UMR Asian Carp Acoustic Telemetry Report 2018

Geographic Location:
The US Fish and Wildlife Service (USFWS) and US Geological Survey (USGS) telemetry receivers span from Pool 5a downstream to Pool 26 on the Upper Mississippi River.

Participating Agencies:
Minnesota Department of Natural Resources (MNDNR)
Missouri Department of Conservation (MDC)
Southern Illinois University (SIU)
U.S. Army Corps of Engineers (USACE)
U.S. Coast Guard (USCG)
U.S. Geological Survey – Upper Midwest Environmental Sciences Center (USGS)
Western Illinois University (WIU)

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Statement of Need:
Populations of Silver Carp (*Hypophthalmichthys molitrix*) and Bighead Carp (*H. nobilis*) as well as hybrids (*H. molitrix x nobilis*) between these species, are advancing in the Upper Mississippi River (UMR) basin (Conover et al. 2007; Chapman and Hoff 2011; O'Connell et al. 2011). Three zones of relative abundance of Asian carp have been identified in the UMR; a robust core population (established) below L&D 19, a transitional zone of moderately dense populations with potential reproduction from L&D19 to L&D 15, and a zone where individual captures of some adults have been recorded above L&D15 (USFWS 2016).

Telemetry programs serve two projects described in the *2018 Monitoring and Response Plan for Asian Carp in the Mississippi River Basin*: Evaluation of controls, impacts and behaviors of Asian carp in the lower UMR and Evaluation of fish passage for assessment of Asian Carp deterrents at multiple locks in the Upper Mississippi River. Distinct descriptions of the contributions of the telemetry programs towards meeting the objectives of the two projects will be provided in this report.

Project 1: Evaluation of controls, impacts and behaviors of Asian carp in the lower UMR

This component of telemetry operations spans all three management zones to help understand movement and habitat use within and among pools across these zones. It is maintained by a multi-agency cooperative with broad interests concerning the management and spatial ecology of Asian carp and native species whose habitats overlap with Asian carp.

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Project Objectives:

1) Utilize real-time and passive receivers to understand Asian carp movement patterns and identify environmental variables that influence those patterns.
2) Increase efficiency of removal efforts by locating congregations of Asian carp and sharing information with removal teams in a timely manner.

Project Highlights:

- To date, the partnership has tagged 461 Bighead, Silver, and Hybrid Carp; 375 transmitters were active the entire year in 2018.
- Two new real-time receivers were installed on backwater lakes in Pools 17 and 18. These receivers have helped inform removal efforts by providing daily information on Asian carp occupancy. Nearly 56,000 pounds of Asian carp were removed from the two locations during 2018.

Methods:

Acoustic Transmitter Tagging: Fish were collected from Pool 17, 18 and 19 using short-term gill net sets. Total length (mm), weight (g), and sex were recorded. Vemco Model V16-6H acoustic transmitters (69 kHz 16mm diameter, 96 mm length, 34g), programmed to transmit on a random delay from 30 to 90 seconds with a battery life of 2,538 days, were tested for recognition with a mobile receiver (VR-100-200) and surgically implanted according to procedures outlined by Summerfelt and Smith (1990). Target tag density was two fish per river mile for each pool. Acoustically tagged Asian carp were also fitted on the upper or lower jaw with a Monel band. Bands were orange and printed with a unique number and USFWS contact information. Post-surgery, each fish was held for observation until the fish recovered enough to maintain equilibrium and swim on its own. Fish were then released in close proximity to the capture location.

Acoustic Receiver Array: An array of stationary receivers (Vemco Model VR2W) was initially installed in the fall of 2013. In 2018, the USFWS deployed 120 stationary receivers, providing coverage from Pool 5a down to Pool 26. Receivers were installed with a higher density in navigation pools 14 to 19 to better determine movements and distribution in this reach at the leading edge of the population where removal efforts for Asian carp are focused (Figure 1). Receivers were also deployed in several tributaries, including the Rock (Pool 16), Iowa (Pool 18), Cedar (Pool 18), and Skunk (Pool 19) rivers to monitor movements in and out of tributaries. The federal telemetry array bridges a gap between the Minnesota Department of Natural Resources array (Pool 1 to Pool 5) and the Missouri Department of Conservation array (Pool 19 to Caruthersville, MO) resulting in combined telemetry coverage of about 1,600 river kilometers. Data from stationary receivers were downloaded monthly or seasonally. These data provide information on gross movements, movement patterns, possible spawning events, and habitat use; and in turn, inform removal and potential deterrent placement.

Real Time Receivers: Two new real-time receivers were constructed and deployed on Pools 17 (Cleveland Slough) and 18 (Boston Bay). These receivers were deployed in direct support of contract removal programs being conducted on the UMR. They were built according to specifications matching those of real-time receivers previously deployed on the Illinois Waterway. The real-time receiver is

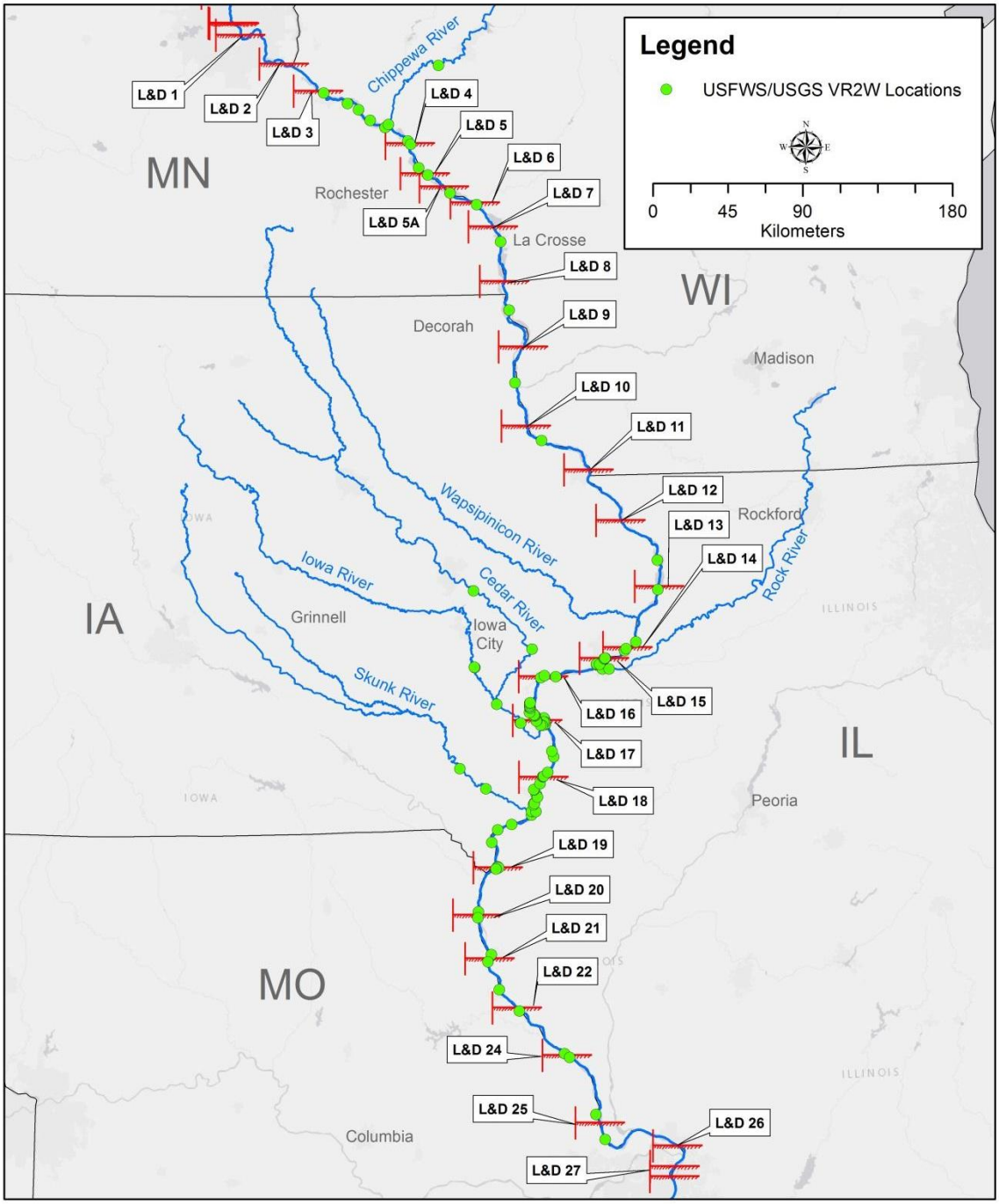

Figure 1. *Locations of stationary receivers deployed by the USFWS/USGS (Green) in the Mississippi river basin during 2017 deployed on navigation buoys or on the bottom of the river.*

comprised of a Vemco Model VR2C receiver combined with a Campbell Scientific datalogger and cellular router mounted on a floating platform. Power was supplied to the electrical components via solar panels mounted on the float. The two receivers were deployed in these two UMR backwaters because previous data collected from both stationary receivers and manual tracking indicated that Asian carp used these locations frequently throughout the spring and summer.

Results:

Acoustic Transmitter Tagging: An additional 96 Asian carp were acoustically tagged in 2018. This addition and the loss of older transmitters dying out resulted in a maximum of 375 active tags during 2018.

Acoustic Receiver Array: During 2018, 15.5 million detections were recorded on stationary receivers. Of note, one female Silver Carp originally tagged in Pool 19 during May 2016 made an upstream migration apparently ending in Pool 9 on 4-5 July 2018. The individual went downstream and was last detected in Pool 13 during November 2018. This fish made a similar migration to Pool 10 during 2017.

Real-time Receivers: 70 Bighead, Silver, and hybrid Asian carp were detected on real-time receivers during 2018. There were significantly more detections of Asian carp in Boston Bay (Pool 18-52 individuals) than in Pool 17 (Cleveland Slough-18 individuals). Initial modeling of real-time data suggests that occupancy on Boston Bay increases each spring during spring floods and again during mid-summer following the spawning period. Data on Asian carp occupancy of both backwater lakes was transmitted to program mangers via text messages each morning. That information was used to guide contract fishers to more productive fishing sites. A total of 44,195 pounds from Boston Bay and 11,565 pounds from Cleveland Slough was removed following the installation of real-time receivers in May-June 2018. In comparison, a total of 155,100 pounds was removed from all UMR Pools above LD19 during 2017.

Discussion:

The maintenance of the longitudinal array of passive receivers continues to provide useful information about the dispersal patterns of Silver and Bighead Carp in the UMR. The longitudinal array, combined with limited manual tracking events during previous years, have helped biologists identify a selection of backwaters where Asian carp congregate and can be targeted by removal efforts. Additionally, the extent of the array has allowed managers to understand the timing and distance of semi-annual migration patterns.

The installation of real-time receivers in two primary Asian carp congregation areas during May-June 2018 furthered the capacity of the telemetry program to inform removal efforts by providing daily information on Asian carp occupancy. Patterns of fish occupancy in these backwaters guides daily scheduling to make removal crews more efficient in their work. Following the direction of the UMR Asian carp workgroup, the USFWS has committed to building and deploying two additional real-time receivers during 2019. Three candidate areas for additional real-time receiver placement have been identified (Credit Island backwater, Pool 16;

Big Timber backwater, Pool 17; and Carthage Lake, Pool 19). Similar to Boston Bay, these are areas where fishes tend to aggregate during certain times of the year and are areas where fish can be corralled for more efficient removal. Knowing the timing of Asian carp usage of these areas on a daily schedule would likely result in increased removal of Asian carp while reducing the probability that crews fish in unproductive locations. These "hot spots" can get "cold" (and vice versa) and this transition from productive to unproductive can be quick and not completely predictable. These hot spots are often a long distance apart in the management zone. Travelling to one unproductive fishing location can cost a day's effort because relocating to an alternative fishing location becomes temporally infeasible. Real-time text communication from the receivers eliminates the loss of time and effort fishing in unproductive locations.

Project 2: Evaluation of fish passage for assessment of Asian Carp deterrents at multiple locks in the Upper Mississippi River

Lock and Dam (L&D) 19 is a major pinch point for Asian carp expansion, restricting all passage to the lock chamber. Fish that achieve upstream passage at this point later experience major impediments to passage at L&D 14 and 15, which are infrequently at open river conditions. These major pinch points make excellent candidates for fish deterrent technologies that aim to impede further Asian carp establishment upstream. Prior to deterrent establishment, it is critical to evaluate the existing effects of these pinch points on passage of native fish species and Asian carp.

Project Objectives:

- Assess Asian carp and native fish behavior and passage at lock and dam structures on the Upper Mississippi River with emphasis at lock and dams 19, 15, and 14 as an assessment tool for the future testing of Asian carp deterrents.

Methods:

Acoustic Receiver Arrays in Locks: USGS, USFWS, Western Illinois University and Missouri Department of Conservation maintained two telemetry receiver arrays at L&D 15 and L&D 19. Six receivers maintained by USGS were deployed at L&D 19, along with three receivers maintained by MDC. The telemetry array at L&D 15 consisted of 15 receivers dispersed in the area encompassing the approaches to both lock chambers as well as the area upstream of the lock chambers.

Asian Carp Acoustic Transmitter Tagging: Biologists from MDC implanted new acoustic transmitters into 44 Bighead Carp and 47 Silver Carp from Pool 20 in 2018.

Native Fish Acoustic Transmitter Tagging: Biologists from WIU implanted acoustic transmitters in 119 paddlefish collected from Pools 14 (N=58) and 16 (N=60) in the UMR during 2018. An additional 41 Paddlefish captured below L&D 19 were implanted with acoustic receivers by MDC.

Evaluating Fish Movements: The arrays of stationary Vemco receivers maintained in the locks by USGS and MDC and in the river by USFWS were used to monitor fish passage events through locks and dams.

Data Analysis: Researchers from USGS gathered lock queue reports that provide daily detail of lock operations from the US Army Corps of Engineers (USACOE). River stage height data were obtained from the USACOE River Gauge Database and water temperature data were obtained from the Vemco receivers. Detection data from the telemetry receivers were converted into discrete residency events implemented in the VTrack package in R (R Development Core Team 2014). Residency data were then analyzed using linear mixed effect models (with a random component for individual fish) to evaluate the relation between fish presence in the lock approaches at LD 15 and LD 19 relative to environmental factors and lock operation. Daily challenge events relative to environmental factors and lock operation were modeled using generalized linear models with binomial distribution and a logit link function.

Results:

Both Asian carp and native fishes have been observed making multiple passages through lock and dam structures on the UMR. Crews from WIU have documented 42 Paddlefish passage events during 2018 (29 downstream passages and 13 upstream passages). During the previous three-years, 90 individual fish tagged by MDC have been detected on the array in Lock 19. Species detected in the lock chamber were 1 American Eel, 5 Bighead Carp, 13 Bigmouth Buffalo, 1 Blue Sucker, 2 Channel Catfish, 4 Flathead Catfish, 5 Grass Carp, 16 Lake Sturgeon, 20 Paddlefish, 18 Silver Carp, and 5 Walleye. Of these, 22 individuals were detected on the receivers above the lock chamber indicating a passage through the lock chamber. The fishes that passed into Pool 19 were 1 Bighead Carp, 9 Bigmouth Buffalo, 3 Walleye, 2 Flathead Catfish, 1 Grass Carp, and 6 Paddlefish. Researchers with USGS are continuing to work on models that provide more detail on Asian carp movements within Locks 15 and 19. The results of these analyses will be released following USGS internal peer-review processes during summer 2019.

Discussion:

The data from these telemetry arrays within and around lock and dam structures are being used to improve understanding of current passage rates of fish at these locations and to better understand factors that affect fish passage. Continued evaluation of fish passage events will provide important information to decision makers charged with determining whether deterrence devices will effectively impede upstream migrations of Asain carp while having minimal negative effects on native species.

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