

**Project Title:** Evaluation and Removal of Invasive Carp in the Tennessee and Cumberland Basins

**Geographic Location:** Tennessee and Cumberland rivers and the 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; Kentucky Department of Fish and Wildlife Resources (KDFWR); Alabama Department of Conservation & Natural Resources, Wildlife & Freshwater Fisheries Division (ADCNR); Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP); U.S. Fish and Wildlife Service (USFWS); U.S. Army Corps of Engineers (USACE); Tennessee Valley Authority (TVA); Murray State University (MSU); and Tennessee Cooperative Fisheries Research Unit, Tennessee Technological University (TTU).

**Statement of Need:** All four species of invasive carp have been collected in the Tennessee and Cumberland rivers (TNCR). The states of Kentucky, Tennessee, Mississippi, and Alabama have significant recreational and ecological resources at risk due to invasive carp. This project is needed to help implement portions of the National Management and Control Plan for Asian Carp (Conover et al. 2007) and portions of the Ohio River Basin Asian Carp Control Strategy Framework (Ohio River Fisheries Management Team 2014). The project objectives and descriptions below consist of important steps to monitor, control, and better understand the impacts of invasive carp in the TNCR, all of which are identified goals of the sub-basin management plan. As individual TNCR states have initiated their carp programs, agencies have recognized the need to align sampling methods to collectively address invasive carp on a basin-wide scale. Partners in the TNCR are committed to identifying and reconciling differences in methodology to meet the broader goals of a basin-wide framework.

TWRA and KDFWR have invested in commercial carp removal programs, and the USFWS has funded a sound barrier experiment at Barkley Lock. To measure the success of these control measures, agencies need standardized sampling methods that will allow comparisons among water bodies and over time. Foundational research on carp sampling has been conducted by USFWS, KDFWR, TWRA, and TTU using USFWS Invasive Carp base funds and local funding sources. These projects have tested many sampling methods in an effort to identify the best available methods for sampling carp. This project will increase capacity for standardized sampling in TN, KY, and AL. Ultimately, while Mississippi Department of Wildlife, Fisheries, and Parks does not have funded work associated with this project currently, they are coordinating with TNCR states and will benefit from this project. The inclusion of all four states is critical for the evaluation of carp populations in the TNCR.

In this project, KDFWR evaluates the response by the native fish community and their fisheries in the presence of invasive carp. The establishment of invasive carp in new areas have been shown to alter native fish communities (Irons et al. 2007) and result in shifting food webs (Collins and Wahl 2017). Fisheries managers seek to understand these dynamics to evaluate the effectiveness of control measures, and to keep stakeholders informed. This work will

complement ongoing projects in the TNCR. In this project, KDFWR evaluates the response of native fishes, such as gizzard shad, buffalo, and paddlefish, which compete directly with bigheaded carp for zooplankton.

The commercial fishing industry has been successful at harvesting carp using gillnets and has benefitted from harvest incentive programs developed by KDFWR and TWRA. Increasing harvest rates remains important if commercial fishing will be used as a means of population control. Due to cost and restrictions on commercial gear types, the private sector cannot easily test new methods. Development of more efficient carp removal methods would greatly benefit the TNCR and potentially other basins. As part of this project, the KDFWR and MSU will continue to evaluate new gears that could be used by resource managers and commercial fishers. This work will benefit all partners in the TNCR as we need highly effective removal methods that are designed for the habitats associated with the TNCR.

**Project Objectives:**

- 1) Estimate invasive carp relative abundance and population demographics in the Tennessee and Cumberland River basins to evaluate management actions.
- 2) Examine invasive carp impacts on native fish communities.
- 3) Target and remove invasive carp to suppress populations and reduce propagule pressure in the Tennessee and Cumberland River basins.

**Project Highlights:*****KDFWR***

- No age-0 silver carp have been collected in either reservoir since 2015, suggesting that these fish continue to immigrate into the reservoirs through the lock systems.
- Commercial fishers removed over 9.5 million pounds of invasive carp statewide and 7.3 million pounds of invasive carp through the Asian Carp Harvest Program in 2022. CPUE (fish/yard) was highest in 4" bar mesh gill nets.
- KDFWR staff conducted 59 ride-alongs with commercial fishers in the carp harvest program, to monitor catch and bycatch data. Out of the 59 ride-alongs, 6 ended with no nets being set.
- Commercial fishers enrolled in the subsidy contract fishing program received \$672,218.49 for invasive carp harvested from Barkley and Kentucky reservoirs.
- KDFWR continued Master Agreement contracts with two private entities to test invasive carp experimental gears in Kentucky waters. During 2022, both entities were active in the program and harvested approximately 243,108 lbs of invasive carp from Kentucky and Barkley Lakes over 13 days.
- KDFWR received four reports of black carp in the Tennessee River during 2022 and none in the Cumberland River.

***TWRA***

- No larval or juvenile invasive carp were collected during sampling efforts, suggesting a continued lack of successful reproduction in the Tennessee and Cumberland rivers and that populations in Tennessee are driven primarily by migration.
- Silver carp greater than 850 mm were captured in all Tennessee and Cumberland River reservoirs; on average, silver carp in upstream reservoirs (Pickwick and Cheatham) were larger than those in downstream reservoirs (Kentucky and Barkley).
- The Tennessee Carp Harvest Incentive Program (TCHIP) resulted in the harvest of 7,797,639 lbs of invasive carp, primarily from Kentucky and Barkley reservoirs.

#### ***ADCNR***

- To date, ADCNR completed the 2022 calendar year of fully implemented sampling efforts. 2022 work included standardized sampling approaches, as well as development of a new occupancy sampling approach. Staff further completed sampling of habitat and site areas for more efficient sampling across the three lower project reservoirs.

#### **Methods:**

##### ***KDFWR (all referenced Tables and Figures for KDFWR located in Appendix A)***

*Objective 1: Estimate invasive carp relative abundance, and population demographics in the Tennessee and Cumberland River basins to evaluate management actions.*

KDFWR used a combination of standardized sampling and monitoring of commercial harvest to evaluate relative changes in invasive carp abundance in Barkley and Kentucky reservoirs. Standard sampling with gill nets was conducted at sixteen sites on Barkley and Kentucky reservoirs. These standard sites were selected to provide adequate sampling parameters, decrease conflict with anglers, and provide static locations to monitor changes in catch per unit effort (CPUE). Four embayment sites and four main channel sites were selected on each reservoir. These sites were sampled once during the following seasons: spring (April), summer (July), and fall (October). A total of four nets were fished at each location during sampling periods and in orientations specific to each location. Sampling occurred when the lake level was greater than 354' in areas where water depth was a minimum of 13'. Nets were deployed, at least one hour before sunset and retrieved at least one hour after sunrise the following morning (according to the official rise and set tables). Specific coordinates were determined for all sets, and nets were set at the same locations each season. Sinking experimental gill nets 10' deep, 300' total length, with 100' panels of 3", 4", and 5" mesh was fished overnight. The gill nets were 12' deep tied down to 10' every 8'. Each of the 100' panels of webbing was hung with 30" stretch in 16" ties (3" square, 5 meshes per 16" of linear net; 4" square, 4 meshes per 16" of linear net; and 5" square, 3 meshes per 16" of linear net). Webbing used in each panel was constructed of 8 ply, 0.2-mm twist mesh. Cross ties for these nets was constructed from #15 white bonded twine through the webbing. Catch rates and species captured were recorded for each gillnet mesh size.

KDFWR partnered with the USFWS to conduct Paupier net sampling in Kentucky reservoir to further inform relative abundance calculations and population demographics. KDFWR provided staff and tender boats to collect length, weights, and aging structures. Sampling design was 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).

The KDFWR Asian Carp Harvest Program (ACHP) requires commercial fishermen to report daily landing records. Occasionally the agency also provides observers to record harvests as the nets are retrieved (ride-alongs). Data collected during ride-alongs with commercial fishers allows KDFWR to estimate average weights of individual silver carp commercially harvested. This information was used inform analysis about invasive carp population demographics.

During the standard sampling described above, total lengths (mm), weights (g), sex and gonad weights (g) were recorded from a subsample of at least 20 bigheaded carp at each sample site, ride-along, or transect. During fall sampling, pectoral fin rays and otoliths were extracted from approximately 100 silver carp from each reservoir for aging or at least 20 per centimeter group. Demographics data may also be collected from invasive carp captured through other KDFWR sampling efforts and included for analyses.

Silver carp movement will be used to estimate periodicity of silver carp spawning attempts, and the data will be aligned with environmental factors to examine potential correlations if such attempts are recorded.

*Objective 2: Examine invasive carp impacts on native fish communities.*

During standard sampling for invasive carp conducted in the TNCR Evaluation and Removal Project: objective 1, total length and weight data was collected from bigmouth buffalo and paddlefish. During Paupier net sampling, total length and weight data was recorded for gizzard shad as well. Measurements were used for determining condition factors through relative weight analysis. Values will be monitored over time to determine if they will be useful to assess impacts that invasive carp may have on conditions of the native fishes. The species chosen for this assessment are often captured in gill nets and have been recognized as being vulnerable to competition for resources with invasive carp species (Irons et al. 2007, Schrank et al. 2003). KDFWR conducted targeted sampling for gizzard shad with pulsed DC boat electrofishing for one week in both Barkley and Kentucky reservoirs. Electrofishing runs did not exceed 15 minutes of peddle time and ran parallel to shore in 3-8ft of water. Length and weight were taken from individuals collected. The first run started at sunset; the rest were done after sunset with LED lights on the front rail.

Barkley and Kentucky reservoirs' tailwaters was sampled with pulsed DC electrofishing in the fall to assess species composition, relative abundance, and condition of represented fish species. Sampling below Kentucky reservoir (Tennessee River) consisted of three 15-minute transects, moving downstream along each bank of the river. Sampling below Barkley reservoir (Cumberland River) consisted of two 15-minute transects, moving downstream along each bank of the river. Fall sampling was conducted one day each month in September, October, and November. Two staff collected fish with nets from the bow, and all fish of every species will be targeted. Data included species, total lengths (mm), and weights (g). When large numbers of a species are collected, measurements on a subsample of at least 25 individuals will be taken and

extrapolated for that species. The data was compared to historical data collected by the KDFWR WFD personnel to assess changes in fish community over time.

Invasive carp harvest continues to increase from Kentucky and Barkley reservoirs, driven by the Asian Carp Harvest Program (ACHP) and the additional processors purchasing carp from western Kentucky. KDFWR continues to monitor conditions of sport fish species to identify trends that may be associated with the increased removal of invasive carps. Information on sport fish has been gathered routinely throughout the past few decades by KDFWR's Western Fisheries District (WFD). Lengthy data sets on black bass, crappie, and catfish in the two lakes are collected from standardized annual sampling. The information will be used to compare sport fish conditions (Wr) with harvest rates of invasive carps to determine if there is a correlation. In spring, summer and fall of 2022, KDFWR conducted the creel survey in the tailwaters of Barkley and Kentucky reservoirs. Random, non-uniform probability creel surveys were conducted from February 16, 2022 through November 15, 2022 in the Kentucky Tailwater and the Barkley Tailwater. The Kentucky Tailwater survey extends from the Kentucky Dam downstream to the Interstate 24 bridge. The Barkley Tailwater survey extends from Barkley Dam downstream to the US Hwy 62 bridge. Dates and periods for surveys each week were randomly selected, and creels were conducted in each tailwater at least 10 days per month in each tailwater, including a minimum of 3 weekend days. Each day was divided into three periods: morning, afternoon, and late evening. The late evening period was only utilized for a portion of the survey to collect snagging and bow fishing data. Daily, access point surveys consisting of instantaneous angler counts and angler interviews were conducted from the bank; no boat was used. Timing of recreational fishers' counts are randomly chosen daily, and data was extrapolated accordingly to calculate daily average and total effort. An attempt to interview all recreational fishers each day was made. Data collected during the creel surveys was compared to historical surveys to determine changes in fish community, catch rates, angler use, and success. Recreational fishers were also administered an angler attitude questionnaire to gauge opinions regarding their levels of satisfaction with the fishery and on current or proposed regulations. Increasing invasive carp numbers in the tailwaters over the past decade has perpetuated a significant increase of bow fishing. During 2019, regulations were enacted in Kentucky to allow the sale of invasive carp harvested by recreational fishers. The 2022 creel survey provided data to assess the effects of the new regulation.

KDFWR continued to administer the Asian Carp Harvest Program (ACHP) and an Experimental Fishing Methods contract program to encourage largescale removal of invasive carp. As fishing effort and techniques develop and increase, there is potential for these activities to negatively impact native fish through excessive bycatch when fishers are attempting to target invasive carp. Commercial fishers on the ACHP are required to submit daily reports indicating species of bycatch, harvest status, or condition of bycatch upon release. KDFWR staff also collected this information during ride alongs with commercial fishers. These two data sets will be analyzed independently to determine if commercial fishing efforts are negatively impacting native fish species.

*Objective 3: Target and remove invasive carp to suppress populations and reduce propagule pressure in the Tennessee and Cumberland River basins.*

KDFWR continues to dedicate staff time towards observing commercial fishing and facilitating efforts to assess the impacts of targeted removal of invasive carp on non-target native species. Commercial fishers requesting to fish in the ACHP are required to provide daily landing reports including amount of fishing effort, the type of gear used, pounds of fish harvested, and bycatch. Fishers are also required to list the number of fish caught for each species, fish released, and disposition. The information is used to assess impacts of commercial harvest on bycatch species.

To verify commercial fishers' reports, KDFWR occasionally provides observers to record harvests (ride-alongs). Observers collect all data required on commercial harvest logs and record GPS fishing locations, water temperature, net soak times, and other metrics. Staff observe several individual fishers throughout the year. Ride-alongs are conducted as fishers pull their nets to harvest fish. When commercial fishers use short net soak times or drifting net sets, KDFWR staff observed during the entire effort. Ride-alongs are conducted from an agency boat located near the commercial fishers or on the commercial fisher's boat if there is adequate space. Observation records were compared to fishers' daily reports to assess commercial reporting accuracy. ACHP data was analyzed to determine the number of fishing trips, amount, and disposition of bycatch by species, and total pounds of invasive carp harvested.

KDFWR continues to offer contract fishing in Barkley and Kentucky reservoirs to ensure commercial fishing effort targeting invasive carp remains robust, to meet agency management objectives. Commercial fishers must apply for the contract program and once approved, will receive a designated price per pound for invasive carp species harvested from Barkley or Kentucky reservoirs. The Asian Carp Harvest Program is one of two programs Kentucky has implemented to increase commercial removal of invasive carp in the reservoirs. In 2018, KDFWR purchased and installed an industrial flake ice machine. Since that time KDFWR has maintained the unit to provide ice to commercial fishers targeting invasive carp. As demand continues to increase, upgrades and additional storage capacity for the ice machine and freezer will be required.

Since the commercial harvest programs for invasive carp have increased and KDFWR staff time is limited, KDFWR staff discontinued conducting targeted removal efforts during 2022.

***TWRA (all referenced Tables and Figures for TWRA located in Appendix B)***

***Objective 1: Estimate invasive carp relative abundance, and population demographics in the Tennessee and Cumberland River basins to evaluate management actions.***

TWRA staff conducted invasive carp sampling with gill nets during summer (May-August) and fall (September-November) 2022, on four reservoirs in the Tennessee and Cumberland River Basin to monitor relative abundance. Sampling was completed on Kentucky (6 sites/season), Barkley (3 sites/season), Pickwick (1 site/season), and Cheatham (3 sites/season) reservoirs. Four nets were deployed during daytime hours at each site on each reservoir during each season and pulled the following morning. Nets were distributed in embayments from the mouth to the back of the embayment (depths greater than approximately 10-foot depth). Individual nets were 300-ft in length with 100-ft panels of 3-, 4-, and 5-inch mesh. Nets were 12-ft deep, hobbled to 10-ft every eight feet; nets had 0.5-inch foamcore for the floatline and 65-lb leadcore for the lead line. The webbing used in each panel was constructed of 8 ply, 0.2-mm twist mesh.

Dozer trawls were conducted in Kentucky (n=125), Barkley (n=25), Pickwick (n=25), and Cheatham (n=25) reservoirs. Kentucky Reservoir was divided into five sections to encompass the large reservoir (n=25 sites/section) (Table 4). Dozer trawls were conducted with a 3.7 meter trawl attached to a 2.1 x 0.9 meter frame which was located off the bow. The trawl frame was connected via aluminum arms which were raised and lowered by a Warn winch located under the front deck. The dozer trawl was electrified by an MLES Infinity electrofishing box with a curtain array located in front of the trawl frame. Dozer trawls were conducted during summer (June – July 2022) and fall (October 2022). Dozer trawl transects were conducted at sites within embayments with depths greater than 1.8 meters for 5 minutes at approximately 6.4 km/h. Voltage and amperage were adjusted to achieve power outputs greater than 4,000 watts. Invasive carp species were measured (mm), weighed (kg), and sexed. Threadfin shad and gizzard shad were separated and counted for all dozer trawl transects. Length (mm) and weight (g) was collected for all skipjack herring and otoliths were extracted for age determination. Smallmouth buffalo were measured (mm) and weighed (kg) and all other by-catch was measured (mm) and released. Silver carp that jumped or evaded capture were counted and recorded. Otoliths and left pectoral fin rays were collected from all invasive carp captured during the fall for age determination.

Standardized electrofishing was conducted to target invasive carp in Old Hickory Reservoir, where previous sampling has resulted in few captures. Because invasive carp captures have been rare in previous efforts, electrofishing boats were utilized, rather than dozer trawls, to cover more area and optimize capture of invasive carp, if located. Old Hickory Reservoir was split into 18 sampling locations (Figure 1). Each location was sampled for 600 continuous seconds. If invasive carp were collected, length (mm), weight (kg), and sex was recorded. Otoliths were also extracted for age determination.

*Objective 3: Target and remove invasive carp to suppress populations and reduce propagule pressure in the Tennessee and Cumberland River basins.*

TWRA continued implementing its carp harvest incentive program, TCHIP. Three wholesale fish dealers were contracted to receive per pound-based reimbursement incentives for invasive carp purchased from commercial fishers fishing in Kentucky and Barkley lakes. Wholesale dealers received \$0.13 per pound in reimbursement and were required to pay out a minimum of \$0.15 per pound or \$0.18 per pound to fishers for fish less than 8 lbs. or greater than 8 lbs., respectively.

***ADCNR (all referenced Tables and Figures for ADCNR located in Appendix C)***

*Objective 1: Estimate invasive carp relative abundance, and population demographics in the Tennessee and Cumberland River basins to evaluate management actions.*

Gillnet Sampling – ADCNR staff conducted gillnet sampling at predetermined, GPS-fixed embayment sites on Pickwick (3 sites), Wilson (2 sites) and Wheeler (3 sites) Reservoirs during spring 2022 (ADCNR 2023; Figure 1). At each area (i.e., embayment), four gill nets were set and fished overnight (as in Fernholz 2018). During summer and fall, these same sites were re-examined and least successful sites (1/embayment) were dropped for a total of three sites per

embayment. Sites were adjusted for minimum distance ( $>0.20$  mi) apart and depth ( $\geq 13$ -ft) spread to fit an occupancy strategy (Sullivan et al. 2018), though most sites locations moved only modest distances. Sites were sampled one repetition in summer and 3 to 4 consecutive-day repetitions during fall. Standardized nets are 300-ft in length and comprised of 100-ft panels of 3-, 4-, and 5-in bar mesh. Standardized nets are 12-ft deep, hobbled to 10-ft every eight feet, featuring 0.5-in foam-core float line and 65-lb lead-core lead line. The multifilament webbing used in each net panel is constructed of 8 ply, 0.2-mm twist mesh. Catch of all invasive carp species were recorded by mesh size and data on individual fish included total length (nearest mm), weight (nearest 0.01 kg), sex, left ovary weight (nearest g) and extraction of pectoral fins and otoliths. All other species were counted by mesh size. Essential length and weight data were recorded for Bigmouth Buffalo and Paddlefish (Schrack et al. 2003, Irons et al. 2007).

Electrofishing & Dozer Trawl – ADCNR staff accessed a new boat motor and commenced winter field trials of the new Oqauwka boat and electrified dozer trawl. This gear was fully implemented during spring sampling. However, damage to the trawl made use obsolete, though did not reduce the ability to electrofish invasive carp effectively. As with gillnetting, electrofishing sites ( $n = 105$ ) were re-evaluated for habitat type and sample efficiency (i.e., preferred transect depths  $< 13$  ft) and fixed at two points in newly selected sites (3/embayment) at two to three areas (i.e., embayments) in each of three Alabama reservoirs, including Pickwick, Wilson, and Wheeler. Multiple factors, such as travel logistics, habitat type (restricted to embayment and overbank) and area were used in determining dimensions and location of sampling sites. Occupancy surveys (Sullivan et al. 2018) were implemented in summer and fall months and conducted during the daytime. Transects did not implement dozer trawl apparatus. Samples were conducted for 5 minutes at 3.0 mph, with typical transect distances of 0.25 to 0.30 miles. The damaged dozer trawl frame is currently being refit with a breakaway system to prevent damage and should be completed by spring 2023.

*Objective 3: Target and remove invasive carp to suppress populations and reduce propagule pressure in the Tennessee and Cumberland River basins.*

Regardless of sampling method, all individual invasive carp were sacrificed upon completion of data collection needs to satisfy.

## **Results and Discussion:**

### ***KDFWR (all referenced Tables and Figures for KDFWR located in Appendix A)***

*Objective 1: Estimate invasive carp relative abundance, and population demographics in the Tennessee and Cumberland River basins to evaluate management actions.*

#### Standard Sampling

Standard sampling data continues to be variable across seasons and years in each reservoir. Data for silver carp suggested that mean catch per unit effort (CPUE), reported as number of fish per linear yard of gill net, was evenly spread throughout different seasons, habitat types, and mesh size. Overall invasive carp CPUE through standard sampling was low (Table 14).

#### Paupier

U.S. Fish and Wildlife Service sampled Kentucky reservoir with their electrified paupier net boat during the fall of 2022. Lengths and weights were collected for all species until N=30 per species and then counted. If a transect concluded with a species count over ~500, they were subsampled and counted by weight. The electrified paupier sampling had a silver carp CPUE (fish/hr) of 105 in Big Bear embayment, which decreased significantly from previous catch rates (Table 22). The paupier sampling creates less sampling bias and therefore a better fitting regression line when looking at Log10 transformed lengths and weights for silver carp; Kentucky reservoir  $R^2=0.88$  whereas Barkley reservoir  $R^2=0.75$  (Figure 7 & 8).

### ACHP

Length and weight data was collected on 1041 silver carp harvested by commercial fishers in 2022. Silver carp lengths ranged from 16.5 - 38.9 inches with an average of 29.9 inches, and weights ranged from 5.1 – 29.2 lbs with an average of 10.9 lbs (Table 18). If this metric is used in correlation with the total pounds of silver carp harvested by commercial fishers through the ACHP in 2022, that would produce a rough estimate of 695,662 individual silver carp being removed from Kentucky waters through the ACHP in 2022 (7,5822,713 lbs; Table 17). During ride-alongs, commercial fishers were observed using gill nets with a range of bar mesh sizes to target invasive carp (3.5” – 5” bar mesh; Table 19, Figure 14). Catch per unit effort of gill nets used to harvest silver carp were highest in gill nets with a bar mesh size of 4” (0.62 fish/yard), followed by 3.75” bar mesh which had a CPUE of 0.51 fish/yard. This has increased from previous three years when the highest CPUE was in 3.25” and 3.5” bar mesh nets. There has been a change in the size gill net mesh commercial fishers are using in Barkley and Kentucky reservoirs, this is likely due to the 2015 cohort of fish being recruited to the bigger size mesh.

Four black carp were harvested by one commercial fisher in January of 2022. Lengths ranged from 836mm – 942mm, were caught in 4” mesh gill nets and all were sent off to research groups with USGS to investigate further.

### Mark-Recapture

From October 2018 through February 2023, KDFWR received 48 tag returns from commercial fishing efforts. Thirty-eight came from Barkley reservoir and ten from Kentucky reservoir (Figure 9). Nine other tags have been returned from bowfishers, government agencies, or found along the river banks. Twelve of the returned fish were double tagged. The higher frequency of returned fish from Barkley reservoir compared to Kentucky reservoir is not surprising given most of the commercial fishing pressure occurs on Barkley (Reported under Objective 3).

Data collected from harvested fish indicated that all fish grew from the time of initial tagging to the point when they were harvested. Inspection of tag insertion locations indicated good healing of the marked fish. All recovered fish exhibited localized redness around the tag insertion, however none showed signs of infection. Many fish were harvested in the same embayment where they were tagged. The tag return data suggests that most of the fish returned have developed site fidelity, however, we have not distinguished specific behavioral or environmental

characteristics that draw them to a constricted geographic area, relative to the area that is available for use. Although, there have been three tag returns from bow-fishers harvesting tagged fish outside of the reservoirs where they were released. Data analysis is in progress with the assistance of the USGS CERC staff and a report is expected in 2023.

### Barkley and Kentucky Reservoir Population Dynamics

A length-frequency histogram was created for silver carp harvested from Barkley and Kentucky reservoirs from all harvest methods in 2022. Data suggested the 700mm size class of silver carp was dominant in both systems (Figures 1 & 2)

### Age and Growth

Pectoral fin rays were collected from silver carp in Barkley and Kentucky reservoirs in the fall of 2022 for aging. Barkley ages ranged from 4 to 8 years old, with age 7 being the most abundant. Kentucky ages ranged from 3 to 8 years old, with age 7 being the most abundant, (Figures 3 & 4). Data suggests a strong presence of two cohorts of silver carp behind the 2015 cohort (7 year old fish). Since no age-0 silver carp have been collected in either reservoir since 2015, logic suggests that these fish continue to immigrate into the reservoirs through the lock systems.

### Mortality

Catch-curve regressions were developed for the 2015 cohort of silver carp by lake. This cohort of silver carp is the only documented cohort known to occupy the lakes at age-0. Data for age frequencies were  $\ln(x+1)$  transformed to compensate for heteroscedasticity. A Chapman-Robson analysis was performed to estimate annual mortality ( $\hat{A}$ ) and instantaneous mortality ( $Z$ ). Annual mortality for silver carp from Barkley reservoir was estimated at 46% and instantaneous mortality was estimated at 0.62 (N= 201,  $F_{1,2}=7.20$ ,  $P=0.07$ ,  $R^2=0.71$ ; Figure 6). Annual mortality for silver carp from Kentucky reservoir was estimated at 38% and instantaneous mortality was estimated at 0.48 (N=232,  $F_{1,2}=29.40$ ,  $P=0.01$ ,  $R^2=0.91$ ; Figure 5). Estimates of annual mortality in 2022 decreased from the values reported in 2021. This is attributed to the wider time series of data for this cohort informing better model predictions.

### Condition

Linear regressions were constructed to describe the  $\log_{10}$  length- $\log_{10}$  weight relationship for silver carp in Barkley and Kentucky reservoirs. The length-weight equation for Barkley was estimated at  $\text{Log}_{10}(\text{weight(g)}) = 3.1151 * \text{Log}_{10}(\text{length(mm)}) - 5.289$  (Figure 8). The length-weight equation for Kentucky was estimated at  $\text{Log}_{10}(\text{weight(g)}) = 3.2649 * \text{Log}_{10}(\text{length(mm)}) - 5.7404$  (Figure 7). Weights were predicted for Barkley reservoir: 450mm (946g), 650mm (2975g) and 800mm (5681g) and Kentucky reservoir: 450mm (836g), 650mm (2776g) and 800mm (5469g) (Table 15). Predicted weights remain higher for Barkley than for Kentucky, both reservoirs indicate that smaller fish (450mm & 650mm) are predicted to weigh less compared to previous years, unlike the larger silver carp (800mm) which increased this year.

Data collected from sampling in the fall of 2022 was used to analyze relative weights (Wr). Relative weight was calculated using the equation  $\text{Log}_{10}(W_s) = -5.15756 + 3.06842(\text{Log}_{10}TL)$  for silver carp and  $\text{Log}_{10}(W_s) = -4.65006 + 2.88934(\text{Log}_{10}TL)$  for bighead carp (Lamer 2015). The mean Wr for silver carp in Barkley reservoir was 102 (N=349, S.E.=±0.5) and the mean Wr for silver carp in Kentucky reservoir was 97 (N=463, S.E.=±0.4). These values are consistent with data collected from previous years. Only one bighead carp was collected in the fall, it was in Kentucky Lake and had a relative weight of 116.

*Objective 2: Examine invasive carp impacts on native fish communities*

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. The Midwest Lake Electrofishing Systems shock box was set to 120 Hertz, 25% duty cycle, 500 volts, 17-20 amps and 10,000-17,000 volts. On Kentucky Lake 6,572 Gizzard Shad, 1,848 Threadfin Shad, and 178 Skipjack Herring were collected. On Barkley Lake 4,990 Gizzard Shad, 3,046 Threadfin Shad, and 426 Skipjack Herring were collected. CPUE for gizzard shad was higher in Kentucky reservoir than Barkley reservoir for both gizzard shad below 180 mm and above 180 mm (Table 2).

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. Table 1), since paupier sampling has occurred. The missing years from 2020 – 2021 has been due to personnel constraints and the Covid pandemic.

Using data collected from both electrofishing and paupier sampling, condition of native baitfish was calculated to better understand the potential impacts invasive carp. Relative weight (Wr) of gizzard shad over 180mm was slightly higher from Kentucky reservoir at 91 compared to Barkley reservoir at 90 (Table 1). Paupier and EF sampling produced CPUE of similar results for gizzard shad (1045 & 1100, respectively) but paupier had much higher CPUEs for threadfin shad, skipjack herring and adult silver carp (Table 3).

Standard Sampling

Capture rates of species with potential direct competition from bigheaded carp (silver and bighead) were observed to be low in the 2022 standard sampling, which continues the trend observed in previous years. No bigmouth buffalo were caught in 2022 standard sampling nets. In Kentucky Lake paddlefish were observed to have a mean Wr of 84 (N=2, S.E. ±11) and in Lake Barkley paddlefish had a mean Wr of 80 (N=14, S.E. ± 4, Wr equations from Blackwell et al 2000) . These species will continue to be monitored and data will be collected

opportunistically. Increased data collection through a gear such as the Paupier net and increased ride alongs with commercial fishers targeting paddlefish, would be very valuable in future assessments of these native species.

During standard sampling in 2022, bycatch in Lake Barkley was comprised of 53 % scaled rough fish (Buffalo spp., Freshwater drum, Gar spp., etc.), 39% catfish spp. (Ictaluridae), 5% paddlefish and 4% sportfish. Bycatch in Kentucky lake was comprised of 47% scaled rough fish, 45% catfish spp., 1% paddlefish and 3% sportfish.

#### Kentucky and Barkley Tailwaters Electrofishing

Fall sampling with electrofishing in the Kentucky Tailwater resulted in the capture of 9,312 total fish comprised of 23 species during 4.5 hours of effort in 2022. Threadfin shad catch rates was the second highest since the study began in 2015 (1860 fish/hr. Table 6), but gizzard shad and skipjack herring stayed around the same as 2021. CPUE of sunfish species including bluegill and longear sunfish, increased from 2021 with a CPUE of 34 fish/hr and 5 fish/hr, respectively. Largemouth and smallmouth bass CPUE increased from 2021 and were similar to catch rates in 2020. Interestingly, for the third year in a row, striped mullet (*Mugil cephalus*) was collected during sampling efforts in the Kentucky Tailwater in 2021. A total of 4 striped mullet were collected ranging from 19 – 21 inches in total length, whereas 5 fish were collected in 2021 and 4 fish were collected in 2020 (Table 4). Silver carp CPUE dropped to the lowest catch rate since the study began in 2015 at 2 fish/hr (Table 6).

Fall sampling in the Barkley Tailwater resulted in the capture of 4,257 total fish comprised of 16 species over 3.0 hours of effort in 2022. Threadfin shad catch rates were like 2020 and 2017 with a CPUE of 1263 fish/hr (Table 7). Sunfish species such as bluegill and longear sunfish produced similar catch rates to 2021, which are some of the lowest catch rates for those species since the survey began in 2016 with a CPUE of 21 fish/hr and 16 fish/hr, respectively (Table 7). Largemouth bass catch rates in 2022 were the lowest observed, but smallmouth bass catch rates like previous years (Table 7). Silver carp CPUE during fall sampling in Barkley Tailwaters was the second lowest since 2016 (11 fish/hr; Table 7).

Length frequency distribution for silver carp collected in Kentucky Tailwater during fall sampling in 2022 ranged from 19-34 inches (N=9; Table 4). Silver carp lengths from Barkley Tailwater during fall sampling ranged from 19-32 inches (N=11; Table 5). These ranges are much wider compared to silver carp collected during fall sampling in 2018 and 2019 and may indicate more mixing of the silver carp population in the Tailwaters, or that fish from a variety of locations are arriving at the tailwaters and looking for passage upstream.

Electrofishing for this project resulted in removal of 9 silver carp and 10 grass carp from Kentucky Tailwater and 32 silver carp from Barkley Tailwater in 2022.

Relative weights (Wr) were calculated for selected species collected during fall sampling to monitor fish condition (Tables 8 & 9). Trends in fish condition are important in the current study, as any observed declines in condition of individual species may be an indicator of competition for resources and reflective of high invasive carp densities in the tailwaters. Low relative weight is generally characteristic of fish in poor health, whereas high values indicate fish in excellent

health (Blackwell et al. 2000). However, ideal target ranges of  $W_r$  values have not been identified for all species and in every habitat type. Therefore, the  $W_r$  values compiled through this study will be used to assess changes in the Tailwater fish community over time. In the Kentucky Tailwater, the mean  $W_r$  of gizzard shad decreased to a value of 89, the second highest observed since the survey began in 2015 (Table 8). Largemouth bass also recorded the second highest  $W_r$  since 2015 at 105 (Table 8). The mean relative weight for white bass increased slightly from 2021, but still isn't up to historical records. However, the mean relative weight for sauger ( $W_r = 71$ ) decreased to the lowest values recorded for those species since the survey began (Table 8). Mean relative weight values for other species in the Kentucky Tailwater remained similar to previous years. In the Barkley Tailwaters, mean relative weight values increased for gizzard shad ( $W_r = 89$ ) from 2021. Smallmouth bass mean relative weight increased to 95 and that is the same as 2017, which are the highest seen since 2016 (Table 9). All other species in the Barkley Tailwaters had similar mean relative weights to previous years.

#### Kentucky and Barkley Tailwater Creel

In 2022 survey results indicated that the fewest number of trips were made to Barkley tailwaters, and the second lowest number of fishing trips were estimated for Kentucky tailwaters (Figures 18 & 19). In 2022 creel survey results from Barkley tailwaters suggests that catch rates were the highest observed, at 2.4 fish/hour (Figure 20). Whereas Kentucky tailwater data suggested that fishers caught 1.89 fish/hour. This was a decrease of 0.9 fish/hour from the record high in 2019 (Figures 21).

Bowfishing made up 35% of the angling from Barkley tailwater and 12% from Kentucky tailwaters (Figure 16 & 17). These are the highest percentage of fishing methodologies reported since the method was included in the creel survey in 2016. Of the 35% of anglers in Barkley tailwaters that were bowfishing, 24% of those were by boat. The overall percentage of anglers in Barkley tailwaters by boat was 23%. Of the 12% of anglers in Kentucky tailwaters, only 4% of those were by boat. The overall percentage of anglers in Kentucky tailwaters by boat was 19%. The difference between Kentucky and Barkley tailwaters differences might be due to shoreline access.

Part of the tailwater creel is an angler attitude survey where anglers are asked their satisfaction with the fishery. In the Barkley tailwaters respondents indicated Asian Carp were most fished for (42%) followed by catfish (29.6%), whereas Kentucky tailwaters anglers' fished for catfish (33.5%) more than Asian carp (16.5%). This would seem to indicate that the invasive carp have created a significant recreational opportunity, especially in Barkley tailwaters. Of those surveyed fishers, a small amount had indicated they had eaten Asian Carp (Barkley 25.4%, Kentucky 21.8%). Given invasive carp's abundance and being considered excellent table fare, more outreach is needed to expose the public to this abundant resource's potential. Of the 21 paddlefish anglers that were interviewed, 42.9% of them were somewhat satisfied with the paddlefish fishing in the Kentucky tailwaters were-as of the 33 interviews in the Barkley tailwaters, only 24.2% were somewhat satisfied (Appendix A & B).

#### Standard Sport Fish Sampling

In Kentucky reservoir, relative weight analysis was conducted for black crappie, white crappie, blue catfish, and largemouth bass (KDFWR 2021). Black and white crappie both exhibited mean

relative weights that were higher than 2021 but were not outside of historical norms with  $Wr$  of 91 and 87, respectively. Largemouth bass average  $Wr$  also remained similar to values calculated for the previous four years ( $Wr = 94$ ). Many factors are known to impact sport fish condition and values recorded since invasive carp have become established in Kentucky reservoir have not fluctuated outside of historical variations. The impacts to sport fish condition associated with this increased removal of invasive carp requires more years of data and will continue to be monitored.

In Barkley reservoir, relative weight analysis was conducted for black crappie, white crappie, largemouth bass, and blue catfish (KDFWR 2021). Mean relative weights for both black and white crappie remained similar to previous years having  $Wr$  of 98 and 100, respectively. Mean  $Wr$  value for largemouth bass in 2022 was 100. Harvest of invasive carp from Barkley reservoir has increased almost every year since the ACHP began in 2013. Similar to Kentucky reservoir, the sharp rise in harvest of invasive carp in 2019 corresponds with lower condition factors of sportfish species, which may be an indicator of high densities of adult invasive carp competing with these sport fish for resources. Therefore, the increase in condition of sport fish in Barkley reservoir in subsequent years, may be influenced by a reduced competition with invasive carp as they are continually harvested. However, sport fish condition in the reservoirs is highly variable due to a variety of factors and will continue to be monitored in following years.

#### Asian Carp Harvest Program Bycatch

According to the KDFWR ACHP regulation (301:KAR 1:152), commercial fishers are allowed to harvest a ratio of 65% Asian carp to 35% scaled rough fish per month. All other fish caught in commercial gear must be released. Commercial fishers are required to submit daily reports that include bycatch species, number caught, number harvested, number released, and disposition upon release (moribund or alive). In previous years, increased effort by commercial fishers fishing under the ACHP has translated into a growing amount of bycatch. In 2022, the total number of bycatch reported decreased and was the lowest recorded since 2018 (when commercial fishing effort increased dramatically. Table 12). This reduction in bycatch per trip is attributed to changing practices of commercial fishers as most fishers have transitioned from passive setting to active setting of gill nets targeting schools of carp identified via their boat electronics. Scaled rough fish, primarily buffalo (*Ictiobus*) species, make up the majority of reported bycatch in commercial gill nets fished under the ACHP (Table 12). Bycatch of rough fish, and subsequent harvest is variable year to year based on what processors are willing to buy. Although commercial fishers on the ACHP are limited to how much of their bycatch they can harvest, KDFWR will continue to monitor this trend in future years. The number of sport fish, catfish, and paddlefish collected as bycatch all decreased in 2022 compared to recent years. Survival rates of sportfish (93.6%) and catfish (98.8%) decreased in comparison to previous years, and the survival rate of paddlefish remained similar (81.0%) (Table 12).

Survival rates of all bycatch caught during ride-alongs in 2022 was documented by KDFWR observers and was analyzed independent of commercial fishers reporting (Table 11). During ride-alongs, the survival rate of sport fish in bycatches decreased from previous years to 83%. Survival rates of catfish species observed as bycatch during ride-alongs was like previous years at 95%. Paddlefish survival rates observed during ride-alongs in 2021 were the lowest observed since 2016, but still was also the lowest number of paddlefish caught (Table 11).

A comparison for bycatch of paddlefish, catfish species, and sport fish species reported by commercial fishers through daily reports and information collected during ride-alongs shows a decrease since 2015 in number of sport fish captured per trip for most species (Table 10). However, bycatch reported captured per trip for recreationally and commercially important species such as paddlefish and catfish spp. is higher during ride-alongs than from commercial fishing reports (Appendix B, Figure 16). Data suggests 50-75% of bycatch is likely not reported in daily logs submitted to KDFWR by commercial fishers. However, ride-alongs account for a small percentage of the total number of trips made by commercial fishers (3% in 2022). To better identify and monitor under reporting of bycatch, KDFWR will continue to increase the number of ride-alongs conducted with commercial fishers targeting Asian carp. To date, there is no indication of negative impacts on the sport fishery resulting from the ACHP.

### *Bycatch of Paddlefish*

As KDFWR monitors sport fish bycatch through the ACHP it also provides the opportunity to monitor other species that compete directly with Asian carp such as paddlefish. Paddlefish are considered a species of conservation need as their life history traits and value of their roe has potential to result in recruitment overfishing of the population. Consequently, there is a need to closely monitor impacts of the ACHP on paddlefish. Generally, experienced commercial fishers can avoid capturing large numbers of paddlefish when they are targeting Asian carp by carefully selecting fishing locations. The number of paddlefish captured is variable over time but is showing a declining trend even though effort is increasing through the ACHP (Table 12).

Paddlefish survival was observed to be low in 2022 (28% during ride-alongs, 81% total ACHP) in relation to other species in the bycatch (Tables 11 & 12). A factor identified as possibly affecting paddlefish survival in gill nets is length of time the nets are left in the water (i.e. soak time). From conducting ride-alongs, it has been observed that the soak time of nets varies among fishers and depends on the location being fished, weather, and water temperature. Overall, fishers tend to leave nets in the water longer when water temperatures are cooler as it increases catch rates and like most fish, invasive carp will survive longer in the cooler temperatures. Therefore, water temperature and soak time have been recorded during ride alongs since 2017. The lowest mean soak time was 3.25 and the typically the lower mean soak times result in a higher survival rate (Table 13), the combination of soak times greater than 8 hours and rising water temperatures attributes to higher catch rates of paddlefish and lower survival rates. However, commercial fishers are more frequently using active methods for targeting invasive carp with gill nets and soak times of nets decreased overall in 2022. To increase the sample size, water temperature and soak times will continue to be recorded during ride-alongs in 2023.

*Objective 3: Target and remove invasive carp to suppress populations and reduce propagule pressure in the Tennessee and Cumberland River basins.*

### Invasive Carp Contract Fishing Program in Barkley and Kentucky Reservoirs

Interest and participation in the KDFWR contract fishing program for invasive carp has varied greatly since it began in 2016. However, in 2019, refinements were made to the program and the number of fishers targeting invasive carp in Barkley and Kentucky Reservoirs increased, which heightened participation in the program. In 2022, contractors received \$672,218.49 for invasive

carp harvested from Barkley and Kentucky Reservoirs. This equates to over 7 million pounds of invasive carp harvested through the contract program in 2022, the second largest harvest to date (Figure 10). Refinements to the program were made in 2021 which removed the varying pay out based on size of fish harvested. As of October 2021, the program now pays contractors \$0.08 / lb for invasive carp harvested from Kentucky waters of the reservoirs regardless of the size of those fish.

### Carp Harvest Program Monitoring

The Asian Carp Harvest Program (ACHP) created by KDFWR allows commercial fishers to target invasive carp in waters where commercial fishing with gill nets is otherwise restricted. The data in this section is compiled from daily and monthly reports submitted by commercial fishers participating in the ACHP. Implementation of the ACHP has been a key element in the increased harvest of invasive carp from Kentucky waters, especially Barkley and Kentucky Reservoirs.

Since 2013, commercial fishers in Kentucky have harvested a total of 34,344,858 lbs of invasive carp through the ACHP (33,841,544 lbs silver carp, 261,889 lbs bighead carp, 241,425 lbs grass carp [2020-2022 only]; Table 17). Total harvest would be higher if grass carp were included for all years, however commercial fishing reports prior to 2020 did not delineate grass carp from common carp. The majority of invasive carp harvested in Kentucky are from Barkley Reservoir (Table 17). Commercial fishers typically prefer fishing Barkley Reservoir over Kentucky Reservoir as it is shallower, has more embayments to corral fish, less recreational traffic, and the fishers believe the silver carp are larger. From 2020 to 2022 there was a decrease in number of individual commercial fishers in Barkley Reservoir, but an increase in harvest, and from 2021 to 2022 there was a decrease of almost 200 trips made on Barkley Reservoir, but an increase in over 200,000 lbs of carp removed, which indicates that commercial fishers are getting more efficient at removal. The amount of harvest of invasive carp from Kentucky Reservoir increased substantially in 2020 and 2021, but saw a decrease in 2022 for the number of fishers, number of trips and in harvest. (Table 17). Number of commercial fishers in Kentucky and associated trips under the ACHP program has varied annually. A decrease in fishing effort (numbers of trips) and invasive carp harvest in 2015 and 2017 was due to inconsistent market demands. Even though there was an increase in harvest from Barkley Reservoir and the Ohio River, statewide we saw a decrease in invasive carp harvest, this was likely due to losing commercial fishers to other states offering incentive programs (Table 17 & Figure 10). Factors affecting the increased efficiency are likely a combination of the 2015 cohort strength and improved commercial practices. Commercial fishers' adaptation in net sizes during the past several years helped facilitate the 2022 harvest as well as improvements to equipment such as boats, trucks, net rollers, cranes, and electronics. KDFWR also continues to maintain an industrial flake ice machine to provide ice to ACHP fishers.

Invasive carp harvest data was summarized by month from January 2015 to December 2022 (Figures 11 & 12). Historically, the number of trips made by commercial fishers under the ACHP decreased during paddlefish season (November-March) and increased again when paddlefish season ended (Figure 11). This shift was expected as many commercial fishers fish Barkley and Kentucky Reservoirs, with a special net permit during paddlefish season, which allows gill netting in the lakes without fishing under the ACHP. However, this is no longer observed since commercial fishers are now targeting invasive carp year round, and are allowed to receive funds through the contract program administered by KDFWR for invasive carp harvested while fishing on their net permit. The highest number of commercial fishing trips recorded in a single month was 302 in January 2020; in 2021, number of trips was more standard across the months, whereas 2022 saw a lot of seasonal differences (Figure 11). Average total pounds of silver carp harvested per trip increased from 2021 and ranged from 2,741 – 5,239 pounds per month in 2022 (Figure 27).

Water conditions routinely affect invasive carp harvest rates, but seasonality is also a factor. KDFWR and MSU telemetry studies indicate that movement rates of silver carp increase in water temperatures between 61.5 °F and 86.0 °F (USFWS 2020). Fish become more active with rising water temperatures in the spring, and they become less susceptible to harvest when moving to the main channels from embayments. Commercial harvest rates also vary among fishers. The most successful fishers understand silver carp behavior better, and they use higher quality gear with larger boats that have higher weight capacities. In 2022, the average number of pounds harvested per trip was calculated for all ACHP fishers (N=39), and average pounds of silver carp harvested varied from 20 lbs/trip to 8,272 lbs/trip. Interestingly, not all fishermen with high catch rates fished frequently (Figure 13) The number of trips a commercial fisherman took in 2022 varied from 1 to 208, with an average of 50 trips. This only included the number of trips where harvest occurred. In 2022, 63% of the requests to fish ended with fish harvested. Some fisherman call in for whole weeks at a time, but may not go out every day, some cancelations were due to weather or equipment being down, other times, a fisherman may go out to gill net, scan around and not find a school of fish big enough to set their net on.

### Ride-Alongs

KDFWR conducted 59 ride-alongs with 16 unique commercial fishers utilizing the ACHP January through December 2022 (Table 20 & Figure 15). During ride-alongs 39,658 yards of gill net were fished and 203,994 lbs of invasive carp were harvested. The majority of fishing effort observed during ride alongs was on Barkley Reservoir(N=46), which is similar to fishing effort in general. Ride-alongs were also conducted in Kentucky Reservoir(N=4) and the Ohio River(N=1). Commercial fishers set nets primarily along secondary channels, on flats on the main lake, and in embayments. In previous years, the northern end of Barkley Reservoir received the most fishing pressure. However, in 2021 and 2022, fishing pressure observed through ride alongs was more evenly distributed throughout Barkley and Kentucky Reservoirs

(Figure 15). The mean effort per trip (yards of net fished) decreased in 2021 and 2022 compared to all previous years, which is reflective of the changing strategies that commercial fishers are employing to catch silver carp (active setting vs. dead setting nets) (Table 20). Average total weight of silver carp harvested per trip during ride-alongs in 2022 (3,731 lbs) was higher than 2021 (Table 21). This is reflective that the commercial fishers are getting more efficient at setting gill nets. There have been multiple instances were KDFWR observed during a ride along that a commercial fisher scanned with side scan technology and ended up not setting a net because they couldn't find a big enough school of invasive carp. This occurred on three occasions during 2021 and six times during 2022. KDFWR has begun to monitor zero net set trips and search time as fisheries dependent trends to inform invasive carp stock assessments..

### Experimental Gears

Robbins Construction LTD harvested approximately 240,467 lbs of invasive carp from Barkley and Kentucky Reservoirs in 2022 with an average of 20,039 lbs/day which increased from his 2021 average of 14,896 lbs/day. 99% of the invasive carp harvested were silver carp and >1% were bighead carp. Sport fish bycatch and other fish species that were not harvested were observed to have an 100% survival rate at the time of release. While outside the scope of this report it is worth noting that Robbins Construction LTD also harvested 31,073 lbs (10,357 lbs/day) of silver carp from the Ohio River and 140,524 lbs (28,104 lbs/day) of silver carp from the Mississippi River in 2022 through the contracted experimental efforts. Robbins seining in Kentucky waters yielded him a total of 412,064 lbs silver carp and an average of 20,603 lbs silver carp per day in 2022. His gill netting in Kentucky waters yielded him a total of 595,606 lbs of silver carp and an average of 8,272 lbs silver carp per day in 2022. His daily average while gill netting is 40% of what his daily average is while seining. Which reaffirms the need to continue developing innovative approaches of harvest.

### ***TWRA (all referenced Tables and Figures for TWRA located in Appendix B)***

*Objective 1: Estimate invasive carp relative abundance, and population demographics in the Tennessee and Cumberland River basins to evaluate management actions.*

TWRA staff conducted 96 gill net nights (2,119.8 hours) that resulted in the collection of 316 silver carp, 8 bighead carp, 27 grass carp, and 0 black carp from Kentucky, Barkley, Pickwick, and Cheatham reservoirs (Table 1). Gill netting hours remained similar in Kentucky, Barkley, Cheatham, and Pickwick reservoirs between 2021 and 2022. Catch per unit effort (CPUE), reported as number of silver carp per net, was highest on Barkley Reservoir in June followed by Kentucky Reservoir in September (Table 2). In 2022, Barkley Reservoir had a mean CPUE of 4.71 silver carp/net, whereas Kentucky Reservoir had 3.21 silver carp/net. Individuals larger than 850 mm total length were captured in all four reservoirs; on average, silver carp were larger in Cheatham and Pickwick reservoirs. Most silver carp were captured in 4-inch mesh on all four reservoirs, representing 83.1% of the silver carp catch on Kentucky Reservoir, 84.1% on Barkley

Reservoir, 50% on Pickwick Reservoir, and 62.2% on Cheatham Reservoir (Table 3). No silver carp were captured from 3-inch mesh on Cheatham or Pickwick reservoirs.

A total of 147 silver carp were captured via electrified dozer trawls on all reservoirs for both summer and fall. Summer catch rates of silver carp (n=86) were greater than fall catch rates (n=61) and percent capture rates were also greater in the summer than the fall in all reservoirs except Kentucky Reservoir (Table 5). Invasive carp captures were highest in Barkley Reservoir and lowest in Pickwick Reservoir in both summer and fall samples. Catch per unit effort per five-minute trawl (CPUE/5-min) and per hour (CPUE/hr) were also highest in Barkley Reservoir and lowest in Pickwick Reservoir for both summer and fall sampling events (Table 6). Dozer trawl sampling was most effective in riverine environments, such as Barkley Reservoir, Cheatham Reservoir, and upstream sections of Kentucky Reservoir, where percent capture rates, CPUE/5-min, and CPUE/hr were higher. Invasive carp catch rates with the dozer trawl decreased as surface area and water depth increased. Few invasive carp were captured in Kentucky Reservoir Section 1, Kentucky Reservoir Big Sandy, and Pickwick Reservoir during summer pool, but increased in Kentucky Reservoir Section 1 and Kentucky Reservoir Big Sandy during winter drawdown. No invasive carp were captured in Pickwick Reservoir during dozer trawl sampling efforts. Silver carp capture in Cheatham Reservoir was greater during winter pool. Due to low water levels at Kentucky Reservoir section 4 in the fall, only 13 of the 25 sites sampled in the summer were accessible. Catch rates still decreased in Kentucky Reservoir section 4 during the fall sample. Depth and surface area were limiting factors for the dozer trawl and increasing both allowed greater chances of gear avoidance.

Few invasive carp (n=3) were observed and collected in Old Hickory Reservoir.

*Objective 3: Target and remove invasive carp to suppress populations and reduce propagule pressure in the Tennessee and Cumberland River basins.*

TWRA's TCHIP resulted in the removal of 7,797,639 lbs of invasive carp from Kentucky and Barkley reservoirs in 2022.

***ADCNR (all referenced Tables and Figures for ADCNR located in Appendix C)***

*Objective 1: Estimate invasive carp relative abundance, and population demographics in the Tennessee and Cumberland River basins to evaluate management actions.*

Initial sampling schemes from 2021 (i.e., n = 105 electrofish sites across five habitat types; fixed-site gillnets, n = 32, in embayments; Geutreuter et al. 1995, DeGrandchamps et al. 2008, Ratcliff et al. 2014) carried into spring 2022. However, ADCNR staff realized that sampling efforts at this wide, random-generated scale including some sites (habitats; McNamara 2018) with undesirable traits (e.g., extreme high or low depths) were neither time-efficient nor statistically effective (Table 1; Quist et al. 2006). Given our reservoirs sit at or upstream of the

invasion front, our goals were to both evaluate spatial distribution and relative abundance, though the latter metric being difficult to ascertain in most studies. Overall, expansion of sample efforts for invasive carp was higher by more than 2-fold for gillnets and 9% for electrofishing in 2022 compared to 2021. This was in part due to addition of a new staff member. However, total catch of invasive carp did not improve (Table 2, Figure 2). In all three years, Silver Carp were captured only in Pickwick Reservoir with most White Amur captured in Wheeler and Wilson. Reconnaissance sampling at Guntersville Reservoir did not yield any invasive carp. During 2022, far more than half of Silver Carp were captured during exclusive sample targeting Objective 3 goals (EF = 53%; GN = 95%). Moreover, the use of occupancy strategies in desirable habitats increased the frequency of visual sightings of Silver Carp, as well as reduced the number of non-target fish by more than two-fold compared to prior years (Table 2; ADCNR 2023). Occupancy sampling was also more efficient for mileage traveled and number of samples completed per sample period, given the same number of staff utilized (ADCNR 2023). Despite small numbers of Silver Carp collected since 2020, we note the only pattern is that no Silver Carp have been collected from reservoirs upstream of Pickwick Reservoir during our standardized sample efforts. We further note that expanding our sampling efforts towards an intensive occupancy sample strategy should expand our ability to better evaluate expansion of carp spatial distributions and possibly catch rates within invaded areas in Alabama waters.

We note, outside of ADCNR sample efforts, a small number (< 4) of Silver Carp were reported captured by bow anglers but only captured in Pickwick Reservoir, as reported to our office.

### **Recommendation:**

#### ***KDFWR***

- Continue to work with partner agencies to develop SOPs for gears, methods, data collection and storage to improve basin wide stock assessments.
- KDFWR will continue to conduct commercial observations to monitor catch and reporting metrics independent of commercial reporting.
- Continue to build and refine the Experimental Gears and Methods program to develop alternatives to gill netting, with the aim being to further increase statewide invasive carp removal.
- Continue to fund the invasive carp subsidy program and alter as needed.
- Discontinue Spring tailwater community surveys because of inconsistent data collection due to unfavorable water conditions.

-Discontinue Standard sampling with gill nets, because the data gained from this method lacks power. Investigate alternative sampling methods to determine relative abundance and changes in the reservoir invasive carp populations.

***ALWFF***

- Given our sample collections to date, we feel expansion of standardized gillnetting and electrofishing should continue for Objective 1 monitoring within an occupancy sample strategy. However, this strategy would be excluded if sampling using either or both gears, combined with modifications (e.g., herding) increase carp catches specifically during Objective 3 work.

- Currently, we do not feel a need for expansion of new studies or actions outside of expanding our sampling regime. Planning for 2023 includes expansion of new sample areas in Wilson (1 area) and Wheeler (2 to 3 areas) Reservoirs. Currently, we do not anticipate changes or additions to management actions, though this may change with needs as per discussions among other TNCR partner agency staff.

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**Appendix A: KDFWR Tables and Figures**

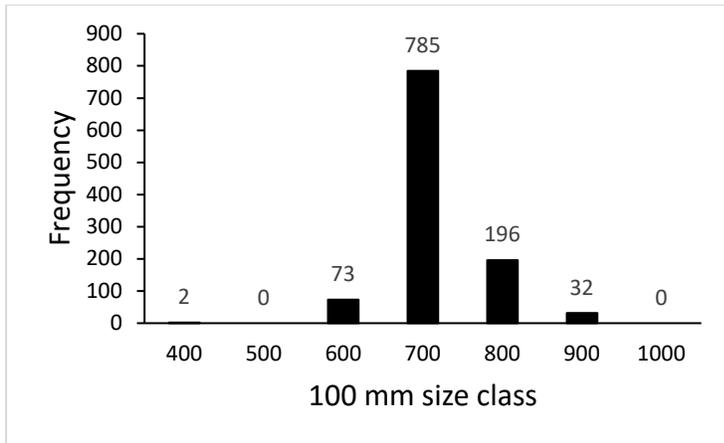


Figure. 1 Length-frequency distribution of silver carp collected from Barkley Reservoir, from all methods in 2022 (N=1088)

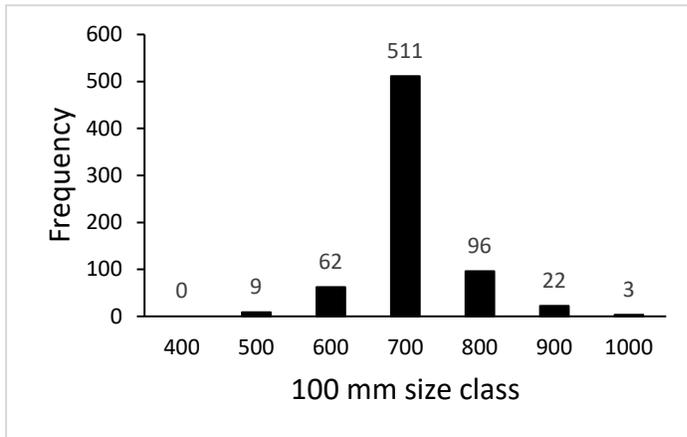


Figure 2. Length-frequency distribution of silver carp collected from Kentucky Reservoir, from all methods in 2022 (N=703).

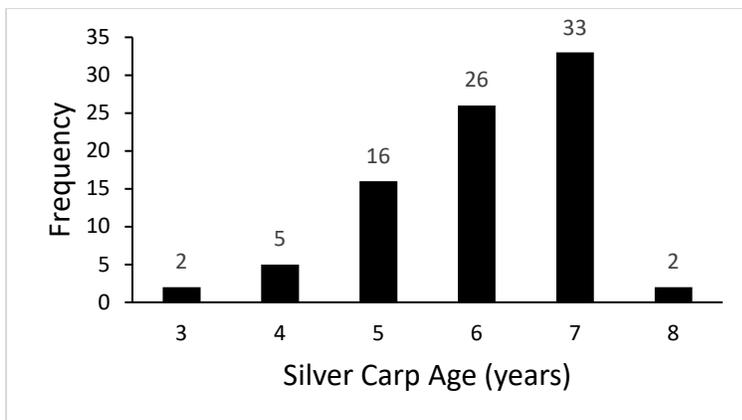


Figure 3. Age-frequency distribution for silver carp collected from Kentucky Reservoir in 2022 (N=84)

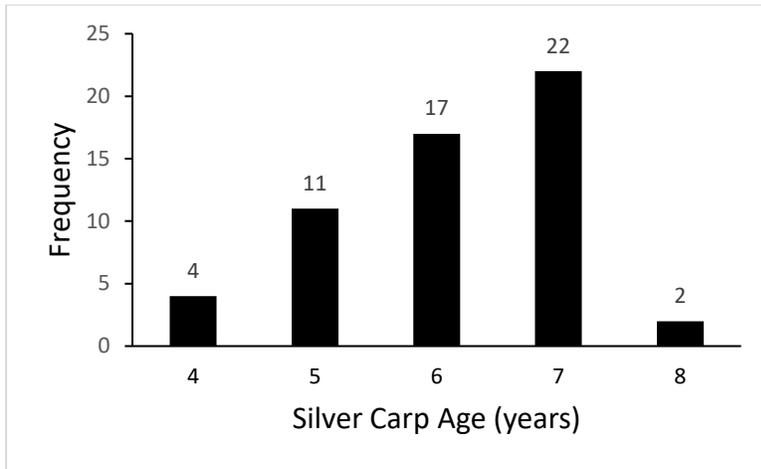


Figure 4. Age-frequency distribution for silver carp collected from Barkley Reservoir in 2022 (N=56).

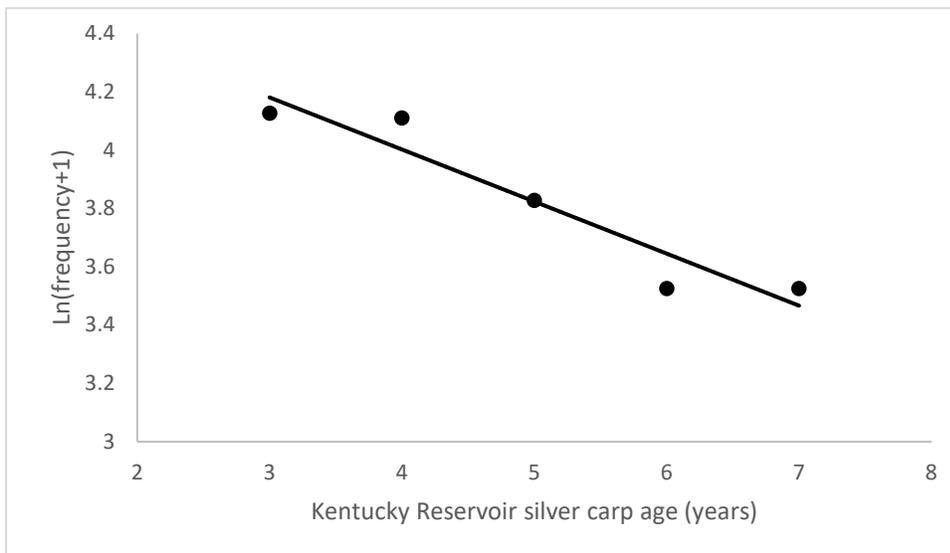


Figure 5. Catch-curve regression estimating mortality of the 2015 cohort of silver carp in Kentucky Reservoir in 2022 (N=232, F1,2=29.40, P=0.01, R2=0.91).

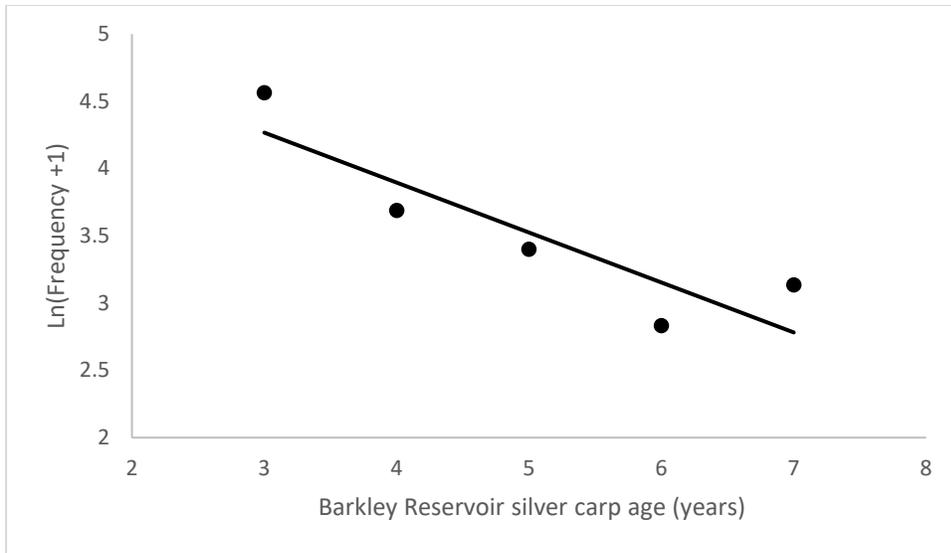


Figure 6. Catch-curve regression estimating mortality of the 2015 cohort of silver carp in Barkley Reservoir in 2022 (N=201, F1,2=7.20, P=0.07, R2= 0.71).

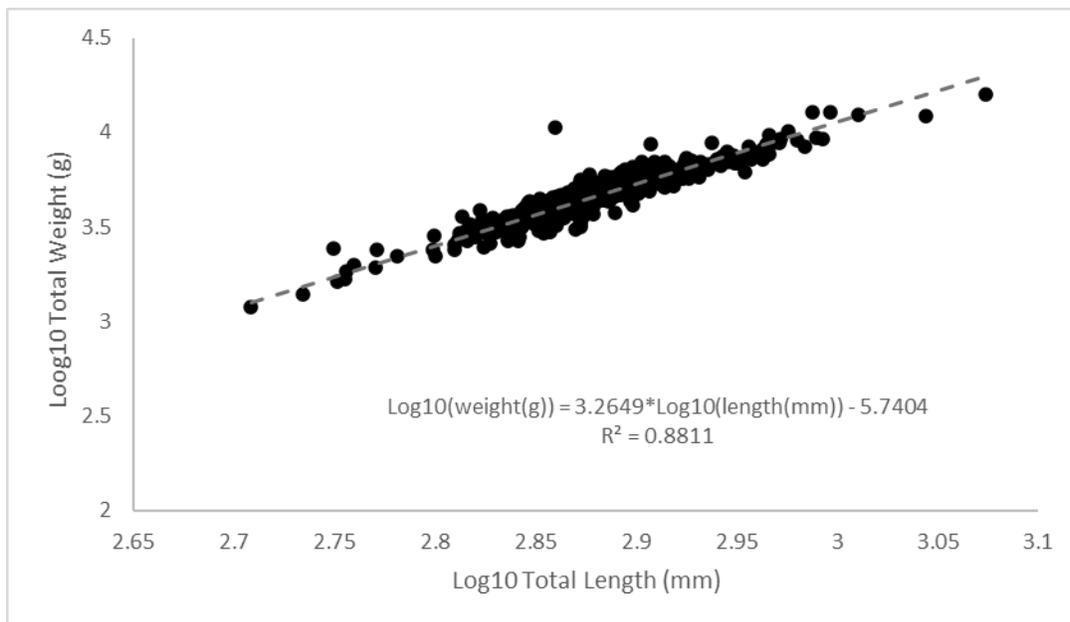


Figure 7. A scatterplot of Log10 transformed lengths and weights for silver carp harvested from Kentucky Reservoir in 2022 with a regression line describing the relationship between lengths and weights (N=702).

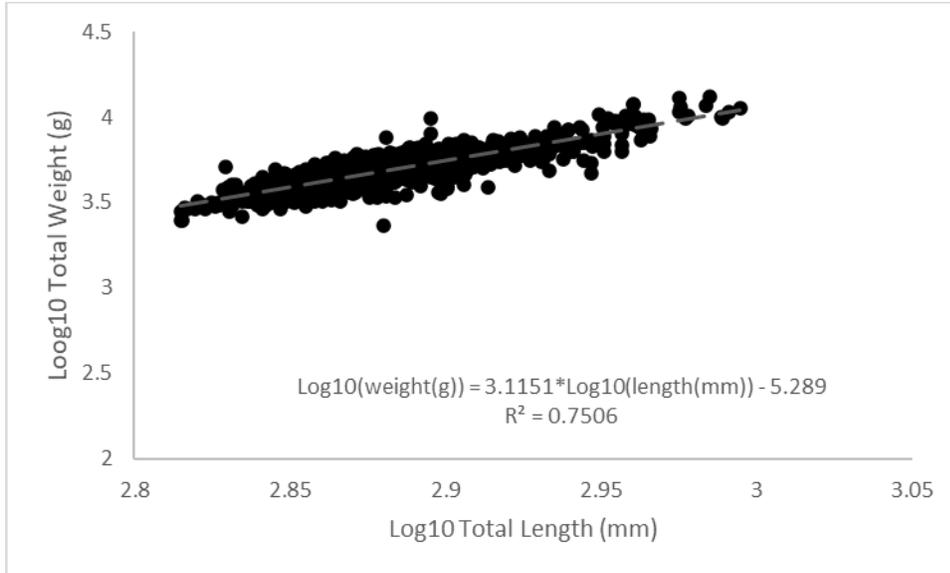


Figure 8. A scatterplot of Log10 transformed lengths and weights for silver carp harvested from Barkley Reservoir in 2022 with a regression line describing the relationship between lengths and weights (N=1084).

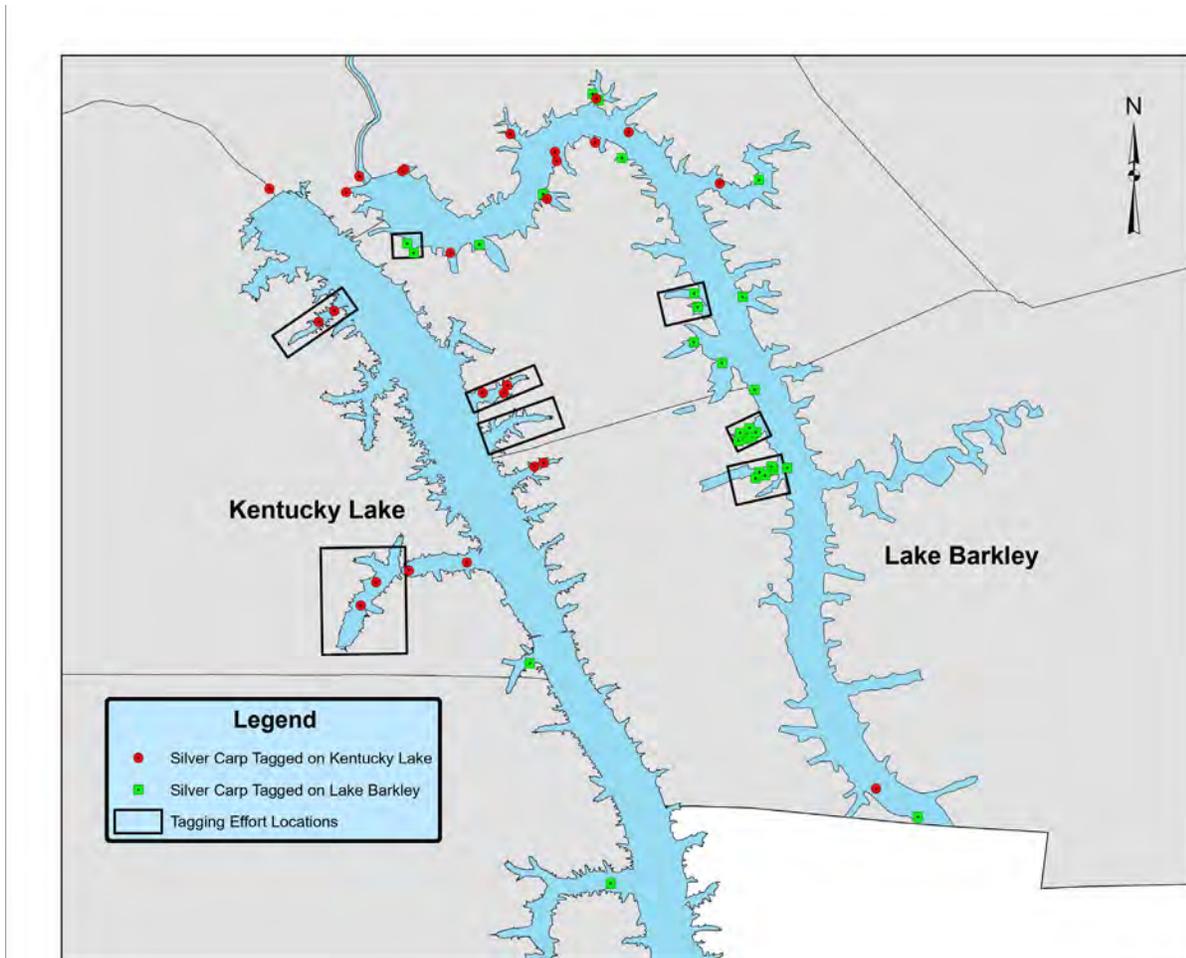


Figure 9. Locations of recaptured silver carp that were tagged as part of the mark-recapture effort to estimate abundance of silver carp in Barkley and Kentucky reservoirs from October 2018-February 2023. (Two recaptured fish not displayed, one was captured in Hovey Lake, IN, other in Green River, KY)

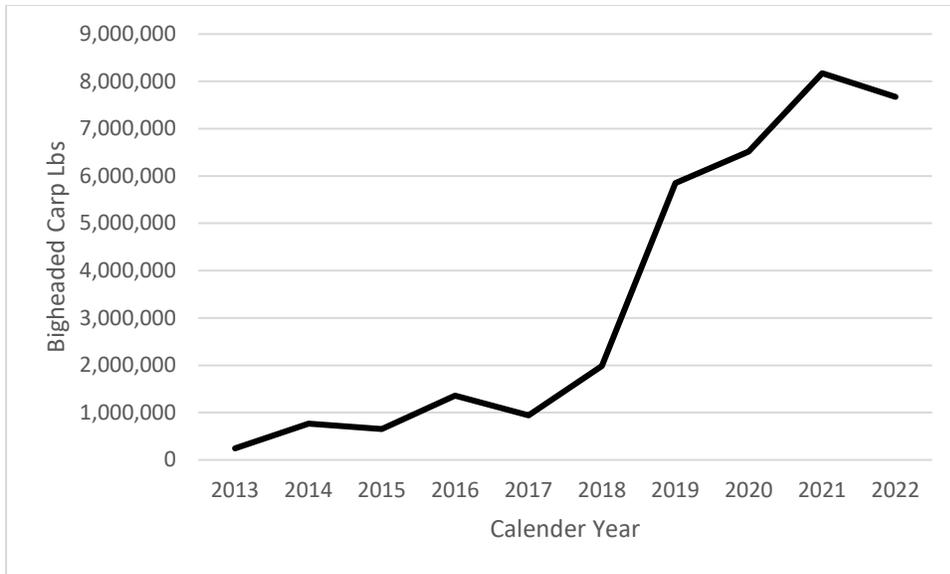


Figure 10. Pounds of bigheaded carp harvested through the Asian Carp Harvest Program by calendar year. \*2020 was the first year that grass carp harvest was tracked through the ACHP and accounted for an additional 111,190 lbs in 2020, 74,430 lbs in 2021, and 55,805 lbs in 2022.

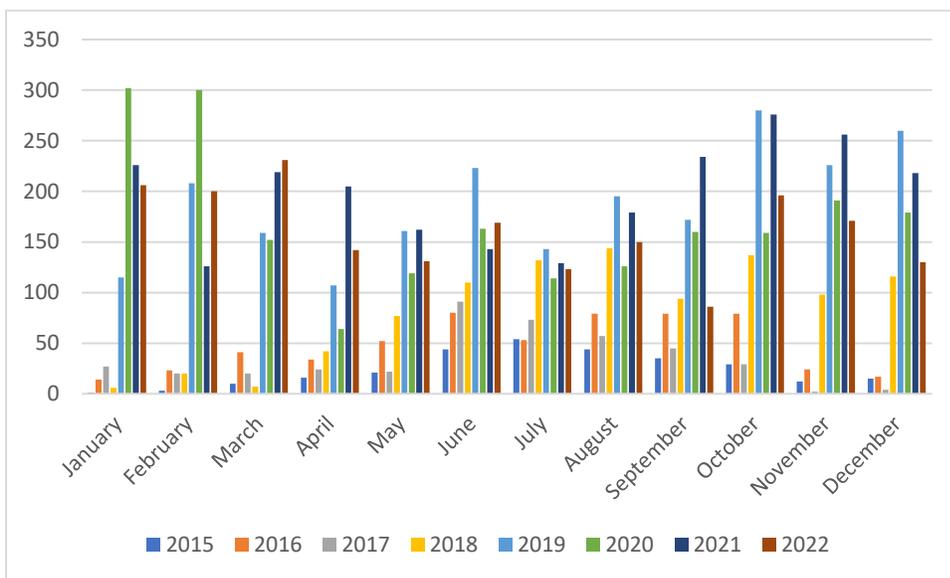


Figure 11. Number of fishing trips made monthly by commercial fishers fishing under the Asian Carp Harvest Program from January 2015 - December 2022.

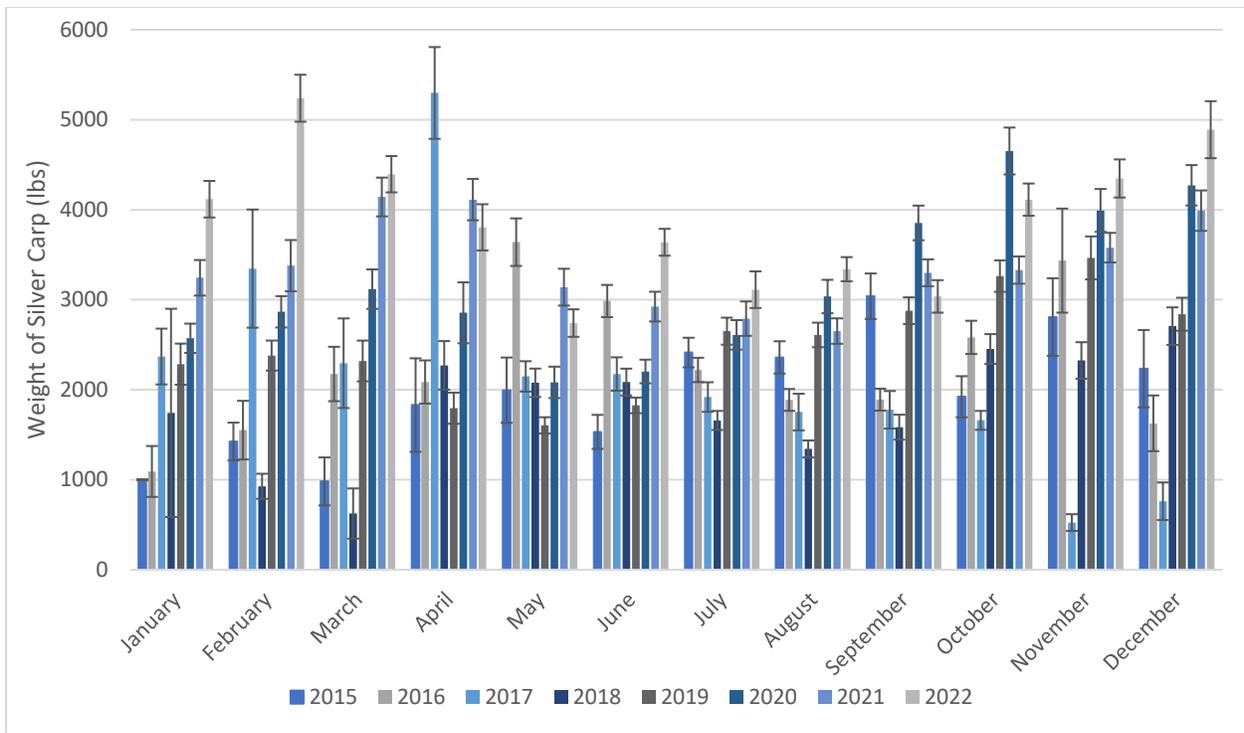


Figure 12. Monthly average total weight (lbs) of silver carp harvested per trip by commercial fishers fishing under the Asian Carp Harvest Program January 2015 - December 2022. Error bars represent standard error values.

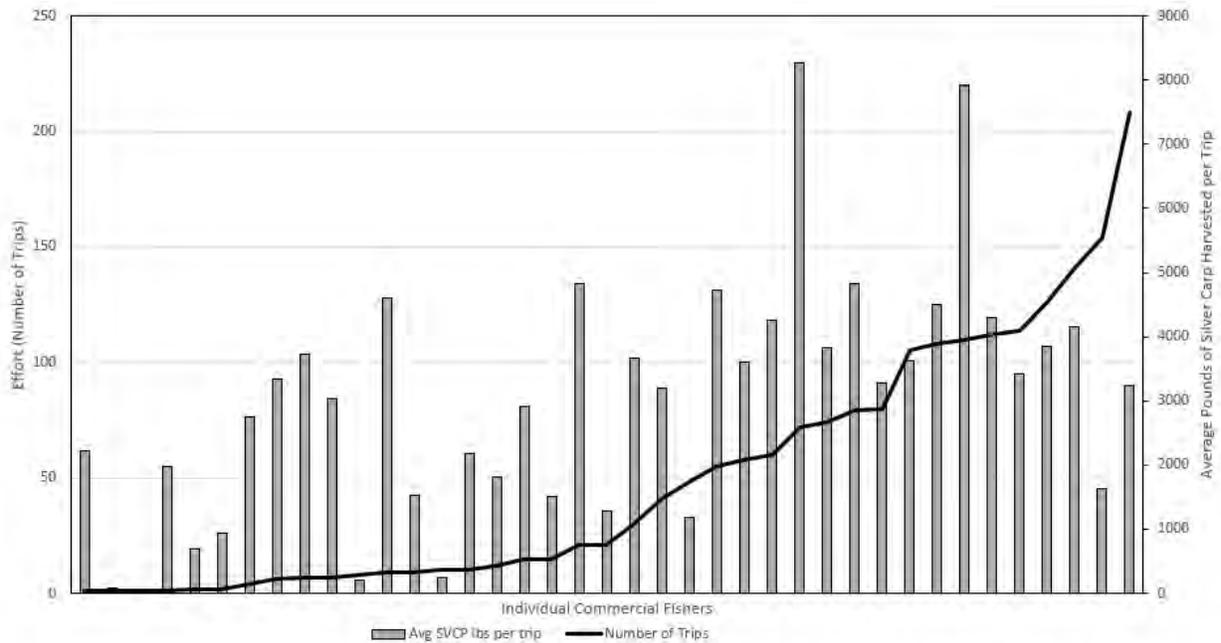


Figure 13. Average silver carp weight harvested per trip by individual commercial fishers compared to the number of trips taken by those fishers under the Asian Carp Harvest Program in 2022.

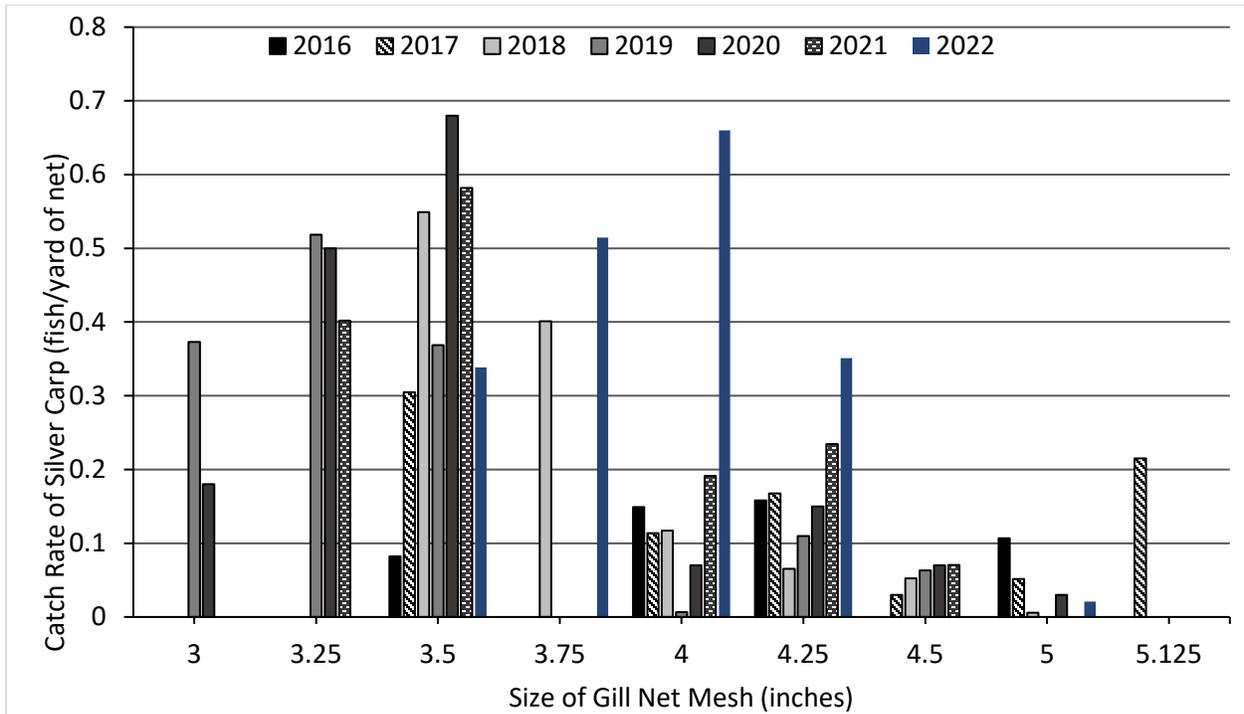


Figure 14. Catch rates (number of fish/yard of net) of silver carp by gill net mesh size during ride-alongs with commercial fishermen fishing under the Asian Carp Harvest Program per year.

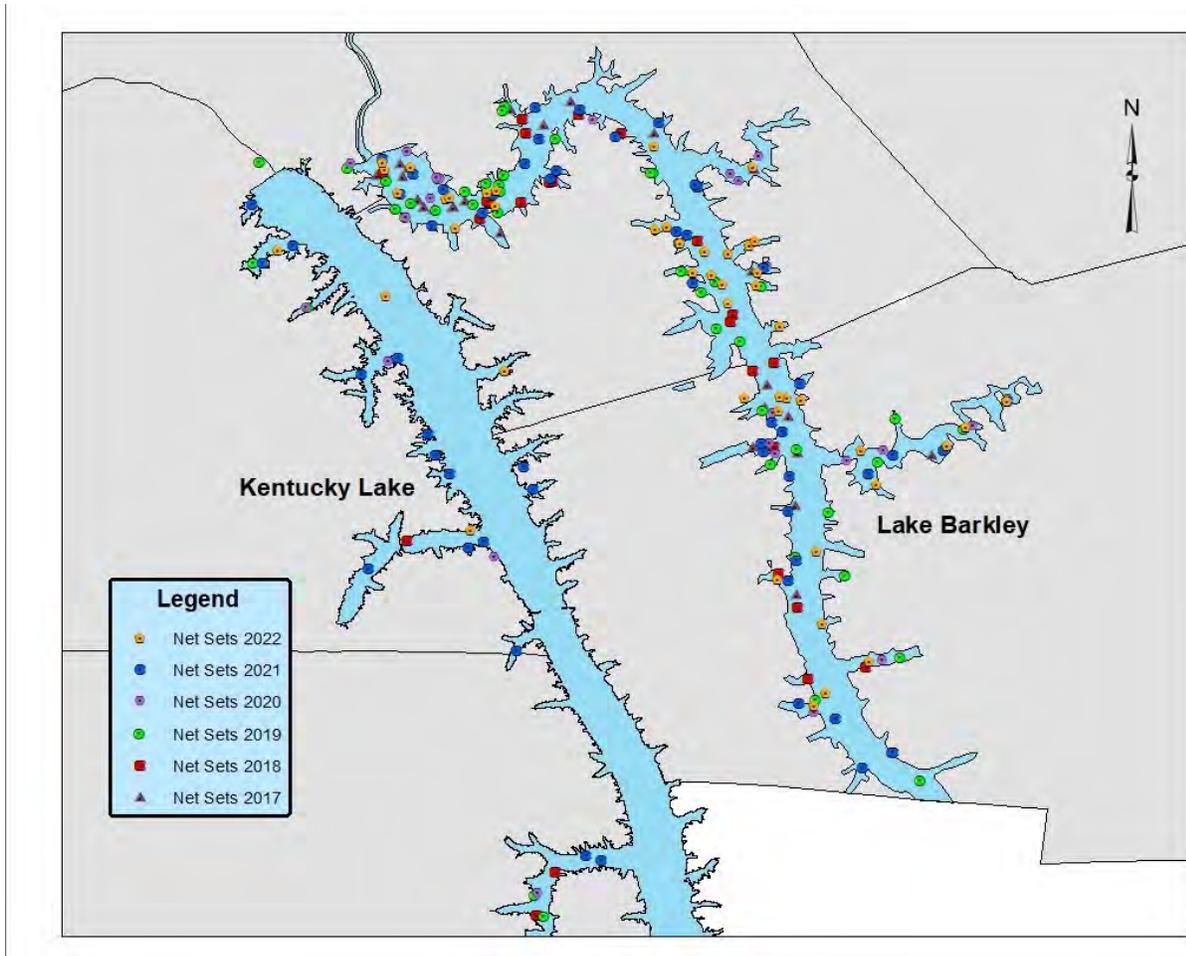


Figure 15. Locations where nets were deployed by commercial fishermen during ride-alongs conducted by KDFWR staff from 2017 through 2022.

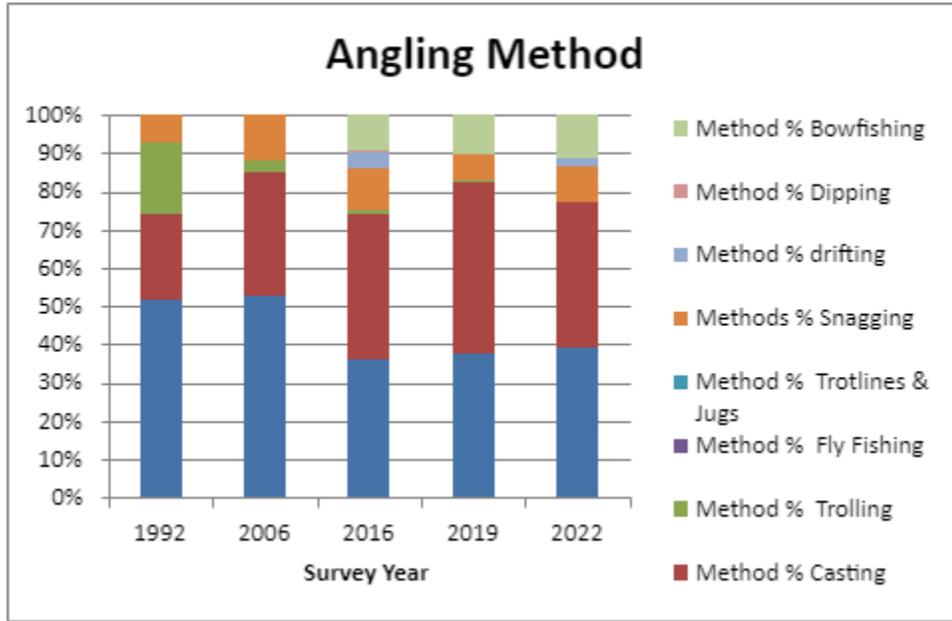


Figure 16. Angling method for fishers in Kentucky Tailwaters.

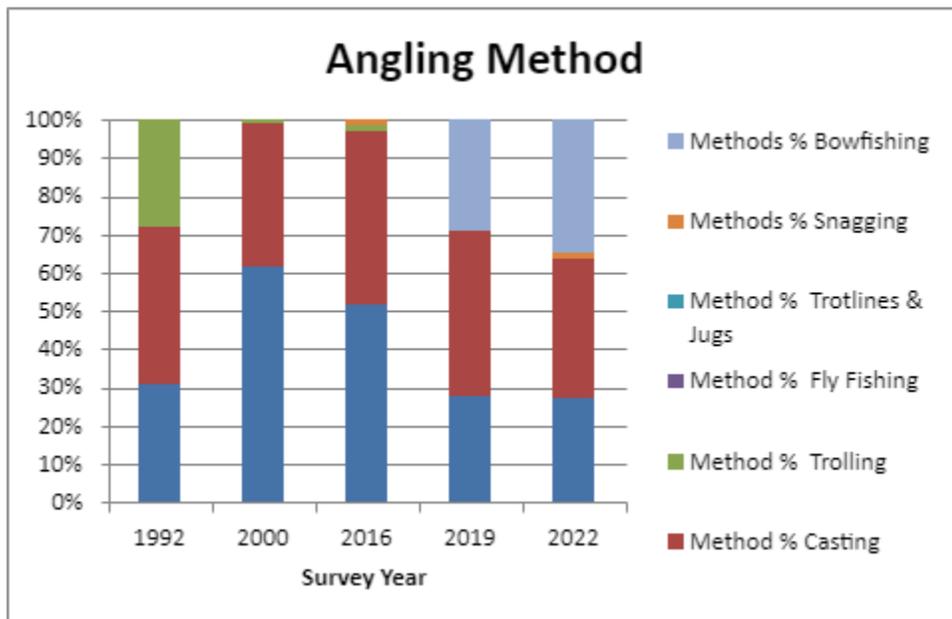


Figure 17. Angling method for fishers in Barkley Tailwaters.

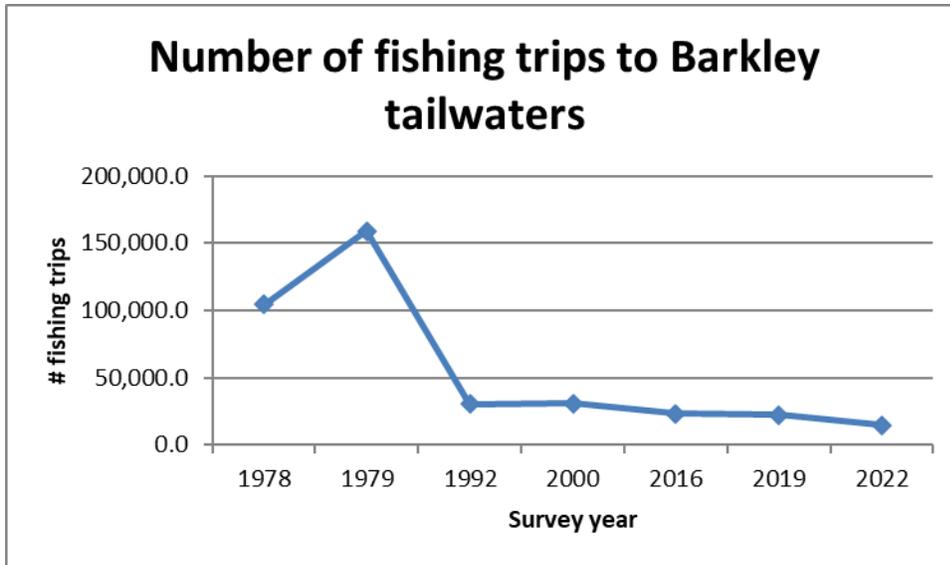


Figure 18. Number of fishing trips to Barkley Tailwaters

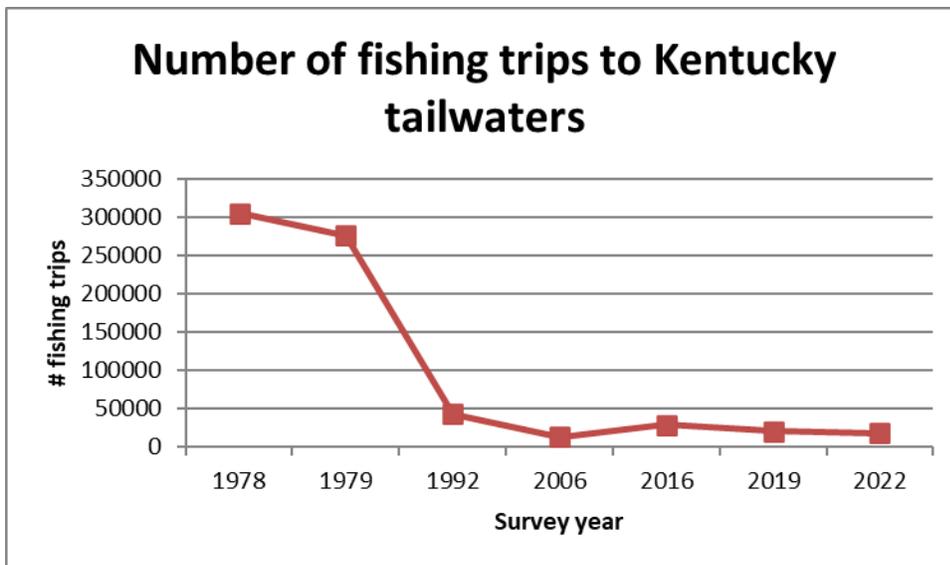


Figure 19. Number of fishing trips to Kentucky Tailwaters.

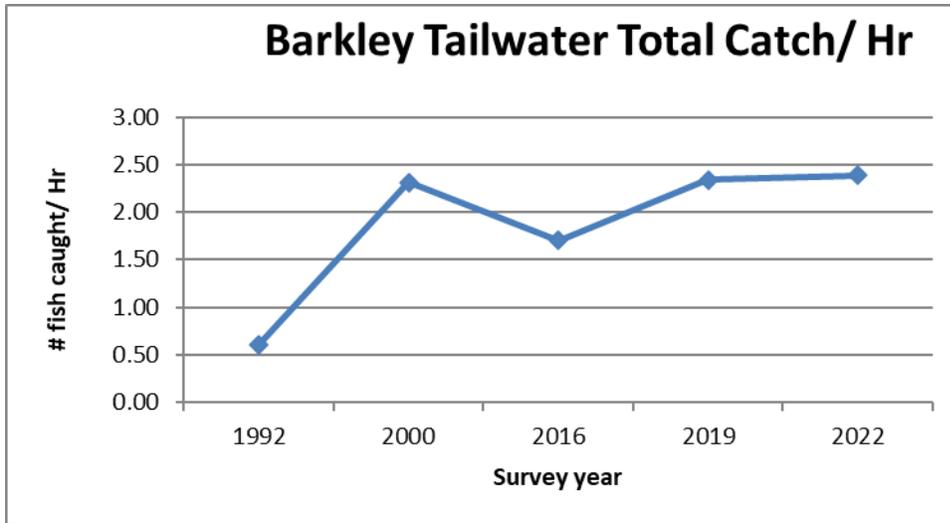


Figure 20. Barkley tailwater total catch per hour.

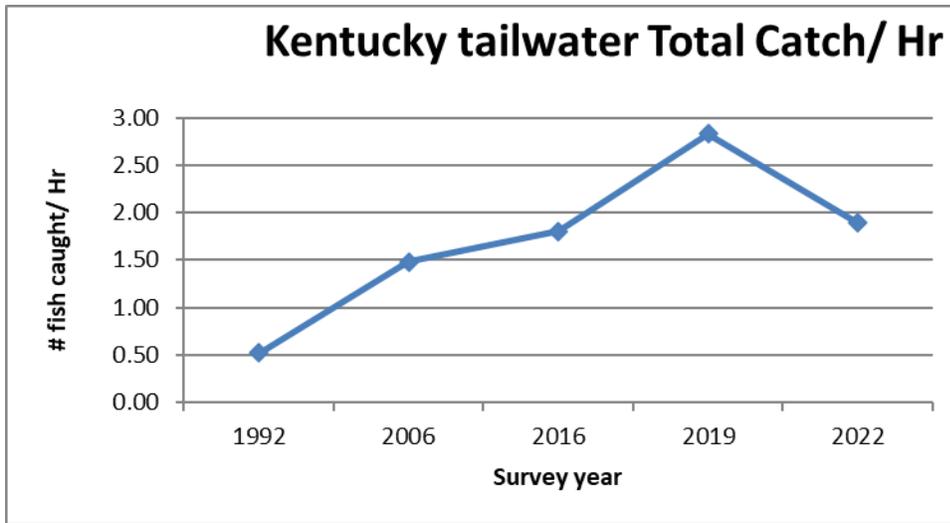


Figure 21. Kentucky tailwater total catch per hour.

Table 1. Relative weight (Wr) values of gizzard shad collected from boat electrofishing and paupier net sampling in Barkley and Kentucky reservoirs in fall of 2017-2022. Gizzard shad relative weights based on formula presented in Blackwell et al. 2000.

Kentucky Reservoir			
Year	No.	Wr	S.E.
2022	1527	91	0.3
2021	85	92	0.5
2020	95	92	0.8
2019	80	92	0.9
2018	268	103	1.70
2017	82	155	1.63

Barkley Reservoir			
Year	No.	Wr	S.E.
2022	440	90	0.49
2021	34	90	1
2020	47	93	0.7
2019	69	94	1
2018	35	92	3.08
2017	125	87	1.99

Table 2. Comparison of CPUEs across embayments and reservoirs of baitfish with nighttime electrofishing in the fall of 2022. \* Mean CPUE for each reservoir

Location	Effort (hr)	CPUE GZSD >180 mm	CPUE GZSD <180 mm	CPUE TFSD	CPUE SKJH	CPUE Adult SVCP
Blood River	1.5	139	1145	451	3	0
Jonathan	1.5	75	1613	189	8	0
Big Bear	1.5	139	823	431	27	1
Sledd Creek	1.5	110	356	309	81	0
Kentucky Res.*	6	116	984	345	30	0

Location	Effort (hr)	CPUE GZSD >180 mm	CPUE GZSD <180 mm	CPUE TFSD	CPUE SKJH	CPUE Adult SVCP
Demumbers/Willow	1.5	72	491	1293	10	3
Eddy Creek	1.5	182	481	71	59	0
Little River	1.5	105	763	248	56	0
Honker Bay	1.5	45	1169	412	194	0
Barkley Res.*	6	101	726	506	80	1

Table 3. Pauiper Net and Night-time Electrofishing (EF) sampling CPUEs for Kentucky Reservoir in fall of 2022. \*Includes embayments other than Big Bear and Sledd Creek

Location	Effort (hr)	GZSD CPUE (fish/hr)	TFSD CPUE (fish/hr)	SKJH CPUE (fish/hr)	SVCP CPUE (fish/hr)
KY Res. Mean EF *	6	1100	345	30	0
KY Res. Mean Pauiper *	5.32	1045	4766	131	72
Big Bear EF	1.5	962	431	27	1
Big Bear Pauiper	1.28	3193	3349	123	82
Sledd Creek EF	1.5	466	309	81	0
Sledd Creek Pauiper	1.42	1077	12165	293	66

Table 4. Length frequency and CPUE (fish/hr) for select species of fish collected during 4.5 hours of electrofishing at the Kentucky Tailwater in fall of 2022. (CPUE = catch per unit

Species	Inch Class																																		TOTAL	CPUE (fish/hr)	S. E.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	34				
Skipjack herring*		1	9	49	6	1	2	2	1																									114	25	13.9	
Gizzard shad*			9	22	16	10	12	17	32	17	17	19	7	8																				211	47	11.4	
Threadfin shad*		50	176	1	1																													8372	1860	795.2	
Grass carp																				1	1			2										10	2	0.7	
Common Carp																				1	1	1	2											5	1	0.7	
Silver carp																			1	1			1			1	3					1	1	9	2	0.7	
Emerald Shiner		22	48	3																															133	30	17.0
Smallmouth buffalo												2	6	2	2	3	4	1	1							1			1					23	5	1.2	
Blue Catfish																				1														1	0	0.2	
Channel Catfish																			1	2	2													5	1	0.6	
Flathead catfish							2		1		1												1											5	1	0.5	
White bass						2		2	1																									5	1	0.7	
Yellow bass			2	5	1	9	4	3	2	1																								27	6	3.1	
Bluegill		7	56	29	28	20	8	3																										151	34	8.2	
Longear sunfish		4	9	5	3	1																												22	5	1.6	
Redear sunfish					2	3	6																											11	2	1.0	
Smallmouth bass		1	13	12	15	15	6	3			1	1	2																					69	15	4.1	
Spotted Bass						1	1							1																				4	0.89	0.52	
Largemouth bass				4	4	3	15	11	5	3	2		2		2	3		3	1	1														59	13.11	3.23	
White Crappie		1																																1	0.22	0.22	
Freshwater drum			6	12	1	1	1		1						1		3	2	2			2											69	15.33	12.54		
White bass/Striped bass hybrid													1	1																				2	0.44	0.3	
Striped Mullet																																		4	0.89	0.61	

\* species were randomly subsampled

Table 5. Length frequency and CPUE (fish/hr) for select species of fish collected during 3.0 hours of electrofishing at the Barkley Tailwater in fall of 2022. (CPUE = catch per unit effort; S. E. = standard error)

Species	Inch Class																																			TOTAL	CPUE (fish/hr)	S. E.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	35					
Skipjack herring			6	19	16	7	4																												52	17	7.3	
Gizzard shad*			2	3	6	13	16	17	17	15	8	5	3	1																					113	38	14.5	
Threadfin shad*		48	205	4																															3789	1263	325.9	
Grass carp																																						
Silver carp																						1	1	1	1		3	3	8	3	2	3	4	1	1	32	11	2.5
Smallmouth buffalo																3	4	9	11	6	3	1	1												38	13	4.8	
Flathead catfish							3				3	3	2		1			1																	13	4	1.3	
White bass					1	1	4	2	2	3	3	1																							17	6	2.9	
Yellow bass			2																																2	1	0.7	
Bluegill		20	19	17	5	1	1	1																										64	21	6.4		
Longear sunfish		2	4	23	19																													48	16	4.1		
Redear sunfish				1																														1	0	0.3		
Smallmouth bass		1	3	11	5	3	2	2	4	3	1																							35	12	2.1		
Largemouth bass				1	2	5		1	2		2	3	2																					18	6	2.3		
Black crappie								1																										1	<1	0.3		
Freshwater drum													1	3	1	8	4	5	8	3														33	11	3.0		
White bass/Striped bass hybrid																																		1	0	0.3		

\* species were randomly subsampled

Table 6. Comparison of fall electrofishing CPUE for selected species collected in Kentucky Lake tailwaters in 2015 (effort = 1.0 hours), 2016 (effort = 1.75 hours), 2017 (effort = 4.5 hours), 2018 (effort = 1.25 hours), 2019 (effort = 3.75 hours), 2020 (effort = 2.75 hours), 2021 (effort = 3.75 hours), and 2022 (effort = 4.5 hours). (CPUE=catch per unit effort; S.E.=standard error)

Species	Fall 2015		Fall 2016		Fall 2017		Fall 2018		Fall 2019		Fall 2020		Fall 2021		Fall 2022	
	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.
Skipjack herring	22	8.4	1	0.6	18	9.5	2	1.6	510	200.3	89	22.3	44	17.6	25	13.9
Gizzard shad	275	58.6	184	78.0	163	61.1	22	10.2	240	92.1	163	69.7	44	21.4	47	11.4
Threadfin shad	251	176.3	1690	1251.0	1263	637.0	2557	1845.1	27	14.9	712	241.1	665	291.6	1860	795.2
Grass carp	13	1.9	6	2.5	2	0.7			6	2.8	8	4.7	1	0.8	2	0.7
Silver carp	6	2.6	44	22.4	4	1.6	9	6.9	4	2.0	9	4.9	9	3.1	2	0.7
Bighead Carp													<1	0.3		
Smallmouth buffalo	10	2.6	9	3.7	5	2.1	1	0.8	8	3.0	2	0.8	4	1.3	5	1.2
Bignmouth buffalo					1	0.4	2	1.0					<1	0.3	<1	0.4
Black buffalo	6	2.0	3	1.9	<1	0.2			1	0.4	<1	0.4			<1	0.4
Blue catfish					<1	0.2			<1	0.3					<1	0.2
Channel catfish			1	0.6	1	0.9			<1	0.3					1	0.6
Flathead catfish			4	1.2	4	1.4			3	1.4	<1	0.4	1	0.4	1	0.5
White bass	8	4.3	7	4.0	<1	0.3	6	5.6	4	1.9	5	2.5	3	1.8	1	0.7
Yellow bass	162	83.5	17	13.3	26	4.1	7	4.3	18	7.8	3	1.6	1	0.4	6	3.1
Striped bass					2	1.0	2	1.0							<1	0.2
Bluegill	96	29.2	41	11.8	128	30.7	20	4.0	127	48.8	26	5.9	4	2.1	34	8.2
Longear sunfish	14	14.0	48	12.0	80	25.0	7	4.8	67	15.4	10	3.9	2	1.2	5	1.6
Redear sunfish	1	1.0	6	2.3	6	1.6			15	3.9	2	1.1	1	0.4	2	1.0
Smallmouth bass	9	2.5	21	5.2	11	3.2	2	1.0	29	12.3	10	2.8	6	2.6	15	4.1
Spotted bass	1	1.0	1	0.6	3	1.4	1	0.8	3	1.4					<1	1
Largemouth bass	62	19.8	86	9.4	35	4.3	7	2.9	29	6.2	15	3.6	5	1.7	13	3.2
White crappie	2	2.0	1	0.7	1	0.4			3	1.9					<1	0.2
Black crappie	2	2.0	1	0.6	3	1.7			2	1.5						
Sauger	1	1.0			1	0.4							1	0.5	<1	0.2
Freshwater drum	13	5.7	6	1.5	4	0.7	4	2.2	8	2.5	11	2.8	5	1.4	15	12.5
White bass/Striped bass hybrid	1	1.0	1	1.1	1	0.5									<1	0.4
Striped mullet											1	1.0	1	0.8	<1	0.6

Table 7. Comparison of fall electrofishing CPUE for all species collected in Lake Barkley tailwaters in 2016 (effort = 1.99 hours), 2017 (effort = 3.0 hours), 2018 (effort = 1.0 hour), 2019 (effort = 3.0 hours), 2020 (effort = 2.75 hours), 2021 (effort = 3.0 hours), and 2022 (effort = 3.0 hours). (CPUE=catch per unit effort; S.E.=standard error)

Species	Fall 2016		Fall 2017		Fall 2018		Fall 2019		Fall 2020		Fall 2021		Fall 2022		
	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	CPUE (fish/hr)	S.E.	
Skipjack herring	<1	0.5	8	2.9	35	18.0	324	158.4	41	10.78	28	10.9	17	7.3	
Gizzard shad	209	52.4	104	18.2	23	8.1	362	224.8	189	49.03	8	5.0	38	14.5	
Threadfin shad	4598	1818.7	1252	602.1	67	12.8	30	18.8	1298	719.49	378	182.4	1263	352.9	
Grass carp	5	2.6	1	0.5			6	1.7	3	1.22	3	0.7			
Silver carp	4	2.0	14	7.7	29	17.2	42	33.4	23	6.58	24	6.4	11	2.5	
Smallmouth buffalo	15	7.6	10	2.7	1	1.0	5	3.2	10	3.75	3	1.6	13	4.8	
Bignmouth buffalo	1	0.9	<1	0.3	1	1.0									
Black buffalo			1	0.7										<1	0.33
Channel catfish	<1	0.4	1	0.5					1	0.49				<1	0.33
Flathead catfish	8	3.6	6	3.1			22	5.9	4	1.57	2	1.2	4	1.3	
White bass	7	3.9	3	1.1	3	3.0	1	0.7	1	0.56	2	1.4	6	2.9	
Yellow bass	2	0.7	28	16.0			4	3.0	3	1.24	2	1.0	<1	0.7	
Striped bass	1	0.9	2	1.4	1	1.0	<1	0.3	2	1.25					
Bluegill	46	15.3	56	14.6	70	14.5	50	13.2	37	11.66	21	5.9	21	6.4	
Longear sunfish	102	25.0	83	16.8	46	25.4	153	30.5	41	10.06	14	4.7	16	4.1	
Redear sunfish	8	2.1	3	1.2	2	1.2	3	1.2	2	0.83	3	1.2	<1	0.3	
Smallmouth bass	7	2.3	9	1.2	4	1.6	29	7.2	8	1.53	13	3.0	12	2.1	
Spotted bass	2	1.0	<1	0.3	1	1.0	7	2.0	1	1.09			<1	0.45	
Largemouth bass	48	8.0	55	10.3	13	5.0	30	8.1	26	11.01	15	5.1	6	2.3	
White crappie	4	1.5	1	0.7			<1	0.3	<1	0.36					
Black crappie			2	1.3			<1	0.3	<1	0.36	<1	0.3			
Freshwater drum			5	1.5	7	4.7	9	3.4	8	1.87	5	1.7	11	3.0	
Striped bass hybrid	<1	0.4	3	2.3	4	4.0			1	0.73	1	1.0	<1	0.3	

Table 8. Mean relative weight (Wr) and standard error for a subsample of fish collected during fall electrofishing at Kentucky Tailwaters in 2015 - 2022. (S.E. = standard error)

Species	2015				2016				2017				2018				2019				2020				2021				2022			
	N	Mean	Wr	S.E.	N	Mean	Wr	S.E.	N	Mean	Wr	S.E.	N	Mean	Wr	S.E.	N	Mean	Wr	S.E.												
Gizzard shad	19	76	2.5	45	72	1.6	215	83	0.7	21	77	2.0	152	85	0.5	66	85	1.6	79	92	6.0	126	89	1.1								
Blue catfish							1	108					1	99											1	84						
Channel catfish				1	102			1	105					1	100										5	101	7.4					
Flathead catfish				7	98	6.2	19	100	6.3				11	99	6.2	1	106		1	123												
Yellow bass	29	74	1.2	29	84	1.8	104	83	2.2	7	90	12.3	33	80	4.6	4			3	88	8.6											
White bass	7	92	4.1	13	99	2.6	2	97	20.4	7	108	1.3	8	90	3.3	9	95	5.1	8	86	5.9	2	88	4.4								
Striped bass										1	101														1	87						
bass/Striped bass hybrid				2	81	7.5																			2	109	7.3					
Bluegill	69	88	1.7	49	103	3.7	220	93	2.2	18	89	6.4	148	94	0.8	41	93	8.3	11	97	4.0	28	86	4.6								
Redear sunfish	1	98	0.0	10	85	6.9	28	93	3.3				42	97	2.3	4	85	5.3	2	104	4.2	6	102	23.6								
Smallmouth bass	6	93	3.1	13	91	2.0	9	92	3.4	1	82		4	92	5.5	6	100	4.9	9	95	4.9	12	93	3.3								
Spotted bass	1	103	0.0	1	123		6	109	3.1				1	117										1	84							
Largemouth bass	42	102	3.2	89	102	1.7	117	97	1.9	7	93	5.5	41	99	1.7	26	113	8.4	17	87	4.9	33	105	2.7								
White crappie	2	79	0.9	2	90	8.7	3	76	7.3				4	84	3.0																	
Black crappie	1	91	0.0				12	90	2.7																							
Sauger	1	87	0.0				3	97	21.8																							
Freshwater drum	12	91	5.4	11	100	2.7	17	92	3.3	5	89	3.8	21	92	2.9	29	91	3.3	18	90	5.6	25	92	2.4								
Smallmouth buffalo	10	76	2.9	15	79	1.5	22	77	1.4	1	78		29	100	3.2	6	81	2.7	14	93	14.3											
Bigmouth buffalo							3	86	1	2	75	7.4																				
Silver carp	6	84	2.3	75	89	1.6	19	82	2.4	11	73	3.2	15	81	1.2	26	76	1.7	32	76	2.0											

Table 9. Mean relative weight (Wr) and standard error for a subsample of fish collected during fall electrofishing at Barkley Tailwaters in 2016 - 2022. (S.E. = standard error)

Species	2016				2017				2018				2019				2020				2021				2022							
	N	Mean	Wr	S.E.	N	Mean	Wr	S.E.	N	Mean	Wr	S.E.	N	Mean	Wr	S.E.	N	Mean	Wr	S.E.	N	Mean	Wr	S.E.	N	Mean	Wr	S.E.	N	Mean	Wr	S.E.
Gizzard shad	96	70	1.6	176	80	0.9	18	75	2.5	45	91	1.2	53	96	4.2	20	73	3.1	82	89	1.5											
Channel catfish	1	67		2	92	1.0							2	111	5.6										1	110						
Flathead catfish	13	94	1.7	17	106	5.8						66	99	3.8	10	96	3.4	6		6.8												
Yellow bass	2	88	8.7	73	79	1.3						11	87	4.5	7	85	4.5	3	74	8.3												
White bass	11	96	3.7	8	86	2.2	3	98	4.9	3	85	7.7	2	115	1.8	3	96	6.4	16	90	3.0											
Striped Bass				2	90	5.9						1	109		5	108	5.6															
White bass/Striped bass hybrid				9	89	2.7	4	103	4.6				2	102	2.8	3	73	5.0	1	99												
Bluegill	49	111	3.1	107	104	2.5	31	115	8.3	85	103	1.6	63	102	2.3	29	118	10.6	27	102	6.2											
Redear sunfish	17	93	2.1	9	97	3.7	2	106	14.6	9	101	3.9	4	101	13.0	4	101	12.4	1	45												
Smallmouth bass	4	86	3.6	11	95	3.8	3	87	5.6	22	92	2.5	11	93	2.5	7	81	4.4	15	95	2.8											
Spotted bass	3	107	11.0				1	125		3	106	10.1	2	103	9.4									2	104.91	2.4						
Largemouth bass	37	101	1.9	118	95	1.2	10	95	3.4	58	98	1.6	41	101	4.3	20	101	7.1	10	102	4.0											
White crappie				3	88	6.6						1	92		1	116																
Black crappie				5	86	6.3						1	76		1	85		1	93													
Freshwater drum	6	84	4.4	14	97	3.0	7	82	3.5	27	103	2.3	22	96	2.3	14	92	2.1	33	95	2.5											
Smallmouth buffalo	21	84	1.4	28	84	1.6	1	99		16	92	1.9	27	81	1.4	9	78	2.6														
Bigmouth buffalo	2	88	4.0	1	79		1	84																								
Silver carp	9	81	2.9	41	83	2.1	29	83	2.7	70	83	1.5	64	77	1.2	70	78	1.3														

Table 10. Comparison for number of paddlefish, catfish, and sport fish caught per trip as reported by commercial fishers fishing under the Asian Carp Harvest Program versus observations made by KDFWR staff during ride-alongs in 2016-2022. (S.E. = standard error).

Species	2016				2017				2018				2019				2020				2021				2022				
	ACHP	S.E.	Ride-alongs	S.E.	ACHP	S.E.	Ride-alongs	S.E.	ACHP	S.E.	Ride-alongs	S.E.	ACHP	S.E.	Ride-alongs	S.E.	ACHP	S.E.	Ride-alongs	S.E.	ACHP	S.E.	Ride-alongs	S.E.	ACHP	S.E.	Ride-alongs	S.E.	
Paddlefish	1.02	0.08	2.96	0.60	0.90	0.12	2.00	0.95	0.22	0.03	1.54	0.53	0.13	0.02	1.31	0.80	0.11	0.01	0.87	0.49	0.05	0.01	0.28	0.13	0.03	0.01	0.15	0.09	
Blue catfish	0.74	0.06	1.21	0.28	0.63	0.08	1.52	0.33	0.47	0.04	1.75	0.37	0.08	0.01	2.00	0.45	0.19	0.01	1.07	0.34	0.15	0.01	0.66	0.2	0.19	0.02	1.35	0.38	
Channel catfish	0.08	0.02	0.36	0.16	0.06	0.02	0.55	0.20	0.09	0.01	0.50	0.13	0.08	0.03	0.27	0.08	0.05	0.01	0.17	0.11	0.05	0.01	0.28	0.08	0.06	0.01	0.07	0.05	
Flathead catfish	0.38	0.04	0.39	0.17	0.41	0.06	0.61	0.19	0.14	0.02	0.33	0.13	0.06	0.01	0.83	0.21	0.06	0.01	0.23	0.09	0.04	0.01	0.45	0.19	0.03	0.01	0.61	0.23	
Catfish*	0.07	0.02		0.17	0.05		0.23	0.04				0.21	0.03				0.08	0.01			0.16	0.01			0.08	0.02			
Largemouth bass	0.08	0.70	0.04	0.04	0.01	<0.01	0.16	0.06	0.01	<0.01	0.08	0.06	0.02	0.01	0.52	0.24	0.02	<0.01			0.02	<0.01	0.16	0.06	0.01	<0.01	0.04	0.03	
Smallmouth bass	<0.01											<0.01	<0.01	0.08	0.05	0.02	<0.01	0.13	0.06	<0.01	<0.01			<0.01	<0.01				
Bass**	0.02	0.02		0.02	0.01		0.01	<0.01				0.02	0.01								<0.01	<0.01			<0.01	<0.01			
Hybrid striped bass	<0.01		0.07	0.05			<0.01	<0.01	0																				

Table 11. Species composition, number of individuals captured, and survival rate of species observed in bycatch during KDFWR ride-alongs with commercial fishers fishing under the Asian Carp Harvest Program in 2016 - 2022. Survival rate of fish is defined as fish that swim away after release.

Species	2016		2017		2018		2019		2020		2021		2022	
	Number captured	Survival rate												
<b>Sport Fish</b>														
White bass	1	<1%					1	100%			2	100%	1	100%
Yellow bass	20	50%	1	100%	6	33%	4	75%			1	100%		
Striped bass	19	79%	1	100%	3	33%	5	80%	10	80%	1	100%	2	50%
Hybrid striped bass	2	100%			1	100%	5	80%	2	100%	1	100%		
Sauger	1	<1%	2	100%	3	33%	4	75%	2	50%	3	100%	3	66%
Largemouth bass	1	100%	5	80%	3	67%	25	80%	4	75%	9	100%	2	100%
Smallmouth bass							4	100%						
Redear sunfish	1	100%			2	50%	6	83%			1	100%	2	100%
Black crappie					5	50%	1	100%	1	100%				
White crappie			1	100%	6	67%	2	50%			1	100%		
<b>Total</b>	<b>46</b>	<b>88%</b>	<b>10</b>	<b>96%</b>	<b>29</b>	<b>54%</b>	<b>57</b>	<b>82%</b>	<b>19</b>	<b>81%</b>	<b>19</b>	<b>100%</b>	<b>10</b>	<b>83%</b>
<b>Catfish species</b>														
Blue catfish	27	74%	47	94%	42	91%	96	95%	32	100%	38	92%	62	97%
Channel catfish	10	80%	17	82%	12	100%	13	100%	5	100%	16	96%	3	100%
Flathead catfish	9	89%	19	100%	8	88%	40	100%	7	100%	26	100%	28	89%
<b>Total</b>	<b>46</b>	<b>81%</b>	<b>83</b>	<b>92%</b>	<b>62</b>	<b>93%</b>	<b>149</b>	<b>98%</b>	<b>44</b>	<b>100%</b>	<b>80</b>	<b>93%</b>	<b>93</b>	<b>95%</b>
<b>Rough Fish*</b>														
Paddlefish	83	48%	62	48%	38	32%	63	48%	26	50%	16	69%	7	28%
Lake sturgeon					1	100%					1	100%		
Shovelnose sturgeon									3	100%				
Skipjack herring	23	17%	47	13%	18	<1%	79	<1%	16	<1%	25	36%	29	52%
Smallmouth buffalo	145	99%	13	85%	98	100%	186	98%	103	100%	173	99%	236	99%
Bigmouth buffalo	8	100%	4	100%	7	100%	34	97%	14	100%	12	75%	6	100%
Black buffalo	17	94%			2	100%	4	100%	1	100%				
Common carp	48	98%	33	94%	27	100%	479	84%	36	97%	17	100%	10	100%
Gizzard shad	5	<1%	3	33%			3	<1%	1	100%				
Freshwater drum	76	67%	27	52%	73	71%	71	63%	40	82%	54	94%	56	89%
River carpsucker	3	100%					35	97%	41	100%	5	100%	2	100%
Spotted gar					2	50%	3	100%	1	100%	2	100%	1	100%
Longnose gar	8	88%	9	44%			9	67%	3	100%	3	100%	7	100%
Shortnose gar	9	44%	1	100%	2	50%	11	55%	5	100%	5	100%	1	100%
<b>Total</b>	<b>571</b>	<b>77%</b>	<b>365</b>	<b>72%</b>	<b>392</b>	<b>83%</b>	<b>1277</b>	<b>87%</b>	<b>329</b>	<b>98%</b>	<b>299</b>	<b>92%</b>	<b>348</b>	<b>93%</b>

\* Rough fish capture numbers only include fish that were released and does not include fish that were harvested.

Table 12. Number and disposition of bycatch from commercial fishing efforts under the Asian Carp Harvest Program by calendar year, January - December. Survival rate is defined as fish that swam away upon being released from the net. Harvest of scaled rough fish is permitted under the Asian Carp Harvest Program.

Year	Sport Fish*		Scaled Rough Fish**		Catfish Species		Paddlefish		Total number of bycatch
	Caught	Survival Rate %	Number Caught	% Harvested	Caught	Survival Rate %***	Caught	Survival Rate %***	
2013	29	100.0	7,132	93.7	100	97.0	305	90.5	7,566
2014	78	92.3	4,505	75.1	128	99.2	120	65.0	4,831
2015	97	89.7	7,462	80.5	719	95.0	980	65.0	9,258
2016	115	75.7	10,811	76.1	719	95.5	573	68.2	12,218
2017	25	92.0	9,565	91.8	541	95.7	314	75.5	10,445
2018	46	71.7	25,703	86.1	1201	98.3	200	85.5	27,150
2019	171	93.6	32,861	80.7	1512	98.7	296	80.7	34,841
2020	148	92.5	17,394	78.8	768	99.2	222	85.7	18,592
2021	126	98.4	19,433	87.7	733	99.0	126	81.0	20,418
2022	47	93.6	11,335	80.2	568	98.8	58	81.0	12,008

\*Sport fish are defined in 301 KAR 1:060

\*\*Scaled Rough fish are defined in 301 KAR 1:152

\*\*\*In 2018 KDFWR began allowing commercial fishermen to receive subsidy funds from the Asian Carp Harvest Program while fishing on their net permit, which allows them to harvest catfish and paddlefish. Therefore, the survival rates for 2018 - 2021 only account for fish that were dead or alive upon release and not those that were harvested.

Table 13. Number and survival rate of paddlefish captured by commercial fishers during KDFWR ride-alongs under the Asian Carp Harvest Program for each month paddlefish were observed caught in 2016 - 2022.

Year	Month	No. paddlefish captured	% released alive	Mean water temp (°F)	Mean soak time (hours)
2017	April	6	0%	67.6	13
	May	15	33%	68.5	10
	June	35	60%	79.5	8.3
	September	2	50%	74	10
	December	4	75%	50	21.3
2018	April	4	75%	54.9	11
	May	9	60%	66.1	10.2
	June	12	35%	81.7	10.6
	August	12	0%	82.9	11.6
2019	February	43	61%	46.9	11.4
	March	1	0%	49.8	11
	April	3	33%	60.25	9.7
	May	7	14%	74	6.4
	June	4	0%	76.9	11.3
	August	2	0%	84.1	8.8
	October	3	67%	69.8	8.2
2020	March	9	89%	49.1	7.8
	May	5	20%	66.1	6.5
	September	11	36%	77	7.25
	October	1	100%	68.6	8.8
2021	March	3	100%	57.5	3.25
	May	5	80%	63	13
	July	4	0%	87	9
	October	4	100%	71	11.25
2022	May	4	0%	75	8.5
	August	2	50%	80.5	3.625
	September	1	100%	76	5.5

Table 14. A summation of catch per unit effort (CPUE) for silver carp collected in Barkley and Kentucky Reservoirs, by month and habitat type in 2022. CPUE reported in fish/linear yard of gill net.

	Site	Month	Bar mesh size			Mean Total CPUE
			3"	4"	5"	
Barkley Reservoir	Main Channel	April	0.000	0.002	0.000	0.001
		July	0.001	0.003	0.000	0.001
		October	0.000	0.004	0.000	0.001
	Embayment	April	0.000	0.002	0.000	0.001
		July	0.001	0.004	0.000	0.002
		October	0.002	0.005	0.000	0.002
Kentucky Reservoir	Main Channel	April	0.000	0.000	0.000	0.000
		July	0.001	0.003	0.001	0.002
		October	0.000	0.001	0.000	0.000
	Embayment	April	0.000	0.002	0.000	0.001
		July	0.000	0.002	0.000	0.001
		October	0.000	0.002	0.001	0.001

Table 15. A summation of estimated weights at three lengths for silver carp collected from Barkley and Kentucky Reservoirs through all methods from 2018 through 2022.

Reservoir	Year	Predicted weight(g) at 450mm	Predicted weight(g) at 650mm	Predicted weight(g) at 800mm
Barkley	2018	933	2789	5176
	2019	1076	2881	5024
	2020	1121	2974	5160
	2021	1038	2980	5403
	2022	946	2975	5681
Kentucky	2018	950	2733	4963
	2019	930	2720	4987
	2020	986	2788	5018
	2021	994	2848	5301
	2022	836	2776	5469

Table 16. Summary of Invasive carp harvest and expenditures of Subsidy funds under the Asian Carp Harvest Program 2016-2022.

Year	Total funds paid out
2016	\$4,706.06
2017	\$9,596.05
2018	\$36,136.98
2019	\$210,163.21
2020	\$453,925.56
2021	\$646,072.68
2022	\$672,218.49

Table 17. Measures of effort and catch reported by commercial fishers fishing under the Asian Carp Harvest Program by calendar year, January -December 2013 - 2022.

Water Body	Year	Number of Days/Trips	Number of fishers	Weight silver carp harvested (lbs)	Weight bighead carp harvested (lbs)	Weight grass carp harvested (lbs)
Barkley Reservoir	2013	45	5	187,022		
	2014	61	6	464,003	1,360	
	2015	189	12	472,487	10,278	
	2016	447	22	1,112,585	5,693	
	2017	345	15	826,016	9,669	
	2018*	835	23	1,762,830	25,932	
	2019	1,846	60	5,318,535	45,665	
	2020**					
	*	1,431	43	4,700,149	28,714	61,487
	2021	1,707	32	5,918,405	18,669	43,213
2022	1,510	30	6,120,640	24,762	37,664	
Kentucky Reservoir	2013	21	4	26,400	491	
	2014	82	3	193,786	992	
	2015	59	6	84,190	17,791	
	2016	52	8	96,652	2,884	
	2017	54	8	71,487	11,754	
	2018*	116	8	143,996	11,537	
	2019	140	28	233,806	1,978	
	2020**					
	*	426	27	1,601,822	4,196	40,882
	2021	587	28	2,154,845	4,227	27,514
2022	309	20	1,184,756	3,074	8,666	
Ohio River	2013					
	2014	11	1	74,879		
	2015	16	3	26,864	1,206	
	2016	30	5	90,012	3,216	
	2017	8	4	11,217	713	
	2018	21	4	37,553	70	
	2019	129	9	142,520	521	
	2020**					
	*	151	13	137,754	7,402	6,402
	2021	56	7	60,741	1,286	3,028
2022	124	11	274,235	5,117	8,872	
Statewide*	2013	76	7	243,121	491	
	2014	160	9	765,768	2,802	
	2015	283	16	617,062	32,800	
	2016	565	24	1,343,464	12,666	

2017	414	21	921,288	23,272	
2018*	982	29	1,945,693	37,739	
2019	2,250	66	5,802,624	50,366	
2020**					
*	2,052	48	6,471,718	43,931	111,190
2021	2,373	38	8,148,093	24,699	74,430
2022	1,951	39	7,582,713	33,123	55,805

\*In 2018 KDFWR began allowing commercial fishermen to receive subsidy funds from the Asian Carp Harvest Program while fishing on their net permit, which allows them to harvest catfish and paddlefish. Commercial fishing effort from net permit holders that received subsidy funds is included in this table for 2018 and 2019.

\*\*Effort and harvest occurs under the ACHP in other water bodies to a lesser degree and is included in the statewide totals.

\*\*\*2020 was the first year that Grass carp harvest was reported separately from common carp harvest through the ACHP.

Table 18. Average length and weight of silver carp harvested during ride-alongs with commercial fishers under the Asian Carp Harvest Program 2015-2022.

Year	Number Sampled	Average total length (inches)	Average weight (lbs)	S. E.
2015	206	33.2	15.2	0.12
2016	448	34.5	17.7	0.10
2017	416	34.0	16.1	0.10
2018	387	31.0	11.6	0.10
2019	924	27.9	8.1	0.09
2020	595	28.0	8.5	0.11
2021	949	27.9	8.9	0.07
2022	1041	29.9	10.9	0.09

Table 19. Number of bighead carp and silver carp captured by gill net mesh size as observed during KDFWR ride-alongs with commercial fishers fishing under the Asian Carp Harvest Program 2016 – 2022. (CPUE = catch per unit effort)

Year	Net Bar Mesh Size (inches)	Effort (linear yards of net)	Number of Silver carp	Silver carp CPUE (fish/yard)	Number of Bighead carp	Number of Grass carp
2016	3.5	1,883	155	0.08		17
	4	2,067	308	0.15		1
	4.25	9,300	1,469	0.16	8	12
	5	16,983	1,811	0.11	44	13
	6	1,067	3	0.00		
2017	3.5	200	61	0.31	4	1
	4	1,983	225	0.11	1	1
	4.25	23,400	3,918	0.17	19	31
	4.5	2,283	68	0.03		
	5	4,125	212	0.05	3	1
	5.125	400	86	0.22	4	2
2018	3.5	6,883	3,778	0.55	8	24
	3.75	167	67	0.40		
	4	3,250	381	0.12	4	3
	4.25	14,100	920	0.07	54	8
	4.5	2,767	145	0.05	4	
	5	867	5	0.01	1	
2019	3	2,967	1,106	0.37	2	5
	3.25	9,600	4,979	0.52	10	83
	3.5	39,300	14,483	0.37	30	177
	4	300	2	0.01	0	0
	4.25	3,700	406	0.11	18	3
	4.5	2,567	162	0.06	5	1
	5	67	0	0.00	0	0
2020	3	100	18	0.18		
	3.25	3,933	1,968	0.50	2	17
	3.5	21,692	14,792	0.68	33	169
	4	533	38	0.07		
	4.25	2,100	319	0.15	6	
	4.5	1,583	104	0.07	5	
	5	267	9	0.03	4	
2021	3.25	2,117	851	0.40		6
	3.5	35,093	20,416	0.58	73	134
	4	2,583	494	0.19	17	3

	4.25	1,100	258	0.23	17	
	4.5	1,450	102	0.07	4	
	3.5	11,000	3,699	0.34	10	11
	3.75	17,292	8,812	0.51	22	12
2022	4	5,033	3,136	0.62	32	4
	4.25	56,667	2,784	0.05	39	
	5	667	10	0.01		

Table 20. Fishing effort and total weight (lbs) of invasive carp harvested during KDFWR ride-alongs with commercial fishers fishing under the Asian Carp Harvest Program 2015 - 2022.

Year	Effort *	Mean effort per trip	S. E.	Number of ride alongs	Number of fishers	Total WT of bighead carp harvested (lbs)	Total WT of silver carp harvested (lbs)	Total WT of grass carp harvested (lbs)
2015	31,583	1,053	78.4	32	8	4,086	68,139	855
2016	30,700	1,096	73.2	28	4	1,067	69,765	630
2017	32,225	1,040	88.6	31	9	763	73,958	746
2018	32,193	1,238	86.1	26	11	957	60,938	583
2019	57,433	1,197	79.8	48	19	1,123	160,981	2,916
2020	30,208	1,007	58.0	30	16	1,226	143,257	1,372
2021	42,193	728	53.0	58	18	1,780	198,249	1,130
2022	39,658	778	55.9	59	16	2,227	203,994	297

\*Effort is calculated in yards of gillnet fished.

Table 21. Comparison of the average weight harvested per trip of silver carp, bighead carp and grass carp during KDFWR ride-alongs, and through commercial fishers reports for the Asian Carp Harvest Program in 2016 - 2022. (S.E. = standard error)

Year		Silver Carp	S. E.	Bighead Carp	S. E.	Grass Carp	S. E.
2016	Ride Alongs	2,280	402.	40	12.	23	10.
	Commercial Fisher Reports	2,378	2	22	4	23	1
2017	Ride Alongs	2,386	395.	25	8.2	24	9.4
	Commercial Fisher Reports	2,225	0	56	7.6		
2018	Ride Alongs	2,219	422.	16	6.9	18.4	8.8
	Commercial Fisher Reports	1,981	6	38	4.0		
2019	Ride Alongs	3,353	475.	23	7.2	60	19.
	Commercial Fisher Reports	2,580	7	22	1.6		3
2020 *	Ride Alongs	4,775	677.	41	14.	46	15.
	Commercial Fisher Reports	3,186	5	22	8	55	5
2021	Ride Alongs	3,389	353.	31	9.4	20	4.0
	Commercial Fisher Reports	3,434	2	10	1.2	31	1.9
2022	Ride Alongs	3,731	365.	147	64.	28	9.2
	Commercial Fisher Reports	3,889	5	137	6	122	13.

\*2020 was the first year that Grass Carp harvest through the Asian Carp Harvest Program was required on commercial fishing reports.

Table 22. Paupier net effort and catch rates from sampling conducted in Big Bear embayment of Kentucky Reservoir. (S.E. = Standard error)

Date (month-year)	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		

**LAKE BARKLEY TAILWATER ANGLER ATTITUDE SURVEY 2022**

1. Have you been surveyed this year? Yes - stop survey No – continue

2. Zip Code \_\_\_\_\_

3. How many times do you fish the Lake Barkley Tailwaters each year? N=168

First time here 11.3% 1 to 4 27.4% 5-10 19.0% More than 10 42.3%

4. What angling techniques do you use when fishing at Lake Barkley Tailwaters (check all that apply)? N=168

Rod and reel 73.8% Snagging 0.0% Bowfishing 48.8% Castnet 0.6%

5. Which species of fish do you fish for at Lake Barkley Tailwaters (check all that apply)? N=169

Asian carp 46.7% Catfish 46.2% Striped Bass/White Bass/Hybrids 26.6% Skipjack 23.1% Paddlefish 19.5%  
 Gar 13.0% Black Bass 11.8% Panfish 3.6% Drum 2.4% Crappie 1.8% Bait Fish 1.8% Buffalo 1.8%  
 Anything 1.8% Bow species 1.2% Sauger 0.6% Walleye 0.6% Suckers 0.6%

6. Which one species do you fish for most at Lake Barkley Tailwaters (check only one)? N=169

Asian carp 42.0% Catfish 29.6% Skipjack 13.0% Striped Bass/White Bass/Hybrids 9.5% Black Bass 2.4% Panfish 1.8%  
 Paddlefish 0.6% Bait Fish 0.6% Anything 0.6%

**Answer the following questions for each species you fish for – (see question 5)**

**Striped Bass/White Bass/Hybrid Anglers**

7. In general, what level of satisfaction do you have with Striped Bass/White Bass/Hybrid fishing at Lake Barkley Tailwaters? N=45

Very satisfied 8.9% Somewhat satisfied 42.2% Neutral 24.4% Somewhat dissatisfied 20.0%  
 Very dissatisfied 4.4% No opinion 0.0%

7a. If you responded with somewhat or very dissatisfied in question (7) – what is the single most important reason for your dissatisfaction? N=11

Number of fish 63.6% Size of fish 0.0% Not happy with regulations 0.0% Too many anglers 0.0%  
 Asian carp 36.4%

**Crappie Anglers**

8. In general, what level of satisfaction do you have with crappie fishing at Lake Barkley Tailwaters? N=3

Very satisfied 0.0% Somewhat satisfied 0.0% Neutral 33.3% Somewhat dissatisfied 66.7%  
 Very dissatisfied 0.0% No opinion 0.0%

8a. If you responded with somewhat or very dissatisfied in question (8) – what is the single most important reason for your dissatisfaction? N=2

Number of fish 50.0% Size of fish 0.0% Not happy with regulations 0.0% Too many anglers 0.0% Asian carp 0.0%  
 Lock approach closed to fishing 50.0%

**Black Bass Anglers**

9. In general, what level of satisfaction do you have with the black bass fishing at Lake Barkley Tailwaters? N=19

Very satisfied 10.5% Somewhat satisfied 42.1% Neutral 36.8% Somewhat dissatisfied 5.3%  
 Very dissatisfied 5.3% No opinion 0.0%

9a. If you responded with somewhat or very dissatisfied in question (9) – what is the single most important reason for your dissatisfaction? N=2

Number of fish 100.0% Size of fish 0.0% Not happy with regulations 0.0% Too many anglers 0.0% Asian carp 0.0%

**Catfish Anglers**

10. In general, what level of satisfaction do you have with the catfish fishing at Lake Barkley Tailwaters? N=78

Very satisfied 29.5% Somewhat satisfied 44.9% Neutral 14.1% Somewhat dissatisfied 10.3%  
 Very dissatisfied 1.3% No opinion 0.0%

10a. If you responded with somewhat or very dissatisfied in question (10) – what is the single most important reason for your dissatisfaction? N=9

Number of fish 33.3% Size of fish 0.0% Not happy with regulations 0.0% Too many anglers 0.0% Asian carp 33.3%  
 Too much commercial fishing 11.1% Dislike electrofishing surveys 11.1% Too many snags 11.1%

**Paddlefish Anglers**

11. In general, what level of satisfaction do you have with the Paddlefish fishing at Lake Barkley Tailwaters? N=33

Very satisfied 15.2% Somewhat satisfied 24.2% Neutral 45.5% Somewhat dissatisfied 15.2%  
 Very dissatisfied 0.0% No opinion 0.0%

11a. If you responded with somewhat or very dissatisfied in question (11) – what is the single most important reason for your dissatisfaction? N=5

Number of fish 80.0%    Size of fish 0.0%    Not happy with regulations 0.0%    Too many anglers 0.0%    Asian carp 20.0%

**Bow Anglers**

12. How many trips do you make to bow fish in Kentucky during the months of March – August? N=82

First time 2.4%    1-10 39.0%    11-20 17.1%    21-30 9.8%    31-40 3.7%    41-50 4.9%    51-60 3.7%    61-70 0.0%    71-80 3.7%    81-90 0.0%    91-100 2.4%    101+ 13.4%

13. On average how many pounds of the following species do you harvest per trip bowfishing?

Pounds of Invasive carp N=82

0-50 35.4%    51-100 23.2%    101-150 2.4%    151-200 12.2%    201-250 3.7%    251-300 4.9%  
301-350 4.9%    351-400 3.7%    401-450 0.0%    451-500 3.7%    501+ 6.1%

Pounds of Buffalo N=82

0 54.9%    1-10 19.5%    11-20 6.1%    21-30 6.1%    31-40 0.0%    41-50 3.7%    51-100 3.7%    101+ 6.1%

Pounds of Gar N=82

0 22.0%    1-10 35.4%    11-20 18.3%    21-30 7.3%    31-40 3.7%    41-50 6.1%    51-100 3.7%    101+ 3.7%

Pounds of Other N=80

0 78.8%    1-10 10.0%    11-20 2.5%    21-30 1.3%    31-40 0.0%    41-50 2.5%    51-100 3.8%    101+ 1.3%

14. How many paddlefish do you shoot per year in Kentucky? N=82

First time 1.2%    0 48.8%    1 18.3%    2 4.9%    3 3.7%    4 2.4%    5 4.9%    6 3.7%    8 2.4%    10 6.1%  
20 1.2%    50 2.4%

14a. The current statewide season for snagging paddlefish is February 1 – May 10. Would you support creating a paddlefish season for bowfishing that aligned with these dates? N=82  
Support 48.8%    Oppose 41.5%    No opinion 9.8%

**All Anglers**

15. Are you aware that you can sell harvested Asian carp to local fish processors with a recreational fishing license? N=169

Yes 59.2%    No 40.8%

15a. If yes, have you ever sold Asian carp to any area processors? N=98    Yes 23.5%    No 76.5%

15b. If NO on 15a, what is the single most important reason you haven't sold to a processor? N=75

Don't know the buyers 9.3%    No way to transport 6.7%    Don't get enough to bother 64.0%  
They don't pay enough 6.7%    Tournament disposes of them 1.3%    Too much time 1.3%  
Takes too long to get paid 1.3%    Take them home to eat 1.3%    Live far away and there's no local Asian carp to sell 1.3%  
Just recently learned of it 1.3%    First time fishing at Barkley tailwaters 2.7%    Don't want to pay taxes 1.3%  
Don't need the money 1.3%

16. What do you normally do with Asian carp that you catch? N=169

Eat 1.8%    Sink 43.2%    Let go alive 16.0%    Use for bait 13.0%    Sell 5.3%    Never caught one 11.8%    Fertilizer 4.1%  
Tournament disposes 1.8%    Throw on rocks 0.6%    Give to someone else 1.8%  
Sink or sell depending on proximity to buyers 0.6%

17. Have you ever tried eating Asian carp? N= 169

Yes 25.4% No 74.6%

18. Are you satisfied with the current size and creel limits on all sport fish at the Lake Barkley Tailwaters? N=169

Yes 97.6% No 2.4%

18a. If not, which species are you dissatisfied with and what species size and creel limits would you prefer? N=4

White Bass minimum length 13" 25.0% Daily limit of 5 fish 25.0% Remove trophy catfish regulation 25.0%

Crappie minimum length 9" 25.0%

**KENTUCKY LAKE TAILWATER ANGLER ATTITUDE SURVEY 2022**

1. Have you been surveyed this year? Yes - stop survey No – continue

2. Zip Code \_\_\_\_\_

3. How many times do you fish the Kentucky Lake Tailwaters each year? N=188

First time here 9.0% 1 to 4 23.9% 5-10 16.0% More than 10 51.1%

4. What angling techniques do you use when fishing at Kentucky Lake Tailwaters (check all that apply)? N=188

Rod and reel 87.8% Snagging 16.0% Bowfishing 21.8%

5. Which species of fish do you fish for Kentucky Lake Tailwaters (check all that apply)? N=188

Catfish 51.1% Skipjack 27.1% Asian carp 26.1% Black Bass 22.9% Striped Bass/White Bass/Hybrids 21.3% Paddlefish 11.2% Crappie 8.0% Gar 7.4% Panfish 7.4% Anything 4.8% Sauger 4.3% Bluegill 3.2% Bait Fish 2.7% Shad 0.5% Yellow bass 0.5% Drum 0.5% Bow species 0.5%

6. Which one species do you fish for most at Kentucky Lake Tailwaters (check only one)? N=188

Catfish 33.5% Asian carp 16.5% Skipjack 13.8% Black Bass 10.6% Striped Bass/White Bass/Hybrids 10.1% Anything 4.8% Bait Fish 2.7% Panfish 2.1% Crappie 1.6% Paddlefish 1.6% Sauger 1.1% Yellow bass 0.5% Bluegill 0.5% Carp 0.5%

Answer the following questions for each species you fish for – (see question 5)

**Striped Bass/White Bass/Hybrid Anglers**

7. In general, what level of satisfaction do you have with Striped Bass/White Bass/Hybrid fishing Kentucky Lake Tailwaters? N=40

Very satisfied 17.5% Somewhat satisfied 40.0% Neutral 17.5% Somewhat dissatisfied 22.5%  
Very dissatisfied 2.5% No opinion 0.0%

7a. If you responded with somewhat or very dissatisfied in question (7) – what is the single most important reason for your dissatisfaction? N=10

Number of fish 80.0% Size of fish 0.0% Not happy with regulations 0.0% Too many anglers 0.0%  
Asian carp 20.0%

**Crappie Anglers**

8. In general, what level of satisfaction do you have with crappie fishing at Kentucky Lake Tailwaters? N=15

Very satisfied 0.0% Somewhat satisfied 20.0% Neutral 53.3% Somewhat dissatisfied 26.7%  
Very dissatisfied 0.0% No opinion 0.0%

8a. If you responded with somewhat or very dissatisfied in question (8) – what is the single most important reason for your dissatisfaction? N=4

Number of fish 50.0% Size of fish 0.0% Not happy with regulations 0.0% Too many anglers 0.0% Asian carp 50.0%

**Black Bass Anglers**

9. In general, what level of satisfaction do you have with the black bass fishing at Kentucky Lake Tailwaters? N=43

Very satisfied 4.7% Somewhat satisfied 62.8% Neutral 20.9% Somewhat dissatisfied 11.6%  
Very dissatisfied 0.0% No opinion 0.0%

9a. If you responded with somewhat or very dissatisfied in question (9) – what is the single most important reason for your dissatisfaction? N=5

Number of fish 80.0% Size of fish 0.0% Not happy with regulations 0.0% Too many anglers 0.0% Asian carp 20.0%

**Catfish Anglers**

10. In general, what level of satisfaction do you have with the catfish fishing at Kentucky Lake Tailwaters? N=96

Very satisfied 24.4% Somewhat satisfied 46.2% Neutral 37.2% Somewhat dissatisfied 10.3%  
Very dissatisfied 5.1% No opinion 0.0%

10a. If you responded with somewhat or very dissatisfied in question (10) – what is the single most important reason for your dissatisfaction? N=12

Number of fish 75.0% Size of fish 0.0% Not happy with regulations 8.3% Too many anglers 0.0% Asian carp 0.0% Bank access closed for construction 8.3% Difficult to snag 8.3%

**Paddlefish Anglers**

11. In general, what level of satisfaction do you have with the Paddlefish fishing at Kentucky Lake Tailwaters? N=21

Very satisfied 4.8% Somewhat satisfied 42.9% Neutral 33.3% Somewhat dissatisfied 9.5%  
 Very dissatisfied 4.8% No opinion 4.8%

11a. If you responded with somewhat or very dissatisfied in question (11) – what is the single most important reason for your dissatisfaction? N=3

Number of fish 100.0% Size of fish 0.0% Not happy with regulations 0.0% Too many anglers 0.0% Asian carp 0.0%

**Bow Anglers**

12. How many trips do you make to bow fish in Kentucky during the months of March – August? N=41

0-10 29.3% 11-20 26.8% 21-30 7.3% 31-40 2.4% 41-50 2.4% 51-60 2.4% 61-70 4.9%  
 71-80 2.4% 81-90 0.0% 91-100 7.3% 101+ 14.6%

13. On average how many pounds of the following species do you harvest per trip bowfishing?

Pounds of Invasive carp N=41

0-50 53.7% 51-100 26.8% 101-150 2.4% 151-200 7.3% 201-250 2.4% 251-300 2.4%  
 301-350 2.4% 351-400 0.0% 401-450 0.0% 451-500 0.0% 501+ 4.9%

Pounds of Buffalo N=41

0 65.9% 1-10 19.5% 11-20 4.9% 21-30 2.4% 31-40 2.4% 41-50 0.0% 51-100 2.4% 101+ 2.4%

Pounds of Gar N=41

0 24.4% 1-10 34.1% 11-20 24.4% 21-30 0.0% 31-40 4.9% 41-50 7.3% 51-100 4.9% 101+ 0.0%

Pounds of Other N=37

0 86.5% 1-10 2.7% 11-20 8.1% 21-30 0.0% 31-40 0.0% 41-50 2.7% 51-100 0.0% 101+ 0.0%

14. How many paddlefish do you shoot per year in Kentucky? N=41

0 61.0% 1 9.8% 2 9.8% 3 2.4% 7 2.4% 10 4.9% 15 4.9% 25 2.4% 30 2.4%

14a. The current statewide season for snagging paddlefish is February 1 – May 10. Would you support creating a paddlefish season for bowfishing that aligned with these dates? N=41

Support 36.6% Oppose 41.5% No opinion 22.0%

**All Anglers**

15. Are you aware that you can sell harvested Asian carp to local fish processors with a recreational fishing license? N=188

Yes 45.7% No 54.3%

15a. If yes, have you ever sold Asian carp to any area processors? N=86 Yes 4.7% No 95.3%

15b. If NO on 15a, what is the single most important reason you haven't sold to a processor? N=82

No way to transport 6.1% Don't get enough to bother 78.0% They don't pay enough 2.4%  
 Tournament disposes of them 1.2% Too far too travel 1.2% Out of state 1.2%  
 Not worth the effort 1.2% Never caught one 1.2% No local markets where they're from 1.2% Just  
 never done it 1.2% Slimy, messy boat 1.2% Don't want to 1.2%

Don't want them in the boat 1.2% Buyers not open 24/7 1.2%

16. What do you normally do with Asian carp that you catch? N=188

Eat 0.5% Sink 37.8% Let go alive 19.1% Use for bait 13.8% Never caught one 22.3% Fertilizer 2.7% Throw on rocks 2.1% Give to someone else 1.6%

17. Have you ever tried eating Asian carp? N= 188

Yes 21.8% No 78.2%

18. Are you satisfied with the current size and creel limits on all sport fish at the Kentucky Lake Tailwaters? N=188

Yes 96.8% No 3.2%

18a. If not, which species are you dissatisfied with and what species size and creel limits would you prefer? N=6

Statewide crappie minimum length 8-9" 16.7% Wants a daily creel limit on catfish 16.7%  
Catfish minimum length 10" 16.7% Remove trophy catfish regulation 16.7% Skipjack daily limit 50 16.7% Slot  
limit on blue catfish 16.7% Catfish maximum length 30" 16.7%  
Add a maximum length limit on paddlefish 16.7%

**Appendix B: TWRA Tables and Figures**

Table 1. Summary of gill netting effort (hours) and invasive carp demographics for Kentucky, Barkley, Pickwick, and Cheatham reservoirs.

	Kentucky Reservoir		Barkley Reservoir		Pickwick Reservoir		Cheatham Reservoir	
Year	2021	2022	2021	2022	2021	2022	2021	2022
Net Hours	1,065.19	1,032.05	522	515	171.8	192.74	361.02	379.97
<b>Invasive Carp Collected</b>								
Silver Carp	137	154	59	113	6	4	53	45
Grass Carp	4	11	6	9	3	2	1	5
Bighead Carp	12	3	1	3	0	0	1	2
Black Carp	0	0	0	0	0	0	0	0
<b>Silver Carp Captured (mm)</b>								
< 250mm	0	0	0	0	0	0	0	0
251mm-475mm	0	0	0	0	0	0	0	0
476mm-650mm	3	2	0	0	0	0	0	0
≥ 651mm	134	152	59	113	6	4	53	45

Table 2. Summary of gill netting effort (sets) and silver carp demographics for Kentucky, Barkley, Pickwick, and Cheatham Reservoirs in 2021 and 2022. Effort is separated between Summer and Fall sampling events for all four reservoirs. (SE = standard error, SD = standard deviation).

2021								
	Kentucky Reservoir		Barkley Reservoir		Pickwick Reservoir		Cheatham Reservoir	
Months	July	Oct	July	Oct	July	Oct	July	Nov
Net Sets	31	24	12	12	4	4	8	8
Silver Carp Captured	41	96	49	10	3	3	37	16
Silver carp/net (SE)	1.32 (0.31)	4.00 (0.78)	4.08 (0.99)	0.83 (0.21)	0.75 (0.48)	0.75 (0.48)	4.63 (0.99)	2.00 (0.53)
Mean TL (SD)	781 (±89)	784 (±54)	757 (±47)	802 (±66)	851 (±30)	890 (±40)	785 (±33)	826 (±67)
Length Range	567-926	641-1004	677-889	732-960	817-871	846-924	703-870	730-1006
2022								
	Kentucky Reservoir		Barkley Reservoir		Pickwick Reservoir		Cheatham Reservoir	
Months	June	Sept	June	Sept	June	Sept	June	Sept
Net Sets	24	24	12	12	4	4	8	8
Silver Carp Captured	66	88	80	33	3	1	39	6
Silver carp/net (SE)	2.75 (.67)	3.67 (.61)	6.7(.81)	2.75 (.82)	0.75 (.47)	0.25 (.25)	4.87 (.99)	0.75 (.66)
Mean TL (SD)	761 (±59)	798 (±49)	767 (±75)	766 (±42)	914 (±7)	815	841 (±65)	879 (±42)
Length Range	559-940	716-965	681-941	660-865	908-921	815	728-985	829-951

Table 3. Summary of gill netting efforts and silver carp demographics by mesh size in Kentucky, Barkley, Pickwick, and Cheatham Reservoirs in 2022. (SE = standard error, SD = standard deviation).

	Mesh Size (inch)		
	3	4	5
<b>Kentucky Reservoir</b>			
Silver Carp Captured	15	128	11
Silver Carp/mesh size (SE)	0.31 (0.32)	2.67 (1.11)	0.23 (0.20)
Mean TL (SD)	727 (89)	786 (44)	814 (84)
Length Range (mm)	559-906	652-945	684-965
<b>Barkley Reservoir</b>			
Silver Carp Captured	9	95	9
Silver Carp/mesh size (SE)	0.38 (0.35)	3.95 (1.37)	0.38 (0.54)
Mean TL (SD)	756 (75)	765 (44)	841 (67)
Length Range (mm)	681-915	660-874	756-941
<b>Pickwick Reservoir</b>			
Silver Carp Captured	0	2	2
Silver Carp/mesh size (SE)	0 (0)	0.25 (0.49)	0.25 (0.49)
Mean TL (SD)	0	864 (69)	915 (9)
Length Range (mm)	0	815-913	908-921
<b>Cheatham Reservoir</b>			
Silver Carp Captured	0	28	17
Silver Carp/mesh size (SE)	0 (0)	1.75 (1.3)	1.06(1.07)
Mean TL (SD)	0	824 (61)	883 (51)
Length Range (mm)	0	728-975	807-985

Table 4. Dozer trawl sampling sections within each reservoir with starting and ending embayments.

<b>Waterbody</b>	<b>Starting Location</b>	<b>Ending Location</b>
Kentucky Reservoir Section 1	Jones Creek	Leatherwood
Kentucky Reservoir Big Sandy	Mouth of Embayment	New Hope Boat Ramp
Kentucky Reservoir Section 2	Lick Creek	Beaverdam
Kentucky Reservoir Section 3	Birdsong	Beech River
Kentucky Reservoir Section 4	Cedar Creek	Horse Creek
Barkley Reservoir	Crockett Bay	Lick Creek
Pickwick Reservoir	State Line	Pickwick Dam
Cheatham Reservoir	Cheatham Dam	Marrowbone Creek

Table 5. Summary of silver carp (SVCP) that evaded capture, were captured, and the percent capture rates for each section of Kentucky Reservoir, Barkley Reservoir, Pickwick Reservoir, and Cheatham Reservoir.

<b>SVCP Capture Rates 2022</b>				
<b>Season</b>	<b>Location</b>	<b>SVCP Evaded</b>	<b>SVCP Caught</b>	<b>Percent Captured</b>
Summer	Kentucky S1	53	1	1.9%
Summer	Kentucky BS	38	0	0%
Summer	Kentucky S2	34	4	11.8%
Summer	Kentucky S3	51	6	11.8%
Summer	Kentucky S4	92	9	9.8%
Summer	Pickwick	4	0	0%
Summer	Barkley	605	61	10.0%
Summer	Cheatham	59	5	8.5%
Fall	Kentucky S1	118	7	5.9%
Fall	Kentucky BS	94	3	3.2%
Fall	Kentucky S2	140	5	3.6%
Fall	Kentucky S3	131	8	6.1%
Fall	Kentucky S4	79	0	0%
Fall	Pickwick	0	0	0%
Fall	Barkley	295	30	10.2%
Fall	Cheatham	139	8	5.8%

Table 6. Summary of dozer trawl season, catch per unit effort per 5-minute trawl (CPUE/5-min) and catch per unit effort per 1-hour of trawls (CPUE/hr) for each section of Kentucky Reservoir, Pickwick Reservoir, Barkley Reservoir, and Cheatham Reservoir in Summer and Fall 2022.

<b>Catch Per Unit Effort Dozer Trawl</b>			
<b>Season</b>	<b>Location</b>	<b>CPUE/5-min</b>	<b>CPUE/hr</b>
Summer	Kentucky S1	0.04	0.48
Summer	Kentucky BS	0	0
Summer	Kentucky S2	0.16	1.92
Summer	Kentucky S3	0.24	2.88
Summer	Kentucky S4	0.36	4.32
Summer	Pickwick	0	0
Summer	Barkley	2.44	29.28
Summer	Cheatham	0.23	2.76
Fall	Kentucky S1	0.28	3.36
Fall	Kentucky BS	0.12	1.44
Fall	Kentucky S2	0.20	2.4
Fall	Kentucky S3	0.32	3.84
Fall	Kentucky S4	0	0
Fall	Pickwick	0	0
Fall	Barkley	1.2	14.4
Fall	Cheatham	0.32	3.84

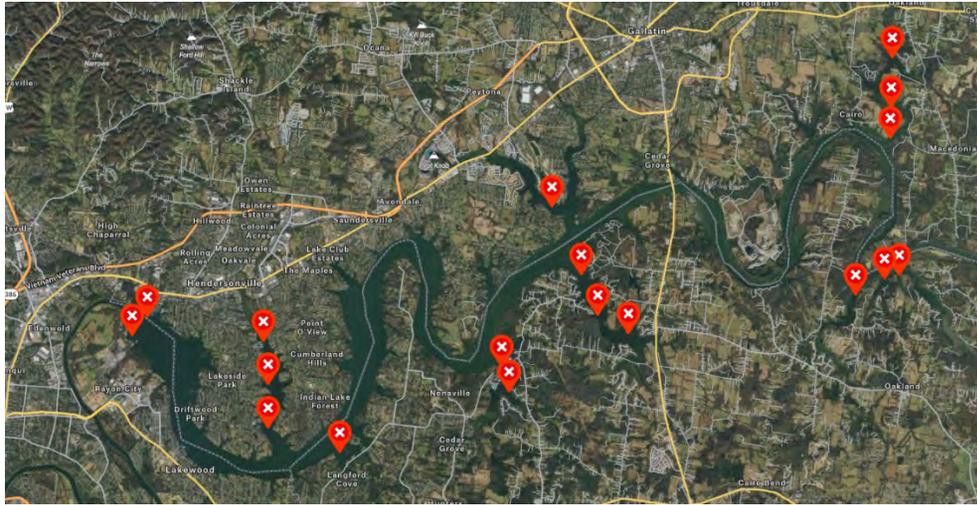


Figure 1. Standardized electrofishing locations for Old Hickory Reservoir.

**Appendix C: ADCNR Tables and Figures****Table 1.** Summary of ADCNR, CY2022 effort and catch data during monitoring, eradication and field reconnaissance of invasive carp populations in four Tennessee River reservoirs in Alabama. Effort and catch-per-unit (CPUE) data are rounded to nearest whole number.

<i>Sample Effort Parameter</i>	<b>TN River Reservoirs (downstream to upstream)</b>				<b>Row Total or Mean</b>
	<b>Pickwick</b>	<b>Wilson</b>	<b>Wheeler</b>	<b>Guntersville</b>	
<b><i>Electrofishing effort</i></b>					
Estimated person hours	330	180	162	27	<b>699</b>
Samples (transects)	91	59	71	5	<b>226</b>
Electrofishing hours	9	5	6	4	<b>24</b>
<b><i>Electrofishing catch</i></b>					
Silver Carp (n)	15	0	0	0	<b>15</b>
White amur (n)	0	0	0	0	<b>0</b>
CPUE (invasive carp/hr)	2	0	0	0	<b>2</b>
<b><i>Gill Netting effort</i></b>					
Estimated person hours	540	198	210	0	<b>948</b>
Samples (net sets)	69	32	48	0	<b>149</b>
Soak time (hours)	642	184	283	0	<b>1109</b>
Miles of nets	4	2	3	0	<b>9</b>
<b><i>Gill Netting Catch</i></b>					
All fish (n)	241	217	219	0	<b>677</b>
Fish species (n)	21	21	21	0	<b>63</b>
Silver Carp (n)	22	0	0	0	<b>22</b>
White amur (n) *	0	7	7	0	<b>14</b>
Hybrid carp (n)	0	0	0	0	<b>0</b>
CPUE (all fish/net)	4	7	5	0	<b>5</b>
CPUE (invasive carp/net)	0	0	0	0	<b>0</b>
<b><i>Other field work: Gear tests, telemetry, site assessment (not by reservoir)</i></b>					
Estimated person hours	128	64	19	38	<b>249</b>
Target Task	Site assessment	Assess gear	Assist agencies Gill net, reconnaissance	Telemetry	
Sample method	Bottom sonar	DC output		Receiver download	

**Table 2.** Summary of ADCNR standard sample efforts and catch rates, CY 2020 - 2022 at three Alabama reservoirs in the Tennessee River. Invasive carp species captured include Silver Carp (SVC) and White Amur (WAM). Total fish includes non-target species.

CY	Gillnet (miles)	Net-sets (n)	Net soak time (Hrs)	Invasive		Total fish / net-set	Electrofishing (days)
				SVC + WAM (n)	carp / net- set		
2020	3.0	53	1043	53	1.0	11.9	6
2021	3.6	64	1191	26	0.4	13.6	32
2022	8.7	149	1109	51	0.3	4.9	35

\* Note: 101 of 149 gill nets set during 2022 were daytime occupancy-strategy sets; average soak time = 1.5 hours, versus night-set nets (n = 48) with soak time average = 20.0 hours

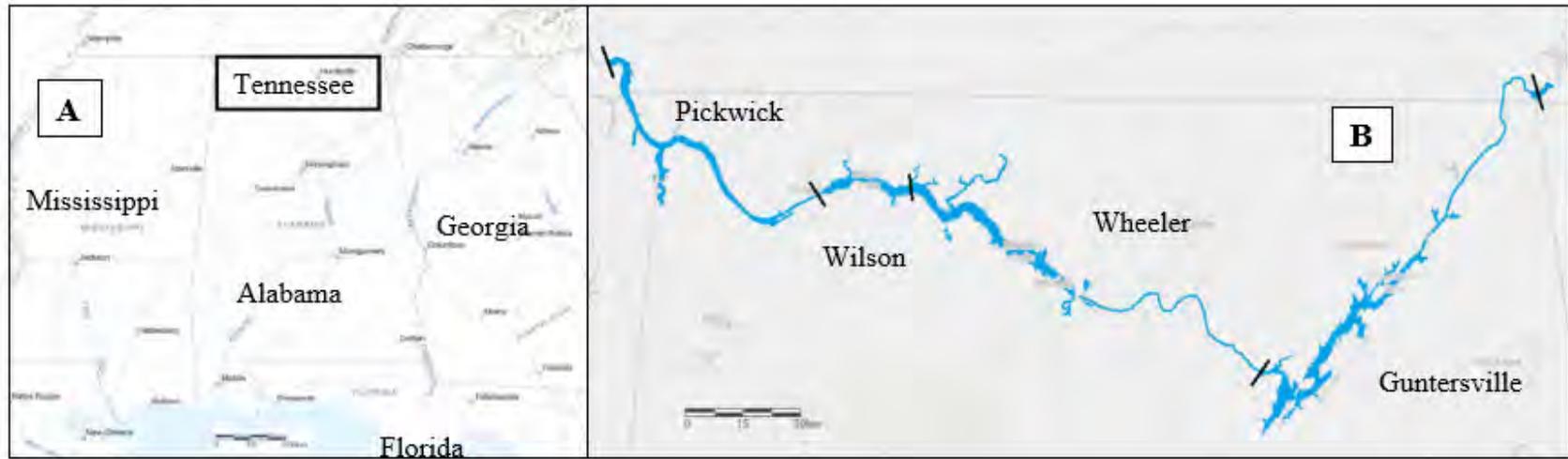


Figure 1. Position of the Tennessee River in Alabama (A) and the relative locations of reservoirs and dams (B) in Alabama and contiguous waters of Mississippi and Tennessee.

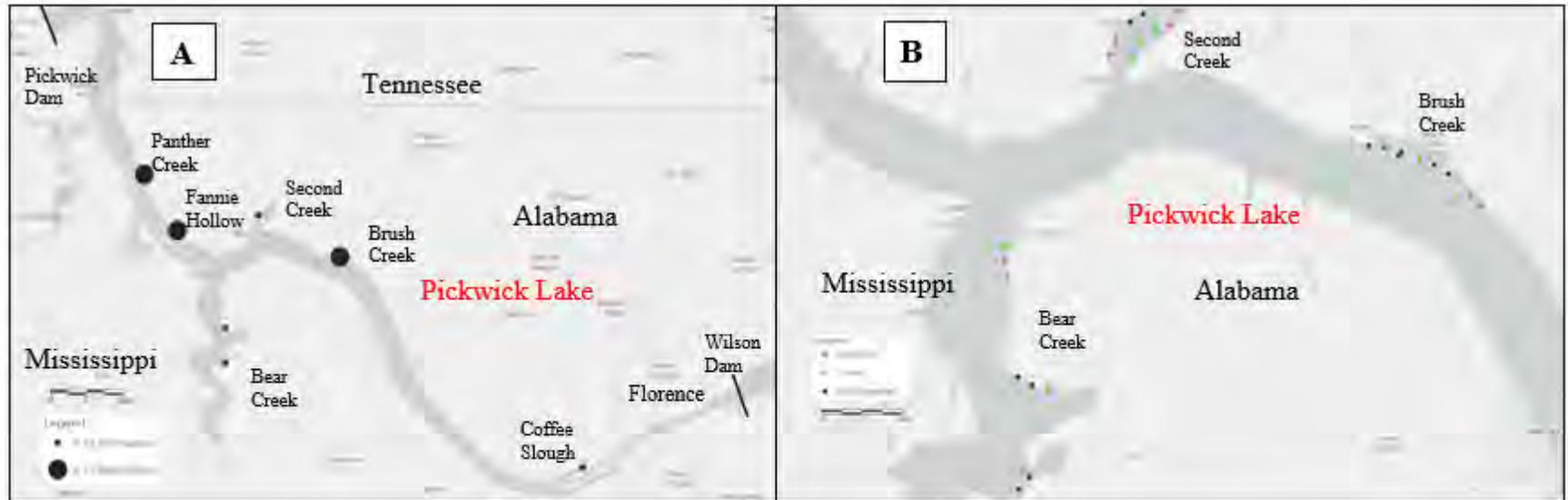


Figure 2. Reservoir position and relative numbers (black dots) of Silver Carp collected at sample area occurrences in Pickwick Lake (A), Tennessee River, Alabama. Inset (B) shows relative locations of 2022 paired gillnet and electrofisher (green or red dots) occupancy sample sites and Silver Carp occurrences (black dots) within each transect.

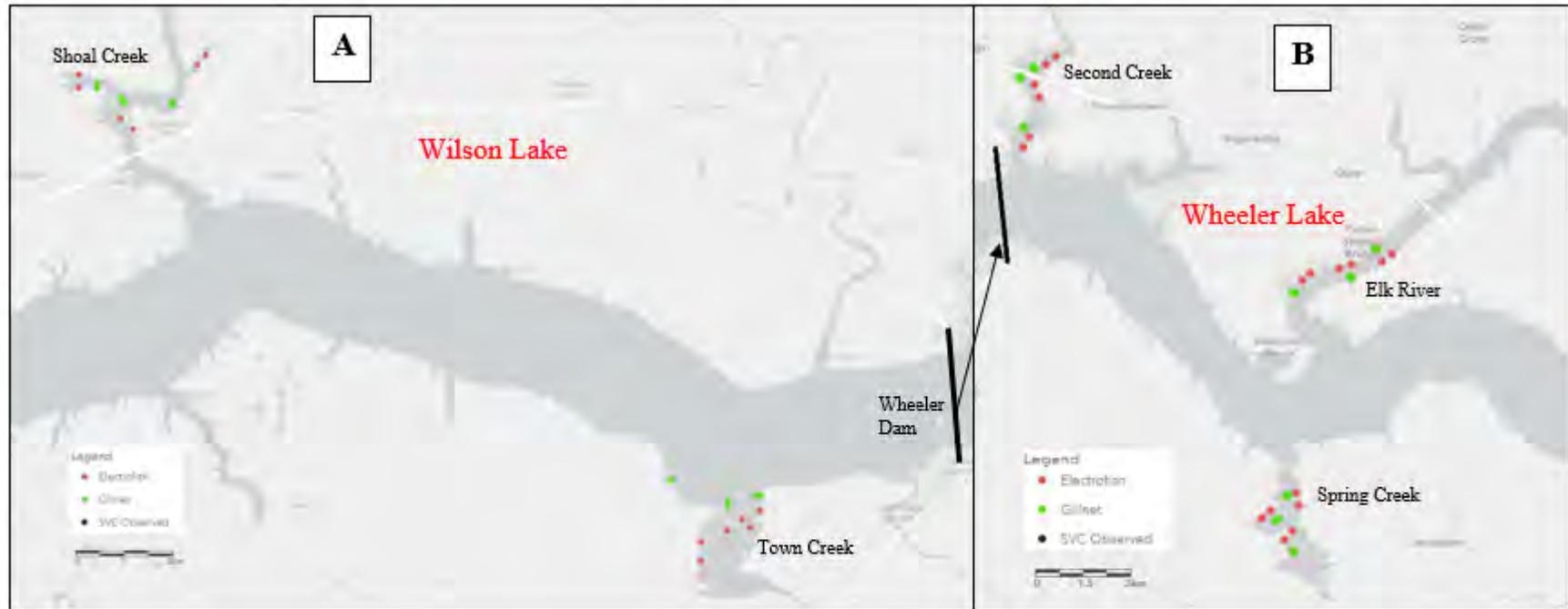


Figure 3. Wilson Lake (A) and Wheeler Lake (B) in the Tennessee River, Alabama. Panels show relative locations of 2022 occupancy sample sites. There were no Silver Carp occurrences ( $n = 0$ ) within paired gillnet and electrofisher (green or red dots) sites.

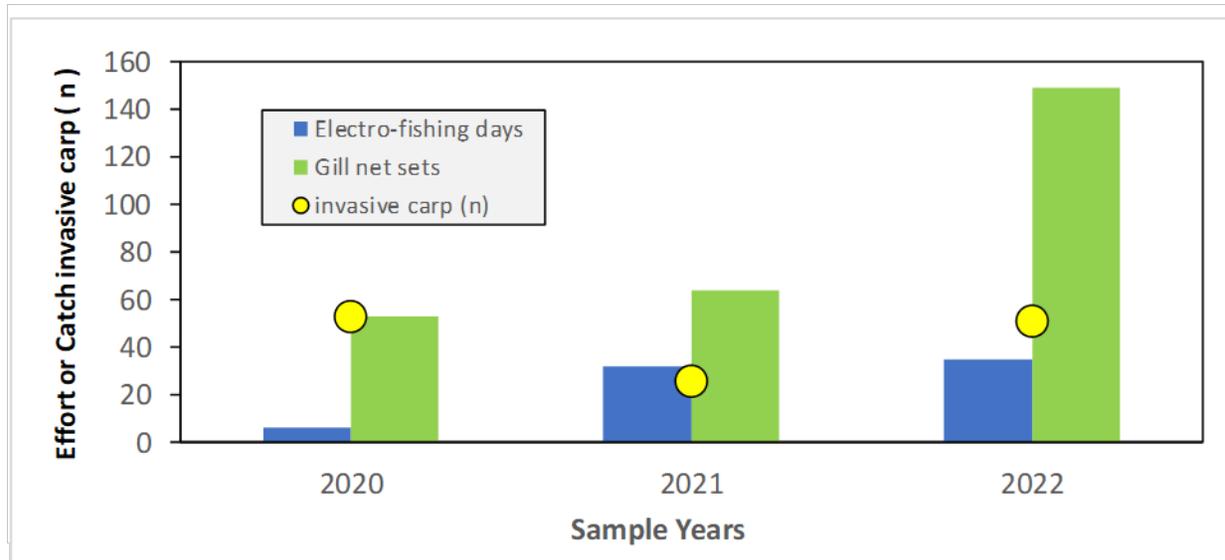


Figure 4. Sample effort by ADCNR staff (electrofishing days; gillnet sets) in three Alabama reservoirs on the Tennessee River, CY2020 through 2022. Yellow dots show total catch (n) of invasive carp (Silver and White amur combined) for both captured or sighted fish.