Project Title: Movement of Invasive Carp in the Arkansas River to Inform Management

Geographic Location: Arkansas River from Pool 4 (Pine Bluff) to Arkansas/Oklahoma State Line (Pool 13), with additional detection capability up to Webbers Fall Lock and Dam 16 in Oklahoma and in the White River between Des Arc and Newport.

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Participating Agencies: University of Arkansas Pine Bluff (UAPB), U.S. Fish and Wildlife Service (Oklahoma Fish and Wildlife Conservation Office (OKFWCO), Lower Mississippi River Fish and Wildlife Conservation Office)

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.

Project 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.

Project Highlights:

- No observed movements among river systems have been detected. (i.e. movement between the Arkansas and White rivers)
- Movements on short time scales (i.e. days) were greater in the White River than the Arkansas River.

- Movements on the short time scales were greater in the fall than the winter.

Methods:

UAPB:
Four Vemco VR2 acoustic receivers were deployed in the upper Arkansas River. One is near David D. Terry Lock and Dam, another is near Toad Suck Lock and Dam, one is near Dardanelle, and the final is near Ozark (Figure 1; Table 1). These receivers were placed to determine whether Silver Carp from the lower Arkansas River transited the state from east to west. Three acoustic receivers were deployed in the upper White River (Figure 1; Table 2). These receivers were deployed near Batesville, Oil Trough, and Augusta. These receivers were placed to determine whether Silver Carp from the lower White River moved up toward Batesville.

In 2021, the upper Arkansas River, the upper White River, and the Red River were sampled using daytime, boat-mounted electrofishing. Sampling was focused in areas with known presence of bigheaded carps, or in areas with suitable habitat. Approximately 30 Silver Carp were collected in the upper Arkansas River. Fifteen Silver Carp were collected in the Red River. Approximately 80 Silver Carp were collected in the upper White River. Each individual was measured for total length (mm) and weighted (kg). Sex was determined for each individual and lapilli otoliths and pectoral spines were removed. Age estimation has not yet occurred. Sampling events began in July 2021 and are ongoing.

OKFWCO:
The Oklahoma Fish and Wildlife Conservation Office (OKFWCO) coordinated with the U.S. Army Corps of Engineers (USACE) to monitor, download, and maintain an Innovasea (formerly Vemco) VR2Tx-69kHtz acoustic receiver at each of the three sites in Oklahoma on the Arkansas River. The receivers were placed in a protective metal stand and attached to the upstream side of the wing wall of the lock using a plastic-coated metal cable. The lock and dams include WD Mayo Lock and Dam 14, RS Kerr Lock and Dam 15 and Webbers Falls Lock and Dam 16 (Figure 2; Table #4). These receivers were placed just upstream of the lock to ensure upstream movement of bigheaded carp through the lock. Receivers were downloaded monthly and data was shared with all partners, via email.

Results and Discussion:

UAPB:
10 Silver Carp have been implanted with acoustic transmitters in the upper Arkansas River. 10 Silver Carp have been implanted with acoustic transmitters in the lower White River. To date, only one transmitter has been detected in the upper Arkansas River (at David D. Terry). Likewise, only one transmitter has been detected in the upper White River (at Augusta).

Preliminary analyses of lengths and weights from the three systems indicates similar mean lengths and weights (Table 3). Samples from the upper and lower Arkansas River are combined. Likewise all samples from the upper and lower White River are combined. Mean lengths of

Silver Carp ranged from 818 mm to 925 mm (Table 3). Mean weights ranged from 7413 g to 8805 g.

OKFWCO:

Acoustic receivers were deployed on 3/26/21 and downloaded monthly. The receiver set at Webbers Falls Lock and Dam was lost the first month it was set due to the line being cut by a barge. A new receiver was placed further upstream along the wing wall but was lost again in October. No additional receivers were placed at this site. To date zero implanted carp from Arkansas have been detected coming into Oklahoma waters. Staff continue to monitor the two lower sites but have discontinued monitoring the upper site.

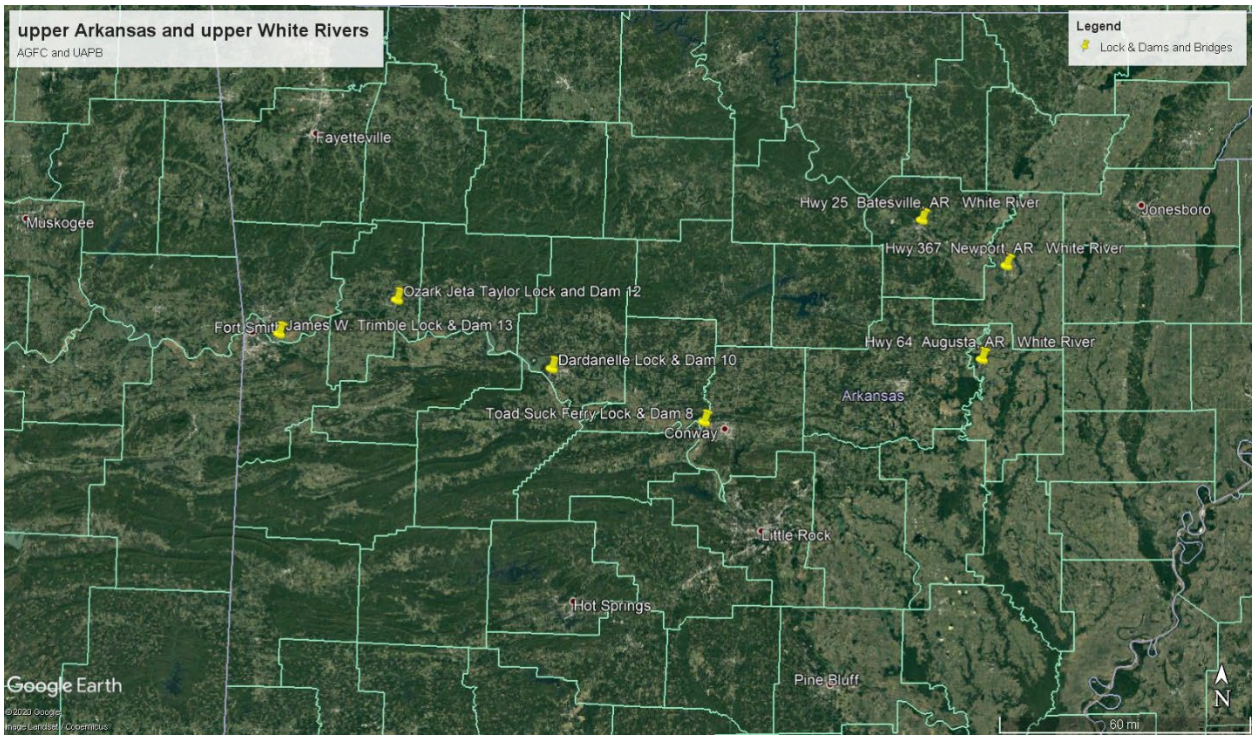

Figure 1. Location for VEMCO Receivers in Arkansas.
Yellow pins designate monitoring sites.

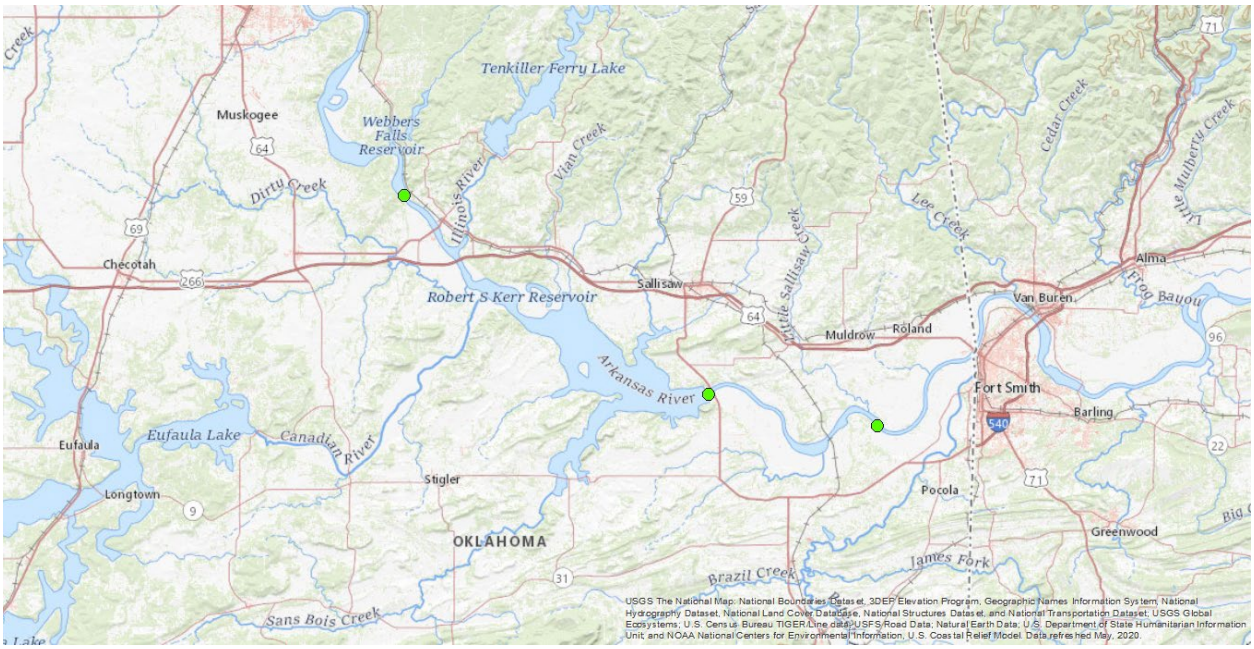

Figure 2 Locations for VEMCO Receivers in eastern Oklahoma. The green dots designate monitoring sites. Sites from west to east include Webbers Falls Lock and Dam 16, RS Kerr Lock and Dam 15, and WD Mayo Lock and Dam 14.

Table 1. Receivers in the upper Arkansas River

Locations	Lat	Long	# Carp Detections
Ozark	35.48298 N	-93.84892 W	0
Dardanelle	35.22172 N	-93.14625 W	0
Toad Suck	35.01155 N	-92.59583 W	0
David D. Terry	34.62167 N	-92.1625 W	1

Table 2. Vemco Receivers in the upper White River

Locations	Lat	Long	# Carp Detections
Batesville	35.75905	-91.64198	0
Oil trough	35.63968	-91.44007	0
Augusta	35.27938	-91.36976	1

Table 3. Lengths and Weights of Silver Carp and Bighead Carp

System	Species	Mean (SD) Length in mm	Mean (SD) Weight in grams
White River	Silver	818 (51)	6460 (1437)
Arkansas River	Silver	925 (106)	8805 (2040)
Red River	Silver	831 (56)	7413 (1293)

Table 4. Vemco Receivers in the Arkansas River in Oklahoma			
Locations	**Lat**	**Long**	**# Carp Detections**
WD Mayo	35.315454	-91.560260	0
RS. Kerr	35.347708	-94.779262	0
Webbers Falls	35.554936	-91.167923	0

Recommendation:

- The course coverage of the stationary receiver array may not be sufficient to ascertain large-scale movements because movements have not been as large as the distance between receivers. More receivers could improve the movement gaps.
- If time and funding is available, try to collect carp from more locations to implant with transmitters.
- Funding that covers multiple years at a time will reduce limitations on the score of movement studies like this.
- Continue to monitor receivers after the study until implanted transmitters battery life has expired.
- Determine whether additional implanting efforts are worth the cost and effort required.
- Continue to monitor movement of bigheaded carp through Dardanelle to determine whether bigheaded carp are able to move through this Lock and Dam. Begin effort to determine what measures need to be taken to ensure this barrier remains to protect the upper Arkansas River from bigheaded carp.
- Implant fish with transmitters from multiple sections of the Arkansas River to see if any Lock and Dam complex is limiting movement. Are the fish in this project not moving as much as other studies (i.e. Kentucky Lake) because of unfavorable river conditions upstream or because they cannot move upstream easily?
- If Dardanelle appears to be slowing upstream movement of bigheaded carp, determine what about it is deterring movement through. If this can be determined, can enhancement be made to ensure no upstream movement of bigheaded carp can occur?
- Continue to monitor whether upstream migration is occurring into Oklahoma waters.
- If certain barriers are preventing carp movement, enhancing other locks to include those barriers to further hinder upstream movement. Eradication efforts can occur upstream of those barriers to push the fish as far downstream as possible.