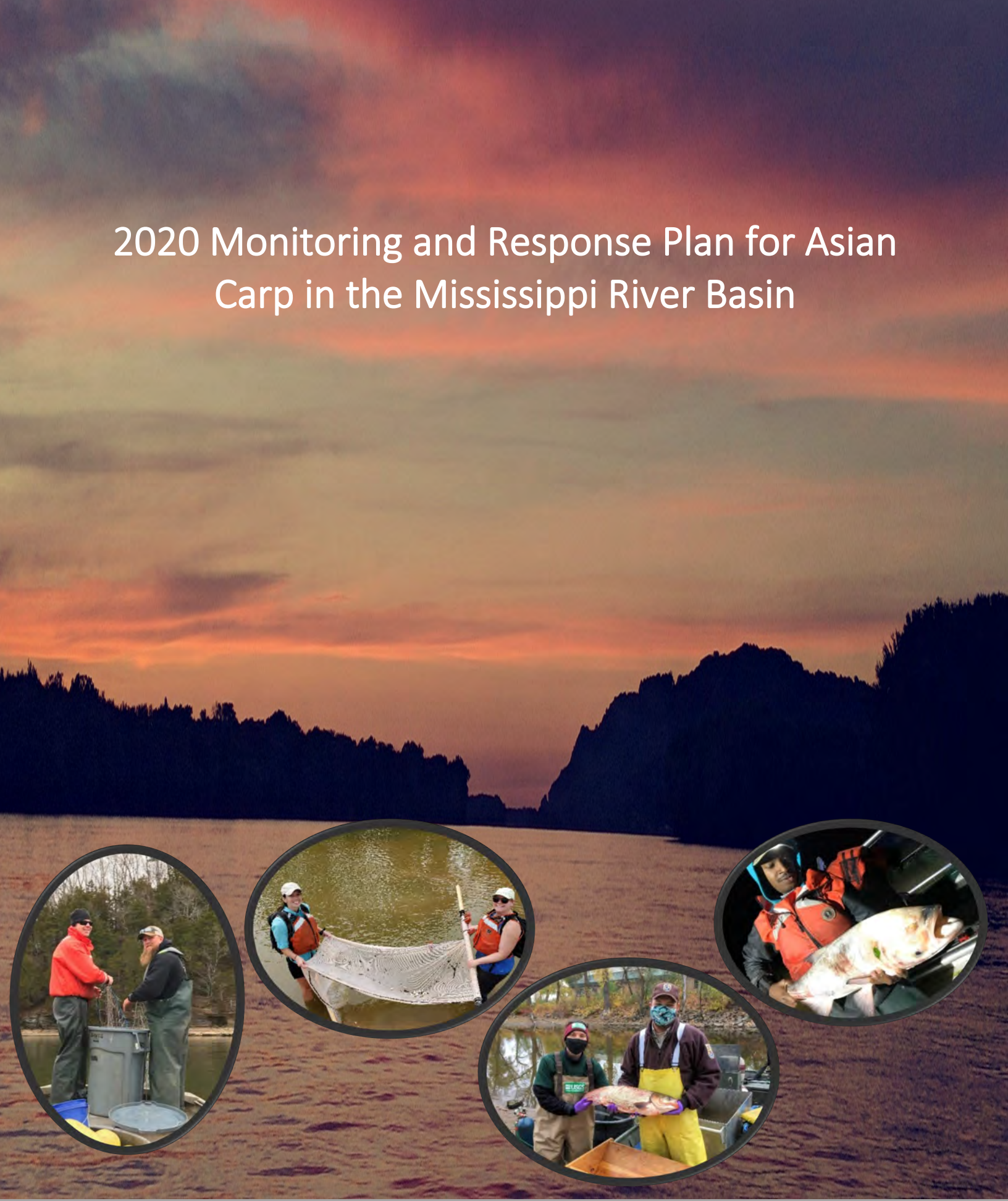
2020 Monitoring and Response Plan for Asian Carp in the Mississippi River Basin



Presented by the Mississippi Interstate Cooperative Resource Association
Asian Carp Advisory Committee

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Introduction

Mississippi River Basin Overview

The Mississippi River and its tributaries comprise one of the largest and most valuable ecosystems in the world. The Mississippi River Basin is the fourth largest watershed in the world, and the largest watershed in the nation, draining all or part of 31 states and 2 Canadian provinces (Figure 1). The watershed measures approximately 1.2 million square miles, covers 41% of the continental United States, and includes numerous large tributary systems including the Arkansas, Illinois, Missouri, Ohio, Tennessee, Cumberland, Red, and White rivers. Recreational boating and fishing in the Mississippi River and tributaries support many local economies throughout the Mississippi River Basin. In 2015, the U.S. Fish and Wildlife Service (USFWS) estimated the economic output from recreational fishing in the Mississippi River Basin at more than $19 billion (USFWS, unpublished data).

Figure 1. Map of the Mississippi River Basin which drains all or a portion of 31 states and 2 Canadian Provinces. Shading indicates the six MICRA sub-basin management units.

Interjurisdictional Fishery Management in the Mississippi River Basin

The Mississippi Interstate Cooperative Resource Association (MICRA) is a partnership of 28 state natural resources management agencies with fisheries management jurisdiction in the Mississippi River Basin. Federal agencies and chartered entities that manage and regulate aquatic resources within the basin also participate in the MICRA partnership. The MICRA partnership was formed in 1991 to improve management of interjurisdictional fishery resources in the basin through coordination, communication, and collaboration among the responsible management entities. MICRA functions as an umbrella organization that provides basin-wide coordination among multi-state compacts and partnerships that address interjurisdictional fishery management issues within six Mississippi River sub-basins: Arkansas-Red-White, Lower Mississippi, Missouri, Ohio, Tennessee-Cumberland, and Upper Mississippi (Figure 1).

Asian Carp Management and Control in the Mississippi River Basin

Aquatic Invasive Species (AIS) are causing negative impacts, potentially reversing progress made towards ecological rehabilitation and restoration in the Mississippi River Basin. Over the past two decades, four species of Asian carp (i.e., Bighead Carp, Black Carp, Grass Carp, and Silver Carp) have become a basin wide issue of concern for natural resource management agencies and the public. Bighead, Silver, and Grass carps have established self-sustaining populations and are spreading throughout the Mississippi River Basin (Figures 2 and 3). In recent years, Black Carp have been captured with increasing frequency in the Lower Mississippi, Upper Mississippi (below Lock and Dam 19), Illinois, lower Missouri, lower Ohio and lower Cumberland rivers. Multiple lines of evidence show that Black carp are self-sustaining in the open reaches of the Mississippi River Basin (records of young-of-year fish, multiple year classes of reproductively viable fish, and results of otolith microchemistry).

The Aquatic Nuisance Species Task Force approved the national *Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States* (National Plan) for implementation in 2007. MICRA actively worked with the six sub-basin groups to develop regional Asian Carp Control Strategy Frameworks (Frameworks) to step-down implementation of the National Plan throughout the Mississippi River Basin. The MICRA member agencies and their federal partners formed four sub-basin Asian carp partnerships (Figure 4) to develop and implement Frameworks in the Lower Mississippi River Sub-basin (LMRB), Missouri River Sub-basin (MORB), Ohio River Sub-basin (ORB), and the Upper Mississippi River Sub-basin (UMRB). The LMRB Framework is inclusive of the Arkansas-Red-White (ARWB) and Lower Mississippi River MICRA sub-basin groups, and the ORB Framework is inclusive of the Tennessee-Cumberland (TNCB) and Ohio River MICRA sub-basin groups. The four sub-basin Asian carp partnerships provide coordinated implementation of regional Frameworks throughout the Mississippi River Basin.

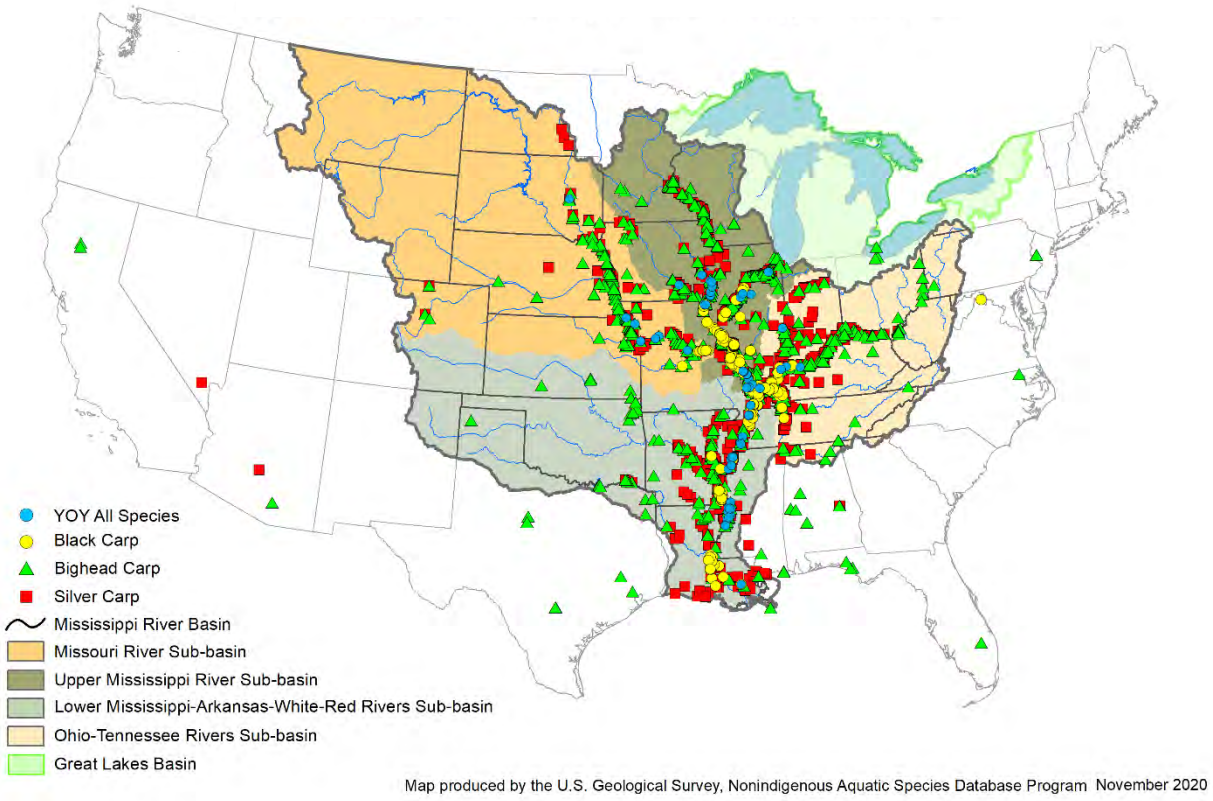


Figure 2. Distribution of Bighead Carp, Silver Carp, and Black Carp in the lower 48 states of the United States as reported to the USGS Nonindigenous Aquatic Species (NAS) Database as of July 2019. Shading indicates the sub-basin Asian carp partnerships within the Mississippi River Basin (Missouri River, Upper Mississippi River, Lower Mississippi-Arkansas-White-Red Rivers, and the Ohio-Tennessee Rivers) and the Great Lakes Basin. Asian carp Control Strategy Frameworks guide collaborative Asian carp efforts within each sub-basin.

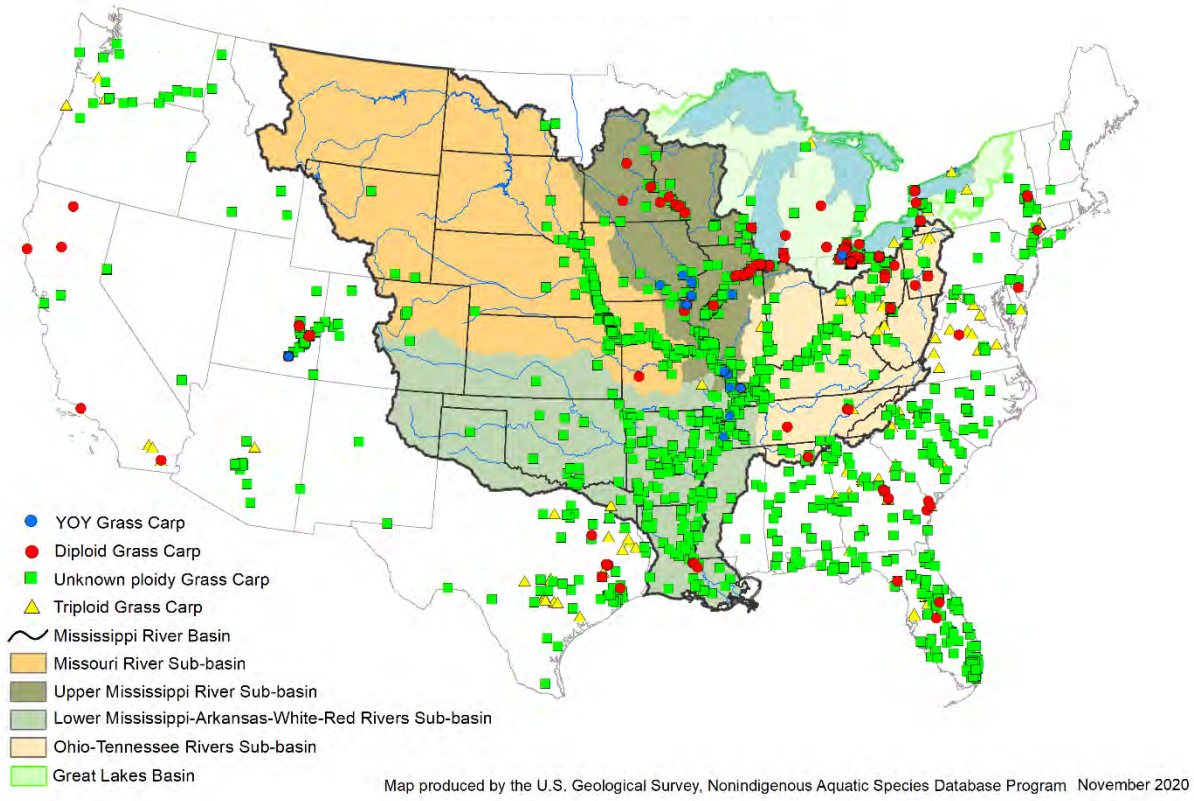


Figure 3. Distribution of Grass Carp in the lower 48 states of the United States as reported to the USGS Nonindigenous Aquatic Species (NAS) Database as of July 2019. Shading indicates the sub-basin Asian carp partnerships within the Mississippi River Basin (Missouri River, Upper Mississippi River, Lower Mississippi-Arkansas-White-Red Rivers, and the Ohio-Tennessee Rivers) and the Great Lakes Basin. Asian carp Control Strategy Frameworks guide collaborative Asian carp efforts within each sub-basin.

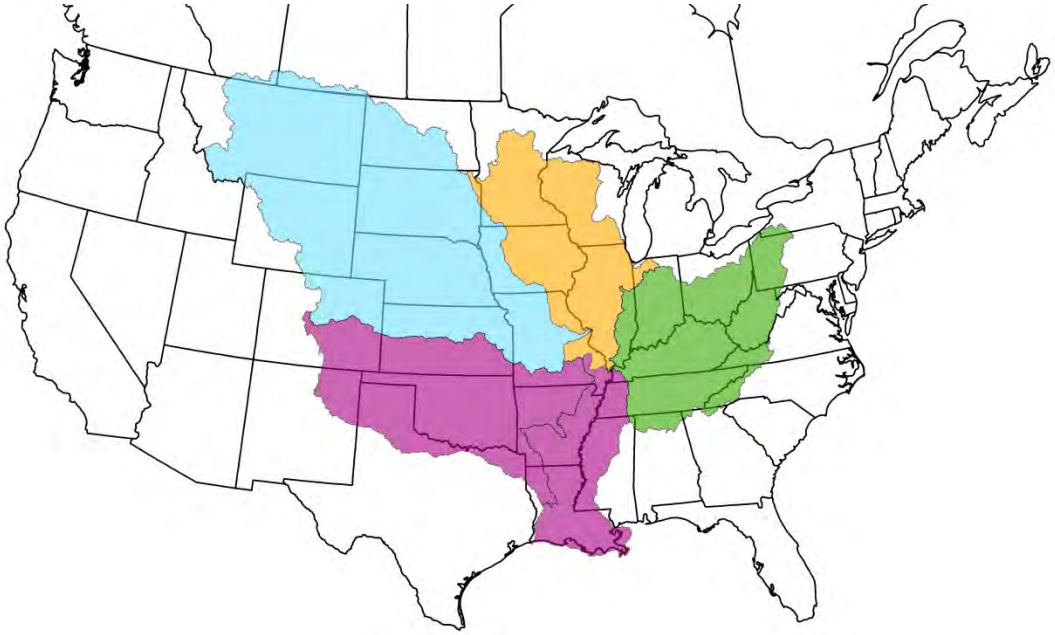


Figure 4. Development and implementation of Asian carp Frameworks in the Mississippi River Basin is broken down into four sub-basins including the Ohio River Sub-Basin (green; includes the Tennessee and Cumberland sub-basin), Upper Mississippi River Sub-Basin (yellow), Missouri River Sub-Basin (blue) and the Lower Mississippi River Sub-Basin (purple; includes the Arkansas, Red, and White sub-basin).

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 (now called an Asian Carp Action Plan) to prevent the introduction and establishment of Bighead and Silver carp populations in the Great Lakes since 2010. The ACRCC Action Plan coordinates the implementation of projects to prevent and control the movement of Bighead and Silver carps from the Mississippi River Basin into the Great Lakes. Many of these projects are implemented in the uppermost 175 miles (282.6km) of the Illinois River and the Chicago Area Waterway System (CAWS).

Mississippi River Basin Asian Carp Federal Authorization and Appropriations Overview

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 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 ORB and UMRB. Congress appropriated $2.4 million in the USFWS's FY2015 base budget for Asian carp prevention and control in the

ORB and UMRB[1], providing the first substantial funding to address Asian carp populations in the Mississippi River Basin beyond the upper Illinois River and the CAWS (Table 1). USFWS funding for Asian carp work in the ORB and UMRB increased to $2.6 million in FY2016. USFWS funding for Asian carp work in the ORB and UMRB totaled $3.1 million in 2017 with the addition of $500,000 by Congress specifically for the development and implementation of deterrence technologies in the field that are transferrable to other basins and potentially useful for other aquatic nuisance species. USFWS funding in FY2018 increased to $4.8 million and includes the addition of $1.7 million to "expand and perfect the combined use of contract fishing and deterrents" in the ORB and UMRB. FY2019 appropriations included an additional $600,000 to focus implementation of the Ohio River Basin Asian Carp Control Strategy Framework (ORB Framework) to the Tennessee and Cumberland Rivers, which are part of the ORB.

Table 1. Total annual appropriations to USFWS for Asian carp prevention and control work outside of the Great Lakes (beyond the upper Illinois River and the CAWS) from 2015-2019, and the amount of agency funding provided by USFWS to the Ohio River Sub-Basin and Upper Mississippi River Sub-Basin partnerships to support implementation of priority Framework actions within these two portions of the Mississippi River Basin.

Fiscal Year	USFWS	Ohio River Basin	Upper Mississippi River Basin
2015	$2,400,000	$400,000	$400,000
2016	$2,600,000	$500,000	$500,000
2017	$3,100,000	$600,000	$600,000
2018	$4,800,000	$1,150,000	$1,050,000
2019	$5,400,000	$1,735,000	$1,055,000

In FY20, Congressional direction and funding was substantially expanded to be inclusive of the entire Mississippi River Basin. The *2020 DOI, Environment, and Related Agencies Appropriations Act* increased the USFWS's FY20 base budget for Asian carp management and control to $25 million, a $14 million increase above FY19. The appropriations language stated that the "increased funding should be used to control Asian carp in the Mississippi River and its Sub-basins, including the Upper Mississippi River Sub-basin, Missouri River Sub-basin, Arkansas-Red-White River Sub-basin, Lower Mississippi River Sub-basin, Tennessee Cumberland Sub-basin, and Ohio River Sub-basin." In FY20, the USFWS worked closely with MICRA and the four Mississippi River sub-basin Asian carp partnerships to identify the highest priority project needs for implementation of the sub-basins' respective Frameworks. The

[1] Although no appropriations for Asian carp management and control in the ORB or UMRB were authorized in WRRDA 2014, the USFWS base appropriations directed to Asian carp management and control in the ORB and UMRB that began in Fiscal Year 2015 are often referred to by partner agencies as "USFWS WRRDA funding".

partnerships developed collaborative project proposals for implementation with FY20 funds to meet funding targets identified by the USFWS (Table 2).

Table 2. USFWS allocation of FY20 base funding for Asian carp prevention and control work in the six Mississippi River sub-basins. USFWS allocated a total of $13,919,996 to the support Framework implementation in the Mississippi River Basin in FY20.

ARWB	LMRB	MORB	ORB	TNCB	UMRB
$1,000,000	$1,300,000	$1,100,000	$8,019,996	$1,000,000	$1,500,000

Mississippi River Basin Asian Carp Project Coordination

To provide for state and federal agency executive level coordination on Asian carp prevention and control in the Mississippi River Basin, MICRA formed an Asian Carp Advisory Committee (ACAC) in 2016 (Figure 5). The ACAC consists of the MICRA Executive Board (i.e., one state agency representative from each of the six MICRA 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 (i.e., National Park Service, U.S. Army Corps of Engineers, and Tennessee Valley Authority). 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 basin-wide Asian carp prevention and control program.

MICRA works closely with USFWS to facilitate coordinated implementation of the national Plan in the Mississippi River Basin. The USFWS provides coordination support to each of the six sub-basin Asian carp partnerships to determine priority projects from their respective frameworks for implementation, identify lead and cooperating agencies for each project, and develop annual project proposals. The individual sub-basin Asian carp project proposals are compiled by MICRA, reviewed by the ACAC, and a Mississippi River Basin proposal package is then submitted by MICRA to the USFWS for funding consideration. Approved project proposals are developed into detailed annual work plans and compiled in the annual 'Asian Carp Monitoring and Response Plan for the Mississippi River Basin' (MRP).

Agencies collaborating on the USFWS-funded partnership projects provide interim annual (calendar year) reports to track and evaluate progress, report results, and inform planning for management and control actions in future years. The annual MRPs and interim annual reports are available on the MICRA website at: http://www.micrarivers.org/asian-carp-plans-and-reports/.

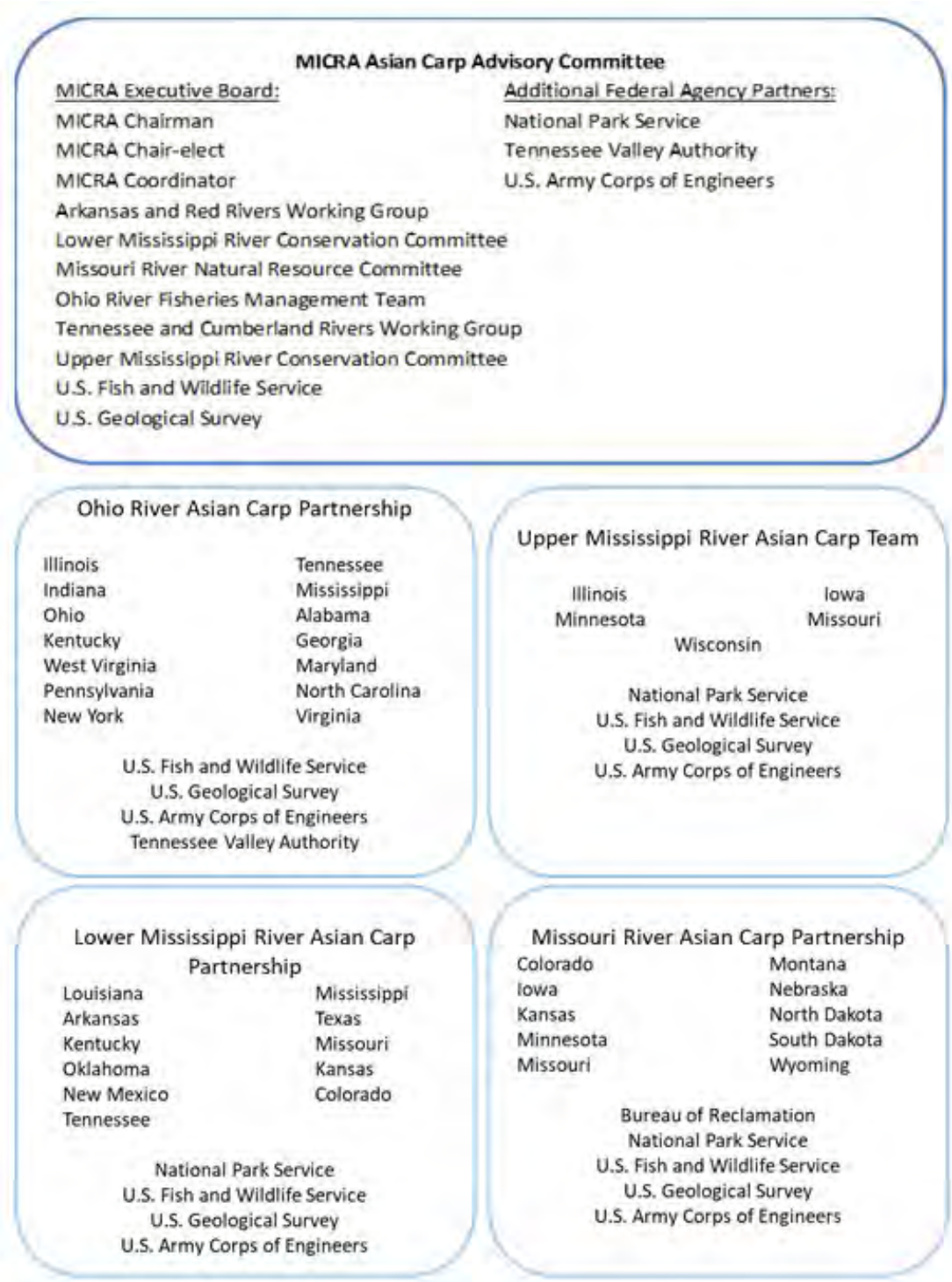


Figure 6. Structure for inter-agency coordination and implementation of Asian Carp Control Strategy Frameworks in the Mississippi River Basin. Basin-wide coordination occurs through the MICRA Asian Carp Advisory Committee and regional coordination occurs through four sub-basin Asian carp partnerships: Ohio River (inclusive of the Tennessee-Cumberland Sub-basin), Lower Mississippi River (inclusive of the Arkansas-Red-White sub-basin), Missouri River, and the Upper Mississippi River.

2020 Monitoring and Response Plan for Asian Carp in the Mississippi River Basin

The 2020 MRP includes project work plans for 25 projects collaboratively developed by state and federal agency partners throughout the Mississippi River Basin working together through four sub-basin Asian carp partnerships. In FY20, USFWS funding support was provided for 8 projects in the LMRB, including the ARWB; 4 projects in the MRB; 7 projects in the ORB, including the TNCB; and 6 projects in the MRB. An overview of each sub-basin partnership, a summary table of FY20 projects receiving USFWS funding support, and the full project work plans are provided in subsequent chapters for each sub-basin partnership.

Lower Mississippi River Sub-Basin Asian Carp Partnership

The Lower Mississippi River Sub-Basin (LMRB) Asian Carp Partnership includes 11 states from the Lower Mississippi River sub-basin and the Arkansas-Red-White River sub-basin. These states convened a partnership to develop an Asian Carp Control Strategy Framework, which steps down the National Plan to a more local level, allowing the partnership to collaboratively develop priority management and control projects. For project planning, the partnership often splits into two groups based on geography, but overlap exists. Partners in this sub-basin are at varying levels of knowledge about Asian carp status within their respective jurisdiction. Initial projects are investigating unknown areas for basic population demographic data, but also include control efforts in locations where practicable, movement projects to better understand passage through locks and dams and also between tributaries, and other high priority actions identified by the partnership.

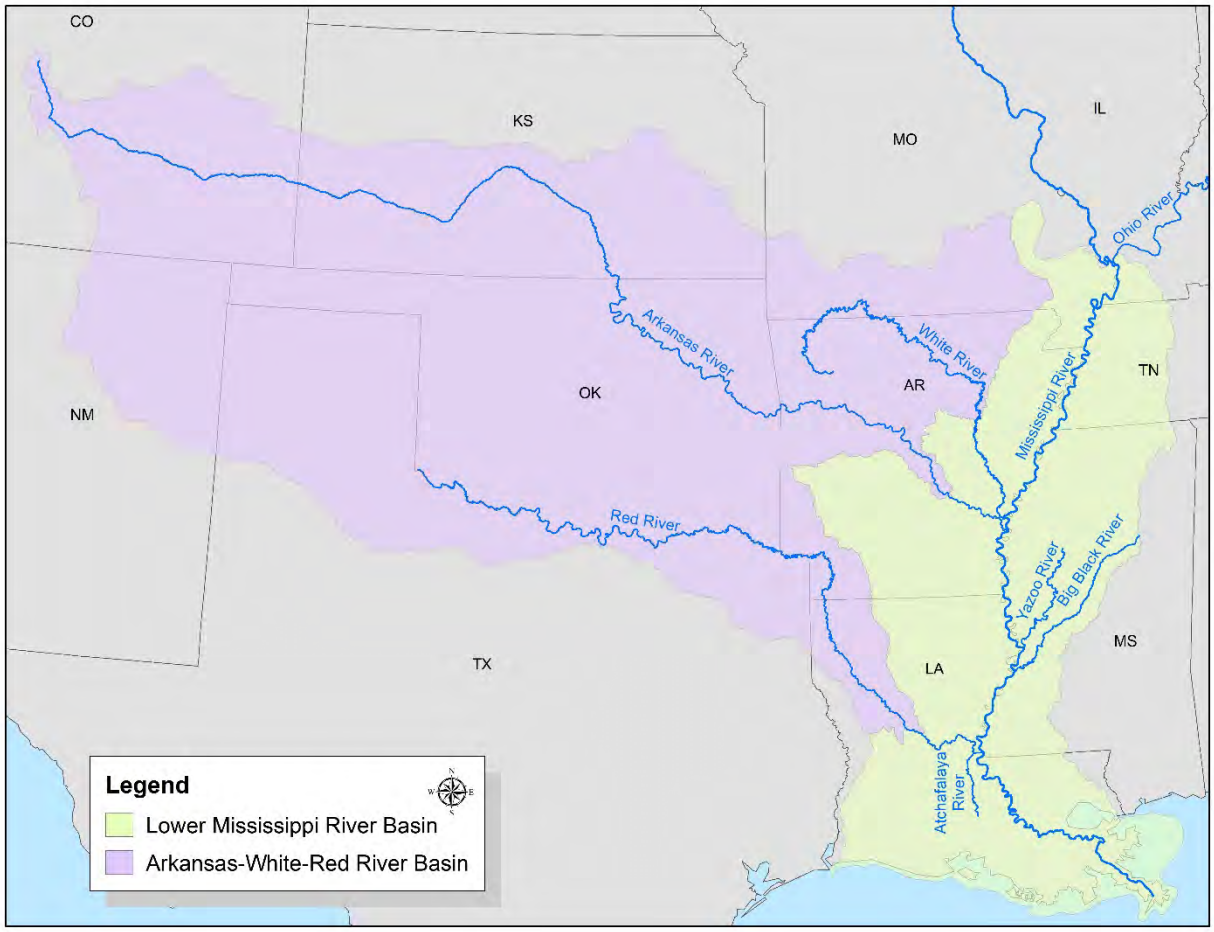


Figure 7. Map of the Lower Mississippi River Sub-Basin

Distribution and Population Demographics of Asian Carp in the Lower Red River Basin

Lead Agency and Author: Texas Parks and Wildlife Department (TPWD); Monica McGarrity (monica.mcgarrity@tpwd.texas.gov)

Cooperating Agencies: Oklahoma Department of Wildlife Conservation (ODWC), Arkansas Game and Fish Commission (AGFC), US Fish and Wildlife Service Oklahoma Fish and Wildlife Conservation Office (OKFWCO), Auburn Cooperative Fish and Wildlife Research Unit (ACFWRU), Texas Tech University (TTU)

Statement of Need: Asian carp pose significant ecological and economic threats to freshwaters around the globe, including in the Mississippi River Basin. Asian carp research activities have primarily focused on large floodplain rivers of the upper Mississippi River basin (e.g., Illinois, Mississippi, and Missouri rivers) where substantial advances in understanding their ecology have been achieved. However, substantially less is known about Asian carp populations in tributaries of the lower Mississippi River Basin where they have been studied less frequently (Chapman and Hoff 2011; Ochs et al. 2019). Their presence has been noted across the lower Mississippi River basin for a while (Thomas et al. 2011, Rodgers 2019) and sampling and landings data suggest their prevalence is increasing in the Lower Red River basin (TPWD, ODWC, AGFC, unpublished data). However, there is a general lack of information regarding the population dynamics of Asian carps and their effects on native fish communities of the lower Mississippi River basin. Understanding occupancy by bigheaded carps in the basin, both spatially and temporally, is vital for directing the management actions. Furthermore, there exists a great need to understand the trajectory of the bigheaded carps' invasion to predict their influences on native fish assemblages within these large tributary basins and associated reservoirs.

The objectives of this project, as outlined in this document, are aligned with and support the goals and objectives of the Lower Mississippi River Asian Carp Control Strategy Framework. This project will initiate a surveillance effort for Asian carp at a broad geographic scale across the Lower Red River Basin as well as establish baseline data for native fish assemblages potentially impacted by Asian carp needed for future evaluations of deleterious impacts. This project will address the general lack of knowledge of Asian carp population dynamics and native fish assemblages in this sub-basin. The intentions of this effort are to aid in early detection, assess population distribution and status, and facilitate future evaluations of deleterious impacts to native fishes. Data on Asian carp populations would also inform potential removal efforts. Collaborative efforts of multiple partners and agencies (state, federal, and university) will be implemented to accomplish the project goals and objectives. This project will provide an ongoing, coordinated effort to evaluate Asian carp distribution and status in the Lower Red River Basin that will contribute to a better understanding of the status of this species in the Mississippi River Basin as a whole.

Objectives:

1. Determine the spatial and temporal distribution and adult population demographics of Asian carp (Silver Carp and Bighead Carp)

2. Establish baseline native and non-native fish assemblage and habitat association data

Agency: Texas Parks and Wildlife Department (TPWD)

Activities and Methods: TPWD will coordinate with other agencies and universities to implement targeted sampling in the Red river and major tributaries in Texas, including the Sulphur River. TPWD will manage research contracts with ACFWRU and TTU to accomplish project objectives, guide identification of sampling sites, and assist with sampling as time and staffing permit. TPWD will lead development of project reports in collaboration with ODWC, AGFC, OKFWCO, ACFWRU, and TTU.

Red River and Tributaries

Portions of the Red River and major tributaries of Texas (Bois D'Arc Creek and Pine Creek) will be sampled; as noted below, OKFWCO will also sample Choctaw Creek in Texas using these methods. Access on extensive portions of the Red River below Texoma can be challenging; thus, we will choose sample locations to both well represent the study extent at locations accessible by boat or raft.

Spatial and Temporal Extent of Bigheaded Carp (Hypopthalmichthys spp.)

We will sample using a wide variety of gears during spring, summer, and fall. Sampling during winter will be limited because sample efficiency is so low due to water temperatures. Our catch rates from our first year of sampling will be used to help us determine which gear is most effective during the second year. We will use a combination of boat electrofishing, experimental gill nets, and trammel nets to sample different locations on the rivers. Several authors have noted that combining gears and 'chasing' fish into nets often produced the best results (Thompson 2013; Bouska et al. 2017; Butler et al. 2019). One reason to combine gears is that electrofishing may be more effective on Silver Carp (Williamson and Garvey 2005), whereas use of trammel nets has been one of the best approaches for sampling Bighead Carp (Garvey et al. 2012). Nets will be placed at narrow locations within the river channel to increase the likelihood of capture while electrofishing. We know that bigheaded carp occupy the Red River, OK as our previous sampling efforts captured them downriver of Lake Hugo on the Kiamichi River and at the confluence of the Muddy Boggy-Red River (Brewer, Unpublished data). This project, in conjunction with existing projects, will add to information on occupancy by carp in the Red River basin. Collectively, our goal is to document the spatial and temporal extent of bigheaded carp in the Red River basin of Oklahoma, Arkansas, and tributaries in Texas (itemized as three proposals with similar objectives). Investigators across the basin will work together to ensure consistency in both sampling and ageing approaches.

Captured fish will be sacrificed and information obtained from several structures. We will measure the total length and weight of all captured fish and determine the sex where possible (Wolf et al. 2018). Gonads of fish will be removed to later determine fecundity (i.e., total gonad weight, and egg counts). We will also remove fin rays and otoliths for later ageing and to determine recruitment patterns and estimate length at age. A subset of otoliths from adult bigheaded carps will be retained for the possibility of additional future work in outyears (not the current proposal) to examine microchemistry analysis to determine origins and coarse-scale movement patterns.

Population Demographics of Bigheaded Carps

An understanding of population demographic parameters is needed to assess the current status of bigheaded carps in the Red River basin. Baseline demographic data can also be used to assess future population responses to management actions (e.g., reduction efforts) and assess bigheaded carps' responses to environmental changes (e.g., flow regime patterns) over time. We will summarize population demographics of bigheaded carps using data collected during Objective 1. We will estimate catch-per-unit effort for each gear type to assess relative abundances of bigheaded carps across the Red River and tributaries (and including the Texas impoundment of Bois D'Arc Creek). The catch per-unit-effort data will provide a baseline estimate of abundance to assess future changes in native fish communities with increases or decreases in bigheaded carps' abundance. We will use individual length data to summarize size structure as a means to assess potential differences in recruitment patterns or growth patterns among drainages. We will also make use of bigheaded carp hard-part structures to facilitate age determination. A subset of 10 individuals from each 10 mm TL size group will have sagittal otoliths and pectoral fins removed (Coggins et al. 2013). We will process and age otoliths (including a second read) and pectoral fins using light microscopes and digital photographs. The subset of aged individuals along with their respective lengths will be used to create an age-length key to predict ages from lengths of unaged individuals. Age structure data will be summarized by location along the Red River and tributaries and used in catch curve regression to estimate instantaneous (Z) and annual (A) mortality rates among locations, if possible (i.e., depends on catch). Additionally, individual carp will be assigned to a year class and indices of recruitment will be assessed among locations. Gonads from both male and female carp will be taken during Objective 1 to assess timing of sexual maturity both in terms of individual fish age and seasonal timing of reproduction.

Habitat Associations of Bigheaded Carps and Native Fishes

Because relatively little sampling has occurred in the Red River basin and tributaries, we will determine habitat associations and large river assemblage structure during sampling for Objective 1. Habitat will be related to channel unit structure (i.e, pool, backwater, main channel, side channel, run) and be tributary specific in both Oklahoma and Texas. All bigheaded carps and native fishes sampled will be identified and native fishes released unless identification needs to be confirmed in the laboratory. All threatened and endangered fishes will be identified and released during the sampling event.

Because bigheaded carps are highly fecund and planktivorous, they are hypothesized to compete with most all native post-larvae and fry stages of fishes (Kolar et al. 2007; Cudmore and Mandrak 2011). Bigheaded carps may also compete for food with native adult planktivores (e.g., Paddlefish *Polyodon spathula*, Bigmouth Buffalo *Ictiobus cyprinellus*, and Gizzard Shad *Dorosoma cepedianum*, Schrank et al. 2003; Irons et al. 2007; Sampson et al. 2009). Moreover, established populations can use physical space typically occupied by native fishes and may result in species displacement leading to reductions in growth and survival.

We will focus additional sampling efforts on relatively shallow-water habitat of the mainstem Red River and major stream tributaries (i.e., especially near the confluences). Although age-0 bigheaded carp have been collected from floodplain lakes (e.g., Pegg et al. 2002; DeGrandchamp et al. 2007), most bigheaded carp collected from the Illinois River used the mainstem channel rather than floodplain lakes during their early life history (Norman and Whitledge 2015).

Because harvesting all sizes of bigheaded carp is necessary to achieve population collapse (see Tsehaye et al. 2013), we need to understand nursery habitats of bigheaded carp and native fishes in the Red River basin. This information is critical to both understanding critical removal areas (spatially and temporally) and it is also informative to understanding how changes in resources and biomass in these habitats might affect native fishes in this basin. Lastly, identifying areas that promote juvenile survival of both native and non-native fishes can be used to guide future management actions (e.g., targeted removal efforts of non-native fishes while minimizing harm to native fishes).

We will sample low-velocity habitats associated with the mainstem and larger tributaries of the Red River. Sampling for native and non-native juvenile fishes will begin in July and continue through September. Larger bigheaded carp typically spawn before smaller individuals (Hintz et al. 2017); thus, sampling as early as July will allow us the opportunity to capture very small juveniles that may be hatched early in the spring. We will sample areas around sandbars, backwater habitat, pool margins, and edges using a combination of seines, push nets, and electrofishing. Because the habitat is both complex and diverse within the Red River and tributaries, we will use a combination of habitat classification used in sand bed and gravel-bed streams (e.g., riffles, runs, pools, chutes, slackwater, ripples, dunes, sand bar heads and tails, backwater, etc). Our classifications will be collapsed into groups of similar mesohabitat character (e.g., ripples and riffles are similar in slope and water depth but differ via dominant substrate); however, differences in mesohabitats will be captured through quantification of specific microhabitat elements (e.g., substrates). Habitat conditions at sampling locations with be quantified at mesohabitat and microhabitat scales. Most captured native fish will be identified and released at the sampling location except a subset to be used as voucher specimens; all threatened and endangered fishes will be identified and released during the sampling event. All bigheaded carp juveniles captured will be removed from the system and otoliths retained.

We will remove lapilli otoliths from up to 20 juvenile bigheaded carp per species from each occupied site on each sampling date for aging. Otoliths will be mounted in thermoplastic cement, placed on microscope slides and sanded using 1,000 grit sandpaper and (or) diamond filament paper. Ring counts on otoliths will be performed by two independent readers using a compound microscope at 100× magnification. If otolith ring counts differ by more than 10% between readers, they will be discarded. We will estimate birth dates of juvenile Asian carp and examine conditions (discharge and temperature conditions) leading to successful recruitment. Otolith samples will be archived for potential future microchemistry analysis to assess origins and coarse-scale movements.

Sulphur River

Sampling on the Sulphur River in Texas will take place at multiple sites distributed across the Sulphur River waterway between Lake Wright Patman and the Arkansas border (Table 1). All Asian carp species encountered will be collected via a suite of sampling gears to track seasonal and annual changes in the presence and numbers of juvenile and adult life stages. The sampling required to achieve this purpose will entail repeated trips to the Sulphur River to deploy gears and collect data. Sampling locations along the Sulphur River will be selected that maximize the likelihood of capturing Asian carp (e.g., tailwaters, backwaters, deeper pool environments).

Additional sampling will occur within Lake Wright Patman to evaluate whether Asian carps may be present as a precautionary measure.

Monitoring data collected during the project will be used to evaluate the spatial and temporal extent of Asian carp and other native fishes within the study area. Study sites were identified as potential locations to deploy multiple gears. Gears will be distributed longitudinally to avoid trap interference (i.e., a trap affects the catch rate of another trap). The presence/abundance of adult and juvenile Asian carp will be used to determine whether reproduction is likely within the Sulphur River or whether they migrate from the Red River. Information including body sizes, sex ratios, and reproductive status will be used to characterize attributes of their population. In addition to assessing Asian carp, catches and body condition of native fishes will provide crucial baseline information (e.g., relative abundance, body condition, assemblage composition) of the native fish community of the Sulphur River. All threatened and endangered fishes will be identified and released during the sampling event.

Table 1. Sampling locations along the Sulphur River in Texas. Sites are approximate locations of proposed sampling.

Site	State	GPS	Habitat	Sampling Length
1	TX	33.264391, -94.347853	L. Wright Patman	
2	TX	33.305199, -94.156531	Dam tailwater	3.5 km
3	TX	33.299744, -94.061774	River/pool	3.5 km

Adult Asian Carp Sampling

Tailwater, pool, and confluence habitats will be prioritized and targeted to increase the likelihood of capturing Asian carp in the Sulphur River. Moreover, shallow stretches of river will be avoided when sampling adult life stages. In large rivers with complex river-floodplain configurations, Asian carp rapidly move amongst habitats, making their capture more difficult. In smaller systems like the Sulphur River, the lateral movements of Asian carp are more constrained by the width of the channel. Consequently, gears can fish a greater proportion of cross-sectional area of the river channel. A combination of hoop net sets, gill net sets, and boat electrofishing will be used to collect adult Asian carp in the Sulphur River. Hoop nets and gill nets are commonly used by commercial fishermen and agency biologists in the upper Mississippi River basin to capture Bighead carp (ACRCC 2016). Moreover, hoop nets are used by commercial anglers in the Sulphur River system, so data may be comparable if Asian carp catches are reported by the commercial fishing sector in the future. Boat electrofishing is commonly used by agency biologists. Data from this project can be used to compare catch rates with other locations in the lower and upper Mississippi River basin.

Hoop nets (4 net nights per site per sample period) will be set parallel to the shoreline to capture fish moving upriver. Hoop nets are 1.2 m in diameter and 4.8 m in length, with square mesh sizes of 6.4 cm. Experimental gill nets (4 net sets per site per sample period; 6-hour deployment) will be deployed concurrently with hoop nets. Hoop nets will be distanced approximately 250 m apart. Similarly, gill nets will be spaced 250 m apart. Hoop and gill nets will be positioned in closer proximity, pending suitable habitat. DC boat electrofishing will be conducted at 3 sites at

each sampling location. Transects will consist of 10-15 minutes of sampling along the river channel.

Juvenile Asian Carp Sampling

The dam at Lake Wright Patman is a potential barrier to the upstream migration of Asian carp. Yet, bait-bucket introductions may circumvent this barrier and facilitate the continued expansion of carps through Texas waterways. If small Asian carps aggregate in the tailwaters of dams, anglers may collect juvenile Asian carp as baitfish and accidentally introduce them above the dam. Juvenile life stages of Asian carps will be sampled monthly during summer months (July – September) to determine whether early life stages use the Sulphur River. Efforts will assess the potential for bait bucket introductions and inform whether additional effort (e.g., public outreach & education) is needed to reduce the spread of invasive fishes in Texas (Rodgers 2019, see Goals 1 and 2, pp 9-12). Sampling will determine whether early life stages are present in the Sulphur River (e.g., tailwaters of Lake Wright Patman; confluence with Red River).

To sample juvenile Asian carp, a combination of gears will be used. Previous work with Asian carps found mini-fyke nets and beach seining to be an effective combination for catching / detecting small (<6 inches) Asian carps (Collins et al. 2017). In general, more juvenile Silver Carp were captured in mini-fyke nets along channel margins of mainstem rivers when compared to backwater lake habitats (Collins et al. 2017). Mini-fyke nets (4 net nights per site per sample period) will be deployed from shorelines as described in Collins et al. (2017). In addition, beach seine hauls (8 hauls per site per sample period) will be used to actively sample the presence/absence of juvenile Asian carp along the Sulphur River. Finally, juvenile Asian carp will be sampled by DC boat electrofishing in conjunction with sampling of adult life stages.

Data collection and analysis

Asian carp catch rates will be determined for each gear type. Catch rates will be contrasted among gears to determine the most effective gear for sampling the Sulphur River. Moreover, catches will be aggregated to best characterize the fish assemblage. Seasonal and annual changes in the fish assemblage will be monitored to establish an ecological baseline. All or subsets of Asian carp will be processed for several metrics (Table 2). Body length (mm) and weight (g or kg) will be collected to determine body condition and population size structure (e.g., length-frequency histograms; mean body size). Estimates of body condition will be compared with Asian carps from other locations and serve as a baseline. Body condition is affected by density-dependence, so rapid changes in body condition could signal a rapid increase in Asian carp populations.

Asian carps will be dissected to determine an individual's sex and overall population sex ratio. Gonads will be removed to determine weight and GSI values. Gonads will be weighed (g), and GSI (GSI = 100 $*$ gonad weight [g]/body weight [g]) will be calculated for males and females (Crim & Glebe 1990). Developmental stages of both genders will be assessed for collected individuals to determine reproduction potential within the Sulphur River. Such assessments can be used to identify whether females spawned once, spawned multiple times, or reabsorbed their eggs (Papoulias et al. 2006, Camacho 2016). Information can be examined relative to hydrographs and water temperatures to assess correlations between potential spawning events and environmental cues. Total numbers of eggs will be determined based on density-weight relationships for each female captured. The ova from a 1 g sample of the ovaries will be

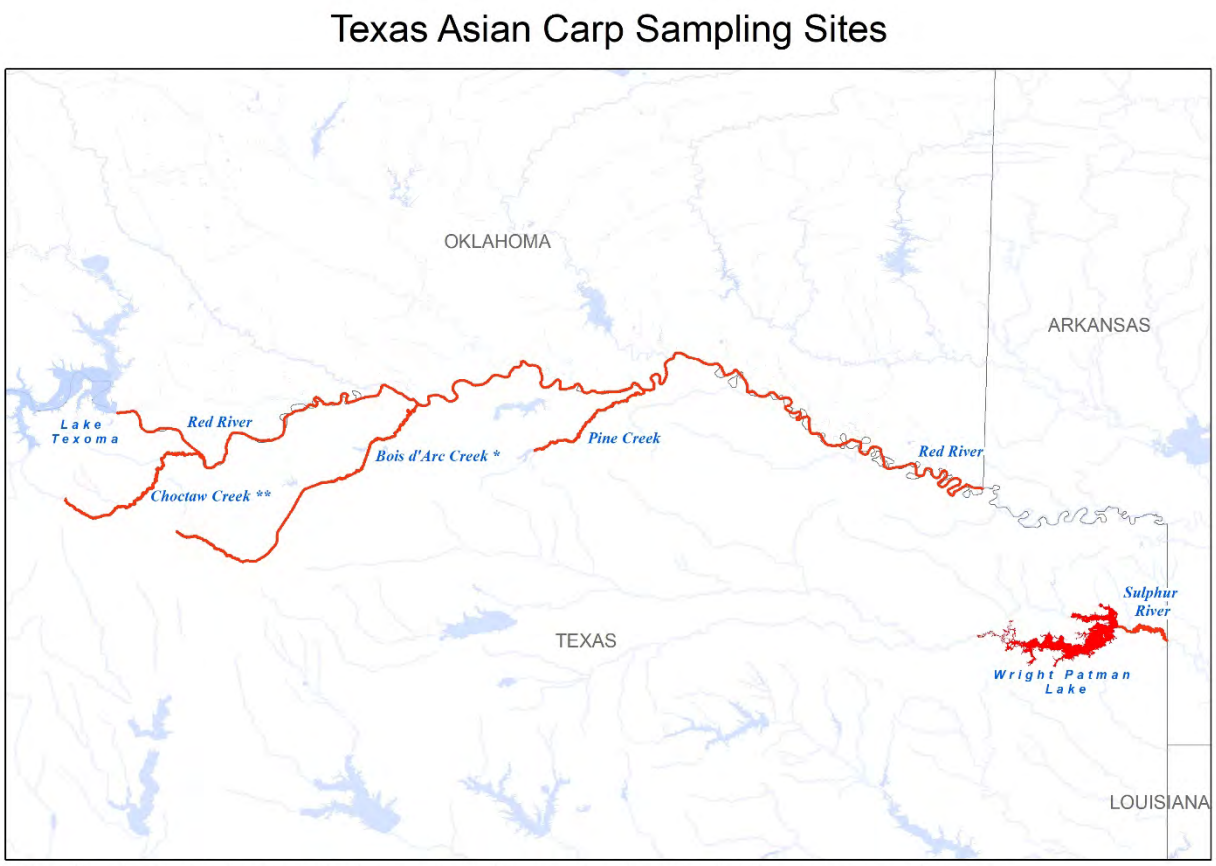
enumerated and multiplied by the weight of both ovaries to estimate fecundity (Crim & Glebe 1990). Findings will be scaled to the population to determine the potential reproductive output by the population.

Otoliths will be extracted to determine annual growth rates, associated age-length relationships of the population, and relationships with gonad weights to estimate age-at-maturity. Following processing, otolith samples will be archived to facilitate potential future microchemistry analysis of fish origins and coarse-scale movements. Environmental variables (temperature, river velocity, dissolved oxygen, pH) will be collected at each site. Data will be used in conjunction with assessments of reproductive development to assess correlations and potential environmental cues for spawning. Liver tissue from each Asian carp will also be collected, preserved, and archived for potential future DNA analysis to assess the degree of hybridization within the sampled population. Samples will also be collected to facilitate future characterization of diet habits of Asian carp to determine what individuals are consuming across seasons. The first 20 cm of the digestive tract will be removed and preserved to characterize the diet habits of Asian carp in the Sulphur River in comparison to data availability. Samples will be stored in ethanol (70%) and archived for future study. Water grab samples will be sieved to collect zooplankton to estimate prey densities. Likewise, surface waters will be collected (100 ml) to determine the concentration of phytoplankton at sampling locations. Samples will be preserved for future analysis to determine spatial patterns of plankton in relation to the dam and examine data in relation to seasonal growth and fecundity of juvenile and adult Asian carp (Williamson and Garvey 2005). Data could also be used in the future as explanatory covariates to analyze catch rates of Asian carp in gears along the Sulphur River to assess whether catch rates are influenced by food availability.

Table 2. Summary of information to be collected from individually captured Asian carp from the Sulphur River. Metrics will be used to examine different components of Asian carp population. Life stage: J = Juvenile, A = Adult.

Metric	Life stage	Quantity	Need
Length, weight	J, A	All	Population size structure, body condition factor
Gonad assessment	A	All	Sex ratio, GSI score, fecundity
Otoliths	J, A	All	Length-age, growth rates
Fin clips	J, A	Subset	DNA analysis for hybridization
Digestive tract	J, A	Subset	Assessment of diet habits

Map of Texas Project Area:



* Bois d'Arc Creek will be impounded by the time of sampling; sampling will occur only in impoundment and downstream
** Choctaw Creek will be sampled by OKFWCO in collaboration with TPWD

Estimated Timetable for activities:

Activity	Time Period (Season, month/year)
Targeted Bigheaded Carp and Native Fish Sampling – Red River and tributaries in OK, TX & AR	Fall 2020, Winter 2020 (limited), Spring/Summer 2021
Targeted Asian Carp and Native Fish Sampling – Sulphur River and tributaries in TX & AR	Fall 2020, Spring/Summer 2021
Project Executive Summary	October 2021
Project Technical Report	February 2022
Targeted Bigheaded Carp and Native Fish Sampling – Red River and tributaries in TX & AR	Fall 2021, Winter 2021 (limited), Spring/Summer 2022
Targeted Asian Carp and Native Fish Sampling – Sulphur River and tributaries in TX & AR	Fall 2021, Spring/Summer 2022
Project Executive Summary	October 2022
Final Project Technical Report	February 2023

Agency: Oklahoma Department of Wildlife Conservation (ODWC)

Activities and Methods: ODWC will coordinate with other agencies and universities to implement targeted sampling in the Red River and major tributaries in Texas, including the Sulphur River. ODWC will manage a research contract with ACFWRU to accomplish project objectives, guide identification of sampling sites, and assist with sampling as time and staffing permit. ODWC will collaborate with TPWD, AGFC, OKFWCO, ACFWRU, and TTU on project report development.

Sampling activities and methods in Oklahoma waters will be the same as described for the Red River and tributaries in Texas (see TPWD activities and methods above). Areas to be sampled in Oklahoma include the Red River downstream of Lake Texoma, lower Muddy Boggy Creek, lower Blue River, and the Kiamchi River downstream of Lake Hugo. Year 2 sampling in Oklahoma waters is not included in the current project due to funding constraints but a separate proposal for this work will be submitted next fiscal year for continuation of these efforts.

Map of Oklahoma Project Area:

Estimated Timetable for activities:

Timeline will be the same as shown above for TPWD for the Red and Sulphur rivers.

Agency: Arkansas Game and Fish Commission (AGFC)

Activities and Methods: AGFC will coordinate with other agencies and universities to implement targeted sampling in the Red River and major tributaries in Texas, including the Sulphur River. AGFC will manage research contracts with ACFWRU and TTU to accomplish project objectives, guide identification of sampling sites, and assist with sampling as time and staffing permit. AGFC will collaborate with TPWD, ODWC, OKFWCO, ACFWRU, and TTU on project report development.

Sampling activities and methods in Arkansas waters will be the same as described for the Red River and tributaries and Sulphur River in Texas (see TPWD activities and methods above).

Sampling sites in Arkansas will be located on the Red River, Little River downstream of Millwood Lake, and the Sulphur River. Sampling on the Sulphur River in Arkansas will take place at multiple sites distributed across the Sulphur River waterway between the Texas border and the confluence of the Red River (Table 3).

Table 3. Sulphur River sampling locations in Arkansas. Sites are approximate locations of proposed sampling.

Site	State	GPS	Habitat	Sampling Length
4	AR	33.195979, -93.936353	River	3.0 km
5	AR	33.093521, -93.862180	River confluence	4.0 km
6	AR	33.112708, -93.858483	Red River	4.0 km

Map of Arkansas Project Area:

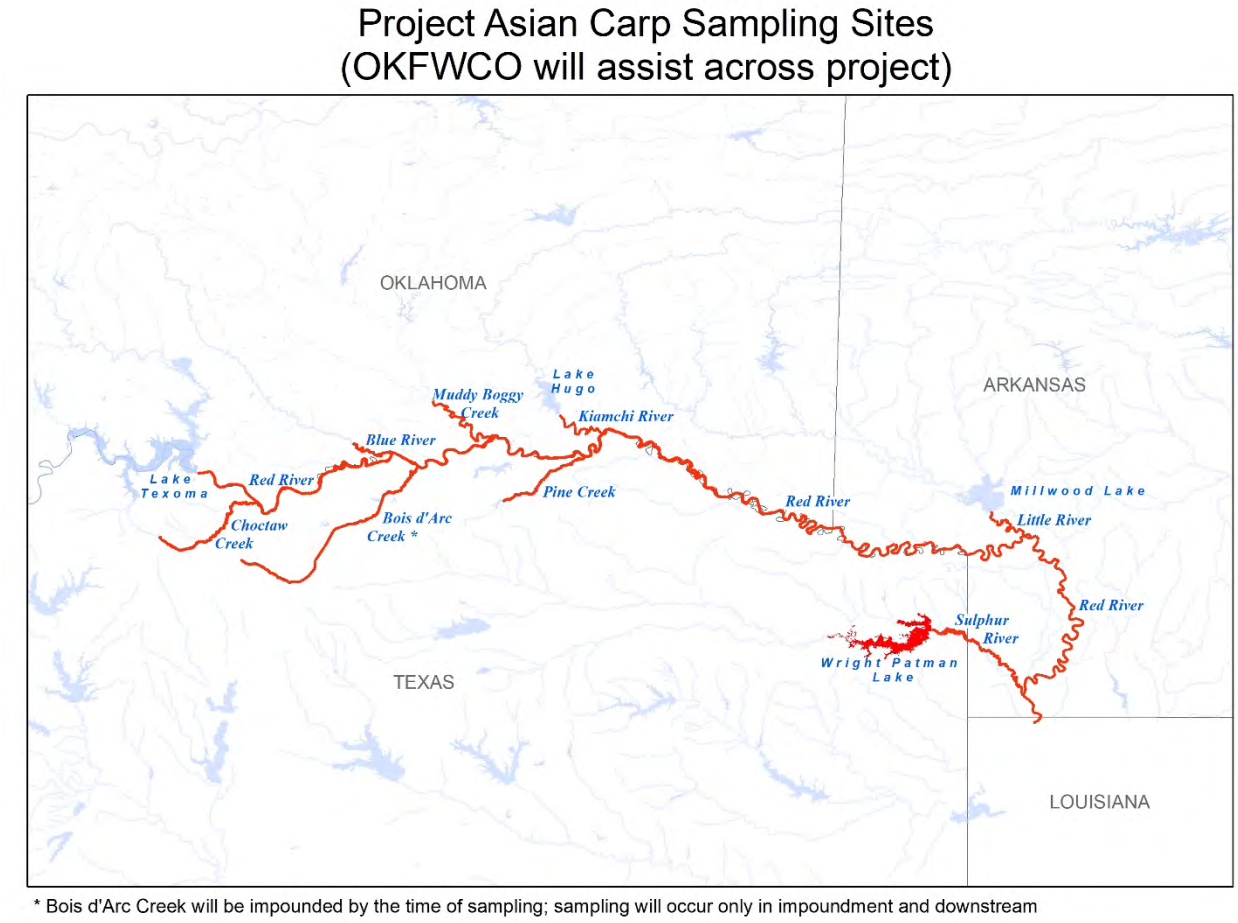
Estimated Timetable for activities
Timeline will be the same as shown above for TPWD.

Agency: US Fish and Wildlife Service, Oklahoma Fish and Wildlife Conservation Office (OKFWCO)

Activities and Methods: OKFWCO will coordinate with other agencies and universities to assist with targeted sampling in the Red River and major tributaries in Texas, including the Sulphur River, as time and staffing permit and will lead sampling on Choctaw Creek (Red River tributary in Texas). OKFWCO will collaborate with TPWD, ODWC, AGFC, ACFWRU, and TTU on project report development.

Sampling activities and methods will be the same as described above for TPWD. Sampling will be conducted in collaboration with researchers at sites designated for Texas, Arkansas, and Oklahoma above with the addition of Choctaw Creek in Texas.

Map of OKFWCO Project Area:



Estimated Timetable for activities

Timeline will be the same as shown above for TPWD.

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Distribution and Population Demographics of Bighead Carp in the Neosho River-Grand Lake System to Inform Removal

Lead Agency and Author: Kansas Department of Wildlife, Parks, and, Tourism (KDWPT**);** Chris Steffen (chris.steffen@ks.gov)

Cooperating Agencies: Oklahoma Department of Wildlife Conservation (ODWC), Missouri State University (MSU)

Statement of Need: Introduced Asian carps (Bighead Carp, Black Carp, Grass Carp, and Silver Carp) have become established in many portions of the Mississippi River Basin (Jennings 1988; Kolar et al. 2005). The feeding habits and population densities of the Asian carps cause significant ecological harm where populations become established (Schrank et al. 2003; Irons et al. 2007; Sampson et al. 2009; Solomon et al. 2015; Phelps et al. 2017a). The resulting diminished opportunity for fishing (recreational and commercial), boating, and other wildlife-associated recreation causes significant negative economic impact.

Bighead Carp are occasionally captured within the Neosho River/Grand Lake system, but very little targeted sampling has occurred in either Kansas or Oklahoma. Existing Bighead Carp records are from a combination of public captures (primarily from paddlefish anglers) and incidental capture of Bighead Carp by ODWC while sampling for other fishes. Due to the limitations of the existing data, the precise distribution and abundance of Bighead Carp in the system is unknown.

This population of Bighead Carp also represents the only known population of either species of Bigheaded Carps in the United States to be potentially reproducing in a reservoir completely isolated from the source populations. This provides a unique opportunity to learn about Asian Carp and test ideas for removal or suppression in this type of system. Reservoir systems are incredibly important recreationally and economically in the United States. As Asian Carp spread up Mississippi River tributaries and congregate below reservoir dams, the risk of introduction of Asian Carp to these reservoirs increases; as does the need to learn more about how to manage Asian Carp populations in reservoirs.

The planned sampling in this project will fill in knowledge gaps on Asian Carp distribution in the Neosho-Grand Lake system, which supports Lower Mississippi River Strategy 2.4 [Implement contract surveillance or targeted Asian carp sampling to monitor the distribution and abundance of Asian carps. (National Goal 2)]. Due to suspected low Bighead Carp density in the system, the use of eDNA sampling is planned, which supports strategy Lower Mississippi River Strategy 2.5 [Use eDNA testing to guide early detection efforts. (National Goal 2)] Sampling will also occur in portions of the basin where it is unknown if Bighead Carp occur in line with Lower Mississippi River Strategy 2.6 [Use new technology and techniques to aid in the detection of Asian carps outside their known distribution. (National Goal 2)]

This project is planned as a stepping-stone to future work. Bighead Carp density and reproduction is likely low in the system, which potentially provides an opportunity to suppress

the population prior to them reaching problematic levels seen in other systems. This initial work will provide guidance on how, where, and when to capture Bighead Carp in this system as well as provide insight into the current size of the population.

Objectives:

1. Identify locations of presence and upstream extent of Bighead Carp population within the Neosho River – Grand Lake system.

2. Collect baseline population demographic information including relative abundance, age and growth, and size structure.

3. Determine broadscale movements within the Neosho River system using otolith microchemistry.

4. Identify locations within the Neosho River – Grand Lake system for containment, removal, and/or eradication efforts.

Agency: Kansas Department of Wildlife, Parks, and, Tourism (KDWPT)

Activities and Methods: KDWPT will coordinate and serve in a guidance role. KDWPT will contract with Missouri State University (MSU), who will be planning and conducting the project activities. ODWC and KDWPT will assist with project objectives as needed.

Objective 1.
Newly emerging protocols (implemented by USFWS) have been developed using eDNA that allow for quickly assessing the distribution and relative abundance of fishes. In cases where an individual species may be rare or difficult to detect using traditional fisheries sampling gear, eDNA provides a cost effective alternative for fisheries monitoring programs.

We propose developing a Neosho River-Grand Lake System Asian carp environmental DNA program throughout the system (see map). We will sample throughout the performance period May 2021-March 2023 (see table below) at spatially selected sites throughout the system. This program would use existing eDNA protocols utilized by the USFWS. The proposed program would use already "in place" infrastructure (i.e., existing eDNA collection and processing approaches) to analyze eDNA samples. This project would be collaborative in nature because personnel in charge of this project have been trained by USFWS service employees for eDNA sampling and would be present during collection.

Furthermore, Asian carp will be sampled at the same sites as above (at eDNA locations if feasible) using a defined compliment gill nets, trammel nets, and electrofishing throughout the performance period (see table below). For each sample, fishes will be identified, quantified (catch per unit effort) measured (to the nearest mm), and weighed (to the nearest gram) in the field. As a point of protocol, macrohabitat type (e.g., channel border, island, tailwater, tributary, main channel, backwater/embayment) and mesohabitat (e.g., water depth, velocity, substrate) will also be recorded at each sampling site (allowing for quantification of habitat use).

Objective 2

Our goal will be to collect as many bigheaded carp as possible throughout Neosho River-Grand Lake System from objective one above (including fish from anglers or other agency sampling). At time of collection, Asian carp will be measured (total length; nearest mm for size structure Phelps and Willis 2013), weighed (nearest g), and otoliths removed for ageing (Seibert and Phelps 2013, Phelps et al. 2017b). Asian carp will also be necropsied or externally viewed to determine sex (Wolf et al. 2018), reproductive potential (reproductive stages; Seibert et al. 2015 for a similar approach), total gonad weight, and egg counts. Stomach analysis will also be conducted to determine forage items and abundance. Using these population-level attribute data, the following will be constructed; length-frequency distributions, age-frequency distributions, condition (via length-weight regressions), sex ratios, fecundity, gonadosomatic index, and size structure index (proportional size distribution).

Furthermore, the dynamic rate functions will be estimated using the following methods:
To determine the relative number of Asian carp that are entering (i.e., recruiting) the systems each year, the number of fish in each year class will be quantified. Ages derived from otoliths will be used to determine recruitment patterns. For each age class present throughout the Neosho River-Grand Lake System, we will quantify the relative strength or weakness of each cohort within each reach using the residual method. Specifically, positive residual values from the regression would indicate a relatively strong year class while negative residuals would indicate weak year classes. Recruitment variability will be quantitatively analyzed using recruitment coefficient of determination. Mortality rates of the Asian carp in the Neosho River-Grand Lake System will be determined using a catch-curve approach. Catch curves will be generated by summing the number of fish caught per age class. These data will allow for the development of individual regression models to estimate instantaneous mortality. Instantaneous mortality rate (Z), which will be used to determine the total annual mortality ($A = 1- e^{-Z}$) for selected fishes from each river reach. Growth will be estimated for Asian carp by determining the mean length at age. Mean-length at age data will be incorporated into Fisheries Analysis and Modeling Simulator and will be used to model growth using a von Bertalanffy approach. The equation generated using the von Bertalanffy growth model is $Lt = L\infty(1-e(-K(t-t0))$; where, Length infinity ($L\infty$) is the theoretical maximum length that a fish can achieve, K is the growth constant or growth rate of the population, and t0 is the theoretical length at time zero (i.e., age 0).

Given the dynamic rate information (i.e., growth, mortality, maximum age, length-weight regression, natural mortality, and male to female ratios) obtained above, we will use the yield-per-recruit modeling option in FAMS (Slipke and Maceina 2014) to determine the relative exploitation rate to overfish the Asian carp population. FAMS uses the Jones (1957) modification of the Beverton– Holt equilibrium yield equation developed by Ricker (Ricker 1975). Within the modelling interface of FAMS, we will use both the yield-per-recruit (YPR) and the static spawning potential ratio (SPR) option. This modeling approach assumes fixed recruitment and all simulations will be started with an initial population size of 1,000 recruits. This will ultimately allow the evaluation of the relative influence of many exploitation rates simultaneously on the population (Slipke and Maceina 2014). Using FAMS, Yield-per- recruit

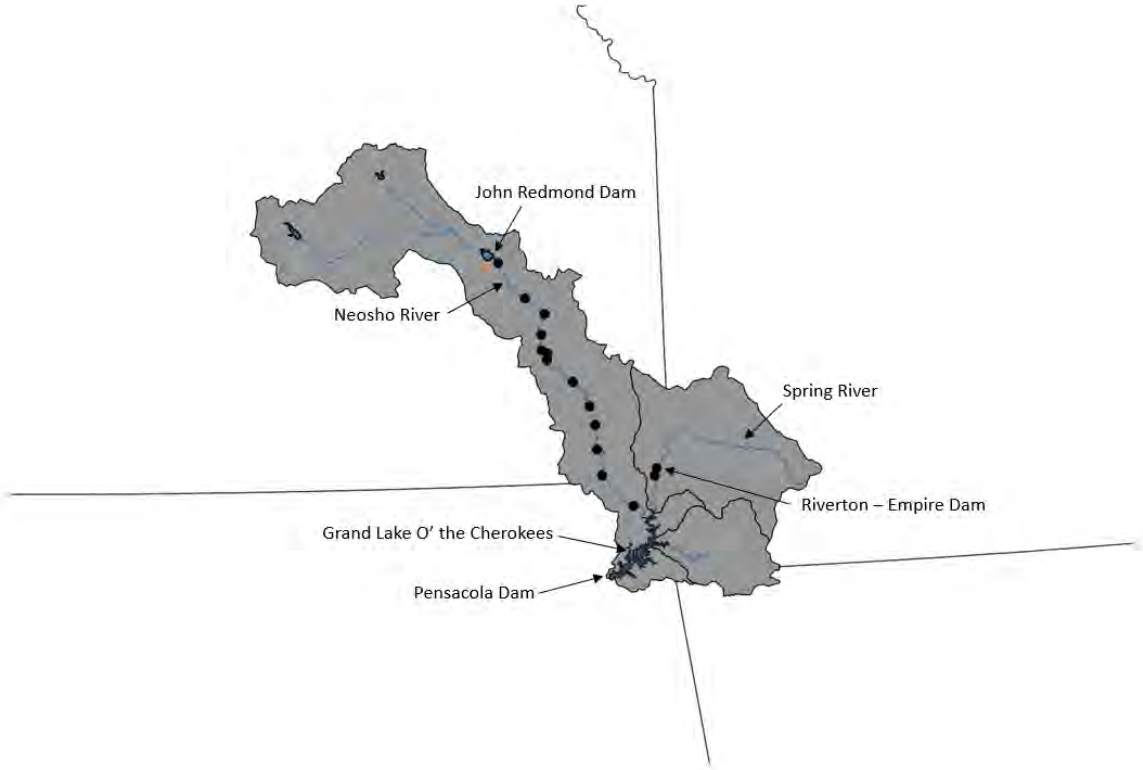
(YPR) and spawning potential ratio (SPR) will be assessed for various exploitation rates in 5% intervals, (i.e., 5% – 95%) with Asian carp of varying target harvest lengths

Objective 3
Recent research has demonstrated that fishes that reside in the Upper Mississippi, Middle Mississippi, Ohio, Missouri, or Illinois rivers can be distinguished from one another using naturally occurring, river-specific chemical "signatures" present in fish otoliths, fin spines, and fin rays. Fish hard parts contain a permanent chronological record of the "signatures" representing environments an individual fish has occupied during its lifetime, enabling reconstruction of that fish's environmental history through sub-sampling for isotopic and elemental analysis across the hard part (Carlson et al. 2017). This approach is currently being applied to identify natal environments and immigration patterns of adult Asian carps in the Illinois River, Missouri River, and Mississippi River.

We propose using a similar approach as above to identify natal/nursery environment throughout the Neosho River, Spring River, and Grand River system and characterize movement patterns for all Asian carps collected throughout the system through analyses of trace elements or isotopes within fish hard parts. Fishes will be collected using a variety of gears, principally electrofishing, gill nets, angling, and trammel nets (see objective one). Fish hard parts (e.g., otoliths) will be extracted from each fish (from objective one); one structure from each fish will be embedded in epoxy, sectioned, cleaned, and analyzed for trace elements or isotopic composition using mass spectrometry. Trace element or isotopic signature at the core will be used to identify natal environment for each fish via comparison with established signatures indicative of residency in each of the river segments listed above. Changes in elemental composition along the fish hard part will be used to infer frequency and timing of immigration into various river reaches from other river segments. Additional water samples will need to be collected overtime to bolster the water chemical library and ensure temporal consistency in water chemistry.

Objective 4
Using insight from information from the 3 objectives above, project participants will enter all data into a standardized database and share with all project partners. Discussions among partnering agencies will occur and an executive summary and final project report will be constructed to determine locations within the Neosho River – Grand Lake system for containment, removal, and/or eradication efforts. MSU will send regular updates to project partners as samples are processed, to inform the group of any new findings. These data will help inform managers of the current status of Asian carp populations in the Neosho River – Grand Lake system. Project partners will disseminate these findings to the basin planning committee, which will be used to guide the allocation of future management efforts to meet the needs of the LMR basin. An executive summary will be provided to the ODWC April 2023.

Map of Project Area (unlabeled dots indicate lowhead dam location):


John Redmond Dam
Neosho River
Spring River
Riverton – Empire Dam
Grand Lake O' the Cherokees
Pensacola Dam

Estimated Timetable for activities

Activity	Time Period (Season, month/year)
Water Chemistry Sampling	**May 2021**
eDNA sampling, traditional sampling	**May-July 2021**
Water Chemistry Sampling	**July-August 2021**
Data Analyses (Population Demographics)	**August 2021**
eDNA sampling, traditional sampling	**October 2021**
Water Chemistry Sampling	**December 2021**
eDNA sampling, traditional sampling	**January 2022**
Data Analyses (Population Demographics)	**February 2022**
eDNA sampling, traditional sampling	**March 2022**
Data Analyses (Population Demographics)	**April 2022**
eDNA sampling, traditional sampling	**May-July 2022**
Data Analyses (Population Demographics)	**August 2022**
Otolith Chemistry Sampling	**August 2022**
eDNA sampling, traditional sampling	**October 2022**
Data Analyses (Population Demographics)	**December 2022**
eDNA sampling, traditional sampling	**January 2023**
Data Analyses (Population Demographics)	**February 2023**
Otolith Chemistry Sampling	**February 2023**
eDNA sampling, traditional sampling	**March 2023**
Summary and Reporting	**March-April 2023**

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Control of Asian Carp in the Arkansas-Red-White River Basin

Lead Agency and Author: Arkansas Game and Fish Commission (AGFC); Jimmy Barnett (jimmy.barnett@agfc.ar.gov)

Cooperating Agencies: N/A

Statement of Need: Asian Carp populations have been increasing in most of Arkansas's big rivers. Bighead carp are known in the Arkansas River from the Oklahoma state line to the Mississippi River and in the White River from Batesville to the Mississippi River. Silver Carp have not been documented above Dardanelle Lock and Dam on the Arkansas or above Dam 2 on the White River. Grass Carp are abundant in both the Arkansas and White Rivers. Black Carp have been documented in the White River up to the Devall's Bluff area. These range extensions suggest that population numbers for these species are increasing and will likely continue to increase into the future, including invasions into the larger tributaries of these rivers.

Public sightings and subsequent reports are increasing in the Arkansas and White Rivers. The increase in Asian Carp populations is doing harm to recreation activities and is likely negatively impacting the native fishery. The tasks outlined in this document are designed to reduce Asian Carp numbers. This activity supports goal 3.2 of the Lower Mississippi River Basin Asian Carp Control Strategy Framework. This is AGFC's first year to attempt to reduce Asian Carp populations. Harvest data should increase our knowledge of Asian Carps, reduce the population size, explore possible deterrent locations, and reduce the chance for upstream range expansion.

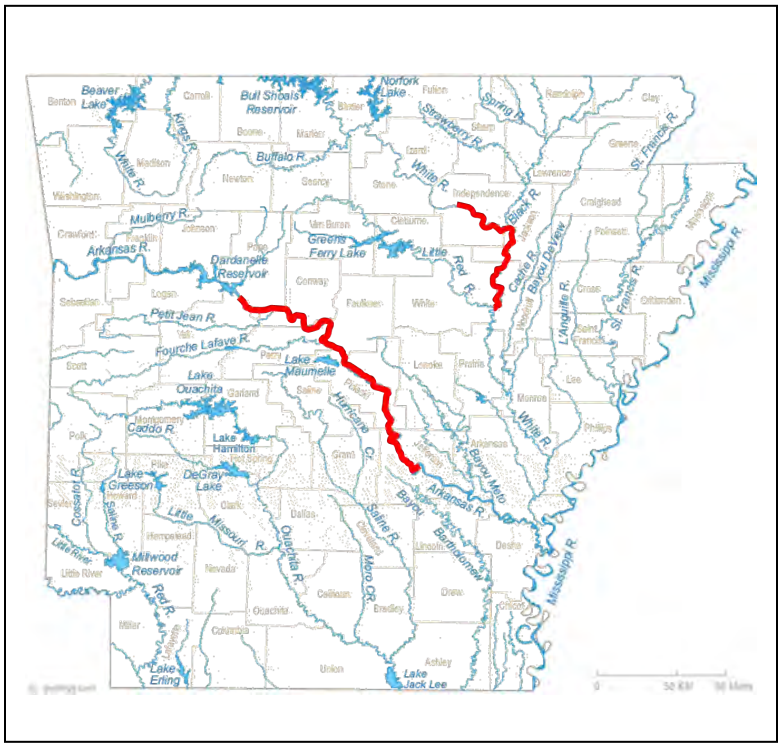
Objective:

1. Reduce Asian carp population numbers by utilizing contracted commercial fishing to implement Asian carp removal programs.

Agency: Arkansas Game and Fish Commission

Activities and Methods: The Arkansas Game and Fish Commission (AGFC) will hire two commercial fishing crews. One crew will have Arkansas River experience and one crew will have White River experience. The methodology to harvest fish from these rivers is very different and requires first-hand knowledge to effectively harvest fish. The Arkansas River crew will fish in pools 5, 6, 7, 8, and 9. The White River crew will fish from the confluence of the Little Red River upstream to Dam 1 at Batesville. Both crews will remove all Asian Carp captured and release all other species immediately upon capture. Crews will record date, capture location, number of each Asian Carp species captured, and the type of tackle used. The fishing crews will receive general netting locations from the AGFC and must contact AGFC prior to netting to provide sample date, and access to be used. The local Wildlife Officers will be notified of the sample dates and locations for spot checks of the fishing crews. The AGFC will work with the crews to schedule ride a longs to collect biological data on harvested Asian Carp. By-catch will also be recorded during ride a longs. All data collected should increase our knowledge of Asian Carp and to improve management and collection options in the future.

Map of Project Area:



Estimated Timetable for Activities:

Activity	Time Period
Arkansas River Pool 5	Fall 2020 – End of summer 2021
Arkansas River Pool 6	Fall 2020 – End of summer 2021
Arkansas River Pool 7	Fall 2020 – End of summer 2021
Arkansas River Pool 8	Fall 2020 – End of summer 2021
Arkansas River Pool 9	Fall 2020 – End of summer 2021
White River RM 289	Fall 2020 – End of summer 2021
White River RM 287.5	Fall 2020 – End of summer 2021
White River RM 278	Fall 2020 – End of summer 2021
White River RM 260	Fall 2020 – End of summer 2021
White River RM 256.5	Fall 2020 – End of summer 2021
White River RM 249.3	Fall 2020 – End of summer 2021
White River RM 207.4	Fall 2020 – End of summer 2021
White River 202	Fall 2020 – End of summer 2021
White River 178.6	Fall 2020 – End of summer 2021

Movement of Asian Carp in the Arkansas River to Inform Management

Lead Agency and Author: Arkansas Game and Fish Commission (AGFC); Bill Posey (William.Posey@agfc.ar.gov)

Cooperating Agencies: University of Arkansas Pine Bluff (UAPB), US Fish and Wildlife Service Oklahoma Fish and Wildlife Conservation Office (OKFWCO), US Fish and Wildlife Service Lower Mississippi River Fish and Wildlife Conservation Office (LMRFWCO)

Statement of Need: Knowledge gaps exist regarding demographic parameters of invasive Silver Carp and Bighead Carp populations within the Arkansas River. Specifically, there is limited information regarding the prevalence of movement of Silver Carp and Bighead Carp among different pools of the McClellan-Kerr Arkansas River Navigation System along the Arkansas River through Arkansas and Oklahoma. Understanding movement through lock-and-dam complexes may highlight potential for these complexes to provide barriers to movement and, thus, reduce farther expansion throughout the basin.

Evaluation of population characteristics and movement patterns will contribute to goals associated with the Lower Mississippi River Basin Asian Carp Control Strategy Framework. In particular, this project will address Goal 1, preventing population expansion, by looking at expansion patterns in a regulated river, where locks and dams may represent barriers to expansion. This project will address Goal 2, monitoring population status, by examining population vital rates in two tributaries of the lower Mississippi River. This project will address Goal 3, by determining habitat requirements and preferences, by monitoring movement and habitat use. This project will address Goal 4, increasing knowledge of these species, by examining hydrologic conditions necessary for successful reproduction in two lower Mississippi River tributaries.

Objectives:

1. Assess movement of Silver Carp and Bighead Carp among lock-and-dam complexes in the Arkansas River from Pine Bluff AR to Pool 16 at Webbers Fall Lock and Dam 16 in Oklahoma and in the White River between Des Arc and Newport.

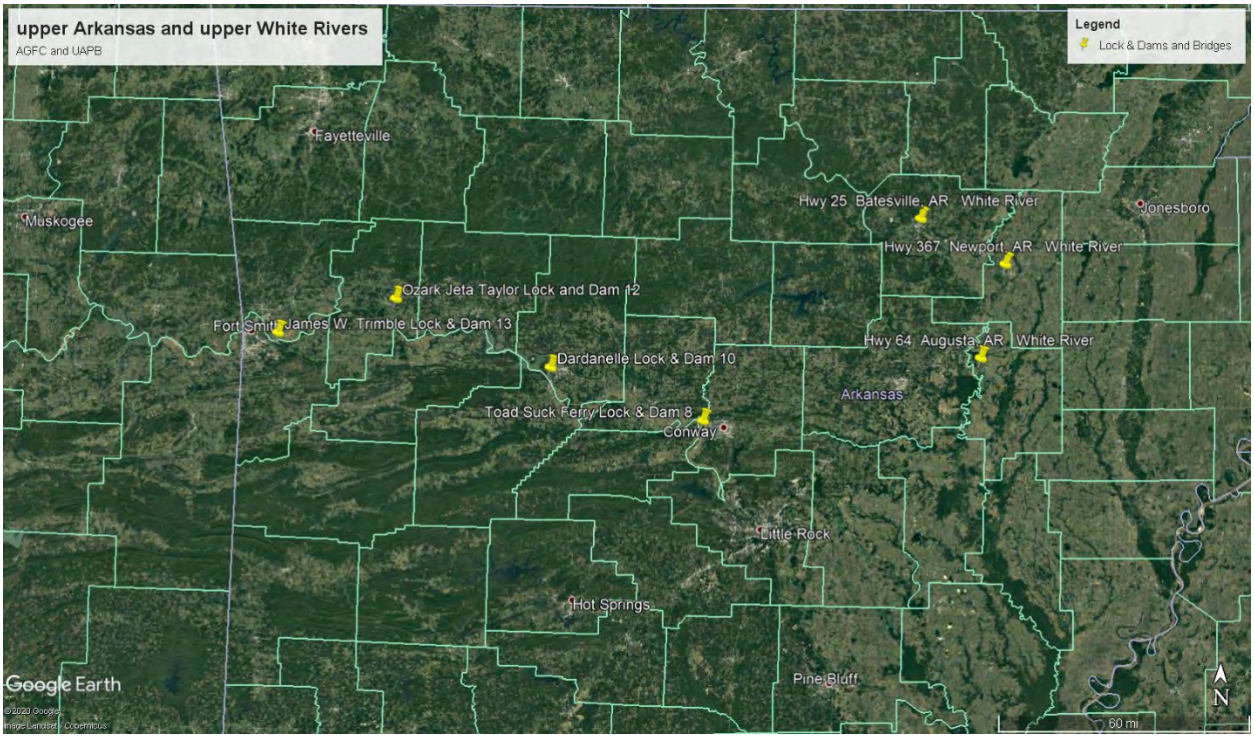
Agency: Arkansas Game and Fish Commission (AGFC)

Activities and Methods: AGFC will contract with the University of Arkansas Pine Bluff to complete this portion of the project. Passive tracking of individual Silver Carp and Bighead Carp with VEMCO acoustic tags and receivers will be used to assess movement through lock-and-dam complexes along the Arkansas River and movements in the White River. Existing acoustic receivers from Arkansas Game and Fish Commission will be deployed along with receivers to be purchased by the US Fish and Wildlife Service. Receivers will be strategically deployed at bridges along the White River to monitor movement patterns. Bridges will include Hwy 64 at Augusta, Hwy 367 at Newport, and Hwy 25 at Batesville. Receivers will also be placed at lock-and-dam complexes of the western Arkansas River in Arkansas to Pool 13. Receivers will be placed at Toad Suck Ferry lock-and-dam 8 near Conway, Dardanelle lock-and-dam 10 near Russellville, Ozark Jeta Taylor lock-and-dam 12 at Ozark, and James W. Trimble lock-and-dam

13 near Fort Smith. Adult Asian Carp movement data could be valuable for identifying spawning sites, barrier passage ability, and informing population control strategies.

Silver and Bighead carp will be captured using electrofishing and gillnetting in Arkansas's Arkansas River pools each year with capture methodology determined and refined once sampling commences. A total of 80 individuals (40 individuals from each species) will be marked with VEMCO V16T-5 acoustic tags. If sufficient numbers of Bighead Carp cannot be found, the remaining tags will be placed into additional Silver Carp. Length and weight will be collected from all individuals. Silver and Bighead carp not tagged will be euthanized and aging structures (otoliths and leading pectoral fin-rays) collected. During active tracking using radio telemetry, habitat use of individual Silver Carp and Bighead Carp in the mainstems of the lower Arkansas and White rivers will be assessed. Individual tagged fish will be located each season and depth, substrate, and meso-habitat characteristics will be assessed. Meso-habitats will include geomorphic characteristics including side-channel, backwater, main-channel, dyke-field complex.

Map of Project Area:



Location for VEMCO Receivers in Arkansas. Yellow pins designate potential monitoring sites.

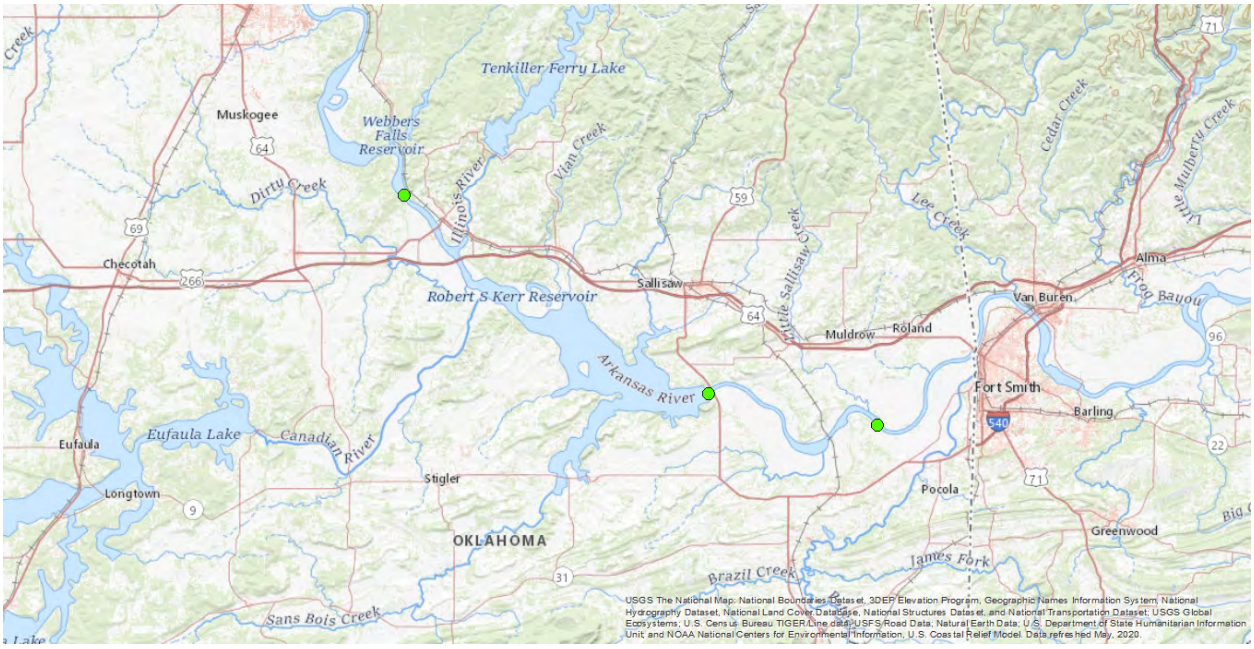
Estimated Timetable for activities

Activity	Time Period (Year, Month[s])
Objective 1	
Recruit graduate student, acquire receivers and transmitters, acquire surgical supplies	Fall 2020
Fabricate tethers for transmitters	Fall 2020
Deploy receivers	Winter 2021
Collect and implant fish	Winter/Spring 2021
Bi-monthly data retrieval from stationary receivers	Summer 2021 to Spring 2022
Bi-monthly mobile tracking	Summer 2021 to Spring 2022
Data analysis and interpretation	Summer/Fall 2022
Manuscript preparation and submission	Fall 2022

Agency: US Fish and Wildlife Service Oklahoma Fish and Wildlife Conservation Office (OKFWCO)

Activities and Methods: The Oklahoma Fish and Wildlife Conservation Office (OKFWCO) will coordinate with the US Army Corps of Engineers (USACE) to install, monitor, download, and maintain a Vemco VR2Tx-69kHtz Acoustic Receiver at each of the three sites to be monitored in Oklahoma on the Arkansas River. Sites are all part of the McClellan-Kerr Arkansas River Navigation System and include the WD Mayo Lock and Dam 14, Robert S Kerr Lock and Dam 15, and Webbers Falls Lock and Dam 16. Acoustic receivers will be attached off lock's wing walls or other agreed upon location that will allow the OKFWCO staff to access monthly to download. The data will be reported and shared with the University of Arkansas Pine Bluff, AFGC, and ODWC. This cooperative effort will extend the range of monitoring Asian Carp movement in the Arkansas River system and provide early detections assisting managing agencies. In addition, adult Asian Carp movement data could be valuable for identifying spawning sites, barrier passage ability, and informing population control strategies.

Map of Project Area:



Locations for VEMCO Receivers in eastern Oklahoma. The green dots designate potential monitoring sites. Sites from west to east include Webbers Falls Lock and Dam 16, RS Kerr Lock and Dam 15, and WD Mayo Lock and Dam 14.

Estimated Timetable for activities:

Activity	Time Period (Season, month/year)
Project logistics: purchasing supplies and equipment	June 2020 – August 2020
Coordinating and securing approvals for monitoring sites with the USACE	June 2020 – August 2020
Equipment Testing and Install	July 2020 – October 2020
2020 OKFWCO Project Progress Report	October 2020
OKFWCO Data Download 1	November 2020
OKFWCO Data Download 2	December 2020
OKFWCO Data Download 3	January 2021
OKFWCO Data Download 4	February 2021
OKFWCO Data Download 5	March 2021
OKFWCO Data Download 6	April 2021
OKFWCO Data Download 7	May 2021
OKFWCO Data Download 8	June 2021
OKFWCO Data Download 9	July 2021
OKFWCO Data Download 10	August 2021
OKFWCO Data Download 11	September 2021
2021 OKFWCO Project Progress Report	October 2021

Abundance and Distribution of Early Life Stages of Asian Carp in Red River Basin in Louisiana and Oklahoma

Lead Agency and Author: Louisiana Department of Wildlife and Fisheries (LDWF); Rob Bourgeois (rbourgeois@wlf.la.gov)

Cooperating Agencies: Louisiana Department of Wildlife and Fisheries (LDWF), Nicholls State University (NSU), US Fish and Wildlife Service Oklahoma Fish and Wildlife Conservation Office (OKFWCO), Southwestern Native Aquatic Resources and Recovery Center (SNARRC)

Statement of Need: Successful management of Asian carp is dependent on a thorough understanding of life histories and interactions with local environments. Reproduction, a key component of life history, can be used to guide control efforts by identifying where large spawning aggregations occur, and by identifying source and sink populations.

The purpose of this project is to determine where successful reproduction of Asian carp is occurring through the identification and cataloging of larval fish samples in Louisiana and Oklahoma waters. The documentation of the presence/absence of Asian carp larvae will assist in determining the leading edge of expansion throughout the Red River Basin and will help document where self-sustaining populations have established. This project will inform the direct management activities to contain the spread of Asian carp such as placement of deterrents and possible locations for other control activities.

In Louisiana, the Red, Atchafalaya, and Mississippi Rivers are connected at the Old River complex which has allowed Asian carp to spread to all three rivers, and further spread to smaller rivers in LA through natural and man-made connections such as flood relief or freshwater diversions used for wetland restoration. Commercial navigation channels have allowed migration between river basins, thereby allowing Asian carp and other fish to move freely between basins. LDWF began monitoring ichthyoplankton in 2013 to better understand the extent of Asian carp reproduction and to quantify larval Asian carp in Louisiana. In 2013, the samples were taken in April, May, and June. This project was modified to have the samples taken in May, June, and July in 2014 to try to define a temporal pattern of the presence of Asian carp early life stages. Sample sites were revisited in 2019 to see if Asian carp reproduction has remained constant over time or has spread to other areas where carp reproduction was not detected in 2013-14. The 2019 samples were taken during a historic flood on the Mississippi and Red Rivers and preliminary results are showing the data does not reflect what we would expect of a “typical” year’s reproduction. Future studies will either confirm that things have changed as reflected by the 2019 results or that the 2013 and 2014 years are more typical.

Previous studies were supported by the state Aquatic Nuisance Species (ANS) grants, which must support all ANS activities in Louisiana. In order to conduct more studies on temporal and spatial variation in Asian carp breeding, other funding sources must be utilized. The long-term goal for the work conducted through this early life stage study, in conjunction with telemetry-based movement studies, is to determine if it would be possible to direct harvest or place barriers or deterrents to further restrict Asian carp movement and reproduction. Without support through

this program, other ANS programs would have to forgo funding for Louisiana to support this plan fully.

In Oklahoma, efforts to evaluate recruitment by Asian carps in the Red River have not yet been conducted. The OKFWCO would begin monitoring for the presence of larval Asian carps in 2021 to determine the distribution and extent of successful reproduction by these species in the Red River and its tributaries. Initiating these assessments for understudied systems will inform long-term control strategies and provide a baseline for monitoring the extent of invasion in Oklahoma and surrounding states.

The Red River flows east in Oklahoma to form its border with Texas. This section of the Red River is characterized by numerous southern-flowing tributaries, which typically possess an impoundment and an associated reservoir above. While these impoundments are considered to be impassable by Asian carp species, the connectivity of the Red River with the lower reaches of its tributaries foster the appropriate conditions for spawning below the dams, as well as the potential for bait fish transfer to nearby reservoirs. This region supports a thriving recreational fishery that could potentially be impacted by Asian carp invasion.

This study supports the objectives of the Lower Mississippi River Basin Asian carp control plan, by helping to determine what aquatic habitats in Louisiana and Oklahoma are suitable for Asian carp spawning. When combined with other studies it may help determine what populations are source populations and help in directing efforts for harvest or exclusion.

Objectives:

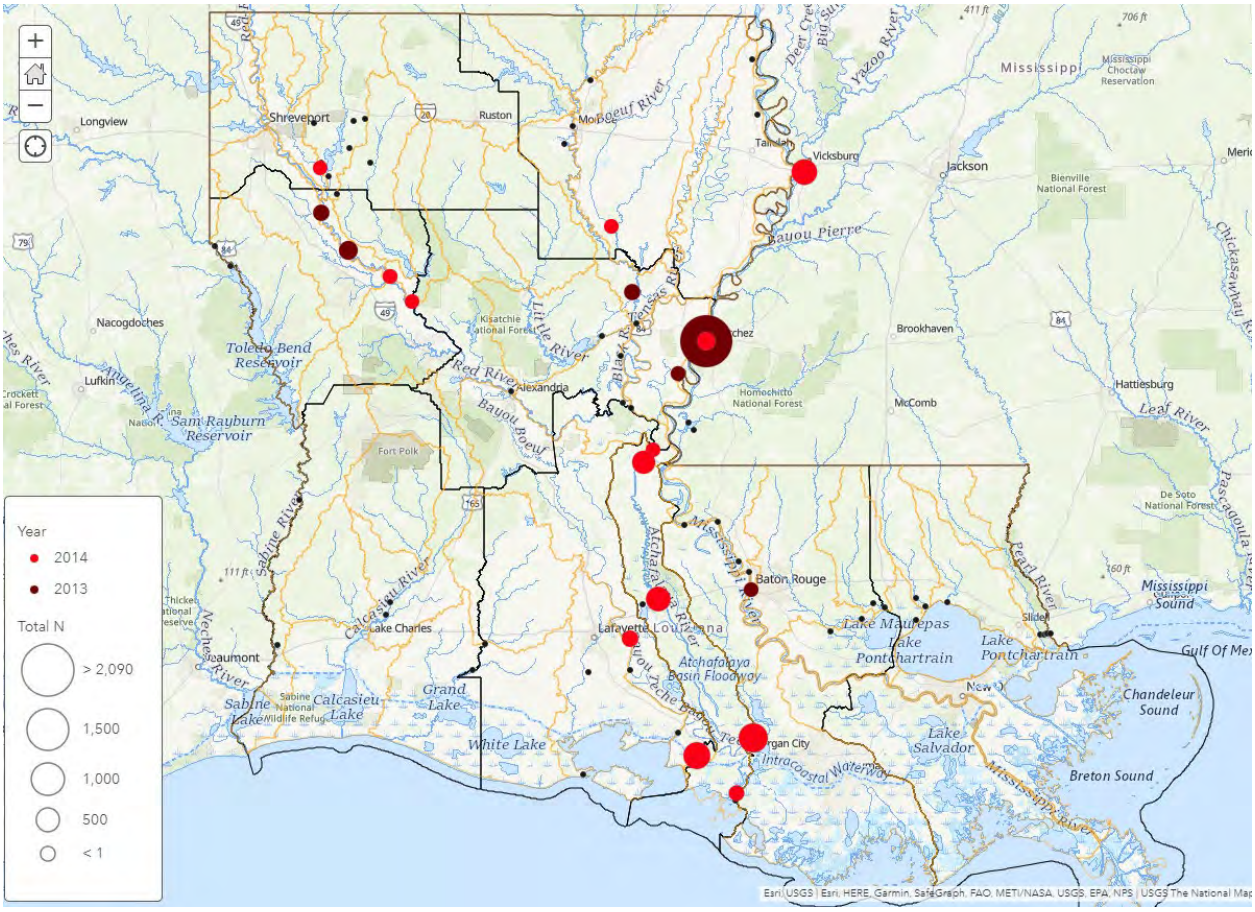
1. Determine the extent of Asian carp spawning activity in the Red River basin.

Agency: Louisiana Department of Wildlife and Fisheries (LDWF)

Activities and Methods: LDWF Inland Fisheries staff will collect the samples for the Red River sites in Louisiana. Between 10 to 15 sampling locations will be sampled monthly in April, May, and June. At each site, a sample will be collected in the center of the waterway as well as along each bank, for a total of three subsamples per site. Ichthyoplankton samples will be collected by towing a 0.5m diameter 500µm mesh ichthyoplankton net just below the water surface, for a duration of 10 minutes per tow. Samples collected in the field will be transferred to one-liter plastic containers and fixed in 70% ethanol. All samples will then be transferred to Nicholls State University (NSU) for analysis. Sample sites will be refined in 2022 based on 2021 findings.

NSU faculty/staff will identify fishes to family based on Auer (1982). Identification of cyprinids such as Asian carp larvae will be based on Chapman (2006), Chapman and George (2011) and George and Chapman (2013). Taxonomic classification beyond family for non-cyprinids will be based on Auer (1982).

Map of Project Area:



Plankton collection sites for the 2013 and 2014 sampling efforts. The black dots represent locations samples in both years. The darker rust colored dots show the sites that had Asian carp collected in 2013. The brighter red dots are the sites that had Asian a carp collected in 2014. At the time of this document, the 2019 sites did not yield any Asian carp in the plankton samples.

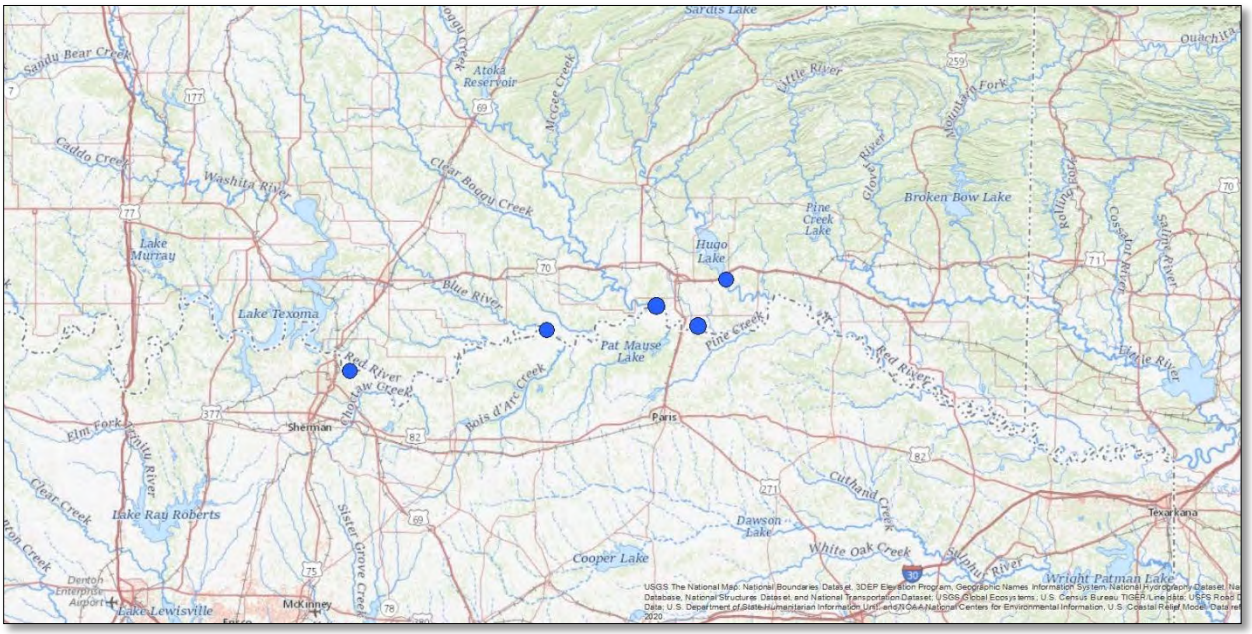
Estimated Timetable for activities:

Project Activity	Time Period (Season, Quarter, month/year)
Project Initiation of funding and contract start	December 15, 2020
Project logistics: purchasing supplies and equipment	Jan 1 2021 – March 31, 2021
LDWF Sampling Event 1	April 2021
LDWF Sampling Event 2	May 2021
LDWF Sampling Event 3	June 2021
Site Selection for 2022 Sampling	March 2022
Project summary report	April 30, 2022
LDWF Sampling Event 4	April 2022
LDWF Sampling Event 5	May 2022
LDWF Sampling Event 6	June 2022
Final report	March 2023

Agency: US Fish and Wildlife Service Oklahoma Fish and Wildlife Conservation Office (OKFWCO)

Activities and Methods: The Oklahoma Fish and Wildlife Conservation Office will survey for larval Asian carp bi-weekly in the Red River system in Oklahoma weekly from April 2021 through July 2021. Focused areas for monitoring will include the Red River below Denison Dam, the Kiamichi River below the Hugo Dam, the Blue River and Red River confluence, and the Red River and Muddy Boggy River confluence. Sampling sites will be chosen based on their proximity to suitable spawning habitat, crew accessibility, and safe navigability. Ichthyoplankton surveys will be conducted using the methods described above by LDWF to ensure comparable data. The OKFWCO will preserve larval fish samples in one-liter plastic containers containing a 95% ethanol solution. A subset of each sample will be sent to the Southwest Native Aquatic Resources and Recovery Center for genetic analysis. The remainder of the ichthyoplankton will be identified by OKFWCO staff using the methods described above by NSU.

Map of Project Area:



The blue dots designate potential sampling sites in the Red River system by the OKFWCO from April 2021 through July 2021.

Estimated Timetable for activities:

Activity	Time Period (Season, month/year)
Project logistics: purchasing supplies and equipment	June 2020 – August 2020
Identify suitable and accessible sites for surveys	June 2020 - August 2021
Equipment Testing	July 2020 - February 2021
2020 OKFWCO Project Progress Report	October 2020
OKFWCO Sampling Event 1	April 12 – 16, 2021
OKFWCO Sampling Event 2	April 26 – 30, 2021
OKFWCO Sampling Event 3	May 10 – 14, 2021
OKFWCO Sampling Event 4	May 24 – 28, 2021
OKFWCO Sampling Event 5	June 7 – 11, 2021
OKFWCO Sampling Event 6	June 21 – 25, 2021
OKFWCO Sampling Event 7	July 5 – 9, 2021
OKFWCO Sampling Event 8	July 19 – 23, 2021
Ichthyoplankton sample analysis	April 2021 – August 2021
2021 Genetic Report from SNARCC	August 2021
2021 OKFWCO Project Progress Report	October 2021

Literature Cited:

Auer, N.A. (ed.). 1982. Identification of larval fishes of the Great Lakes basin with emphasis on the Lake Michigan drainage. Great Lakes Fishery Commission, Ann Arbor, MI 48105. Special Pub. 82-3:744 pp.

Chapman, D.C., ed. 2006. Early development of four cyprinids native to the Yangtze River, China: U.S. Geological Survey Data Series 239, 51p.

Chapman, D.C., and George, A.E., 2011. Developmental rate and behavior of early life stages of bighead and silver carp. U.S. Geological Survey Scientific Investigations Report 2011–5076. 11 pp.

George A.E., and Chapman D.C. 2013. Aspects of Embryonic and Larval Development in Bighead Carp *Hypophthalmichthys nobilis* and Silver Carp *Hypophthalmichthys molitrix*. PLoS ONE 8(8): e73829

Asian Carp Movement and Assessment to Inform Management and Removal Efforts in the Lower Mississippi River Basin

Lead Agency and Author: Louisiana Department of Wildlife and Fisheries (LDWF); Robby Maxwell (rmaxwell@wlf.la.gov)

Cooperating Agencies: Arkansas Game and Fish Commission (AGFC), University of Arkansas Pine Bluff (UAPB), Louisiana State University (LSU), Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP), Mississippi State University (MSU), Missouri Department of Conservation (MDC), Tennessee Wildlife Resources Agency (TWRA), US Fish and Wildlife Service Lower Mississippi River Fish and Wildlife Conservation Office (LMRFWCO)

Statement of Need: Successful containment and control of invasive species is reliant on an understanding of movements and life histories of populations in response to local conditions. Agencies involved in the LMR Asian carp movement studies are seeking to use active and passive ultrasonic acoustic telemetry and population assessments to gather data to inform efficient and effective placement of passage barriers and deterrents, as well as to guide removal efforts. Proposed projects also include monitoring of inter- and intrabasin movements in a variety of habitat types. The proposed studies will be the first collaborative tracking efforts of this scale that will be conducted on Asian carp across the LMR. Proposed networks of receiver arrays will build upon existing networks of compatible Vemco technology maintained by cooperating and partner agencies, with data sharing being of high priority. A value-added benefit of the proposed projects is expanded capability to detect fish involved in other movement studies, which coincides with the expanded detection capabilities of Asian carp in existing networks maintained by partner agencies.

The proposed studies address the "LMR Basin Asian Carp Control Strategy Framework" goals and strategies by identifying and utilizing habitat requirements, barriers, or deterrent technologies to control Asian carp. The proposed studies also address goals and strategies by using technology, methods, and capabilities necessary to monitor and control Asian carp, while opening lines of interagency cooperation and collaboration.

Objectives:

1. Determine interbasin movement to inform placement of potential deterrent technologies and removal efforts.

2. Determine feasibility of deterrent technologies by evaluating migration pathways into a natural lake.

3. Determine distribution and estimate population demographics of Asian carp in the lower Arkansas and lower White rivers to inform control measures including removal efforts.

4. Assess the contribution of Asian carp produced in the Mississippi River to populations in the lower Arkansas and lower White rivers to inform control measures including removal efforts.

Agency: Louisiana Department of Wildlife and Fisheries (LDWF)

Activities and Methods: In support of Objective 1, LDWF will coordinate with Louisiana State University and other partner agencies to track the movements of Asian carp in South Louisiana. Commercial anglers will be contracted to capture Asian carp at several key locations along the Intracoastal Waterway (ICWW) near intersections with major rivers and/or estuaries of the lower Mississippi River Basin. The majority of tagging effort will be focused between the Mississippi and Atchafalaya Rivers, with additional tagging effort between the Calcasieu River and Vermilion Bay, as well as east of the Mississippi River near Lake Borgne and Lake Pontchartrain, depending on availability of specimens. While commercial netting will be the primary method of capture, additional techniques (electro fishing, gill nets) may be used as needed by researchers to supplement tagging numbers. Acoustic transmitters (Vemco V-16-4H, 69kHz) will be surgically implanted in 200 adult Asian carp in southern Louisiana water bodies over the two-year study period. Each uniquely coded transmitter will be programmed with a nominal delay of 60 seconds (30-90 seconds) and will have an expected battery life of 5-6 years. In addition, individuals will be tagged with a jaw tag and/or external floy tag to reduce harvest of tagged fish and encourage reporting of recaptured individuals. Fish will be measured, weighed, and sexed when possible, and water quality parameters (e.g. temperature, dissolved oxygen, salinity) of the location of capture/release will be measured by YSI and recorded. Tagged fish will be allowed to recover following surgery, and then released in the same general area of capture. Lastly, we will engage and work closely with Louisiana commercial anglers to disseminate information about the project and to encourage release of tagged fish captured in local fisheries that are in good condition.

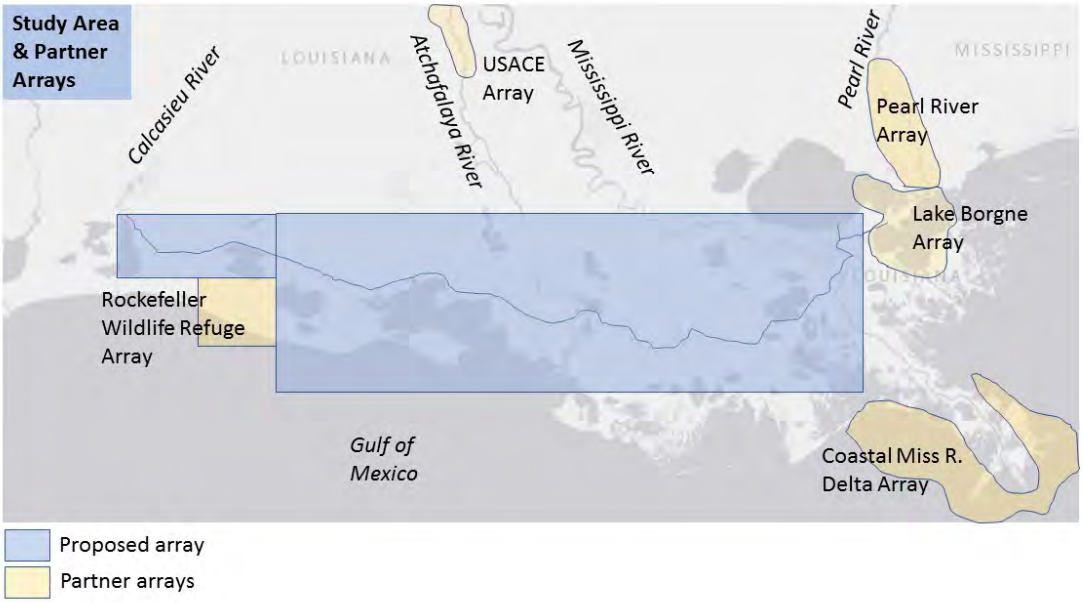
An array of 40 acoustic receivers will be deployed by LSU throughout the study area in the spring of 2021 to monitor movements of Asian Carp in coastal areas of the lower Mississippi River Basin. The array will consist of Vemco VRTx receivers, which will record temperature and ambient noise in addition to tag detections. These receivers also contain a transmitter, which allows them to be detected by other receivers or from the surface using an active hydrophone (VR100). The array will consist of receivers distributed west to east along the ICWW between the Calcasieu River and Lake Borgne. Areas of special interest (and a higher concentration of receivers) include major river confluences such as the Mississippi River, Atchafalaya River, Mermentau River, and Calcasieu River, as well as connections to major estuaries of interest such as Vermilion Basin, Barataria Basin, and Terrebonne Basin. Receivers will be attached to existing structures (pilings, channel markers), or anchored to the bottom and tethered to the shoreline. Salinity data loggers will be co-located with receivers deployed in the upper reaches of coastal estuaries to improve our understanding of salinity tolerance and responses of these species and the capacity for movement and additional expansion using coastal water bodies in Louisiana. Receivers and salinity loggers will be serviced by LSU every 8-12 weeks to retrieve and download data, monitor receiver condition, clean receivers, and replace batteries (as needed). We will also leverage existing and soon-to-be deployed arrays operated and maintained by partners including US Fish and Wildlife Service, US Army Corps of Engineers, and LSU to provide additional receiver coverage beyond the proposed array. These areas include Lake Borgne, Pearl River, Lake Pontchartrain and the Bonnet Carre Spillway, Rockefeller Wildlife Refuge, Atchafalaya River, and the Mississippi River Delta. We will also work closely with state

agency partners throughout the Mississippi River Basin to monitor inter-state movements of Asian carp both from and into our study area. Data sharing will occur across agencies and partner arrays to maximize the potential coverage area.

Active tracking using a Vemco VR100 will be used, as able, to supplement receiver coverage and provide additional information on fish movement. We will conduct active surveys at point locations (5 minutes in duration) along the ICWW and other areas of high interest that are outside the detection range of passive acoustic receivers to supplement our passive monitoring efforts.

Annual reports will detail monitoring efforts and movement/habitat analyses linking environmental variables to spatiotemporal patterns in carp occupancy, movement, and habitat/space use including probabilities of movement, distances traveled, basins crossed, seasonal movements and/or shifts in home range and habitat use, and other notable movements of all species targeted. The final report will include recommendations for the placement of passage barriers or deterrents in the ICWW or other points of ingress/egress in south Louisiana. Recommendations for population reduction efforts based on movements will also be made.

Map of Project Area:



Estimated Timetable for Activities:

Activity	Time Period (Season, month/year)
Purchase Equipment	January 2021
Graduate student and technician start	January 2021
Deployment of Acoustic Array	February - March 2021
Receiver Maintenance	Ongoing throughout 2-year period, every 8-12 weeks
Acoustic Tagging (Multiple locations)	Spring 2021
Additional Acoustic Tagging (Multiple locations), as needed	Fall 2021
Annual Report	March 2022, March 2023 (covering calendar year)
Data Analysis	Ongoing as data is received, final analyses Spring 2023

Agency: Arkansas Game and Fish Commission (AGFC)

Activities and Methods: AGFC will coordinate with UAPB to use a combination of radio telemetry and acoustic telemetry to assess Silver Carp movement and Bighead Carp movement to meet the goal of Objective 1. We will use both passive and active tracking of individual adult Silver Carp and Bighead Carp to assess movement through lock-and-dam complexes along the lower Arkansas River. We will attach acoustic receivers at lock-and-dam complexes so that individuals can be detected. We will make use of existing acoustic receivers from AGFC and purchase new receivers that can be strategically deployed in these two systems at bridges to monitor movement patterns. Receivers will be placed on the following lock-and-dam complexes: Montgomery Point lock-and-dam, Norrell lock-and-dam 1, Joe Hardin lock-and-dam 3, Charles Maynard lock-and-dam 5, and Murray lock-and-dam 7. We will also place acoustic receivers at bridged spanning the lower White River including Hwy 1 at St. Charles, Hwy 79 at Clarendon, and Hwy 38 at Des Arc (see map). During active tracking using radio telemetry, we will assess habitat use of individual Silver Carp and Bighead Carp in the mainstems of the lower Arkansas and White rivers. We will locate individuals each season and assess depth, substrate, and meso-habitat characteristics. Meso-habitats will include geomorphic characteristics including side-channel, backwater, main-channel, dyke-field complex.

In support to Objective 3, we will focus sampling efforts in the lower Arkansas River from Pool-4 to Pool-2. We will sample the Post Canal connecting the Arkansas River to the White River. We will stratify each pool along the Arkansas River by river kilometer. We will use a combination of boat electrofishing and gill nets to sample randomly selected river kilometers in

Spring and Summer 2021 and 2022. Additional gear types, including drifting experimental trammel nets, may be considered and tested depending on catch with electrofishing and gill nets.

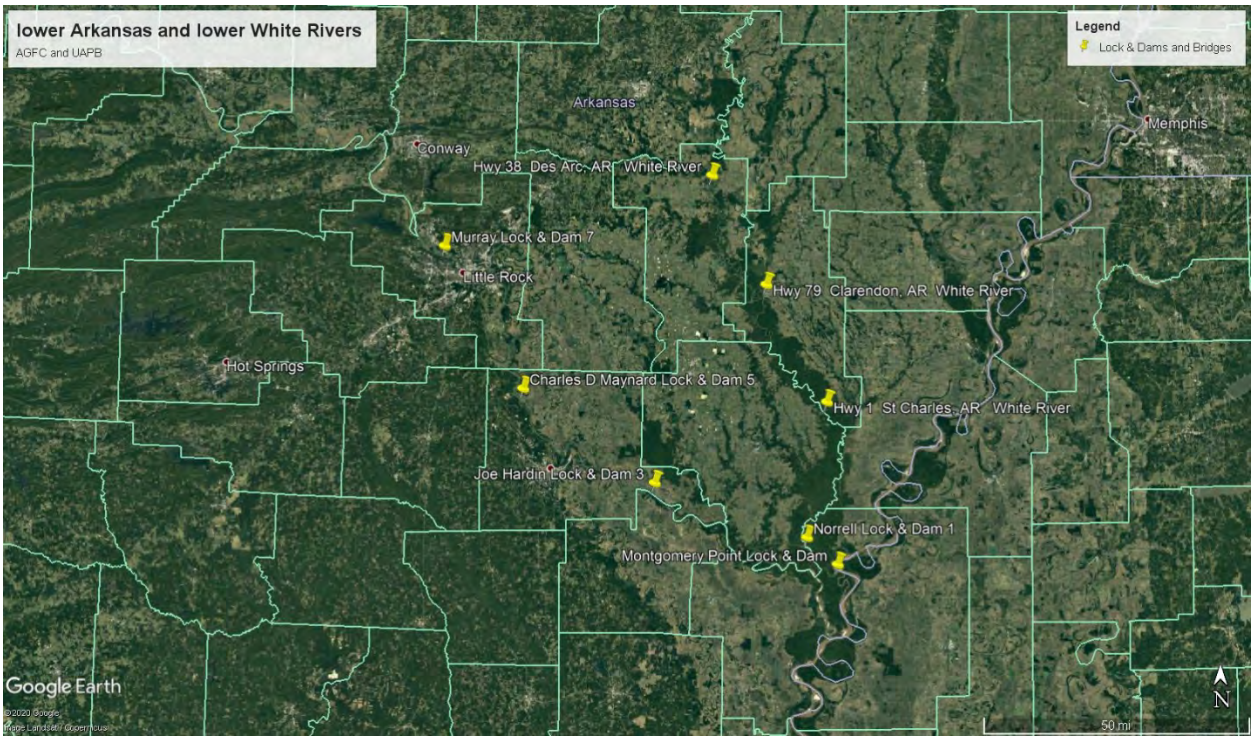
We will focus sampling efforts in the lower White River from Des Arc, AR, to the confluence with the Mississippi River. We will stratify the lower White River by river kilometer. We will use a combination of boat electrofishing and gill nets to sample randomly selected river kilometers in the Spring and Summer 2021 and 2022. Additional gear types, including drifting experimental trammel nets, may be considered and tested depending on catch with electrofishing and gill nets.

We will measure length (TL, mm) and weight (g) for each individual fish captured. We will determine sex for each individual. We will take otoliths and the right leading pectoral fin ray from up to 10 individuals per cm length group from each river kilometer sampled.

In support of Objective 4, we will use otolith microchemistry to assess the contribution of individuals produced in the Mississippi River to populations in the lower Arkansas and lower White rivers. Otoliths collected from individuals in Objective 3 will be sent to Southern Illinois University (SIU) for analysis of Sr, Ba, and Ca composition. Otolith microchemical signatures will be related to water microchemical signatures from the Mississippi River, lower Arkansas River, and lower White River. A discriminant rule will be developed to predict location of origin for individuals.

*Note: Bighead Carp are thought to be less abundant than Silver Carp in both the lower Arkansas River and the lower White River. We will deploy gears to sample both species, but may not capture sufficient numbers of Bighead Carp to conduct all analysis.

Map of Project Area:



Estimated Timetable for Activities:

Activity	Time Period (Year, Month[s])
Objective 1	
Recruit graduate student, acquire receivers and transmitters, acquire surgical supplies	Fall 2020
Fabricate tethers for transmitters	Fall/Winter 2020
Deploy receivers	
Collect and implant fish	Winter/Spring 2021
Bi-monthly data retrieval from stationary receivers	Spring/Summer/Fall 2021 Winter/Spring/Summer 2022
Bi-monthly mobile tracking	Summer/Fall 2021 Winter/Spring 2022
Data analysis and interpretation	Summer 2022
Manuscript preparation and submission	Fall 2022
Objective 3	
Recruit RA, Grad Student, Account Setup, Supplies acquisition	Fall 2020
Collect fish, aging structures, ovaries	Spring/Summer/Fall 2021
Prepare aging structures and age fish	Winter/Spring 2022
Data analysis and interpretation	Summer 2022
Manuscript preparation and submission	Fall 2022
Objective 4	
Microchemistry analysis at SIU	Spring 2022
Data analysis and interpretation	Spring/Summer 2022
Manuscript preparation and submission	Fall 2022

Agency: Mississippi Department of Wildlife, Fisheries and Parks (MDWFP)

Activities and Methods: In support of Objective 1, MDWFP will partner with MSU to monitor Asian carp in Moon Lake and connected waterbodies. Silver carp (N = 60) will be collected in Moon Lake and Yazoo Pass with the assistance of commercial fishers contracted through MSU. Captured silver carp will be measured for total length (nearest 1 mm) and weighed (nearest 1 g). Silver carp across the range of sizes will be surgically implanted with VEMCO V16 transmitters and tagged externally with a Floy loop tag. Carp not selected for telemetry tagging will have hard structures removed (e.g., vertebrae, lapillus otoliths, pectoral spines, postcleithra) for age estimation. Tags will be distributed evenly, if possible, between Yazoo Pass and Moon Lake to capture potential movement in and out of the lake through this major connection.

Seasonal spatial and temporal distribution of silver carp within the oxbow lake will be examined with mobile telemetry. A VEMCO VR100 hydrophone and receiver will be used to determine the location of telemetry tagged carp in the oxbow lake and associated macrohabitat variables and location specific variables (e.g., depth, temperature, dissolved oxygen). Location-specific and macrohabitat-specific covariates will be used to evaluate habitat use and if possible, habitat selection. Tracking intensity will likely differ seasonally and among locations.

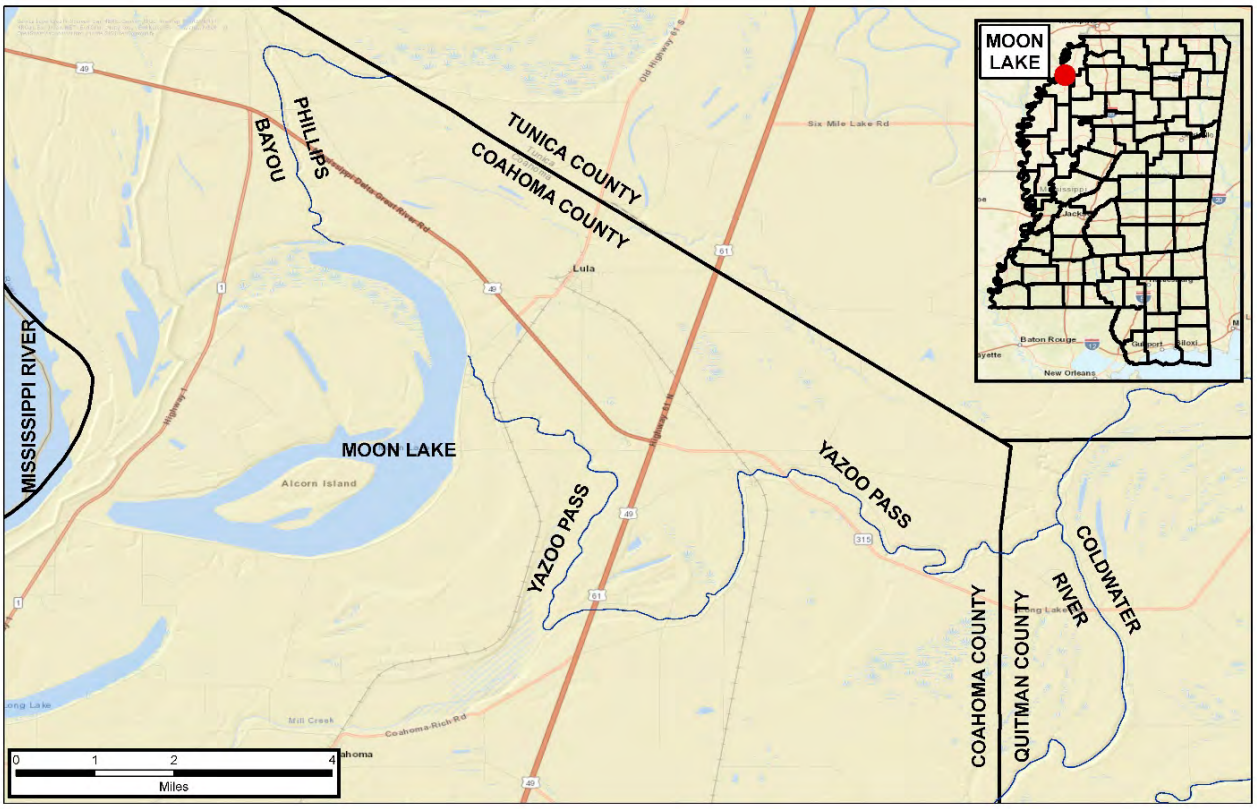
To log the dates and times of individual fish movements into or out of Moon Lake, VEMCO VR2 stationary receivers (N=10-12) will be deployed at key spatial unit boundaries delineated within the lake, the discharge stream, and the Coldwater River. Additionally, receivers will be placed in major neighboring streams to identify alternative entry or exit routes. A receiver will also be secured 25-50 miles downstream from the confluence of Yazoo Pass and Coldwater River to detect fish that might have left the area. Receivers will be monitored monthly to download fish detections at each receiver location.

Seasonal and temporal movements of silver carp into and out of the oxbow lake will be examined with a combination of fixed telemetry and mobile telemetry. Mobile tracking within Moon Lake and Yazoo Pass associated with Objective 2, and as needed, depending on major hydrological events, will be used to confirm the presence of fish within the study area. All fish locations will be assigned to a spatial unit (e.g., Moon Lake, Yazoo Pass). To identify variables that potentially influenced silver carp movements into different spatial units, we will use capture-recapture analysis to estimate the probability of movement among the spatial units. The capture-recapture analysis can explicitly evaluate variables like air temperature, precipitation, lake and river stage, seasonality, and time of day on the probability that tagged fish will move into a different spatial unit. Air temperature and precipitation data will be obtained from the NOAA for the nearest weather station. Water temperature and lake water level will be monitored with HOBO temperature and HOBO water level data loggers (HOBO Pendant; Onset Computer Corp., Bourne, Massachusetts). We will work with USGS water resources to install a temporary station to obtain water discharge information.

The capture-recapture analysis will provide a predictive model to evaluate risk of movement into or out of the oxbow lake. The predicted probabilities of movements can be used to inform the potential operations of a barrier if installed. For example, if environmental covariates are

associated with increased probability of movement into the oxbow lake then the barrier can be operated. Alternatively, if environmental covariates are associated with increased probability of movement out of the oxbow lake then the barrier can be turned off. Varying operational rule sets can be developed to minimize the risk of silver carp moving into the oxbow lake while potentially promoting movement out of the lake.

Map of Project Area:
Showing the locations of Moon Lake, the Yazoo Pass and the Coldwater River.



Estimated Timetable for Activities:

Activity	Time Period (Season, month/year)
Complete IACUC protocol, select MS student, conduct recognizance of study area, contact USGS about installing a water stage station in Yazoo Pass, contact commercial fishers about fish collections, install receivers, implant tags in fish, begin mobile tracking	Sep-Dec 2020
Continue to implant tags in fish, continue mobile tracking, monitor receivers, monitor water level and discharge sensors	Jan-Apr 2021
Continue to implant tags in fish (if needed), continue mobile tracking, monitor receivers, monitor water level and discharge, prepare annual report	May-Aug 2021
Continue mobile tracking, monitor receivers, monitor water level and discharge, through GIS begin developing a classification of the types of discharge canals existing in major oxbow lakes of the MAV	Sep-Dec 2021
Continue mobile tracking, monitor receivers, monitor water level and discharge, complete classification of the types of discharge canals existing in major oxbow lakes of the MAV	Jan-Apr 2022
Continue mobile tracking, monitor receivers, monitor water level and discharge sensors, develop models relating hydrodynamics, temperature, and weather-related variables to carp movement, prepare final report	May-Aug 2022

Agency: Missouri Department of Conservation (MDC)

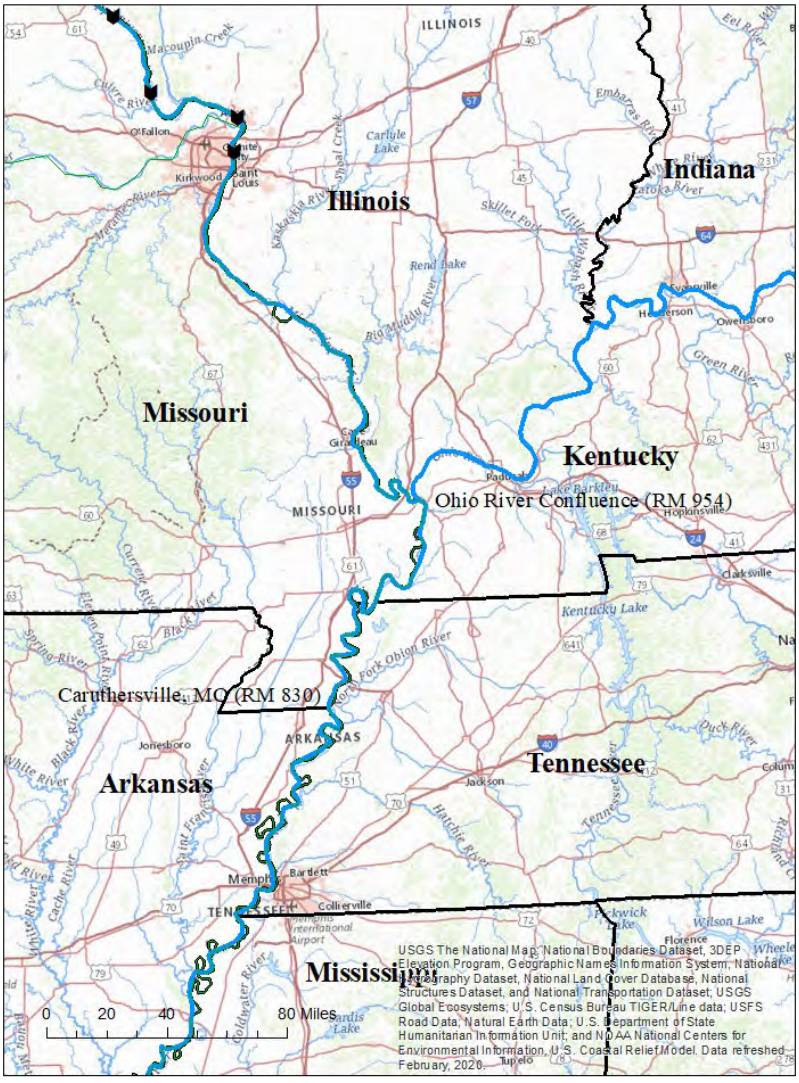
Activities and Methods: In support of Objective 1, MDC will expand and continue to maintain the existing stationary receiver array from Pool 20 downstream into the Lower Mississippi River, including associated major tributaries. Currently, there are Silver Carp and Bighead Carp with functional tags throughout the Upper Mississippi River, Illinois River, Ohio River, Kentucky Lake, and Barkley Lake, and Black Carp are tagged in the Middle Mississippi River, but the stationary receiver array between these basins is sparse. This year, Asian carp telemetry will additionally occur in the Missouri and Lower Mississippi Rivers and their tributaries, adding to the level of information gained by expanding the stationary receiver array. Specifically, the equipment requested this fiscal year will allow MDC to increase coverage in the Lower Mississippi River from the confluence of the Ohio River at Cairo, IL, to the southern Missouri border near Caruthersville, MO. A pair of stationary receivers will be placed every 30 miles (exact location will depend on multiple variables) to track residency time and transition rates between states and basins. The addition of 100 transmitters implanted in Asian carp (50 Silver

and 50 Bighead) will increase detection and provide information about movement among basins and tributary use.

Data from the Lower Mississippi River telemetry efforts will help fill in information gaps, since Missouri is centrally located between all the basins (OHR, MOR, UMR, LMR), providing information about mixing between basins. This project will also look at movement within the LMR and its tributaries and could inform removal efforts of Asian carp. These data will also be available for use to inform complex temporal-spatial models (i.e., SEACarP) that could be developed for the LMR by adapting models developed in other basins.

MDC will coordinate with the LMR Partnership to ensure data is shared and updates are provided.

Map of Project Area:



Estimated Timetable for Activities:

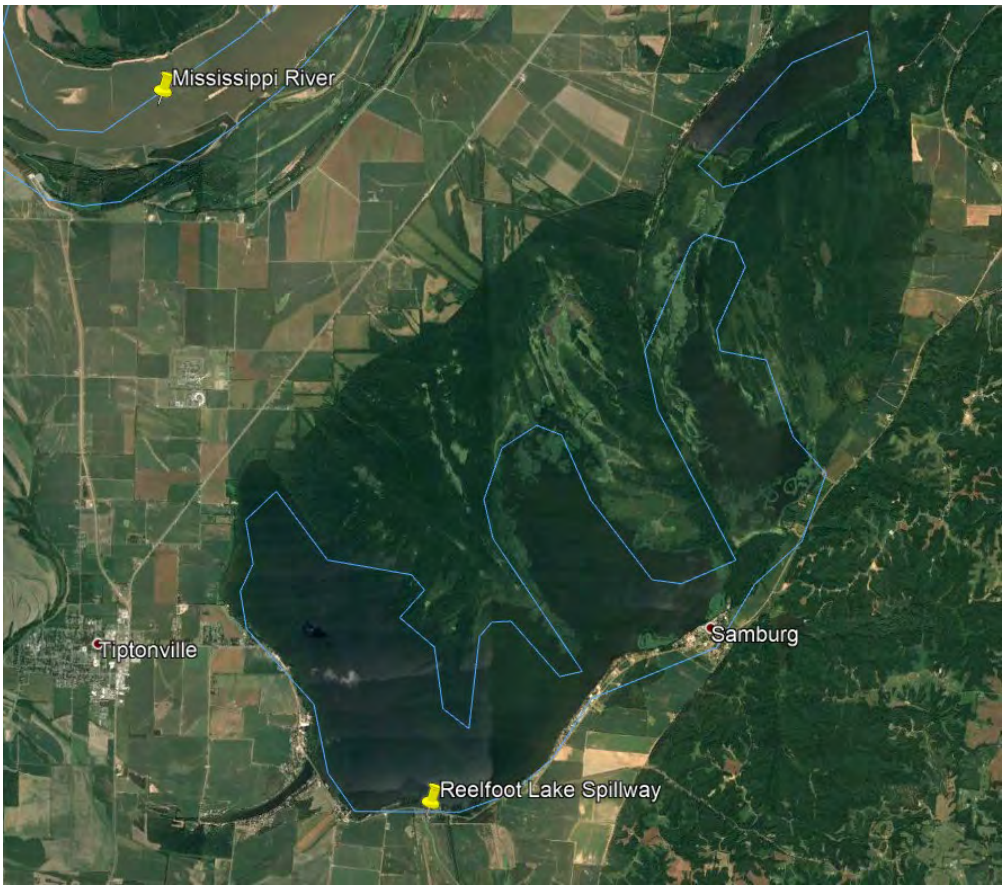
Project Activity	Season	Year
Deploy Acoustic Array	Summer/Fall	2020
Implant Acoustic Tags in Asian Carp	Fall	2020
Download Receiver Data	Every 4-6 weeks	2020/2021
Annual Report	March	2021

Agency: Tennessee Wildlife Resources Agency (TWRA)

Activities and Methods: In support of Objective 2, TWRA will work with state and federal partners to gather information on currently available deterrent technology, and to evaluate the need for/feasibility of a deterrent system at Reelfoot Lake. Currently, Asian carp migrate into Reelfoot Lake from a connection to the Mississippi River at high water levels. The extent of this migration is unknown. Where available, data related to water level, discharge, and spillway operation, will be compiled and summarized to describe the circumstances and frequency under which Asian carp migration into Reelfoot Lake is possible.

TWRA staff will conduct electrofishing surveys below the Reelfoot Lake Spillway. Sites may vary due to water level fluctuations associated with the spillway. Transects will be conducted for 15 minutes with two dip netters. Only carp species will be collected and catch rate will be reported. Electrofishing data from below the spillway coupled with electrofishing, gillnet, and commercial removal data from above the spillway (to be collected as part of the LMR "Control of Asian Carp in the Lower Mississippi River Basin" project) will provide managers with valuable information regarding the current extent of migration.

Map of Project Area:



Estimated Timetable for Activities:

Activity	Time Period (Season, month/year)
Compiling data/information from partners	ASAP, 2020-2021
Electrofishing	Spring-Fall, 2021
Data analysis and Final Report	Spring 2022

Control of Asian Carp in the Lower Mississippi River Basin

Lead Agency and Author: Missouri Department of Conservation (MDC); Sara Tripp (sara.tripp@mdc.mo.gov)

Cooperating Agencies: Arkansas Game and Fish Commission (AGFC), Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP), Tennessee Wildlife Resources Agency (TWRA)

Statement of Need: Invasive species cause billions of dollars in ecologic and economic damage every year in the United States (Pimentel et al. 2005). While complete elimination of invasive species is nearly impossible, the management or control of these non-native species is necessary to reduce the impact on native species, the ecosystem, and the economy. The rapid expansion of Asian carp (Silver, Bighead, Black, and Grass Carp) throughout the Mississippi River and its tributaries has caused concern throughout the basin. The ability of this group of fishes (especially Silver and Bighead Carp) to rapidly expand and colonize river reaches in high densities, has led to changes in the food webs of the invaded aquatic ecosystems (Irons et al. 2007, Freedman et al. 2012; Sass et al., 2014; Solomon et al., 2016; Pendleton et al., 2017; DeBoer et al. 2018). Not only do Asian carp have ecological impacts, they also pose economic threats through reduction in recreational and commercial opportunities (e.g., reduced recreation, tourism). In response to these threats, many states throughout the Mississippi and Great Lakes basins have been working to find effective strategies to control the expansion of Asian carp into adjacent aquatic systems.

Currently, multiple types of technologies (i.e., Electrical Dispersal Barrier System, Bio-Acoustic Fish Fence, Acoustic Deterrent System, CO_2, etc.) are being used or field tested to both prevent more Asian carp from entering specific locations and prevent invasion of new areas, but these types of technology are not financially or physically possible in all locations. Because of the need for multiple options to prevent the expansion of and control Asian carp populations, many states are employing contracted commercial harvest. The Asian Carp Regional Coordinating Committee Contract stated that commercial harvest remains one of the most successful tools to reduce the threat of Asian carp moving toward the Great Lakes in the 2019 Asian Carp Action Plan. In the 2019 plan, the coordinating committee also emphasized the importance of harvest in the lower pools as to reduce the overall relative abundance of Asian carp in the Illinois River, which could subsequently reduce propagule pressure in areas of lower density. This technique has not only been shown to be successful in the Illinois River, but also in the Ohio River and in Kentucky and Barkley Lakes.

All four Asian carp species are found in the Lower Mississippi River Basin; Grass Carp have been stocked in the past so they are not the focus of control and management efforts. Silver and Bighead Carp are found throughout the Lower Mississippi River (LMR) and Black Carp are being collected more regularly (Rodgers 2019). The states with the Lower Mississippi River Basin understand the magnitude of the Asian carp threat and the need for coordinated efforts to prevent their continued spread, explore strategies to reduce the abundance of established populations, and better understand the impacts of established populations (Rodgers 2019). The removal efforts within this work plan not only address the need for control and management, but also provide the opportunity to collect data on the Asian carp population and the native fish community which can also provide an assessment tool to help inform future efforts in the LMR.

One of the main priorities for the Lower Mississippi River Sub-basin Working Group is population control through removal efforts to reduce the impact of Asian carp, while effectively relaying this information to the constituents (i.e., recreational and commercial anglers, recreational users, etc.) of the Mississippi River. Both objectives 1 and 2 of this project address this priority as well as the National Asian Carp Framework Goals 2, 3, and 5.

Objectives:

1. Reduce overall Asian carp population numbers and alleviate propagule pressure in areas with low population density by implementing Asian carp removal programs utilizing commercial fishing in the Lower Mississippi River and tributaries (National Plan Goals 2 and 3).

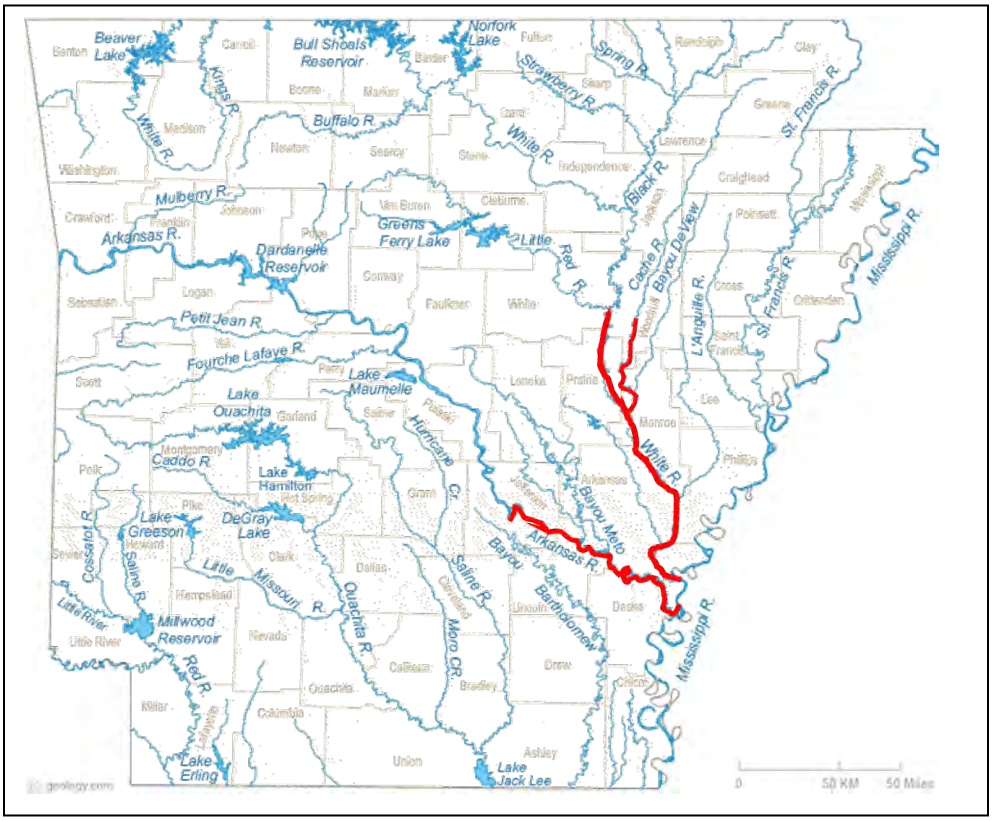
2. Reduce the overall density and determine population characteristics of Asian carp in a large natural lake (National Plan Goals 2, 3, and 5).

Agency: Arkansas Game and Fish Commission (AGFC)

Activities and Methods: AGFC will commence a pilot program consisting of Asian Carp harvest utilizing commercial fishermen focusing solely on catching and removing Grass, Silver, Bighead and Black Carp. All other species will be released. Two crews will be used where one will work on the White and Cache Rivers while the other crew will work on the Arkansas River. They will target areas that have known concentrations of Asian Carp as determined by previous monitoring. Contract crews will be required to notify the AGFC ANS Coordinator of the date and access area to be used before conducting harvest work. AGFC will schedule personnel to monitor activities and record demographic data of Asian Carp and by-catch numbers and condition of by-catch species up on release. AGFC will also complete random checks to insure compliance with contract requirements. Crews will be required to collect catch locations, tackle used and numbers of each species removed. The removed fish will be disposed by being made available for human consumption, pet food, fertilizer or an approved landfill. Confirmed weight of removed fish will be required from each crew. Harvest statistics will be used to inform future harvest efforts.

The goal of this project is the removal of 150,000 to 250,000 pounds of Asian Carps for each crew. A tiered payment schedule using bench marks of 150,000, 200,000 and 250,000 harvested pounds will be used. The White/Cache River crew will work from RM176 downstream to the Mississippi River on the White River and the Cache River from Highway 38 to the confluence with the White River. The Arkansas River crew will work from RM63 downstream to the Mississippi River. Both crews will work main stem and backwaters.

Map of Project Area:



Estimated Timetable for activities:

Activity	Time Period (Season, month/year)
Contract set up and removal	**Fall 2020 through Summer 2021**
Demographic Data Collection	**Random throughout project**
Annual Report	**Winter 2021**

Agency: Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP)

MDWFP will contact (letter, phone or email) all currently licensed freshwater commercial fishermen residing in the Yazoo River Basin counties and those counties which border on the Mississippi river to inform them of this harvest opportunity and provide the financial compensation basics to participate. All currently licensed Mississippi nonresident freshwater commercial fishermen (n <20) will also be contacted.

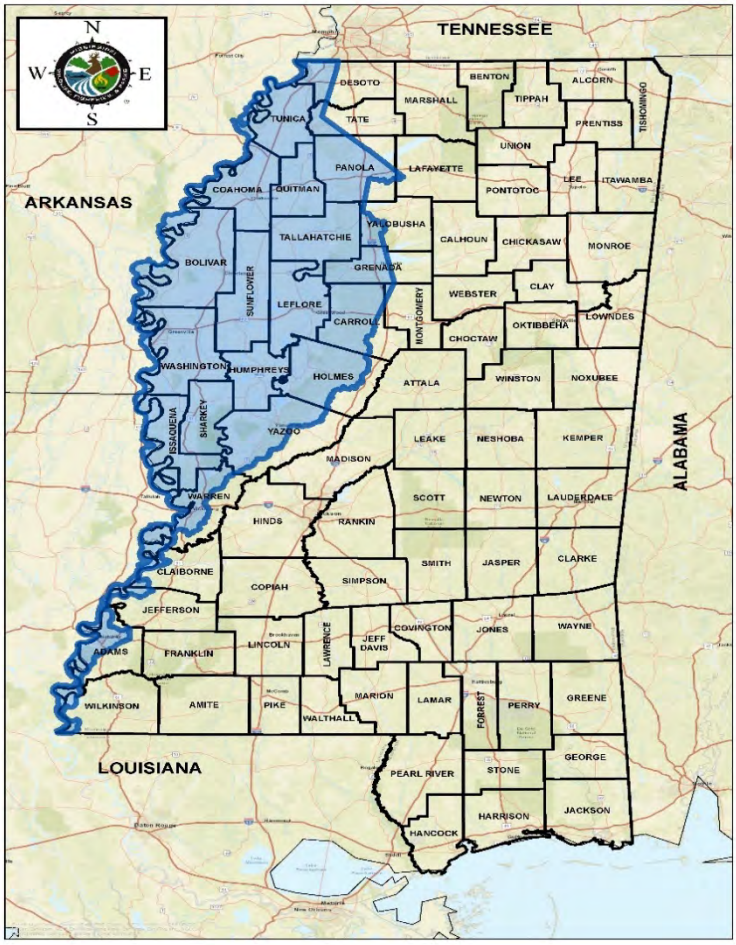
MDWFP will also contact fish buyers to determine if they are willing to serve as overall contractors who will hire local fishermen as subcontractors. Contracts executed with fish houses will specify the data reporting, and invoicing requirements necessary for reimbursement to the contractor who will then reimburse the fishermen. The contractor will be responsible for obtaining all data from the fishermen, pay the fishermen and provide MDWFP with reimbursement invoices at agreed upon rates for days of fishing and price per pound of harvested Asian Carp contingent upon MDWFP receiving all data required prior to the payment of any invoice.

Working with fishermen and/or possible contractors, MDWFP will provide fishermen agreements and/or contractor agreements detailing information which must be submitted to receive financial reimbursement. All fishermen and contractors hired will be issued no cost permits to participate in this program. Data reporting requirements from the fishermen and/or the contractors will include date and time of harvest, harvest location, number of gear used by gear type (gill nets, trammel nets, hoop nets) and gear specifics (length and depth, mesh size, hang ratio, mesh material), fishing effort (hours or net nights), number of species harvested by species or pounds of fish by species type, by catch numbers and disposition of bycatch. MDWFP plans to assign fisheries biologist to do initial monitoring of harvest activities and to ensure fishermen know the reporting requirements and record the desired data mentioned above. Subsequent periodic monitoring by MDWFP fisheries biologists will occur to verify harvest effort and reinforce the importance of data recording.

Data obtained from the hired fishermen and/or those working for a contractor on this program will be recorded, summarized and analyzed to provide specifics on all data parameters collected by month, location and species. Other data may be collected to meet the agreed upon regional standard data reporting guidelines.

MDWFP will provide accounting and project coordination to document project expenditures and seek federal reimbursement on a monthly basis as payments are made to fishermen and contractors. A daily minimum reimbursement rate will be established by mutual agreement between MDWFP and the fishermen or their contractors. The MDWFP may also pay a price per pound for all Asian Carp (Bighead, Black, Grass and Silver carp) harvested per day for poundage exceeding a minimum daily poundage covered by the daily fishing rate.

Map of Project Area:



Contract fishing will occur in the Yazoo River Basin and in the Mississippi River as shown in blue.

Estimated Timetable for activities:

Activity	Time Period (Season, month/year)
Contract set up and Asian carp removal	Fall and Winter 2020
Demographic Data Collection Fall and Winter 2020	Fall and Winter 2020
Data Summary/Analysis	Winter 2020/2021
Annual Report	Spring 2021

Agency: Missouri Department of Conservation (MDC)

Activities and Methods: MDC will pilot an Asian carp harvest program that will employ a tiered approach with the potential to use both contract fishing (weekly contracts) and enhanced fishing ($0.10/lb harvested) to support Objective 1. Both methods have been employed by neighboring states and will inform the most effective approach for Missouri Asian carp control and management in the future. Missouri removal efforts will occur in the LMR from the Ohio River Confluence (RM 954) to the southern border of Missouri near Caruthersville (RM 830). If conditions are unfavorable for mainstem sampling, there will be opportunities for removals in tributaries and old oxbows (only under special contract with an agency observer). Removal efforts will take place in the fall and winter of 2020 as river conditions permit and contracts are in place. Effort will be spread throughout the LMR reach with an overall goal of removing at least 600,000 pounds, the amount removed will ultimately be driven by how the contracts are set up with the majority of funding requested going to the removal effort, for example if only enhanced fishing were used $60,000 could be used to remove 600,000 pounds, but if weekly contracts are set up with specific fishermen that meet the requirements of the contract even more pounds could be harvested depending on the crews success.

The other portion of funding will be used to support a biologist that will be coordinating removal efforts, pick up for harvested Asian carp by processors (coordinating with IL and KY for pick up if a certain number of pounds are harvested), and the collection of demographic data. Similar to what other agencies are doing, if a contract is obtained, the observer will record length and weight from Asian carp prior to being sacrificed and bycatch will be identified to species, enumerated, and disposition will be recorded (i.e. healthy, moribund, dead) prior to release. MDC biologist will also collect up to 100 Bighead and Silver carp (50 per species) monthly to collect more specific data such as sex, GSI, and fecundity. The aging structure (lapilli otoliths) will also be collected from 100 individuals from each species to be used to populate harvest models and also serve as a measure to look at trends through time to evaluate the effects of harvest.

Map of Project Area:

Estimated Timetable for activities

Activity	Time Period (Season, month/year)
Contract set up and Asian carp removal	**Fall and Winter 2020**
Demographic Data Collection	**Fall and Winter 2020**
Data Summary/Analysis	**Winter 2020/2021**
Annual Report	**Spring 2021**

Agency: Tennessee Wildlife Resources Agency (TWRA)

Activities and Methods: TWRA staff will identify sites (minimum of 4) on Reelfoot Lake to set clusters of gillnets. Each site will be sampled at least twice per year, once during summer (July-Sept) and again in the winter (Nov-Jan). At each site, four overnight gillnet sets will be deployed. Individual nets will be 300-ft in length with 100-ft panels of 3-, 4-, and 5-in mesh. Nets will be 12-ft deep, hobbled to 10-ft every eight feet; nets will have 0.5-in foamcore float line and 65-lb leadcore lead line. The webbing used in each of these panels will be constructed of 8 ply, 0.2-mm twist mesh. Catch of all species will be recorded by mesh size. We are not attempting to herd fish into nets using electrofishing, acoustic boats, or any other method.

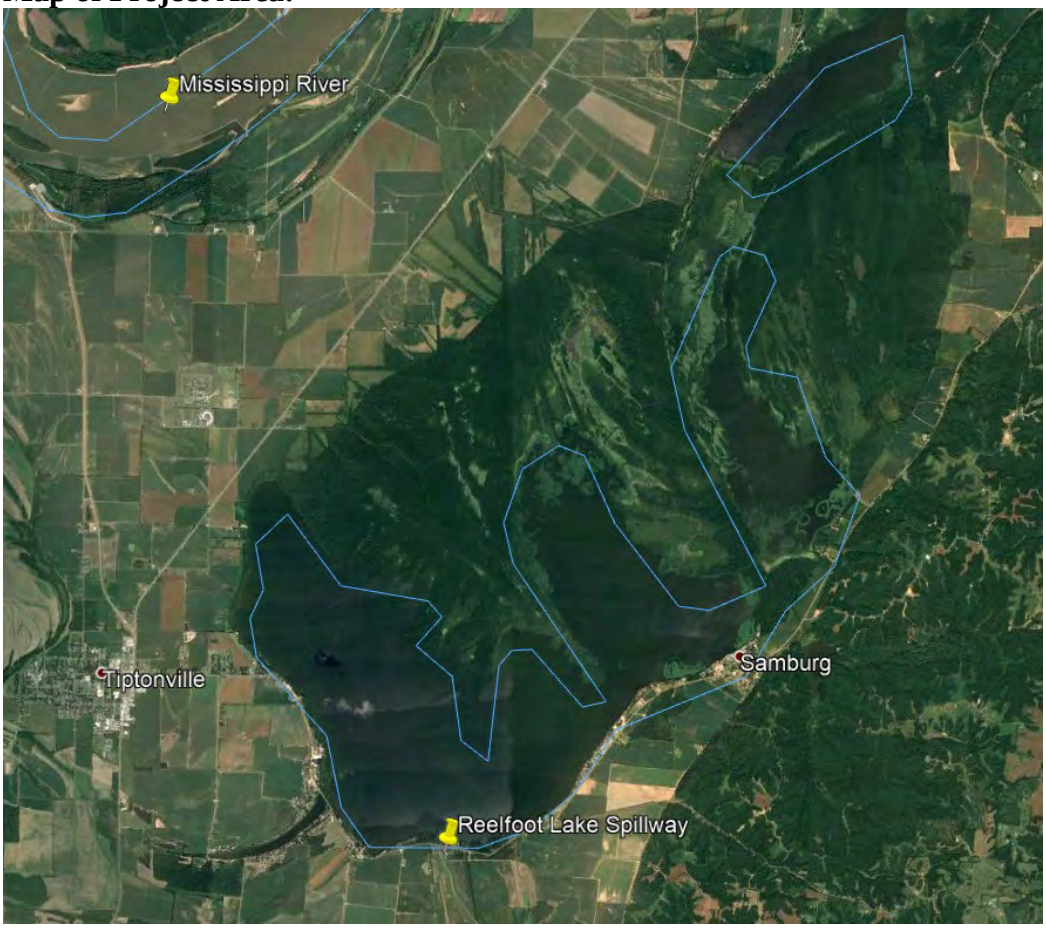
TWRA staff will establish 15 electrofishing sites on Reelfoot Lake. Sampling will occur at least twice per year (spring and fall). Electrofishing surveys will be conducted during the daytime using a high-frequency pulsed DC boat electrofishing. Voltage and amperage will be adjusted to achieve a 3,000-W power output, as possible (Stuck et al. 2015). Electrofishing transects will be conducted for 15 minutes each with two dip netters.

Catch rates will be calculated from agency sampling efforts. All carp species will be removed from the lake. Carp species (or a subsample) will be examined for species, length (mm), weight (g), and sex. Otoliths will be collected to estimate age and growth. Data will be used to prepare length and age frequency histograms, estimate growth and mortality, and assess condition.

TWRA may contract with licensed wholesale fish dealers, commercial fishers, or private entities to remove Asian carp from Reelfoot Lake. Payments will be made on either a per pound basis or based on a predetermined amount of removal effort. Depending on industry needs, gillnet material may be provided to commercial fishers. All removal efforts will require regular reporting to TWRA consistent with state rules. Harvest will be quantified, and subsamples may be used to determine species, length (mm), weight (g), sex, and age and growth estimates.

TWRA may organize a bowfishing tournament as a means of removal and outreach. On Reelfoot Lake, bowfishing could provide a unique opportunity to remove fish in areas where traditional removal and sampling effort are less successful (due to shallow water and an abundance of stumps). Additionally, bowfishing tournaments present an opportunity to activate and educate new stakeholders. As with other sampling and removal efforts, harvest will be quantified, and subsamples may be collected from fish as needed.

Map of Project Area:



Estimated Timetable for activities:

Activity	Time Period (Season, month/year)
Commercial/contract removal	**ASAP, 2020-2021**
Electrofishing	**Spring-Fall, 2021**
Gillnetting	**Summer-Winter, 2021**
Bowfishing tournament	**TBD**
Final report	**Spring, 2022**

Literature Cited:

DeBoer, J.A., A.M. Anderson, and A.F. Casper. 2018. Multi-trophic response to invasive silver carp (Hypophthalmichthys molitrix) in a large floodplain river. Freshwater Biology 63(6):597-611.

Freedman, J.A., S.E. Butler, D.H. Wahl DH. 2012. Impacts of Asian Carps on native food webs. Final Project Report- Illinois-Indiana Sea Grant.

Irons, K.S., G.G. Sass, M.A. McClelland, M.A. Stafford. 2007. Reduced condition factor of two native fish species coincident with invasion of non-native Asian carps in the Illinois River, U.S.A. is this evidence for competition and reduced fitness? Journal of Fish Biology 71(Supplement D):258-273.

Pendleton, R.M., C. Schwinghamer, L.E. Solomon, A.F. Casper. 2017. Competition among river planktivores: are native planktivores still fewer and skinnier in response to the silver carp invasion? Environmental Biology of Fishes 100:1213–1222.

Pimentel, D., R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics 52(3 SPEC. ISS.):273–288.

Rodgers, A., editor. 2019. Lower Mississippi River Basin Asian Carp Control Strategy Framework. Lower Mississippi River Basin Asian Carp Team. Tupelo, Mississippi, 45 pp.

Sass, G.G., C. Hinz, A.C. Erickson, N.N. McClelland, M.A. McClelland, J.M. Epifanio. 2014. Invasive bighead and silver carp effects on zooplankton communities in the Illinois River, Illinois, USA. J Great Lakes Research 40:911–921.

Solomon, L., R. Pendleton, J. Chick, A. Casper. 2016. Long-term changes in fish community structure in relation to the establishment of Asian carp in a large floodplain river. Biological Invasions 18:2883–2895.

Stuck, J.G., A.P. Porreca, D.H. Wahl, and R.E. Columbo. 2015. Contrasting population demographics of invasive silver carp between an impounded and free-flowing river. North American Journal of Fisheries Management 35:114–122.

Abundance and Distribution of Early Life Stages of Asian Carp in the Lower Mississippi River Basin.

Lead Agency and Author: Louisiana Department of Wildlife and Fisheries (LDWF); Rob Bourgeois (rbourgeois@wlf.la.gov)

Cooperating Agencies: Louisiana Department of Wildlife and Fisheries (LDWF), Nicholls State University (NSU)

Statement of Need: Successful management of Asian carp is dependent on a thorough understanding of life histories and interactions with local environments. Reproduction, a key component of life history, can be used to guide control efforts by identifying where large spawning aggregations occur, and by identifying source and sink populations.

The purpose of this project is to determine where successful reproduction of Asian carp is occurring through the identification and cataloging of larval fish samples in Louisiana waters. The documentation of the presence/absence of Asian carp larvae will assist in determining the leading edge of expansion throughout the Lower Mississippi River Basin and will help document where self-sustaining populations have established. This project will inform the direct management activities to contain the spread of Asian carp such as placement of deterrents and possible locations for other control activities.

In Louisiana, the Red, Atchafalaya, and Mississippi Rivers are connected at the Old River complex which has allowed Asian carp to spread to all three rivers, and further spread to smaller rivers in LA through natural and man-made connections such as flood relief or freshwater diversions used for wetland restoration. Commercial navigation channels have allowed migration between river basins, thereby allowing Asian carp and other fish to move freely between basins. The LDWF began monitoring ichthyoplankton in 2013 to better understand the extent of Asian carp reproduction and to quantify larval Asian carp in Louisiana. In 2013, the samples were taken in April, May, and June. This project was modified to have the samples taken in May, June, and July in 2014 to try to define a temporal pattern of the presence of Asian carp early life stages. Sample sites were revisited in 2019 to see if Asian carp reproduction has remained constant over time or has spread to other areas where carp reproduction was not detected in 2013-14. The 2019 samples were taken during a historic flood on the Mississippi and Red Rivers and preliminary results are showing the data does not reflect what we would expect of a “typical” year’s reproduction. Future studies will either confirm that things have changed as reflected by the 2019 results or that the 2013 and 2014 years are more typical.

Previous studies were supported by the state Aquatic Nuisance Species (ANS) grants, which must support all ANS activities in Louisiana. In order to conduct more studies on temporal and spatial variation in Asian carp breeding, other funding sources must be utilized. The long-term goal for the work conducted through this early life stage study, in conjunction with telemetry-based movement studies, is to determine if it would be possible to direct harvest or place barriers or deterrents to further restrict Asian carp movement and reproduction. Without support through this program, other ANS programs would have to forgo funding for Louisiana to support this plan fully.

This study supports the objectives of the Lower Mississippi River Basin Asian carp control plan, by helping to determine what aquatic habitats in Louisiana and Oklahoma are suitable for Asian carp spawning. When combined with other studies it may help determine what populations are source populations and help in directing efforts for harvest or exclusion.

Objectives:

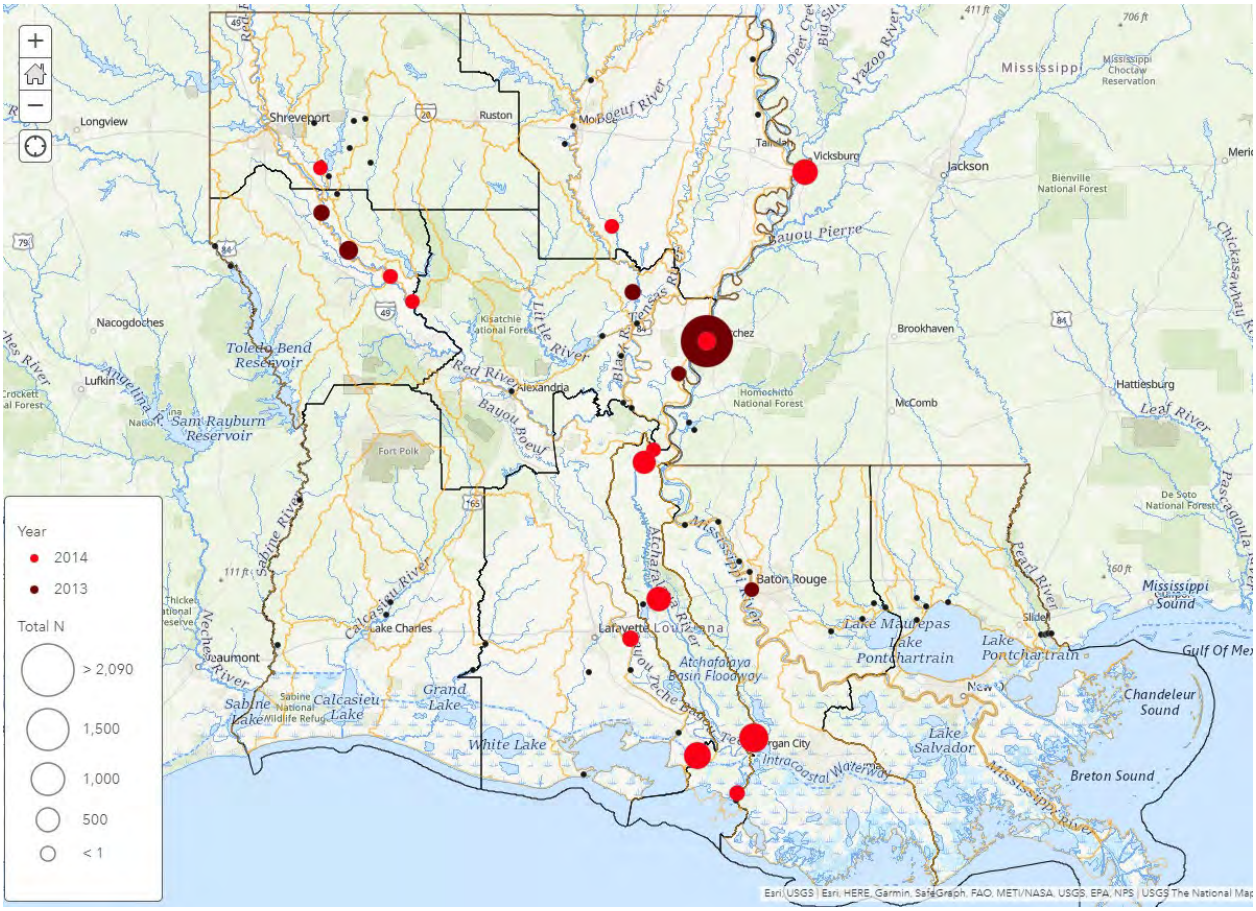
1. Determine the extent of Asian carp spawning activity Mississippi River; Atchafalaya River, Ouachita River and Tensas River Basins within Louisiana.

Agency: Louisiana Department of Wildlife and Fisheries (LDWF)

Activities and Methods:
In Louisiana, LDWF Inland Fisheries staff will collect the samples for Mississippi River; Atchafalaya River, Ouachita River and Tensas River Basins sites in Louisiana with an emphasis in the southern portions of the state to study basin transfer via the various navigation channels. Between 40 and 55 sampling locations will be sampled monthly in April, May, and June. Samples collected in the field. At each site, a sample will be collected in the center of the waterway as well as along each bank, for a total of three subsamples per site. Ichthyoplankton samples will be collected by towing a 0.5m diameter 500µm mesh ichthyoplankton net just below the water surface, for a duration of 10 minutes per tow. Samples collected in the field will be transferred to one-liter plastic containers and fixed in 70% ethanol. All samples will then be transferred to Nicholls State University for analysis. Sample sites will be refined in 2022 based on 2021 findings.

NSU faculty/staff will identify fishes to family based on Auer (1982). Identification of cyprinids such as Asian carp larvae will be based on Chapman (2006), Chapman and George (2011) and George and Chapman (2013). Taxonomic classification beyond family for non-cyprinids will be based on Auer (1982).

Map of Project Area:



Plankton collection sites for the 2013 and 2014 sampling efforts. The black dots represent locations samples in both years. The darker rust colored dots show the sites that had Asian carp collected in 2013. The brighter red dots are the sites that had Asian a carp collected in 2014. At the time of this document, the 2019 sites did not yield any Asian carp in the plankton samples.

Estimated Timetable for activities:

Project Activity	**Time Period (Season, Quarter, month/year)**
Project Initiation of funding and contract start	December 15, 2020
Project logistics: purchasing supplies and equipment	Jan 1 2021 – March 31, 2021
LDWF Sampling Event 1	April 2021
LDWF Sampling Event 2	May 2021
LDWF Sampling Event 3	June 2021
Site Selection for 2022 Sampling	March 2022
Project summary report	April 30, 2022
LDWF Sampling Event 4	April 2022
LDWF Sampling Event 5	May 2022
LDWF Sampling Event 6	June 2022
Final report	March 2023

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Missouri River Sub-Basin Asian Carp Partnership

The Missouri River Sub-Basin (MORB) comprises one-sixth of the continental United States and is surpassed in area only by the greater Mississippi River Basin in the U.S. It includes all or parts of 10 states (Figure 5) and two Canadian provinces. Recognizing the increasing threat of Asian carp in the MORB, the Missouri River Natural Resources Committee (MRNRC) developed an Asian Carp Technical Committee (Committee) made up of representatives from ten states in the basin and five federal agencies. The Committee finalized the *Missouri River Basin Asian Carp Control Strategy Framework* to minimize the social, ecological, and economic impacts of invasive carp to the MORB. The Framework applies the National Plan at the Missouri River sub-basin level.

Fiscal year 2020 was the inaugural year of funding Asian carp management and control in the Missouri River Basin as part of National Plan implementation. The Committee partnered with state and federal agencies and universities to develop four projects addressing the highest priorities: defining the geographic extent and population demographics of Asian carp populations within the sub-basin; understanding bigheaded carp movements and habitat use in tributaries; and investigating management actions to contain and reduce populations. The four projects resulted in $1.1M in grants allocated to five of the ten states in the Missouri River Basin.

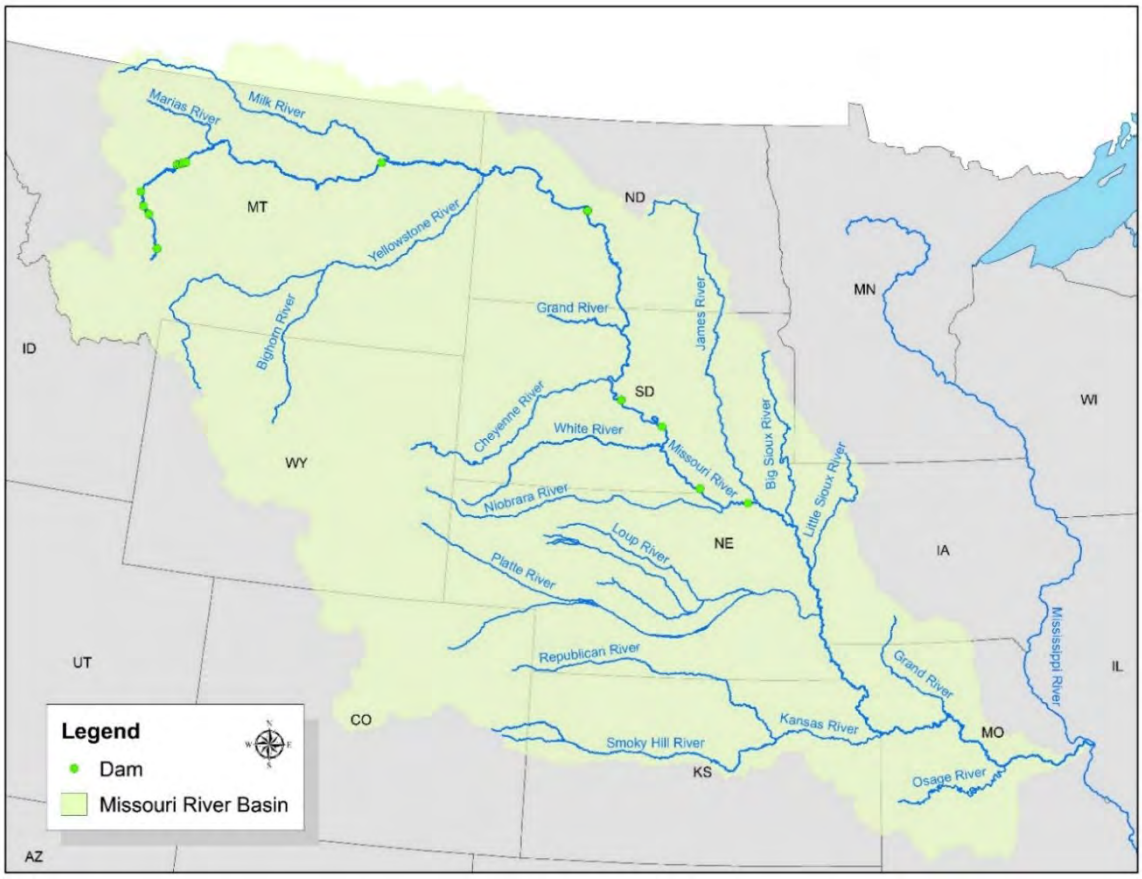


Figure 5. Map of the Missouri River Sub-Basin

Define the Spatial Distribution and Population Demographics of Asian Carp Populations and the Associated Fish Community in the Missouri River Basin

Lead Agency and Author: Nebraska Game and Parks Commission (NGPC); (kirk.steffensen@nebraska.gov) and US Fish and Wildlife Service Columbia Fish and Wildlife Conservation Office (CFWCO); Emily Pherigo (emily_pherigo@fws.gov)

Cooperating Agencies: South Dakota Department of Game, Fish, and Parks (SDGFP), East Dakota Water Development District (EDWDD), University of South Dakota (USD), Iowa Department of Natural Resources (IADNR); Iowa State University (ISU), Nebraska Game and Parks Commission (NGPC), University of Nebraska-Lincoln (UNL), Missouri Department of Conservation (MDC), US Fish and Wildlife Service (USFWS) Columbia Fish and Wildlife Conservation Office, Bozeman Fish Health Lab, Missouri River Fish and Wildlife Conservation Office, and Great Plains Fish and Wildlife Conservation Office

Statement of Need: The USFWS and the Aquatic Nuisance Species Task Force, in collaboration with multiple stakeholders, released a national Asian carp management and control plan (National Plan; Conover et al. 2007) to limit ecological and economic problems posed by these species. Despite tremendous progress towards achieving National Plan goals, there remains great need to develop metrics to quantify the success of Asian carp management and inform control efforts, especially in the Missouri River Basin where funding for Asian Carp research has been lacking. Defining the spatial distribution and demographics of Asian carp populations in the Missouri River Basin is fundamental to prescribing and assessing management actions as outlined in the National Plan Goals and Strategies related to prevention, containment and control, and extirpation. In addition, understanding the status and trends in abundance, size or age structure, maturity schedules, or fecundity of fish in a population are central to informed decision making.

Currently, more information on the abundance and distribution of Silver *Hypophthalmichthys molitrix*, Bighead *Hypophthalmichthys nobilis*, and Black Carp *Mylopharyngodon piceus* is needed to inform the strategic placement, development, and assessment of management actions across the Missouri River Basin as population assessments provide baseline population data to inform management decisions. Early detection sampling is used to detect new introductions and the spread of existing populations and can provide managers with critical information about the speed and mechanisms of spread. By detecting new populations early, actions can more effectively be implemented to control the population. Developing tools to assist with fish egg identification can help expedite the identification of range expansion. Monitoring provides empirical data about population changes over time and space, the ability to compare multiple populations, and a basis to evaluate the efficacy of management actions. Furthermore, historical and current information on select species and fish communities can identify species which may be negatively impacted by Asian carp and priority areas where Asian carp may be having a greater impact while providing metrics to measure success of future management actions. These efforts may require long-term commitments of 3 to 10 years, depending on the complexity and scope of the situation.

Too effectively guide efforts to manage and control Asian carp in the Missouri River Basin, managers must understand the factors influencing population dynamics. Examples of population variables that should be accounted for in management actions include numbers and locations of distinct populations within the basin, population sources and sinks, and movement into, out of, and within the basin. Technologies to answer questions about fish distribution and abundance are constantly advancing, and it would benefit managers to understand and implement emerging technologies that provide accurate and precise information. Environmental DNA (eDNA; presence/absence of DNA from the target species in

the environment) is one example that is of interest to Missouri River Basin partners. The scope of this work and the depth of specialized knowledge will require a collaborative effort among partners to develop and implement an effective protocol.

The tasks outlined in this document are the initial development of Asian Carp monitoring in the Missouri River and its tributaries. Collaborations between the U.S. Fish and Wildlife Service, the Missouri River basin states, universities, and other state partners will work towards the objectives listed below.

Objectives:

1. Determine the geographic extent (presence/absence) of Bighead, Silver, and potentially Black Carp throughout the Missouri River Basin to evaluate current barriers, prevent further range expansion, and identify potential control/removal opportunities (Agencies involved: SDGFP, NGPC, USFWS).
    a. Develop a Missouri River Basin Asian Carp Genetics Team to increase understanding of environmental DNA (eDNA) as a tool for the detection and measurement of Asian carp populations, host informational webinars/workshops from experienced labs to provide education and learning opportunities for labs in the Missouri River Basin, and develop a standard framework for field collection, laboratory analysis, database development, and results communication.
    b. Implement a strategy for information sharing on the methods needed to successfully analyze eDNA samples for Asian carp primers, coordinate efforts with USFWS Bozeman Fish Health Lab in Bozeman, MT & Whitney Genetics Lab in La Crosse, WI, to integrate methods with partners already using eDNA for detection of Asian carp.
    c. Determine the feasibility and efficacy of eDNA analysis in these aquatic systems to detect the presence of Asian carp in water and/or sediment samples across various sized drainage areas.
    d. Determine the presence/absence of Bighead and Silver Carp and investigate the feasibility of using eDNA for detecting Black Carp in the Missouri River and its tributaries concentrating above and below fish movement barriers to better understand Asian carp distributions.

2. Characterize spatial (tributaries longitudinally distributed in the Lower Missouri River) and temporal (seasonal and annual) patterns in the Silver and Bighead Carp population demographics (e.g., size structure and relative abundance) while developing standard operating procedures that are specific for the lower Missouri River Basin to prescribe and assess population control measures (Agencies involved: NGPC, MDC, USFWS).
    a. Evaluate a suite of gears and sampling logistics to determine an effective and efficient method to sample all sizes of Silver and Bighead Carp in a variety of aquatic systems.
    b. Determine the size distribution, relative abundance, and other population characteristics of the Silver and Bighead Carp populations in a variety of aquatic systems to help identify areas where population control measures can be implemented.

   c. Pair fishery sampling efforts with and eDNA sampling sites to validate eDNA results.

3. Characterize the historic and current fish community in the inter-reservoir reach and the Lower Missouri River to assess the impacts to the fish community pre- and post-invasion as well as provide a baseline data for comparison to prescribe and assess future management actions. (Agencies involved: NGPC, MDC).
   a. Deploy fish community assessment gears in the inter-reservoir reach and, in the lower Missouri River, use the data collected from Objective 2.1 to characterize the fish community and select native fish species.
   b. Determine the size distribution, relative abundance, and other population characteristics of select fish species to help identify potential differences between areas with and without established Asian carp populations.
   c. Utilize historic fisheries data (i.e., Pallid Sturgeon Population Assessment or Benthic Fishes) to determine changes in the associated fish community diversity, richness, size distribution, relative abundance, relative condition and other population dynamics parameters.

4. Develop a computer based application based on previous Bighead Carp and Silver Carp research and monitoring in the Upper Mississippi River for expeditious laboratory identification of fish eggs collected during ichthyoplankton sampling as part of an early detection protocol for Bighead, Silver, Grass or Black Carp. (Agency involved: IA DNR).

Agency: Nebraska Game and Parks Commission (NGPC) & University of Nebraska-Lincoln (UNL)

Activities and Methods:

Objective 1

NGPC in conjunction with UNL will assess the presence/absence of Asian carp above Gavins Point Dam using eDNA methodologies and surface ichthyoplankton drift nets. Specific study regimes will likely include bi-monthly or monthly surface water samples collected from Lewis and Clark Lake (multiple lake locations) and immediately below the Gavins Point Dam powerhouse. DNA will be extracted from each water sample and tested for primers consistent with Asian carp (collectively Silver Carp, Bighead Carp, and their hybrids). Additionally, surface ichthyoplankton drift nets will be deployed to document potential Asian carp presence and reproduction above Lewis and Clark Lake.

NGPC in conjunction with UNL will assess the feasibility of detecting the presence/absence of Black Carp in the upper segments of the lower Missouri River using eDNA methodologies. Specific study regimes will likely include bi-monthly or monthly surface water samples or sediment samples collected from Ponca State Park (rkm 1,212.6), Blair, NE (rkm 1,031.6) and Nebraska City (rkm 906.9). DNA will be extracted from each water sample and tested for primers consistent with Black Carp. This will determine the presence/absence and if present, the longitudinal distribution of Black Carp in the lower Missouri River.

NGPC in conjunction with UNL will use data gathered from fish sampling efforts (see Objective 2 below) for field verification of eDNA results collected during UNL's Nebraska Environmental Trust (NET)

project 'Improving Water Quality and Surveying Fish populations using eDNA in Nebraska'. A major objective in the NET project focuses on Asian carp presence/absence using eDNA methodologies. The combined efforts (field sampling and eDNA testing) will determine presence/absence of current and expanded distribution of Asian carp throughout interior rivers of Nebraska. Additional efforts will be targeted upstream of known locations in an effort to detect new unknown areas of Asian carp presence.

Objective 2

NGPC in conjunction with UNL will assess population demographics (relative abundance, size structure, age and growth, mortality, recruitment) of Bighead and Silver Carp in the Gavins Point Dam tailwaters, the most upstream infestation on the mainstem Missouri River, as well as Missouri River tributaries and periphery streams in Nebraska. Sampling efforts will include a suite of gears dependent on the size of the river/stream and the existing habitat. Potential methods include boat or barge electrofishing, electrified dozer trawl, trammel nets, gill nets, mini-fyke nets, seines and electric seines. In tributaries and periphery streams, the majority of effort will be focused near pool habitats below barriers and locations where Asian carp have the potential to congregate.

Objective 3

NGPC in conjunction with UNL will characterize fish communities and assess select fish species (e.g. Paddlefish, Buffalo spp.) in the Gavins Point Dam tailwaters, the most upstream infestation on the mainstem Missouri River, as well as Missouri River tributaries and periphery streams in Nebraska. Sampling methods and locations detailed under Objective 2 will be utilized for this assessment as well. Comparative fisheries assessments will be conducted at the Fort Randall Dam tailwaters to characterize the current fish community and facilitate the ability to document impacts if Asian carp infestation occurs in the future. In tributary streams and areas near the leading edge of Asian carp expansion, analyses will also focus on fish community characteristics in the presence or absence of Asian carp, and where absent will facilitate the ability to document impacts if infestation does occur in the future and inform where prevention management activities could occur. Additionally, concurrent standard fish population surveys and historical data will be utilized to document and better understand Asian carp impacts.

Map of Project Area: The proposed project area for work conducted by NGPC and UNL includes the mainstem Missouri River, interior tributaries and periphery streams.

Objective 1

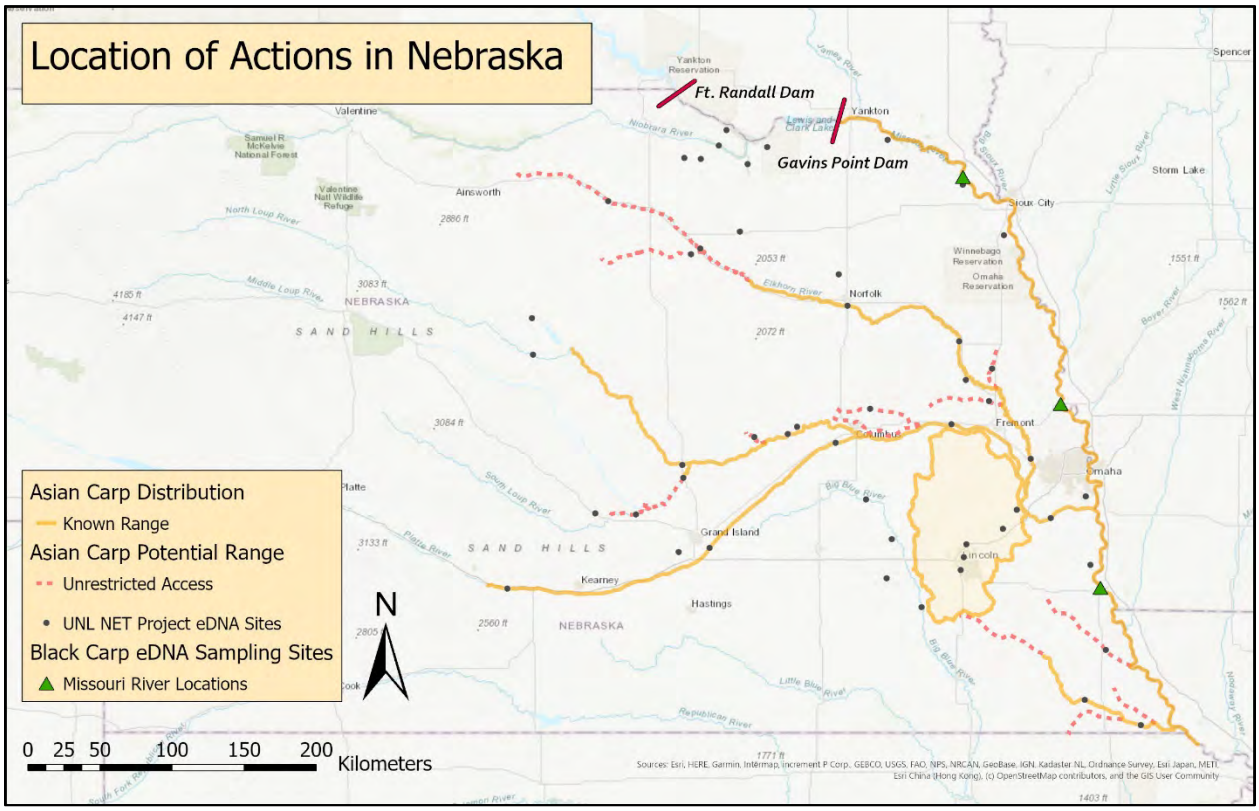
Mainstem Missouri River: This includes two reaches of the mainstem Missouri River. The upper reach is from Fort Randall Dam (rkm 1,416.2) to Gavins Point Dam (rkm 1,305.2), which includes Lewis and Clark Lake. The lower reach is from Gavins Point Dam to the confluence of the Kansas River (rkm 590.9). Gavins Point Dam is generally denoted as the start of the lower Missouri River. Gavins Point Dam is approximately 2 miles long with a powerhouse and spillway located on the south end. The Dam is a rolled-earth embankment with the powerhouse and spillway constructed of concrete. It is important to note that at multi-purpose lake levels there is approximately a 40-foot difference between the lake and river elevations, making it a physical barrier to fish movement.

Objective 2

Missouri River tributaries and periphery streams within eastern and central Nebraska. Potential rivers and watersheds include: Platte, Elkhorn, Loup, Niobrara, Big Nemaha, and Little Nemaha.

Nebraska Tributaries:

- Niobrara River from the confluence with the Missouri River (rkm 0.0) to Cornell Dam near Valentine, NE (rkm 230.0) -- efforts will likely be focused immediately below the dam area.
- Platte River (NE) from the confluence with the Missouri River (rkm 0.0) to the diversion dam near Paxton, NE (rkm 545.0) on the South Platte River including associated Platte River canal systems and the Salt Creek watershed.
- Elkhorn River from the confluence of the Platte River (NE) to Atkinson Lake Dam near Atkinson, NE (rkm 315.0).
- Loup River from the confluence of the Platte River (NE) to the Milburn Diversion Dam (rkm 265.0) on the Middle Loup River, the Taylor-Ord Diversion Dam near Taylor, NE (rkm 230) on the North Loup River, and associated canal systems.
- Big Nemaha from the confluence with the Missouri River (rkm 0.0) to Firth, NE (rkm 135).
- Little Nemaha from the confluence with the Missouri River (rkm 0.0) to Palmyra, NE (rkm 85).



Estimated Timetable for activities:

Activity	Time Period
Hire grad student	January 2021
Training, equipment requisition, background research, historical data acquisition, sampling site reconnaissance	January – April 2021
Field sampling for Objectives 1-3 on the mainstem Missouri River, tributaries and periphery streams	May – October 2021
Sample analysis, data entry, data analysis and report writing	October 2021 – March 2022

Agency: Missouri Department of Conservation (MDC)

Activities and Methods:

Objective 2

MDC will conduct targeted Asian carp sampling in 4 tributaries of the Missouri River, associated Missouri River bends, and potentially 2 Missouri River oxbow lakes between river kilometers 0.0 and 885. Waterbodies will be separated into sampling units. Up to the lower 40 river kilometers of each tributary will be divided into sampling units. The Missouri River will use river bends as the sampling unit. Different suites of gears for each type of waterbody based on current literature and expert opinion (including but not limited to boat electrofishing, mini-fyke nets, and gill nets) will be deployed in the various sampling units to evaluate gear efficiencies to help develop a standardized operating procedure for Asian carp in the Missouri River basin. Sampling will also obtain population demographic data (relative abundance, size structure, age and growth, mortality, recruitment). All species will be measured and weighed. Aging structures will be collected from a subsample of fish and analyzed in collaboration with other agencies. Sampling in tributaries and Missouri River bends will also aim to be complementary to fish community sampling being done in the same sampling units. Habitat variables will be recorded to help provide insight on local environmental, hydrologic, or geomorphological variables which promote concentration, production, and/or recruitment of Asian carp that can inform future management actions.

Objective 3

MDC will conduct fish community sampling in 4 tributaries of the Missouri River, associated Missouri River bends and potentially 2 Missouri River oxbow lakes between river kilometers 0 and 885 to obtain baseline data for comparison after future management actions are implemented. Sampling units delineated for Objective 2 will also be used for fish community sampling. Tributary sampling gears and regime will be based on Dunn and Paukert 2020, while Missouri River bend sampling will be based on Welker and Drobish 2016. This will allow for comparison to other programs' fish community work to evaluate long term trends in areas with Asian carp. Along with overall fish community sampling, selected species of interest will be sampled to monitor any impacts. Species of interest will be selected based on current literature, expert opinion, and agency priorities.

Map of Project Area: The study area for objective 2 and 3 on the mainstem Missouri River is between rkm 0.0 and 885. The focus will be on bends located at the mouth of the 4 selected tributaries. The two potential oxbow lakes for sampling include Big Lake located in Holt County Missouri near rkm 805 and Creve Coeur Lake located in St. Louis County Missouri near rkm 50.

Missouri Tributaries:

- Nodaway River from the confluence with the Missouri River (rkm 0.0) to 40 rkm upstream.
- Platte River (MO) from the confluence with the Missouri River (rkm 0.0) to 40 rkm upstream.
- Grand River from the confluence with the Missouri River (rkm 0.0) to 40 rkm upstream.
- Lamine River from the confluence with the Missouri River (rkm 0.0) to 40 rkm upstream.

Map of proposed actions by Missouri Department of Conservation for Objective 1 and 2 including sampling locations on the Missouri River between river kilometers 0.0 and 885 (green circles), sampling stretches of the selected tributaries (lower 40km highlighted with blue) and potential oxbow lakes (identified in dark blue).

Estimated Timetable for activities:

Activity	Time Period
Pilot sampling protocols	August – September 2020
Acquire additional nets/equipment	Winter 2020/2021
Asian Carp population demographic sampling	Summer/Fall 2021
Fish Community sampling	Summer/Fall 2021
Sample analysis, data entry, analysis and report writing	October 2021 – April 2022
Submit Annual Report	March 2022

Agency: South Dakota Department of Game, Fish and Parks (SDGFP), East Dakota Water Development District (EDWDD), University of South Dakota (USD)

Activities and Methods:

Objective 1

SDGFP and USD staff will participate in environmental DNA (eDNA) training with USFWS staff from the Whitney Genetics Lab and the Bozeman Fish Health Center, along with staff from other basin partners, during the later summer of 2020. Training will occur in eastern South Dakota, and samples will be collected from a combination of the Big Sioux, Vermillion, and James Rivers, where Silver Carp and Bighead Carp (hereafter-Asian carp) are known to persist. Topics to be covered during the training session include proper sampling protocols, collection and pre-processing techniques, and broader discussions on efficacy, sample sizes, preservation, and processing techniques. Sampling conducted in 2020 will provide preliminary data on fish distribution, eDNA efficacy in eastern SD, and the effectiveness of barriers to fish movement on the Big Sioux and Vermillion Rivers.

Beginning in 2021, a graduate student at USD will begin collecting and processing water samples in the Big Sioux, Vermillion, and James Rivers. Information obtained as part of the 2020 sampling training with experienced staff from the Whitney Genetics Lab will be utilized to guide protocols associated with timing, number of samples, preservation, and other sampling considerations. Previous research suggests that detection probability of Asian carp eDNA is lowest in late summer and early fall (Erickson et al. 2017), so samples will likely be collected in spring or fall (see also Mize et al. 2019). We plan to take a total of 100-150 water samples across all three rivers, but a greater emphasis will be placed on the Big Sioux and Vermillion Rivers in relation to the perceived fish barriers. Water samples will be placed on ice immediately after collection, and a series of control samples with purified water will be “collected” at each site following methods similar to those described in Erickson et al. (2017).

Sampling locations in the Big Sioux and Vermillion Rivers will correspond with locations above and below presumed barriers. On the Big Sioux River, samples will be collected in Sioux Falls below the natural waterfalls (rkm 243) and/or below the manmade diversion spillway (rkm 241), where Asian carp are known to persist. Samples will also be taken above the barrier at locations

to be determined where Asian carp have never been documented. One potential sample site above Sioux Falls is below Flandreau Dam (rkm 357), which acts as the next barrier to fish movement under normal water conditions on the Big Sioux River. Water samples will be collected on the Vermillion River will occur below the East Vermillion Lake spillway (rkm 192), where Asian carp are known to exist, and at a location to be determined above East Vermillion Lake.

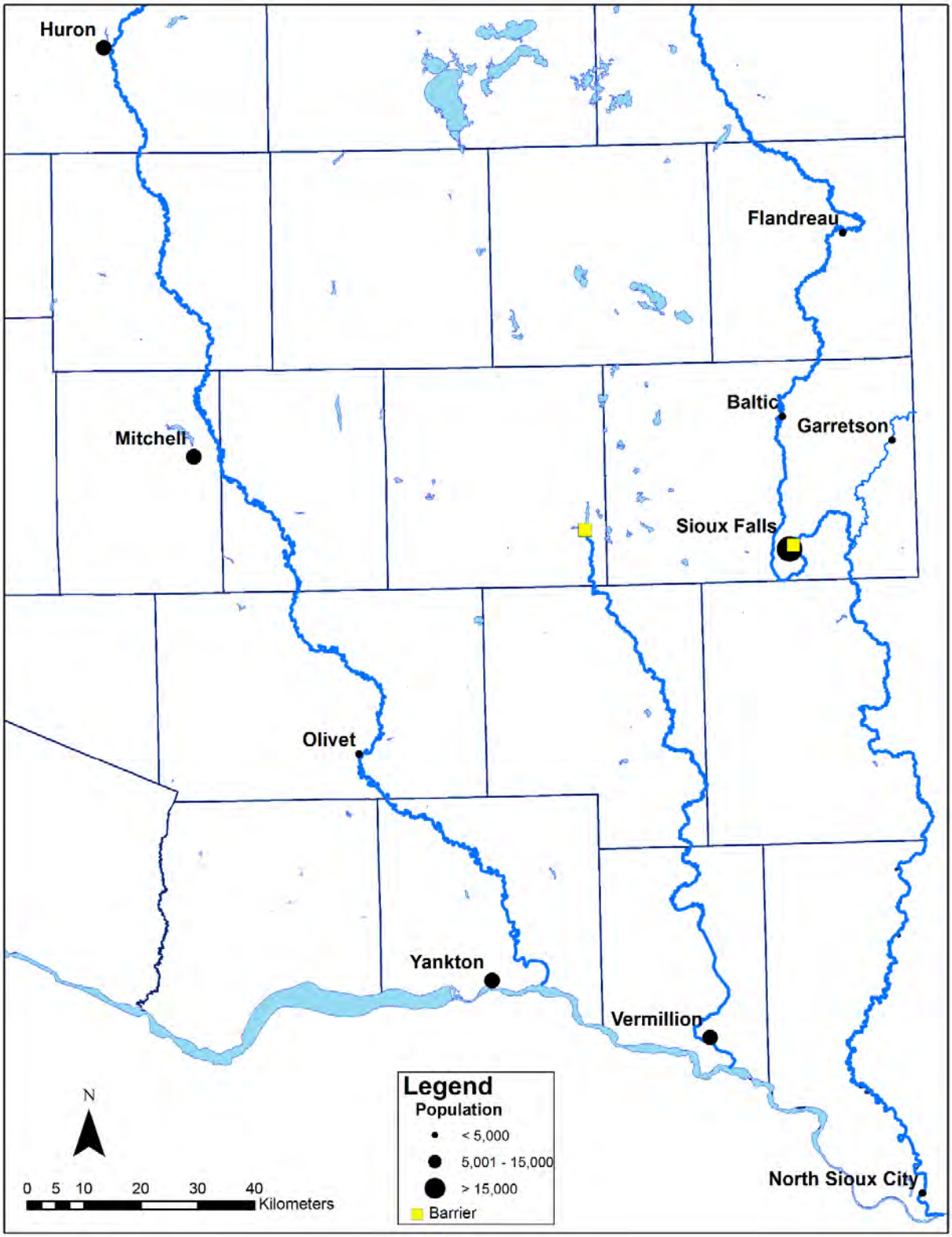
In the laboratory, we will follow the procedures detailed in the Quality Assurance Project Plan eDNA Monitoring of Bighead and Silver Carps (QAPP; USFWS 2019) for storing, extracting, and amplifying samples. Water samples will be centrifuged to concentrate genetic material, and eDNA will be extracted from swabs of the centrifuged pellet material using a commercially available extraction kit (i.e., DNeasy Blood & Tissue; Qiagen Inc). Samples will then be processed using replicated quantitative polymerase chain reactions (qPCRs) using Asian carp-specific primers (Amberg et al. 2015). Because of the smaller scale of our laboratory effort relative to those on the main stem Mississippi River, specific modifications to these procedures will be further made following discussion with the Whitney Genetics Lab.

Immediately following the collection of water samples, fish sampling will occur upstream of the water collection site to confirm the presence of Asian carp. Wherever possible, boat electrofishing will be used to collect adults. Locations where boat electrofishing is not feasible will be sampled with a variety of other gears including, but not limited to, seines and cast nets. Additionally, visual observation of jumping carp can serve as a detection of Asian carp if two biologists make positive identification above the water sampling site. The primary goal of this sampling will be to detect the presence or absence of Asian carp upstream of water sampling sites, but information on relative abundance in the form of catch per unit effort may be collected to inform detection probabilities.

Map of Project Area: Missouri River tributaries within eastern South Dakota, including the James, Vermillion, and Big Sioux Rivers with perceived barriers to fish movement indicated by yellow squares.

South Dakota Tributaries:

- Lower James River from the confluence with the Missouri River (rkm 0.0) to Huron, South Dakota (rkm 358.0) where there is a small low-head dam that acts as a barrier during low water conditions.
- Vermillion River from the confluence with the Missouri River (rkm 0.0) to East Vermillion Lake spillway (rkm 192.0) where there is a physical barrier that prevents fish movement. Samples will also be taken above the barrier at location to be determined where Asian carp have never been documented.
- Big Sioux River from confluence with the Missouri River (rkm 0.0) to Sioux Falls, SD where there is a natural fish barrier (rkm 247.0). Samples will also be taken above the barrier at locations to be determined where Asian carp have never been documented.


Huron
Flandreau
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Garretson
Mitchell
Sioux Falls
Olivet
Yankton
Vermillion
North Sioux City
N
0 5 10 20 30 40
Kilometers
Legend
Population
< 5,000
5,001 - 15,000
> 15,000
Barrier

Estimated Timetable for activities:

Activity	Time Period
Training with Whitney Lab	August 2020
Develop sampling protocols for 2021	Winter 2020/2021
Collect water samples	Late spring-midsummer 2021
Conduct fish sampling	Late spring-midsummer 2021
Process eDNA samples	Fall 2021
Interim progress report	Fall 2021
Data analysis and synthesis	Winter 2021-2022
Final Report	Fall 2022

Agency: U.S. Fish and Wildlife Service (USFWS) including the Columbia Fish and Wildlife Conservation Office, Bozeman Fish Health Lab, Missouri River Fish and Wildlife Conservation Office, and the Great Plain Fish and Wildlife Conservation Office

Activities and Methods:

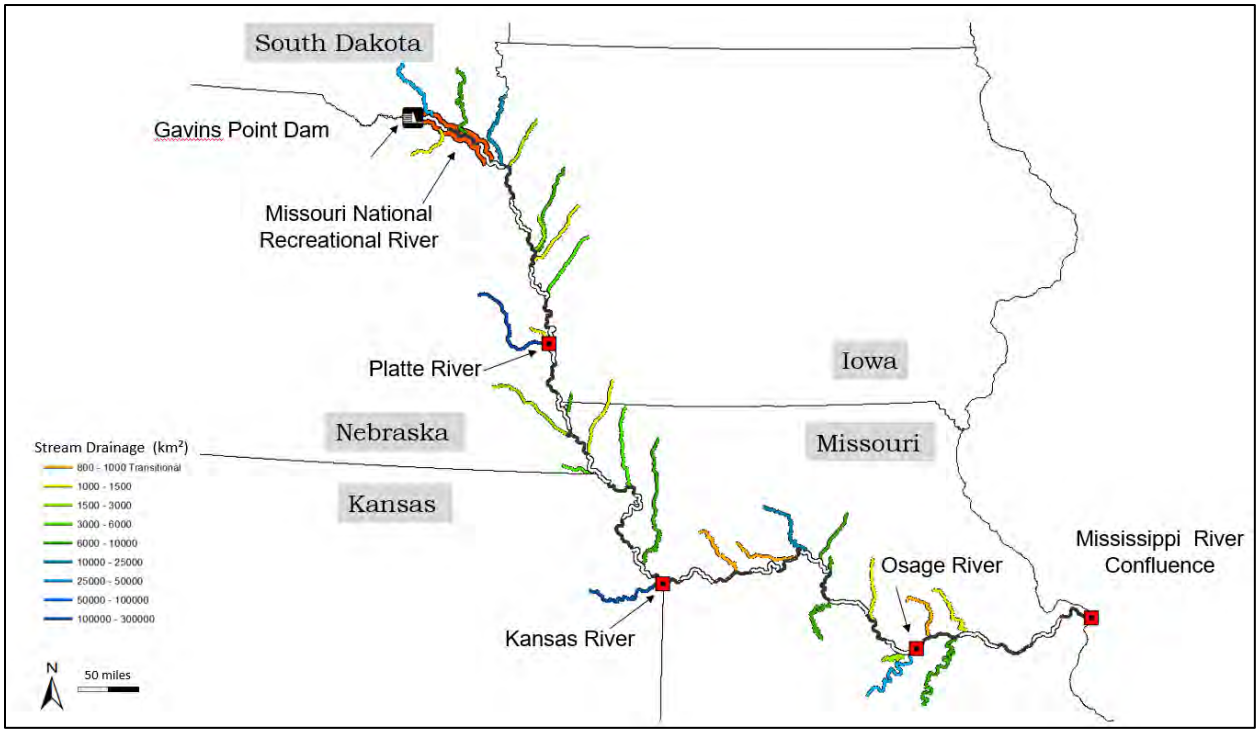
Objective 1

USFWS: USFWS is working with Whitney Genetics Lab (WGL) to increase and enhance existing eDNA laboratory capacity in the Missouri Basin at Bozeman Fish Health Center (BFHC) in Bozeman, MT. Missouri River FWCO staff will use their existing Asian carp mapping to develop eDNA sampling site strategy for Vermillion, Big Sioux and James Rivers following WGL protocols. Field sampling will be conducted in partnership with the La Crosse FWCO genetics trailer team. BFHC in Bozeman, MT will determine presence/absence of Bighead and Silver Carp using eDNA methodologies.

Objective 2

Confluence areas of major Missouri River tributaries will be sampled in the fall using an electrified dozer trawl to gather population demographic information for bighead and silver carp. Tributaries below Gavins Point Dam (RM 811; upper limit of known bighead and silver carp presence) will be selected based on navigability (at least 800 km^2 watersheds; Flotemersch et al. 2006), and confluences up to the lowest 20 river km will be sampled to focus results on confluence assemblages (Thornbrugh and Gido 2010). Sampling will be conducted in the fall to allow for more stable water levels, reduce the impact of reproduction on length-weight relationships, and coincide with annulus formation on otoliths (Thompson and Beckman 1995), in addition to providing the highest and therefore more consistent catch rates of silver carp (Sullivan et al. 2017). An electrified dozer trawl (described in Hammen et al. 2019) will be the primary means of collecting bighead and silver carp. At each tributary, total length (mm), weight (g), and sex will be recorded and aging structures extracted for a subset of bighead and silver carp. Any additional bighead or silver carp as well as any bycatch will be measured for total length (mm) and enumerated for relative abundance estimates. Aging will be conducted in a centralized location using accepted protocols. For each tributary with adequate data, relative abundance, sex ratio, body condition, recruitment, growth, and mortality for each species will be calculated, then compared longitudinally and across tributaries. Relative standard error will provide an estimate of precision for catch rates (Dumont and Schlechte 2004) and, in combination with field observations, will be used to conduct power analyses and adapt protocols in the future as needed.

Map of Project Area:



Overview map of Missouri River from confluence with Mississippi River (lower right) to Gavins Point Dam (river mile 811; upper left). The Missouri River is in alternating black and white, where each black or white band represents 50 river miles. Tributaries are color-coded by cumulative drainage area. The unchannelized portion of the Missouri River is highlighted in orange and labeled as the Missouri National Recreational River. Select tributary confluences are highlighted with red boxes.

Estimated Timetable for activities:

Project Activity	Time Period
Project development and sample site selection	February – April 2020
Field collections	September – October 2020
Partner update	November 2020
Lab analysis	September 2020 – February 2021
Data analysis	November 2020 – March 2021
Final report	April 2021
State-specific fact sheets	May 2021

Agency: Iowa Department of Natural Resources (IADNR) and Iowa State University (ISU)

Activities and Methods:

Objective 4

Understanding when and where Asian Carp are reproducing is critical for understanding population sources and how they are spreading. Consequently, many state and federal agencies and Universities throughout the United States have been and continue to sample fish eggs and larvae to detect and quantify Asian Carp reproductive success. While several resources exist to identify fish larvae based on morphological features, similar tools do not exist for the identification of fish eggs. Consequently, egg data collected during routine ichthyoplankton sampling is either 1) not included in analyses, resulting in sampling inefficiencies and missed opportunity to learn more about Asian Carp reproductive ecology, or 2) eggs must be identified using genetic analysis which is an expensive and time consuming process. Thus, a need exists to develop a tool for rapid identification of fish eggs based on morphological characteristics to learn more about where and when Asian Carp, and other fishes, are reproducing. Camacho et al. (2019) developed a highly accurate egg identification model to identify fish eggs in the Upper Mississippi River based on morphological characteristics. The model is currently being validated with independent data and preliminary results corroborate our original work and suggest that this model could be extremely valuable for rapidly assessing Asian Carp reproduction. Random forest models are frequently very successful classifiers, with low mis-classification rates. However, their disadvantage is that the model exists only inside a computer and cannot be written down on paper, either as an equation or as a dichotomous key. Thus, the Camacho et al. (2019) random forests model used to identify fish eggs coded in R is not very 'user friendly' to interpret and implement with new data, currently limiting its utility for assessing Asian Carp reproduction.

We propose to convert the existing R code from the Camacho et al. (2019) model into a web based app for computers or mobile devices. A user would provide some simple egg characteristics and the app would identify the species of egg (for species included in the Camacho et al. (2019) model) and the uncertainty in that identification. Consequently, this app could be a highly successful screening tool that could be used quickly and inexpensively by anyone to determine when and where Asian Carp reproduction is occurring.

Personnel at Iowa State University will take the model developed by Camacho et al. (2019) to develop a web based app using Shiny. Shiny is a R package for developing web-based user interfaces to an R program. Shiny apps allow users to access the capabilities of R through an interactive point and click interface that requires no knowledge of R. The user is able to enter data into a web page. That information is passed to a server (another computer) running an R program that does the appropriate computations and passes the results back to the user's web page. For the egg classification model, we envision the user entering characteristics of a single egg or an excel file with information about multiple eggs. The server will use the random forest model to classify the egg and estimate the uncertainty in that classification. This app could be run in any web browser running on a laptop or mobile device. We anticipate having time to build a mobile device-specific app using shinyMobile.

Estimated Timetable for activities:

Activity	Time Period
Meet with project collaborators to discuss Camacho et al. model, brainstorm, and develop detailed work plan	October-December 2020
Work on app development	November 2020 – September 2021
App testing	May – August 2021
Completed app	October 2021

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Asian Carp Movement and Habitat Use in the Missouri River Basin to Inform Containment and Control Management Actions

Lead Agency and Author: US Fish and Wildlife Service Columbia Fish and Wildlife Conservation Office (CFWCO); Emily Pherigo (emily_pherigo@fws.gov)

Cooperating Agencies: Iowa Department of Natural Resources (IADNR), Iowa State University (ISU), Missouri Department of Conservation (MDC), South Dakota Department of Game, Fish, and Parks (SDGFP), University of South Dakota (USD), US Fish and Wildlife Service Great Plains Fish and Wildlife Conservation Office (GPFWCO)

Statement of Need: Containment (Goal 2 in the National Plan and Goal 3 in the Missouri River Framework) prevents Asian carp from expanding a known population confined to its current geospatial distribution. Knowing the movement range of Bighead and Silver Carp in the Missouri River basin as well as the environmental conditions associated with movements or congregations in association with deterrent barriers currently present in the Missouri River Basin will allow for the identification of locations where deterrence technologies, concentrated removal efforts, physical barriers, or other emerging technologies can be utilized for containment and control. Identification and evaluation of containment opportunities can facilitate the implementation of deterrent and/or removal systems that may limit dispersal, reproduction, or recruitment of Asian carp. A better understanding of the movement and behavior of Asian carp in tributaries and in association with barriers as outlined in this proposal is critical to devising strategies for successful containment. As stated in National Plan Goal 6, scientifically valid research is necessary to provide accurate information for the effective management and control of Bighead and Silver Carp. This research will be used to develop criteria for deterrent barriers, harvest regulations, or other management activities.

Asian carp are well established throughout the Missouri River and tributaries downstream of Gavins Point Dam. Knowing when and under what environmental conditions adult Bighead and Silver carp are moving into the tributaries will help inform when to monitor the population as well as implement management actions. Understanding the movement range of Bighead and Silver Carp in the Missouri River basin, the environmental conditions associated with movements, and the conditions associated with congregations at deterrent barriers currently present in the Missouri River Basin will allow for the identification of locations where deterrence technologies, concentrated removal efforts, physical barriers, or other emerging technologies can be utilized for containment and control. Identification and evaluation of containment opportunities can facilitate the implementation of deterrent and/or removal systems that may limit dispersal, reproduction, or recruitment of Asian carp. A better understanding of the movement and behavior of Asian carp in tributaries and in association with barriers as outlined in this proposal is critical to devising strategies for successful containment.

Asian carp populations extend into the interior waters of Missouri River Basin states such as Minnesota via the Little Sioux River in northwestern Iowa and North Dakota via the James River. The Little Sioux and James rivers have barriers that act as deterrents under certain conditions. Flooding in 2012 allowed Asian carps to invade the Iowa Great Lakes that are

comprised of seven different waterbodies that are extremely important recreationally and economically. The IADNR, Minnesota Department of Naturnal Resources, and local partners responded to the invasion by installing an electric barrier on the outlet of Little Gar Lake, the most downstream lake in the Iowa Great Lakes chain with a 352 km^2 watershed that includes both Iowa and Minnesota. Additionally, the Little Sioux River originates in southwestern Minnesota and in December 2019, a Silver Carp was captured in the Ocheyedan River, about 100 yards from the Iowa border in southwestern Minnesota.

The electric barrier on the outlet of the Iowa Great Lakes is 49 m wide and 8 m long and consists of eight electrodes and seven pulsers that span the width of the outlet with a gradient of electrical intensity. The barrier is only activated when water on the barrier surpasses 3", which typically occurs in the spring when Asian carps migrate upstream for spawning but can also occur periodically during the summer and fall, albeit less frequently. While the barrier has been in place since 2013, no evaluations have occurred to determine how effective it is at slowing or stopping upstream movements of Asian carp. Asian carp are frequently observed below the barrier and anecdotal evidence suggests that they may have passed the barrier during high water in 2018, as individuals are occasionally captured in the Iowa Great Lakes; however, it is unknown if these fish are new individuals that have recently passed the barrier or fish that were part of the initial invasion. Downstream movement of fishes past the barrier from the Iowa Great Lakes is commonly observed; thus, upstream fish passage through the barrier may also be possible.

A number of different Asian carp barrier evaluations have been conducted to date using a variety of different deterrents. However, most of these evaluations have occurred in laboratory settings due to the cost and regulations associated with installing barriers in natural environments. Electrical barriers likely hold the most promise for limiting or stopping the upstream movement of Asian carp and the barrier currently in place on the Iowa Great Lakes is only one of a few systems available in the world that provides an opportunity to test its effectiveness under natural conditions. However, no evaluations of this barrier have been conducted to date and it is currently unknown how effective the barrier is at preventing upstream movement of fish. Additionally, no information is available regarding the seasonal presence of Asian carp at the barrier or the source of these fish (e.g., Little Sioux River residents or migrants from the Missouri River). Further, the timing and frequency of Asian carp movements further upstream into Minnesota is unknown, but could provide information about invasion phenology. Thus, more information regarding tributary movements of Asian carp and potential effectiveness of electric barriers at minimizing or stopping their upstream movements is needed.

Objectives:

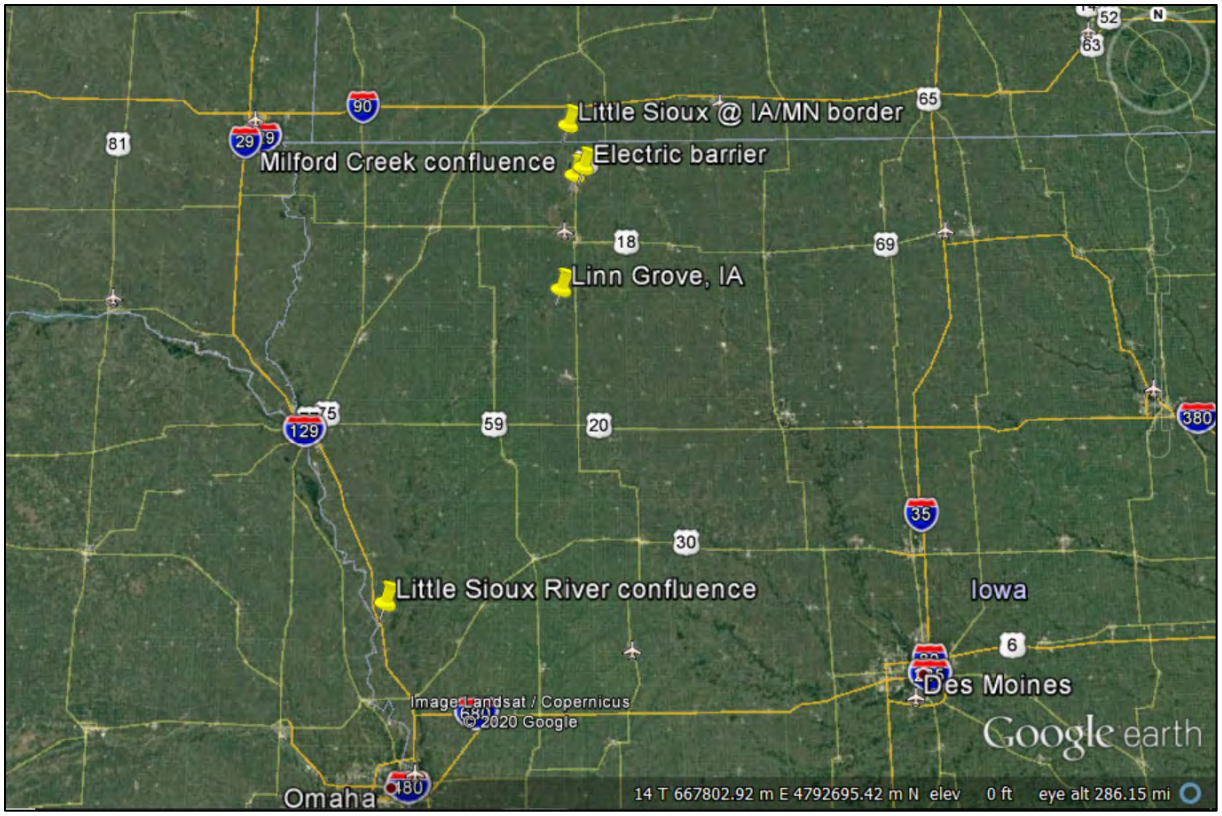
1. Determine Silver Carp and Bighead Carp residence time and movement in the Missouri River and its tributaries in association with season, environmental conditions, and barriers to inform containment and control management actions.
    a. Determine if Silver Carp and Bighead Carp have extended presence in tributaries and directional movement into and out of Missouri River tributaries.
    b. Evaluate environmental factors (e.g., season, temperature, discharge) for Silver Carp and Bighead Carp movements in select Missouri River tributaries.

c. Assess fish behaviors in association with an electric barrier at the outflow of the Iowa Great Lakes, a concrete spillway at Creve Coeur Lake, and dams on the Kansas River (WaterOne Dam and Bowersock Dam), particularly how fish approach, challenge, and pass the barriers.
d. Evaluate seasonal congregations of Silver Carp and Bighead Carp in Missouri River tributaries, particularly as they relate to fish barriers.

Agency: Iowa Department of Natural Resources (IADNR) and Iowa State University (ISU)

Activities and Methods: Acoustic receivers will be placed around the electric barrier as well as in the Iowa Great Lakes. In spring 2021, acoustic tags will be implanted in Silver and Bighead Carp below the electric barrier to assess fish behaviors in association with the barrier. Acoustic receivers will be maintained throughout 2021 to evaluate seasonal congregations of fish near the barrier and how fish approach, challenge, and pass the barrier. Acoustic receivers will also be placed at locations throughout the Little Sioux River between the Iowa-Minnesota border and the Little Sioux confluence with the Missouri River to evaluate downstream movement of fish tagged near the outlet of the Iowa Great Lakes. This acoustic receiver array will also be used to assess potential upstream movement of Asian Carp and other fishes tagged by basin collaborators (e.g., USFWS, MDC, SDGFP).

Map of Project Area: The Little Sioux River joins the Missouri River at approximately rkm 1,077 and extends into Iowa and Minnesota by way of the Iowa Great Lakes, which are comprised of seven different waterbodies that are extremely important recreationally and economically. This study will focus on the 415 rkm from the confluence with the Missouri River to the electric barrier on the outlet of the Iowa Great Lakes and upstream to the Iowa-Minnesota border.



Estimated Timetable for activities

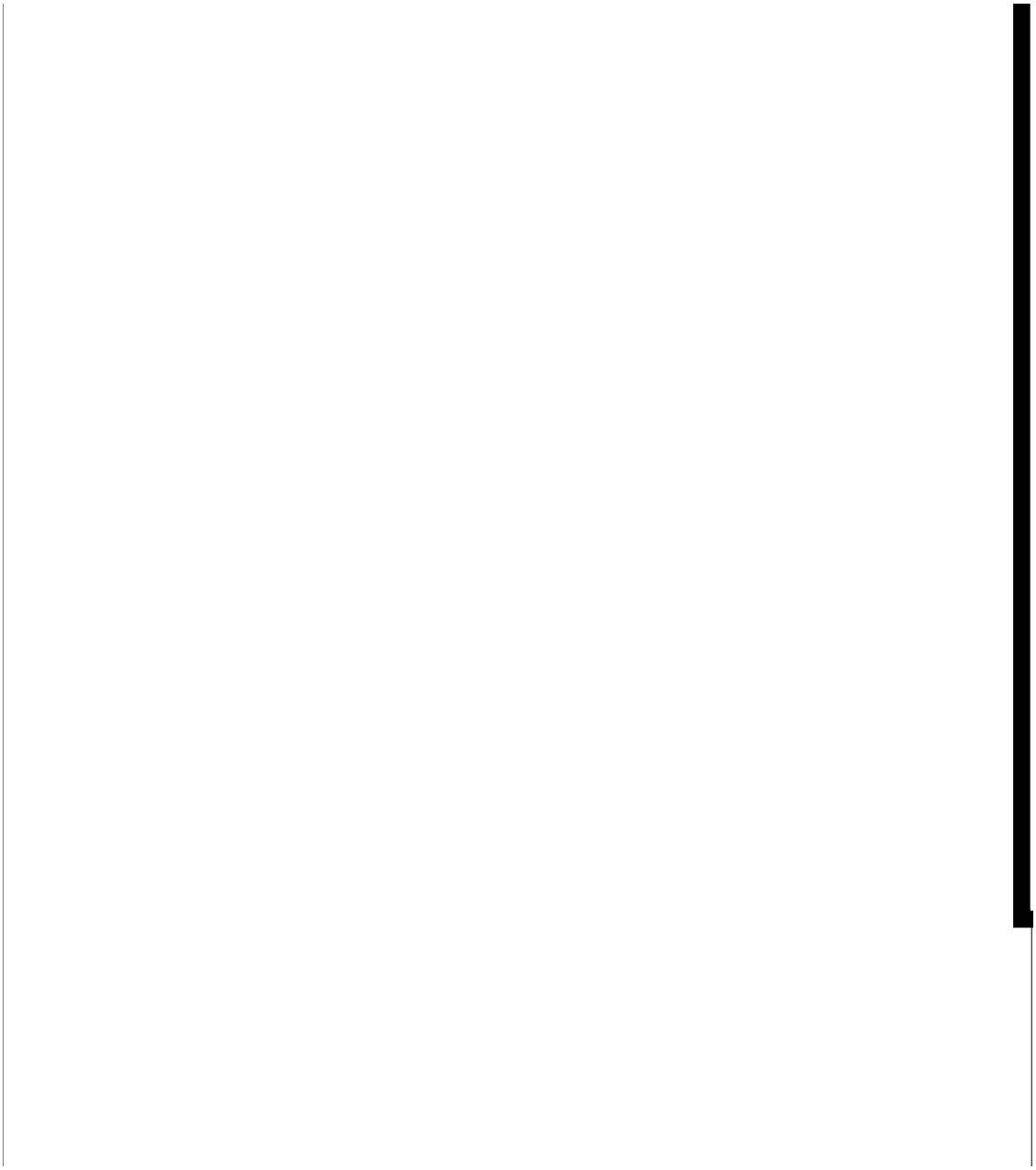
Activity	Time Period (Season, month/year)
Site visits, scout potential receiver locations, range testing, logistical planning	October 2020 – March 2021
Purchase supplies	October 2020 – March 2021
Deploy receivers and tag fish	March-June 2021
Record fish locations	March-October 2021
Download receivers	September-October 2021

Agency: Missouri Department of Conservation (MDC)

Activities and Methods: During the winter of 2020/2021 stationary receiver arrays and HOBO temperature/water level loggers will be deployed at each of the five tributaries in Missouri (Creve Coeur, Moreau, Lamine, Grand and Kansas rivers). Each tributary array will consist of five stationary receivers and two HOBO loggers. Near the mouth of each tributary, two receivers will be deployed so that the direction of movement (entering or exiting) can be determined and the remaining three receivers will be placed further upstream depending on access and presence of Asian carp. A HOBO logger will be placed on the receiver closest to the confluence of the Missouri and at the furthest upstream receiver. The HOBO loggers will provide the environmental data needed to determine if there are any patterns or environmental cues that can be linked to timing of movement and tributary use. A minimum of 50 Silver Carp or Bighead Carp will be surgically implanted with V16 (6H or 4H, depending on fish size) transmitters in each system. Receivers and HOBO loggers will be downloaded on a regular basis (every 4-6 weeks) and active tracking may be employed to inform removal efforts. Downloaded data will be shared with partnering agencies as appropriate and analyzed for Silver Carp tributary use and movement in relation to season and environmental conditions.

Data collected from the stationary receivers in the tributaries will be used to fulfill Objective 1 by providing the residence time and movement of Asian carp in tributaries, while the HOBO loggers will allow us to evaluate whether environmental factors effect movement and use of tributaries. All of this information combined will be used to inform future removal efforts and also inform decisions in locations where barriers occur (Bowersock Dam and Creve Coeur).

Map of Project Area:



Estimated Timetable for activities

Activity	Time Period (Season, month/year)
Deploy Acoustic Array	Fall/Winter 2020
Implant Acoustic Tags in Asian Carp	Fall/Winter 2020
Download Receiver Data	Every 4-6 weeks 2020/2021
Annual Report	March 2021

Agency: South Dakota Department of Game, Fish, and Parks (SDGFP) and University of South Dakota (USD)

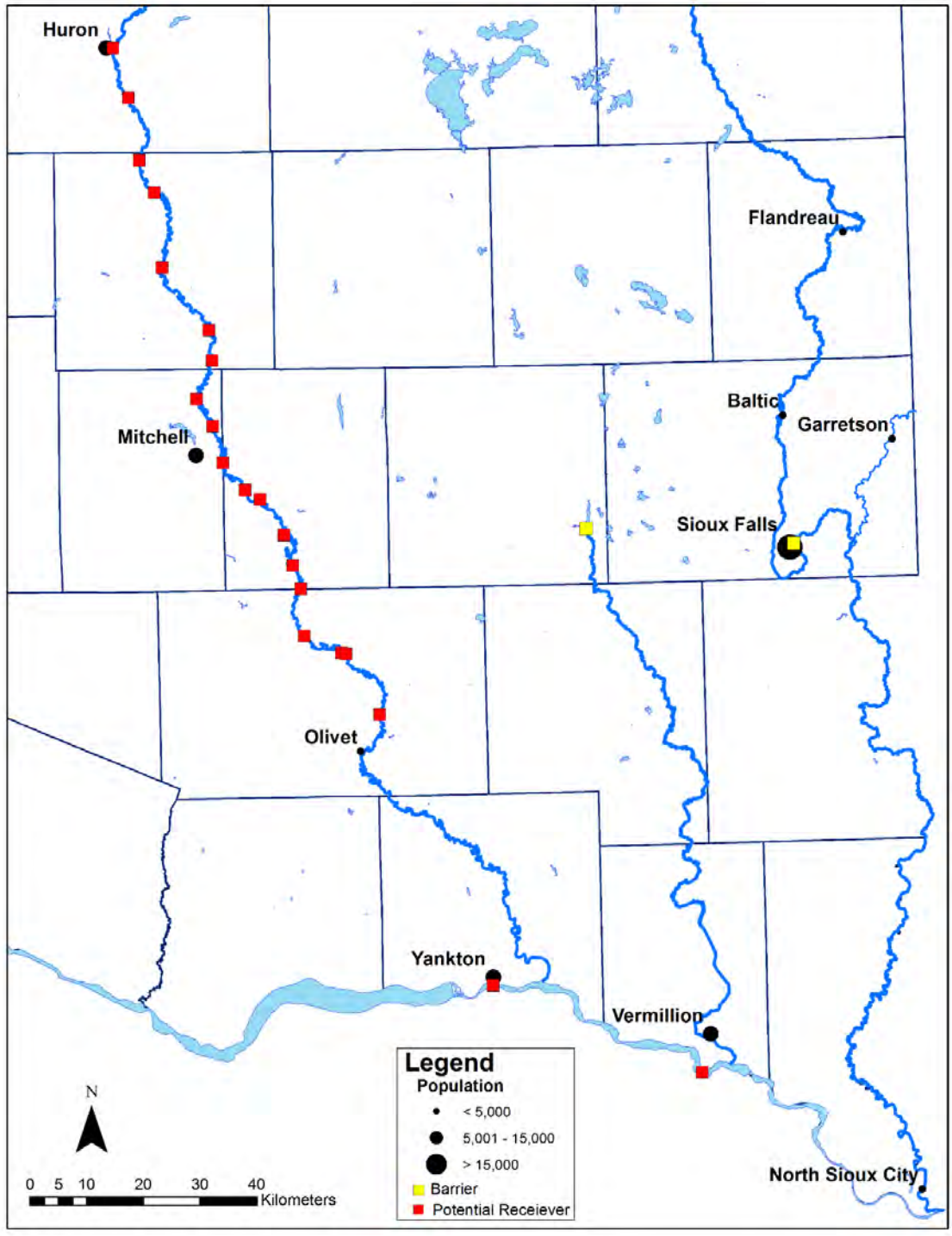
Activities and Methods: A minimum of ten acoustic receivers (Vemco VR2W) will be deployed in the James River between Olivet, South Dakota (rkm 105) and Huron, South Dakota (rkm 358). An additional 1-2 VR2W receivers will be deployed either at locations in the Missouri River or the James River. Placement of these receivers will depend on deployment of Vemco acoustic receivers being used for studies of other species (i.e., Saugeye, Walleye, Blue Suckers, Pallid Sturgeon) in the Missouri River, Lake Lewis and Clark, and Missouri River tributaries. Potential receiver deployment locations in the mainstem Missouri River include the Yankton bridge (rkm 1,297) and the Vermillion-Newcastle bridge (rkm 1,252). A receiver array of VR2Ws will already exist downstream of Olivet, SD on the James River to the confluence of the Missouri River as part of an ongoing Blue Sucker telemetry project. Receivers will be attached to the downstream side of bridge pilings and secured inside 4" PVC tubing.

Silver Carp will be collected in spring 2021 and surgically implanted with Vemco V16 acoustic transmitters. Tags will only be implanted if the tag weight is <2% of the total mass of the individual fish. Tags will be implanted following similar procedures as described in DeGrandchamp et al. (2008) and Coulter et al. (2016) A small incision will be made on the ventral side of the fish between the pelvic and anal fins such that the tag can be inserted into the coelomic cavity. The incision will be closed with 2-3 absorbable sutures. Fifty Silver Carp will be tagged with V16 tags, with tags distributed between tagging locations between the confluence of the James River with the Missouri River and Huron, SD. Likely tagging locations include the James River confluence, Olivet, Mitchell, and Huron, but tag distribution will likely be determined by Silver Carp availability.

Water temperature loggers will be deployed near the confluence and at several upstream locations and 1-2 water level loggers will be placed near the confluence of the James River to monitor the impact of backflow from the Missouri River into the James River. Data will be downloaded from the acoustic receivers, temperature loggers, and water level loggers in fall 2021 and fall 2022, at a minimum. Available habitats will be mapped in the James River using side scan sonar. Discharge and gage height data will be collected from the USGS National Water Information System website. Analysis of movement and environmental data will be conducted following data retrieval each fall.

Map of Project Area:

Map of Big Sioux, Vermillion, and lower James River with barriers to fish movement indicated by yellow squares and potential acoustic receiver locations indicated with red squares.



Estimated Timetable for activities

Activity	Time Period (Season, month/year)
Deploy Acoustic Receivers	Spring 2021
Implant Acoustic Tags	Spring 2021
Deploy temperature and water level loggers	Spring 2021
Retrieve data from acoustic receivers and environmental loggers	Fall 2021
Interim Progress Report	Fall 2021
Annual report to sub basin partnership	December 2021-February 2022
Habitat mapping	Summer 2022
Retrieve data from acoustic receivers and environmental loggers	Fall 2022
Data analysis and synthesis	Fall 2022
Final Report	Fall 2022

Agency: US Fish and Wildlife Service Great Plains Fish and Wildlife Conservation Office (GPFWCO)

Activities and Methods:

Acoustic Transmitter Tagging

Stationary large mesh (3" to 5" bar mesh, depth 6' to 8', 50' to 75' in length) gill nets or electrofishing will be used to collect Silver Carp in the lower Vermillion and lower Big Sioux rivers. Gill net sets will be short when water temperatures >15°C to minimize mortality of bycatch.

A total of 100 Silver Carp (> 500 mm TL, and > 1200 g) in each river will be tagged with acoustic transmitters (Vemco, Model V16-4H; 69kHz, 16mm diameter, 68 mm length, 24g) at multiple locations within the rivers to assess movement over the entire study reach. V16-4H coded transmitters have a 1350 day battery life and random delay from 30 to 90 seconds. Fish will be held in a tank with a continuous flow of fresh river water, anesthetized with Aqui-S 20E, and tags implanted following surgical procedures outlined in Summerfelt and Smith (1990). Each fish will be weighed (g), measured for total length (mm), and sexed. A Floy T-bar anchor tag (Model FD-94; Floy Tag & Mfg. Inc) with a unique identification code and contact information (CARP@FWS.GOV) will be attached near the dorsal fin base. Following surgery fish will be placed into a tank with a continuous flow of fresh river water until the fish recovered enough to maintain equilibrium and swim independently. Once recovered the fish will be released near the point of capture.

Acoustic Receiver Array

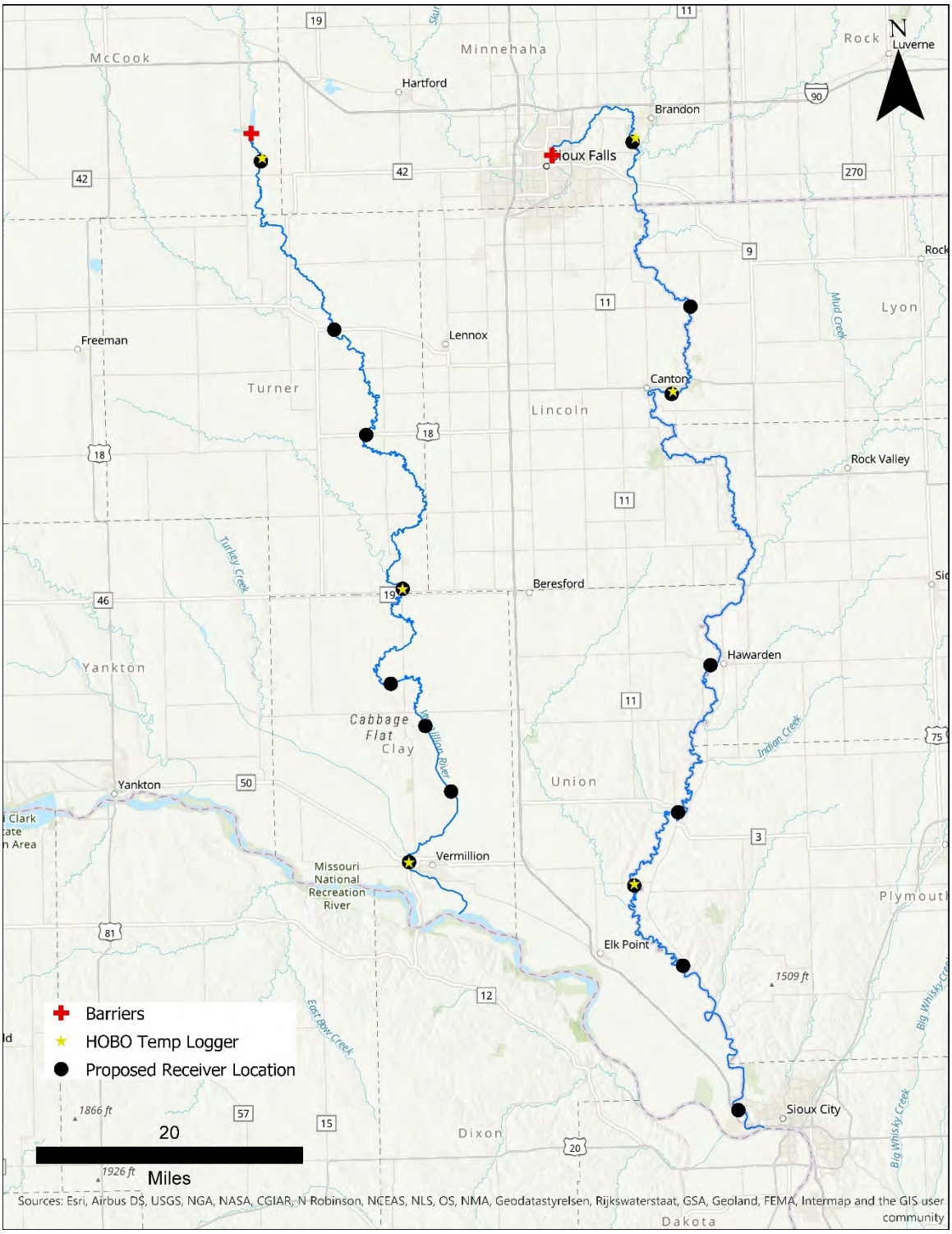
Silver Carp movement will be assessed by stationary receiver arrays consisting of 8 Vemco receivers (combination of VR2W and VR2Tx) and 3 HOBO water temperature loggers in each river. Receivers will monitor movements in and out of the tributaries. Data from stationary receivers and HOBO temperature loggers will be downloaded monthly.

Active Tracking

Active tracking will be used to locate fish within the tributaries to determine fine scale movement patterns outside of stationary receiver coverage. Tracking will be attempted monthly from April to October (depending on river conditions, staff availability, and distance from boat ramp). Habitat data will be recorded once a reading of >75 db is achieved. Depth (m), water temperature (°C) and GPS location will be recorded at each fish location. Fish will be located with a Vemco VR100 receiver and a VH110 or VH165 hydrophone.

Map of Project Area:

- The Vermillion River joins the Missouri River at approximately rkm 1,242 and extends into South Dakota. The study area will focus on the lower 192 rkm of the Vermillion River upstream to the East Vermillion Lake dam.
- The Big Sioux River joins the Missouri River at approximately rkm 1,181 and extends into Iowa and South Dakota. The study area will focus on the lower 255 rkm of the Big Sioux River upstream to the Sioux Falls in Sioux Falls, SD.
- Potential locations of stationary VR2W receivers and HOBO water temperature loggers in the Vermillion and Big Sioux rivers.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Yankton
Cabbage
Flat
Clay
Union
Vermillion
Missouri
National
Recreation
River
Elk Point
Plymouth
Sioux City
Dixon
Dakota
Barriers
HOBO Temp Logger
Proposed Receiver Location
20
Miles
Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

Estimated Timetable for activities

Activity	Time Period (Season, month/year)
Equipment purchase and acquisition	October-February 2021
Silver Carp tagging efforts	March-May 2021
Deployment of VR2W receivers and HOBO temperature loggers	March-May 2021
Data offload of receivers and HOBO loggers	Monthly 2021
Manual tracking (dependent on staff availability)	May-October 2021
Data entry and analysis, annual report	October- December 2022
Data offload of receivers and HOBO loggers	Monthly 2022
Manual tracking (dependent on staff availability)	May-October 2022
Data entry and analysis, annual report	October-December 2022
Data offload of receivers and HOBO loggers	Monthly 2023
Manual tracking (dependent on staff availability)	May-October 2023
Data entry and analysis	October-December 2023
Final report	December 2023 - February 2024

Literature Cited:

Coulter, A. A., E. J. Bailey, D. Keller, and R. R. Goforth. 2016. Invasive Silver Carp movement patterns in the predominantly free-flowing Wabash River (Indiana, USA). Biological Invasions 18:471-485.

DeGrandchamp, K. L., J. E. Garvey, and R. E. Colombo. 2008. Movement and habitat selection by invasive Asian carps in a large river. Transactions of the American Fisheries Society 137:45-56.

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Control and Containment of Invasive Carp in the Missouri River Basin

Lead Agency and Author: Missouri Department of Conservation (MDC); Joe McMullen (joe.mcmullen@mdc.mo.gov)

Cooperating Agencies: Kansas Department of Wildlife, Parks, and Tourism (KDWPT), Missouri Department of Conservation (MDC), US Fish and Wildlife Service Columbia Fish and Wildlife Conservation Office (CFWCO)

Statement of Need: The Kansas River drains approximately the north half of the state of Kansas and a portion of south-central Nebraska and flows east to its confluence with the Missouri River at Kansas City. The Bowersock Dam at Lawrence, Kansas serves as a barrier to the upstream movement of Asian carp except during periods of exceptionally high flow (approximately >120,000 cfs). Only six (6) Bighead Carp have been documented upstream of this barrier. These fish likely passed over the Bowersock Dam during extreme flooding in 1993. At that time, the Asian carp population in the Kansas River was very low and the number of fish that migrated upstream over the dam was insufficient to establish a breeding population in the upper portion of the river basin. The Kansas River basin contains multiple flood control reservoirs upstream from the Bowersock Dam that largely mitigate high flow conditions on the mainstem river except for short-lived flooding that occurs immediately after extraordinary rainfall in the unimpounded portion of the basin. Removing Asian carp downstream from the Bowersock Dam would reduce the number of fish that may attempt to pass over the dam during a high flow event, decreasing the potential for a breeding population to establish upstream of the dam. Long-term, we are exploring ways to install a barrier at the Bowersock Dam that would prevent passage over the dam during high flow events. The fish removal described in this proposal will be a temporary stopgap to provide time to work toward a more permanent solution. In addition to the upstream barrier (Bowersock Dam), there is a downstream semi-passable barrier (WaterOne Dam at Edwardsville, KS) that limits further upstream movement in the Kansas River from the Missouri River during normal flows. Data from a 2017-2018 study found that the demographic data for Silver Carp in the section of Kansas River proposed to be fished are different than those of fish in the lowest portion of the Kansas River. Therefore, we do not expect harvested fish to be quickly replaced by migrants. In addition, very few juvenile Asian carp were encountered in the section of river proposed to be fished; most fish will be vulnerable to commercial harvest. KDWPT intends to meet the objective of population reduction by contracting with a commercial fisherman to remove Asian carp below Bowersock Dam. To prevent a reduction in fishing effort in conjunction with an expected reduction in harvest, we anticipate an effort-based (rather than catch-based) payout.

MDC, in cooperation with CFWCO, will evaluate multiple bighead carp and silver carp removal methods and identify areas with a high probability of capture. This project will be a multi-year assessment and efforts conducted during fiscal year 2020 would be focused on pilot evaluations of removal methods, site identification, and gear procurement. Targeted sampling for the pilot evaluations will be conducted in the Missouri River between RKM 0 and 885, including select tributaries and cutoff lakes, using a suite of gears.

The general methodology being proposed for future years would entail identifying discrete habitat types with high densities of Bighead and Silver Carp in the Missouri River, primary tributaries, and cutoff lakes. Age and size structure data would be collected from these selected sites to estimate pre-removal mortality. Then, multiple gears would be deployed at variable levels of effort targeting removal of bighead and silver carp. Size structure data would be collected in future years to estimate post-removal mortality.

Objectives:

1. Remove Asian carp to provide a buffer against upstream range expansion should Bowersock Dam be inundated during a high flow event.

2. Determine the feasibility and exploitation of various removal techniques on adult and juvenile bighead and silver carp and the effects on other fish species in the Lower Missouri River to inform control actions.
    a. Compare the catchability of different size classes of bighead carp and silver carp among multiple removal methods in the mainstem Missouri River, mid-sized tributaries, and floodplain waterbodies.
    b. Estimate the amount of fishing effort required to achieve targeted exploitation rates among top-performing removal techniques.
    c. Assess the feasibility of a fishery-induced collapse of bighead carp and silver carp.

Agency: Kansas Department of Wildlife, Parks, and Tourism (KDWPT)

Activities and Methods: KDWPT currently has a commercial fisher on contract for rough fish removal in reservoirs throughout the state. Funds from this grant will be used to direct commercial fishing efforts toward Asian carp removal in the Kansas River from immediately below the Bowersock Dam (Lawrence, KS, RKM 60) downstream to the WaterOne Dam (Edwardsville, KS, RKM 24).

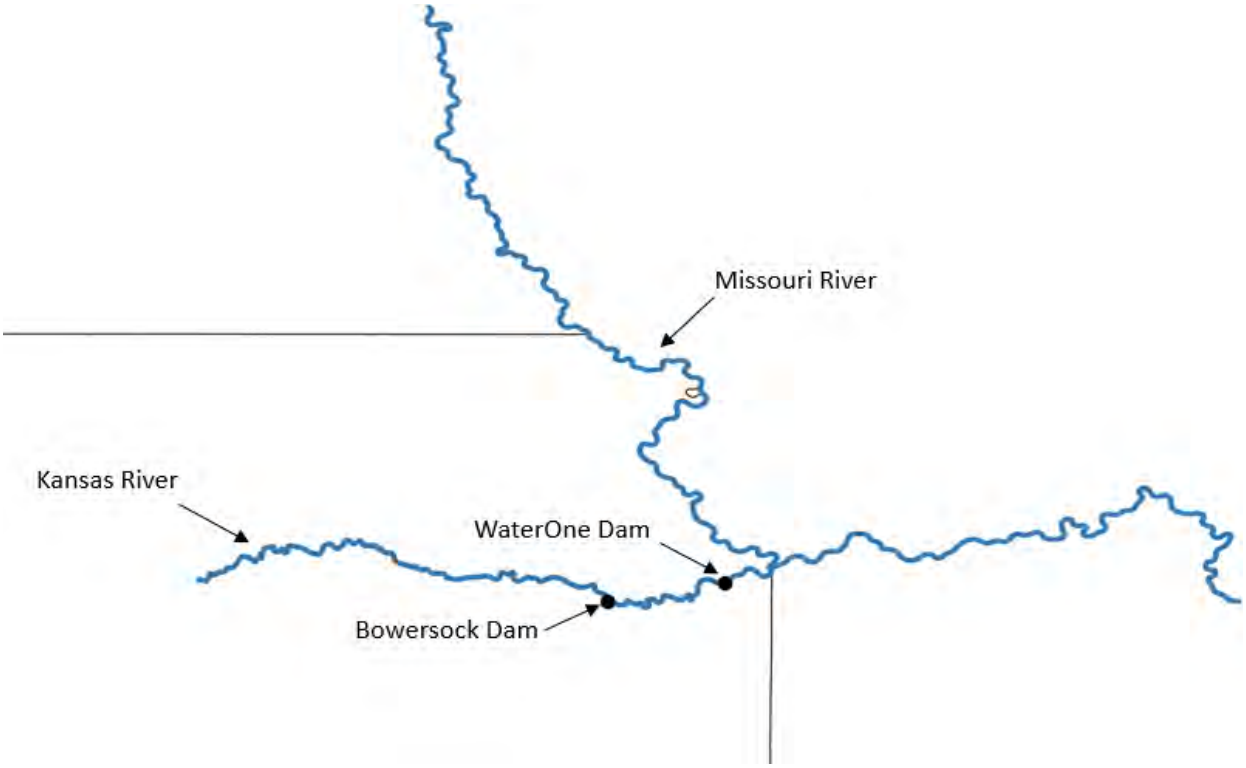
Asian carp removal efforts have not previously occurred on this stretch of river. The Kansas River is generally shallower and more braided than other locations in the Mississippi River basin where commercial and suppression Asian carp fishing efforts are occurring. Therefore, experimentation with gear types, techniques, and deployment locations will be necessary. Traditional commercial fishing gears such as gill-nets and hoop-nets in a suite of configurations and mesh sizes will be deployed. Electrofishing equipment may also be used to “herd” Asian Carp into static gears.

Since abundance and potential catch rates of Asian carp in the system are unknown, funds will be used to compensate for fishing effort of Asian carp. This system also incentivizes the commercial fisherman to keep removing Asian carp even if catch rates drop during the course of the project.

KDWPT employees will serve as observers during commercial fishing efforts. Observers will collect demographic information on captured Asian carp. Total Asian carp removed, gear types used, and effort information will be recorded. Notes on bycatch will be collected as well.

At the conclusion of removal efforts, KDWPT will prepare a final report. The final report will summarize observer data as well as pre-removal and post-removal Asian carp demographics

Map of Project Area:



Estimated Timetable for activities

Activity	Time Period (Season, month/year)
KDWPT collect pre-removal demographic information	October 2020 – November 2020
KDWPT and contract fisherman conduct coordination, training, and test removal locations, gears, and techniques	October – November 2020
Contract fisherman removes Asian Carp	November 2020 – December 2021
KDWPT staff observe, record harvest and demographic information, and assist in Asian Carp removal efforts	November 2020 – December 2021
KDWPT staff collect supplementary post-removal demographic information	October 2021 – January 2022
KDWPT staff prepare report	February – March 2022

Agency: Missouri Department of Conservation (MDC)

Activities and Methods: Based on findings from the Defining Asian Carp Populations study, locations for testing removal efforts will be selected. Age and size structure data from these selected sites will be used to estimate pre-removal mortality. At these locations MDC, in cooperation with CFWCO, will apply variable levels of effort using multiple bighead carp and silver carp gears, techniques, and removal methods. Gears will include commercially available nets (e.g., gill nets, trap nets) as well as gears being used by state and federal agencies (e.g., dozer trawl). Size structure data will be collected post removal to estimate post-removal mortality. Based on results of removal efforts on the population structure, estimates of the amount of effort needed to achieve published exploitation rates in Siebert et al. 2015, Tripp and Phelps 2018, and ACRCC 2019 using top-performing removal techniques will be calculated. This information will be used to determine the feasibility of a fishery-induced collapse of invasive carp at these locations. This project will be a multi-year assessment and efforts conducted during fiscal year 2020 would be focused on pilot evaluations of removal methods, site identification, and gear procurement. First year removal efforts will take place in 2021 and an annual report over current progress submitted by March 2022. Further removal efforts will be needed in 2022 and 2023 to fully evaluate exploitation.

Map of Project Area: Map of proposed actions by Missouri Department of Conservation for Objective 1 and 2 including sampling locations on the Missouri River between river kilometers 0.0 and 885 (green circles), sampling stretches of the selected tributaries (lower 40km highlighted with blue) and potential oxbow lakes (identified in dark blue).

Estimated Timetable for activities

Activity	Time Period (Season, month/year)
Pilot removal efforts and gear procurement	September 2020 – March 2021
Removal efforts and post removal evaluation	September 2021 – March 2022
Data entry, analysis and report writing	February 2022 – March 2022
Submit Annual Report	March 2022
*Removal efforts and post removal evaluation	September 2022 – March 2023
*Data entry, analysis and report writing	February 2023 – March 2023
*Submit Annual Report	March 2023
*Removal efforts and post removal evaluation	September 2023 – March 2024
*Data entry, analysis and report writing	February 2024 – March 2024
*Submit Report	March 2024

***Future work needed for complete evaluation.**

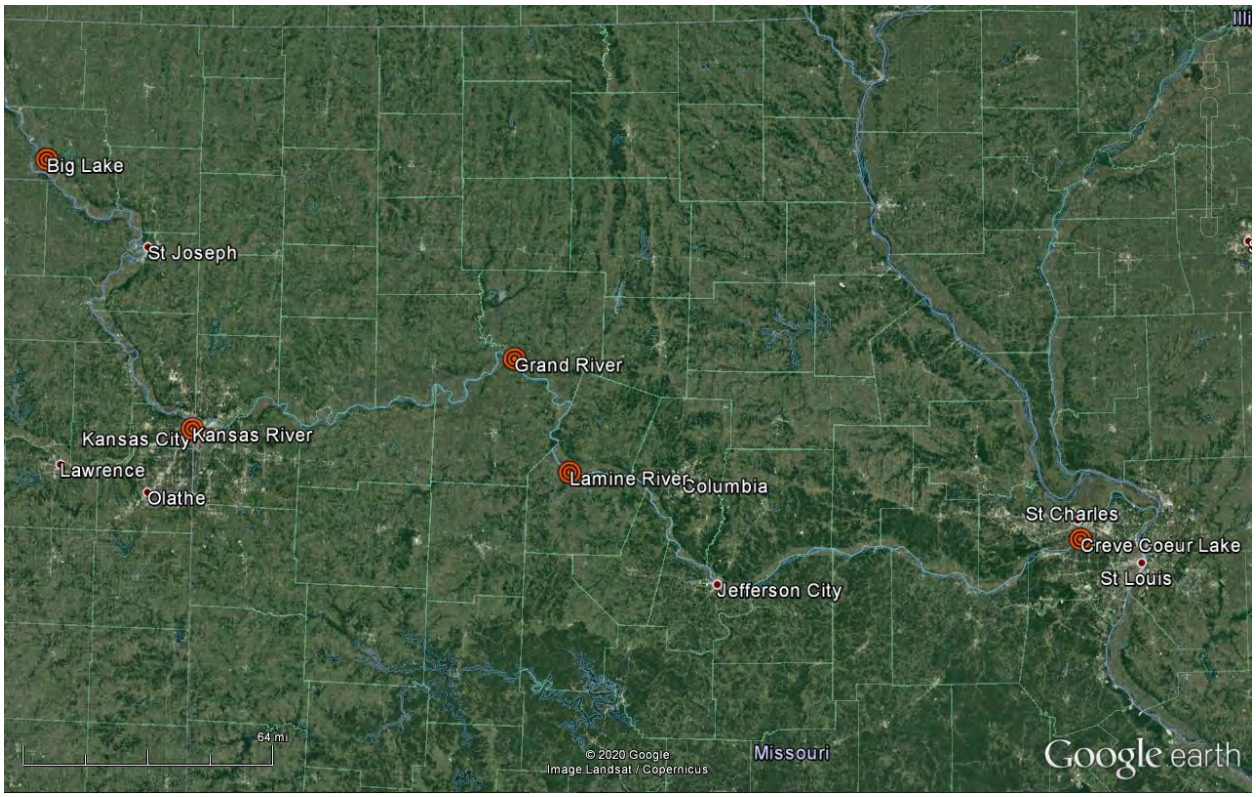
Agency: US Fish and Wildlife Service Columbia Fish and Wildlife Conservation Office (CFWCO)

Activities and Methods: We will test the feasibility of mass-harvest methods designed for rapid large-scale removal within known high-population areas. Methods include electrified trawls, trap/herding/weir systems and large surface twin trawls in conjunction with traditional entanglement netting. Pre-and post-harvest assessments, using sonar, will describe the availability of the population of fish (carp and native species) as a method of detecting change.

In conjunction with MDC and other partners, we will evaluate carp exploitation among gears through a Gear Efficiency Index Model (GEIM). The GEIM index will provide a comparative value that incorporates harvest of varying sizes of carp in relation to bycatch and time constraints of using a gear. Further parameterization of existing exploitation models will include gear efficiency constraints within harvest events, such as bycatch sorting, gear maintenance, fish disposal, mechanized harvest tactics, heavy equipment infrastructure, environmental factors, etc). Complementary models that explore exploitation, population expansion, and gear efficiency will provide sensitivity analyses, important for understanding the constraining variables that determine the likelihood and cost of achieving sustained population reduction within target areas.

Map of Project Area:

- Kansas River, Lamine River, Grand River, Creve Ceour Lake, and Big Lake, Additional floodplain lakes (e.g., refuge backwater or waterfowl- management area lakes) and small tributaries of the Missouri River may be added.



Estimated Timetable for activities

Activity	Time Period (Season, month/year)
Sonar assessments and model development	September 2020-March 2021
Pilot removal efforts and gear procurement	September 2020 – March 2021
Removal efforts and post removal evaluation	April– December 2021
Data entry, analysis and report writing	December 2021 – March 2022
Submit Annual Report	March 2022

Literature Cited:

Asian Carp Regional Coordinating Committee (ACRCC). 2019. 2019 Asian carp action Plan. Asiancarp.us

Seibert, J.R., Q.E. Phelps, K.L. Yallaly, S. Tripp, L. Solomon, T. Stefanavage, D.P. Herzog, and M. Taylor. 2015. Use of exploitation simulation models for silver carp (*Hypophthalmichthys molitrix*) populations in several Midwestern U.S. rivers. Management of Biological Invasions 6(3) 295-302.

Tripp, S. and Q.E. Phelps. 2018. Asian carp expansion in the Mississippi River: focusing on the leading edge of the invasion front. Acta Hydrobiologica Sinica 42(6): 1075-1080.

Kansas River Bowersock Dam Barrier Feasibility Study

Lead Agency and Author: Kansas Department of Wildlife, Parks, and Tourism (KDWPT); Chris Steffen (chris.steffen@ks.gov)

Cooperating Agencies: N/A

Statement of Need: Introduced Asian carps (Bighead Carp, Black Carp, Grass Carp, and Silver Carp) have become established in many portions of the Mississippi River basin since the 1970s. Bighead and Silver Carp were first noted in the Kansas River in 1987 and 1991, respectively (Kansas Fishes Committee 2014). Asian carp were introduced into waters of the United States as the result of combinations of direct stockings by (or authorized by) various agencies, unauthorized stockings by private individuals, and unintentional escapes from university research facilities, federal and state agency facilities, and private aquaculture operations (Conover et al. 2007). The diets of Bighead and Silver Carp overlap with some native species (Sampson et al. 2009, Freedman et al. 2012). Bighead and Silver Carp can consume the majority of available plankton where populations become abundant and alter foodwebs (Freedman et al. 2012). These (and other) detrimental impacts of Asian carp have the potential to cause ecological, recreational, and economic harm.

The Kansas River drains approximately the north half of the state of Kansas and a portion of south-central Nebraska and flows east to its confluence with the Missouri River at Kansas City. The Bowersock Dam at Lawrence, Kansas serves as a barrier to the upstream movement of Asian carp and other fish except during periods of exceptionally high flows of approximately >120,000 cfs (Sarah Hill-Nelson, Bowersock Power and Mills Company, personal communication). Only six (6) Bighead Carp have been documented upstream of this barrier (KDWPT, unpublished data). These fish likely passed over the Bowersock Dam during extreme flooding in 1993. At that time, the Asian carp population in the Kansas River was very low and the number of fish that migrated upstream over the dam was insufficient to establish a breeding population in the upper portion of the river basin. The Kansas River basin contains multiple flood control reservoirs upstream from the Bowersock Dam that largely mitigate high flow conditions on the mainstem river except for short-lived flooding that occurs immediately after extraordinary rainfall in the unimpounded portion of the basin.

A barrier to upstream movement of fish at Bowersock Dam that functions during high flow events could prevent Asian carp from establishing in the portion of the Kansas River Basin above Bowersock Dam. This section of river represents one of the few large, unimpounded reaches of Midwestern prairie rivers that remains unimpacted by Asian carp and harbors a relatively intact ecosystem of native fishes.

A feasibility study would be used to determine which current barrier technologies would be most practically integrated into this location to prevent upstream spread of Asian carp during high flow events. KDWPT would contract with a qualified party to conduct the feasibility study and produce a report which includes information on potential barrier options as well as approximate costs.

It is worth noting that a unique opportunity currently exists in that the City of Lawrence, Kansas is in the early stages of a multi-million dollar, multi-stage renovation of the dam and surrounding area. If this project is initiated soon, this barrier technology could be more cost effectively implemented by integrating it into the larger renovation project.

This feasibility study is the first step in a project to prevent the further spread of Asian carp in the Kansas River basin, which supports Goals 1 and 3 of the Missouri River Basin Asian Carp Control Strategy Framework (more specifically strategies 1.3 and 3.2). In addition, the project supports Goal 6 (strategy 6.3) by working with stakeholders to both educate and involve them in potential management activities.

Objectives:

1. Conduct a feasibility study to determine the options and approximate costs for an Asian carp barrier at Bowersock Dam during high flow events.

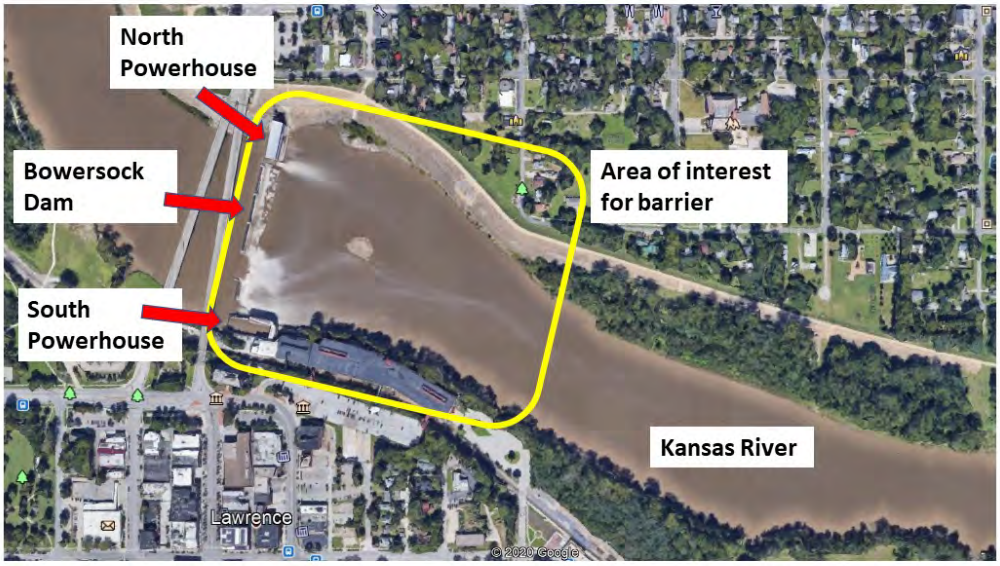
Activities and Methods: KDWPT will utilize an RFP to locate and contract with a qualified engineering firm to conduct the feasibility study. As KDWPT lacks the staff and expertise to conduct a study of this type internally, it is necessary to acquire the services of an experience engineering firm. KDWPT staff will compose the RFP, review bids, and select the engineering firm most capable of completing the task. KDWPT will also provide data, stakeholder contact information, and other assistance as available.

The contractor will be required to conduct a thorough review of available fish barrier technologies that could supplement the capabilities of the Bowersock Dam location as an Asian Carp barrier. Contractor will be required to provide cost estimates for design, installation, and maintenance of multiple barrier technologies. In addition, the contractor will be required to provide operational ranges (flow rates) and expected lifespan of barrier options. Public safety and recreational access impacts of barrier technologies will also need to be addressed.

The contractor will be required to work closely with the City of Lawrence (dam owner) and Bowersock Power and Mills Company (hydropower operator) to account for their needs, concerns, and requirements for any supplemental Asian Carp barrier technology placed near the Bowersock Dam. The City of Lawrence and Bowersock Power and Mills Company have already had multiple contacts and meetings with KDWPT and are supportive of the idea to place supplemental Asian Carp barrier technology near (or potentially on) the Bowersock Dam. KDWPT anticipates continued support and assistance from these entities throughout the feasibility study.

Contractor will be required to provide a preliminary report of findings to KDWPT. KDWPT staff will use this opportunity to review and provide input and direction on this preliminary report to ensure that the contractor will produce a satisfactory final report. The final report is expected to provide KDWPT with the necessary information to make knowledgeable, fiscally responsible decisions concerning supplemental Asian Carp barrier activities at the Bowersock Dam location.

Map of Project Area:



Estimated Timetable for activities

Activity	Time Period (Season, month/year)
Compose RFP to find engineering firm	October 2020
Open/release RFP for bids	October 2020
Close and review bids	December 2020
Award bid and complete contract	January 2021
Engineering firm makes field visits, consults with Bowersock dam operators (City of Lawrence, Bowersock Mills and Power Company), gathers data, drafts preliminary report	January – September 2021
KDWPT assists engineering firm as needed	January – October 2021
Preliminary report due from engineering firm to KDWPT	July 2021
Final report due from engineering firm to KDWPT	September 2021
KDWPT complete project executive summary	October 2021

Literature Cited:

Conover, G., R. Simmonds, and M. Whalen, editors. 2007. Management and control plan for bighead, black, grass, and silver carps in the United States. Asian Carp Working Group, Aquatic Nuisance Species Task Force, Washington, D.C. 223 pp.

Freedman, J. A., S. E. Butler, and D. H. Wahl. 2012. Impacts of invasive Asian carps on native food webs. Final project report to Illinois–Indiana Sea Grant. University of Illinois, Sullivan

Kansas Fishes Committee. 2014. Kansas fishes. University Press of Kansas, Lawrence, Kans.

Sampson, S.J., Chick, J.H. & Pegg, M.A. 2009. Diet overlap among two Asian carp and three native fishes in backwater lakes on the Illinois and Mississippi rivers. Biol Invasions 11, 483–496.

Ohio River Sub-Basin Asian Carp Partnership

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 limit the negative impacts of Asian carp in the ORB. The ORFMT engaged the remaining ORB states and key federal partners in the development of an Ohio River Basin Asian Carp Control Strategy Framework (ORB Framework) to prevent further range expansion, reduce populations, better understand and minimize impacts of Asian carps, and improve communication and coordination in the basin. The Tennessee and Cumberland rivers (TNCR) are major tributaries to the mainstem OHR, and are therefore included as part of the ORB Framework. However, because independent funding was provided through legislation to the Tennessee and Cumberland River partners, two teams (ORFMT and TNCR) come together to implement the ORB Framework that was completed in October 2014.

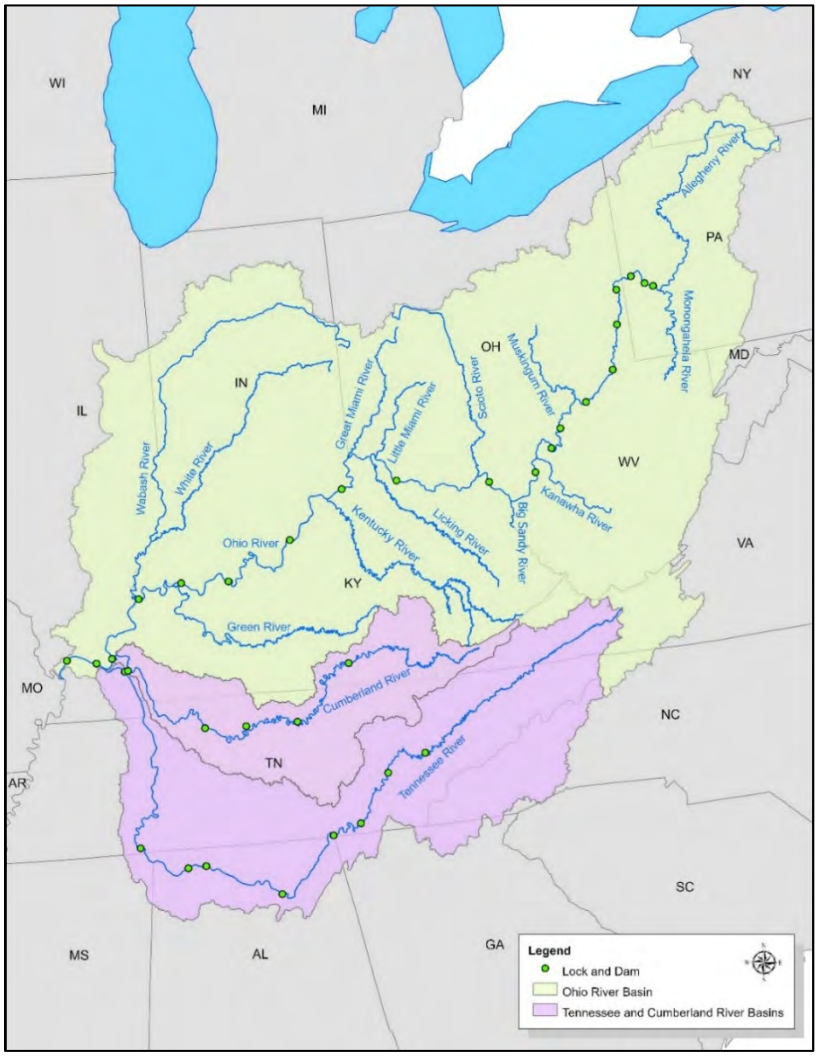


Figure 7. Map of the Ohio River Basin.

Early Detection and Evaluation of Asian carp Removal in the Ohio River

Lead Agency and Author: Kentucky Department of Fish and Wildlife Resources (KDFWR); Andrew Stump (andrew.stump@ky.gov)

Cooperating Agencies: Illinois Department of Natural Resources (ILDNR), Indiana Department of Natural Resources (INDNR), Pennsylvania Fish and Boat Commission (PFBC), Southern Illinois University (SIU), U.S. Fish and Wildlife Service Carterville Fish and Wildlife Conservation Office (CFWCO), West Virginia Division of Natural Resources (WVDNR)

Statement of Need: Invasive species are responsible for undesirable economic and environmental impacts across the nation (Lovell and Stone 2005, Pimentel et al. 2005, Jelks et al. 2008). Negative impacts of Asian carp in the United States are a major concern because of their tolerance and adaptability to a wide range of environmental conditions (Kolar et al. 2005, Zhang et al. 2016). Their ability to quickly colonize novel habitats with dense populations have caused significant impacts on tourism and recreation, and potentially threaten native ecosystems throughout the entire Mississippi River basin, including the Ohio River sub-basin. In response, it is necessary to gather information on invasive carp distributions, behavior, and population characteristics in the Ohio River basin (ORB). This information will be used to assess management actions related to their removal, suppression, and containment.

The tasks outlined in this document would add a sixth year of multi-agency and university surveillance and data collection focused on Asian carp early detection and removal primarily above Cannelton Dam. Collaborative efforts have included fish community sampling, targeted Asian carp sampling, and incorporation of unique data such as hydroacoustics. The primary goal of these projects is to provide an accurate population trend assessment of Asian carp control and response efforts. In addition, fish community data may aid in determining impacts of carp on native fish assemblages. This project provides an ongoing, coordinated approach to assess Asian carp management and suppression in the ORB.

Aside from state matching funds, these projects are possible because of Congressional support starting with WRRDA 2014 and subsequent appropriations since which provide funds to the US Fish and Wildlife Service (USFWS) to work with the states to control and reduce Asian carp numbers and ranges in the Mississippi River basin. The USFWS has provided states across three federal regions within the ORB with funding, equipment, and staff time, and all the agencies partner to implement the ORB framework devised in 2014. To date, basin partners have successfully established standardized monitoring and evaluation methods that, with increased funding and staffs in 2020, will be much more useful in describing Silver Carp populations in the middle ORB. Bighead and Black Carp are sampled in lower numbers due to their lower abundances, and collecting sufficient data to adequately describe their populations' demographics will continue to be challenging.

Objectives:

1. Inform management actions and required changes to those actions as determined by assessments of population structure, distribution, and relative abundance of Asian carp in the Ohio River.

2. Monitor long term trends in native fish communities as indicators of changes in Asian carp populations.

3. Survey Asian carp presence in upstream areas where carp are rarely detected to inform response and containment efforts.

4. Determine spatial distributions (hotspots) and densities of Asian carps in the lower Wabash and White rivers to inform and assess harvest.

5. Quantify changes in Asian carp density before and after select removal events in backwaters of the Wabash and White rivers to assess effectiveness at reducing abundance.

Agency: Indiana Department of Natural Resources (INDNR)

Activities and Methods: To assess population structure, distribution, and relative abundance of Asian carp in the Ohio River for informing management actions, INDNR will utilize pulsed-DC boat electrofishing and gill netting techniques to target bigheaded carps within Cannelton Pool of the Ohio River. Electrofishing will be conducted during the day (0800 to 2100 hours local time) with one staff in the bow of the boat dip-netting fish (dipper). Sampling is conducted in the spring of each year when water temperatures are 50°F – 65°F. Electrofishing is conducted in a general downstream direction for 900 seconds. Carp should be targeted with pulsed-DC electricity at 80 pulses per second (PPS) and a 40% duty-cycle (or comparable settings). A power goal allowing the minimum transfer of 3,000 Watts from water to fish will be targeted (Burkhardt and Gutreuter, 1995). Adjustment to the electrical output will be made as needed to increase effectiveness. Driving speed adjustments and pursuit of individual carp is allowed upon fish sightings. Non-target fish species should be ignored during sampling; however, all small, shad-like species should be dipped and examined thoroughly before being released to avoid misidentifying young Asian carps. Banks and any structure within the sampling area are to be shocked thoroughly and the boat's pilot is free to modify the forward and backward boat movement to permit the most effective fish collection method. The straight-line distance attained during electrofishing should be approximately 400 m (~0.25 miles) of shoreline. Gill netting will be conducted at fixed sites in the same timeframe as boat electrofishing. Each site will include 300 ft of 4-in. bar webbing and 300 ft of 5-in. bar webbing for a total of 600 ft of net fished at each site. Gill nets will primarily be set perpendicular to the shoreline, but may need to be set parallel to shore when water flow is excessive. Nets will soak for 2 hrs/set, and boat noise and herding techniques will be applied to drive fish into the gear. Records of bycatch will be kept for each mesh size including species, and a subsample of total lengths. All bycatch will be recorded and released immediately after capture. Information from targeted sampling will be used to track changes in relative abundances of bigheaded carp. All invasive carps captured during sampling will be euthanized and a subsample of lengths, weights, and sex will be recorded.

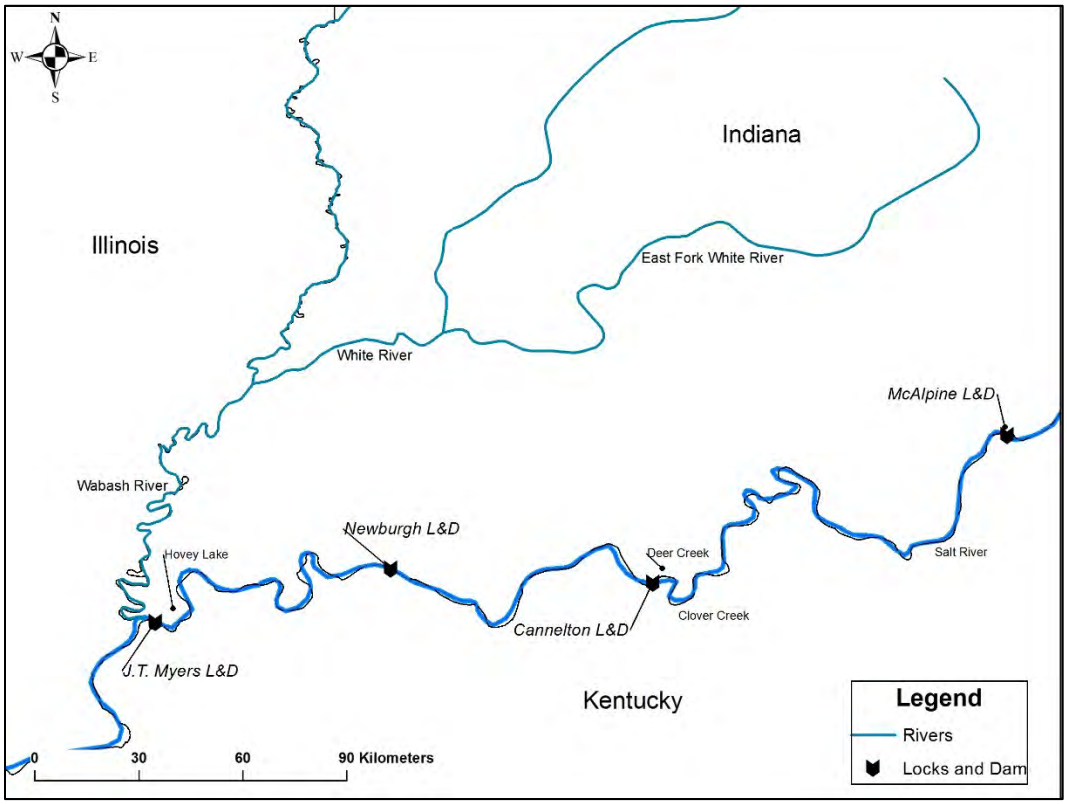
To track long-term trends in native fish species, INDNR will coordinate with agencies to conduct community fish surveys in Cannelton Pool. Sampling will be conducted in the fall of each year when water temperatures are 55°F – 65°F. Electrofishing will be conducted in a general downstream direction using one dipper for 900 seconds. All fish entrained to the anodes should be dipped except when large schools of fish (e.g. Clupeids or Cyprinids) are encountered. When large schools blanket the water column, fish should be dipped continuously at a constant rate in a straight-line distance until the school is passed. Community sampling is conducted with pulsed-DC electricity at 60 pulses per second (PPS) and a 25% duty-cycle (or comparable settings). A power goal allowing the transfer of 3,000 Watts from water to fish should be targeted (Burkhardt and Gutreuter, 1995). Because output affects catch rates of fish with variations in size and species, it is important to maintain consistent power during community sampling. For this reason, setting adjustments will be made depending on fish recovery and response to electricity, but it is suggested that the output power does not deviate from the suggested power goal by more than 20% (Burkhardt and Gutreuter, 1995). The straight-line distance covered during electrofishing should be approximately 200 m (~0.125 miles) of shoreline. Gill netting will be conducted at fixed sites in the same timeframe as boat electrofishing. Each site will include 300 ft of 4-in square net and 300 ft of 5-in square net for a targeted length of net fished at each site equal to 600 ft. Gill netting protocol will follow the same methods as described above and records of catch will be kept for all species captured. All fish captured using either gear will be identified to the lowest possible taxonomic level and total length (mm) and weight (kg) with be recorded for a subsample of 15 individuals of each species for each sampling event. Asian carp will either be implanted with an acoustic transmitter or euthanized depending on their location and condition.

To determine spatial distributions and densities of Asian carps in the lower Wabash and White rivers, INDNR will conduct fish sampling at four locations throughout the lower Wabash River. SIU will conduct hydroacoustic sampling at eight to sixteen sites, and INDNR will collect fish community data at a subsample of sites to "ground truth" the hydroacoustic data. INDNR will utilize electrofishing and gill netting at each site. One hour of electrofishing (two 15-minute transects down each bank) will be conducted in a general downstream direction at each site using one dipper. All fish should be dipped except when large schools of fish (e.g. Clupeids or Cyprinids) are encountered. When large schools blanket the water column, fish should be dipped continuously at a constant rate in a straight-line distance until the school is passed. Sampling is conducted with pulsed-DC electricity at 60 pulses per second (PPS) and a 25% duty-cycle (or comparable settings). A power goal allowing the transfer of 3,000 Watts from water to fish should be targeted (Burkhardt and Gutreuter, 1995). The straight-line distance covered during one 15-minute electrofishing transect should be approximately 200 m (~0.125 miles) of shoreline. Gill netting will be conducted at sites in the same timeframe as boat electrofishing. Each site will include 300 ft of 4-in square net and 300 ft of 5-in square net for a targeted length of net fished at each site equal to 600 ft. Gill netting protocol will follow the same methods as described above and records of catch will be kept for all species captured. All fish captured using either gear will be identified to the lowest possible taxonomic level and total length (mm) and weight (kg) with be recorded for all species. Asian carp will be euthanized.

To quantify changes in Asian carp density before and after select removal events, INDNR will coordinate with SIU and plan removal events accordingly. SIU will sample selected sites with

hydroacoustics prior to and immediately following removal events. During removal events, INDNR will record all catch data and report those to SIU. SIU will process the data to determine any changes in Asian carp densities and size distributions as a result of the removal effort.

Map of Project Area:



Estimated Timetable for Activities:

Activity	Time Period (Season, month/year)
Executive Technical Report	Spring, March/2021
Targeted Sampling Field Work	Spring, April/2021
Wabash River Fish Community Work	Spring, April and May/2021
Removal Effort Evaluations	Summer, June – Aug/2021
Community Surveys Field Work	Fall, October/2021
Executive Technical Report	Spring, March/2022

Agency: Pennsylvania Fish and Boat Commission (PFBC)

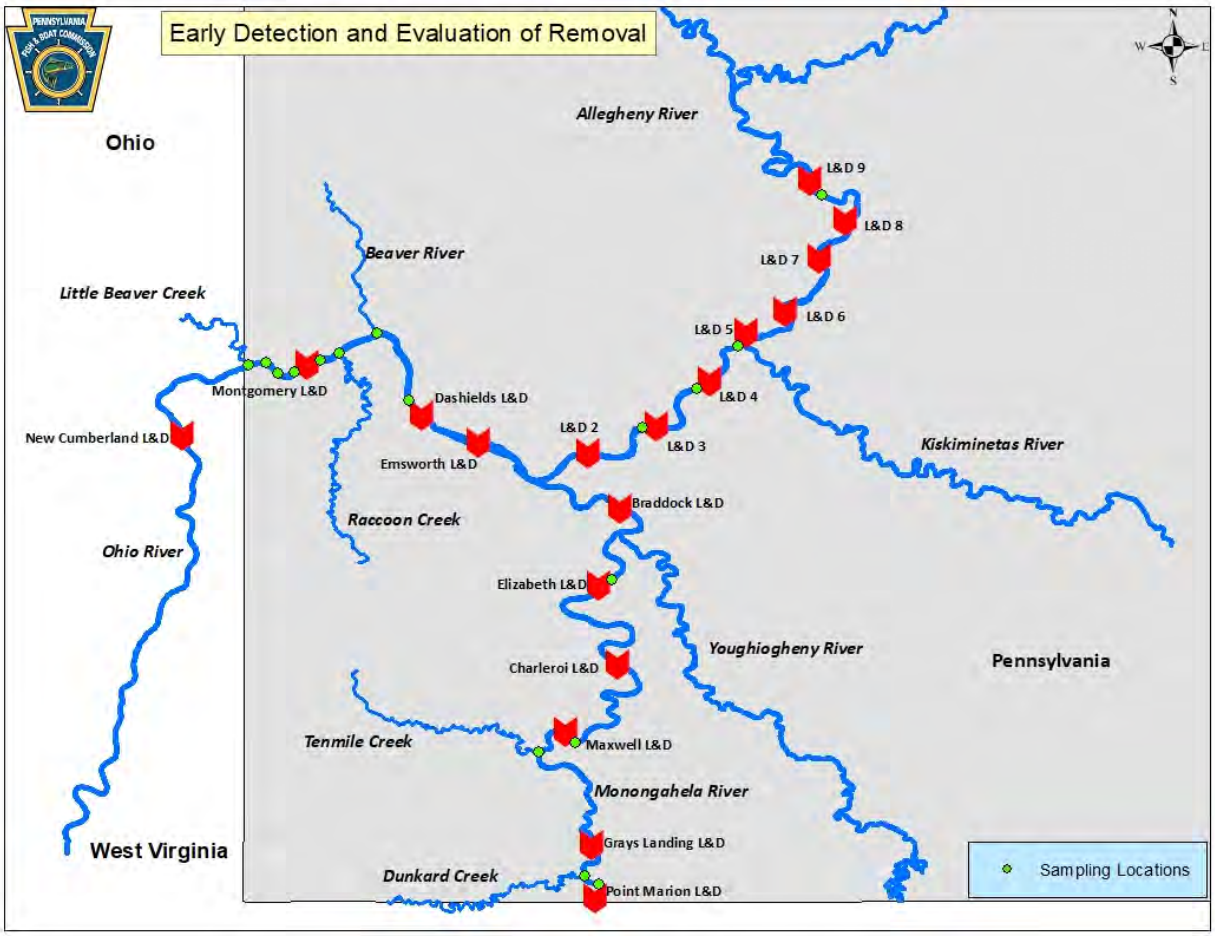
Activities and Methods: The PFBC will assist the CFWCO in conducting eDNA sampling on the Ohio River in the fall of 2020 and 2021. Locations of positive eDNA hits for Bighead and Silver Carp, including locations with positives from previous years, will be used to guide targeted gill net sampling. Additional locations for targeted gill net sampling will include backwater areas, thermal discharges, and creek mouths. Targeted sampling will be performed in the New Cumberland and Montgomery Pools of the Ohio River and will consist of ~24 hour gill net sets in the fall of 2020. Gill nets used will be 91.4 m long, 3.7 m in depth, with either 76, 102, or 127 mm mesh. All fish species captured in gill nets will be recorded. Any Asian Carp species will be euthanized.

Tailwater community fish surveys from 2008-2016 will be used to establish and refine future sampling locations. A second round of such surveys began in 2018 and will continue until 2023. Boat electrofishing (60 pps, 25% duty cycle, typically 200-500 volts) at each tailwater will consist of 10 minute transects across 17 fixed tailwater sites in total for the duration of the project. Ten transects will be sampled at each site with five transects conducted on each bank. Sampling will begin on the right descending bank as close as possible to the dam and will proceed downstream for five consecutive runs. The same procedure will then be conducted on the left descending bank. We will conduct fish community surveys in the spring of 2021 at a minimum of seven tailwaters on the Ohio, Allegheny, and Monongahela Rivers. All fish will be netted and those large enough to identify in the field will be enumerated; small individuals will be retained for identification in the laboratory. In addition to the tailwater community surveys, the PFBC will likely assist the EPA in performing additional fish community surveys on the Monongahela River at two locations in the vicinity of two sizable tributaries with historic problems with pollution. Protocols will be similar to tailwater fish community surveys (10 transects) with the exception that five transects will be conducted both upstream and downstream of the tributary mouth on only one shoreline.

The PFBC will conduct additional fish community surveys in the Montgomery Pool in August 2021. Monitoring will be conducted using seines (20 m length, 6 mm mesh) at six historic sites. All fish captured, with the exception of larger individuals, will be retained for identification in the laboratory.

The PFBC conducts additional targeted sampling for various gamefish throughout the Ohio, Allegheny, and Monongahela Rivers on an annual basis. Incidental Asian Carp captures will be recorded during these surveys.

Map of Project Area:



Estimated Timetable for activities:

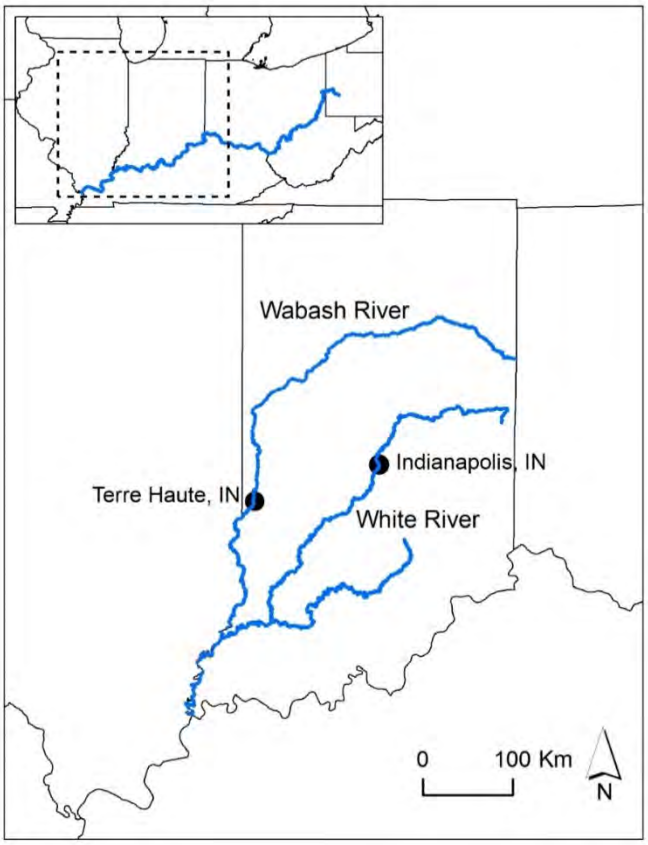
Activity	Time Period (Season, month/year)
Assist eDNA sampling	Fall, October/2020
Targeted Sampling Field Work	Fall, November/2020
Executive Technical Report	Spring, March/2021
Community Surveys Field Work	Spring, May/2021
Community Surveys Field Work	Summer, August/2021
Assist eDNA sampling	Fall, September/2021
Executive Technical Report	Spring, March/2022

Agency: Southern Illinois University (SIU)

Activities and methods: SIU will be contracted by the Illinois Department of Natural Resources (ILDNR) to complete hydroacoustic sampling in the Wabash and White rivers to quantify bigheaded carp spatial distributions and identify density hotspots to inform and assess harvest efforts (objectives 4 and 5). Densities will be assessed in the lower Wabash River between the confluence with the Ohio River and Terre Haute, IN in June of 2021. Hydroacoustic sampling equipment will consist of two 200-kHz split-beam BioSonics transducers that will be horizontally oriented toward the center of the river while sampling. The horizontal positioning of the transducers will be offset so that one transducer will sample the shallower portion of the water column and the second transducer will sample the deeper portion. Mobile surveys will consist of 4-mile long transects parallel with the shoreline, with two nearshore transects (one upstream and one downstream) conducted at each site. Across all sites, 128 miles of survey transects will be sampled, with 16 sites sampled throughout the lower Wabash River. Specific site locations will be determined after consultation with ILDNR and INDNR and an initial in-person visit to potential sites. Physical capture data used in hydroacoustic data analysis will be collected by INDNR. Species-specific proportional abundance will be calculated by size class from capture data. These data will then be applied to the number of fish observed within the same size classes from hydroacoustic sampling, along with the volume of water ensonified, to estimate species-specific densities. Sampling and data analysis techniques follow protocols used in the ongoing Ohio River mainstem (CFWCO) and in the Illinois River for long-term Asian carp monitoring (MacNamara et al. 2016; Coulter et al. 2018). Resulting data include species-specific density estimates for each site, as well as site-specific bigheaded carp density heat maps to identify spatial distributions for removal efforts.

SIU will also conduct mobile hydroacoustic surveys in backwaters of the Wabash and White rivers to identify bigheaded carp spatial distributions for informing coordinated removal events and in assessing potential changes in density and size distributions due to harvest. SIU will partner with INDNR to identify specific backwaters for coordinated removal events. Within 48 hours prior to each removal event, SIU will conduct a mobile hydroacoustic survey throughout the backwater site to identify bigheaded carp spatial distributions prior to harvest. Sampling procedures and data analysis will be identical to those described for hydroacoustic sampling in the lower Wabash River channel. Heatmaps depicting bigheaded carp density hotspots will be generated from this sampling and shared with INDNR prior to harvest. SIU will also conduct mobile hydroacoustic surveys at each site within 48 hours after harvest. Bigheaded carp densities and size distributions will be compared between pre-harvest and post-harvest sampling at each site to evaluate potential changes in relative abundance and size distributions as a result of harvest. Capture data (species size and relative abundances) that are needed for analyzing hydroacoustic data will be collected by INDNR during the harvest events.

Map of Project Area:



Estimated Timetable of Activities:

Activity	Time Period (Season, month/year)
Determine Wabash River Sites for Main Channel Sampling	Spring, April 2021
Interim Progress Report and Executive Technical Report	Spring, March 2021
Conduct Wabash River Hydroacoustic Sampling	Spring, June 2021
Pre- and Post-Harvest Hydroacoustic Surveys at Targeted Removal Sites	Summer, June-Aug 2021
Final Project Report	Winter, November 2021

Agency: Kentucky Department of Fish and Wildlife Resources (KDFWR)

Activities and Methods: Federal funding for this project for FY2020 increased by 28% and will enable KDFWR to deploy an additional crew for all sampling, effectively doubling previous years' efforts. Congress and the USFWS require justification for funding projects. Therefore, perhaps as important as removing Asian carp from the Ohio River study area is our ability to determine the effects of removal efforts have on relative Asian Carp densities above Cannelton

Dam. In prior years, high variability in annual sampling data, along with relatively high occurrences of zero-catch events indicated the need for increased effort to examine trends in relative abundances. Increased sampling will improve accuracy for describing relative density trends and other population demographics, especially for the more abundant Silver Carp.

KDFWR will track relative abundances and population characteristics independently and through coordination with other state agencies to conduct targeted sampling for Asian carp along several pools, upriver of the Cannelton Locks and Dam complex (See map). Pulsed-DC boat electrofishing and gill netting techniques will be utilized to target bigheaded carps along the river. Electrofishing will be conducted during the day (0800 to 2100 hours local time) with one staff in the bow of the boat dip-netting fish (dipper). Sampling is conducted in the spring of each year when water temperatures are 50°F – 65°F. Electrofishing is conducted in a general downstream direction for 900 seconds. Carp will be targeted with pulsed-DC electricity at 80 pulses per second (PPS) and a 40% duty-cycle (or comparable settings). A power goal allowing the minimum transfer of 3,000 Watts from water to fish will be targeted (Burkhardt and Gutreuter, 1995). Adjustment to the electrical output will be made as needed to increase effectiveness. Driving speed adjustments and pursuit of individual carp is allowed upon fish sightings. Non-target fish species should be ignored during sampling; however, all small, shad-like species should be dipped and examined thoroughly before being released to avoid misidentifying young Asian carps. Banks and any structure within the sampling area are to be shocked thoroughly and the boat's pilot is free to modify the forward and backward boat movement to permit the most effective fish collection method. The straight-line distance attained during electrofishing should be approximately 400 m (~0.25 miles) of shoreline.

Gill netting will be conducted at fixed sites in the same timeframe as boat electrofishing (See map). Each site will include 300 ft of 4-in. bar webbing, 300 ft of 5-in. bar webbing, and 150 ft of 3 in. bar webbing for a total of 750 ft of net fished at each site. Gill nets will primarily be set perpendicular to the shoreline, but may need to be set parallel to shore when water flow is excessive. Nets will soak for 2 hrs/set, and boat noise and herding techniques will be applied to drive fish into the gear. Records of bycatch will be kept for each mesh size including species, and a subsample of total lengths. All bycatch will be recorded and released immediately after capture. Information from targeted sampling will be used to track changes in relative abundances of bigheaded carp. All invasive carps captured during sampling will be euthanized and lengths, weights, and sex will be recorded.

Data collected outside of this project during activities focused around Asian carp in the ORB will also be compiled and used to inform field sampling and analyses on bigheaded carp distribution and population characteristics. Otoliths collected during removal will be used to get age distributions by pool and provide estimates of mortality. ORSANCO's annual sampling data and the USGS Nonindigenous Aquatic Species (NAS) database will be sourced to provide additional information on the range and confirmed sightings of Asian carps along the Ohio River and its tributaries. Additional data sources may become relevant for this project and will be considered and incorporated when possible.

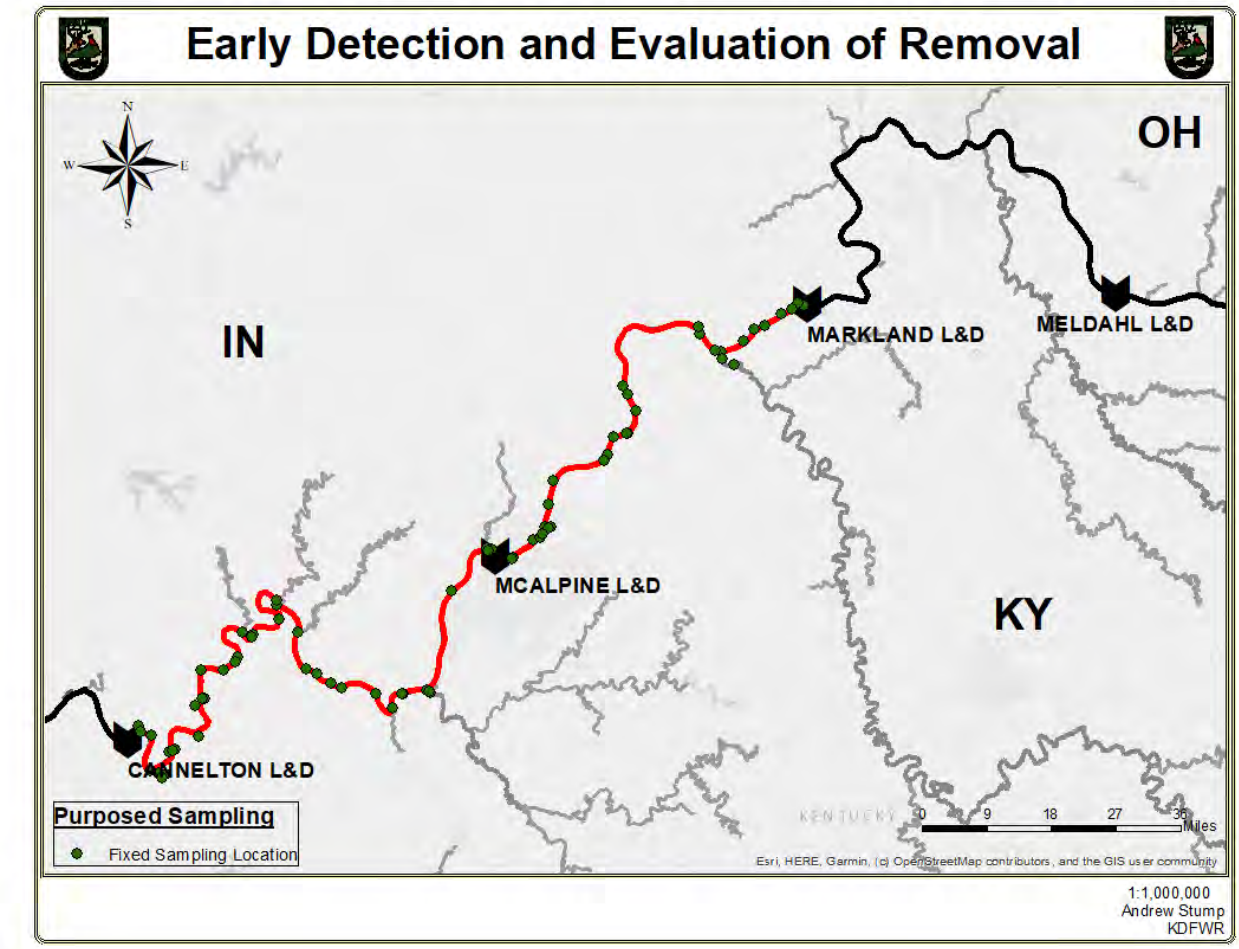
To track long-term trends in native fish species, KDFWR will coordinate with agencies to conduct community fish surveys in Cannelton and McAlpine pools. Sampling should be

conducted in the fall of each year when water temperatures are 55°F – 65°F. Electrofishing is conducted in a general downstream direction using one dipper for 900 seconds. All fish entrained to the anodes should be dipped except when large schools of fish (e.g. Clupeids or Cyprinids) are encountered. When large schools blanket the water column, fish should be dipped continuously at a constant rate in a straight-line distance until the school is passed. Community sampling is conducted with pulsed-DC electricity at 60 pulses per second (PPS) and a 25% duty-cycle (or comparable settings). A power goal allowing the transfer of 3,000 Watts from water to fish should be targeted (Burkhardt and Gutreuter, 1995). Because output affects catch rates of fish with variations in size and species, it is important to maintain consistent power during community sampling. For this reason, setting adjustments will be made depending on fish recovery and response to electricity, but it is suggested that the output power does not deviate from the suggested power goal by more than 20% (Burkhardt and Gutreuter, 1995). The straight-line distance covered during electrofishing should be approximately 200 m (~0.125 miles) of shoreline.

Gill netting will be conducted at fixed sites in the same timeframe as boat electrofishing. Each site will include 300 ft of 4-in square net and 300 ft of 5-in square net, and 150 ft of 3-in bar mesh, making the overall targeted length of net fished at each site equal to 750 ft. Gill netting protocol will follow the same methods as described above and records of catch will be kept for all species captured.

All fish captured using either gear will be identified to the lowest possible taxonomic level and total length (mm) and weight (kg) with be recorded for a subsample of 15 individuals of each species for each sampling event. Asian carp will either be implanted with an acoustic transmitter or euthanized depending on their location and condition.

Map of Project Area:



Estimated Timetable for activities:

Activity	Time Period (Season, month/year)
Community Surveys Field Work	Fall, October/2020
Executive Technical Report	Spring, March/2021
Targeted Sampling Field Work	Spring, April/2021

Agency: West Virginia Division of Natural Resources (WVDNR)

Activities and Methods: WVDNR will coordinate with other state agencies to track relative abundances and populations characteristics of Asian carp by conducting targeted sampling for Asian carp along several pools, upriver of the Cannelton Locks and Dam complex. WVDNR will conduct targeted samples in the Greenup and R.C. Byrd pools. Both pulsed-DC boat electrofishing and gill netting techniques will be utilized to target bigheaded carps. Sampling will occur during the spring (water temperatures at 50°F – 65°F) at fixed sites previously identified in

earlier years' sampling. Electrofishing surveys will consist of timed 15-minute shoreline transects in a downstream direction during the day at fixed sites throughout each pool. Electrofishing settings will be dependent upon river conditions. Driving speed adjustments and pursuit of individual carp is allowed upon fish sightings. Non-target fish species will be ignored during sampling; however, small, shad-like species will be dipped on occasion and examined thoroughly to ensure identification of young Asian carps. The number of samples completed will be dependent upon staff availability, environmental conditions, and distance travelled from boat ramps.

Gill nets sets will be conducted during the same time frame as boat electrofishing. Gill net sets will consist of two-hour sets during the day at fixed sites throughout each pool. Nets will be either 300ft or 150ft in length with 5" bar mesh. Gill nets will primarily be set perpendicular to the shoreline, but may need to be set parallel to shore when water flow is excessive. Each net set will be actively monitored and effort will be expended to run fish into the nets with boat noise and herding techniques. All by-catch will be recorded and any non-target fish will be released immediately after capture.

Information from targeted sampling will be used to track changes in relative abundances of bigheaded carps in the Ohio River. All feral Asian carps captured during sampling will be removed from the system. Otoliths and fin rays will be removed as needed from Asian carp for age and growth analysis.

To track long-term trends in native fish communities, WVDNR will coordinate with agencies to conduct community fish surveys from Cannelton to R.C. Byrd pool. Specifically, WVDNR will conduct community surveys in the Greenup and R.C. Byrd pools. Pulsed-DC boat electrofishing and gill netting techniques will be utilized primarily. Boat ramp seine hauls and benthic trawls may also be employed to more effectively sample the small and benthic fish community. Surveys will be conducted in the fall when water temperatures are 55°F – 65°F. 15-minute shoreline transects in a downstream direction during the day at fixed sites throughout each pool (Table 1). Gill nets will consist of two hour sets during the day at fixed sites throughout each pool (Table 1). Nets will be either 300ft or 150ft in length with 5" bar mesh. Gill nets will primarily be set perpendicular to the shoreline, but may need to be set parallel to shore when water flow is excessive. Each net set will be actively monitored and effort will be expended to run fish into the nets with boat noise and herding techniques. Boat ramp seine hauls will be conducted at boat ramps located directly or adjacent to the mainstem Ohio River (see table). One seine haul will be conducted at each ramp with a 30ft seine with 3/16" mesh and a 6ft bag (1/8" mesh). Benthic trawling may also be conducted following agency protocols. All fish captured using these gears will be identified to the lowest possible taxonomic level and a total length (mm) and weight (kg) with be taken to evaluate condition on select species. Fish collected via seining and trawling will be retained for identification and enumeration in the laboratory. All Asian carp without surgically implanted transmitters will be exterminated upon capture.

To assess movement of Asian carp further up the Ohio River mainstem, WVDNR will assist CFWCO to conduct eDNA surveillance surveys in the upper Ohio River. Specifically, WVDNR will participate in sample collection in the Racine Pool and the Winfield Pool of the Kanawha River, a major tributary of the Ohio River in the R.C. Byrd Pool. WVDNR staff will assist with

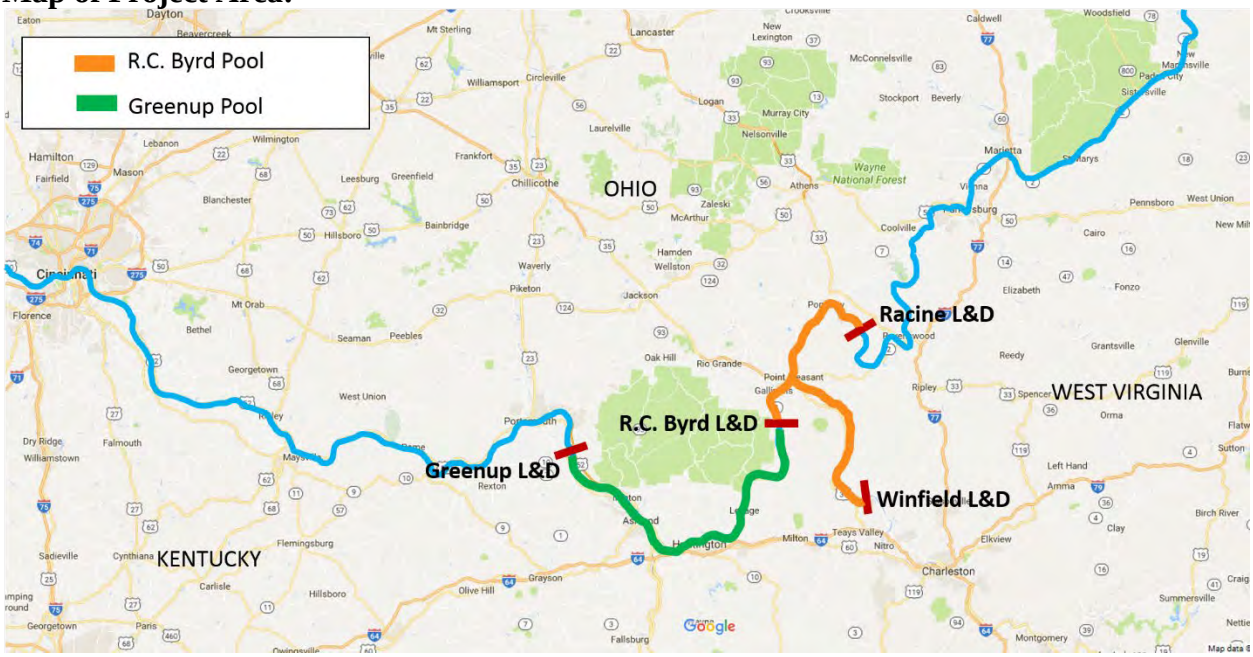
collecting and processing water samples on site according to USFWS sampling protocols. New or concerning positive results of Asian carp DNA may lead to a targeted sampling effort to collect fish.

WVDNR conducts other fisheries surveys at several dam tailwaters, tributaries, and embayments of the Ohio River. Data collection during these surveys has been augmented to report Asian carp captured during sportfish sampling and provide information on sportfish condition. All Asian carp collected will be identified, sexed (when applicable), lengths will be noted when possible and removed from the system.

List of boat ramps targeted for seine hauls

Pool	Boat Ramp Name	River Mile	Latitude	Longitude
Greenup	Little Sandy PAS	336.2	38.579786	082.84299
Greenup	Virginia Point Park PAS	317	38.413045	082.595301
Greenup	Guyandotte PAS	305.2	38.431393	082.391179
Greenup	Greenbottom PAS	287.7	38.589167	082.222774
R.C. Byrd	City of Gallipolis Boat Ramp	269.7	38.805332	082.205948
R.C. Byrd	Crooked Creek PAS	265.6	38.838605	082.131659
R.C. Byrd	Town of Mason PAS	250.2	39.025002	082.030437
R.C. Byrd	Racine Village PAS	241.2	38.962397	081.915251

Map of Project Area:



Estimated Timetable for Activities:

Activity	Time Period (Season, month/year)
Targeted Asian carp Sampling in R.C. Byrd Pool	April 2021
Targeted Asian carp Sampling in Greenup Pool	April 2021
Community Fish Surveys in R.C. Byrd Pool	October 2020
Community Fish Surveys in Greenup Pool	October 2020
eDNA Sampling in Racine and Winfield (Kanawha) pools	May/June 2021
Sportfish surveys in All WV Ohio River Pools	January-December 2020-21
Project Technical Report	February 2021

Agency: US Fish and Wildlife Service Carterville Fish and Wildlife Conservation Office (CFWCO)

Activities and methods: The US Fish and Wildlife Service will conduct mobile hydroacoustic surveys on the Ohio River from J.T. Myers to McAlpine to assess the spatial dynamics of Asian Carp. Sampling will start in J.T. Myers pool and move upstream through McAlpine. Sites in Cannelton and McAlpine will remain consistent with previous years of this project, with three sites in each pool. Sites in J.T. Myers and Newbourgh pools are new additions to this project and locations are still being determined. Site location will be based on fish community sampling performed by state partners and initial site visits. Each site will consist of a main channel section and an associated tributary. For main channel surveys, 4-nmi of each shore will be surveyed with the transducers facing towards the shore to better capture suitable fish habitat in. Tributaries will be surveyed with the transducers facing towards the middle of the channel, and will be traversed as far as the channel is passable, or until 1-nmi. Hydroacoustics survey equipment will be comprised of two BioSonics split-beam transducers. The transducers are calibrated at 200-kHz and are oriented so one transducer samples the more shallow portion of the water column and the other samples the deeper portion of the water column. Hydroacoustics analysis will be conducted according to MacNamara et al. (2016) and the Large River Hydroacoustics Mobile Survey Standard Operating Procedure, Region 3 U.S. Fish and Wildlife Service in Echoview Version 10.0. State partners will collect physical capture data to inform hydroacoustics analysis. Results will include species-specific density and biomass density estimates per habitat type, site, and pool.

Estimated Timetable for Activities:

Activity	Time Period (Season, month/year)
Hydroacoustics Surveys	October/November 2020
Data Processing and Analysis	Winter 2020
Results and Reporting	Spring 2021

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Table 1. Fixed site locations for targeted and community sampling on the Ohio River between the Cannelton Lock and Dam and the Racine Lock and Dam.

Pool	Site Description	Gear	State	Type	Agency
Cannelton	Carter's Landing Bar	Boat Electrofishing	IN	MAIN	INDNR
Cannelton	Clover Creek - Upper	Boat Electrofishing	KY	TRIB	INDNR
Cannelton	Clover Creek - Lower	Boat Electrofishing	KY	TRIB	INDNR
Cannelton	Millstone Creek	Boat Electrofishing	IN	TRIB	INDNR
Cannelton	Deer Creek - Lower	Boat Electrofishing	IN	TRIB	INDNR
Cannelton	Deer Creek - Upper	Boat Electrofishing	IN	TRIB	INDNR
Cannelton	Clover Creek - Lower	Gill Netting	KY	TRIB	INDNR
Cannelton	Deer Creek - Lower	Gill Netting	IN	TRIB	INDNR
Cannelton	Oxbow Bend	Boat Electrofishing	IN	MAIN	INDNR
Cannelton	Wolf Creek	Boat Electrofishing	KY	TRIB	INDNR
Cannelton	Little Blue River	Boat Electrofishing	IN	TRIB	INDNR
Cannelton	Wattson Creek	Boat Electrofishing	KY	TRIB	INDNR
Cannelton	Flint Island	Boat Electrofishing	KY	MAIN	INDNR
Cannelton	Oil Creek	Boat Electrofishing	IN	TRIB	INDNR
Cannelton	Oxbow Bend	Gill Netting	IN	MAIN	INDNR
Cannelton	Little Blue River	Gill Netting	IN	TRIB	INDNR
Cannelton	Rock Run Bar	Boat Electrofishing	IN	MAIN	INDNR
Cannelton	Buck Creek	Boat Electrofishing	IN	TRIB	INDNR
Cannelton	Haunted Hollow Bar	Boat Electrofishing	IN	MAIN	INDNR
Cannelton	Indian Creek	Boat Electrofishing	IN	TRIB	INDNR
Cannelton	Blue River Bar	Boat Electrofishing	KY	MAIN	INDNR
Cannelton	Blue River	Boat Electrofishing	IN	TRIB	INDNR
Cannelton	Buck Creek	Gill Netting	IN	TRIB	INDNR
Cannelton	Blue River Bar	Gill Netting	KY	MAIN	INDNR
Cannelton	McAlpine Lock & Dam	Boat Electrofishing	IN	TAILW	INDNR
Cannelton	Sand Island	Boat Electrofishing	KY	ISLBC	INDNR
Cannelton	Hughes Bar	Boat Electrofishing	IN	MAIN	INDNR
Cannelton	Salt River - Upper	Boat Electrofishing	KY	TRIB	INDNR
Cannelton	Salt River - Lower	Boat Electrofishing	KY	TRIB	INDNR
Cannelton	Otter Creek	Boat Electrofishing	KY	TRIB	INDNR
Cannelton	Hughes Bar	Gill Netting	IN	MAIN	INDNR
Cannelton	Salt River - Mouth	Gill Netting	KY	TRIB	INDNR
McAlpine	Fourteen Mile Creek	Boat Electrofishing	IN	TRIB	KDFWR
McAlpine	Harrods Creek - Upper	Boat Electrofishing	KY	TRIB	KDFWR
McAlpine	Harrods Creek - Lower	Boat Electrofishing	KY	TRIB	KDFWR
McAlpine	Six Mile Island	Boat Electrofishing	IN	ISLBC	KDFWR

McAlpine	Beargrass Creek	Boat Electrofishing	KY	TRIB	KDFWR
McAlpine	Toehead Island	Boat Electrofishing	KY	ISLBC	KDFWR
McAlpine	Harrods Creek - Lower	Gill Netting	KY	TRIB	KDFWR
McAlpine	Toehead Island	Gill Netting	KY	ISLBC	KDFWR
McAlpine	Corn Creek	Boat Electrofishing	KY	TRIB	KDFWR
McAlpine	Patton's Creek	Boat Electrofishing	KY	TRIB	KDFWR
McAlpine	Big Saluda Creek	Boat Electrofishing	IN	TRIB	KDFWR
McAlpine	Little Camp Creek	Boat Electrofishing	IN	TRIB	KDFWR
McAlpine	Eighteen Mile Creek	Boat Electrofishing	KY	TRIB	KDFWR
McAlpine	Eighteen Mile Island	Boat Electrofishing	KY	ISLBC	KDFWR
McAlpine	Patton's Creek	Gill Netting	KY	TRIB	KDFWR
McAlpine	Eighteen Mile Island	Gill Netting	KY	ISLBC	KDFWR
McAlpine	Craig's Bar	Boat Electrofishing	IN	MAIN	KDFWR
McAlpine	Kentucky River - Upper	Boat Electrofishing	KY	TRIB	KDFWR
McAlpine	Kentucky River - Lower	Boat Electrofishing	KY	TRIB	KDFWR
McAlpine	Little Kentucky	Boat Electrofishing	KY	TRIB	KDFWR
McAlpine	Locust Creek	Boat Electrofishing	KY	TRIB	KDFWR
McAlpine	Indian-Kentucky Creek	Boat Electrofishing	KY	TRIB	KDFWR
McAlpine	Craig's Bar	Gill Netting	IN	MAIN	KDFWR
McAlpine	Kentucky River - Mouth	Gill Netting	KY	TRIB	KDFWR
McAlpine	Markland L&D, KY	Boat Electrofishing	KY	TAILW	KDFWR
McAlpine	Markland L&D, IN	Boat Electrofishing	IN	TAILW	KDFWR
McAlpine	RM 534 Main	Boat Electrofishing	IN	MAIN	KDFWR
McAlpine	Plum Creek	Boat Electrofishing	IN	MAIN	KDFWR
McAlpine	Vevay Bar	Boat Electrofishing	KY	MAIN	KDFWR
McAlpine	Indian Creek	Boat Electrofishing	IN	TRIB	KDFWR
McAlpine	Markland L&D, IN	Gill Netting	IN	TAILW	KDFWR
McAlpine	Vevay Bar	Gill Netting	KY	MAIN	KDFWR
Markland	Big Sugar Creek	Boat Electrofishing	KY	TRIB	KDFWR
Markland	PaintLick Creek	Boat Electrofishing	KY	TRIB	KDFWR
Markland	Craig's Creek - Upper	Boat Electrofishing	KY	TRIB	KDFWR
Markland	Turtle Creek	Boat Electrofishing	IN	TRIB	KDFWR
Markland	Craig's Creek - Lower	Boat Electrofishing	KY	TRIB	KDFWR
Markland	Belterra Embayment	Boat Electrofishing	IN	MAIN	KDFWR
Markland	Craig's Creek - Upper	Gill Netting	KY	TRIB	KDFWR
Markland	Belterra Embayment	Gill Netting	IN	MAIN	KDFWR
Markland	Big Bone - Upper	Boat Electrofishing	KY	TRIB	KDFWR
Markland	Big Bone - Lower	Boat Electrofishing	KY	TRIB	KDFWR
Markland	Gunpowder Creek	Boat Electrofishing	KY	TRIB	KDFWR

Markland	Laugherty Island	Boat Electrofishing	IN	ISLBC	KDFWR
Markland	Grant's Creek	Boat Electrofishing	IN	TRIB	KDFWR
Markland	RM 514 Main	Boat Electrofishing	KY	MAIN	KDFWR
Markland	Arnold's Creek	Boat Electrofishing	IN	TRIB	KDFWR
Markland	Big Bone - Lower	Gill Netting	KY	TRIB	KDFWR
Markland	Big Bone - Upper	Gill Netting	KY	TRIB	KDFWR
Markland	Little Miami River	Boat Electrofishing	OH	TRIB	KDFWR
Markland	Licking River - Upper	Boat Electrofishing	KY	TRIB	KDFWR
Markland	Licking River - Lower	Boat Electrofishing	KY	TRIB	KDFWR
Markland	Medoc Bar	Boat Electrofishing	KY	MAIN	KDFWR
Markland	Great Miami River	Boat Electrofishing	OH	TRIB	KDFWR
Markland	Tanner's Creek	Boat Electrofishing	IN	TRIB	KDFWR
Markland	Laughery Creek	Boat Electrofishing	IN	TRIB	KDFWR
Markland	Hogan Creek	Boat Electrofishing	IN	TRIB	KDFWR
Markland	Tanner's Creek	Gill Netting	IN	MAIN	KDFWR
Markland	Great Miami River	Gill Netting	OH	TRIB	KDFWR
Markland	Meldahl L&D, OH	Boat Electrofishing	OH	TAILW	KDFWR
Markland	Meldahl L&D, KY	Boat Electrofishing	KY	TAILW	KDFWR
Markland	RM 437 Main	Boat Electrofishing	OH	MAIN	KDFWR
Markland	Big Indian Creek	Boat Electrofishing	OH	TRIB	KDFWR
Markland	Twelvemile Creek	Boat Electrofishing	OH	TRIB	KDFWR
Markland	RM 456 Main	Boat Electrofishing	KY	MAIN	KDFWR
Markland	Big Indian Creek	Gill Netting	OH	TRIB	KDFWR
Markland	RM 456 Main	Gill Netting	KY	MAIN	KDFWR
Meldahl	Straight Creek	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	White Oak Creek	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	RM 426 Main	Boat Electrofishing	OH	MAIN	KDFWR
Meldahl	Bracken Creek	Boat Electrofishing	KY	TRIB	KDFWR
Meldahl	Locust Creek	Boat Electrofishing	KY	TRIB	KDFWR
Meldahl	Snag Creek	Boat Electrofishing	KY	TRIB	KDFWR
Meldahl	White Oak Creek	Gill Netting	OH	TRIB	KDFWR
Meldahl	Bracken Creek	Gill Netting	KY	TRIB	KDFWR
Meldahl	Cabin Creek	Boat Electrofishing	KY	TRIB	KDFWR
Meldahl	Red Oak Creek	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	Big Three Mile Creek	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	Eagle Creek	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	Lawrence Creek	Boat Electrofishing	KY	TRIB	KDFWR
Meldahl	Charleston Bar	Boat Electrofishing	KY	MAIN	KDFWR
Meldahl	Cabin Creek	Gill Netting	KY	TRIB	KDFWR

Meldahl	Straight Creek	Gill Netting	OH	TRIB	KDFWR
Meldahl	Ohio Brush Creek - Upper	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	Ohio Brush Creek - Lower	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	Ohio Brush Creek Island	Boat Electrofishing	KY	ISLBC	KDFWR
Meldahl	Manchester Island Two	Boat Electrofishing	KY	ISLBC	KDFWR
Meldahl	Isaacs Creek	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	Crooked Creek	Boat Electrofishing	KY	TRIB	KDFWR
Meldahl	Ohio Brush Creek - Mouth	Gill Netting	OH	TRIB	KDFWR
Meldahl	Manchester Island One	Gill Netting	KY	ISLBC	KDFWR
Meldahl	Greenup L&D, OH	Boat Electrofishing	OH	TAILW	KDFWR
Meldahl	Greenup L&D, KY	Boat Electrofishing	KY	TAILW	KDFWR
Meldahl	Pine Creek	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	Little Scioto River	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	Tygarts Creek	Boat Electrofishing	KY	TRIB	KDFWR
Meldahl	Scioto River - Upper	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	Scioto River - Lower	Boat Electrofishing	OH	TRIB	KDFWR
Meldahl	Little Scioto River	Gill Netting	OH	MAIN	KDFWR
Meldahl	Scioto River - Lower	Gill Netting	OH	TRIB	KDFWR
Greenup	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
Greenup	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
Greenup	Guyandotte River	Boat Electrofishing	WV	TRIB	WVDNR
Greenup	Symmes Creek	Boat Electrofishing	OH	TRIB	WVDNR
Greenup	Twelvepole Creek	Boat Electrofishing	WV	TRIB	WVDNR
Greenup	Big Sandy River, I-64 bridge	Boat Electrofishing	WV	TRIB	WVDNR
Greenup	Big Sandy River, #2	Boat Electrofishing	WV	TRIB	WVDNR
Greenup	Ginat Run	Gill Netting	OH	TRIB	WVDNR
Greenup	Little Sandy River	Gill Netting	KY	TRIB	WVDNR
Greenup	Storm Creek*	Gill Netting	OH	TRIB	WVDNR
Greenup	Little Sandy, #1	Boat Electrofishing	KY	TRIB	WVDNR
Greenup	Little Sandy, #2	Boat Electrofishing	KY	TRIB	WVDNR
Greenup	Storm Creek	Boat Electrofishing	OH	TRIB	WVDNR
Greenup	Mainchannel Random	Boat Electrofishing	KY	MAIN	WVDNR
Greenup	Mainchannel Random	Boat Electrofishing	KY	MAIN	WVDNR
Greenup	Ginat Creek	Boat Electrofishing	OH	TRIB	WVDNR
Greenup	Big Sandy River - Mouth	Gill Netting	WV	TRIB	WVDNR
Greenup	Big Sandy River (additional upstream)	Gill Netting	WV	TRIB	WVDNR
Greenup	Twelvepole Creek	Gill Netting	WV	TRIB	WVDNR
Greenup	Guyan Creek	Boat Electrofishing	WV	TRIB	WVDNR

Greenup	RC Byrd L&D-gates	Boat Electrofishing	WV	TAILW	WVDNR
Greenup	RC Byrd L&D-locks	Boat Electrofishing	WV	TAILW	WVDNR
Greenup	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
Greenup	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
Greenup	Unnamed Island	Boat Electrofishing	WV	ISLBC	WVDNR
Greenup	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
Greenup	Guyandotte River Lower	Gill Netting	WV	TRIB	WVDNR
Greenup	Symmes Creek	Gill Netting	OH	TRIB	WVDNR
Greenup	Mainchannel Random*	Gill Netting	WV	MAIN	WVDNR
Greenup	Unnamed Island	Gill Netting	WV	ISLBC	WVDNR
Greenup	Guyan Creek	Gill Netting	WV	TRIB	WVDNR
Greenup	Mainchannel Random*	Gill Netting	WV	MAIN	WVDNR
RC Byrd	Racine L&D-gates	Boat Electrofishing	WV	TAILW	WVDNR
RC Byrd	Racine L&D-locks	Boat Electrofishing	WV	TAILW	WVDNR
RC Byrd	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
RC Byrd	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
RC Byrd	Trib-Sliding Hill Ck.	Boat Electrofishing	WV	TRIB	WVDNR
RC Byrd	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
RC Byrd	Trib - Leading Ck.	Boat Electrofishing	OH	TRIB	WVDNR
RC Byrd	Chickamauga Creek	Gill Netting	OH	TRIB	WVDNR
RC Byrd	Gallipolis Island	Gill Netting	WV	ISLBC	WVDNR
RC Byrd	Raccoon Creek	Gill Netting	OH	TRIB	WVDNR
RC Byrd	Eightmile Island	Boat Electrofishing	WV	ISLBC	WVDNR
RC Byrd	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
RC Byrd	Kyger Creek	Boat Electrofishing	OH	TRIB	WVDNR
RC Byrd	Old Town Creek	Boat Electrofishing	WV	TRIB	WVDNR
RC Byrd	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
RC Byrd	Crooked Creek-Kanawha R.	Boat Electrofishing	WV	TRIB	WVDNR
RC Byrd	Three Mile Ck-Kanawha R.	Boat Electrofishing	WV	TRIB	WVDNR
RC Byrd	Leading Creek	Gill Netting	OH	TRIB	WVDNR
RC Byrd	Eightmile Island	Gill Netting	WV	ISLBC	WVDNR
RC Byrd	Gallipolis Island	Boat Electrofishing	WV	ISLBC	WVDNR
RC Byrd	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
RC Byrd	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
RC Byrd	Mainchannel Random	Boat Electrofishing	WV	MAIN	WVDNR
RC Byrd	Raccoon Creek	Boat Electrofishing	OH	TRIB	WVDNR
RC Byrd	Crab Creek	Boat Electrofishing	WV	TRIB	WVDNR
RC Byrd	Kan R - Crooked Creek	Gill Netting	WV	TRIB-TRIB	WVDNR
RC Byrd	Kan R - N. Threemile Creek	Gill Netting	WV	TRIB-TRIB	WVDNR

RC Byrd	Kan R - Fivemile Creek	Gill Netting	WV	TRIB-TRIB	WVDNR
RC Byrd	Kan. R-Winfield L&D-gates	Boat Electrofishing	WV	TRIB-TAILW	WVDNR
RC Byrd	Kan. R -Winfield L&D-locks	Boat Electrofishing	WV	TRIB-TAILW	WVDNR
RC Byrd	Kan.R Mainchannel Random	Boat Electrofishing	WV	TRIB-MAIN	WVDNR
RC Byrd	Kan.R - Hurricane Creek	Boat Electrofishing	WV	TRIB-TRIB	WVDNR
RC Byrd	Kan. R- 5 & 20 Mile Ck.	Boat Electrofishing	WV	TRIB-TRIB	WVDNR
RC Byrd	Kan. R- 18Mile Ck.	Boat Electrofishing	WV	TRIB-TRIB	WVDNR
RC Byrd	Kan.R Mainchannel Random	Boat Electrofishing	WV	TRIB-MAIN	WVDNR
RC Byrd	Kan R - Ninemile Creek	Gill Netting	WV	TRIB-TRIB	WVDNR
RC Byrd	Kan R - Tenmile Creek	Gill Netting	WV	TRIB-TRIB	WVDNR
RC Byrd	Kan R - Thirteenmile Creek	Gill Netting	WV	TRIB-TRIB	WVDNR

Abundance and Distribution of Early Life Stages of Asian Carp in the Ohio River

Lead Agency and Author: Indiana Department of Natural Resources (INDNR); Craig Jansen, cjansen1@dnr.in.gov

Cooperating Agencies: Kentucky Department of Fish and Wildlife Resources (KDFWR), West Virginia Division of Natural Resources (WVDNR), West Virginia University (WVU), US Fish and Wildlife Service Carterville Fish and Wildlife Conservation Office (CFWCO), Southern Illinois University (SIU), Ball State University (BSU)

Statement of Need: Acquiring a full understanding of the early life history information is imperative for evaluating the population status (i.e., extent of invasion). As defined in the Upper Mississippi River basin (Brent Knights and Ann Runstrom, personal communication), the extent of Asian carp invasion has three predominate levels (presence front, invasion front, and established front) that will guide specific management actions. The "presence front" is the most upstream extent of Asian carp capture where densities are low and reproduction has not occurred. The "invasion front" is that location(s) where reproduction (i.e., eggs, embryos, or larvae) has been observed but recruitment has yet to be documented. The "established front" is that location(s) where reproduction and recruitment to the adult life stage are currently occurring. Identifying the specific locations that differentiate both the extent of spawning and recruitment is crucial information for implementation of management or control efforts (e.g. targeted removal efforts, informing barrier or deterrent placement, etc). In order to identify these locations, quantifying abundance and distribution of Asian carp early life stages is needed. For the purposes of this plan, the term 'Asian carp' is referring to Silver Carp and Bighead Carp (*Hypophthalmichthys* species), also known as bigheaded carp.

In order to limit the negative impacts of Asian carp populations and their further spread, efforts have increased to understand the distribution and abundance of Asian carp in the waters they currently inhabit. Previous sampling efforts on the Ohio River have documented adult Asian carp presence as far upstream as Robert C. Byrd Dam near Gallipolis Ferry, West Virginia. Densities of adult Asian carp are highest downstream of McAlpine Lock and Dam (Louisville, KY) and substantially decline farther upstream. Despite the high abundance of adults in Cannelton Pool and additional targeted juvenile sampling there in 2019, efforts have only captured young-of-year (YOY) Asian carp as far upstream as Newburgh Pool, with the majority of the YOY being consistently captured in J.T. Myers Pool since 2016.

Suspected reproduction of non-indigenous bigheaded carp, through the identification of Asian carp-type larvae, was documented in Meldahl Pool in 2016 by EA Engineering. In addition, Asian carp larvae were captured from Newburgh to McAlpine Pools in 2018, and suspect bigheaded carp eggs and larvae were collected as far upstream as Cannelton Pool during last year's iteration of this project. Previous efforts have been successful in collecting Asian carp eggs, embryos, and larvae in the Ohio River. However, defined spawning locations and the spatial extent of spawning in the Ohio River remains a knowledge gap. Multiple years of data collection covering a broader spatial extent under a variety of environmental conditions will be necessary to fully understand Asian carp early life history among pools.

Objectives:

1. Determine the extent of bigheaded carp spawning activity in the Ohio River above Markland Dam.

2. Identify tributaries and areas of the Ohio River in which spawning of bigheaded carp occurs.

3. Determine the geographic extent and locations of Asian carp recruitment in the Ohio River.
4. Identify characteristics of potential Asian carp nursery areas when juvenile Asian carp are encountered.

5. Estimate Hovey Lake recruitment potential and evaluate the feasibility of drain structure modifications to limit Asian carp recruitment from Hovey Lake.

6. Determine the propagule source of Asian carp in the Ohio River.

Agency: Indiana Department of Natural Resources (INDNR)

Activities and Methods: To identify tributaries and areas in which spawning occurs, INDNR will conduct and coordinate sampling for Asian carp eggs, embryos, and larvae at high priority sites of Newburgh, Cannelton, and McAlpine pools. Locations will include suspected areas of spawning in tributaries based on current information, and locations in the mainstem river above and below Locks and Dams to determine if dams are providing ideal spawning locations. Conical ichthyoplankton tows (0.76m, 500 µm mesh) will be conducted at least twice at each site during ideal spawning conditions (water temperatures between 64 to 80°F with moderate to high flows) through June and July, 2021. Field staff will coordinate closely with KDFWR personnel to communicate when spawning patches begin to develop on female Asian carp and will use that knowledge as another indicator to sample. A single ichthyoplankton net will be deployed on the side of the boat facing upstream, with each tow lasting 3 minutes. A flow meter will be used to determine water volume sampled. At each site, the main stem Ohio River will be sampled via three ichthyoplankton tows - one on each right and left descending portions of the river and one in the middle of the river. At tributary sites, three tows will be taken within the tributary at least one-half mile upstream of the Ohio River confluence. Depth (m) and water temperature (°C) will be recorded using a boat-mounted depth sounder at each sampling site. All contents will be preserved in 95% ethanol for identification in the lab. Morphometric characteristics developed by Chapman and George (2011) will be used to identify suspected bigheaded carp eggs, embryos, and larvae. If necessary, a subsample of suspected bigheaded carp eggs, embryos, and/or larvae can then be sent to Whitney Genetics Laboratory for confirmation of species. Results will be used to locate spawning locations in the Ohio River Basin and thus will guide future management actions (e.g. targeted removal efforts and/or barrier placement considerations).

To determine the geographic extent of Asian carp recruitment, Indiana DNR will conduct targeted sampling for juvenile Asian carp in J.T. Myers, Newburgh, and Cannelton pools of the Ohio River. Because typical nursery habitat in the form of shallow backwater areas is less prominent in the Ohio River, flooded creek mouths and tributaries likely serve as a substitute. Previous sampling efforts regularly captured YOY in J.T. Myers Pool, occasionally captured them in Newburgh Pool, and have not captured YOY Asian carp in Cannelton Pool despite the high relative abundance of adults present and additional targeted sampling there in 2019. Each site will be targeted with pulsed DC electrofishing during July and August, the time of year when juvenile Asian carp have been captured in the lower Ohio River in previous years. Electrofishing samples will consist of at least one 15-minute transect at each sample site, using an MLES Infinity control box set at 80 pulses per second and 40% duty cycle. Output will be standardized based on water conductivity. In addition, a 12-foot surface trawl will be used at suitable sites because it has proven effective for capturing young-of-year Asian carp. Surface trawl samples will consist of at least two 5-minute tows at each sample site. The surface trawl is constructed of an inner bag of 1 ¼" number 12 netting, and an outer bag of 3/16" 35 lb Delta style knotless mesh. The trawl is approximately 12 ft wide and 2 ft tall at the mouth, and is 18 ft long. Floats were added to the otter boards (12" x 24") and the float line of the trawl mouth to suspend the net on the surface. Tow lines are attached to the bow of the boat and the boat is motored in reverse between 1.5 to 2.0 mph. Juvenile

Asian carp collected will be identified to species, geo-located and enumerated. When Asian carp are encountered, lengths and weights will be recorded and a subsample of aging structures will be collected; Otoliths will be taken from fish >200 mm, and fish <200 mm will be frozen whole and taken back to the lab for dissection of aging structures. Results will be used to estimate the extent of Asian carp recruitment in the Ohio River and thus will directly inform future management actions (e.g. targeted removal efforts and/or barrier placement considerations).

In addition to sampling, participating agencies will collaborate with other fisheries professionals to inform them to report back with any confirmed findings of juvenile Asian carp within the basin. State partners will reach out to other biologists within their respective states and if a new instance is reported, will gather data and site location information if possible. These data will be compiled by the project lead and will be used to inform future planning efforts.

To identify characteristics of potential Asian carp nursery areas INDNR will collect a suite of habitat measurements at each sample site during targeted juvenile efforts to describe both the morphology characteristics (average depth, maximum depth, tributary width, presence/absence of woody debris and aquatic vegetation) of the tributary as well as water quality parameters (water temperature, Secchi disk visibility, conductivity, pH, dissolved oxygen). Data will be compiled with previous year's data to help categorize and identify areas that may provide the necessary habitat for Asian carp growth and development.

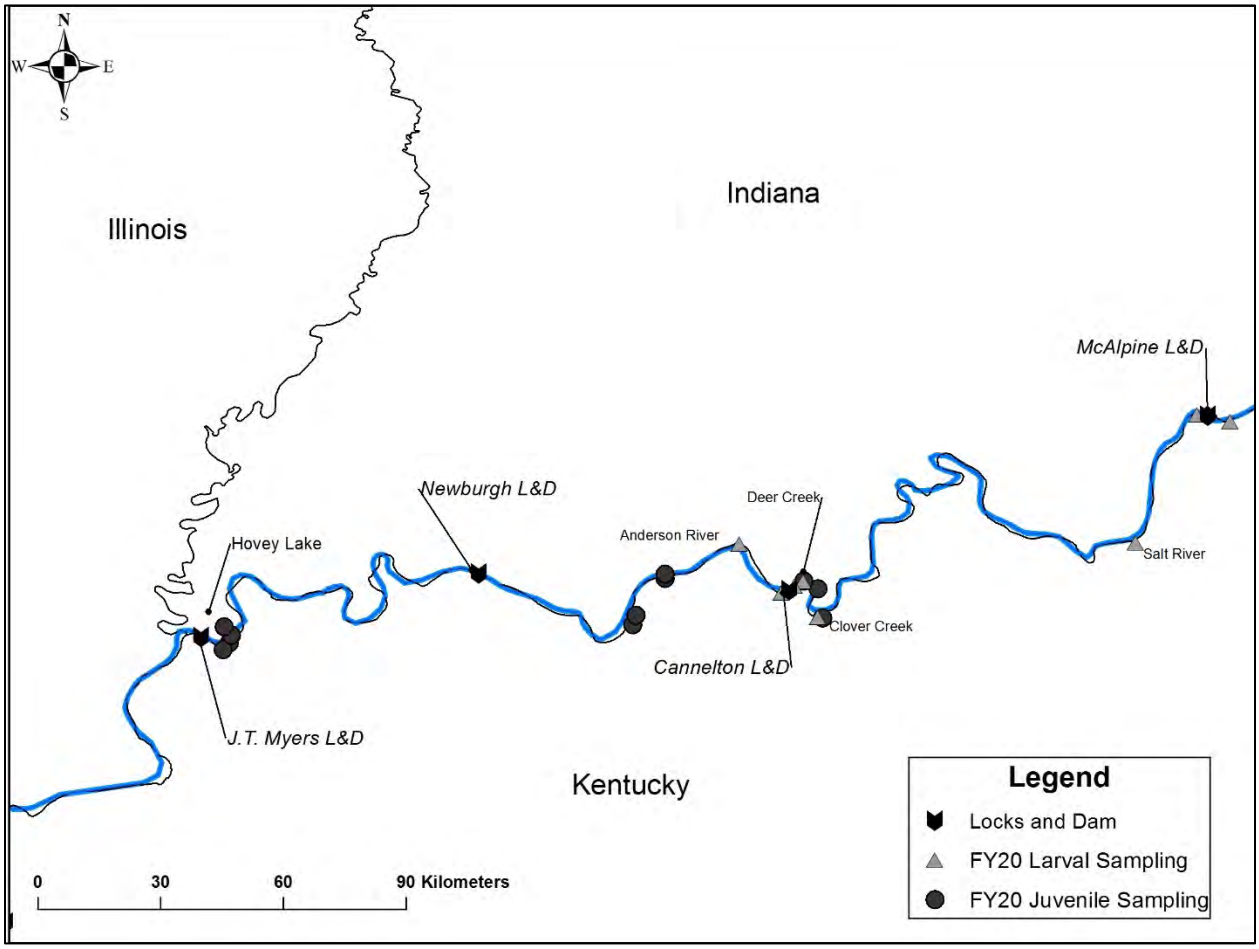
To estimate the recruitment potential of Hovey Lake, INDNR will contract with BSU to complete this work. Specific work will include quantifying the input of larval Asian carp from the Ohio River through the drain structure into Hovey Lake. The Hovey Lake drain consists of a 70 meter cement dam across the outlet of the lake. During normal flows, all water is constricted to flowing through three culvert pipes, each approximately 1 meter diameter. Flow can be impeded through these culvert pipes with the manual placement of boards, to block water from entering or leaving the lake. The current design allows for fish passage to be restricted solely through culvert pipes until the river stage reaches 30 ft at the J.T. Myers gage. Once the river tops 30 ft, water begins to flow over the cement dam freely into the lake, allowing more unrestricted fish passage. Using larval nets and/or fine mesh bait nets, the drain will be sampled across a variety of flows and conditions in May, June, and July to estimate YOY Asian carp passage into the lake. These data will be used to estimate a total number of YOY that have passed into the lake. Throughout June, July, and August, surface trawls and electrofishing will be used within Hovey Lake to capture YOY Asian carp. All YOY captured will be euthanized and taken back to the lab where otoliths will be extracted. Daily growth rings will be counted on otoliths to develop daily survival estimates of YOY Asian carp. Survival data will then be paired with estimates of YOY Asian carp in the lake to determine Hovey Lake recruitment contribution to the Ohio River basin Asian carp population.

In addition, BSU will evaluate the feasibility of drain structure modifications to significantly reduce Asian carp recruitment from Hovey Lake. Using GIS, an analysis of floodplain connectivity at various river stages will be conducted. In addition, site visits to confirm connectivity will be necessary. These data will be used to quantify historic timeframes and durations of connectivity between the lake and river, and will help determine what modifications to the existing drain structure may be needed to reduce Asian carp recruitment.

To determine the propagule source of Asian carp in the Ohio River, INDNR will contract with Southern Illinois University (SIU) to complete this work. Water samples will be collected during summer and fall months from rivers that are potential recruitment sources for Asian carps collected from the Wabash, White, and Ohio rivers. Water samples will be filtered in the field using a syringe filtration (0.45 μm pore size) technique and analyzed for Sr, Ba, and Ca concentrations using high-resolution, inductively coupled

plasma mass spectrometry. Lapilli otoliths will be removed from bigheaded carps collected in the Wabash, White, and Ohio rivers and analyzed trace element:calcium ratios (Sr:Ca, Ba:Ca, Mg:Ca). One otolith from each fish will be embedded in epoxy and sectioned in the transverse plane (otoliths from age-1 and older fish) or affixed directly to a glass microscope slide with a drop of cyanoacrylate glue and gently sanded to expose the otolith core (otoliths from age-0 fish). Otolith samples will be analyzed for Sr:Ca, Ba:Ca, and Mg:Ca using laser ablation-ICPMS. The laser will be used to ablate a transect extending from one side of the otolith primordium to the edge of the opposite side of the otolith along the longest axis of the otolith cross-section; this will enable identification of natal environment and movement among chemically-distinct locations during the fish's lifetime. Water chemistry data and published relationships between water and otolith chemistry for bigheaded carps will be used to estimate expected, multivariate otolith chemical "signatures" for all potential natal rivers for bigheaded carps in the study area. Otolith core chemistry data for bigheaded carps will be compared with these expected chemical "signatures" to identify natal environment for each fish. At a minimum, this approach will enable us to distinguish fish spawned in the Ohio River from those that originated in Ohio River tributaries; we will also assess whether finer-scale resolution of locations in the Wabash River basin may be possible.

Map of Project Area:



Estimated Timetable for Activities:

Activity	Time Period Season, month/year
Executive technical report for 2020 data	Spring, March/2021
Larval AC Sampling	Spring, May-June/2021
BSU – Hovey Lake drain sampling	Spring, May-June/2021
BSU – Hovey Lake juvenile sampling and daily growth	Summer, June-Sept/2021
BSU – Hovey Drain feasibility	Summer, June-Sept/2021
SIU – Process otoliths	Summer, June-Sept/2021
SIU – Collect water samples	Summer and Fall, July-Oct/2021
Juvenile AC Sampling	Summer, July-Aug/2021
Nursery Habitat Assessment	Summer, July-Aug/2021
Process larval samples	Summer, July-Aug/2021
Otolith collections	Summer, August/2021

Agency: Kentucky Department of Fish and Wildlife Resources (KDFWR)

Activities and Methods: KDFWR will conduct sampling for Asian carp eggs, embryos, and larvae using conical tows during peak spawning periods in the Ohio River. The main stem Ohio River will be sampled above and below locks and dams to determine if Asian carp are using tailwater areas to spawn. Some tributaries believed to be important to spawning will also be investigated using similar sampling protocols.

Three-minute conical ichthyoplankton tows (0.76m, 500 µm mesh) will be conducted on at least two dates from May through July during ideal spawning conditions (water temperatures from 64° to 80°F with moderate to high flows). To determine optimal sampling periods, field staff will coordinate with INDNR personnel to identify when spawning patches begin to develop on female Asian carp. At each sampling site, 3 ichthyoplankton net sets will be deployed for 3 minutes near each descending bank and one located in the middle of the river or tributary. A flow meter will be used to determine the volume of water sampled. All contents will be rinsed into a 500-µm sieve and preserved in 95% ethanol for identification in the lab. Morphometric characteristics will be used to identify suspected bigheaded carp, eggs, embryos, and larvae (Chapman and George 2011). If necessary, a subsample of suspected bigheaded carp eggs, embryos, and/or larvae will be sent to Whitney Genetics Laboratory for species confirmation. Results will be used to identify pools and tributaries where spawning is successful and will be to help develop population status changes that will guide future management actions (e.g. targeted removal efforts and/or barrier placement considerations).

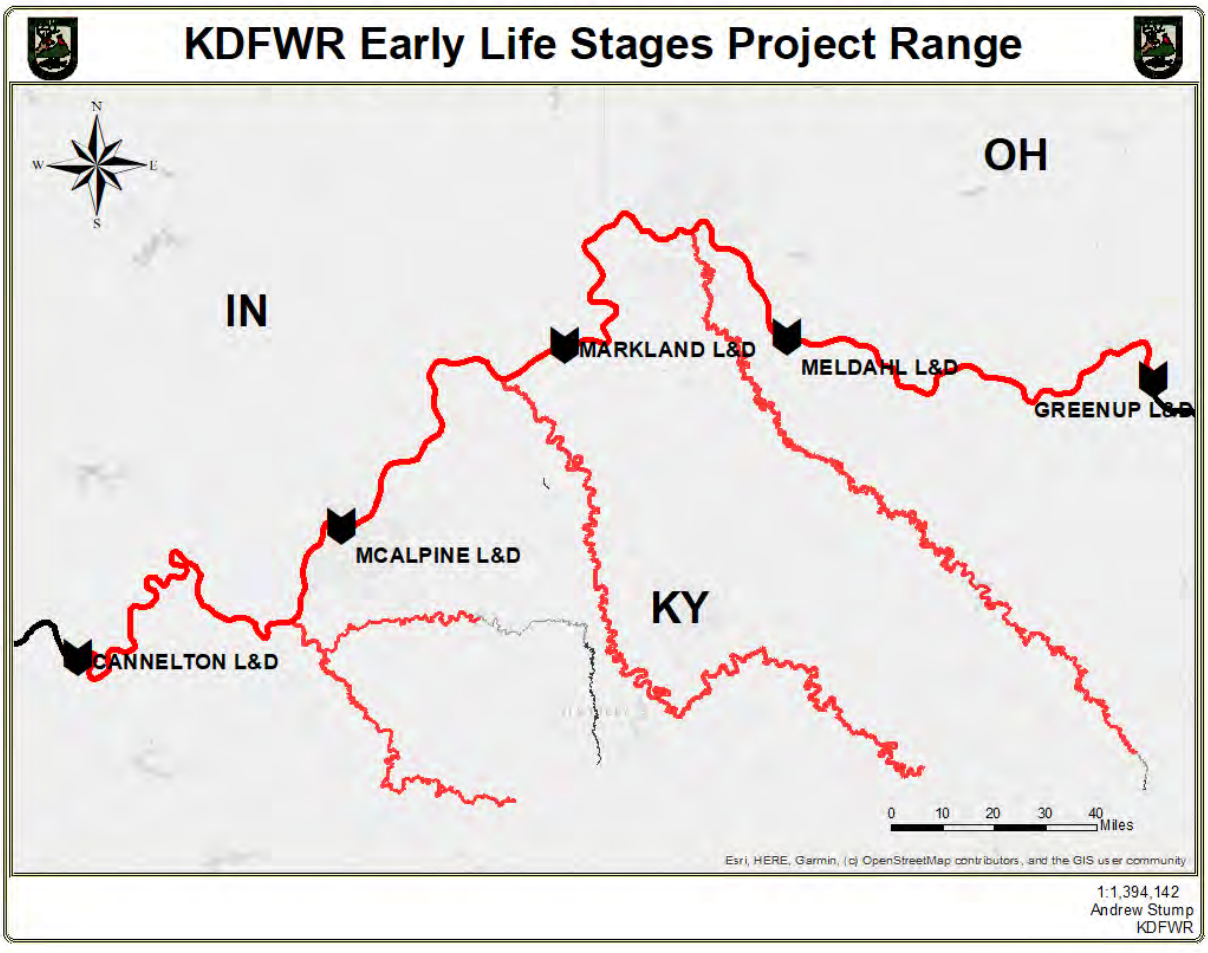
To determine the geographic extent of Asian carp recruitment in the Ohio River, KDFWR will survey the Cannelton and McAlpine pools for young-of-year (YOY) Asian carp. Because typical nursery habitat (shallow backwater areas) is less prominent in the Ohio River, flooded creek mouths, embayments, and tributaries likely serve as a substitute. Previous sampling efforts have regularly captured YOY in JT Myers Pool with occasional captures in Newburgh Pool. However, despite extensive sampling effort, YOY Asian carp have not been observed in Cannelton Pool. Suspected locations believed to be important for recruitment will be targeted with pulsed DC electrofishing during July and August. Additional gears

(trap nets, surface trawls, and seines) will be used in an effort to confirm juvenile carp presence or absence.

If juvenile Asian carp are encountered, lengths and weights will be recorded and a subsample of aging structures will be collected; Otoliths will be taken in the field from fish > 200 mm while fish < 200 mm will be frozen whole for dissection and collection of aging structures in a lab setting. A suite of habitat measurements will be collected at each site to describe both the characteristics (average depth, maximum depth, tributary width, presence/absence of woody debris, and aquatic vegetation) of the tributary as well water quality parameters (water temperature, Secchi disk visibility, conductivity, pH, dissolved oxygen). Data will be shared with INDNR for compilation with previous data to help categorize and identify areas that may provide the necessary habitat for Asian carp growth and development.

In addition to sampling, participating agencies will collaborate with other fisheries professionals to inform them to report back with any confirmed findings of juvenile Asian carp within the basin. State partners will reach out to other biologists within their respective states and if a new instance is reported, will gather data and site location information if possible. These data will be compiled by the project lead and will be used to inform future planning efforts.

Map of Project Area:



Estimated Timetable for activities:

Activity	Time Period (Season, month/year)
Search for YOY Carp in Cannelton and McAlpine pools	Summer, July – August/2020
Edits to Annual Report	Spring, March/2021
Collection of Eggs, Embryos, and Larval Fish	Spring, May – July/2021
Search for YOY Carp in Cannelton and McAlpine pools	Summer, July – August/2021
Eggs, Embryos, Larval Fish Isolated from Samples and Potential Carp Identified	Winter, December/2021
Data and Suspect Samples Sent to INDNR for Molecular Verification	Winter, January/2022
Edits to Annual Report	Spring, March/2022

Agency: West Virginia Division of Natural Resources (WVDNR)

Activities and Methods: Determine the extent of bigheaded carp spawning activity in the Ohio River above Markland Dam, WVDNR will assist and coordinate with participating agencies in conducting sampling for Asian carp eggs, embryos, and larvae in R.C. Byrd and Greenup pools. Specifically, WVDNR will assist in sampling at Kyger Creek Plant R.C. Byrd Pool and Guyandotte River in Greenup Pool.

To identify tributaries and areas in which spawning occurs, WVDNR will also conduct and coordinate sampling for Asian carp eggs, embryos, and larvae at Raccoon Creek in R.C. Byrd Pool to determine if spawning is occurring. Raccoon Creek is a highly productive tributary of the Ohio River where the majority of bighead carp are captured during targeted surveys. Several female bighead carp with mature ovaries (eggs) have been captured in this creek leading to a concern that a successful spawn could take place at this location.

Conical ichthyoplankton tows (0.76m, 500 μm mesh) will be conducted once per week at each site during ideal spawning conditions from mid-May through late-July (water temperatures 64 - 80°F with moderate to high flows). Four tows will be completed at each site; one each along the left and right descending banks, one in the mainstem and one at the water intake (power plant) or one within the tributary. For targeted tributary sites, three tows will be conducted within the tributary at least one-half mile upstream of the mouth. A single ichthyoplankton net will be deployed on the side of the boat facing upstream, with each tow lasting 3 minutes. A flow meter will be used to determine water volume sampled. Depth (m) and water temperature (°C) will be recorded using a boat-mounted depth sounder at each sampling site. All contents will be preserved in 95% ethanol for identification in the lab. WVDNR will sort ichthyoplankton samples for larval fishes and transfer those to a smaller container for shipping to INDNR for identification. Results will be used to locate spawning locations in the Ohio River Basin and thus will guide future management actions (e.g. targeted removal efforts and/or barrier placement considerations).

In addition to sampling, participating agencies will collaborate with other fisheries professionals to inform them to report back with any confirmed findings of juvenile Asian carp within the basin. State partners will reach out to other biologists within their respective states and if a new instance is reported, will gather data and site location information if possible. These data will be compiled by the project lead and will be used to inform future planning efforts.

Map of Project Area:

Estimated Timetable for Activities:

Activity	Time Period Season, month/year
Executive technical report for 2020 data	Spring, March/2021
WVDNR Larval AC Sampling	Spring, May-July/2021
WVU Larval Sampling	Spring, May-July/2021
WVU Process larval samples	Summer, July-Aug/2021
WVU Send compiled data to INDNR	Summer, Aug-Sept 2021
WVU Report to WVDNR	Fall, December 2021
Project Report Technical Document	Spring, March/2022

Literature Cited:

Chapman, D. C. and A. E. George. 2011. Developmental rate and behavior of early life stages of Bighead Carp and Silver Carp. U.S. Geological Survey Scientific Investigations Report 2011-5076. 62p.

Control and Containment of Asian Carp in the Ohio River Basin

Lead Agency and Author: Kentucky Department of Fish and Wildlife Resources (KDWFR); Andrew Stump (andrew.stump@ky.gov)

Cooperating Agencies: West Virginia Division of Natural Resources (WVDNR), Illinois Department of Natural Resources (ILDNR), Indiana Department of Natural Resources (INDNR), Southern Illinois University (SIU)

Statement of Need: Invasive species are continually responsible for undesirable economic and environmental impacts across the nation (Lovell and Stone 2005, Pimentel et al. 2005, Jelks et al. 2008). Asian carp rapidly colonize river reaches in high densities, affecting the native food webs important to ecosystem functions (Irons et al. 2007, Freedman et al. 2012) and inflicting significant impacts on recreation and natural aesthetics. The Ohio River basin (ORB) provides a broad variety of potential habitats for invasive carp, putting the entire basin at considerable risk. In response, funding has been allocated to agencies, which manage fish in the basin to limit the impacts of Asian carp where they exist, as well as halt their spread into uninhabited waters.

Tasks outlined in this document add a sixth year of multi-agency efforts to remove and contain carp populations in the Ohio River. Collaborative efforts have included large-scale removal events, consistent agency efforts to target and remove carp year-round, and an expanding contract-fishing program. The goal of this project is to slow and reverse the expansion of Asian carp populations up the Ohio River system.

Aside from state matching funds, these projects have been funded because of Congressional appropriations to the US Fish and Wildlife Service (USFWS) for purposes of working with state agencies to implement plans outlined in the ORB Framework. The USFWS has provided states across three federal regions within the ORB with funding, equipment, and staff time, and all the agencies partner to implement the ORB Framework devised in 2014. To date, basin partners have successfully established methods and locations for targeting and harvesting fish, developed a contract fishing program designed to encourage the accomplished commercial fishers to target and harvest invasive carp, and identified several hot-spots in lower density pools where fish can continually be targeted for removal.

Objectives:

1. Target and remove Asian carp to suppress populations and reduce propagule pressure in the Ohio River basin.

2. Implement a removal program using contracted fishers at intensive management zones to reduce invasive carp numbers across the Ohio River basin.

3. Develop an Ohio River Contingency Response Plan.

Agency: Kentucky Department of Fish and Wildlife Resources (KDFWR)

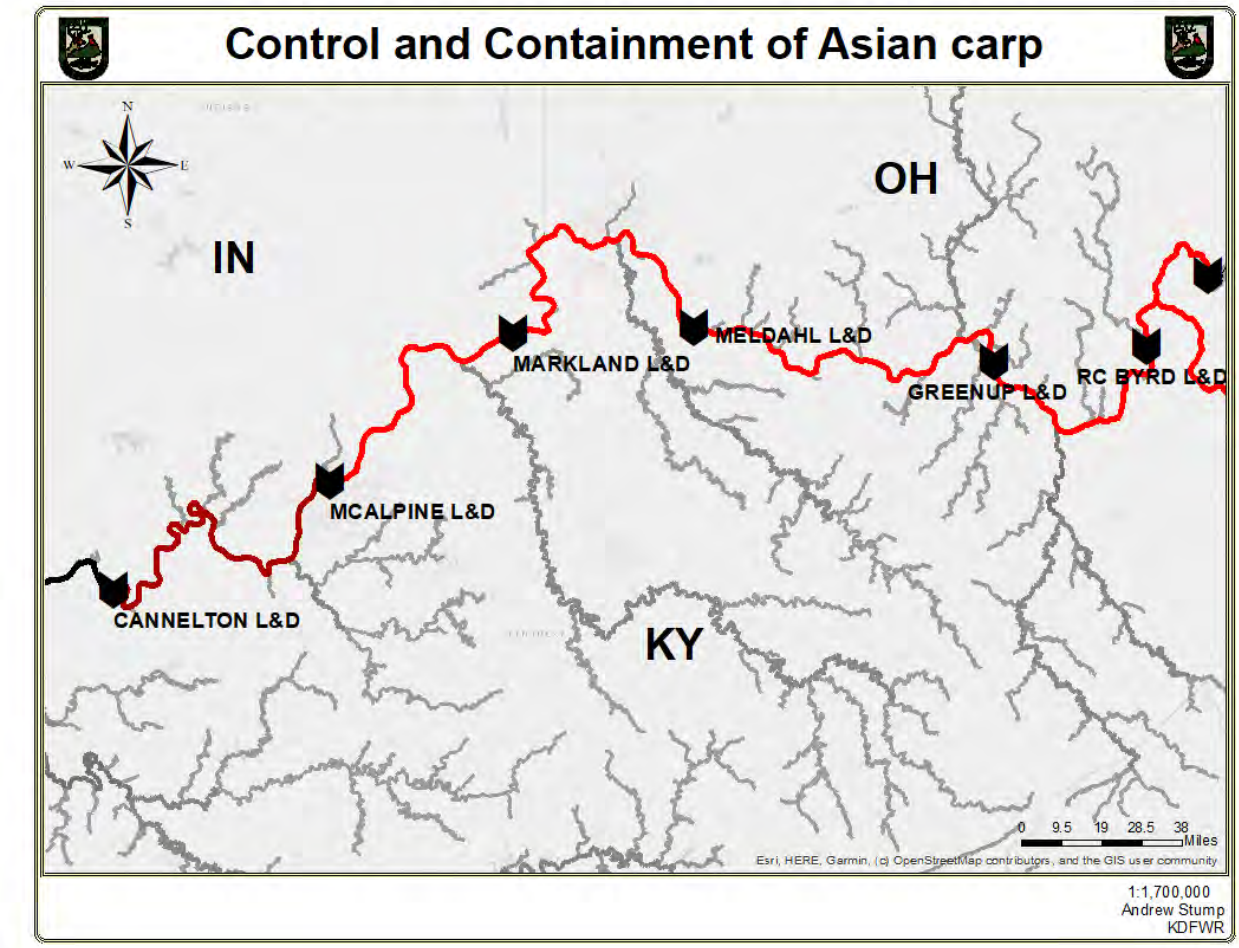
Activities and Methods: Federal funding for this project for FY2020 increased by 31% and will enable KDFWR to deploy an additional crew for all sampling, effectively doubling previous years' efforts. Congress and the USFWS require justification for funding projects. Increased removal effort will continue to lower carp numbers and further implementation of contract fishing will expand this program's ability to contain and lower upriver dispersal of invasive carp species.

Agency crews will remove Asian carps from the Ohio River for approximately 80 fishing days, focusing on known or suspected areas where fish congregate. Agency efforts will rely on pulsed-DC electrofishing and gill nets, but other gear types may be used to increase catchability depending on sampling circumstances. Information from literature, expertise of researchers, and references from contract or commercial fishers will be investigated when possible to improve yields. Samples of harvested fish will be used to provide otoliths for aging (Beamish 1981, Schrank and Guy 2002, Williamson and Garvey 2005, Seibert and Phelps 2013). All by-catch and collected fish will be identified, counted, geo-referenced, and disposition of bycatch will be noted upon release. The majority of nonindigenous carps will be euthanized upon capture, but some fish may be surgically implanted with a sonic transmitter to augment the Ohio River Telemetry Project.

Previously, agency crews have focused removal efforts in high density pools such as Cannelton and McAlpine. However, in 2019, KDFWR and INDNR implemented a contract fishing program to increase carp harvest numbers in Cannelton pool. Contracted anglers were employed to conduct regularly scheduled removal, and using a suite of special Kentucky regulations (Asian Carp Harvest Program), were given access to otherwise net-restricted waters in order to target Asian carp species. Agencies tracked daily progress using impartial, on-board observers, GPS trackers, and harvest records from angling efforts. Asian carp subsamples were taken from the harvests to record sex ratios and length distributions. In 2020, this program will be continued using contracted fishers and is expected to provide approximately 350 contract fishing days and reach a minimum benchmark of 220,000 lbs of carp harvested in the Cannelton Pool. KDFWR will track gear used, locations and conditions surrounding removal efforts, and record all bycatch information including disposition upon release.

KDFWR will finalize the ORB response plan drafted in 2018. The finalized plan will include population invasion statuses for four species of Asian carp in the ORB, high priority waters necessary of additional protection and focus, and response recommendations for changes in carp invasion statuses by pool.

Map of Project Area:



Estimated Timetable for activities

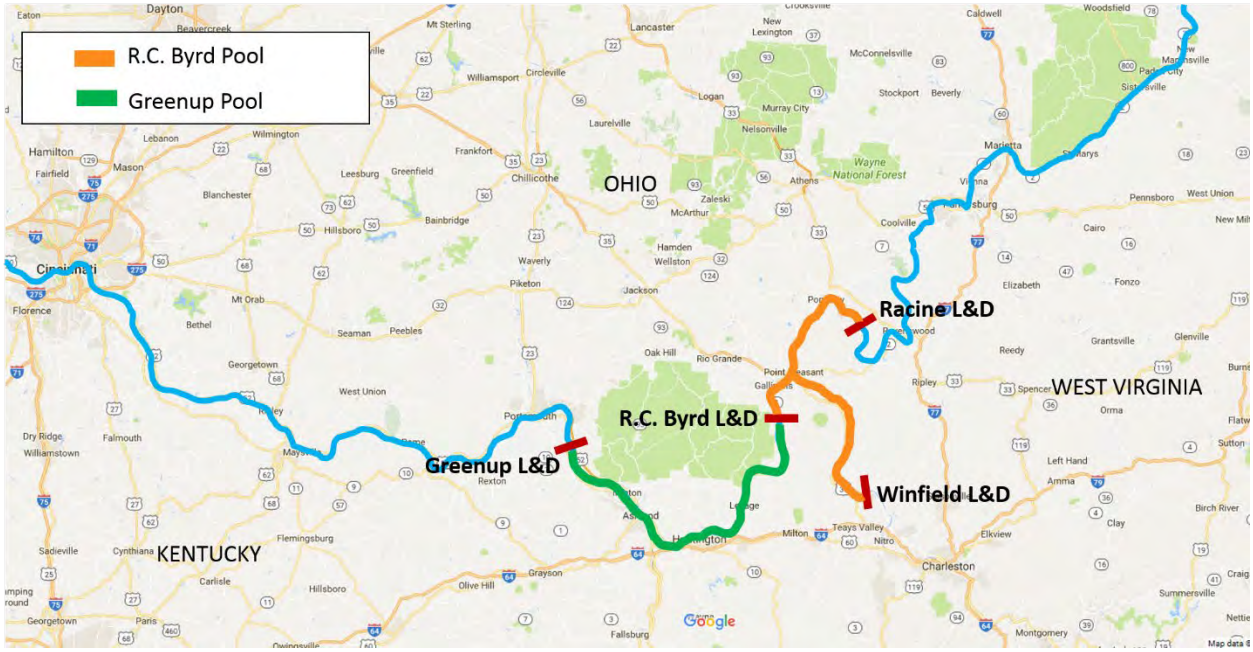
Activity	Time Period (Season, month/year)
Contract Removal in Cannelton Pool	Start Summer, July/2020 (Continue through 2021)
Agency Removal and Aid to Contract Fishers	Start Summer, July/2020 (Continue through 2021)
Final Draft of ORB Contingency Plan	Winter, January/2021
Project Report Technical Document	Spring, March/2021

Agency: West Virginia Division of Natural Resources (WVDNR)

Activities and Methods: Agency crews will remove Asian carps from of the Ohio River in the R.C. Byrd Pool of the Ohio River, focusing on known or suspected areas of occurrence (i.e. Raccoon Creek). Exact effort that can be afforded is unknown as removal events will depend on staff availability and river conditions, but a minimum of five events will be conducted. Given the nature of bigheaded carp behavior and the low population levels in this area, the number of fish removed cannot be estimated. Agency efforts will rely on pulsed-DC electrofishing and gill nets, but other gear types will be utilized to increase catchability depending on sampling circumstances. Information from the literature, expertise of researchers, and commercial anglers will be employed to investigate improvements in capturing Asian carps. Exterminated fish will be used to provide otoliths and/or pectoral fin rays for aging. All by-catch and collected fish will be identified, counted, and geo-referenced for reporting purposes. Most nonindigenous carps targeted throughout this project will be euthanized upon capture, but a few fish may be surgically implanted with a sonic transmitter to augment the Ohio River Telemetry Project.

WVDNR staff will work with KDFWR staff to finalize the ORB response plan drafted in 2018. The finalized plan will include population invasion statuses for four species of Asian carp in the ORB, high priority waters necessary of additional protection and focus, and response recommendations for changes in carp invasion statuses by pool.

Map of Project Area:



Estimated Timetable for activities

Activity	Time Period (Season, month/year)
Agency Removal in R.C. Byrd Pool	August-December 2020 (Continue through 2021)
Final Draft of ORB Contingency Plan	Winter, January/2021
Project Report Technical Document	Spring, March/2021

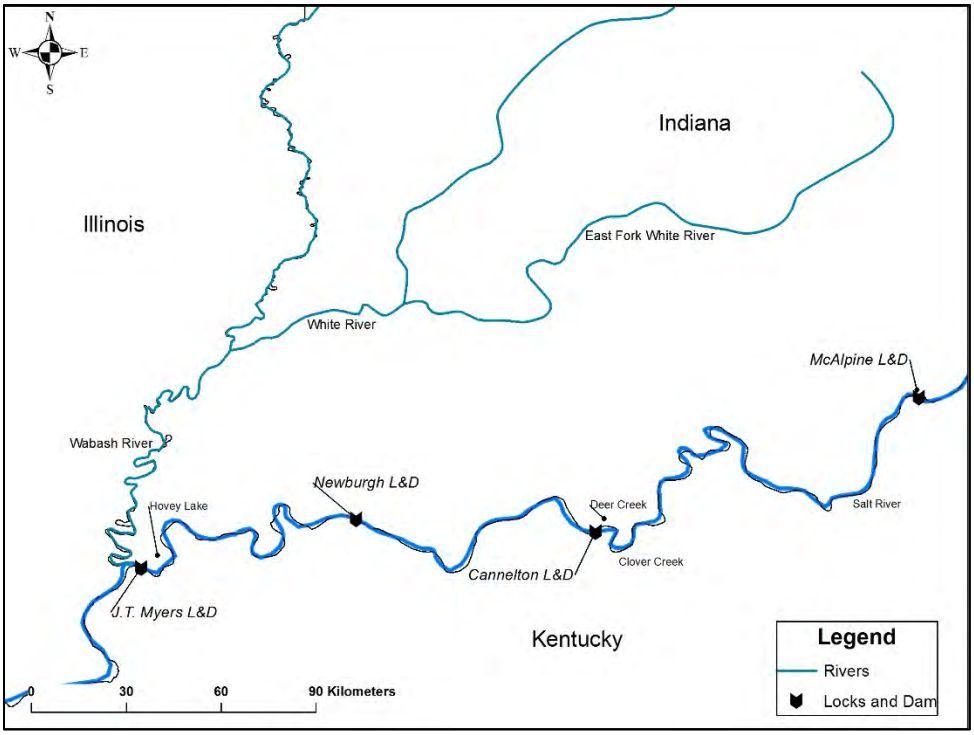
Agency: Indiana Department of Natural Resources (INDNR)

Activities and Methods: INDNR will use agency crews to target and remove Asian carp to suppress populations and reduce propagule pressure in the Ohio River basin. Crews will work with KDFWR, ILDNR, and contract fishers to conduct coordinated removal efforts in areas with large numbers of Asian carp (portions of the White, Wabash, and Ohio rivers). Agency efforts will primarily consist of pulsed-DC electrofishing and gill nets, but other gears may be utilized to increase catchability. Block nets will be used where applicable to minimize carp escapement and increase yields. All by-catch and collected fish will be identified, counted, geo-referenced, and disposition of bycatch will be noted upon release. The majority of nonindigenous carps will be euthanized upon capture, but some fish may be surgically implanted with a sonic transmitter to augment the Ohio River Telemetry Project.

INDNR will help implement a removal program using contracted fishers at intensive management zones to reduce invasive carp numbers across the Ohio River basin. In 2019, KDFWR and INDNR implemented a contract fishing program to increase carp harvest numbers in Cannelton Pool and this program will be continued into 2021. Contracted anglers will be employed to conduct regularly scheduled removal, and using a suite of special Kentucky regulations (Asian Carp Harvest Program), will be given access to otherwise net-restricted waters in order to target Asian carp species. INDNR will provide onboard observers for this program to collect daily location, harvest, bycatch, and effort data. INDNR will establish a program similar to the Kentucky Asian Carp Harvest Program to allow additional Asian carp harvest opportunities in Indiana waters. This program is anticipated to be operational in 2021 and will allow INDNR to bring contracted fishers into otherwise closed waters for the purpose of additional Asian carp harvest. INDNR will work closely with ILDNR to increase contract removal effort on the Wabash River while providing observers to collect ride-along data.

To help facilitate harvest of Asian carp, INDNR is currently determining suitable locations for ice supply houses. At least one ice supply house will be developed in the lower Ohio River and/or lower Wabash River area to make harvest and selling of Asian carp more feasible for commercial and contract fishers. Ice supply houses will be regulated in that only persons actively involved in Asian carp harvest will be permitted to use them. INDNR will consult with active Asian carp commercial fishers to determine best locations, quantities, and logistic challenges to ensure resources are fully utilized.

Map of Project Area:



Estimated Timetable for Activities:

Activity	Time Period (Season, month/year)
Staff observers for contract removal in Cannelton Pool	Start Fall, October/2020 (Continue through 2021)
Agency Removal and Aid to Contract Fishers	Start Fall, October/2020 (Continue through 2021)
Send observer data to KDFWR	Start Fall, October/2020 (Continue through 2021)
Finalize rule language to permit additional regulated Asian carp harvest in IN waters	Winter, December/2020
Finalize locations for ice houses	Start Fall, October/2020
Final Draft of ORB Contingency Plan	Winter, January/2021
Project Report Technical Document	Spring, March/2021
Increase removal and ride alongs in the Wabash River	Start Spring, March/2021
Increase agency based removal efforts in White, Wabash, and Ohio Rivers	Start Spring, March/2021
Have ice houses installed and operational	Summer 2021

Agency: Illinois Department of Natural Resources (ILDNR)

Activities and Methods: ILDNR will implement an Asian carp removal program utilizing contract fishing, enhanced contract fishing, and facilitation allowing a customized approach to removal based on local conditions to meet management objectives of increasing Asian carp removal in key locations.

Contract Fishing, where fishers will be under contract to ILDNR directly will be undertaken in late 2020 and early 2021 as necessary. These fishers, already under contract with ILDNR will be directed to fish the Wabash/White rivers in IL and IN with observers on board. As an extension of the agency, these fishers will likely fish entanglement gear (gill and trammel nets), which is currently not permitted in the Wabash River, to inform agencies on 1) carp densities, 2) efficacy of the gear in these waters, and 3) by-catch. All non-Asian carps will be enumerated and released back into the water, while all Asian carps will be disposed of through markets, processors, or landfill as needed. Fisherman will not be compensated for catch but will work 4 full days in a week as constrained by a response contract with ILDNR. Payments to contracted commercial fishers for weekly fishing is the sole use of these contract fishing funds; agency and university staff will attend these efforts under separate funding. While removal of quantities of Asian carp is desired, these efforts overall will inform managers of both Illinois and Indiana regarding future management goals and considerations.

Enhanced Contract Fishing includes payments to fishers by pounds removed and allows agencies to direct and enhance the fishing effort in places where commercial removal already exists. The current program initiated in September 2019 on the Illinois River will be expanded to include the commercial waters of the following rivers: 1) the Wabash River that runs along the borders of Illinois and Indiana from the mouth of the Ohio River to the point south of Terre Haute where it departs from Illinois; 2) Little Wabash River, 3) Embarras River, except from Route 130 in Coles County upstream to the Harrison Street Bridge, including Lake Charleston, and 4) Skillet Fork River.

Current enhanced fishing contracts will be amended to include the new water bodies referenced above and made available to any licensed Illinois and/or Indiana commercial fishers who wish to participate in the program. Contracts will provide $.10 per pound payments to be made for Asian carp caught in the authorized waters stated above and sold to processors or other buyers for a minimum price per pound (anticipated to be $.07 per pound). Prior to reimbursement, fishermen will be required to present to the program a cover sheet and receipt for each catch. Cover sheets will include fisher name, address, commercial fishing license, equipment used, catch location (by pool), affidavit, signature and date. Receipts must contain name, address, license number, catch location and date as well as buyer name and address, invoice number, listing of each species, each species weight, and price per pound.

Prior to each fishing day, fisherman will be required to notify the program of their intended fishing location and boat ramp they expect to use. A program monitor will perform frequent unannounced spot checks of reported fishing activity to verify that fishing is occurring in reported location(s). A second program monitor will make periodic unannounced visits to the area to check on overall program functioning, verification and spot check activities.

Data collected through this program will include fish weight by species, catch locations, dates and equipment used. These will be measured against hydroacoustic and other fish population analyses to determine population changes and effects of removal on population characteristics. Removal goal for Enhanced Contract Fishing for the period of performance is 1.5 million pounds of Asian carp.

Contracted Facilitation includes offloading of Asian carp catches from commercial vessels at designated shoreline locations to support increased removal where contract and enhanced contract harvest is ongoing. This effort will encompass regional river systems including: 1) Peoria Pool of the Illinois River, 2) Pools 20 - 22 of the Upper Mississippi River, 3) Wabash River, and 4) Kentucky and Barkley lakes in KY and TN. A similar contract to the Enhanced Contract Fishing program will be made available to any licensed buyer authorized to operate in Illinois (for offloading in IL) and Missouri (for offloading in MO). Companies/buyers must register in the form of a contract to pick up fish within these watersheds to be eligible for this facilitation as locations and regulations will be coordinated and customized for each management area/state/jurisdiction. Considerations for pickup locations will be coordinated with state and local managers. The companies are not restrained by where they are from, just the locations/distance they are picking up fish from target waterbodies (estimated 10 miles from shore, see below). The contract will provide payment of $.05 per pound for Asian carp offloaded from commercial fishers while funds are available and/or additional funds refreshed recognizing constraints if too many fish come in during one funding cycle.

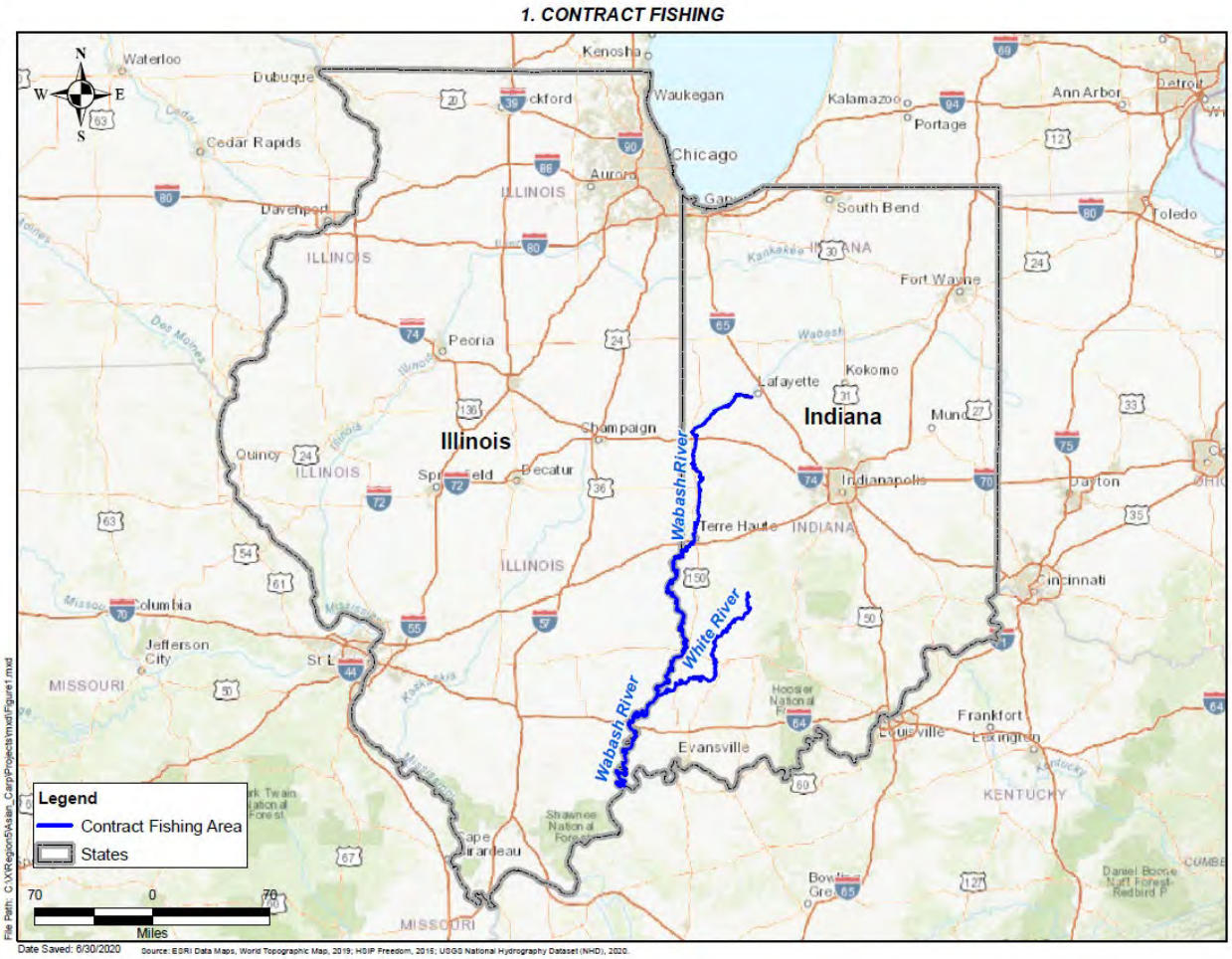
Payment will be made for fish caught in commercial waters associated with the shoreline location. These locations will be established on or near the referenced water bodies above and will be required to be pre-approved by the program prior to use. Locations may be established at public boat launches and may be up to an anticipated 10 miles from the shoreline. Buyers will be required to pay the same minimum price established for the Enhanced Contract Fishing program, and will be required to present copies of receipts for Asian carp purchased at a designated location. These receipts must contain the same information as for the Enhanced Contract Fishing program and will be required to be accompanied by a similar cover sheet.

Prior to pick up, the buyer will be required to notify the program of the intended pick-up location and (if applicable) license plate of the truck to be used. A program monitor will perform frequent unannounced spot checks of reported pick-up activity and a second program monitor will make periodic unannounced visits to the area to check on overall program functioning, verification and spot check activities.

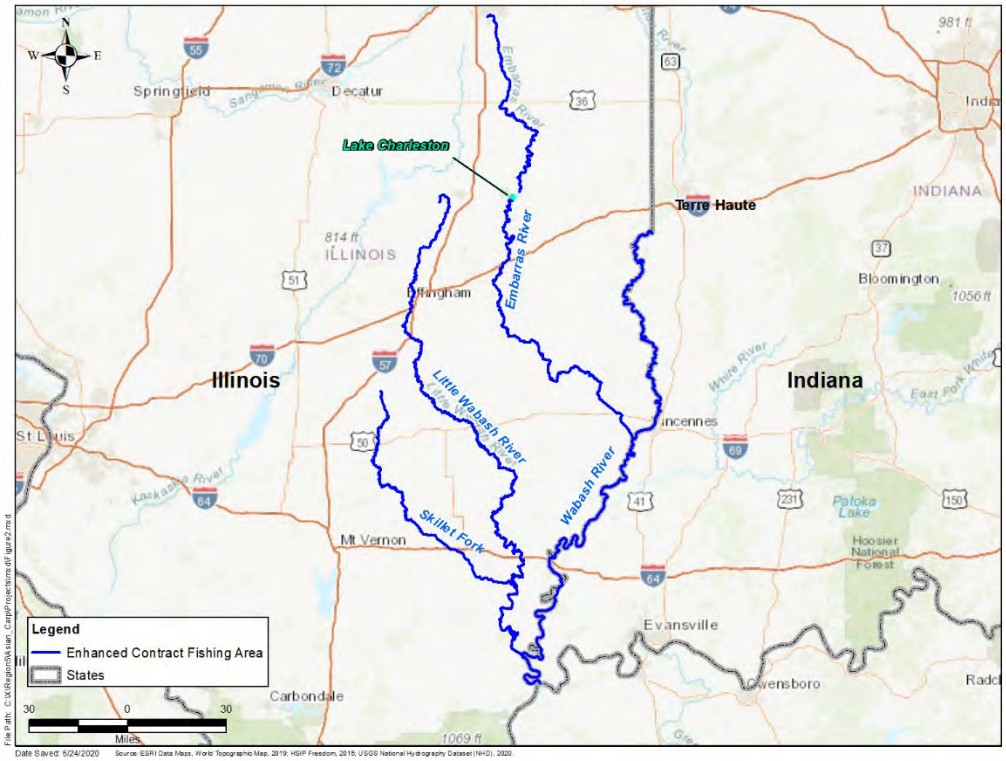
Facilitation efforts under this program are complementary and additive (but not redundant) to contract fishing efforts identified in the Asian Carp Regional Coordinating Committee Action Plan as well as ongoing state Asian carp removal programs including Tennessee Wildlife Resources Agency Asian Carp Harvest Incentive Program and KDFWR Asian Carp Harvest Program. Contracted Facilitation is a proof of concept for which design and scope are critical to evaluation and application in the future. Removal goal for Contracted Facilitation for the period of performance is 5 million pounds of Asian carp.

This project will support SIU's efforts to evaluate contracted facilitation as a method of increasing Asian carp harvest to increase ability to manage/reduce the invasive species while informing future investments in these basins and others. Data collected will not duplicate data collected in the Enhanced Contract Fishing program, though will include the same information of fish weight by species, catch locations, dates and equipment used. These will be measured against hydroacoustic and other fish population analyses to determine population changes and effects of removal on population characteristics.

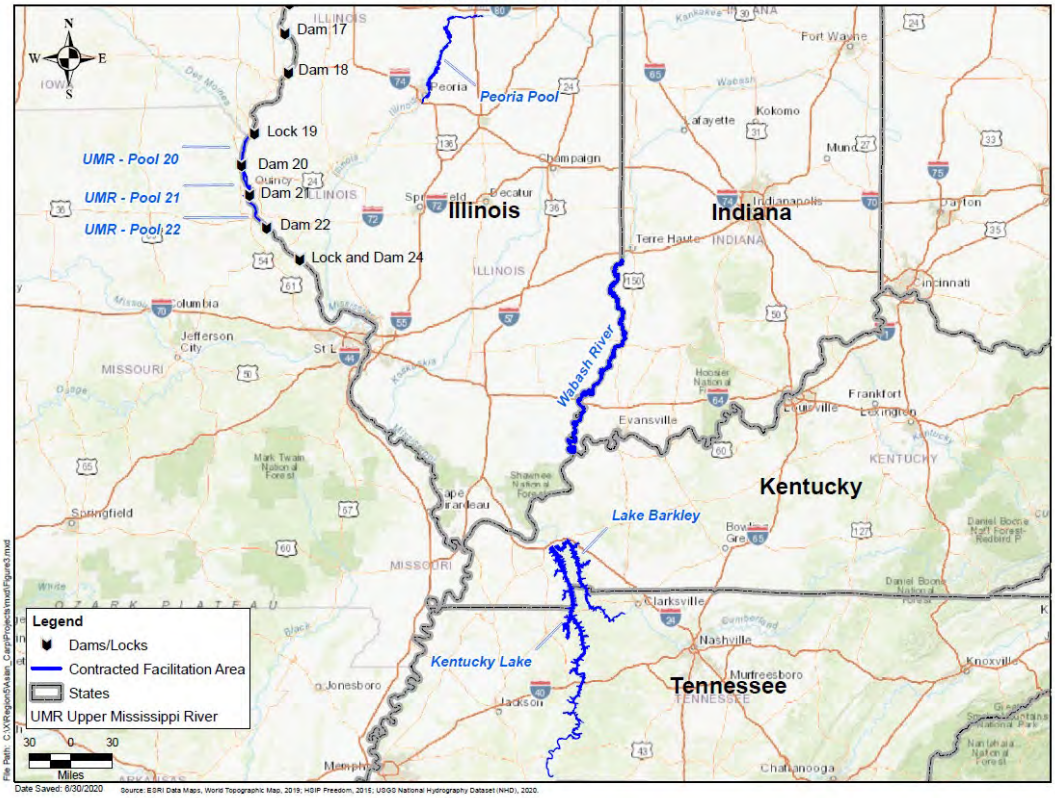
Maps of Project Areas



2. ENHANCED CONTRACT FISHING



3. CONTRACTED FACILITATION



Estimated Timetable for Activities

Activity	Time Period (Season, month/year) *
Contract Removal	Start October 2020 (Continue through March 2021)
Enhanced Contract Removal	Set-Up September through November 2020; Start December 2020 (Continue through 2021)
Contracted Facilitation	Set-Up September through November 2020; Start December 2020 (Continue through 2021)

* Timelines subject to funding availability and participation in contracts.

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Relative Population Densities of Asian Carp in the Tennessee River and Cumberland River, Tributaries of the Ohio River

Lead Agency and Author: Tennessee Wildlife Resources Agency (TWRA); Mark Rogers, TTU/USGS, (mwrogers@tntech.edu)

Cooperating Agencies: Kentucky Department of Fish and Wildlife Resources (KDFWR), Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP), Alabama Department of Conservation and Natural Resources (ADCNR), Tennessee Tech University (TTU)

Statement of Need: Adult bigheaded carp (that include Silver Carp and Bighead Carp; hereafter "bigheaded carp" have been collected in the Tennessee and Cumberland rivers (tributaries to the Ohio River) for the last ten to fifteen years. These waterways are multi-jurisdictional and include waters within Kentucky, Tennessee, Mississippi, and Alabama. Thus, Asian carp invasion is a threat to multiple agencies and the valuable sport fisheries and ecosystems in their respective states. Asian carp reports suggest increasing immigration upstream in both systems, however there are many uncertainties regarding their abundance, their movement rates and timing, and if they are reproducing within the rivers. Master's theses completed in 2016 and 2018 were the first rigorous evaluation of relative abundance and age and growth of Silver Carp and Bighead Carp in Kentucky and Barkley reservoirs. Currently, sub-basin agencies and universities are collaborating to enhance that preliminary work by surveying relative densities to inform control needs. The proposed projects described below will fill knowledge gaps necessary for understanding the distributions and habitat use of Asian carp populations in the Ohio River sub-basin, the extent of spawning occurring within the systems, movement within the systems, and will provide better life history and population dynamics data for informing Tennessee River specific-models that are being applied in the Ohio River and other basins for estimating control needs and invasion impacts.

In 2017, TTU commenced standardized, systematic sampling on Kentucky, Barkley, Cheatham, and Pickwick reservoirs to evaluate relative densities of Asian carp using gill nets and electrofishing. This project will fund another year of systematic sampling conducted in spring, summer, and fall at those reservoirs.

This ongoing work also aims to increase samples used to characterize populations (e.g., age and growth analysis). TWRA and KDFWR commenced inter-agency carp sampling in spring 2019. In 2020, TTU will work with those agencies to continue sampling but work to further support those agencies' needs on Asian carp populations in the Tennessee and Cumberland rivers so that data collection and timing are more comparable.

Objectives:

The purpose of the project is to collect demographics data from systematic, fisheries-independent data.

1. Conduct systematic sampling for the purpose of surveillance, early detection, distribution, and relative population characteristics of Asian carp in the Tennessee and Cumberland rivers.

2. Asian carp surveillance and directed sampling in the Tennessee and Cumberland rivers that includes larval sampling and collaboration for controls and monitoring.

Agency: Tennessee Wildlife Resources Agency (TWRA)

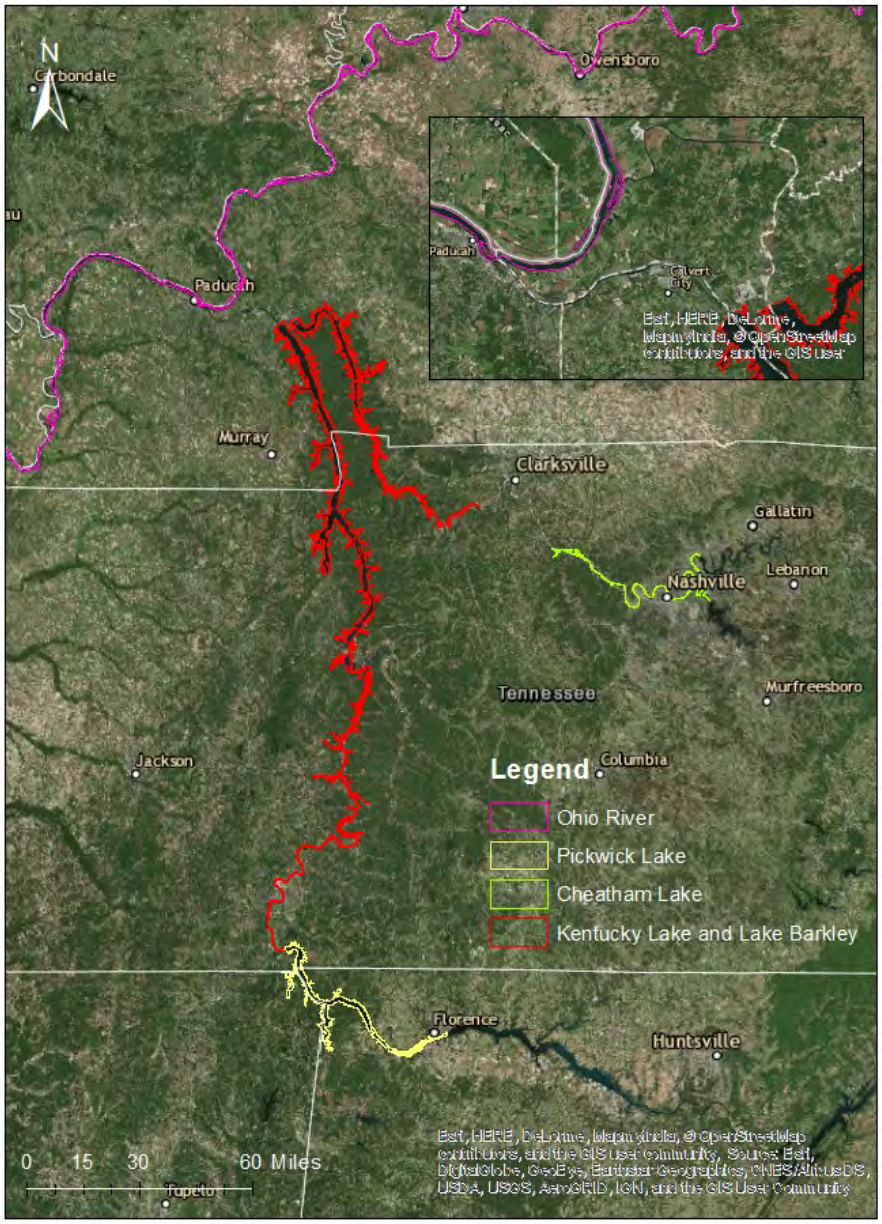
Activities and Methods: Multi-season sampling with gill nets and electrofishing will be used to evaluate relative abundance and density of adult Asian carp in Kentucky, Barkley, Cheatham and Pickwick reservoirs. Experimental gill nets will consist of panels measuring 3 inches to 5 inches (bar measure) of 8-ply twisted monofilament mesh. These nets were chosen following discussion with commercial fishers that target Asian carp to maximize retention and minimize gear destruction. Gill net soak times will be over-night sets after seeing improved catches relative to short (2-hour) net sets. Three gangs will be set in each study area within each reservoir and gillnetting sampling season (see below). Summer sampling will utilize an electrified dozer trawl to capture fish and possibly detect young-of-year in late summer. All electrofishing will use pulsed-DC current (5-8 Amps, 535 Volts, 120 pulses per second). Survey sites will be stratified by lake area (e.g., downstream versus upstream) following the study design from previous years (see Maps 1 and 2). Three strata in Kentucky and Barkley reservoirs where abundances are higher than in Cheatham and Pickwick reservoirs, which will have two spatial strata. Dozer trawl transects will have fixed time periods (e.g., 900 seconds); all collected fish will be identified, and length and weight taken; otoliths will be taken from a subsample of collected fish in each length bin to allow later extrapolation to an age-length key. Target otolith sample sizes will be 10 fish per two inch length group. Sampling will enhance estimates of total mortality and survival for these reservoirs, which is a needed input for population models and stock assessment. Sex-ratio and a gonadosomatic index (female gonad weight to body weight ratio) data will continue to be collected to help inform population models and potential spawning time.

Sampling gears, locations, and timing of deployments for all objectives will be adapted to seasonal water temperatures to ensure minimal mortality of bycatch, valuable sportfish, and no detrimental effects to endangered species or valuable landscape features.

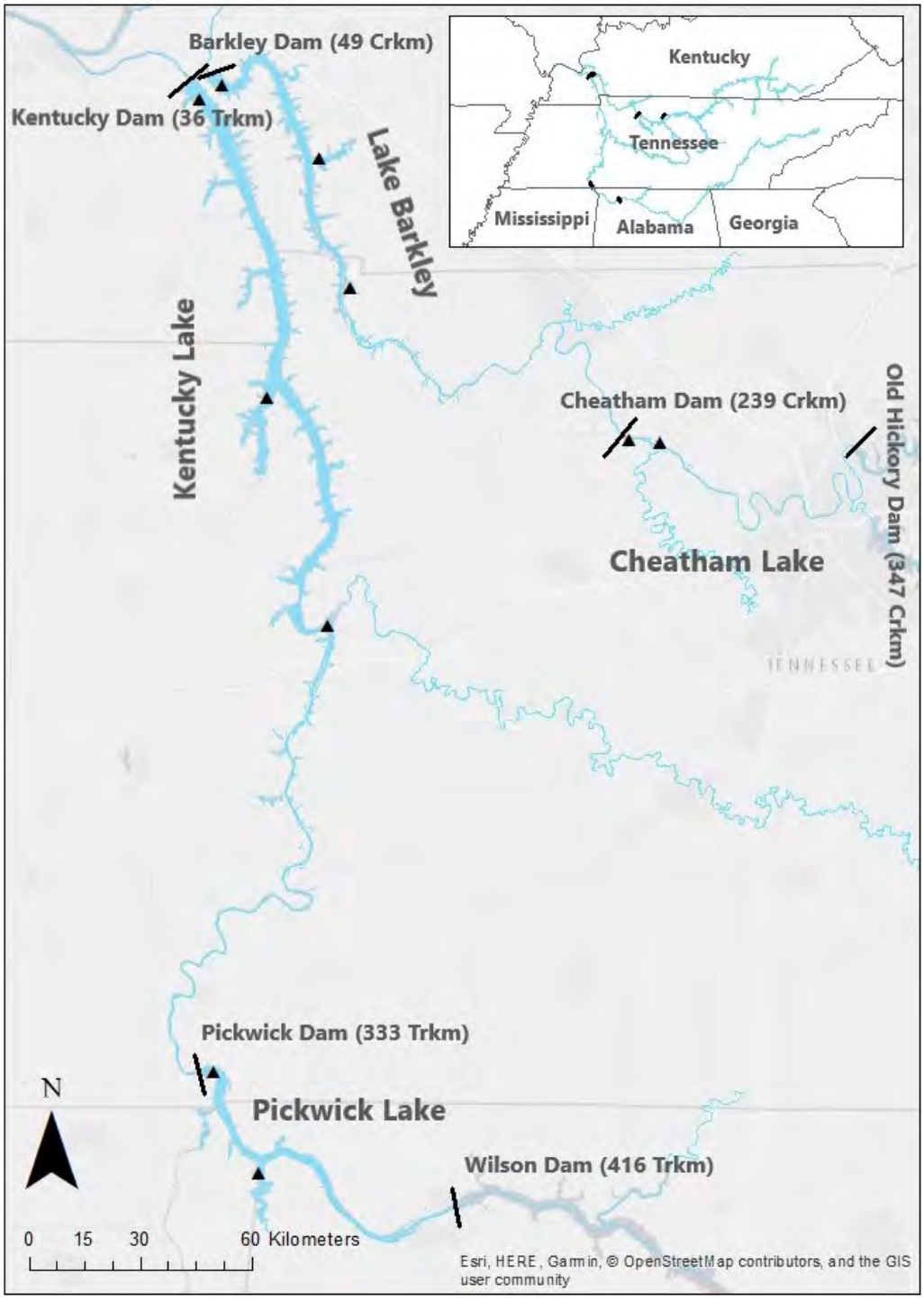
Estimated Timetable for Activities

Project Activity	Reservoir	Month	Year
Gill Netting	Kentucky, Barkley, Cheatham, and Pickwick	Spring (May-June), Fall (October-November)	2020 and 2021
Adult Density Electrified Dozer Trawling	Kentucky, Barkley, Cheatham, and Pickwick	Summer	2020 and 2021
Final Report		Spring	2022

Map of Project Area:



Map 1. Proposed reservoirs for measuring relative density and population characteristics of Asian carp in the Tennessee River and Cumberland River.



Map 2. Standardized, systematic sampling areas for measuring relative density and population characteristics of Asian carp in the Tennessee River and Cumberland River. Sampled reservoirs include Barkley, Kentucky, Pickwick, and Cheatham.

Deterrent Strategy Planning for Asian Carp in the Ohio River Basin

Lead Agency and Author: Tennessee Wildlife Resources Agency (TWRA); Mark Rogers, TTU/USGS (mwrogers@tntech.edu)

Cooperating Agencies: Kentucky Department of Fish and Wildlife Resources (KDFWR), Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP), Alabama Department of Conservation and Natural Resources (ADCNR), US Army Corps of Engineers (USACE), Tennessee Valley Authority (TVA), Murray State University (MSU), Tennessee Technological University (TTU), US Geological Survey (USGS), US Fish and Wildlife Service Carterville Fish and Wildlife Conservation Office (CFWCO).

Statement of Need: Adult bigheaded carp have invaded the Ohio River and its tributaries including the Tennessee and Cumberland rivers. Increased interest and efforts to install deterrents to minimize invasion are increasing, but rely on abundance and movement data to inform decisions on placement and baseline data to inform effectiveness.

Within the Ohio River, movement data have been collected to inform pool-to-pool movement and estimate trade-offs between deterrent location, deterrent effectiveness, and removal efforts for population control. Increased data within the Ohio River would further support these evaluations. In the Tennessee and Cumberland rivers, baseline movement and lock and dam passage data are at initial phases of collection and critical to understanding deterrent location and deterrent effectiveness.

Adult bigheaded carp have been recognized in the Tennessee and Cumberland rivers (tributaries to the Ohio River) for the last ten to fifteen years, but a high recruitment event in 2015 (believed to be immigrants from the Ohio River) caused a large increase in abundance within the systems. These waterways are multi-jurisdictional and include waters within Kentucky, Tennessee, Mississippi, and Alabama. Thus, Asian carp invasion is a threat to multiple agencies and the valuable sport fisheries and ecosystems in their respective states. Asian carp reports suggest increasing immigration upstream in both systems, however there are many uncertainties regarding their abundance, their movement rates and timing, and if they are reproducing within the rivers. A Master's Thesis completed in 2016 was the first rigorous evaluation of age and growth of Silver Carp and Bighead Carp in Kentucky and Barkley reservoirs. Currently, sub-basin agencies and universities are collaborating to enhance that preliminary work by surveying relative densities to inform control needs, monitor movements through locks and dams to inform lock management and deterrent barriers, and determine if natural recruitment is occurring in the reservoirs. The proposed projects described below will fill knowledge gaps necessary for understanding movement within the Ohio River tributaries and lock and dam passage. Data will inform Tennessee River specific-models that include movement and control needs as are being applied in the Ohio River.

Efforts to understand and control Asian Carp in the Tennessee River and Cumberland River have increased recently and federal funding has the ability to further enhance control and management capabilities. Murray State University and KDFWR have implanted over 150 Silver Carp with acoustic transmitters and engaged in active and stationary tracking of movements. MDWFP and TTU have also tagged over 75 Silver Carp in Kentucky and Pickwick reservoirs and deployed

stationary receivers for detecting Asian carp movements through lock and dams. Increasing the number of tagged fish in the systems will provide more precise information on invasion rates and timing to help inform barrier needs and efficacy.

The project will support goals and strategies of the sub-basin framework including prevention and monitoring and response. The specific strategy supported is to evaluate the use of deterrent barriers at strategic locations to limit further dispersal of Asian carp in the Ohio River basin.

Objectives:

1. Characterize the need for deterrents and evaluate priority locations for deterrent placement to control movement of Asian Carp in the Tennessee and Cumberland rivers.

2. Collect baseline movement information among reservoirs to inform Asian carp deterrent efficacy and lock and dam passage.

Agency: Tennessee Wildlife Resources Agency (TWRA)

Activities and Methods: Required methods support monitoring, maintenance, and increasing capacity for acoustic telemetry movement data for Asian carp. Receivers will be monitored and maintained on a seasonal frequency, preferably every two months, depending on flows and river conditions. Vemco telemetry receivers are in place at all locks and dams in the Tennessee River from Kentucky Dam to Guntersville Dam to inform movement among locks and dams and across reservoirs. Receiver downloading and maintenance is a multi-state effort by KDFWR, TWRA, TTU, MDWFP, and ADCNR. A focused effort to increase the number of tagged Asian carp in the upper end of Kentucky Lake occurred in 2017,2018, and 2019. TTU crews worked with TWRA and MDWFP to tag fish in upper Kentucky Reservoir and in Pickwick Reservoir. Tagging requires catching fish in good condition to have certainty of survival, and thus, very short set gill nets (e.g., 20 minutes) and electrofishing have been used to capture fish during cool water conditions. Fish are treated for minimal handling effects including electro-anesthesia and immediate release. Efforts to tag fish on the leading edge of invasion at upstream locks and dams (e.g., Pickwick Dam and Cheatham Dam) will allow execution of tagging; if sufficient numbers of fish (minimum number of 50) are not captured then more tags will be implanted at local proximity areas. The number of fish tagged will be increased in 2020 and 2021 to help further inform movement through locks and dams. Collaboration with USGS partners in 2020 and 2021 will enhance movement information and modelling to inform deterrents in the Tennessee and Cumberland river systems.

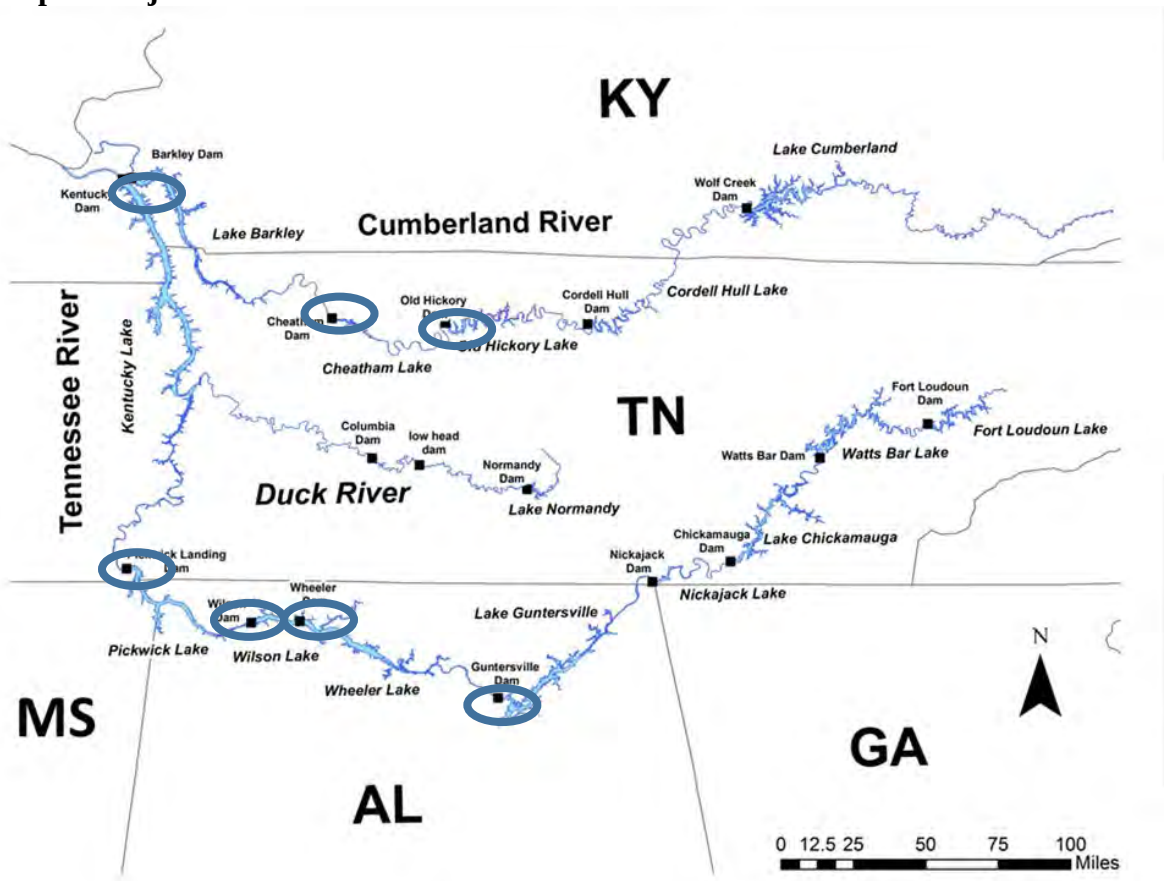
Data will be evaluated to determine conditions that allow fish passage through locks (e.g., time of year) or how and when deterrents could best limit further upriver movements through locks and dams. Previous data shows individual fish moving through Pickwick Dam, however no passage at Wilson Dam, and Wheeler Dam has been detected. A Tennessee River acoustic telemetry network of biologists has been established to facilitate communication of receiver locations and positive tag detections and the network is in communication with Asian carp telemetry collaborations in the Mississippi River and other basins to facilitate data sharing.

Implementation of this project will not jeopardize the continued existence of any federally listed threatened or endangered species, or critically designated habitat. The purpose of this project is to conduct routine sampling and monitoring of Asian carp and the fish communities they inhabit in the Ohio River watershed. No federally threatened/endangered fish, wildlife, or plant species will be impacted as a result of actions set forth in this project proposal. All sampling methodologies and techniques employed will be scientifically sound and the experimental designs shall be substantial in character and design.

Estimated Timetable for Activities

Project Activity	Reservoir	Month	Year
Acoustic Tag implantation	Kentucky, Barkley, Pickwick and Cheatham reservoirs	water temperature dependent	fall 2020 and spring and fall 2021 (until all tags are at-large)
Acoustic Receiver deployment and maintenance	Kentucky, Pickwick, Wilson, Wheeler, Cheatham, Old Hickory	Seasonally (bi-monthly as feasible) or as needed for maintenance	2020 and 2021
Data summarization/reporting	TNCR	quarterly updates in congruence with data downloads	2021

Map of Project Area:



Map 1. The Tennessee River and Cumberland River locks and dams (circled) that are monitored using acoustic telemetry receivers to measure Asian carp upstream invasion.

Agency: Murray State University (MSU)

Activities and Methods:

Efficacy of consistent Asian carp harvest efforts below Kentucky Dam as a deterrent to passage

MSU will partner with KDFWR, the USGS, and multiple research agencies to assess consistent Asian carp harvest efforts below Kentucky Dam as deterrence to dam passage. MSU will work with research entities and KDFWR to experiment with a variety of Asian carp harvest gears and methods to efficiently and consistently harvest Asian carp from the tailwater below Kentucky Dam, and to assess if consistent effort will create a deterrence to the invasive fishes' movement into Kentucky Lake. The USGS has proposed to work with MSU and KDFWR to study Asian carp movements towards and below Kentucky Dam pertaining to periodicity and water conditions, and the fishes' behavior in the presence of consistent removal efforts. MSU will coordinate efforts with the USGS and provide pertinent information to the USGS regarding removal efforts that may impact telemetry study results. MSU will be the principal investigator for Asian carp harvest efforts and will collect data associated with factors that affect harvest efficiencies. Water quality data will be collected by all participating entities to provide a better understanding of river conditions that compel Asian carp movements towards and through the

dam. This research project will provide important insight for harvest potentials below dams and will provide guidance to fishers or agencies attempting to target and remove Asian carp in tailwater habitats across the Mississippi River basin. Additionally, in the process of conducting this research, it is expected that several million pounds of Asian carp will be removed annually from below Kentucky Dam, thereby reducing propagule pressure that is unimpeded to date.

Asian Carp Movement Information: Tennessee and Cumberland Rivers
MSU will conduct tracking of tagged Asian Carp within Kentucky and Barkley lakes to determine diurnal movements, distances traveled, and habitat usage. Manual tracking effort will be increased substantially to better inform fine scale movements of Silver Carp in Kentucky Lake. Additional silver carp in Kentucky Lake will be collected and surgically implanted with transmitters for this study. MSU will conduct analysis on information downloaded from stationary receivers in the TNCR basin by KDFWR and will provide associated reports.

Estimated Timetable for Activities:

Project Activity	Location	Month	Year
24hr manual tracking	KY Lake	Seasonally	2020-2021
24hr manual tracking	Lake Barkley	Seasonally	2020-2021
Receiver Deployment	Tennessee River	as needed	2020-2021
Receiver Deployment	Cumberland River	as needed	2020-2021
Implantation of Transmitters	Kentucky Lake	Seasonally	2020-2021
Contracted Removal as Deterrent	Kentucky Dam Tailwaters	As contractor is available	2020-2021
Project Technical Report	N/A	February	2021

Agency: Kentucky Department of Fish and Wildlife Resources (KDFWR)

Activities and Methods: Federal funding for FY2020 towards this project increased significantly and will not only assist KDFWR with expenses previously unfunded by federal monies, but will allow increased agency effort towards the objectives.

Efficacy of consistent Asian carp harvest efforts below Kentucky Dam as a deterrent to passage
Kentucky will provide support to MSU for assessing consistent Asian carp harvest efforts below Kentucky Dam as deterrence to dam passage. The USGS has proposed to work with KDFWR and MSU to study Asian carp movements towards and below Kentucky Dam pertaining to periodicity and water conditions, and the fishes' behavior in the presence of consistent removal efforts. KDFWR will assist with surgically implanting Asian carp with sonic transmitters, deploying stationary receivers, collecting data from the receivers, and support MSU contracted carp harvest efforts. The USGS will be responsible for telemetry data analysis and producing summaries regarding tagged fish movement in the tailwaters of Kentucky Dam. Water quality data will be collected by all participating entities to provide a better understanding of river conditions that compel Asian carp movements towards and through the dam. This research

project may provide better understanding of Asian carp movements and presence near dams in general and will provide important insight for harvest potentials below dams.

Characterizing the Need for, and Placement of, Deterrents
KDFWR will participate in annual meetings with collaborating agencies to provide updates on the distribution of Asian Carp populations, identify available deterrent methods, and prioritize installation and maintenance of deterrents. The product of these meetings will be to identify and make necessary changes to the prioritized list of where deterrents to Asian carp movement are needed. Deterrent placement will be characterized by locations that will strategically reduce the potential of Asian carp expansion upstream in the Ohio, Tennessee, and Cumberland rivers. Locations for field testing of available deterrent strategies will also be determined.

Asian Carp Movement Information: Ohio River
KDFWR continues to work with multiple agency partners to monitor the pool-to-pool movements of Asian carp in the middle Ohio River. Movements of Asian carp among pools and comparisons of the possible open river conditions at various Locks & Dams will be used to determine the best options for the placement of Asian carp deterrent technologies.

Asian Carp Movement Information: Tennessee and Cumberland Rivers
KDFWR will continue partnering with MSU to conduct tracking of tagged Asian Carp within Kentucky and Barkley lakes to determine diurnal movements, distances traveled, and habitat usage. Resolution of the VEMCO stationary receiver array will also be improved, primarily around Kentucky Lock and Dam and the canal connecting Kentucky and Barkley reservoirs. Additional receivers will provide a more accurate depiction of telemetered fish passage which will be used to further advise potential deterrent placements. These efforts are being expanded to the larger Tennessee and Cumberland river basin. Passage of Asian carp through lock chambers on the Tennessee and Cumberland rivers is also being assessed. In order to quantify fish passage and ultimately assess deterrence strategies in these river systems, tagging of additional Asian carp and placement of supplementary receivers is essential.

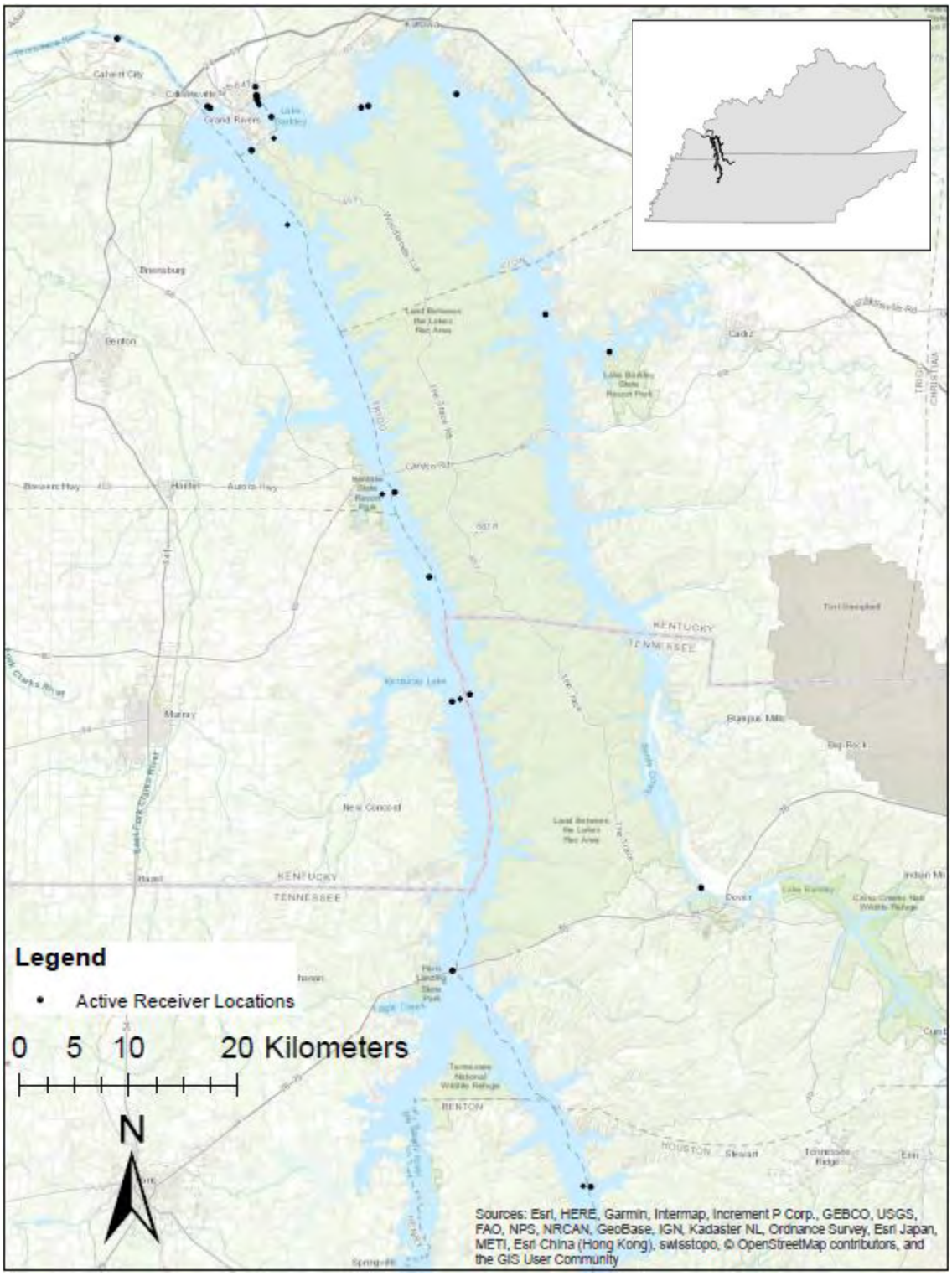
Collection of Baseline Data to Inform Deterrent Efficacy
KDFWR is engaged in assisting the CFWCO with testing of a Bio-Acoustic Fish Fence (BAFF) technology on the downstream approach to Lake Barkley Lock chamber (Map 4). In spring and fall, KDFWR will tag an additional 75 bigheaded carp below the lock structure with VEMCO transmitters. Some native fish species will also be implanted with VEMCO acoustic transmitters to assess movement around and through the lock structure throughout testing of the BAFF system. These will include 20 smallmouth buffalo, 20 paddlefish, and 20 freshwater drum in spring and fall of 2020. Fish will be collected by electrofishing and gill netting, and then surgically implanted with transmitters. All VEMCO telemetry receivers will be maintained and data collected monthly. Analysis of data collected in the Kentucky portions of the Tennessee and Cumberland rivers will continue to be a joint effort with Murray State University. Receiver locations, acoustic tag numbers, and data collected will be promptly communicated to project partners. Data collected by all partner agencies will be analyzed to determine when fish passage through lock chambers is greatest and how deterrents could best be utilized on the Tennessee and Cumberland rivers.

KDFWR will provide assistance for monitoring the efficiency of the BAFF at deterring Asian carp movement through the lock structure and its effect on native fish species after installation. KDFWR staff will lead efforts to implant silver carp with acoustic transmitters from HTI. The number of fish implanted and timing of efforts will be determined by the BAFF research group. The HTI 3-D movement detection system requires an array of receivers around Barkley Dam. KDFWR will assist with deployment of receivers and maintenance of the receiver array throughout the study. The equipment associated with the BAFF is contained in two conex containers on Barkley Lock. KDFWR will perform maintenance on the equipment onsite including changing filters, monitoring oil levels, and adjusting pressure released by the air compressor as needed. The BAFF research team has study design requiring the BAFF to be turned on and off at weekly intervals, of which KDFWR will be responsible and of keeping records for other activities associated with BAFF maintenance and oversite. To prevent damage to the BAFF, a fishing and boating restriction zone has been defined in KDFWR regulations which includes the lock canal approaching the system (Evaluation of a Bio-Acoustic Fish Fence (BAFF) at Barkley Lock and Dam: Study Design, USFWS).

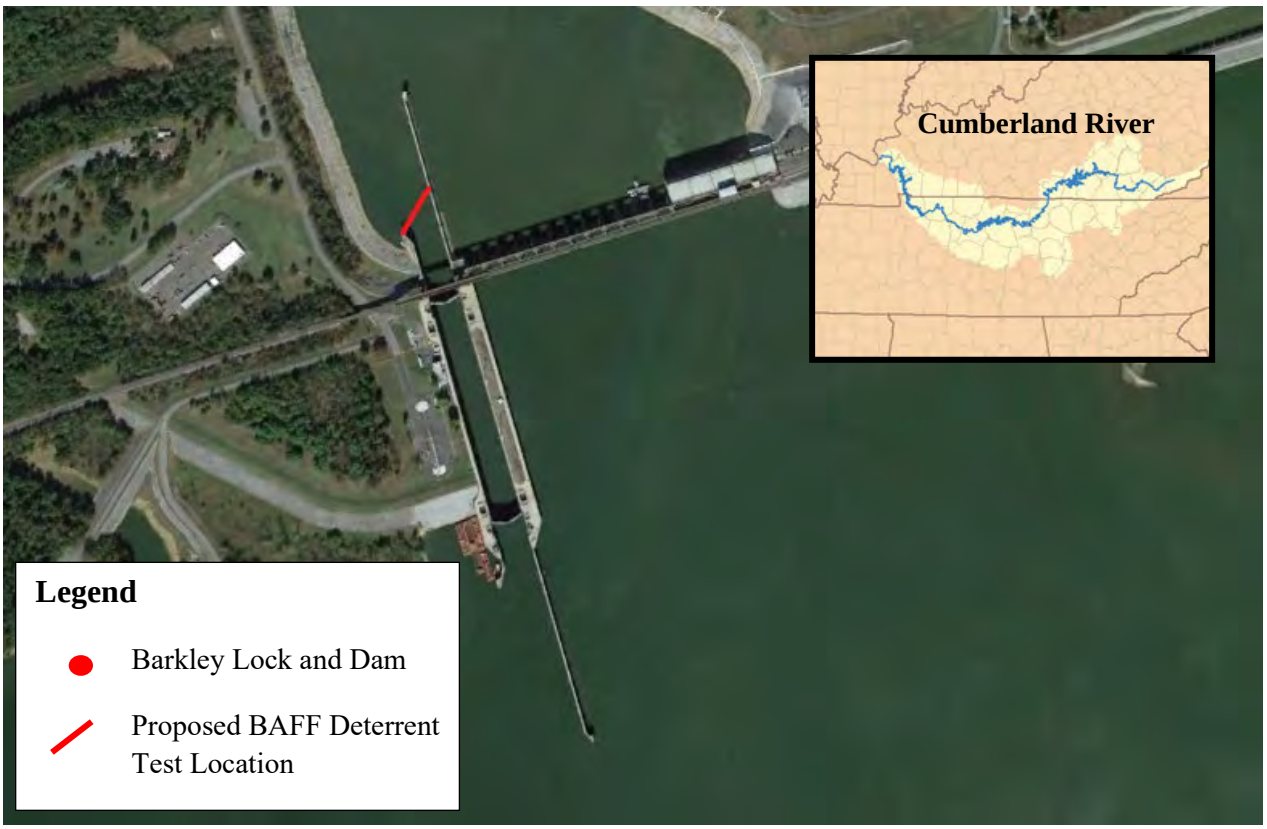
Estimated Timetable:

Project Activity	Location	Month	Year
24hr manual tracking	KY Lake	Seasonally	2020-2021
24hr manual tracking	Lake Barkley	Seasonally	2020-2021
Receiver Deployment	Tennessee River	as needed	2020-2021
Receiver Deployment	Cumberland River	as needed	2020-2021
Implantation of Transmitters	Barkley Dam Tailwaters	March, April, October, November	2020-2021
Downloading of Receivers	Kentucky Lake & Lake Barkley	Bi-Monthly	2020-2021
Downloading of Receivers	Kentucky Lock & Dam, Barkley Lock & Dam, Tailwaters	Monthly	2020-2021
Assist with Contracted Removal as Deterrent	Kentucky Dam Tailwaters	As contractor is available	2020-2021
Project Technical Report	N/A	February	2021

Map of Project Area:



Map 1. Stationary receiver locations in Tennessee and Cumberland rivers that are maintained by KDFWR to measure Asian carp upstream invasion.



Map 2. Location of Bio-Acoustic Fish Fence (BAFF) deterrent system being tested at Lake Barkley Lock and Dam on the Cumberland River. Kentucky Department of Fish and Wildlife Resources assists with equipment maintenance, telemetry array, and monitoring of system effectiveness.

Quantifying Lock and Dam Passage, Habitat Use, and Survival Rates of Asian Carp in the Ohio River Basin

Lead Agency and Author: US Fish and Wildlife Service Carterville Fish and Wildlife Conservation Office (CFWCO); Kevin Haupt, kevin_haupt@fws.gov

Cooperating Agencies: Southern Illinois University (SIU), Eastern Illinois University (EIU), Indiana Department of Natural Resources (INDNR), Illinois Department of Natural Resources (ILDNR), Kentucky Department of Fish and Wildlife Resources (KDFWR), Ohio Division of Wildlife (ODOW), West Virginia Division of Natural Resources (WVDNR), US Army Corps of Engineers (USACE), and US Geological Survey (USGS)

Statement of Need: Asian carp have become well established in the lower and middle reaches of the Ohio River and are known to reproduce as far upstream as Louisville, Kentucky. 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). Populations of Asian carp have grown exponentially because of their rapid growth rates, short generation times, and dispersal capabilities (Peters et al. 2006; DeGrandchamp et al. 2008). The need exists to prevent the establishment of these species into the upper portions of the Ohio and Tennessee River Basins. By understanding Asian carp dispersal and movement in the Ohio River Basin, we can better inform management actions that limit their spread into additional habitats y

Understanding the movement patterns of Asian carp will provide information on how and when fish transition among pools, habitat use, and potential routes of invasion into adjacent basins and upstream movements. Monitoring the movements of fishes can also reveal timing and potential locations of spawning indicated by mass movement. This information is used to create management strategies to limit population expansion and inform management actions such as large scale removal efforts and barrier feasibility and effectiveness. Understanding large-scale movements throughout the Ohio River and the associated tributaries is required to predict population range expansion, determine transition and movement probabilities that can reveal best locations for management actions and can facilitate determining how efforts such as deterrents to movement across locks and dams and harvest could slow the progression of range expansion. Better knowledge of fine-scale movements related to habitat use and how these patterns are affected by time of day, season, flow, and other factors can increase our capture efficiency for removal efforts. Moreover, determining how patterns of movement change with increasing levels of removal is very important to determine whether these efforts are effective and efficient, particularly if large-scale movement patterns or habitat use are related to population density.

Asian carp movements will be assessed using ultrasonic acoustic telemetry using a stationary receiver array across the study reach and active tracking at specified reaches including Ohio River pools and multiple tributaries (e.g., Wabash River). Movement data at this spatial scale will provide information on Asian carp from which to evaluate their dispersal and invasion dynamics, their ability to navigate the lock and dam systems, the contribution of the Wabash River Basin to the Ohio River Basin Asian carp population, and identify areas of seasonal congregations in the Ohio River and its tributaries. This project include the expansion of the

existing telemetry network into two new areas (Smithland, J.T. Myers, Newburgh, and Cannelton pools of the lower Ohio river and the Wabash and White river systems) and adds additional active tracking in select reaches (Wabash and White river and Markland and Cannelton pools of the Ohio river).

With this approach, this project will provide support to the National Goals and Strategies while meeting the management plans and strategies outlined for the Ohio River sub-basin. Specifically, telemetry data collected at the spatial scale represented in this project plan will work towards containing and controlling the expansion of Asian carp populations within the Ohio River Basin, detect and minimize range expansion and early invasion fronts, guide efforts to establish sustainable and effective control methods, evaluate potential locations for deterrent barriers and identify how lock and dam operations may be used to deter passage of Asian carp. This project relies heavily on the strong relationships established within the sub-basin and relies on collaborative inter-agency coordination to implement field work and provide results on a yearly basis. This design allows for timely dissemination of data and analysis to further our understanding and guide management actions.

Objectives:

1. Understand use of tributaries as potential sources for recruitment and routes of invasion into adjacent basins.

2. Delineate the upstream population distribution.

3. Quantify passage of Asian carp through Ohio River locks and dams.

4. Quantify movement patterns within the Wabash River Basin including assessing movement between the Wabash and Ohio rivers (Contribution of Wabash River fish to Ohio River fish) and between the White and Wabash rivers.

5. Inform Asian carp removal efforts by quantifying fine-scale habitat use and how this changes through time in the Wabash and White rivers

Agency: Kentucky Department of Fish and Wildlife Resources (KDFWR)

Activities and Methods: KDFWR will maintain all stationary receiver sites that are located within the first ~140 miles of the project's original 500-mi long array. This stretch of the array consists of 33 sites of three different types (mainstem, tributary, lock & dam) distributed across the Cannelton, McAlpine and lower Markland pools (Table 1). In the spring of both 2020 and 2021, KDFWR field staff will offload tag detections from tributary and L&D receivers. If river conditions allow, this will also be when crews redeploy receivers to mainstem sites in Cannelton and McAlpine. For the remainder of year, each receiver site will be visited every couple months to offload data and conduct any required maintenance (i.e. replace batteries, cables, etc.). Over the same time period, KDFWR will maintain (data offloads, battery replacements, etc.) the HOBO temperature loggers that have been deployed to most of the tributaries, but these efforts will occur less frequently than those involving telemetry receivers.

From late November to early December, field staff will visit each receiver station to complete site-specific end of year maintenance. Receivers that have been deployed to the tributary and L&D sites will be offloaded and reset. Any receivers associated with mainstem river sites will be detached from their navigational buoy and stored off-river to reduce losses that are caused by the winter conditions.

KDFWR will also participate in multi-agency (CFWCO, INDNR, WVDNR) efforts to increase the number of tagged carp. Crews will utilize a combination of pulsed DC electrofishing and gill nets to collect bigheaded carp that are large enough to be surgically implanted with a ~4" long transmitter. All tagged carp will be externally marked and released back into the river. The tagging efforts that KDFWR plans to participate in will focus on pools that have a low-density AC population (Markland and Meldahl), or contain a number of tagged carp with transmitters that will be shutting down by the end of 2020 (Cannelton and McAlpine). As time allows, KDFWR will also assist with the spring 2021 efforts to tag Asian Carp in the downstream pools (Newburgh & J.T. Myers) that will soon be added to the project.

KDFWR will utilize additional telemetry funds to expand active tracking efforts. The initial focus of these efforts in 2020 will be to relocate tagged carp that disappeared after being regularly detected by stationary receivers. Early tracking efforts conducted in the Kentucky River for two days in 2019 were able to relocate a tagged carp that went undetected for almost two years. However, since it was found <3 miles from the tributary's upper receiver site, this silver carp wouldn't have been classified as an emigrant despite having left the mainstem Ohio River over a year ago. These preliminary results have helped to support KDFWR's 2020 plans for field crews to continue using the active tracking efforts to relocate tagged carp in the Kentucky River and other large tributaries of the middle OHR (i.e. Indian-Kentuck, Harrods and Ohio Brush creeks). The search area will be determined by the overall size of a tributary, but it can range anywhere between 3 to 30 miles beyond the most upstream receiver site.

In the latter half of 2020, KDFWR will continue expanding their active tracking to include sections of the lower Markland and lower Cannelton pools that directly contact the telemetry array, but have been without stationary receivers for a number of reasons. However, active tracking is necessary because these areas are large enough (> 30 mi) to allow any number of tagged carp to remain undetected for several years. The tracking effort that KDFWR is planning for the lower Markland Pool will be conducted with an additional emphasis on identifying the path of any tagged carp that happen to be detected. This originated from the belief that Markland L&D could be an important structure separating the low-density Asian Carp population of the upper Ohio River from areas located directly downstream that contain substantially higher numbers. Telemetry results from the past few years continue to support the conclusion that there aren't many carp that challenge Markland Dam and it appears that there are even fewer that succeed. However, the lack of receiver coverage directly upstream of the dam would help conceal any tagged carp that may have successfully transferred pools without being detected. Hence, in 2020, KDFWR will conduct active tracking to search the mainstem Ohio River and any unmonitored tributaries located in the first 20+ miles of the Markland Pool. Any unexpected detections made during these efforts will be cross-checked against known tagging locations and previous project data to determine if Asian Carp do in fact move through Markland Dam without

being detected, which would certainly cast some doubt on the structure's ability to hinder the expansion of the AC population.

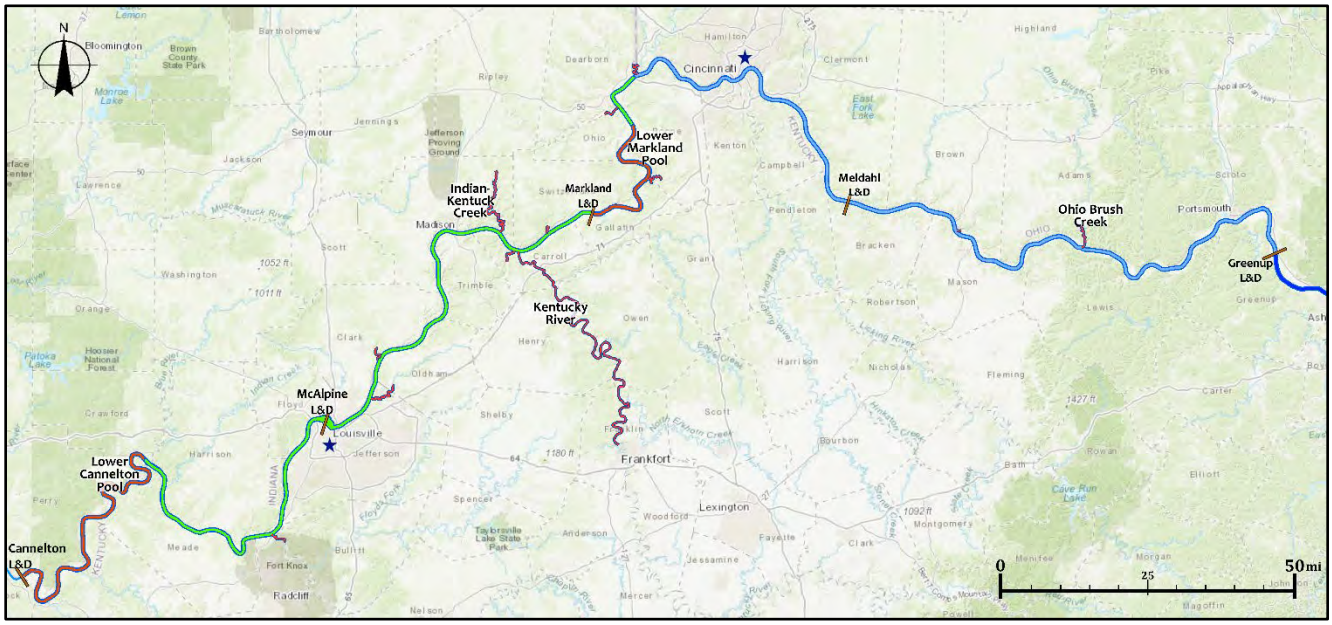
Throughout 2020, KDFWR will continue to maintain the OHR AC telemetry database that has served as the project's primary data repository since 2014. Similar to previous years, the bulk of this effort in 2020 will involve processing (error-checking, formatting, etc.) the files that CFWCO, ODOW and WVDNR staff upload to an online resource (i.e., FTP site, Drive, etc.) after completing their regular visits to assigned receiver sites. The total amount of detections being imported into the database during most of the 2020 is expected to be similar to that of previous years. However, one exception that could occur near the end of the year would be the likely increase in detections resulting from INDNR planned efforts to expand the telemetry array further downstream. The location of each established site and the information gathered from newly tagged carp will have to be integrated into the project's lookup tables before any related offloads can be added to the database. At regular intervals throughout the year, a KDFWR biologist will employ a semi-automated process that reduces the raw data and then combines it with information that's necessary to create two autonomous datasets containing either the hourly or daily detections of the project's tagged carp. Once compiled, these datasets will be uploaded to a FTP site and a Google Drive folder that will be shared with all project partners. The overall dataset and related lookup tables will also be made available to any partnering agencies upon request.

KDFWR will also continue gathering environmental data (i.e. river levels and water temps) in order to determine the extent to which these variables influence a tagged carp's tendency to occupy a tributary over the mainstem Ohio River. And finally, at two specific times during the year, the KDFWR biologist will compile an up-to-date dataset containing all hourly and daily detections that project receivers had recorded thus far in 2020. These datasets, the compiled results and any additional analyses will be provided to the CFWCO following a timeline that would allow them to complete an executive summary by the end of October 2020 and the project's Annual Technical Report by March 2021.

Table 1. Receiver counts (by site type) for the first 4 pools of the 2020 telemetry array.

Agency	Pool	US RM	DS RM	Mainstem Receivers	Tributary Receivers	L&D Receivers
KDFWR	Cannelton (upper)	605.0	630.0	3	3	--
KDFWR	McAlpine	531.7	605.0	6	10	3
KDFWR	Markland (lower)	491.0	531.7	--	7	1
ODOW	Markland (upper)	436.3	491.0	6	4	3
ODOW	Meldahl	341.5	436.0	12	8	4

Map of Project Area:



The KDFWR will be responsible for all stationary receivers located within the 1st ~140 miles (green outline) of the project's original 500-mile long telemetry array. Receivers found within the first ~150 miles above (light blue outline) KDFWR's section are maintained by ODOW, and any sites that occupy the 150+ miles above that are shared between WVDNR & CFWCO. A downstream expansion of the array is expected in late 2020 – early 2021 when INDNR starts establishing new receiver sites in Newburgh and J.T. Meyers. Red outlines mark the areas (mainstem river & tributaries) where KDFWR plans to conduct active tracking in order to relocate tagged carp that haven't been detected in some time.

Estimated Timetable for activities:

Activity	Time Period (Season, month/year)
Monthly visits to sites in Cannelton, McAlpine & lower Markland to offload receivers & complete other maintenance tasks.	Summer-Fall, Aug-Nov/2020
Conduct active tracking in tributaries and mainstem areas of lower Markland & Lower Cannelton.	Summer-Fall, Aug-Nov/2020
Assist w/ tagging efforts in McAlpine, Markland & Meldahl	Fall, Sep-Oct/2020
Pull receivers from mainstem sites for over-winter storage.	Winter, Dec/2020
Redeploy mainstem receivers to sites in Cannelton, McAlpine & lower Markland; Resume offloads of other receivers in these same pools.	Spring, Apr-Jun/2021
Assist w/ tagging efforts in McAlpine, JT Meyers & Newburgh Pools	Spring, Apr-May/2021

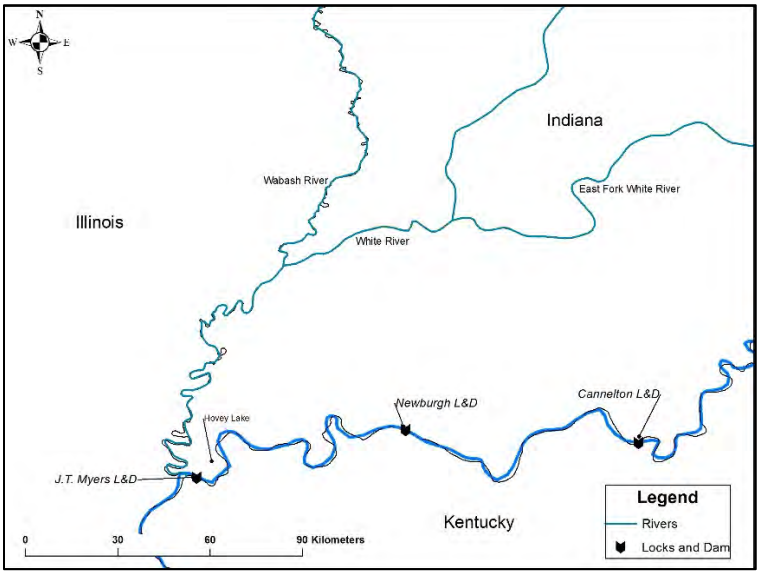
Agency: Indiana Department of Natural Resources (INDNR)

Activities and Methods: To understand the use of tributaries as potential sources for recruitment, INDNR will help deploy, maintain, and offload at least 12 receivers positioned in select tributaries of J.T. Myers, Newburgh, and Cannelton pools. A pair of receivers will be deployed in at least two key tributary or backwater areas in each of the three pools; paired designs will allow for determining directionality of Asian carp movements within the tributaries. Prior telemetry work on the Ohio River has primarily focused on areas upstream of Cannelton Pool to determine invasion rates throughout areas with less dense carp populations. Work conducted by INDNR in 2021 will focus on expanding the existing array into portions of lower pools with higher carp densities which are likely acting as propagule sources for pools farther upstream. Understanding tributary use in these lower pools will help managers determine potential spawning locations and help determine productive areas for removal efforts. INDNR will utilize active tracking in select tributaries to obtain real-time usage information.

To quantify passage of Asian carp through Ohio River locks and dams, INDNR will deploy at least 18 receivers in Smithland (N = 2) J.T. Myers (N = 6), Newburgh (N = 6), and Cannelton (N = 4) pools. This will expand the current array and allow managers to quantify Asian carp passage through dams throughout high density pools. Both J.T. Myers and Newburgh locks and dams are significantly different than most other locks and dams upstream in the Ohio River because they have fixed weirs that allow free-flowing water conditions during moderate flows. These areas may provide easy passage upstream, and learning how Asian carp utilize them will help managers determine if barriers could be useful at these locations. KDFWR currently has two receivers in the lock chambers of both J.T. Myers and Newburgh locks and dams, so INDNR will provide at least two additional receivers (one upstream and one downstream) for each dam and locate them in key locations to determine carp passage over the fixed weirs. Two receivers will be installed in the lock chambers at Cannelton Locks and Dam in addition to a receiver above and below the dam in the main channel. The remaining 10 receivers will be deployed in the Ohio River on navigation buoys or bridge piers from RM 848 (Wabash River confluence) to RM 709 (lower Cannelton Pool) to track inter-pool movement and help determine survival rates of tagged fish. INDNR will offload receivers monthly and send data to KDFWR for compiling with existing array data. INDNR will also purchase 300 Vemco tags to be implanted in Asian carp within Smithland, J.T. Myers, and Newburgh pools. Tagging locations will be spread out among pools to insure oversaturation of tags in an area does not occur. INDNR will coordinate with crews from CFWCO and KDFWR to tag adult Asian carp. Fish will be tagged in the spring and fall when water temperatures are suitable for survival.

To quantify movement patterns and inform Asian carp removal efforts within the Wabash River basin, INDNR will assist SIU with receiver offloads and manual tracking of fish. SIU will be leading this project and INDNR will provide support when needed. Active tracking of Asian carp will allow determination of fine-scale habitat use which will assist in finding locations for removal events. INDNR will send all receiver and tracking data to SIU for compilation, who will share data with other basin partners.

Map of Project Area:



Estimated Timetable for Activities:

Activity	Time Period Season, month/year
Tag Asian carp in Smithland, J.T. Myers, and Newburgh pools	Spring, March-May/2021
Deploy receivers in Smithland, J.T. Myers, Newburgh, and Cannelton pools	Spring, April-May/2021
Maintain and download receivers	Monthly, May-Nov/2021
Assist SIU with receiver offloads	Summer, June-Aug/2021
Conduct active tracking in Ohio, Wabash, and White rivers	Summer, June-Aug/2021
Tag additional Asian carp	Fall, October/2021
Pull receivers from all mainstem sites for overwinter storage	Winter, December/2021

Agency: West Virginia Division of Natural Resources (WVDNR)

Activities and Methods: To delineate upstream population movement WVDNR will assist and coordinate with CFWCO with maintaining the stationary receiver array in the mainstem river in Greenup, R.C. Byrd, Racine, Belleville and Willow Island pools (RM 161-RM 280). This stretch of the array consists of sites of three different types (mainstem, tributary, lock & dam) distributed across the pools (see table below). WVDNR will deploy, download and retrieve receivers within these pools. WVDNR will also maintain the receiver array located at the lock and dam complexes within these pools.

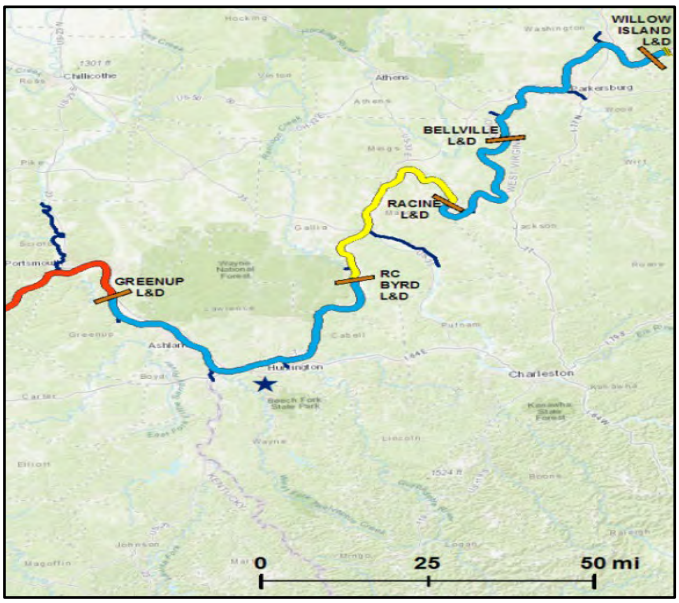
In late fall 2020, the mainstem receivers located on US Coast Guard buoys will be removed to prevent loss from river ice. In early spring 2021, these mainstem receivers will be re-deployed back into the river once the threat of ice has expired. Crews will visit receiver sites in the main stem, lock and dams, and tributaries to offload receivers on a monthly basis. During receiver

download, compromised or aging cables and/or hangers will be replaced... If battery life is low on any receiver, a new battery will be installed. Some manual tracking of tagged carps may be conducted in the R.C. Byrd pool as time allows. All data collected on Asian carp will be shared with KDFWR and CFWCO. Receivers in the upper portions of the Ohio River will allow for the capture of dispersal and movement throughout the basin. Detection data from the upper most receivers in the array will be analyzed to distinguish the dispersal and upper limits of Asian Carp in the upper Ohio River mainstem and tributaries.

WVDNR has augmented the receiver array in the R.C. Byrd pool for state fisheries investigations on catfish and paddlefish. These investigations also include manual tracking of fishes. Any detections of tagged Asian carp collected from these projects will be noted and data will be shared with KDFWR and CFWCO.

WVDNR will assist CFWCO with tagging efforts in McAlpine, Markland and Meldahl pools of the Ohio River to tag new fish and replace lost or expired tags within the system. Sampling and surgery methods will follow CFWCO protocols.

Map of Project Area:



Estimated Timetable for Activities:

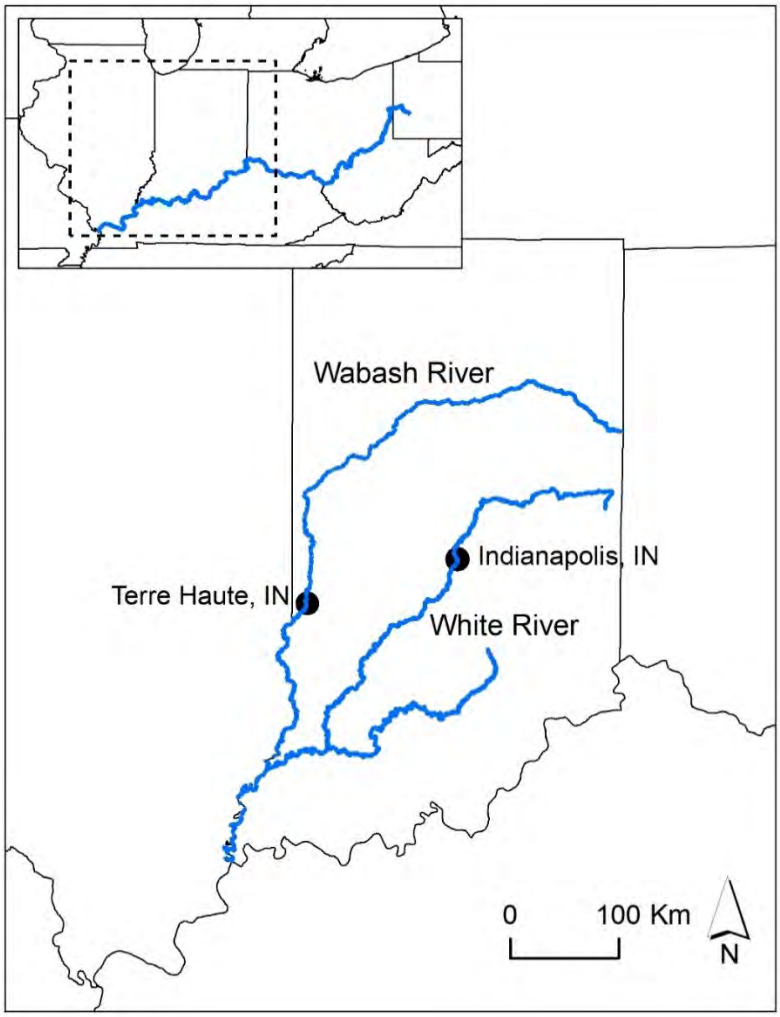
Activity	Time Period Season, month/year
Offload data from receivers	Monthly, Aug-July 2020-21
Retrieve mainstem receivers	Fall, December 2020
Deploy mainstem receivers	Spring, March 2021
Asian carp tagging	Spring and Fall, Oct-Nov 2020, May-July 2021
Project Report Technical Document	Spring, March/2021

Agency: Illinois Department of Natural Resources (ILDNR) and Southern Illinois University (SIU)

Activities and Methods: SIU will be contracted by ILDNR to complete work on acoustic telemetry of bigheaded carp in the Wabash and White rivers (Objectives 4 and 5). SIU, INDNR and EIU will collect and tag Silver Carp from the Wabash River, from its confluence with the Ohio River to Terre Haute, IN, and within the White River from its confluence with the Wabash River to Indianapolis, IN. Three hundred bigheaded carp (225 from the Wabash River and 75 from the White River) will be collected via boat electrofishing and implanted with Vemco V16 69kHz tags using surgical procedures as outlined in Lubejko et al. (2017). Fish total length and weight will be recorded and each fish will receive an external jaw tag with an SIU phone number to identify individuals with internal telemetry tags and to facilitate tag returns of harvested fish. Tags will be distributed in at least three locations along the White River and five locations along the Wabash River to avoid oversaturation of acoustic tags in one location. Tagging locations will be determined in consultation with INDNR and following a survey of the study sites. Information about tagged fish (length, weight, tag location, species) will be shared with other groups engaged in telemetry in the Ohio River Basin and with the FishTracks database.

SIU will deploy a series of twenty pairs of acoustic stationary receiver (Vemco VR2Ws; 40 total receivers) in the Wabash and White rivers to monitor the movements of tagged bigheaded carp. Stationary receiver pairs will be located on opposite sides of the river channel, staggered ~100 m upstream/downstream of each other. Staggering the pairs helps ensure that, as a tagged fish swims through the area, the fish's acoustic tag will ping when it is within range of at least one stationary receiver. If fish are detected on both receivers in a pair then the direction of travel can also be determined. Stationary receiver pairs may also be deployed at areas of interest after consultation with INDNR (e.g., White River backwaters where removal events may occur). At least five stationary receiver pairs will be placed in the White River (between confluence with the Wabash River and Indianapolis, IN) and placed in a manner to evaluate use of Wabash vs. White rivers, and the two branches of the White River (e.g., near confluence areas and locations where the river branches). Remaining receiver pairs will be deployed in the Wabash River, spaced as evenly as possible (approximately every 25 km). However, stationary receivers function best in deeper water with hard substrate and so placement will depend on available habitat. Stationary receivers will be downloaded once in spring 2021 and once in late summer 2021, depending on water levels. SIU will QA/QC data to identify and remove false detections from the dataset and then combine with other telemetry data from around the Ohio River Basin (dependent on sufficient numbers of fish moving/not moving). Telemetry data will be used to quantify movement probabilities among the Ohio, Wabash, and White rivers following the same analysis procedure described in Coulter et al. (2018). Additionally, information on movement patterns, including distances and directions traveled and seasonal patterns (Coulter et al. 2016) within the White and Wabash rivers, will be quantified. This project will contribute to the existing acoustic telemetry network in the Ohio River Basin.

Map of Project Area:



Estimated Timetable for Activities

Activity	Time Period (Season, month/year)
Survey to Determine Tagging and Stationary Receiver Sites	Fall, October 2020
Deployment of Stationary Receiver Array	Spring, March 2021
Acoustic Tagging of Bigheaded Carp	Spring, March - April 2021
Interim Progress Report and Executive Technical Report	Spring, March 2021
Stationary Receiver Downloads	May 2021, September 2021
Final Report	Winter, November 2021

Agency: Illinois Department of Natural Resources (ILDNR) and Eastern Illinois University (EIU)

Activities and Methods: EIU will be contracted by ILDNR to complete work on the acoustic telemetry of bigheaded carp in the Wabash and White Rivers (Objectives 4 and 5). EIU will assist with acoustic tagging of bigheaded carp (described in SIU section) and will collect active tracking and habitat use data from acoustically tagged fish.

Monthly, EIU personnel will actively track the lower Wabash River (termed, 'reach tracking'). Beginning at the Terre Haute boat ramp and continue down the middle of the river, ending at the confluence of the Ohio River. This methodology will also be accomplished on the lower White River to the confluence with the Wabash River. This method of reach tracking will be conducted during day light hours only. The end tracking point for one day will become the starting point for tracking the following day. During all methods of active tracking, we will maneuver the boat between 6 and 11 km per hour downstream, while towing an omnidirectional hydrophone. When a transmitter is detected we will triangulate the position using a submersible directional hydrophone. At every fish detection we will record; the fish identification number, time, date, GPS location (Garmin GPSmap62s), depth (m) (Lowrance depth finder), secchi (m) (secchi disk), substrate type (petite ponar), temperature (°C) (YSI-85 multi-meter), conductivity (µS) (YSI-85 multi-meter), dissolved oxygen (mg/L) (YSI-85 multi-meter), flow (m/s) (Marsh-McBirney hand held flow meter), habitat, microhabitat, and behavior (active or sedentary) of the fish.

In order to analyze habitat use, we will differentiate habitat types based on a modification of Cobb (1989), as suggested by Koch et al. (2012). Shoreline habitats include outside bend (OB), channel border open (CBO), and inside bend (IB). Microhabitat categories were defined as follows; logjam is a shoreline with woody debris/ terrestrial structure in the water, run is a shoreline with swift flowing water and no debris/structures (includes eddy, eroded banks and non-eroded banks), rip rap is a shoreline that contains large boulders, sand bar is a sand or gravel shoreline caused from sediment deposition, and the thalweg is the deepest, fastest flowing part of the river. To determine if habitat and microhabitat of fish locations were randomly distributed annually and within seasons, we will use likelihood ratio chi-squared analysis using the proportion of observations per habitat (and microhabitat) type.

In order to determine if bigheaded carps are selective in habitat use, we will calculate habitat selection ratios, suggested by Manly et al. (1993). In order to calculate the proportion of each habitat type, we will use ArcMap to measure the total area of each site (extent of site was dependent on range of fish locations) and the area of each habitat type (m^2). Data generated from the habitat assessment will be used to determine areas of the Wabash and White Rivers that are likely of harboring bigheaded carps in high numbers.

Map of Project Area: See SIU section

Estimated Timetable for activities:

Activity	Time Period (Season, month/year)
Deployment of Stationary Receiver Array	Spring, March 2021
Acoustic Tagging of Bigheaded Carp	Spring, March- April 2021
Interim Progress Report and Executive Technical Report	Spring, March 2021
Active Tracking	April – September 2021 (monthly)
Final Report	Winter, November 2021

Agency: US Fish and Wildlife Service Carterville Fish and Wildlife Conservation Office (CFWCO)

Activities and Methods: Carterville FWCO will lead tagging efforts within the mainstem Ohio River to replace expiring tags in Meldahl, Markland and McAlpine pools. All tagging will take place in the spring and fall when water temperatures are most conducive to survival. Fish will be collected using daytime electrofishing and short-term gill net sets. Total length (mm), weight (g), and sex will be recorded along with an external tag to identify individuals with internal telemetry tags and to facilitate tag returns of harvested fish. Vemco Model V16-6H acoustic transmitters (69 kHz 16mm diameter, 96 mm length, 34g), programmed to transmit on a random delay from 20 to 60 seconds with a battery life of 1,825 days will be used document movement of tagged fish. Tags will be tested for recognition with a mobile receiver (VR-100-200) and surgically implanted according to procedures outlined in Lubejko et al. (2017).

Tagging effort will be directed within pools with tags expected to expire as outline in the table below during Fall 2020 tagging efforts. This effort will assist in maintaining 200 active tags in McAlpine pool, 50 active tags in Markland pool and 30 active tags in Meldahl pool. Tagging effort will be spread out across the length of the pool to prevent oversaturation of tagged fish in a given area and a mix between fish collected within tributaries and the mainstem Ohio River.

Number of expiring tags to be replaced by pool and species during Fall 2020 tagging effort

McAlpine		Markland		Capt A Meldahl	
Silver	Bighead	Silver	Bighead	Silver	Bighead
97	5	9	5	15	5

CFWCO will also assist with tagging adult Asian carp within J.T. Myers and Newburgh pools being lead by INDNR. Additional information regarding the effort to tag fish in these pools can be found in the INDNR section of this document.

In addition to tagging fish, CFWCO will assist in deploying and maintaining the telemetry array associated with the mainstem Ohio river. See information of existing array provided in the

KDFWR and WVDNR section of this document and information on the expanded telemetry network in INDNR section of this document.

All tagging and telemetry data will be sent to KDFWR for initial processing and uploaded to ODOW's FTP site for use by all partners. CFWCO will analyze data from the mainstem telemetry array to estimate pool-to-pool transition probabilities, estimate annual survival and detection probabilities using Program MARK (G.C. White, Dept. of Fish, Wildlife, and Cons. Bio., Colorado State University, Fort Collins, CO). A report of calendar year 2020 activity and analysis will be available March, 2021.

Estimated Timetable for Activities

Activity	Time Period (Season, month/year)
Assist with receiver deployment into mainstem Ohio River and replacement of batteries in tributary and L&D receivers	Spring, April/May
Assist with offloading data and maintenance of all receivers	Spring, Summer Fall, May thru November
Asian carp tagging	Spring, March and April/2020 Fall, September, October and November/2020
Assist with retrieval of receivers from the mainstem Ohio River. Assist with final data offload from tributary and L&D receivers	Winter, December/2020
Report	Winter, March/2021

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Evaluation and Removal of Asian Carp in the Tennessee and Cumberland Basins

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Cooperating Agencies: Kentucky Department of Fish and Wildlife Resources (KDFWR), Alabama Department of Conservation & Natural Resources, Wildlife & Freshwater Fisheries Division (ALWFF), US Fish and Wildlife Service Columbia Fish and Wildlife Conservation Office (CFWCO), US Army Corps of Engineers (USACE), Tennessee Valley Authority (TVA), Murray State University (MSU), and Tennessee Cooperative Fisheries Research Unit, Tennessee Technological University (TTU).

Statement of Need: As of 2019, all four species of Asian carp have been collected in the Tennessee and Cumberland rivers (TNCR). The states of Kentucky, Tennessee, Mississippi, and Alabama have significant recreational and ecological resources at risk due to Asian carp. This project is needed to help implement portions of the National Management and Control Plan for Asian Carp (Conover et al. 2007) and portions of the Ohio River Basin Asian Carp Control Strategy Framework (Ohio River Fisheries Management Team 2014). The project objectives and descriptions below consist of important steps to monitor, control, and better understand the impacts of Asian carp in the TNCR, all of which are identified goals of the sub-basin management plan. This opportunity represents the second year of funding for the TNCR. As individual TNCR states have initiated their carp programs, agencies have recognized the need to align sampling methods to collectively address Asian carp on a basin-wide scale. Partners in the TNCR are committed to identifying and reconciling differences in methodology to meet the broader goals of a basin-wide framework.

This project will further develop standardized protocols to assess abundance and population dynamics of Asian carp and determine effectiveness of control measures. TWRA and KDFWR have invested in commercial carp removal programs, and the USFWS has funded a sound barrier experiment at Barkley Lock. To measure the success of these control measures, agencies need standardized sampling methods that will allow comparisons among water bodies and over time. Foundational research on carp sampling has been conducted by CFWCO, KDFWR, TWRA, and TTU using the USFWS Asian Carp Base Funds and local funding sources. These projects have tested many sampling methods, identifying the best available methods for sampling carp. This project will increase capacity for standardized sampling in TN, KY, and AL. Ultimately, while Mississippi Department of Wildlife, Fisheries, and Parks is not requesting funding for this project for FY 2020, they are coordinating with TNCR states and will benefit from this project. The inclusion of all four states is critical for the evaluation of carp populations in the TNCR.

In this project, KDFWR will evaluate the response by the native fish community and their fisheries in the presence of Asian carp. Fisheries managers need to understand these dynamics to evaluate the effectiveness of control levels, and to keep stakeholders informed. This work will complement ongoing projects in the TNCR. For example, all state agencies have been monitoring native sport fisheries in the TNCR, and the TVA has a long-term monitoring program for native fish communities in the Tennessee Valley. In this new project, the KDFWR will evaluate the response of native fishes, such as gizzard shad, buffalo, and paddlefish, which compete directly with bigheaded carp for zooplankton.

The commercial fishing industry has been successful at harvesting carp using gillnets. Increasing harvest rates remains important if commercial fishing will be used as a means of population control. Due to cost and restrictions on commercial gear types, the private sector cannot easily test new methods. Development of more efficient carp removal methods would greatly benefit the TNCR and potentially other basins. As part of this project, the KDFWR and MSU will continue to evaluate new gears that could be used by resource managers and commercial fishers. This work will benefit all partners in the TNCR as we need highly effective removal methods that are designed for the habitats associated with the TNCR.

Objectives:

1. Estimate Asian carp relative abundance, and population demographics in the Tennessee and Cumberland River basins to evaluate management actions.

2. Examine Asian carp impacts on native fish communities.

3. Target and remove Asian carp to suppress populations and reduce propagule pressure in the Tennessee and Cumberland River basins.

Agency: Kentucky Department of Fish and Wildlife Resources (KDFWR)

Activities and Methods: Federal funding for FY2020 towards this project increased significantly and will not only assist KDFWR with expenses previously unfunded by federal monies, but will allow increased agency efforts for each of the objectives. Perhaps as important as removing Asian carp from the Tennessee and Cumberland rivers is our ability to determine the effects that fish removal and deterrent systems have on their relative densities above Kentucky and Barkley Dams. Staff and equipment increases will enhance agency sampling efforts to make those assessments, and will also allow KDFWR to continue its oversite of the commercial fishing industry. KDFWR will elevate participation with testing new or different standard sampling technologies, such as a Dozer trawl and other sampling methods designed to assess abundances of Asian carp in Kentucky and Barkley lakes and their associated tailwaters. Significant funds will also be directed to contract research entities to assist with a wide variety of projects with goals of assessing gear efficiencies for targeting and removing mass amounts of Asian carp from Kentucky and Barkley reservoirs.

Objective 1: Estimate Asian Carp Relative Abundance and Population Demographics
KDFWR will use a combination of standardized sampling and monitoring of commercial harvest to evaluate relative changes in Asian carp abundance. Standard sampling will be conducted at sixteen sites on Barkley and Kentucky reservoirs. These standard sites were selected to provide adequate sampling parameters, decrease conflict with anglers, and provide static locations to monitor changes in catch per unit effort (CPUE). Four embayment sites and four main channel sites were selected on each reservoir. These sites will be sampled once during the following seasons; spring (April), summer (July), and fall (October). A total of four nets will be fished at each location during sampling periods and in orientations specific to each location. Sampling will occur when the lake level is greater than 354’ in areas where water depth is a minimum of 13’. Nets will be deployed one hour before sunset and retrieved one hour after sunrise the following morning (according to the official rise and set tables). Specific coordinates will be

determined for all sets, and nets will be set at the same locations each season and for each subsequent year of gill netting effort. Sinking experimental gill nets 10' deep, 300' total length, with 100' panels of 3", 4", and 5" mesh will be fished overnight. Gill nets will be 12' deep tied down to 10' every 8'. Each of the 100' panels of webbing will be hung with 30" stretch in 16" ties (3" square, 5 meshes per 16" of linear net; 4" square, 4 meshes per 16" of linear net; and 5" square, 3 meshes per 16" of linear net). Webbing used in each panel will be constructed of 8 ply, 0.2-mm twist mesh. Cross ties for these nets will be constructed from #15 white bonded twine through the webbing. Catch rates and species captured will be recorded for each gillnet mesh size.

KDFWR will continue to partner with the CFWCO to conduct Paupier net and Dozer trawl sampling in Kentucky Lake to further inform relative abundance calculations and population demographics. KDFWR will provide staff and tender boats to increase efficiencies as needed. The KDFWR Asian Carp Harvest Program requires commercial fishermen to report total weights of harvested Asian carp species daily. Occasionally the agency also provides observers to record harvests as the nets are retrieved (ride-alongs). Data collected during ride-alongs with commercial fishers allows KDFWR to estimate average weights of individual silver carp commercially harvested. This value will be used to determine the number of individual silver carp harvested during the study. Commercial fishers' nets' dimensions will be recorded to correlate mesh sizes with the size of fish caught. This information will be an additional metric in the assessment of Asian carp population demographics.

During the standard sampling described above, total lengths (mm), weights (g), genders and gonad weights (g) will be recorded from a subsample of 10 silver carp and 10 bighead carp at each sample site. During fall sampling, pectoral fin rays and otoliths will be extracted from approximately 100 silver carp from each reservoir for aging. Data will also be collected bi-weekly from commercial markets. Total lengths (mm), total weights (g) and total gonad weights (g) will be collected from twenty, randomly selected fish. If less than ten females are examined in the random samples, additional female silver carp will be selected until the goal of ten is reached. Gonad weights will be used to construct a timeline of gonadosomatic indices to estimate periodicity of silver carp spawning attempts/events. Observations of spawning patches on bigheaded carps will also be recorded during field work. Demographics data may also be collected from Asian carp captured through other KDFWR sampling efforts and included for analyses. Silver carp movement information will be used to assist with estimating periodicity of silver carp spawning attempts, and the data will be aligned with environmental factors to examine potential correlations.

Objective 2: Examine Asian Carp Impacts on Native Fish Communities
During standard sampling described above, total length and weight data will be collected from bigmouth buffalo and paddlefish. During Paupier net sampling, total length and weight data will be recorded for gizzard shad. Measurements will be used for determining condition factors through relative weight analysis. Values will be monitored over time to determine if they will be useful to assess impacts that Asian carp may have on conditions of the native fishes. The species chosen for this assessment are often captured in gill nets and have been recognized as being vulnerable to competition for resources with Asian carp species (Irons et al. 2007, Schrank et al. 2003).

Asian carp harvest continues to increase from Kentucky and Barkley lakes, driven by the Asian Carp Harvest Program (ACHP) and the public/private partnership fish house (Kentucky Fish Center). KDFWR will continue to monitor conditions of sport fish species to identify trends that may be associated with the increased removal of Asian carps. Information on sport fish has been gathered routinely throughout the past few decades by KDFWR's Western Fisheries District (WFD). Lengthy data sets on black bass, crappie, and catfish in the two reservoirs are collected from standardized annual sampling. The information will be used to compare sport fish conditions (Wr) with harvest rates of Asian carps to determine if there is a correlation. Although previous data has not indicated that Asian carp densities have negatively affected Largemouth Bass or Catfish growth or body conditions, Crappie relative weights in Kentucky Lake have decreased over the past decade. Therefore, aside from continually monitoring the other two important sportfish species for changes in condition, Crappie conditions may be more insightful as to assessing effects of increased commercial harvest of Asian carp.

Kentucky and Barkley reservoirs' tailwaters will continue to be sampled with pulsed DC electrofishing in the spring and fall to assess species composition and relative abundance of represented fish species. Sampling below Kentucky Lake (Tennessee River) and Lake Barkley (Cumberland River) will consist of three 15-minute transects, moving downstream along each bank of both rivers. Spring samples will be collected one day each month in April, May, and June. Fall sampling will be conducted one day each month in September, October, and November. Two staff will collect fish from the bow, and all fish of every species will be targeted. Data will include species and total lengths (mm), and weights (g) will be recorded during fall. When large numbers of a species are collected, measurements on a subsample of at least 25 individuals will be taken and extrapolated for that species. The data will be compared to historical data collected by the KDFWR WFD personnel to assess changes in fish community over time.

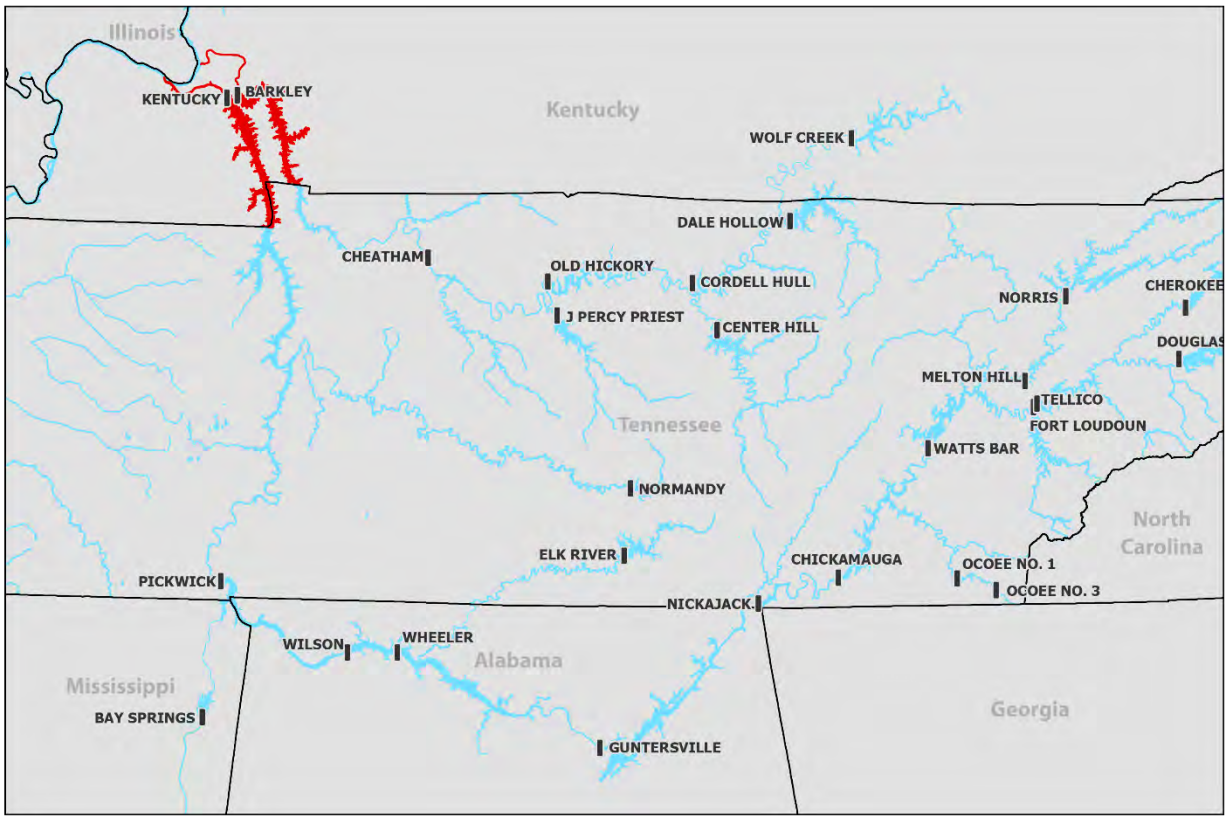
Objective 3: Target and Remove Asian Carp
Increased federal funding in FY2020 will allow KDFWR to increase staff time towards observing commercial fishing and facilitating efforts to assess the impacts of targeted removal of Asian carp on non-target native species. Commercial fishers requesting to fish in the ACHP are required to provide daily reports including amount of fishing effort, the type of gear used, pounds harvested, and bycatch. Fishers are also required to list the number of fish caught for each species, fish released, and disposition. The information will be used to assess impacts of commercial harvest on bycatch species.

To verify commercial fishers' reports, KDFWR occasionally provides observers to record harvests (ride-alongs). Observers collect all data required on commercial harvest logs and record GPS fishing locations and net soak times. Staff observe several individual fishers throughout the year. Ride-alongs are conducted as fishers pull their nets to harvest fish. When commercial fishers use short net soak times or drifting net sets, KDFWR staff will observe during the entire effort. Ride-alongs are conducted from an agency boat located near the commercial fishers. Observation records will be compared to fishers' daily reports to assess commercial reporting accuracy. ACHP data will be analyzed to determine the number of fishing trips, amount and disposition of bycatch by species, and total pounds of Asian carp harvested. Federal funding towards these activities increased for FY2020 and will not only allow KDFWR to conduct

additional effort, but also assist KDFWR with expenses previously unfunded by federal monies. KDFWR will continue to offer contract fishing in Kentucky and Barkley lakes to ensure commercial fishing effort targeting Asian carp remains strong. Commercial fishers must apply for the contract program and once approved, will receive a designated price per pound for Asian carp species harvested from Kentucky or Barkley reservoir, and their tailwaters. The Asian Carp Harvest Program is one of two programs Kentucky has implemented to increase commercial removal of Asian carp in the reservoirs. KDFWR also initiated a public/private fish house contract, and the successful bidder (Kentucky Fish Center, a.k.a. KFC) is provided goal-oriented state grant incentives to purchase and sell Asian carp quantities that increase each year over a 6-year period. KFC is located in two areas near or on the reservoirs, offers assurances to commercial fishers that their harvests will be purchased as markets allow and ensures that the payments for fish are solvent. Commercial fishers are guaranteed a specific, minimum amount for their harvests on a per pound basis, depending upon size of fish. In 2018, KDFWR purchased and maintains an industrial flake ice machine. The ice is free to commercial fishers targeting Asian carp. As harvests continue to increase, an additional ice machine and freezer will be required.

KDFWR staff will conduct targeted removal of Asian carp through electrofishing and gillnetting as time allows. Electrofishing will occur on the lower Cumberland River below Barkley Dam and the lower Tennessee River below Kentucky Dam. These areas have high densities of Asian carp in confined areas and will be targeted when conditions are most conducive for mass removal with this gear (i.e. low water elevation, warm water temperatures, reduced barge traffic). Gillnetting effort will be focused on Kentucky and Barkley lakes and may coincide with training new commercial fishers. Active sets will be used primarily, targeting large schools of Asian carp that can be encircled with nets and harvested. Previous years efforts included approximately 40 days of agency removal effort, however, a significant amount of staff time will be expended in FY20 and FY21 to assist other research and private entities to test new Asian carp harvest gears. Testing will be conducted as collaborative effort with entities including but not limited to MSU, CFWCO, USGS, commercial processors or fishers, and other private entities. All gear types will be evaluated by appropriate staff from each agency or entity involved. KDFWR will support and assist with gear development and testing, and identification and clearing of Asian Carp Harvest Areas. KDFWR staff will be present when any experimental gears are tested. Fish population demographics will be recorded to assess gear efficiencies, bycatch, and determine potential of the methods to be used for assessing Asian carp abundances in the reservoirs. KDFWR will use various media forums to provide public awareness and ensure law enforcement is aware of all special projects testing experimental gears. Data collected on fish captured through all removal efforts will be used to inform Objectives 1 & 2.

Map: Areas in red indicate study area for KDFWR.



Estimated Timetable:

Project Activity	Pool	Month	Year
Standard Asian Carp Sampling	Kentucky	Spring, Summer, Fall	2020 - 2021
Standard Asian Carp Sampling	Barkley	Spring, Summer, Fall	2020 - 2021
Collection of Asian Carp Demographics Information	Kentucky	All Seasons	2020 – 2021
Collection of Asian Carp Demographics Information	Barkley	All Seasons	2020 – 2021
Ride Alongs with Commercial Fishermen	Kentucky	All Seasons	2020 – 2021
Ride Alongs with Commercial Fishermen	Barkley	All Seasons	2020 – 2021
Ride Alongs with Commercial Fishermen	Lower Tennessee River	All Seasons	2020 – 2021

Ride Alongs with Commercial Fishermen	Lower Cumberland River	All Seasons	2020 – 2021
Tailwater Community Survey	Lower Tennessee River	Spring and Fall	2020 - 2021
Tailwater Community Survey	Lower Cumberland River	Spring and Fall	2020 - 2021
Testing of Experimental Gears	Kentucky / Barkley	Fall, Winter, Spring	2020 – 2021
Purchasing and Acquisition of Equipment	Kentucky / Barkley and their respective tailwaters	All Seasons	2020-2021
Paupier Net Sampling for Relative Abundance	Kentucky / Barkley	Fall and Spring	2020 - 2021
KDFWR Removal Efforts: Gill nets, Electrofishing, Paupier Net Boat	Kentucky / Barkley and their respective tailwaters	All Seasons	2020-2021
Clearing of Asian Carp Harvest Areas	Kentucky / Barkley	Fall, Winter, Spring	2020-2021
USGS Depletion Studies	Kentucky	Winter	2020-2021
Contracted MUM efforts	Kentucky / Barkley	Winter, Spring	2020-2021
Contract with Commercial Fishers Harvesting Asian Carp	Kentucky / Barkley and their respective tailwaters	All Seasons	2020-2021
Purchasing, Set Up, and Maintenance of Industrial Ice Machine	Kentucky / Barkley	Winter	2020 - 2021

Agency: Murray State University (MSU)

Project Activities and Methods: Federal funding for FY2020 towards this project increased significantly, and will allow increased research efforts by MSU for each of the objectives. MSU will work with KDFWR to elevate participation with testing new or different standard sampling technologies, such as a Dozer trawl and other sampling methods designed to assess abundances of Asian carp in Kentucky and Barkley lakes and their associated tailwaters. MSU will also conduct significant research on a variety of projects to assess gear efficiencies for targeting and removing mass numbers of Asian carp from Kentucky and Barkley reservoirs.

Objective 1: Estimate Asian Carp Relative Abundance and Population Demographics
To supplement standard sampling with gill nets conducted by KDFWR, MSU will assist the CFWCO to further examine the efficacy of the electrified Paupier sampling method to assess

relative abundance trends of Asian carp in Kentucky Lake. Previous years sampling by the CFWCO have identified standard sampling criteria including electrical array designs and electricity output specifications, areas and diel periods most suitable for optimizing sampling efficiencies. Specific sampling regimes will be developed by the USFWS and closely mimic sampling efforts conducted with those gears in previous years (Towne et al. 2020). MSU may contract with a private entity that has a Paupier net boat in order to increase sample numbers and discrete locations sampled, which will improve statistical accuracy of relative abundance estimates. Electric fields of both Paupier net boats will be mapped by the USFWS and settings of electrofishing units will be determined by the USFWS. The USFWS, KDFWR and TWRA are also interested in research comparing sampling efficiencies between the Paupier and Dozer methods. Demographics data will be collected from Asian carp captured as needed included with KDFWR data for analyses.

Objective 2: Examine Asian Carp Impacts on Native Fish Communities
During sampling described above, total length and weight data will be collected from gizzard shad, bigmouth buffalo, and paddlefish. Measurements will be used for determining condition factors through relative weight analysis. This information will be incorporated with data collected through KDFWR sampling.

Objective 3: Target and Remove Asian Carp
In FY20 and FY21, MSU will partner with the USGS to deploy the full Modified-Unified Method (MUM) in two Kentucky Lake bays. The project is being developed to sample the bays with a 14-day maximum per event. The bays will be blocked off at their entrances, and four consecutive harvest efforts will be conducted in each bay in an attempt to gather data and use the Delury depletion method to estimate Asian carp numbers in each bay. The results from that data will be used to compare relative density assessments derived from USFWS hydroacoustics and USGS side-scan data. Comparing statistically defensible numbers derived from the depletion method to the hydroacoustics and sidescan information should facilitate advancement of our understanding of the latter two methods data in terms of actual and relative fish densities. Along with testing variations of MUM procedures, the USGS primary goals are to: 1) Develop needs assessment for reservoir monitoring and evaluations; 2) Identify key elements of monitoring plan needed to support management decisions; 3) Determine feasibility of hydroacoustics and side-scan technology; and 4) assess population status and distributions. Bycatch will be recorded by species, number collected, and final disposition. MSU will contract with an entity to assist with the project data collection in accordance with removing, transporting, and disposing of all fish harvested. In addition to the research, we expect to harvest large quantities of Asian carp from the two bays sampled, which is the underlying goal of all our experimental testing.

In addition to assisting the USGS with the MUM, MSU will contract at least one research entity to further test more extensive variations of the MUM to find potential increases in Asian carp removal efficiencies. The additional MUM-type research will include sampling at least five Kentucky Lake bays, and executing three attempts in each bay to quantify harvest efficiencies. Emphasis will be placed on significantly modifying herding and seining techniques, which are the most time consuming aspects of the MUM. A research entity or contractor will assist with most aspects of this extension of the MUM research, including blocking the bays with nets,

herding the fish, seining, removal, transportation, and fish disposal. Data recorded will mimic the MUM research plan.

The winter 2020 MUM research provided considerable information as to some of the challenges of using the method in a very popular sportfishing reservoir because of the amount of artificially placed fish attractors and habitats. The man-made structures reduced harvest efficiencies of the MUM efforts significantly. In fall 2020, MSU will contract an entity to work with KDFWR to identify and clear at least seven "Asian carp harvest areas" of substrate debris. Working with the USGS, KDFWR will identify two potential research bays for the MUM effort in December 2020 and January 2021 and clear specific areas of debris to reduce the likelihood that seining efforts will be compromised. An additional 5 -8 harvest areas will be cleared for further mass-removal methods that MSU and KDFWR will test. Each harvest area will be approximately 300 x 100 meters, and they will be marked to inform fishers, researchers, and the public of their locations. Outreach to the public will be extensive to ensure they are aware of the reasons for the areas and do not place new structures within the buoy boundaries. Data collected on fish captured through all removal efforts will be used to inform Objectives 1 & 2.

Estimated Timetable:

Project Activity	Pool	Month	Year
Paupier Net & Dozer Trawl Sampling	Kentucky / Barkley	October – November April	2020 2021
Clearing of Asian Carp Harvest Areas	Kentucky / Barkley	September – March	2020-2021
USGS Depletion Studies	Kentucky	December – February	2020-2021
Contracted MUM efforts	Kentucky / Barkley	December – March	2020-2021

Agency: Tennessee Wildlife Resources Agency (TWRA)

Activities and Methods:

Objective 1

TWRA will use gillnets, electrified dozer trawls, and boat-mounted electrofishing to estimate relative abundance and characterize carp populations. To meet Objective 1, TWRA will need to purchase gillnets, and purchase supplies and services to obtain, maintain, and operate new and existing equipment. Procurement will occur as needed throughout the performance period.

TWRA staff will identify fixed sites in Kentucky (6 sites), Pickwick (1), Barkley (3), Cheatham (3), and Old Hickory (3) lakes to set clusters of gillnets. Additional sites may be identified in Nickajack, Chickamauga, and Watts Bar lakes as feasible. Each site will be sampled at least twice a year, once during summer (July-Sept) and again in the winter (Nov-Jan). At each site, four overnight gillnet sets will be deployed. Nets will be distributed in embayments from the mouth to the back of the embayment (approximately 10-foot depth). Individual nets will be 300-ft in length with 100-ft panels of 3-, 4-, and 5-in mesh. Nets will be 12-ft deep, hobbled to 10-ft every eight feet; nets will have 0.5-in foamcore float line and 65-lb leadcore lead line. The

webbing used in each of these panels will be constructed of 8 ply, 0.2-mm twist mesh. Catch of all species will be recorded by mesh size. We are not attempting to herd fish into nets using electrofishing, acoustic boats, or any other method.

TWRA staff will conduct electrified dozer trawls as a standard method of sampling. Dozer trawl sites will be established in Kentucky, Pickwick, Barkley, Cheatham, and Old Hickory lakes. Multiple factors, such as logistics, feasibility, and scientific and statistical robustness, will be used in determining number and location of sampling sites. Specifications of the dozer trawl will be similar to those currently operated by TTU and CFWCO. Dozer trawl surveys will be conducted during the daytime. Sampling transects may include a variety of habitat types (i.e., backwaters, channel borders, shoreline areas, open water). Each trawl sample will be conducted for 5 minutes. All species will be counted, and catch rates will be calculated as fish/5-min. Though electrified dozer trawls will replace boat-mounted electrofishing as the standard method, boat-mounted electrofishing will still be utilized on an as needed basis and in special circumstances.

All carp species will be removed from the lake. Carp species (or a subsample) will be examined to determine species, length (mm), weight (g), and sex. Sex of bigheaded carp will be determined based on the morphology (serrated pectoral spines are males). During this project, TTU will be conducting complementary samples that will yield otoliths to estimate age and growth, and gonad measurements to determine gonadosomatic index. Unless additional samples are requested, we will not be removing otoliths or measuring gonads. All non-carp species will be released. Gillnetted buffalo (*Ictiobus spp.*) and paddlefish (*Polyodon spathula*) will be measured (length and weight) to monitor condition of these species and disposition will be recorded to track bycatch mortality. These data will be used to prepare length and age frequency histograms, estimate growth rates, assess recruitment variability, and estimate mortality.

Through the TWRA's Asian Carp Harvest Incentive Program (ACHIP), commercial fishers and buyers are required to report the total weight of Asian carp that are harvested and purchased daily. To qualify for ACHIP, fish must be harvested from TWRA specified lakes. TWRA staff will characterize the size and age structure of species harvested through ACHIP by collecting a subsample of harvested fish. TWRA staff will meet commercial fishers as they arrive at the market to offload catch, or conduct ride-along surveys. Commercial fishing surveys will be conducted at least 3 times a year (Mar-Apr, Jul-Aug, and Dec-Jan). We will record capture location and examine a subsample of carp to determine species, length (mm), weight (g), and sex. During this project, TTU will be conducting complementary samples that will yield otoliths to estimate age and growth, and gonad measurements to determine gonadosomatic index. Unless additional samples are requested, we will not be removing otoliths or measuring gonads during commercial surveys.

Objective 3
TWRA will contract with licensed wholesale fish dealers to remove Asian carp from waters specified by the agency. Wholesale dealers are licensed by TWRA to purchase fish from commercial fishers. Payments will be made on a per pound basis, and rates may vary by location. Depending on industry needs, gill net materials may be provided to commercial fishers. By state

rule, wholesale fish dealers and commercial fishers submit monthly reports that are then used to verify all ACHIP purchases and quantify harvest.

Map: Areas in red indicate study area for TWRA. Yellow stars indicate areas where additional work may be conducted as feasible.

Estimated Timetable:

Project Activity	Pool	Month	Year
Procurement	-	ASAP	2020 and 2021
Electrofishing	Kentucky Lake	July-Sept and Nov-Jan	2021
Gillnet	Kentucky Lake	July-Sept and Nov-Jan	2021
Electrofishing	Pickwick lake	July-Sept and Nov-Jan	2021
Gillnet	Pickwick Lake	July-Sept and Nov-Jan	2021
Electrofishing	Barkley Lake	July-Sept and Nov-Jan	2021

Project Activity	Pool	Month	Year
Gillnet	Barkley Lake	July-Sept and Nov-Jan	2021
Electrofishing	Cheatham Lake	July-Sept and Nov-Jan	2021
Gillnet	Cheatham Lake	July-Sept and Nov-Jan	2021
Electrofishing	Old Hickory Lake	July-Sept and Nov-Jan	2021
Gillnet	Old Hickory Lake	July-Sept and Nov-Jan	2021
Gillnet	Nickajack Lake	July-Sept and Nov-Jan	2021
Gillnet	Chickamauga Lake	July-Sept and Nov-Jan	2021
Gillnet	Watts Bar Lake	July-Sept and Nov-Jan	2021
Commercial Surveys	Sample carp harvested within ACHIP program (Agency specified lakes)	Mar-Apr, Jul-Aug, and Dec-Jan	2021
Targeted removal (ACHIP)	Agency specified lakes	ASAP	2020-2021

Agency: Alabama Division of Wildlife and Freshwater Fisheries (ALWFF)

Activities and Methods:

Objective 1

Field work will focus on the region stretching from the state border with Tennessee and Mississippi eastward to Guntersville Dam (see map); however, Guntersville Reservoir may also be included if deemed necessary. ALWFF will survey Asian carp populations using a variety of standardized sampling methods, primarily gillnetting and electrofishing, to estimate relative abundance and population demographics. Surveys will be conducted at pre-determined sites throughout the region. Information obtained will be used to help define the "invasion front" of Asian carp in the Tennessee River basin within Alabama. All information from targeted sampling will be used to track future changes in relative abundance. Additional information may also be obtained through interaction with commercial and recreational anglers. Any data sources deemed relevant for this project will be reviewed and incorporated when possible. ALWFF staff will also be available to assist partner state agencies with sampling in their waters for training purposes.

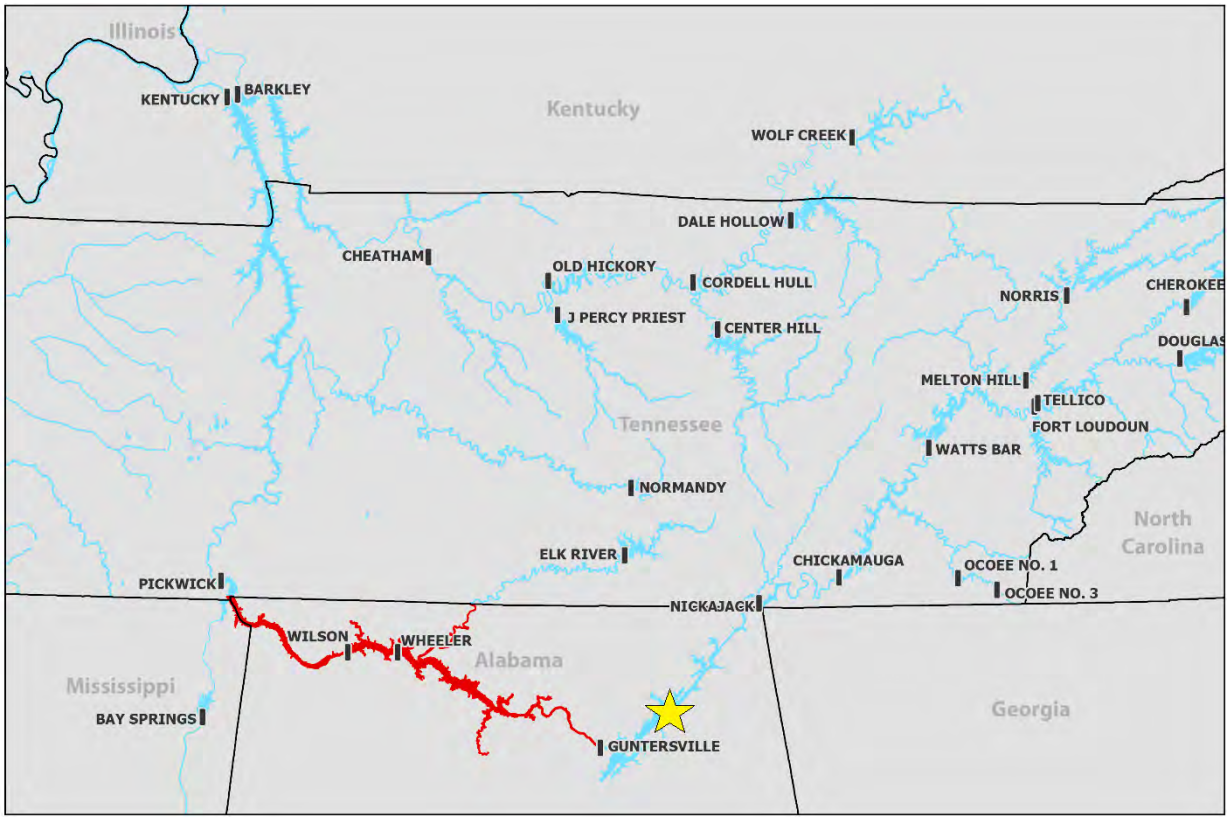
ALWFF will conduct gillnet sampling at predetermined sites on Pickwick Reservoir (3 sites), Wilson Reservoir (3 sites), and Wheeler Reservoir (4 sites). At each site, four gill nets will be set and fished overnight. Each site will be sampled a minimum of twice per year; once during the summer season and again in the winter. The number of total net-nights sampled will be determined by success rate. If fish are difficult to capture at a given location, then more net-nights of sampling may be necessary. Individual nets will be 300-ft in length with 100-ft panels of 3-, 4-, and 5-in mesh. Nets will be 12-ft deep, hobbled to 10-ft every eight feet; nets will have 0.5-in foam-core float line and 65-lb lead-core lead line. The webbing used in each of these panels will be constructed of 8 ply, 0.2-mm twist mesh. Catch of all Asian carp species will be recorded by mesh size.

ALWFF staff will conduct electrified dozer trawls as a standard method of sampling. Dozer trawl sites will be established in Pickwick, Wilson, and Wheeler Reservoirs. Multiple factors, such as logistics, feasibility, and scientific and statistical robustness, will be used in determining number and location of sampling sites. Specifications of the dozer trawl will be like those currently operated by TTU and CFWCO. Dozer trawl surveys will be seasonal, similar to gill netting, and conducted during the daytime. Sampling transects may include a variety of habitat types (i.e., backwaters, channel borders, shoreline areas, open water). Each trawl sample will be conducted for at least 5 minutes. All species will be counted, and catch rates will be calculated as fish/5-min. Though electrified dozer trawls will replace boat-mounted electrofishing as the standard method, boat-mounted electrofishing will still be utilized on an as needed basis and in special circumstances.

All collected Asian carp specimens, or an appropriate subsample, will be examined to determine species, length (mm), weight (g), and sex. Otoliths and/or fin rays will be removed from Asian carp for age and growth analysis. Other metrics may be collected if needed.

Objective 3
All Asian carp collected during the project sampling period will be removed during the fish survey work described in Objective 1; however, any Asian carp collected with a tracking device will be documented and released immediately. This active removal of fish will be especially important to slow the upstream migration of Asian carp, since the leading edge of their migration in the Tennessee River basin is likely located in Alabama. All by-catch for each sampling gear will be recorded and any non-target fish will be released immediately after capture.

Map: Areas in red indicate study area for ALWFF. The yellow star indicates where additional work may be conducted, if needed.



Estimated Timetable:

Project Activity	Location	Dates	Year
Gillnetting	Pickwick Reservoir	Various (Seasonal)	2020 & 2021
Gillnetting	Wilson Reservoir	Various (Seasonal)	2020 & 2021
Gillnetting	Wheeler Reservoir	Various (Seasonal)	2020 & 2021
Electrofishing	Pickwick Reservoir	Various (Seasonal)	2020 & 2021
Electrofishing	Wilson Reservoir	Various (Seasonal)	2020 & 2021
Electrofishing	Wheeler Reservoir	Various (Seasonal)	2020 & 2021

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Schrank, S. J., C. S. Guy, and J. F. Fairchild. 2003. Competitive Interactions between Age-0 Bighead Carp and Paddlefish. Transactions of the American Fisheries Society 132:6, 1222-1228.

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Upper Mississippi River Sub-Basin Asian Carp Partnership

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 formed an Ad-hoc Asian Carp Team (UMRACT) to develop an Upper Mississippi River Basin Asian Carp Control Strategy Framework (UMRB Framework) to coordinate Asian carp prevention and control efforts in the UMRB. The UMRB Framework was completed in August 2018 as a regional stepdown plan from the National Plan and is based on the existing UMRCC's 2010 Fisheries Plan Goal 4.

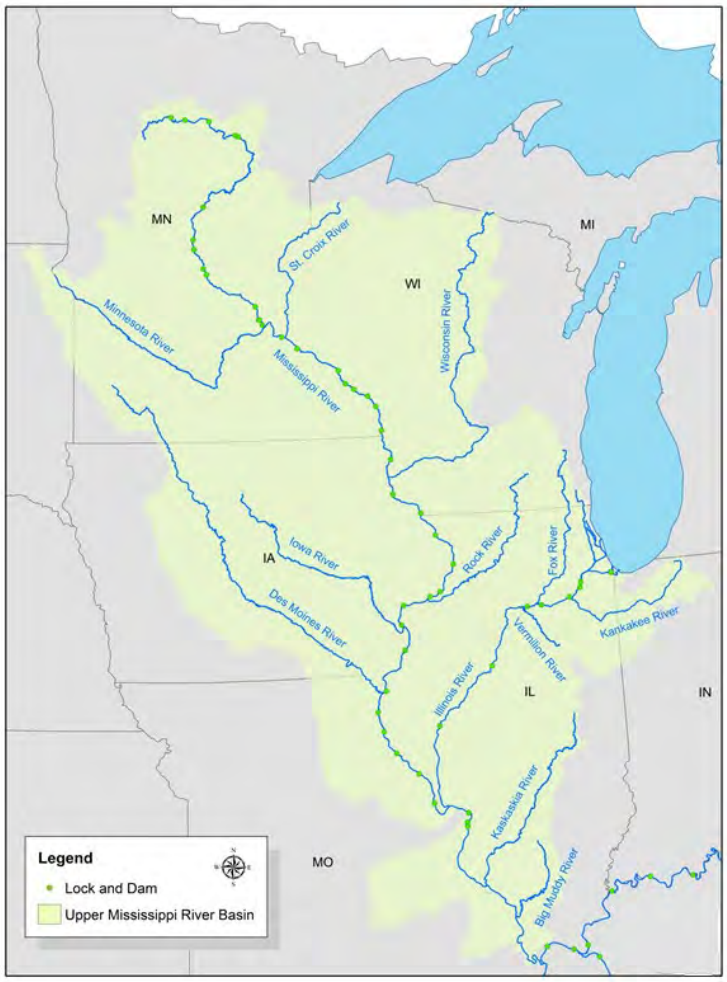


Figure 8. Map of the Upper Mississippi River Basin.

Detection of and Response to Invasive Carp in the Presence Front and at the Invasion Front in the Upper Mississippi River

Lead Agency and Author: Minnesota Department of Natural Resources (MNDNR);
Nick Frohnauer (Nick.Frohnauer@state.mn.us)

Cooperating Agencies: US Fish and Wildlife Service La Crosse Fish and Wildlife Conservation Office (LFWCO), US Geological Survey (USGS), Wisconsin Department of Natural Resources (WIDNR), Iowa State University through the Iowa Department of Natural Resources (IADNR), National Park Service (NPS)

Statement of Need: Bighead Carp *Hypophthalmichthys nobilis*, Black Carp *Mylopharyngodon piceus*, Grass Carp *Ctenopharyngodon idella*, and Silver Carp *H. molitrix* (collectively called invasive carp) are non-indigenous fishes that were introduced to the USA in the 1960s and 1970s from Asia for human consumption and biological control. Since that time, invasive carp have expanded their range (e.g., escaping secure facilities) and are now occurring more frequently throughout the Upper Mississippi River Basin. Current scientific evidence supports a strong likelihood of negative impacts to native species (e.g., freshwater mussels and fishes). Preventing population expansion is the most cost effective way to limit negative impacts. Understanding current population dynamics and employing response actions are a key component in a deterrent and control strategy.

Partners will continue adaptive development and implementation of a comprehensive and complementary early detection and response program for Bighead, Silver, Grass, and Black carps in the Upper Mississippi River Basin. The early detection program helps define the current presence, invasion, and established fronts and evaluate how these fronts change through time, important knowledge for management decisions. Additionally, this effort helps evaluate the effects of management actions: a commercial harvest program and the Upper Mississippi River Deterrent Strategy. Sampling uses a diverse array of traditional and novel gears to sample all potential life stages in targeted areas. Responding to invasive carp captures has also been part of the program but has taken on an increased significance in 2020 with the capture of 50 invasive carp in Pool 8 in March 2020.

Prior to 2018, the monitoring project included the entire Upper Mississippi River. Using data collected from the monitoring project in 2015-2017, there is a better understanding of invasive carp populations throughout the river and the UMR Asian carp partnership has identified zones of river where population differences exist for each species. There is an established zone, a management zone, a presence but unestablished zone, and the section where carp have not been found. Given the different objectives and sampling strategies in each zone, the UMR partnership decided to split the monitoring project into two projects. Though split, monitoring participants will still coordinate and communicate efforts throughout the basin. Overlap does occur between the sections of river to ensure there are no gaps.

Understanding the population status in the presence zone is important for a variety of reasons. At this time, there are no deterrents in place on the Mississippi River. While lock and dams likely slow the upstream movement, invasive carp are still able to make it upstream as evidenced

by the capture of 50 invasive carp in Pool 8 in March 2020. It is important to know where carp are established or reaching spawning thresholds to decide when and where to implement management strategies such as deterrents or removal efforts. Also, response removal efforts may help delay populations from reaching numbers that result in successful spawning events. Lastly, having a strong data set helps managers measure the success of management efforts.

Objectives:

1. Measure Invasion Front Population Characteristics and Distribution, and Respond Accordingly
    - A coordinated, basin wide Asian carp population evaluation program was established in 2015 with the formalization of the UMR Asian carp workgroup. Adjustments to goals, methodologies, and sampling targets have occurred annually utilizing knowledge gained from this data.

2. Monitor Movement of Invasive Carp to Refine Monitoring Locations, Assess Habitat Use, and Inform Current Population Status
    - Detecting and accurately estimating density of invasive carp in the presence zone is difficult. Captures of invasive carp in the presence front have been relatively stable the past five years. Biologists are fairly confident this is an accurate picture of the current population status based on negative larval samples and improving sampling strategies. Using tracking data to improve sampling methodology increases certainty in results. Secondarily, partner agencies in the established and management zone have shown that using telemetry tagged fish has increased invasive fish captures.

3. Measure the Upstream Extent of Asian Carp Larval Fish Production
    - This objective focuses on understanding the reproductive boundary of invasive carps. This is critical information for managers in the UMR who are determining the placement of deterrents and guiding targeted commercial efforts to prevent the range expansion of invasive carps.

4. Employ Reasonable Response Efforts to New Captures of Invasive Carp.
    - This objective focuses on responding to a large capture of invasive carp in the presence zone. Understanding the population size in Pool 8 and removing invasive carp is important to prevent spawning in this section of the river.

Agency: Minnesota Department of Natural Resources (MNDNR)

Activities and Methods: Larval trawling will be conducted from mid-May through mid-July at potential indicator sites in the UMR and its tributaries. If a peak in the hydrograph is observed or once water temperatures reach 62-65º F (17 or 18º C), larval sampling will be conducted. A bow mounted icthyoplankton 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. Trawling locations will target areas biologists consider, based on current knowledge, a high probability for sampling invasive carp eggs and larval fish if they are present. 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, will be rinsed with water, and preserved in 90% ethanol. All eggs and fishes will be identified to the lowest taxonomic category until they are deemed either positive invasive carps or negative invasive carps.

A large purse seine will be used to sample deep water habitats for adult invasive carp throughout the year. A purse seine is an invaluable tool to sample previously under sampled deep habitats both for invasive carp and native planktivores. From our acoustic tagging results of the first Bighead Carp, this fish inhabited Lake St. Croix from Hudson, WI to Afton, MN throughout the year in water that was routinely deeper than 50 feet but only ventured to depths below 20 feet on rare occasions. While sampling for the tagged Bighead Carp, crews were also able to sample and tag an increased number of Paddlefish, a native planktivore with similar movement patterns and similar feeding niche.

The seine measures 2000 ft. long and 40 ft. deep with 5 inch stretched mesh (2 ½" square mesh). The seine will also be constructed in panels connected with ½" braided poly rope and snap links to allow for reconfiguration to allow crews to use the seine as a standard commercial beach seine. The seine will be set using a small boat pulling one end of the net in a circular manner from another boat carrying the remainder of the seine. Once the seine is deployed, a purse line on the bottom of the net will be pulled tight to entrap the fish present within and the net will be hauled by winch or by hand to allow for the sorting of the enclosed fish. It is expected that the state contract commercial fisherman will transport and haul this seine due to its size and the expertise commercial fishermen have with setting a commercial-sized net of this complexity.

Electrofishing will occur from May through September in a variety of habitats including backwaters, side channels, main channel borders, and over wing dikes. Sampling locations will be determined at the discretion of the sampler in a manner to target potential congregations of invasive carp throughout the field season. During large sampling events, electrofishing will be done in conjunction with gill netting to better push fish into large mesh gill nets.

A smaller electrofishing boat with an outboard jet motor will be used to sample shallow backwaters, in conjunction with the larger electrofishing boat. It is believed that juvenile invasive carps are a limiting life stage to their populations' growth and that juvenile invasive carps likely overwinter in anoxic backwaters.

Gill netting and trammel netting will occur from March through December as time and conditions allow. 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 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 60º F.

Commercial fishermen will be contracted to target invasive carp with both gill nets and seines on all monitored systems. MNDNR personnel will accompany contracted commercial fisherman to direct sampling locations and monitor efforts. Netting will occur at the discretion of MNDNR personnel in likely invasive carp habitats or as a response to captures. 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.

In addition, private commercial gill net and seine operations will be monitored when possible to observe for invasive carp. 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.

Pursuant to Minnesota Statute 84D.05, invasive carp collected in Minnesota waters can be tagged and released by MNDNR staff: "**Permit for invasive carp".** The commissioner may issue a permit to departmental divisions for tagging bighead, black, grass, or silver carp for research or control. Under the permit, the carp may be released into the water body from which the carp was captured. This subdivision expires December 31, 2021." Based on the tagging results, researchers will gain a better understanding of movement patterns and habitat preferences, while posing a very low risk to native fish populations or risk of increasing invasive carp populations. This information will be used to inform detection and removal efforts.

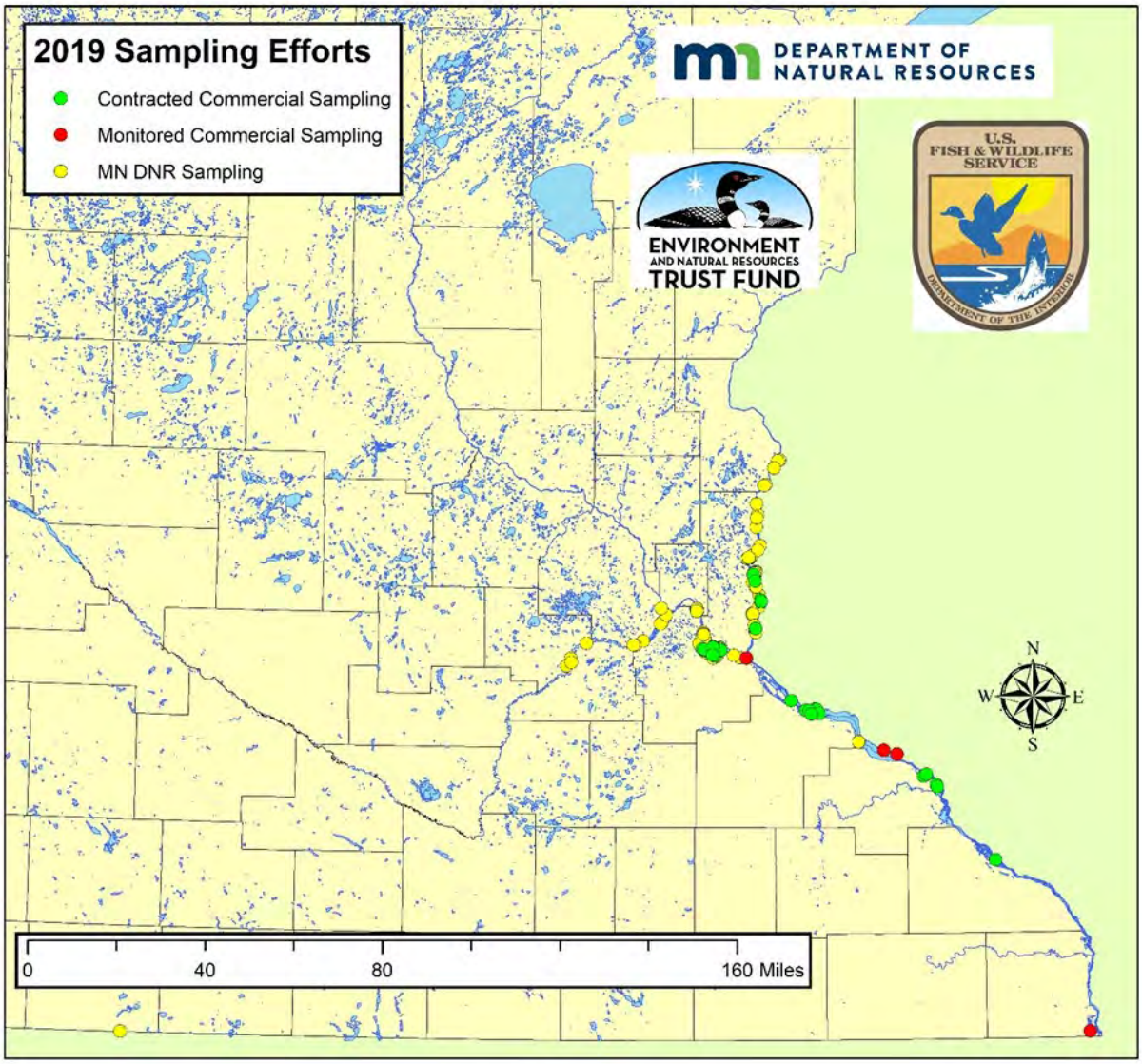
In 2020, multiple invasive carp are permitted to be tagged and at liberty at one time and tracking of these fish will be done using both passive telemetry (using an elaborate receiver array already in place) and active tracking (using finer scale tracking techniques) to determine preferred habitats, movement patterns, and ultimately to re-capture tagged fish and remove other invasive carp caught. It will ultimately be the discretion of the permittee if a given invasive carp should be tagged and released based on variables including location of capture, time of year, river flows, ability to successfully track the fish at staff levels available, as well as other contingencies dictated by the circumstances present and the in-depth knowledge of these species' biology and trends in movements and behaviors.

In 2020, a real-time receiver will be deployed on the St. Croix River to provide the details of the tagged Bighead Carp (or subsequent tagged invasive carp) through emails and/or text messages. Similar to acoustic receivers already in place, the receiver (a VEMCO VR2C cabled receiver) will be able to receive, decode, and log transmissions from tagged fish in the area including the fish's unique identification number. In addition, this receiver will be fitted with solar panels and a modem to transmit the data of specific fish electronically through 4G telecommunications to the MNDNR invasive carp crew without the need to be in the field actively tracking the fish. It is expected, this real-time receiver will be placed in an area that can be effectively blocked off and extensively sampled to provide the best opportunity for recapture or the capture of additional invasive carp schooling with the tagged individual.

The described activities require a special permit issued by MNDNR Division of Ecological and Water Resources (EWR). For more details regarding this permit, please contact the MNDNR for

a copy. For results from the first tagged invasive carp in Minnesota, see the 2017- Present invasive carp sampling reports.

Map of Project Area:



Minnesota DNR 2020 invasive carp sampling area. Map depicts 2019 sampling locations which will be similar in 2020 with added effort in the furthest downstream reach (Pool 8).

Estimated Timetable for activities

Activity	Time Period (Season, month/year)
Gill/Trammel Netting	March – November (2020/21)
Electrofishing	May – September (2020/21)
Larval Trawling	May – July (2020/21)
Commercial Seining	Year round (2020/21)
Commercial Gill Netting	Year round (2020/21)
Carp Tracking	Year round (2020/21)
Annual Project Report / Executive Summary	April 2020 and 2021

Agency: Iowa State University (ISU)

Activities and Methods: Larval fishes will be sampled during May and June 2021 in pools 14-16 of the Mississippi River using ichthyoplankton tows. Ichthyoplankton tows (0.5 m diameter net) 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 flowmeter will be mounted in the mouth of the net to estimate volume of water filtered during each tow. After each tow, ichthyoplankton net contents will be rinsed toward the cod end, placed in sample jars, and preserved in 95% ethanol. In the lab, fish larvae will be identified to family.

Chlorophyll *a* will be collected in conjunction with each icthyoplankton tow. Chlorophyll *a* will be measured by filtering approximately 200 mL of water through a GF/F Whatman© glass fiber filter (47 µm porosity) and placed on ice. Chlorophyll *a* will be extracted with 90% acetone and quantified using a Fluorometer (Tuner Designs) to obtain chlorophyll *a* concentrations (µm/L).

Map of Project Area:

Map of Iowa, USA with locks and dams denoted by black lines and pools 14-16 where sampling will occur denoted with red dots.

Estimated Timetable for Activities

Activity	Timeframe
Ichthyoplankton tows	May-June 2021
Chlorophyll *a* sampling	May-June 2021
Sample processing in the lab	May 2021-September 2022

Evaluation of Controls on Density and Behaviors of Asian Carp in the Lower UMR

Lead Agency and Author: US Fish and Wildlife Service La Crosse Fish and Wildlife Conservation Office (LFWCO); Wesley Bouska (wesley_bouska@fws.gov) and Mark Fritts (mark_fritts@fws.gov)

Cooperating agencies: Illinois Natural History Survey (INHS), Illinois Department of Natural Resources/Western Illinois University (SIU), Missouri Department of Conservation (MDC), US Geological Survey (USGS).

Statement of Need: The Upper Mississippi River (UMR) Asian carp partnership has identified the area from LD 15 downstream to LD 19 as the Intensive Management Zone (IMZ) for Bighead Carp (*Hypophthalmichthys nobilis*) and Silver Carp (*Hypophthalmichthys molitrix*). Contracted removal efforts have been implemented in this zone since 2016, but the impacts of those efforts are largely unknown. Furthermore, additional contract removals have been slated for funding in pools 20-22 beginning in FY20. A robust stock assessment program is needed to more directly evaluate how populations of Asian carps may be affected by current contract removals and to forecast their future response to alternative removal strategies. A robust stock assessment program should incorporate information from multiple fishery-dependent and independent sources to provide the least-biased composite estimate of carp abundance, biomass, demographic distributions, and migratory tendencies. Therefore, the primary objective of this plan is to describe a unified stock assessment program that will provide a system of data-driven feedback loops that managers can use to evaluate the impacts of their previous management decisions and consider alternative management strategies for the future.

In 2019 the LFWCO conducted hydroacoustic surveys in pools 16-19 of the UMR to obtain data on the relative abundance, size distribution, spatial distribution, and biomass of Bighead Carp and Silver Carp. Hydroacoustics requires physical fish sampling to separate the overall fish community size distribution into species-specific distributions. Fish community data collected in 2019 included electrofishing surveys by the Illinois Natural History Survey (INHS) conducted as part of their Long Term Electrofishing Program (LTEF), and also additional electrofishing surveys conducted by INHS in side-channel and backwater habitats, specifically to inform hydroacoustics. Fish community data was also made available from the contracted removal programs that operate in those pools through the Illinois Department of Natural Resources (ILDNR) and the INHS. In addition, spatial and temporal trends in Silver and Bighead Carp movements in response to contract removals and environmental changes, was investigated using sonic telemetry in Pools 5A-20.

Extreme flooding in the Spring of 2019 delayed the deployment of telemetry gear that would be used to monitor Asian carp movements, and atypical flooding and high water was still present in the IMZ during Fall of 2019 when hydroacoustics and physical fish sampling was scheduled. All sampling was still completed, although contract removal effort was reduced because of high water. Pools 16-19 generally have a low abundance of Asian carp to begin with, and high water creating refuge areas in flooded timber, exacerbated the already difficult task of collecting Asian carp with electrofishing in these pools. As a result, no Asian carp were collected in our fishery-independent sampling, and fishery-dependent data was very limited as well, due to the

aforementioned flooding. Consequently, hydroacoustic data did not have the robust fish community data necessary to calculate species specific density and abundance estimates.

Hydroacoustic surveys and the accompanying physical sampling, had not been previously attempted in the UMR, with 2019 being the inaugural year. This program should be expected to adapt over time as protocols are refined. In FY20, stock assessment efforts, including hydroacoustics and fishery-independent physical sampling, will be shifted downstream to Pools 19-21. These pools, particularly 20 and 21, have much higher densities of Asian carp. We also plan on increasing physical sampling effort 2-3 fold within these pools. In addition to having fishery-independent data being collected by INHS, the LFWCO and the Missouri Department of Conservation (MDC) will also be conducting sampling, which will include additional gears/sampling methods to ensure the collection of robust fish community data that will be able to accurately describe the Asian carp population relative to other fishes. Over time we will better understand the amount of physical sampling necessary to accomplish this work across UMR pools of varying Asian carp densities.

Objectives:

1. Determine Silver and Bighead Carp population densities via hydroacoustics surveys in Pools 19-21.

2. Conduct fishery-independent monitoring to support hydroacoustics surveys and deliver data on demographic parameters of Silver and Bighead Carp in Pools 19-22.

3. Conduct fishery-dependent analysis of demographic parameters from Silver and Bighead Carp captured by contracted fishers in Pools 14-22.

4. Monitor spatial and temporal trends in Silver and Bighead Carp movements in response to contract removals and environmental changes using sonic telemetry in Pools 5A-20

Agency: US Fish and Wildlife Service La Crosse Fish and Wildlife Conservation Office (LFWCO)

Activities and Methods:

In support of Objective 1, the LFWCO will conduct hydroacoustic surveys to obtain data on the relative abundance, size distribution, spatial distribution, and biomass of Bighead Carp and Silver Carp in the lower UMR. Hydroacoustic sampling is the least size-biased sampling gear currently available to fisheries professionals, thereby providing more accurate relative abundance and size distribution information for stock assessment purposes. Furthermore, the large spatial coverage capabilities of hydroacoustics can provide more precise and accurate relative abundance estimates, particularly for patchily distributed fish such as Asian carp. However, hydroacoustics is not a stand-alone gear, and does require physical fish sampling to separate the overall fish community size distribution into species-specific distributions. Hydroacoustics should be considered as a component of a larger comprehensive stock assessment program that is required for monitoring Asian carp populations and evaluating control efforts.
LFWCO will conduct mobile hydroacoustic surveys in pools 19-21 of the UMR. Hydroacoustic data will be collected similar to that described in MacNamara et al. (2016). LFWCO will use two

horizontally oriented split-beam transducers (200 kHz; BioSonics, Inc.) offset in angle to maximize water column coverage. Prior to each survey, each transducer will be calibrated on-axis following Foote et al. (1987). Surveys will be conducted from mid-September through October at selected areas of the main channel, side channels, bays and backwaters of pools 19-21. Following Coulter et al. (2018), these pools will be subsampled using approximately four-mile long transects along the main channel such that a minimum of 35% of the main channel length of each pool will be sampled, in addition to adjacent off-channel habitats.

Hydroacoustic data will be analyzed following MacNamara et al. (2016) using Echoview 11.0. Single targets will be detected using parameter values from Parker-Stetter et al. (2009). Multiple targets from a single fish will be grouped using Echoview's fish tracking algorithm to reduce the potential of over counting fish targets. The size of fish targets (total length; cm) will be estimated from mean acoustic target strength (dB) using a function specific to side-looking hydroacoustics (Love 1971). Hydroacoustic data will be informed by pool-specific fish community data that will be collected using traditional fisheries gears. Specifically, pool-specific proportions of fish will be determined for each 1 cm length group from 15-120 cm TL for Silver Carp, Bighead Carp, and other fish species. Length-specific proportions will then be used to categorize acoustically detected fish. Pool-specific length-weight regressions will then be used to estimate length-specific biomass for each species of interest, and density (numeric and mass) will be estimated.

In addition to pool-wide population surveys, additional surveys may also be conducted in FY20 at removal areas that feature real-time receivers. Using the same data collection methods as the pool-wide surveys, these surveys would be conducted pre- and post- contracted harvest events to evaluate harvest efficacy and establish the relationship between hydroacoustic density estimates, harvest CPUE, and real-time fish detection data. Hydroacoustic surveys may also occur along MN/WI border waters with a whole-pool survey of Pool 8, and additional surveys of selected areas upstream of Pool 8 at sites suggested by the MNDNR in an attempt to guide contracted fishers to Asian carp for removal.

In support of Objective 2, the LFWCO will conduct fishery-independent sampling to collect information on the relative abundance of Asian carp within the UMR fish community. Additionally, physical captures of fishes will facilitate collection of important demographic information (aging structures, individual lengths and weights, sex, tissue samples for genetic and physiologic studies, etc.). Furthermore, hydroacoustics gear requires physical sampling to separate the overall fish community size distribution into species-specific distributions. Fishery-independent sampling using traditional sampling gears like electrofishing will be less size selective than commercial netting, and provide more robust estimations of the fish community size structure. The ability to detect small fishes could enhance our capacity to detect sources of Asian carp recruitment and deliver additional data to build mathematical models exploring the response of the UMR population to future contract harvest scenarios.

In FY20, the LFWCO will conduct sampling in pools 19-21 using modified boat electrofishing or electrified dozer trawl, and gill nets. The use of a modified approach to boat electrofishing and an experimental gear (the electrified dozer trawl) will complement the traditional LTRM style electrofishing that will be occurring simultaneously in these pools by MDC and IL NHS (see sections below) with the intent of increasing the capture probability of Asian carps.

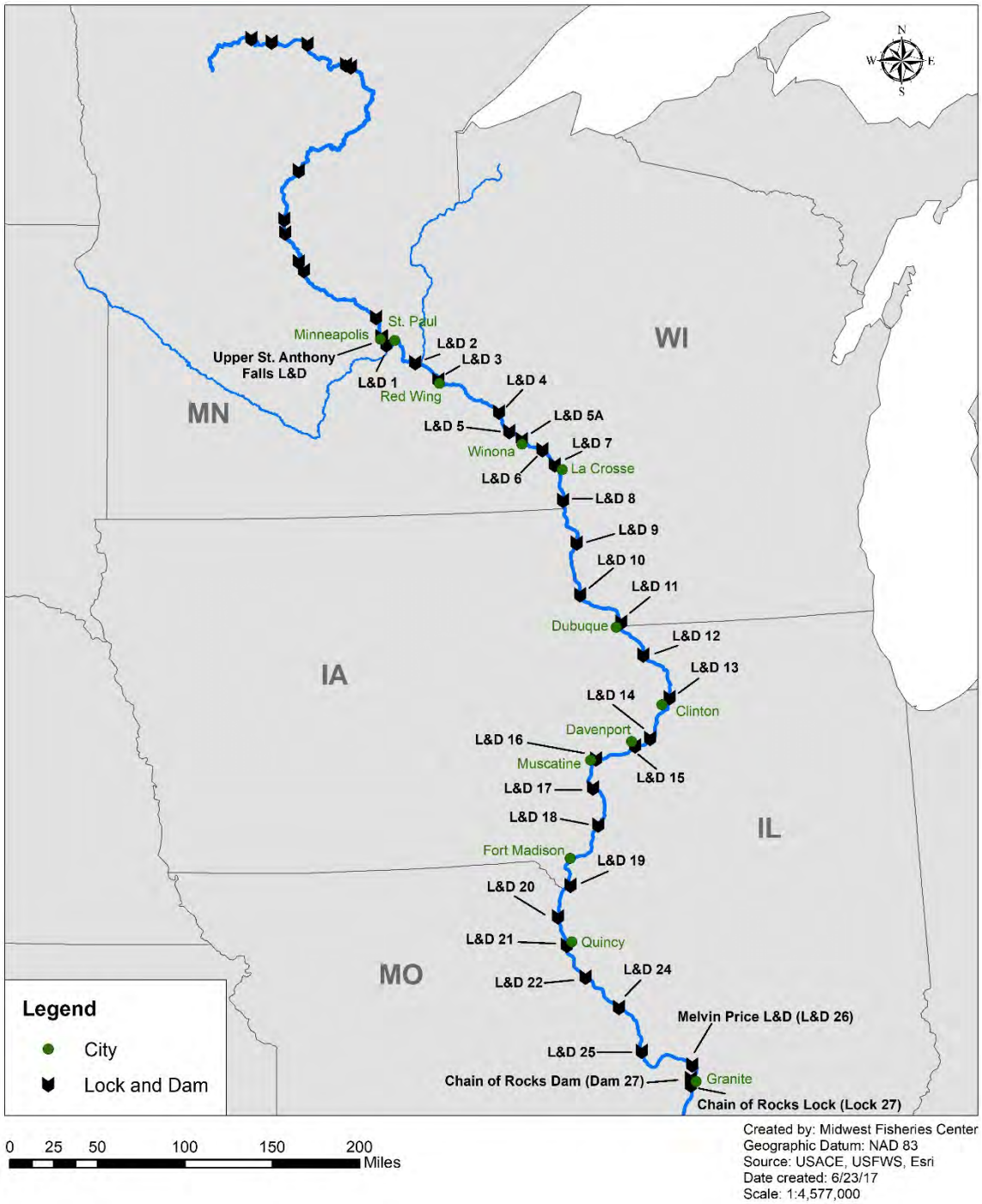
Electrofishing sites will be selected through a stratified random sampling design that will proportionately represent main channel border, side-channel, and backwater habitats in each pool. In the Fall of 2020, the LFWCO will conduct fishery-independent electrofishing surveys at up to 40 sites in Pool 19, up to 20 sites in Pool 20, and up to 30 sites in Pool 21. Additionally, we will conduct targeted, fishery-independent sampling with gillnets including up to 10 nets sets in Pool 19, up to five in Pool 20, and up to 10 sets in Pool 21.

LFWCO staff will be following an adaptive monitoring approach while implementing this program as an intertwined component of the larger comprehensive stock assessment. Sampling protocols may be re-evaluated in the future to include additional gears, and to expand or contract effort among pools depending on data needs and funding availability. Data generated via fishery-independent sampling will be integrated into a regional database designed to facilitate rapid data processing and sharing with Asian carp researchers. These data will also be available to other researchers studying elements of UMR fish communities. The operator/administrator of this fishery-independent survey will submit a brief annual report to summarize the data.

In support of Objective 4, the LFWCO will continue to maintain an extensive acoustic telemetry network in Pools 5a-20. Over 300 Silver Carp and Bighead Carp currently carry functional tags and provide information on the movements of Asian carp throughout the UMR. The primary function of the telemetry program is to provide information about congregations of fishes to maximize contract harvest efforts, identify priority locations for potential deterrent technologies and determine both individual and mass movements of Asian carp among pools and tributaries of the UMR. Real-time receivers will be seasonally deployed in Boston Bay (Pool 18), Cleveland Slough (Pool 17), Big Timber (Pool 17), and Credit Island (Pool 16) to provide daily updates to INHS and the contracted commercial fishers. This specialized technology allows INHS personnel to accurately direct the timing and location of fishing efforts to maximize harvest rates. The LFWCO will coordinate efforts with MDC, who will be maintaining some receivers in the lower river below Pool 20, and with MNDNR, who maintain some receivers in the upper UMR above Pool 5a (see sections below); with INHS, who use this data, and real-time receiver data in particular, to direct commercial fishing removals; and with USGS who run some telemetry equipment on the UMR and also house the telemetry database.

Data generated from the telemetry program are being used to monitor spatial and temporal trends in Silver and Bighead Carp movements in response to contract removals, actively direct contract removal efforts, and increase the efficiency of control and deterrence techniques and technologies. These data are also being used to generate complex temporal-spatial analyses that will be used to produce scientific manuscripts during FY 20-21.

Map of Project Area:



Estimated Timetable for activities

Project Activity	Pool	Season	Year
Hydroacoustic evaluation concurrent with removals	16-19	TBD	2020
Hydroacoustic Pool Surveys	19-21	Fall	2020
Hydroacoustic Surveys in MN/WI Waters	3-8	TBD	2020
Fishery-Independent Monitoring	19-21	Fall	2020
Deploy Acoustic Array	5a-20	TBD	2020
Implant Acoustic Tags in Asian Carp	TBD	TBD	2020
Download Receiver Data	5a-20	Every 4-6 weeks	2020

Agency: Illinois Natural History Survey/Illinois Department of Natural Resources (INHS)

Activities and Methods: In support of Objective 2, the INHS will conduct fishery-independent sampling to collect information on the relative abundance of Asian carp within the UMR fish community. Physical captures of fishes will facilitate collection of important demographic information (individual lengths and weights, etc.), and additionally will provide the information needed to separate the hydroacoustics overall fish community size distribution into species-specific distributions. Fishery-independent sampling using traditional sampling gears like electrofishing will be less size selective than commercial netting, and provide more robust estimations of the fish community size structure. The ability to detect small fishes could enhance our capacity to detect sources of Asian carp recruitment and deliver additional data to build mathematical models exploring the response of the UMR population to future contract harvest scenarios.

The INHS Illinois River Biological Station currently maintains an extensive standardized electrofishing program called the Long-term Survey and Assessment of Large River Fishes in Illinois or the LTEF program. The program uses pulsed-direct current electrofishing to sample fish communities at randomly selected locations throughout Pools 16-21 of the Mississippi River. The program operates on a tri-annual sampling schedule and traditionally has limited sampling to main channel border habitats. However, starting in FY19, additional funding was provided to expand sampling in Pools 16-19 to backwater and side-channel habitats that represent preferred habitats for Asian carp.

The LTEF program in FY20 will again provide supporting data that can be used to calibrate estimates of Asian carp derived from hydroacoustics surveys as well as a source of information about the relative abundance of Asian carp in the UMR. Expanded LTEF effort in FY20 will be focused on Pools 19-21. Electrofishing sites will be selected through a stratified random sampling design that will proportionately represent main channel border, side-channel, and backwater habitats in each pool. In the Fall of 2020, the INHS will conduct additional fishery-independent electrofishing surveys at up to 40 sites in Pool 19, up to 20 sites in Pool 20, and up to 30 sites in Pool 21.

In support of Objective 3, Silver and Bighead Carp from fishery-dependent sampling (this data is collected in a separate work plan) will provide information on the relative abundance of species in the UMR fish community and facilitate the collection of important demographic information (aging structures, individual lengths and weights, sex, tissue samples for genetic and physiologic studies, etc.), from Pools 14-19, and natal origin/spatial life history for fish above Lock and Dam 19. These data will be used to populate models to help direct fishing efforts and determine a basin/pool strategy for effort allocation to minimize upstream movement. A model for the Illinois River already exists and in partnership with USFWS we will seek to inform the models for insights into uses for UMR populations/strategies. Fishery-dependent data may also be part of the overall comprehensive stock assessment and be used in conjunction with fishery-independent data to inform hydroacoustic sampling. An executive summary of the fishery dependent monitoring program will be provided by October 2020 and an annual technical report will be provided by March 1, 2021.

Map of Project Area:

Estimated Timetable for activities

Project Activity	Pool	Season	Year
Fishery-independent Data Collection	19-21	Fall	2020
Analysis of fishery-dependent data	14-19	April-Oct	2020
Executive Summary	14-19	October	2020
Annual Technical Report	14-19	March	2021

Agency: Missouri Department of Conservation (MDC)

Activities and Methods: In support of Objective 2 and in conjunction with LFWCO and INHS, MDC will be conducting fishery-independent sampling. MDC will focus on the lower pools below the intensive management zone, Pools 20-22. Sampling will be conducted similar to USFWS and INHS with standardized electrofishing based on the LTEF and Long Term Resource Monitoring (LTRM; Ratcliff et al. 2014) fish element protocols. Both programs use pulsed-DC electrofishing at sites selected through a stratified random sampling design. Sites selection will include side-channel and backwater areas (if present) in addition to the typical main channel border sites, based on availability of habitats in each pool. In the Fall of 2020, MDC will conduct fishery-independent electrofishing surveys at up to 30 sites in Pool 20, up to 30 sites in Pool 21, and up to 30 sites in Pool 22. This sampling effort will provide information on the relative abundance of Asian carp within the UMR fish community, provide important demographic data (length, weight, condition, growth, mortality), and inform the hydroacoustic surveys proposed by the LFWCO.

Additionally, we will conduct targeted, fishery-independent sampling with gillnets and modified electrofishing within each of the target pools including up to 10 sites in each Pool 20, 21, and 22. The additional Asian carp collected in this targeted effort will be also be used for demographic information (length, weight, sex, GSI, fecundity, and lapilli otoliths will be taken from each individual). The demographic information gained from the Asian carp collected in the random and targeted efforts will be used to develop length and weight frequencies, condition indices, growth curves, and mortality estimates. This information will then be used to inform harvest models as well as serve as a measure of the effects of proposed removal efforts. The funding requested for this objective will be used to support two biologists to collect the fishery-independent data as well as process samples and analyze the data. The biologists will also aid in preparing updates for the partnership and annual reports.

Fishery-dependent data collection supporting objective 3, will be taking place under another workplan by MDC biologist that accompany commercial fishermen during contract removal efforts. Fish harvested in that effort will provide individual length, weight, condition, age, GSI, and fecundity for each Asain carp processed by biologist, as well as provide fish community data

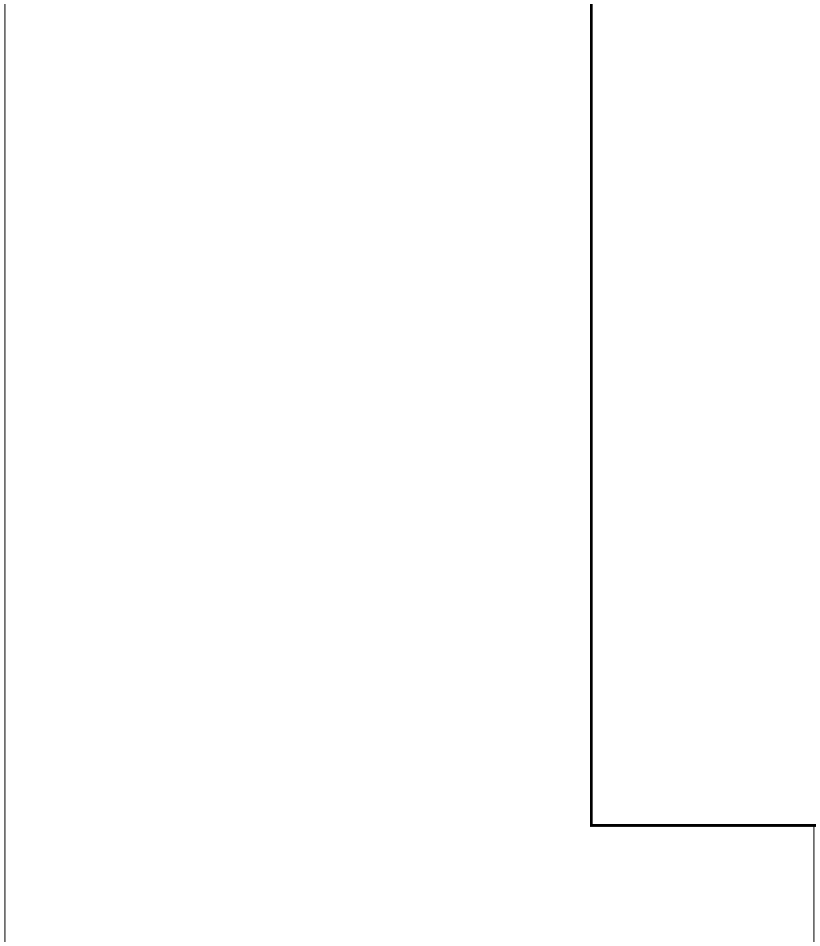
and native fish disposition upon release. This will provide information on the relative abundance of species in the UMR fish community, increase the collection of important demographic data, and also could be used to inform hydroacoustic analysis. The combination of this each agencies fisheries-dependent and fisheries-independent data, as well the hydroacoustic surveys will be part of a comprehensive stock assessment plan and can be used to evaluate Asian carp control measures and inform harvest models.

In support of Objective 4, MDC will continue to maintain an extensive acoustic telemetry network from Pool 20 downstream into the Lower Mississippi River. MDC has over 200 Silver and Bighead Carp with active transmitters in Pool 20, but there are over 300 Silver Carp and Bighead Carp currently carry functional tags and provide information on the movements of Asian carp throughout the UMR. The primary function of the telemetry program below Lock and Dam 19 is to provide information about Asian carp passage above Lock and Dam 19 into the Intensive Management Zone and potential deterrent location, but it also provided information about movements of Asian carp among pools and tributaries of the UMR and other Basins. Specifically, the funds requested this fiscal year will allow MDC to increase coverage in the lower pools (20-26). A pair of stationary receivers will be placed above and below each Lock and Dam to track number of implanted Asian carp within each pool, residency time, and transition rates between pools and basins. Not included in our funding request but to ensure detection of fish in the lower pools (21-26) 100 transmitters will be implanted in Asian carp distributed evenly per pool.

Data from the lower pool telemetry efforts will help fill in information gaps, inform removal efforts, and describe movements of Asian carp in response to contract removal. These data will also be available for use to inform complex temporal-spatial models (i.e., SEACarP) that could be developed for the UMR by modifying models developed in other basins.

MDC will coordinate with the UMR Partnership to ensure data is shared and updates are provided.

Map of Project Area:



Estimated Timetable for activities

Project Activity	Pool	Season	Year
Fishery-Independent Monitoring	20-22	Fall	2020
Analysis of Fishery-Dependent Monitoring	20-22	Winter	2020/2021
Deploy Acoustic Array	20-26	Summer/Fall	2020
Implant Acoustic Tags in Asian Carp	20-26	Fall	2020
Download Receiver Data	20-26	Every 4-6 weeks	2020/2021
Annual Report	20-26	March	2021

Literature Cited

Coulter, D.P., R. MacNamara, D.C. Glover, J.E. Garvey. 2018. Possible unintended effects of management at an invasion front: Reduced prevalence corresponds with high condition of invasive bigheaded carps. Biological Conservation 221: 118-126.

Foote, K.G., H.P. Knudsen, G. Vestnes, D.N. MacLennan, and E.J. Simmonds. 1987. Calibration of acoustic instruments for fish density estimation: a practical guide. ICES Cooperative Research Report 144: 1-57.

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MacNamara, R., D. Glover, J. Garvey, W. Bouska, and K. Irons. 2016. Bigheaded carps (Hypophthalmichthys spp.) at the edge of their invaded range: using hydroacoustics to assess population parameters and the efficacy of harvest as a control strategy in a large North American river. Biological Invasions 18: 3293-3307.

Parker-Stetter, S.L., L.G. Rudstam, P.J. Sullivan, D.M. Warner. 2009. Standard operating procedures for fisheries acoustic surveys in the Great Lakes. Great Lakes Fisheries Commission Special Publication 09-01.

Ratcliff, E. N., E. J. Gittinger, T. M. O'Hara, and B. S. Ickes. 2014. Long Term Resource Monitoring Program Procedures: Fish Monitoring, 2nd edition. A Program Report submitted to the U.S. Army Corps of Engineers' Upper Mississippi River Restoration-Environmental Management Program. June 2014. Program Report LTRMP 2014-P001. 88 pp. including Appendixes A–G.Foote,

Contract Fishing for Asian Carp Detection and Removal

Lead Agency and Author: Illinois Department of Natural Resources (ILDNR)/Illinois Natural History Survey (INHS); Jim Lamer (lamer@illinois.edu)

Cooperating Agencies: Missouri Department of Conservation (MDC), Iowa Department of Natural Resources (IADNR), US Fish and Wildlife Service La Crosse Fish and Wildlife Conservation Office (LFWCO)

Statement of Need: Adult Bighead, Grass, and Silver carps are present in varying abundance in Upper Mississippi River (UMR); however black carp have not been collected above Lock and Dam 19 (LD19). Dense populations of Bighead, Grass, and Silver carps with reproduction do exists in the lower pools of the Upper Mississippi River (20-26) and moderate populations with limited reproduction/recruitment occur in Pools 18 and 19, with some recent commercial catches being reported as far upstream as Pool 8. Bighead Carp and Silver Carp (Asian carp) populations are increasing in abundance and expanding their upstream range within the Upper Mississippi River (UMR). Limited fish passage at Lock and dam 19 (LD19) has slowed their progression and establishment in UMR reaches above Keokuk, IA. However, the detection of young-of –year Asian carp above LD19, especially a large year class in 2016, 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 16, 17, 18, and 19), additional measures are needed to monitor, control and manage Asian carp while densities are still low and manageable. We propose to use commercial fishers to intensively target Asian carp species for removal at the established front and invasion front (reaches above pool 16) and determine population abundance to determine the effects of harvest. This reduction in densities will alleviate upstream pressure on potential pinch points at Lock and dam 14 and 15, which provide an additional defense to slow the spread and establishment upstream. Removal efforts in pools below Lock and Dam 19, may not directly affect the reduction in reproduction and recruitment in the Intensive Management Zone, but it will reduce the overall density of Asian carp in the pools in the secondary management zone (Pools 20-22). This reduction in density below Lock and Dam 19 will decrease the number of Asian carp attempting to pass upstream into the Intensive Management Zone, which will be key in aiding the upstream removal efforts.

Decreasing the abundance and removal of Asian carp by commercial fishers has been successfully executed in the upper IL River to decrease pressure on the electric dispersal barrier. This targeted system of removal is needed in the UMR above LD19 as populations have attained densities high enough to support reproduction and continue to be detected in far northern reaches of the UMR in Wisconsin and Minnesota. Lock and dam 19 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, they have now reached densities that are increasingly detectable (jumping Silver Carp), 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 100,000 – 200,000 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. Total counts and biomass will be recorded from all locations and fish will be available for further scientific inquiry (e.g., age and growth studies, genetic identity, morphometric identification, condition factor, etc.). Total counts and biomass will be directly correlated with recovered jaw tags and population estimates.

Evidence of Asian carp reproduction was detected as early as 2009 in pool 19, and indicates that areas of the UMR above LD19 are capable of providing the hydrological requirements needed for successful Asian carp spawning, egg maturation, and development. This is reinforced with FWS/USGS telemetry movement information. Furthermore, this indicates that Asian carp have reached densities high enough to allow for potential mates to find each other and spawn successfully. The highest abundance of adult Asian carp above LD19 occurs in pools 17, 18, and 19, and larvae and young-of-year Asian carp have been detected from pools 16, 18, and 19.

With efforts in the Pools above Lock and Dam 19 to reduce abundance and eliminate reproduction potential, reducing the number of Asian carp attempting to pass upstream from lower pools will also be a component in this effort. The Illinois River has experienced success with contract removal in the Upper Pools reducing pressure on the electric barrier and stopped the upstream expansion, but an effort to reduce the population below the invasion front has also been shown to reduce the overall relative abundance (2020 Asian carp Action Plan). Learning from the Illinois River model, a multipronged approach with removal above the invasion front in Pools 14-19 and removal efforts below Lock and Dam 19 in Pools 20-22 will not only reduce the likelihood of upstream expansion and but also reduce the overall abundance of Asian carp.

This work acknowledges the sub basin framework's goals and strategies in development of this scope and meets these goals through by controlling and reduce populations of Bighead, Silver, Black and Grass Carp to reduce adverse effects from their feral populations (Objective 3) and physically remove Asian carps (Strategy 3.1),

Objectives:

1. Targeted removal of Asian carp species in UMR pools 14-22 using contracted commercial fishers and intensive agency netting in Pools 14-19.

2. To intensively target backwaters in Pools 14-19 for Asian carp removal by contracted commercial fishers during periods of peak backwater aggregation for 4 weeks in March and April, 2021

3. Collect Asian carp demographic information that can be used to inform harvest from Pools 16-22.

Agency: Illinois Department of Natural Resources/Illinois Natural History Survey (INHS)

Activities and 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). An INHS or ILDNR 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 LFWCO conducted as part of the intensive monitoring efforts within this reach.

INHS 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 week. Total length will be recorded for all or a subset of bycatch per boat, per week. Asian carp species will be counted and weighed in bulk to determine a total biomass removal for each 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 LFWCO 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. Body condition and gonad weight will be collected monthly and aging structures collected in November through January to be consistent with previous sampling. These data will be used to monitor for declining trends in density dependent response variables in response to harvest and to inform spatially explicit models to help direct fishing effort.

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

Objective 1
Targeted removal of Asian carp species in UMR pools 14-19 using contracted commercial fishers and intensive agency netting

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, Tuesday – Friday. Additional INHS 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 300,000-400,000 lbs.

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 to Darrick Garner (Palmyra, MO) or Shafer Fisheries (Fort Madison, IA) for use as liquid fertilizer

Objective 2
To intensively target backwaters in Pools 14-19 for Asian carp removal by contracted commercial fishers during periods of peak backwater aggregation for 4 weeks in March and April, 2021.

Three additional fishing crews will fish and remove Asian carp for a 4 week period in March and April in Pools 14-19 (time period of high density Asian carp backwater aggregation). This four week window has consistently been shown by USFWS-La Crosse to be a time of high density Asian carp aggregation in backwaters as they stage, conserve energy, and feed, prior to leaving the backwaters to spawn. This is the most predictable time to intensively target Asian carp populations in Upper Mississippi River backwaters. Given the large spatial scale of the Upper Mississippi River, this is a difficult distance to fish intensively and dedicate adequate fishing coverage during the spring high density backwater aggregation. Multiple crews spread out between the pools will allow for a much more effective and efficient harvest from Pools 17-19 and allow for mass removal within a small time frame. Additionally, since this is a predictable backwater staging time for the intensively fished lower pools (higher density pools), it is likely that upper pools that contain very low, hard to target densities, contain similar Asian carp backwater use and behavior during this time period. This would provide personnel to dedicate effort to these upper pools in this 4 week window, which would greatly enhance our success of removal in these areas. The unpredictable behavior of Asian carp outside of this time period, makes targeting low concentrations very difficult, especially in the absence of acoustically tagged fish in these areas. Commercial fishers during this time will also be required to assist with pound net deployment and emptying if these gears are utilized during this time.

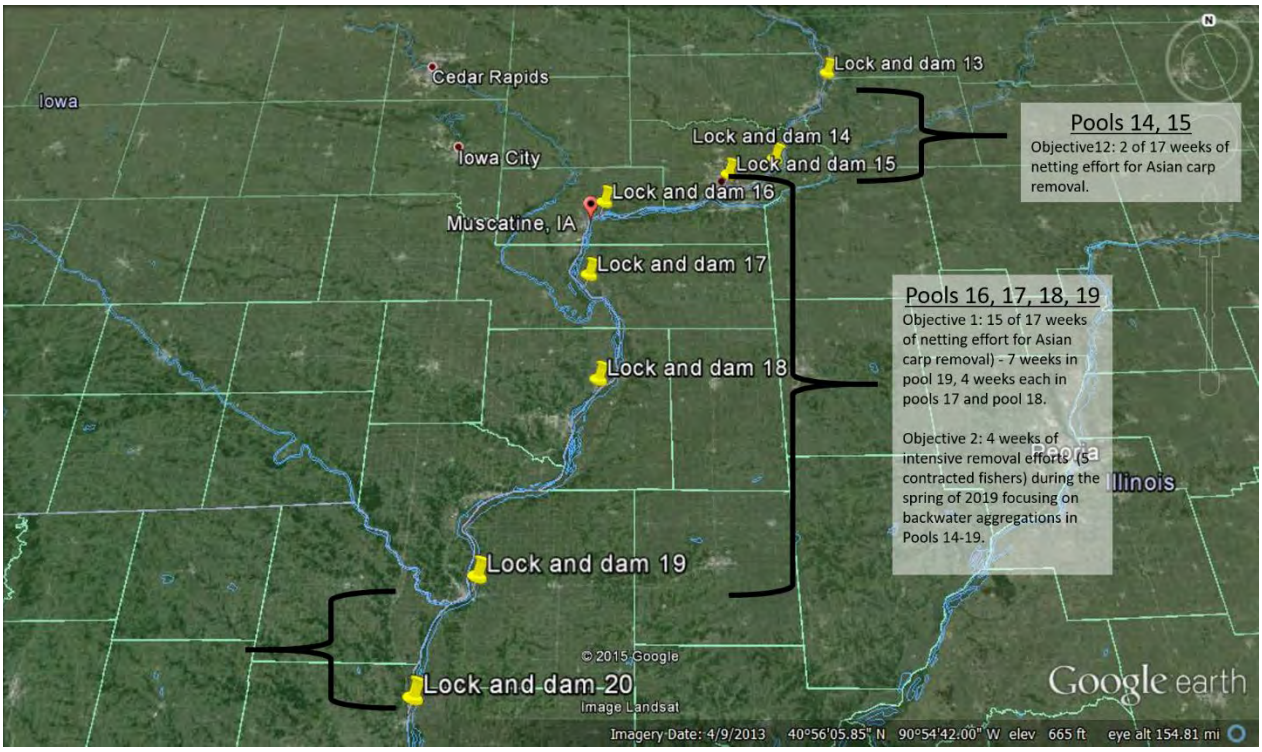
Length and weight will be recorded from each Asian carp prior to being sacrificed; individual jaw tag numbers will be recorded for all recaptured Asian carp. Non-target bycatch will be identified to species, enumerated, and condition recorded (i.e. healthy, moribund, dead) prior to release. All non-native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

Objective 3

Collect Asian carp demographic information that can be used to inform harvest from Pools 16-19

During contracted fishing, INHS crews will monthly collect up to 100 Bighead Carp and Silver Carp (50 per species) from Pools 16-19. Fish length and weight will be recorded to incorporate into body condition and vital rates analysis. All fish will be dissected, gonads visually staged, removed and weighed for GSI and egg condition analyses. Additionally, within the time range of November through January, 100 fish of each species from Pools 16-19 will be collected and aging structures removed (pectoral spines, postcleithra, and lapillus otoliths) will be used to model growth and in vital rate analyses. These data will be used to monitor for declining trends in density dependent response variables in response to harvest and also to inform spatially explicit models to help direct fishing effort. All results will be summarized in the annual report and formatted for SEACARP modeling.

Map of Project Area:



Estimated Timetable for Activities:

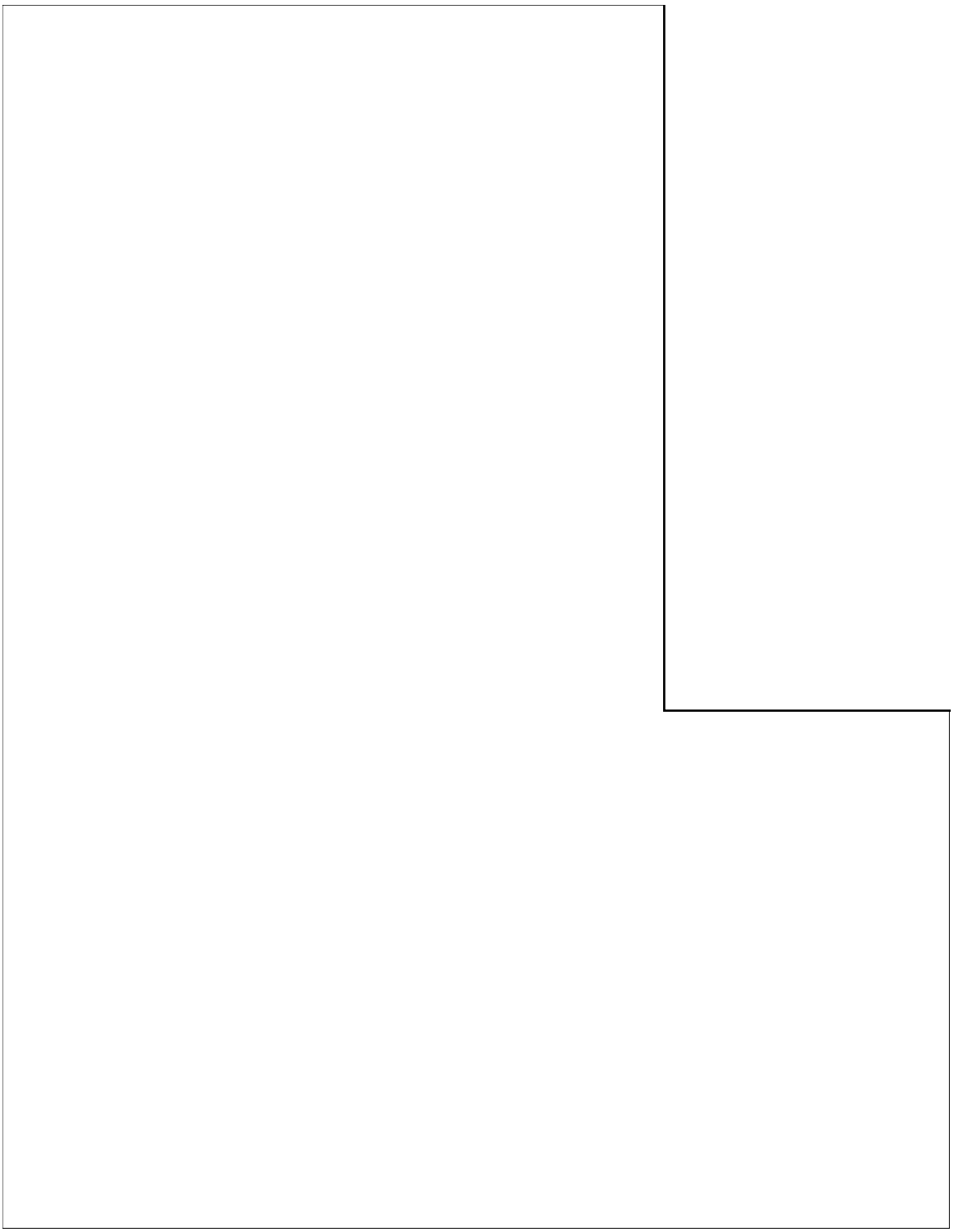
Project Activity	Pool	Month	Year
Harvest	14-19	October-July	2020-2021
Intensive harvest	16-19	April	2021
Demographics	14-19	Yearly	2020-2021

Agency: Missouri Department of Conservation (MDC)

Activities and Methods: MDC will pilot an Asian carp harvest program that will employ a tiered approach with the potential to use both contract fishing (weekly contracts) and enhanced fishing ($0.10/lb harvested) to support Objective 1. Both methods have been employed by neighboring states and will inform the most effective approach for Missouri Asian carp control and management in the future. Missouri removal efforts will occur in Pools 20, 21, and 22 to alleviate upstream pressure on Lock and Dam 19 and further spread into the Intensive Management Zone above Lock and Dam 19. Removal efforts will take place in the fall and winter of 2020 as river conditions permit and contracts are in place. Effort will be spread throughout the three pools with an overall goal of removing at least 1,000,000 pounds, the amount removed will ultimately be driven by how the contracts are set up with the majority of funding requested going to the removal effort, for example if only enhanced fishing were used $120,000 could be used to remove 1,200,000 pounds, but if weekly contracts are set up with specific fishermen that meet the requirements of the contract even more pounds could be harvested depending on the crews' success.

In support of Objective 3, the other portion of funding will be used to support a biologist that will be coordinating removal efforts, pick up for harvested Asian carp by processors (coordinating with IL and KY for pick up if a certain number of pounds are harvested), and the collection of demographic data. Similar to what INHS and IDNR will be doing in the upper pools, length and weight will be recorded from Asian carp prior to being sacrificed and bycatch will be identified to species, enumerated, and disposition will be recorded (i.e. healthy, moribund, dead) prior to release. MDC biologist will also collect up to 100 Bighead and Silver Carp (50 per species) monthly to collect more specific data such as sex, GSI, and fecundity. The aging structure (lapilli otoliths) will also be collected from 100 individuals from each species in each Pool (20-22) to be used to populate harvest models and also serve as a measure to look at trends through time to evaluate the effects of harvest.

Map of Project Area:



Estimated Timetable for Activities:

Activity	Pool	Time Period (Season, month/year)
Asian carp removal	20,21,22	Fall/Winter 2020 and Spring 2021
Demographic Data Collection	20,21,22	Fall/Winter 2020 and Spring 2021
Data Summary/Analysis	20,21,22	Winter 2020/2021 and Spring 2021
Annual Report	20,21,22	March 2021

Literature Cited:

2020 Asian Carp Action Plan. http://www.asiancarp.us/PlansReports.html

Evaluation of Fish Passage for Assessment of Bigheaded Carp Deterrents at Locks in the Upper Mississippi River

Lead Agency and Author: US Geological Survey (USGS); Andrea Fritts (afritts@usgs.gov)

Collaborating Agencies: Illinois Natural History Survey (INHS), Missouri Department of Conservation (MDC), US Fish and Wildlife Service La Crosse Fish and Wildlife Conservation Office (LFWCO), US Army Corps of Engineers (USACE)

Statement of Need: Invasive carp are established in the upper, middle, and lower Mississippi River and their expansion upstream threatens a variety of aquatic ecosystem services including fishing and recreational boating. The physical and operational characteristics of Lock and Dam (LD) 19 restrict upstream migration of fishes because the only upstream fish passage route is through the lock chamber. This restriction might be hindering consistent reproduction and recruitment of bigheaded carps enough to reduce their abundance upstream of LD19.

Acoustic deterrents have been developed for limiting the range of fish, and those systems show promise in deterring Asian carps. To date, small-scale acoustic deterrents have been tested on many native fishes and Asian carps in labs, outdoor ponds, and small rivers, but they have not been tested on a larger scale such as at lock and dam structures on the large rivers where Asian carps are abundant (Vetter et al. 2015, 2017; Murchy et al. 2017). Federal, state, and local partners have agreed to move forward with testing an Acoustic Deterrent System (ADS) at LD19 on the Mississippi River, with potential installation of the ADS in December 2020-Feb 2021. Testing of an ADS at a pinch-point dam, such as LD19, may help to prevent immigration into the Intensive Management Zone (IMZ) from Pool 20 and may minimize the continued expansion of Asian carp populations in the UMR (Whitledge et al. 2019). There is a need to collect baseline movement data on Asian carps and native fishes that can be used to aid planning and evaluation of an experimental ADS at LD19. Our project proposes continued collection of movement data using Vemco receiver arrays and acoustically tagged fish in the UMR to inform planning and evaluation of this ADS.

A better understanding of the position and timing of native fish and bigheaded carp in the lock chamber and approach is needed to aid in deterrent design. Depth tags (n = 25) were deployed in silver carp and bighead carp in spring 2019. Initial analysis of the depth data indicates that these tags perform well within this location and provide valuable information about the behavior of fishes in the downstream lock approach, lock chamber, and upstream lock approach. FY20 funds are needed to purchase acoustic depth-sensor tags (n = 100) for native fishes in Pool 20 (e.g., Bigmouth Buffalo, Paddlefish, Lake Sturgeon, Flathead Catfish) and to provide funding for 1/3 time for an INHS staff member to assist with the deterrent project (e.g., tagging, tracking, downloading receivers). State and federal partners have identified evaluating the effects of an ADS on native species as a high priority and depth-sensor tags will enable a better understanding of how natives behave within this system and in response to an ADS.

A translocation effort occurred in spring 2019, during which 72 silver and bighead carps were captured in Pool 19 and translocated and released downstream into Pool 20. These fish have

demonstrated a higher rate of upstream passage relative to Asian carps collected and tagged in Pool 20. During FY20, we propose to conduct a similar translocation with Grass Carp (n = 50) and Bigmouth Buffalo (n = 50). Bigmouth Buffalo, a native fish species, have been documented to complete upstream passage at LD19. This would provide pre-deterrent information about the movement patterns and behavior of translocated Bigmouth Buffalo and Grass Carp. Translocating these fish and tagging them with Vemco tags will allow us to use the existing Vemco longitudinal array to track their broader movements within the Mississippi River. Analyzing the behavioral data of translocated Bigmouth Buffalo and Grass Carp with the Vemco system will inform the value of translocating fishes that will be tagged with HTI telemetry transmitters during the evaluation phase of the ADS.

Vemco telemetry data are currently being collected by MDC, INHS, LFWCO and USGS from previously tagged fish (Asian carps and native species) moving through longitudinal and 2-dimensional arrays of Vemco acoustic receivers. Many of the previously tagged fish will continue to be tracked in addition to the newly tagged fishes. Information gathered from these receiver arrays are providing insight on how these fishes are passing through these locks and dams, and how passages relate to lock operation and river traffic. These data are being used to guide the design and installation of an experimental ADS at LD19.

Objectives:

1. Assess fish behavior and passage rates of Asian carps and native fishes at LD 19 to inform the design and testing of experimental Acoustic Deterrent Systems (ADS) to deter bigheaded carp while minimizing effects to native species

2. Deploy depth-sensitive transmitters in native fish species for determining vertical position in the water column and how native species interact with the physical structure of LD 19

3. Increase receiver coverage in and around lock chambers to improve one-, two-, or three-dimensional tracking of tagged fishes (native species and invasive carps)

4. Analyze depth-sensor data from Asian carps to determine vertical positioning within the water column

5. Evaluate if location of fish origin affects motivation to complete upstream passage

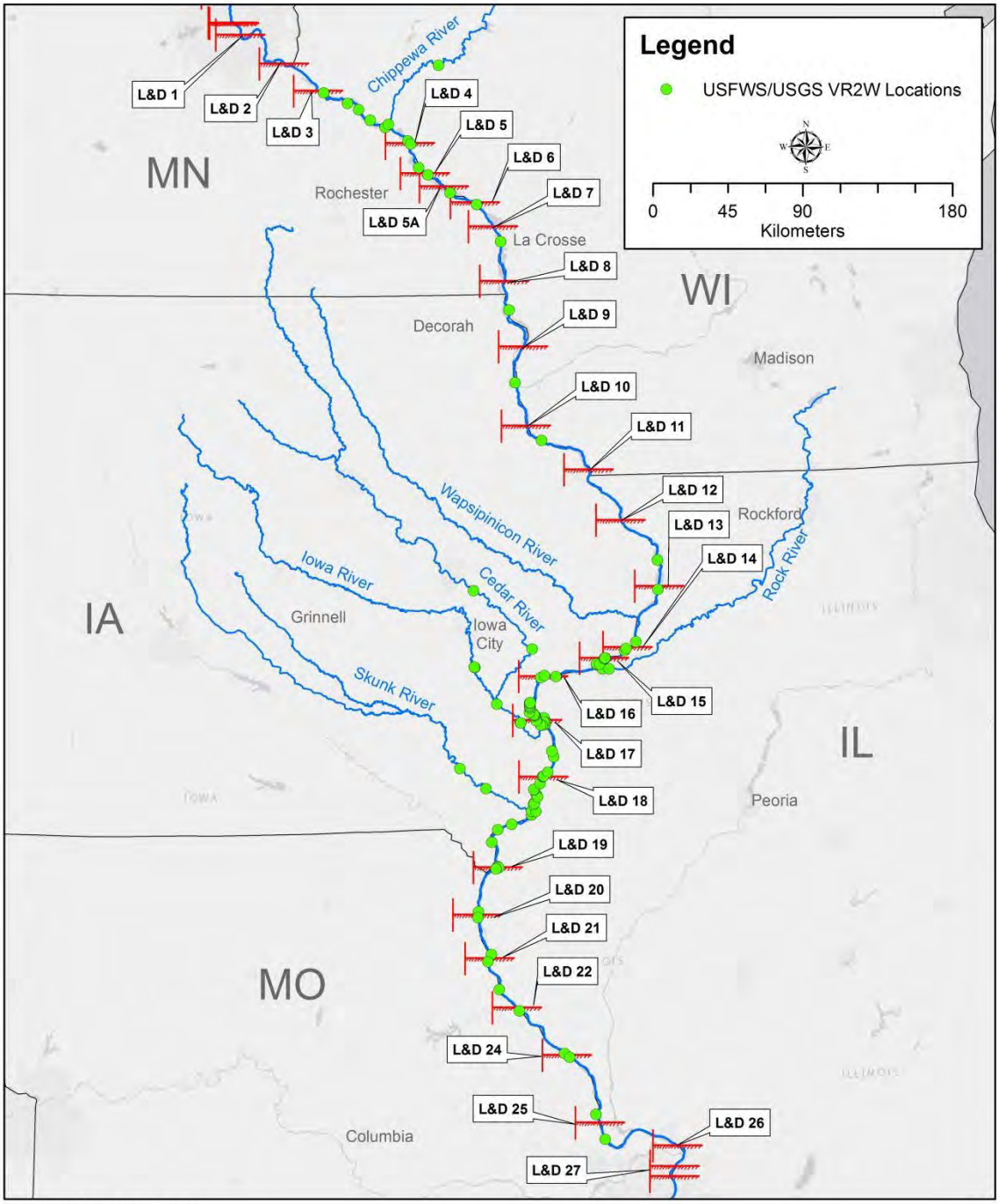
6. Use USACE Lock Queue Reports to inform the relationship between fish movements and behavior in relation to lock structures and operation

Agency: Illinois Natural History Survey/Illinois Department of Natural Resources (INHS)

Activities and Methods: Collaborating agencies will continue to quantify native and non-native fish passage in the IMZ, with special emphasis on LD19. The LFWCO longitudinal remote receiver array will be redeployed in pools 5A-19 in the spring of 2020 and the MDC stationary array will be maintained in pools 19-26. In 2019, MDC implanted transmitters into an additional 4 Bighead Carp, 9 Silver Carp, 29 Paddlefish, 43 Bigmouth Buffalo, 29 Flathead Catfish, and 67 Lake Sturgeon in P20. USGS and partners translocated 72 Asian carps from locations upstream of LD19 to Pool 20 during spring of 2019. These combined efforts resulted in > 600 potentially active tags in native and invasive species in P20 during the year of 2019. These fish will continue to be acoustically tracked to determine the frequency of dam passage and environmental conditions associated with passage.

FY2020 funds will be used to purchase 100 Vemco depth-sensitive transmitters to enhance understanding of native fish behavior in relation to the physical structure of LD19. Four species of native fish will be targeted for the depth tags: Bigmouth Buffalo, Lake Sturgeon, Paddlefish, and Flathead Catfish. Fish tagging will occur during fall 2020 and/or spring 2021. Individual fish will be weighed and measured for total length or fork length as appropriate. All acoustic transmitters will operate at the same frequency as existing tags in this stretch of the river. FY2020 funds will also used to provide funding for 1/3 time for an INHS staff member to assist with the deterrent project (e.g., tagging, tracking, downloading receivers).

Map of Project Area:



Map created by: Jeena Credico
Sources: USFWS, USGS, and Esri
Scale: 1:3,050,000
Projection: NAD 83 UTM Zone 15N

Locations of stationary receivers in the large-scale longitudinal array deployed in the Mississippi River basin. Receivers are maintained by USFWS and Missouri Department of Conservation.

Estimated Timetable for Activities:

Project Activity	Pool	Season	Year
Deploy longitudinal receiver array	All locations	Spring, summer	2020
Receiver downloads	All locations	Summer, fall, winter	2020-2021
Tagging	20	Fall, spring	2020-2021
Manual tracking	20	Monthly	2020-2021

Agency: US Geological Survey (USGS)

Activities and Methods: Two-dimensional positioning arrays have been deployed at LD19 (March 2017 to Nov 2018, April 2019 - present) and LD 15 (Oct 2016 to Nov 2018, April 2019-present). During 2019, additional receivers were deployed in the lock chambers and above the lock chambers to improve vertical positing and ability to detect fish in these locations. These arrays will be maintained during 2020. Data recorded on remote receivers from acoustically tagged fish (already tagged or to be tagged by MDC, WIU, INHS, USGS, and/or LFWCO) will be analyzed to determine pool to pool movement. Comparison of lock chamber receiver data to within pool receiver data will identify fish that have passed the dam without moving through the lock chamber. Data from the lock approach arrays will allow computation of time spent in or near the lock approach and lock, and within pool receivers should confirm or refute successful passage. With adequate 2D resolution, heat maps will be created to identify areas of frequent use in the downstream approach and lock chamber at LD 19.

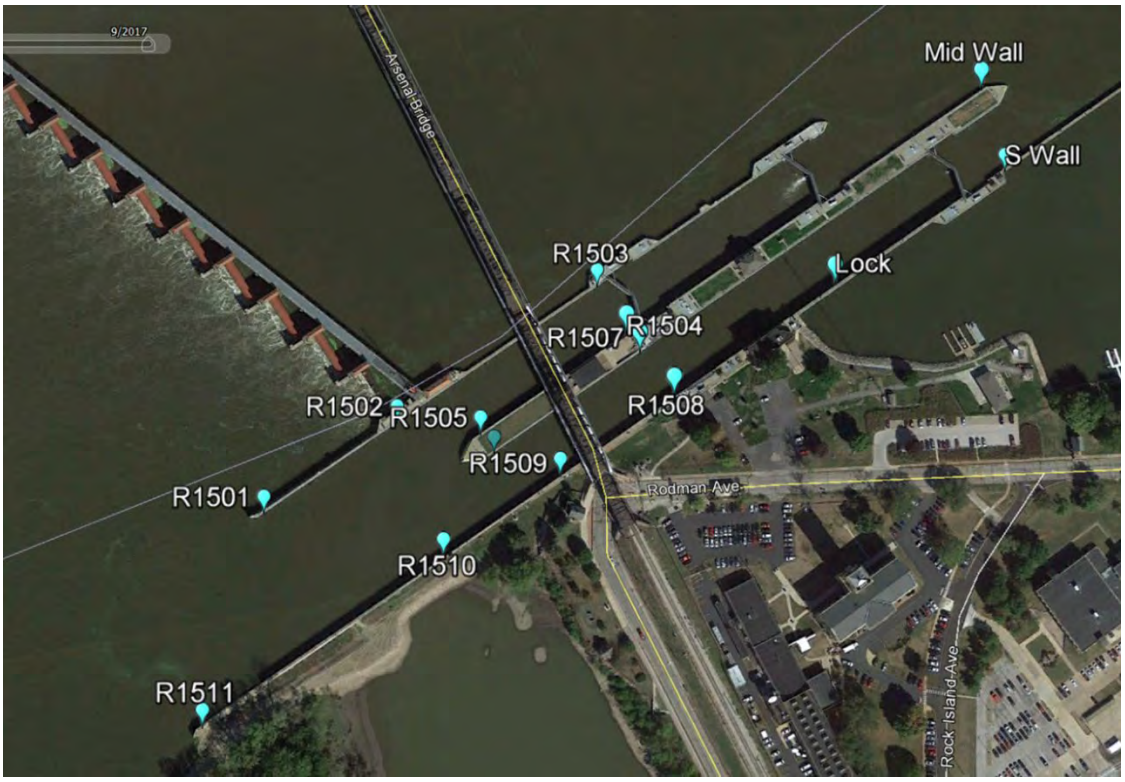
Depth sensitive transmitters (n = 25 total) were deployed in Asian carps during spring 2019. Data from these tags will be analyzed to study the behavior of Asian carps with regard to position within the water column and to understand how fishes interact and respond to river vessel presence in the downstream lock approach and the lock chamber. Depth tags were split between bigheaded carps that originated from P19 (n = 12) and P20 (n = 13). Analyses will be conducted to evaluate if location of origin affects Asian carp behavior and the depths at which they reside.

The discrepancy in successful upstream passages between bigheaded carps from P19 versus P20 prompted a decision to translocate 72 bigheaded carps in 2019. Translocated bighead and silver carps completed upstream passages much more frequently than their counterparts that were tagged in P20. Some native species tagged in P20 have exhibited successful upstream passage (e.g. Bigmouth Buffalo, Paddlefish), but no native species have been tagged upstream of LD19 to compare upstream passages of native species that originate above LD19. Additionally, Grass Carp have never been tagged upstream of LD19. During FY20, we will translocate 50 Bigmouth Buffalo and 50 Grass Carp to provide pre-deterrent information about the movement patterns of translocated native fish and Asian carps. Translocating these fish and tagging them with Vemco tags will allow us to use the longitudinal array to track their broader movements within the Mississippi River. Analyzing the behavioral data of translocated fishes with the Vemco system will inform the value of translocating individuals that will be tagged with HTI telemetry

transmitters during the evaluation phase of the ADS. All fish that are translocated will be noted in the database and will be treated separately for statistical analyses. Telemetry transmitters for this effort will be contributed by USGS.

Map of Project Area:

Location of receivers completing the fine-scale array in the lock approach at Lock 19. Receivers noted in blue are in the downstream lock approach, receivers in yellow are located inside the lock chamber, and the receiver in purple is located in the upstream lock approach.



Location of receivers completing the 2D array in the lock approach at Lock 15.

Estimated Timetable for Activities:

Project Activity	Pool	Season	Year
Download lock approach receivers	LD15, LD19	Spring, summer, fall, winter	2020
Tagging and translocating	Collect from P19, move to P20	Spring, fall	2020
Analyze fish behavior and passage events	LD15, LD19	Winter, spring	2020-2021

Literature Cited:

Murchy KA, Cupp AR, Amberg JJ, et al (2017) Potential implications of acoustic stimuli as a non-physical barrier to silver carp and bighead carp. Fish Manag Ecol 24:208–216. doi: 10.1111/fme.12220

Vetter BJ, Casper AF, Mensinger AF (2017) Characterization and management implications of silver carp (Hypophthalmichthys molitrix) jumping behavior in response to motorized watercraft. Manag Biol Invasions 8:113–124. doi: 10.3391/mbi.2017.8.1.11

Vetter BJ, Cupp AR, Fredricks KT, et al (2015) Acoustical deterrence of Silver Carp (Hypophthalmichthys molitrix). Biol Invasions 17:3383–3392. doi: 10.1007/s10530-015-0964-6

Whitledge GW, Knights B, Vallazza J, et al (2019) Identification of Bighead Carp and Silver Carp early-life environments and inferring Lock and Dam 19 passage in the Upper Mississippi River: insights from otolith chemistry. Biol Invasions 21:1007–1020. doi: 10.1007/s10530-018-1881-2

Strategy for eDNA Monitoring in the Upper Mississippi River Basin

Lead Agency and Author: US Fish and Wildlife Service La Crosse Fish and Wildlife Conservation Office (LFWCO); Jenna Bloomfield (jenna_bloomfield@fws.gov)

Cooperating Agencies: N/A

Statement of Need: The goal of using eDNA is to apply a monitoring tool that has a much lower false negative (fail to detect eDNA that is present) rate than other monitoring methods, such as electroshocking and gill netting, which have a very high false negative rate when animals are present in very low abundance (Darling and Mahon 2011). Using multiple detection methods provides a balanced and more complete monitoring program in areas where the target species is rare. Most efforts to monitor and remove Silver and Bighead carp from the Upper Mississippi River occur below Lock and Dam 15. Using eDNA upstream of this area as a long-term monitoring tool could provide early evidence to changes in the Asian carp presence in those pools where traditional capture gears are not heavily utilized. Recommendations from the latest research aimed at refining eDNA use for Bighead and Silver carp DNA detection are being implemented in the UMR each year and annual eDNA results in the UMR contribute to better understanding and utilization of eDNA technology for this purpose.

The use of eDNA sampling to monitor Asian carps works under Goal 2 of the Upper Mississippi River Basin Plan to "Contain expansion of Asian carps in the UMR while minimizing impacts to native species movement" and subsequently it contributes to Strategy 2.1 "Continue the UMR comprehensive monitoring program to maintain a current understanding of Asian carp distribution at all life stages for early detection, prevention, response, control and containment" and Strategy 2.5 "Develop and implement new early detection and monitoring tools to supplement eDNA" by providing a non-invasive method of detecting Asian carp DNA to give evidence to the expansion or containment of established populations and provide data that can be used to prioritize new areas of focus for other Asian carp detection methods and control actions.

Objectives:

1. Determine if Asian carp eDNA is present in targeted backwaters in the pools immediately upstream of the Intensive Management Zone

2. Inform managers of potential trends in Asian carp presence and provide data to support the prioritization of new backwaters to target with traditional capture methods

3. Refine detection probability and optimal sampling design of eDNA in the UMR.

Agency: US Fish and Wildlife Service La Crosse Fish and Wildlife Conservation Office (LFWCO)

Activities and Methods: The objectives of eDNA sampling in the Upper Mississippi River (UMR) is to 1) Determine if Asian carp eDNA is present in targeted backwaters in the pools immediately upstream of the Intensive Management Zone; 2) Inform managers of potential

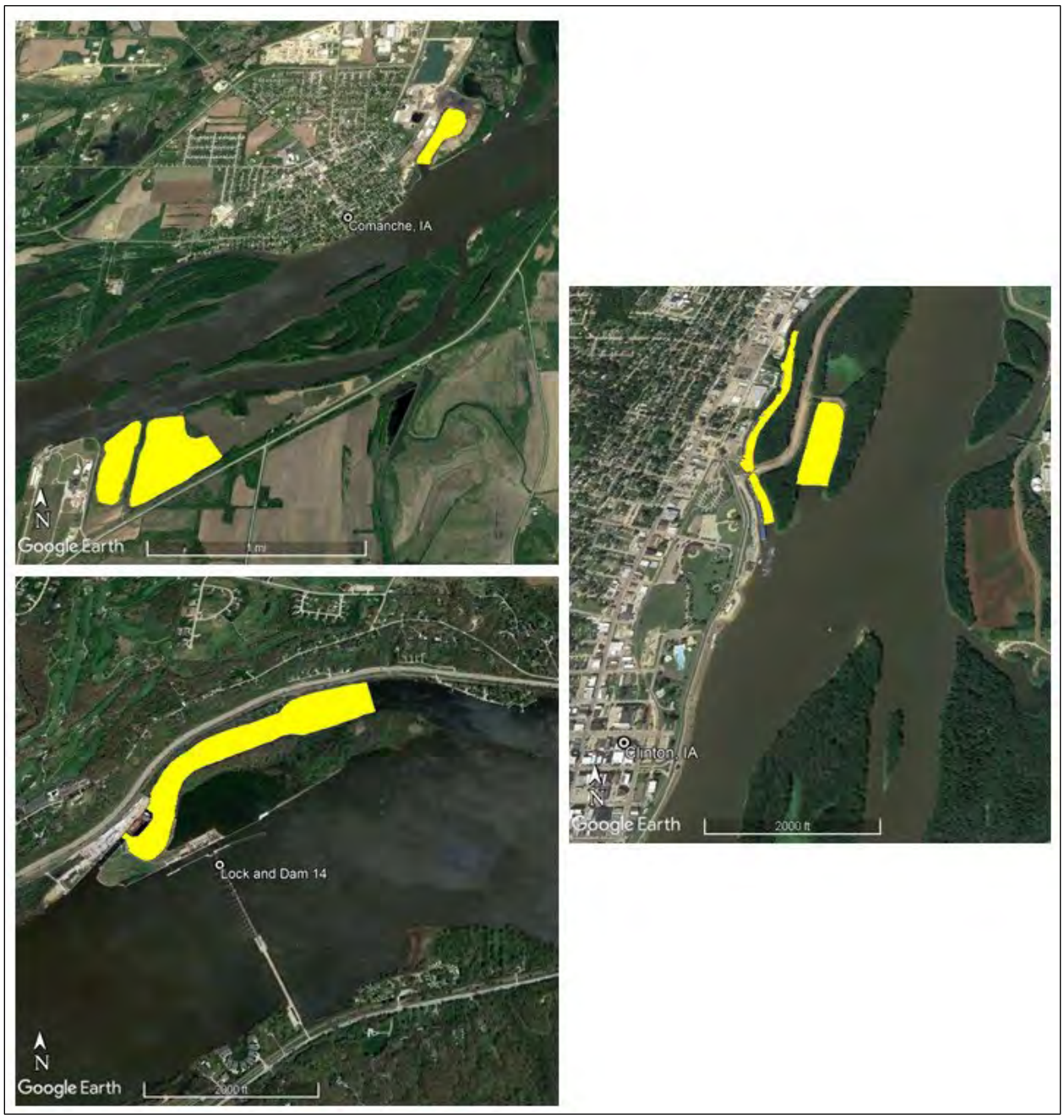
trends in Asian carp presence and provide data to support the prioritization of new backwaters to target with traditional capture methods; and 3) Refine detection probability and optimal sampling design of eDNA in the UMR. eDNA samples will be collected from pools 13, 14 and 16. Pools 13 and 14 will be targeted because they are immediately upstream of the Intensive Management Zone (IMZ; Pools 16-19), where Bighead and Silver carp have established reproducing populations. Pools 13 and 14 contain abundant backwater and off-channel habitat. Additionally, these pools are not sampled by other USFWS Asian carp monitoring efforts so eDNA can potentially give evidence to changes in Asian carp presence over time. Unpublished telemetry data from Pool 18 show that tagged fish move into backwater habitats in the spring, when water temperatures are between about 8-15 °C, and reside there prior to making spawning runs to tributaries (Kyle Mosel, USFWS, personal communication). Mize et al. (2019) showed that the probability of detecting eDNA was greater in a UMR habitat characterized by low flow (e.g. a backwater) in the spring and fall, as compared to higher flow areas (e.g. tributary and impoundments). Therefore, backwaters in Pools 13 and 14 were intended to be sample in both the spring and the fall of 2020. However, due to unforeseen circumstances as a result of the Coronavirus pandemic, no spring sampling was completed. Fall sampling will occur as planned with a return to biannual sampling in 2021. In addition to backwaters being sites of seasonal carp congregating, advantages of sampling backwaters in the spring and fall are that water temperatures are likely to be cooler, decreasing the rate of eDNA degradation in the water, and flow is low in these habitats, increasing eDNA residence at the site. Three backwater sites in Pool 13 and six sites in Pool 14 will be targeted. Sites were chosen based on flat pool bathymetry indicating depth greater than 4 feet at flat pool (USGS 2016). The goal of sampling Pool 13-14 is to assess trends in eDNA presence in backwaters over time and potentially use those data to prioritize areas to implement traditional capture gears to support Asian carp telemetry tagging and removal efforts outside of the IMZ, if desired in the future.

Additionally the backwater east of Credit Island in Pool 16 will be sampled for eDNA. This site was selected because a real-time telemetry receiver will be deployed at this location and Asian carp have been observed and captured at this location in the past. The intention of collecting eDNA from this site is to continually compare eDNA results to presence of telemetered fish and potentially hydroacoustic data. Due to delays if field work caused by the Coronavirus pandemic, real-time telemetry receivers were not deployed during the spring as intended. The Pool 16 Credit Island site will only be sampled for eDNA in the fall if the real time receiver is deployed by the time of sampling. These data and the results from Pools 13 and 14 will be used to further refine detection probability and sampling design year after year.

Based on recommendations from an eDNA occurrence model (Erickson et al., 2019; Mize et al., 2019), each backwater site will be sampled at a density of 1 sample per 0.01 km^2 with a minimum of 80 samples per site (i.e. backwater). Each sample will consist of 5, 50 mL conical tubes. Sampling and processing procedures will follow the USFWS 2020 Quality Assurance Project Plan (QAPP).

Maps of Project Area:

Backwater sites in Pool 13 of the Mississippi River that will be sampled for Asian carp eDNA in 2020.



Backwater sites in Pool 14 of the Mississippi River that will be samples for Asian carp eDNA in 2020.

Backwater site in Pool 16 of the Mississippi River that will be sampled for Asian carp eDNA in 2020.

Estimated Timetable for Activities:

Project Activity	Pool	Number of Samples	Month	Year
eDNA sampling	13-14, 16	640	April-May	2020
eDNA sampling	13, 14, 16	640	October-November	2020

Literature Cited:

Darling, J.A. and A.R. Mahon. 2011. From molecules to management: adopting DNA-based methods for monitoring biological invasions in aquatic environments. Environmental Research 111:978-988. https://doi.org/10.1016/j.envres.2011.02.001.

Erickson, R. A., C. M. Merkes, and E. L. Mize. 2019. Sample designs for landscape-level eDNA monitoring programs. Integrated Environmental Assessment and Management. Doi: 10.1002/ieam.4155.

Mize, E., R. Erickson, C. Merkes, N. Berndt, K. Bockrath, J. Credico, N. Grueneis, J. Merry, K. Mosel, M. Tuttle-Lau, K. Von Ruden, Z. Woiak, J. Amberg, K. Baerwaldt, S. Finney, and E. Monroe. 2019. Refinement of eDNA as an early monitoring tool at the landscape-level: Study design considerations. Ecological Applications. 15(5): 760-771.

U.S. Geological Survey (USGS). 2016. UMRR Topobathy. www.sciencebase.gov/catalog/item/5589ae19e4b0b6d21dd63942. Retrieved March 2018.

Development and Implementation of a UMRACT Invasive Carp Communications Plan

Lead Agency and Author: US Fish and Wildlife Service La Crosse Fish and Wildlife Conservation Office (LFWCO); Mark Fritts (mark_fritts@fws.gov)

Cooperating Agencies: Minnesota Department of Natural Resources (MNDNR), Wisconsin Department of Natural Resources (WIDNR), Iowa Department of Natural Resources (IADNR), Illinois Department of Natural Resources (ILDNR), Missouri Department of Conservation (MDC), US Geological Survey (USGS), US Army Corps of Engineers (USACE), National Park Service (NPS)

Statement of Need: The UMRACT identified improved public communications as a critical need/objective that should guide our group's annual decision-making process during a Structured Decision Making workshop in June 2019. While individual state partners and the ACRCC have established communications plans, the UMRACT does not have a current mechanism for developing and communicating messaging to non-scientific stakeholders on a regional scale. The proposed stakeholder identification workshop represents a first attempt at developing a communications strategy for the UMRACT. The purpose of this meeting is to work with UMR partners within the UMRACT towards the development of a combined communications strategy.

Objectives:

1. Conduct a communications workshop with USFWS Region 3 External Affairs to establish key messages and audiences.

2. Use results of workshop exercises to create communications products (reports, social media) that improve messaging on progress and continuing concerns.

3. Enhance coordination between UMR partners in the routing and response to public, elected official and media inquiries.

Activities and Methods: Biologists from the LFWCO will lead efforts to engage with communications and outreach specialists within their agency. Representatives from state and academic partners will participate in a workshop(s) organized to help our group identify key audiences for our messages and propose communication tools for future implementation during FY20. Internal USFWS funds will be used to cover salary and travel costs for agency communications specialists associated with this project. Specific goals of this project during FY20 will include: 1) the development of a written communications plan that can direct efforts to develop communication strategies and tools in FY21 and beyond and 2) in conjunction with USFWS communication specialists, propose and develop specific communication tools to increase stakeholder and legislative knowledge of UMR progress and funding needs.

Estimated Timetable:

- Stakeholder Identification Workshop with Katie Steiger-Meister, USFWS Region 3 External Affairs, 19 March 2020, Dubuque, Iowa.
- New outreach materials that highlight progress and funding needs of the effort to control Asian carp in the UMR

Feasibility Study for Developing a Unified Data Management Strategy for UMR Asian Carp Projects

Lead Agency and Author: US Fish and Wildlife Service La Crosse Fish and Wildlife Conservation Office (LFWCO); Mark Fritts (mark_fritts@fws.gov)

Cooperating Agencies: Minnesota Department of Natural Resources (MNDNR), Wisconsin Department of Natural Resources (WIDNR), Iowa Department of Natural Resources (IADNR), Illinois Department of Natural Resources (ILDNR), Missouri Department of Conservation (MDC), US Geological Survey (USGS), US Army Corps of Engineers (USACE), National Park Service (NPS)

Statement of Need: The UMRACT has no established data management strategy to govern how project data is stored, shared, and archived following collection. At present, individual partners manage project data according to a number of different strategies. Consistent data management policies among the UMRACT partners has the potential to enhance the collective impact of our programs on Asian carp management in the UMR by; 1) increasing the visibility, reproducibility, and validity of research projects because data are well documented, including the project's approach and methodology; 2) reducing unnecessary duplication of data collection or procurement by ensuring that all partners are aware of on-going and previous projects; 3) helping ensure data and data products are accessible and available for re-use in the long term.

During 2018, Congress passed the Foundations of Evidence-Based Policymaking Act of 2018. Section 303(a) (§3581) of the Act requires executive branch agencies to make data assets available, upon request, to any statistical agency or unit in a timely manner for purposes of developing evidence. The purpose of this project is to conduct a feasibility study that will allow the UMR Asian carp work group to identify possible paths towards a unified data management plan that meets the needs of our partnership and satisfies Federal regulation while also determining possible conflicts that could curtail these efforts.

Objectives:

1. Develop a feasibility study from interviews of UMRACT members that can inform the potential development of a plan for unified Asian carp data management in the UMR during FY21.

2. Conduct an initial evaluation of the feasibility of creating and maintaining a unified UMR Asian carp data management plan that includes detailed assessments of data collection, quality assurance, secure data transfer, and data archival. Summarize these findings in a feasibility study report to UMRACT.

Agency: US Fish and Wildlife Service La Crosse Fish and Wildlife Conservation Office (LFWCO)

Activities and Methods: The purpose of this template is to propose a feasibility study that will allow the UMR Asian carp work group to identify possible paths towards a unified data management plan and determine possible conflicts that curtail these efforts. Specifically, LFWCO personnel will work to develop and administer a questionnaire that facilitates the compilation of responses from UMR partners about their individual visions and concerns for a unified data management plan. This compilation of responses will be formed into a cohesive report detailing the feasibility of developing a unified data management plan. This report will directly address questions of:

1. Which data types will be requested from individual state and academic partners?
2. What kinds of data sharing agreements will need to be developed in order to comply with the policy of individual partner institutions?
3. How can a data management plan balance the needs of academic partners to secure data for peer-reviewed publications while allowing managers ready access to up-to-date data to inform decision-making?
4. How can innovative front-end applications (e.g. data collections apps, digital forms) ease efforts to standardize data collection for individual partners?
5. How can we secure funding to support the implementation of a data management plan?

Estimated Timeline:

- During February and March 2020, LFWCO biologists will develop a series of standardized interview questions for the UMRACT members designed to evaluate their perceptions of the strengths, weaknesses, opportunity, and threats posed by a prospective consolidation of data management strategies and the potential establishment of a unified regional database for Asian carp project data.
- LFWCO biologists will contact individual members of the UMRACT during April and May 2020 to conduct private interviews where participants can respond to the standard set of questions.
- LFWCO biologists will summarize the results of these interviews and develop prospective outlooks for potential UMRACT consolidated data management strategies in a feasibility study report during June 2020.
- The report will be shared with UMRACT membership ahead of summer 2020 project planning meetings to facilitate further discussion of developing shared data management strategies and developing a unified UMRACT project database.