

# 2015 Annual Report to Congress

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

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





# Second Annual Report to Congress

Summary of Activities and Expenditures to  
Manage the Threat of Asian Carp in the Upper  
Mississippi and Ohio River Basins:  
July 2014 through September 2015



**Contents**

| <b><u>Section</u></b>  | <b><u>Page</u></b> |
|--|--------------------|
| Executive Summary.....   | ES1                |
| Acknowledgments.....   | ES8                |
| 1.0 INTRODUCTION .....   | 1                  |
| 1.1 Interagency Management of Asian Carp in the Upper Mississippi River and Ohio River Basins – Collaboration under WRRDA 2014 .....                             | 1                  |
| 1.2 The Asian Carp Challenge .....   | 5                  |
| 1.3 Progress since the Last Report.....  | 6                  |
| 2.0 OBSERVED CHANGES IN THE RANGE OF ASIAN CARP IN THE UPPER MISSISSIPPI AND OHIO RIVER BASINS AND TRIBUTARIES .....   | 8                  |
| 2.1 Analysis of Black and Grass Carp Reproductive Status (Ploidy).....   | 15                 |
| 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..... | 18                 |
| 3.1 New Collaborative Basinwide Interagency Planning and Project Implementation in FY 2015.....  | 18                 |
| 3.2 Enhanced Upper Mississippi River Basin Agency Coordination.....  | 19                 |
| 3.3 Enhanced Ohio River Basin Agency Coordination .....  | 21                 |
| 3.4 Federal Agency Activities in the UMRB.....   | 22                 |
| 3.4.1 U.S. Army Corps of Engineers .....   | 22                 |
| 3.4.2 U.S. Fish and Wildlife Service .....   | 28                 |
| 3.4.3 U.S. Geological Survey.....  | 32                 |
| 3.4.4 U.S. Coast Guard .....   | 34                 |
| 3.4.5 National Park Service .....  | 34                 |
| 3.4.6 Department of Commerce - National Oceanic and Atmospheric Administration..   | 34                 |
| 3.4.7 U.S. Environmental Protection Agency.....  | 35                 |
| 3.5 UMRB State Agency Accomplishments by Activity.....   | 35                 |
| 3.5.1 Interagency Coordination .....   | 35                 |
| 3.5.2 Field Monitoring and Early Detection .....   | 35                 |
| 3.5.3 Rapid Response .....   | 37                 |
| 3.5.4 Grass Carp Recommendations .....   | 37                 |
| 3.5.5 Active Prevention.....   | 37                 |
| 3.5.6 Outreach with Industry or the Public.....  | 37                 |
| 3.5.7 Research.....  | 38                 |
| 3.6 Federal Agency Activities in the ORB.....  | 40                 |
| 3.6.1 U.S. Army Corps of Engineers .....   | 40                 |
| 3.6.2 U.S. Fish and Wildlife Service .....   | 40                 |
| 3.6.3 U.S. Geological Survey.....  | 43                 |
| 3.6.4 U.S. Coast Guard .....   | 43                 |
| 3.6.5 U.S. Environmental Protection Agency.....  | 43                 |



|       |  |    |
|-------|--|----|
| 3.7   | ORB State Agency Accomplishments by Activity .....   | 43 |
| 3.7.1 | Interagency Coordination .....   | 43 |
| 3.7.2 | Field Monitoring and Early Detection .....   | 43 |
| 3.7.3 | Active Prevention .....  | 45 |
| 3.7.4 | Research .....   | 45 |
| 3.7.5 | Law enforcement/regulatory actions .....   | 45 |
| 3.7.6 | Outreach .....   | 46 |
| 4.0   | RESEARCH AND TECHNOLOGIES POTENTIALLY USEFUL FOR CONTROLLING THE SPREAD OF ASIAN CARP .....                    | 47 |
| 5.0   | METRICS AND METHODOLOGIES FOR EVALUATING SUCCESS OF ACTIONS TO CONTROL THE SPREAD OF ASIAN CARP .....          | 50 |
| 5.1   | Short-term Actions to Address the Need for Interagency Coordination.....                                       | 50 |
| 5.2   | Quantitative Measure of Progress.....  | 52 |
| 5.3   | Qualitative Measures of Progress.....  | 55 |
| 6.0   | CROSS-CUT SUMMARY OF FEDERAL AND NON-FEDERAL EXPENDITURES IN THE UPPER MISSISSIPPI AND OHIO RIVER BASINS ..... | 57 |
| 7.0   | FUTURE INTERAGENCY COLLABORATIVE EFFORTS .....   | 60 |

**LIST OF FIGURES**

|            |   |    |
|------------|---|----|
| Figure 1.  | Upper Mississippi River and Ohio River Basins .....   | 4  |
| Figure 2.  | Silver Carp recorded occurrences. ....  | 9  |
| Figure 3.  | Bighead Carp recorded occurrences.....  | 10 |
| Figure 4.  | Grass Carp recorded occurrences.....  | 11 |
| Figure 5.  | Black Carp recorded occurrences. ....   | 12 |
| Figure 6.  | Characterization of current (2015) relative abundance of Bighead Carp and Silver Carp in the UMRB and ORB. ....               | 15 |
| Figure 7.  | Black Carp captured on June 24, 2015.....   | 16 |
| Figure 8.  | Structure for inter-agency coordination and implementation of Asian carp control strategy frameworks in the ORB and UMRB..... | 22 |
| Figure 9.  | USACE telemetry network activities in 2015 .....  | 24 |
| Figure 10. | Electrical dispersal barrier location map.....  | 25 |
| Figure 11. | Flood Bypass Areas in the Chicago Area Waterways System .....   | 26 |
| Figure 12. | Sluice gates at Thomas J. O’Brien Lock and Dam.....   | 27 |
| Figure 13. | Paupier butterfly frame trawl. ....   | 28 |
| Figure 14. | Two DIDSON units being deployed.....  | 30 |
| Figure 15. | Overview of all 2015 eDNA sampling sites and results.....   | 53 |

**LIST OF TABLES**

|          |  |    |
|----------|--|----|
| Table 1. | Total FY 2015 Expenditures for Asian Carp Activities ..... | 59 |
|----------|--|----|



## 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 a broad array of agency actions and public projects across the United States. Section 1039 (b) of WRRDA authorizes the Director of the U.S. Fish and Wildlife Service (USFWS) to coordinate with the Secretary of the Army, the Director of the National Park Service, and the Director of the U.S. Geological Survey (USGS) to lead a multiagency effort to address the spread of Asian carp in the Upper Mississippi River Basin (UMRB) and the Ohio River Basin (ORB) and tributaries. Those actions include the provision of technical assistance, coordination, best practices, and support to state and local governments engaged in Asian carp prevention and control. WRRDA also requires development of an annual report to the United States Congress (Report) summarizing strategies, expenditures, and progress in addressing the threat of Asian carp in the UMRB and ORB and their tributaries.

The 2015 Report includes the following information:

- i. Observed changes in the range of Asian carp in the UMRB and ORB from July 2014 through September 2015, including further definition of the location of Asian carp in tributaries of the UMRB and ORB;
- ii. A summary of Federal agency efforts from July 2014 through September 2015, including cooperative efforts with non-federal partners, to control the spread of Asian carp in the UMRB and ORB and their tributaries;
- iii. Research continued and conducted since the first report was submitted that could improve the ability to control the spread of Asian carp;
- iv. An evaluation of quantitative and qualitative measures identified in the initial 2014 Report to Congress to document progress by all agencies in controlling the spread of Asian carp; and
- v. A cross-cut accounting of Federal and non-federal expenditures during agency Fiscal Year 2015 to control the spread of Asian carp.

The 2015 Report represents the collective efforts to manage Asian carp populations - including Bighead Carp (*Hypophthalmichthys nobilis*), Silver Carp (*H. molitrix*), Grass Carp (*Ctenopharyngodon idella*), and Black Carp (*Mylopharyngodon piceus*) – with a focus on the large river systems of the Midwest.

The USFWS, working in close coordination with the Secretary of the Army and other Federal and State partners, developed this second annual Report to summarize cooperating agency accomplishments on Asian carp management in the UMRB and ORB. This report includes activities conducted from July 2014 through September 2015 and contains related agency expenditures for their 2015 Federal or State fiscal year reporting periods. This 2015 Report builds on the initial 2014 Report to Congress, which summarized management efforts and expenditures for June 2012 through June 2014.



The 2015 Report provides a summary of the numerous Asian carp prevention efforts being conducted to protect the ORB, UMRB, and Great Lakes Basin (GLB). WRRDA directs the focus of agency reporting and coordination to address the threat of Asian carp in the ORB and UMRB. However, Asian carp management efforts conducted in the GLB are included in this Report since the hydrologic delineation that defines the UMRB extends nearly to Lake Michigan and includes waterways critical to Great Lakes protection - the interconnected Illinois Waterway (IWW) and the Chicago Area Waterway System (CAWS). The CAWS has been identified as the primary potential vector for the introduction of Asian carp into the GLB via the Mississippi River watershed, and is therefore the primary geographic focus for most Federal and State prevention efforts associated with the Asian Carp Regional Coordinating Committee (ACRCC). This Report is intended to focus on the Federal and State agency actions undertaken to prevent further expansion of Asian carp within the mainstem rivers and tributaries of the ORB and UMRB (excluding the CAWS and IWW). Funding and support for these efforts was provided through a combination of Federal and State agency appropriations (Section 6). However, since there is a direct connection to Great Lakes ecosystem protection, the CAWS and IWW are eligible for funding through the Great Lakes Restoration Initiative (GLRI) even though these waterways are within the boundaries of the UMRB. Funding from GLRI is appropriated annually to the U.S. Environmental Protection Agency (USEPA) and allocated to Federal and other resource agencies to supplement agency base funds and support conservation goals within the Great Lakes Basin (GLB). These GLB-focused efforts and expenditures are included in this Report to provide a complete picture of Asian carp activities conducted within the UMRB, yet are also identified in the ACRCC's annual Control Strategy Framework (<http://asiancarp.us/documents/2015Framework.pdf>). As shown in Table 1 (Section 6.0), a significant portion of the reported FY 2015 agency expenditures, approximately \$44.2 million, were for actions conducted in the CAWS portion of the UMRB, exclusively for Great Lakes protection from Asian carp. This report focuses on the remaining \$5.7 million, which was spent on activities to protect the UMRB and ORB from the threat of Asian carp.

### **The Challenge**

For decades, waters of the United States have been increasingly under assault from a growing number of AIS. Such species pose significant challenges to the health of native species and the ecosystems they depend on by compromising conservation missions of State and Federal agencies and their partners. In addition to widespread and longstanding ecological consequences, AIS often result in significant economic losses to stakeholders, resource users, and entire communities. In total, AIS have cost our nation's economy billions of dollars per year. AIS, including Asian carp, are often resilient species that possess characteristics that are advantageous over native species and provide an ability to survive in impaired environments. In addition, these species are often capable of rapid reproduction, allowing them to establish self-sustaining populations in areas with few or no natural predators. Developing effective and holistic prevention and control strategies to manage AIS requires in-depth knowledge of the life history traits, including feeding ecology and reproductive behavior, and potential vectors of species introduction.

In recent years, Asian carp have steadily increased their range through portions of the UMRB, ORB, and other basins, posing a threat to the rich biodiversity and related economies of these watersheds. One or



more of these four species of Asian carp now occurs in 45 States. As populations expand in number and range, focused prevention and control efforts require the use of comprehensive, robust, and scientifically informed strategies that are implemented through broad, inclusive multi-jurisdictional partnerships. Limited resources available for these efforts require leveraging technical capacity and development in addition to the use of adaptive, up-to-date mechanisms for making well-informed management decisions in an ever-changing environment. Accordingly, coordination among the various watersheds and basin partnerships is essential to address the threat of Asian carp and ensure that complementary strategies are in place across the landscape to minimize the risk of further introductions. Coordination efforts also ensure that management strategies use all available technologies in the most effective manner possible.

Research conducted on Asian carp control options in the CAWS and IWW may yield significant benefits to other basins. However, as new Asian carp control tools and technologies are developed and refined to support basinwide strategies in the UMRB and ORB, their subsequent implementation, operation, and ongoing maintenance will require designated resources.

To help inform planning of management actions, the 2015 Report includes detailed results on the occurrence of Asian carp in United States waters, including summaries of historical and new detections by species and assessments of changes in the observed range of each species since the 2014 Report. Data collected since the last report showed new occurrences of three of the four species of Asian carp. Although these new occurrences may indicate an increase in the observed range since June 2014, it is also possible that Asian carp were present in these locations prior to 2014, but only recently detected as a result of increased monitoring efforts focused on the leading edge of Asian carp ranges.

Changes in observed ranges are as follows:

- Silver Carp: Increase in observed range upstream in the Mississippi River (71 miles) and upstream in the Tennessee River (27 miles), and into Ohio River tributaries of Indiana (62 miles up the White River system)
- Bighead Carp: Increase in observed range upstream in the Mississippi River (8 miles), upstream in the St. Croix River (6 miles), and upstream in the Licking River, Kentucky (93 miles)
- Grass Carp: No increase in observed range in the UMRB or ORB
- Black Carp: Increase in observed range upstream in the Mississippi River (12 miles)

### **Current Prevention and Control Efforts**

Coordination among the numerous State and Federal agencies and other organizations working to address the threat of Asian carp in the UMRB and ORB remains the cornerstone for planning and implementing effective monitoring, prevention, and control strategies. Asian carp prevention has become an increasingly high-priority for resource managers within both the UMRB and ORB watersheds. This priority is now addressed in many individual State and Federal agency management plans and strategies as well as within broader coordinated regional or basinwide management strategies. For example, priority goals on interagency coordination, research, monitoring, and communication are



identified as high-priority actions within the *Ohio River Basin Asian Carp Control Strategy Framework*. This Framework was developed by the Ohio River Fisheries Management Team (ORFMT) and includes actions for the jurisdictions of the six states that share management of the watershed. Similar priorities are also included in the *Minnesota Invasive Carp Action Plan (MICAP)*, the State of Minnesota's blueprint for Asian carp prevention in its waters. The priority actions identified in these plans, as well as those of the ACRCC's Framework, are consistent with and complementary to the *Management and Control Plan for Bighead, Black, Grass, and Silver Carp in the United States (National Plan)*, the initial national strategy developed and approved by the Aquatic Nuisance Species Task Force in 2007. Goals of the National Plan include: preventing the introduction and establishment of self-sustaining populations of Asian carp in waters of in the United States; containing, controlling and reducing Asian carp populations, where established; conducting research to provide accurate and scientifically valid information necessary for the effective management of Asian carp; providing information to the public, commercial entities, and government to improve effective management and control of Asian carp; and effectively planning, implementing, and evaluating management and control efforts for Asian carp in the United States. Examples of ongoing developments that support basinwide Asian carp management strategies and the National Plan include:

- Continued implementation and refinement of an interagency Asian carp early detection monitoring program using both traditional gear and eDNA (genetic) sampling methods
- Development of new and refinement of existing basinwide and statewide Asian carp prevention strategies, tools, and technologies for early detection and control
- Progress on the analysis of potential AIS control alternatives that can be deployed in or adjacent to lock and dam structures, yet allow continued navigation
- Closure of St. Anthony Lock in Minneapolis, Minnesota, as authorized under WRRDA, to prevent further upstream movement of Asian carp in the Mississippi River
- Further development of standardized datasets that track the status of Asian carp populations in waters of the United States, focusing on the UMRB and ORB
- Expanded collaborative interagency partnerships in the UMRB and ORB to manage the threat of Asian carp across multiple jurisdictions, including selection of priority Asian Carp partnership projects in the UMRB and ORB
- Enhanced interbasin collaboration between the UMRB, ORB, and Great Lakes Basin.

In FY 2015, additional funding was provided to USFWS for Asian carp prevention efforts through its annual agency base appropriations. These resources were used to coordinate an enhanced multiagency Asian carp management response in the UMRB and ORB, as directed by WRRDA, Section 1039, that emphasized new detection and prevention projects. Projects were developed cooperatively between State and Federal agencies to address key needs identified in the basinwide Asian carp management strategies and the National Plan. These needs addressed numerous management goals including prevention, control, monitoring and response, research, and communication.

Collaborative Asian carp management projects supported with these funds (in whole or in part) include:





In the UMRB,

- Monitoring - Comprehensive surveillance program to evaluate the status of Asian carp populations in key locations, focusing on range expansion and population characteristics
- Control - Contract fishing to reduce propagule pressure and to characterize adult Asian carp populations
- Prevention / Research - Evaluation of Asian carp and native fish passage at Lock and Dams 8 and 19

In the ORB,

- Monitoring - Use of telemetry to determine distribution, movement, and lock and dam passage of Asian carp
- Control - Active removal of Asian carp
- Prevention - Limiting Asian carp dispersal at lock and dams
- Research - Evaluating the impact of Asian carp on native fishes in the Wabash River
- Communication - Asian carp partner/stakeholder coordination and outreach

Accomplishments achieved through these projects will be included in subsequent versions of the Report. Additionally, the collaborative processes used to develop priority projects will be used to evaluate project effectiveness, report measurable accomplishments, and inform subsequent management strategies and actions. In addition to these collaborative projects, other ongoing activities are being conducted by State and Federal partners to address the threat of AIS, including Asian carp, in the UMRB, ORB, and other waters. A summary of all efforts conducted during the reporting period to address the threat of Asian carp in the specified basins is provided in Section 3 and Appendix 1 of this report.

Reported State and Federal agencies expenditures related to Asian carp prevention and control efforts in the UMRB and ORB in 2015 were estimated at \$49,856,215 for this reporting period (defined as each respective agency's designated FY 2015). Of this amount, \$5,650,284 was expended on actions outside of the CAWS (Table 1 in Section 6.0). As highlighted in this report, these funds were used to leverage and expand existing partnerships, strategies, and research to bring additional capacity and expertise to significantly augment Asian carp management in the UMRB and ORB.

### **Applying Lessons-Learned and Transferring Technology**

A growing number of technologies are currently under development or have been proposed for use in controlling or preventing spread of Asian carp. The immediate focus of many of these activities has been aimed at managing Asian carp populations in the IWW and the CAWS to prevent introduction into the Great Lakes, yet many tools have the potential for use in other waterways (including the ORB and UMRB). Working closely with Federal and State partners, USGS has taken the lead on research and development of new and emerging technologies to control Asian carp in the United States. A brief description of the agency's work is provided in this Report, with a detailed description in Appendix 2 (available online at [www.asiancarp.us](http://www.asiancarp.us)).



The U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) coordinates closely with the USGS and other State and Federal agencies and universities to significantly advance the science and capacity for managing Asian carp, including development and refinement of tools for early detection.

Current research and development projects on Asian carp can generally be described under one of the following categories:

- Early Detection and Monitoring
- Life History/Behavior
- Feeding Ecology
- Prevention
- Control
- Integrated Pest Management (IPM) Strategies

Research efforts being conducted by State and Federal agencies, universities, and other organizations are described within individual lead-agency sections in this Report. The technological research priorities currently being evaluated and developed demonstrate potential to provide additional prevention and control opportunities, with many individual projects designed to exploit known life-history vulnerabilities and behavioral characteristics of Asian carp. In addition, Integrated Pest Management (IPM) strategies have been developed and continue to be refined for use at selected sites for Asian carp management. IPM strategies provide a more comprehensive and robust approach to Asian carp management by exploiting multiple opportunities for control (such as feeding ecology, swimming behavior, sound/carbon dioxide [CO<sub>2</sub>] avoidance) by concurrently or sequentially implementing specific tools in a complementary manner. Further research being conducted by other agencies and academic institutions will produce new and emerging technologies that may prove beneficial for use in UMRB and ORB strategies. Whenever possible, opportunities to apply the lessons-learned from this research will be identified and incorporated into strategies for the UMRB, ORB, and other basins.

### **Establishing Measures of Effectiveness for Asian Carp Prevention**

WRRDA 2014 directed the USFWS to identify measures to document collective progress in controlling spread of Asian carp in the UMRB and ORB and tributaries. The 2014 Report identified: (1) proposed measures and outcomes for ensuring progress toward the goals of controlling spread of Asian carp in the designated watersheds, and (2) specific critical short-term actions to continue and expand current efforts to ensure multiagency coordination to achieve common prevention-based goals. Development of this 2015 Report included a review of the long-term utility of the original measures proposed in the 2014 Report for effectively tracking performance and progress. This review informed recommendations to discontinue a number of specific measures (see *Section 5 - Metrics and Methodologies for Evaluating Success of Actions to Control the Spread of Asian Carp*). The remaining measures will continue to be assessed and refined based on their practicality and utility as a tool for: (1) annually tracking actions and reported outcomes implemented by agencies for Asian carp prevention, and (2) assessing general progress toward achieving long-term goals within Asian carp strategies. The use of these measures will increase management efficiency and accountability for implementing Asian carp strategies in the UMRB



and ORB. Roll-up summaries of accomplishments achieved under each measure will be provided in subsequent reports.

### **Future Interagency Collaborative Efforts**

Future coordination and implementation efforts focused on Asian carp prevention will continue to build on existing collaborative planning efforts. The basinwide coordination and interagency planning conducted since WRRDA was enacted in June 2014 has provided a strong foundation for developing priority management and policy actions needed to achieve both short- and long-term objectives outlined in Asian carp management strategies. Enhanced coordination will continue through 2016, with an emphasis on opportunities to address ambitious, but achievable, goals that support long-term prevention and control of Asian carp and natural resource protection. Within the ORB and UMRB, potential future actions to prevent additional spread of Asian carp include:

#### **Coordination**

- Continue refinement and formalization of interagency coordination (State and Federal agency, Mississippi Interbasin Cooperative Resource Association [MICRA], other cooperative resource organizations), priority-setting, and decision-making processes for developing holistic strategies and long-term priorities
- Continue to develop and implement consensus-based protocols for data collection, assessment, management, and communication
- Continue to expand and build upon interagency partnerships to identify and implement highest-priority Asian carp monitoring and control activities in support of basinwide, regional, and national strategies

#### **Monitoring and Response**

- Conduct monitoring to locate potential target areas for limiting the spread of reproducing Asian carp within the UMRB and ORB
- Develop additional early detection and response plans, where needed, in the UMRB and ORB
- Conduct early detection monitoring in the upper Ohio and Tennessee rivers with traditional fisheries sampling gears and eDNA
- Address Asian carp expansion while also considering opportunities for broader detection and control of other priority AIS such as Northern Snakehead and Round Goby, when possible

#### **Communication and Outreach**

- Establish communication networks with non-governmental stakeholder groups to support additional outreach to stakeholders within basins

#### **Research**

- Assess and characterize nursery habitats in lower ORB to identify locations for effective implementation of management actions to minimize survival of young Asian carp
- Assess Asian carp passage through McAlpine and Markland dams to inform potential locations for deterrent barriers that may reduce the number of adult Asian carp migrating upriver



- Assess population density in Barkley, Kentucky, and Pickwick lakes and Cheatham Reservoir to evaluate the extent of Asian carp migration and inform the design and implementation of management actions to prevent the establishment of Asian carp populations
- Assess and characterize Asian carp reproductive success in Kentucky and Barkley Lakes to determine if populations are self-sustaining and to identify appropriate management actions
- Characterize established population range and habitat in Ohio, Tennessee and Cumberland rivers to determine the potential distribution of established populations in these watersheds
- Enhance telemetry array for better coverage of the ORB to better understand the extent and timing of habitat use in specific locations by Asian carp

#### Control

- Increase harvest of Asian carp in the lower ORB and Kentucky and Barkley Lakes to prevent or reduce numbers of adult Asian carp migrating upriver
- Increase harvest in the upper ORB to minimize the potential for reproduction above McAlpine Lock and Dam and to remove adult fish at the leading edge
- Increase active telemetry in the lower ORB to find spawning congregations and inform Asian carp removal efforts
- Investigate how technologies such as bubbles, lights, and sounds can inhibit Asian carp movement

Interagency partnerships will build from existing efforts to continue identification and implementation of the highest-priority Asian carp monitoring and control activities that support basinwide, regional, and national strategies. The ability of agencies and their partners to fully implement comprehensive prevention strategies will be based on the availability of resources to support efforts in the UMRB, ORB, and other priority waters of the United States.

## 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: U.S. Army Corps of Engineers (USACE), U.S. Geological Survey (USGS), U.S. Environmental Protection Agency (USEPA), National Park Service (NPS), U.S. Department of Agriculture – Forest Service (USFS), Department of Commerce - National Oceanic and Atmospheric Administration (NOAA), U.S. Coast Guard (USCG); and the States of Georgia, Iowa, Illinois, Indiana, Kentucky, Minnesota, Missouri, Mississippi, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Wisconsin, and West Virginia.

Their efforts included acquiring, analyzing, and summarizing fiscal and biological data; generating and providing descriptions of project accomplishments; and continually engaging with the USFWS 2015 Report to Congress development team to ensure accuracy and completeness in our collective communication of Asian carp management efforts within the Upper Mississippi River Basin (UMRB), Ohio River Basin (ORB) and other waters of the United States.



## 1.0 INTRODUCTION

### 1.1 Interagency Management of Asian Carp in the Upper Mississippi River and Ohio River Basins – Collaboration under WRRDA 2014

On June 10, 2014, the President signed into law the Water Resources Reform and Development Act of 2014 (WRRDA), Public Law 113-121, authorizing a broad array of agency actions and public projects across the United States. As a part of WRRDA, the U.S. Fish and Wildlife Service (USFWS) is authorized, in collaboration with the National Parks Service (NPS) and the U.S. Geological Survey (USGS), to take actions to slow, and eventually eliminate, the spread of Asian carp in the upper Mississippi River Basin (UMRB) and the 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. Additionally, WRRDA directs USFWS to develop, in coordination with the Secretary of the Army, an annual report to Congress (Report) summarizing accomplishments and expenditures related to efforts to manage the threat of Asian carp in the UMRB and ORB as well as emerging research and other tools and proposed processes for evaluating the effectiveness of these efforts.

The direction provided in WRRDA Section 1039 for Asian carp prevention complements existing Federal and State authorities that, in many cases, more broadly address aquatic invasive species (AIS) in waters of the United States. Congress enacted the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA), which called for establishment of a comprehensive Federal effort to prevent introduction, establishment, and proliferation of introduced aquatic nuisance species. In the Act, Congress established the Aquatic Nuisance Species (ANS) Task Force, with co-chair responsibilities assigned to the USFWS and the National Oceanic and Atmospheric Administration (NOAA). In 1996, the National Invasive Species Act (NISA) re-authorized NANPCA. 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 laws and regulations include Title 18 of the Lacey Act (enacted in 1900), which regulates importation and interstate transport of species listed as injurious. Bighead Carp, Silver Carp, and Black Carp are all listed as injurious species under the Lacey Act, providing an important tool to prevent further spread of Asian carp and other AIS in the United States. The Great Lakes and Mississippi River Interbasin Study (GLMRIS), authorized in Section 3061(d) of the Water Resources Development Act (WRDA) of 2007, identified a range of options and technologies that could prevent movements of AIS between the Great Lakes and Mississippi River basins via aquatic pathways. Detailed information can be found at: <http://glmr.is.anl.gov/>. Results of GLMRIS have also been used to inform efforts to address the potential movement of Asian carp between drainages via secondary pathways (e.g., temporary hydrologic connections created during flooding events) connecting the ORB and GLB in Indiana and Ohio. Specific projects to address these pathways are described later in the Report.

As stipulated in WRRDA, the USFWS, working in close coordination with the Secretary of the Army and Federal, State, Canadian, and non-governmental partners, developed *"The First Annual Report to Congress: Summary of Activities and Expenditures to Manage the Threat of Asian Carp in the Upper*



*Mississippi River and Ohio River Basins, June 2012 to June 2014*” (2014 Report)

(<http://www.fws.gov/midwest/fisheries/asian-carp/WRRDA2014.pdf>), which included a summary of efforts preceding and up to the date the law went into effect. In addition to having a strong focus on actions in the UMRB and ORB, the 2014 Report also addressed Asian carp management efforts focused elsewhere in the United States and summarized activities and expenditures over the previous 2 years for both Federal and non-federal partners. In January 2015, the Director of the USFWS submitted the 2014 Report to the U.S. Congressional committees stipulated in WRRDA. As requested, it described coordinated strategies and progress made toward the goal of controlling and eliminating Asian carp in the UMRB and ORB and tributaries.

Information gathered for development of the 2014 Report revealed the wide variety of actions taken by many agencies and organizations to address the threat of Asian carp across the landscape and illustrated the many opportunities for realizing efficiencies through ongoing and enhanced communication, coordination, and collaboration.

The 2015 Report builds upon the 2014 Report and includes the following information:

- I. Observed changes in the range of Asian carp in the UMRB and ORB from July 2014 through September 2015, including further definition of the location of Asian carp in tributaries of the UMRB and ORB;
- II. A summary of Federal agency efforts from July 2014 through September 2015, including cooperative efforts with non-federal partners, to control the spread of Asian carp in the UMRB and ORB and their tributaries;
- III. Research continued and conducted since the first report was submitted that could improve the ability to control the spread of Asian carp;
- IV. An evaluation of quantitative and qualitative measures identified in the first report to document progress by all agencies in controlling the spread of Asian carp; and
- V. A cross-cut accounting of Federal and non-federal expenditures during agency Fiscal Year 2015 to control the spread of Asian carp.

For the 2015 Report, State and Federal agencies reported all Asian carp management activities conducted in the UMRB and ORB during the reporting timeframe. Reported management activities include any actions that support Asian carp monitoring and early detection, containment, or control. These activities included Asian carp population monitoring using both traditional sampling equipment (e.g. nets and electrofishing) and eDNA (genetic-based monitoring), population control, rapid response, public outreach and awareness, law enforcement, research and development, barrier development and related studies, and interagency coordination.

The 2015 Report also includes descriptions of new collaborative prevention and control projects and strategic planning efforts being funded, in whole or in part, through additional appropriated funds provided for Asian carp prevention in the Fiscal Year 2015 USFWS budget. These additional funds are being used to support Asian carp activities outside of the GLB, including the UMRB, ORB, and other priority locations.



The UMRB is defined by the USGS Hydrologic delineations of the UMRB (Regional Code 7) and is described as the drainage of the Mississippi River Basin (MRB) above the confluence with the Ohio River, excluding the Missouri River Basin (MORB). This area includes the Chicago Area Waterways System (CAWS) and up to River Mile (RM) 333 of the Illinois Waterway (IWW), where it ends at the entrance to Lake Michigan. The UMRB includes parts of Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, South Dakota, and Wisconsin. The ORB is defined consistent with USGS Hydrologic delineations of the ORB (Regional Code 5) as the drainage of the Ohio River Basin, excluding the Tennessee River Basin. This definition includes parts of Illinois, Indiana, Kentucky, Maryland, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. The 2015 Report also includes the Tennessee River (Regional Code 6), including parts of Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia. The entire drainage area for each basin is shown in Figure 1.

As directed in WRRDA, the 2015 Report will be formally transmitted to the Committee on Appropriations and the Committee on Environment and Public Works of the Senate; and the Committee on Appropriations, the Committee on Natural Resources, and the Committee on Transportation and Infrastructure of the House of Representatives. In addition, it will be made available to the public and other stakeholders via the Internet at [www.asiancarp.us](http://www.asiancarp.us).

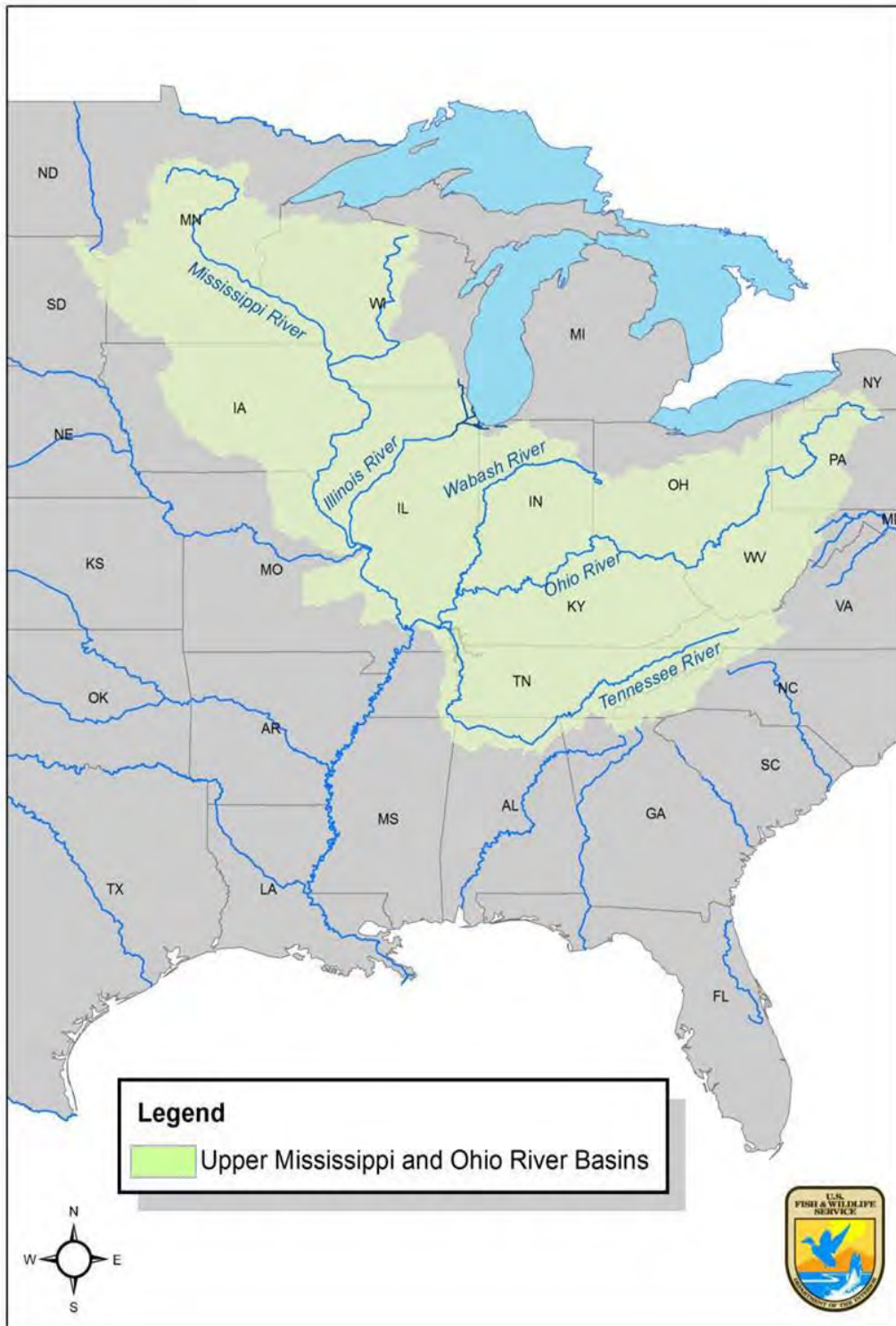


Figure 1. Upper Mississippi River and Ohio River Basins as defined by the USGS Hydrologic delineations





## 1.2 The Asian Carp Challenge

AIS pose significant challenges to the sustainability of native species and the ecosystems they depend on as well as the conservation missions of State and Federal agencies and their partners. 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 UMRB and ORB. This expanded range poses a threat to the rich biodiversity and related economies of the UMRB, ORB, GLB and other watersheds. In addition to significant environmental harm, AIS have cost our nation's economy billions of dollars per year<sup>1</sup>. Significant portions of America's interior river systems are now occupied by one or more Asian carp species, with populations now established in 45 states. The range of Asian carp populations continues to expand, increasing the threat to uninvaded watersheds within and adjacent to the UMRB and ORB.

To address this issue, current efforts focus on developing and utilizing capacity to strategically conduct scientific sampling of at-risk locations for rapid detection of Asian carp (if present) and, if warranted, implementation of effective response actions to prevent further geographic spread or establishment of populations. 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 further spread in waters of the United States. To better inform these prevention strategies and provide the most accurate and current profile of Asian carp population status, standardized and geographically referenced data describing all life stages (eggs, larvae, juveniles, and adults) is needed in each river basin and adjacent watersheds. While the cooperative network of Federal and State agencies is working to expand and update this body of scientific information, data gaps remain in key areas and have been identified as a priority management need. As control technologies are developed and deployed on experimental or trial basis, future challenges will be identifying and developing strategies for fishery management agencies to implement these control technologies. In addition, identifying both short- and long-term resources necessary to implement these technologies will be critical.

Lessons learned from resource management agency and grassroots collaborative partnerships across the United States have guided development of a model of cross-jurisdictional collaboration with clear and common goals to address the threat of invasive species. This model has been fundamental to the success of partnerships working to address Asian carp prevention in the UMRB, ORB, and GLB. This partnership includes an increasingly wide array of agencies working toward a shared goal of ecological and economic resource protection. Coordination and communication within and between the partnerships are being facilitated, enhanced, and formalized in support of WRRDA. These partnerships will require ongoing interagency commitment to efficiently leverage available resources and capacity, and effectively implement long-term Asian carp management strategies.

---

<sup>1</sup> Pimentel, D., Zuniga, R., & Morrison, D. (2005). Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological economics*, 52(3), 273-288.



### 1.3 Progress since the Last Report

Notable progress has been made toward addressing the threat of Asian carp since the 2014 Report was completed. This progress is in part attributed to the increased scope of coordination and collaboration between Federal and State agencies and other organizations, which produced strengthened and expanded partnerships. These efforts led to increased monitoring and surveillance for Asian carp, further development and field testing of detection and control tools, priority research to identify and investigate potential new technologies, and development of communication strategies and mechanisms to share information and engage partners, stakeholders, and the public.

In 2015, coordination between and among State and Federal agencies working to address the threat of Asian carp in the UMRB and ORB occurred through formal planning meetings, workshops, and teleconferences as well as *ad hoc* meetings. The Asian carp invasion has become an increasingly high priority for resource managers within both the UMRB and ORB watersheds and is addressed in many of their management and annual work plans developed at the individual State and Federal agency levels. Many of the highest-priority goals and tactics found in these plans are also reflected in broader basinwide or national strategies for Asian carp prevention and control. Coordination among the plan goals and actions is essential and provides opportunity to identify priorities, ensure that redundancy and overlap does not occur, and establish cooperative approaches to Asian carp management.

State and Federal agencies in the UMRB engaged in a variety of management activities, including monitoring of high-risk sites and development and implementation of control measures. This work included projects that were planned and implemented by individual agencies as well as development of comprehensive strategies. This includes the *Minnesota Invasive Carp Action Plan* (MICAP), a strategy to identify and promote implementation of high-priority actions and recommendations to control Asian carp in the Minnesota waters of the UMRB. In addition, the USFWS is leading efforts with State partners, including the Upper Mississippi River Conservation Committee, (see section 3.2 below for State partnerships) to develop the basinwide *Action Plan for Management of Asian Carp in the Upper Mississippi River Basin*, which will build on the foundation of the MICAP, the *Management and Control Plan for Bighead, Black, Grass, and Silver Carp in the United States* (National Plan), and other relevant strategies.

Significant progress on collaborative Asian carp management was also made in the ORB. In October 2014, the Ohio River Fisheries Management Team (ORFMT) released the *Ohio River Basin Asian Carp Control Strategy Framework* (ORB Framework). The ORB Framework was developed to support other regional plans and outlines actions for prevention, monitoring and response, population control, research to better understand impacts, and communication to collectively prevent further expansion and reduce populations of Asian carp. Additionally, the Asian Carp Regional Coordinating Committee (ACRCC) continued its bi-national partnership efforts focused on Asian carp in the UMRB, specifically the CAWS and IWW, with the goal of protecting the GLB from the threat of Asian carp. Many of the efforts supported by the ACRCC through its '*Asian Carp Control Strategy Framework*' (Framework) may yield advancements in Asian carp prevention, control, and detection technologies, tools, and strategies that can be applied to protect the UMRB, ORB, and other waters in the United States. For example, targeted



commercial fishing has been used to reduce the Asian carp biomass by as much as 68% in portions of the upper Illinois River, for the purposes of reducing the advancement of Asian carp upstream toward Lake Michigan. This demonstrates that control actions used to support protection of the Great Lakes may benefit the UMRB and ORB by reducing Asian carp population numbers in key locations. Additionally, development and deployment of new gears targeting small Asian carp have shown promise for detection and removal of juvenile/sub-adult fish before they can reproduce. New genetic markers are also being developed that will enhance the ability of agencies to detect and respond to new occurrences of Asian carp. Further, electrical barrier fish deterrent technology continues to be implemented and refined, providing examples of technology that could be deployed in the appropriate control locations, with available resources. Additionally, significant progress has been made in the development of comprehensive Integrated Pest Management (IPM) strategies focused on effective and coordinated Asian carp prevention and control. These IPMs will provide a multi-tiered, but focused approach for cooperating agencies to use in rivers and basins to manage Asian carp and include a suite of control options that can be used under different scenarios to maximize the effects of all available tools.

In FY 2015, additional funding provided to the USFWS through agency base appropriations allowed for greater support of Asian carp control efforts in the UMRB and ORB and other waters of the United States. Projects were developed cooperatively with State agencies and multijurisdictional resource organizations to address key needs that support goals of basinwide Asian carp management strategies and those of the National Plan. The collaborative projects developed and implemented through this process will augment ongoing activities conducted by State and Federal partners to address the threat of AIS, including Asian carp, in the UMRB, ORB, and other waters.

Overall in 2015, significant progress was made on development of Asian carp detection, prevention, and control technologies; interagency data collection, management, and analysis tools and protocols for tracking range; and evaluation of potential options for longer-term AIS control projects. A summary of all efforts conducted to address the threat of Asian carp in the specified basins during the 2015 Report reporting period is provided in subsequent sections of this document.

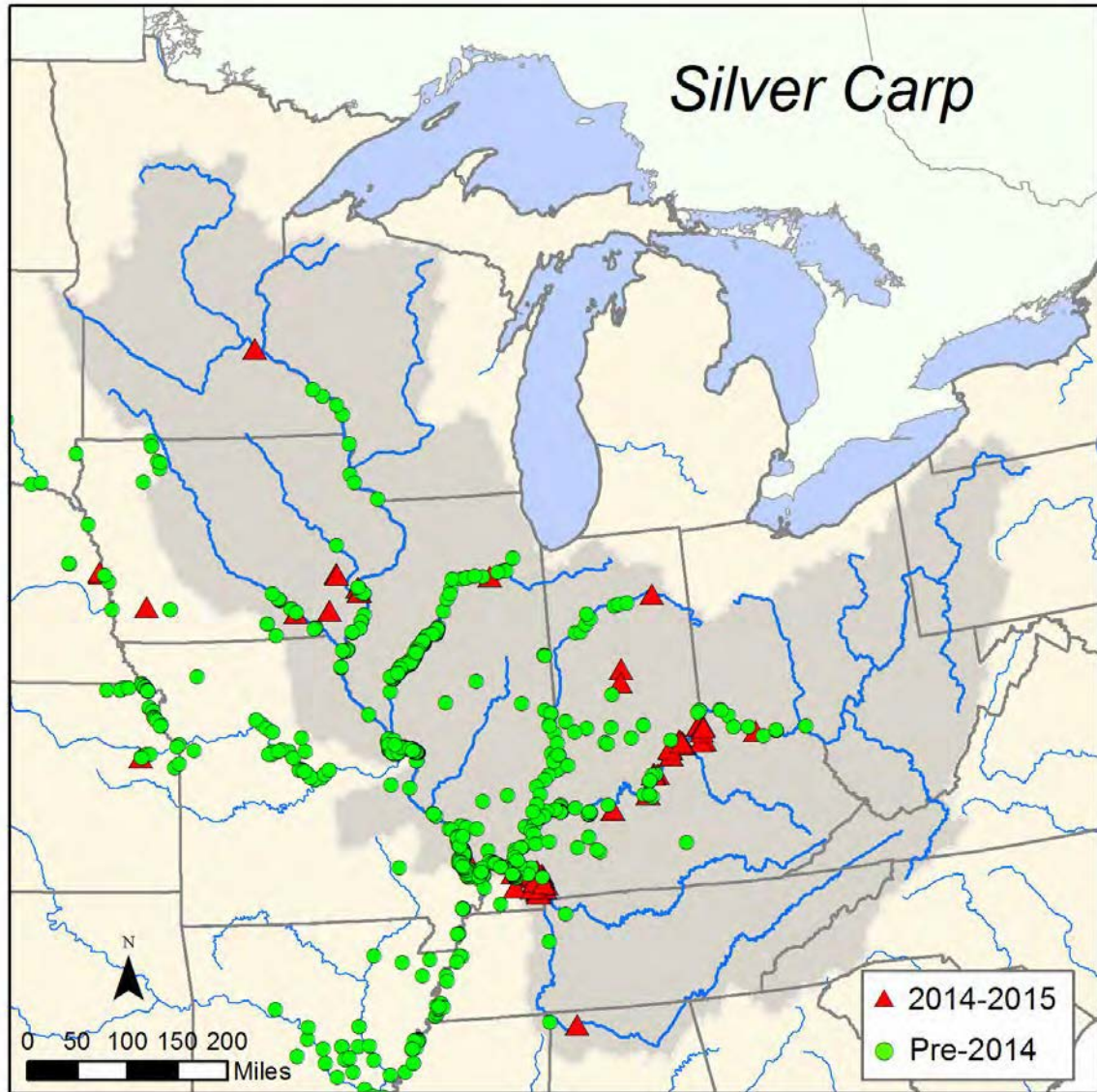


## 2.0 OBSERVED CHANGES IN THE RANGE OF ASIAN CARP IN THE UPPER MISSISSIPPI AND OHIO RIVER BASINS AND TRIBUTARIES

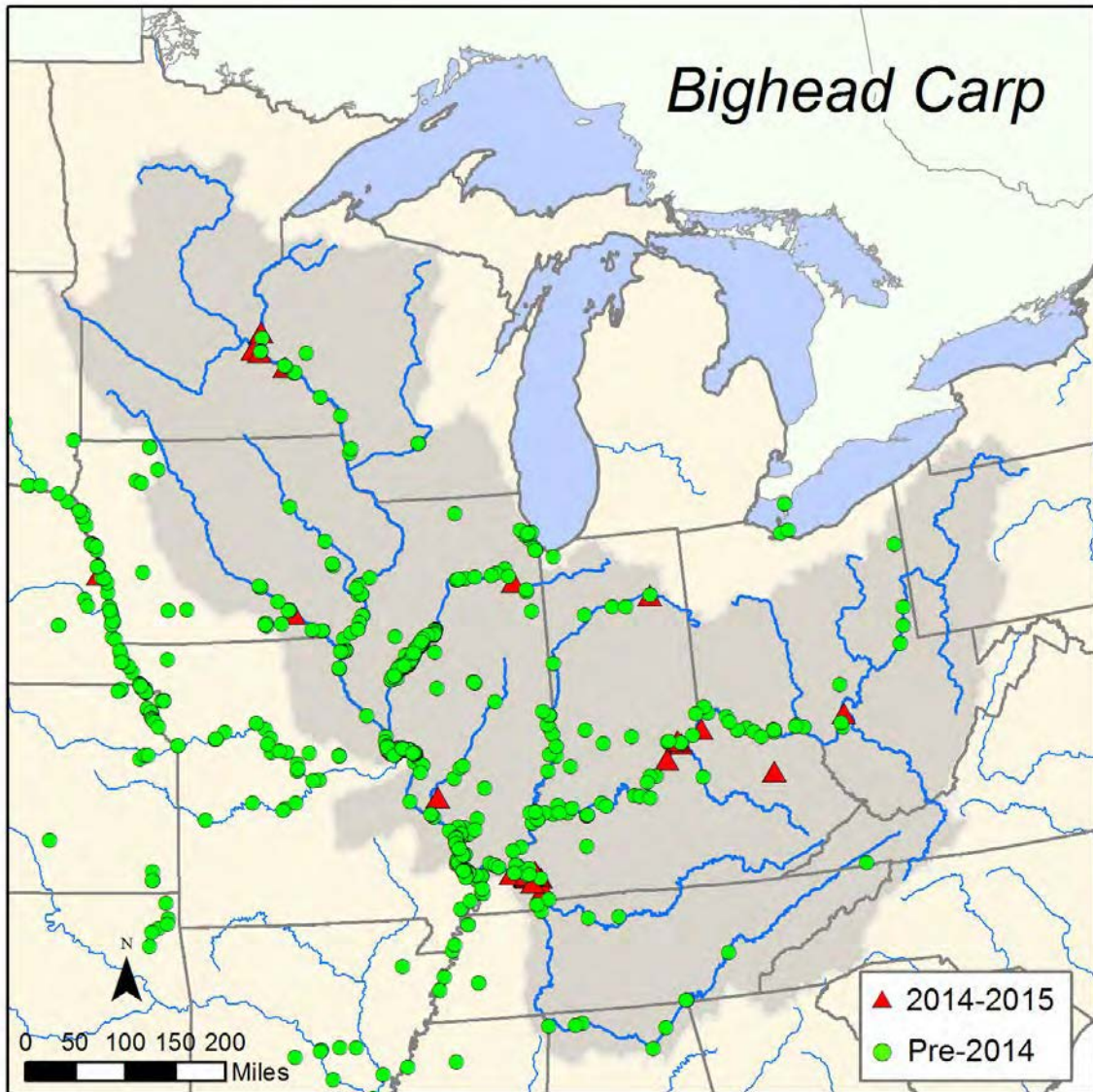
Changes to the range for all four species of Asian carp in the UMRB and ORB was evaluated for this Report. An increase is defined as the difference (increase) in geographic occurrence for detections of each species since the 2014 Report. This was calculated for each species and basin by comparing new data collected for the 2015 Report (reporting timeframe of July 2014 to September 2015) to species range data included in the 2014 Report. As in the 2014 Report, the Nonindigenous Aquatic Species (NAS) database was the primary source of information for this data. The NAS, maintained by USGS, 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 data acquired from many other 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 the 2015 Report, the farthest known distribution points (both upstream and downstream) were identified for each Asian carp species within each mainstream river and major tributary of the UMRB and ORB. These points were compared to those from the 2014 Report to measure any potential increases in observed range. Of note, data indicating the presence of a species at a particular site does not infer species abundance or establishment. Data were mapped and described under two categories: "Pre-2014" (data summarized in the 2014 Report) and "2014-2015" (new data collected for the 2015 Report). Observed change in distribution was assessed by comparing the farthest distance upstream where an individual Asian carp was reported in 2014-2015 with the documented leading edge of the invasion evidenced in pre-2014 data.

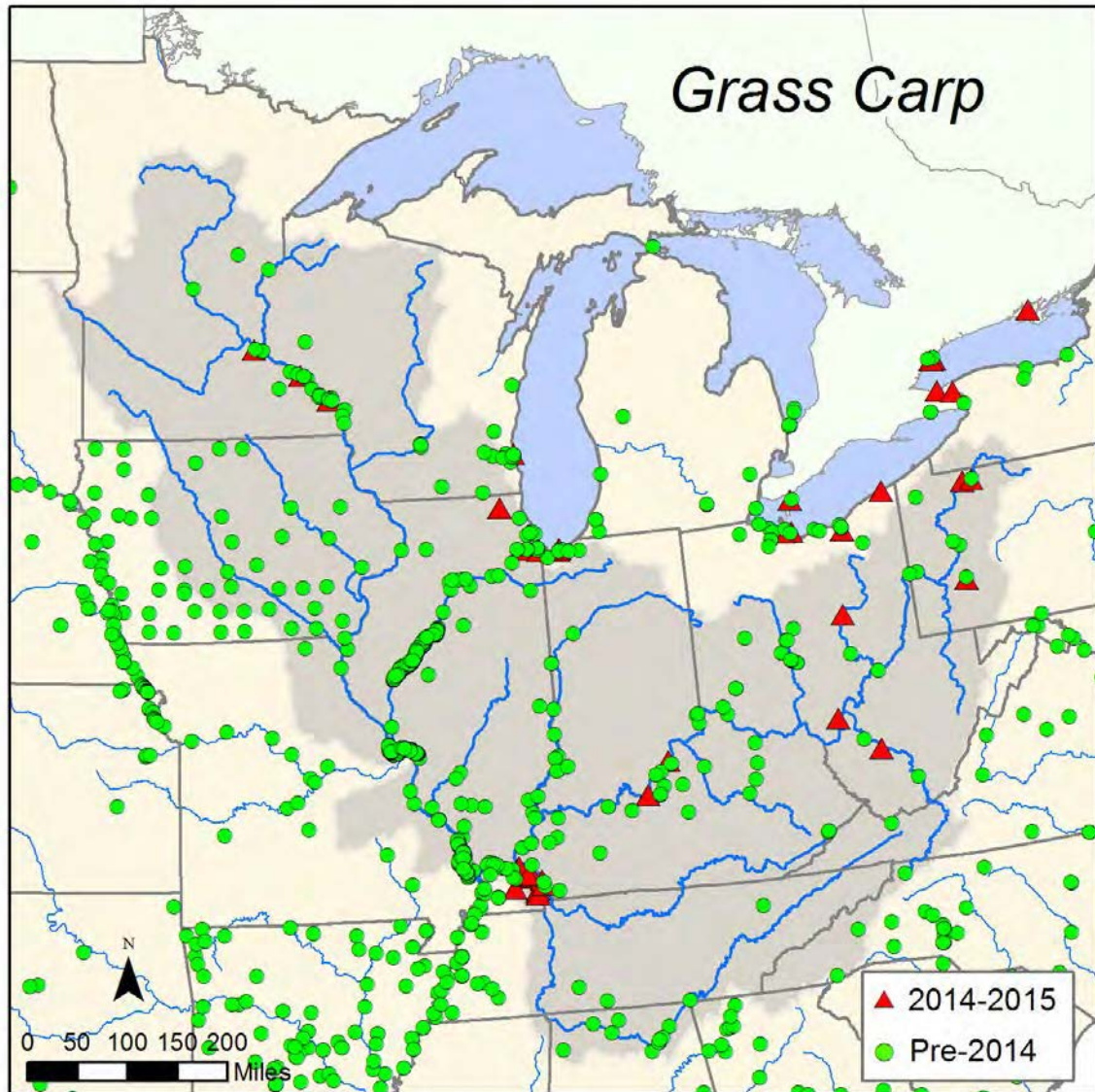
Figures 2, 3, 4 and 5 demonstrate the extent of increased observed range and individual new occurrences observed for each of the four species of Asian carp covered in this Report. Green circles represent the "Pre-2014" data points and red triangles identify the new data points collected in 2014-2015. In the figures, the red markers represent recent captures and are not necessarily indicative of an increase in the observed range. Only when the red markers are beyond any green marker (upstream or downstream), would this be considered an increase in observed range since it is beyond the previous range reported for the particular species. The UMRB and ORB are represented by the grey shaded areas on each map.



**Figure 2. Silver Carp recorded occurrences.** Green circles represent the “Pre-2014” data points and red triangles identify the new data points collected in 2014-2015.



**Figure 3. Bighead Carp recorded occurrences.** Green circles represent the “Pre-2014” data points and red triangles identify the new data points collected in 2014-2015.



**Figure 4. Grass Carp recorded occurrences.** Green circles represent the “Pre-2014” data points and red triangles identify the new data points collected in 2014-2015.



**Figure 5. Black Carp recorded occurrences.** Green circles represent the “Pre-2014” data points and red triangles identify the new data points collected in 2014-2015.





Analysis of the data suggests that three of the four species of Asian carp exhibited an increased observed range within the UMRB or ORB between July 2014 and September 2015. Summarized changes for each species are as follows:

**Silver carp:** Silver Carp have been detected approximately 71 miles further upstream in the Upper Mississippi River, 27 miles further upstream in the Tennessee River in the ORB, 62 miles further upstream in Indiana tributaries of the Ohio River (the White River system), and 28 miles further upstream in the Wabash River.

**Bighead Carp:** Bighead Carp exhibited a small increase in observed range in the Upper Mississippi River and St. Croix Rivers (8 miles and 6 miles, respectively) and a significantly larger increase in Kentucky (93 miles up the Licking River).

**Grass carp:** There were no new occurrences of Grass carp noted in the UMRB and ORB that were outside their previously documented observed range.

**Black Carp:** Black Carp exhibited a slight increase in observed range of 12 miles upstream in the UMRB; however, none have been collected in the ORB to date.

Evaluation of Individual occurrence data to monitor for increases in the observed range of Asian carp should consider that the NAS data only indicates the presence or absence of a species. Relative abundance is also important in assessing risk and determining the degree of establishment of Asian carp in each basin. Relative abundance numbers are also a function of effort for many areas of the river and not necessarily a direct representation of the true status of the population. New occurrences detected in 2014 – 2015 may indicate an increase in the observed range, yet it is also possible that Asian carp were present in these locations prior to 2014, but were only recently detected as a result of increased monitoring efforts focused on the leading edge of Asian carp ranges.

The 2015 Report considers a fish population to be established when there is evidence of successful spawning and survival of the larval fish to young-of-year, or juvenile stage. Effectively sampling and accurately describing all characteristics and life-stages of an Asian carp population requires robust and ongoing monitoring efforts using multiple techniques and sampling timeframes, making this challenging. Monitoring efforts have increased focus on detection of adults at the leading edge of populations; however, monitoring focused on recruitment (determining the number of fish spawned during a given year class that survive to reach a certain lifestage) 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 other anecdotal reports.

Figure 6 characterizes Bighead Carp and Silver Carp establishment and relative abundance in the UMRB and ORB, as determined using the most-current data provided by State and Federal partners. This information is provided to add context to the maps (Figures 2- 5) of observed range developed for each species. For the 2015 Report, establishment of Bighead Carp and Silver Carp was the primary focus of this exercise given the significantly-greater amount of information available on these species'



distribution, relative abundance, and spawning in the UMRB and ORB. Information is not available on the relative abundance of Grass Carp and Black Carp for either basin (therefore not identified in Figure 6), although Grass Carp are known to have breeding populations in many parts of the UMRB and ORB.

In Figure 6, the red-shaded area indicates areas of establishment, where reproduction (spawning) has been verified by collecting taxonomically or genetically confirmed eggs or larvae or young-of-year Bighead or Silver Carp. The orange-shaded areas indicate areas where the population is stable with regular catches of adults, but spawning has not been confirmed. The blue-shaded areas indicate areas where occasional adults are captured. Capture in these areas is from either agency monitoring efforts or commercial fisher catch and should not be considered uniform throughout those reaches.

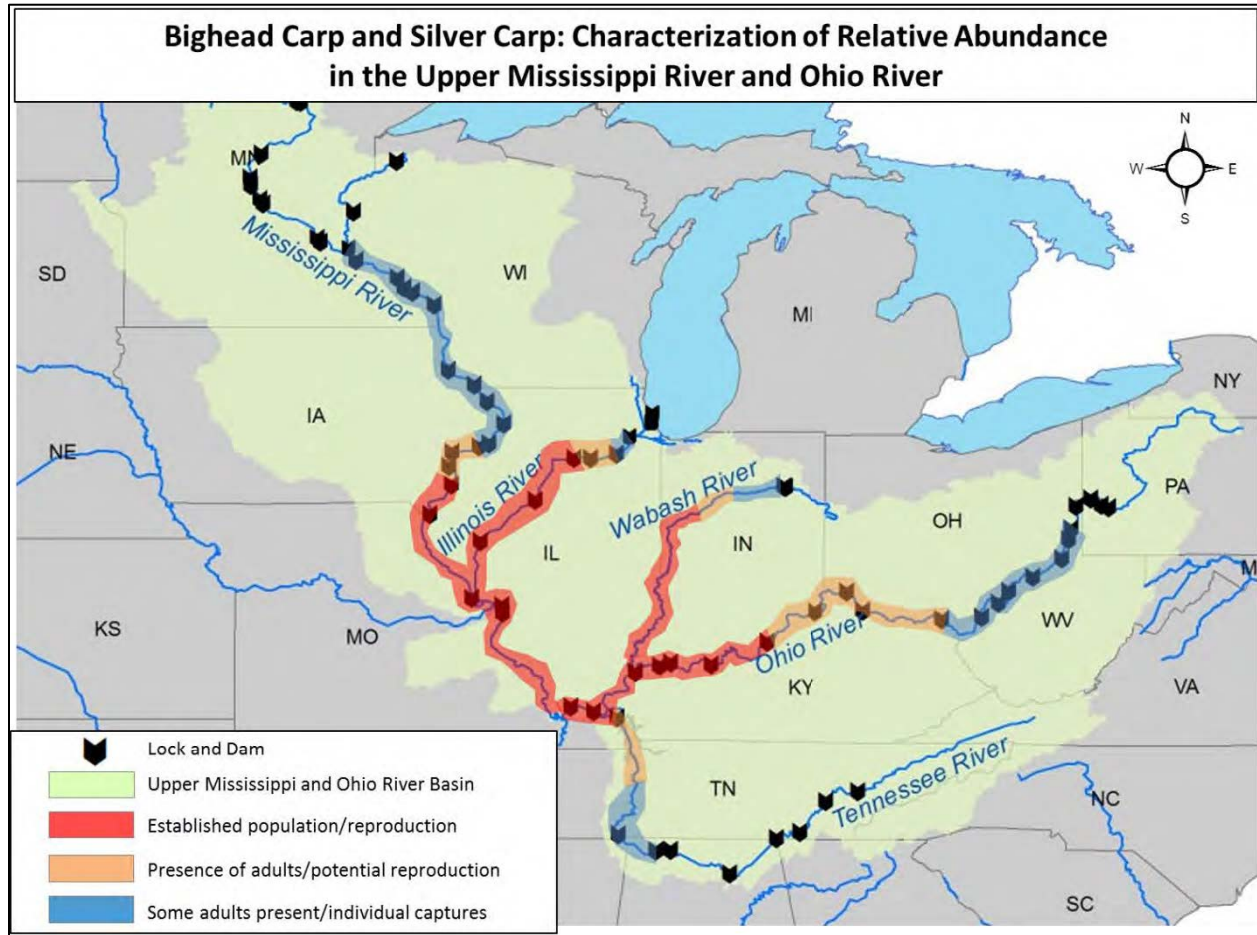
Bighead Carp and Silver Carp are abundant in large portions of the UMRB and ORB. In the UMRB, eggs or larvae of these species, along with Grass Carp, have been collected in Pool 16 on the Mississippi River, two pools upstream of what was reported in the 2014 report. Individual occurrences of adult Bighead Carp have been verified in Lock and Dam 2, near the Minneapolis-St. Paul metro area of Minnesota. In June of 2015, five Bighead Carp were captured in the St. Croix River near Stillwater, Minnesota, more than 6 miles upstream of previous areas of capture. However, no spawning activity has been confirmed this far upstream.

Relative abundance of Asian carp within the IWW is estimated to be the highest population density of Bighead and Silver Carp in the world with established populations in most of the river. In September small Silver Carp were captured in the Starved Rock Pool, about 2 miles downstream of the Marseilles Lock. This location is 52 miles farther upstream than what was reported in the 2014 Report and 54 miles downstream of the USACE Electric Dispersal Barrier System located near Romeoville, 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 Bighead and Silver Carp. This population is located about 47 miles from Lake Michigan, yet spawning has not been confirmed in this pool. A current map of Asian carp distribution in the IWW can be found at [www.AsianCarp.us](http://www.AsianCarp.us). Note: This map is updated regularly to reflect new information as it becomes available, including upstream advances of juvenile Asian carp within the range of existing adult populations.

The ORB also has established populations of Bighead Carp and Silver Carp, with a significant portion of the basin having established or potentially spawning populations. In the Ohio River, the population of both species is established up to McAlpine Lock and Dam near Louisville, Kentucky. Although successful spawning has not been confirmed in the Cannelton Pool (the next pool downstream), evidence suggests that reproduction is likely based on the high Asian carp density and size ranges reported from that pool. Spawning has been confirmed from the Newburgh Pool, two pools below McAlpine. Above the McAlpine Lock and Dam, 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 netting 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, PA. In May 2015, a 62-pound Bighead Carp was captured in the Lower Kanawha River (a tributary to the Ohio River) near Point Pleasant, West Virginia.



**Figure 6. Characterization of current (2015) relative abundance of Bighead Carp and Silver Carp in the UMRB and ORB.**

### 2.1 Analysis of Black and Grass Carp Reproductive Status (Ploidy)

Black and Grass carps are sold commercially as a means to control snail-borne parasites and aquatic vegetation. Some states still allow diploid (capable of reproduction) individuals to be stocked into aquaculture ponds or recreational reservoirs for management purposes, yet many states allow only triploid (sterile) individuals for stocking purposes. Ploidy determination is a procedure conducted on select species to confirm the reproductive capability of individual fish using established biochemistry-based (flow cytometry) analytical processes. Ploidy status for Black Carp and Grass Carp is conducted at USFWS Midwest Fisheries Center (MFC) and assists managers in determining the reproductive risk if an individual of either of these two species is captured in an open water system.



A total of 11 Black Carp were captured from the UMRB between July 2014 and September 2015. All were determined to be diploid except for one individual for which ploidy could not be determined because DNA had degraded in the sample. Diploid Black Carp have been captured as far north in the Mississippi River as Louisiana, MO.

No Black Carp were collected in the ORB between July 2014 and September 2015.



**Figure 7. Black Carp captured on June 24, 2015, north of the City of Louisiana, Missouri (between Ducher/Fritz Island and the Illinois bank) on the Illinois side of the chute. This fish (determined to be diploid) represents the northern-most capture of Black Carp in the UMRB to date (at RM 288 on the UMR).**

A total of 10 Grass Carp were captured from the UMRB and ORB between July 2014 and September 2015. Of the five captured in the UMRB, four were diploid and 1 was triploid. Of five Grass Carp captured in the ORB, four were triploid and one was diploid. Results of ploidy analysis and additional collection data (date, location, etc.) were entered into USGS-NAS database:

- Black Carp: <http://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=573>
- Grass Carp: <http://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=514>

Tissue sampling of captured Black Carp and Grass Carp was coordinated between Southern Illinois University, USGS-Columbia Environmental Research Center, and MFC. Sampling included otolith microchemistry, aging, gonadosomatic index development, and ploidy determination. Samples (post-ploidy analysis) from both carp species were forwarded to the ERDC for eDNA marker development. Collaborative partners supporting research needs and methods development for ploidy determination were USGS-National Wetlands Research Center and Virginia Commonwealth University.

Commercial fishermen were the only segment of the angling population that reported capturing Black Carp, this raised concerns that underreporting may be hindering adequate monitoring of this species. Given the preference of Black Carp for benthic (bottom-dwelling) habitat and deeper water, targeted monitoring by management agencies must be employed to obtain accurate population data for risk assessment. Although captures of large Black Carp adults in the IWW has alerted managers to their proximity to the GLB, reproduction and recruitment of this species in United States rivers has only recently been documented. A recent study using otolith microchemistry and stable isotope analyses of



19 adult Black Carp collected from the Mississippi, Kaskaskia, and Illinois Rivers between 2011 and 2014 indicate that the otolith core data of diploid fish are consistent with riverine signatures, confirming that natural reproduction and recruitment has occurred. Additionally, otolith core data for these Black Carp diploids indicate that Black Carp reproduction is not confined to the middle and lower Mississippi River, but has also occurred in the upper Mississippi and Illinois Rivers (Greg Whitley, personal communication).

In this same study, Genetic Stock Identification (GSI), age, and growth rate for each captured Black Carp specimen were evaluated. Eighteen of 19 individuals tested were diploid (Jen Bailey, personal communication). Fish ranged in size from 445 to 1,380 millimeters, in weight from 1.1 to 34.5 kilograms, and ages ranged from 2 to 16 years, with multiple year classes present. High river discharge may have resulted in a relatively strong year class in 2011, which may explain the increased number of Black Carp caught by commercial fishermen during 2013 and 2014 (Duane Chapman, personal communication). All captured fish above age 6 were sexually mature; one age-4 female was also mature (Duane Chapman, USGS, personal communication). Age -4 is earlier than reproductive ages reported for Black Carp in native waters (typically six or more years as reported in Nico et al. 2005<sup>2</sup>).

In 2015, the Illinois Department of Natural Resources (ILDNR) funded a study to collect additional information on Black Carp in the upper Mississippi River system. To increase reporting and acquire additional data, Southern Illinois University has been offering a bounty (\$100 per fish) to any angler or commercial fisher that turns in a Black Carp specimen. USGS uses the collected specimens to investigate fish morphological structures, diet, and locations, and habitat types occupied to help inform potential early-detection and other management actions. In 2015, 6 Black Carp were collected through the bounty program, providing evidence that its inception increased the reporting rate (just prior to the bounty, no fish had been reported for 8 months). While the program has not produced reports of Black Carp from river reaches where they had not been found previously, it does provide one means of monitoring Black Carp range. Collected specimens through the bounty program also provide managers with additional samples to characterize population characteristics including age at maturity, age distribution/year class strength, and individual growth rates. Knowledge of where commercial fishers are capturing Black Carp will also serve as a starting point for development of targeted sampling programs to monitor Black Carp observed range and abundance and to collect fish for stomach content analysis.

---

<sup>2</sup> Nico, L.G., J.D. Williams, and H.L. Jelks. 2005. Black Carp: Biological Synopsis and Risk Assessment of an Introduced Fish, American Fisheries Society Special Publication 32, Bethesda, MD. 337 p.



### 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

Collaboration among the numerous State and Federal agencies working to address the threat of Asian carp in the UMRB and ORB is the cornerstone for planning and implementing effective monitoring, prevention, and control efforts. State agencies regularly communicate and coordinate on interjurisdictional fishery resource management issues in the UMRB and ORB through the long-standing multi-agency partnerships of the Upper Mississippi River Conservation Committee (UMRCC) and the Ohio River Fisheries Management Team (ORFMT). The UMRCC and ORFMT both have standing Fisheries Technical committees and convene *ad hoc* committees to address specific issues. Asian carp prevention and control have become an increasingly high priority for resource managers within both the UMRB and ORB watersheds and are addressed in many of their management and annual work plans developed at the individual State and inter-agency levels. However, the increasing magnitude and complexity of Asian carp prevention and control warranted development and implementation of action plans that specifically address Asian carp in each basin. State and Federal agency partners in both the UMRB and ORB collaborated on development of sub-basin-specific Asian Carp Control Strategy Frameworks that incorporate the goals and objectives of the National Asian Carp Management and Control Plan. For additional information on agency Asian carp activities as they pertain to this Report, please refer to Appendix 1, available on line at [www.AsianCarp.us](http://www.AsianCarp.us).

#### 3.1 New Collaborative Basinwide Interagency Planning and Project Implementation in FY 2015

To increase the impact of annual base appropriations, the USFWS provided a total of \$800,000 of its FY 2015 base funding for Asian carp to support collaborative implementation of the highest priority projects in the UMRB and ORB Asian Carp Control Strategy Frameworks. The USFWS, USGS, USACE, and NPS agreed to utilize the existing inter-agency coordination structures in place in the sub-basins and MICRA for Asian carp coordination in the Mississippi River Basin. USFWS, USGS, and the Tennessee Valley Authority (TVA) are among the members of MICRA, whereas USACE and NPS are considering a request to formally join the MICRA partnership.

MICRA formed an Asian Carp Advisory Committee (ACAC) to provide for State and Federal agency executive level coordination on Asian carp prevention and control in the Mississippi River Basin. The ACAC provides a mechanism for coordination, communication,

#### Mississippi Interstate Cooperative Resource Association (MICRA)

MICRA is a partnership of 28 State agencies with fisheries management jurisdiction in the Mississippi River Basin. Federal agencies with relevant authorities in the Mississippi River and tributaries also participate in the MICRA partnership. MICRA functions as an umbrella organization that provides coordination and communication among the multi-state partnerships that address interjurisdictional fishery management issues within six Mississippi River sub-basins: Upper Mississippi, Lower Mississippi, Ohio, Tennessee-Cumberland, Missouri, and Arkansas-Red. The existing multi-state sub-basin groups provide a forum for Asian carp coordination, project development, and implementation at the sub-basin level, and MICRA provides a mechanism for coordination and collaboration between the basins.



and collaboration across the regional sub-basin efforts to provide for the most effective implementation of a Mississippi River basinwide strategy for prevention and control.

The USFWS, in partnership with MICRA, worked with Federal and State agency partners in the UMRB and ORB to identify priority project needs for the two basins and to develop a 2015 Asian Carp Monitoring and Response Plan for the Mississippi River Basin (available at [www.AsianCarp.us](http://www.AsianCarp.us)). The FY 15 funding provided through USFWS base appropriation supported a mixture of early detection monitoring, monitoring and assessment, control and removal, and containment actions to prevent further distribution and establishment of Asian carp in both the UMRB and ORB.

UMRB 2015 Priority Asian carp projects for USFWS funding included the following:

- Comprehensive surveillance program to define presence, range expansion, and established fronts in the Upper Mississippi River
- Contract fishing to reduce propagule pressure in Pool 20; population reduction in Pool 19-17; and characterize adult Asian carp catches in Pool 16-13
- Evaluation of Asian carp and native fish passage at Lock and Dam 8 and Lock and Dam 19

ORB 2015 Priority Asian carp projects for USFWS funding included:

- Use of telemetry to determine distribution, movement, and lock and dam passage of Asian carp
- Control and removal of Asian carp in the Ohio River
- Limiting Asian carp dispersal at lock and dams
- Long-term fishery evaluation in the Wabash River to assess impacts of Asian carp on native fishes
- Monitoring and response of Asian carp in the Ohio River
- Asian carp coordination and outreach

Detailed descriptions of all of the projects are included in Appendix 1. Interim project reports, including results and analysis and recommendations for modifications and enhancements to the project plans, will be reported by the cooperating agencies for all project work completed through 2015. MICRA will compile the interim project reports from both sub-basins into a comprehensive report for the Mississippi River Basin. The 2015 Monitoring and Response Plan and 2015 Interim Project Reports will be available to the public on [www.AsianCarp.us](http://www.AsianCarp.us).

### 3.2 Enhanced Upper Mississippi River Basin Agency Coordination

State and Federal agencies in the UMRB engaged in a variety of prevention-focused activities, including monitoring and assessment, control and removal, and the development and implementation of technologies of control. These activities included projects that were planned and implemented by individual agencies and the development of the *Minnesota Invasive Carp Action Plan* (MICAP). The MICAP is a prospective strategy that identifies and promotes implementation of

#### Federal/State Agencies Involved in the UMRB

USFWS  
USGS  
USACE  
USCG  
NPS  
Minnesota  
Wisconsin  
Iowa  
Illinois  
Missouri



high-priority actions and recommendations to control Asian carp and builds on existing state and national Asian carp management plans. While the MICAP is specific to further preventing and controlling the Asian carp invasion into Minnesota waters, the majority of State and Federal agencies and other natural resource organizations within the UMRB were active in preparing the document. Updated in December 2014 by the Invasive Carp Work Group, the MICAP identifies actions for (1) early detection and monitoring of susceptible waters; (2) prevention and deterrence; (3) response preparation; (4) management and control; and (5) outreach and communication. MICAP is intended to be a working document that addresses immediate needs and will be updated to reflect new tools and technologies, scientific advancements, and the status of Asian carp in Minnesota waters. The plan recognizes that current technologies are not yet 100 percent effective to assess the abundance of Asian carp or stop upstream migration; yet it identifies potential actions that could be used to slow the spread of Asian carp while more effective control technologies continue to be pursued. For example, new evidence suggests that modified operating procedures at Lock and Dams #2 (Hastings), #5 (Minnesota City), and #8 (Genoa, Wisconsin) may serve as a means for halting or slowing the movement of Asian carp up the Mississippi River and subsequently into the Minnesota and St. Croix Rivers. Implementing these operational procedures may delay spread of Asian carp until a more effective tool is identified.

The Upper Mississippi River Conservation Committee (UMRCC) is a partnership of the five states that border the Upper Mississippi River (Illinois, Iowa, Minnesota, Missouri, and Wisconsin). The UMRCC Fisheries Technical Committee, which includes Federal agency partners, completed a revised *Upper Mississippi River Fisheries Plan* in 2010. Goal 4 in the 2010 Fisheries Plan is to “slow or eliminate the spread or introduction of aquatic nuisance species, including pathogens to the Upper Mississippi River.” Members of the UMRCC Fisheries Technical Committee undertook collaborative development of an UMRB Asian Carp Control Strategy Framework (UMRB Framework) to coordinate Asian carp prevention and control efforts in the Upper Mississippi River and develop a sub-basin-level step-down plan of the National Plan. The Fisheries Technical Committee formed an *ad-hoc* Asian Carp Planning Team to coordinate the collaborative development and implementation of the UMRB Framework, select highest priority projects from the UMRB Framework for implementation in 2015, identify lead and cooperating agencies for each project, and develop project proposals for USFWS funding consideration. UMRB Planning Team project proposals were provided to the MICRA ACAC, compiled with project proposals from the ORB, and submitted as part of a comprehensive Mississippi River Basin proposal package to the USFWS for funding consideration. The UMRB Planning Team developed funded project proposals into full project work plans for implementation and inclusion in the 2015 Asian Carp Monitoring and Response Plan for the Mississippi River Basin.

**Federal/State Agencies  
Involved in the ORB**

USFWS  
USGS  
USACE  
USCG  
New York  
Illinois  
Indiana  
Ohio  
Pennsylvania  
West Virginia  
Kentucky  
Mississippi  
Alabama  
Georgia  
Tennessee  
Tennessee Valley Authority  
Maryland  
North Carolina  
Virginia





### 3.3 Enhanced Ohio River Basin Agency Coordination

The Ohio River flows through or along the border of Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia. The six states collaboratively manage fisheries in the mainstem Ohio River through the ORFMT. The ORFMT recognized the magnitude of the Asian carp threat and the need for coordinated efforts. In October 2014, the ORFMT released the *Ohio River Basin Asian Carp Control Strategy Framework*. The ORB Framework was developed as a sub-basin-level step-down plan of the National Plan and outlines actions for prevention, monitoring and response, population control, understanding impacts, and communication to collectively prevent further expansion, reduce populations, and better understand the impacts of Asian carp in the ORB. Implementation of this Control Strategy Framework is intended to minimize the social, ecological, and economic impacts of these invasive fishes.

The ORFMT formed an *ad hoc* Asian Carp Planning Team that includes State agencies throughout the ORB and Federal agency partners to collaboratively develop and implement the ORB Framework, select highest priority projects from the ORB Framework for implementation in 2015, identify lead and cooperating agencies for each project, and develop project proposals for USFWS funding consideration. ORB Planning Team project proposals were provided to the MICRA ACRC, compiled with project proposals from the UMRB, and submitted as part of a comprehensive Mississippi River Basin proposal package to the USFWS for funding consideration. The ORB Planning Team developed funded project proposals into full project work plans for implementation and inclusion in the 2015 Asian Carp Monitoring and Response Plan for the Mississippi River Basin.



**Figure 8. Structure for inter-agency coordination and implementation of Asian carp control strategy frameworks in the ORB and UMRB.**

### 3.4 Federal Agency Activities in the UMRB

Federal agencies such as USFWS, USACE, USCG, United States Department of Agriculture (USDA)-Forest Service, USEPA, NOAA, and others have played major roles in the Asian carp management activities undertaken in the UMRB and ORB. The following is a summary of major Federal activities that address Asian carp management in the UMRB:

#### 3.4.1 U.S. Army Corps of Engineers

The USACE has worked with various workgroups including, but not limited to, the ACRCC and its workgroups, the Great Lakes and Mississippi River Interbasin Study (GLMRIS) Executive Steering



Committee, and the Brandon Road Working Group. Additional interagency coordination occurred during activities described in the subsequent sections of this report. USACE also participated in the following organized stakeholder groups:

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

As part of the ACRCC's Monitoring and Response Workgroup (MRWG), USACE monitored for the presence of Asian carp within the CAWS and its tributaries largely using two tools: telemetry and electrofishing. The telemetry program consists of tagging fish with individually coded ultrasonic transmitters in the Upper IWW and CAWS. Telemetry is used to assess the effectiveness of the Electrical Dispersal Barrier System by monitoring movement of fish in the immediate vicinity of the barriers to determine if the fish can challenge 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 (Common Carp and Buffalo spp.) were tagged at and near the USACE electrical barrier in the Lockport Pool, while Asian carp were tagged in the Dresden Island and Marseilles Pools. The acoustic network, shown in Figure 9, is composed of stationary acoustic expansion receivers supplemented by a mobile hydrophone unit.



## USACE Telemetry Network 2015

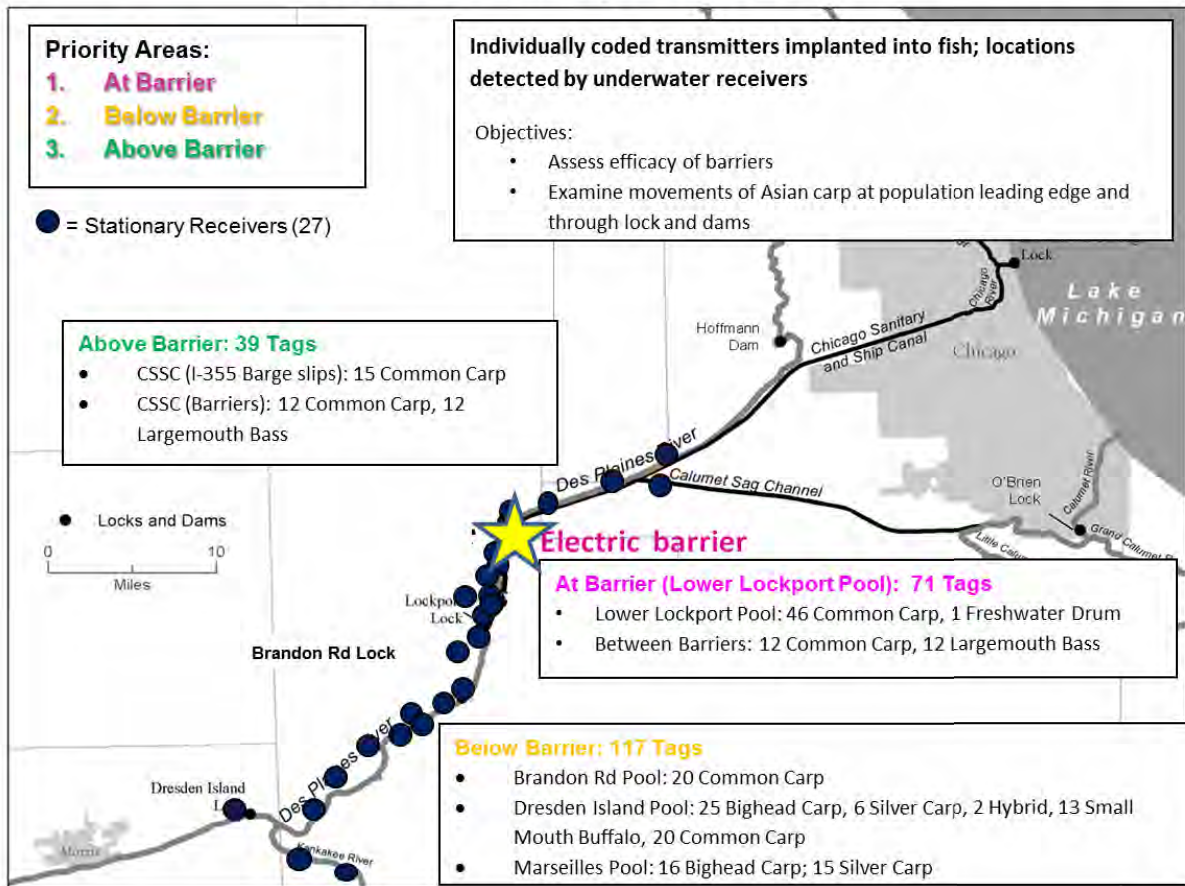


Figure 9. USACE telemetry network activities in 2015

Ongoing participation by the USACE in the ACRC includes the following contributions:

- Collaboration, technical, and field support to the ACRC MRWG on implementation of the Asian Carp Control Strategy Framework and the annual Monitoring and Response Plan
- Collaboration and evaluation of Asian carp control measures for use in the IWW and development of monitoring strategies and a project implementation plan at Brandon Road Lock and Dam



- Internal USACE coordination on ACRCC-related planning and support activities
- Biological, engineering, and navigation technical expertise on ACRCC collaborative Asian carp planning

In support of protection for the Great Lakes from Asian carp, USACE applies three different types of fish deterrent measures throughout the CAWS, described below. Each is designed to prevent a distinct pathway of Asian carp toward the Great Lakes. These deterrent measures, specifically the Electric Dispersal Barrier, also provide two-way protection to the UMRB from the dispersal of non-native fish species potentially moving downstream from the GLB through the CAWS.

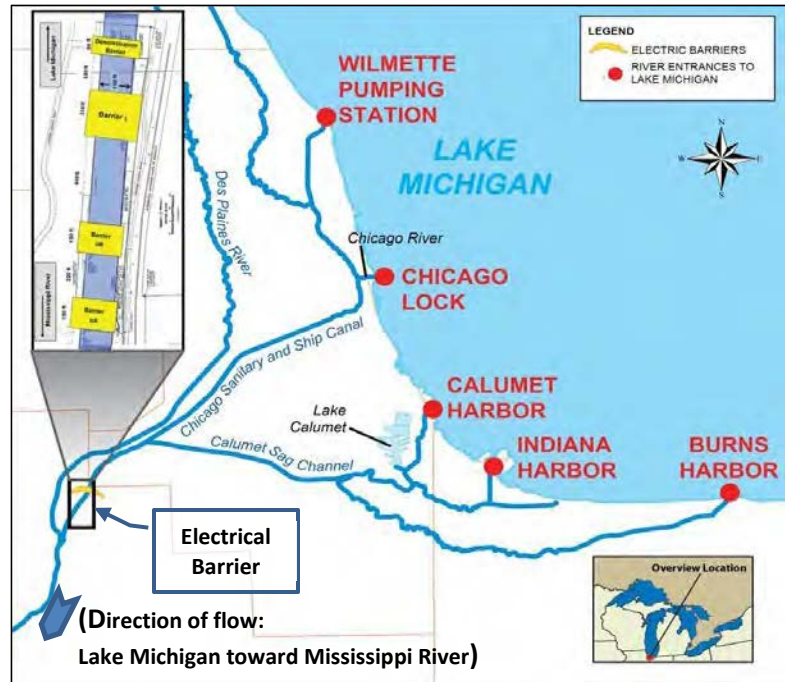


Figure 10. Electrical dispersal barrier location map

- The Electrical Dispersal Barrier System, located on the Chicago Sanitary and Ship Canal (CSSC) in Romeoville, Illinois, was designed to reduce the risk of transfer of fish between the Mississippi River and the Great Lakes drainage basins via the CSSC. The location and configuration of the Electrical Dispersal Barrier System is provided in Figure 10. The system currently consists of three barriers (Demonstration, IIA, and IIB) that create a waterborne, pulsed, direct current, electric field in the canal, which expose 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 before 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. As the Electric Dispersal Barrier provides two-way protection against the interbasin movement of fish, it also affords protection to the UMRB from non-native fish species potentially moving downstream from the GLB through the CAWS.
- 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 Electrical Dispersal Barrier System that occur during flooding from the Des Plaines River and the Illinois and Michigan (I&M) Canal, thereby halting possible fish movement through this area. The barriers in these locations are intended to stop juvenile and adult Asian carp. A map depicting the alignment of the barrier is included in Figure 11.

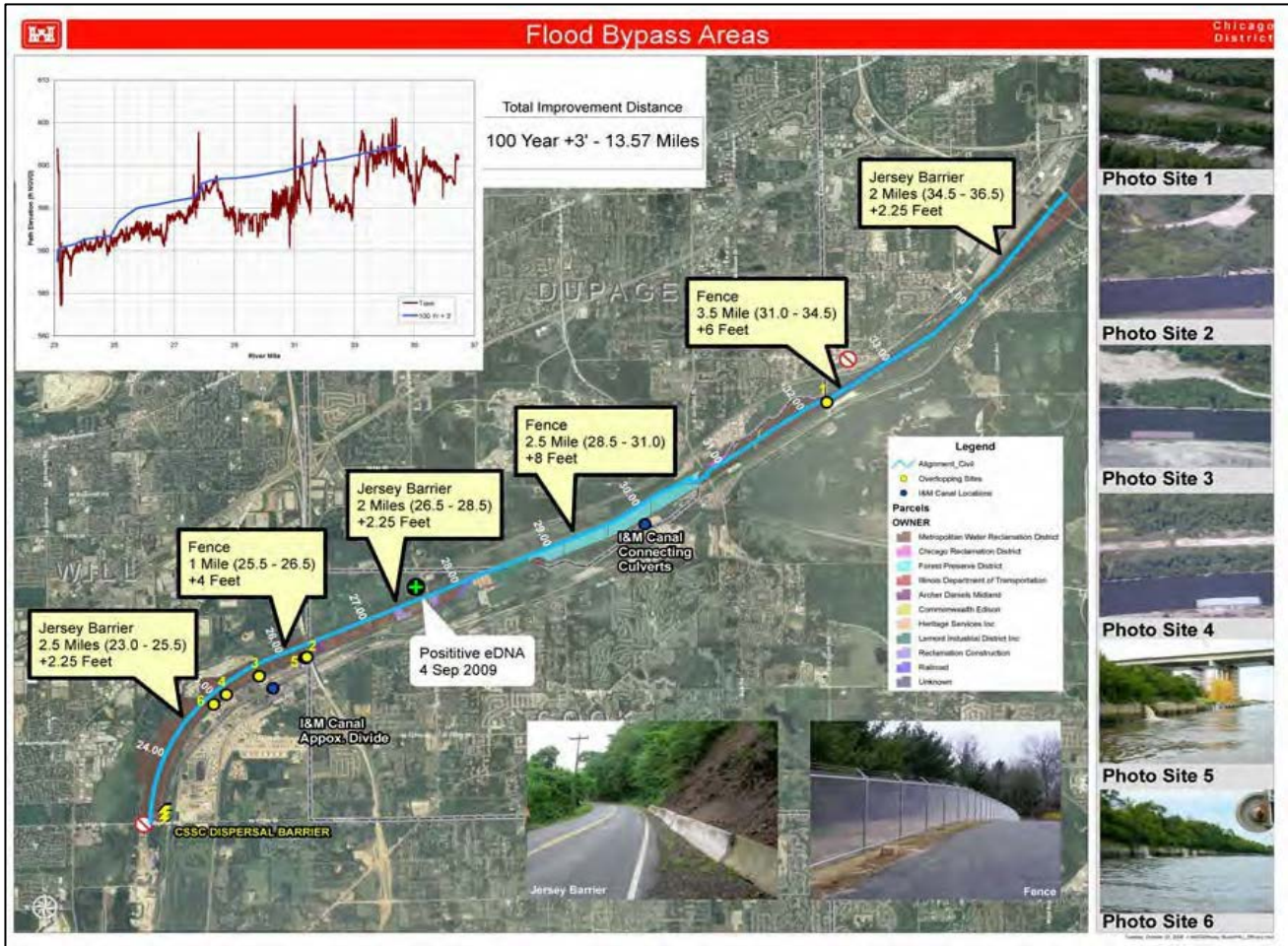


Figure 11. Flood Bypass Areas in the Chicago Area Waterways System



- Bar screens on sluice gates at Thomas J. O'Brien Lock and Dam were installed to address potential transfer of Asian carp from the rivers to Lake Michigan (see Figure 12).

USACE research focused on development or refinement of new tools and techniques; USACE conducted field and laboratory research to assess the efficacy of the Electric Dispersal Barrier System and to improve their effectiveness. Some of the projects conducted include:

- Laboratory research was conducted to assess the impact of various environmental conditions on barrier effectiveness and fish behavior. Tests confirmed optimal operating parameters for the barriers by examining a number of factors including, but not limited to, how variations in canal water temperature and dissolved oxygen levels alter the effectiveness of the barrier. USACE also conducted tests that exposed fish to the electrical field for longer durations to evaluate whether the fish become less affected by the field over time.
- USACE led the eDNA Calibration Study (ECALS) to improve the application of eDNA methodology to assess and manage uncertainty. ECALS investigated alternate sources of Asian carp DNA, developed improved genetic markers, and investigated the relationship between the number and distribution of positive eDNA samples with the density of Asian carp populations. The results of this study will allow project managers to better interpret eDNA results, as well as investigate ways to make the eDNA process more efficient (decrease processing time and cost).
- USACE cooperated with the University of Minnesota Aquatic Invasive Species Research Center (MAISRC) on its work to assess deterrent technology and Asian carp swim capabilities at varying river flow velocities through dam gates. The St. Paul District entered into a real estate agreement that allowed 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.
- As directed by Section 2010, Upper Mississippi River Protection, subsection (b) of WRRDA in 2014 the USACE closed the Upper St. Anthony Falls Lock and Dam to navigation traffic at midnight on June 9, 2015. USACE also cooperated with USFWS and State of Minnesota in the placement of monitoring equipment at Corps locks within the St. Paul District footprint.



**Figure 12. Sluice gates at Thomas J. O'Brien Lock and Dam.**



### 3.4.2 U.S. Fish and Wildlife Service

The USFWS serves as Chair of the ACRCC and has actively participated in ACRCC-related technical work groups, meetings, and decision-making bodies. This includes membership on the ACRCC's MRWG and the Brandon Road Workgroup, and serving as Co-chair of the Communications Work Group and co-lead of the Barrier Studies Work Group. The USFWS is also involved with the efforts of broader AIS groups that coordinate and communicate activities related to Asian carp management efforts, including the Aquatic Nuisance Species Task Force (ANSTF) and ANSTF's Mississippi River Basin Panel (MRBP) and Great Lakes Panel (GLP). USFWS also led the development of the interagency Upper Mississippi River Basin Asian Carp Control Strategy Framework.



**Figure 13. Paupier butterfly frame trawl.**

USFWS conducted monitoring and surveillance of the leading edge of the Asian carp in the UMRB to inform ongoing collaborative management efforts. To assist these efforts, USFWS and partner agencies developed a variety of new fish trawls to detect, monitor, and remove Asian carp of all sizes in varying habitats. Gears and techniques that have proven successful for commercial fishing or monitoring continue to be investigated and compared to traditional fisheries gears and techniques (such as minifykes and boat electrofishing) for their ability to increase capture rates or to capture different sizes of fish in certain waters. These studies have identified several techniques and gear types that improve the ability to capture Asian carp and will be used, as appropriate, by cooperating agencies. These include the paupier butterfly frame trawl, surface trawl, and dozer trawl. Each trawl design targets a specific habitat type and location (including a targeted portion of the water column), as well as fish size classes. The paupier butterfly frame trawl (Figure 13) was modeled after gear types used on shrimp trawlers in the Gulf of Mexico, and utilizes paired nets extending 12 feet on either side of the boat. This trawl is capable of fishing a maximum of 10 feet below the surface of the water, but can be raised to sample





water as shallow as 2 feet. The customized paupier butterfly frame trawl can also be electrified and used to capture Asian carp of all sizes in open water habitats. Combining sampling techniques with electricity greatly increases the likelihood that an Asian carp greater than 100 millimeters will be caught.

New gear types are being incorporated into both control strategies for defense of the Electric Dispersal Barrier System and research on the movement and distribution of small Asian carp. For example, the USFWS used these newly-developed trawls types to assist the Illinois Department of Natural Resources with electrofishing efforts to monitor for small Asian carp at fixed sites downstream and upstream of the Electric Dispersal Barrier System in the IWW. During July through October, 2014, Asian carp sampling efforts included the use of traditional boat electrofishing, push trawl, and mini-fyke nets in Starved Rock, Marseilles, and Dresden Island pools. In 2015, sampling efforts were expanded to the LaGrange and Peoria Pools and included use of other techniques including the paupier butterfly frame trawl, surface trawls, and dozer trawls. USFWS also continued traditional gear monitoring at priority areas in the IWW and upper Illinois River throughout 2015. USFWS targeted young-of-year and juvenile Asian carp within the invasion front (where Asian carp are present in noticeable abundance, yet there is no evidence or documentation of successful recruitment) to detect any successful reproduction. Large mesh gill nets were used in pools to evaluate changes in population density. Targeted locations were areas that had: 1) previously reported captures from commercial fishermen, 2) particular concern or interest from partners, 3) high-quality Asian carp habitat, and 4) frequent detections of Asian carp. Results from sampling efforts and acoustic telemetry studies conducted in 2014 informed 2015 fishing efforts through improved knowledge of where and when to conduct sampling and yielding increased catch-per-effort of Asian carp.

Additionally, USFWS initiated an acoustic telemetry study to identify specific locations where Asian carp are found to aggregate, better define locations and characteristics of advancing populations, and establish triggers of fish movement or population advancement. Remote receivers are currently deployed from Pools 5a to 19 on the UMRB. 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 receivers on commercial navigation vessels travelling from St. Paul, Minnesota, to New Orleans, Louisiana, to gather additional data during their upstream and downstream transiting along the Mississippi River. The acoustic tracking data have provided much-needed information to improve monitoring within the pools where tagged fish are present and to apply that information to pools where Asian carp densities are still low. Telemetry tagging work (gillnetting and electrofishing) was also conducted by the USFWS in the Ohio River and tributaries during 2014, in which 75 Asian carp were tagged with ultrasonic transmitters. Downloading and retrieving telemetry receivers occurred during July, August, and November 2014; however, severe flooding postponed redeployment of receivers until April and July 2015.



**Figure 14. Two DIDSON units being deployed into the CSSC using a telescopic boom lift (A-C) and the two DIDSON units being operated on one computer (D).**

Preliminary surveys were conducted by the USFWS during fall 2014 and spring 2015 to investigate the likelihood of successful lock-mediated fish passage at the Brandon Road Lock. Surveys were designed to investigate 1) the extent fish are utilizing the lock structures, 2) the effect that locking operations have on the ability of acoustic remote sensing gears to quantify fish density and size, and 3) the survey design best suited to quantify between reach movements of fish through the lock chambers. Results of these preliminary surveys suggested that fish are utilizing the Brandon Road Lock structure as habitat and were present at densities greater than observed in the Lockport, Brandon Road, or Dresden Island study reaches. These results were noted in spite of the Brandon Road Lock doors being closed except to receive in-coming vessel traffic. Additionally, the USFWS found that acoustic remote sensing gear was efficient at observing and quantifying fish density within the lock chamber, both at the empty stage and at the full stage. Results of the study suggest that deployment of a stationary acoustic remote sensing system on the upstream side of the lock chamber would allow for data collection to quantify lock-mediated fish passage rates through the Brandon Road Lock chamber. These results were provided to the USACE as they investigate potential alternatives for AIS control at the Brandon Road Lock and Dam.

Direct observations of fish behavior near the Electric Dispersal Barrier System were made by the USFS using two Dual Frequency Identification Sonar (DIDSON) multi-beam sonar systems that were deployed directly over the narrow array of Barrier IIB (area of ultimate field strength). A boom lift was used to deploy both sonar units into the canal from a position on the west canal bank (Figure 14). This system provides video quality acoustic images of fish as they probe and challenge the Electrical Dispersal Barrier System.

USFWS also provided field support for a sound deterrent study conducted by the University of Minnesota at Lock and Dam 1. USFWS staff and equipment were used to capture Lake Sturgeon that were later tagged with acoustic transmitters by the University of Minnesota. The University is now using these fish to evaluate whether the sound deterrent will negatively affect native species.



The USFWS also undertook split-beam hydroacoustic remote sensing surveys of the Lockport, Brandon Road, and Dresden Island navigation pools in the Upper IWW during spring, summer, and fall of 2014 and 2015. This work provided a greater understanding of temporally varying fish densities, patterns in spatial distribution, and size frequency distributions of the fish communities in these study areas. In addition, the USFWS deployed a stationary split beam acoustic remote sensing system at the upstream side of the Brandon Road Lock chamber in June 2015. This system used two split-beam transducers of 120 kilohertz (kHz) and 420 kHz and collected data on fish density, fish size, and direction of travel 24 hours a day, 7 days a week throughout the summer.

Data collected from these various studies have provided a better understanding of the distribution and movement of Asian carp of various life stages in the IWW and CAWS, including key information on their behavior in or near lock structures and the Electric Dispersal Barrier System. This information is being used to inform managers' understanding of the level of risk of Asian carp being present in or near these structures (and therefore, potentially moving through them to further upstream locations) under different scenarios.

USFWS is also working with USGS and Iowa State University to evaluate Asian carp reproduction in the UMRB. Ichthyoplankton (egg and larvae of fish) samples were collected from 12 locations in the Des Moines, Skunk, Iowa, Cedar, and Mississippi Rivers in southeastern Iowa. These samples are currently being genetically analyzed at Iowa State University. While egg morphology (unique physical characteristics) 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 University is currently extracting the DNA from the samples and will follow up with DNA sequencing to identify each sample to species. Further, the USFWS conducted egg and larval sampling in Pool 8 to assist the Minnesota Department of Natural Resources (DNR) with its Asian carp monitoring. Samples were preserved and transferred to Minnesota DNR for sorting and analysis and results will be used to expand on the data for Asian carp reproduction in the UMRB.

Finally, an evaluation of Asian carp reproduction in the UMRB focused in Iowa tributaries is being conducted by the Iowa Department of Natural resources with funding provided by USFWS (see "*Project Update: Asian Carp Reproduction in the Upper Mississippi River and Tributaries in Southeast Iowa*" for an overview of this work).

**Project Update:****Asian Carp reproduction in the Upper Mississippi River and Tributaries in Southeast Iowa**

*Asian carp have been expanding their range wherever there is suitable spawning and early life stage habitat. Designing effective management strategies to address this expansion begins with an understanding of the current status of the populations as well as the potential dispersal pathways and mechanisms for these invasions. Although these data are critical to developing effective prevention and control actions, it is often lacking for watersheds within the United States.*

*As an example, observations of adult Asian carp in Iowa tributaries connected to the Upper Mississippi River have increased, and it was unknown whether this increase is a result of migrants from established populations downstream or the result of local reproduction. To address this question, Iowa State University researchers conducted 700 ichthyoplankton tows from 19 sites across the Des Moines, Skunk, Iowa, Cedar, and Upper Mississippi Rivers. A combined total of 149 Asian carp larvae were collected from the Skunk and Iowa Rivers 1 to 3 kilometers upstream from each confluence with the Mississippi River. Larval densities were 1.7 larvae/cubic meter (m<sup>3</sup>) on May 25 in the Skunk River and 0.3 larvae/m<sup>3</sup> on June 21 in the Iowa River. Prior to 2014, Asian carp reproduction had not been documented upstream of Lock and Dam 19, a partial fish barrier, on the Mississippi River. The collection of Asian carp larvae in the Skunk and Iowa Rivers was the first observation of reproduction and potential establishment in Iowa tributaries and at a location 108 kilometers farther upstream in the Upper Mississippi River than previously described. This new information is key to ensuring management agencies have the most current information available for informing Asian carp management at the watershed scale.*

*“The evidence of Asian carp reproduction in Iowa rivers indicates the need for Asian carp management options beyond the Upper Mississippi River itself in order to control their expanding populations,” said Kim Bogenschutz, Aquatic Invasive Species Program Coordinator for the Iowa Department of Natural Resources.*

**3.4.3 U.S. Geological Survey**

Scientists from 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 (IPM) Control strategies for Asian carp in the UMRB. In particular, USGS has completed an extensive telemetry study in Navigation Pools 17 to 20 of the UMRB to identify seasonal habitat use and behaviors of Asian carp to inform effective *in situ* control measures. Understanding the habitat use and behaviors of Asian carp in rivers, with respect to invasion status, season, river stage, reproduction, food resources, and disturbance, is necessary for effective application of species-specific control measures including removal fishing, piscicidal microparticles (particles that release fish toxicants), and containment deterrents. Nearly 100 Asian carp were monitored during this 2-year period. Preliminary analyses indicate that Asian carp congregate in spring at tributary mouths and in a few relatively deep backwaters during winter suggesting they might be vulnerable to control measures at specific times and places. This preliminary information has been shared with partner management agencies to inform



control and monitoring efforts described elsewhere in the Report. USGS will continue to collaborate on additional Asian carp telemetry studies in the UMRB and Illinois River with USFWS in 2016.

USGS and collaborators at Western Illinois University have also completed studies determining patterns of predation on Asian carp by native fish in the UMR and Illinois River. This work suggests that several native predatory fish species feed on young Asian carp, when present. These results have been shared with regional resource management agencies to inform fishery stock management strategies as a potential control tool within IPMs, and to develop additional needed analysis of native predator effectiveness to better understand their ability to impact Asian carp population levels.

Recently completed USGS studies on egg and larval drift in the newly invaded UMRB have identified new areas of Asian carp reproduction as far upstream as Pool 16 near Fairport, Iowa. USGS demonstrated that molecular techniques are needed to definitively identify field-collected Asian carp eggs in the UMRB because of overlapping egg morphologies between Asian carp and another cyprinid fish species (from the same taxonomic family). Studies are underway to determine if advanced molecular techniques (i.e. next generation sequencing) could be used to increase efficiency and effectiveness of monitoring for Asian carp eggs and larvae.

USGS and Southern Illinois University are collaborating on another study to determine the sources of young fish recruiting to the adult population in the reach of the UMR above Lock and Dam 19. Specifically, they are trying to determine whether these adults are originating from reproduction above this dam or from migration of fish from below the dam. This study is using microchemistry on the otoliths (a bone in the ear of fish) of adult AC to determine where they originated from. Preliminary assessment of the water chemistry from 14 tributaries and the UMR above Lock and Dam 19 indicate that otolith microchemistry might be a useful method to determine the source of Asian carp. USGS is also conducting studies on juvenile habitat use in the Illinois River and UMRB to inform monitoring and control efforts. If juvenile habitats can be identified then control measures can be tailored to these habitats.

All of the work described above is reliant on a network of collaborators including Western Illinois University, Iowa State University, Southern Illinois University, and USFWS. USGS will continue to participate in the basin planning efforts to control and contain Asian carp in the UMRB and ORB, and look for opportunities to collaborate with regional managers and scientists to conduct studies to inform control and monitoring as part of IPM. USGS also continues to develop deterrent and monitoring technologies that will be applicable nationwide to the control efforts for Asian carp as part of IMP.

USGS-UMESC, in cooperation with the five UMRB states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin also conducts research and monitoring through the USACE Upper Mississippi River Restoration (UMRR) Program. The work is completed within the Long Term Resource Monitoring (LTRM) element of the UMRR Program. The UMRR 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 LTRM 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, USGS' long-term data (20 plus years) on fish communities, water quality, and aquatic vegetation are unique assets available for addressing AIS in the UMRB. The robust water quality, fish, and vegetation data gathered under the LTRM has placed USGS 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. LTRM data and information are available at <http://www.umesc.usgs.gov/ltrmp.html>.

Key contributions from the LTRM relative to Asian carp include research on the following:

- 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
- Status and Trends of Selected Resources of the Upper Mississippi River System

#### **3.4.4 U.S. Coast Guard**

The role of USCG is to ensure the safety, security, and environmental protection of the Great Lakes and the Western Rivers. With respect to Asian carp, USCG focuses on ensuring the safety of mariners, vessels, ACRCC personnel, and the public when Asian carp activities are conducted on or near federally navigable waterways or in the vicinity of the electric fish barriers. When operations associated with the electric fish barrier, rapid response, research, or any other Asian carp activity will impede the flow of traffic on a navigable waterway, the USCG issues a Regulated Navigation Area (RNA) or safety zone and provides notice to the public and mariners to inform them of the planned activities and expected impact to navigation.

#### **3.4.5 National Park Service**

NPS participates in numerous activities in the UMRB including the creation of blueprints for a sound and bubble barrier at the mouth of the St. Croix River. This project is not currently being funded, but plans will allow for a quicker response should the need arise.

#### **3.4.6 Department of Commerce - National Oceanic and Atmospheric Administration**

NOAA scientists provided model results of potential risk of establishment and impact of Silver and Bighead Carp to the USACE for its assessment of Brandon Road Lock and Dam. In addition, 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 and Silver Carp on Lake Michigan, Lake Huron, and Lake Erie food webs. NOAA scientists worked with scientists from the University of Georgia, the University of Nevada-Reno, and the Nature Conservancy to model the suitability of habitats for the presence of Grass Carp through the GLB



### **3.4.7 U.S. Environmental Protection Agency**

USEPA serves as the co-chair for the ACRC and develops the Asian Carp Control Strategy Framework each year to track Federal and State agencies efforts within the GLB. USEPA routinely conducts multi-agency calls and quarterly ACRC meetings to discuss and coordinate Asian carp efforts, share knowledge and expertise, and prevent duplication of efforts by agencies where possible. USEPA provided Incident Command System (ICS) and rapid response training as well as “tabletop” scenario-based simulated response exercises for State and Federal fisheries management agencies to prepare them to respond to invasive species incident within their jurisdictions. USEPA provided GLRI funding for State and Federal agencies for direct rapid response support and for State agencies to develop their State ANS management plans that include rapid response strategies and tactics for new AIS introductions.

### **3.5 UMRB State Agency Accomplishments by Activity**

In addition to the Federal agencies, states within the UMRB have played major roles in the Asian carp management activities. The following is a summary of major activities from State agencies and other organizations in addressing control of Asian carp in the UMRB.

#### **3.5.1 Interagency Coordination**

UMRB states were involved with several interagency efforts related to preventing the spread of Asian carp within the UMRB, participated in the ACRC and were active in MICRA, the Upper Mississippi River Basin Association, the GLP and MRBP of the ANSTF, and 100th Meridian Initiative. Strong interagency coordination occurred while developing an UMR Asian Carp Action Plan and identifying priority projects from the plan for FY 2015 funding. State agency staff were members of the UMRB Asian carp project planning team that collaborated on a UMRB multi-year work plan, identified annual priorities, and developed project proposals. Other interagency coordination took place in the form of discussions and exchange of information through the MRBP, the Association of Fish and Wildlife Agencies (AFWA) 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. To coordinate and prevent duplicative efforts between agencies, State agencies shared information on Asian carp research and monitoring plans in the Mississippi River and tributaries in Iowa with each other as well as with the USGS and USFWS .

#### **3.5.2 Field Monitoring and Early Detection**

In 2015, the UMRB states remained 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



Illinois DNR, in collaboration with other agencies, undertook monitoring and early detection effort in the Upper Illinois River, including:

- Seasonal intensive monitoring in CAWS
- Contract commercial fishing to reduce upstream population by sixty eight percent
- eDNA monitoring in the CAWS and Upper Des Plaines River
- Larval fish and productivity monitoring
- Young-of-year and juvenile Asian carp monitoring
- Distribution and movement of small Asian carp in the IWW
- Fixed site monitoring downstream of the Electric Dispersal Barrier System
- Monitoring fish abundance, behavior, and fish-barge interactions at the barrier
- Evaluating Asian carp detection techniques with SONAR
- Des Plaines River and overflow monitoring
- Illinois River Basin surveys summary
- Long-term resource monitoring program summary.

Iowa DNR provided funding to Iowa State University to evaluate adult population characteristics and dynamics of Bighead, Silver and Grass 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. Juvenile and adult Asian carp were sampled monthly at 13 sites from these rivers using electrofishing and trammel nets from July through October 2014 and April through September 2015. Results from the project should provide data needed to assess Asian carp reproduction status in Iowa.

Missouri DNR is monitoring the expansion of Silver Carp in the lower Mississippi River as catches have increased since 2007 and successful spawning and recruitment have been evident. Additionally, the Mississippi Department of Wildlife, Fisheries and Parks (MDWFP) is evaluating the potential for the inter-basin transfer of Asian carp from the Tennessee River basin to the Mobile River basin via the Tennessee-Tombigbee Waterway (TTW) from the Tennessee River system. MDWFP also assisted the USFWS with collecting water samples from Lock E and Bay Springs Lake along the TTW for analysis for Asian carp eDNA to establish the leading edge of the invasion. In addition, Tennessee undertook monitoring and public education and awareness actions and purchased sampling gear and supplies for Asian carp efforts on the Tennessee River in 2015. Agencies have identified the need for additional research on Asian carp ecology and behavior to better inform management actions, including to more fully evaluate the early life history of Silver Carp in the MRB. Additional research projects in the MRB include:

- Mesohabitat Associations in the Mississippi River Basin: A Long-Term Study on the Catch Rates and Physical Habitat Associations of Juvenile Silver Carp and Two Native Planktivores
- Paddlefish, Sturgeon, and Bighead Carp of the Yangtze and Mississippi Rivers: Their Status, Biology, and Management
- Incorporating Approaches to Evaluate the Effects of Invasive Silver Carp on Native Fishes
- Prey Selectivity of Common Predators on Silver Carp





- Grass Carp Hatch Timing in the Middle Mississippi River
- Age-0 Silver Carp and Gizzard Shad Daily Growth and Hatch Date Timing in the Middle Mississippi River
- Interactions among Asian carp and Paddlefish in the Mississippi River
- Grass Carp Population Dynamics in the Mississippi River

### 3.5.3 Rapid Response

In May 2015, Minnesota DNR completed a rapid response exercise after an angler reported catching a Bighead Carp at a power plant outlet near Stillwater, Minnesota. When the catch was verified, Minnesota DNR responded with targeted sampling, including a commercial angler, using a variety of gears at the capture location. As a result of this extensive sampling, only a single Bighead Carp was captured, indicating that Bighead Carp were not established in this area. .

### 3.5.4 Grass Carp Recommendations

In 2015, MICRA submitted a report to the USFWS titled: *“The use of Grass Carp (Ctenopharyngodon idella) in the United States: Production, triploid certification, shipping, regulation, and stocking recommendations for reducing spread throughout the United States.”* The report provided recommendations to address the risk of diploid Grass Carp being transported and stocked through the triploid Grass Carp chain of supply. The recommendations are being worked on by the Iowa DNR and Minnesota Center for Environmental Advocacy.

### 3.5.5 Active Prevention

The Minnesota DNR received FY 13 funding from the Outdoor Heritage Fund (State of Minnesota) to place additional barriers in southwest Minnesota. To determine the best locations for barrier placement, the Minnesota DNR identified seven priority aquatic resources that were in need of protection from the threat of Asian carp. Construction of the barriers to protect these high-value areas continued into 2015; for example, two sites in the Le Sueur River watershed are currently in the design stage and negotiations with landowners are under way. As funding becomes available, additional barrier sites will be chosen to prevent Asian carp from expanding into priority resources.

In the upper IWW, Illinois DNR significantly reduced numbers of Asian carp downstream of the USACE Electric Dispersal Barrier System through the targeted deployment of contracted commercial fishing. It has been determined that reducing Asian carp populations downstream in the IWW would likely lower propagule pressure (expansion and dispersal of a growing, reproducing population) and the chances that Asian carp would subsequently access waters upstream of the barrier. Primary areas fished include IWW navigation pools downstream of the barrier, including Dresden Island, Marseilles, and Starved Rock pools. Through September 2015, a total of 70,882 Bighead Carp, 191,031 Silver Carp, and 1,718 Grass Carp were removed by contracted commercial fishermen. Since 2010, nearly 3.8 million pounds of Bighead and Silver Carp have been removed from Starved Rock, Marseilles, and Dresden Island Pools. Evaluation of Bighead Carp and Silver Carp populations with hydroacoustics from 2012-2014 have decreased the carp population in Dresden Island Pool (the pool with the most upstream population



of carp) by approximately 68 percent. Use of contract commercial fishing as an Asian carp control tool will be increased in 2016, with effort focused on areas that would realize greatest likelihood of population level-reductions, as informed by monitoring and catch data collected and analyzed through 2015.

### **3.5.6 Outreach with Industry or the Public**

In many states, signs alerting the public to the presence of Asian carp were 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. In addition to these signs, the states used outreach materials to inform water recreationists in Iowa. "Stop Aquatic Hitchhiker" signs were posted at all boat access sites and additional information was available on the Iowa DNR website. Brochures, identification cards, posters, and banners were available for distribution and use at watercraft inspection stations, outdoor events and fishing clinics, the Iowa State Fair, parks and nature centers, and businesses supporting aquatic based recreation activities. Many states also provide AIS information and a list of AIS-infested waters in fishing regulations booklets. Information on Asian carp can also be found on billboards and news releases. Iowa DNR staff also inspected watercraft and interviewed boat operators at boat access sites at high-use and infested waterbodies throughout Iowa during the summers of 2014 and 2015. The Minnesota DNR routinely engages with Minnesota Stop Carp Coalition, an active group of non-governmental organizations collaborating to bring attention and support efforts on the invasive carp issue.

### **3.5.7 Research**

The University of Minnesota is continuing to pursue a number of research initiatives, including:

- Understanding and developing strategies for 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 "Judas fish," a new behavioral tool to locate aggregating invasive fish so they might be tracked and removed ("Judas fish" are sterilized individuals that are tagged and released into locations where Asian carp occur. By tracking the individual, the locations of the population at large can be inferred)
- Developing food, pheromone, and hormone attractants for Asian carp to induce high-density aggregation for the purposes of fish detection, measurement, control, and removal
- Conducting an assessment of the 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
- Assessing the potential use of native pathogens as invasive carp control agents
- Conducting risk analyses to identify Asian carp control priorities and methods

In addition, the University of Minnesota is continuing its collaboration with USACE to apply new technologies and develop ways to modify operations of Lock and Dam numbers 2 through 8 with the



intent of impeding 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, including installation of an experimental underwater sound deterrent shield
- Quantification of adult Bighead Carp swimming capabilities
- Testing and development of new acoustical deterrent systems for locks that deter Asian carp and minimally affect native fishes

The Minnesota DNR contracted with Minnesota State University to evaluate the Minnesota River for invasive carp risks and barrier potential. The university began collecting data in Spring 2015 and a progress report was submitted to the Minnesota DNR in December 2015. In addition, the Minnesota DNR began a fish telemetry study in Spring 2013 to understand fish movement around lock and dams and in the Mississippi River system. This study was ultimately connected with one located in downstream in Missouri to help monitor carp movements throughout the river. This study continued in 2014 and 2015.

Illinois DNR, in collaboration with other agencies, has undertaken significant research efforts in the Upper Illinois River and the CAWS, including:

- Identifying Asian carp movement bottlenecks and changes in population characteristics to estimate Asian carp abundance, biomass, size structure, demographics (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
- Using telemetry monitoring to assess if fish are able to challenge and penetrate the Electric Dispersal Barrier System and pass through navigation locks in the upper Illinois Waterway
- Assessing fish movement between barriers structures (Electric Dispersal Barrier System and lock and dams) using tagged surrogate species in Dresden Island, Brandon Road, and Lockport Pools and Rock Run Rookery. Research is also designed to obtain information on recapture rates of surrogate species to help verify sampling success using multiple gear types
- Evaluating effectiveness 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)
- Developing exploratory gear to develop and build enhanced purse seines, trawls, and gill nets for more effective harvest of Asian carp. Enhanced gears will be evaluated in areas known to have abundant Asian carp populations. If effective, gears may be used in place of chemical treatments (e.g. rotenone) for removal actions in the CAWS and for commercial fishing in the lower Illinois River or other Asian carp-infested waterways
- Developing unconventional gear to construct an effective trap or netting method capable of capturing low densities of Asian carp in the deep-draft canal and river habitats of the CAWS, lower Des Plaines River, upper Illinois River, and possible Great Lakes spawning rivers



- Developing and testing a water gun to deter fish in close proximity to the wave source. This technology is being evaluated to assess their efficacy as a tool to modify Asian carp behavior and act as a barrier that can support maintenance of the Electric Dispersal Barrier System

### 3.6 Federal Agency Activities in the ORB

Federal agencies such as the USFWS, USACE, and others have played major roles in the activities undertaken in the ORB. The following is a summary of major Federal activities used to manage Asian carp in the ORB:

#### 3.6.1 U.S. Army Corps of Engineers

The USACE has worked with various workgroups including, but not limited to, the ACRCC and its workgroups. In addition, USACE Louisville District provided feedback to Natural Resource Conservation Service (NRCS) on construction-related changes relative to closure structures at Eagle Marsh near Fort Wayne, Indiana. USACE also monitored flood conditions at Eagle Marsh relative to inter-basin species transfer.

Other activities of the USACE included the following:

- The USACE prepared a draft report titled; *Building a Generalized Fish Passage Assessment Tool for Application at Corps' Lock and Dams in Support of EMRRP Work Unit Managing Movement of Threatened, Endangered, and Invasive Species Using Corps Water Resources Infrastructure*. This draft report provides information pertaining to development of a generalized approach to building computational fluid dynamics (CFD) models to be used to assess fish passage potential at USACE lock and dams.
- The Nashville District performed research and development in conjunction with ERDC to evaluate the 2014 fish kill of Silver and Bighead Carp at Barkley Dam on the Cumberland River in Kentucky which resulted in an estimated die-off of 300,000 to 500,000 Silver Carp in mid-April 2014. This evaluation centered on whether any operational aspects or water quality conditions could be identified and replicated during 2015. The start-up of a hydropower turbine after an extended period of inactive operation was identified as the potential primary cause of the fish kill.

#### 3.6.2 U.S. Fish and Wildlife Service

The USFWS has been instrumental in working with MICRA and State partners to formulate field projects and longer term plans for managing Asian carp in the ORB. USFWS led and facilitated planning efforts in the ORB and conducted monitoring and surveillance of the leading edge of Asian carp to support collaborative prevention efforts. Telemetry tagging work using fish captured through gillnetting and electrofishing was conducted by USFWS in September and October 2014. During 2014, a total of 75 Asian carp were tagged with ultrasonic transmitters in the ORB. Severe flooding postponed redeployment of receivers until April 2015 and July 2015. Downloading of telemetry-tagged fish data and fish tagging work was initiated after July 2015, when water levels in the Ohio River receded (see



textbox titled “Project Update: Asian Carp Telemetry in the Ohio River Basin” for detailed information on the 2015 USFWS telemetry study in the ORB).



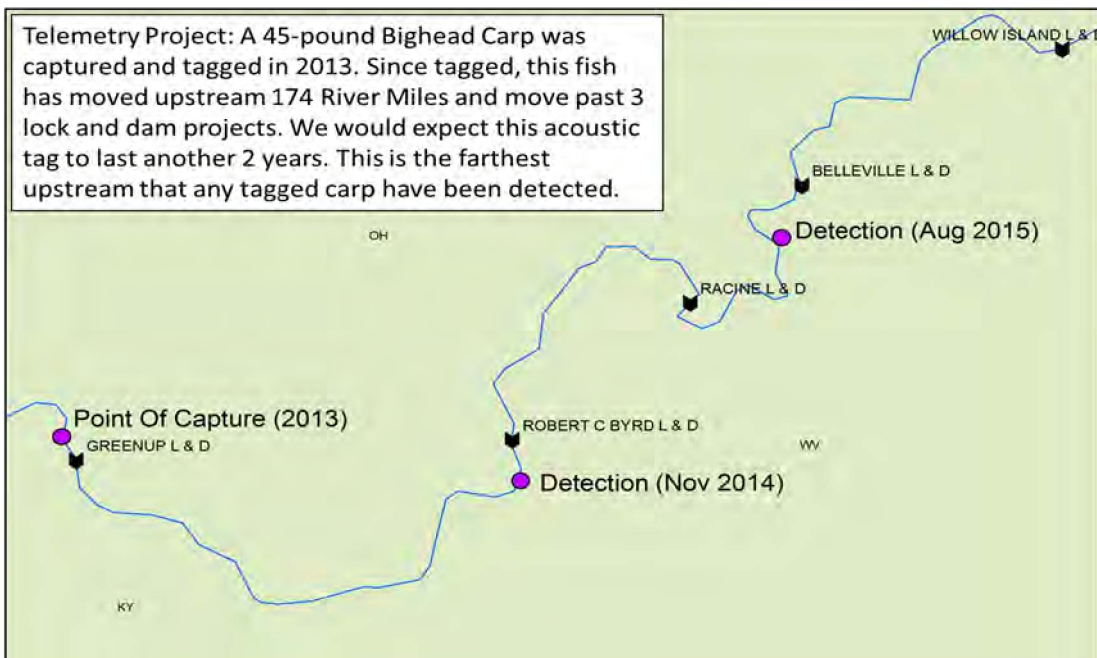
**Project Update:**

**Asian Carp Telemetry in the Ohio River Basin**

USFWS leads a telemetry project in the Ohio River, where 75 Asian carp were tagged with ultrasonic transmitters in the Ohio River and tributaries. One of these fish, a Bighead Carp, was captured and tagged in June 2013 near Wheelersburg, Ohio in the Meldahl Pool of the Ohio River. This fish was 43 inches total length and weighed 45 pounds. The Meldahl Pool represents the most upstream pool where presence of adults are regularly documented, or the leading edge of the “invasion front.”

Over the course of two and a half years, this fish has continuously moved upstream more than 174 river miles, and has passed upstream through three lock and dams, and was last detected in the Racine Pool. This pool is the farthest upstream that any of the tagged carp have been detected. This is significant as this location is well upstream of what is considered the "leading edge" of the Asian carp population in the Ohio River. There are only three other records of Bighead Carp upstream of this point, according to the NAS database. This fish’s acoustic tag is expected to last about another 2 years. The new detection data triggered a more intensive sampling response action to locate the fish, but recapture attempts were not successful (see inset figure).

This tagged carp provides evidence that the Ohio River telemetry system not only provides information concerning movement patterns, but it is also operates as an alarm to the project’s partners. Asian carp typically move in large schools, thus Ohio River states and USFWS grouped efforts to locate the fish and set fishing gear to determine if more than one or two fish moved upriver together. No other fish were seen or caught during the effort. This information may indicate that movement was limited to a few fish. As our proficiency improves at capturing Asian carp in low density situations, the telemetry array will be even more beneficial in the future.





### **3.6.3 U.S. Geological Survey**

The USGS collected hydraulic and water-quality data on the Muskingum River in 2014. The purpose of the data collection was to characterize the river so the likelihood of Asian carp spawning success could be determined. The Muskingum River data were collected June 23-26, 2014 in an 80 km (50 mi) reach from Coshocton (where the Walhonding and Tuscarawas rivers join) to McConnelsville. The collected field data were supplemented with a HEC-RAS hydraulic model of the lower 100 km (60 mi) of the Muskingum River developed by USGS in 2014 for the purposes of floodplain mapping. The Fluvial Egg Drift Simulator (FluEgg) model will be used to analyze the likelihood of spawning success and results will be published in 2016.

### **3.6.4 U.S. Coast Guard**

The role of USCG is to ensure the safety, security, and environmental protection of the Great Lakes and the Western Rivers. With respect to Asian carp, USCG focuses on ensuring the safety of mariners, vessels, and the public when Asian carp activities are conducted on or near federally navigable waterways. When operations associated with rapid response, research, or any other Asian carp activities that will impede the flow of traffic on a navigable waterway, USCG issues an RNA or safety zone and provides notice to the public and mariners to inform them of the planned activities and expected impact to navigation.

### **3.6.5 U.S. Environmental Protection Agency**

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 the spread of Asian carp into the GLB. In addition, funding was provided by EPA through GLRI to the State of Indiana to construct an earthen berm barrier at Eagle Marsh (near Fort Wayne, IN). The GLMRIS report identified this as a high-priority secondary pathway for potential movement of Asian carp into the Great Lakes as the Maumee River is a major tributary of Lake Erie. The barrier will ensure Asian carp cannot traverse from the Wabash River into the Maumee River. Completion of the earthen berm is anticipated in Spring 2016. A permanent separation will require mediation of potential flooding impacts.

## **3.7 ORB State Agency Accomplishments by Activity**

In addition to the Federal agencies, the ORB states have played major roles in the activities undertaken in the ORB. The following is a summary of major activities of State agencies and other organizations to manage the threat of Asian carp in the ORB.

### **3.7.1 Interagency Coordination**

All ORB states actively participate in implementation of the ORFMT Ohio River Basin Asian Carp Control Strategy. In addition, the Great Lakes States of the ORB all participate in ACRC activities.

### **3.7.2 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

The ORB states participate in a cooperative Asian carp telemetry project directed at understanding movement and habitat use of Asian carp in the upper Ohio River. The primary method of detection is an array of 125 receivers stationed from McAlpine Lock and Dam to Hannibal Lock and Dam. There are currently 176 tagged Asian carp at large in the Ohio River. With the assistance of the USACE, stationary receivers were placed in lock chambers in September 2015 to specifically assess Asian carp movement through lock chambers.

The Kentucky Department of Fish and Wildlife Resources (KDFWR) collaborates with the other ORB states on Asian carp work within the lower Ohio, Tennessee, and Cumberland Rivers, including Kentucky Lake and Lake Barkley in western Kentucky. KDFWR has led additional monitoring efforts (electrofishing and gillnetting) in the Upper Ohio River and its tributaries. The work was conducted jointly with USFWS and West Virginia DNR to provide information on Asian carp distribution. KDFWR partnered with Murray State University (MSU) and the USFWS to perform a pilot hydroacoustics study on the lower Tennessee River below Kentucky Dam. KDFWR is also cooperating with Murray State University to implement an Asian carp telemetry project in Kentucky Lake.

Indiana DNR confirmed juvenile Silver Carp distribution more than 100 miles farther up the Wabash River than previously documented. This occurrence was documented on August 6, 2015 when a few young fish were found in a puddle left behind after floodwaters receded near an area where the Tippecanoe River joins. Additional field monitoring in Indiana was included in annual sampling of the lower Wabash River and lower White River to monitor the Asian carp population.

The Ohio DNR undertook traditional fisheries monitoring in the Ohio River to observe and remove Asian carp when they are captured as non-target (secondary objective) species. In addition, law enforcement staff within the Ohio DNR monitored bait dealers for the presence of invasive species.

The Pennsylvania Fish and Boat Commission (PFBC) conducted Asian carp surveillance surveys using boat electrofishing gear on (1) the upper Ohio River at the tailwaters of New Cumberland Locks and Dam; (2) within the Ohio River Montgomery Slough; and (3) tributary Raccoon Creek. In addition, as part of its programmatic fisheries management strategies for the upper Ohio River, PFBC conducts periodic surveys at fixed sites within the tailwaters of navigation locks and dams to monitor trends in abundance, size structure, and age structure of sport fish species, which provides additional opportunities for Asian carp detection.





### 3.7.3 Active Prevention

In Indiana, active prevention was focused on severing the upper Wabash and Maumee watershed connection at Eagle Marsh. Engineering plans were developed by USDA – Natural Resources Conservation Service to construct a nearly 2-mile-long earthen berm on the Eagle Marsh property to separate the watersheds. It was anticipated that berm construction would begin in the spring of 2015 and be completed by October 2015; however, the Fort Wayne area unfortunately experienced record rainfall in the summer of 2015 and the site was flooded for a large portion of the summer. The berm will be completed in late 2015 or early 2016.

In Kentucky, the KDFWR Control and Removal project is specifically targeting removal of Asian carp from the Ohio River and its tributaries to limit their upstream movement. As a result of low densities of Asian carp in the upper reaches of the Ohio River in Kentucky (Meldahl and Greenup pools), removal efforts in 2015 were focused on the McAlpine and Cannelton pools. In addition, KDFWR continues to promote commercial fishing to reduce Asian carp populations in the lower Ohio, Tennessee, and Cumberland Rivers, as well as Kentucky and Barkley Lakes. KDFWR also continues to manage an Asian Carp Harvest Program (ACHP), which works closely with commercial fishers to allow access to dense populations of Asian carp in areas that are typically closed to commercial fishing.

The Ohio DNR is evaluating the following four additional aquatic pathways connecting the Ohio River and Lake Erie watersheds, as identified in the GLMRIS *Focus Area 2: Aquatic Pathways Assessment Summary Report*:

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

These pathways have been identified as potential vectors for the movement of Asian carp between the basins. Evaluations will consider engineering design needs and logistics related to closure of these GLMRIS pathways.

### 3.7.4 Research

KDFWR began assessing new, non-traditional fish sampling gears that may improve catch rates of Asian carp. These gear types are variations of gill nets that take advantage of the behavior and habitat preferences of Asian carp to improve capture.

### 3.7.5 Law enforcement/regulatory actions

Illinois DNR continues to undertake alternate pathway surveillance in Illinois and further coordinate these efforts across the Midwest. This effort is an effective enforcement component of Illinois DNR's invasive species program by increasing education and enforcement at bait shops, bait and sport fish production and distribution facilities, fish processors, fish markets, and food establishments known to have a preference for live fish for release or food preparation. A second component conducts surveys using conventional gears (electrofishing and trammel or gill nets) in urban fishing ponds in the Chicago Metropolitan area included in the Illinois DNR Urban Fishing Program. Ponds with positive detections



for Asian carp eDNA, or those with a history of channel catfish stockings, are targeted in an effort to remove any accidentally stocked Bighead or Silver Carp. IL DNR has found a correlation between historical catfish stockings from sources in the Southern United States prior to 2005 to presence of Bighead Carp in stocked ponds. This relationship is apparent across the Midwest United States and is not limited to Illinois.

### **3.7.6 Outreach**

The ORB states have continued outreach efforts within the ORB through advertisements and signage to promote awareness of AIS issues. ORB states continue work with commercial fishermen, fish processing facilities, and investors to promote fishing for Asian carp. Current outreach programs in Kentucky seek to negate potential conflict between commercial fishers and recreational anglers in the Asian Carp Harvest Program. KDFWR staff has placed signs at boat ramps in areas that are routinely fished by commercial fishers at Kentucky Lake and Lake Barkley and has distributed pamphlets describing the ACHP to marina operators and anglers at boat ramps. The *Kentucky Afield* television show and magazine have also been used to educate the public about the ACHP.



## 4.0 RESEARCH AND TECHNOLOGIES POTENTIALLY USEFUL FOR CONTROLLING THE SPREAD OF ASIAN CARP

State, Federal, academic, and non-governmental partners are conducting priority research supporting the development and implementation of new technologies for the early detection, prevention, and control of Asian carp within the UMRB and ORB. Federal efforts are led primarily by USGS, with additional research conducted by USACE and USFWS. State agencies and universities are also conducting key research for the development of new tools, adding to the overall portfolio of projects currently under way and potential new options for Asian carp management.

Current research and development projects on Asian carp can be generally categorized as follows:

- Early Detection and Monitoring
- Life History/Behavior
- Feeding Ecology
- Prevention
- Control
- Integrated Pest Management Strategies

Projects being conducted by USGS are described in detail in Appendix 2. Research currently being conducted has been developed to target potential opportunities for Asian carp control based on known life-history vulnerabilities and unique behavioral characteristics of the species. Research and development of new tools must also consider and avoid potential impacts to native species, in particular depleted or imperiled State or Federally-listed species. As a result, several control tools currently being developed are highly-specific to Asian carp species (primarily Bighead and Silver Carp) to avoid impacts to non-target native aquatic species. Prevention actions that are more general and not selective for Asian carp (e.g. sound, CO<sub>2</sub>, or bubble barriers to fish movement) are designed to be deployed in a manner to deter fish movement while not being lethal.

Preliminary research has been completed and State and Federal management agencies have begun identifying potential pilot projects for field implementation. Examples include the following:

- Underwater Sound Technology to alter behavior of Asian carp: In previous lab and pond tests, scientists found that Bighead and Silver Carp reacted strongly to complex noises such as underwater recordings of boat motors. In field trials conducted in 2015, initial analyses of fish movement patterns indicate that the fish sought out quieter locations. These studies are ongoing and will inform study designs implemented in 2016
- Portable hand-held environmental DNA (eDNA) detection device: In 2015, USGS validated a commercially-available genetic tool to detect the eDNA of Asian carp. Using the hand-held kit significantly reduces the time between sample collection and results compared to typical laboratory-based analysis which generally require several days to obtain. The kits were tested by conservation officers not trained in genetics and they were able to detect the presence of a



single, minnow-sized Silver Carp comingled with over 10,000 Fathead Minnows held in a fish transport tank at a loading rate commonly used to transport baitfish.

- **Fluvial Egg Drift Simulator (FluEgg):** In 2015, Grass Carp egg and larval data were incorporated into and enhanced the FluEgg model for use in predicting adequacy of rivers for Grass Carp reproduction and recruitment. This model is a tool being used to predict likely Asian carp spawning locations and where conditions exist that would allow eggs and larval fish to survive until they can find nursery habitat. FluEgg could also be used to assess risk of establishment of new spawning populations and evaluation of possible control measures.
- **CO<sub>2</sub> as a barrier:** Large-scale CO<sub>2</sub> field trials were completed in 2015 to evaluate the application of CO<sub>2</sub> into an area comparable to the approach channel at Brandon Road Lock and Dam in the Illinois River. Although the CO<sub>2</sub> infusion system was not sized appropriately for the flow and river stage conditions initial results indicate that acoustically-tagged Silver Carp and Bighead Carp didn't cross the barrier during peak CO<sub>2</sub> concentrations. USGS scientists are evaluating how fish interact with a CO<sub>2</sub> gradient to determine optimal exposure conditions and working with partners to determine better methods to deliver CO<sub>2</sub>.

IPM strategies have also been developed and continue to be refined for use at selected sites for Asian carp management. These strategies provide a more comprehensive and robust approach to Asian carp management by exploiting multiple opportunities for control (such as feeding ecology, swimming behavior, sound/CO<sub>2</sub> avoidance) by concurrently or sequentially implementing specific tools in a complementary manner. Ultimately, the strategic and effective implementation of both individual control tools and comprehensive IPM strategies within priority locations of the UMRB and ORB are informed by current and comprehensive data on Asian carp population status. The information on Asian carp range included in this report, as well as other available data on species occurrence and distribution, is used to inform decision-making on implementation of monitoring and control tactics and strategies.

Since 2013, 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 may be vulnerable to targeted control efforts as part of an 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.

The USGS has led and organized an interagency collaborative between USFWS, Iowa State University, and the Minnesota DNR to identify recruitment constraints by collecting ichthyoplankton samples from more than 20 locations stretching from the confluence of the Des Moines and Mississippi Rivers to La Crosse, Wisconsin. This network of sites will allow identification of the approximate locations where Asian carp reproduction occurs in this emerging population, the environmental conditions that lead to successful spawning activity, and whether spawning may be an opportunity to target Asian carp with control measures. Other work on recruitment constraints has focused on evaluating 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 found that previously established methods for identifying Asian carp eggs and larvae are insufficient to establish identity (thus necessitating the use of genetic methods).



Deployments of IPM systems to reduce Asian carp abundance are most likely to be successful in large ecosystems where 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. 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 individuals that are tagged and released into locations where Asian carp are present. By tracking them, the locations of the population at large can be inferred).

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. USGS is measuring particle size distributions in the water column and in the guts of Asian carp to determine whether Asian carp select particular seston (organisms and non-living matter swimming or floating in a water body) size classes from the water column. Concurrent work is identifying the spatial distribution in particle sizes among habitats at different conditions (at different discharges and different habitat types).

Appendix 2 provides a summary of completed or ongoing research being undertaken in 2015 by USGS and USFWS, with the assistance of other Federal, State, and research institutions that focuses on prevention and control of Asian carp in waters of the United States. This information complements the summary of research projects that were identified in other sections of the 2014 Report.



## 5.0 METRICS AND METHODOLOGIES FOR EVALUATING SUCCESS OF ACTIONS TO CONTROL THE SPREAD OF ASIAN CARP

WRRDA directed the USFWS to identify quantitative measures for use in documenting collective progress in controlling spread of Asian carp. The 2014 Report identified: (1) proposed quantitative and qualitative measures and outcomes for ensuring progress toward the goals of controlling spread of Asian carp in the designated watersheds, and (2) specific critical short-term actions to continue and expand current efforts to ensure multiagency coordination to achieve common prevention-based goals.

For the 2015 Report, a review of the long-term utility of the original measures proposed in the 2014 Report for effectively tracking performance and progress was conducted and informed recommendations to discontinue a small sub-set of measures; these were discontinued as they were considered redundant with other measures, or would not provide tangible additional tracking and management benefits based on data that could be consistently collected on an annual basis. These measures are not included in the 2015 Report.

Additional data will result from new and ongoing activities being conducted in 2015 and outyears. This information will be used to populate and support the continued use of measures for evaluating progress in controlling the spread of Asian carp

### 5.1 Short-term Actions to Address the Need for Interagency Coordination

- **Development of interagency UMRB, ORB and other basin-specific Asian carp control strategies that complement the National Plan while addressing the management needs of each basin**
  - **Progress to date:** In 2014, the ORFMT released the *Ohio River Basin Asian Carp Control Strategy Framework*. This Framework outlines actions for prevention, monitoring and response, population control, understanding impacts, and communication to collectively prevent further expansion, reduce populations, and better understand the impacts of Asian carp. Implementing the Control Strategy Framework is intended to minimize the social, ecological, and economic impacts of these invasive fishes. The UMRB Asian Carp Control Strategy Framework exists in draft form and is expected to be completed in 2016.
- **Identification of Federal and State resources potentially available for implementing control strategies and actions**
  - **Progress to date:** USFWS has worked extensively with UMRB and ORB states and other Federal agencies to identify resources potentially available for implementing control actions and to leverage those resources where feasible. Limitations in State agency budgets have not allowed some states to significantly supplement Federal funding; however, states that received additional USFWS funding for Asian carp projects in conjunction with their ANSTF approved State ANS management plans provided a 25% match for these funds. State staff have also dedicated significant hours to planning and executing Asian carp control projects.



- **Development of ORB/UMRB formal institutional arrangements, using a collaborative model similar to the ACRCC, to facilitate interagency coordination, collaboration, and plan implementation.**
  - **Progress to date:** The ORFMT and UMRCC adopted an agency coordination model utilizing MICRA to provide recommendations for any future funding under WRRDA, with the USFWS making final funding decisions. State representatives from both sub-basins recommended that the USFWS work through MICRA for executive-level Asian carp coordination and multi-state project planning and implementation in the Mississippi River Basin. The sub-basin partnerships identified potential inter-agency management structure for coordinated planning and reporting, development of funding strategies, and implementation of actionable plans.
  
- **Development of an agreement (memorandum of understanding or operation principles) to identify roles and responsibilities of all participating agencies.**
  - **Progress to date:** More formal agreements such as memorandum of understanding or operation principles will be pursued in future years, if deemed necessary.
  
- **Development of an annual project plan with management structure and appropriate funding.**
  - **Progress to date:** MICRA, ORFMT and UMRCC adopted annual project plans for 2015, whereas ORFMT and UMRB fish managers are currently developing 2016 project plans. With the organizational arrangement through MICRA, development of an annual project plan has been assured. No future reporting on this measure is necessary.
  
- **Development of a process to ensure actions are strategically prioritized and properly sequenced.**
  - **Progress to date:** USFWS has worked extensively with the UMRB and ORB states, MICRA, and other Federal agencies to ensure that individual activities proposed for Asian carp prevention are strategically prioritized and properly sequenced. This action will continue annually.
  
- **Preparation of an annual report measuring success and identifying the strategy for moving forward, including identification of costs for future actions.**
  - **Progress to date:** USFWS, through this Report, has developed an annual report to measure progress and to identify successes and strategies for moving forward, including identification of costs for future actions. USFWS will continue to 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.



## 5.2 Quantitative Measure of Progress

- **Changes in movement in the current verified adult Asian carp population front in both the Ohio and Mississippi River basins and tributaries.**
  - **Progress to date:** Since the 2014 Report, Silver Carp have been detected approximately 71 miles further upstream in the Upper Mississippi River, 27 miles further upstream in the Tennessee River in the ORB, 62 miles further upstream in Indiana tributaries of the Ohio River (the White River system), and 28 miles further upstream in the Wabash River. Bighead Carp exhibited a range expansion up the Upper Mississippi River and St. Croix Rivers (8 miles and 6 miles, respectively) and up the Licking River (93 miles) in Kentucky. Although additional captures of Grass Carp were noted in the UMRB and ORB in 2015, there were no new occurrences outside of their previously documented range within those basins. Black Carp exhibited an increase in observed range up the Mississippi River (12 miles) and to date none have been collected in the ORB.
  
- **Changes in numbers or range of current verified spawning areas in the rivers and tributaries.**
  - **Progress to date:** Asian carp spawning has been documented in Pool 16 of the Mississippi River (near Fairport, Iowa), which is two pools upstream than what was reported in the 2014 report.
  
- **Changes in eDNA positive findings within areas upstream of the known adult population front.**
  - **Progress to date:** In 2015, 7,526 water samples were collected and processed for the presence of Bighead and Silver Carp DNA as part of the USFWS-led eDNA Surveillance Program. Samples were collected from Great Lakes tributaries (5,028), the UMR (660), CAWS (240), Ohio and Tennessee Rivers (1,370), and Missouri River (228). The only positive detections for Bighead and Silver Carp DNA were in the ORB. On the Tennessee River, a positive for Silver Carp occurred in Pickwick Lake. Positives for both Silver and Bighead Carp (including one sample that tested positive for both species) in Wheeler Lake alerted State agencies of the potential presence of these fish, which have been previously captured near these areas. USGS NAS lists a number of records of Bighead and Silver Carp from the Tennessee River reservoirs, including a Silver Carp captured in Pickwick Lake below the Wilson Dam in 2015 and individual Bighead Carp records in the system as far upstream as Watts Bar Lake (2010), upstream of the positive eDNA detections. On the Ohio River, positives for Bighead Carp in Little Beaver Creek and Montgomery Island Pool were novel detections of Asian carp and are located upstream of where any Asian carp specimens have been captured. In response to the 2015 positive eDNA results, the Pennsylvania Fish and Boat Commission responded with traditional monitoring but did not find any fish. Subsequent eDNA sampling later in the year returned all negative eDNA results for these areas.

Of note, the 2015 eDNA sampling conducted in the CAWS in 2015 returned all negative eDNA results for the first time since monitoring began in 2009. Figure 14 shows an overview





of all 2015 sampling sites and results. The only positive detections for Bighead and Silver Carp DNA were in the Ohio River basin.

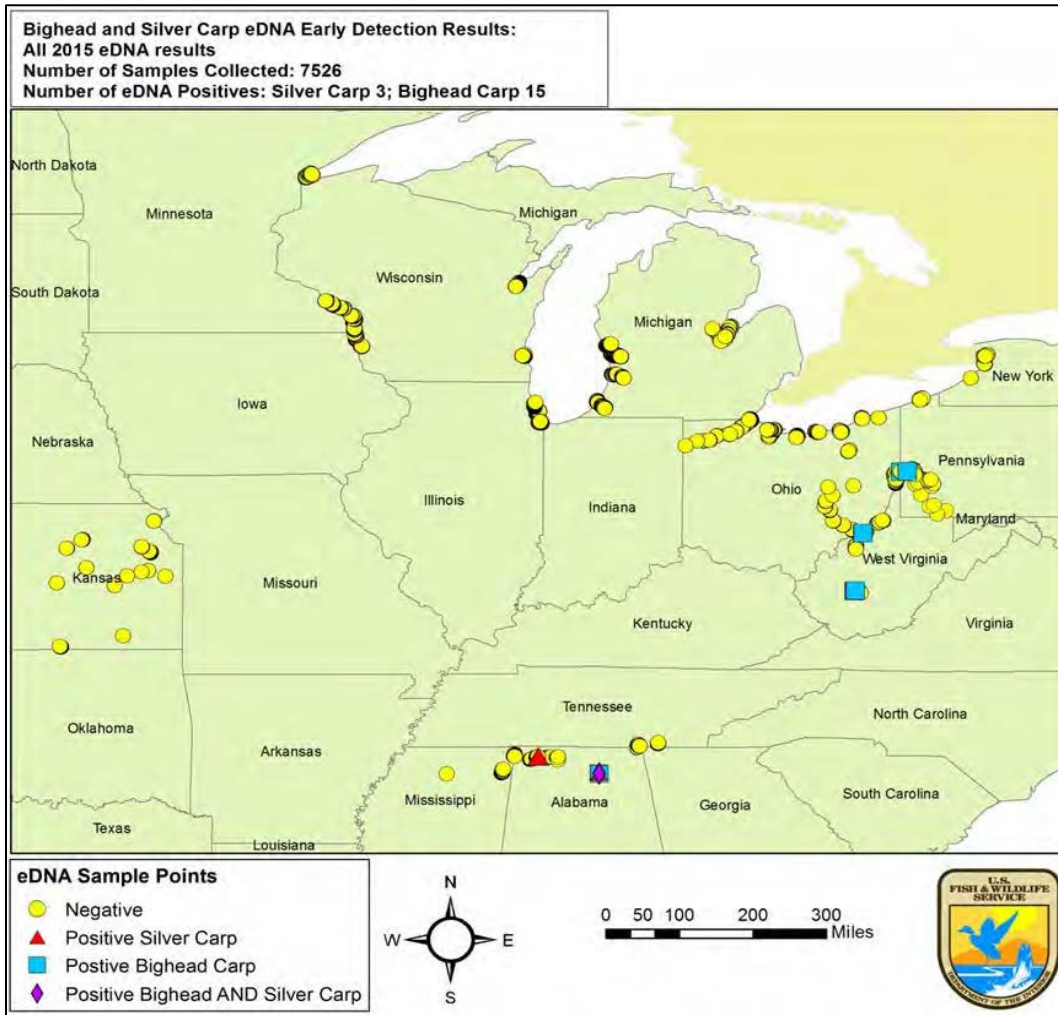


Figure 15. Overview of all 2015 eDNA sampling sites and results

- **Miles of streams excluded or protected from Asian carp movement.**
  - **Progress to date:** No streams have been excluded or protected from Asian carp movement during the reporting period. Potential candidate streams for exclusion areas are currently being evaluated by cooperating agencies.
  
- **Number of stream miles assessed for presence of Asian carp.**
  - **Progress to date:** ORB and UMRB State and Federal agencies do not track the number of stream miles currently assessed for presence of Asian carp. This information will be supplemented in future versions of this report.



- **Number of control technologies proven to control or eradicate Asian carp that are ready for in-the-field use.**
  - **Progress to date:** UMRB and ORB are working with the ACRC to develop and evaluate potential control technologies. In addition, many states are working with local universities to address research needs in both basins. USGS is working collaboratively with other agencies to identify additional barrier technologies and deterrents for evaluation of the effectiveness in many locations in the UMRB and the ORB. The ACRC's Monitoring and Response Work Group is working collaboratively with both UMRB and ORB states to evaluate and implement new monitoring technologies. The following technologies are being evaluated for potential pilot deployment in the field.
    - Underwater Sound Technology to alter behavior of Asian carp: In laboratory and pond tests, scientists found that Bighead and Silver Carp reacted strongly to complex noises transmitted underwater. Field trials were conducted in 2015; additional analysis is ongoing and will inform study designs and potential pilot trials to be implemented in 2016.
    - Portable hand-held environmental DNA (eDNA) detection device: In 2015, USGS validated a commercially-available genetic tool (hand-held sampling kit) to detect the eDNA of Asian carp. The kits were tested by agency conservation officers, successfully allowing them to detect the presence of a single small Silver Carp included in a batch of over 10,000 Fathead minnows (a common baitfish in trade in the United States) held in a fish transport tank and under simulated industry transport conditions. This tool will support the ability to manage potential accidental transport of Asian Carp to new waters through bait transport vectors.
    - Fluvial Egg Drift Simulator (FluEgg): In 2015, Grass Carp egg and larval data were incorporated into a scientific model for predicting suitability of rivers for Grass Carp reproduction and recruitment. This model (FluEgg) will be used to predict likely Asian carp spawning locations, and where conditions exist that would allow eggs and larval fish to survive until they can find nursery habitat. FluEgg could be used to assess risk of establishment of new spawning populations and evaluation of possible control measures.
    - CO<sub>2</sub> as a barrier: Large-scale CO<sub>2</sub> field trials were completed in 2015 to evaluate the application of CO<sub>2</sub> into water in navigation approach channels or other navigation structures (e.g. locks). Initial results indicate that Asian carp did not cross a CO<sub>2</sub> barrier at peak concentrations. USGS scientists are evaluating how fish interact with a CO<sub>2</sub> gradient to determine optimal exposure conditions (minimum levels required for Asian carp dispersal), and working with partners to determine better methods to deliver CO<sub>2</sub>.
- **Number of agencies with model regulations or ordinances focused on Asian carp prevention in place.**



- **Progress to date:** No new regulations or ordinances have been developed during this reporting period.

### 5.3 Qualitative Measures of Progress

- **Monitoring and Assessment of Asian carp** – This effort includes establishment of a long-term, comprehensive, cooperative monitoring and assessment program within each basin.
  - **Progress to date:** Minnesota DNR is leading an effort to develop a comprehensive surveillance program to define presence, invasion, and established fronts in Upper Mississippi River. Participating with Minnesota DNR on this effort are Illinois DNR, Western Illinois University and Iowa DNR. In the ORB, USFWS is assessing the distribution, movement, and lock and dam passage of Asian carp through the use of telemetry. Participating with USFWS are Kentucky DNR, West Virginia DNR, Purdue University, and Ohio DNR. In addition, West Virginia DNR will be taking the lead on identifying monitoring and response actions for Asian carp in the Ohio River. Kentucky DNR, Pennsylvania Fish and Boat Commission, Illinois DNR, Indiana DNR, Ohio DNR, and New York DEC will be working with West Virginia DNR on this effort. In the upper Illinois River and CAWS, the multiagency Monitoring and Response Work Group of the ACRCC annually develops and implements its Monitoring and Response Plan that includes monitoring of Asian carp populations (determining status of adult population front and presence of all life stages [adults and juvenile fish, larvae, and eggs]).
- **Preventing the introduction and movement of Asian carp via identified pathways** – This effort includes establishment of strategies to manage pathways for accidental or deliberate unauthorized introductions of Asian carp.
  - **Progress to date:** In the UMRB, Illinois DNR along with Western Illinois University will be undertaking contract fishing to reduce propagule pressure in Pool 20; population reduction in Pool 19-17; and characterize adult Asian carp catches in Pool 16-13. Participating with Illinois DNR-WIU are Missouri DNR and Iowa DNR. In the ORB, Kentucky Department of Fish and Wildlife resources will also be undertaking efforts to control and remove Asian carp. West Virginia will be participating with Kentucky on this effort.
  - Many states have developed informational signs at boat ramps to help anglers identify Asian carp and avoid accidental transport and introduction to new waters. In addition, bait shop minnow information campaigns encourage anglers to be vigilant for Asian carp minnows.
  - Illinois DNR conservation police officers employ surveillance to prevent the intentional or unintentional movement of all invasive species and works collaboratively with Federal and regional State agencies.
- **Rapid Response Planning** – Rapid response plans available to prevent range expansions and eradicate new introductions in both basins are necessary.
  - **Progress to date:** Each state develops response actions or plans as deemed necessary.



- **Collaborative Research** – Currently, the necessary tools are not available to ensure complete control of Asian carp. While Illinois has seen reductions of Asian carp populations in the Upper Illinois Waterway through control activities, additional 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 United States. Continuation of current research efforts and research into new tools and control methods are critical for developing and assisting implementation of control technologies and assessment of methods for population reduction.
  - **Progress to date:** Federal and State agencies are working collaboratively to develop and evaluate potential control technologies, with the goal of field trial implementation and, where feasible, long-term installation. In addition, many states are working with local universities to address research needs in both basins. For example, Ball State University is evaluating the impact of Asian carp on native fishes in the Wabash River. USGS is working collaboratively with other agencies to identify additional barriers, technologies, and deterrents for evaluation of the effectiveness in many locations in the UMRB and the ORB. The ACRCC’s Monitoring and Response Work Group is working collaboratively with both UMRB and ORB states to evaluate and implement new monitoring technologies. In addition to advances in technical research and development, interagency meetings were convened to address site selection for potential implementation as well as environmental regulations and permitting requirements for field implementation of specific control techniques, including CO2. Work is being conducted to address the requirements concurrent to the ongoing research to refine and complete necessary research in advance of deployment.
  
- **Develop strategies to minimize adverse effects** – The 2014 Report identified a key component of an overall strategy to control Asian carp as 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.
  - **Progress to date:** In the UMRB, Minnesota DNR will be evaluating Asian carp and native fish passage at Lock and Dam 8 and Lock and Dam 19. Participating with Minnesota DNR are Missouri DNR and Iowa DNR. In the ORB, Kentucky DNR will be evaluating efforts to limit Asian carp dispersal at lock and dams. West Virginia, USACE, USGS, and USFWS will be participating with Kentucky DNR on this effort.
  
- **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 to improve effective management and control of Asian carp in the ORB and the UMRB.
  - **Progress to date:** For the ORB, West Virginia and Kentucky will be taking the lead on an Asian carp coordination and outreach effort. Pennsylvania Fish and Boat Commission, Illinois DNR, Indiana DNR, Ohio DNR, West Virginia DNR, and New York DEC will be assisting with this effort.



- In 2015, the National Wildlife Federation and the Indiana Wildlife Federation are leading development of a network of conservation organizations in the ORB states to communicate priorities and progress on Asian carp control plans and actions. These organizations will work within each state to build knowledge and support for continuing and expanding Asian carp control projects for State and Federal partners.
- In addition, many states have developed informational signs at boat ramps to help anglers identify Asian carp and avoid accidental transport and introduction to new waters. Furthermore, bait shop minnow information campaigns encourage anglers to be vigilant for Asian carp minnows.
- **Effective Regulations and Laws** – A long-term strategy for both the UMRB and the ORB includes development of an effective system of compatible laws and regulation, both at the Federal and State levels.
  - **Progress to date:** No new regulations or ordinances have been developed during this reporting period. This topic will be covered under Quantitative Measures in future reports.
- **Ensuring Sufficient Resources Available** – As identified in the 2014 Report to Congress, adequate resources are critical for successful implementation of any strategy. Sufficient financial resources must be available to Federal, State, and local agencies to address the long-term issue of controlling and reducing risk from Asian carp in both basins.

**Progress to date:** USFWS has received additional agency funding for efforts outside of the Great Lakes, including the UMRB and the ORB. These resources, along with other State and Federal resources are being leveraged to support current activities.

## 6.0 CROSS-CUT SUMMARY OF FEDERAL AND NON-FEDERAL EXPENDITURES IN THE UPPER MISSISSIPPI AND OHIO RIVER BASINS

This cross-cut summary includes an overview of expenditures directly related to Asian carp management activities conducted by Federal and State agencies in the UMRB, ORB, and GLB. In total, agencies reported \$49.9 million expended on actions to address Asian carp in the UMRB and ORB, of which \$44.2 million was for actions in the CAWS to protect the Great Lakes from Asian carp. A total of \$5.7 million was expended on activities outside the CAWS to address Asian carp within the ORB and UMRB and tributaries. This report summarizes major activities accomplished in the UMRB, ORB, and GLB (where a benefit to the previous basins is realized), yet focuses on those efforts funded by the \$5.7 million that was dedicated to address the threat of Asian carp in the UMRB and ORB.

Agencies were queried for an accounting of all Asian carp-related expenditures recorded during their respective Fiscal Year 2015 for activities related to the following:

- Research focused on development of new tools and techniques for prevention,
- “Active” prevention (implementation or assessment of dispersal barriers, targeted commercial fishing, and similar means),
- Interagency coordination,



- Monitoring and early detection,
- Rapid response and risk assessment exercises,
- Law enforcement and regulatory actions, and
- Outreach with industry or the public and stakeholder participation

Table 1 provides a summary of expenditures by individual agency and funding source. Columns in the table are identified as follows:

- **Total Agency GLRI:** Total reported expenditures of GLRI funds for all activities in support of GLB Asian carp prevention.
- **Total Agency Base:** Total reported expenditures of agency base funds for all activities in support of UMRB, ORB, and GLB Asian carp management.
- **Total Reported Expenditures:** Total reported expenditures of agency base, GLRI, or other funds for all activities in support of UMRB, ORB, and GLB Asian carp prevention.
- **Total UMRB/ORB (w/o CAWS) Expenditures:** Total reported expenditures of agency base or other funds for all activities in support of UMRB and ORB Asian carp prevention (excludes all GLB activity expenditures).

Note that funding provided by granting agencies (e.g. USEPA and USFWS) as financial support dispersed to another recipient partner agency is only reported once as an expenditure by the recipient as they expend funds and conduct the actual prevention activity. Individual agency reported expenditures totaling less than \$10,000 were not included in the Report.

**Table 1. Total FY 2015 Expenditures for Asian Carp Activities.\***

| Agency                | Total Agency GLRI Expenditures <sup>1</sup> | Total Agency Base Expenditures | Total Reported Expenditures <sup>2</sup> | Total UMRB/ORB (w/o CAWS) Expenditures <sup>3</sup> |
|-----------------------|---|--------------------------------|--|---|
| USEPA                 | --  | --                             | --                                       | --  |
| USACE                 | \$2,797,233                                 | \$25,745,752                   | \$28,542,985                             | \$192,000   |
| USDA (Forest Service) | --  | \$27,000                       | \$27,000                                 | \$27,000  |
| USGS                  | \$3,044,673                                 | \$5,193,799                    | \$8,238,472                              | \$405,249   |
| NOAA                  | --  | \$44,220                       | \$44,220                                 | --  |
| USFWS                 | \$2,321,033                                 | \$2,352,500                    | \$4,673,533                              | \$1,570,000   |
| USCG (9th District)   | --  | \$46,648                       | \$46,648                                 | \$46,648  |
| NPS                   | --  | \$40,000                       | \$40,000                                 | \$40,000  |
| Indiana               | \$287,401                                   | --                             | \$421,001                                | \$421,001   |
| Iowa                  | NA  | \$146,378                      | \$146,378                                | \$146,378   |
| Kentucky              | NA  | \$60,000                       | \$130,000                                | \$130,000   |
| Illinois <sup>3</sup> | \$4,124,000                                 | \$58,000                       | \$4,357,000                              | --  |
| Minnesota             | --  | \$85,000                       | \$1,910,011                              | \$1,910,011   |
| Mississippi           | NA  | --                             | --                                       | --  |
| Missouri              | NA  | \$119,929                      | \$119,929                                | \$119,929   |
| New York              | --  | --                             | --                                       | --  |
| North Carolina        | NA  | --                             | --                                       | --  |
| Ohio                  | \$1,012,651                                 | \$28,387                       | \$1,041,038                              | \$519,068   |
| Pennsylvania          | --  | \$40,000                       | \$40,000                                 | \$40,000  |
| Tennessee             | NA  | \$54,000                       | \$78,000                                 | \$78,000  |
| West Virginia         | NA  | --                             | --                                       | --  |
| Wisconsin             | --  | --                             | --                                       | --  |
| <b>Total</b>          | <b>\$13,586,991</b>                         | <b>\$33,877,464</b>            | <b>\$49,856,215</b>                      | <b>\$5,650,284</b>                                  |

\* Agency expenditures under \$10,000 were not reported or included for the purposes of this report except where it is specifically known that no money was spent.

- 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. GLRI activities expenditures are included in this Report to provide a complete picture of Asian carp activities conducted within the UMRB, yet are also identified in the ACRCC's annual Control Strategy Framework Strategy (<http://asiancarp.us/documents/2015Framework.pdf>).
- 2 Total Report Expenditures includes any other outside funding sources reported. (e.g. Minnesota expenditures include funding from the Minnesota Environment and Natural Resource Trust Fund and the Minnesota Outdoor Heritage Fund).
- 3 Total UMRB and ORB (without CAWS) Expenditures was used for the work that is highlighted in this Report. This work was conducted to directly protect the UMRB and ORB and tributaries from Asian carp.



## 7.0 FUTURE INTERAGENCY COLLABORATIVE EFFORTS

Development of the 2014 Report provided a key baseline on the status of coordinated efforts to address the threat of Asian carp within and between watersheds in the United States. Following leadership from the USFWS, the partner agencies have developed a strong consensus supporting increased collaboration and interjurisdictional planning and implementation in 2015.

Coordinated planning efforts will continue to incorporate and build off of demonstrated advancements in Asian carp prevention and control, including:

- Targeted commercial fishing, which has been shown to reduce the Asian carp biomass by as much as 68% in portions of the upper Illinois River and is being used to reduce Asian carp numbers in other key locations, including the ORB
- Development and deployment of new gears targeting Asian carp of various life stages and in different habitat types for use in improved detection and removal (e.g. removal of juvenile/sub-adult Asian carp before they can reach adult size and produce offspring)
- Development and use of new genetic markers for the early detection of Asian carp species, allowing agencies to respond more effectively in the event of a positive finding
- Continued deployment and refinement of Electrical Dispersal Barrier fish deterrent technology as a primary tool for preventing dispersal
- Development and implementation of Integrated Pest Management (IPM) strategies focused on Asian carp prevention and control, offering a comprehensive suite of control options for use under different scenarios to maximize the effects of all available tools
- Analysis and implementation of control actions to address potential pathways and vectors of Asian carp movement (e.g. closure of GLMRIS secondary pathways)

Coordination and implementation efforts focused on Asian carp management going forward in 2016 will utilize best –practices and demonstrated successful tactics, and continue to build on the enhanced collaborative in place. Basinwide interagency planning conducted in 2014 and 2015 has provided a strong foundation for collectively identifying and developing the priority management and policy actions needed to achieve both short-term and long-term goals and to ensure their alignment under Federal and State agency, basinwide, and national Asian carp management strategies. Enhanced coordination will continue during 2015 and 2016, with an emphasis on opportunities to address ambitious, but achievable, goals to support long-term prevention and control of Asian carp and natural resource protection. The coordination mechanisms that have been developed will be used to identify and prioritize future needs (and related costs and potential challenges) to allow agencies to continue to address the threat of Asian carp. Within the ORB and UMRB, potential future actions to prevent additional spread of Asian carp include:

### Coordination

- Continue refinement and formalization of interagency coordination (State and Federal agency, Mississippi Interbasin Cooperative Resource Association [MICRA], other cooperative resource





organizations), priority-setting, and decision-making processes for developing holistic strategies and long-term priorities

- Continue to develop and implement consensus-based protocols for data collection, assessment, management, and communication
- Continue to expand and build upon interagency partnerships to identify and implement highest-priority Asian carp monitoring and control activities in support of basinwide, regional, and national strategies

#### Monitoring and Response

- Conduct monitoring to locate potential target areas for limiting the spread of reproducing Asian carp within the UMRB and ORB
- Develop additional early detection and response plans, where needed, in the UMRB and ORB
- Conduct early detection monitoring in the upper Ohio and Tennessee rivers with traditional fisheries sampling gears and eDNA
- Address Asian carp expansion while also considering opportunities for broader detection and control of other priority AIS such as Northern Snakehead and Round Goby, when possible

#### Communication and Outreach

- Establish communication networks with non-governmental stakeholder groups to support additional outreach to stakeholders within basins

#### Research

- Assess and characterize nursery habitats in lower ORB to identify locations for effective implementation of management actions to minimize survival of young Asian carp
- Assess Asian carp passage through McAlpine and Markland dams to inform potential locations for deterrent barriers that may reduce the number of adult Asian carp migrating upriver
- Assess population density in Barkley, Kentucky, and Pickwick lakes and Cheatham Reservoir to evaluate the extent of Asian carp migration and inform the design and implementation of management actions to prevent the establishment of Asian carp
- Assess and characterize Asian carp reproductive success in Kentucky and Barkley Lakes to determine if populations are self-sustaining and to identify appropriate management actions
- Characterize established population range and habitat in Ohio, Tennessee and Cumberland rivers to determine the potential distribution of established populations in these watersheds
- Enhance telemetry array for better coverage of the ORB to better understand the extent and timing of habitat use in specific locations by Asian carp.

#### Control

- Increase harvest of Asian carp in the lower ORB and Kentucky and Barkley Lakes to prevent or reduce numbers of adult Asian carp migrating upriver
- Increase harvest in the upper ORB to minimize the potential for reproduction above McAlpine Lock and Dam and to remove adult fish at the leading edge
- Increase active telemetry in the lower ORB to find spawning congregations and inform Asian carp removal efforts



- Investigate how technologies such as bubbles, lights, and sounds can inhibit Asian carp movement

This report portrays the breadth of activities being conducted to address the threat of Asian carp and prevent further spread in the UMRB, ORB, and GLB. Of the total expenditures of \$49.9 million reported in FY2015 for these activities, approximately 89% supported management activities and research conducted by Federal agencies within the IWW and CAWS for Great Lakes protection. These activities supported key regional management goals since the IWW/CAWS corridor serves as a critical chokepoint to prevent Asian carp introduction into the Great Lakes.

By comparison, \$5.7 million, or approximately 11% of the total FY2015 reported expenditures, supported key interagency Asian carp prevention efforts in the UMRB (excluding the CAWS and IWW) and the ORB, two geographically expansive watersheds. Accordingly, this report summarizes the numerous partnerships, strategies, and research that are augmenting Asian carp management in the UMRB and ORB. Significant progress has been made; however, opportunities remain to further develop and implement effective control measures to prevent further expansion of Asian carp across both river basins and in other priority waters of the United States. The USFWS and its partner agencies will continue to collaborate and coordinate to implement actions to most strategically address the growing national threat from Asian carp, commensurate with the limited level of available resources