Control and Removal of Asian carp in the Ohio River

2016 Technical Report

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Introduction:
Eradication of invasive species after establishment is difficult and often limited by available resources. Since their introduction in the Mississippi River basin, Asian carp (silver carp, bighead carp, and grass carp) have steadily increased their range (Kolar et al. 2005) and may densely colonize river reaches, affecting the native food webs in large river ecosystems (Irons et al. 2007, Freedman et al. 2012). Prevention and rapid response are the best tools for limiting establishment of costly invasive species and physical removal of Asian carp in the Ohio River basin may be an effective tool to slow their upriver expansion.

Recent studies on Asian carp harvest programs in the Illinois River show that the collapse of silver and bighead carp populations are possible if all fish sizes are targeted (Tsehaye et al. 2013). Diverse and consistent removal efforts in portions of the Ohio River where Asian carp are established may disrupt upriver movement of Asian carp, decrease pressure on defined barriers, and reduce numbers of Asian carp in sensitive areas to protect species of conservation need or important sport fisheries. Removal efforts also provide data on the population parameters for Asian carp in higher density pools of the Ohio River Basin (ORB). This data will provide an assessment tool that will guide monitoring, barrier defense, and population control efforts in future years.

Objectives:
- Remove Asian carp from portions of the Ohio River where they are established.
- Pursue novel gear types, attractants, and the use of sound to congregate Asian carp for capture.
- Identify private entities that have a use for removed fish and support the creation of Asian carp markets as possible.
- Encourage removal of all size classes of Asian carps in the commercial fishery.

Methods:
Removal efforts in 2016 were confined to Ohio River pools below Markland Lock and Dam (Figure 1). This was a change from 2015 in order to focus removal efforts in higher density pools where the largest impact could be made. All removal or tagging efforts conducted in pools above Markland Lock and Dam are reported in the Leading Edge Asian Carp Suppression project for the 2016 sampling season.

Physical Removal of Asian Carps
Electrofishing and gill netting for removal in 2016 were conducted for approximately 18 weeks from May through September. Removal took place a minimum of 4 days per week. Electrofishing was not standardized, but total effort (hours) was recorded. Pulsed DC electricity at 40% duty-cycle and 80 pulses per second was used most often and voltage was adjusted to attain maximum power for each run. Large mesh (4.0” – 5.0”) gill nets were used with each set consisting of a minimum 180 minutes of soak time with fish being driven toward the nets with boat noise at 30-minute intervals. Nets were occasionally set overnight in areas where they did not create hazards to navigation.

Sampling sites focused on tributaries and embayments where densities of Asian carp are highest and fish are easiest to capture. The majority of these locations were derived from monitoring sampling sites in 2015 and 2016. Some effort was expended to investigate additional sites that were either remotely identified using GIS and map study or contained characteristics of typical carp habitat; however, the majority of effort was spent in known, high-density locations where the largest impact could be made.

All Asian carps and by-catch were identified to species. All carp were inspected for tags (either jaw or ultrasonic VEMCO tags) before being euthanized for population control or tagged for the Ohio River Telemetry project. All by-catch was immediately returned to the water upon recovery. Asian carp species (bighead carp, silver carp, and grass carp) from each sampling location were measured for total length (in) and weight (lbs) to provide estimates of the minimum total weight harvested. When possible, supplemental data included a record of sex and a collection of aging structures (spines) for each silver or bighead carp captured (Williamson and Garvey 2005, Seibert and Phelps 2013). In addition to spines, some otoliths were taken for microchemistry analysis. These samples were sent to Dr. Gregory Whitledge Ph.D., Southern Illinois University, and are awaiting analysis.

Pursuit of Novel Capture Techniques

Several novel techniques were explored during removal in 2016. These efforts were intended to inform basin partners on strategies and gears that may effectively target carp for population control in the future. However, because the primary goal during this project was to remove carp and reduce propagule pressure, little time was given to conducting controlled experiments to specifically test the effectiveness of each technique.

A four-foot, winged hoop net was purchased and modified with the intention of testing its utility when targeting Asian carp at known high-density locations. This gear was appealing due to existing literary references when targeting bighead carp and because it could be left unmonitored for several days at a time. Hoop nets were fished over a 48-hour period on three separate occasions. Nets were set well below the surface in flow, with throat facing downstream, and the two 25-ft wings positioned to either side to act as a corral for fish swimming upriver towards the throat.

Night electrofishing was attempted on three occasions where carp were known to congregate. An electrofishing boat was outfitted with four LED floodlights at the bow allowing the driver and dipper to navigate and capture fish in the dark. An additional floodlight was positioned at the stern of the boat for rear visibility and a spotlight could be used by the driver to visually investigate any objects outside of the of the floodlight range. Electrofishing was not standardized, but total effort was recorded. Pulsed DC electricity at 40% duty-cycle and 80 pulses per second was used and voltage was adjusted to attain maximum power goals for each run.

The use of boat electrofishing as a herding tool, in combination with top-set gill nets, was also employed as a removal technique. Large mesh, floating gill nets were set in areas where fish could be pushed into entanglements. Because of the large amount of variation between sets and sites there was no effort to maintain consistency in the design or implementation of this technique. In addition, these captures were achieved during the combination of active boat electrofishing and passive net sets and comparisons between individual gears were never made.

Collaborative work between USGS, KDFWR, and USFWS was conducted using sound equipment and attractants in an effort to herd or congregate fish in low-density areas of the Ohio River during the month of August. Gill nets were used to block off sections of a tributary into defined reaches. Then complex sound was applied in an effort to herd fish downstream towards an entanglement. In addition to using sound, an automatic feeder was set up in an attempt to congregate fish around the feeder for easier

capture. No data was collected associated with the feeder's ability to increase densities of carp because the platform was destroyed during a heavy rain event.

Support Creation of Asian Carp Markets
The Kentucky Department of Fish and Wildlife Resources executive leadership is currently working with private business and commercial anglers to aid in furthering the development of an Asian carp fishing industry in Kentucky. Several barriers for a successful industry start-up have been identified and multiple strategies are being developed to address some of the logistical hurdles to increase the productivity of the market. One strategy being assessed is the feasibility of a partnership is to between commercial anglers, processors, and KDFWR to overcome some startup costs and training of new fisherman.

Results:
Physical Removal of Asian Carps
A total of 90.45 hours were spent electrofishing in four pools of the Ohio River and its tributaries between Newburgh and Markland Lock and Dam (Table 1). Fifteen thousand and twenty-one carp were removed using DC-pulsed electrofishing over these four pools in 2016. The highest level of effort was expended in the Cannelton pool where a total number of 1,297 carps, weighing approximately 16,445lbs, were removed. Total effort and capture numbers accounted for in this report include some time and effort placed into the Abundance and Distribution of Juvenile Asian Carp project. However, this report does not contain all effort in the pools where juvenile sampling took place. For more detail on effort and removal conducted during juvenile sampling in 2016, please refer to that report.

A total of 6,745ft of large mesh (4" and 5" bar) gill nets were used in capturing 21 invasive carps in the Cannelton and McAlpine pools (Table 2). This amounted to 353lbs of bighead and silver carp combined. The largest amount of effort was expended in the Cannelton pool with 4,090ft of gill net fished to remove 16 fish, weighing approximately 233lbs.

Pursuit of Novel Capture Techniques
Winged hoop nets were fished for a total of 144 hours; however, they did not require crews to be present for fish capture. All other techniques required crews to be present and less effort could be dedicated to investigate their use. No carp were captured using the hoop net, and by-catch was high. Hoop nets were the only gear that included sportfish species as by-catch. Nets were deliberately set at sites where electrofishing and gill nets have consistently caught Asian carp (particularly bighead carp) in the past.

Sound herding into net entanglements did not produce any carp captures. On one occasion in Eagle Creek (Meldahl pool), a tagged bighead carp was located near the mouth of the tributary using manual tracking. Nets were placed downstream of the fish and sound was applied in an attempt to move the fish closer to the net set. After sound application was finished, manual tracking revealed that the fish did not appear to have moved in the intended direction. Additional replications of this design were cut short by poor weather conditions and no conclusions about the utility of this technique could be made.

The use of boat electrofishing in combination with gill nets captured 11 total carp, but usually included by-catch in gill nets. Three bighead carp were captured, which have been difficult to catch using established gear types. Night electrofishing captured seven silver carp in total and resulted in no captures of bighead carp. This method did not produce any by-catch since carp could be visually targeted by the dipper, but carp are more difficult to chase and dip in the dark so a higher proportion eluded the dipper during these runs.

As mentioned above, calculating capture efficiencies for novel techniques was not attempted due to variations in the gear, set characteristics, duration of application, and site characteristics. However, an attempt to quantify the total effort, in hours, for each method was tracked along with the resulting catch of

targeted fish. In addition, by-catch from each technique was tracked to gain an idea of a particular strategy's ability to specifically target carp (Table 3).

Support Creation of Asian Carp Markets

In 2015, over 1 million pounds of Asian carp were harvested from Kentucky waters and sold to processors within various domestic and exported markets. In 2016, commercial fisherman participating in the Asian Carp Harvest Program in Kentucky waters yielded ~1.4 million pounds of carp which were also sold to various markets. Executive leadership in the KDFWR agency has gained an understanding of how commercial fishers and processors operate from inquiries conducted over these two years and have identified several limiting factors in growing the industry.

Removal in Other Projects

While removal was not listed as a primary objective in other ORB projects, Asian carp captured during any sampling on the Ohio River were euthanized unless they were tagged for tracking purposes. Accounts of 51 additional fish captured outside of this project were removed from the system during monitoring and leading edge projects. Details on these additional fish captured during non-targeted sampling are not included here, but are mentioned in each respective ORB report. Considering this, the numbers of removed fish referenced here should be considered a minimum total count of targeted Asian carps removed during the 2016 sampling season.

Discussion:

Because removal was confined to the lower pools of the invasion front in 2016, efforts from 2015 are only comparable on a pool-by-pool basis. Despite this, electrofishing conducted within the removal framework in 2016 was about a 100% increase in effort when compared to work completed in all five pools sampled in 2015. In addition, there was roughly a 340% increase in catch of targeted carp with the bulk of those captures being in the Cannelton and McAlpine pools. The disproportional increase in catch, when compared to the increase in effort, can be partially attributed to the redirection of effort to higher density pools; but this increase is also likely due to better site selection and increased experience among removal crews. An electrofishing technique involving more aggressive movements and a sinuous pattern along structure was developed for targeting silver carp and needs to be further developed and compared to other capture techniques. It is also necessary to begin standardizing effort between these runs now that a specific electrofishing technique has been developed. This will likely give more precise estimates of silver carp abundances by pool. These estimates may be useful for model-based applications leading to more informed removal and measures of performance on an annual basis.

Gill netting efforts in Cannelton and McAlpine pools alone were approximately equivalent to all the effort placed into the five pools previously targeted for removal in 2015. Total catch in Cannelton and McAlpine also increased (over 160%) when compared to total carp captured by gill netting in all pools in 2015. Again, this can be partially attributed to the focus in higher density pools and increased crew experience. Gill net designs in 2016 were also different from those used in 2015 and the new design appeared to have slightly better success when targeting carp than previous sets.

No quantitative comparisons can be made between alternative methods used during removal. However, it did appear that both night electrofishing and the combination of boat electrofishing with gill nets produced higher success rates than the other alternative techniques. With the lack in ability to target bighead carp using conventional gears on the Ohio River, it may be important to pursue the use of combined electrofishing runs and gill net sets to target bighead in the future. Exploration of these gears needs to be better structured during future removal efforts if direct comparisons are to be made between alternative techniques.

Recommendations:
We recommend that removal continue in the Cannelton and McAlpine pools with more emphasis on comparing gear types for targeted efficiency. Electrofishing runs during removal should be conducted in consistent time intervals to make CPUE data more comparable across sites for better relative abundance estimates. These estimates may be important for data-driven modeling and more productive population control during future removal seasons. Variations in sampling techniques should be tracked consistently and total man-hours should be recorded for each activity to gain a better assessment of the costs and benefits for strategies using multiple gears or novel removal methods. Target parameters should be established to provide a measurement of population control efforts; this would allow for informed decisions on a regular basis when considering adaptive management strategies.

Project Highlights:

- Prevention and control are currently the best tools for limiting establishment of costly invasive species. Physical removal of Asian carps in the Ohio River basin may be an effective tool to slow their upstream expansion.
- Removal in 2016 was altered from removal conducted in 2015 in order to focus removal efforts in higher density pools were larger impacts could be made.
- Electrofishing conducted in JT Myers though McAlpine pools in 2016 produced about a 100% increase in effort and a 340% increase in catch when compared to work completed in all five pools sampled in 2015.
- Gill netting efforts in Cannelton and McAlpine alone were approximately equivalent to all the effort placed into the five pools previously targeted for removal in 2015. Total catch increased (over 160%) when compared to removal in all pools in 2015.
- Both night electrofishing and the combination of boat electrofishing with gill nets produced higher success rates than the other alternative techniques.
- It may be important to pursue the use of combined electrofishing runs and gill net sets to target bighead carp in the future.
- Exploration of novel gears needs to be better structured in order to make direct comparisons between alternative techniques.
- Development of target parameters should be established to provide a measurement of population control efforts and be used to inform decisions on regular basis for adaptive management strategies.

Literature Cited

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Tables

Table 1. Electrofishing effort (hours) and resulting catch of three species of Asian carp (number and weight) in four pools of the Ohio River during Asian carp removal efforts in 2016.

Pool	Electro Hours	Bighead Carp (N)	Silver Carp (N)	Grass Carp (N)	Total (N)	Bighead Carp (Lbs)	Silver Carp (Lbs)	Grass Carp (Lbs)	Total (Lbs)
McAlpine	30.95	1	201	0	202	50	2881	0	2931
Cannelton	55.37	9	1274	14	1297	165	16045	235	16445
Newburgh	2.25	1	16	0	17	4	136	0	140
JT Myers	1.88	0	5	0	5	0	40	0	40
Total	90.45	11	1496	14	1521	219	19102	235	19556

Table 2. Gill netting effort (ft) and resulting catch of three species of Asian carp (number and weight) in four pools of the Ohio River during Asian carp removal efforts in 2016.

Pool	Electro Hours	Bighead Carp (N)	Silver Carp (N)	Grass Carp (N)	Total (N)	Bighead Carp (Lbs)	Silver Carp (Lbs)	Grass Carp (Lbs)	Total (Lbs)
McAlpine	2655	1	4	0	5	56	64	0	120
Cannelton	4090	1	15	0	16	32	201	0	233
Newburgh	0	0	0	0	0	0	0	0	0
JT Myers	0	0	0	0	0	0	0	0	0
Total	6745	2	19	0	21	88	265	0	353

Table 3. Effort (hours) expended into exploring novel capture techniques and the total resultant capture of Asian carps produced using each method.

		Total Captures (N)				
Capture Technique	Effort (hrs)	Bighead Carp	Silver Carp	Grass Carp	Totals	By-Catch
Winged Hoop Net	144.00	0	0	0	0	YES
Night Electrofishing	4.50	0	7	0	7	NO
Boat EF Herding w/ Nets	9.00	3	8	0	11	YES
Sound Herding w/ Nets	8.00	0	0	0	0	YES
Attractants	N/A	N/A	N/A	N/A	N/A	N/A

Figures

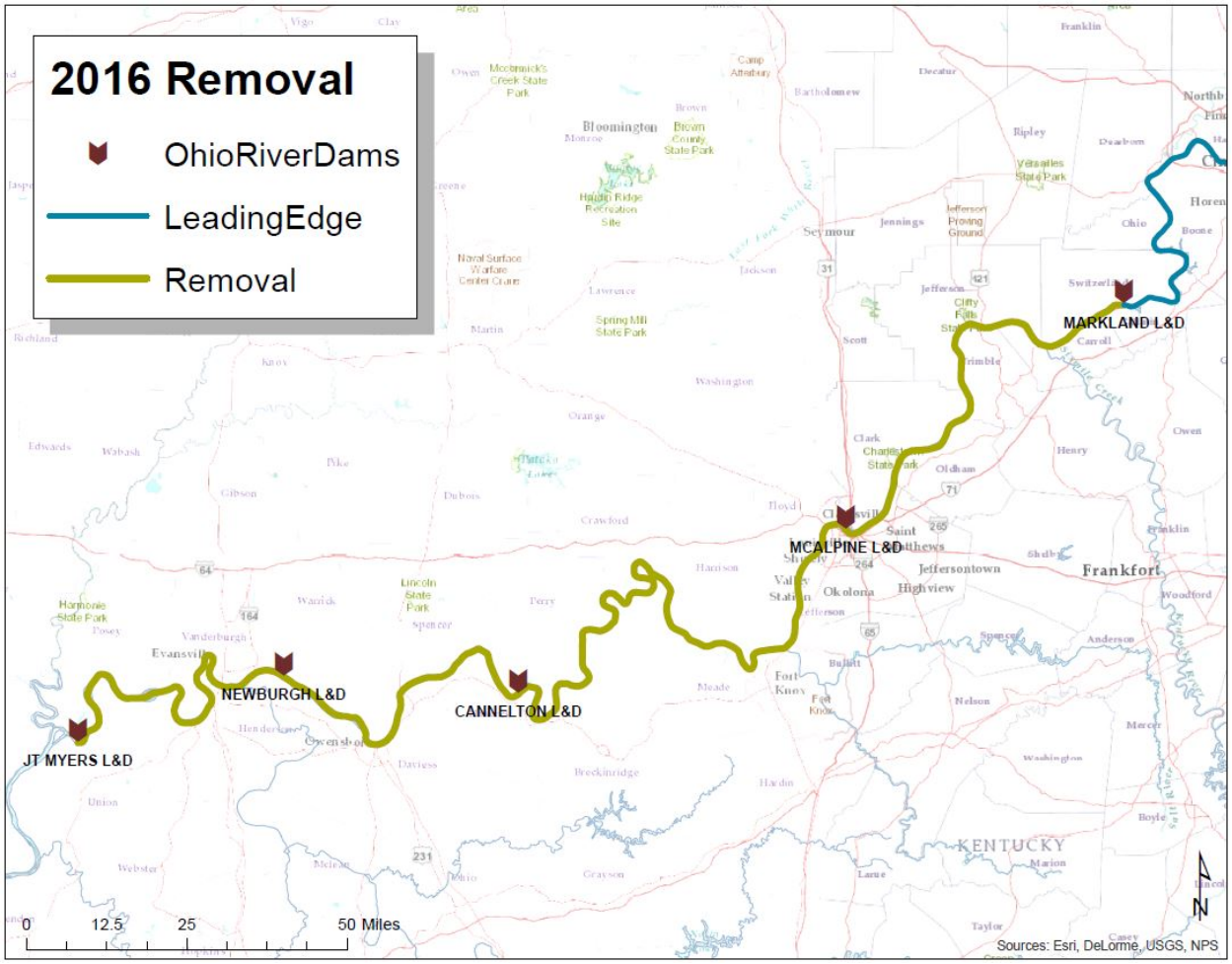

Figure 1. A map highlighting the four pools of the Ohio River where Asian carp removal was conducted in 2016.