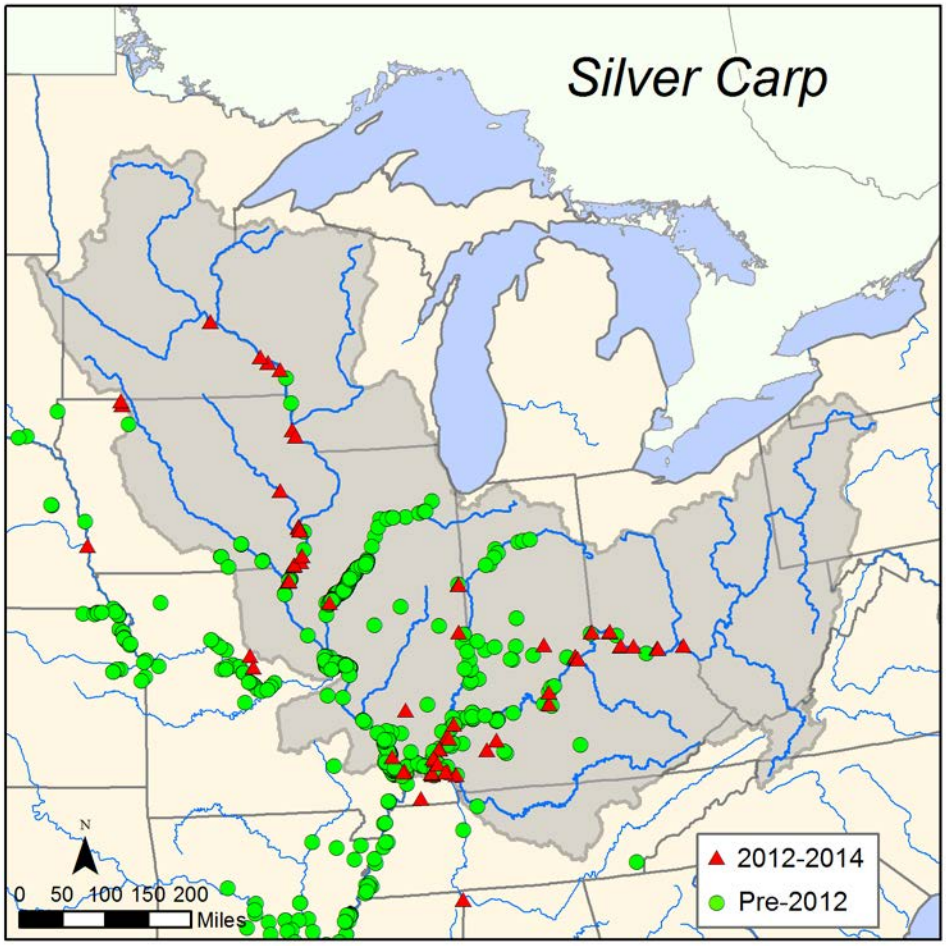

Figure 2. Range expansion of Silver Carp in the UMRB and ORB (basins shaded grey). Green circles represent occurrences from the USGS NAS Database before 2012. Red triangles indicate occurrences from 2012 through 2014.

2.2 Bighead Carp

Bighead Carp, which can tolerate a wide range of temperatures and water quality conditions, were also imported to the United States in the early 1970s for municipal waste water and aquaculture purposes and subsequently escaped into the Mississippi River. They are now found in 26 states, and in high abundance in the UMRB and ORB.

Bighead Carp typically have a lifespan of approximately 8 to 10 years, can reach lengths of over 5 feet, and weights in excess of 100 pounds. Reaching a large body size early in life limits their susceptibility to native fish predators. Bighead Carp reach sexual maturity between 2 and 4 years of age, and multiple spawning events during a single year have been documented. Bighead Carp are planktivorous, generally consuming microorganisms at the base of the food web, but can be opportunistic and consume a variety of food sources, based on availability. Their dietary patterns may allow them to out-compete both small and large native fish for this important forage resource by quickly and effectively filtering large amounts of plankton from the water column.

From 2012-2014, the range of Bighead Carp expanded upriver in the upper Mississippi River to approximately 7 miles within Minnesota, and bypassed Lock and Dam 2; no range expansion occurred upriver in the Ohio River (Figure 3). Reported individual occurrences of Bighead Carp in the UMRB after 2012 included 27 captures; and 9 captures occurred in the ORB. No population estimate of this wide ranging species are available, however, Bighead Carp is likely the second most abundant species of Asian carp in the UMRB and ORB.

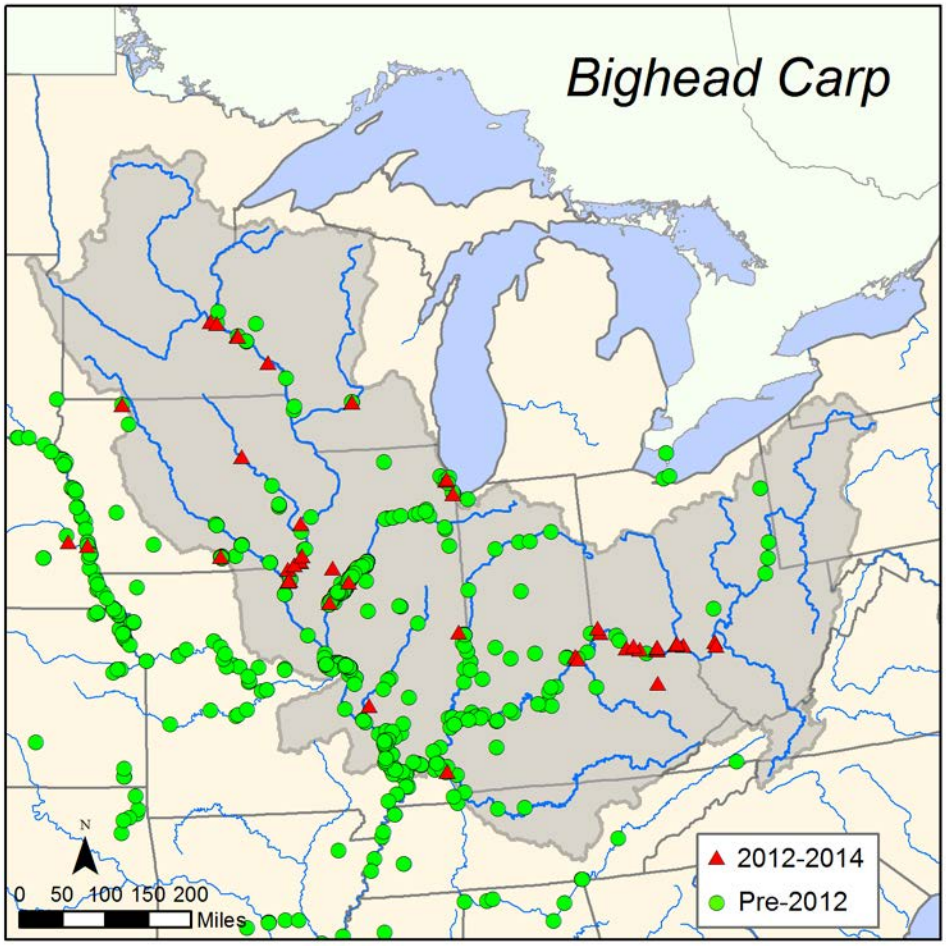

Figure 3. Range expansion of Bighead Carp in the UMRB and ORB (basins shaded grey). Green circles represent occurrences from the USGS NAS Database before 2012. Red triangles indicate occurrences from 2012 through 2014.

2.3 Grass Carp

Grass Carp were first imported into the U.S. in the early 1960s to help control invasive aquatic vegetation in reservoirs, lakes, and ponds. It is large-bodied species, achieving lengths of 4 to 5 feet, and attaining weights of nearly 100 pounds by feeding on vegetation. Grass Carp were stocked in at least 45 states by the mid-1970s, prior to concerns about the potential for them to become establish in the wild. Although not considered established outside the Mississippi River Valley (except in Texas), Grass Carp are now the most widespread species of Asian carp, found in 45 states and Puerto Rico.

From 2012-2014, Grass Carp expanded their range upriver in the upper Mississippi River by approximately 109 miles into the State of Minnesota (Figure 4), bypassing three navigational locks (Lock and Dam 1, St. Anthony Falls Lower Lock and Dam, and St. Anthony Falls Upper Lock and Dam), and one hydroelectric dam (Sartell Dam, just north of St. Cloud, Minnesota). Expansion of Grass Carp range in the ORB was indicated by capture of two triploids in the Allegheny River, a tributary of the Ohio River in Pennsylvania. Reported individual occurrences of Grass Carp in the UMRB after 2012 included 16 captures; 11 individuals were captured in the ORB.

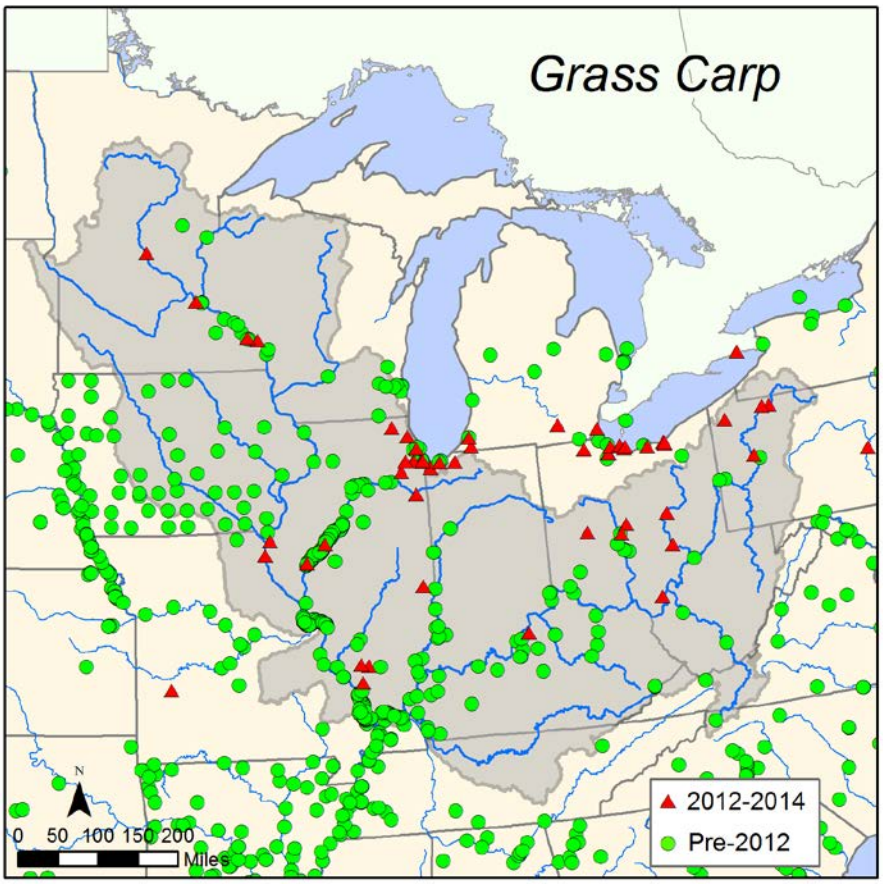

Figure 4. Range expansion of Grass Carp in the UMRB and ORB (basins shaded grey). Green circles represent occurrences from the USGS NAS Database before 2012. Red triangles indicate occurrences from 2012 through 2014.

Note about ploidy

Triploid Grass Carp Inspection Program

USFWS operates the National Triploid Grass Carp Inspection and Certification Program, and inspects and certifies grass carp to be triploid (functionally sterile) within the confidence limits of the inspection process. "Triploidy" refers to the extra set of chromosomes that renders the fish sterile, thereby reducing potential for damage as a result of the establishment of self-sustaining populations. States throughout the country rely on this program to ensure that Grass Carp entering their respective jurisdictions are indeed triploid. The program is a user-pay government program wherein 100% of inspection costs (labor, fuel, vehicles, supplies, etc.) are covered by fees collected by Grass Carp inspectors at the time of service.

From June 2012 to June 2014, USFWS inspectors inspected 592 lots of presumed positive triploid Grass Carp at Grass Carp farms. Two lots failed inspection and were not released, preventing entry of diploid (reproductively viable) Grass Carp into the supply chain and into areas within which presence was unwanted. Over 1,087,000 triploid Grass Carp passed inspection and were distributed for release in 29 states.

Comprehensive review of production, certification, inspection, distribution, and regulation of Grass Carp in the United States

The USFWS maintains a cooperative agreement with the Mississippi Interstate Cooperative Resource Agency (MICRA) to review and evaluate the entire supply chain of Grass Carp in the United States. MICRA engaged a private independent contractor (HDR Inc.) to acquire data for this project. Initial input into scoping the project came from MICRA's invasive species panel and a steering committee that included Grass Carp experts at state and federal levels and within private industry.

HDR, Inc. conducted an in-depth national analysis of Grass Carp regulation, production, triploid certification, shipping, and stocking. The intent of this effort was to determine if public and private entities producing, certifying, shipping, stocking, and regulating Grass Carp are taking effective and integrated actions to safeguard aquatic resources by preventing accidental or illegal introduction of diploid or triploid Grass Carp. USFWS representatives, state agency representatives, Grass Carp producers, and Grass Carp distributors were formally interviewed to gain a nationwide perspective and comprehensive understanding of all parts of Grass Carp industry in order to identify the sources of unwanted introduction of Grass Carp to the supply chain and the wild. MICRA is preparing recommendations to the USFWS to remedy any potential vectors for introduction. Results and a report of this project are being finalized as of this writing and will be included in future WRRDA reports.

Feral Grass Carp Ploidy Analysis

The USFWS's Whitney Genetics Laboratory (WGL) in LaCrosse, WI is working with partners to analyze the ploidy (reproductive status) of Grass Carp caught in the Great Lakes, UMRB, and ORB. Naturally spawned Grass Carp are diploid; however, aquaculturalists can cause Grass Carp eggs to become triploid by adding heat and pressure during egg fertilization. Data acquired during the project can help us understand whether wild-caught fish are domestic escapees or were spawned in the wild. State, federal, and non-government partners participating in this project send wild-caught Grass Carp to WGL for ploidy analysis, and a database of these fish is maintained by the USFWS. From June 2012 to June 2014, WGL

analyzed 74 fish for ploidy: 16 Black Carp and 58 Grass Carp. Approximately 59% of Grass Carp were diploid, 38% were triploid, and 3% were undetermined. Approximately 75% of Black Carp were diploid, and 25% were undetermined (none was triploid). See Figures 5 and 6 below.

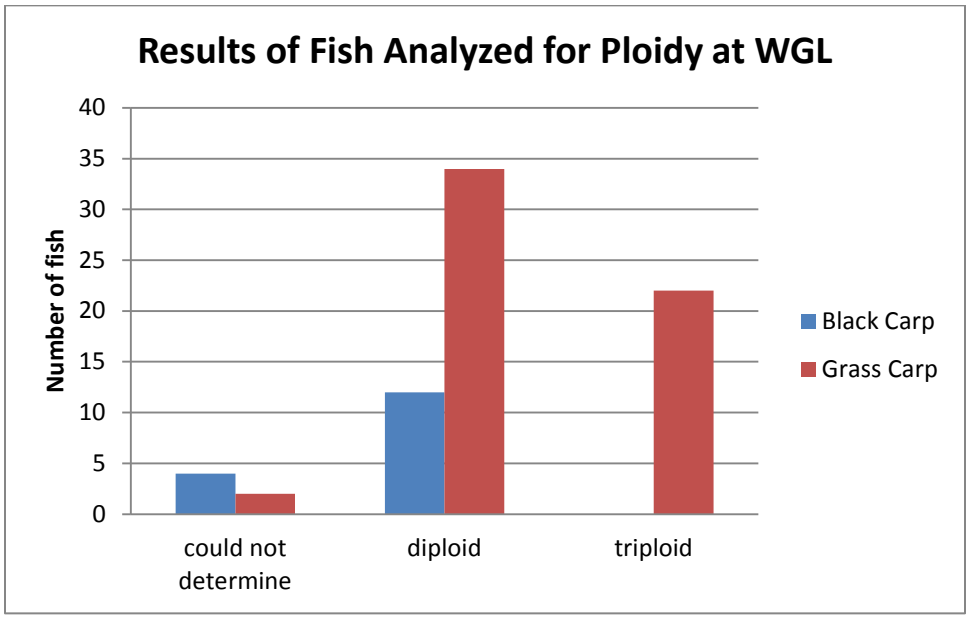

Figure 5. Results of fish analyzed for ploidy at WGL.

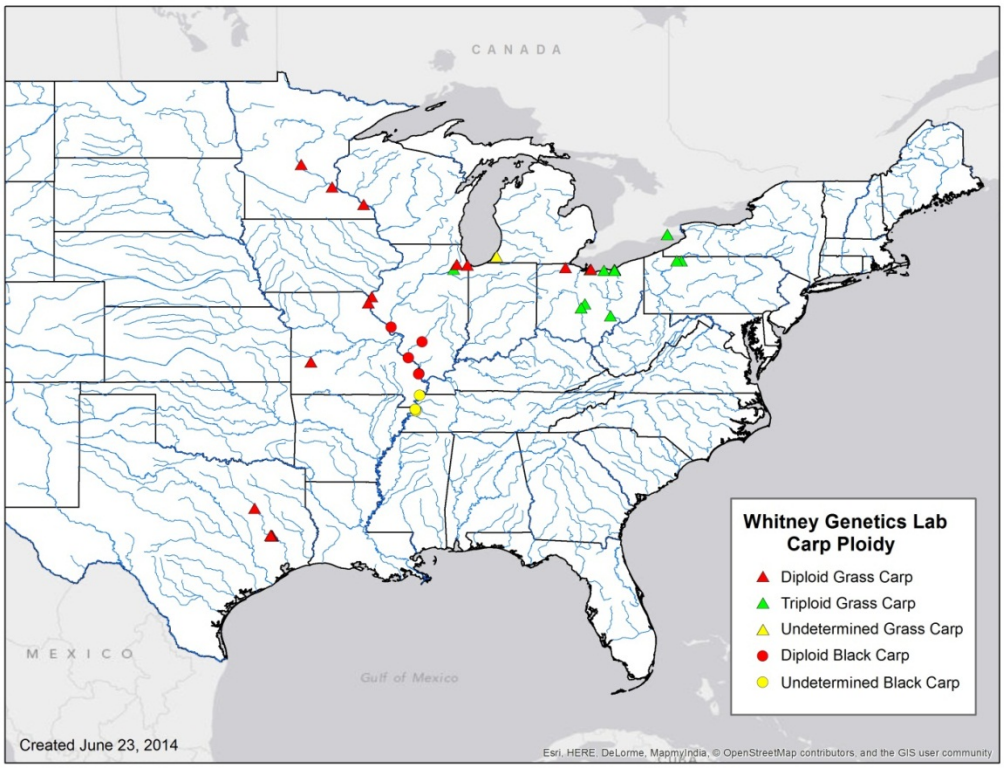

Figure 6. Geographic distribution of fish analyzed at WGL for ploidy.

2.4 Black Carp

Black Carp is the fourth species of Asian carp that was imported into the United States in the early 1970s, likely in conjunction with other Asian carp species. As a molluscivore (feeds on molluscs, snails, etc.), its preference is to occupy benthic areas of rivers, rendering it excellent for biological control of snail populations in aquaculture ponds. Its escapement into the Mississippi River raised significant concern for its preferred food because nearly 70% of native mussel fauna in the UMRB are imperiled or extinct. Black Carp can also achieve very large body sizes, reaching lengths of up to 5 feet and weights in excess of 150 pounds, with some individuals achieving much larger sizes. They are longer lived, with a life span of up to 15 years, and reach sexual maturity anywhere from 6 to 11 years of age.

From 2012-2014, Black Carp expanded their range into the Kaskaskia River within the UMRB of southern Illinois approximately 70 miles from the nearest documented population in the Mississippi River (Figure 7). No expansion of range in the upper Mississippi or Ohio Rivers has occurred. Individual occurrences of Black Carp in the UMRB after 2012 included 9 captures. No captures occurred in the ORB. Based on incidental catches, Black Carp appear to be the least abundant species of Asian carp in the UMRB and ORB.

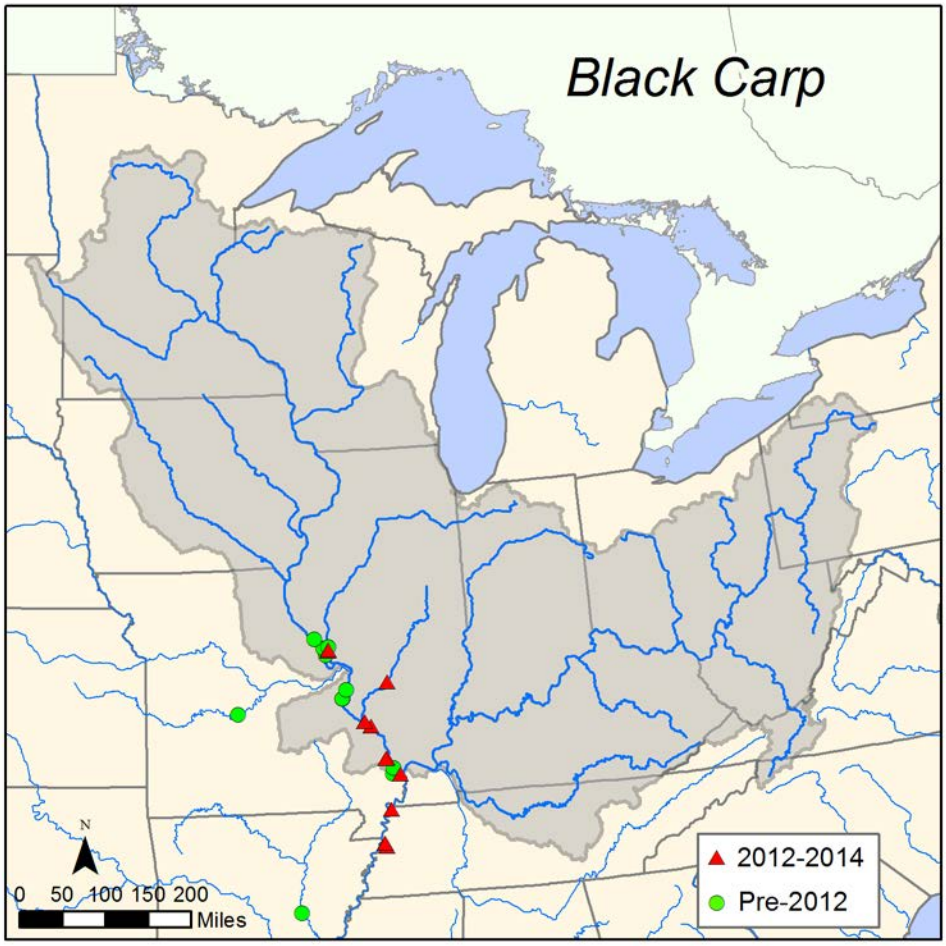

Figure 7. Range expansion of Black Carp in the UMRB and ORB (basins shaded grey). Green circles represent occurrences from the USGS NAS Database before 2012. Red triangles indicate occurrences from 2012 through 2014.

In summary, each of the four species of Asian carp has increased range in the UMRB within the last two years. Grass Carp and Silver Carp have increased respective ranges in the ORB; and Silver Carp shows the greatest spread over the past 2 years within the UMRB and ORB drainages. In the upper Mississippi River, Bighead, Silver, and Grass Carp have moved farther into Minnesota, and occurrences of Black Carp continue in the lower Illinois River approximately 305 miles from Lake Michigan.

Individual occurrence data is important to monitor for range expansion of adult Asian carp throughout the UMRB and ORB. However, the NAS data currently available only provides a partial description of the current situation. Relative abundance of these species is also important in assessing risk, and determining the state of establishment of these fish in these basins. For many areas of the river, even these relative abundance numbers are a function of effort and not a representation of what the population truly is (meaning, the more fishing effort in an area, the more information we have about the population density). For purposes of this Report, a fish population is considered established when there is successful spawning survival of the larval fish to young-of-year. Monitoring and surveillance efforts are critical in assessing

these elements as some areas of river systems may have mature adults, but lack the necessary conditions for successful spawning or eggs or larval survival. There is also the possibility that monitoring efforts are not robust enough to capture the true state of the population. Monitoring efforts are primarily focused on detection of adults at the leading edge of populations. Wide spread monitoring focused on recruitment is currently not occurring in many parts of the UMRB and ORB. As a result, much of the information on recruitment comes from incidental collections during standard fishery surveys for other species, and from anecdotal reports.

Figure 8 characterizes Bighead Carp and Silver Carp establishment and relative abundance in the UMRB and ORB, given the current state of knowledge from state and federal partners. This information is provided to provide context to the range expansion maps described previously. For purposes of this Report, establishment of Bighead Carp and Silver Carp are the focus because there is significantly more information on these species' distribution, relative abundance, and spawning in the UMRB and ORB. Although Grass Carp are known to have breeding populations in many parts of the UMRB and ORB, this Report has not characterized their risk in Figure 8. Black Carp reproduction and relative abundance information is unknown and also not identified in Figure 8.

In Figure 8, the red-shaded area indicate areas of establishment, where spawning has been verified with the collection of taxonomically or genetically confirmed eggs or larvae, or young-of-year Bighead or Silver Carp. The orange-shaded areas indicate areas of adult Bighead or Silver Carp, where the population is stable with regular catches of adults, but spawning has not been confirmed. The blue-shaded areas indicate the areas of these rivers where occasional adults are captured, either through agency monitoring efforts or commercial fisher catch.

Bighead Carp and Silver Carp are abundant in large portions of the UMRB and ORB. In the UMRB, spawning has been verified in Pool 18 near Burlington, Iowa. Although there is also a robust adult population in Pool 17 (New Boston, IA), spawning has not been confirmed. Individual occurrences of adults from both species have been verified up to Lock and Dam 2, near the Minneapolis-St. Paul metro area of Minnesota. Again, spawning has not been confirmed in these waters and the fish caught are typically from agency monitoring or commercial catch.

This Report includes information on relative abundance for the IWW, which is in the UMRB, and noteworthy since it is estimated that the IWW has the highest population density of Bighead and Silver Carp in the world. An established population covers most of the river, up to about RM 190 near Henry, Illinois. The presence of a healthy adult population continues up to the Dresden Island Lock and Dam, about 62 miles from the entrance to Lake Michigan. Most of the Dresden Island Pool, ending at Brandon Road Lock and Dam, contains some adult Asian carp, but the invasion front ends in this pool at approximately RM 281.5, over 50 miles from Lake Michigan. This front has not changed since 2006 (Baerwaldt et al. 2013).

The ORB also has established populations of both Bighead Carp and Silver Carp, with a significant portion of the basin having established or potentially spawning populations. Spawning has been confirmed below the McAlpine Lock and Dam near Louisville, Kentucky. The presence of adults of both species has been detected up to Greenup Lock and Dam, near Huntington, West Virginia, but only one Bighead Carp was collected after extensive fishing and electrofishing efforts in 2013. There are currently

no signs of successful spawning in this area or any pool above McAlpine Lock and Dam. Individual catches of Bighead Carp have been reported up to Pike Island Pool, near Wheeling, Pennsylvania just southwest of Pittsburgh.

It should be noted that to accurately assess the characterization of risk in the ORB, increased monitoring and surveillance efforts are needed and require considerably more funding. To date, only a small amount of funding has been procured for this critical scientific need. Similar to other basins that have experienced the introduction of Asian carp species, and based on the knowledge of the population dynamics of these invasive fish, the presence of established Bighead Carp and Silver Carp populations in the ORB represent a significant threat to the basin. It is not a question of if they will impact the system; it is a question of when.

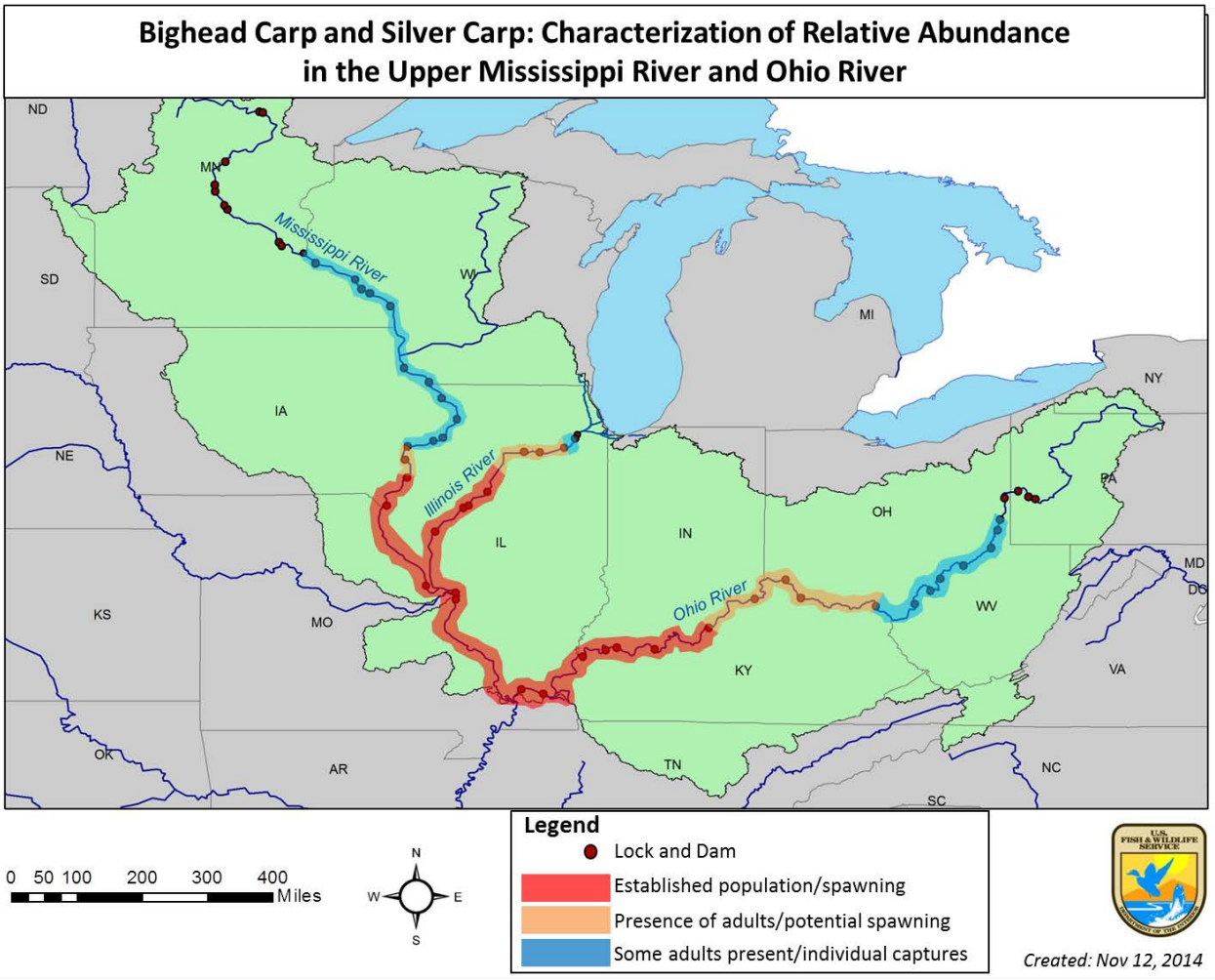

Figure 8. Characterization of current (2014) relative abundance of Bighead Carp and Silver Carp in the Upper Mississippi River and Ohio River.

3.0 Federal Agency and Cooperative State/non-Governmental Partner Activities to Control Spread of Asian Carp in the Upper Mississippi and Ohio River Basins

Efforts to prevent and contain spread of Asian carp in the UMRB and ORB include a broad scope of diverse activities of federal, state, and local agencies; non-governmental and academic organizations; industry; and the public. Among these activities are: deterrent and containment technologies and devices, outreach and education programs within the public and private sectors, law enforcement and other regulatory actions, monitoring of populations, and field and laboratory research. Agency and partner activities are designed to be comprehensive, complementary and cooperative, and often conducted across multiple jurisdictions, inclusive of various agencies and organizations, and implemented by application of common strategies.

Coordination between and among the numerous State and Federal agencies working to address the threat of Asian carp in the UMRB and ORB occurred on a regular basis in various forums, including formal face-to-face planning meetings, workshops, and teleconferences; as well as ad hoc meetings, convened as needed. The issue has become an increasingly high-priority for resource managers within both the UMRB and ORB watersheds, and is addressed in many of their respective management and annual work plans developed at the individual state or federal agency level. Many of the highest-priority goals and tactics that are common to these plans are subsequently reflected in broader regional or basin-wide roll-up strategies for Asian carp prevention. For example, priority goals on interagency coordination, research, monitoring, and communication are identified as high-priority actions within the basin-wide *Ohio River Basin Asian Carp Control Strategy Framework*, developed by the Ohio River Fisheries Management Team and encompassing jurisdictions of the five States sharing management of the watershed. The priority actions identified in these plans are also consistent with and complementary to those of the ACRCC's Control Strategy Framework; and the National Plan, developed for the entire United States in 2007.

In the UMRB and ORB watersheds, multiple agencies are directly involved with efforts to control spread of Asian carp and other AIS. Organizations that facilitate regular and ongoing coordination between federal and state agency partners to address resource management issues include:

- Upper Mississippi River Basin Association (UMRBA)
    - State members include Illinois, Iowa, Minnesota, Missouri, and Wisconsin
    - Advisory members include USACE, U.S. Department of Agriculture (Natural Resources Conservation Service), U.S. Department of Homeland Security (USCG and Federal Emergency Management Agency), U.S. Department of the Interior (USFWS and USGS), U.S. Department of Transportation (Maritime Administration), and USEPA
- Upper Mississippi River Conservation Committee (UMRCC)
    - Executive Board with one voting member from Illinois, Iowa, Minnesota, Missouri, and Wisconsin
    - Coordinator and support staff provided by USFWS

- Contributing agencies include USACE, USGS, USEPA, USCG, USDA

- Mississippi Interstate Cooperative Resource Association (MICRA)
    - Membership includes the respective Natural Resource Departments of the 28 States within the Mississippi River basin

- Association of Fish and Wildlife Agencies (AFWA)
    - Membership includes all 50 States, with participation by federal resource management agencies

- Asian Carp Regional Coordinating Committee (ACRCC)
    - For agency membership see box at right

- Aquatic Nuisance Species Task Force (ANSTF) and its associated panels, particularly the Mississippi River Basin and Great Lakes panels

- Ohio River Fish Management Team (ORFMT)
    - Membership includes the Natural Resource Departments of 7 states located along the Ohio River mainstem

ACRCC Members

Illinois
Indiana
Michigan
Minnesota
New York
Ohio
Pennsylvania
Wisconsin
Ontario
Quebec
NOAA
USDA - NRCS
USACE
USCG
USDOT
USEPA
USFWS
USGS
CEQ
DFO Canada
City of Chicago
Great Lakes Fishery Commission
Metropolitan Water Reclamation District of Greater Chicago

Between June 2012 and June 2014, activities focused on preventing the spread of Asian carp occurred in every state within the UMRB and ORB. Categories of actions that supported prevention efforts included population monitoring and assessment, implementation of dispersal barriers and related technologies, outreach and awareness campaigns engaging industry and the general public, population containment and control, and research and development of new technologies. These activities are addressed in this Section. Specific findings from each state and federal agency can be found in Appendix 2.

A growing number of technologies are under development or have been proposed for use in controlling or preventing the spread of Asian carp in waters of the U.S. The USGS is the primary federal agency spearheading research and development of new and emerging prevention technologies in the U.S. In-depth descriptions of the ongoing research effort are in Section 4 of this Report titled *Research and Potential Technologies for Controlling Spread of Asian Carp*. USGS science focuses on development of new management control tools and strategies to prevent spread of Asian carp and reduce current populations, where possible. While the immediate focus of many of these activities has been on the challenge of managing Asian carp populations in the IWW and the CAWS, many tools that prove to be successful will have potential application in other waterways threatened by AIS, such as the ORB and UMRB. Other federal agencies, as well as state, non-governmental, and academic partners are conducting additional work. Each new technology, once fully developed, provides an additional critical tool for agencies to apply strategically as a complement to other tools involved in the effort. As assessments and deployments of

technologies proceed, the knowledge gained is applied to management strategies and to development of even newer, more effective tools.

Significant support for interagency efforts to address the Asian carp threat was provided through federal appropriations under the Great Lakes Restoration Initiative (GLRI), an effort focused on restoring and maintaining the natural health of the Great Lakes ecosystem and providing benefits to the basin's communities and stakeholders. This initiative, administered by the USEPA, utilizes the Great Lakes Regional Collaboration Strategy as a framework for its action plan, and includes invasive species as one of its five core components, including efforts to institute a "zero tolerance policy" toward new invasions (including the establishment of self-sustaining populations of invasive species, such as Asian Carp). Through GLRI, resources have been provided annually to agencies and their partners since Fiscal Year 2010 to support Asian carp prevention in the CAWS and other location within the Great Lakes basin. Results of this work will directly help support Asian carp control in other watersheds and basins outside of the Great Lakes, and contribute significantly to the body of knowledge and tools available for fighting this invasive species.

3.1 Upper Mississippi River Basin

Federal/State Agencies Involved in the UMRB

USFWS
USGS
USACE
USCG
USEPA
NPS
Minnesota
Wisconsin
Iowa
Illinois
Missouri

State and federal agencies in the UMRB engaged in a variety of prevention-focused activities, including monitoring and assessment, and the development and implementation of technologies of control. This included projects that were planned and implemented by individual agencies, as well as the development of broad, collectively-derived comprehensive strategies, most notably the *Minnesota Asian Carp Action Plan* (MACAP). While the MACAP is specific to controlling the Asian carp invasion into Minnesota waters, the majority of state and federal agencies and other organizations within the UMRB were active in the preparation of the document. The MACAP is a prospective strategy that identifies and promotes the implementation of high-priority actions and recommendations to control Asian carp. In addition, the USFWS is leading efforts to develop the *Action Plan for Management of Asian Carp in the Upper Mississippi River Basin,* which will build upon the foundation of the MACAP, and the recommendations and actions contained in the National Plan as well as other relevant strategies.

3.1.1 Basin-wide Planning

Minnesota Asian Carp Action Plan

A coalition of state and federal agencies, local governments, non-governmental organizations, and other interested stakeholder groups formed a Task Force to address the issue of Asian carp advancement toward Minnesota waters. The Task Force developed the MACAP, a step-wise approach to assess the threat posed by Asian carp and actions needed to minimize their impact in Minnesota. It focuses on the

Mississippi, St. Croix, and Minnesota rivers, and builds upon existing state and National Asian carp plans.

The Task Force realizes that preventing Asian carp from entering Minnesota via the Mississippi River is nearly impossible. Accordingly, the plan emphasizes actions to slow the spread and minimize impacts of Asian carp should they enter Minnesota waters. Plan elements include: early detection and response, prevention and deterrence, mitigation and control, and outreach and communication.

Minnesota Asian Carp Action Plan Participants

National Park Service (NPS)
Mississippi National River and Recreation Area
St. Croix National Scenic Riverway
USFWS
USGS
Minnesota DNR
Wisconsin DNR
City of Minneapolis
City of St. Paul
City of Hastings
Prairie Island Indian Community
Shakopee Mdewakanton Sioux Community
Saint Paul Port Authority
Three Rivers Park District

Technical Advisors
University of Minnesota
USACE, St. Paul District Mississippi River Fund
St. Croix Valley Foundation

Observers
Friends of the Mississippi
Upper Mississippi River Waterways Association

Early Detection and Response – Early detection of the presence of Asian carp is critical to allow time for the coordination and mobilization of control or eradication techniques. Early detection and response activities will include:

- Monitor commercial fishing catch in Pools 2-9
- Collate and update existing information on fisheries surveys, Asian carp captures, and prevention efforts within upper Mississippi River states (Illinois, Iowa, Minnesota, and Wisconsin)
- Request the public to report potential sightings
- Conduct testing for environmental DNA (eDNA) of Asian carp
- Use targeted commercial fishing gear to capture Asian carp
- Support research that can quantify abundance and population dynamics of Asian carp

Prevention and Deterrence

Prevention and deterrence includes establishment or modified operation of permanent structures that prevent or slow upstream movement of Asian carp. Specific actions include:

- Complete feasibility study of a permanent fish barrier at Upper St. Anthony Falls and other appropriate locations
- Create backup barrier at the Coon Rapids Dam
- Evaluate and, if feasible, install deterrent barriers (acoustic, bubble, light, etc.) to slow Asian carp movement at strategic locations
- Explore options to voluntarily limit lock usage

- Support research on new technologies to selectively deter upstream movement of invasive fish

Mitigation and Control - Mitigating and controlling populations of Asian carp is a critical element of the plan. Despite barriers and other technologies, pathways may exist that allow movement of Asian carp, including illegal or unintentional transport by bait dealers, anglers, and others. Recommended actions include:

- Support and accelerate research on behavior of Asian carp and long-term control methods
- Physically remove Asian carp
- Improve water quality and habitat so native species can better compete with Asian carp and other invasive species
- Evaluate the effectiveness of more restrictive harvest regulations for some species of commercial and sport fish

Outreach and Communication - Communication among agencies and outreach to the general public, commercial and recreational users of the Mississippi River and other connected waters, media, legislators, and local officials is critical to success of this action plan. Outreach and communication actions focus on establishing primary contacts, web links, news releases, and media events. Recommended efforts include:

- Establish and maintain a contact list of agency staff for media access
- Link agency websites
- Provide regular news releases and conduct media events
- Provide a network to distribute scientific literature on carp in the upper Mississippi watershed

Action Plan for the Management of Asian Carps in the Upper Mississippi River Basin

The USFWS and others recognized the need to collaboratively develop an Action Plan for the Management of Asian Carps in the Upper Mississippi River Basin (UMR Action Plan) for the purposes of supporting the coordination of monitoring and response efforts, and leveraging the expertise and capacity of agencies and other partner organizations within the basin. To address this need, the USFWS formed a team of representatives from all UMRB States, as well as USGS, USACE, Iowa State University, University of Minnesota, and Southern Illinois University. The team ultimately drafted the UMR Action Plan, a strategy that was heavily informed by existing plans such as the Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States; the MACAP; the Ohio River Asian Carp Control Strategy Framework; UMRCC Fisheries Plan 2010; and the Asian Carp Surveillance Plan for Areas Outside of the Great Lakes. The primary goal of the UMR Action Plan is to minimize the impact of Asian carp on the ecosystem function, recreation, and navigation in the UMRB. Objectives are:

1. Prevent new introductions
2. Slow, stop, or control the spread of existing populations
3. Monitor populations
4. Plan responses

5. Research to develop control mechanisms
6. Coordinate, communicate and educate
7. Adapt efforts

The USFWS is continuing to lead this effort and expects to have a completed plan identifying necessary actions in FY 2015.

Upper Mississippi River Conservation Committee Fisheries Plan

Comprised of the states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin the Upper Mississippi River Conservation Committee (UMRCC), in cooperation with the USFWS, USACE, and the USEPA, developed the Upper Mississippi River Fisheries Plan in 2010. The plan focuses on priority aquatic resource management objectives of mutual concern. A primary goal of the UMRCC Fisheries Plan is to slow or eliminate the spread or introduction of AIS (including Asian carp) to the UMRB—with a key objective of utilizing standardized monitoring activities to determine the status and distribution of AIS known or suspected to be present in the UMRB.

3.1.2 UMRB Agency Activities

In addition to the UMRB states, the USFWS, USACE and USDA have played major roles in the activities undertaken in the basin. The following is a summary of major activities of state and federal agencies addressing control of Asian carp in the UMRB:

USFWS

In addition to leading and facilitating the development of the UMR Action Plan outlined in section 3.1.1, the USFWS conducted ongoing monitoring and surveillance of the leading edge of Asian carp in the basin to support collaborative Asian carp management efforts in the UMRB.

The USFWS initiated efforts in 2010 to identify and obtain the critical expertise and capacity needed to implement a standardized field-based Asian carp early detection and monitoring program using cutting-edge science. This included design and development of the new, state-of-the-art, Whitney Genetics Lab (WGL), which is co-located at the La Crosse (Wisconsin) Fish Health Center. The creation of the WGL allowed for a focused program to be developed on uses of eDNA to collect and genetically analyze biological matter (sloughed skin cells, feces, mucous, etc.) from a given body of water as a means to detect the possible presence of Asian carp. The WGL opened in 2013, and its addition significantly increased the USFWS capacity for the early detection and monitoring of AIS. The USFWS now operates a regional eDNA surveillance program aimed at the early detection of Bighead and Silver Carp in the UMRB, as well as the ORB and Great Lakes. Genetic markers for Black Carp and Grass Carp are being developed and may be included in genetic surveillance programs in the future.

Since 2013, the USFWS has monitored for Asian carp in Pools 7-10 and 16-19 of the Upper Mississippi River utilizing traditional fisheries gear. In early 2014, the USFWS coordinated field activity planning with our partner agencies. Priority monitoring areas were identified by the partner agencies and activities were coordinated to ensure priority areas were monitored during the 2014 field season. Various life history stages of Asian carp were targeted in these efforts, including, egg, larvae, young-of-

year, juvenile and adult. Monitoring by the USFWS complimented efforts of MN DNR, WI DNR, Iowa DNR, USGS, Iowa State University, and MDC.

To support the efforts to effectively monitor for Asian carp in the basin, the USFWS has been conducting an acoustic telemetry study during the reporting timeframe. The purpose of the study is to identify specific locations where Asian carps are found to aggregate, define the break from the established invasion front (where Asian carp are present and have reproduced and recruited successfully) and the advanced front (where Asian carp are present in noticeable abundance but there is no evidence or documentation of successful recruitment), and determine triggers of fish movement or population advancement. Additionally, the USFWS will investigate if there is any relationship in movement behavior or invasion advancement relative to population density. Remote receivers are currently deployed from Pools 5 to 19 on the UMR. This work complements an array of receivers deployed by the Missouri Department of Conservation (MDC) from Pool 20 downstream, and by Minnesota DNR from Pool 5 upstream. Southern Illinois University and the USACE also have receivers in the Illinois and Des Plaines rivers. Additionally, MDC has placed MDC and USFWS receivers on commercial navigation vessels travelling from St. Paul, MN to New Orleans, LA to gather additional data during their up- and downstream transiting along the Mississippi River.

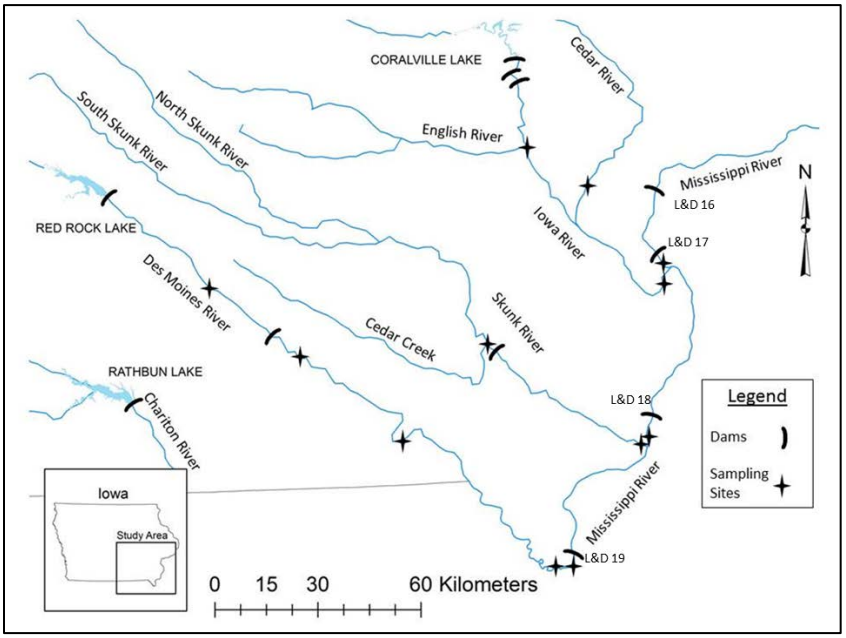

Figure 9. Approximate sampling (star) and dam (curved line) locations in rivers across southeastern Iowa (map provided by Iowa State University).

In addition, the USFWS is working with USGS and Iowa State University to evaluate Asian carp reproduction in the UMRB. Ichthyoplankton samples were collected from 12 locations in the Des Moines, Skunk, Iowa, Cedar, and Mississippi rivers in southeastern Iowa (Figure 9). These samples are being genetically analyzed at Iowa State University. While egg morphology reliably distinguishes Asian carp eggs from native species in the Missouri River, recent USGS findings have shown that genetic analyses are necessary to distinguish Asian carp eggs from those of native fishes in the UMRB. Iowa

State University is currently extracting the DNA from the samples and will conduct DNA sequencing in order to identify the species represented in each sample. Results of these analyses are anticipated by early 2015.

The USFWS was also a primary partner in efforts to monitor Asian carp in the CAWS, including eDNA sampling, electrofishing and gill netting. Support was also provided to the Barrier Defense effort, assisting with Asian carp monitoring and removal in downstream pools of the river.

USACE

The USACE plays a major role in the operation of the lock and dam system on the Upper Mississippi River and has cooperated with the USFWS and the Minnesota DNR in placement of monitoring equipment at USACE locks within the St. Paul District footprint. The USACE also collaborated with the Minnesota DNR to assess the potential benefits of a deterrent barrier at Lock and Dam 1 in Minneapolis, Minnesota, which the State of Minnesota would design, construct, and operate. Given that the WRRDA directed the closure of the Upper St. Anthony Falls Lock and Dam, the Minnesota DNR has determined that an electrical barrier at Lock and Dam 1 is no longer needed and will not pursue final USACE approval for the barrier.

In addition, the USACE collaborated with the Minnesota Aquatic Invasive Species Research Center (MAISRC) to assess deterrent technology and Asian carp swim capabilities at varying river flow velocities through dam gates. The USACE entered into a real estate agreement allowing the MAISRC to install and operate an array of acoustic deterrent speakers at Lock and Dam 8 as a demonstration project. The demonstration project began operation in early August 2014.

The USACE was directed by Congress through the Water Resources Development Act of 2007 to study factors that could potentially reduce the effectiveness of the electric dispersal barriers. The USACE has assessed various technical, environmental, and biological factors that are published as part of a series of efficacy studies. These studies include the identification of potential bypass barriers, research to determine the optimum operating parameters of the barriers, evaluation for risk reduction of fish movement through changes in operation of lock structures, and investigation into new technologies to potentially inhibit Asian carp movement (USACE 2010).

USGS

Scientists from the USGS, including the Upper Midwest Environmental Sciences Center (UMESC) and the Columbia Ecological Research Center, have conducted intensive research in support of Integrated Pest Management Control strategies for control of Asian carp in the UMRB. In particular, the USGS has established an extensive telemetry network in Navigation Pools 19 and 20 of the UMR to identify feeding habits of Asian carp as the basis of effective *in situ* control measures. Understanding the distribution of Asian carp in rivers, with respect to river stage, food availability and habitat use, is necessary for effective application of species specific piscicidal microparticles (particles that release fish toxicants). Well over 60 fish are now being monitored to better understand habitat use, including patterns of movement among habitats and during large changes in river stage. Further, detailed studies characterizing the food particles

available to Asian carp, as well as the particles being targeted by Asian carp, are being completed. The USGS is also completing studies determining patterns of predation on Asian carp by native fish predators, information necessary for effective fishery management in support of Asian carp control. As well, the USGS studies on egg drift in the UMR have shown the difficulties of identifying Asian carp eggs with standard morphological diagnoses; USGS showed molecular techniques are needed to definitively identify field-collected eggs. This work is reliant on a network of collaborators that includes Western Illinois University, Iowa State University, and the USFWS.

The USGS-UMESC, in cooperation with the five UMR states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin also conduct research and monitoring through the Long Term Resource Monitoring Program (LTRMP). The LTRMP is part of the USACE Upper Mississippi River Restoration (UMRR) program for the UMRB and is the first comprehensive program for ecosystem restoration, scientific research, and monitoring on a large river system in the world.

The monitoring and research activities of the LTRMP are focused on identifying status and trends in critical natural resources and gaining insight into ecosystem function and the factors influencing the community structure of fishes and aquatic vegetation. Although the UMRR was not designed to specifically address Asian carp or other invasive species, the USGS' long-term data (20 plus years) on fish communities, water quality, and aquatic vegetation are unique assets available for addressing invasive species in the UMRB. The robust water quality, fish, and vegetation data gathered under the LTRMP has placed the USGS is in a unique position to establish pre-invasion baseline conditions within the UMRB and to carry out rigorous analyses to identify harmful effects of Asian carp (and other non-natives) on native fauna and ecosystem processes. LTRMP data and information are available at http://www.umesc.usgs.gov/ltrmp.html.

Key contributions relative to Asian carp include research regarding:

- Nonnative fishes in the Upper Mississippi River System
- Status and Trends of Selected Resources of the Upper Mississippi River System
- Multiyear synthesis of the fish component from 1993 to 2002 for the Long Term Resource Monitoring Program
- Maintenance of the NAS database
- Status and Trends of Selected Resources of the Upper Mississippi River System

USDA

The USDA Forest Service worked with Wildlife Forever to educate the public about AIS and to encourage behaviors that prevent spread of invasive species. A component of this effort relates specifically to preventing the spread of Asian carp. The USDA Forest Service outreach activities include billboards, television and radio public service announcements, presentations at public events, and social media campaigns to educate the public on the importance of controlling Asian carp.

3.1.3 UMRB Accomplishments by Activity

Interagency Coordination

Many federal and state agencies were involved in several interagency efforts related to preventing spread of Asian carp within the UMRB. Most of this interagency coordination occurred via discussions and exchanges of information through the Mississippi River Basin Panel on ANS, the AFWA Invasive Species Committee and Fisheries and Water Resources Policy Committee, and the Midwest Governors Association AIS Collaborative. In addition, federal and state agencies cooperated in efforts such as the Upper Mississippi River Asian Carp Action Plan, MICRA, UMRCC, and the Upper Mississippi River Basin Association and served on a working group that prepared the Minnesota Asian Carp Action Plan. Many of the states and federal agencies have also shared information on plans for researching and monitoring Asian carp in the Mississippi River and tributaries in order to preclude duplicative efforts among agencies.

Field Monitoring and Early Detection

The UMRB states have been active in efforts to detect and monitor expansion of Asian carp in the UMRB. These efforts include:

- Traditional fisheries monitoring programs
- Targeted sampling
- Contracted commercial fishing
- Monitoring commercial catches
- Reported sightings

Major monitoring and assessment activities are ongoing in the IWW and CAWS and its tributaries. The CAWS monitoring program was developed by the Monitoring and Response Work Group of the ACRCC. These activities include:

- A telemetry program to assess effectiveness of the electric barriers and to identify the leading edge of the Asian carp population
- Fixed site monitoring upstream and downstream of the electrical dispersal barrier
- Larval fish and productivity monitoring

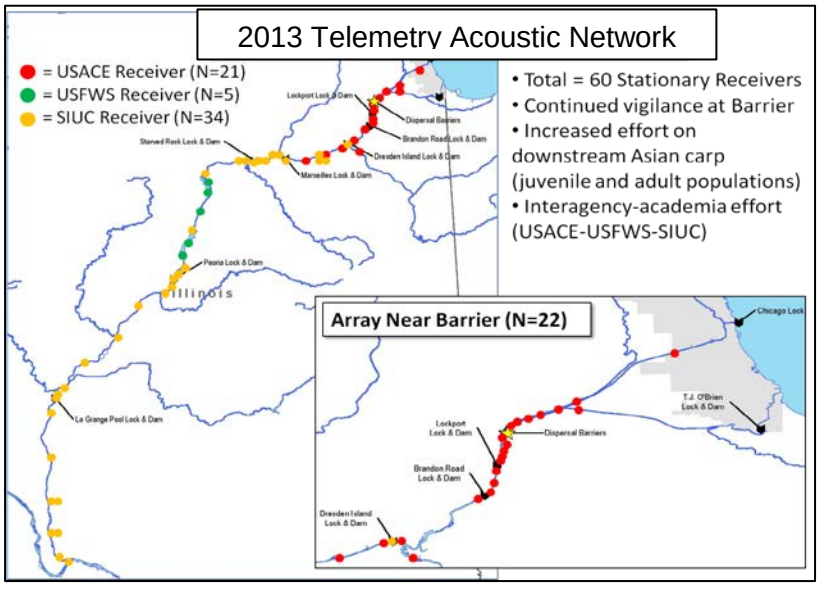

Figure 10. 2013 telemetry acoustic monitoring in the CAWS.

- Young-of-year and juvenile Asian carp monitoring
- Distribution and movement of small Asian carp in the IWW
- Fixed location monitoring in the CAWS for presence of Asian carp and local fish population. These data were also used to inform a fishery statistical-based model that will ultimately quantify potential for Asian carp presence/absence and relative abundance.

Risk Assessment

The Minnesota DNR began a high priority Geographic Information System (GIS)-based Asian carp risk assessment project in September 2012. Goals of this project were to visualize the potential pathways of Asian carp upstream dispersal, assess aquatic barriers for ability to limit dispersal, identify potential watershed breaches (i.e., pathways across major watershed boundaries such as ditches, culverts, etc.), identify waters "at-risk" for infestation, quantify resources affected, consider dispersal/infestation scenarios, and identify strategic sites for Asian carp barriers. Future work will include verifying and refining data, prioritizing locations for stream barrier construction or enhancement, and prioritizing watershed breaches for projects to prevent fish passage.

As part of the Great Lakes and Mississippi River Interbasin Study (GLMRIS, USACE 2014a), the USACE conducted a risk assessment to identify the potential risk of current and future ANS, including Asian carp, establishment and associated adverse impacts. The risk analysis process employed for the study is an adaptation of the generic model and process described in the Generic Nonindigenous Aquatic Organisms Risk Analysis Review Process (For Estimating Risk Associated with the Introduction of Nonindigenous Aquatic Organisms and How to Manage for that Risk) (ANSTF, 1996). The results of the risk assessment were used in the identification and evaluation of potential control measures for reducing, to the maximum extent possible, the risk of interbasin ANS transfer via surface water connections between the basins. The risk assessment was conducted to identify measures for controlling interbasin transfer of ANS, including Asian carp, between the two basins. In Focus Area I (the CAWS), the GLMRIS risk assessment categorized and ranked the ANS on the basis of: likelihood of becoming established in a new basin; potential for successfully undergoing interbasin transfer; and potential for adversely impacting environmental, economic, and social resources and services (USACE 2014b). For Focus Area II (Pathways outside the CAWS), the risk assessment focused on the question of whether or not a viable aquatic pathway exists, rather than the probability that an ANS will colonize in or spread through the receiving waterway or basin (USACE 2013).

Active Prevention

The USACE applies three different types of fish deterrent measures throughout the CAWS. Each is designed to block a distinct pathway of Asian carp toward the Great Lakes.

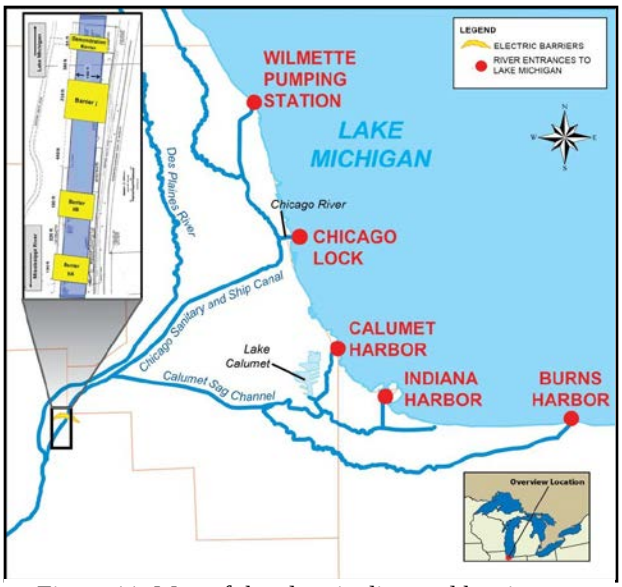

Figure 11. Map of the electric dispersal barrier system and the CAWS.

- The Electrical Dispersal Barrier System, on the CSSC in Romeoville, IL, was designed to prevent movement of fish between the Mississippi River and the Great Lakes drainage basins via the CSSC. The system currently consists of three barriers (Demonstration, IIA, and IIB) that create a waterborne, pulsed, direct current, electric field in the canal, which subjects fish penetrating the electric field to electrical stimuli that act as a deterrent. A map depicting the barrier is found in Figure 11.

- The Des Plaines River Bypass Barrier is a 13-mile long combination of fence material and jersey barrier that physically blocks known bypasses around the electric barriers which occur during periods of flooding from the Des Plaines River and the Illinois and Michigan (I&M) Canal, thereby halting possible fish movement through this area. The barriers placed at these locations are intended to stop juvenile and adult Asian carp.

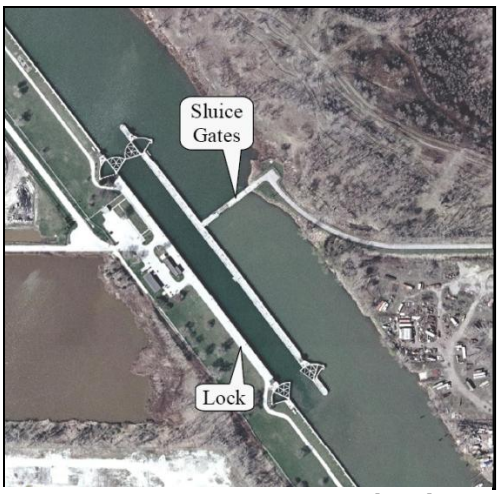

Figure 12. T.J. O'Brien Lock and Dam

- Bar screens on sluice gates at Thomas J. O'Brien Lock and Dam were installed to impede entry of Asian carp to Lake Michigan. See Figure 12.

Minnesota also has exerted vigorous efforts to prevent spread of Asian carp within its borders, including the following:

- **St. Anthony Falls** – The Minnesota DNR indicated that the best way to keep Asian carp out of the upper Mississippi River watershed was to close the Upper St. Anthony Falls Lock, which is administered by the USACE. This required an act of Congress. Lock closure provisions were included in WRRDA. The lock must be closed not later than one year after enactment of WRRDA, which was June 10, 2014. To date, the USACE is developing a Federal Register notice regarding the closure of the Upper St. Anthony Falls Lock and Dam seeking public comment.

The USACE will then evaluate these comments and determine the next steps necessary to meet the legislative intent of section 2010 of WRRDA.

- **Coon Rapids Dam** (Legislative Appropriation) – In 2011, the Minnesota Legislature approved $16 million to fund improvements to the Coon Rapids Dam, which included features to render it a more effective barrier to upstream movement of invasive carp. Nine steel, hydraulically operated crest gates are being installed to replace inflatable gates in order to maintain enough head to prevent carp from passing. Completion of the project is anticipated in December 2014.
- **Lock and Dam 1** – At the beginning of 2013, the Minnesota DNR explored alternative barrier technologies to prevent upstream movement of Asian carp, because at that time, it was not clear whether Congress would enact legislation to close St. Anthony Falls Lock.
- **Barrier for Lock and Dam** 1 – In May 2013, the Minnesota DNR contracted with Smith-Root, an electrical barrier engineering firm, to design a barrier utilizing new technology for Lock and Dam 1. This technology, referred to as "sweeping" electrical, uses electricity to move fish away from the lock chamber. However, the barrier will not be built due to closure of Upper St. Anthony Falls Lock.
- **Southwest Minnesota Barriers** – In fiscal year 2013, the Minnesota DNR received funding from the Outdoor Heritage Fund (State of Minnesota) to place additional barriers in southwest Minnesota. The area fisheries office identified seven sites for new projects to prevent spread of Asian carp into high-value lakes or between watersheds. With populations of Asian carp already present lower in the watershed, these projects were deemed high priority.

Research

(This section contains additional basin-specific research activities not included in Section 4.0: Research and Technologies Potentially Useful for Controlling Spread of Asian Carp)

In Minnesota, the majority of research on Asian carp prevention has involved collaboration with the Minnesota Aquatic Invasive Species Research Center (MAISRC), which is housed at the University of Minnesota – Twin Cities. The Minnesota DNR began a fish telemetry study during spring 2013 to understand fish movement around locks and dams and in the Mississippi River Basin. The USFWS connected with the receiver system in Missouri to help monitor carp movements throughout the river.

The University of Minnesota is pursuing a number of research initiatives, including:

- Implementing eDNA as a molecular technique to assess potential presence of Asian carp in large Minnesota rivers
- Evaluating the potential to detect and locate Asian carp through the use of other fish to locate aggregating invasive fish so they might be tracked and removed
- Developing food attractants (new biochemical technique) and other tools specific for Silver Carp to induce high-density aggregation for the purposes of fish control and removal

- Assessment of effectiveness of enhanced bubble curtains as deterrents of Asian carp movement into small tributaries
- Installation of sound deterrents to Asian carp in the Mississippi River
- Monitoring of abundance and distribution of AIS using new molecular tools to guide implementation of control and response actions
- Assessment of the potential use of native pathogens invasive carp control agents
- Conducting risk analyses to identify Asian carp control priorities and methods

In addition, the University of Minnesota received funding to collaborate with USACE in development of ways (including applications of new technologies) to modify operations of Lock and Dam numbers 2 through 8 to optimize their ability to impede Bighead and Silver Carp movement into the St. Croix and Mississippi Rivers within Minnesota. Specific activities include:

- Immediate development and implementation of a deterrent strategy for Lock and Dam 8
- Testing and development of new acoustical deterrent systems for locks that deter Asian carp and minimally affect native fishes
- Development of solutions to address weaknesses in Lock and Dam 2, and to optimize gate operations at Lock and Dam 2 through 8

3.2 Ohio River Basin

Similar to the UMRB, state, federal, and non-governmental partners in the ORB carried out a broad array of both individual short-term projects focused on Asian carp prevention in their respective waters; and long-term, comprehensive collaborative planning to develop a multijurisdictional prevention strategy for addressing the threat within the basin. Specifically, the Ohio River Basin Asian Carp Control Strategy Framework was developed by the Ohio River Fishery Management Team (ORFMT) states who share jurisdiction and management of the mainstem Ohio River. The ORFMT collaborates with representatives from all ORB states and federal and non-governmental entities to implement the Framework. In addition to this comprehensive long-term planning process, three of the ORFMT state agencies and the USFWS were regularly engaged in monitoring and assessment activities within the basin. These assessment activities were designed to determine the potential leading edge of Asian carp populations and better understand potential habitat use, seasonal movements, and interaction with native species. Furthermore, “active” prevention tactics including targeted contractual fishing, primarily funded by Colcom of Pennsylvania (a non-government foundation) and

Federal/State Agencies Involved in the ORB

USFWS
USGS
USACE
USCG
U.S. Department of Transportation – Maritime Administration
USEPA
USDA – Natural Resources Conservation Service (NRCS)
Kentucky
Illinois
Indiana
New York
North Carolina
Ohio
Pennsylvania
West Virginia
Tennessee

Kentucky were accomplished. This section provides a summary of the many state, federal, and non-governmental partners activities conducted for Asian carp prevention in the ORB between June 2012 and June 2014.

3.2.1 Basin-wide Planning

Ohio River Basin Asian Carp Control Strategy Framework

The *Ohio River Asian Carp Control Strategy Framework* was prepared by the ORFMT with assistance from MICRA. Seven states (Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, and West Virginia) work collaboratively to manage fishery resources in the mainstem Ohio River through the ORFMT. These states recognized the need for long-term, coordinated efforts throughout the basin, and formed the ORFMT to develop a unified strategic vision, plan strategies, and make decisions. Building from the National Plan, the Great Lake's Regional Framework, and other regional strategies, the ORFMT developed the Ohio River Basin Asian Carp Control Strategy Framework that identifies timely actions by state and federal agencies necessary to prevent continued spread, reduce abundance of established populations, and minimize impacts of Asian carp populations in the ORB.

The Ohio River Basin Asian Carp Control Strategy Framework, developed by the ORFMT, includes specific recommendations for early detection, rapid response, prevention and deterrence, population control, and communication and coordination to achieve long-term success. The goals of this framework and other regional efforts will be most effective if implementation of priority actions are coordinated and strategically implemented jointly as part of a single national strategy and if funding can be procured to accomplish the tasks outlined in each goal. Specific ORFMT recommendations identified in the framework for early detection, rapid response, prevention and deterrence, population control, and communication and coordination are presented below:

Early Detection - Early detection of newly introduced Asian carp or recent expansion of Asian carp population is necessary to determine if a response effort can be effectively implemented to prevent establishment and continued spread in the ORB. Intensive, targeted surveillance efforts focused on high-priority locations are needed (e.g., open waters at greatest risk from continued dispersal of Asian carp) to detect incipient populations and provide the greatest opportunity to evaluate and implement reasonable and effective response measures. Traditional gears have been largely ineffective in detecting low abundances of Asian carp, and surveillance efforts may be enhanced or informed via use of molecular tools (e.g. eDNA) or other emerging technologies. The ORFMT recommended:

- Standardized, targeted Asian carp sampling in priority areas
- Contracting of commercial fishers to enhance early detection capabilities
- Reports of sightings of Asian carp at locations where not established
- Use of eDNA testing to guide early detection efforts
- Research to improve capabilities to detect early stages of invasion and spawning populations

Rapid Response - Following detection of an incipient population of Asian carp, a rapid response action could prevent establishment and continued spread of the population. A rapid response action could range from an immediate survey to better understand the threat of the identified population to an

attempted eradication. Appropriate rapid response actions must be considered on a case-by-case basis. An Incident Command System (ICS)-based rapid response plan will be necessary for use of federal funds to support a response. The ORFMT recommends development of an ICS-based rapid response plan for the ORB.

Prevention and Deterrence - Active measures are needed to prevent dispersal of Asian carp throughout the ORB and via human-mediated spread. Barrier and deterrent technologies could restrict or slow dispersal of Asian carp; however, considerable research is needed. Consideration must be given to the risks and cost/benefits to determine when actions are warranted. The ORFMT recommended:

- Assessment of risk from human-mediated pathways for movement and introduction of Asian carp, and development of strategies to address high risk pathways
- Coordination of regulations and enforcement that prohibit sale, transport, possession, production, and use of live Bighead, Silver, and Black Carp
- Development of coordinated outreach messages and tools to educate and engage the public to prevent spread of Asian carp
- Evaluation, and if feasible, installation of deterrent barriers at strategic locations to limit further dispersal of Asian carp in the ORB
- Investigation of operational changes at locks and dams to deter passage of Asian carp

Population Control - Reducing abundance of established populations of Asian carp is necessary to slow their spread and minimize their impacts. Current research funded through the GLRI may lead to development of additional tools for population control; however increased harvest is currently the only potential method of substantially reducing Asian carp populations over the near term. Harvest programs should be implemented in the upper basin to prevent establishment of reproducing populations. Increased commercial harvest in the lower Ohio River should be implemented to reduce numbers of Asian carp moving upriver and dispersing throughout the basin. Commercial harvest of Asian carp has been occurring in the MRB and ORB for several years and is increasing steadily each year in both basins (Appendix 2). Additional reduction in abundances of established Asian carp is necessary to minimize their undesirable impacts. The ORFMT recommended:

- Encouragement of increased commercial harvest and implementation of contract fishing for Asian carp
- Removal of regulatory barriers and use of information programs to encourage and promote increased recreational harvest of Asian carps
- Support for and acceleration of research on behavioral and long-term control methods
- Development of models to inform and evaluate Asian carp population control efforts
- Documentation of ecological, recreational, and economic impacts of Asian carp

Coordination and Communication - Funding and implementation of this Action Plan is necessary for a coordinated and strategic approach to prevent spread and minimize impacts of Asian carp throughout the ORB. Effective communication among agencies and provision of information to the general public,

commercial and recreational users of the ORB, media, legislators, and local officials will be critical for success. Implementation of the Ohio River Framework is also important to the Great Lakes Framework for preventing dispersal of Asian carp into areas that are potential pathways to the Great Lakes. To achieve goals of this framework and success in other regional efforts, priority actions must be coordinated and strategically implemented as part of a single national strategy. The ORFMT recommended:

- Development of communication and coordination among ORFMT members
- Coordination with national and other regional efforts to prevent introductions and control populations of Asian carp
- Development of information regarding prevention and control of Asian carp in the ORB

3.2.2 ORB Agency Activities

The following is a summary of activities conducted by federal and state agencies to control Asian carp in the ORB.

USFWS

In the ORB, the USFWS conducted monitoring activities for Asian carp including eDNA sampling, telemetry, hydroacoustics work, monitoring with traditional gears, and response actions. To determine the potential presence of Asian carp at the invasion front in the ORB, 200 eDNA samples were collected and analyzed for Bighead Carp and Silver Carp eDNA in 2013. Results yielded two positive detections in the Ohio River mainstem, over 60 river miles upstream of where individual Asian carp have been captured. In 2014, eDNA monitoring will include the collection of 935 samples from several pools and tributaries of the Ohio River. Working with state and federal partners, the USFWS has partially funded and, with state agencies' efforts, have assisted in deploying a stationary telemetry receiver network in the ORB. This receiver network is located in the upper portions of the basin near the invasion front at Willow Island, Belleville, Racine, R. C. Byrd, Greenup, Mehldahl, and Markland Pools. This telemetry project will help managers to monitor the rate of spread and rates of passage through dams on the ORB. Additionally, the USFWS has conducted preliminary hydroacoustic assessments in the ORB to locate potential optimal sites for targeted efforts to sample and remove Asian carp. Future work will focus on field sampling for the collection of eggs and larvae to establish Asian carp spawning and recruitment locations within the ORB and microchemistry analysis on Asian carp otoliths to determine the likely origin of individual populations.

The USFWS has regularly been engaged in coordinating and communicating Asian carp management activities within the resource agency partnerships in the ORB. A group of interested federal and state agencies meets regularly to coordinate and carry out the field activities listed above. In addition, the USFWS, in conjunction with the MICRA, has initiated the development of a partnership that will draft a comprehensive management plan (building off of existing efforts) and work to coordinate all aspects of Asian carp control and management in the ORB in the future.

3.2.3 ORB Accomplishments by Activity

Interagency Coordination

Most agencies have been actively involved in development of the Ohio River Basin Asian Carp Control Strategy Framework, through the ORFMT. In addition, many federal and state agencies have participated in the ACRCC and GLMRIS Executive Steering Committee. Most agencies also participated in the MICRA evaluation of the Grass Carp regulation program.

Field Monitoring and Early Detection

The ORB states have been active in efforts to detect and monitor expansion of Asian carp in the ORB. These efforts include:

- Telemetry, eDNA, and electrofishing
- Traditional fisheries monitoring programs
- Targeted sampling
- Contracted commercial fishing
- Monitoring of commercial catch
- Reported sightings
- Age and growth assessments

In addition, the Indiana DNR through Purdue University evaluated Asian carp movements and spawning in the upper Wabash (primarily from Lafayette and upstream). The Indiana DNR now has 300 tagged Asian carp at large for the telemetry work. Also, a number of federal and state agencies developed the cooperative Asian carp telemetry project on the upper Ohio River. Ohio, Kentucky, and West Virginia are working together to assist the USFWS in implementing the telemetry study as part of Ohio River Asian Carp Monitoring and Assessment. The Kentucky Department of Fish and Wildlife Resources (KDFWR) is also partnering with the USFWS and Murray State University in hydroacoustics work on Kentucky Lake to assess Asian carp abundance.

The Ohio DNR and the Kentucky DFWR conducted electrofishing surveys and coordinated contract net-fishing efforts targeting Asian carp in the Markland and Meldahl pools following reported captures of Silver Carp by the Ohio River Valley Water Sanitation Commission (ORSANCO) in June 2012. The Ohio DNR also assisted The Nature Conservancy with eDNA water sample collection in a project funded by the Muskingum Watershed Conservancy District to conduct Asian carp surveillance. A finding of positive eDNA results in samples collected in the Muskingum River during October 2013 resulted in a planned sampling response following release of this information in April 2014. During June-July 2014, an additional 110 eDNA samples were collected by the USFWS, and electrofishing crews from the Ohio DNR and the USFWS sampled 126 sites. The Pennsylvania Fish and Boat Commission (PFBC), with the USFWS, collected and analyzed water samples from the upper Ohio River and several tributaries for analysis for Asian carp eDNA. The WV DNR also coordinated with the USFWS on eDNA monitoring, including sampling in the Kanawha and Little Kanawha Rivers in 2014.

Risk Assessment

As part of the GLMRIS, the USACE conducted a risk assessment to identify potential risk from current and future AIS (including Asian carp) establishment and associated adverse impacts. Results of the risk assessment were used in identification and evaluation of potential control measures for reducing, to the maximum extent possible, risk of interbasin AIS transfer via surface water connections between the basins.

Active Prevention

Eagle Marsh is an NRCS Wetland Reserve Program (WRP) wetland site near Fort Wayne, Indiana owned jointly by Little Rivers Wetland Project and the Indiana Department of Natural Resources. The owners have been actively maintaining a temporary fence constructed in the marsh, as well as the Graham-McCulloch berm as the only barriers in place to prevent movement of Asian carp from the Wabash watershed into the Maumee watershed during flooding conditions. Through ongoing efforts at Eagle Marsh, the USDA-NRCS has worked with the USACE and other federal, state, and local agencies to identify options for designing a berm to permanently restrict Asian carp entry into the Great Lakes via the Eagle Marsh. The NRCS holds a WRP easement on the site. To implement the closure, WRP funding will cover costs within the area of the easement, and GLRI funding will be expended to tie the berm in at the ends of the project, off the WRP property.

The Eagle Marsh project will create an earthen berm across the floodway to prevent mixing of the watersheds at the 100-year flood level. It will be built in two phases to quickly maximize prevention of interbasin spread of AIS while also preventing potential induced flood damages to properties currently in and adjacent to the floodplain between the basins. The first phase will be completed by September 2015, and it will consist of the entire berm, with the exception of a small notch (200'-300' long), which will be built to the approximate 50-year flood elevation. A mesh screen will be installed along the length of the notch up to the top of the berm at both ends to prevent alteration of the flood crests, with a screen opening that will block AIS at elevations that exceed the 100 year, 1% chance flood event. The second phase will remove the screen and fill in the notch but cannot be completed until all flood risk in the area has been mitigated.

The Ohio DNR is addressing four additional aquatic pathways between the Ohio River and Lake Erie watersheds identified in the GLMRIS report Focus Area 2: Aquatic Pathways Assessment Summary Report. Action has been taken on all four pathways identified in Ohio:

- Grand Lake St. Marys
- Little Killbuck Creek
- Mosquito Creek Lake
- Ohio-Erie Canal at Long Lake

In addition, the Colcom Foundation provided grant funding to address Asian carp in the Ohio River. The ORFMT used the funds to hire contract commercial fishermen to attack the Asian carp leading edge in Kentucky (Ohio River Meldahl Pool and Greenup Pool). The KDFWR has also initiated removal efforts and promoted commercial fishing to reduce Asian carp populations in the lower Ohio,

Tennessee, and Cumberland Rivers, as well as in Kentucky and Barkley Lake. KDFWR has also attempted to bridge the pay gap between commercial fishermen and processors. By January 2015, Kentucky will have three major fish processing companies established with ultimate goals of removing up to 150 tons of Asian carp from the Mississippi River basin on a daily basis. Commercial fishing efforts are mostly centered in and below Kentucky and Barkley lakes due to the location of the domestic market and processing facilities. Commercial fishing efforts currently remove approximately 40 tons of Asian carp weekly. Some smaller Kentucky processors are also exploring domestic markets for Asian carp filets and patties.

4.0 Research and Technologies Potentially Useful for Controlling Spread of Asian Carp

A growing number of technologies are under development or have been proposed for use in controlling or preventing spread of Asian carp in waters of the U.S. While the immediate focus of many of these activities has been on the challenge of managing Asian carp populations in the IWW and the CAWS, many tools that prove successful have promise for use in other waterways (including the ORB and UMRB) threatened by AIS. The USGS is the primary federal agency spearheading research and development of new and emerging prevention technologies in the U.S., working closely with the USFWS, USACE, and USEPA. In this regard, the USGS focuses on development of new management and control tools, strategies, and science for preventing spread of Asian carp and, where possible, reducing current populations. Other sections of this Report describe additional research by the USACE and the USFWS, other state and federal agencies, and academic and non-governmental partners. Each new, fully developed technology hopefully will be a significant tool when deployed according to prevention strategies and work plans. As technologies are explored and utilized, new knowledge gained via use of these will be incorporated into management strategies, and will be applied to development of newer, even more effective tools.

This section presents a summary of recently completed or ongoing research efforts and technology developments focused on Asian carp prevention. A detailed summary of research efforts focused on prevention and control of Asian carp can be found in Appendix 1.

4.1 Risk Assessment and Life History

Science-based predictive models and risk-assessments are critical for managers and scientists to identify locations at highest risk for invasion, exploitation, or colonization by Asian carp species. These models consider species life history and incorporate biological, hydraulic, and other data to assess probability of successful Asian carp invasion and reproduction within specified lakes and rivers. Understanding and quantifying the likelihood that an area is at risk of invasion is critical to informing and focusing key monitoring and prevention actions, thereby making more effective use of limited resources. The following risk assessment and life history research projects have been undertaken:

- Assessment of the life history traits, reproductive behavior, habitat use, and predatory exploitation of Asian carp in established and emerging populations to identify opportunities for control
- Assessment of Great Lakes tributaries for Asian carp habitat suitability/Development of tributary assessment tool
- Evaluation of the effects of water hardness on hatching success of Asian carp
- Evaluation of the relationship between Asian carp and bluegreen algae as a factor for predicting risk of invasion
- Assessment of the Illinois River and other rivers for hydraulic and water-quality influences on Asian carp movement, spawning, and recruitment lakes

- Development of risk assessment for Asian carp establishment in the Great Lakes as a function of food availability

4.2 Early Detection and Monitoring

State-of-the-art techniques for effectively sampling large river and lake systems are fundamental for early detection of Asian carp species. Utilization of traditional gears has recently been augmented by use of eDNA, an early detection monitoring technique that detects genetic material from a specific species to indicate possible presence of that species in the water body. The method involves collecting water samples from a waterbody and analyzing for presence of genetic material, using known genetic markers for a specific species. Management agencies and researchers nationally and internationally within various programs have adopted eDNA as tool for early detections of a variety of species. This technique of early detection allows effective implementation of subsequent, rapid-response strategies to prevent Asian carp range expansion or introduction into new waters. The following early detection and monitoring research projects have been undertaken:

- Completion of Calibration Study (ECALS): Asian Carp eDNA calibration and sampling efficiency studies
- Development of Asian Carp eDNA probabilistic model
- Development of Asian carp eDNA genetic species markers
- Correlation of Asian carp eDNA or microbial tracking with telemetry data in the Wabash River
- Use of acoustic video and side-scan technology to determine behavior and net avoidance ability of Asian carp
- Evaluation of the Chicago Area Waterways System monitoring network
- Evaluation of the potential for interbasin invasive species movement by way of groundwater pathway near Lemont, Illinois
- Hydrologic data support for the prevention of the interbasin transfer of Asian carp at an intermittent connection of the Ohio River
- Use of augmented real-time detection of Bighead carp at selected Wabash River and tributary sites
- Investigation of the status of Grass Carp in the Sandusky River in Ohio

4.3 Integrated Pest Management Strategies and Controls

Integrated Pest Management (IPM) strategies are designed to use the most current and comprehensive scientific information available on life cycles of Asian carp and their interaction with the environment. IPM is a holistic, tiered strategy that incorporates multiple overlapping management actions to address all aspects of a species' ecology and behavior (particularly those aspects rendering the species most vulnerable to control), and the species' possible introductory and transmission vectors. The IPM

strategies specific to Asian carp utilize multiple layers of prevention-based actions, incorporating surveillance/early detection, containment, and control tools to exploit opportunities for Asian carp population management based on feeding and reproductive ecology, movement, and other known traits. The following IPM strategies and controls research projects have been undertaken:

- Evaluation of an IPM approach to Bighead and Silver Carp control
- Communication and demonstration of new technologies for controlling and monitoring Asian carp

4.4 Dispersal/Control Barrier Technology

Sound pressure wave technology has proven successful in altering Asian carp swimming behavior via creation of hydroacoustic barriers to movement, with potential to contain, repel, or direct individual or schools of fish. Additionally, investigators have found evidence that introducing concentrated levels of carbon dioxide into contained aquatic environments can create biological barriers to fish movement, and can possibly protect specific locations from introductions. These new technologies are designed for field deployment and mobility, to the extent practicable. The following dispersal/barrier technology research projects have been undertaken:

- Use of seismic technology control Asian carp movements
- Field testing of carbon dioxide barrier to deter Asian carp

4.5 Feeding-Based Control Technology

Asian carp have been shown to be strongly attracted to certain mixtures of algae, providing opportunities for exploiting feeding behavior for control purposes. Algal attractants can be used to congregate fish at specific locations; and targeted, species-specific piscicides (fish poison) can then be introduced in formulations lethal only to Asian carp, or containing other chemical or biological control agents. Additionally, feeding behavior can be used to congregate fish for physical removal by netting or other means. The following feeding ecology-based control technology research projects have been undertaken:

- Field evaluation of chemical attractants to control Asian carp/development of protocols for field verification of response
- Development of targeted microparticle and piscicide control systems for Asian carp
- Development of targeted control systems for Asian carp based on species-specific digestive system characteristics
- Identification of potential compounds for inclusion in a toxicant screening program for control of Asian carp
- Use of real-time dye tracking to ensuring environmentally responsible application of piscicides in rivers used for control of Asian carp

5.0 Metrics and Methodologies for Evaluating Success of Actions to Control Spread of Asian Carp

5.1 Measures to Document Progress in Controlling Spread of Asian Carp

This section of the Report, as required by WRRDA, directs the USFWS to identify measures for documenting collective progress in controlling spread of Asian carp in the Ohio and upper Mississippi River basins. Identified below are proposed measures and outcomes for ensuring progress toward the goals of controlling spread of Asian carp in the UMRB and ORB and tributaries.

Critical in the short term are the continuation and expansion of current efforts to ensure multiagency coordination and collaboration to achieve common prevention-based goals. Short-term priorities that address the need for interagency coordination include:

- Development of respective UMRB and ORB Asian carp control strategies. These strategies would include, in part, a subset of the National Plan and would address the ORB and UMRB and tributaries, to include the following:
    - Identification of federal and state resources potentially available for implementing control actions
    - Development of ORB/UMRB formal institutional arrangements, using a collaborative model similar to the ACRCC, to facilitate interagency coordination, collaboration, and plan implementation
    - Development of an agreement (memorandum of understanding or operation principles) to identify roles and responsibilities of all participating agencies
    - Development of an annual project plan with management structure and appropriate funding
    - Development of a process to ensure actions are strategically prioritized and properly sequenced
    - Preparation of an annual report measuring success and identifying the strategy for moving forward, including identification of costs for future actions

The USFWS will provide leadership in coordinating this effort on behalf of the federal agencies (as prescribed in WRRDA) with assistance from other state and federal agencies, non-governmental organizations, and local entities.

Additional critical measures are to continue current monitoring and assessment efforts, and to expand current research and development of control options. Currently, the necessary tools to control spread of Asian carp are not available, and continued research and follow-up implementation of controls will be essential to success. Moreover, addressing each of the four species of Asian carp requires varied assessment, research and control measures. Each measure must be evaluated based on the life history and current location of each species.

5.2 Quantitative Measure of Progress

WRRDA directs USFWS to identify measures for documenting collective progress in controlling spread of Asian carp in the Ohio and upper Mississippi Rivers. Specifically, WRRDA calls for identification of:

> *"…any quantitative measures that the Director intends to use to document progress in controlling the spread of Asian carp;"*

Quantitative measures recommended for potential use by the Director include:

- Changes in movement in the current verified adult Asian carp population front in both the Ohio and Mississippi River basins and tributaries
- Changes in numbers or range of current verified spawning areas in the rivers and tributaries
- Changes in eDNA positive findings within areas upstream of the known adult population front
- Miles of streams excluded or protected from Asian carp movement;
- Number of stream miles assessed for presence of Asian carp
- Number of agencies with Asian carp response plans in place
- Number of control technologies proven to control or eradicate Asian carp that are ready for in-the-field use
- Number of agencies with model regulations or ordinances focused on Asian carp prevention in place

Information necessary to use these measures may not be currently available for all areas of the Ohio and Mississippi River basins. Moreover, the level of information available also varies by species of Asian carp.

5.3 Qualitative Measures of Progress

In addition to quantitative measures of progress, a number of qualitative measures will be strong indicators of progress in efforts to control Asian carp. The additional long-term qualitative measures that will be needed to successfully control Asian carp are:

Monitoring and Assessment of Asian Carp – Establishment of a long-term, comprehensive, cooperative monitoring and assessment program within each basin is critical. This would include federal, state, and local stakeholders dedicated to monitoring and assessing potential expansion of the current range of each species, at each life stage. Actions that document progress are as follows:

- Identification of areas where each of the four species of Asian carp is established;
- Development of current range and establishment maps of all four species including observed spawning, verified eggs, verified larvae, and adults;
- Identification of tributaries with one or more Asian carp species present;
- Identification of the number of Asian carp captured by pool in the Ohio and Mississippi River basins;
- Identification of areas where use of eDNA has yielded positive results, including identification of changes in number and locations of positive results;

- Identification of areas of concern regarding sportfish and other unique species (sturgeon, paddlefish, and mussels).

Preventing the introduction and movement of Asian carp via identified pathways– Establishment of strategies to manage pathways for accidental or deliberate unauthorized introductions of Asian carp is necessary. Actions that document progress include:

- Evaluation of all potential vectors within the basins to determine relative risk of introduction, via each pathway, of each Asian carp species;
- Identification of connections to lakes or backwaters that could be closed completely or screened to stop dispersal;
- Implementing necessary prevention and control measures in pathways identified in the GLMRIS to ensure no movement of Asian carp between the Mississippi River and the Great Lakes.

Rapid Response Planning – Rapid response plans available to prevent range expansions and eradicate new introductions in both basins are necessary. Actions that document progress include:

- Establishment of rapid response plans for both the UMRB and ORB, including all federal and state agencies;
- Availability of effective rapid response plans to prevent range expansions and eradicate new introductions in both basins;
- Development of a mutual aid agreement to ensure availability of resources.

Collaborative Research – Currently, the necessary tools are not available to ensure control of Asian carp. Collaborative efforts to conduct research that will yield accurate and scientifically valid information are necessary for effective management and control of Asian Carp in the U.S. Some research efforts are under way to evaluate and develop new tools. Continuation of current research efforts and research into new tools and control methods are critical for developing and assisting implementation of control technologies and/or assessment of methods for population reduction. Actions that document progress include:

- Continued development and registration of potential control technologies such as seismic technology, carbon dioxide, the GLMRIS lock, electricity in a controlled channel, chemical attractants, biological controls, pheromones, and Asian carp specific piscicides;
- Development of sterile and transgenic Asian carps for release to reduce the size of a target population;
- Development of real-time eDNA detection kits for use in the field (to augment current laboratory-based analysis which can take several weeks for analysis);
- Acquisition of fundamental understanding of Asian carp biology and life history, and of potential for habitat or hydrologic modification to control or to facilitate harvest of Asian carp;
- Concurrent developments of effective sampling gears and physical, chemical, or biological controls to reliably determine the relative abundance of Asian carp species and potential for population reductions or eradications;

- Identification and evaluation of economically and ecologically safe alternatives to Asian carp;
- Development of ways to ensure that any future use of Asian carp is low risk (i.e., low likelihood of escape and low consequence of escape).

Develop strategies to minimize adverse effects – A key component of an overall strategy to control Asian carp is the establishment of collaborative strategies to eradicate or minimize potential adverse effects. Identifying interim solutions can play a key role in minimizing impacts of Asian carp within some areas. Actions that document progress include:

- Development of a strategy to encourage and expand harvest of Asian carp, including:
  - Enhancement of commercial harvest focused on removal and not sustainable harvest through education, market research, gear development, and possibly financial incentives;
  - Increased recreational harvest, without creating an expectation of a permanent fishery;
  - Increased physical removal by natural resources management agencies.
- Development of strategies for restoring and maintaining populations of key or threatened species that could be affected;
- Identification of mitigative actions that enhance native populations and their habitats;
- Identification of locks and dams that could impede range expansion;
- Identification of approach channels and other structural areas that could exclude Asian carp;
- Evaluation of lock structures to identify control technologies that could be used to deter fish passage;
- Identification of target locations where control technologies (i.e., electricity, sound, water guns, food attractants, etc.) could be employed to impede range expansion;
- Verification and quantitation of ecological and economic effects of past and potential introductions of Asian carp to convince managers, stakeholders, and the general public of the importance of preventing further introductions.

Information and Education – Information and education is essential to long-term success in controlling Asian carp. A critical measure of success is establishing strategies to provide information to the public, commercial entities, and government agencies in order to improve effective management and control of Asian carp in the ORB and the UMRB. For greatest effectiveness, each component of an information/educational program should be developed via a stakeholder participatory process, and subsequently monitored, evaluated, and adaptively managed. Actions that document progress include:

- Developing a strategy to identify specific needs and audiences to receive information and education efforts;
- Identifying a process to develop a collaborative, inclusive, information/education effort;
- Identifying the most effective approaches to reach and inform all affected groups;
- Developing a system to validate credibility of materials;

- Developing partnerships and leaders for planning, implementing, and evaluating education initiatives;
- Identifying gaps in knowledge or needs that can be addressed via applied or adaptive research.

Effective Regulations and Laws – A long-term strategy must include development of an effective system of compatible laws and regulation, both at federal and state levels. Adequate and successful regulations/laws must be in place within each sub-basin that focus on Asian carp prevention. Actions that document progress include:

- Development of a process to evaluate effectiveness of existing state and federal regulations/laws at achieving on Asian carp/AIS prevention goals, building upon AFWA efforts
- Development of model regulations/laws to address gaps in existing authorities focused on Asian carp/AIS prevention

Ensuring Sufficient Resources Available – Successful implementation of any strategy requires availability of adequate resources. Sufficient financial resources must be available to federal, state, and local agencies to address the long-term issue of controlling/reducing risk from Asian carp in both basins. Actions that document progress include:

- Development of a strategy to ensure critical elements of the Asian carp control effort are identified and supported with adequate resources
- Identification and evaluation of existing resources available for control efforts, and prioritization of those resources
- Identification of alternative resources that may be available for collaborative control efforts at both federal and state levels

6.0 Cross-cut Summary of Federal and non-Federal Expenditures to Control Spread of Asian Carp in the Upper Mississippi and Ohio River Basins: June 2012 to June 2014

For the purposes of this Report, a summary was compiled of all expenditures incurred by state and federal agencies on actions conducted to prevent the spread of Asian carp in the UMRB and ORB from June 2012 to June 2014.

The expenditures included in this summary represent activities supported through both state and federal appropriations. Agencies were queried, with the request that they include all expenditures related to the following activities: research focused on development of new tools/techniques for Asian carp prevention, "active" prevention (e.g. implementation or assessment of dispersal barriers, targeted commercial fishing, etc.), interagency coordination, monitoring and early detection for Asian carp, rapid response and risk assessment exercises, law enforcement/regulatory actions focused on Asian carp prevention, and outreach with industry or the public/stakeholder participation focused on Asian carp prevention.

Primary sources of federal agency contributions included both agency base budgets and GLRI funding. The majority of these expenditures were directly related to work focused on Asian carp prevention efforts in the CAWS. Within the UMRB, the State of Minnesota led all agencies in total expenditures related to Asian carp prevention.

Development of the expenditure summary was complicated by the various fiscal reporting timeframes used by state and federal agencies, and by the reporting timeframe being used for the initial Report (June to June). Future versions of the Report will use a reporting timeframe based on calendar year or full fiscal year cycle to allow for more efficient and accurate reporting.

Table 1. UMRB and ORB Expenditures June 2012 to June 2014

Agency	Total Agency GLRI[1]	Total Agency Base	Total Reported Expenditures[2]	Total UMRB/ORB Expenditures (Except CAWS)
USEPA	$1,302,895	< $10,000	$1,302,895	$0
USACE	$11,131,431	$40,092,129	$51,223,560	$0
USDA	< $10,000	$37,000	$37,000	$37,000
USGS	$6,025,058	$5,193,799	$11,218,857	$0
NOAA	< $10,000	< $10,000	$97,509	$0
USFWS	$4,467,706	$2,721,280	$7,188,986	$1,484,950
USCG	$1,332,740	$244,987	$1,577,727	$0
NPS	< $10,000	$63,500	$63,500	$63,500
CEQ	$688,000	NA	$688,000	$0
Indiana	$525,000	< $10,000	$525,000	$525,000
Iowa	< $10,000	$151,320	$151,320	$151,320
Kentucky	< $10,000	$215,000	$365,000	$365,000
Illinois	$10,356,225	< $10,000	$10,356,225	$0
Minnesota	< $10,000	$169,999	$8,801,161	$8,886,162
Missouri	< $10,000	< $10,000	< $10,000	$0
New York	< $10,000	$18,650	$18,650	$18,650
Ohio	$503,220	< $10,000	$503,220	$503,220
Pennsylvania	< $10,000	$25,000	$175,000	$175,000
Tennessee	< $10,000	$14,000	$14,000	$14,000
West Virginia	< $10,000	$191,000	$191,000	$0
Wisconsin	< $10,000	< $10,000	< $10,000	$0
Total	**$36,332,275**	**$49,137,664**	**$94,498,610**	**$12,223,802**

* Agency expenditures under $10,000 were not reported or included for the purposes of this report.

1 GLRI funds are used exclusively for work within the Great Lakes Basin or to conduct mitigative actions within hydrologic connections between the Great Lakes and the UMRB and the ORB.

2 Total Report Expenditures includes any other outside funding sources reported.

7.0 Discussion and Recommendations

This 2014 Report conveys key information regarding multi-agency Asian carp prevention and control efforts throughout the UMB and ORB over the 2-year timeframe, and thus serves as a critical tool for planning, developing, and implementing future collaborative efforts across the basins. Data provided in each annual Report will facilitate implementation and, as needed, refinement of current national, regional (basin-wide), and state Asian carp management strategies. Success of these management strategies in achieving the goal of controlling Asian carp will rely heavily on strong overarching coordination; cultivation and maintenance of robust state, federal, Tribal, and non-governmental partnerships; identification and codification of common goals, management practices, funding strategies, and measures of performance for Asian carp prevention; and effective, expeditious sharing and application of emerging tools, science, and lessons-learned from throughout the nation in the battle against Asian carp.

Information gathered for development of this Report reveals the wide variety of actions by the many agencies and organizations addressing the threat of Asian carp across the landscape; and also illustrates many opportunities for realizing efficiencies through enhanced and ongoing communication, coordination, and collaboration.

Fortunately, mechanisms are in place within the UMRB and ORB watersheds to facilitate regular and ongoing coordination among federal and state agencies and non-governmental entities regarding resource management issues, including Asian carp prevention. Again, these include the following:

- UMRBA
    - State members include Illinois, Iowa, Minnesota, Missouri, and Wisconsin
    - Advisory members include USACE, U.S. Department of Agriculture (Natural Resources Conservation Service), U.S. Department of Homeland Security (USCG and Federal Emergency Management Agency), U.S. Department of the Interior (USFWS and USGS), U.S. Department of Transportation (Maritime Administration), and USEPA
- Upper Mississippi River Conservation Committee (UMRCC)
    - State members include Illinois, Iowa, Minnesota, Missouri, and Wisconsin
    - Advisory members include USACE, U.S. Department of the Interior (USFWS and USGS), and USEPA
- MICRA
    - Membership of which includes the respective Natural Resource Departments of the 28 States within the Mississippi River basin, with participation of USFWS and USGS
- ACRCC
    - See Page 18 (inset box) for agency membership
- AFWA
    - Membership of which includes all 50 States, with participation by federal resource management agencies

- ANSTF and its associated panels, particularly the Mississippi River Basin and Great Lakes panels
- Ohio River Fish Management Team (ORFMT)
    - Membership includes the Natural Resource Departments of 7 states located along the mainstem Ohio River

These partnerships provide a strong foundation for future collaborative efforts to address the threat of Asian carp in the UMB and ORB.

The USFWS will continue to provide leadership among the federal agencies in coordinating efforts to prevent the spread of Asian carp, with enhanced effort in the ORB and UMRB. In addition to leveraging the existing resource management partnerships, the model of the ACRCC will be adapted and potentially used for convening the breadth of state and federal agencies, and non-governmental partners addressing Asian carp within the two basins. Additionally, USFWS will seek to utilize the capacity of the Landscape Conservation Cooperatives (LCCs), as appropriate, to inform science-based decision making and strategies for the prevention and control of Asian carp and other aquatic invasive species in the ORB and UMRB. LCCs are comprised of federal, state, and local governments, along with Tribes and First Nations, non-governmental organizations, universities, and interested public and private organizations; and are focused on integrating science and management to address landscape/watershed scale issues. LCCs that are included, in part, within the ORB and/or the UMRB include the Upper Midwest and Great Lakes, Eastern Tallgrass Prairie and Big Rivers, and Appalachian.

Priority actions will focus on convening basin-specific partnerships to develop common strategies and objectives, and expand current efforts in order to ensure the highest level of coordination and collaboration moving forward. Additionally, coordination will include the identification of highest-priority tactics and activities across the various basins and partnerships working to address the Asian carp, for the purposes of focusing limited collective resources on key issues or needs. Coordination will include the establishment of regular and ongoing dialogue within and between partnerships to leverage resources and maximize efficiencies for Asian carp prevention.

Priorities that will be addressed through interagency coordination include the development of individual comprehensive Asian carp control strategies for the UMRB and the ORB (mainstem rivers and their tributaries). These strategies will be developed around a subset of highest-priority recommendations and actions from the National Plan, as well as existing or in-development state and basin-wide plans addressing Asian carp or AIS, in general. Specifically, the USFWS will lead efforts to complete the strategy titled *Action Plan for Management of Asian Carp in the Upper Mississippi River Basin*, which will provide critical guidance for implementing technical assistance, coordination, and field surveillance to assess and monitor the spread of these fish, and to share information learned from Asian carp control efforts in other areas.

Components of these basin-wide strategies include:

- Identification of federal and state resources potentially available for implementing control actions;

- Development of an ORB and a UMRB formal institutional arrangement, including a network similar to the ACRCC, to facilitate interagency coordination, collaboration, and plan implementation;
- Development of an agreement (memorandum of understanding or operation principles) to identify roles and responsibilities of all participating agencies;
- Development of an annual project plan with management structure and appropriate funding;
- Development of a process to ensure actions are strategically prioritized and properly sequenced, and;
- Preparation of an annual report measuring success and identifying the strategy for moving forward, including identification of costs for future actions.

Additionally, the USFWS and the USGS will lead interagency coordination to ensure that lessons-learned and technologies developed and successfully applied to Asian carp prevention and control in areas outside of the UMRB and ORB are effectively documented, communicated and incorporated into new basin-wide strategies, for implementation, as appropriate and with adequate resources. This includes the implementation of control and dispersal tools (e.g. water guns, acoustic barriers, carbon dioxide barriers, Asian carp specific microparticle piscicdes), risk assessment models, integrated pest management plans and rapid response strategies, and other new science which has a high probability of being successfully implemented within the UMRB and/or the ORB to prevent the expansion of Asian carp. The USFWS and USGS will maintain responsibility for ensuring coordination of the opportunities to the basin-wide partnerships for their consideration in appropriate strategies.

Building upon the recommendations of the Asian carp prevention strategies developed for the respective basins, the Service will work with its state and federal partners to identify and prioritize specific research and development needs, and identify associated costs and timelines for potential implementation. These efforts will build upon and leverage existing research and development activities currently being conducted by the USGS, USACE, USFWS and others focused on Asian carp prevention, containment, and eradication in the CAWS and adjacent areas.

Efforts to address the threat of Asian carp in the UMRB, ORB and other at-risk waterways will require the commitment of all resource users within the respective basins working collaboratively toward aggressive but achievable prevention goals. The scope of the challenge will require the fostering of increasingly comprehensive partnerships, including industry sectors and the public, to engage and leverage the broadest spectrum of public-private resources available. State and federal agency partnerships must engage with commercial transporters and shippers, municipal and industrial water users/conveyers, commercial fishers, aquaculture, and other resource users and stakeholders to explore all possible options for Asian carp prevention and control. Fortunately, a comprehensive network of resource management capacity and scientific expertise has evolved to address this issue, and will serve as a strong foundation for expanding these collective efforts. The framework provided in this Report will serve as dynamic guidance for implementing the goals set forth in WRRDA, and will be revised and updated to incorporate the most current developments, tactics and strategies in the battle against Asian carp.

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APPENDIX 1

SUMMARY OF RECENTLY COMPLETED OR ONGOING RESEARCH FOCUSED ON PREVENTION AND CONTROL OF ASIAN CARP

U.S. FISH & WILDLIFE SERVICE

APPENDIX 1:
SUMMARY OF RECENTLY COMPLETED OR ONGOING RESEARCH FOCUSED ON PREVENTION AND CONTROL OF ASIAN CARP

Since 2013, the U.S. Geological Survey (USGS) has been conducting research on Asian carp life-history characteristics to identify vulnerabilities in established and emerging Asian carp populations. These studies are designed to identify places and times when Asian carp would be vulnerable to targeted control efforts as part of an Integrated Pest Management (IPM) system. These efforts broadly fall into three primary categories: 1) identifying Asian carp recruitment constraints, 2) identifying habitat use and 3) identifying food selection.

Work to identify recruitment constraints has included the USGS leading and organizing a collaboration between USFWS, Iowa State University and the Minnesota DNR to collect ichthyoplankton samples from more than 20 locations stretching from the confluence of the Des Moines and Mississippi Rivers to La Crosse, WI. This network of sites will allow us to determine the approximate locations where Asian carp reproduction occurs in this emerging population, the environmental conditions that lead to successful spawning activity and whether or not spawning activities are likely to be an opportunity to target Asian carp with control measures. Other work on recruitment constraints has focused on determining whether natural predators and habitat availability might constrain larval and juvenile survival. Thus far this work has confirmed reproduction of Asian carp in the Mississippi River above Keokuk, Iowa, but also found that previously established methods for identifying Asian carp eggs and larvae are insufficient to establish identity (thus necessitating the use of genetic methods).

Deployment of IPM systems to reduce Asian carp abundance are unlikely to be successful in large ecosystems unless significant aggregations of Asian carp can be located. As a result, identifying the habitats used by Asian carp is essential to the success of IPM. Previous Asian carp telemetry work has been focused on movement of fish between pools using passive sensors at impoundments and in the navigation channel. Very little work has explored habitat use at a scale that would be meaningful for control efforts in these large systems. The USGS is using acoustic telemetry to track Asian carp in a location with an emerging population, and to determine whether 'Judas fish' are meaningful representations of existing Asian carp populations. Judas fish are sterilized fish that are tagged and released in locations where Asian carp occur. By tracking the Judas fish, one can infer the locations of the population at large.

A key IPM method being investigated is the use of microparticles as a delivery mechanism for toxins. However, relatively little is known about food selection by size in wild Asian carp populations. The USGS is measuring particle size distributions in the water column and in the guts of Asian carp to determine whether or not Asian carp select particular seston size classes from the water column. Concurrent work is identifying the spatial distribution in particle sizes among habitats at different conditions (i.e., at different discharges, different habitat types).

The following is a summary of recently completed or ongoing research being undertaken by USGS and USFWS, with the assistance of other Federal, state and research institutions, and focused on prevention and control of Asian carp in waters of the United States:

Risk Assessment and Life History

- **Assessing life history, reproductive behavior, habitat use, and predatory exploitation of established and emerging populations of Asian carp to identify opportunities for control**

U.S. Geological Survey (USGS) scientists conducted research on established and emerging populations of Asian carp in the Upper Mississippi River basin to identify opportunities for control strategies based on vulnerabilities related to life histories and behavioral characteristics of Asian carp and its predators. Investigations utilized telemetry tracking, sonar, and conventional fish sampling to determine: (1) temporal and spatial dynamics of Asian carp aggregation, (2) habitat overlap between Asian carp and native fishes (especially native filter-feeding fishes and potential predators), and (3) suitability of large rivers and tributaries for successful spawning by Asian carp. Research also focused on the influence of mainstem navigation dams on Asian carp reproductive success. In addition, researchers sampled potential nursery areas for presence of larval and juvenile Asian carp and their potential predators, and concurrently conducted laboratory research to evaluate effectiveness of various predatory species under varying environmental conditions (predator species and density, water column depth, turbidity, and aquatic vegetation coverage). Results of this research will aid development of safe and effective control strategies and measures to be implemented in systems with established or emerging Asian carp populations. Partners include the USGS Columbia River Research Laboratory, Western Illinois University, Illinois Department of Conservation, Illinois Department of Natural Resources, Illinois Natural History Survey (INHS), Iowa State University, Iowa Department of Natural Resources (DNR), Minnesota DNR, Missouri Department of Conservation, Wisconsin DNR, and the U.S. Fish and Wildlife Service (USFWS).

- **Assessment of Great Lakes tributaries for Asian carp habitat suitability/development of tributary assessment tool**

Utilizing Asian carp habitat suitability data, USGS scientists developed a tributary assessment tool to help predict which tributaries within the Great Lakes may be conducive to Asian carp spawning and successful egg transport and development. Incorporating water flow, turbulence, and other hydrologic data, along with biological data specific to Asian carp egg developmental rates and transport requirements, scientists determined the approximate minimum length of river reach needed (as little as 16 miles) that may allow Asian carp eggs sufficient time to develop and hatch. This information is important for use in identifying potential spawning and nursery locations within river systems, and can help managers locate specific target locations and identify most appropriate control measures in rivers where Asian carp could reproduce. In addition, USGS published a scientific report presenting new findings on timeframes needed for Bighead Carp and Silver Carp egg development and subsequent larvae growth needed to reach the stage at which they are able to swim on their own. This has implications for identifying river stretches or watersheds that may be suitable for establishment of Asian carp populations because of presence of habitat needed for development and survival of larvae. These findings have potential application both within and outside of the Great Lakes basin, and will (1) inform development of Asian carp Integrated Pest Management (IPM) programs and new and ongoing risk assessments (e.g., Great Lakes Mississippi River Interbasin Study, Asian Carp Binational Risk Assessments), and (2) help in locating zones in rivers to best deploy target control methods where Asian carp are already established. Partners include the University of Illinois and Ohio DNR**.**

- **Effects of water hardness on hatching success of Asian carp eggs**

USGS scientists conducted research to determine hatching success rates of Asian carp eggs as a function of water hardness. Results demonstrated that both Bighead Carp and Silver Carp eggs develop and hatch normally in all water hardness levels tested, including very soft water. Previously published scientific literature had indicated that Asian carp introductions would be limited to areas with high water hardness. Scientists raised Bighead Carp and Silver Carp in waters of varying hardness, monitoring survival, correct development, and hatching success. Additionally, scientists completed a detailed search of the Asian literature (including Chinese-language literature) on water hardness in native Asian carp areas. This work will be useful to inform risk assessments and other work focused on identifying locations potentially at risk for Asian carp introduction, and can be applied to assessments of various watersheds.

- **Evaluation of the relationship between Asian carp and bluegreen algae as a factor in predicting risk of invasion to the Great Lakes**

Researchers evaluated the contribution of bluegreen algae to the bioenergetics of Bighead Carp and Silver Carp for possible use in identifying potential suitable habitat at various locations of the Great Lakes. Research results aided development of improved and validated bioenergetic models for Bighead Carp and Silver Carp, and enhanced understanding of the relationship between algal production dynamics and presence of Asian carp. Also, remote sensing data indicating presence of green and bluegreen algae were acquired within select Great Lakes waters, and were used, along with the improved bioenergetic model, to map when and where adequate concentrations of chlorophyll (as an estimate of algae) in Lake Erie and St. Clair could support survival and growth of Bighead Carp. Results of the research indicate that large areas of Lake Erie and Lake St. Clair could support growth and survival of Bighead Carp and Silver Carp. Bluegreen algae (primarily *Microcystis sp.*) blooms may be an excellent food source for Bighead Carp, providing more suitable conditions to support their introduction and survival. Additionally, research demonstrated that noxious bluegreen algal blooms, under some circumstances, can be enhanced by interaction with Bighead Carp and Silver Carp, and presence of these carp may enhance toxin production by noxious algae. This research has implications for identifying habitat that may be suitable for establishment, growth, and survival of populations of Bighead Carp and Silver Carp. These findings have potential application both within and outside of the Great Lakes basin.

- **Risk assessment of Asian carp establishment in the Great Lakes as a function of food availability**

To develop risk assessments of invasion and establishment, scientists conducted research to evaluate potential importance of plankton and invasive mussel species to the diets of Asian carp. Research focused on consumption of: (1) *Cladophora*, a common Great Lakes plankton species, and (2) waste materials (feces and pseudofeces) produced by *Dreissenid* mussels (zebra and quagga mussels). Certain Asian carp species have been observed to diversify their diets as needed, feeding on organic matter under certain conditions and on the basis of availability of food resources. However, whether these food sources are adequate for growth and survival of Asian carp is currently unknown. Scientists are now testing an established predictive model that indicates Asian carp cannot survive in certain Great Lakes environments (Lake Michigan) based on known available food types. Findings

from this research will help in refinement of this model and allow scientists and managers to more accurately identify locations that may be capable of sustaining Asian carp based on availability of prey.

- **Assessment of Illinois River and other rivers for hydraulic and water-quality influences on Asian carp movement, spawning, and recruitment**

Within stretches of the Illinois River, USGS scientists acquired data on available food supply, river hydrology, and fish (Asian carp) movement. In addition to sampling prey (plankton), scientists evaluated the day-to-day movement of Asian carp by tracking fish via telemetry, utilized Acoustic Doppler Current Profilers to obtain detailed velocity data over a range of flows in the main channel and backwater areas of the river, and initiated mapping of these data using the Velocity Mapping Tool. Scientists are assessing potential invasion risks from Asian carp to downstream sections of the Illinois River by evaluating and applying the acquired data. Studies of upstream movement of Asian carp through the Illinois River have documented the distribution of Asian carp populations within the pools of the Illinois River, and have identified habitats favorable for their introduction and establishment. However, distinct differences observed between these pools and the Chicago Area Waterway System (CAWS) in habitat, flow conditions, water quality, and food supply may be preventing further expansion of the range of Asian carp movement. In addition to the Illinois River, other rivers, such as the Wabash River in Indiana and reservoir tributaries in Missouri, offer opportunities to examine factors influencing Asian carp movement, spawning, and recruitment. These water bodies represent the lower end of the size range of rivers believed used by Asian carp species for spawning. A major objective of this project is to determine the controlling factor(s), with the possibility that one or more of these factors could be utilized to prevent future expansion into additional rivers or to reduce Asian carp populations. Partners include USACE, Illinois DNR, Metropolitan Water Reclamation District of Greater Chicago, USFWS, and Southern Illinois University

Early Detection and Monitoring

- **Use of acoustic video and side-scan technology to determine behavior of Asian carp (net avoidance)**

USGS scientists have been assisting Illinois DNR and USFWS in separate efforts to test and develop new, more efficient, and less labor-intensive netting technologies. These technologies may detect "near misses" of catches that would otherwise be undetected and thus possibly result in dismissal of a gear type that might otherwise prove useful in control or detection activities. Furthermore, use of side-scan sonar in combination with these gear tests allows enumeration of carp present and potentially subject to the gear, allowing more accurate comparisons among gear types. Data analysis involves two stages: (1) subjective observations from viewing videos, leading to generation of hypotheses; and (2) digital images and video parameterized and transformed into data by application of techniques common to terrestrial and avian behavior research, possibly allowing statistical tests of those hypotheses generated in the first round of viewing. Tests occurred in the Illinois River, the Mississippi River, and the Missouri River, because these very different regions will require different fishing techniques, and different conditions can induce different fish behaviors. In the turbid waters inhabited by Asian carp, direct observation or normal photography is typically impossible. Results

from application of acoustic technology could lead to understanding of exactly how Asian carp avoid nets, and to adjustment of tactics accordingly. In field applications of scent or pheromone attractants together with capture gear, acoustic video technology allows us to determine the interaction of scent and gear. Partners include Illinois DNR.

- **Environmental DNA (eDNA) Calibration and Probabilistic Model**

Significant results of this ongoing study identified bacteria unique to Silver Carp, which may allow use of microbial source tracking (MST) to supplement surveillance of Asian carp environmental deoxyribonucleic acid (eDNA). Scientists also designed multiple new markers for detection of the deoxyribonucleic acid (DNA) of Bighead Carp and Silver Carp, including a new allelic discrimination marker and a series of increasing length "stair-step" markers. USGS scientists detected long sequences of Silver Carp DNA only after a spawning event on the Wabash River, suggesting that DNA sequences rapidly degrade to smaller, undetectable fragments. Understanding the degradation pattern of DNA could be extremely useful to interpretation of eDNA detections. In coordination with USFWS and USACE, USGS validated a new eDNA extraction kit. Use of this tool has become vital for early detection of invasive Asian carp. eDNA is genetic material from cells shed from fish into the water, and can include skin cells, intestinal cells, and sperm and eggs. eDNA can also come from fish carcasses in the water, from boats and fishing gear that have been used in areas with Asian carp, and from waste from animals that have eaten the fish. USGS is continually examining how Asian carp DNA is distributed in the environment, how it degrades, its persistence in the environment, and the rates at which it is shed from the fish. USGS is also leading efforts to validate the new genetic makers that will be used in the USFWS eDNA surveillance program. Partners include USACE and USFWS.

- **Development of a rapid and quantitative genetic-based Asian carp detection method**

Promising preliminary results indicate that microbial source tracking could complement eDNA monitoring for Asian carp. Specific microbial populations associated with Grass Carp, Gizzard Shad, and Silver Carp were observed during initial work on this project, suggesting primers specifically targeting these microbial populations can be designed and used as biomarkers. USGS scientists completed sequencing of ribosomal ribonucleic acid (rRNA) from microbes present in the gastrointestinal tract of Silver Carp, Bighead Carp, Gizzard Shad, and Bigmouth Buffalo taken from the Wabash River, Illinois River, Mississippi River, Missouri River, and James River. Scientists also identified unique bacterial species present in the hindgut of Silver Carp, and developed initial markers to identify some of the unique bacteria associated with Silver Carp and Grass Carp. Early detection is a vital part of managing any invasive species, including Asian carp. Methods for early detection have thus far relied on capture of fishes or presence of eDNA from sloughed cells from Asian carp. The initial goal of this project was to develop and validate a genetic-based method that can complement current methods of surveillance of Asian carp through identification of microbial populations unique to the Asian carp gut microbiota in a manner similar to microbial source tracking. Microbial source tracking is based on the concept that microbes from a polluted site can be traced to source species, thus indicating the origin of the fecal contamination. If key microbial populations can be identified in the gastrointestinal tract of Asian carp, these could be used for development of a genetic-based method to detect presence of Asian carp in water bodies. Partners include the University of Illinois, Urbana-Champagne (UIUC); INHS; Purdue University; and South Dakota State University.

- **Evaluation of Chicago Area Waterways System Monitoring Network**

This project resulted in development of CAWS database on-line observatory (http://il.water.usgs.gov/data/cwo/). This database includes historical flow and water-quality data from the CAWS that will streamline hydraulic and water quality model development and calibration. USGS scientists also completed data acquisition for a bathymetric survey of Lake Calumet. Scientists evaluated historical databases and the current network of USGS gaging stations on the CAWS to identify critical inputs and gaps in information. Some identified data gaps have been addressed through various field measurements. Hydrologists completed a synoptic survey of water temperature throughout the CAWS to provide a snapshot of thermal conditions. The CAWS is on the front line of the battle to keep Asian carp out of the Great Lakes because of continuous waterway connections within the CAWS. USGS has been asked to provide hydraulic and water-quality information obtained throughout this system to assist in eDNA detection, rapid response actions, ecological separation evaluations, and flow reversals through the electric fish barrier. Current capabilities of flow monitoring stations on the CAWS are insufficient to address many of these critical issues. Hydraulic and water quality models of the CAWS are important for data-based decision making. Development and calibration of these models require flow data from throughout the CAWS. Partners include Illinois DNR, USFWS, USACE, and the Metropolitan Water Reclamation District of Greater Chicago**.**

- **Potential for interbasin invasive species movement by way of groundwater pathway near Lemont, Illinois**

This investigation focused on possibility of Asian carp egg and larvae movement via fractures from the Des Plaines River (DPR) into the Chicago and Sanitary Ship Canal (CSSC) above the electric barrier that currently prevents their movement into Lake Michigan. Although hydraulic potential exists for water to flow from the DPR into the groundwater, and from the groundwater into the CSSC, water-level and water-quality data do not indicate the presence of a fracture or network of fractures connecting these two water bodies, and thus do not substantiate presence of this migration pathway in the area of investigation. Nevertheless, there is a possibility that invasive species could move from the DPR (Mississippi River basin) to the CSSC (Great Lakes basin) through a network of fractures in the bedrock between these two water bodies. Indeed, when USGS scientists acquired acoustic data and undertook a field examination of the bedrock, which included the characterization of the geology, hydrology, sediment, and water quality of the DPR, Illinois and Michigan (I&M) Canal, the CSSC, and the aquifer between these water bodies along a 19-mile reach of interest, they identified the geometry of the CSSC and detected areas with fractures that could transport water from the DPR or I&M Canal to the CSSC by way of the groundwater system. Specifically, researchers acquired sediment, geologic, and hydraulic data that could indicate a connection between the surface-water bodies and the groundwater. As another investigative measure, scientists injected dye into the DPR and tracked this dye to see if it traveled through the groundwater into the observation wells or into the CSSC. Results of this dye tracer test in the DPR indicate that water from the DPR requires more than 14 days to migrate to the CSSC, which is more than the 2 days carp eggs would survive in groundwater. Partners include USACE.

- **USGS hydrologic support to prevent interbasin transfer of Asian carp at an intermittent connection of the Ohio River (Wabash River watershed) and Great Lakes (Maumee River watershed) basins**

Scientists installed hydrologic and temperature measurement gauges and video webcam to validate flooding conditions when observers must mobilize to watch for Asian carp at a barrier fence constructed at Eagle Marsh, Indiana, a location where an intermittent hydrologic connection occurs between the Great Lakes and Ohio River basins during periods of high water. Acoustic streamflow and temperature gages were installed at Graham McCullouch Ditch (Wabash River watershed within the Ohio River Basin) and Junk Ditch (Maumee River watershed within the Great Lakes Basin) to measure stream flows and temperatures during episodes of high water after rainfall, and to reveal periods when flow conditions on Junk Ditch reverse direction westward from the St. Mary's River toward Eagle Marsh. USGS also finalized streamflow data from year 1 through review of quality assurance measurements, and developed rating of streamflow by assessing water level, velocity, and flow direction measurements. Presence of adult Bighead Carp in the Wabash River basin has been confirmed 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 project provides essential streamflow, water temperature, and water-level data to validate feasible designs of a structure to separate the basins and prevent migration of Aquatic Nuisance Species (ANS), including adult Bighead Carp and Round Goby, while maintaining the marsh as viable flood relief for Fort Wayne, Indiana. The data from this project will directly help prevent ANS migration between watersheds by providing the basis for a design that separates the two basins and limits possible flooding. Partners include USACE, Indiana DNR, and the Little River Wetlands Project.

- **Removing Uncertainty of eDNA Monitoring for Invasive Species in the Upper Mississippi River Basin**

USGS scientists initiated contact with state natural resource agencies and universities to assist in collection of native fishes. Scientists also completed the following tasks successfully: collected and extracted DNA from tissues of native fishes; sequenced mitochondrial DNA (mtDNA) from native fishes using Next-Generation Sequencing, an efficient method of gene analysis; developed a searchable library of mtDNA sequences from native fishes; and deposited sequence information into GenBank (a database of genetic sequences). Uncertainty hinders acceptance of applying eDNA to monitor invasive species. This technique is potentially useful for early detection of Asian carp DNA and identification of distribution patterns of DNA in the waterway, because it can presumably detect presence of DNA in waters where only a few fish may exist. A positive eDNA sample indicates presence of Asian carp DNA and possible presence of live fish, allowing resource managers to implement an appropriate management strategy. Uncertainty derives from dependence of this technology on the specificity of markers used in the assay, and insufficient knowledge of DNA sequences within most fishes found in these waters for comparison to the eDNA markers. This project aims to remove much of the uncertainty around eDNA monitoring of Asian carp, and to provide resource managers with additional information useful for developing programs for surveillance of native fish populations, including imperiled species. Partners include Minnesota DNR, Wisconsin DNR, University of Minnesota, and University of Wisconsin.

- **Correlating Asian carp eDNA or microbial tracking with telemetry data in the Wabash River**

USGS scientists collaborated with Purdue University scientists and provided training to Purdue University personnel on proper procedures for collecting and processing eDNA samples. Studies were initiated to link Asian carp movement, spawning activity, and abundance to eDNA and microbial source tracking in the Wabash River. Development of the final report has begun, and release of the report is anticipated in FY15. The project involves sampling downstream of potential spawning locations before, during, and after periods of fish movement and probable spawning activity. Those water samples are to be processed by use of new eDNA markers. Correlating eDNA detection with fish movement and/or spawning activity can dramatically increase understanding of the meaning of an eDNA detection and how this might be applied in a management context. Partners include USFWS and Purdue University

- **Augmented Real-Time detection of Bighead Carp at Selected Wabash River and Tributary Sites**

USGS co-located telemetry detectors and temperature sensors at existing USGS streamflow gage sites, and used telemetry to acquire early-warning, real-time data on movement of acoustically tagged Bighead Carp and Silver Carp up the Wabash River and selected tributaries toward the adult Asian carp barrier at Eagle Marsh. A Purdue University network of tagged carp provides an opportunity to implement early-warning carp detection and control strategies already under development in an environment similar to those of concern in large streams in the Great Lakes and upper Mississippi basins. Data from the USGS real-time gages will help accelerate Indiana DNR and Ohio DNR responses to adult Asian carp migration events in the Wabash River watershed toward the Eagle Marsh adult Asian carp barrier to the Great Lakes. This also will allow earlier acquisition of quality assurance data regarding presence of Asian carp to support USGS validation testing of emerging rapid eDNA and microbial tracking methods of detecting Asian carp. This information on Asian carp movements and spawning events and relations of these to temperature and flooding conditions (Purdue University/Illinois DNR study) will increase our understanding of how these fish may migrate within similar large rivers in the Great Lakes basin. Additional scientific activity prior to this work included identifying locations to disrupt spawning success, and focusing on evaluation of response of Asian carp eggs to electrical fields, sonication, etc., in order to develop methods to reduce egg viability while the eggs drift downstream of Asian carp spawning areas. USGS procured, installed, and is operating (1) four automated receivers at or near existing USGS streamgage sites to monitor and transmit real-time data on movements of acoustically tagged Asian carp, and (2) temperature sensors at these sites to indicate thermal conditions favorable to carp migration. Installation of USGS real-time detectors of acoustically tagged Asian carp on USGS streamgages at mainstem Wabash and Little Rivers will allow evaluation of whether and how real-time streamflow data correlate with Asian carp detections. This project will enable relocation of several existing stationary receivers operated by Purdue University researchers to other Wabash River or tributary sites where more data are needed regarding fish movements. Asian carp detection data from the real-time sites will be reported on-line at approximately 1-4 hour intervals via the existing USGS National Water Information System NWIS-WEB system (http://waterdata.usgs.gov/in/nwis/rt), and will be archived in that system. In previous work on the Wabash, scientists also tested use of physical

methods to disrupt Asian carp spawning activities in identified tributaries coupled with attractant pheromones to limit success of Asian carp reproduction. Partners include Indiana DNR and Purdue University.

- **Investigating the status of Grass Carp in the Sandusky River**

Completed efforts include identifying sampling locations and testing gear on the Sandusky River, and sampling three consecutive days during the first high-flow event in early June 2014. In late 2012, a commercial fisherman caught six Grass Carp in the Sandusky River, Ohio. Scientists determined that all six Grass Carp were available to reproduce, and likely had spawned during spring 2011, each from a unique set of parents. Microchemistry analysis indicated that the fish had spent their entire lives in the Sandusky River, thus implying presence of a spawning population of adult Grass Carp in the river. This provided the first indirect evidence of Grass Carp reproduction in the Great Lakes, but direct evidence is lacking. The goal of this project is to find and analyze direct evidence of this. Project researchers at the USGS Lake Erie Biological Station will be using three different gears to try to capture eggs and larvae of Grass Carp: bongo nets, light traps, and dipnets. A Grass Carp Initiative is also forming to bring together state resource managers and other federal agencies to collectively move forward intelligently and efficiently. Partners include Ohio DNR and Bowling Green State University.

- **Refinement and standardized implementation of environmental DNA analysis for use in early detection monitoring of Asian carp**

    - **Implementation of science-based standard operating procedures to ensure consistent use of eDNA sampling for Asian carp monitoring**

      USFWS is responsible for maintaining the *Quality Assurance Project Plan (QAPP): eDNA Monitoring of Bighead and Silver Carps* (http://www.fws.gov/midwest/fisheries/eDNA.html). The QAPP serves as the standard operating procedure to ensure continuity among all agencies involved in eDNA monitoring activities by setting the same protocols for collection and processing of eDNA samples. The QAPP developed by the USACE-USFWS team has been peer-reviewed; the processes and methods have been audited by the U.S. Environmental Protection Agency (USEPA), and verified in at least three independent federal labs, as well as in academic labs; and the methods have been evaluated by an independent external peer review team. The updates, modifications, and improvements are continually validated in several laboratories and peer-reviewed. All users of eDNA for early detection of Bighead Carp and Silver Carp are strongly encouraged to follow the QAPP, so that results can be comparable and meet the same standard of rigor.

    - **Environmental DNA Calibration Study (ECALS)**

      ECALS is a multi-year study to improve understanding and interpretation of detection of Asian carp DNA in environmental samples (eDNA) used in early detection monitoring. The study involves collaboration among USACE, USGS, and USFWS. ECALS addresses three major Action Items from the Asian Carp Regional Coordinating Committee's (ACRCC)

Asian Carp Control Strategy Framework, results of which to date are presented below. ECALS began in 2011 as a direct result of improving our knowledge and interpretation of eDNA findings in the CAWS, and how to use the results in a context of management decision-making. Initial ECALS efforts focused on eDNA vectors, whereas marker development and calibration experiments received greater attention in 2013.

- **Analysis of potential 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 that confirmed storm sewer transport, transport via fishing gear, bird transport and deposition of eDNA, fish carcasses and transport on barges, and presence of eDNA in sediment. In 2013, ECALS further investigated vessel hulls, fishing nets, and sediment eDNA. The vessel hull and fishing net trials in 2013 confirmed presence of very large quantities of eDNA possibly transported by these vectors. Sediment studies confirmed that eDNA sorption on sediments can occur, and low-level, long-term eDNA releases are possible from undisturbed and re-suspended sediment (based on 21-day study). It was concluded 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 original eDNA markers developed for both Bighead Carp and Silver Carp were conventional end-point polymerase chain reaction (PCR) or competitive polymerase chain reaction (cPCR), which detect short segments of the mtDNA control region (or "D-loop") and provide information primarily on presence/absence of that DNA in a sample. One of the objectives of ECALS was to develop a suite of different markers with different capabilities, including (1) improved detection probabilities by increasing the number of markers concurrently assayed, (2) more efficient processing by reducing background non-target PCR amplification, (3) real-time quantitative PCR (qPCR) estimates of DNA abundance (qPCR has added benefit of increased efficiency by eliminating need for gel electrophoresis and reducing or eliminating 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 of an eDNA sample or time since deposition of that eDNA sample. The data generated in this study allowed us to develop markers better tailored to detection of individuals from the Asian carp populations in North America. This is an improvement from the original D-loop markers and markers designed for this study that had been chosen from mtDNA regions most divergent among species; the data acquired during this study should correspond to markers with highest likelihood of being species-specific. The new real-time PCR markers developed as part of this study were then tested for reliability in three independent federal labs (USFWS, USGS, USACE), within the national quality control framework of Minimum Information for Publication of Quantitative Real-Time PCR Experiments (MIQE). The validation study had two primary objectives: (1) validate reliability of new real-time PCR markers, and (2) compare detection of carp DNA via new markers with the original cPCR markers in several different surface waters (three

known carp positive and three known carp negative). Both objectives were met: all new real-time PCR markers passed minimum national requirements, and use of all new markers was successful in detecting presence of carp DNA in carp positive water, while indicating no or very low presence of carp DNA in presumed negative water. Results were shared with state partners during a June 2014 workshop that documented the entire study and results. The new markers were then approved for integration into the QAPP for use in eDNA monitoring throughout the region. A formal, peer-reviewed report of results from this study is under development.

- **Increasing Asian carp eDNA analysis efficiency and calibration**

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 are required. ECALS has evaluated ways to reduce time and effort during 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 results from sampling at different depths in the CAWS. Based on these efforts, changes to the QAPP have occurred.

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 water flow may distribute deposited eDNA in the CAWS. The team designed experiments to determine how fish size, number, behavior, water temperature, and diet influence eDNA loading (or shedding) by Asian carp. The team also investigated sperm as a source of eDNA over time under static water conditions.

Loading Studies

Loading studies have shown that eDNA shedding rates are consistent at different water-flow rates, but vary according to feeding rates of fish. Fish fed algae shed nearly 10-fold higher rates of eDNA than non-fed fish, likely due to intestinal cells sloughing off in excrement. Non-fed fish shed detectable amounts of DNA, but studies comparing shedding rates among different aged fish (juvenile, subadult, and adults) have not shown statistically significant differences in amounts of eDNA. We found no correlation between water temperature and eDNA shedding rates, but eDNA loading did correlate with fish density. Studies of eDNA from sperm in water showed that eDNA was detectable for at least 17 days. In controlled lab studies, eDNA in water samples can be quantified using qPCR, but accuracy depends on time-consuming but necessary optimization of the assay (cycling temperature, reagent amounts). In the environment, the quantity of DNA can be highly variable, likely reflecting clumped eDNA distribution.

Degradation Studies

Trials assessing influence of environmental factors on degradation rate of eDNA assessed effects of temperature, pH, microbial loads, light, and water turbulence. Most 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. Temperature, pH, and microbial load have been identified as factors that can affect degradation, notably that higher temperature, higher pH, and higher microbial loads are associated with more rapid DNA degradation. In every case, DNA abundances capable of producing positive detections with qPCR or conventional PCR assays persisted beyond the length of trials (14, 15, 28, or 91 days).

Probabilistic Model

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

- **Implementation of an eDNA-based early detection monitoring program for Asian carp**

USFWS is the lead federal agency for use of eDNA as a genetic surveillance method for early detection of Bighead Carp and Silver Carp in the Midwest Region. In 2013, USFWS implemented a comprehensive, basin-wide eDNA Monitoring Program targeted to detect genetic presence of these two species of Asian carp in the Great Lakes, Ohio River, and Upper Mississippi River (also including the CAWS). The goal of the program is to use eDNA as a monitoring tool for early detection of genetic presence of Bighead Carp and Silver Carp DNA, and to use this information to help inform other monitoring efforts, such as state-directed netting and traditional sampling methods or rapid assessment tools. In developing the Regional Monitoring Program, USFWS coordinated with states, as well as Canada, to identify sampling sites and determine the number of samples to be collected during 2014. Water samples collected as part of this program are tested for presence or absence of genetic material from Bighead Carp and Silver Carp, processed by the USFWS Whitney Genetics Lab (WGL) in Onalaska, Wisconsin. Following a 5-business day notification period to the states, results of all sampling efforts will be posted on-line at http://www.fws.gov/midwest/fisheries/eDNA.html. WGL was created as a result of a request by state resource agencies involved in ACRCC. ACRCC, USACE, USFWS, and state partners decided that USFWS should manage the carp monitoring program. The new lab was constructed in Onalaska, Wisconsin, at the La Crosse Fish Health Center, and is a 5800-square-foot, state-of-the art facility completed in November 2013 and staffed by six personnel: a molecular geneticist, three fish biologists, and two biological science laboratory technicians. After completion of a rigorous transition plan to demonstrate competence and adherence to the QAPP, WGL has assumed responsibility of processing all official eDNA monitoring samples. The lab also participates in validation studies regarding all upgrades and changes to the QAPP, and collaborates with eDNA researchers in USGS, USFWS, and USACE. Sampling sites for 2014 included waters of the CAWS,

Great Lakes, Ohio River, and the Upper Mississippi River. Sampling sites in the CAWS were concentrated at entryways to Lake Michigan, including the North Shore Channel, Chicago Lock, Lake Calumet, and the Little Calumet River. CAWS sites were sampled twice in 2014, each time immediately prior to the Seasonal Intensive Monitoring events scheduled for June and September as outlined in the 2014 ACRCC Monitoring and Response Plan. The sites and their respective priority levels in the Great Lakes, Ohio River, and Upper Mississippi River were chosen based on evaluation from the USACE GLMRIS Report and extensive input from state natural resource agencies. USFWS also maintained a reserve of samples to repeat sampling at specific areas or to sample in other areas as requested by the states.

Integrated Pest Management Strategies and Controls

- **Evaluation of an Integrated Pest Management approach to control of Bighead Carp and Silver Carp**

  In a collective establishment of an IPM approach, three techniques were utilized: (1) USGS scientists deployed algal attractants (a mixture of powdered algae and water that Asian carp find desirable) at the Morris, Illinois site (a backwater of the Illinois River) to determine behavioral response to the installed feeding stations; (2) water guns were manipulated to keep carp in the designated area and move carp toward nets for capture, and (3) commercial fisherman were employed (Illinois DNR) to net and remove Bighead Carp. Fisherman successfully withdrew over 15,000 pounds of Bighead Carp, significantly more than had occurred during previous efforts. Scientists assessed change in fish distribution within the backwater as a function of algal feeding, water gun barrier operation, and commercial fishing pressure, and determined presence of fish near the water gun barrier. Understanding Asian carp history from various levels and perspectives is essential for development and application of tools for prevention, surveillance, and control of Asian carp. Integrating several developing management controls within this project via an IPM approach enabled us to identify vulnerabilities of Asian carp that can be exploited for control. The goal of this work was to evaluate an approach to integrate various potential controls, with intent to increase/maximize effectiveness and efficiency of Asian carp control. Partners include Illinois DNR and Southern Illinois University.

- **Communication and demonstration of new technologies for controlling and monitoring Asian carp**

  USGS scientists conducted a demonstration of various new Asian carp control technologies incorporated into an IPM strategy at a backwater location (abandoned quarry) adjacent to the Illinois River near Morris, Illinois. State and federal natural resource agency partners participated in the demonstration, which included coordinated application of seismic water guns, algal feeding attractants, acoustic fish tracking, and commercial fishing, with the goal of reducing the Asian carp population within the backwater quarry. Scientists from the partner agencies collaborated and evaluated the multiple control technologies implemented during field tests to examine potential effectiveness of these technologies as Asian carp control mechanisms. Critical information on new and emerging Asian carp control and monitoring technologies is, and will be, communicated to agency decision makers and managers continually to ensure effective planning and, if needed, implementation of these new tools. USGS continually conveys results from multiple, concurrent research projects to stakeholders and managers via coordinated site visits and other communications

to demonstrate effectiveness and application of new monitoring and control technologies. Partners include Illinois DNR and Southern Illinois University.

Dispersal/Barrier Technology

- **Use of seismic technology to control Asian carp movement**

  USGS scientists and partners conducted studies focused on both biological and structural implications of using water guns for controlling Asian carp. Seismic water guns employ sound pressure wave technology to emit pulses of acoustic energy that alter Bighead Carp and Silver Carp behavior by creating pressure barriers that contain, repel, or herd Asian carp. Potentially, this technology can be manipulated to deny Bighead Carp and Silver Carp access to off-channel refuge areas, to create static barriers to fish movement, or to disrupt spawning. Scientists measured effects of the pressure waves created by the deployed water guns to ensure that the emitted pressure would not exceed safe and acceptable levels identified by USACE for avoiding damage to lock structures and channel walls. USGS scientists also created pressure maps indicating and analyzing the sound pressures from water guns deployed in man-made ponds under field conditions. Water gun testing was used in combination with algal attractants, hydroacoustic technologies, and commercial fishing efforts to further develop a multi-pronged IPM strategy for Asian carp control. Scientists examined effects of waterguns on carp behavior and found that carp move away from the waterguns, thus verifying effectiveness of this component of the integrated effort. USGS and USFWS initiated ongoing coordination on necessary additional research and evaluations to determine potential effects of water guns on native mussels, and to identify potential high-priority, suitable locations for initial deployment of both static water gun barriers and mobile water gun systems. Partners include Illinois DNR, USACE, USFWS, UIUC, and Southern Illinois University.

- **Field testing of carbon dioxide barrier to deter Asian carp**

  Scientists completed a large-scale evaluation of the behavioral response of Bighead Carp and Silver Carp to deployment of a carbon dioxide barrier. Behavioral responses of non-target fishes (Bigmouth Buffalo, Channel Catfish, Paddlefish, and Yellow Perch) were also assessed. When carbon dioxide is added to water, it reduces pH and increases concentrations of dissolved carbon dioxide in the water. Fish have specialized receptors in their gills to detect carbon dioxide, and to detect and avoid areas of increased carbon dioxide concentration. Results of testing in study ponds indicated that small fish detected and avoided areas of elevated carbon dioxide concentration, and larval fish experienced significant physiological disturbances similar to adult fishes. Together, these and other results to date have indicated that environments of elevated carbon dioxide act strongly as a non-physical barrier detering movement of fishes of many body sizes (small fingerlings to adults). USGS has also been working with USEPA on registration of carbon dioxide as a barrier and a control agent, and with USFWS on addressing Section 7 Endangered Species Act (ESA) requirements. Previous work has demonstrated that carbon dioxide gas applied to water can cause significant behavioral, physical, and physiological disturbances of Asian carp and induce their efforts at active avoidance. These results seem to promise significant benefits from application of carbon dioxide as a novel fish barrier, as a redundant barrier technology supplementing existing electric barriers. The overall goal of this project is to quantify effectiveness and feasibility of using carbon dioxide gas as a novel Asian carp deterrent at ecologically relevant scales in real-world scenarios. A full-scale carbon dioxide barrier at a location

was developed, implemented, and tested. Quantitative evidence of barrier effectiveness was accomplished through use of a telemetry array or remote monitoring of fishes currently residing downstream of the lock chamber. Partners include University of Illinois, USACE, USEPA, and Illinois EPA.

Feeding Ecology-Based Control Technology

- **Field evaluation of chemical attractants to control Asian carp/development of protocols for field verification of response**

  USGS scientists tested algal attractants to Asian carp in both the Illinois and Missouri Rivers to identify potential mixtures for use in control actions based on degree of persistence and duration of fish attraction, and developed related protocols to quantify and evaluate responses for management use during field application. Selection and location of food sources by filter-feeding fish such as Asian carp are largely based on chemical cues specific to desired items. Scientists also field tested new automated feeding apparatus for algal food attractants in the Missouri River, conducted tests to confirm the possibility that carp can be conditioned to feeding stations which can be used to facilitate their capture, and explored methods for sustained release of the stimulant through tests of various media. During this research, scientists determined that Asian carp were strongly attracted to a liquid mixture of powdered algae and water, a very significant finding for developing subsequent food-based control methodologies. Further studies were conducted to quantify the results and enhance the techniques for use in the field. Partners include state natural resource agencies and USFWS.

- **Developing Targeted Microparticle and Piscicide Control Systems for Asian Carp**

  Through various studies to enhance selectivity of microparticles (oral toxicant), scientists (1) identified antimycin as the toxin to incorporate in the microparticle, (2) determined that Silver Carp and Bighead Carp prefer to eat particles of a specific size, (4) designed the microparticle at the preferred size, and (3) found that the Asian carp digestive system is the best location for selective release of the microparticle where the enzyme trypsin, present in greater quantity in Asian carp than in native fish, triggers release of the toxin within the carp, thus avoiding harm to native fish. Testing occurred in the lab and is expected to move to the field in FY15. USGS scientists are also developing additional particles capable of delivering other types of control agents including chemical controls and biological control agents such as fish pathogens. Current toxic control agents registered for use to control invasive or nuisance fish are not selective, and when applied throughout the entire water column, result in equal exposures to native fishes. Development of a microparticle delivery system selectively consumed by or active in filter-feeding Bighead Carp and Silver Carp, and that could reduce impacts on non-target species by limiting their exposure to the control agents, requires a better understanding of native species and Asian carp feeding habits, filtering anatomy, digestive physiology, and metabolism. Using technologies developed for aquaculture and for pharmaceutical and agrochemical industries, USGS is developing and evaluating different microparticle formulations to identify those that may deliver biological or chemical agents to control populations of Bighead Carp. Applied in conjunction with the feeding attractants developed by USGS scientists, managers could target delivery of control agent-laden microparticles at locations where Bighead Carp congregate to feed, thus minimizing the area within which the microparticles are applied and limiting

potential effects on native species. Partners include Advanced BioNutrition Corporation, INHS, Purdue University, University of Wisconsin – La Crosse, UIUC, and Viterbo University.

- **Developing targeted control systems for Asian carp based on species-specific digestive system characteristics**

  USGS scientists conducted research on the feeding physiology of Asian carp to gather information needed for developing feeding-related control technologies. Little information is available on overwintering feeding habits of Asian carp and native plankton-eating fish species (planktivores) in northern rivers of the United States. Analyses of diets of these species that potentially compete directly for resources suggest that Silver Carp feed at temperatures and times that native planktivores do not. This information will help determine optimal time for applying Asian carp control toxicants (for example, an oral toxicant), which will decrease the potential undesirable impacts on non-target native fishes while maximizing impacts on the target invasive species (Asian carp). In addition, research yielded further important information on the biochemistry of Asian carp nutrition and digestive processes, allowing researchers to pinpoint the best location for release of toxin from the microparticle within the body of an Asian carp, and the specific enzyme (trypsin) needed to trigger the release. These are significant steps in the effort to develop the most effective toxicant-based control technology. Current toxicants used to control Asian carp are non-selective and act throughout the entire water column, resulting in equal exposures of native and invasive species to the toxicant. Development of a delivery system selectively consumed by or active in an invasive species could reduce non-target species exposure to the toxicant and may enhance selectivity and reduce effects on non-target species. Partners include INHS, Purdue University, and South Dakota State University

- **Identifying potential compounds for inclusion in a toxicant screening program for control of Asian carp**

  USGS scientists conducted critical research on improving the process to identify potential toxicants for use in Asian carp control actions. Through this work, scientists successfully prepared fish cell lines for immediate availability to test any range of chemicals on multiple fish species, developed links between physiochemical properties and toxicant trends, and prepared results for application into chemical databases to identify potential fish species-specific toxicants. Fish cell lines can be used as an initial, simplistic, relatively inexpensive screening tool. Currently, no species-selective toxicants specific to Asian carp are known. Identifying a selective toxicant would significantly advance our ability to control Asian carp species, while minimizing effects on other native non-target aquatic species. The toxicants with best selectivity for Asian carp, as determined by fish cell line response, will subsequently undergo additional screenings and evaluations to determine their viability as candidates for registration as new fish toxicants. Partners include USGS, Viterbo University, USFWS, and USEPA.

- **Ensuring environmentally responsible application of piscicides (fish poison) in rivers by using real-time dye tracking**

  A report published in January 2014 documented the 2009 and 2010 Large-Scale Rotenone Applications in the CAWS. USGS scientists leading this project tracked the rotenone plume that was applied in the CAWS in December 2009 by encasing the plume in Rhodamine WT dye (red in color),

providing real-time feedback to shore personnel regarding the plume extent as it moved downstream. Such methods minimized collateral damage to fisheries downstream and ensured that the toxins were applied in an environmentally friendly manner. Subsequently, project leads tracked a second application of rotenone in May 2010 to the Little Calumet River near O'Brien Lock and Dam (Illinois). Piscicides, or fish poisons, are chemicals often used throughout the United States to eradicate invasive fish populations. Given that current piscicidal chemicals are not selective for Asian carp, currently applied methods impact all aquatic species present within the environment of deployment. One of the most commonly used non-selective piscicides is rotenone, a fish toxicant that targets gill-breathing organisms by inhibiting respiration. To ensure that this colorless and odorless chemical targets only fish within the designated treatment reach of a river, the toxin must be deactivated by release of additional chemicals downstream. Proper timing of the deactivation requires accurate knowledge of the location of the toxin plume at all times during the treatment. Studies specific to this project focused on controlling and tracking the released rotenone plume and chemical degradation, as well as refining alternative piscicides for potential release. Partners include Illinois DNR, USFWS, and USEPA.

APPENDIX 2

SUMMARY OF FEDERAL AND STATE AGENCY ACTIONS

U.S. FISH & WILDLIFE SERVICE

APPENDIX 2. SUMMARY OF FEDERAL AND STATE AGENCY ACTIONS

The following is a detailed summary of federal agencies' Asian carp activities in both the Upper Mississippi River basin (UMRB) and Ohio River basin (ORB) from June 2012 to August 2014.

These summaries are based on information provided directly from the agencies.

National Park Service (NPS)

In January 2011, the Mississippi National River and Recreation Area (NRRA) and St. Croix National Scenic Riverway (NSR), both units of NPS, initiated a meeting with the St. Paul District, U.S. Army Corps of Engineers (USACE), the Minnesota Department of Natural Resources (DNR), and the U.S. Fish and Wildlife Service (USFWS) to try to identify invasion fronts of Asian carp in the Upper Mississippi River. After January 2011, the group expanded its membership to some 20 entities and became the Ad Hoc Asian Carps Task Force for the State of Minnesota. NPS and Minnesota DNR acted as co-chairs, and the membership was limited to federal, Tribal, state, and local governments. The goal was to develop an Asian Carp Action Plan, with an emphasis on action. In November 2012, the Action Plan was completed. NPS developed a division of labor to address Asian carp on the Mississippi and St. Croix Rivers. NRRA handles the overall campaign effort, and NSR handles the biological research and testing.

Monitoring

In 2011, NPS (NRRA and NSR), along with the Mississippi River Fund and Minnesota DNR, initiated environmental deoxyribonucleic acid (DNA) sampling to determine whether Asian carp might be present. NSR took the lead in this effort for NPS. NPS staff, with assistance from USFWS (La Crosse Fish and Wildlife Conservation Office) and Minnesota DNR, collected water samples at several locations on the St. Croix, Mississippi (Pools 1 and 2 and above St. Anthony Falls and Coon Rapids), and Minnesota Rivers. These samples were sent to a private lab for analysis. Results from these samples continue to be a source of debate, as detections of Silver Carp were noted. No live fish had been found near the sampling locations at that time. Since then, Silver Carp and Bighead Carp have been found in Pool 2 above Hastings, Minnesota. Follow up work in 2012 and 2013 was again conducted by NPS and Minnesota DNR. Currently, water samples are collected for archive by the University of Minnesota Aquatic Invasive Species Research Center (MAISRC). Equipment was provided to the University by NPS for lab and field processing.

Research

A cooperative research study by USGS, Minnesota DNR, and NPS is addressing food web and migration information gaps regarding Lake Sturgeon in interstate waters of Minnesota and Wisconsin. The research will provide valuable background data about Lake Sturgeon ecology, address potential effects of proposed Asian carp barriers on lake sturgeon, and facilitate future comparisons to Lake Sturgeon populations should Asian carp populations become established in the St. Croix River and northern reaches of the Mississippi River. Development of trace element techniques would also prove valuable for understanding migratory behavior of other fish species including movements of host fishes for endangered mussel populations.

In 2010, a zooplankton study of Lake St. Croix (the lower 25 miles of the river), became the foundation for a larger food web project designed to help understand impacts of a possible Asian carp invasion. Results from that study, combined with results of the 2013 isotope study, are being analyzed; however, some results thus far are obvious: Pool 2 is homogenous, while St. Croix has a much more complex mosaic of food webs. The study results are based on a solid and robust data set for setting baseline

conditions at a high resolution. This will be critical to track food web changes if the carp establish. Further information related to this study will be delivered to NPS as a preliminary report in December 2014, with a final draft (including the lipid data from USGS) due by January 2016.

Asian carp Forums

The initial Action Plan meetings drew some interest by non-governmental organizations (NGO), including those involved with environmental and navigation activities. It became clear that the effort had to expand, and on December 8, 2011, NRRA and DNR held the first of five Asian carp Forums. NRRA has been the primary lead on the Forums. The Forums have included the governmental organizations that worked on the Action Plan, aides to many of the Minnesota Congressional Delegation members, some state legislators, entities with interests in navigation, marina owners, environmental and angling groups, the University of Minnesota, and lake associations. The meetings have provided updates on the plans and actions concerning Asian carp, and have drawn 80-110 people.

Outreach

Between 2011 and 2013, NRRA gave many presentations to the public and various organizations on Asian carp. The presentations focused on educating the public about the fish and the threat they represent. NSR gave 13 formal presentations and numerous informal talks to a wide variety of interested audiences. These groups included Asian carp workshop attendees, Audubon and Isaac Walton members, Power Squadron members, business employees, agency staff, and conference participants.

On August 2, 2013, the governmental agencies and NGOs working on Asian carp decided to update the plan and formed a committee. Minnesota DNR and NRRA are the co-chairs, along with a representative from MAISRC. The draft update is nearing completion. A draft updated plan will be released soon for comment by all the organizations and may be released for public review.

While NRRA could not advocate closing the locks in the Twin Cities, it has joined the Stop Carp Coalition in pursuing a voluntary program for avoiding lock use. Along with the Mississippi River Fund, the National Parks Conservation Association (NPCA), St. Croix National Scenic Riverway, St. Croix River Association, and others, NRRA has developed small identification cards and posters to educate the public about Asian carp and discourage the public from using the locks. The Stop Carp Coalition just completed an infographic to promote disuse of the locks. This campaign is especially important given that commercial fisherman hired by Minnesota DNR caught an adult Bighead Carp and an adult Silver Carp in the Mississippi River in lower Pool 2, just below St. Paul, Minnesota, and caught Bighead Carp in the St. Croix River, near Prescott, Wisconsin.

Fiscal Expenditures

The primary fiscal contribution from NRRA to the Asian carp effort since initiation of the effort in 2011 has been time and, therefore, salaries. The total spent by NRRA park staff from June 2012 through August 2014 was roughly $26,000 in salaries. NSR purchased approximately $4,500 in supplies and equipment for monitoring. This was in addition to the approximately $33,000 in salaries during the same period. Total expenditure of NPS was $63,500.

USACE

The major role of USACE is operation of the lock and dam system within the Ohio and Upper Mississippi river systems. The jurisdiction of the USACE includes planning, construction, and operation of navigation and flood damage reduction projects, hydropower operations, environmental protection and restoration, water conservation, and recreation and disaster assistance.

USACE's major activities in controlling Asian carp in the ORB and UMRB include the following:

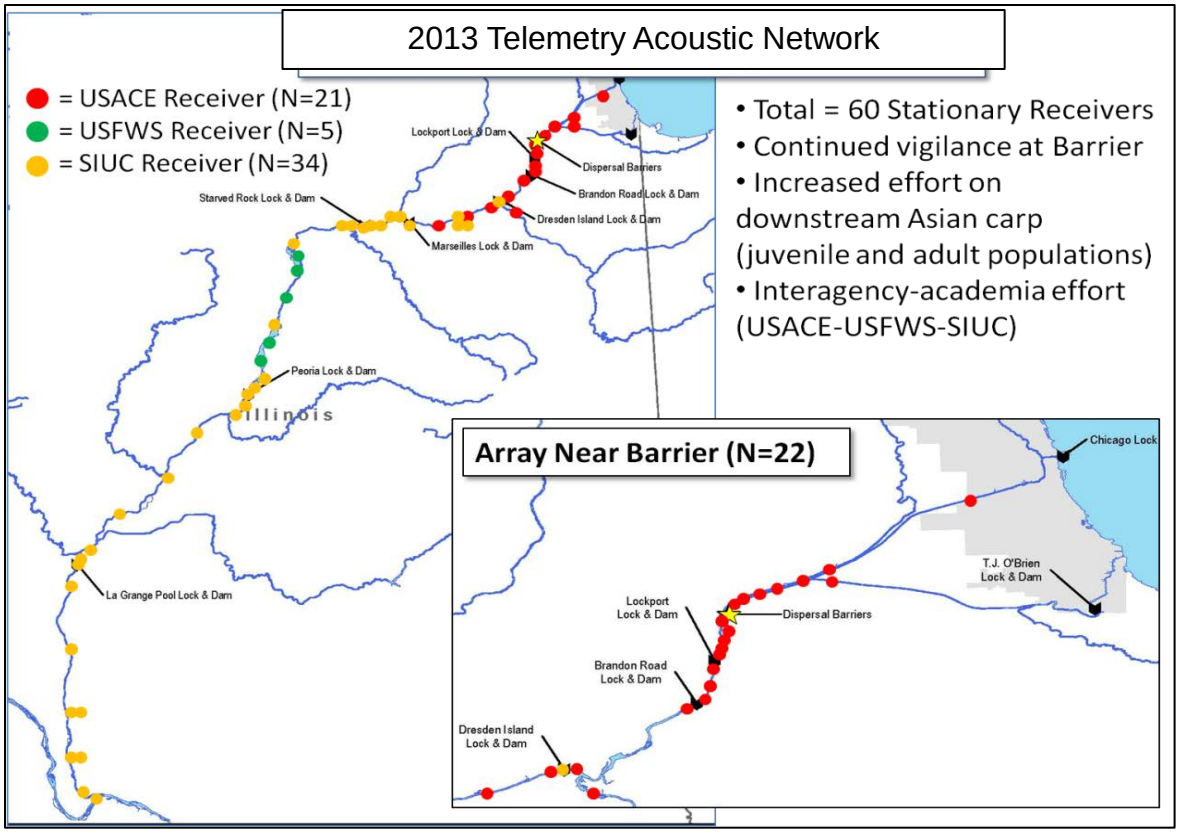
Interagency Coordination

Work under this category consists of participation in various workgroups including, but not limited to, the Asian Carp Regional Coordination Committee (ACRCC), the Great Lakes and Mississippi River Interbasin Study (GLMRIS) Executive Steering Committee, and the Barrier Safety Committee. Unstructured interagency coordination occurred during activities described in the subsequent sections of this report.

Monitoring

As part of ACRCC's Monitoring and Response Workgroup (MRWG), USACE monitored for Asian carp presence during the reporting period within the Chicago Area Waterway System (CAWS) and its tributaries using telemetry, environmental DNA (eDNA), and electrofishing.

The telemetry program consists of tagging fish with individually coded ultrasonic transmitters in the Upper Illinois Waterway (IWW) and CAWS. Telemetry is used to assess effectiveness of the electric barriers by monitoring movement of fish in the immediate vicinity of the barriers in order to determine if the fish can challenge and/or penetrate the barriers. Additionally, telemetry is used to identify the leading edge of the Asian carp population and whether Asian carp can navigate through lock structures in the IWW system. Surrogate species (i.e., Common Carp, buffalo spp.) were tagged at and near the Barrier in the Lockport Pool, while Asian carp were tagged in the Dresden Island and Marseilles Pools. The acoustic network, shown below, is composed of stationary acoustic receivers supplemented by a mobile hydrophone unit.



eDNA Monitoring and Study Design

During the reporting period, USACE with support from USFWS and Illinois DNR tested for presence of Asian carp eDNA in the CAWS weekly. Water samples were collected by USFWS and Illinois DNR, while USACE and the U.S. Environmental Protection Agency (USEPA) filtered them. USACE processed the samples at the Engineer Research and Development Center laboratories. This monitoring effort began with USACE in 2009 and transitioned to USFWS in 2013.

During the reporting period, Indiana DNR, USFWS, and USACE coordinated efforts to sample at five fixed locations and additional reaches in the CAWS for presence of Asian carp and local fish population. In addition to monitoring for Asian carp, these data were used to inform a fishery statistical-based model that will ultimately quantify potential for Asian carp presence/absence and relative abundance. This effort is part of a larger CAWS monitoring program developed by MRWG of ACRCC. In addition, USACE conducts monthly electrofishing surveys at the Barrier, outside of the regular MRWG fixed site monitoring activities.

USACE also cooperated with USFWS and Minnesota DNR in placement of monitoring equipment at USACE locks within the St. Paul District footprint.

Rapid Response

None

Risk Assessment

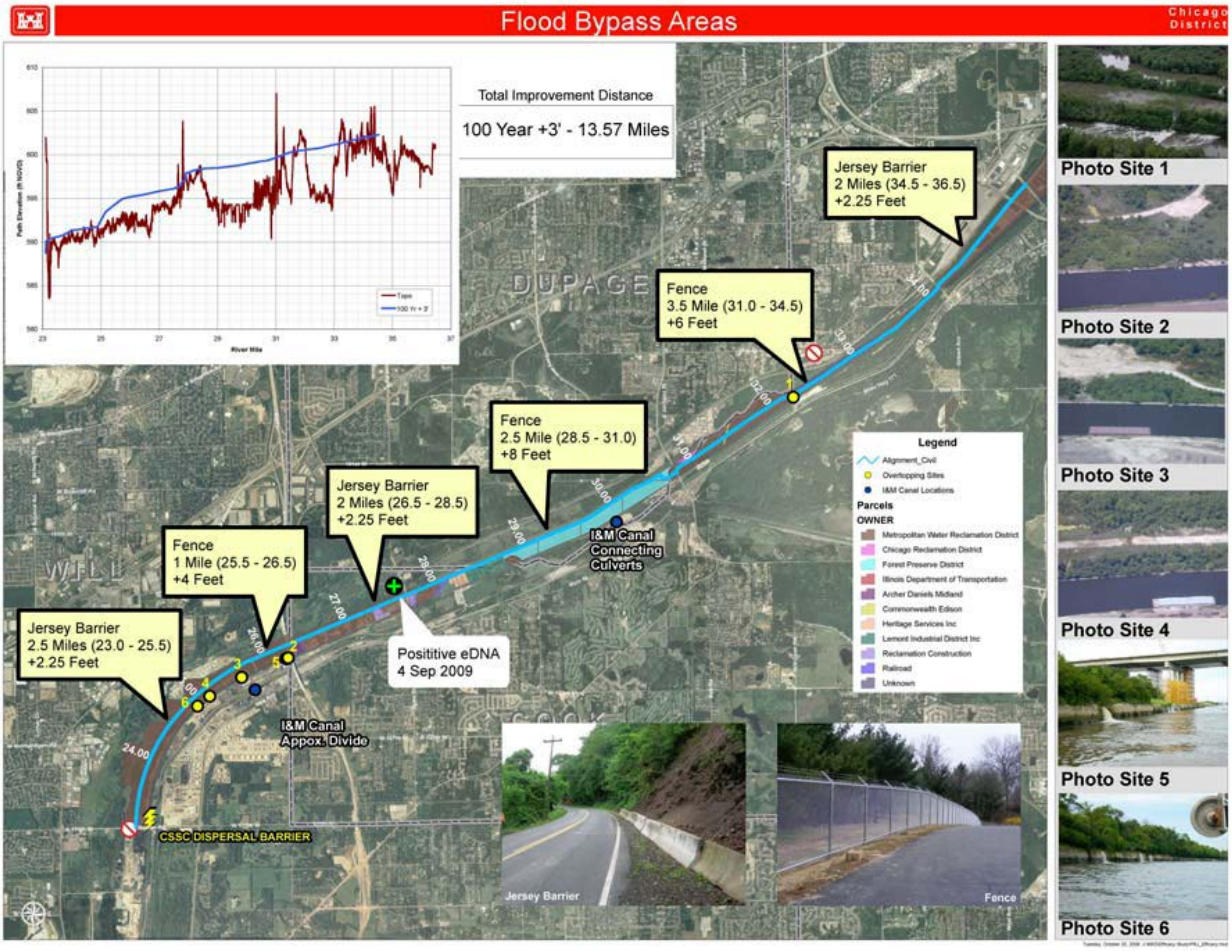
As part of the GLMRIS, USACE conducted a risk assessment to identify potential risk of current and future aquatic nuisance species (ANS) (including Asian carp) establishment and associated adverse impacts. The risk analysis process employed for the study is an adaptation of the generic model and process described in the Generic Nonindigenous Aquatic Organisms Risk Analysis Review Process (For Estimating Risk Associated with the Introduction of Nonindigenous Aquatic Organisms and How to Manage for that Risk) (Aquatic Nuisance Species Task Force [ANSTF] 1996). Results of the risk assessment were used in identification and evaluation of potential control measures for reducing, to the maximum extent possible, risk of interbasin ANS transfer via surface water connections between the basins. The risk assessment was conducted to identify measures for controlling interbasin transfer of ANS, including Asian carp, between the two basins. In Focus Area I (the CAWS), the GLMRIS risk assessment categorized and ranked ANS on the basis of: (1) likelihood of establishment in a new basin, (2) potential for interbasin transfer; and (3) potential for adverse impacts on environmental, economic, and social resources and services. For Focus Area II (Pathways outside the CAWS), the risk assessment focused on the question of whether or not a viable aquatic pathway exists, rather than probability that an ANS will colonize in, or spread through the receiving waterway or basin.

Active Prevention

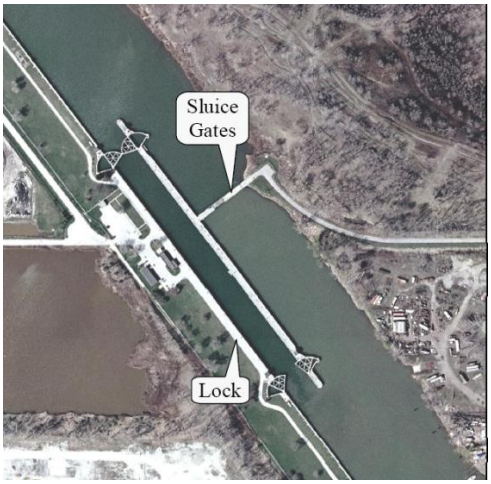
USACE applies three different types of fish deterrent measures throughout the CAWS. Each is designed to block a distinct pathway of Asian carp toward the Great Lakes.

The Electrical Dispersal Barrier System, on the Chicago Sanitary and Ship Canal (CSSC) in Romeoville, Illinois, was designed to reduce risk of movement of fish from the Mississippi River to the Great Lakes drainage basins via the CSSC. The system currently consists of three barriers (Demonstration, IIA, and IIB) that create a waterborne, pulsed, direct current, electric field in the canal, which subjects fish penetrating the electric field to electrical stimuli that act as a deterrent. As fish swim into the field, they feel increasingly uncomfortable. When the sensation is too intense, the fish are either immobilized or deterred from progressing farther into the field. Although the barriers were placed into service prior to the reporting period, USACE continues to operate and maintain them as an integral part of its strategy to prevent movement of Asian carp toward the Great Lakes.

The Des Plaines River Bypass Barrier is a 13-mile-long combination of fence material and jersey barrier that physically blocks known bypasses around the electric barriers that occur during periods of flooding from the Des Plaines River and the Illinois and Michigan (I&M) Canal, thereby halting possible fish movement through this area. Barriers placed at these locations are intended to stop juvenile and adult Asian carp. A map depicting alignments of barriers appears below.



Bar screens on sluice gates at Thomas J. O'Brien Lock and Dam were installed to impede entry of Asian carp to Lake Michigan.



USACE also cooperated with Minnesota DNR regarding a possible deterrent barrier at Lock and Dam 1 in Minneapolis, Minnesota, that would be designed, constructed, and operated by the State of Minnesota. USACE is authorized by 33 *United States Code* (U.S.C.) 408 (Section 408) to permit such an alteration and modification by others to existing USACE projects if the proposed action would not adversely impact the purpose of the project(s) and would not injure the public. However, because the Water Resources Reform and Development Act of 2014 (WRRDA) directed closure of the Upper St. Anthony Falls Lock and Dam, Minnesota DNR has determined that an electrical barrier at Lock and Dam 1 is not necessary, and will not pursue final USACE approval for the barrier.

Outreach

USACE participated in the following organized stakeholder groups:

- Technical and Policy Workgroup consisting of academia and NGOs interested in technical and policy issues relating to design and operation of electric barriers
- Barrier Navigation Task Force consisting of representatives of the navigation industry interested in research on efficacy of electric barriers
- CAWS Advisory Committee composed of more than two dozen stakeholder organizations that have expressed an interest in preventing transfer of aquatic invasive species (AIS) into the Great Lakes, especially Asian carp.

Additionally, USACE employed a comprehensive public engagement strategy during the reporting period consisting of public meetings, focused briefings, stakeholder conference calls, media events, social media, and project websites.

Law Enforcement/Regulatory Actions

None

Research

During the reporting period, USACE conducted field and laboratory research to assess efficacy of the electric barriers and to improve their effectiveness. Some of the projects conducted include:

- Canal wall effects study: walls of the CSSC are extremely rough and irregular, and could provide shelter from the electrical field, allowing fish to pass. This field study measured electric field strengths along the canal walls, including at the various notches and cracks, and compared the measurements to similar measurements from the middle of the canal.
- Laboratory research to assess impacts of various environmental conditions on barrier effectiveness and fish behavior: laboratory tests were conducted to confirm barrier optimal operating parameters by examining a number of factors including, but not limited to, how variations in canal water temperature and dissolved oxygen levels impact effectiveness of the barrier. USACE also conducted tests that exposed fish to the electrical field for longer durations of time to determine if the fish become less affected by the field over time.
- Steel-hulled Barges Study: barges were outfitted with specially designed electrical probes to assess the effect of metal barge hulls on the barriers' electrical fields as the barges move over the barriers. The testing included measurement of the electric field strength at the voltage probes as the barges traversed the barriers. The barge tow configuration and the operating parameters of Barriers IIA and IIB were varied to simulate different operating scenarios.
- Barge Entrainment Study: this laboratory study involved development of a scale physical model to evaluate possibility of fish inadvertently transported across the electric barriers by navigation operations in the CSSC. The study considered different barge configurations, barge drafts, vessel speeds, and relative positions in the channel to identify potential mechanisms for movement of Asian carp.

USACE led the eDNA Calibration Study (ECALS) to improve application of eDNA methodology for assessment and management of uncertainty. ECALS investigated alternate sources of Asian carp DNA, developed improved genetic markers, and investigated the relationship between (1) number and distribution of positive eDNA samples and (2) density of Asian carp populations. Results of this study will allow project managers to better interpret eDNA results, as well as investigate ways to increase efficiency of the eDNA process (decrease processing time and cost).

USACE cooperated with MAISRC on its work to assess deterrent technology and Asian carp swim capabilities at varying river flow velocities through dam gates. The district has entered into a real estate agreement allowing MAISRC to install and operate an array of acoustic deterrent speakers at Lock and Dam 8 as a demonstration project. The demonstration project became operational in early August 2014.

Financial Support Provided to Partner Agencies/Organizations to Support Asian Carp Prevention

None

Expenditures

Expenditures of USACE during the June 2010 to June 2014 time period were as follows:

	Base Agency Funding	**Great Lakes Restoration Initiative (GLRI) Funding**	**Total Expenditures**
June 2012 - Sept 2012	$1,903,814.33	$4,003,048.22	$5,906,862.55
Oct 2012 - Sept 2013	$21,941,494.15	$5,888,693.76	$27,830,187.91
Oct 2013 - May 2014	$16,246,820.34	$1,239,689.50	$17,486,509.84
Total	$40,092,128.82	$11,131,431.48	$51,223,560.30

<u>Department of Commerce – National Oceanic and Atmospheric Administration (NOAA)</u>

Major roles of NOAA are implementation of technical assistance and management/orientation of research programs that support coastal zone management. NOAA funds research studies and activities, and provides technical assistance to research entities.

NOAA's major activities in controlling Asian carp in the ORB and UMRB include the following:

Interagency Coordination

NOAA scientists provided feedback on the USFWS survey of potential risk from establishment and spread of Asian carp species (Silver, Bighead, Black Carp) in the Maumee River and western Lake Erie areas if Ballville Dam would be removed. Staff also participated in the Asian Carp Regional Control Committee activities.

Monitoring

NOAA did not participate in monitoring activities.

Rapid Response

NOAA did not participate in rapid responses.

Risk Assessment for Asian carp

NOAA did not undertake risk assessment activities on this issue.

Active Prevention

NOAA did not undertake active prevention regarding this issue.

Outreach

NOAA scientists develop species profiles of Asian carp to appear on the Great Lakes Aquatic Nonindigenous Species Information System (GLANSIS) website. GLANSIS is a publicly available decision support tool that synthesizes available information on economic, social, and ecological impacts of current and future aquatic non-indigenous species in the Great Lakes.

Law Enforcement/Regulatory Activities

NOAA did not undertake law enforcement/regulatory activities on this issue.

Research

NOAA scientists worked with university scientists from the University of Notre Dame and the University of Michigan to develop computer simulation models to forecast spread and potential impacts of Bighead Carp and Silver Carp on Lake Michigan and Lake Erie food webs. This project was funded through USEPA GLRI and NOAA Center for Sponsored Coastal Ocean Research (CSCOR), and is entitled: "Forecasting spread and bioeconomic impacts of aquatic invasive species from multiple pathways to improve management and policy in the Great Lakes." NOAA staff time was funded through internal NOAA base funds.

In addition, NOAA staff presented project results before fisheries managers and policy makers at regional and international meetings.

Staff also assisted with development of habitat layers useful for predicting spread of Asian carp in Lake Michigan and Lake Erie.

Financial Support Provided to Partner Agencies/Organizations to Support Asian carp Prevention

NOAA scientists worked with scientists from the University of Notre Dame and the University of Michigan to develop computer simulation models to forecast spread and potential impacts of Bighead Carp and Silver Carp on Lake Michigan and Lake Erie food webs. This project was funded through USEPA GLRI and NOAA CSCOR. NOAA Asian carp-related activities took up staff time equivalent to a cost of $97,509.

U.S. Department of Agriculture (USDA) – Forest Service

Interagency Coordination

USDA-Forest Service participated in in-person meetings and conference calls of the Mississippi River Basin Panel of the Aquatic Nuisance Species Task Force. USDA also participated in the Aquatic Nuisance Species Task.

Research

USDA does not undertake its own research on this issue.

Monitoring

USDA does not monitor for Asian carp.

Rapid Response

USDA does not undertake rapid response activities on this issue.

Risk Assessment for Asian carp

USDA does not undertake risk assessment activities on this issue.

Active Prevention

Eagle Marsh lies within the watershed break for the Mississippi River Basin and the Great Lakes (Lake Erie) Basin. A portion of the water draining from Eagle Marsh drains into Graham McCullough Ditch and ultimately into the Mississippi River, and a portion drains into Junk Ditch and then on to Lake Erie. Aquatic nuisance species (ANS) have been identified as a serious issue in the Great Lakes. In particular, Asian carp is an ANS of high concern. The Asian Carp Regional Coordinating Committee has identified the Eagle Marsh watershed as a site of critical concern to stop movement of Asian carp from the Mississippi River Basin to the Great Lakes.

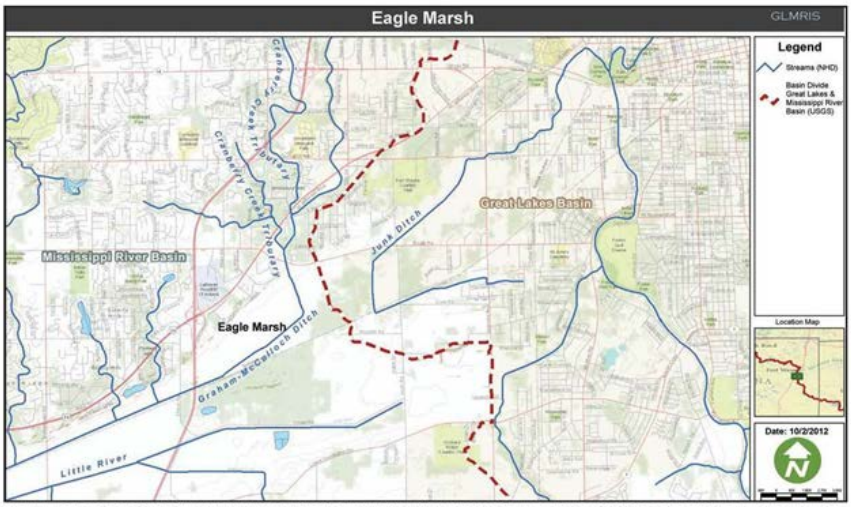


Figure 7. Location of Eagle Marsh relative to Fort Wayne, Indiana. The approximate divide between the Great Lakes Basin and Mississippi River Basin is shown by the red-white line. Base imagery courtesy of Bing Maps.

At Eagle Marsh in Fort Wayne, Indiana, a wetland site is owned jointly by Little Rivers Wetlands and Indiana Department of Environmental Management. USDA – NRCS worked with federal, state, and local agencies to identify options for designing a berm to permanently restrict Asian carp entry into the Great Lakes at the Eagle Marsh site. NRCS holds a Wetland Reserve Program (WRP) easement on the site. To implement closure, Wetland Reserve Program funding will be used to cover costs of the WRP easement, and GLRI funding will be used to tie the berm in at the ends of the project, off the WRP property. The

project will create a berm that will ensure no mixing of the watersheds at the 100-year flood level, at an elevation based on USACE studies.

In 2013/2014, NRCS engineering staff developed construction plans for Eagle Marsh in consultation with Indiana DNR and USACE staff. The plan involves construction of an earthen berm with associated structures that will stop mixing of waters between the two watersheds. Federal and state permits are required to do this proposed work, and Indiana DNR has secured the appropriate permitting. As a part of the permitting process, off-site mitigation was required. IDNR has secured additional funds to complete the mitigation work. Indiana DNR advertised a bid for the construction work in late August 2014, and a contractor was selected and given the notice to proceed on October 3, 2014. Construction activities will begin during fall 2014. The construction bid completion date is September 1, 2015.

Outreach

During fall 2013, three Asian carp forums were held (Fort Wayne, Portage, and Indianapolis) to provide information on Asian carp issues within Indiana. Presentations were given by representatives of Indiana DNR, USDA-NRCS, White House Council on Environmental Quality, and USACE. These forums were attended by private individuals and representatives of state, federal, and local governments.

Law Enforcement/Regulatory Activities

USDA did not undertake law enforcement/regulatory activities on this issue.

Research

USDA did not undertake research on this issue.

Financial Support Provided to Partner Agencies/Organizations to Support Asian carp Prevention

Financial support provided to partner agencies/organizations to support Asian carp prevention are as follows:

- Partnership agreement with the NGO Wildlife Forever to educate the public about AIS and to encourage behaviors that prevent spread of invasive species. A portion of the activities in this partnership specifically relate to preventing spread of Asian carp (approximately 20 percent of total partnership contribution from USDA – Forest Service to Wildlife Forever). Outreach activities include billboards, TV and radio public service announcements, presentations at public events, and social media campaigns.

- Funding has been secured from USDA - GLRI to accomplish the work off the WRP easement. An agreement was signed between Indiana DNR and NRCS for the GLRI portion of the work. This agreement involves expenditure of $600,000, with effective dates from April 1, 2014, through September 30, 2016. For the WRP portion of the work, a plan/schedule of operations was signed by Indiana DNR, Little Rivers Wetlands (as co-owners), and NRCS. This plan was signed on September 8, 2014, with anticipated cost of $2,208,884.00. The effective date for the WRP plan is September 8, 2014.

From June 2012 to June 2014, expenditures by USDA to control spread of Asian carp totaled $15,000 (from Agency Base Appropriations), and covered travel and salary for meeting attendance and committee work.

U.S. Coast Guard (USCG) Ninth District

The role of USCG is to ensure safety, security, and environmental protection. USCG manages waterways through Regulated Navigation Areas, and safety and security zones. USCG regulates the marine industry and supports marine transportation systems.

USCG major activities in controlling Asian carp in the Ohio and UMRBs include the following:

Interagency Coordination

The role of the Coast Guard is to ensure safety, security, and environmental protection of the Great Lakes and the Western Rivers. With respect to Asian carp, USCG focuses on ensuring safety of mariners, vessels, ACRCC personnel, and the public in the vicinity of the electric fish barrier and at any other locations of Asian carp activities on or near federally navigable waterways. USCG also exercises control of ballast/potable water on vessels transiting the CAWS to reduce risk of Asian carp movement toward the Great Lakes. To carry out these responsibilities, USCG manages federally navigable waterways through establishment and enforcement of Regulated Navigation Areas and safety zones.

When operations associated with the electric fish barrier, rapid response actions, research projects, or any other Asian carp activity will impact flow of traffic on a navigable waterway, USCG issues a Regulated Navigation Area or safety zone and provides notice to the public and mariners of the planned activities and expected impact on navigation. If a partial or full closure of a navigable waterway is required, USCG may deploy assets on scene to enforce the closure. For extended closures, USCG may also establish a temporary vessel traffic service that tracks delayed vessels and facilitates orderly resumption of traffic after the closure is lifted.

The Ninth Coast Guard District, in Cleveland, Ohio, is the primary USCG representative to the ACRCC. The Ninth District participates in regular ACRCC teleconferences to discuss Asian carp control activities. The Ninth District also participates in ACRCC Senior Executive teleconferences among the federal agencies to collaborate on Asian carp projects. Finally, Ninth District personnel travel to attend ACRCC meetings, which are normally held in or near Chicago, Illinois. USCG Headquarters in Washington, DC, supports Asian carp funding requests and processes interagency agreements regarding Asian carp activities. These offices also represent USCG in briefings on Asian carp activities to the Office of Management and Budget and Congressional representatives.

Research

The Coast Guard Research and Development Center conducts independent Asian carp research and advises the Ninth Coast Guard District, Sector Lake Michigan, and Marine Safety Unit Chicago on technical issues regarding Asian carp control measures.

On September 17, 2013, USCG's Research and Development Center (RDC) delivered a report titled "Chicago Sanitary and Ship Canal (CSSC) Marine Safety Risk Assessment." This report categorized risks to mariners and shore personnel in the vicinity of the CSSC electrified barriers near Romeoville, Illinois.

Monitoring

USCG does not participate in Asian carp monitoring.

Rapid Response

USCG does not directly conduct rapid response operations; however, USCG does support response activities of other ACRCC members when their efforts could conflict with vessel traffic on federally navigable waterways. In these instances, USCG may establish a temporary safety zone to restrict or stop vessel traffic in the vicinity of Asian carp rapid response activities in order to ensure safety of responders and maritime traffic. USCG did not support any rapid response actions from June 2012 to June 2014.

Risk Assessment Regarding Asian carp

USCG's RDC performed two risk assessments from June 2012 to June 2014.

- On January 4, 2011, RDC delivered a report titled, "Water Transport During Normal Operation of Towboats and Barges in the Illinois River," which detailed potential for barges and towboats to transport Asian carp across the electrical fish dispersal barrier in the CSSC.
- On March 22, 2012, RDC delivered a second report titled, "Survivability of Asian Carp in Barge Tanks," which detailed findings from experiments with Asian carp larvae in tanks and voids of barges and towboats. The experiments addressed potential for vessels to transport Asian carp across the electrical fish dispersal barrier in the CSSC.

Active Prevention

USCG does not participate in active Asian carp prevention efforts. USCG monitors efforts of other ACRCC members engaged in active prevention, and provides support when prevention efforts could conflict with vessel traffic on federally navigable waterways. In these instances, USCG may establish and enforce a temporary safety zone to restrict or stop vessel traffic in the vicinity of Asian carp prevention activities.

Outreach

USCG conducts public outreach when other agencies are engaged in electric barrier testing, maintenance, or construction activities; rapid response activities; fish suppression activities; tool/technology testing activities; or any other Asian carp action that could impact a federally navigable waterway. The type of outreach depends on possible impacts of these activities on vessels and mariners operating nearby (i.e., from awareness only to full waterway closures). Communication tools include Broadcast Notice to Mariners, Local Notice to Mariners, Marine Safety Information Bulletins, and in certain situations, direct telephone contact with local industry stakeholders.

In addition, on April 16, 2014, USCG organized a marine industry stakeholder meeting for federal agencies to provide an overview of the electric fish dispersal barrier, Asian carp control technologies currently under development, and findings from fish/barge interaction research by USACE and USGS. The agencies gathered stakeholder feedback on future research efforts and possible solutions that could mitigate risk from Asian carp entrainment in barge tows.

Law Enforcement/Regulatory Actions Focused on Asian carp Prevention

USCG has created the Safety Zones and Regulated Navigation Areas listed below.

Waterway Traffic Management, Safety Risk Assessment Tools	
Safety Zone , CSSC, Romeoville, Illinois	**Title 33 *Code of Federal Regulations* (CFR) Part 165.923(a)** All vessels are prohibited from transiting the safety zone with any non-potable water on board if they intend to release that water in any form within, or on the other side of the safety zone. Non-potable water includes, but is not limited to, any water taken on board to control or maintain trim, draft, stability, or stresses of the vessel. These provisions are enforced at all times.
Regulated Navigation Area, CSSC, Romeoville, Illinois	**Title 33 CFR Part 165.923(b)** USCG has established a permanent Regulated Navigation Area at the barrier to prescribe vessel size, type, and operating requirements. These requirements are necessary to protect vessels and mariners from hazards associated with the electric current radiating from the fish barrier. These provisions are enforced at all times.
Safety Zone, Brandon Road Lock and Dam to Lake Michigan including Des Plaines River, CSSC, Chicago River, and Calumet-Saganashkee Channel, Chicago, Illinois	**Title 33 CFR Part 165.930** To support Asian carp activities anywhere in the CAWS, USCG created a safety zone in 2010 that covers 77 miles of the CAWS and allows USCG to restrict or stop vessel traffic for Asian carp activities. Although the Safety Zone is always in place, USCG enforces the safety zone only when restrictions or closures are necessary. USCG strives to provide at least a 30-day notice to waterway users prior to safety zone enforcement, but immediate measures can be put in place without advanced notice if these are needed to protect mariners, vessels, or the public.

USCG has established a Regulated Navigation Area and Safety Zone from mile (MM) 296.1 to 296.7 on the CSSC that, among other stipulations, sets restrictions on discharge of non-potable water from vessels that transit the safety zone with intent to release that water in any form within or on the other side of the Safety Zone. The non-potable water requirements were implemented to address concerns about the potential transport of carp eggs, gametes, and juvenile fish in bilge, ballast, or other non-potable water.

USCG's regulatory effort in establishing and enforcing the Regulated Navigation Area and Safety Zone focuses primarily on safety. The document regarding the Regulated Navigation Area states: "the Coast Guard's Ninth District Commander has determined that the electric current radiated from the electric barriers poses certain safety risks to commercial vessels, recreational boaters, and people on or in portions of the CSSC in the vicinity of the barriers." Consequently, the Ninth Coast Guard District Commander

has concluded that a Regulated Navigation Area is necessary to mitigate such risks. Several times a year, in support of operations between MM 296.1 and 296.7 on the CSSC, USCG has issued a Notice of Enforcement for the safety zone listed within 33 CFR 165.930. Operating out of a trailer provided by the Will County Office of Emergency Management, USCG Auxiliary and Active Duty personnel coordinate with vessels from the Romeoville Fire Department, and/or Illinois DNR to manage passing vessel traffic at each end of the Safety Zone.

Research

USCG does not develop its own Asian carp prevention tools/techniques. USCG supports other agencies as they develop tools/techniques by providing advice focused on safety of vessels and mariners that may need to operate near Asian carp prevention measures.

Financial Support Provided to Partner Agencies/Organizations to Support Asian carp Prevention

USCG did not provide financial support to partner agencies/organizations in their efforts to address Asian carp.

USEPA

Interagency Coordination

USEPA serves as the Co-chair for the ACRCC Executive Committee. USEPA also develops the Asian Carp Control Strategy Framework each year to track each effort by federal and state agencies. USEPA routinely conducts multi-agency calls and quarterly ACRCC meetings to discuss and coordinate Asian carp efforts, share knowledge and expertise, and prevent duplication of efforts by agencies where possible.

Field Monitoring

USEPA provided funding for electrofishing, seining, netting, and commercial fishing to monitor for presence of Asian carp in the CAWS and areas of the Great Lakes Basin. In addition, USEPA provided GLRI monies for state ANS plans that outline strategies of states to monitor for Asian carp and other invasive species in the field.

Rapid Response

USEPA directly provided Incident Command System (ICS) and rapid response training for state and federal fisheries management agencies to prepare them to respond to an incident of invasive species within their jurisdictions. USEPA conducted tabletop exercises with state and federal fisheries management agencies to enhance their capabilities to response to an incident of invasive species. USEPA provided GLRI funding for state and federal agencies for direct rapid response support and also for state agencies to develop their state ANS plans that include rapid response strategies and tactics for invasive species incidents.

Risk Assessment

USEPA provided GLRI funding for USGS, USFWS, USDA, and Illinois to conduct assessment activities throughout the Great Lakes and CAWS. Activities included assessments of establishment of Asian carp in new waterways, pathway impacts, and habitat selection. State ANS plans for which USEPA provided GLRI monies also include risk assessment actions.

Active Prevention

Through the GLRI, USEPA provided funding for the State of Ohio to assess closure alternatives for the Ohio Erie Canal and the Little Killbuck Creek to stop spread of Asian carp into the Great Lakes Basin. In addition, funding was provided to the State of Indiana to construct a barrier at Eagle Marsh to ensure Asian carp cannot traverse from the Wabash River into the Maumee River. USEPA also provided funding to the State of Illinois for targeted fishing activities to reduce Asian carp populations in the Illinois River, and to lower propagule pressure on the barrier system into the CAWS and the Great Lakes Basin.

Outreach

GLRI funding was provided by USEPA to USFWS for the Asiancarp.us website. USEPA provided staff and contractor support for ACRCC public meetings to further outreach to the public and industry partners. USEPA provided GLRI funds to the State of Illinois, the Great Lakes Fisheries Commission, and the State of Michigan to promote public education through videos, pamphlets, and other materials for agency and public use.

Law Enforcement/Regulatory Actions

USEPA provided GLRI funding for the Great Lakes' States ANS plan, and provided funding to USFWS and Illinois DNR for law enforcement actions against Asian carp.

Research

USEPA GLRI funding was provided to the USGS for a several research activities including seismic technology development, targeted piscicide development, attractants and repellents, and food selection. GLRI funding was also provided to Illinois DNR for net development. USFWS received funding from USEPA for several new tools and research activities, including the registration process, ECALS, and eDNA marker development for analysis.

Financial Support

Total funding from GLRI to all the agencies for work cited above is nearly $50 million. Specific funding amounts are conveyed in this report within sections discussing activities of each agency.

USFWS

Upper Mississippi River basin

With FY13 and FY14 funding, the La Crosse Fish and Wildlife Conservation Office (FWCO) initiated an acoustic telemetry study in the UMR. The purpose of the telemetry study is to identify specific areas Asian carp like to congregate, define the break from the established invasion front (where Asian carp are present and have reproduced and recruited successfully) and the advanced front (Asian carp present in noticeable abundance but no evidence or documentation of successful recruitment), and determine triggers of fish movement or population advancement. Additionally, the USFWS will try to determine if there is any relationship in movement behavior or invasion advancement relative to population density. Remote receivers are in place from Pools 5 to 19 on the UMR. This work compliments an array of receivers in place by Missouri Department of Conservation (MDC) from Pool 20 downstream and by Minnesota DNR from Pool 5 upstream. Southern Illinois University and the USACE also have receivers

in the Illinois and Des Plaines rivers. Additionally, MDC has placed MDC and USFWS receivers on commercial navigation vessels travelling from St. Paul to New Orleans. To complement the MDC study and to corroborate with them, USFWS tagged 5 fish in pool 20 in the fall of 2013. In the fall of 2013 and spring of 2014 USFWS tagged 40 silver and bighead carp in pools 17, 18, and 19 with an additional 36 silver carp tagged in Pool 17 in the fall of 2014. Movement patterns show fish intermixing among pools 17-19, but no fish have moved into or out of Pool 20. One fish moved up into Pool 16 but then moved back down into Pool 18. This was the only fish in our study that moved upstream of Pool 17.

While tagging fish for study in Pool 17, USFWS assisted USGS with a Judas fish study on Pools 17-20. Because of the schooling behavior of Asian carp, USGS is testing the feasibility of using telemetered Asian carp to locate other resident Asian carp. If feasible, this could be used to assist with Asian carp capture and removal efforts.

In addition to the efforts to capture fish for these telemetry studies, large mesh gill nets were deployed in pools 7, 8, 9 and 10 to monitor for adult Asian carp. USFWS conducted early detection efforts collecting water samples for eDNA analysis from pool 5A, 6, 8 and 9. These samples are currently held at Whitney Genetics and scheduled to be analyzed and completed in early December 2014. In cooperation with Minnesota's Aquatic Invasive Species Center, La Crosse FWCO will also collected samples from pools 2, 5A, and St. Croix River. These samples are be archived at the MAISC.

USFWS is working with USGS and Iowa State University to evaluate Asian carp reproduction in the Upper Mississippi River basin. Ichthyoplankton samples were collected from 12 locations in the Des Moines, Skunk, Iowa, Cedar, and Mississippi Rivers in southeastern Iowa (Figure 1). These samples are currently being analyzed at Iowa State University. While egg morphology was once believed to be a reliable predictor of Asian carp eggs, recent findings have indicated that genetic analyses are necessary to identify Asian carp eggs from other native fishes. Iowa State is currently extracting the DNA from the samples and will follow up with PCR and DNA sequencing to identify each sample to species. Results should be complete by late winter.

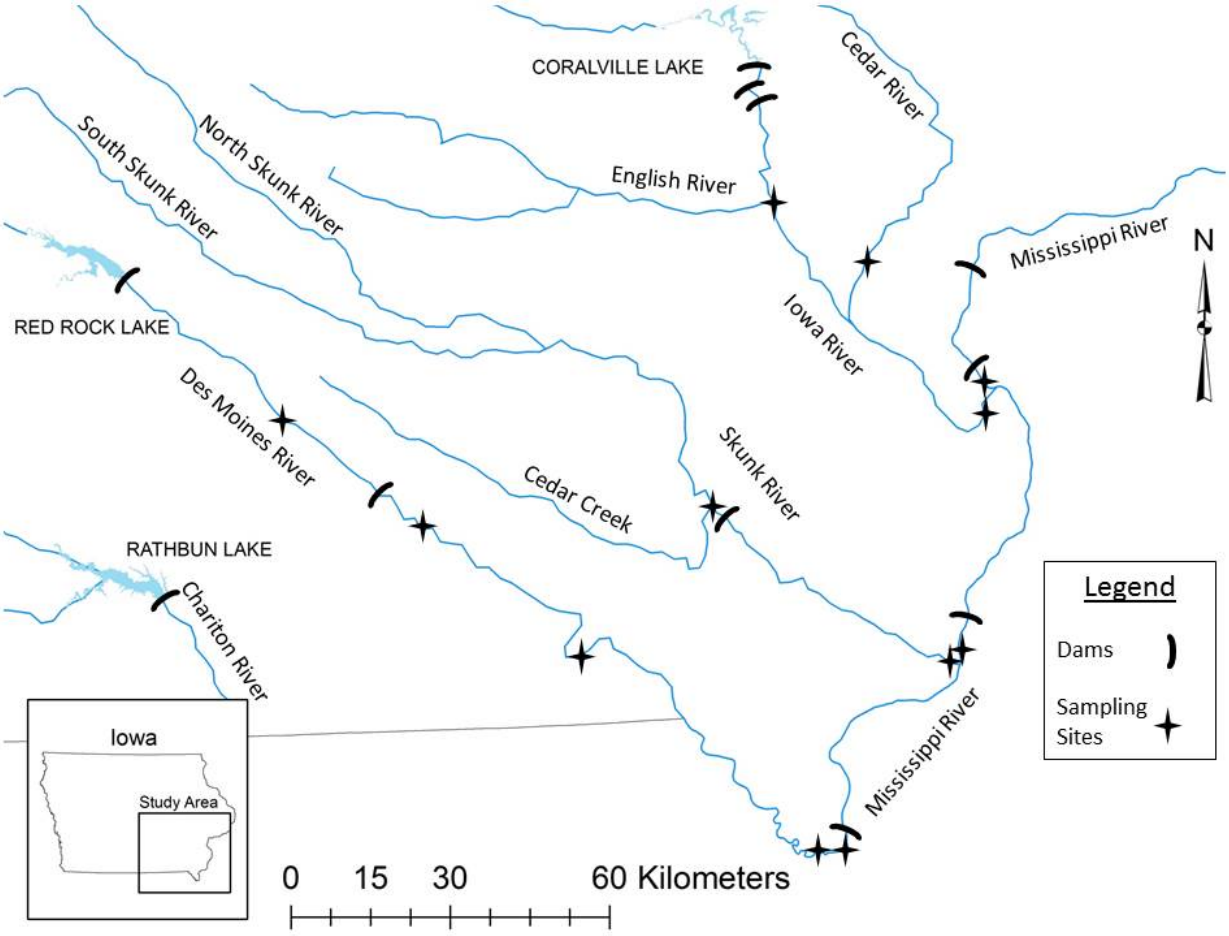


Figure 1. Approximate sampling (star) and dam (curved line) locations in rivers across southeastern Iowa (map provided by Iowa State University).

The USFWS also contributed greatly to the effort in the Chicago Area to monitor Asian Carp in the CAWS. Crews worked on several different aspects of the monitoring project including eDNA sampling by coordinating 2 weeks of sampling in the and collecting 380 samples. Seasonal Intensive Monitoring was conducted by electrofishing and gill netting during 3 weeks and fixed and random site monitoring downstream of the barrier was also conducted for 3 weeks. Assistance was also provided to the Barrier Defense effort, assisting with Asian carp removal in downstream pools of the river.

The USFWS has expended significant effort in coordinating and communicating Asian carp studies and information amongst our partners and interested parties along the UMR. An Interagency team was developed that includes representatives from each of the UMR states, USGS, USACE, Universities of MN, Iowa State and Southern Illinois. This team met via teleconference multiple times and reviewed an Asian Carp Management Action Plan for the UMR. The USFWS plans to complete a final draft by the end of 2015. Acknowledging that immediate coordination of field plans would be useful, the USFWS communicated with and met with our partners in the UMR and drafted a document outlining all Asian carp field activities planned for 2014. Additionally, La Crosse FWCO maintains an email list for distributing information on notable Asian carp captures and other time sensitive Asian carp information.

In FY 2013, the USFWS received base funds of $186,540 to support Asian carp control efforts in the UMR. In FY 2014, the Service received $280,000 for the UMR. Total support for the two years was $466,540.

Ohio River Basin

In the Ohio River Basin (ORB), Carterville FWCO completed numerous activities using FY13 and FY14 funding. These activities include eDNA sampling, telemetry, hydroacoustics work, monitoring with traditional gears, and response actions.

In order to determine the potential presence of Asian carp in sensitive areas (e.g. where there are potential connections to the Great Lakes) and other areas on the invasion front, numerous eDNA samples were taken in the ORB. In 2013, 200 samples were collected and analyzed for the eDNA of Bighead Carp and Silver Carp, returning two positive detections in the Ohio River mainstem, over 60 river miles upstream of where individual Asian carp have been captured. In 2014, eDNA monitoring will collect 935 samples from several pools and tributaries of the Ohio River.

Working with state and federal partners, USFWS has partially funded and deployed a stationary telemetry receiver network in the ORB. This receiver network is located in the upper portions of the ORB near the invasion front in Willow Island, Belleville, Racine, R. C. Byrd, Greenup, Mehldahl, and Markland Pools. Currently approximately 60 receivers are deployed and 60 tagged fish have been released and are being monitored. This telemetry project will help managers to monitor the rate of spread and rates of passage through dams on the ORB. Additionally, tagged fish may be followed and attempted to be recollected in hopes that additional Asian carp near our tagged fish can be located and removed.

The USFWS participated with Ohio DNR in June of 2014 during a large effort to find and remove any potential Asian carp in the Muskingum River Basin, a potential connection to the Great Lakes. Electrofishing crews sampled 125 sites along the entire stretch of the Muskingum River, as well as portions of the Tuscarawas and Walhonding rivers.

The Carterville FWCO has done some preliminary hydroacoustics work in the ORB in hopes of identifying more productive areas to sample and remove Asian carp. Plans are being developed to attempt collection of eggs and larvae to establish where spawning and recruitment is taking place. Additionally, there are plans to perform microchemistry analysis on Asian carp otoliths to determine the origin of the Asian carp population.

The USFWS, and the Carterville FWCO in particular, have expended significant effort in coordinating and communicating Asian carp control and management activities with amongst our partners in the ORB. A group of interested federal and state agencies meets regularly to coordinate and carry out the field activities listed above. This team meets once a year via teleconference and once a year face to face. The Carterville FWCO drafted a Scope of Work for all field activities that is used to plan and carry out field work projects. In addition, the USFWS, in conjunction with the Mississippi Interstate Cooperative Resource Association is forming a group that will draft a comprehensive management plan and work to coordinate all aspects (not just field projects) of Asian carp control and management in the ORB in the future. The Carterville FWCO also maintains an email list for distributing information on notable Asian carp happenings in the ORB and facilitates a website for data sharing among partner agencies.

In FY 2013, the Service received $186,460 directed to support Asian carp control efforts in the ORB. In addition FY 2014, the Service received $140,000 to support Asian carp control efforts in the ORB. Total support for the two years was $326,460.

Summary of Cooperating States Actions

The following is a detailed summary of activities of agencies of cooperating states in the UMRB and ORB. These summaries are based on information provided directly from the state agencies.

This section of the report, as required by the Water Resources Reform and Development Act of 2014 (WRRDA), describes coordinated strategies established and progress toward the goals of controlling and eliminating Asian carp in the UMRB and ORB and tributaries. This component of the report summarizes efforts of non-federal partners to control spread of Asian carp in the UMRB and ORB and tributaries, and provides accounting of non-federal expenditures to control spread of Asian carp.

Each state in the ORB and UMRB was asked to provide a narrative summary of its agencies' activities to prevent spread of Asian carp in the UMRB and ORB between June 10, 2012, and June 10, 2014, grouping specific activities within the following general categories:

- Interagency coordination;
- Field monitoring for Asian carp;
- Rapid response (specific discrete and intensive detection/eradication/containment efforts based on indications of elevated potential for Asian carp presence);
- Risk assessment regarding Asian carp;
- Active prevention (e.g., implementation or assessment of dispersal barriers, targeted fishing to reduce Asian carp populations, focused containment activities);
- Outreach with industry or public/stakeholder participation focused on Asian carp prevention;
- Law enforcement/regulatory actions focused on Asian carp prevention;
- Research focused on development of new tools/techniques for Asian carp prevention;
- Financial support provided to partner agency/organizations to support Asian carp prevention.

Summaries of activities and expenditures by the states to control spread of Asian carp in the ORB and UMRB (June 2012 - June 2014) are as follows:

In the ORB:

Agency Activities	Indiana	Kentucky	New York	Ohio	North Carolina	Pennsylvania	Tennessee	West Virginia
Financial support provided to partner agency/ organizations	Personnel costs estimated at $90,000. In addition, two Purdue contracts totaled $364,000. Little River Wetlands Project was paid $70,000 to maintain the fence and berm at Eagle Marsh.	$150,000 - COLCOM Foundation for contract fishing on the Ohio. $40,000 – contribution for contract fishing. $100,000 – transfer in process from West Virginia Division of Natural Resources (WVDNR) to Kentucky Department of Fish and Wildlife Resources (KDFWR) for contract fishing. Conservative estimate of staff time – $75,000.	Estimated expenditures total $18,650	No state funding.	No fiscal expenditures directly related to Asian carp prevention and control.	$150,000 was awarded to the Ohio River Fisheries Management Team (ORFMT) by Colcom Foundation. Staff time total approximately $25,000	Estimated staff expenditures total $14,000.	Estimated expenditures total $191,000.

In the UMRB:

Agency Activities	Iowa	Minnesota	Missouri	Wisconsin
Financial support provided to partner agency/organizations	Funded a research project totaling $212,555 conducted by Iowa State University.	Minnesota Environment and Natural Resource Trust Fund (ENTRF) – $540,000; Minnesota Outdoor Heritage Fund – $7.5 million. State of Minnesota – $16 million. Minnesota DNR base funding – ~$85,000/year. Over 20 staff have contributed time to the Asian carp effort.	No state funding.	As Mississippi River Interstate Cooperative Resource Association (MICRA) chair, provided approximately 1,200 hours of staff time and $10,000 of additional support. Fisheries also provided time and expertise as part of traditional commercial and riverine monitoring. Cooperated with the U.S. Fish and Wildlife Service (USFWS) on eDNA sampling. Approximately $6,000 was expended in a contract to Cornell. Developed Asian carp signs costing $973.

State of Illinois activities and funding to control spread of Asian carp in both the UMRB and ORB (June 2012 - June 2014) were as follows:

Agency Activities	Illinois
Financial support provided to partner agencies/organizations	Statewide fishery strategic plans does support local fishery management, but statewide aquatic nuisance species (ANS) funding available to partnerships is limited to approximately $24,000 supplied by USFWS to support the Illinois ANS plan. Up to $5 million annually has been awarded as part of USEPA/GLRI for upper Illinois River/Great Lakes Asian carp work.

Council on Environmental Quality

The Council on Environmental Quality (CEQ) Asian carp efforts focused on support and coordination of ACRCC efforts to prevent invasive Asian carp from establishing in the Great Lakes as chair of the ACRCC. CEQ worked with USEPA in the development of the Asian Carp Control Strategy Frameworks (Framework). The Framework outlines an aggressive, multi-tiered strategy including monitoring; barrier construction; harvesting; enforcement and outreach. The actions identified in the Framework were carried out by the ACRCC, led by CEQ, with support from federal, state, provincial, and local agencies. Under the direction of CEQ, the ACRCC management strategy and current and future actions were reported through the ACRCC's website at www.asiancarp.us.

CEQ also led the coordination of Great Lakes Asian carp prevention communication efforts through the continued engagement of Federal, state and local governments. CEQ led the efforts of the ACRCC to provide outreach to Congressional staff and media contacts. In addition, CEQ led the coordination of Great Lakes Asian carp prevention communication efforts by engaging Federal, State, Provincial agencies and stakeholders in both the private and public sectors.

CEQ, through the ACRCC provided strategic oversight of each of the actions outlined in the Framework, including:

- Coordinated the development of the annual Framework;
- Assisted in the development and release of the annual Monitoring and Response Plan;
- Worked with the USACE on the public/stakeholder involvement for the GLMRIS Report;
- Worked with Indiana DNR, USACE, USDA-NRCS and Ohio DNR to continue the progress to close off the pathways in Indiana (Eagle Marsh) and Ohio (Killbuck Creek and Ohio-Erie Canal);
- Assisted in the coordination of scientific research and development, including public and stakeholder involvement;
- Worked with the ACRCC members to develop the Asian Carp Toolkit (currently available at www.asiancarp.us);
- Assisted in the development of the Ohio River and Upper Mississippi River Asian carp control efforts (technology transfer); and
- Worked with Illinois DNR and other entities to identify potential marketing efforts for Asian carp products.

The role of CEQ has evolve slightly in 2014 to continue to provide strong support and guidance on policy, strategy, budget, and agency coordination while USFWS will be taking on an expanded mission as chair of the ACRCC and leading a multi-agency effort slow the spread of Asian carp in the Upper Mississippi and Ohio River basins.

ILLINOIS

Interagency coordination

As part of the Asian Carp Monitoring and Response Workgroup, Illinois coordinates efforts on monitoring, removal, research, and response regarding Asian carp activities; all coordination efforts are outlined in the Monitoring and Response Plan for Asian Carp in the Upper Illinois River and Chicago Area Waterway System. All projects are summarized in the Asian Carp Monitoring and Response Plan Interim Summary Reports.

Field Monitoring

- **Fixed Site Monitoring Upstream of the Dispersal Barrier:** This project included standardized monitoring with pulsed-DC electrofishing gear and contracted commercial fishers at fixed and random sites in the CAWS upstream of the Electric Dispersal Barrier.
    - Estimated over 12,030 person-hours spent sampling at fixed sites upstream of the Electric Dispersal Barrier during 2010-2013.
    - 636.5 hours spent electrofishing and 420 kilometers (km) (261.1 miles) of trammel/gill net deployed at fixed sites during 2010- 2013 and at random areas during 2012- 2013. Sampled 227,181 fish representing 72 species and 2 hybrid groups during electrofishing and trammel/gill netting at fixed sites during 2010- 2013 and at random sites during 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 2 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.
- **Strategy for eDNA Monitoring in the CAWS**: This project involved a strategy for bi-weekly eDNA monitoring in the CAWS upstream of the Electric Dispersal Barrier.
    - Two eDNA comprehensive sampling events occurred in the CAWS at four regular monitoring sites in 2013.
    - June event: 18 positive detections of Silver Carp DNA, 0 positive detections of Bighead Carp DNA.
    - November event: 3 positive detections of Silver Carp DNA, 0 positive detections of Bighead Carp DNA.
    - Positive detections consistent with previous patterns of eDNA distribution in the CAWS.
- **Larval Fish and Productivity Monitoring:** Sampling for fish eggs and larvae and productivity monitoring occurred biweekly from May-October 2012 at 10 sites downstream of the Electric Dispersal Barrier (LaGrange to Brandon Road pools) and at 4 sites in the CAWS upstream of the barrier.

- Over 500 larval fish samples were collected at 13 sites across the length of IWW during May-October 2013, with capture of over 27,000 larval fish, including 344 larval Asian carp.
- Larval Asian carp were collected in the Peoria pool only in May, and in the LaGrange pool only in June. No Asian carp larvae were detected in the upper IWW or in Illinois River tributaries.
- Phosphorus concentrations were highest in the Des Plaines River and the lower CAWS. Chlorophyll *a* concentrations did not appear to correlate with phosphorus concentrations, and were highest in the lower Illinois River.
- Zooplankton densities in the CAWS appeared similar to or higher than those found in the Illinois River, suggesting that the CAWS can provide sufficient food resources for Asian carp.

- **Young-of-Year and Juvenile Asian carp Monitoring**: Monitoring for presence of young-of-year Asian carp in the Illinois River, Des Plaines River, and CAWS occurred via sampling for other projects outlined in the Asian Carp Regional Coordination Committee's Monitoring and Response Plan (MRP), and targeted a segment of the Asian carp population typically missed with use of 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 millimeters (mm) (6 inches) long in the CAWS and IWW 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 miles downstream from the Electric Dispersal Barrier.
- **Distribution and Movement of Small Asian carp in the IWW:** This project in 2012 further focused on monitoring distribution, abundance, and age structure of small Asian carp in the middle and upper IWW using mini-fyke nets; large-frame, small-mesh fyke nets; electrofishing; and push trawls to collect fish.
  - A total of 37,790 fish specimens were collected and examined. Sixty seven species and one hybrid combination were identified. Seven species collected were non-native exotics.
  - No young-of-year Asian carp were collected during 2013.
  - Lack of collection of young-of-year Asian carp suggests that little or no successful reproduction occurred upstream of the reach of rivers Illinois DNR examined during 2013. Locations where young-of-year Silver Carp were collected in 2012 still are the farthest upstream documentation of young-of-year Asian carp in the IWW (at River Mile 194).

- **Fixed Site Monitoring Downstream of the Dispersal Barrier**: This project included monthly standardized monitoring with pulsed-DC electrofishing gear and contracted commercial fishers at four fixed sites downstream of the Electric Dispersal Barrier in Lockport pool and downstream of the Lockport, Brandon Road, and Dresden Island locks and dams. It provides information regarding location of the Asian carp detectable population front and upstream progression of populations over time.
    - An estimated 7696.5 person-hours were spent sampling at fixed, random, and additional sites and netting locations downstream of the Electric Dispersal Barrier during 2010-2013.
    - 222.5 hours were spent electrofishing and 236 km (146.7 miles) of trammel/gill net was deployed.
    - 105,466 fish were collected, representing 92 species and 7 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 during electrofishing from 2010-2013.
    - Eighteen Bighead Carp and 293 Silver Carp were captured by electrofishing in Marseilles pool from 2010-2013.
    - The detectable population front of mostly Bighead Carp was 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 has occurred within the past 7 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.

Response Actions

- **Illinois DNR threshold framework**: This was established to support decisions regarding response actions to remove any Asian carp from the CAWS upstream of the Electric Dispersal Barrier by use of conventional gear or rotenone.
    - No Response actions in 2013.
    - Completed three planned intensive surveillance events by use of 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 discussed in their respective sections.
- **Planned Intensive Surveillance in the CAWS**: This project is a modification of response actions in the CAWS, and surveillance events will target areas previously monitored during response actions. These efforts will benefit from advanced planning, and will occur at locations where repeated detections of eDNA occurred in previous years, indicating potential presence of Asian carp in the waterway.

- Completed three planned intensive surveillance events by use of 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, made three 800-yard (732-meter)-long commercial seine hauls, and deployed three tandem trap nets and eight hoop nets equal to 25.2 net-days of effort.
- Across all response actions and gears, collected 22,896 fish representing 50 species and 3 hybrid groups.
- Examined 4,757 young-of-the-year Gizzard Shad and found no Asian carp young-of-the-year.
- No Bighead Carp or Silver Carp were captured or observed during response actions.

- **Barrier Maintenance Fish Suppression:** This project involves a fish suppression plan to support U.S. Army Corps of Engineers (USACE) maintenance operations at the Electric 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 by use of split-beam hydroacoustics, 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 Barrier 1 and 2A for necessary barrier fish suppression in three separate operations during the reporting period.
  - A total of 115 fish were removed by use of pulsed DC-electrofishing and 9-meter (30-foot)-deep gill nets, with 27 fish > 305 mm (12 inches) in length.
  - For 2 hours and 20 minutes, split-beam hydroacoustics and side-scan sonar were used to assess 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
- **Barrier Defense Asian Carp Removal Project:** **T**his program was established to reduce numbers of Asian carp downstream of the Electric Dispersal Barrier through controlled commercial fishing. Illinois DNR anticipates that reducing Asian carp populations will lower propagule pressure and the chances of Asian carp gaining access to waters upstream of the barrier. Primary areas fished include Dresden Island, Marseilles, and Starved Rock pools.
  - Contracted commercial fishers and assisting Illinois DNR biologists deployed 1585 km (985 miles) of net in the upper IWW from 2010 to 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).
- **Monitoring Asian carp Population Metrics and Control Effort**: 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, and Dresden Island pools of the Illinois and Des Plaines Rivers.

- Although data processing is ongoing, Asian carp abundance appeared to be at a low level in 2012-2013. Poor recruitment and natural mortality, perhaps coupled with harvest, contributed to this pattern.
- Continued contract harvest in the upper Illinois River (above Starved Rock Lock and Dam) plus intensive commercial harvest in the lower Illinois River may reduce density, potential recruitment, and perhaps immigration of Asian carp and their hybrids toward the location of the electric defense barrier in Lockport pool.

- **Telemetry Monitoring Plan**: This project uses ultrasonic transmitters implanted into Asian carp and surrogate species to assess if fish are able to challenge and/or penetrate the electric barrier system and pass through navigation locks in the upper IWW. An array of stationary acoustic receivers and mobile tracking was used to gather information on Asian carp and surrogate species movements.
  - To date, Illinois DNR has noted 8.9 million detections from 315 tagged fish.
  - Our conclusion for testing to date from the small fish and adult fish telemetry studies is that the barriers are effectively preventing all upstream passage of tagged fish.
  - Inter-pool movement of tagged fish occurs in both directions through all locks within the study area except for upstream movement through the Brandon Road Lock.
  - Asian carp are consistently using the Kankakee River, Hanson Material Services East Pit, and Rock Run Rookery.
  - While two tagged fish have approached the Brandon Road Lock and Dam to date, it appears that the Asian carp population front is still at River Mile 281.5 near Rock Run Rookery.
  - Both Silver Carp and Bighead Carp move similarly within the Illinois River.
  - Bighead Carp appear to be more active during the summer months.
  - Proportions of diel and seasonal movements are related, with most movement occurring during spring and summer, as well as at night and during crepuscular diel periods.

- **Monitoring Fish Abundance, Behavior, and Fish-Barge Interactions at the Barrier:** This project uses split-beam hydroacoustics, side-scan SONAR, Dual-Frequency Identification SONAR (DIDSON), and caged fish experiments to assess fish abundances and behavior at the electric barrier system designed to prevent fish passage between the Mississippi River and Great Lakes Basins. This is an updated plan that includes protocols for monitoring fish at the electric barrier system.
  - Of 72 10-minute DIDSON samples that were recorded, 44 of them (61 percent) recorded at least one school of fish breaching the barrier.
  - Of the 44 samples in which a breach was recorded, 27 of them (61 percent) recorded multiple schools of fish breaching.
  - All fish that breached the barrier did so in schools, and the average sizes of the fish were 5-10 centimeters (cm_ (2-4 inches) total length, as measured via the DIDSON software.

- Fish sampling within and around the zone of ultimate field strength in the Electric Dispersal Barrier revealed all *Clupeidae* species (Gizzard Shad, Threadfin Shad, and Skipjack Herring).
- Only 1 out of 36 caged fish that were moved through the Electric Dispersal Barrier was incapacitated while inside the rake-to-box barge junction wedge.
- Several small, wild fish that were not stocked by USFWS were observed being entrained beyond the Electric Dispersal Barrier within the rake-to-box junction wedge and the pocket eddy adjacent to the tow vessel.
- All barge configurations yielded some percentage of fish entrainment beyond the Electric Dispersal Barrier when loose, tethered fish were deployed either within various barge junction wedges or immediately below the barrier as the barge was approaching.
- Alternative modes of barge navigation through the Electric Dispersal Barrier were either impractical or still facilitated fish movement beyond the barrier.
- Four complete assessments of the Electric Dispersal Barrier system were performed during generator testing.
- Pre- and post-barrier switch surveys were performed on two occasions.
- On three occasions, Illinois DNR assisted partners during rapid-response clearing events by informing crews on site of how many fish to target and how many fish still remained within the Electric Dispersal Barrier system.

- **Evaluating Asian carp Detection Techniques with SONAR:** This project evaluates use of multiple hydroacoustic SONAR frequencies to assess whether live Asian carp can be specifically identified apart from any other fish species. These identifications could significantly reduce the amount of water targeted for future response efforts.
  - Illinois DNR collected and ensonified 436 different fish, and analysis is ongoing to determine if Asian carp can be discriminated from other fish.

- **Des Plaines River and Overflow Monitoring:** This project included periodic monitoring for Asian carp presence and spawning activity in the upper Des Plaines River downstream of the Hofmann Dam. In a second component, efficacy of the Asian carp barrier fence constructed between the Des Plaines River and CSSC was assessed by monitoring for any Asian carp juveniles that may be transported to the CSSC via laterally flowing Des Plaines River floodwaters passing through the barrier fence.
  - Collected 5,052 fish representing 49 species and 2 hybrid groups from 2011-2013 via electrofishing (30.5 hours) and gill netting (82 sets; 5,746 meters [6,284 yards]).
  - Illinois DNR basin survey completed 17 hours of electrofishing in 2013.
  - No Bighead Carp or Silver Carp have been captured or observed through all years of sampling.
  - Three Grass Carp were captured in 2013. Analysis indicated all three were triploid.

- **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 will 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.
- Asian carp were most abundant in the LaGrange and Peoria pools; abundance declined at upstream sites, and no Asian carp were observed 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 by use of pulsed-DC electrofishing gear in the Spoon, Sangamon, Mackinaw, and Kankakee Rivers during 2013. No Asian carp were observed in the Kankakee, 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.

- **Alternate Pathway Surveillance in Illinois:** This project creates a more robust and effective enforcement component of Illinois DNR's invasive species program by increasing education and enforcement activities at bait shops, bait and sport fish production/distribution facilities, fish processors, and fish markets/food establishments known to prefer live fish for release or food preparation. A second component involves surveys at urban fishing ponds in the Chicago Metropolitan area included in the Illinois DNR Urban Fishing Program, as well as at ponds where positive detections of Asian carp eDNA have occurred by use of conventional gears (electrofishing and trammel/gill nets) in an effort to remove accidentally stocked Bighead Carp or Silver Carp.

  In Urban Fishing Pond Surveys:

  - Thirty-two Bighead Carp have been removed from five Chicago area ponds by use of electrofishing and trammel/gill nets since 2011.
  - Four ponds were sampled by use of electrofishing and trammel/gill nets during 2013.
  - An estimated 165 person-hours were spent sampling Chicago area ponds in 2013.
  - A total of 179 fishes were sampled representing 5 species and 1 hybrid group.
  - Six Bighead Carp were removed from Humboldt Park and Flatfoot Lake; a replica of the carp from Flatfoot Lake has been made for outreach and educational events.

Outreach With Industry or the Public/Stakeholder Participation Focused on Asian carp Prevention

Illinois DNR staff participated in numerous outreach events, including several sport shows and the Illinois State fair at which videos were demonstrated and several thousand "Be a Hero Transport Zero" bobbers were handed out. Illinois DNR partners with Illinois-Indiana Sea Grant to promote the message of stopping transport of ANS using various outreach materials such as bobbers, stickers, videos, and watch carps.

Law Enforcement/Regulatory Actions

- Educational materials produced to facilitate training in invasive species enforcement;
- Active participation and leadership role in Asian Carp Task Force;
- Arrest of aquatic life dealer illegally stocking and selling invasive species in Illinois;
- Plea agreements pending in court totaling over $24,000 in fines for aquatic life code violations;
- Bait dealer arrest for Viral hemorrhagic septicemia (VHS), restricted species permits, and aquatic life dealer's license violations;
- Seizure and disposal of two shipments of illegal aquatic life;
- Discovery of illegal sale of aquatic life parts in fish markets.

Research Focused on Development of New Tools/Techniques

- **Exploratory Gear Development:** Illinois DNR initiated research to develop gears that will be more effective than traditional gears at catching all life stages of Asian carp. Developers of these gears will consider Asian carp behavior, life history strategies, habitat types, and feasibility of use. Gears will be evaluated within areas known to have low, moderate, and high abundance of Asian carp populations. Gears are expected to be used for detection and monitoring of Asian carp, and for mass density reductions.
    - Butterfly (Paupier) net electrified in 2013 allowing for capture of Asian carp ranging in size from 100 to 900 mm.
    - Mamou net designed and deployed in 2013 was successful at capturing small-bodied fish ranging in size from 10 to 100 mm.
    - Purse seine seems a promising application for mass density removal efforts. Modifications to net are necessary to improve feasibility and effectiveness.
- **Unconventional Gear Development Project:** Illinois DNR initiated research 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 possibly Great Lakes spawning rivers.
    - Large (2-meter) hoop nets captured fewer fish of all taxa, and fewer Asian carp than standard (1.2-meter-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 applying traditional pounding methods or control sets.

- No Asian carp were captured in pound nets at Lake Calumet in 2013. 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).

- **Water Gun Development and Testing:** Pneumatic water guns that emit high-pressure underwater sound waves have potential to deter fishes or kill them if they are in close enough proximity to the wave source. This technology is under evaluation to determine its effects on structural components of the CAWS (e.g., canal walls and in-water equipment), and as an alternative tool to rotenone for fish suppression in support of Electric Dispersal Barrier maintenance.

  Pressure gradients around the S80 water gun(s) were mapped in three different configurations at a controlled pond and at one open water field setting.

  - Maximum operating conditions of the current water gun/compressor configuration were determined to be 1,500 pounds per square inch (psi) with discharge every 10 seconds.
  - Behavioral responses of Asian carp and native fishes were observed with sonar and acoustic telemetry under controlled conditions. Initial results indicate fish avoid water guns during operation.
  - Methods for successful implementation of water gun barriers in open water environments were demonstrated in 2013.
  - Incorporating water gun barrier technology into Integrated Pest Management (IPM) applications is feasible.

Outreach

AIS are a major threat to the waters of Illinois. Since the early 1800s, more than 120 AIS have been introduced into Lake Michigan, many of which have had strong negative effects on the integrity and stability of the Lake's ecosystem. Many of these harmful organisms have also spread to inland waterways. To effectively address this complexity of AIS issues, the State of Illinois needs outreach and tools at its disposal. This grant has funded the following progressive steps in satisfying these outreach needs:

- Via in-person events, 7,275 recreational water users (RWU) were exposed to AIS issues and ways in which RWU can prevent introduction and spread of AIS. This number far exceeded the 3,500 interactions that were promised.
- Of the RWUs surveyed during 2014, 86 percent were familiar with AIS; 86 percent remove plants, animals, and mud from all equipment; 92.2 percent drain all water; and 81.3 percent dry everything with a towel. These results exceeded our goal of 80 percent having knowledge of AIS and 60 percent of those with knowledge following suggested prevention steps.
- The "Be A Hero – Transport Zero" RWU brand and the TransportZero.org website were created and marketed through a variety of outlets, resulting in nearly 6500 visits to the TransportZero.org website by more than 3000 unique IP addresses.
- Television, print, and website advertising netted the "Be A Hero – Transport Zero" campaign more than 150 million impressions, which is the number of times the ads were seen or heard.

- The “Be A Hero – Transport Zero” webpage had 6,553 visitors, who were motivated to learn more about the campaign and its message.
- The “Be A Hero – Transport Zero” RWU brand will be expanded to the Illinois DNR forestry and Wildlife Action Plan audiences, gaining even more exposure and brand recognition for the RWU version of the brand.
- A needs assessment regarding water gardeners and aquarium hobbyists was completed, thereby increasing our understanding of the two major components of the organisms-in-trade (OIT) audience, including (1) barriers to proper OIT species disposal behaviors, and (2) appropriate avenues for dissemination of information to water gardners and aquarium hobbyists.
- Via person-to-person interactions, 1,122 water gardeners and aquarium hobbyists were exposed to AIS issues and the ways in which they can prevent introduction and spread of AIS.
- A total of 7,940 copies of hydrilla outreach materials have been distributed to individuals and organizations throughout Illinois, thereby increasing Illinois’ capacity for early detection of this invasive plant.
- Illinois now has an Early Detection—Rapid Response (EDRR) plan for hydrilla, which also serves as a model EDRR plan for other invasive aquatic plants.
- Over 150 gallons of liquid and 347 pounds of granular herbicide have been purchased and stored, and are immediately available for application, affording Illinois the ability to rapidly respond to detection of an invasive aquatic plant of grave concern such as hydrilla.
- Illinois now has a comprehensive database of the non-native species established within its borders.
- The Illinois ANS Management Plan is now updated to reflect current AIS issues and distributions.
- Illinois is progressing in addressing the State’s AIS issues, as evidenced by the activities cited above and elsewhere within this document. These activities focus on immediate needs, as well as creation of future capacity. Continuing efforts such as these are required to protect Illinois waters from the harmful effects of AIS.

INDIANA

Interagency Coordination

Indiana DNR is very active in the Great Lakes and Mississippi River Interbasin Study (GLMRIS) other pathways assessment. Indiana DNR had three pathways ultimately identified in the final report. Eagle Marsh has been identified as the highest risk pathway behind Chicago, and Indiana DNR has been actively developing a solution for this location, with construction beginning in October 2014. The Parker-Cobb Ditch pathway in Indiana has also been designated to eventually require design of a "fix" at this location. Although Loomis Lake was also identified, the team realized that risk is rather low and did not recommend modifications.

- Via Indiana DNR participation with the Ohio River Asian carp task force, strategies have been developed to assess the Asian carp population, monitor Asian carp movement, and reduce the leading edge.
- Indiana DNR participated in the MICRA Grass Carp evaluation that was contracted to HDR, Inc.
- Participation in the ACRCC.

Field Monitoring for Asian carp

Indiana DNR contracted with Purdue University to evaluate Asian carp movements and spawning in the upper Wabash River (primarily from Lafayette and upstream). This work began during fall 2010 and will finish this fall (4 years). Indiana DNR now has 300 tagged Asian carp at large for the telemetry work. Observations have indicated that most fish remain between Lafayette and Logansport. During high-discharge periods, fish venture upstream, but when flows subside, the fish drop back downstream again to within the Lafayette to Logansport area. The research has also revealed that quite large spawning events can occur between Lafayette and Logansport when the temperature is right and flow is high. Most noteworthy was a huge egg collection event on June 4, 2013, in Lafayette; and the day before, a resident along the river reported a 0.75-mile-long concentration of Silver Carp in the Wabash River near Lockport, Indiana. Even when flows are low, Purdue University participants regularly see release of a few Asian carp eggs through the summer. On only one occasion have eggs been found upstream of Logansport, but at very low numbers.

- The Indiana DNR Big Rivers team began regular monitoring for Asian carp in the lower portion of the Wabash River during this reporting period, mainly to acquire age and growth information on Bighead Carp and Silver Carp.
- The Indiana DNR Big Rivers team has conducted annual surveys for Shovelnose Sturgeon, and in these surveys has regularly encountered Asian carp. Although the team does not target Asian carp during these surveys, the team does gather data regarding Asian carp.

Rapid Response (Specific Discrete and Intensive Detection/Eradication/Containment Efforts Based on Indications of Elevated Potential for Asian carp Presence)

Indiana DNR has not conducted any rapid response activities related to Asian carp during the period. Indiana DNR did perform a tabletop mock exercise in August 2012, and the scenario was Asian carp moving into Eagle Marsh (watershed divide) from the Wabash watershed.

Risk Assessment Regarding Asian carp

The MICRA-funded Grass Carp assessment was essentially an assessment of how diploid Grass Carp could enter the triploid Grass Carp supply chain.

Active Prevention (e.g., Implementation or Assessment of Dispersal Barriers, Targeted Fishing to Reduce Asian carp Populations, Focused Containment Activities)

During the period, Indiana DNR maintained the temporary fence across Eagle Marsh, as well as the Graham-McCulloch berm—the only barriers in place right now to prevent movement of Asian carp from the Wabash watershed into the Maumee watershed. During spring and summer 2013, two flood events on the Graham-McCulloch damaged portions of the berm. Indiana DNR took quick action to repair the damage. The fence installed during fall 2010 remains intact and structurally sound.

Outreach with Industry or the Public/Stakeholder Participation Focused on Asian carp Prevention

Indiana DNR developed a brochure and sign that has been installed at boat ramps at Asian carp infested areas. The main message is that it is risky to move bait fish collected from one body of water to another because to the untrained eye, Asian carp look remarkably similar to native baitfish.

Law Enforcement/Regulatory Actions Focused on Asian carp Prevention

Covert law enforcement activities have occurred regarding Asian carp, but no details are available at this time regarding findings. During the period, regulations were changed to allow taking of Asian carp via commercial fishing gear in waters where commercial fishing is allowed. Regulations were also adopted legalizing taking of Asian carp via more unconventional gear types such as arrow, fish spear, gig, etc. Crossbows were added as a legal means of taking rough fish including Asian carp.

Research Focused on Development of New Tools/Techniques for Asian carp Prevention

Indiana DNR funded research with Purdue University to research pathogens to which Asian carp may be susceptible. This work occurred between November 2012 and April 2014.

Financial Support Provided to Partner Agencies/Organizations to Support Asian carp Prevention

Total personnel costs expended by Indiana DNR during the time period are estimated at $90,000. During the period, the two Purdue University contracts totaled $364,000, and the money Indiana DNR paid the Little River Wetlands Project to maintain the fence and berm at Eagle Marsh totaled $70,000.

IOWA

Interagency Coordination

Iowa DNR AIS and Fisheries Bureau staffs were involved with several interagency efforts related to preventing spread of Asian carp within the UMRB. Most of this interagency coordination occurred in the form of discussions and exchange of information through the Mississippi River Basin Panel on ANS, the Association of Fish and Wildlife Agencies Invasive Species Committee and Fisheries and Water Resources Policy Committee, the Upper Mississippi River Conservation Committee, the Upper Mississippi River Basin Association, and the Midwest Governors Association AIS Collaborative. Iowa DNR staff also shared information with the U.S. Geological Survey (USGS), USFWS, and adjacent state agency staff on plans for research and monitoring of Asian carp in the Mississippi River and tributaries in Iowa in order to coordinate and to avoid duplicative efforts among agencies. Iowa DNR staff are also members of a working group drafting an Upper Mississippi River Asian Carp Action Plan.

Field Monitoring for Asian carp

Bighead Carp and Silver Carp have been reported throughout the Mississippi River and in its tributaries in southern and central Iowa for over 10 years. These fish have been collected or observed as far upstream in Iowa as Pool 9 (Allamakee County) of the Mississippi River, below the Lake Red Rock dam (Marion County) on the Des Moines River, below the Oakland Mills dam (Henry County) on the Skunk River, and below the Center Street dam in Iowa City (Johnson County) on the Iowa River. In the Cedar River, Bighead Carp have been collected as far upstream as Waterloo (Black Hawk County), and Silver Carp have been collected as far upstream as Palisades Kepler State Park (Linn County). Stocking of diploid Grass Carp is allowed in Iowa, and their distribution is widespread throughout lakes and ponds in Iowa. Grass Carp have also been reported from the Mississippi River up to Pool 9, and at multiple locations on the Cedar, Des Moines, Iowa, Raccoon, Skunk, and Winnebago Rivers. No Black Carp have been documented in Iowa.

Bighead Carp and Silver Carp reproduction have not been documented in Iowa. Iowa DNR staff conducted egg and larval tows to detect Asian carp reproduction after river level rises below Lake Red Rock on the Des Moines River during spring and early summer 2012. No Asian carp eggs or larval fish were collected before low water levels halted sampling efforts. Iowa DNR staff used electrofishing to sample Bighead Carp and Silver Carp, and determine population structure below dams in the Des Moines, Chariton, and Cedar Rivers during summer 2013, and in the Des Moines, Chariton, Iowa, and Skunk Rivers during summer 2014. No specific monitoring for Grass Carp by Iowa DNR staff occurred from 2012 through 2014. Bighead, Silver, and Grass Carp collections during routine fisheries management surveys and during Long Term Resource Monitoring Program surveys in Pool 13, as well as commercial fishing reports, are documented yearly in annual Iowa DNR reports.

Iowa DNR staff also assisted with Asian carp sampling during an Iowa State University research project funded by Iowa DNR to evaluate adult population characteristics and dynamics of Asian carp in the Mississippi, Des Moines, Skunk, Iowa, and Cedar Rivers, and to evaluate Asian carp reproduction and recruitment in the Mississippi, Des Moines, Skunk, Iowa, and Cedar Rivers. Preliminary electrofishing for adults and juveniles occurred during fall 2013, and procedures and equipment used for age estimation were finalized. Sampling adult and juvenile Asian carp was attempted once per month by use of boat electrofishing and trammel nets at 13 sites on the Mississippi, Des Moines, Skunk, Iowa, and Cedar Rivers from April through June 2014; however, flooding river levels forced investigators to skip sampling at sites each month. Surface ichthyoplankton tows were conducted every 10 days when possible from April through June 2014 at the same sites where adult fish samples were collected in the Des Moines,

Skunk, Iowa, and Cedar Rivers. Age-lengths keys will be used to assign ages to all individuals collected, and age-frequency distributions shall be used to determine recruitment patterns in each river. This research project will continue through 2016 to increase understanding of Asian carp populations in Iowa, and to guide future efforts at preventing spread of invasive fishes in Iowa.

Rapid Response

Iowa DNR staff did not conduct any rapid response exercises or projects specific to Asian carp during this reporting period.

Risk Assessment Regarding Asian carp

Iowa DNR staff members were on the steering committee for a project funded by MICRA that was a national analysis of regulation, production, triploid certification, shipping, and stocking of Grass Carp. Part of this project assessed the risk that diploid Grass Carp might be transported and stocked through the triploid Grass Carp chain of supply.

Active Prevention

Iowa DNR staff did not coordinate active prevention projects within the UMRB during this reporting period.

Outreach with Industry or the Public/Stakeholder Participation Focused on Asian carp Prevention

Iowa DNR staff were included in two Iowa Public Television programs on Asian carp. Signs alerting the public to presence of Asian carp are posted at fishing access sites below dams with known populations of Bighead Carp and Silver Carp. The signs show how to identify the species and warn that it is illegal to possess or transport live Asian carp. Along with these Asian carp-specific signs, Iowa DNR distributes different types of outreach materials targeting water recreationists in Iowa. Stop Aquatic Hitchhiker signs are posted at all boat access sites, and information is available on the Iowa DNR website. Brochures, identification cards, posters, and banners are available for distribution and use at watercraft inspection stations, outdoor events and fishing clinics, the Iowa State Fair, parks and nature centers, and businesses (e.g., marinas, bait shops, sporting goods stores). The Iowa Fishing Regulations booklet contains AIS information and a list of AIS-infested waters in Iowa. Iowa DNR also provides information via billboards and news releases. Exhibits at the Iowa State Fair include an aquarium with Bighead Carp and Silver Carp. Television commercial advertising is aired during the summer months, and advertisements appear in local magazines.

Law Enforcement/Regulatory Actions Focused on Asian carp Prevention

Iowa DNR attempted to amend rules in 2014 to list diploid grass carp as an invasive species, restrict culture of diploid Grass Carp, and permit culture and sale of triploid Grass Carp. Stakeholders with an interest in invasive species and aquaculture in Iowa were invited to meetings to learn about the proposed rule changes and offer comments. Private aquaculture producers opposed the rule changes, and Iowa DNR did not move forward with the proposed changes. However, the private producers also offered several compromises that Iowa DNR staff will discuss, and possibly attempt to agree on a compromise option with the producers.

Legislation passed in 2013 that amended the AIS Law in Iowa, making it illegal to transport aquatic plants (in addition to prohibited AIS) on water-related equipment. Boaters are also required to drain all water from boats and equipment before leaving a water body, and to keep drain plugs removed or opened during transport. It is also illegal to release unused bait into a water body in Iowa.

Research Focused on Development of New Tools/Techniques for Asian carp Prevention

None.

Financial Support Provided to Partner Agencies/Organizations to Support Asian carp Prevention

As described under Field Monitoring for Asian carp, Iowa DNR is funding a research project by Iowa State University from 2013 through 2016 that will cost $212,555. A sum of $101,320 was provided to Iowa State University during this reporting period. Iowa DNR staff time and expenditures related to Asian carp activities were estimated at $50,000 during this reporting period.

KENTUCKY

Interagency Coordination

KDFWR has been the leader in the Ohio River Leading Edge project, involving contract fishing for removal, as well as telemetry. The contract fishing portion of the program has been a cooperative effort among KDFWR, Pennsylvania Fish and Boat Commission (PFBC) through Colcom Foundation of Pennsylvania, and WVDNR. PFBC was instrumental in orchestrating funding to be transferred to KDFWR. KDFWR contracted commercial fishermen from Kentucky to remove Asian carp from the Upper Ohio River 2 weeks a month. KDFWR coordinated fishing schedules and observers with WVDNR.

KDFWR has also assumed a large role in a cooperative Asian carp telemetry project on the upper Ohio River. USFWS has provided receivers and KDFWR, WVDNR, and USFWS biologists download receivers monthly on a rotating schedule. KDFWR has been the primary source for gillnetting fish and implementing transmitters. To date, Kentucky has tagged 51 fish and USFWS has supplied 150 more tags. The project has over 60 stationary receivers stationed from Markland Lock and Dam to Willow Island Lock and Dam.

On other fronts, KDFWR is also leading efforts to assess Asian carp abundance on Kentucky and Barkley Lakes. KDFWR initiated the Carp Madness tournament in 2013 and carried it out with assistance from Tennessee Wildlife Resources Agency (TWRA) and donations from multiple non-governmental organizations (NGO). The tournament was a commercial fishing tournament during which more than 80,000 pounds of Asian carp was removed from the lakes in 2 days.

KDFWR plans to partner with USFWS and Murray State University to perform hydroacoustics work on Kentucky Lake in order to assess Asian carp abundance. In addition, KDFWR is trying to establish a partnership among KDFWR, USFWS and TWRA to conduct a telemetry project on Kentucky Lake and the Lower Ohio aimed at understanding reproduction and movement of Asian carp populations among the Middle Mississippi, Lower Ohio, and Kentucky and Barkley Lakes.

KDFWR's staff, working with the Ohio River Fisheries Management Team (ORFMT), spurred formation of a Basin Management Plan that can be implemented immediately if funding is received.

Field Monitoring for Asian carp

In addition to commercial gill netting for Asian carp, KDFWR has regularly sampled for Asian carp in newly populated areas. Routine gill net sampling and electrofishing has occurred in the Smithland, McAlpine, Markland, Meldahl, and Greenup pools of the Ohio River. Other sampling efforts have been undertaken in the Salt River, Green River, Licking River, Tennessee River, Cumberland River, and Big Sandy River.

In addition to sampling for adults, KDFWR also collected numerous larval carp samples in 2012-2013.

Rapid Response (Specific, Discrete, and Intensive Detection/Eradication/Containment Efforts Based on Indications of Elevated Potential for Asian carp presence)

An established rapid response protocol for ANS is under development. In early 2014, KDFWR hired a full-time ANS coordinator who handles all rapid response efforts. KDFWR biologists and permit holders for scientific collections are requested to report observations of any ANS. In 2014, KDFWR created a statewide ANS distribution database to track Asian carp range expansion and to target areas for public education and signage, targeted removal, and containment efforts.

New observations of Asian carp have occurred in Kentucky over the last 2 years, including observations on the Kentucky River, Green River, and Licking River. However, after an assessment of the likelihood of success in containment efforts, minimal sampling occurred. Rapid responses focused on areas where the only means of Asian carp range expansion is human-induced movement (e.g., below reservoir dams). In those cases, area-specific education was deemed the best option.

Risk Assessment Regarding Asian carp

No state-specific risk assessment has been conducted regarding Asian carp in Kentucky. However, both contract fishing efforts on the Ohio and the aforementioned hydroacoustics project on Kentucky and Barkley Lakes seek an estimate of relative abundance of Asian carp. One of the ultimate goals of these projects is to relate changes in our long-term sportfish sampling data to relative abundance of Asian carp.

Active Prevention (e.g., Implementation or Assessment of Dispersal Barriers, Targeted Fishing to Reduce Asian carp Populations, and Focused Containment Activities)

KDFWR has been vocal about implementing active prevention measures to reduce probability of Asian carp range expansion. The primary concern thus far has been movement up the Ohio River. KDFWR has been the lead in organizing contract commercial fishermen in the upper Ohio River to target and remove Asian carp on the leading edge of their range expansion. Colcom Foundation of Pennsylvania contributed $150,000 to the project, and WVDNR contributed observers; KDFWR contracted the fishermen, organized fishing days/locations, and coordinated observers with other states. Similar efforts appear to be successful in the Illinois River. Unfortunately, funding limitations have precluded large-scale removal efforts on the upper Ohio River. Funding thus far has come from already restricted state budgets or donations from NGOs. Lack of funding has restricted removal efforts to two to four contract fishing vessels fishing only the leading edge of the expansion, despite the overall goal of also removing large numbers of Asian carp from the denser populations downriver.

In addition to the work on the upper Ohio River KDFWR has initiated removal efforts and promoted commercial fishing to reduce Asian carp populations in the lower Ohio, Tennessee, and Cumberland Rivers, as well as Kentucky and Barkley Lakes. These efforts include the Carp Madness tournament and "loosening" of commercial regulations governing Asian carp removal.

KDFWR has also attempted to bridge the pay gap between commercial fishermen and processors. Currently, commercial fishermen report that they are unable to support fishing for Asian carp for less than 15 cents per pound, while processors report being unable to purchase Asian carp for more than 10 cents per pound. In an effort to bridge the gap KDFWR will subsidize 5 cents per pound for Asian carp removed from the lower Ohio, Cumberland, and Tennessee Rivers, as well as from Kentucky and Barkley Lake while funding persists.

Outreach with Industry or the Public/Stakeholder Participation Focused on Asian carp Prevention

KDFWR has led outreach efforts within the ORB via active involvement in a delegation from MICRA that was formed to educate Congressional members and their staffs in Washington D.C. regarding Asian carp issues in the ORB, and to increase awareness of ORB needs. In addition, Kentucky led an effort of ORFMT to work with other agencies to create an Ohio River Basin Management Plan and Ohio River Basin Asian Carp Action Team, which has a membership including many state and federal agencies and over 60 NGOs as interested parties.

KDFWR staff have spent numerous hours working with commercial fisherman, fish processing facilities, and investors to promote fishing for Asian carp. This has included assisting visiting facilities and

listening to commercial fishermen, as well as working to bridge the price gap between processors and fishermen. In addition, KDFWR has worked with our Senators to lobby for tax incentives for investors looking to establish Asian carp processing facilities.

Regarding outreach and education, KDFWR has taken several different avenues to raise public awareness. The most effective public education campaign has been the Carp Madness tournament, which was televised by KDFWR's Kentucky Afield television show. The segment was an eye opener for Kentuckians, who learned about the amount of carp removed from Kentucky and Barkley Lakes. Kentucky Afield also has aired at least 10 publicly televised Asian carp segments, including segments on filleting, bowfishing, current research, process facilities, and commercial removal. All are available for viewing on YouTube, and the segment focusing on the Carp Madness tournament is nearing half a million views.

Law Enforcement/Regulatory Actions Focused on Asian carp Prevention

New laws within the specified time frame are as follows:

- Live, wild-caught Asian carp, shad, or Skipjack Herring may be used only in the waters from which they were caught.
- Special Harvest Season: Commercial fishermen are allowed to request special permission to fish waters during offseason if their catch is composed of at least 75 percent Asian carp.
- No movement or selling of live Asian carp is permitted.

Research Focused on Development of New Tools/Techniques for Asian carp Prevention

This has mostly been covered above in the information regarding hydroacoustics, telemetry, and contract fishing efforts. Other specific tools/techniques are new experimental sampling including "wings" on electrofishing boats to catch jumping carp, and modified gillnets to capture carp that are jumping nets.

Financial Support Provided to Partner Agencies/Organizations to Support Asian carp Prevention

KDFWR has been the funneling agency through which other states and organizations have donated funds for research and removal efforts:

- $150,000 from COLCOM Foundation of Pennsylvania to Kentucky Fish and Wildlife Foundation for contract fishing on the Ohio River;
- $40,000 Kentucky contribution from its Federal ANS grant (Catalog of Federal Domestic Assistance [CFDA] #15.632) for contract fishing removal in 2014;
- $100,000 transfer in process from West Virginia to KDFWR for contract fishing.
- $75,000 (conservative estimate) worth of staff time contributed by KDFWR. Unfortunately, because this time has not been tracked via a grant code, an exact estimate is not possible.

MINNESOTA

Interagency Coordination

Minnesota DNR and the National Park Service (NPS) co-chaired an ad hoc task force to develop an Invasive Carp Action Plan for the State of Minnesota. Participants included NPS (co-chair), Mississippi National River and Recreation Area, St. Croix National Scenic Riverway, Minnesota DNR (co-chair), USFWS, USGS, Minnesota Department of Transportation, Wisconsin DNR, City of Minneapolis, City of St. Paul, City of Hastings, Prairie Island Indian Community, Shakopee Mdewakanton Sioux Community, Saint Paul Port Authority, and Three Rivers Park District (county). The plan was finalized on November 2, 2011. The plan is undergoing update by a workgroup including Minnesota DNR, NPS (co-chair), University of Minnesota Aquatic Invasive Species Research Center (MAISRC), USFWS, USGS, USACE, Minnesota Stop Carp Coalition, City of Hastings, barge industry representative, and a private citizen.

Minnesota DNR has been an active participant in ACRCC, Upper Mississippi River Asian Carp Action Plan, Mississippi River Interstate Cooperative Resource Association, Upper Mississippi River Conservation Committee, Upper Mississippi River Basin Association, Great Lakes Panel on Aquatic Nuisance Species, and Mississippi River Basin Panel on Aquatic Nuisance Species.

Minnesota DNR has a full-time employee to help coordinate its carp efforts both within the agency and with other entities.

Field Monitoring for Asian carp

Minnesota DNR relies on several methods to detect and monitor expansion of Asian carp into Minnesota (funding source):

- Traditional fisheries monitoring programs (Base)
- Targeted sampling (Environment and Natural Resources Trust Fund, ENTRF)
- Contracted commercial fishing (ENTRF)
- Monitoring of commercial catch (Base)
- Reported sightings (Base and ENTRF).

Minnesota DNR has sought to maintain two full-time invasive carp specialists (ENTRF) during this time period for targeted sampling at Mississippi River Pool 2 and the lower St. Croix River. Efforts and results are summarized in the following annual reports:

- Minnesota DNR – Division of Fish and Wildlife. 2013. *Asian Carp Sampling Report June-December 2012*. Minnesota DNR, St. Paul, MN.
- Minnesota DNR – Division of Fish and Wildlife. 2014. *Asian Carp Sampling Report January-December 2013*. Minnesota DNR, St. Paul, MN.

Minnesota DNR hired a third full-time invasive carp specialist (ENTRF) in July 2013 to conduct work on the Minnesota River.

Rapid Response

No rapid response exercises occurred during this time period. Minnesota DNR invasive carp specialists respond to verified captures with targeted sampling at the capture locations if possible.

Risk Assessment Regarding Asian carp

Minnesota DNR Fisheries began a Global Information System (GIS)-based Asian carp risk assessment project in September 2012. Project objectives were to:

- Visualize potential pathways of Asian carp upstream migration.
- Assess aquatic barriers for ability to limit migration.
- Identify potential watershed breaches (i.e., pathways across major watershed boundaries such as ditches, culverts, etc.).
- Identify waters "at-risk" for infestation.
- Quantify resources affected.
- Consider migration/infestation scenarios.
- Identify strategic sites for Asian carp barriers.

The project applied GIS analysis to data within several barrier databases and data acquired from field level professionals. In November 2013, a preliminary risked-based spatial map was released depicting where Asian carp may spread by their own swimming capabilities. The project also produced the following outcomes:

- Determination of relative risk of Asian carp passage at stream barriers;
- GIS tools for quantifying resources and evaluating scenarios;
- Identification of watershed breaches.

Future work will include verifying and refining data, prioritizing locations for stream barrier construction or enhancement, and prioritizing watershed breaches for projects to prevent fish passage. This project was deemed high priority and was completed by staff on base funding.

Active Prevention (e.g., Implementation or Assessment of Dispersal Barriers and Targeted Fishing to Reduce Asian carp Populations, and Focused Containment Activities)

- **St. Anthony Falls**

  Minnesota DNR decided that the best way to keep invasive carp out of the upper Mississippi River watershed would be to close the Upper St. Anthony Falls Lock. To close the lock, which is administered by USACE, required an Act of Congress. Lock closure provisions were included in the WRRDA bill signed into law by President Obama on June 10, 2014. The lock must be closed not later than one year after enactment of the WRRDA, June 10, 2015.

- **Coon Rapids Dam (Legislative Appropriation)**

  In 2011, the Minnesota Legislature approved $16 million to fund improvements to the Coon Rapids Dam, including features to make it a more effective barrier to invasive carp movement

upstream. Nine steel, hydraulically operated crest gates are being installed to replace inflatable gates in order to maintain enough head to prevent carp from getting past. Completion of the project is anticipated in December 2014.

- **Lock and Dam 1 (Minnesota Outdoor Heritage Fund [OHF])**

  At the beginning of 2013, Minnesota DNR explored alternative barrier technologies to prevent upstream movement of Asian carp. The agency took this approach because it was unknown whether a St. Anthony Falls Lock closure provision would pass at the federal level, either as an independent bill or as part of a larger bill.

  In May 2013, Minnesota DNR contracted with Smith-Root, an electrical barrier engineering firm, to design a barrier utilizing new technology for Lock and Dam 1. This technology, referred to as "sweeping" electrical, uses electricity to move fish away from the lock chamber. Formal completion of the design was expected in November 2014, but the barrier will not be constructed due to the anticipated closure of Upper St. Anthony Falls Lock stipulated under WRRDA.

- **SW MN barriers (OHF)**

  In fiscal year 2013, Minnesota DNR received funding from the Outdoor Heritage Fund (State of Minnesota) to place additional barriers in southwest Minnesota. The area fisheries office identified seven sites for new projects to prevent spread of Asian carp into high-value lakes or between watersheds. With populations of Asian carp already present lower in the watershed, the following projects were deemed high priority:

  - Site 1A-UTM E: 303645.4 N: 4837322.0: Minnesota DNR acquired a flowage easement so that two county culverts could be removed. With these culverts removed, the township gravel road would act as a physical berm to separate the watersheds.
  - Site 1C-UTM E: 306805.8 N:4835148.6: Minnesota DNR removed two small culverts and installed a 12- by 6-foot electrified culvert.
  - Site 2-UTM E:31536783.4 N:4836794.1: Minnesota DNR worked with the Jackson County Soil and Water Conservation District (SWCD) and a private landowner to build up an earthen dike berm at this location to maintain watershed separation.
  - Site 3-UTM E: 303196.8 N: 4835388.6: Minnesota DNR worked with a county highway department and Minnesota Department of Transportation to install a grate system at the upstream end of a culvert, and hickenbottom caps on tile line intakes to maintain watershed separation.
  - Site 4-UTM E:281783.4 N: 4836891.0: Minnesota DNR plugged a connecting ditch to reestablish watershed separation within a wildlife management area (WMA). Minnesota DNR also installed a larger capacity outlet to the WMA to handle increased water flows.
  - Site 6-UTM E:306832.1 N:4823957.3: Minnesota DNR will install an electric barrier at a lake outlet to protect high-value recreational lakes. Project design is completed, but the barrier is not yet installed.
  - Site 10-UTM E:309733.4 N:4868541.2: Minnesota DNR installed a ditch plug to reestablish watershed separation.

Outreach with Industry or the Public/Stakeholder Participation Focused on Asian carp Prevention

Minnesota DNR routinely engages with Minnesota Stop Carp Coalition, an active group of NGOs collaborating to bring attention to the Invasive carp issue. Minnesota DNR maintains an invasive carp web page. The agency collaborated with NPS to host several forums open to the public. The Minnesota DNR invasive carp coordinator routinely conveys information about efforts to a variety of groups.

Law Enforcement/Regulatory Actions Focused on Asian carp Prevention

Sections of Minnesota Statute 97C and Minnesota Statute 84D pertain to invasive carp prevention.

Research Focused on Development of New Tools/Techniques for Asian carp Prevention

Most research proceeds in collaboration with MAISRC. Minnesota DNR fisheries began a fish telemetry study during spring 2013 to understand fish movement around locks and dams, and in the Mississippi River system. USFWS also connected the receiver system with one located in Missouri to help monitor carp movements throughout the river. Preliminary information appears in the following report: Minnesota DNR – Division of Fish and Wildlife. 2014. East Metro Area Rivers Telemetry Project – 2013 Progress Report. Minnesota DNR, St. Paul, Minnesota.

Financial Support Provided to Partner Agencies/Organizations to Support Asian carp Prevention

- ENTRF – $540,000 for the period July 1, 2013, to June 30, 2015; $200,680 spent by June 10, 2014.
- OHF – $7.5 million for the period July 1, 2013, to June 30, 2016; $3,578,487 spent or allocated by June 10, 2014.
- State of Minnesota – $16 million appropriated (Coon Rapids Dam renovation).
- Minnesota DNR base funding – ~$85,000/year for coordinator; additionally, more than 20 staff have contributed time to the invasive carp effort (ranging from a few hours to more than 100 hours).

In addition, MAISRC received the following funding for Asian carp facilities and equipment prior to June 10, 2014:

Source	Funding received for Asian carp facilities and equipment (approx.)	Status of funds
Minnesota Law (ML) 2012: ENRTF	$424,000	Ongoing
ML 2012: Clean Water Fund (CWF)	$431,000	Ongoing

Moreover, funding was received for the following projects focused on Asian carp that began prior to June 10, 2014:

Source of funding	Funding received for Asian carp projects (approx.)	Start of project	Brief synopsis	Status of funds	Staff & effort (approx.)
ML 2012: ENRTF	$695,000	July 1, 2012	Funding was provided to start the following studies of Asian carp designed to control this species: (1) establishing and implementing eDNA as a molecular technique to assess presence of Asian carp in large Minnesota rivers; (2) testing whether carp can be located using "Judas fish," a new behavioral tool to locate aggregating invasive fish so they might be tracked and/or removed; (3) developing food attractants to Silver Carp that can be used to induce aggregation and control them (a new biochemical tool); and (4) Ascertaining whether an enhanced bubble curtain could deter Asian carp movement into small tributaries in a practical manner; immediately installing sound deterrents in the Mississippi River	Ongoing	0.2 Full-time Equivalent (FTE) Faculty 3 FTE Post-doctoral Associates 1 FTE Research Assistant 2.4 FTE Technicians
ML 2012: CWF	$2,000	July 1, 2012	Funding for graduate students and faculty to further develop, and then present and demonstrate, the Asian carp BayesNet decision/support tool to USFWS	Spent	.04 FTE Faculty
ML 2013: ENRTF	$2,445,995	July 1, 2013	Funding for starting additional research on Asian carp and to continue studies via the ML 2012 ENRTF appropriation as follows: (1) monitoring abundance and distribution of AIS by use of new molecular tools in conjunction with techniques to delay their spread; (2) developing effective tools to attract and locate aggregations of invasive carp; (3) exploring whether native pathogens can be used to control invasive carp; (4) conducting a risk analysis to identify Asian carp control priorities and methods.	Ongoing	0.96 FTE Faculty 16.64 FTE Post-doctoral Associates 2 FTE Research Assistants 3.08 FTE Technicians

Source of funding	Funding received for Asian carp projects (approx.)	Start of project	Brief synopsis	Status of funds	Staff & effort (approx.)
ML 2014: ENRTF	$854,000	July 1, 2014	Funding for collaborating with USACE to develop ways, including new technologies, to modify operations of Lock and Dam Numbers 2 to 8 in order to optimize their ability to impede Bighead Carp movement into the Minnesota, St. Croix, and Mississippi Rivers. Specific activities include: (1) Immediate Development and Implementation of a Deterrent Strategy for Lock and Dam Number 8; (2) Quantify Adult Bighead Carp Swimming Capabilities; (3) Test and Develop New Accoustical Deterrent Systems for Locks that Deter Carp and Have Minimal Effects on Native Fishes; and (4) Develop Solutions to Address Weaknesses in Lock and Dam Number 2, and then Optimize Gate Operations at Lock and Dams Numbers 2 through 8.	Ongoing	0.12 FTE Faculty 1.5 FTE Post-Doctoral Associates 3.97 FTE Technicians

MISSOURI

Observed changes in the Range of Asian carp in the Upper Mississippi Basin and Tributaries during the 2-year period

Missouri Department of Environmental Conservation (MO DEC) is unaware of any changes in the range of Asian carp. However, MO DEC has recently documented reproduction in several tributaries within the lower portion of the Upper Mississippi River. Although reproduction has likely occurred in these tributaries previously, this is the first formal evaluation that has documented Asian carp spawning in the large tributaries of this reach of river.

Agency Narrative Summaries of Activities to Control Spread of Asian carp in the Upper Mississippi Basin (Including Population Monitoring [Traditional Gears and eDNA]), Rapid Response, Public Awareness, Law Enforcement, Research and Development, etc.)

Much research and monitoring has occurred in Missouri. MO DEC has issued publications and conducted seminars on carp. Recently, MO DEC was invited to present at Pittsburg State University in Kansas regarding carp. On average, MO DEC conducts between 20 and 30 Asian carp public outreach seminars per year (Taste Test). Between 2,000 and 5,000 individuals attend these seminars annually. MO DEC personnel have been involved with several interviews on television and radio (Bizarre Foods, St. Louis FOX, Cape Girardeau CBS, and local National Public Radio [NPR]). MO DEC usually offers 5-10 presentations per year to the scientific community.

Agency Roll-up of Expenditures on Reported Activities (and Any Partner Activities Funded through Agency Expenditures)

No within-state funding has supported Big Rivers and Wetlands Field Station, despite attempts during the previous 2 years to acquire funding for these projects. However, MO DEC has acquired additional funding from USFWS to evaluate early life history and juvenile movement patterns in our stretch of the Upper Mississippi River. MO DEC has also been funded by the Upper Mississippi River Restoration – Environmental Management Program (UMRR-EMP) of USACE to evaluate invasive carp population characteristics within Pool 4 (Minnesota), Pool 8 (Wisconsin), Pool 13 (Iowa), Pool 26 (Illinois), La Grange (Illinois), and the open river (Missouri). MO DEC is completing this project.

Ongoing Surveys and Assessments of Fisheries within Department Jurisdiction (In Addition to Asian Carp Monitoring)

MO DEC has several projects relating to the assessments, with only outside funding from Long Term Resource Monitoring Program (LTRMP) and USFWS, USACE/USFWS.

Bighead Carp and Silver Carp Commercial Harvest

Commercial harvest of Bighead Carp and Silver Carp was first reported from Missouri fishers in 1992, and harvest generally increased until 2002, after which harvest has generally declined with peaks in 2008 (68,360 pounds) and 2012 (52,064 pounds) (Figure 1). Harvest decreased from 52,064 pounds in 2012 to 23,964 pounds in 2013, the third lowest harvest in 18 years. In 2012, 81 percent of the total harvest was from the Mississippi River; conversely, 97 percent of the 2013 harvest was from the Missouri River. Missouri River harvest increased from 9,823 pounds in 2012 to 23,243 pounds in 2013, while Mississippi River harvest declined drastically from 42,241 pounds to 721 pounds during the same time. This dramatic shift in harvest was the first exceedance by the Missouri River harvest of the Mississippi River harvest since 2006.

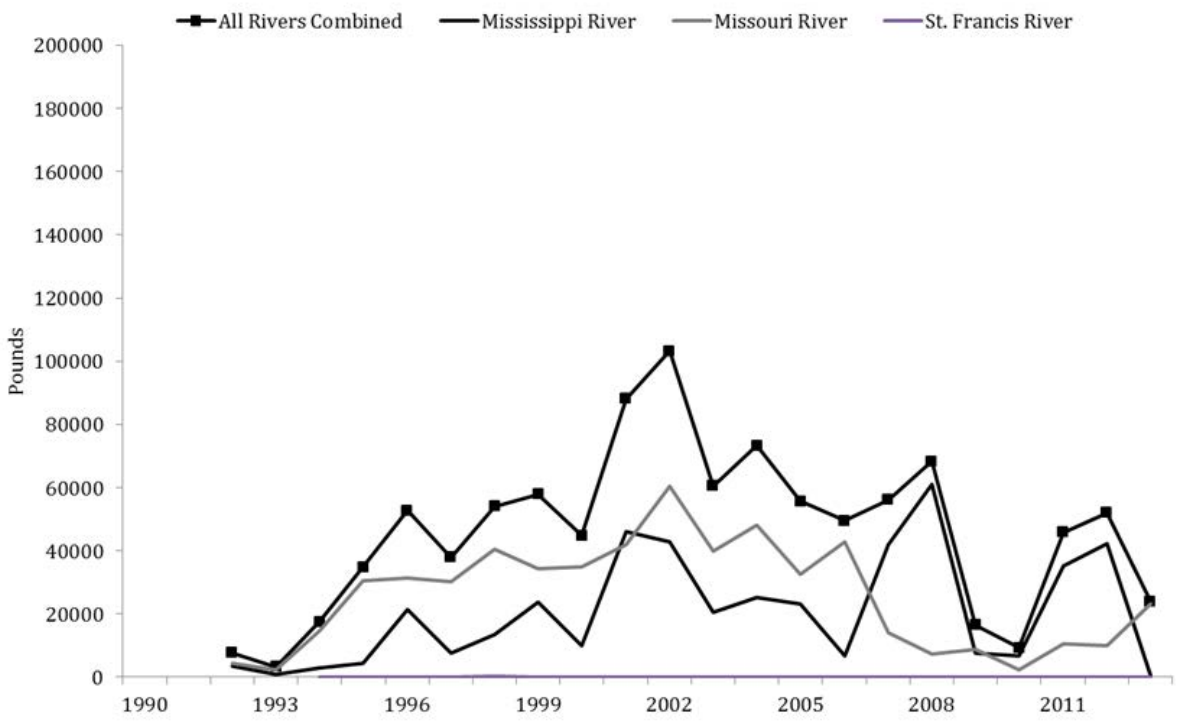


Figure 1. Pounds of Bighead Carp and Silver Carp Harvested from Missouri's Commercial Waters from 1992 to 2013.

NEW YORK

New York Department of Environmental Conservation (NY DEC) staff effort has been directed toward evaluation of potential pathways from ORB into New York's waterways, review of GLMRIS, and participation in conference calls and meetings with the GLMRIS team.

Four NY DEC staff spent an estimated 29 staff days on activities regarding Asian carp in the ORB and UMRB. The approximate value of this effort was $11,700 (salary) or $18,650 (total compensation).

OHIO

Inter-agency Coordination: Regional Communication and Response

From 2012 to present, Ohio DNR has participated in:

- ACRCC correspondence, conference calls, and meetings;
- GLMRIS correspondence, conference calls, and meetings;
- MICRA meetings and communications;
- Mississippi River Basin Panel Aquatic Invasive Species (AIS) correspondence and meetings;
- ORFMT (which includes Pennsylvania, West Virginia, Ohio, Kentucky, Indiana, and Illinois) meetings, communications, and cooperative fisheries projects;
- Ohio AIS Committee correspondence, meetings, discussions, and development of the Ohio *River Basin Asian Carp Control Strategy Framework*
- A meeting in August 2012 with ORFMT partners to begin development of an Ohio River Asian Carp Task Force and associated action plan.
- Work in August 2012 with partner states along the Ohio River to develop and distribute two Asian carp posters at bait shops, access areas, and other sites:
    - *Bighead Carp and Silver Carp are Harmful Invaders*
    - *Report New Sightings of Bighead Carp and Silver Carp to 877-STOP-ANS*
- The *Ohio River Asian Carp Leading Edge Project* led by KDFWR (April-October 2013) for which Ohio DNR – Division of Wildlife provided an onboard observer to work with contract commercial fishers in conducting surveillance of Asian carp, primarily in the Markland and Meldahl pools.
- Completion by partner states in September 2014 of the *Ohio River Basin Asian Carp Action Plan*, developed through the Ohio River Asian Carp Task Force. The plan focuses on early detection, rapid response, prevention and deterrence, population control, and communication and coordination. Through this effort, the Task Force has identified 19 actions to address these five focal points. In addition, efforts are recommended to develop and maintain communication and coordination among Task Force members, coordinate with national and other regional efforts to prevent introductions and control populations of Asian carp, and provide information on prevention and control of Asian carp in the ORB.

Field Monitoring: Tracking Range Expansion in the Ohio River Watershed

Each year, Ohio DNR – Division of Wildlife routinely conducts fish surveys in the Ohio River and inland lakes and reservoirs through our standardized sampling program, conducted primarily by use of gillnets, trap nets, and electrofishing. Field crews target sport species but are instructed to observe, capture, and report Asian carp as well. For example, during September 2012, during routine black bass surveys, one of our crews captured two Silver Carp in the Markland Pool (Great Miami River). Ohio DNR works with partner state agencies on the Ohio River to provide coverage of all Ohio River pools along the 451-mile Ohio River border, and Ohio DNR samples approximately 170 reservoirs statewide.

- March-October 2012: An Ohio River creel survey monitored catches of sport anglers. However, by using 10 creel clerks to sample the entire 451-mile Ohio-West Virginia-Kentucky border, Ohio DNR – Division of Wildlife was also poised to acquire information from anglers regarding Asian carp sightings or catches.

- July 2012: Ohio DNR – Division of Wildlife conducted electrofishing surveys targeting Asian carp in the Markland and Meldahl pools following reported captures of Silver Carp by the Ohio River Sanitary Commission (ORSANCO) in June 2012. Surveys were conducted at 16 sites between River Miles 341 and 491, with three Silver Carp captured, confirming range expansion.

- October 2013: Ohio DNR – Division of Wildlife assisted The Nature Conservancy with eDNA water sample collection in a project funded by the Muskingum Watershed Conservancy District to conduct Asian carp surveillance.

Planned Response: Reacting Promptly and Deliberately to New Information

Findings of positive eDNA results in 10 of 222 samples collected in the Muskingum River during October 2013 resulted in a planned sampling response following release of this information in April 2014. During June-July 2014, an additional 110 eDNA samples were collected by USFWS, and electrofishing crews from Ohio DNR – Division of Wildlife and USFWS sampled 126 sites. No results from water samples analyzed to date have been positive for Bighead Carp or Silver Carp eDNA, and no Bighead or Silver Carp were captured or cited during electrofishing surveys.

Active Prevention: Ohio's Highest Priority

Ohio's greatest priority is addressing four aquatic pathways between the Ohio River and Lake Erie watersheds identified in the GLMRIS report *Focus Area 2: Aquatic Pathways Assessment Summary Report*. Action has occurred within all four pathways identified in Ohio:

- **Grand Lake St. Marys**: Two Ohio DNR divisions, Wildlife and Parks, have been working with a private consulting firm to evaluate options for engineering solutions, with a completed report anticipated during September 2014. Several meetings and multiple on-site visits to this area have occurred during the past 2 years.

- **Little Killbuck Creek**: Ohio DNR – Division of Wildlife is working with partners at Natural Resources Conservation Service (NRCS) and a private consulting firm to develop options for closure of this connection. Several meetings have been conducted with the primary land owner to discuss the closure options.

- **Mosquito Creek Lake**: Evaluation of this site will be conducted by a private consulting firm to develop closure options.

- **Ohio-Erie Canal at Long Lake**: Ohio DNR – Division of Wildlife is working with local municipalities and USACE to develop options for closure. The USACE assessment will be completed during September 2014.

Outreach: Constituent Awareness as a Means of Surveillance and Prevention

Ohio DNR – Division of Wildlife posted a web page for constituents to learn about and report sightings of Asian carp (see www.ohiodnr.gov/asiancarp). This web site provides planning documents, identification information, and updates on regional information.

- August 2012: Ohio DNR Divisions of Wildlife and Watercraft worked together to develop and distribute two posters at bait shops, access areas, and other sites:
    - *It is ILLEGAL to use Bighead Carp and Silver Carp as LIVE bait in Ohio*
    - *Bighead Carp and Silver Carp in the Ohio River Basin*
- 2012-Present: Staff have made several presentations to constituents and the Ohio Wildlife Council regarding the Asian carp issue.
- 2012-Present: Routine press releases have occurred to keep the public aware of new findings and the threat of Asian carp range expansion.
- 2013-2014: The mail and e-mail survey *Fishing Activities and Stewardship on the Ohio River* was conducted via a research partnership with The Ohio State University. This survey included questions related to angler knowledge and concerns about Asian carp in the Ohio River.

Law Enforcement /Regulatory Actions: Leveraging Ohio Administrative Code (OAC)

Changes to OAC prohibited possession of Asian carp (Bighead, Silver, Black, and Grass Carp) unless headless, preserved in ethanol or formaldehyde, or eviscerated—unless carp would be used for research, by zoos, by public aquariums, or for public displays with written permission of the Chief of Ohio DNR – Division of Wildlife.

- June 2014: Changes to OAC prohibited possession of Stone Moroko *Pseudorasbora parva*, Zander *Sander lucioperca*, Wels Catfish *Silurus glanis*, Killer Shrimp *Dikerogammarus villosus*, and Golden Mussel *Limnoperna fortune*.
- July 2014: Changes to OAC were proposed to clarify that it is unlawful for any person to release any fish or aquatic insect into waters of the state, or waters under control of the Ohio DNR – Division of Wildlife, *from which it did not originate*, without first obtaining permission from the Chief of Ohio DNR – Division of Wildlife. This change is intended to directly address bait transfer as a vector, particularly between the Ohio River and inland waters.
- July 2014: A new operational project *Risk Assessment of Triploid Grass Carp Supply Chain in Ohio* was launched, which involves 2 years of sampling imported shipments of Grass Carp presumed to be triploid, and analyzing samples to determine ploidy.

Research: Learning About Range Expansion and Impacts on Aquatic Communities

From June 2013 to present, Ohio DNR – Division of Wildlife has joined neighboring states Kentucky and West Virginia to assist USFWS in implementing the telemetry study *Ohio River Asian Carp Monitoring and Assessment*, led by Jeff Stewart, USFWS Region 3. In 2013, Ohio DNR – Division of Wildlife purchased 11 hydrophones for the Ohio River array to contribute to this effort (approximately $15,000), and in 2014, provided a 40-hour per week employee during May through October to assist with field work. In addition, Ohio DNR – Division of Wildlife is helping to maintain and download data from the hydrophone array in the Markland and Meldahl pools.

Other Planning: Strategies to Address Asian carp

- March 2013: Revised the Ohio DNR – Division of Wildlife *State Management Plan for Aquatic Invasive Species*, which clarifies goals associated with: leadership, prevention, early detection

and rapid response, control and management, and research and education. This plan identifies federal, regional, and state roles; priorities; programs; and steps for implementation to address all AIS, including Asian carp.

- January 2014: Completed the Ohio DNR – Division of Wildlife *Asian Carp Tactical Plan: 2014-2020*, which identifies five desired outcomes (goals) and 21 specific objectives. The plan addresses the Lake Erie and Ohio River watersheds. Four of the five goals and 14 of the objectives directly apply to the Ohio River watershed.
- May 2014: Completed a risk and return-based matrix and flow chart for addressing new findings regarding Asian carp, whether eDNA, juvenile fishes, or adult fishes, to facilitate communication and coordination of planned responses throughout Ohio.
- September 2014: Completed the Ohio DNR – Division of Wildlife *Rapid Response Plan for Aquatic Invasive Species*, which provides policy and guidance for addressing AIS via detailing: (1) capabilities; (2) concept of operation; (3) incident management actions, roles, and responsibilities; (4) establishment of mutual understandings of roles (local, state, federal, other); and (5) synchronization of effective use of state and federal resources within Ohio for rapid AIS operations.

PENNSYLVANIA

The following is a summary of activities of the Pennsylvania Fish and Boat Commission (PFBC) between June 10, 2012, and June 10, 2014, to prevent spread of Asian carp in the ORB:

Interagency Coordination

As a member of ORFMT, PFBC has collaborated at regular intervals with state and federal agencies to coordinate Asian carp activities on the Ohio River. On many occasions, these interactions have occurred informally (e.g., regular phone calls and email correspondence), as well as formally during the following assemblies:

- **Meetings**
  - September 18 and 19, 2012; Frankfort, Kentucky: PFBC participated in the first meeting of the Ohio River Asian Carp Working Group, comprised of ORFMT member biologists (e.g., WVDNR, KDFWR) and USFWS Carterville FWCO staff, to prepare the draft *Ohio River Basin Asian Carp Action Plan*.
  - February 27, 2014; Williamstown, West Virginia: PFBC participated in a planning meeting to coordinate and schedule Asian carp monitoring activities (e.g., eDNA sampling, surveillance surveys, telemetry, contract commercial fishing) proposed for the upcoming field season on the Ohio River. Attending were ORFMT member biologists and USFWS Carterville FWCO staff.
- **Teleconferences**
  - November 30, 2012: PFBC participated in a teleconference with ORFMT member biologists to discuss the Asian carp telemetry project on the Ohio River.
  - January 9, 2013: PFBC participated in a teleconference with the Ohio River Asian Carp Working Group to review edits to the draft *Ohio River Basin Asian Carp Action Plan*.
  - February 26, 2013: PFBC participated in a teleconference with ORFMT member biologists to discuss the project of contract commercial fishing at the Asian carp leading edge on the Ohio River.
  - April 4, 2013: PFBC participated in a teleconference with ORFMT member biologists to discuss the Asian carp telemetry project on the Ohio River.
  - April 23, 2013: PFBC participated in a teleconference with ORFMT member biologists to discuss the Asian carp telemetry project and the project of contract commercial fishing at the Asian carp leading edge on the Ohio River.
  - November 26, 2013: PFBC participated in a teleconference with ORFMT member biologists to discuss proposed Asian carp surveillance surveys of the Ohio River.
  - December 6, 2013: PFBC participated in a teleconference with ORFMT member biologists to discuss proposed Asian carp surveillance surveys of the Ohio River.
  - August 4, 2014: PFBC participated in a teleconference with ORFMT member biologists and USFWS Carterville Conservation Office staff to provide updates on all Asian carp monitoring activities on the Ohio River.

Field Monitoring

- **Specific to Asian Carp**

  The PFBC assisted staff from the USFWS Carterville Conservation Office and collected 595 water samples from the upper Ohio River and several tributaries for analysis for Asian carp eDNA. This sampling effort is summarized as follows:

Sample Stream	Number of Samples Collected*	Most Downstream Sample (River Mile)	Most Upstream Sample (River Mile)
Little Beaver Creek (Pennsylvania [PA])	25	0.1	0.4
Raccoon Creek (PA)	23	0.0	1.0
Beaver River (PA)	23	0.3	2.7
Chartiers Creek (PA)	23	0.1	0.8
Monongahela River (PA)	46	0.2	11.2
Allegheny River (PA)	92	0.2	14.4
Ohio River (PA)	232	39.8	0.3
Ohio River (Ohio and West Virginia)	131	81.0	39.9

* At the time of preparation of this summary report, MO DEC was awaiting eDNA sample results from the USFWS Whitney Genetics Laboratory.

During August 5-6, 2014, PFBC conducted Asian carp surveillance surveys using boat electrofishing gear on (1) the upper Ohio River (River Mile 57.4 upstream to River Mile 54.3 at the tailwaters of New Cumberland Locks and Dam, and River Mile 31.6 upstream to River Mile 30.9 within the Montgomery Slough), and (2) tributary Raccoon Creek (River Mile 0.0 upstream to River Mile 0.7). No Asian carp were collected or observed during these surveys.

- **Nonspecific to Asian carp**

  As part of its programmatic fisheries management strategies for the upper Ohio River, PFBC conducts periodic surveys at fixed sites within tailwaters of navigation locks and dams to monitor trends in abundance, size structure, and age structure of sport fish species. Many of these surveys are coupled with evaluations of overall fish assemblage diversity. At the time of preparation of this summary report, Asian carp were not primary targets during PFBC's routine stock assessments of Ohio River sport fish species (e.g., Smallmouth Bass, Walleye, and Sauger). However, PFBC feels that any fisheries survey on the Ohio River could serve as surveillance for AIS. All stock assessment surveys by PFBC on the Ohio River over the past several years are summarized as follows:

Survey Purpose/Gear Type	Montgomery L/D Tailwaters (River Miles 39.1 to 31.7)	Dashields L/D Tailwaters (River Miles 15.5 to 13.3)
Night boat electrofishing collecting all fish	May 21, 2013*	
Night boat electrofishing targeting Walleye and Sauger (conducted jointly with Ohio DNR)	November 14, 2012* November 18, 2014	
Night boat electrofishing targeting Black Bass, White Bass, Striped Bass, and their hybrids (conducted jointly with Ohio DNR)	September 16, 2013*	
Low-frequency day boat electrofishing targeting Flathead Catfish (conducted jointly with WVDNR)	May 8, 2013*	
Day boat electrofishing targeting young-of-year Smallmouth Bass		July 17, 2012* July 24, 2013* July 23, 2014*
Nearshore beach seining collecting all fish		August 20, 2012* August 20, 2013* August 11, 2014*
Baited tandem hoop net arrays targeting catfish	September 19, 2013*	

*No Asian carp were collected or observed during any of these surveys.

Rapid Response

At the time of preparation of this summary report, PFBC was conducting an ongoing investigation to substantiate illegal presence of Asian carp in a private pay lake (composed of three impoundments) in southwestern Pennsylvania. These impoundments feed the headwaters of a large tributary of the Ohio River. In August 2010, a picture of an angler-caught Asian carp was posted on the Facebook page of the pay lake. Another Asian carp picture was posted May 2014. Following collection of additional evidence at the pay lake, PFBC initiated the Pennsylvania Invasive Species Council's (2013) *Rapid Response Plan and Procedures for Responding to Aquatic Invasive Species in Pennsylvania* (Rapid Response Plan). Actions 1 through 6 of the Rapid Response Plan have been completed in 2014 for this ongoing investigation:

1. Report suspected AIS to the AIS coordinator.
2. Determine if the report is high priority.
3. Identify/verify the species.
4. Conduct a risk assessment to determine if the species is a candidate for rapid response action.
5. Conduct a site-specific assessment and evaluate response options.
6. Develop and implement an incident response plan.

On July 1 and 2, 2014, PFBC conducted surveillance surveys at eight locations on the receiving stream of the pay lake impoundments to investigate the possibility that Asian carp had escaped. No Asian carp were collected or observed during these surveys.

Risk Assessment

See Rapid Response section.

Active Prevention

See Rapid Response section.

Outreach

PFBC has information regarding Asian carp posted on its Website (http://www.fish.state.pa.us/newsreleases/2013press/asian-carp-edna.htm). PFBC recently published an article on Asian carp in the *Pennsylvania Angler & Boater* (http://fishandboat.com/anglerboater/2014ab/vol84num4_julaug/07asian.pdf). Also, as part of the lesson plans for our Family Fishing Program, discussions regarding AIS and Asian carp often occur.

Law Enforcement

PFBC's Bureau of Law Enforcement played a pivotal role in the ongoing investigation summarized in the Rapid Response section.

Research

PFBC allows introduction of live triploid Grass Carp for control of nuisance aquatic vegetation. Purchase and possession of live Grass Carp is monitored via a permit system—purchase of Grass Carp must be from a USFWS-certified supplier who deals in certified triploid Grass Carp. From 1994 through 2013, PFBC issued 6,467 Grass Carp permits. PFBC knows via observations during surveys that Grass Carp have escaped private ponds and entered jurisdictional flowing waters. Considering recent finds of wild diploid Grass Carp in Lake Erie and some of its tributaries, PFBC implemented a Grass Carp ploidy testing program for escaped/feral Grass Carp collected by PFBC biologists during surveys or by anglers. Eyeballs are sent to the USFWS Whitney Genetics Laboratory for ploidy testing to determine if diploid fish have eluded the USFWS National Triploid Grass Carp Inspection and Certification Program.

Financial Support

On behalf of ORFMT, PFBC served as the lead agency for preparation and submittal of a Colcom Foundation grant to address Asian carp in the Ohio River. In February 2013, $150,000 was awarded to ORFMT by the Colcom Foundation. ORFMT decided to use the funds to hire contract commercial fishermen to attack the Asian carp leading edge in Kentucky (Ohio River Meldahl Pool and Greenup Pool).

TENNESSEE

Most efforts of the Tennessee Wildlife Resource Agency (TWRA) occur on the Tennessee River, with some sampling within the Cumberland River system that includes the southern portion of Barkley Reservoir and Cheatham Reservoir. Most of these efforts have involved electrofishing. Currently, Tennessee is not engaged in any type of prevention activity. Sampling is occurring to determine the leading edge, assess recruitment, and acquire data regarding age and growth. Estimated expenditures total $14,000.

WEST VIRGINIA

Interagency Coordination

The WVDNR strongly believes that the most efficient manner to both prevent spread of Asian carp and aid in monitoring impacts is to engage in a cooperative and collaborative approach. WVDNR staff have spent considerable time with state and federal agencies, as well as policy makers to facilitate information exchange.

- WVDNR staff visited Congressional staff in 2013 and 2014 as part of a MICRA-sponsored event to provide both information and technical assistance.
- WVDNR staff represented the ORB and presented related information at a Congressional briefing on Asian carp in 2013.
- WVDNR staff visited Congressional staff in June 2013 to provide information on a potential revision to the Lacy Act regarding invasive species.
- WVDNR staff visited several federal agencies in 2013 and 2014 to discuss the current status and potential future impacts of Asian carp on fisheries, water-related recreational activities, and human health.

A high priority has been placed on developing a basin framework and public information plan regarding Asian carp.

- WVDNR was a primary author of the Ohio River Asian Carp Action Plan. The plan is now under review by all Ohio River natural resources state agencies.
- WVDNR staff aided in drafting a poster explaining what Asian carp are and their potential threats to water-based recreation. WVDNR printed over 1,000 copes for all ORB states to distribute.
- WVDNR staff and Pennsylvania Fish Commission staff drafted a joint news release on the findings of positive eDNA results in the upper ORB.

Cooperative efforts to prevent spread of Asian carp, as well as monitor their population status and potential impacts on other fish populations, is another high priority.

- WVDNR staff aided in writing a successful grant concerned with Asian carp. The grant, Asian Carp Education and Monitoring Program, was funded by the Colcom Foundation. Additional funds were provided by Ohio River natural resources agencies.
- WVDNR staff worked with staff from the States of Kentucky, Pennsylvania, and Ohio, as well as USFWS, in developing and implementing an Asian carp monitoring program
- WVDNR staff functioned as:
    - Observers with contracted fishers in 2013 and 2014. Contracted fishers are professionally trained individuals engaged in focused Asian carp fishing in the Mississippi River basin. Observers were charged with determining by-catch and securing biological information on Asian carp and other fish species. This work was funded through the Colcom Foundation and the KDFWR. This Fishing the Edge Program focused on determining the current status of Asian carp in the middle and upper Ohio River, and aided in training agency staff.

- Technical staff in 2013 and 2014 aided in collection and interpretation of eDNA surveys and results.
- Technical staff in 2013 and 2014 aided in deployment and data acquisition during a telemetry study on the Ohio River.

Field Monitoring for Asian carp

The majority of field monitoring tasks have involved cooperative efforts with other ORB states, as well as USFWS.

- WVDNR staff worked with staff from the States of Kentucky, Pennsylvania, and Ohio, as well as USFWS, in conducting field monitoring for Asian carp. Tasks included both gill net-based and eDNA surveys.
- WVDNR staff have independently monitored for Asian carp in the Greenup navigation pool downstream of the R.C. Byrd Lock and Dam complex. This included both gill net and electrofishing surveys.

Field Monitoring For Asian carp Impacts

The WVDNR staff conduct annual field monitoring surveys for percids (Sauger and Walleye), Black Bass (Largemouth, Spotted, and Smallmouth Bass), Paddlefish, Catfish (Blue, Channel, and Flathead Catfish), and True Bass (White, Hybrid Striped Bass, and Striped Bass). Surveys occur throughout the 277-mile reach of the West Virginia portion of the Ohio River, as well as at lower reaches of the Kanawha River and Big Sandy River. One purpose of these surveys is to determine impacts of Asian carp.

- WVDNR staff conducted percid surveys at five Ohio River tailwaters in 2012 and four Ohio River tailwaters in 2013. Sauger were measured and a sub-set aged. Walleye were measured, and all were genotyped. Percid surveys also were conducted at two Kanawha River locations during both years.
- WVDNR staff conducted black bass surveys throughout the Ohio River and major tributaries in both 2012 and 2013. Fifty locations were surveyed in 2012, and 94 locations were surveyed in 2013.
- WVDNR staff conducted Paddlefish surveys in the Greenup Pool of the Ohio River in both 2012 and 2013.
- WVDNR staff conducted an extensive study of catfish in the West Virginia reach of the Ohio River in both 2012 and 2013. Staff conducted electrofishing surveys at all seven tailwaters in both years. Effort focused on the Greenup and R.C. Byrd pools in 2012.
- WVDNR staff conducted true bass surveys at five tailwaters of the Ohio River in 2012. No true bass evaluations occurred in 2013.
- WVDNR staff conducted an angler-based survey at the Racine, Belleville, and Willow Island pools in 2013 to assess night-time fishing. The survey occurred during a 4-month period (May-August) to target catfish angler catch, harvest, and use.

- WVDNR staff cooperated with the Ohio Division of Wildlife and KDFWR on an Ohio River angler use survey in 2012. The Ohio Division of Wildlife was the primary agency responsible for the survey. WVDNR staff provided technical support and minimal financial support.

Rapid Response

No rapid response-based tasks have been conducted.

Risk Assessment Regarding Asian carp

WVDNR staff attended a USFWS-sponsored workshop on developing Hazard Analysis and Critical Control Point (HACCP) plans for invasive species. The training was valuable in drafting a plan for the WVDNR fish culture program that includes both prevention techniques and risk assessment components. This plan is currently under review and will be implemented in 2015.

Active Prevention

WVDNR has been working with KDFWR. These efforts are addressed in the *Fishing the Edge* Program, which enlists contracted fishers to not only remove Asian carp, but more importantly train agency staff in directed collection of these invasive species. WVDNR staff served as observers with contracted fishers in 2013 and 2014. Staff spent 3 weeks in 2013 and 2 weeks in 2014 with contracted fishers within both Kentucky and West Virginia reaches of the Ohio River.

Outreach with Industry or the Public/Stakeholder Participation Focused on Asian carp Prevention

Outreach efforts have focused on providing information to the public, as well as updating policy makers on Asian carp.

- WVDNR staff aided in preparing a poster explaining what Asian carp are and their potential threats to water-based recreation. WVDNR printed over 1,000 copes for all ORB states to distribute. The poster has been displayed at river access sites and bait venders.
- WVDNR staff developed a page for the agency's web site that included a method to report sightings of Asian carp (http://wvdnr.gov/Fishing/Asian_Carp.shtm).
- WVDNR staff worked with print reporters at the regional and national level to provide information on Asian carp (http://www.wvgazette.com/News/201305120002).
- WVDNR staff worked with public radio to explain the Asian carp issue to a regional audience (http://www.alleghenyfront.org/story/asian-carp-nuisance-west-virginia-streams).
- WVDNR staff visited with U.S. Department of Commerce staff to discuss promotion of the Asian carp commercial fish industry.
- WVDNR staff has been active with other Mississippi River states in developing guidelines for the commercial Asian carp fishing industry. Staff presented at the 2013 Mississippi River Basin Panel meeting, outlining concerns from non-commercial fishing states and how communication can aid in development of the industry.

Law Enforcement/Regulatory Actions Focused on Asian carp Prevention

During the 2013 and 2014 West Virginia legislative session, WVDNR supported legislation to aid in prevention of spread of Asian carp and other invasive species. The 2013 legislative package also included language on preventing transmission of fish pathogens.

- Legislation introduced in the 2013 session was not passed because of questions regarding fish pathogen transmission.
- Two bills, Senate Bill 403 and House Bill 4293, introduced in 2014, were passed by the West Virginia House of Delegates and Senate, and signed by Governor Tomblin. The legislation made it illegal to possess live Asian carp in West Virginia._Language approved is as follows:

  "It is unlawful for any person to possess, sell, offer for sale, import, bring, or cause to be brought or imported into this state or release into the waters of this state, in a live state, any Bighead Carp (*Hypophthalmichthys nobilis*), Silver Carp (*Hypophthalmichthys molitrix*), Black Carp (*Mylopharyngodon piceus*), largescale Silver Carp (*Hypophthalmichthys harmandi*), diploid White Amur (*Ctenopharyngodon idella*) or Snakehead (*Channa* spp.), gametes or eggs of the same, or any hybrids of these species. The director may not issue a stocking permit to any person for the species and their hybrids listed in this subsection, but may issue written authorization for the importation or possession of these species or their hybrids into this state if the importation or possession does not violate any federal law and if the use is limited to scientific research."

Financial Support Provided to Partner Agency/Organizations to Support Asian carp Prevention

WVDNR has been working through the State of West Virginia administrative process to transfer funds to KDFWR in order to aid in Asian carp efforts. These efforts are addressed in the *Fishing the Edge* Program.

Financial Expenditures by WVDNR

The reported expenditures for related Asian carp tasks during the period from June 10, 2012, to June 10, 2014, are based on an estimate of staff time, travel costs, and supplies and equipment purchases during the reporting period. Funds are primarily from the Ohio River Account. The Ohio River Account is an endowment-based fund used solely for management of the Ohio River and its natural resources. Other financial resources acquired through the Sport Fish Restoration Account were used for assessing the status of recreationally important fish in the Ohio River and selected large tributaries. Finally, financial resources derived from the WVDNR License Account, which is funded by purchases of hunting and fishing licenses. A summary of these expenditures is as follows:

Item	Ohio River Account[1]	Sport Fish Restoration Account[2]	WVDNR License Account	Total
Interagency Coordination	27,000	0	5,000	32,000
Field Monitoring For Asian carp	45,000	0	5,000	50,000
Field Monitoring For Asian carp Impacts	30,000	45,000	10,000	85,000
Rapid Response	0	0	0	0
Risk Assessment for Asian carp	5,000	0	0	5,000
Active Prevention	0	0	0	0

Item	Ohio River Account[1]	Sport Fish Restoration Account[2]	WVDNR License Account	Total
Outreach	6,000	0	1,000	7,000
Law Enforcement/Regulatory Actions	1,500	0	3,000	4,500
Financial Support Provided to Partner Agency/Organizations	5,500	0	2,000	7,500
WVDNR Total Expenditures	**$120,000**	**$45,000**	**$26,000**	**$191,000**

[1] Ohio River account funds are used solely on Ohio River aquatic resources management tasks.

[2] Sport Fish Restoration Account Funds are used only to monitor potential impacts of Asian carp via surveys of recreational fisheries

WISCONSIN

Interagency Coordination

Wisconsin provided the chairman of MICRA, which has been instrumental in coordination of the states on this issue. Each state has and had its own issues, worries, and politics. MICRA tries to meld the states of the Mississippi River Basin into a unified voice on the issue. Wisconsin, in providing the chair, was instrumental in this effort. The MICRA chair also is on the Mississippi River Basin Panel and is a member of the Aquatic Nuisance Species Task Force (ANSTF) for further national coordination.

Field Monitoring

In the lower Wisconsin River since 2011, Wisconsin DNR crews, anglers, and the public have found or captured three Grass Carp and eight Bighead Carp. Three of the Bighead Carp were caught by anglers, one was found dead on shore, and four were caught in Wisconsin DNR gill nets. The detections are summarized as follows:

Species	Date	Reporter	Gear	Notes	Picture Available
Grass Carp	April 2011	Sciences Services	Electrofishing	Confirmed triploid	Yes
Grass Carp	June 2011	Public	Bow and arrow		Yes
Bighead Carp	July 2011	Public	Hook and line	First confirmed Bighead Carp in inland waters	Yes
Grass Carp	September 2011	Science Services	Electrofishing		Yes
Bighead Carp	October 2011	Wisconsin DNR	Gill net		Yes
Bighead Carp	November 2011	Public	Hook and line	Current state record for hook and line	Yes
Bighead Carp	April 2012	Wisconsin DNR	Found dead		Yes
Bighead Carp	October 2012	Wisconsin DNR	Gill net		Yes
Bighead Carp	November 2012	Wisconsin DNR	Gill net		No
Bighead Carp	November 2012	Wisconsin DNR	Gill net		No
Bighead Carp	March 2013	Wisconsin DNR	Hook and line		Yes

Currently, Asian carp are incidental to other commercial fishing activities.

Wisconsin also monitors a commercial fishery in the upper Mississippi that borders the State. Those businesses fish approximately 2 million feet of net each year, and occasionally Asian carp are collected.

Wisconsin has cooperated with USFWS in eDNA sampling for Asian carp within various water bodies. Approximately $6000.00 was expended in a contract to Cornell University.

Rapid Response

Wisconsin has developed an Aquatic Invasive Species Rapid Response Framework that includes all AIS, including Asian carp. This document was developed by a team of staff across the Water Division.

Risk Assessment

Wisconsin has not independently developed a risk assessment, but previously worked with USGS on risk assessments regarding Silver Carp and Bighead Carp.

Active Prevention

No prevention activities have occurred.

Outreach

Wisconsin provided a grant to an NGO (the Wisconsin River Alliance) to hire a staff person for outreach along the Mississippi river. Wisconsin Bureau of Law Enforcement provides staff at boat ramps to further education regarding invasive species.

Law Enforcement/Regulatory Actions

Wisconsin Bureau of Law Enforcement provides staff at boat ramps to further education regarding invasive species, and to fortify Wisconsin's bait transport rules.

Research Focused on Development or Refinement of New Tools/Techniques

No research activities have occurred.

Financial Support

The MICRA chairperson for the state of Wisconsin provided approximately 1200 hours of staff time and $10000.00 of additional support. Fisheries also provided time and expertise as part of traditional commercial and riverine monitoring. In addition, Wisconsin has cooperated with USFWS in eDNA sampling within various water bodies for Asian carp. Approximately $6000.00 was expended in a contract to Cornell University. Wisconsin's invasive species program also developed Asian carp signs costing $973.

Other Activities

No other activities identified.