FY20 Annual Progress Report

Project Title: Evaluation of fish passage for assessment of bigheaded carp deterrents at locks in the Upper Mississippi River

Agency: U.S. Geological Survey

Project Highlights:

- We observed 13 bigheaded carps (*Hypophthalmichthys molitrix* and *H. nobilis*) that were originally tagged upstream of Lock and Dam (LD) 19 and then detected downstream in Pool 20 during 2020. Seven of these bigheaded carp were then again detected above LD 19 during 2020 (i.e., 54%).
- In May 2019, 72 bigheaded carps were collected from Pools 18 and 19, then were implanted with transmitters and released downstream of LD 19. Fourteen of the translocated carps were detected in the downstream lock approach during 2020. Five of these translocated carps were then detected in the lock chamber then detected upstream of LD 19 in Pool 19 (i.e., 36% of the translocated carps detected during 2020).
- Five bigheaded carp that originated upstream of LD 19 have completed this upstream movement pattern multiple times from 2017-2020 (i.e., 2, 3, or 4 times per individual over the past four years).
- Depth sensitive transmitters were deployed in bigheaded carp during 2019, of which six were detected in the downstream approach at LD19 during 2020. One translocated bighead carp that was tagged with a depth sensitive transmitter was detected in the downstream lock approach, then detected in the lock chamber, then detected upstream of LD 19. The depth sensor transmitters are providing information on the depth of bigheaded carps in the water column when inside the lock approach and lock chamber.

Methods:

USGS maintained two telemetry receiver arrays at LD 19 and LD 15. Six receivers were deployed in the downstream lock approach at LD 19 (Figure 1). Three additional receivers were deployed in the lock chamber and one additional receiver was deployed above the upper lock gates at LD 19 to enhance vertical positioning in the lock chamber and to supplement the existing receivers maintained by Missouri Department of Conservation. The telemetry array at LD 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 (Figure 2). These receivers were

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used to monitor the movement of bigheaded carps and native species tagged within the Intensive Management Zone (IMZ; Pools 16 through Pool 19) as well as fishes tagged in Pools 15 and 20.

A translocation effort occurred in spring 2019, during which 72 silver and bighead carps were captured in Pools 18 and 19 and translocated, tagged, and released downstream into Pool 20. This was done to increase the sample size of bigheaded carps near LD19 to increase the amount of data available to assess their behavior in relation to environmental factors (e.g., barges, season, discharge, water levels). A subset of these translocated fish were redetected near LD 19 during 2020. Additional translocation efforts for bigmouth buffalo and grass carp originally planned for 2020 were postponed because of COVID-19 travel restrictions. USGS did not deploy any additional transmitters in the vicinity of LD 19 during 2020. All detection data from 2020 originated from fishes that had been tagged in previous years.

Lock Queue Reports were obtained from the U.S. Army Corps of Engineers Lock Performance Management System to evaluate the relation between fish passage and operation of the lock for river vessels. Fish residency and presence within the lock approach at LD 19 was evaluated against environmental variables and lock operation using generalized linear mixed-effects models and generalized linear models implemented in R.

Results:

From 2017-2019, USGS and partners documented a total of 27 instances when bigheaded carps were detected in the downstream lock approach, then detected in the lock chamber, then detected upstream of LD 19 in Pool 19. Twenty-six of these events involved bigheaded carps that were originally tagged in the IMZ and one event involved a bigheaded carp originally tagged in Pool 20. During 2020, 7 additional bigheaded carp (that were originally tagged in the IMZ) were detected in the downstream lock approach, then detected in the lock chamber, then detected upstream of LD 19 in Pool 19. Five bigheaded carp that originated upstream of LD 19 have completed this upstream movement pattern multiple times from 2017-2020 (i.e., 2, 3, or 4 times per individual over the past four years).

In 2019, USGS and partners documented a total of 13 instances when translocated bigheaded carps were detected in the downstream lock approach, then detected in the lock chamber, then detected upstream of LD 19 in Pool 19. In 2020, there were 5 instances when translocated bigheaded carps were detected in the downstream lock approach, then detected in the lock chamber, then detected upstream of LD 19 in Pool 19.

When combining natural movement IMZ bigheaded carp, translocated bigheaded carp, and Pool 20 bigheaded carp, there have been 45 instances from 2017-2020 when bigheaded carp were

detected in the downstream lock approach, then detected in the lock chamber, then detected upstream of LD 19 in Pool 19.

Depth sensitive transmitters were deployed in bigheaded carp during 2019; these tags were split between bigheaded carps that originated from P19 (translocated fish; n = 12) and Pool 20 (n = 13). Six of the depth tags (2 translocated and 4 from Pool 20) were redetected in the downstream approach at LD19 during 2020. One of the translocated bighead carp that was tagged with a depth sensative transmitter was detected in the downstream lock approach, then detected in the lock chamber, then detected upstream of LD 19 during 2020. The depth sensor transmitters are providing information on the position of bigheaded carps in the water column when inside the lock approach and lock chamber.

Presentations of bigheaded carp behavior at LD 19 were provided at the International Conference on Aquatic Invasive Species and the National Conference of the American Fisheries Society during early FY20. Additional conference presentations were cancelled due to COVID-19 restrictions. Data from 2017-2018 were analyzed to determine how environmental conditions and lock operations affect native species and invasive carp movement and behavior at LD 19. These analyses were published in the journal Biological Invasions.

Fritts, A.K., B.C. Knights, J.C. Stanton, A.S. Milde, J.M. Vallazza, M.K. Brey, S.J. Tripp, T.E. Devine, W. Sleeper, J.T. Lamer, K.J. Mosel. 2021. Lock operations influence upstream passages of invasive and native fishes at a Mississippi River high-head dam. *Biological Invasions* 23: 771-794. https://doi.org/10.1007/s10530-020-02401-7

Analysis of depth sensor tags and an evaluation of differences in behavior of invasive carps that originated from the UMR IMZ relative to invasive carps collected from Pool 20 is currently being conducted and an associated manuscript will be submitted to a peer reviewed journal in 2021.

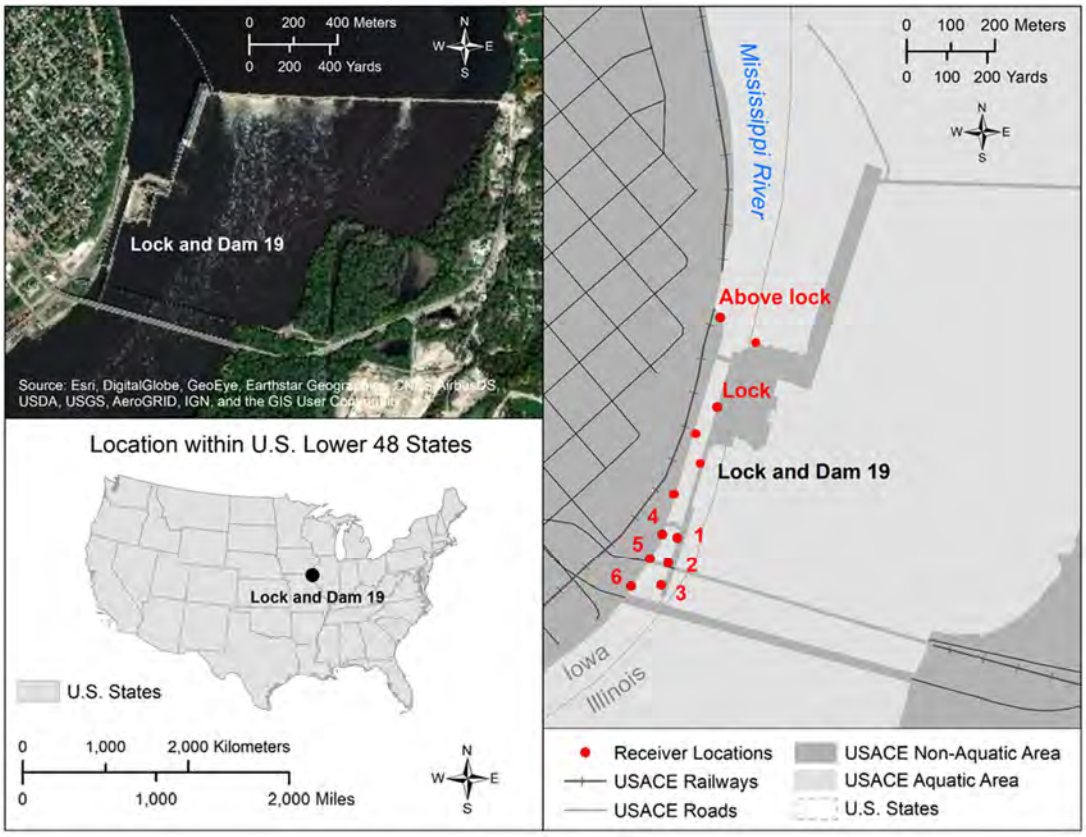

Figure 1. Location of Lock and Dam 19 and the VEMCO receiver array.

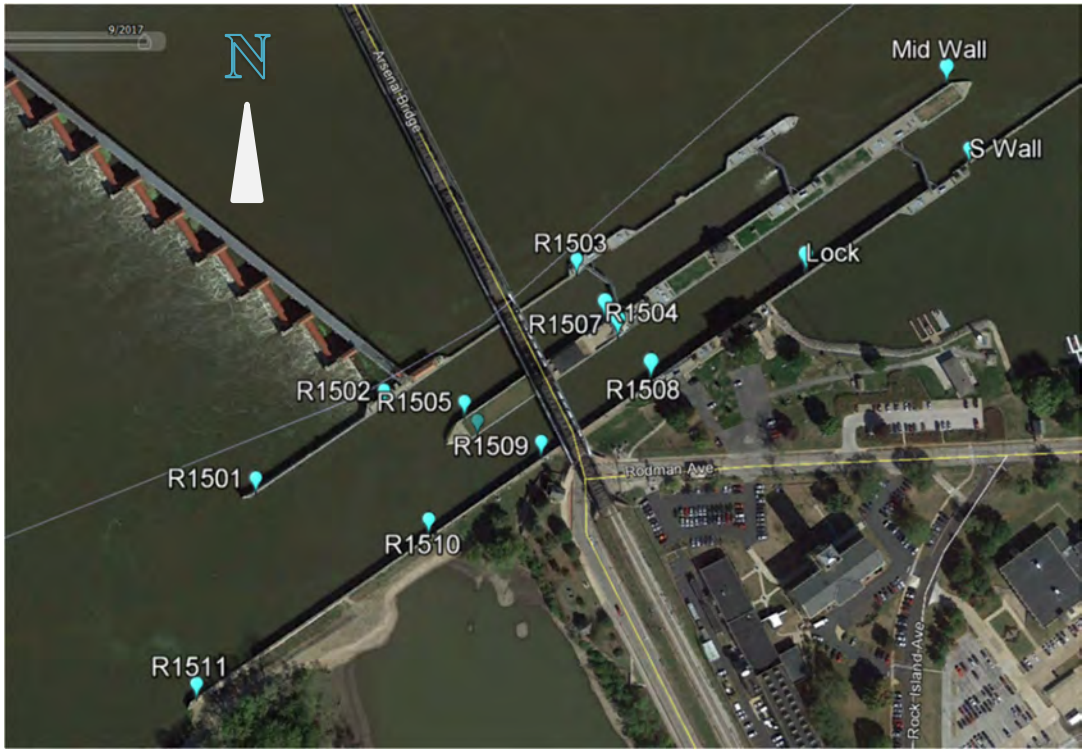

Figure 2. Location of receivers completing the array in the lock approach at Lock 15.