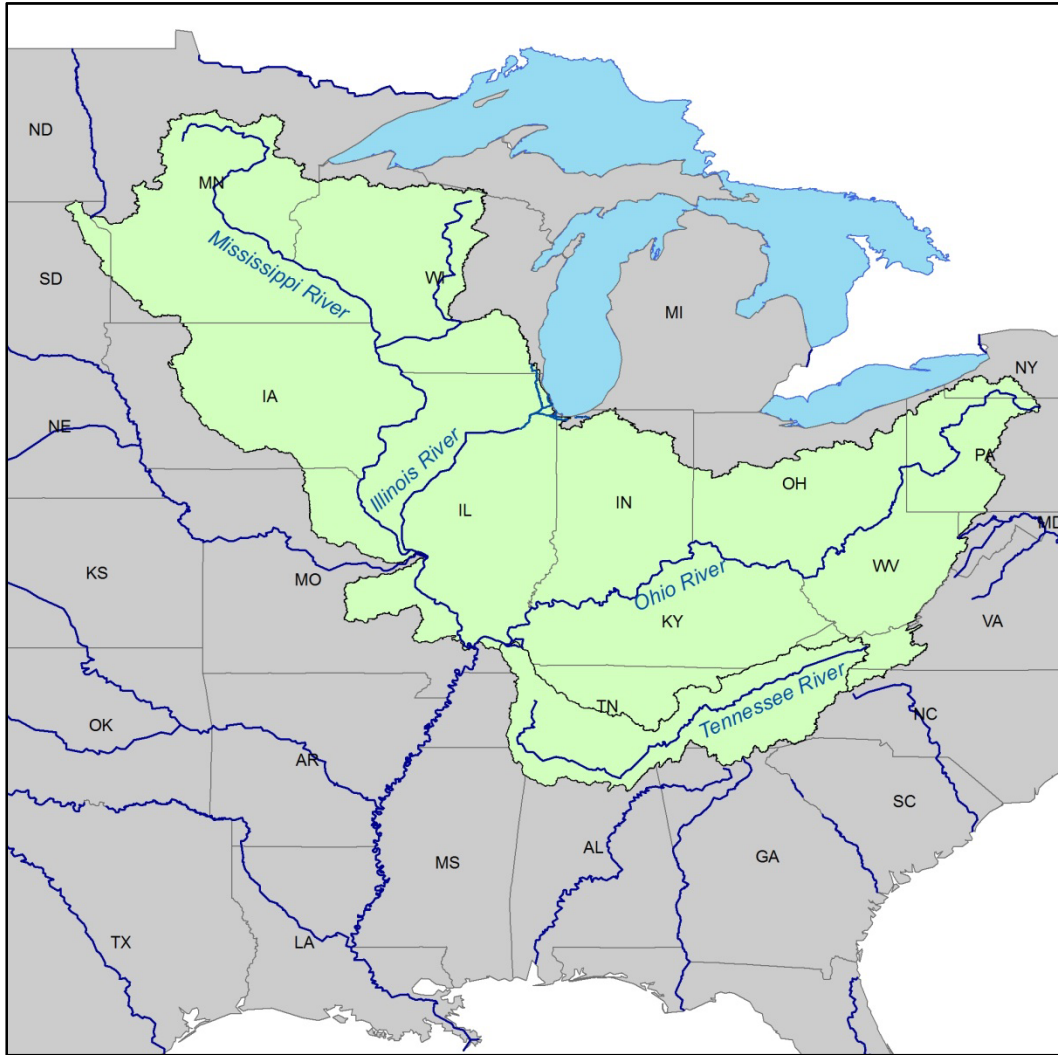


Monitoring and Response Plan for Asian carp in the Mississippi River Basin



Prepared by the
Mississippi Interstate Cooperative Resource Association
Asian Carp Advisory Committee
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Introduction

This is the first Monitoring and Response Plan for Asian carp (bighead carp, black carp, grass carp, and silver carp) in the Mississippi River Basin. The 2015 Monitoring and Response Plan provides a summary of the collaborative partnership efforts planned in Fiscal Year 2015 to implement Asian Carp Control Strategy Frameworks developed for the Ohio River and Upper Mississippi River sub-basins. These sub-basin control strategy frameworks are step-down plans of the national *Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States* (National Plan). The National Plan was approved for implementation by the Aquatic Nuisance Species Task Force in 2007; however minimal resources have been available to prevent the continued range expansion and population growth of Asian carp in the Mississippi River basin. Although USFWS received no funding for implementation of Asian carp prevention and control efforts in the Ohio and Upper Mississippi river basins in Fiscal Year (FY) 2012, small amounts of funding were available for USFWS efforts in these basins in FY2013 (\$373,000) and FY2014 (\$600,000). States have been working with their partners to assess the status of Asian carp populations in their waters and implement monitoring and response programs to the extent possible.

The Asian Carp Regional Coordinating Committee (ACRCC), a partnership of state, provincial, and United States and Canadian federal agencies and other stakeholders, has coordinated the development and implementation of an annual Asian Carp Control Strategy Framework (Framework) to prevent the introduction and establishment of bighead and silver carp populations in the Great Lakes since 2010. The ACRCC Framework coordinates the implementation of strategically targeted actions to prevent and control the movement of bighead and silver carp from the Mississippi River Basin into the Great Lakes. Many of these projects are implemented in the uppermost reach of the Illinois River (43 miles; 69.2 km) and the Chicago Area Waterways System (CAWS). Asian carp prevention and control efforts in this small area within the Mississippi River Basin are addressed in the ACRCC Monitoring and Response Plan.

Bighead, silver, and grass carps have been established in the lower reaches of the Ohio and Upper Mississippi rivers for more than two decades. In recent years, black carp have been captured with increasing frequency in the Upper Mississippi River below Lock and Dam 19 and in the lower Illinois River. Although spawning and recruitment of young-of-the-year black carp has not been documented, the repeated captures of adult diploid black carp of varying size and age indicate that black carp are likely self-sustaining in the open reach of the Mississippi River. There have been no confirmed collections of black carp in the Ohio River basin to date.

On June 10, 2014, the United States Congress, in Section 1039 (b) of the Water Resources Reform and Development Act of 2014 (WRRDA), charged the U.S. Fish and Wildlife Service (USFWS), to work in coordination with the Secretary of the Army, the Director of the National Park Service (NPS), and the Director of the U.S. Geological Survey (USGS) to lead a multiagency effort to slow, and eventually eliminate, the spread of Asian carp in the Upper

Mississippi River Basin (UMRB) and Ohio River Basin (ORB) and tributaries. Congress then appropriated \$2.365 million in the USFWS's FY2015 budget for Asian carp prevention and control in the Ohio and Upper Mississippi rivers and tributaries, providing the first substantial funding to address Asian carp populations in the Mississippi River basin beyond the upper Illinois River and the CAWS.

The USFWS met with state and federal agency partners in the Ohio River and Upper Mississippi River sub-basins in February and March 2015, respectively, to foster inter-agency coordination and to discuss planning, funding, and operations for Asian carp prevention and control. The USFWS informed the sub-basin groups that the agency would provide a total of \$800,000 of its FY2015 base funding for Asian carp to support implementation of the highest priority actions identified in the Asian carp control strategy frameworks for both the Ohio River and Upper Mississippi River. The sub-basin partnerships considered a potential inter-agency management structure for coordinated planning and reporting, development of funding strategies, and implementation of actionable plans. State representatives from both sub-basins recommended that the USFWS work through the Mississippi Interstate Cooperative Resource Association (MICRA) for executive level Asian carp coordination and multi-state project planning and implementation in the Mississippi River Basin.

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 basin-wide.

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 consists of the MICRA Executive Board (i.e., one state agency representative from each of the six sub-basin groups, two federal entity members, MICRA Chairman, MICRA Chairman-elect, and MICRA Coordinator) and a single agency representative from key federal partners not on the MICRA Executive Board (Figure 1). The ACAC provides a mechanism for coordination, communication, 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 Executive Boards of the regional sub-basin groups in the Ohio and Upper Mississippi River basins are comprised only by state agencies. The ACAC provides an opportunity for federal agency partners to participate in the decision making process at the executive level.

The Ohio River (OHR) flows through or along the border of Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia; these six states collaboratively manage fisheries in the mainstem OHR through the Ohio River Fisheries Management Team (ORFMT). The ORFMT recognized the magnitude of the Asian carp threat and the need for coordinated efforts to prevent the continued spread, explore strategies to reduce the abundance of established populations, and better understand the impacts of established populations. The ORFMT engaged the remaining OHR basin states and key federal partners in the development of an Ohio River Asian Carp Control Strategy Framework (Ohio River Framework) to collaboratively prevent further range expansion, reduce populations, better understand and minimize impacts of Asian carps, and improve communication and coordination in the basin. Following completion of the Ohio River Framework in October 2014 the OHR basin partners formed an OHR Planning Team to implement the Ohio River Framework. The OHR Planning Team met several times during 2015 to determine highest priority projects from the Ohio River Framework for implementation in 2015, identify lead and cooperating agencies for each project, and develop project proposals for USFWS funding consideration. OHR Planning Team project proposals were provided to the MICRA ACAC through the ORFMT, compiled with project proposals from the Upper Mississippi River basin, and submitted as part of a Mississippi River Basin proposal package to the USFWS for funding consideration. The OHR 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. Project implementation and coordination between agencies occurred at the field level and was not a function of the OHR Planning Team.

The Upper Mississippi River Conservation Committee (UMRCC) is a partnership of the five mainstem Upper Mississippi River (UMR) states. 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 UMR.’ The UMRCC Fisheries Technical Committee members undertook the collaborative development of an Upper Mississippi River Asian Carp Control Strategy Framework (UMR Framework) to coordinate Asian carp prevention and control efforts in the Upper Mississippi River. The UMR Framework is designed as a regional stepdown plan from the National Plan and is based on the existing UMRCC’s 2010 Fisheries Plan Goal 4. The Fisheries Technical Committee formed an Ad-hoc Asian Carp Planning Team to coordinate the collaborative development and implementation of the UMR Framework, determine highest priority projects from the UMR Framework for implementation in 2015, identify lead and cooperating agencies for each project, and develop project proposals for USFWS funding consideration. UMR Planning Team project proposals were provided to the MICRA ACRC through the UMRCC Executive Committee, compiled with project proposals from the Ohio River basin, and submitted as part of a Mississippi River Basin proposal package to the USFWS for funding consideration. The UMR 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. Project implementation and coordination between agencies occurred at the field level and was not a function of the UMR Planning Team.

MICRA has an active role working with planning teams throughout the Mississippi River Basin to develop sub-basin level Asian Carp Control Strategy Frameworks. In the Ohio and Upper Mississippi River basins, where the USFWS has committed federal funding for implementation of highest priority control strategy framework projects, MICRA actively works with the sub-basin planning teams to identify annual priorities, develop project proposals and work plans, and to prepare the Asian Carp Monitoring and Response Plan for the Mississippi River Basin. Results and analysis will be reported by the cooperating agencies for each of the projects described in the 2015 Monitoring and Response Plan. MICRA will compile the individual reports from both sub-basins into an interim report summary. The interim report summary is intended to include recommendations for modifications and enhancements to the project plans based on past results and experiences. MICRA will use the interim report summary as a tool when working with the sub-basin planning teams each year to review and revise the sub-basin priorities and projects, and to annually update the Monitoring and Response Plan.

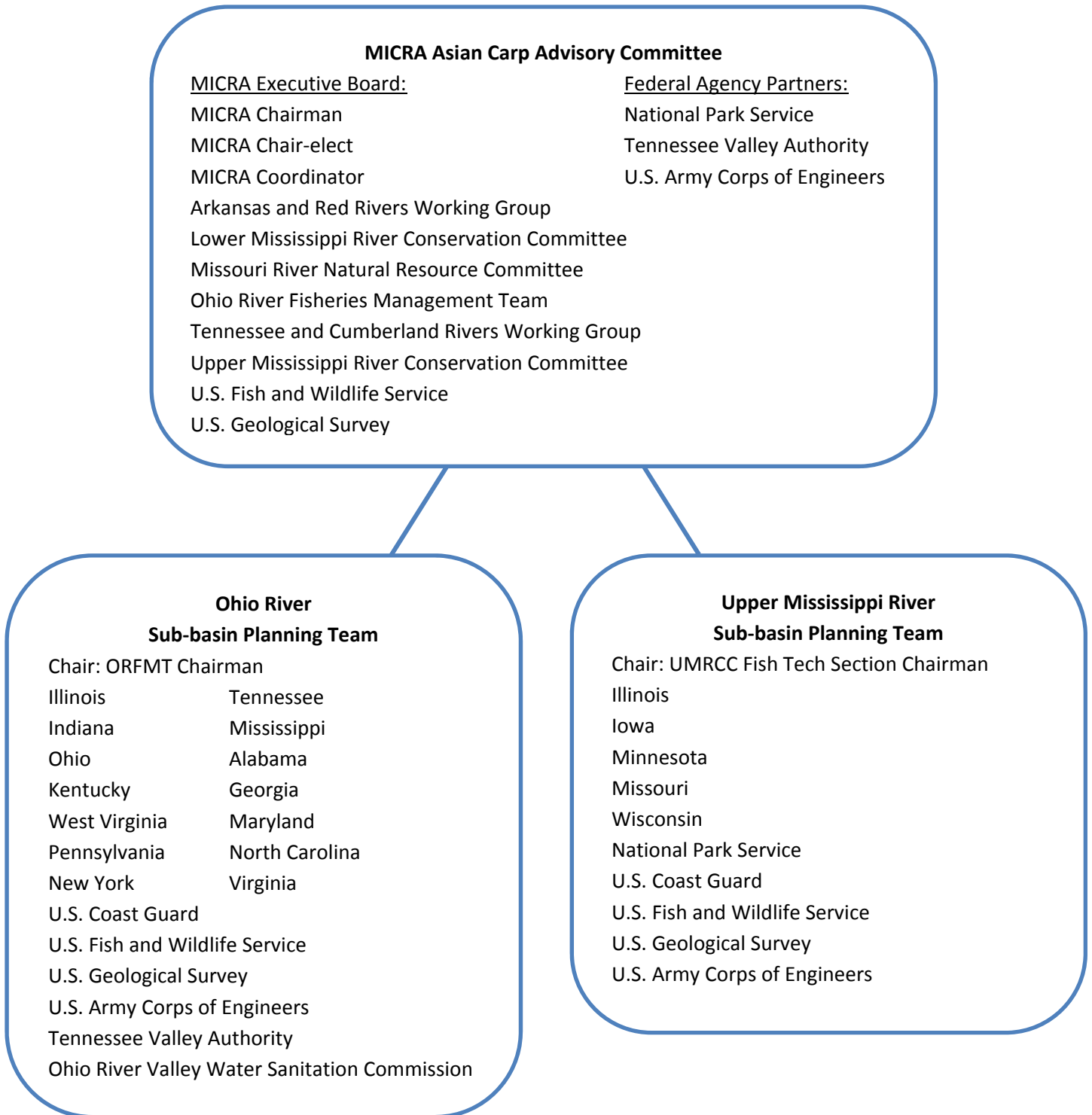


Figure 1. Structure for Inter-agency Coordination and Implementation of Asian Carp Control Strategy Frameworks in the Ohio River and Upper Mississippi River Basins

Best Management Practices to Prevent the Spread of Aquatic Nuisance Species during Asian Carp Monitoring and Response Field Activities

Implementation of the project plans described in the Monitoring and Response Plan pose a risk of transporting and introducing aquatic nuisance species (ANS), including fish, plants, invertebrates, and pathogens. These best management practices (BMPs) are designed to be effective, easy to implement, and realistic; their use should reduce or potentially eliminate the threat of ANS spread by Monitoring and Response Plan activities. Further, BMPs combined with diligent record keeping can benefit the organizations participating in Monitoring and Response Plan activities by demonstrating that they are taking effective actions to prevent the spread of AIS.

For the purposes of these BMPs, all gear utilized in the process of field work that comes in contact with the water, including but not limited to those in the list below will be referred to as “sampling gear.”

boats	eDNA collection gear	cast/beach/purse seines	hoop nets
trailers	personal gear	trammel nets	pound nets
electrofishing gear	ichthyoplankton nets	fyke nets	gill nets
hydroacoustic gear	cast nets	trawl nets	fish collection tubs

Field activities that have location-specific gear may need to do less to ensure that they are not transporting ANS or their genetic material. Examples might include boats, electrofishing gear, nets, or personal gear that are only used to sample one location. If potentially contaminated gear does not travel, the possibility of that equipment transporting ANS is reduced or eliminated. Maintaining duplicate gear for use in contaminated vs. non-contaminated locations or sampling all non-contaminated locations before moving on to contaminated locations may also reduce or eliminate the possibility of ANS spread.

Before traveling to a sampling location:

- Check** gear and determine if it was previously cleaned. Accurate record-keeping can eliminate the need for inspecting or re-cleaning prior to equipment use. If you do not know if the sampling gear was cleaned after its last use, inspect and remove any plant fragments, animals, mud, and debris, and drain any standing water. If necessary, follow the appropriate “Clean” step(s) listed below.

After each sampling event, before leaving waterbody:

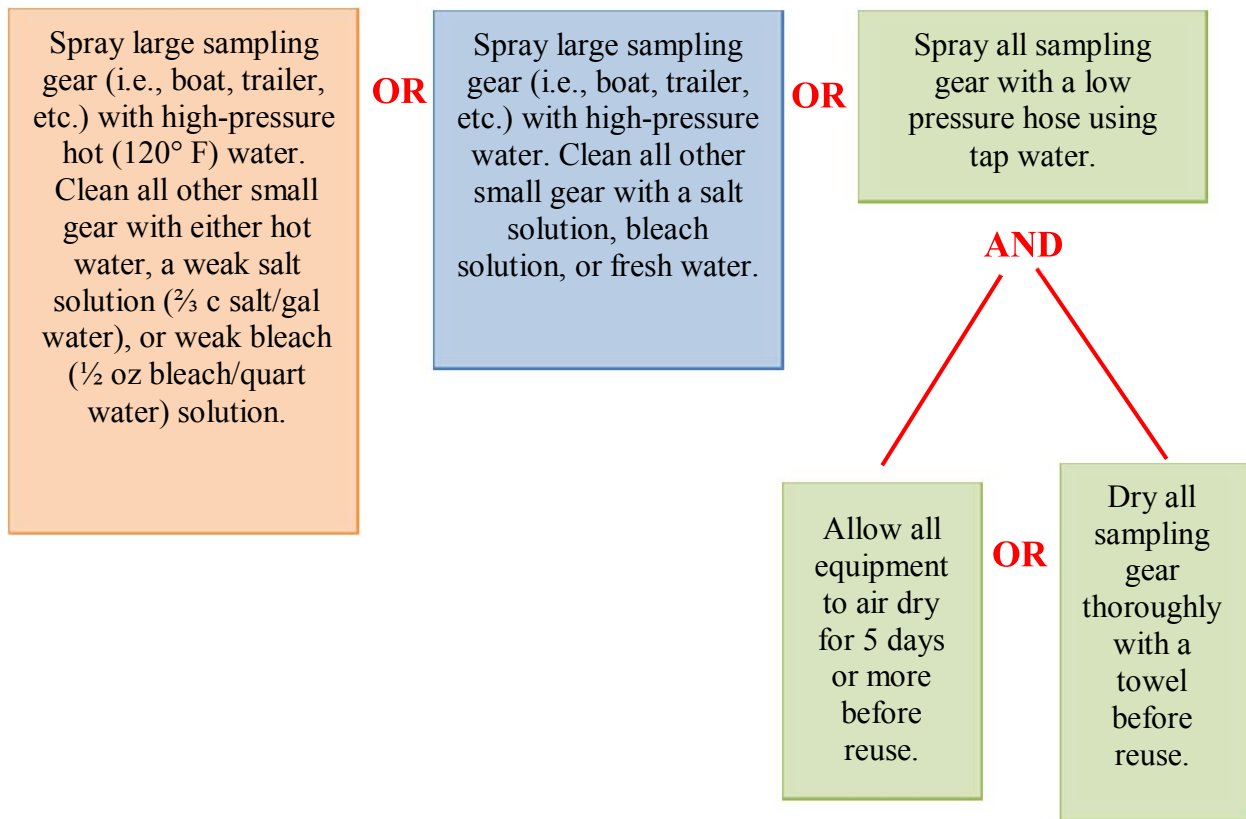
The following steps should occur before gear is transported away from the waterbody to prevent transport of aquatic plants and animals by boats, trailers, and vehicles.

- Remove** plants, animals, and mud from all sampling gear.
- Drain** all water from boat and sampling gear.

After each sampling event, before using gear at another location:

The following cleaning/decontamination steps may occur either at the water access point (preferred, if possible) or may be completed at the gear storage location.

- ❑ **Clean** all sampling gear. Select an option below based on the available equipment (i.e., high-pressure hot washer, pressure washer, and low-pressure hose). In general, pressure wash removes organisms while high temperatures will kill organisms. A three-minute pressure wash is effective at removing zebra mussel larvae and other microscopic organisms. Keep nozzle at a 90 degree angle to the boat and at least 12 inches away from the boat to prevent removing decals.



Keep Records:

Develop a Standard Operating Procedure (SOP) or checklist for cleaning equipment to make ANS prevention steps easy to follow and documentable. Complete the checklist for each sampling event with date, location, the recorder’s name and what was done. These records over time demonstrate a solid commitment to AIS prevention, will help build a standard cleaning protocol, and will eliminating wasted time spent re-checking or re-cleaning equipment.

(Adapted by Illinois-Indiana Sea Grant from BMPs created by the Great Lakes Sea Grant Network.)

Project Plans

Nine project plans have been prepared for 2015 to address the highest priority prevention and control needs for Asian carp in the Mississippi River Basin. The project plans summarize the activities funded (in full or in part) by USFWS FY2015 base funding for Asian carp. Following the USFWS coordination meetings with state and federal agency partners in the Ohio River and Upper Mississippi River sub-basins in February and March 2015, the partnerships in both sub-basins held numerous meetings (face-to-face and teleconference) to collaboratively identify Asian Carp Control Strategy Framework priority needs, determine cooperating agencies and funding needs for each project, and to develop project proposals and work plans. Consequently, most cooperating agencies did not initiate grant agreements with the USFWS until late in the fiscal year. Much of the work described in the project plans will be on-going or initiated during the coming year. Project plans and schedules are included as a guideline for implementation; however actual plans and implementation schedules may vary as actions are undertaken.

Ohio River Basin

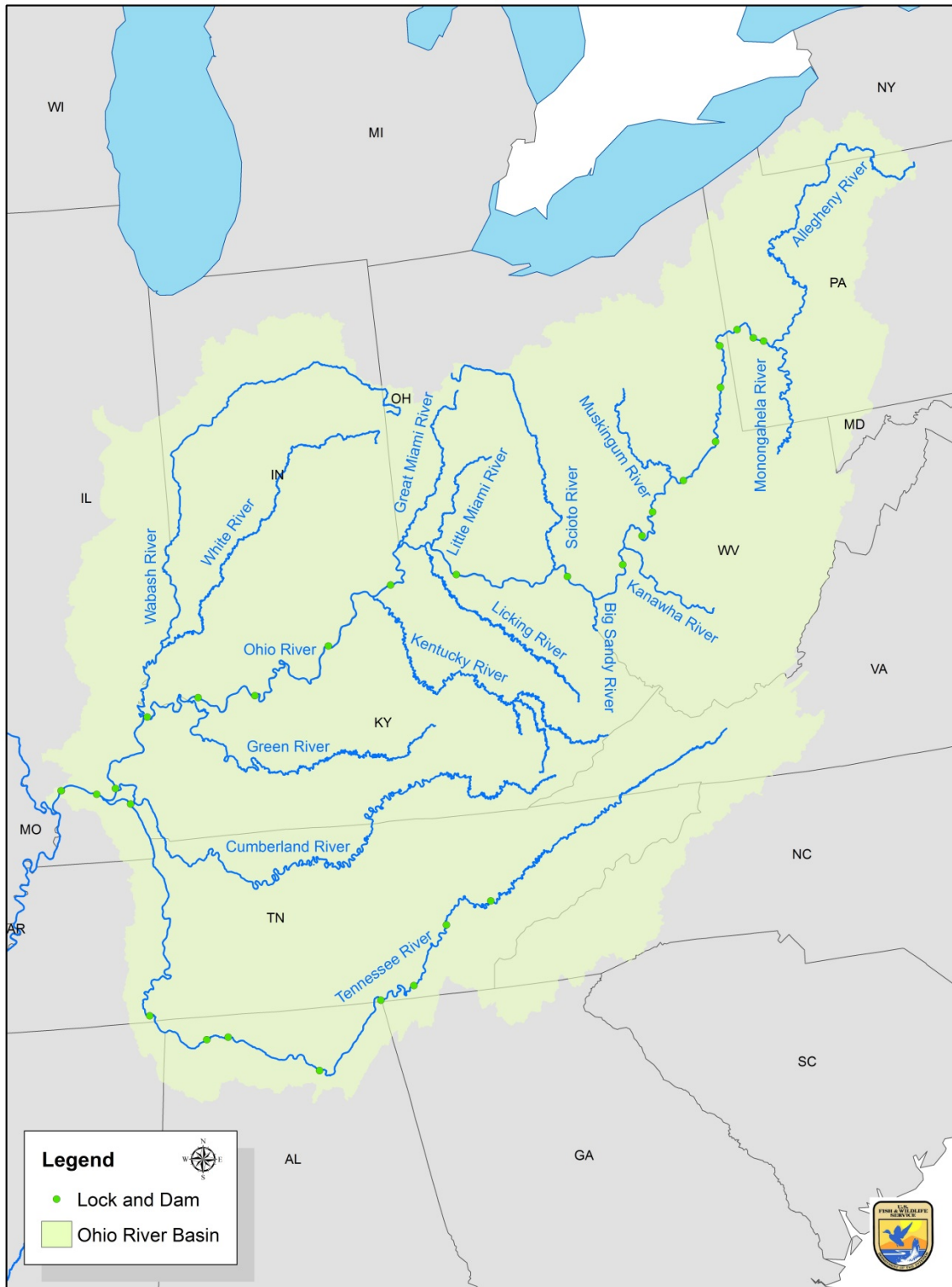


Figure 2. Map of the Ohio River Basin.

Monitoring and Response of Asian carp in the Ohio River

Participating Agencies: West Virginia Division of Natural Resources, USFWS, Kentucky Department of Fish and Wildlife Resources, Indiana Department of Natural Resources, Illinois Department of Natural Resources, Pennsylvania Fish and Boat Commission, Ohio Department of Natural Resources

Location: Ohio River pools from the McAlpine lock and dam complex to the R.C. Byrd lock and dam complex.

Introduction and Need: Invasive species are increasingly responsible for impacts to both local and regional economy and the environment (Pimentel et al. 2004; Jelks et al. 2008). Although considerable effort has been expended to understand and manage Asian carp in the Mississippi River basin, focused activities have been to a lesser degree in the Ohio River sub-basin. The tasks outlined in this template will not only allow for the continuation of current information gathering tasks by both state and federal agencies within the Ohio River sub-basin, but will initiate a planning process that will guide expanded efforts in upcoming years. The major outcome of these activities will be to not only conduct on-river activities in a coordinated approach, but more importantly develop planning protocols for future activities that will enhance this collaborative approach through more efficient and effective methodologies.

Objectives:

- 1) Conduct targeted sampling for surveillance, early detection, and distribution of Asian carp upstream of the McAlpine lock and dam complex to the R.C. Byrd lock and dam complex
- 2) Monitor Asian carp population dynamics in the Ohio River upstream of the McAlpine lock and dam complex to the R.C. Byrd lock and dam complex
- 3) States augment protocols for existing annual fisheries surveys as needed to include collection, identification, data gathering and reporting of Asian carps.

Status: This project is an increase in effort to the ongoing “leading edge” project. Since 2013 various sampling efforts have resulted in the capture of 404 Asian carp. Asian carp were collected in all pools (Greenup, Meldahl, Markland, and McAlpine).

Methods: KDFWR and WVDNR will monitor Asian carp presence and distribution through targeted gill netting and electrofishing surveys. Each pool will be segmented into four macrohabitat types island back channel, embayment, tailwater, and tributary. During each week of monitoring, we will target 48 electrofishing runs (24 random sites, 24 fixed sites) and up to 6000 yards of gill net (6 random sites, 6 fixed sites) will be fished in each pool. Effort will be partitioned into upstream and downstream halves of each pool. The number of samples completed per day will be dependent on sampling conditions, fish densities, habitat types, and distance between sites. Sampling effort may be amended after the initial round of monitoring is completed.

Electrofishing based-techniques will use pulsed-DC current and include 1-2 dippers (two dippers preferred). Depending on distance traveled between sampling sites, the target number of

sampling sites will be 12 per day (6 random, 6 fixed). Each sampling transect will be identified with GPS coordinates, and each run will begin at the coordinate and continue downstream for 15 minutes. All fish will be dipped and placed in a live well. Schools of small shad will be sub-sampled by dipping a portion of each school encountered. Small shad-like fish will be examined closely to identify potential Asian carp. All fish will be identified and counted.

Gill nets will consist of large mesh (3-4”(7.62-101.6mm)) 8-10’ deep in lengths of 100 yards (91.4 m). At each gill net site, up to 500 yards of net will be placed in the water. Sets will be of short duration (20 minutes) and include driving fish into the nets by creating noise (banging on boats, revving motor) within 150 yards (137.2 m) of the net. The target effort will be three net sites per day of sampling. Nets will be attended at all times. Collected fish will be identified to species and enumerated.

All Asian carp collected will be inspected for the presence of tags (sonic and jaw tags), identified, geo-located, and subsamples of individual total lengths, total weights, and gonad weights will be recorded. Otoliths and pectoral fin rays will be removed from Asian carp for microchemistry and age and growth analysis as needed.

Table 1. Draft schedule (Weather permitting) of Asian carp removal efforts in 2015.

Week of	Agency	Pool	Week of	Agency	Pool
13-Jul	KDFWR	Meldahl	2-Nov	KDFWR	Markland
20-Jul	KDFWR	Markland	9-Nov	KDFWR	McAlpine
20-Jul	WVDNR	Greenup	9-Nov	WVDNR	Greenup
27-Jul	KDFWR	McAlpine	16-Nov	KDFWR	Meldahl

During the fall sample period, WVDNR crews will conduct a fish community assessment within the Greenup and R.C. Byrd Pools. Surveys will be conducted at previously determined locations in the main river, tailwater reaches, and selected backwater type habitat. Survey techniques will follow that described in the Asian carp monitoring section. All fish species will be collected and measured (total or standard length) and weighed to allow for a length-weight based condition analysis. Eight days of sampling effort will be expended in these surveys.

KDFWR and other agencies routinely sample the Ohio River for other projects. Where possible, these sampling protocols will be modified to include collection of Asian carp (all size classes). When Asian carp are encountered, they will be enumerated. These data will be compiled in final reports as well as the dedicated Asian carp monitoring.

Table 2. KDFWR 2015 sportfish sampling schedule for Ohio River and tributaries.

Annual sampling planned for the next 5 years.

Location	Targeted Species	Time of Year	Gear	Effort Days
Kentucky River (Pools 2 - 4)	Musky	Spring and Fall	Electrofishing	6
Green River (Pool 6)	Black	Spring and Fall	Electrofishing	8

	Bass/Rockbass			
Ohio River (Multiple Pools)	Catfish	May	Hoopnets	15
Ohio River (Meldahl and Cannelton)	Catfish	June - August	Trotlines	18
Ohio River (All Pools)	Catfish	June - July	Electrofishing	15
Barren River (Pool 1)	General Sport fish	Fall	Electrofishing	2
Kentucky River (Multiple Pools)	General Sport fish	Fall	Electrofishing	5

Sampling planned for fall 2015 – spring 2016 only.

Location	Targeted Species	Time of Year	Gear	Effort Days
Eagle Creek	General Sport fish	Spring	Electrofishing	5
Tygarts Creek	General Sport fish	Spring	Electrofishing	5
Floyds Fork	General Sport fish	Spring	Electrofishing	4
Green River (Pool 3)	General Sport fish	Fall	Electrofishing	3

Table 3. WVDNR 2015 Fish sampling schedule for Ohio River and tributaries

Location	Targeted Species	Time of Year	Gear	Effort Days
Ohio River (all WV Reach tailwaters)	Catfish	May and June	Electrofishing	8
Ohio River (All WV Reach Pools)	Black Bass	Fall	Electrofishing	20
Ohio River (all WV Reach tailwaters)	Percids	Fall	Electrofishing	10
Ohio River (selected Tailwaters)	Paddlefish	Winter	Gill Netting	10
Kanawha River (all Tailwaters)	Percids	Fall	Electrofishing	3

Deliverables: Sampling results will be compiled for weekly summaries. Data will be compiled for annual reports and updated project plans.

Ohio River Asian Carp Telemetry

Participating Agencies: USFWS (lead); Kentucky Department of Fish and Wildlife Resources, West Virginia Department of Natural Resources, Ohio Department of Natural Resources, Indiana Department of Natural Resources, Purdue University

Location: The Ohio River from below the McAlpine Lock and Dam near Louisville, KY, upstream to Broadback Island near the town of Willow Island, WV; Wabash River from confluence with the Ohio River upstream to Merom, IN

Introduction and Need: The bigheaded carps, herein referred to as Asian carp, include the Silver Carp (*Hypophthalmichthys molitrix*) and Bighead Carp (*H. nobilis*) as well as hybrids between these species. Populations of these two introduced aquatic nuisance species (ANS) are spreading throughout the Mississippi River Basin (Conover et al. 2007; Chapman and Hoff 2011; O'Connell et al. 2011). Kolar et al. (2007) rated the probability of Silver and Bighead Carp spreading to previously uncolonized areas as “high” and assigned this rating a “very certain” degree of certainty. Asian carp are highly invasive fishes that have been expanding their range in the U.S. since the early 1980's when they first began to appear in public waters (Freeze and Henderson 1982; Burr et al 1996). Populations of Asian carp have grown exponentially because of their rapid growth rates, short generation times, and dispersal capabilities (DeGrandchamp 2003; Peters et al. 2006; DeGrandchamp et al. 2008). Asian carp have been shown to exhibit very high reproductive potentials with high fecundity and the potential for a protracted spawning period (Garvey et al. 2006). Garvey et al. (2006) stated that high reproductive capacity of both species, in particular Silver Carp ensure that attempts to exclude or remove individuals will require a massive undertaking that targets juveniles as well as adults. These fishes have invaded the Ohio River system and are spreading up the river and many tributaries. Populations of Asian carp have become well established in the lower and middle reaches of the Ohio River and successful reproduction is suspected as far upstream as the Falls of the Ohio at Louisville, Kentucky. The Wabash River, a tributary of the lower Ohio River, is extensively invaded by Asian carp, and there is considerable evidence that both bigheaded carps are well established throughout much of the main stem. The upper reaches of the Ohio River as well as many upper basin tributary streams may not currently be inhabited by Asian carp. The need exists to prevent the establishment of these species into the upper portions of the Ohio basin. Any information that we can learn about Asian carp distribution, abundance, and/or biology that could help managers to limit or stop their spread would be important to a wide variety of ecosystems.

The Great Lakes and Mississippi River Interbasin Study (GLMRIS) identified six different possible routes for ANS to access the Great Lakes Basin through tributaries of the Ohio River. Because of these potential connections between Ohio River tributaries and Lake Erie, natural resource managers are concerned about the potential for the invasion of Asian carps into the Great Lakes Basin through the upper Ohio River watershed. If Asian carp gain entry into the Great Lakes they could pose a significant threat to established fisheries by competing with economically and recreationally important fishes for limited plankton resources (Sparks et al. 2011). They would also pose a very real danger to recreational boaters. Although predictions of the effects of Asian carp on the Great Lakes ecosystem vary widely, negative impacts on the fishery and recreational use of these resources are expected.

The overall goal of these efforts is to understand the distribution and movement patterns of Asian carp in the middle and upper Ohio River, as well as intrabasin movements of these species between the Wabash River and the Lower Ohio River. Understanding these aspects of Asian carp biology in the Ohio and Wabash Rivers will assist efforts to minimize their further spread in the basin and reduce the size of existing populations.

Objectives:

1. Understand Asian carp use of tributaries with potential connections to the Great Lakes.
2. Delineate the upstream-most distribution of Asian carp and potential for further upstream movement. This will help with identification of barrier sites or other points where fish can be slowed or stopped.
3. Utilize mobile tracking data and Judas fish techniques to guide contract fishers and agency sampling efforts.
4. Determine Asian carp movement patterns and habitat use in the lower Wabash River; detect movements of tagged fishes between the lower Wabash River and the lower Ohio River.

Status: The Ohio River Asian Carp Telemetry project is a continuation of work begun in 2013; Wabash River telemetry work began in 2011 and is based on 300 tagged fishes at large in the Wabash River.

Methods: Ultrasonic telemetry will be used to track the movements of Asian carp and evaluate their ability to navigate the lock and dam systems upstream of current known populations.

Ultrasonic Transmitter Tagging: Adult Bighead Carp and Silver Carp will be surgically implanted with ultrasonic transmitters (Vemco, Model V16-6H; 69 kHz) which provide individual identification. The V16-6H coded transmitters being used are nominally programmed to transmit a signal every 40 seconds yielding a battery life of 1,825 days. Fish to be tagged will be collected by Agency personnel from the McAlpine, Markland, Meldahl, or Greenup pools. They will be implanted with transmitters according to surgical procedures described by Summerfelt and Smith (1990). Following surgery, fish will be measured for total length (mm) and weight (g), visually or manually sexed (if possible). Fish will be allowed to revive before being released, any tagged fish which does not appear robust (i.e. swimming upright and vigorously) will be destroyed and the tag retrieved for use in another fish. Tagged fish will be fitted with an individually numbered external jaw tag which is applied to the dentary bone (lower jaw) (National Tag Co. #1242 F9). Beginning in the summer and fall of 2015 (Schedule below) Bighead Carp and Silver Carp will be tagged and released into the McAlpine, Markland, Meldahl, or Greenup pools. Location of this tagging, and subsequent releases will depend on locations of captures during agency netting and electrofishing efforts. Trammel nets, gill nets, and/or hoop nets will be used to capture Asian carp for implantation of ultrasonic transmitters. Boat electrofishing may be used to supplement netting efforts. The Meldahl, Markland, McAlpine, Greenup, and possibly R.C. Byrd pools will be sampled. If Asian carp are found in pools upstream of known populations, efforts will be moved upstream to attempt to document the upstream extent of Asian carp distribution. Trammel nets, gill nets, and/or hoop nets will be fished in areas that may be attractive to Asian carp such as side channels, island tips, backwaters, and drowned creek mouths.

Ultrasonic receiver array: An array of VR2W receivers was installed in the river beginning in summer 2013. Fifty-eight receivers were placed above and below lock and dams, in the lower portions of major tributary streams, and at regular intervals between lock and dams. Figure 3 illustrates the locations of VR2W receivers that have been deployed. Receivers will be re-deployed into the mainstem river during Spring and Summer 2015. Additional receivers will be placed in the approach to each lock chamber on the upstream side of the lock and in each lock chamber (mounted behind recessed ladders). Additional tributaries will have one or more receiver deployed far enough upstream of the confluence with the Ohio River that it cannot detect fish from the mainstem Ohio, including four receivers deployed in the lower Wabash River from its confluence with the Ohio River upstream to Merom, IN. Mainstem receivers will be deployed at lock and dam complexes downstream of McAlpine pool in 2015. Any receivers that are lost will be replaced as quickly as possible. Receiver data will be downloaded monthly. Data gleaned from stationary receivers will provide information on gross movements of tagged fish including any movements upstream or downstream through lock and dam complexes and movements into or out of tributaries.

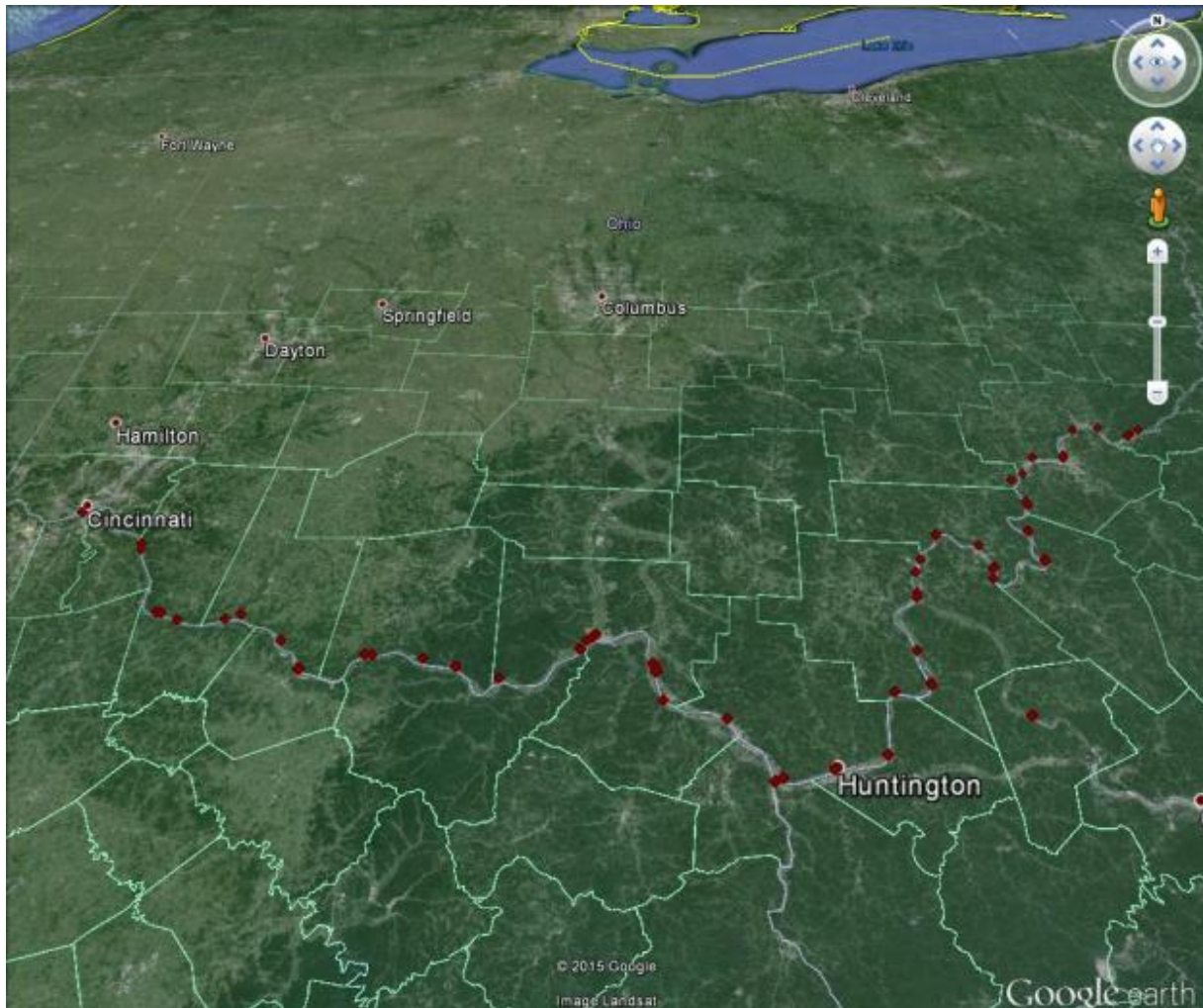


Figure 3. Locations of stationary VR2W receivers. Individual points may represent more than one receiver at this scale.

Mobile Tracking: Active tracing will be used in concert with other collecting methods to locate tagged fish and increase the likelihood of capturing new fish to tag. Fish will be located with a portable hydrophone and receiver (Vemco Model VH110-10M and Vemco Model VR100, respectively) and GPS coordinates will be recorded at each site of location.

Roles for telemetry work: Personnel from USFWS, Kentucky Department of Fish and Wildlife Resources (Kentucky), Ohio Department of Natural Resources (Ohio), the West Virginia Division of Natural Resources (West Virginia) and Purdue University (Indiana) (collectively referred to as the states) will be responsible for placement of stationary receivers and routine downloading of data. Mobile tracking of tagged fish will be done by the states and USFWS. USFWS will purchase an additional 200 V-16 6H transmitters for implantation this year. Ohio will provide 10 additional VR-2Ws, and USFWS will purchase 40 additional receivers for deployment during 2015. USFWS will purchase replacement batteries and desiccant packs for all receivers in use. Telemetry data will be shared with all partners via an FTP site that Ohio DNR established during 2014.

2015 Sampling Schedule:

Week	Agency	Pool	Activity
6 July	USFWS, KDFWR, WVDNR	Multiple pools	Install receivers
27 July	USFWS	McAlpine	Tag Fish
17 August	USFWS	Meldahl	Tag Fish
24 August	USFWS	McAlpine	Tag Fish
14 September	USFWS, KDFWR, WVDNR	McAlpine	Tag Fish
28 September	USFWS	Meldahl	Tag Fish
5 October	USFWS, KDFWR, WVDNR	McAlpine	Tag Fish
19 October	USFWS	Meldahl	Tag Fish
2 November	USFWS	Markland	Tag Fish
16 November	USFWS	Multiple pools	Remove receivers

2015 Download Schedule:

Pool	June	July	August	September	October	November
Willow Isl.	OH D4	USFWS	OH D4	USFWS	OH D4	USFWS
Belleville	OH D4	USFWS	OH D4	USFWS	OH D4	USFWS
Racine	OH D4	USFWS	OH D4	USFWS	OH D4	USFWS
RC Byrd	OH D4	USFWS	OH D4	USFWS	OH D4	USFWS
Greenup	OH D5	USFWS	OH D5	USFWS	OH D5	USFWS
Meldahl	OH D5	KDFWR	OH D5	KDFWR	OH D5	KDFWR
Markland	OH D5	KDFWR	OH D5	KDFWR	OH D5	KDFWR
McAlpine	KDFWR	KDFWR	KDFWR	KDFWR	KDFWR	KDFWR
Wabash	N/A	N/A	Purdue	Purdue	Purdue	Purdue

Deliverables: Status reports covering any urgent and significant findings will be shared among partner agencies as soon as possible following the finding. An annual report summarizing all work in 2015 will be produced by approximately March 31, 2016.

Strategy for eDNA Monitoring in the Ohio River Basin

Participating Agencies: US Fish and Wildlife Service (Lead), West Virginia Department of Natural Resources, Kentucky Department of Fish and Wildlife Resources, Ohio Department of Natural Resources, Alabama Department of Conservation and Natural Resources, Mississippi Department of Wildlife, Fisheries, and Parks, Tennessee Wildlife Resources Agency

Location: eDNA samples in 2015 will be taken in the Muskingum River, mainstem Ohio and Tennessee Rivers, and important tributaries in the upper Ohio River. See sampling schedule for greater detail.

Objectives:

- 1) Determine whether Asian carp DNA is present in strategic locations in the Ohio River Basin to inform status of Asian carp
- 2) Detect Asian carp DNA in areas that have been monitored since 2009 to maintain annual data collection which may inform future work in the CAWS

Status: 2015 is a continuation of eDNA sampling that has occurred in the Ohio River in 2014. Additional sites in the Tennessee River Basin have been added in 2015.

eDNA Sampling: A total of 700 samples will be taken from the Tennessee River System, 300 samples from the Upper Ohio River and tributaries, 70 samples from Pennsylvania Pay Lakes, 125 samples from the Muskingum River System, and 250 samples from West Virginia Waters. The draft Standard Operating Procedure for Asian Carp eDNA Collection for the Great Lakes will be used as guidance for collection, processing, and chain-of-custody of water samples (Strakosh et al. 2013). In order to perform laboratory molecular analyses to detect eDNA, water samples will be collected from designated focus areas using sterilized collection tubes to be centrifuged and tested for Asian carp eDNA.

Samples will be taken from the top 4 cm of surface waters in areas of surface film accumulation such as in eddies, foamy areas, downstream of structures, and in backwaters. Wind direction and currents will be taken into consideration when selecting sampling locations.

Depth, wind direction, water temperature, and geographic coordinates in decimal degrees will be measured and recorded at every sample location.

eDNA has not been predesignated to be used as a trigger for rapid response actions. eDNA results will be communicated to the states in which they are collected as soon as they are available, and then posted on the USFWS eDNA webpage per our communication protocol. States can request follow up eDNA sampling, and take actions based on their results as their discretion, potentially enlisting the assistance of the USFWS. A summary of all 2015 eDNA results will be made available at the end of the year.

Table 1. Site description, dates, and number of samples to be taken in the Ohio River Basin in 2015. Additional sites may be sampled for follow up at the request of state partners.

Tennessee River System- Week of April 27

Bay Springs Lake	(n=100)
Bear Creek	(n=50)
Wilson Lake	(n=100)
Wheeler Lake	(n=100)
Elk River	(n=50)
Guntersville Lake	(n=100)
Nickajack Lake	(n=100)
Chickamuga Lake	(n=100)

Upper Ohio River and Tributaries- Week of May 11

Pike Island Pool	(n=50)
New Cumberland Pool	(n=50)
Little Beaver Creek	(n=10)
Montgomery Island pool	(n=50)
Beaver River	(n=20)
Dashields/Emsworth Pools	(n=50)
Chartiers Creek	(n=20)
Allegheny River	(n=25)
Monongahela River	(n=25)

Week of May 11

7 PA Pay Lakes	(n=70)
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Muskingum River System- Week of June 15

Muskingum River	(n=125)
Tuscarawas River	

West Virginia Waters- Week of June 22

Willow Island Pool	(n=100)
Little Kanawha River	(n=50)
Kanawha River	(n=100)

Appendix: Contact Information of Key Staff:

Staff	Role/Office	Number
Rob Simmonds	Project Leader - Carterville	618-997-6869 ex14
Sam Finney	Assistant Project Leader - Carterville	618-997-6869 ex17
Kelly Baerwaldt	eDNA Program Coordinator - RO	309-757-5800 ex 208
Maureen Gallagher	Program Supervisor FO Fisheries - RO	612-713-5102

Shipping Contacts

Emy Monroe	eDNA Processing Leader - WGL	608-518-0127
Maren Tuttle-Lau	DNA Processing QA Specialist - WGL	608-780-0834
Nick Grueneis	WGL	608-518-0129
Jennifer Bailey	Data Documentation & Reporting Specialist - WGL	608-518-0128
Nick Berndt	WGL	608-780-9144
Kyle Von Ruden	WGL	608-780-9022

Limiting dispersal of Asian carp at Lock and Dam Facilities in the Ohio River Basin

Participating Agencies: Kentucky Department of Fish and Wildlife Resources (lead), West Virginia Department of Natural Resources, USFWS, and USACE

Location: Lock and Dam facilities near the “leading edge” of carp dispersal in the Ohio River Basin

Introduction and Need: The national ANSTF Asian carp management plan goals and strategies outline the importance of limiting continued dispersal of Asian carp throughout the river basins they inhabit. We know that Asian carp can navigate many of the dams in our large rivers from telemetry work done on the Upper Mississippi, Illinois, and Ohio Rivers in recent years (Garvey et al. 2014, Tripp et al. 2014). However, in select locations, this movement may be limited to passage through lock chambers. This project specifically addresses limiting Asian carp movement by focusing efforts on lock and dam facilities that create pinch points, or areas where upstream movement is decreased. At these pinch points, movement may be limited either by creation and implementation of barrier technologies such as sound, CO₂, electricity, or water guns, or by alteration of operational methods at existing facilities (e.g. altering lock operation and flow regimes; Best Management Practices, BMP’s).

Technologies have been developed and are currently being tested to limit the upstream movement of Asian carp in large river systems. For example, an electric barrier has limited the upstream movement of Asian carp in the Illinois River and CAWS in Illinois, sound barriers have been deployed at Lock and Dam 8 on the Upper Mississippi River, and water gun technology and CO₂ barriers are being tested by the USGS, USACE, the University of Illinois and others. It has been suggested that a suite of barrier technologies may be the best approach to stop movement of Asian carp, and each technology and specific site will require rigorous testing and coordination between multiple agencies prior to implementation.

While novel technologies provide opportunities to limit upstream movement of Asian carp, evaluation of current lock and dam operational methods may provide additional opportunities. In some lock and dam locations, United States Army Corps of Engineers officials are considering operational changes that limit movement of Asian carp and other ANS through lock chambers and create favorable conditions for removal of Asian carp. For example, a lockmaster may keep a lock chamber closed until the gates are opened for a barge or boat passage. Under this scenario Asian carp are prevented from entering the lock chamber except during boat passage. Furthermore, there was a large die off of Asian carp in the Lake Barkley tail water on the Cumberland River in the spring of 2014. USACE officials and KDFWR are currently exploring ways to recreate the conditions that contributed to that die off. BMP’s such as this could be effective at all lock and dam operations, but especially in locations where passage of Asian carp is already limited such as Meldahl or Cannelton on the Ohio River and multiple dams on the Tennessee and Cumberland Rivers.

Objectives: The objectives of this project are broken down into two sections including “barrier technology” and “operational guidelines” at lock and dam facilities.

Barrier Technology

- 1) Establish an ORFMT USACE liaison who would handle these projects and other coordination between agencies.
- 2) Create a list of existing barrier technologies and associated contacts and their current status in other basins.
- 3) Create a list of potential lock and dam sites and associated contacts where field testing may be implemented.
- 4) Develop site specific study designs to test applicability/feasibility of proposed barrier types.
- 5) Create assessment project plans that assess effectiveness and cost of barrier programs.

Operational Guidelines

- 1) Identify lock and Dam operation BMP's that minimizes Asian carp passage, or that create conditions that favor Asian carp removal.
- 2) Work with USACE partners to identify key contacts and locations to target lock and dam operation BMP's and determine feasibility of implementation.
- 3) Develop site specific study designs to test applicability/feasibility of proposed guidelines.
- 4) Implement BMP's where feasible.

Status: ORB partners have discussed potential barrier projects in recent years and made contacts with researchers working on barrier technologies. The initial phase of this project will begin a formal effort to organize those contacts and project ideas into project plans ready for implementation in future years.

Methods: Because many lock and dam facilities provide a pinch point to Asian carp movement, the current lock and dam infrastructure in the Ohio River Basin provides an untapped toolset for limiting dispersal of Asian carp. Efforts will fall into one of two categories: "barrier technologies" and "operational guidelines." Each case requires coordination between the ORFMT and the managing entity (United States Army Corps of Engineers) or research institution (USGS). To efficiently coordinate among various managing entities, the ORFMT will designate a liaison to establish efficient lines of communication.

Barrier Technology

There are currently many technologies being discussed as potential barriers to dispersal of Asian carp. The lock and dam liaison will compile a list of current technologies, their current status in terms of development and potential deployment, hurdles to their deployment, and lead investigators of projects involving each technology. Each technology will be ranked based on its status, cost, and expected effectiveness. The ORFMT will engage USACE officials to discuss the potential implementation of barrier technology at lock and dam facilities. When potential sites are chosen, the liaison and barrier technology partners will work together to create specific project plans to implement barrier technologies and assess the effectiveness of each project.

Operational Guidelines

The USACE is responsible for operation and maintenance of lock and dam structures in the Ohio River Basin, which includes multiple USACE districts. The lock and dam liaison will determine

the appropriate level of contact in each district and schedule formal discussions of the potential to limit Asian carp passage via changes in lock and dam operations. The liaison will work with the USACE to develop a project plan to implement new operational guidelines (best management practices) and sampling plans that will assess their effectiveness.

Deliverables: Report on current barrier technologies, BMP's, and their current status and readiness for field testing. Report on primary locations for testing barrier technologies and BMP's. Study design/project plan for assessment of barrier technologies and BMP's once implemented.

Control and Removal of Asian carp in the Ohio River

Participating Agencies: Kentucky Department of Fish and Wildlife Resources (lead) and West Virginia Department of Natural Resources

Location: Removal effort will concentrate in Ohio River pools including McAlpine, Meldahl, Markland, and Greenup. Increased effort will occur in priority areas that will be determined as removal and monitoring efforts are implemented and areas where success is likely (Asian carp density is highest) such as tributaries and pinch points.

Introduction and Need: Invasive species are increasingly responsible for severe economic and environmental damages in the United States (Pimentel et al. 2004; Jelks et al. 2008). Prevention and rapid response are the best tools for limiting establishment of costly invasive species, but recent studies on Asian carp harvest programs in the Illinois River show that the collapse of silver and bighead carp populations is possible if all fish sizes are targeted and silver carp are the focus of commercial fishers (Tsehaye et al. 2013).

Eradication of invasive species after establishment is difficult. Asian carp removal efforts may be effective at slowing the upstream expansion of Asian carp. Diverse and consistent removal efforts in the portion of the Ohio River where Asian carp are established will limit distribution of Asian carp, decrease pressure on defined barriers, and reduce numbers of Asian carp in sensitive areas to protect species of conservation need or important sport fisheries. Removal efforts will also complement monitoring efforts to further understand the status, distribution, and biology of Asian carp in the Ohio River. This data will provide an assessment tool which will guide monitoring, barrier defense, and removal efforts in future years.

Objectives:

- 1) Remove Asian carp from Ohio River pools above McAlpine Dam.
- 2) Compile information on Asian carp population dynamics as a tool for assessing success of removal efforts.
- 3) Encourage commercial removal of Asian carp in the Upper Ohio River and provide information to current and potential Asian carp processors.
- 4) Provide information and data to monitoring and response efforts.

Status: This project is an increase in effort to the ongoing “leading edge” project. Since 2013, various sampling efforts in the Ohio River and its tributaries resulted in a total capture of 404 Asian carp from the upper pools that were sampled (Greenup, Meldahl, Markland, and McAlpine).

Methods: Electrofishing and gill netting will be conducted for 13 weeks from August- October. Removal will take place a minimum of 4 days per week. Large mesh (3.0” – 5.0”) gill nets will be used and each set will consist of 30 minutes of soak time with fish being driven to the nets. Nets may be set overnight in areas where they will not create hazards to navigation.

Table 1. Proposed Asian carp removal efforts for the 2015 sampling year by pool and gear type. Electrofishing effort is based on one crew, four days per week, 3 hours of pedal time per day. Gillnetting effort is based on one crew, 4 days per week, 1000 yards of webbing per day.

Ohio River Pool	Gillnetting (yds)	Duration (weeks)	Electrofishing (hours)	Agency
McAlpine	16,000	4	48	KDFWR
Markland	16,000	4	48	KDFWR
Meldahl	12,000	3	36	KDFWR
Greenup	8,000	2	24	WVDNR
Total	52,000	13	156	

Field staff will enumerate and record the catch of Asian carp and identify by-catch to species. Asian carp will be inspected for tags (ultrasonic and jaw tags) and by-catch will be returned live to the water. Representative samples of up to 25 of each Asian carp species (Bighead Carp, Silver Carp, and Grass Carp) from each sampling location will be measured in total length (mm) and weighed (g) to provide estimates of total weight harvested for each sampling event. Supplemental samples including gonad weights, aging structures, and genetic samples will be collected as needed. Population metrics (e.g. relative abundance, lengths, weights, ages) will be analyzed to gauge the potential effectiveness of these efforts or commercial fishing efforts if undertaken.

Specific sampling sites have been determined focusing on tributaries and embayments where densities of Asian carp are highest. An effort will be made in each pool to find high density areas of Asian carp and remove them (See Table 2). If densities are not high enough to warrant targeted removal, sampling efforts will move down river to higher density areas.

Table 2. Ohio River Tributaries for Potential Asian Carp Sampling by Pool. Rating based on ease of sampling from previous experience. Sites that have not been sampled were given a 3 by default. RM= river mile, AC= If Asian carp have been collected there before.

Pool	Tributary	RM	State	AC	Rating
Greenup	Little Guyandotte River	287	WV	No	3
	Guyandotte River	305	WV	No	4
	Symmies Creek	308	OH	No	3
	Twelvepole Creek	313	WV	No	7
	Big Sandy River	317	WV	No	5
	Strom's Creek	328	OH	No	3
	Little Sandy River	336	WV	No	5

Meldahl	Little Scioto River	349	OH	No	5
	Tygarts Creek	353	KY	No	3
	Scioto River	356	OH	No	3
	Kinniconick Creek	368	KY	No	4
	Ohio Brush Creek	388	OH	Yes	10
	Cabin Creek	403	KY	No	6
	Little Threemile Creek	406	OH	No	3
	Big Threemile Creek	412	OH	No	5
	Lawrence Creek	415	KY	No	6
	Eagle Creek	416	OH	Yes	10
	Red Oak Creek	417	OH	No	6
	Straight Creek	421	OH	No	6
	White Oak Creek	424	OH	Yes	10
	Bracken Creek	426	KY	No	6
	Big Turtle Creek	428	KY	No	5
	Bullskin Creek	432	OH	No	6
	Locust Creek	433	KY	Yes	10
Big Snag Creek	436	KY	Yes	9	
Markland	Big Indian Creek	445	OH	No	3
	Little Miami River	463	OH	No	5
	Licking River	470	KY	No	2
	Great Miami River	491	IN/OH	Yes	7
	Tanner's Creek	495	IN	No	4
	N. and S. Hogan Creek	496	IN	No	3
	Laughery Creek	498	IN	No	3
	Woolper Creek	500	KY	No	4
	Arnold Creek	508	IN	No	3
	Grant's Creek	510	IN	No	2
	Gunpowder Creek	513	KY	No	6
	Big Bone Creek	516	KY	Yes	9
	Goose Creek	518	IN	No	3
	Wade Creek	519	IN	No	3
	Paint Lick Creek	521	KY	No	6
	Bryant Creek	527	IN	No	2
	Turtle Creek	529	IN	No	3
Craig's Creek	530	KY	No	5	
McAlpine	Indian Creek	540	IN	No	3
	Kentucky River	545	KY	Yes	9
	Little Kentucky River	546	KY	Yes	10
	Indian Kentucky Creek	550	IN	Yes	10
	Corn Creek	570	KY	No	3

Patton's Creek	579	KY	No	3
Little Camp Creek	578	IN	No	3
Eighteenmile Creek	581	KY	No	3
Fourteenmile Creek	589	IN	No	3
Harrod's Creek	596	KY	No	1
Beargrass Creek	602	KY	No	2

State fish and wildlife agencies that currently allow commercial fishing will work within their authorities to increase opportunities for commercial harvest of Asian carp. State fish and wildlife agencies will continue to closely monitor commercial fishing effort and harvest. States that allow commercial fishing (IL, IN, KY) will work to develop standard reporting forms and data sharing protocols for captures of Asian carp and bycatch that will aid in determining population trends as control efforts are implemented. States can assist, where appropriate, in sharing information with current and prospective Asian carp buyers as requested.

Table 3. Draft schedule (Weather permitting) of Asian carp removal efforts in 2015.

Week of	Agency	Pool	Week of	Agency	Pool
3-Aug	KDFWR	McAlpine	14-Sep	KDFWR	McAlpine
10-Aug	KDFWR	Markland	21-Sep	KDFWR	Markland
10-Aug	WVDNR	Greenup	28-Sep	KDFWR	Meldahl
17-Aug	KDFWR	McAlpine	5-Oct	KDFWR	McAlpine
24-Aug	KDFWR	Markland	19-Oct	WVDNR	Greenup
31-Aug	KDFWR	McAlpine	19-Oct	KDFWR	Meldahl
7-Sep	KDFWR	Meldahl	26-Oct	KDFWR	Markland

Deliverables: Results of each sampling event will be summarized in a weekly sampling summary. Data will be compiled in an annual interim report and project plans will be updated annually.

Ohio River Asian Carp Coordination and Outreach

Participating Agencies: West Virginia Department of Natural Resources (lead), Illinois Department of Natural Resources, Indiana Department of Natural Resources, Kentucky Department of Fish and Wildlife Resources, Ohio Department of Natural Resources, Pennsylvania Fish and Boat Commission, New York Department of Environmental Conservation, and USFWS

Location: Ohio River sub-basin

Introduction and Need: Every program requires a successful communications effort (Bigford 2013; Osborne-Gowey 2014). There are many examples of successfully executed projects that were not effectively communicated to the appropriate audiences. The collaborative Mississippi River basin Asian carp field efforts conducted by multi-agency work groups have been coordinated effectively. Communication of project results between these groups will be achieved through inter-agency efforts outlined in associated templates. The focus of this template is to enhance effective communication between and amongst state and federal agencies, and the public, as well as elected officials.

The ORFMT member states and other ORB partners have conveyed the issues concerned with Asian carp on a limited basis. Future communications strategies will operate on two fronts. First, interagency communication must be effective to aid in field related activities. This will be accomplished through efforts associated with directed project templates. The second effort will be to develop collaborative outreach messages and approaches. These efforts will focus on the success of field work that is ongoing, future goals and strategies of Asian carp monitoring, prevention, and control. This will be achieved through a communication plan developed by a working group of both biologists and communication specialists and overseen by the ORFMT member states, the USFWS, and ORB partners.

Objectives:

- 1) Gather information and direction from ORFMT and ORB partners for development of an Ohio River basin Asian carp communications plan;
- 2) Develop a Ohio River basin Asian carp communications plan for ORFMT and ORB partner review that clearly defines:
 - a. Communication objectives ,
 - b. Target audiences,
 - c. Key messages for specific target audience,
 - d. Best communications tools and activities for each target audience,
 - e. Human and financial resources to implement tools and activities,
 - f. Expectations and timetables for implementation, and
 - g. Evaluation processes.
- 3) Develop coordinated communications tools, activities, messages, and materials as identified in the Ohio River basin Asian carp communication plan.
- 4) Develop web content as requested by ORFMT or identified in the Ohio River basin Asian carp communication plan for posting on www.Asiancarp.us

Status: The ORFMT member states currently communicate through meetings and email to coordinate field efforts. Individual states currently report project reports individually or in cooperation with USFWS.

Methods: Initially, a communication workgroup will be created that includes representatives from ORFMT member states and ORB partners. This work group will consist of both natural resources and communication professionals. ORFMT and ORB partners will identify information needs and elements for a communication plan through a facilitated discussion with a communications specialist (WV DNR) and contracted individuals. An Ohio River basin Asian carp communications plan will be developed with assistance of agency communications specialists. Ohio River communications work group will also develop web content for posting on www.Asiancarp.us

2015 Schedule:

Creation of Communication Group	August 2015
Initial Meeting of Communication Group	September 2015
Follow-up Meetings of Communication Group	October-November 2015
Draft Asian Carp Communication Plan Outline	December 2015

Deliverables: Formation of a communication workgroup of both natural resources and communication professionals. Draft Asian Carp Communication Plan outline which will include information needs and elements of a comprehensive communication plan.

Upper Mississippi River Basin



Figure 4. Map of the Upper Mississippi River Basin.

Upper Mississippi River Invasive Carp Monitoring

Participating Agencies: Minnesota Department of Natural Resources (lead), Iowa Department of Natural Resources/Iowa State University, Illinois Department of Natural Resources/Western Illinois University, Missouri Department of Conservation, and USFWS

Location: Mississippi River Pool 19 through Pool 1, St. Croix River from mouth to St. Croix Falls Dam, Des Moines, Skunk, Iowa, and Cedar rivers

Introduction and Need:

Partners will continue development and implementation of a comprehensive and complementary early detection and surveillance program for bighead, silver, grass, and black carps in the Upper Mississippi River (UMR) basin. Black carp have not been collected above Lock and Dam 19. Adult bighead, grass, and silver carp are present in varying abundance in Pools 19 through Pool 13, but resource managers do not have a clear understanding of population status within each pool. The comprehensive surveillance program is intended to provide empirical data to define the current invasion status throughout the UMR above Lock and Dam 19 by defining the current presence front (i.e., occasional collection of an individual fish), invasion front (i.e., high numbers of adults collected), and the established front (i.e., areas with verified spawning and recruitment to Age-1) of the four species of invasive carp and evaluate how these fronts change through time. This is fundamental information that will inform all aspects of prevention and control such as where to target early detection monitoring, where to consider containment measures such as deterrent barriers, where to target management actions to disrupt spawning and recruitment, and where to target control activities. Additionally, this effort will help evaluate the effects of proposed management actions (e.g., adult harvest, barrier at Lock and Dam 19). Sampling will use a diverse array of traditional and novel gears to sample all potential life stages in targeted areas.

Objectives:

- 1) Delineate geographic boundaries of the various stages of invasion and monitor invasive carp population changes at the presence front.
- 2) Determine the extent of bighead, silver, and grass carp reproduction above Lock and Dam 19.

Status:

Minnesota DNR has been conducting monitoring at the presence front since 2012. Iowa State University initiated a project looking at invasive carp reproduction in Mississippi River Pools 18 through 20 and select Iowa tributaries in 2014 and 2015. Iowa DNR monitors invasive carp through its base management activities. USFWS La Crosse FWCO began monitoring invasive carp in the UMR in 2013. While agencies have been conducting various monitoring projects and programs, 2015 is the first year agencies begin to formally collaborate on a basin wide monitoring program.

Minnesota DNR maintains an array of 50 stationary acoustic receivers (Vemco Model VR2W) in the Mississippi River from the Coon Rapids Pool to Pool 3; the St. Croix River to Taylors Falls, MN; and the Minnesota River to Shakopee, MN. USFWS maintains an array of 56 stationary

acoustic receivers (Vemco Model VR2W) from Pool 5A (RM 737) to Pool 19 (RM 375). Stationary receivers have been deployed on navigation buoys above and below dams in all pools from 5A through 19 and in lock chambers at locks 14-18 to monitor movement within and among pools. Stationary receivers have also been deployed in selected backwaters of the Mississippi River and attached to bridge piers in four major tributaries (Skunk, Iowa, Rock, and Wapsipinicon Rivers). The Missouri Department of Conservation (MDC) maintains an array of 20 stationary acoustic receivers (Vemco Model VR2W) above, below, and inside the lock chamber at Lock and Dam 19 and at locations downstream to Cairo, IL.

USFWS implanted 18 bighead, 58 silver and 5 hybrid invasive carps in Pools 17-19, and 5 bighead carp in Pool 20 with ultrasonic tags in 2013 and 2014. MDC has implanted 10 bighead carp and 15 silver carp in Pool 20 near LD19 with ultrasonic tags. MN DNR has not implanted sonic tags into any invasive carp.

Methods:

Larval Trawling

A bow mounted ichthyoplankton net (0.75 m x 3 m) consisting of 500 um mesh will be pushed near the surface into the current so that the velocity of the water entering the net is between 1.0 to 1.5 m/s. At sampling locations where no water current exists (e.g. backwaters), sampling will occur towards a random direction that will allow for a complete sample to be taken in a relatively linear path. A mechanical flow meter will be placed in the mouth of the net to determine the volume of water sampled. Each location will be sampled with two, five-minute pushes. Sample contents will be placed in containers labeled with sample location, name of water body, and date, and will be preserved in 10% buffered formalin for 24-48 hours, rinsed with water, and preserved in 90% ethanol. All fishes will be identified to lowest feasible taxonomic category and enumerated.

Hoop Netting

Two different hoop nets will be used. The large 4 ft. diameter “buffalo” nets consist of 9 tapered steel hoops and three throats, with a tapered mesh size of 3 in. sq. mesh at the mouth, 2 in. sq. mesh in the middle, and 1.5 in. sq. mesh at the cod end. The 3 ft. diameter hoop nets consist of seven tapered steel hoops and two throats, with either 1 in. or 2 in. sq. mesh throughout. Preference will be placed towards using the “buffalo” nets over the smaller nets. Specific sampling sites cannot be preemptively set, because exact set locations will vary along with varying water levels and flows. Hoop nets will be set on Monday, checked and re-set on Wednesday, and checked and pulled on Friday.

Mini-Fyke and Trap Netting

The mini-fyke nets consist of a double frame (27 in. x 39 in.), four hoops (2 ft.), a single throat, and a 25 ft. lead, with a square mesh size of 0.125 in. throughout. The standard trap nets consist of a double frame (36 in. x 72 in.), five hoops (30 in.), two throats, and a 40 ft. lead, with a square mesh size of 0.75 in. throughout. If possible mini-fyke and trap netting will be conducted in occurrence with hoop netting. Mini-fyke and trap nets will be set on Monday, checked and re-set on Tuesday and Wednesday, and checked and pulled on Thursday. If possible all fish will be identified and enumerated in the field. If positive identification is not possible, voucher specimens will be kept, labeled and preserved in 90% ethanol for later identification.

Electrofishing

All electrofishing will use pulsed-DC current (6-8 Amps, 360 Volts, 60 pulses per second) and include two netters. Standardized electrofishing sites have fixed distances of 500 m in length. All electrofishing transects are conducted in a downstream direction. All observed fish will be collected, identified, measured and weights and aging structures will be taken from fish included in the age and growth analysis. If positive identification is not possible, voucher specimens will be kept, labeled and preserved in 90% ethanol for later identification. At non-standardized sampling sites, most observed fish will be identified in the water, and only fish needed to collect aging structures and invasive carps will be collected. This will reduce unnecessary processing time and will allow for greater sampling effort.

Gill and Trammel Netting

Stationary large mesh gill nets of depths from 8 to 24 ft. with square mesh sizes of 3.5 to 6 in. will be used to target adult invasive carps. Stationary trammel nets with outside wall square mesh sizes of 12 to 14 in. and inner square mesh sizes of 2 to 4 in. will also be used to target adult invasive carps. Stationary experimental gill nets 250 ft. in length and 6 ft. deep consisting of 50 ft. compliments of net with square mesh sizes 0.75, 1, 1.25, 1.5, 2 in. will be used to target juvenile invasive carps. Nets may be set either short term or overnight, with short-term sets favored when water temperatures are greater than 60° F. Species, number, and condition (i.e., healthy, moribund, dead) of non-target species captured in nets will be recorded and reported.

Commercial Fishing

Commercial fishermen will be contracted to target invasive carp with both gill nets and seines at strategic locations. Agency personnel will accompany contracted commercial fisherman to direct sampling locations and monitor efforts. Netting will occur in likely invasive carp habitats, determined at the discretion of the agency field crews. Fish collected that are also needed for age and growth analysis or tagging may be utilized. Number of fish caught by species will be recorded during gill netting operations and total weight harvested will be requested from the commercial fisherman for both gill netting and seining operations. Sampling site locations, sampling dates, gear description, effort, habitat type (main channel border, backwater, wing dike, etc.), water depth, and crew details will be recorded for each net set.

Light Traps

Quadrafoil type larval light traps (Aquatic Research Instruments) will be deployed at randomly generated sites in Pool 17 backwaters to target recently hatched invasive carp. Traps will be deployed at a minimum of an hour after sunset (4 traps at a time), allowed to fish for approximately 60 minutes, contents removed and redeployed 2 additional times during the night (total of 12 traps per night). Water quality, site description, depth, coordinates and soak time will be recorded for all traps for each individual sampling event. Traps will be set far enough away from other traps to avoid the effects of light contamination from nearby traps. All contents will be preserved in formalin and all larva and fish will be enumerated and identified to the lowest possible taxonomic rank. If target species are identified, a subsample of 30 target species will be measured and staged.

Telemetry

USFWS will use gill and trammel nets (3", 3.5", 4", 4.25" and 5" bar mesh) to collect and tag 64 bighead and silver carp from pools 17 and 18 with coded acoustic transmitters (Vemco, Model V16-4H; 69kHz, 16mm diameter, 67mm length, 26g, or V16-6H; 69kHz, 16mm diameter, 95mm length, 34g). V16 coded transmitters have a 708 (4H) or 1300 (6H) day battery life and a random delay from 30 to 90 seconds. Each transmitter will be tested before implantation for recognition with a portable receiver and hydrophone (Vemco Model VR-100 and Vemco Model VH-165). Fish will be held in a holding tank or net with oxygenated water, anesthetized with carbon dioxide gas, and implanted with transmitters according to surgical procedures described by Summerfelt and Smith (1990). Individual fish will also be tagged with uniquely numbered floy-tags or Monel jaw bands printed with contact information. Following surgery, fish will be placed in a recovery tank saturated with dissolved oxygen before release near the capture site.

Movement of tagged fish within and among pools will be monitored throughout the UMR with an expansive array of more than 100 stationary receivers (Figure 5). USFWS and MN DNR receivers above Lock and Dam 15 will be downloaded two times per year during the spring and fall seasons. In the Pools where tagged invasive carp are present (Pools 16-19, and upstream as necessary), data from stationary receivers will be downloaded monthly during the field season to provide information on gross movements of tagged fish.

USFWS will conduct mobile telemetry monthly to determine habitat use and movement on a finer scale than what is detected with the remote receivers. Manual tracking will also be used to discover new locations of invasive carp aggregations. Depth (m) and temperature (°C) will be recorded at sites where tagged fish are located.



Figure 5. VR2W stationary receiver locations on the Upper Mississippi River for the 2015 field season. Yellow circles indicate Minnesota Department of Natural Resources VR2 locations, green circles indicate USFWS VR2 locations, and red circles indicate Missouri Department of Conservation VR2 locations.

Sampling Sites:

Minnesota - St. Croix and Upper Mississippi River Pools 2, 3, 4, and 8

Minnesota DNR's sampling design includes both fixed and targeted sites. Fixed sites were established in 2012 and have not changed. Targeted sampling varies by year, based on current conditions, and focused on areas most likely to sample targeted invasive carp. Fixed sampling includes 16 electrofishing sites and 37 larval trawling sites on the Mississippi and St. Croix rivers (Figure 6). Estimated targeted sampling includes 24 electrofishing transects, 18 gill/trammel nets, 21 hoop nets, 8 commercial seines, and 12 commercial gill net sets on the Mississippi and St. Croix rivers. USFWS will assist by collecting two larval trawl samples every 2 weeks at one site in Pool 8 from June through September.

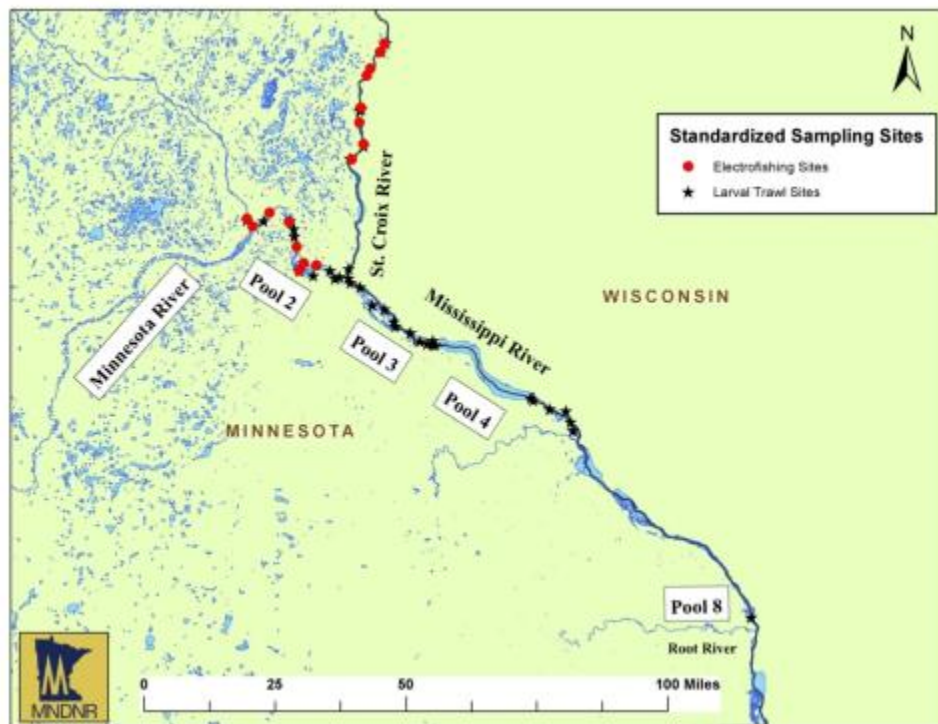


Figure 6. Minnesota DNR 16 standardized electrofishing sites and 37 larval trawling sites on the Mississippi (including Pool 2, 3, 4, and 8) and St. Croix rivers.

Illinois - Upper Mississippi River Pool 17

Western Illinois University's sampling design includes a total of 36 quadrafoil type larval light traps (Aquatic Research Instruments) to be deployed at randomly generated sites in open and vegetated (if present), shallow backwater areas in Pool 17 (Figure 7) every other week from July 1 until conditions are no longer conducive to invasive carp spawning.

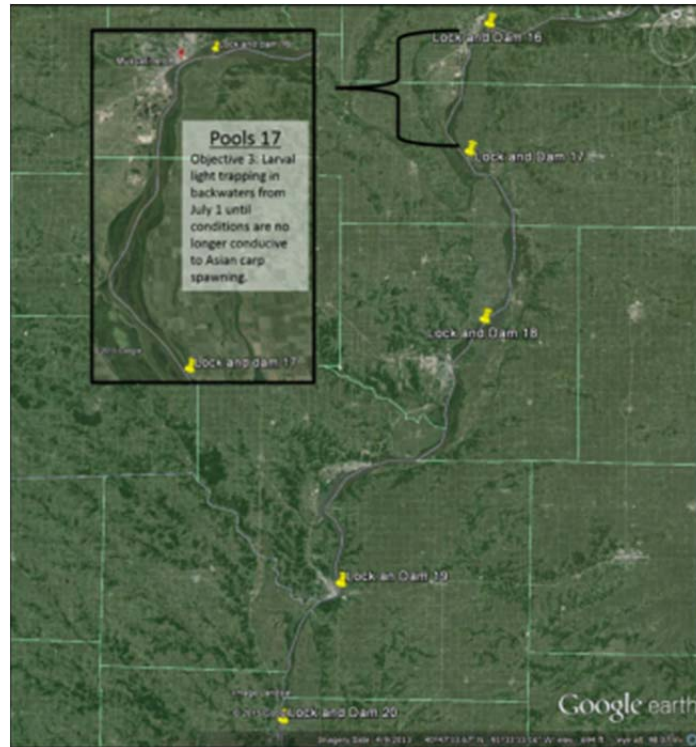


Figure 7. Western Illinois University will deploy larval light traps at randomly generated sites in open and vegetated (if present), shallow backwater areas in Pool 17.

Iowa - Upper Mississippi River Pools 18, 19, 20 and Des Moines, Skunk, Iowa and Cedar rivers
 Adult invasive carp are sampled monthly from April to October 2015 at 9 sites in the Mississippi, Des Moines, Skunk, Iowa, and Cedar rivers (Figure 8) using daytime boat electrofishing and trammel nets. Electrofishing (DC; amps 4-13, voltage 100-500) will target channel border and backwater areas less than 4 m deep. When river conditions allow, a 100 meter, 10 cm bar mesh trammel net will be set in order to block the main escape route from the electrofishing area. Electrofishing will be conducted at three transects in side channel and/or backwater habitats moving towards the trammel net for 15 minutes each per site. Invasive carp eggs and larvae are sampled at 19 locations (Figure 6) approximately every 10 days depending upon river conditions from the end of April until September 2014 and 2015 (53 tows per session). Ichthyoplankton (0.5 m diameter net with 500 μm mesh) tows will be conducted at the surface at a constant boat speed relative to the shoreline up to four minutes depending on debris load. A General Oceanics Model (2030R) flowmeter will be mounted in the mouth of the net to estimate volume (m^3) of water filtered during each tow. Three tows will be conducted at each site parallel to river flow. The first tow will be in the main thalweg for drifting eggs and larvae (less than 24 hours post fertilization), the second tow will be near channel borders where water velocity is moving downstream slower than the thalweg, and the third will be in an adjacent backwater area for mobile larvae (>24 hours post fertilization). After each tow, ichthyoplankton net contents will be rinsed toward the cod end, placed in sample jars, and preserved in 95% ethanol.

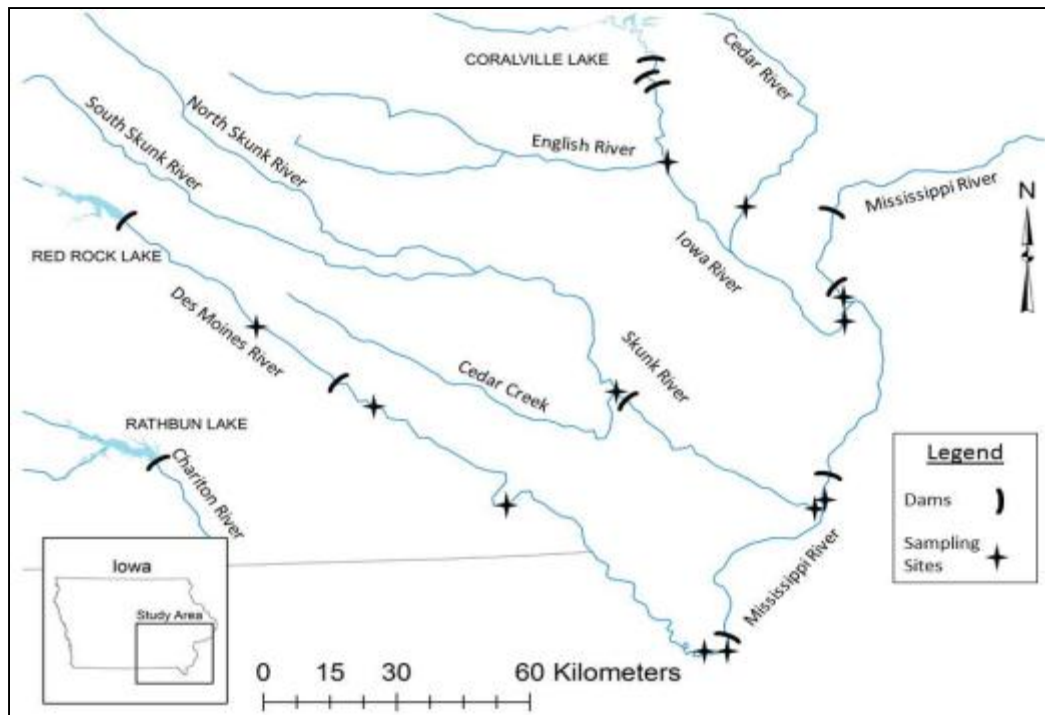
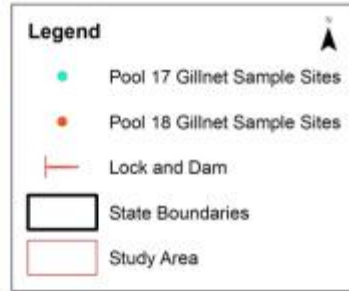


Figure 8. Iowa State University nine primary electrofishing (n=9) and larval (n=19) sampling sites (stars) on the Des Moines, Skunk, Iowa, Cedar, and Mississippi rivers. Larval trawling at river confluences occurs above, in, and below the confluence mouth.

USFWS

USFWS will conduct adult sampling with large mesh gill and trammel nets in one pool a minimum of one week per month. Areas targeted will be sites with appropriate invasive carp habitat (deep areas in plankton rich backwaters), where previous captures have been reported and/or in response to recent capture events (Figures 9-12). Up to 64 invasive carp captured in pools 17 or 18 will be implanted with acoustic transmitters. Any invasive carp captured in Pool 10 through 16 will be implanted with acoustic receivers with appropriate state approvals. Bighead, silver, and black carp captured above Lock and Dam 9 will be removed and sacrificed, and otoliths collected for age and microchemistry analysis. Eye tissue will be collected for ploidy analysis from grass and black carp.

Yearling and young of year invasive carp will be targeted in pools 18 and 19 to document evidence of recruitment. Mini-fyke nets will be used along with some electrofishing effort. A minimum of one week of effort will be conducted per month from June through early September (Figure 13).



Created by: Jeena Credico
Date: 10/2/15
Projection: NAD_1983_Great_Lakes_Basin_Albers
Scale: 1:100,000 and 1:30,000,000
Source: USFWS, USGS, and Esri Software

Figure 9. USFWS large mesh gillnet sample sites in pools 17 and 18 of the Upper Mississippi River, 2015.

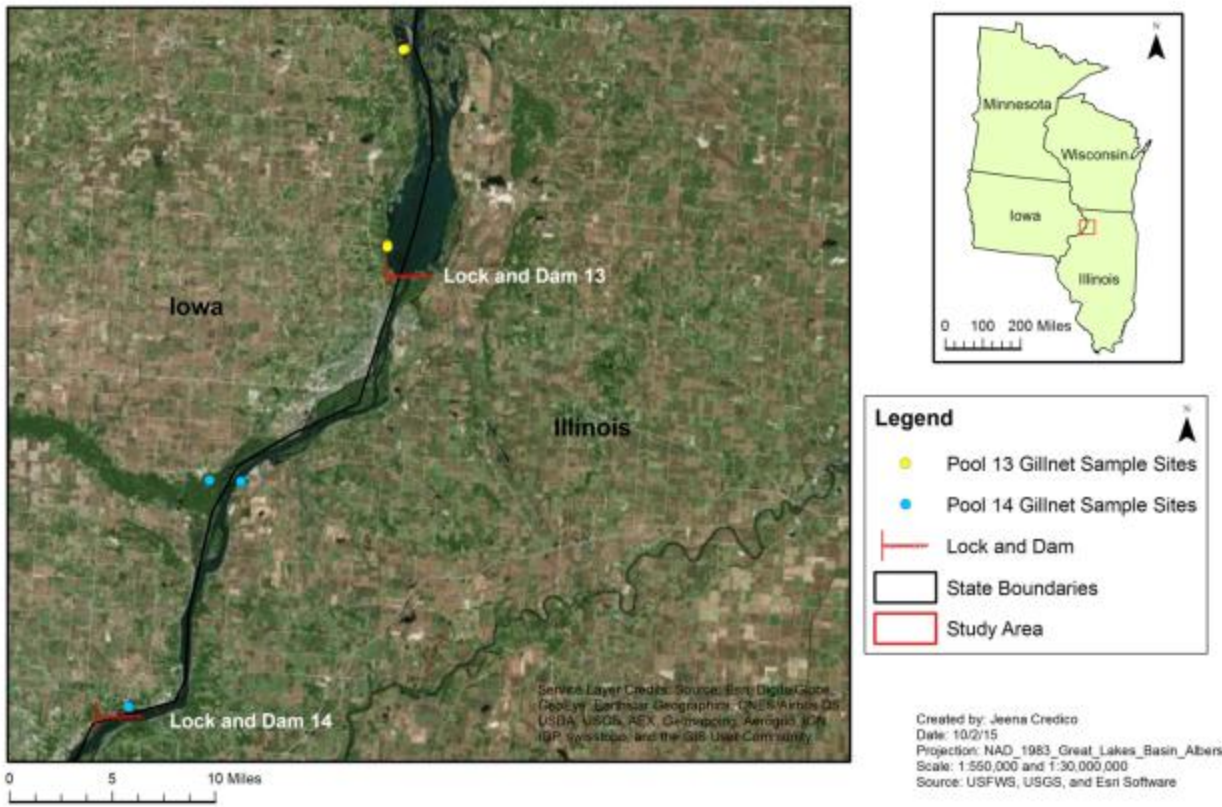


Figure 10. USFWS large mesh gillnet sample sites in pools 13 and 14 of the Upper Mississippi, 2015.

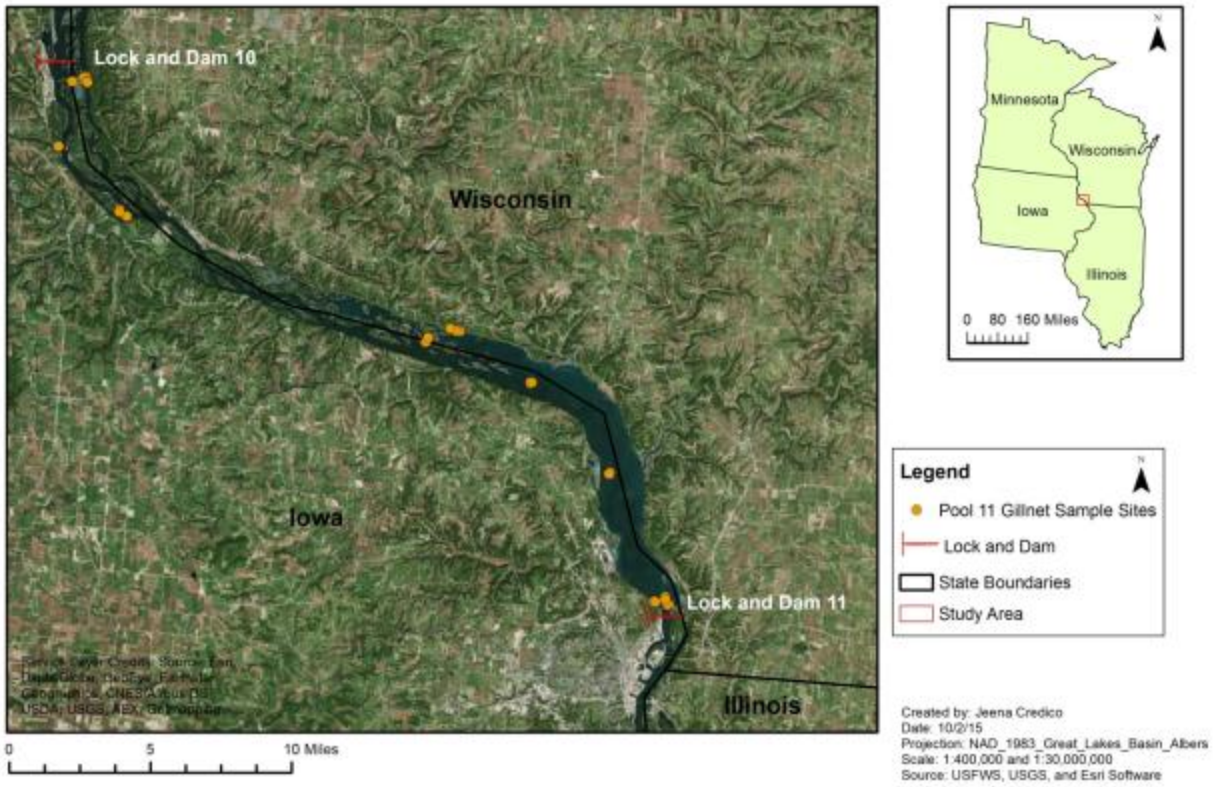


Figure 11. USFWS large mesh gill net sites in Pool 11 of the Upper Mississippi River, 2015.

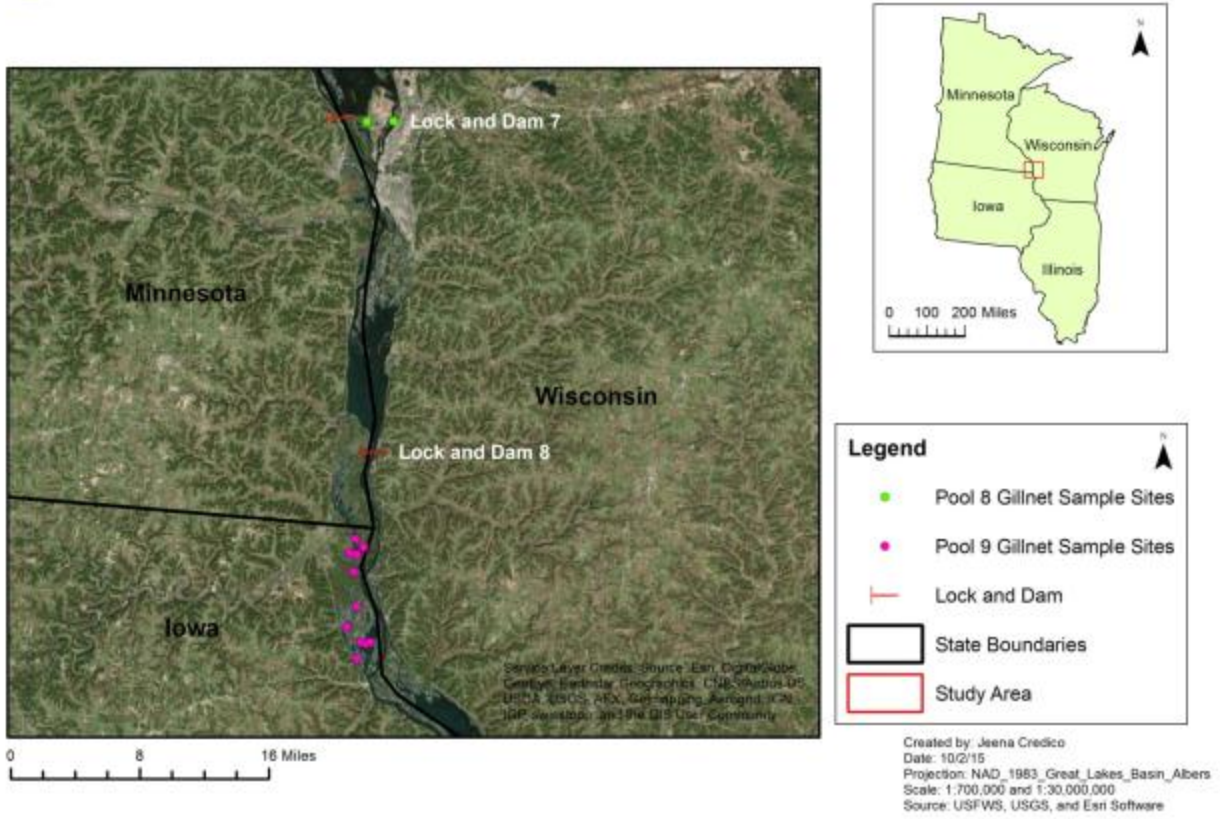


Figure 12. USFWS Large mesh gillnet sample sites in pools 8 and 9 of the Upper Mississippi River, 2015.

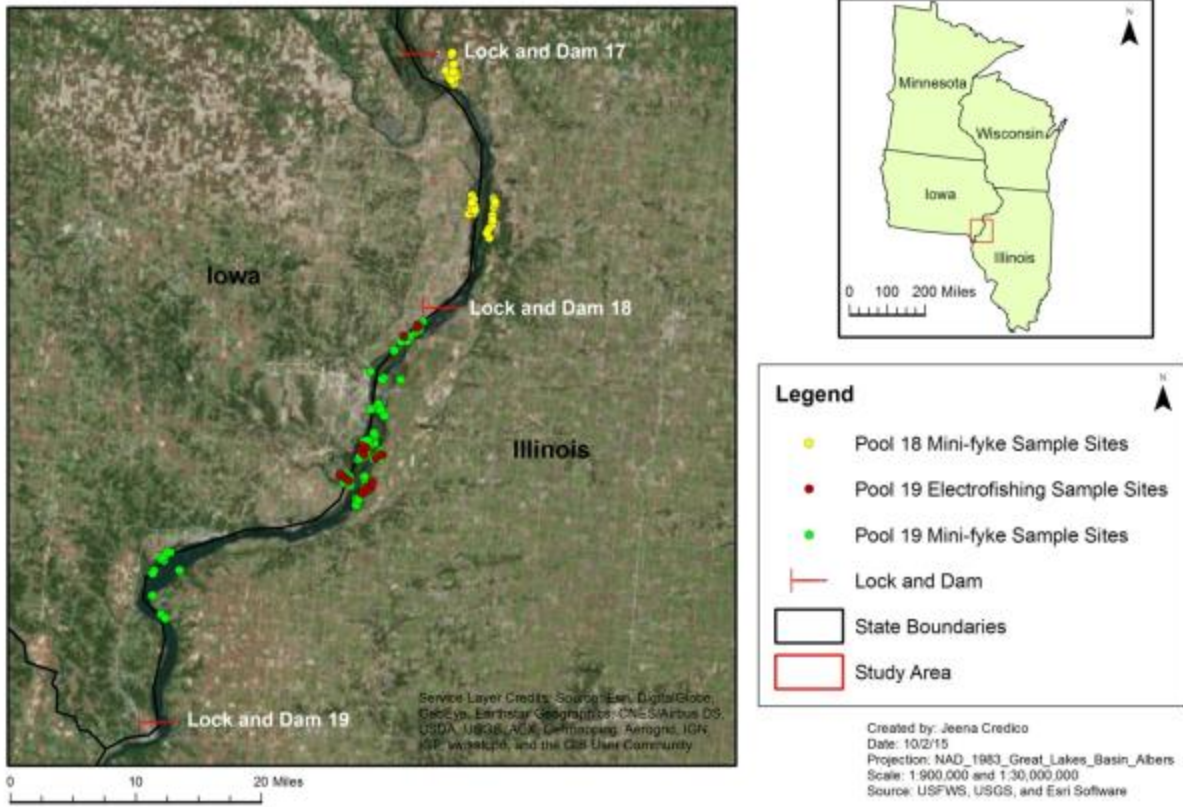


Figure 13. USFWS Mini-fyke and electrofishing sample sites in pools 18 and 19 of the Upper Mississippi River, 2015.

2015 Sampling Schedule:

Table 1. A list of primary gears, sampling time periods, estimated annual sampling events and days spent sampling, and estimated annual effort for each gear used by Minnesota Department of Natural Resources to target invasive carps in Mississippi River Pools 1-8 and the St. Croix River up to Taylors Falls, MN.

Gear	Time Period	Sampling		Effort
		Events	Days	
Gill/Trammel Netting	March - November	18	18	27,000 feet of net
Electrofishing	May - September	48	24	2,400 minutes
Hoop Netting	May - October	8	21	320 net nights
Mini-Fyke/Trap Netting	June - September	6	15	180 net nights

Larval Trawling	May - September	128	36	256 pushes
Commercial Seining	Year round	8	8	8 seine hauls
Commercial Gill Netting	Year round	12	12	40,000 feet of net

Table 2. A list of the primary gears, sampling time periods, estimated annual sampling events and days spent sampling, and estimated annual effort for each gear used by Western Illinois University to target invasive carps in Mississippi River Pools Mississippi River Pool 17.

<i>Gear</i>	<i>Time Period</i>	<i>Sampling</i>		<i>Effort</i>
		<i>Events</i>	<i>Days</i>	
<i>Larval Trawling</i>	<i>July - September</i>	<i>12</i>	<i>18</i>	<i>216 light trap sets</i>

Table 3. A list of primary gears, sampling time periods, estimated annual sampling events and days spent sampling, and estimated annual effort for each gear used by Iowa State University to target invasive carps in Mississippi River Pools 18-20, and the Des Moines, Skunk, Iowa, and Cedar rivers during 2015.

Gear	Time Period	Sampling		Effort
		Events	Days	
Gill/Trammel Netting	April - October	7	28	~100 sets, 10,000 ft of net
Electrofishing	April - October	7	28	~2,800 minutes
Hoop Netting	NA	NA	NA	NA
Mini-Fyke/Trap Netting	NA	NA	NA	NA
Larval Trawling	April – September	14	42	700

Table 4. A list of primary gears, sampling time periods, estimated annual sampling events and days spent sampling, and estimated annual effort for each gear used by USFWS to target invasive carps in Mississippi River Pools 8-19 during 2015.

Gear	Time Period	Sampling		Effort
		Events	Days	
Gill/Trammel Netting (Pools 8, 9, 11, 13, 14, 17, 18)	April - September	6	18	~ 100 sets, 30,000 ft of net
Electrofishing (Pool 19)	June-July	3	6	19 EF runs

Mini-Fyke Netting (Pools 18 and 19)	May-September	5	15	250 net sets
Larval Trawling	July-September	7	7	14 five minute hauls
Receiver Download (Pools 16-19)	April – November	8	16	1 crew, 2 people per crew, 16 days=32 staff days
Receiver Download (Pools 5A-15)	Spring and Fall	2	6	1 crew, 2 people per crew, 6 days per year =12 staff days
Manual Tracking	April-November	8	36	2 crews, 2 people per crew, 4 days per week, 8 weeks per year=128 staff days

Deliverables:

Data will be summarized in annual reports and project plans updated for annual revisions. Data will be used by the UMR workgroup to prioritize and guide deterrence and management actions.

Strategy for eDNA Monitoring in the Upper Mississippi River

Participating Agencies: US Fish and Wildlife Service

Location: eDNA samples in 2015 will be taken from pools 5A, 6, 8 and 9; and 10, 13, 14, 16, and 17.

Objectives:

1. Establish baseline eDNA data within the Asian carp presence front of the UMR during conditions conducive to spawning and post-spawning.
2. Determine the utility of cold water eDNA surveillance to identify Asian carp congregations.

Status: 2015 sampling in pools 5A, 6, 8, and 9 is a continuation of eDNA sampling that was completed in 2014. Sampling in pools 10 and downstream is a new effort for the purpose of increasing our understanding of eDNA results and to improve the utility of eDNA as a surveillance method.

eDNA Surveillance: There will be two separate sampling events in UMR pools 5A, 6, 8, and 9 in 2015. Each event will result in collection of 300 samples, 100 each from pools 8 and 9, and 50 each from pools 5A and 6 for a total of 600 samples in the year. The first sampling event is scheduled for July and the second is scheduled for late September. The July sampling will take place when conditions are conducive to Asian carp spawning. An established baseline of eDNA data during this period will aid in early detection of Asian carp spawning. Fall sampling will take place when conditions are not conducive to spawning. Post-spawn sampling will provide a comparison dataset to aid in detecting eDNA spikes resulting from spawning. Additionally, data from multiple sampling events may provide increased understanding in normal variability of eDNA results at extremely low densities. Samples from these events within the presence front will be collected, processed and reported following the QAPP.

eDNA Utility Test: A second effort in pools 10 and downstream will be conducted during the winter season utilizing data on congregation areas identified with acoustic telemetry. In cold water temperatures, telemetry data suggest Asian carp congregate in preferred habitat and exhibit very little movement. Therefore, it is reasonable to assume that once present in winter habitats, fish are unlikely to move until water temperatures increase. Acoustic tagged fish will be used to verify the presence of Asian carp at winter congregation sites. Collecting location data simultaneously with eDNA sampling will allow us to know with certainty that Asian carp are present during eDNA sample collection, allowing us to test whether or not eDNA results differ when congregations of Asian carp are known to be present within the invasion front. Acoustic tagged Asian carp are present in Pools 17-19 and an ongoing telemetry study has identified high use areas in these pools. We have been unable to collect Asian carp in Pools 10, 13, 14, and 16, and there are no acoustic tagged carp in Pools 10, 13, and 14. A small number of tagged fish from Pool 17 move into and out of Pool 16, spending short periods of time there. eDNA will be collected simultaneously with tracking data that indicates fish are congregating in high use areas of Pool 17 when water temperatures are below 8°C. eDNA will also be collected from sites with similar habitat characteristics in pools 10, 13, 14, and 16. Between 25-50 eDNA

samples will be collected from each target area, up to a maximum of 500 samples for the study. Results from this study can potentially identify overwintering areas in sparsely populated pools (the transition zone between the invasion front and the presence front). Any sites with eDNA results that indicate presence of an overwintering population of Asian carp will be netted after ice out and prior to spring emigrations. These areas could also be targeted for future tagging and removal operations.

Samples for this test will be collected and processed following the QAPP, with the exception of using 50 ml per sample as opposed to 250 ml. Also, since this is a study to improve the utility of this tool, the results will not be communicated or posted per the Service’s communication protocol outlined in the QAPP.

Table 1. Site description, dates, and number of samples to be taken in the Upper Mississippi Basin in 2015. Additional sites may be sampled for follow up at the request of state partners.

Monitoring in Wisconsin/Minnesota waters, July 2015

Pool 9	(n=100)
Pool 8	(n=100)
Pool 6	(n=50)
Pool 5A	(n=50)

Monitoring in Wisconsin/Minnesota waters, September 2015

Pool 9	(n=100)
Pool 8	(n=100)
Pool 6	(n=50)
Pool 5A	(n=50)

Utility Study in Iowa/Illinois/Wisconsin waters of the UMR

Pool 17	(n=100)
Pool 16	(n=100)
Pool 14	(n=100)
Pool 13	(n=100)
Pool 10	(n=100)

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Invasive Carp and Native Fish Passage Investigation at Upper Mississippi River Locks and Dams

Participating Agencies: Minnesota Department of Natural Resources /University of Minnesota (lead agency), Missouri Department of Conservation, Iowa Department of Natural Resources, USFWS, USACE

Location: Lock and Dam 19 – Keokuk, IA; Lock and Dam 8 – Genoa, WI

Introduction and Need:

Prevention is accepted as the best method to limit the impacts of invasive species given the difficulty and costs of eradication and control. Over the long term, prevention is the most cost effective strategy for limiting impacts of bighead (*Hypophthalmichthys nobilis*), black (*Mylopharyngodon piceus*), grass (*Ctenopharyngodon Idella*), and silver (*Hypophthalmichthys molitrix*) carp; collectively referred to as invasive carp. Invasive carp are established in the upper, middle, and lower Mississippi River and expanding upstream threatening a variety of aquatic habitats. The upper Mississippi River contains a network of locks and dams that may provide an opportunity for deterring upstream movement of invasive carp. Though telemetry studies have shown that invasive carp can move through upper Mississippi River locks during closed river conditions (Tripp et al. 2013), ongoing computer modeling at the University of Minnesota and concurrent tests of silver carp swimming performance suggest that lock and dam structures in the Upper Mississippi River may reduce the upstream movement of bighead and silver carps. The geomorphological, economical, and recreational complexity of the Mississippi River requires technological innovation for both deterrent systems and evaluation of these systems.

Lock and Dam 19 near Keokuk, IA, is a major barrier to fish passage in the Upper Mississippi River, as the only upstream passage through it is the navigation lock chamber. Silver and bighead carps are established below Lock and Dam 19 with populations characterized by high adult abundance, reproduction, and recruitment; whereas bigheaded carp populations upstream of Lock and Dam 19 exhibit lower adult abundance, minimal natural reproduction, and seemingly limited recruitment. Black carp catches in the Upper Mississippi River have increased in recent years; however black carp have not been captured above Lock and Dam 19. As the abundance of invasive carp species increases in the Upper Mississippi River, it is important to evaluate the feasibility of using deterrent barrier technologies and operational modifications at lock and dams to minimize the upstream passage of invasive carp, while maximizing native fish passage. Operational modifications at navigation locks and dams may also prove useful as a tool to increase effectiveness of control tools (e.g. harvest). Deterrent barriers and/or operational modifications at other locks and dams located upstream in the system may further minimize the expansion of invasive carp populations in the upper Mississippi River.

Minnesota has identified the lock and dam system as the best way to slow expansion of invasive carp in the Mississippi River and important tributaries, especially the St. Croix and Minnesota Rivers. Dr. Peter Sorensen with the Minnesota Aquatic Invasive Species Research Center (MAISRC) at the University of Minnesota received funding from the Minnesota Environmental and Natural Resources Trust Fund (ENRTF) to produce recommendations on new dam gate

operating protocols for the US Army Corps of Engineers (USACE) to enhance the ability of Locks and Dams 1 through 8 to reduce bigheaded carp passage. Acoustic deterrent systems are also being studied the University of Minnesota, the University of Minnesota at Duluth, and the U. S. Geological Survey at Onalaska. MAISRC installed a demonstration project at Lock and Dam 8 in 2014. The acoustic system was placed on the lock doors and hydraulic modeling is being conducted to establish points of weakness in the gated portion. A fine-scale evaluation of the movement of both carps and native fishes around this structure (and its gates) is needed to confirm and enhance this important modeling effort and the deterrent mounted on its lock doors. Information from native fishes is especially important because of local concerns and no swim performance data exists for most species. The goal is to develop a working knowledge of lock and dam function at Lock and Dam 8 and then apply this knowledge across the entire lock and dam system to create an integrated suite of deterrents that do not hinder navigation or human safety. Lock and Dam 5 is of particular interest because it has high head, rarely is it in open river conditions with gates out of the water, and it is located downstream of the Minnesota and St. Croix Rivers systems. Concurrent research continues on acoustic deterrents at Lock and Dam 1 and in the laboratory.

USACE is responsible for operation and maintenance of the lock and dam structures in the Upper Mississippi River. MN DNR, University of Minnesota, MDC, and USFWS will coordinate field work in and around the locks and dams with USACE through the duration of this project. In addition to coordinating field work in and around the locks and dams, USACE is a participating agency in the collaborative effort to evaluate options and alternatives for the use of deterrent barriers to prevent upstream passage of invasive carps through navigation locks and dams in the Upper Mississippi River.

The purpose of this project is to leverage research at Lock and Dam 19 with on-going research at Locks and Dams 1 and 8. Knowledge gained from this research can be used to inform future management decisions on the use of deterrent barriers and operational modifications of locks and dams to minimize upstream passage of bigheaded carps, while maximizing native fish passage.

Objectives:

- 1) Quantify native and non-native fish passage at Lock and Dam 19 in the Upper Mississippi River.
- 2) Evaluate the movement of fish at Lock and Dam 8 and its structural components (roller gates, tainter gates and lock) to confirm and enhance numeric models and acoustic deterrents.
- 3) Test effectiveness of acoustic technology on wild populations of bigheaded carps.
- 4) Begin work (design and permits) for possible deterrent installation at Lock and Dam 19.

Status:

The Sorensen laboratory and MAISRC installed an acoustic system on the doors to the lock chamber at Lock 8 in June 2014. This system is still operating. Completion of initial hydrologic modeling of water velocities through the tainter and roller gates in Dam 8 under various operational conditions in August 2015. By early 2016, the model will include data in bigheaded

carp swimming performance and predictions of exactly when and where (within a meter) carp migrate through this structure.

Methods:

Lock and Dam 8

An automated fish tracking system will be designed for use on Lock and Dam 8. This system will be able to identify what components (i.e. roller or tainter gates or the lock) might allow tagged fish to pass through the structure. The system will be installed across the entire structure and a DIDSON camera will also be installed downstream of the lock to provide complimentary information on fish immediately in front of that structure when the deterrent is either turned on or off. Once these systems are operational, batches of tagged fish will be released downstream of Lock and Dam 8 and their passage tracked. If possible, this work will be complimented by manual tracking from a boat. Both common carp and several native species will be tagged. This work could be expanded to allow us to purchase additional tags in the future to place in a variety of species and locations and to experiment with different types of acoustical deterrents. Coordinated work with Lock and Dam 19 will provide a complete picture.

Lock and Dam 19

In order to monitor the movement and potential passage of invasive carp around Lock and Dam 19, we will utilize an existing monitoring array that is a combination of stationary receivers (Vemco VR2W) placed on navigation buoys, bottom stands, manual tracking (state agencies, federal agency, and commercial navigation industry [e.g., ADM]), and a lock chamber attachment. Two stationary receivers are strategically placed below the lock chamber entrance (one approximately a mile downstream and another directly below the entrance), one receiver is placed within the lock chamber, and two other stationary receivers are deployed covering the channel a mile upstream of the dam (Figure 14). To focus on the movement and potential passage at Lock and Dam 19, invasive carp will be sampled within 5 kilometers upstream and downstream of Lock and Dam 19.

During fall 2015 (lower water temperatures to reduce stress), invasive carp and native fishes will be captured using a compliment of gears (e.g., electrofishing, experimental gill nets [multiple mesh sizes], trammel nets, and hoop nets) that will sample the broadest size and age distribution to garner a representative sample of the fishes in this location. All fishes sampled will be weighed and measured. Species, numbers and condition (i.e., healthy, moribund, dead) of all non-target species captured in nets will be recorded and reported. Approximately 150 representative invasive carp will be implanted with ultrasonic transmitters (Vemco V16-5H; 69kHz) using methods described in Tripp et al. (2013). An additional 100 transmitters will be implanted in native fishes (including skipjack, blue catfish, and American eel). Fishes will be anesthetized and once equilibrium is lost or swimming ability ceases, surgeries will commence.



Figure 14. The Upper Mississippi River VR2W array from Keokuk, IA to Caruthersville, MO with an inset of the local array surrounding Lock and Dam 19.

Fish will be placed onto a clean V-shaped surgery board, and water will be circulated over the gills. In all surgeries the incision area will be disinfected. All surgeries will be made by experienced surgeons (>1000 fish surgeries combined experience) ventral to the lateral line and anterior to the anal opening. A scalpel and curved hemostats will be used to lift tissues while cutting to avoid damage to internal organs, and three or four Ethicon 3-0 monofilament sutures will be evenly placed to close the incision site. Sutures will be closed with a simple interrupted technique, deemed the strongest and most suitable for closing the skin of fish (Summerfelt and Smith 1990). Once fishes are fitted with transmitters, movement and passage will be documented throughout the life of the transmitters (up to 5 years). Transmitter detections from the stationary receivers will be summarized to describe invasive carp movement around Lock and Dam 19. We also plan to employ manual tracking (Vemco VR100) throughout the study to garner more fine scale habitat information (e.g., spawning locations) and “hot spots” (e.g., areas of high invasive carp concentration).

To further evaluate distribution of fishes, hydroacoustic sampling will be carried out above and below Lock and Dam 19 by USFWS. Hydroacoustics will be conducted during day-time hours and during normal river conditions to ensure safety of equipment and personnel. Hydroacoustics sampling will be conducted once during each season throughout the duration of the project. Transects will be stratified (lock, gates) and then randomly sampled within a safe distance around the lock and dam structure. Data from these locations will be used to evaluate the distribution of fishes with respect to location of the lock and dam structure. We are hopeful that this technology will allow us to determine species specific distribution patterns in this location. Lastly, if time is available and because of the interest in regards to passage through the lock chamber, additional hydroacoustics transects may be conducted inside the lock chamber.

Lock and Dam 19 is located in Iowa and Illinois waters with the lock located on the Iowa side of the river. While this portion of the project is being led by the Missouri Department of Conservation, they have the full support of the Iowa DNR to conduct this work within their jurisdiction. Iowa DNR will also provide additional assistance contingent on availability of resources.

2015 Schedule:*Lock and Dam 8*

June – August: Develop an automated fish tracking system and design for deploying DIDSON sonar.

August: First version of model available for discussion with partners.

Fall: Attempt initial tests of fish tracking system (weather permitting)

Fall: Advertise for postdoc to run project

Lock and Dam 19

October 2015 – May 2016: Implant ultrasonic transmitters and place receivers to monitor movement of invasive carp and native fishes in the upper Mississippi River above and below L&D 19

July 2016 – September 2016: Hydroacoustics assessments above and below L&D 19 (one per season)

FY 2016

Activity	O	N	D	J	F	M	A	M	J	J	A	S
Field sampling	X	X	X	X	X	X	X	X				
Telemetry tracking	X	X	X	X	X	X	X	X	X	X	X	X
Hydroacoustic assessment									X	X	X	X
Database management	X	X	X	X	X	X	X	X	X	X	X	X
Data analysis			X	X	X	X	X	X	X	X	X	X
Draft Report												X

Deliverables:

Annual reports summarizing effort and preliminary findings. Final report detailing findings on native fish passage, invasive carp deterrence, and recommendations for using acoustic barriers. A preliminary design for an acoustic barrier at Lock and Dam 19. Permitting process initiated for Lock and Dam 19.

Literature Cited:

Tripp, S., R. Brooks, D. Herzog, and J. Garvey. 2013. Patterns of fish passage in the Upper Mississippi River. *River Research and Applications*. Volume 30(8) pages 1056-1064. Accessed on 29 June 2014 at <http://onlinelibrary.wiley.com/doi/10.1002/rra.2696/full>.

Targeted Asian Carp Removal in the Upper Mississippi River

Participating Agencies: Illinois Department of Natural Resources /WIU (lead), Missouri Department of Conservation, Iowa Department of Natural Resources

Location: Tagging and targeted removal of Asian carp will take place in pools 14-20 in the Upper Mississippi River.

Introduction and Need: Adult bighead, grass, and silver carps are present in varying abundance in Upper Mississippi River (UMR) pools 20 through 14; however black carp have not been collected above Lock and Dam 19 (LD19). Bighead and silver carp populations are increasing in abundance and expanding their upstream range within the UMR. Limited fish passage at LD19 has slowed their progression and establishment in UMR reaches above Keokuk, IA. However, the detection of young-of-year Asian carp above LD19, although in small densities, indicates that Asian carp populations have reached densities capable of detectable reproduction. To combat this population expansion and decrease Asian carp densities at the established front (pools 17, 18, and 19), additional measures are needed to monitor, control and manage Asian carp while densities are still low and manageable. Contracted commercial fishers will be used to intensively target Asian carp species for removal at the established front and invasion front (reaches above pool 17).

Decreasing the abundance of Asian carp by commercial fishers has been successfully executed in the upper Illinois River to decrease pressure on the electric dispersal barrier. This targeted system of removal is needed in the UMR above LD19 as population have attained densities high enough to support reproduction and continue to be detected in far northern reaches of the UMR in Wisconsin and Minnesota. LD19 is a high head dam with a maximum head difference of 38 ft, restricting all upstream fish passage to the 1200 foot lock chamber. Even though this limited passage has slowed the infiltration and establishment of Asian carp above LD19, bighead, silver, and grass carps have now reached densities that are increasingly detectable, capable of finding mates to support reproduction, and can be sufficiently targeted in known areas of aggregation throughout their established front. The targeted removal of 50,000 – 100,000 lbs of Asian carp annually will help reduce their ecological impact, slow their spread and establishment in the UMR above LD19 and decrease their effective population size. Furthermore, by decreasing their population size we will reduce their opportunities to find mates (Allee effect) and reduce the probability of successful spawning interactions. Additionally, in order to decrease pressure on LD19, targeted sampling and removal efforts will also be conducted by commercial fishers and agency personnel in Pool 20.

Initial population estimates will be obtained for Asian carp populations in UMR pools 17, 18, and 19 using mark-recapture data to assess the efficiency and effectiveness of Asian carp sampling and removal efforts. Initial estimates will set future benchmarks for removal and determine the effectiveness of harvest on an annual basis as part of an adaptive strategy. Population estimates will be calculated for Asian carp in Pool 20 throughout the duration of the study to evaluate the effectiveness of commercial harvest in Pool 20 and assess the feasibility of commercial fishing to reduce the Asian carp population and propagule pressure below LD19.

Objectives:

- 1) Determine population abundances of Asian carp species in UMR pools 17, 18, 19, and 20.
- 2) Targeted removal of Asian carp species in UMR pools 14-20 using contracted commercial fishers and intensive agency netting.
- 3) Assess the feasibility of commercial fishing to reduce Asian carp populations below LD19 in the UMR.

Status: Targeted Asian carp removal efforts have not been attempted in UMR pools 14-20. This will be the initial implementation and assessment of these control strategies in the UMR.

Methods: The sampling design includes agency sampling and the use of contracted commercial fishers to intensively capture Asian carp species using a variety of trammel nets, gill nets, hoop nets, and a commercial seine. Nets used will be large mesh (3.0-5.0 inches (76.2-127 mm)) trammel or gill nets 8-10 feet (2.4-3 m) high and in lengths of 200 yards (182.9 m). Sets will be of short duration and include driving fish into the nets with noise (e.g., plungers on the water surface, pounding on boat hulls, or racing tipped up motors). In lower density areas, dead sets may be set over night (no more than 15 hours and only in water temperatures below 75 F) and emptied first thing each morning. Otherwise, nets will be attended at all times. Captured fish will be identified to species and enumerated. Species, numbers and condition (i.e., healthy, moribund, dead) of all non-target species captured in nets will be recorded and reported in interim reports. Locations of net sets will be recorded with GPS coordinates (decimal degrees preferred). A WIU or IA DNR biologist or technician will be assigned to each commercial net boat to monitor operations and record data. Netting efforts and locations of sets will be guided by the expertise of the commercial fishers and will also be informed by telemetry efforts by USGS and USFWS conducted as part of the intensive monitoring efforts within this reach.

WIU biologists will be assigned to each commercial net boat to monitor operations and record data. These duties will include recording species, length (mm), and weight (g), on up to 100 Asian carp species per boat, per day. Total length will be recorded for all bycatch per boat, per day. Individual Asian carp species greater than 100 fish per boat, per day, will be counted and weighed in bulk to determine a total biomass removal for the day for each species. Duties also include monitoring the safe return of native bycatch, recording water quality data, tagged fish information and site information, monitoring for telemetered and tagged fish, and working with USFWS and USGS telemetry crews to help inform netting efforts. All telemetered fish captured will be returned to the water immediately. The tags will be decoded if possible before returning the fish to the water, and the information provided to the respective agency. All non-target bycatch will be identified to species, enumerated, and condition recorded (i.e. healthy, moribund, dead). All native bycatch will be returned to the water upon removal from the nets and all other non-native species will be removed, but total weights kept separate from Asian carp biomass.

All fish removed throughout the study will be transported daily to Wade Robbins (Bonaparte, IA) or Shafer Fisheries (Fort Madison, IA) where all fish will be iced down in large totes and used as fertilizer. Fish cannot be marketed and sold by the contracted commercial fishers and the fish cannot be used for human consumption. All WIU biologists and technicians participating in the removal will be required to possess an Illinois sportfishing license.

Objective 1. Determine population abundances of Asian carp species in UMR pools 17, 18, 19, and 20

Two commercial fishing crews will operate for a total of four weeks in pools 17-19 (pool 17 = 1 week, pool 18 = 1 week, pool 19 = 2 weeks). Each commercial fisher boat crew will fish four consecutive weeks from 8 am to 5 pm, Monday – Friday. WIU biologists will be assigned to each commercial net boat to monitor operations and record data. All Asian carp captured during the initial four weeks of effort will be marked with a uniquely numbered aluminum jaw tag and released.

WIU crews will use a compliment of standard fish sampling techniques (e.g., experimental gill nets [multiple mesh sizes], trammel nets, and hoop nets) to collect Asian carp species in the upper reaches of Pool 20 in the vicinity of LD19. Netting efforts and locations of sets will be guided by the expertise of the commercial fishers and will also be informed by MDC telemetry efforts conducted as part of the fish passage project work within P20. All Asian carp captured during the first four weeks of targeted sampling in Pool 20 will be marked with an aluminum jaw tag and released.

In all pools, non-target bycatch will be identified to species, enumerated, and condition recorded (i.e. healthy, moribund, dead) prior to release. All non-native species, other than Asian carp species, will be removed and transported daily to Wade Robbins (Bonaparte, IA) or Shafer Fisheries in Fort Madison, IA.

Recapture events obtained during implementation of Objective 2 will allow for the calculation of population estimates. Program MARK will be used to obtain closed system population size estimates for pools 17-20 as a function of recaptured (without replacement) versus initially marked and untagged individuals. Population estimates will be calculated for Asian carp in Pool 20 throughout the duration of the study.

Objective 2. Targeted removal of Asian carp species in UMR pools 14-20 using contracted commercial fishers and intensive agency netting

Following the initial four weeks of capturing, tagging, and releasing Asian carp in pools 17-19, two contracted commercial fishing crews will operate for a total of 17 weeks in pools 14-19 for targeted removal of Asian carps. Targeted removal efforts will alternate between pools, with approximately 15 of the 17 weeks of effort split between pools 17-19 (pool 17 = 4 weeks, pool 18 = 4 weeks, pool 19 = 7 weeks). Two weeks of effort will be devoted to pools 14-16, where Asian carp are present but not in high enough densities to effectively target large numbers of Asian carp.

Each commercial fisher boat crew will fish every other week from 8 am to 5 pm, Monday – Friday. Additional WIU watercraft will be used to assist commercial netting efforts, especially shallow water vessels capable of driving fishes from shallow American lotus beds and shallow backwaters. The goal for targeted removal of Asian carp species above LD 19 is 50,000-100,000 lbs.

Targeted capture and removal of Asian carp in Pool 20, following an initial four weeks of effort to mark and release Asian carp with jaw tags, will be conducted by WIU biologists and technicians. One or two WIU boat crews will target Asian carp for removal on opposite weeks of commercial fisher efforts throughout the duration of the study.

Length and weight will be recorded from each Asian carp prior to being sacrificed; individual jaw tag numbers will be recorded for all recaptured Asian carp. Non-target bycatch will be identified to species, enumerated, and condition recorded (i.e. healthy, moribund, dead) prior to release. All non-native species, other than Asian carp species, will be removed and transported daily to Wade Robbins (Bonaparte, IA) or Shafer Fisheries in Fort Madison, IA.

Objective 3. Assess the feasibility of commercial fishing to reduce Asian carp populations below LD19 in the UMR.

MDC will use a suite of standard fisheries sampling techniques to collect, tag (floy tags), and release Asian carp in Pool 20. MDC will determine the rate of recaptures by commercial fishers to evaluate the effectiveness of commercial harvest in Pool 20. MDC will compare recapture data (surrogate for exploitation) to existing commercial harvest models generated for the area at LD19.

Non-target bycatch collected in gill and trammel nets will be identified to species, enumerated, and condition recorded (i.e. healthy, moribund, dead) prior to release.

Deliverables: Results and biomass estimates for removal efforts in pools 14-20 will be reported daily during events and compiled for weekly sampling summaries. Mark-recapture data will be used to estimate Asian carp population size in Pool 20 and evaluate the potential effectiveness of commercial fishing at reducing Asian carp abundances below LD19. Data and results will be summarized for an annual interim report. Species, number and condition (i.e., healthy, moribund, dead) of all non-target species captured in nets will be summarized and reported in the annual report.

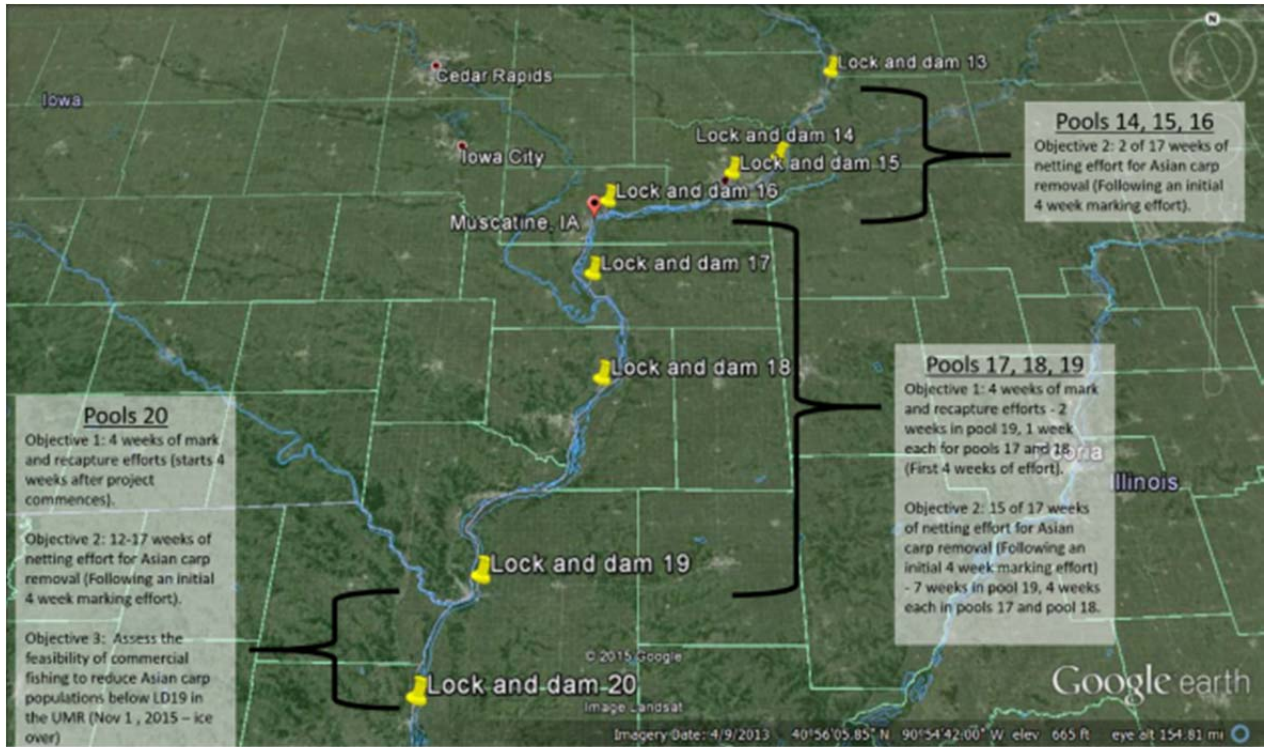


Figure 15. Project overview

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