

Project Title: Early Detection of Invasive Carp Reproduction and Population Expansion in the Tennessee and Cumberland Rivers

Geographic Location: Tennessee and Cumberland rivers and northern section of the Tennessee-Tombigbee Waterway (Divide Cut and Bay Springs Lake).

Lead Agency: Tennessee Wildlife Resources Agency (TWRA; Cole Harty, cole.r.harty@tn.gov)

Participating Agencies: TWRA, Tennessee Technological University (TTU), Kentucky Department of Fish and Wildlife Resources (KDFWR), Alabama Department of Conservation and Natural Resources (ADCNR), and Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP)

Statement of Need:

Invasive carp have been present in the Tennessee and Cumberland rivers for over two decades. They negatively impact fisheries where they are present and pose a significant threat to waters upstream of their leading edge. In response to the ongoing invasion, state and federal wildlife agencies have undertaken efforts to reduce the current populations and are working to prevent further invasion. An increased understanding of invasive carp reproduction where the species' occur and increased surveillance for population expansion beyond the current presence and invasion fronts have significant implications for informing management actions such as targeted removal efforts and deterrent strategies.

Invasive carp reproductive success has not been definitively confirmed above Kentucky and Barkley dams in the Tennessee and Cumberland rivers (TNCR) despite the observation of large numbers of young of year carp during the fall of 2015. Limited evidence of successful invasive carp reproduction, including collection of eggs by Tennessee Valley Authority and one genetically identified larval silver carp from TWRA (2017), has been detected during larval sampling efforts and the 2015 year class remains a dominant cohort of fish captured during sampling efforts since 2016. The larval and juvenile sampling in this plan are critical for understanding the source of carp in the TNCR and making relative management decisions (location and amount of harvest and deterrence projects).

In addition to monitoring for invasive carp recruitment in reservoirs with existing populations, surveillance and monitoring efforts are needed in waters upstream of the existing invasion front, including in adjacent, connected basins such as the Tennessee-Tombigbee Waterway (TTW). Reports/encounters with individual invasive carp in upstream reservoirs and connected basins are infrequent, but important to informing our understanding of the invasion front and documenting range expansion.

Project Objectives:

- 1) Conduct systematic sampling to monitor for and document invasive carp and recruitment.
- 2) Develop and implement monitoring programs for early detection of invasive carp in waters upstream of the current leading edge.

- 3) Determine invasive carp relative densities and assess sampling needs in the Tennessee-Tombigbee Waterway.

Project Highlights:*TWRA*

- No evidence of successful recruitment by invasive carp was detected in Kentucky or Barkley reservoirs in 2022
- No silver carp were detected via electrofishing surveillance efforts conducted below dams in East Tennessee, including Nickajack, Chickamauga, Watts Bar, Ft. Loudoun, and Melton Hill dams.

KDFWR

- No young of year invasive carp were found in Barkley or Kentucky reservoirs

ADCNR

- ADCNR staff accessed a new motor for an Oqauwka electrofisher boat and paired with a second boat, a smaller Duracraft with a Smith-Root (model: 5.0) electrofisher, were able to commence with spring-fall field sampling described below. To date, ADCNR completed the 2022 calendar year with fully implemented sampling efforts at three target tailwater areas. Work included standardized sampling approaches and development of area maps. Despite substantial efforts, no invasive carp were captured nor witnessed within any of the defined sample areas.

MDWFP

- Joint sampling efforts by biologists in MDWFP's Northeast Region and the USFWS Lower Mississippi River Fish and Wildlife Conservation Office occurred in the upper pools of the Tennessee-Tombigbee Waterway in the spring and fall of 2022. A total of 64 sites were sampled with three gear types. No invasive carp were observed or captured during these events, suggesting carp densities likely remain low in the upper pools of the Waterway. Monitoring will continue in these pools and additional sampling methods will be utilized, as resources allow, to increase confidence that lack of observation represents true absence.

Methods:*TWRA*

Objective 1. Conduct systematic sampling to monitor for and document invasive carp recruitment.

TWRA began conducting larval and juvenile monitoring for invasive carp with pilot work conducted in 2016 on Kentucky and Barkley reservoirs. Initial sampling included larval tows and light traps. Larval tows and light traps were conducted annually from May through August. Tows were conducted using a 500-micron net attached to a 1-meter square frame moving upstream with a flowmeter to standardize collections by volume with each sample consisting of 10,000 – 12,500 units. Light traps were set in the hour prior to sunset and retrieved after approximately 1.5 hours of soak time. Traps were distributed from the mouth to the back of embayments, with preference for depths of less than 8-ft. Tailwater electrofishing and mini-fyke nets were incorporated into sampling efforts beginning in 2017 and 2018, respectively. Tailwater

electrofishing was conducted below Pickwick and Cheatham dams during summer in the immediate vicinity of the dams and nearby shoreline. Mini-fyke nets were utilized during August. Net leads were oriented perpendicular to shore with the cod end stretched lakeward, typically in less than 8-ft of water. Daytime sets of approximately 6 hours soak were used. These efforts have since been conducted on an annual basis, including in 2022.

Samples collected via larval tows and light traps were split and preserved for either visual ID or genetic analysis. Visual ID was reported at the Family level through 2020 but has not been completed in recent years. Samples for visual ID are still being collected and preserved, but visual ID will not be completed unless a positive genetic ID result is obtained. Genetic analysis was conducted on subsamples of the larval collection through 2020 by Whitney Genetics. In 2021, we pursued alternatives for genetic analysis of larval samples. We have since partnered with Tennessee Tech University to complete the genetic analysis. Tennessee Tech staff have been refining methodology for this analysis and expect results by July 2022. Samples collected from mini-fyke nets were sorted to remove any black bass or larger sportfish. A cursory examination of each sample was completed prior to preserving samples for visual identification at a later time, should a positive genetic result be obtained or other encounter (e.g., public report or positive ID, encounter of juveniles in standard fisheries sampling) necessitate examining the samples.

Objective 2. Develop and implement monitoring programs for early detection of invasive carp in waters upstream of the current leading edge.

Silver carp surveillance was conducted approximately every two weeks from March through August of 2022 below five dams in East Tennessee – Nickajack, Chickamauga, Watts Bar, Ft. Loudoun, and Melton Hill dams (Appendix A. Figures 1 – 5). Boat electrofishing utilizing high-frequency electrofishing settings was conducted to survey tailwater areas in the vicinity below each dam. Electrofishing transects were completed by 2 boats, electrofishing in tandem, on each downstream bank. The face of the dam and the lock chambers were also surveyed.

KDFWR

Objective 1. Conduct systematic sampling to monitor for and document invasive carp recruitment.

KDFWR sampled for invasive carp young of year (YOY) in Barkley and Kentucky reservoirs. This work was conducted for one week on each reservoir in the fall. From each reservoir, 4 embayment's were chosen based on size and boat ramp availability. If YOY invasive carp are collected, then length and weights will be recorded, and specimens will be kept for further analysis if desired. Environmental parameters such as water surface temperature, reservoir elevation, discharge, and depth were recorded for the sample locations. Boat electrofishing will be conducted during the nighttime. This sampling will also be used to look at condition of baitfish in each reservoir to look at the effects invasive carp have on native baitfish. Transects will not exceed 15 minutes of peddle time. Sampling was conducted with an MLES box at 500 volts, 19-30 amps, and 10,000-16,000 watts.

KDFWR partnered with the U.S. Fish and Wildlife Service (USFWS) to conduct paupier net sampling in Kentucky reservoir to further inform population demographics and to search for YOY invasive carp. KDFWR provided staff and tender boats to collect length, weights, and aging structures. Sampling design was be informed by previous efforts with this gear type by the USFWS and agreed upon by basin partners. Sampling in Kentucky reservoir was done in six embayments over the course of four nights during the month of October. Transects were no more than five minutes long and number of transects per bay was calculated by shoreline distance (one transect/km).

ADCNR

Objective 2. Develop and implement monitoring programs for early detection of invasive carp in waters upstream of the current leading edge.

Boat Electrofishing – Crews plan to conduct tailwater surveillance targeting invasive carp below dams using boat electrofishing. All locations, except for Wilson Dam, will be sampled once every month. Wilson Dam will be sampled once or twice, if possible, during the first spring months (April to May). This project began in April with final collections during September 2022 (Appendix C. Table 1). Three dams below Wilson, Wheeler and Gunterville Reservoir pools were located within the tailwaters, respectively at Pickwick, Wilson, and Wheeler Reservoirs in Alabama waters of the Tennessee River. Sample protocol copied that from verbal communications with and a TWRA staff report written by K. Chestnut-Faull (2021); where two electrofisher boats (4 staff members) moved in tandem from downstream-to-upstream in offset pairs. The paired boats completed two contiguous transects near the bank moving (3 to 4 mph) towards the reservoir dam at each location and both sides of the river. Pre-sample ETS (model: Trident) electrofisher system settings were based on conductivity (Miranda 2009). However, the Smith-Root model was only able to maintain a range of 6 to 8 Amps regardless of conditions. Regardless, this boat fished effectively. The two transects ended near the same locations at the dam wall face to form one large transect. Effort (nearest s) and temperature (nearest 0.1 F) was recorded. Both the driver and dipper made continuous visual sweeps over the sampled areas to observe either stunned or jumping carp. Invasive carp, encountered during this sampling effort will be documented and, if collected, processed for demographic data (i.e., length, weight, sex, otoliths, and pectoral spines).

MDWFP

Objective 3. Determine invasive carp relative densities and assess sampling needs in the Tennessee-Tombigbee Waterway.

A “two-pool” rule was implemented into the early detection sampling design of this project. The two-pool rule establishes that monitoring for invasive bigheaded carps will be conducted in all pools with previous detections and the first two pools distal to the leading-edge pool. In this instance, because bigheaded carps have been detected in Bay Springs Lake, sampling was conducted in the two pools below Jamie L. Whitten Lock and Dam—Pool E (G. B. “Sonny” Montgomery Lock) and Pool D (John Rankin Lock). The two-pool rule will be applicable within and among sampling events. To illustrate, if a silver carp was detected in Pool E, but not Pool D, during the first sampling event, sampling would be extended into Pool C (Fulton Lock) for that sampling event.

Sampling for invasive bigheaded carp occurred in February and October of 2022 in Tennessee-Tombigbee Waterway Pools E and D. February sampling consisted solely of modified electrofishing. Sampling in October added gill nets with electrical herding and hoop nets.

Modified electrofishing protocols followed the procedures outlined in Bouska et al. (2017). This protocol affords the boat operator the ability to selectively apply power to encircle or trap invasive carp. Electrofishing transects consisted of ten, randomly selected, ten-minute sites. Power output at each site was standardized to a power goal based on water temperature and conductivity of the sampling area.

Additionally, six sites on each pool were sampled using surface-to-bottom gill netting with electrical herding. Gill nets were 92 m in length and 2.4 or 4.9 m in depth depending on water depth at the site. Net construction consisted of three 30.5m panels with increasing mesh size measuring 7.6, 10.2, and 12.7 cm bar length. Herding crews moved approximately 150 m upstream and downstream of the net and electroshocked perpendicular to the net for the ten-minute duration of the set.

Hoop nets, constructed of 2.5 and 7.6 cm bar mesh, were deployed at six random sites parallel to shore in habitats outside the navigation channel. Nets were anchored at both the upstream and downstream ends to prevent collapse due to low flow and soaked for one night.

Results and Discussion:

TWRA

Objective 1. Conduct systematic sampling to monitor for and document invasive carp recruitment.

Total effort is summarized in Appendix A, Tables 1 and 2. No larval invasive carp were detected via visual ID that was completed for sampling through 2020 (Appendix A, Table 3). One positive genetic identification in 2017 was collected from Kentucky Reservoir (Appendix A, Table 4). However, age-0 and age-1 invasive carp were not collected or observed during tailwater electrofishing surveys, mini-fyke net sampling, or extensive sportfish sampling via trap nets and electrofishing in subsequent years.

Though anecdotal evidence (observation of flowing and spent females) and the positive genetic ID of one larval silver carp suggest that invasive carp attempt to spawn in Kentucky and Barkley reservoirs, their attempts have not been successful. If spawning attempts by invasive carp were successful, the observation of numerous larval and juvenile carp would be expected from sampling efforts. Additionally, fisheries staff would expect to receive and confirm numerous reports from the boating/angling public, which has not been the case. The lack of larval and juvenile invasive carp observed suggests that these fish are not successfully spawning or recruiting to the population on a regular basis in Kentucky and Barkley reservoirs.

Objective 2. Develop and implement monitoring programs for early detection of invasive carp in waters upstream of the current leading edge.

Total surveillance effort in 2022 was nearly 59 hours and is further broken down by site in Appendix A, Table 5. Additionally, in East Tennessee, TWRA fisheries staff detected no silver carp in the entirety of regional sampling efforts, received no reports of silver carp during creel, received no reports of silver carp captured via commercial fishing, and received no reports of silver carp from boaters/anglers.

KDFWR

Objective 1. Conduct systematic sampling to monitor for and document invasive carp recruitment.

Electrofishing

KDFWR sampled for YOY invasive carp nighttime boat electrofishing, in conjunction with sampling for projects under the monitoring of native fish project. This sampling occurred for a week on Barkley reservoir and a week on Kentucky reservoir in October of 2022. Sampling targeted young of year invasive carp, gizzard shad (GZSD), threadfin shad (TFSD), skipjack herring (SKJH) and emerald shiners. No YOY invasive carp were collected from either reservoir.

Paupier

Sampling with USFWS collected a total of 40,564 fish with the electrified paupier net boat over four nights spent on Kentucky reservoir. This sampling was targeting young of year invasive carp, adult invasive carp, gizzard shad, threadfin shad, and skipjack herring. No YOY invasive carp were collected. CPUE of adult silver carp was lowest it has been in Big Bear embayment (105.9 fish/hr. Appendix B. Table 1), since paupier sampling has occurred. The missing years from 2020 – 2021 has been due to personnel constraints and the Covid pandemic.

ADCNR

Objective 2. Develop and implement monitoring programs for early detection of invasive carp in waters upstream of the current leading edge.

Guntersville Dam & Tailwater – ADCNR staff electrofished the tailwater section below Guntersville Dam on six occasions between April 7 and September 27, 2022 (Appendix C. Table 1, Figure 1). Effort included 24-person days and 11.02 h (2-boats) of pedal time. The two upstream transects ran for a distance of 2.96 km from the south, beginning at Shoal Creek, and 1.64 km from the boat access ramp on the north banks, respectively. The dam encompassed an additional 1.29 km of sample distance for a total of 5.89 km. Electrofisher settings were standardized based on conductivity (ETS system only) readings. Surface water temperatures ranged from 15.6 to 30.8 °C and conductivity ranged from 143 to 181 µs. No invasive carp were captured nor visually identified by staff during sampling events.

Wheeler Dam & Tailwater – ADCNR staff electrofished the tailwater section below Wheeler Dam on six occasions between April 21 and September 7, 2022 (Appendix C. Table 1, Figure 2). Effort included 24-person days and 13.62 h (2-boats) of pedal time. The two upstream transects ran for a distance of 0.82 km from the south, beginning at the Wheeler Dam boat access, and 0.73 km from the western-most edge of the rip-rap armoring area on the north banks, respectively. The dam encompassed an additional 2.65 km of sample distance for a total of 4.2 km. Other areas and island edges were occasionally sampled as well. Electrofisher settings were

standardized based on conductivity (ETS system only) readings. Surface water temperature was 25.2 °C and conductivity was 163 μs . No invasive carp were captured nor visually identified by staff during sampling events.

Wilson Dam & Tailwater – ADCNR staff electrofished the tailwater section below Wilson Dam on one occasion during June 6, 2022 (Appendix C. Table 1, Figure 3). Effort included 4-person days and 2.24 h (2-boats) of pedal time. The two upstream transects ran for a distance of 1.21 km from the south, beginning at the Rockpile boat access, and 1.49 km from the eastern-most transmission line crossing the navigation channel on the north banks, respectively. The dam and Jackson Island encompassed an additional 2.49 km of sample distance for a total of 5.19 km. Electrofisher settings were standardized based on conductivity (ETS system only) readings. Surface water temperatures ranged from 17.4 to 31.0 °C and conductivity ranged from 152 to 176 μs . No invasive carp were captured nor visually identified by staff during sampling events.

MDWFP

Objective 3. Determine invasive carp relative densities and assess sampling needs in the Tennessee-Tombigbee Waterway.

No invasive carps were observed or collected in the Tennessee-Tombigbee Waterway during sampling efforts in 2022. A total of 64 sites were surveyed in Pools E and D using multiple gear types including 40 electrofishing transects, 12 gill net sets with herding, and 12 hoop net sets. A total of 595 fishes representing 11 families and 30 species were captured during 2022 sampling efforts in Pools E and D.

Appendix A – TWRA Tables and Figures:

Table 1. Number of larval tows, light traps, and mini-fyke nets conducted to monitor for invasive carp in Kentucky and Barkley reservoirs from 2017 – 2022.

Year	Kentucky Reservoir			Barkley Reservoir		
	Light Traps	Larval Tows	Mini-fyke Nets	Light Traps	Larval Tows	Mini-fyke Nets
2017	180	254	N/A	70	110	N/A
2018	180	225	40	70	75	15
2019	170	164	62	120	118	20
2020	120	183	30	130	160	50
2021	350	400	100	80	130	20
2022	260	310	140	100	130	30
Total	1260	1536	372	570	723	135

Table 2. Tailwater electrofishing effort (hrs) conducted targeting invasive carp below Pickwick and Cheatham dams from 2017 – 2022.

Year	Hours of Electrofishing	
	Pickwick Tailwater	Cheatham Tailwater
2017	3.1	3.07
2018	2.37	2.41
2019	1	1.4
2020	3.27	2.19
2021	2.5	2.5
2022	2.5	2.7

Table 3. Number of larval fish visually identified in larval light trap and larval tow samples, May – August, 2017 – 2020. Larval fish were identified to Family level.

Family	Kentucky Reservoir				Barkley Reservoir			
	2017	2018	2019	2020	2017	2018	2019	2020
Atherinidae	777	92	181	341	1,508	411	394	871
Catastomidae	12	18	16	18	32	0	3	0
Centrarchidae	1,120	1,234	409	394	1,323	3,965	983	1474
Clupeidae	1,295	258	506	2870	1,314	1,083	460	181
Cyprinidae (non-invasive carp)	1,039	256	694	8150	580	504	268	232
Cyprinodontidae	0	0	0	0	0	0	0	1
Percidae	0	0	33	52	0	0	2	1
Poeciliidae	0	0	0	7	0	0	0	1
Sciaenidae	1	0	2	7	0	0	0	0
TOTAL	4,244	1,858	1841	11839	4,757	5,963	2110	2761

Table 4. Summary of samples collected and analyzed for genetic identification.

Year	Total Samples	Samples Processed	Samples Positive Invasive Carp
2017	88	49	1 (Silver carp)
2018	88	51	0
2019	88	15	0
2020	88	8	0
2021	NA	NA	NA
2022	NA	NA	NA

Table 5. Silver carp surveillance effort in East Tennessee reservoirs in 2022 (March – August).

Tailwaters	Avg Temp (C)	Avg Discharge (cfs)	Total Effort (hrs:mins:secs)	Bigheaded Carps Present (Yes/No)
Nickajack	25.0	17,226	18:24:30	No
Chickamauga	24.4	18,130	13:28:26	No
Watts Bar	22.2	19,034	10:27:21	No
Ft. Loudoun	20.8	12,633	8:30:03	No
Melton Hill	18.2	4,211	2:54:21	No
Total:	22.1	13,939	58:56:49	



Figure 1. Electrofishing site below Nickajack Dam for targeted Silver Carp surveys in Guntersville Reservoir in 2022; red indicates survey area (start: 35.024810, -85.637710, end: 35.003735, -85.620142).

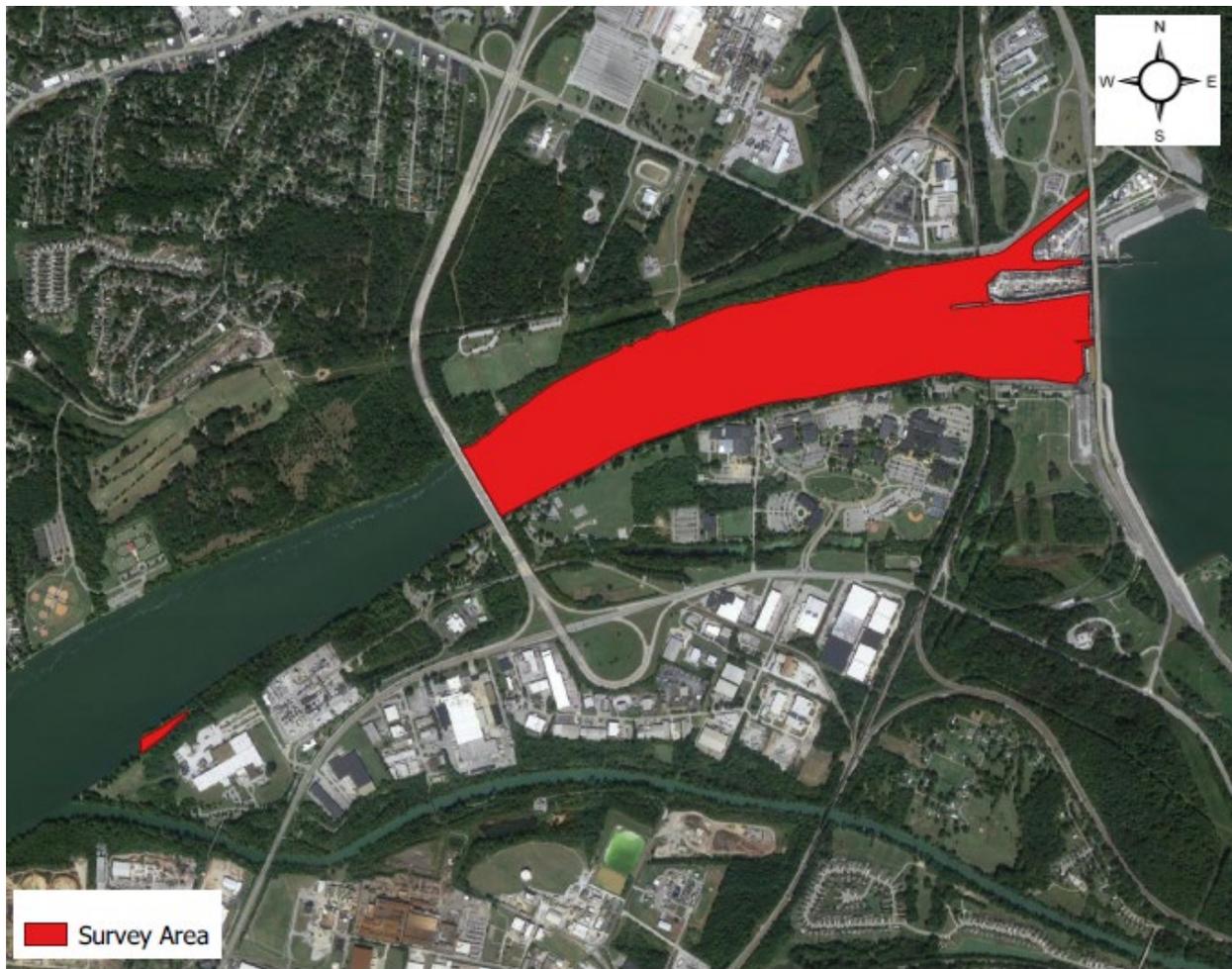


Figure 2. Electrofishing sites below Chickamauga Dam for targeted Silver Carp surveys in Nickajack Reservoir in 2022; red indicates survey areas (start: 35.098613, -85.251988, end: 35.108279, -85.229355), (additional site: 35.091367, -85.265451). The additional survey site downstream of the C.B. Robinson Bridge was selected as it provides a natural barrier ideal for isolating individuals.



Figure 3. Electrofishing site below Watts Bar Dam for targeted Silver Carp surveys in Chickamauga Reservoir in 2022; red indicates survey area (start: 35.608272, -84.778132, end: 35.621143, -84.781706).



Figure 4. Electrofishing site below Fort Loudoun Dam for targeted Silver Carp surveys in Watts Bar Reservoir in 2022; red indicates survey area (start: 35.785816, -84.256391, end: 35.791178, -84.242715).



Figure 5. Electrofishing site below Melton Hill Dam for targeted Silver Carp surveys in Watts Bar Reservoir in 2022; red indicates survey area (start: 35.88830508, -84.31066639, end: 35.885365, -84.300438).

Appendix B – KDFWR Tables and Figures

Table 1. Paupier net effort and catch rates from sampling conducted in Big Bear embayment of Kentucky Reservoir. (S.E. = Standard error)

Date	Net Hours	Number of Silver carp captured	Mean Silver carp CPUE (fish/hr)	S.E.	Number of Grass carp captured	Number of Bighead carp captured
Nov-16	9.12	1,406	168.9	23.0	3	
Oct-17	2.12	516	229.2	40.3		2
Oct-18	4.72	1496	308.3	61	1	2
Oct-22	1.28	105	105.9	33.2		

Appendix C – ADCNR Tables and Figures

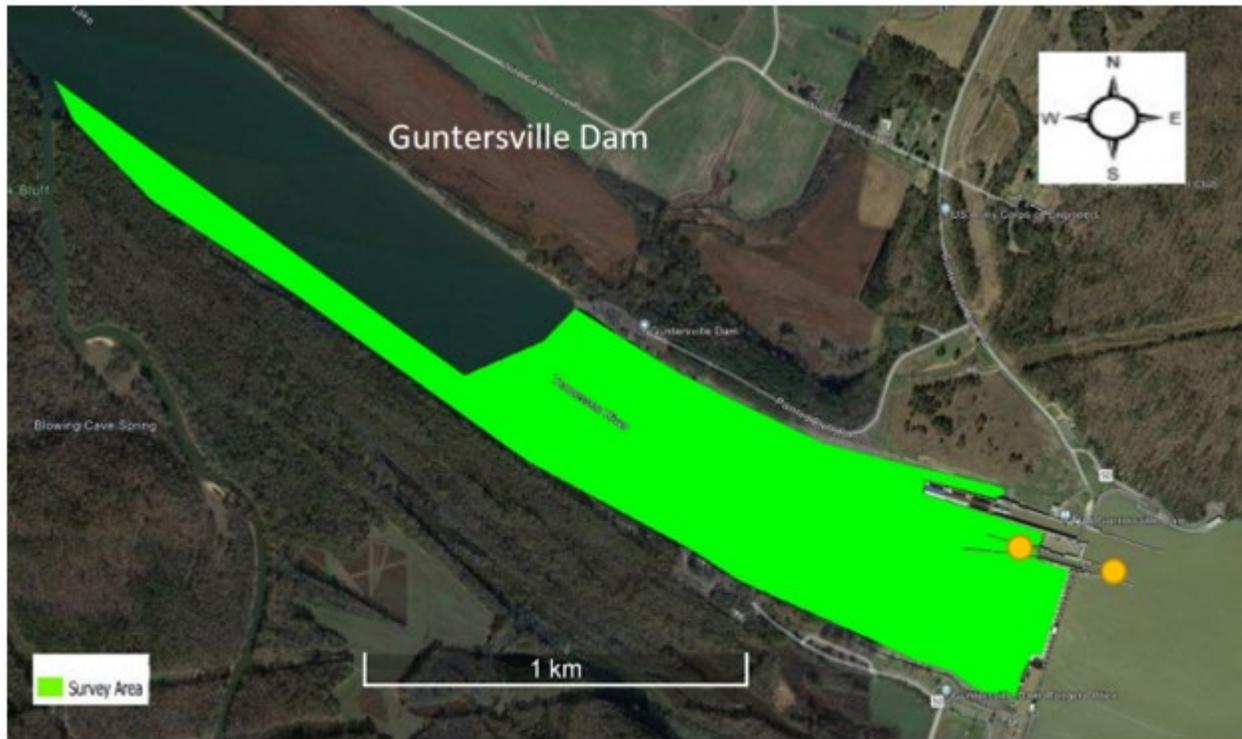


Figure 1. Map of tailwater electrofishing area below Guntersville Dam for targeted carp surveys in Wheeler Reservoir during 2022; green shading indicates survey area upstream of the north access area ramp (34.4315439, -86.4055221) and Shoal Creek (34.436793, -86.420648) to the south. Yellow dots denote telemetry receivers within lower and upper lock chambers.

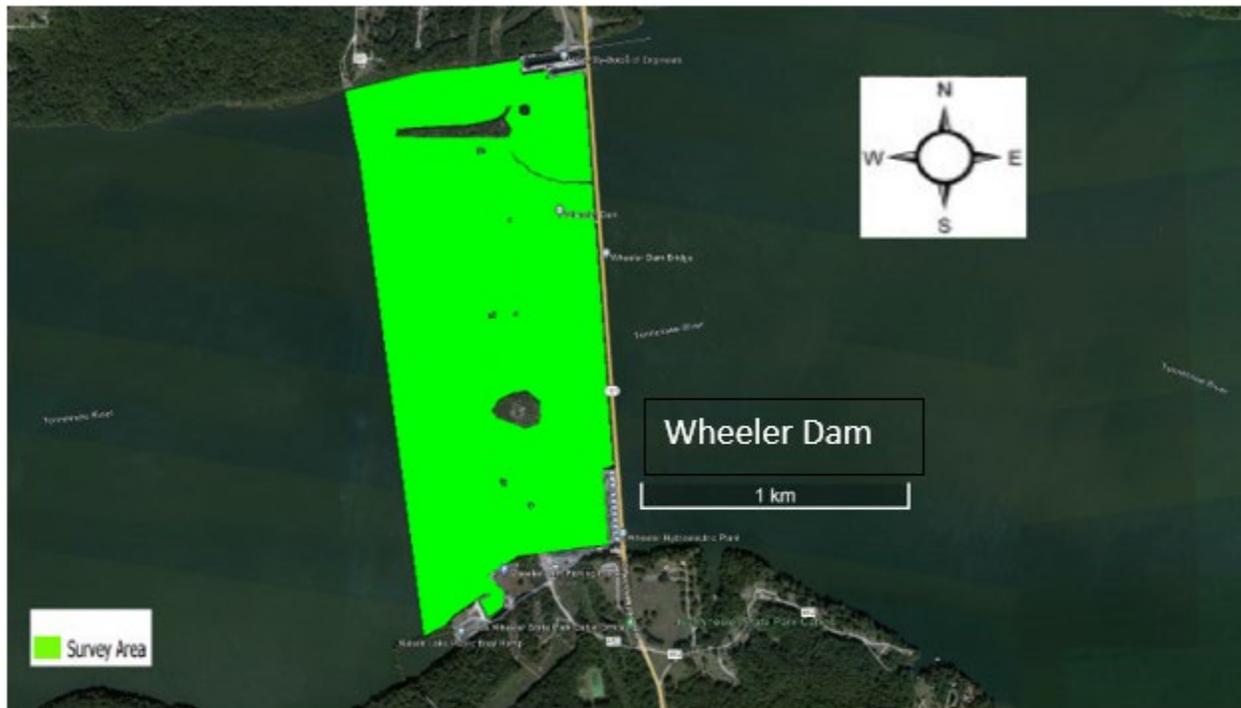


Figure 2. Map of the tailwater electrofishing area below Wheeler Dam for targeted carp surveys in Wilson Reservoir during 2022. Green shading indicates survey area upstream of the south access area ramp (34.7940983, -87.3892511) and north rip-rap armored bank (34.8114032, -87.3917301).

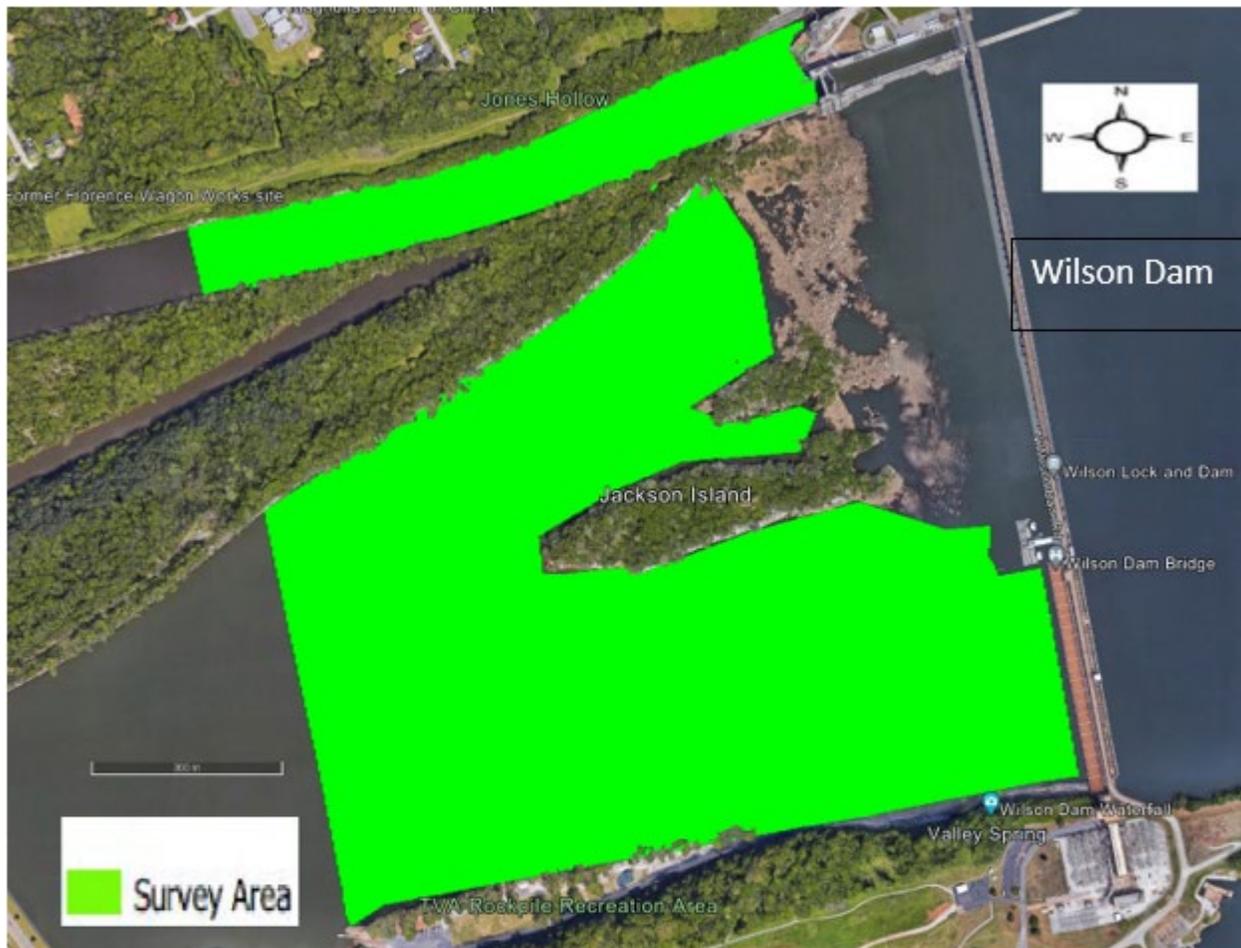


Figure 3. Map of the tailwater electrofishing area below Wilson Dam for targeted carp surveys in Pickwick Reservoir during 2022. Green shading indicates the survey area upstream of the north bank transmission line (34.802063, -87.6399441) and the Rockpile Landing access area ramp (34.792417, -87.637669) on the south bank.

Table 1. Summary of ADCNR standard electrofisher efforts CY2022 at three Alabama tailwater locations below Wilson, Wheeler and Guntersville Dam on the Tennessee River (upper to lower sites). Pedal-time effort (one boat, s) was converted to hours (nearest 0.01). Gear or staff days of effort, catch, water quality, electrofisher settings (ETS System) and output parameters as shown. Total (2-boat) effort was 26.88 hours.

Date	Tailwater dam	Reservoir pool at tailwater	Effort (1 boat, h)	Boat days (n)	Staff days (n)	Carp catch	Temperature (°F)	Conductivity (µs)	AMPS	Volts	Pulses/s	Duty Cycle
						or sighted (n)						
4/7/2022	Guntersville	Wheeler	1.42	2	4	0	15.6	143	24	520	118	12
5/2/2022	Guntersville	Wheeler	0.78	2	4	0	20.1		20	555	64	33
6/1/2022	Guntersville	Wheeler	0.80	2	4	0	25.8	161	13	500	59	12
7/5/2022	Guntersville	Wheeler	1.03	2	4	0	30.8	156	16	315	64	26
8/4/2022	Guntersville	Wheeler	0.60	2	4	0	29.1	148	12	300	63	25
9/27/2022	Guntersville	Wheeler	0.88	2	4	0	23.6	181	13	425	64	26
4/21/2022	Wheeler	Wilson	1.18	2	4	0	17.4	152	21	550	61	12
5/3/2022	Wheeler	Wilson	1.09	2	4	0	20.0		24	560		
6/14/2022	Wheeler	Wilson	0.89	2	4	0	29.0	168	12	320	54	15
7/6/2022	Wheeler	Wilson	1.48	2	4	0	31.0	176	14	335	64	26
8/2/2022	Wheeler	Wilson	1.18	2	4	0	29.1	164	12	300	63	26
9/7/2022	Wheeler	Wilson	0.99	2	4	0	27.7	166	12	200	64	26
6/2/2022	Wilson	Pickwick	1.12	2	4	0	25.2	163	12	435	62	15
			13.44	26	52	0						

Appendix D – MDWFP Tables and Figures

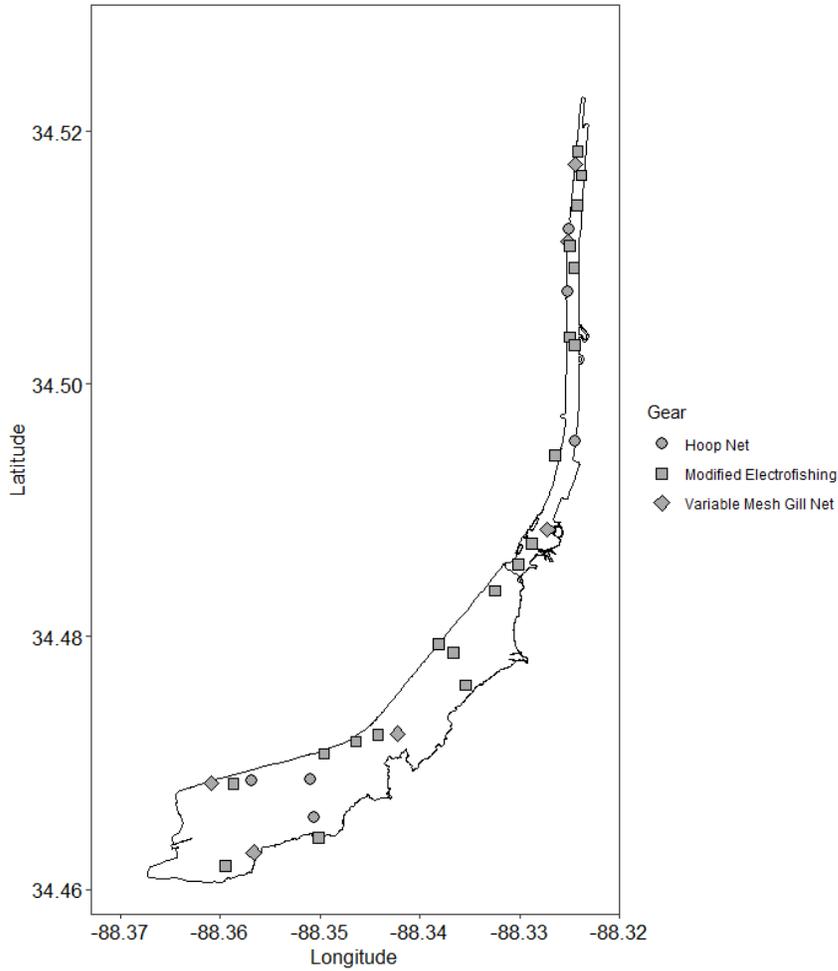


Figure 1. Sampling sites for electrofishing, gill netting, and hoop netting on Pool E of the Tennessee-Tombigbee Waterway. Figure courtesy of USFWS LMRFWCO.

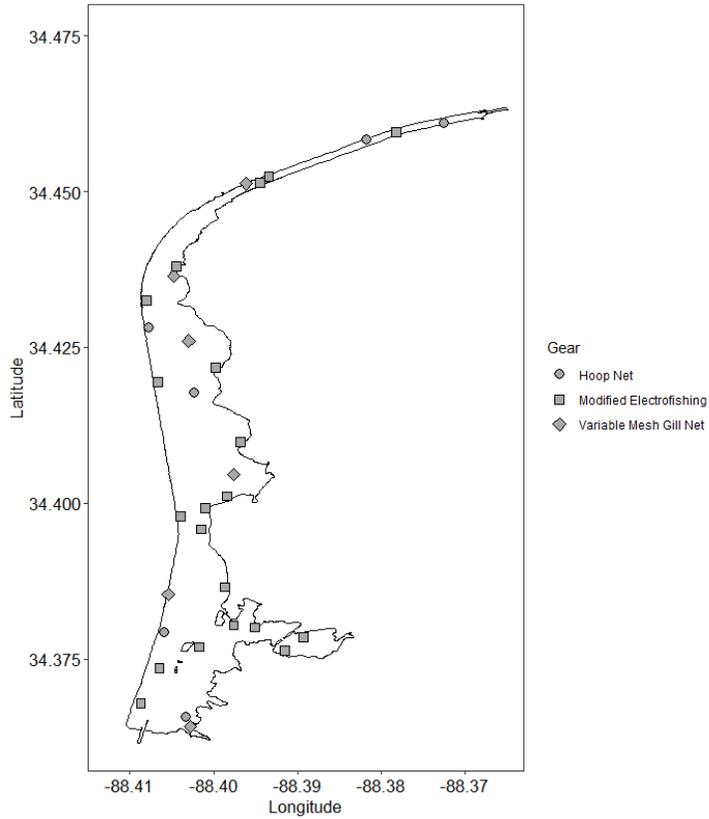


Figure 2. Sampling sites for electrofishing, gill netting, and hoop netting on Pool D of the Tennessee-Tombigbee Waterway. Figure courtesy of USFWS LMRFWCO.

Recommendation:

- Continue monitoring for evidence of successful invasive carp reproduction and recruitment in the Tennessee and Cumberland rivers, specifically in Kentucky and Barkley reservoirs.
- Continue monitoring upper reaches of the Tennessee River to inform current understanding of carp population status and define presence, invasion, and establishment fronts.
- KDFWR recommends to sample for YOY invasive carp in the lower Tennessee and Cumberland rivers and continue to monitor within Barkley and Kentucky reservoirs.
- ADCNR; Currently, there is no immediate need for expansion of new studies or actions outside of current management plans and actions during 2023. This may change with needs or adjustments per discussions among other TNCR partner agency staff.
- Continue monitoring the Tennessee-Tombigbee Waterway for invasive carp.
- Consider alternative sampling methodology including electrofishing using multiple boats and using sidescan sonar to locate fish.

References:

- ADCNR. 2023. Invasive Carp Monitoring Plan in Alabama Waters of Tennessee River Reservoirs. Draft report (January 3, 2023), 10 pp.
- Bouska, W. W., D. C. Glover, K. L. Bouska, and J. E. Garvey. 2017. A refined electrofishing technique for collecting Silver Carp: implication for management. *North American Journal of Fisheries Management* 37:101–107.
- Chestnut-Faull, K. 2021. Silver Carp Surveillance, TWRA Region III Reservoirs, Tennessee Wildlife Resources Agency. Report dated 10 August, 2021. 13 pp.
- Conover, G., R. Simmonds, and M. Whalen, editors. 2007. Management and control plan for bighead, black, grass, and silver carps in the United States. Asian Carp Working Group, Aquatic Nuisance Species Task Force, Washington, D.C. 223 pp.
<http://www.micrarivers.org.php7-35.lan3-1.websitetestlink.com/wp-content/uploads/2018/08/Final-ANSTF-Approved-Asian-Carp-Plan.November-2007.pdf>
- Miranda, L. E. S. 2009. Standardizing electrofishing power for boat electrofishing. In S. Bonar, W. Hubert, A. Hubert, & D. Willis (Eds.), *Standard methods for sampling North American freshwater fishes*. Bethesda, MD: American Fisheries Society.
- Ohio River Basin Asian Carp Control Strategy Framework. Ohio River Fisheries Management Team, October 24, 2014. http://www.micrarivers.org.php7-35.lan3-1.websitetestlink.com/wp-content/uploads/2018/08/ORFMT_Asian_Carp_Strategy.pdf