Telemetry of Asian Carp in the Ohio River

2016 Technical Report

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Introduction:

The bigheaded carps, herein referred to as Asian carp, include the Silver Carp (*Hypophthalmichthys molitrix*) and Bighead Carp (*H. nobilis*) as well as hybrids between these species. Asian carp are highly invasive fishes that have been expanding their range in the U.S. since the early 1980's when they first began to appear in public waters (Freeze and Henderson 1982; Burr et al 1996). 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 (DeGrandchamp 2003; Peters et al. 2006; DeGrandchamp et al. 2008). Tsehaye et al. (2013) stated that high reproductive capacity of both species, in particular Silver Carp ensure that attempts to exclude or remove individuals will require a massive undertaking (>70% exploitation) that targets all age classes and sizes. Any information that we can learn about Asian carp distribution, abundance, and/or biology that could facilitate targeting susceptible life stages could therefore limit population expansion.

Populations of Asian carp have become well established in the lower and middle reaches of the Ohio River and successful reproduction is suspected as far upstream as the Falls of the Ohio at Louisville, Kentucky. The upper reaches of the Ohio River as well as many upper basin tributary streams may not currently be inhabited by Asian carp. The need exists to prevent the establishment of these species into the upper portions of the Ohio basin

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

The overall goal of these efforts is to understand the distribution and movement patterns of Asian carp in the middle and upper Ohio River. Understanding these aspects of Asian carp biology in the Ohio River will assist efforts to minimize their further spread in the basin and reduce the size of existing populations.

Objectives:

1. Delineate the leading edge of Asian carp and potential for further upstream movement.
2. Identify habitat preferences of Asian carp within the middle and upper Ohio River including tributary use.
3. Quantify passage of Asian carp at Ohio River locks and dams.

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

Ultrasonic Transmitter Tagging: Adult Bighead Carp and Silver Carp were surgically implanted with ultrasonic transmitters (Vemco, Model V16-6H; 69 kHz) which provide individual identification. The V16-6H coded transmitters are nominally programmed to transmit a signal every 40 seconds yielding a battery life of 1,825 days. Fish tagged were collected by Agency personnel from the Cannelton, McAlpine, Markland, Meldahl, and R. C. Byrd pools. Following surgery, fish were measured for total length (in.) and weight (lb.), and visually or manually sexed (if possible). Tagged fish were fitted with an external jaw tag applied around the dentary bone (lower jaw) (National Tag Co. #1242 F9). Gill nets and Direct Current (DC) boat electrofishing were used to capture Asian carp for tagging. Efforts were concentrated in areas that are attractive to Asian carp such as side channels, backwaters, and tributary creeks and rivers.

Ultrasonic receiver array: An array of VR2W receivers was redeployed in the river in spring 2016. Receivers were placed above and below lock and dams, in the lower portions of major tributary streams, and at regular intervals between lock and dams. Receiver data were downloaded monthly. Mainstem Ohio River VR2W receivers are removed from the river over the winter months to avoid loss of equipment to ice flows.

Mobile Tracking: Active tracking was used in concert with netting and electrofishing to help locate tagged fish and increase the likelihood of capturing new fish to tag. Fish were located with a portable hydrophone and receiver (Vemco Model VH110-10M and Vemco Model VR100, respectively).

Progress/Results:
Receiver Array Placement - Mainstem and tributary VR2W receivers were installed from late March through early April, as well as seven newly deployed receivers in Cannelton pool. Five VR2AR acoustic release receivers were downloaded and redeployed approximately one mile upstream of the Markland, Meldahl, Greenup, Byrd, and Belleville dams during April. Additional VR2AR receivers were installed in three tributaries (Ohio Brush Creek, Big Sandy River, and Kanawha River) where VR2W deployments were not possible. Figure 1 illustrates the locations of VR2W receivers deployed in 2016. Receivers were deployed over a 501.8 river mile (RM) reach of the Ohio River from Leavenworth, IN upstream to Eureka, WV.

Receivers were generally concentrated within the Captain Anthony Meldahl pool during 2015 and 2016 due to a concurrent catfish telemetry study being conducted by the Ohio Division of Wildlife within that pool. By using the same telemetry equipment both studies are able to share all of the fish detection data. Recorded detections were downloaded on a monthly schedule and data uploaded to an FTP site maintained by ODNR.

Fish Tagging Efforts– To date 401 Asian carp have been surgically implanted with acoustic transmitters from the Cannelton, McAlpine, Markland, Meldahl, and R. C. Byrd pools of the Ohio River (Table 2). During 2016, fish collection efforts included seven weeks of tagging effort consisting of gill netting and boat DC electrofishing.

Fish Detections – Between 01 January 2016 and 12 December 2016 receivers recorded 2,621,069 individual Asian carp detections. Seventy-four of 117 receivers deployed recorded detections. Of the 401 fish tagged in this study, 237 were detected in 2016.

Fish Movements – From 2013 to 2016 the majority of tagged fish in this study remained in the pool in which they were initially tagged. 58.7% of the tagged fish detected during this study moved less than five miles up or downstream from their original tagging location. Bighead Carp moved greater mean distances both upstream (18.31 mi.) and downstream (34.26 mi.) than Silver Carp (5.18 mi. and 15.37 mi. respectively) (Figure 2.).

Tributary Use – Between October 2015 and September 2016, over 50% of detected Asian Carp within all pools were found using tributaries during some time of the year. During October 2015, over 79% of the fish within Meldahl pool were using tributaries, however, by November that percentage had dropped to just over 30%. Factors influencing tributary use, including water temperature and discharge, require additional analyses to acquire a more complete picture of the importance of tributaries to all life stages of Asian Carp.

Dam Passage – Throughout this study, there have been twenty-five dam passage events by ten Silver Carp and five Bighead Carp. Of these fifteen fish, two Bighead Carp and one Silver Carp were responsible for eleven (44%) of the passage events. Nine of the twenty-five passage events were in an upstream direction by two Bighead Carp (6 passes) and two Silver Carp (3 passes). Of the tagged Bighead and Silver Carp, 23.8% and 4.3% respectively were found to pass through dam structures (Figure 3.). A time-to-event analysis was used to determine which factors influenced dam passage among tagged fish. In both upstream and downstream passage analyses, Bighead Carp were found to be nearly twenty times more likely than Silver Carp to pass through dam structures ($p = 0.007$).

The Rogue Bighead Carp - Bighead Carp #28345 was captured in a 4" mesh gill net and was tagged on 11 June 2013 at the town of Wheelersburg, Ohio within the Meldahl pool. At the time of capture it was 43" total length and weighed 45lb. During summer 2013 it moved 60 RM downstream and took up residence in Ohio Brush Creek over the winter of 2013-2014. Then in April and May of 2014 it moved upstream passing the Greenup Dam and through the Greenup pool to just below the R.C. Byrd dam (receivers were ca. 4 miles downstream of the dam). Between May and November the fish swam back and forth between the Byrd dam and Greenup dam and was resident above the Greenup dam as of November 2014. During 2013-2014 it moved at least 790 miles in total and 98 miles upstream and passed one lock and dam.

On 20-21 October 2015 this fish was detected in the Racine Pool at RM 214. Sometime between November 2014 and June 2015 it moved past the R.C. Byrd and Racine lock and dams, an additional 65 river miles upstream. The week of 26 October crews manually tracked the Racine pool and found fish #28345 in Mill Creek at the town of Millwood, West Virginia. An attempt was made to capture it with gill nets but we were unable to get the fish to move. On 5 November a biologist from WVDNR went back to Mill Creek and manually tracked the area and the fish was gone. This fish is now just below Belleville Locks and Dam and is detected regularly on a receiver on the lower lock chamber approach.

Since it was tagged in 2013 this fish has moved upstream a minimum of 200 river miles and has passed three lock and dam projects. Given the proximity of this fish to the lock chambers at Belleville L&D and its propensity to pass through lock and dams, we expect it will pass into Belleville pool during the spring or summer of 2017.

Recommendations:

The differences in movement between Bighead Carp and Silver Carp may affect the best control and management strategy. Largescale movements of Asian carp (i.e., pool to pool movement) appear to be occurring by a few number of individuals within the population, with Bighead Carp being more mobile than Silver Carp. That said, current estimates of movement probabilities are hampered by low sample

sizes. As such, we recommend tagging of additional Asian carp in the Meldahl and Markland pools in 2017. Given the gaps in spatial coverage, we also recommend expansion of the receiver network to fill in these. To gain a better understanding of tributary use in the Ohio River Basin, we recommend the addition of receivers to several important tributaries, as well as adding secondary receivers to currently covered tributaries to determine directional movement. Lastly, to gain better insight into factors related to pool to pool movement, or within pool movement, we recommend installing water temperature loggers to each tributary and pool to determine water temperature effects on fish movement and habitat use.

Project Highlights:

An extensive array of 117 stationary receivers was deployed during 2016 which recorded 2,621,069 detections of 237 Silver and Bighead Carp throughout six Ohio River pools.

Most of the fish tagged during the course of this study remain in the Ohio River pool where they were tagged. Nearly 60% of tagged fish have made net movements of five miles or less both upstream and downstream since they were tagged.

Only three fish to date have moved upstream out of the pool in which they were tagged including one Bighead Carp and two Silver Carp. Thirteen fish moved downstream out of the pool in which they were tagged including four Bighead Carp and nine Silver Carp. Fifteen of the 246 fish (~6%) that have been detected since tagging are responsible for the twenty-five dam passage events since 2013.

Bighead Carp were found to be nearly twenty times more likely to pass through dams, both upstream and downstream, than Silver Carp.

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Figures and Tables:

Table 1. Distribution of telemetry receivers in 2016 (Rec. = receivers, RM = river miles)

Ohio River Pool	# of Rec.	RM in Pool	RM/Rec.	Rec. in Locks	Rec. in Tribs.
Cannelton	7	55	7.9	0	0
McAlpine	13	75	5.8	0	1
Markland	17	95	5.6	3	3
Capt. A. Meldahl	35	95	2.7	3	9
Greenup	11	62	5.6	3	1
R.C. Byrd	14	42	3	3	5
Racine	7	31	4.4	3	0
Belleville	12	42	3.5	3	1
Willow Island	1	35	35	3	0
Totals	117			21	20

Table 2. Bighead Carp and Silver Carp tagged from 2013 - 2016

	Pool					
	Cannelton	**McAlpine**	**Markland**	**Meldahl**	**R. C. Byrd**	**Total**
2013						
Silver Carp				6		6
Bighead Carp				13		13
2014						
Silver Carp		115	6	10		131
Bighead Carp		4	4			8
2015						
Silver Carp		22	3	5		30
Bighead Carp		1	1	5		7
2016						
Silver Carp	92	94	6			192
Bighead Carp	4	1	4	2	3	14
Totals	96	237	24	41	3	401

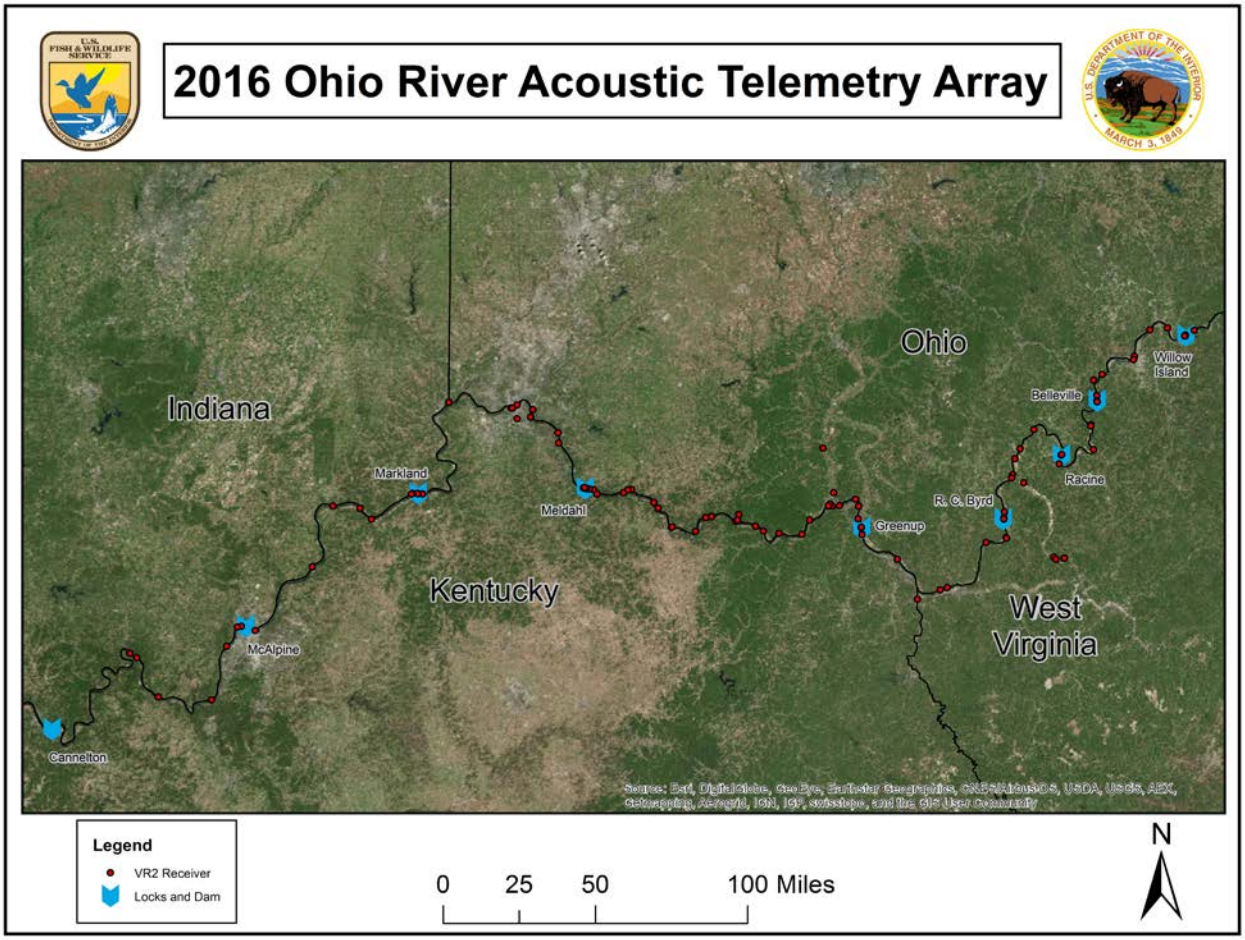

Figure 1. Locations of stationary VR2W and VR2AR receivers in 2016. Individual points may represent more than one receiver at this scale.

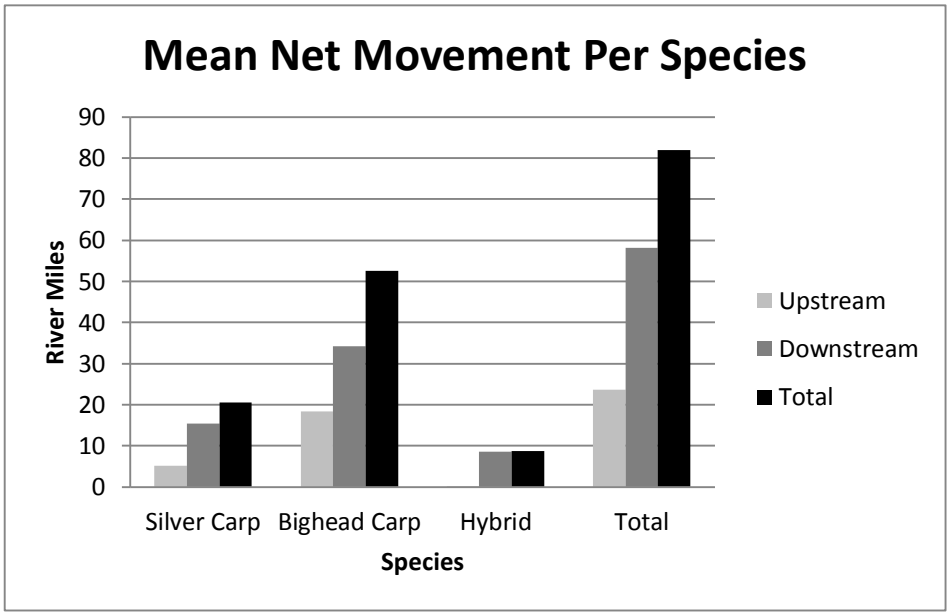

Figure 2. Mean net movement from original tagging location to last known location of 2016 by species.

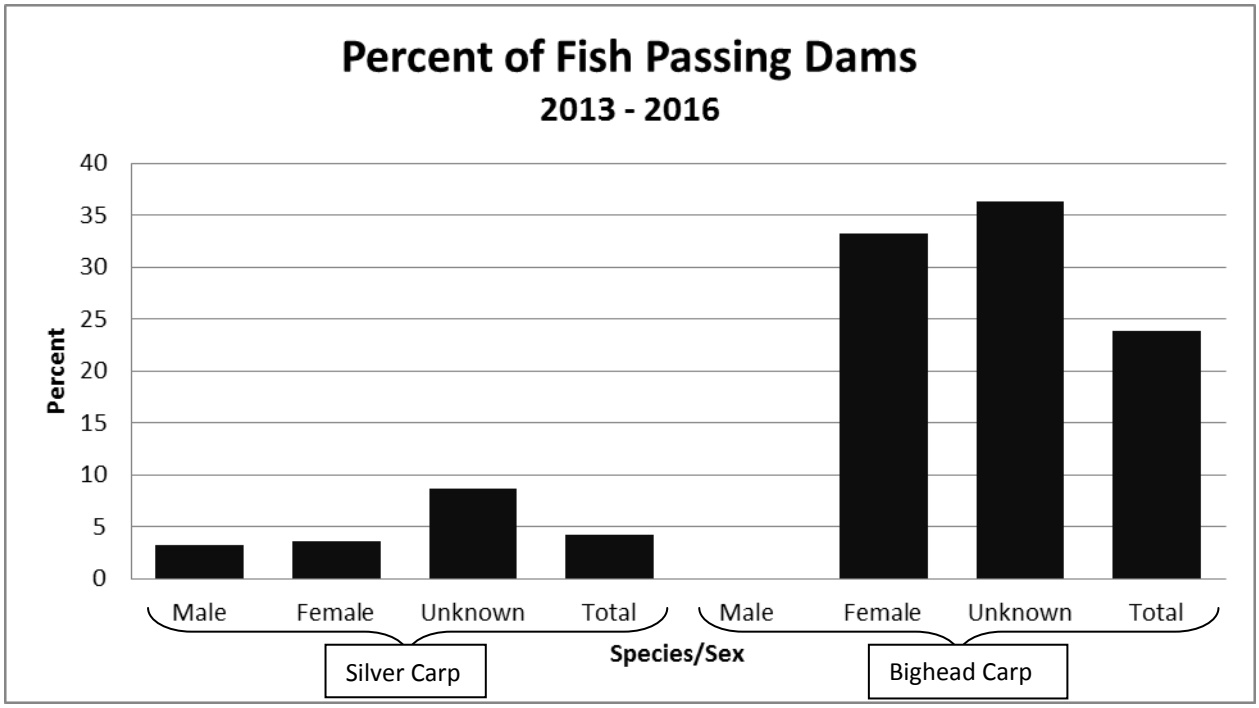

Figure 3. Percent of tagged fish detected >1 time crossing through locks and dams on the Ohio River.