Kirby Reservoir

2017 Fisheries Management Survey Report

PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-3

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

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July 31, 2018

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Survey and Management Summary

From 2014-2018, fish populations in Kirby Reservoir were surveyed by various methods including electrofishing, low-frequency electrofishing, tandem hoop netting, trap netting, and jug lining. This report summarizes the results of the surveys and contains a management plan for the reservoir based on those findings.

Reservoir Description: Kirby Reservoir is a 740-acre impoundment at conservation pool located within the city limits of Abilene, Texas. The reservoir is an impoundment on Cedar Creek within the Brazos River Basin. During fall 2000, the lake went completely dry but refilled by July 2002. Since September 2001, treated effluent water has been pumped into the reservoir to help manage the water level. After heavy rains in 2015 and 2016, the reservoir was refilled to full pool and has steadily declined in water level since. Predominant habitat features consist of mud flats, rocks, brush, and vegetation mostly consisted of bulrush, black willow, and exotic salt cedar. One boat ramp and one handicap-accessible fishing pier were available during the survey period, and bank-fishing access was plentiful.

Management History: Sport fish include Blue Catfish, Channel Catfish, Flathead Catfish, White Crappie, Saugeye, Largemouth Bass, and sunfishes. All sport fishes, except for Blue and Channel catfishes, are managed under current statewide harvest regulations. In 2011, Blue and Channel catfishes harvest regulations were modified to allow for harvest without a minimum length limit and a daily bag limit increase from 25 to 50 fish/day in combination with no more than 5 fish ≥20 inches.

Fish Community

- **Prey species:** Electrofishing catch of Gizzard Shad was adequate and most were available as prey to sport fish. Electrofishing catch of Bluegill was high, and few Bluegill were over 6-inches long. Green Sunfish were also numerous and supported the prey fish community.
- **Catfishes:** Channel Catfish were numerous, but their growth to stock size was variable (2-6 years to 11 inches). Blue Catfish were relatively abundant, and fish ≥stock size appear to be available to anglers. Blue Catfish grew to quality-size in about 8 years. Flathead Catfish were relatively abundant, and many individuals ≥18 inches were available to anglers.
- **Largemouth Bass:** Largemouth Bass had low relative abundance, which was similar to years prior. Catch rate of legal-sized fish was low, but those sampled had good body condition. Allele frequency for Florida Largemouth Bass was approximately 80%.
- **White Crappie:** White Crappie were moderately abundant with few legal-size fish available to anglers. Legal-sized fish sampled had good body condition. Aged crappie ranged from about 5-10 inches; the two crappie aged at 9.0-10.9 inches were age-1.

Management Strategies: Conduct a creel survey during 2019-2020. Work with the controlling authority to address access and aesthetic issues (i.e., trash and road conditions) at the reservoir. Inform the public about the negative impacts of aquatic invasive species. Conduct routine monitoring during the winter for golden alga. Conduct biennial low-frequency electrofishing in late spring or early summer 2019 and 2021, tandem hoop netting in summers 2019 and 2021, electrofishing in fall 2021, and trap netting in late fall 2021. Access and vegetation surveys will be conducted in 2021.

Introduction

This document is a summary of fisheries data collected from Kirby Reservoir in 2014-2018. The purpose of the document is to provide fisheries information and make management recommendations to protect and improve the sport fishery. While information on other fishes was collected, this report deals primarily with major sport fishes and important prey species. Historical data are presented with the 2014-2018 data for comparison.

Reservoir Description

Kirby Reservoir is a 740-acre impoundment (at conservation pool) located within the city limits of Abilene, Texas and is controlled by the City of Abilene. The reservoir is in Taylor County and is an impoundment on Cedar Creek within the Brazos River Basin. Primary reservoir water uses included non-potable municipal water supply, water storage, and recreation. During fall 2000, the lake went completely dry, but refilled to full pool by July 2002. A treated effluent water discharge permit was approved in 2001, and the City of Abilene began pumping reuse water into Kirby Reservoir in September 2001. Kirby Reservoir's water level elevation has fluctuated within about five feet below conservation pool elevation from 2004-2011, but the reservoir dropped to about eight feet low from fall 2011-spring 2012. The reservoir refilled from heavy rainfall during 2015, and water level fluctuated from about one foot over conservation pool and two feet below conservation pool until 2017. Water level has steadily declined since (Figure 1). Other descriptive characteristics for Kirby Reservoir are in Table 1.

Angler Access

Two public boat ramps can be found at Lake Kirby Park; however, one ramp was inaccessible and in need of repair. Bank access was available through most of the shoreline. One handicap-accessible fishing pier was available inside Lake Kirby Park. Boat ramp characteristics are detailed in Table 2.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Homer and Amoroso 2014) included:

1. Conduct biennial low-frequency electrofishing surveys to better assess relative abundance, size structure, age structure, and condition of Blue Catfish.

   Action: Surveys were conducted in 2014 and 2017.

2. Conduct tandem hoop net survey in 2014 and 2016 to better assess relative abundance, size structure, age structure, and condition of Channel Catfish.

   Action: Surveys were conducted in 2014 and 2017.

3. Conduct a quarterly creel survey from June 2017-May 2018 to determine angler-directed effort for catfishes, specifically individuals of quality-size.

   Action: A creel survey was not conducted during this monitoring period. The survey will be rescheduled to occur within the next monitoring period.

4. Conduct a mark-recapture study to estimate population size and calibrate accuracy of population estimate to low-frequency electrofishing CPUE for Flathead Catfish.

   Action: A mark-recapture study was conducted from fall 2014-spring 2015.

5. Conduct biennial low-frequency electrofishing surveys to attain better estimates of relative abundance, relative weights, and size structure for Flathead Catfish.

   Action: A low-frequency electrofishing survey was conducted in 2014, and a mark-recapture study was conducted from fall 2014 – spring 2015.

6. Conduct trap netting in 2015 and 2017 with increased effort for White Crappie to assess recruitment and to determine if harvestable-sized White Crappie are available for anglers.

   Action: Trap netting was conducted in fall 2014, 2015, and 2017.

7. Conduct a Blue Catfish diet study to determine if White Crappie is a preferred prey species for Blue Catfish in Kirby Reservoir.

   Action: A diet study was not conducted after trap netting resulted in improved catch of sub-legal White Crappie. Relative abundance of White Crappie appeared strongly linked to water level and availability of littoral habitat.

8. Stock Florida Largemouth Bass fingerlings in 2014 and 2015 at about 100 fish/acre.

   Action: Florida Largemouth Bass were stocked in 2014 only. The fall 2014 electrofishing survey suggested that there was poor stocking success, and a 2015 stocking was not conducted because of poor habitat availability.

9. Conduct bass-only electrofishing in 2014 and 2015 to monitor relative abundance of Largemouth Bass, particularly sub-stock bass, to evaluate recruitment of stocked fish. Fin clips will be collected for genetic analysis to determine if age-0 bass collected in the fall were from stocking or natural reproduction.

   Action: Bass-only electrofishing was conducted in fall 2014, and a complete electrofishing survey for Largemouth Bass and prey species was conducted in fall 2016.

10. Meet with the City of Abilene to discuss aesthetics and access issues within the Lake Kirby Park and in the surrounding lake area.

    Action: TPWD Inland Fisheries – Abilene Team met with City of Abilene multiple times throughout the survey period to discuss access and aesthetics issues. City of Abilene has installed some additional trash receptacles to prevent littering on-site. Repairs to the fishing pier and boat dock were made by the City of Abilene Parks Department, but road conditions were not addressed. TPWD Inland Fisheries – Abilene Team also participated in the planning talks of a nature playground and the development of Lake Kirby Park's master plan.

11. Collaborate with Keep Abilene Beautiful, Boy Scouts of America, and other groups on beautification projects to improve aesthetics at the park as well as possible native vegetation plantings.

    Action: TPWD Inland Fisheries – Abilene Team discussed possible collaborations with multiple groups during the survey period. Artificial habitat enhancement by installing recycled Christmas trees along the perimeter of the fishing pier was conducted in 2016 to improve angler catch rates of Largemouth Bass, White Crappie, and sunfish.

12. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir.

    Action: Signage to inform the public of invasive zebra mussels and proper clean, draining, and drying of boats to prevent their spread were installed at the public boat ramp.

13. Educate the public about invasive species with media and the internet. Make a speaking point about invasive species when presenting to constituent and user groups.

Action: Multiple popular press articles were written during the survey period, as well as several media interviews were conducted with local media to discuss the threats of invasive species. Multiple presentations were also given to bass clubs and other groups.

Harvest regulation history: Prior to September 2011, all sport fishes were managed with the statewide harvest regulations. Catfish harvest regulations were changed to allow harvest of Blue Catfish and Channel Catfish without a minimum length limit, and the bag limit was increased from 25 to 50 fish in combination, with no more than 5 fish/day at 20 inches or greater. In 2016, an unlawful ordinance that prohibited use of trotlines and juglines for fishing was redacted by City of Abilene. Other sport fishes are still managed with the statewide harvest regulations (Table 3).

Stocking history: After Kirby Reservoir went completely dry in 2000, and water level returned to a suitable level for stocking by 2001. Prey species including Threadfin Shad, Golden Shiners, Bluegill, Fathead Minnows, and Inland Silversides were stocked. Sport fish stockings were conducted to restore Blue Catfish, Channel Catfish, Flathead Catfish, and Largemouth Bass. A Saugeye stocking and fishery evaluation study was conducted from 2001-2011, and stockings ceased after creel surveys indicated poor utilization of the fishery. Florida Largemouth Bass were stocked in 2014 and 2016. The complete stocking history for the reservoir from 2000-2018 is described in Table 4.

Vegetation/habitat management history: In 2000, Kirby Reservoir went completely dry. Vegetation and habitat management has been limited to a few projects for constructing and deploying artificial habitat structures. Recycled Christmas trees were deployed along the perimeter of the fishing pier at Lake Kirby Park in 2016.

Water transfer: There are no existing interbasin water transfers for Kirby Reservoir. Kirby Reservoir is primarily used for municipal water supply for the City of Abilene. Treated effluent water is pumped into the reservoir from a City of Abilene-owned water treatment plant to help maintain the water supply.

Methods

From 2014-2018, surveys were conducted to achieve objectives outlined in Homer and Amoroso (2014) as well as an objective-based sampling (OBS) plan for Kirby Reservoir (Table 5; TPWD unpublished). All survey sites were randomly selected except those for sampling Flathead Catfish and one additional site to collect Largemouth Bass for fin clips (see APPENDIX A). All surveys were conducted according to the TPWD Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Electrofishing – During fall 2014, bass-only electrofishing was conducted for 1 hour at 12, 5-min stations. In fall 2016 and 2017, Largemouth Bass, sunfishes, and Gizzard Shad were collected by electrofishing (1 hours at 12, 5-min stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing.

Low-frequency electrofishing – Blue Catfish and Flathead Catfish were collected by exploratory low-frequency electrofishing. During 2014, Blue Catfish were sampled for 0.5 hour, at 10, 3-min stations. Blue Catfish were collected for 1 hour at 20, 3-minute stations during summer 2017. Catch per unit effort (CPUE) for Blue Catfish electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing. Otoliths were retained from Blue Catfish 5.0-20.9 inches to assess age and growth. Flathead Catfish were sampled at a combination of random and non-random stations for approximately 2.7 hours during fall 2014 and 1.9 hours in spring 2015. Sampling occurred for at least 2.5 minutes at each station, and CPUE was determined by the number of fish caught per hour (fish/h) of actual electrofishing. During sampling, Flathead Catfish were marked by clipping the adipose fin and left pectoral spine. Sampling was conducted by low-frequency electrofishing from October 2014-April 2015 over one initial marking event, three mark-recapture events with replacement of caught individuals, and one final recapture event with replacement of caught individuals. The Schnabel population estimator (Schnabel 1938) and the Chapman modifier (Chapman 1954) were used to estimate abundance of Flathead Catfish in the reservoir.

Trap netting – During fall 2014, 2015, and 2017, White Crappie were collected by using single-cod trap nets (10 net nights at 10 stations in 2014 and 2017 and 15 net nights at 15 stations in 2015). Catch per unit effort (CPUE) for trap netting was recorded as the number of fish caught per net night (fish/nn). During 2015, ages for White Crappie were determined by using otoliths from 32 fish that were 4.6-10.4 inches.

Tandem hoop netting – Channel Catfish were collected during an exploratory tandem hoop netting survey conducted during summer 2014 (9 tandem series for two-night sets at 9 random stations) and summer 2017 (8 tandem series for two-night sets at 8 random stations). During 2017, initially four stations were set with cheese log bait, but the bait disintegrated rapidly and was ineffective. These stations were dropped from the analyses because very few fish were caught. The remaining eight stations were set with soap bait. Catch per unit effort (CPUE) for tandem hoop netting was recorded as the number of fish caught per tandem series set (fish/tandem series). In 2014, otoliths were retained from 131 fish that were 10.9-17.5 inches to assess age and growth.

Jug lining – Blue Catfish were collected during an exploratory jug lining survey conducted during winter 2018. Juglines baited with cut Common Carp were deployed in pairs, (one setup with two 5/0 circle hooks and the other with two 7/0 circle hooks) approximately 10-15 yards apart at randomly selected stations in depths ≥ 6 ft., and they were set for about 18-24 hours and retrieved. Catch per unit effort (CPUE) was recorded as the number of fish caught per jugline pair (fish/jugline pair). Otoliths from 42 fish that were 15.0-20.9 inches were retained for age and growth estimation.

Genetics – Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015). Micro-satellite DNA analysis was used to determine genetic composition of individual fish.

Statistics – Sampling statistics (CPUE for various length categories), structural indices [Proportional Size Distribution (PSD), terminology modified by Guy et al. 2007], and body condition indices [relative weight (Wr)] were calculated for target fishes according to Anderson and Neumann (1996). Index of vulnerability (IOV) was calculated for Gizzard Shad (DiCenzo et al. 1996). Standard error (SE) was calculated for structural indices and IOV. Relative standard error (RSE = 100 X SE of the estimate/estimate) was calculated for all CPUE statistics. For the habitat survey and for the mark-recapture study for Flathead Catfish, 95% lower and upper confidence limits (i.e., LCL and UCL) were calculated.

Habitat – A vegetation and structural habitat survey was conducted in August 2017 by using the random point method. Structural habitat and exotic vegetation were surveyed by circumnavigation of the reservoir and by the digital shapefile method (TPWD unpublished manual, TPWD 2015). A total of 200 random points throughout the reservoir, and presence/absence was determined for vegetative and structural habitat types identified at or below the waterline at all stations. Eighteen stations were discarded because they could not be sampled. Percent occurrence (% = [# stations habitat present / total stations sampled] X 100) and associated Wilson 95% confidence intervals (Ausvet 2018) were calculated for each habitat feature type (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Water level – Source for water level data was the United States Geological Survey (USGS 2018).

Results and Discussion

Habitat: Habitat at the reservoir consisted of primarily featureless (i.e., natural) and rocky shoreline (Table 6). Notable vegetation that was present was flooded terrestrial vegetation, exotic salt cedar, giant bulrush, and black willow (Table 7**Error! Reference source not found.**). Notable structural habitat features that were encountered were pebbles, cobble, and small boulders. Exotic salt cedar was found throughout the reservoir, and exotic giant reed (*Arundo donax*) was also documented in isolated locations (see APPENDIX B).

Prey species: Bluegill, Gizzard Shad, Green Sunfish, and Longear Sunfish have historically been productive in the reservoir and have comprised much of the available fish prey base for sport fish in the

reservoir. Other prey species encountered during survey period included Orangespotted Sunfish, Inland Silversides, hybrid sunfishes, Common Carp, and Logperch (see APPENDIX C). Gizzard Shad catch rates in 2013 (506.0/h) and 2016 (526.0/h) were similar, but the rate in 2017 (218.0/h) was substantially lower (Figure 2). Despite the lower catch in 2017, Gizzard Shad consistently had IOV values >90 during the survey period, suggesting that most individuals were of optimal prey size for sport fish. Catch rates of Bluegill fluctuated from 684.0/h in 2013 to 475.0/h in 2017(Figure 3). Similarly, CPUE for stock-sized Bluegill fluctuated from 599.0/h in 2013, to 165.0/h in 2016, and to 475.0/h in 2017. Bluegill in the samples were mostly 4-5 inches, and PSDs decreased from 28 in 2013 to 3 in 2017. Green Sunfish catch rates increased from 129.0/h in 2013 to 201.0/h in 2017; Stock CPUE had a similar increase during that period from 119.0/h to 193.0/h (Figure 4). Prey species have been prolific in Kirby Reservoir, and ample numbers appear to be available to sport fish (see APPENDIX D).

Blue Catfish: Blue Catfish have historically been the most popular recreational species among anglers at Kirby Reservoir, and the species has been productive (Homer and Amoroso 2014). Blue Catfish total catch rates during summer electrofishing surveys increased from 71.0/h in 2012, to 204.0/h in 2014, and to 376.0/h in 2017 (Figure 5). Catch rates for stock-sized (≥12 inches) Blue Catfish fluctuated from 19.0/h in 2012, to 132.0/h in 2014, and to 15.0/h in 2017. The CPUE-20 from 2012-2017 varied from 7.0/h in 2012, to 44.0/h in 2014, and to 1.0/h in 2017. Not enough stock-sized fish were collected during the 2017 survey to evaluate PSD, though the high relative abundance of sub-stock-sized fish suggested successful reproduction occurred. Sizes of Blue Catfish in the 2017 survey ranged from 4-21 inches, which 67.3% of catfish sampled were 5 inches. Body condition (i.e., mean relative weights) ranged from poor to fair. The meager sample of fish >10 inches in 2017 warranted additional sampling by baited juglines during winter 2018. The objective to obtain a sample with better representation of size groups >10 inches was achieved with jug lining (Figure 6). Jug lining CPUE-Total was 0.9/jugline pair, which increased from the rate of 0.3/jugline pair in 2009. Sizes of Blue Catfish caught in the jugline survey ranged from 15-37 inches, which most individuals were between 19-21 inches (Figure 6). Blue Catfish achieved stock-size in about 2.5 years (N=4), and they grew to quality-size in about 8 years (N=27).

Channel Catfish: Channel Catfish have been productive in Kirby Reservoir and have been an important species targeted by anglers (Homer and Amoroso 2014). Catch rates of Channel Catfish in summer tandem hoop net surveys fluctuated from 37.7/tandem series in 2012 to 60.7/tandem series in 2014 (Figure 7). In 2017, sampling with cheese logs as bait was attempted, but the formulation and the consistency of the bait was changed and resulted in the bait disintegrating rapidly upon net setting. Thus, soap bait was used as an alternative. In 2017, tandem hoop netting CPUE-Total was 72.3/tandem series, and CPUE for stock-size fish was 36.8/tandem series. Size structure, as indicated by PSD, was consistently low and ranged from 0-4, which most individuals sampled were <quality-size. Mean relative weights for individuals caught during the 2017 survey were <95 and were poor. Growth of Channel Catfish to stock size (11 inches) ranged from 2-6 years (see APPENDIX E. – Age data for Channel Catfish.

Flathead Catfish: Flathead Catfish have been present in historical surveys. In 2014, catch rate of Flathead catfish was 23.6/h (RSE=37), and fish ranged from 16-40 inches. Catch rate for legal-sized fish was 23.0/h. Relative weights for individuals appeared adequate and ranged from 94-131. Spring 2015 total catch rate was 14.4/h (RSE=34), and lengths ranged from 20-40 inches. From 2014-2015, 96 fish were caught and marked, and only six fish were recaptured (Figure 8). During the survey period, only two fish smaller than legal length were captured, and fish ranged from 16.3-40.9 inches. Approximately, 512 Flathead Catfish ≥16 inches (95% LCL=62; 95% UCL=962) were estimated to be in the reservoir by use of the Schnabel population estimator. The Flathead Catfish population appeared to have an ample number of large-sized individuals to support a quality fishery.

Largemouth Bass: The total catch rate of Largemouth Bass decreased from 25.0/h in 2014 to 18.0/h in 2017 (Figure 9). Catch rates for stock-size fish fluctuated from 22.0/h in 2014 to 5.0/h in 2016 to 17.0/h in 2017. Catch rates for legal-sized fish fluctuated from 21.0/h in 2014 to 1.0/h in 2016 and to 4.0/h in 2017. The target sample sizes for evaluating PSD and body conditions with the desired levels of precision were

not achieved during sampling. However, individuals that were sampled had adequate body conditions. Sizes of Largemouth Bass collected during 2017 ranged from 5-17 inches, which most individuals were 11 inches. The allele frequencies for Florida Largemouth Bass have varied from about 82% in 2005 to 62% in 2013 to 80% in 2016 (Table 8). In 2016, 20 pure Florida Largemouth Bass were present in the sample, suggesting good stocking success during that year. Three pure Northern Largemouth Bass were consistently found in samples collected from 2007, 2013, and 2016.

White Crappie: Since 2014, White Crappie catch rates substantially increased from 1.2/nn to 34.7/nn in 2017 (Figure 10). Increases in catch rates were observed for stock-sized and legal-sized fish during the monitoring period which suggest improved recruitment. Specifically, the catch rate of legal-sized White Crappie increased from 0.5/nn in 2015 to 4.7/nn in 2017. Sizes of White Crappie in the 2017 survey ranged from 4-13 inches, which most individuals were 5-6 inches. Proportional size distribution in 2017 was 34, increasing from 24 observed in 2015. The low PSDs in both 2015 and 2017 suggest that the population likely experienced optimal reproduction, which may be attributed in the increased availability of vegetation and structural habitat from an increase in water level from rainfall in 2015 and 2016. Mean relative weights ranged from fair to good and ranged from 86-114. In 2015, the 32 White Crappie that were used for age estimation ranged from 4-10 inches. All but two fish were determined to be age-0, and the remaining two fish were 9 and 10 inches and were determined to be age-1. The high number of age-0 fish in the sample suggests that a successful year class was produced in 2015.

Fisheries Management Plan for Kirby Reservoir

Prepared – July 2018

ISSUE 1: Catfishes are the most targeted species group by anglers at Kirby Reservoir (Homer and Amoroso 2014). In 2011, a regulation was enacted to protect quality-sized and larger fish and to increase take of smaller fish to improve growth rates. The regulation allows for no minimum size restrictions and increased daily bag limits for Blue Catfish and Channel Catfish ≤20 inches, and no more than 5 fish ≥20 inches. Evaluation of the effectiveness of the special regulation as well as the removal of the City of Abilene's ban on jug lines and trot lines are necessary to ensure proper management for the fishery.

MANAGEMENT STRATEGIES

1. Conduct a creel survey from 2019-2020 to determine directed angling effort, harvest, and expenditures for the fishery.
2. Obtain creel information from passive gear anglers to assess fishing effort, harvests, releases, and demographics.
3. Continue to monitor growth of Blue and Channel Catfish by using otoliths for age estimation.

ISSUE 2: Lack of access and diminished aesthetics from litter have been demonstrated to be constraints to angling participation (Hunt 2005), and such constraints may be preventing potential anglers from fishing at Kirby Reservoir. Lake Kirby Park is the primary access location for the reservoir. The park's roadways and shoreline could use improvements for reservoir access and aesthetics. Bank anglers make up most of the anglers, and litter surrounding the shoreline and roadways may impede access and deter anglers from fishing. Road conditions are poor and need resurfacing and leveling. Water level fluctuations also affect the usability of the fishing pier and boat dock.

MANAGEMENT STRATEGIES

1. Work with City of Abilene to develop a plan to implement potential strategies for improving angler access, aesthetics, and road conditions in the reservoir.
2. Collaborate with other stakeholders to develop and implement potential strategies to improve angler aesthetics and stewardship at the reservoir.

ISSUE 3: Kirby Reservoir is subject to extreme fluctuations in water level. As a result, important structural habitat and vegetation becomes inaccessible to sport fish such as Largemouth Bass and White Crappie as well as their prey which can result in increased rates of interspecific competition, increased predation rates on juveniles, and poor fishing quality. Habitat enhancement efforts may help mitigate some loss of important habitat for these species as well as may improve fishing quality for anglers who frequent the reservoir.

MANAGEMENT STRATEGY

1. Seek funding and in-kind collaborations for habitat enhancement projects to improve shoreline habitat conditions.

ISSUE 4: Many invasive species threaten aquatic habitats and organisms in Texas and can adversely affect the state ecologically, environmentally, and economically. For example, zebra mussels (*Dreissena polymorpha*) can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches, and plugging engine cooling systems. Giant salvinia (*Salvinia molesta*) and other invasive

vegetation species can form dense mats, interfering with recreational activities like fishing, boating, skiing, and swimming. The financial costs of controlling and/or eradicating these types of invasive species are significant. Additionally, the potential for invasive species to spread to other river drainages and reservoirs via watercraft and other means is a serious threat to all public waters of Texas.

MANAGEMENT STRATEGIES

1. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir.
2. Educate the public about invasive species with media and the internet.
3. Make a speaking point about invasive species when presenting to constituent and user groups.
4. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.

ISSUE 5: Golden alga (*Prymnesium parvum*) was discovered by TPWD during winter 2014. While the introduced species has not produced a toxic algal bloom, its presence in the reservoir is a threat to existing fisheries.

MANAGEMENT STRATEGY

1. Conduct routine monitoring during winter months (December-March) to collect water quality data and to determine golden alga cell densities and prymnesin toxicity.

ISSUE 6: Invasive salt cedar (*Tamarix* sp.) and giant reed (*Arundo donax*) are established at Kirby Reservoir.

MANAGEMENT STRATEGIES

1. Inform and educate City of Abilene as well as constituents regarding the impacts of salt cedar and Giant reed.
2. Work with City of Abilene to develop strategies for potential control of these invasive species.

Objective-Based Sampling Plan and Schedule (2018–2022)

Sport fish, forage fish, and other important fishes: Species that have comprised the sport fish community include Blue Catfish, Channel Catfish, Flathead Catfish, Largemouth Bass, Saugeye, and White Crappie. The prey fish community includes Gizzard Shad, Bluegill, Green Sunfish, Longear Sunfish, Orangespotted Sunfish, sunfish hybrids, Inland Silversides, Common Carp and Logperch. The proposed sampling schedule is in Table 9.

Low-density fisheries: Saugeye are present in Kirby Reservoir, but they have not been stocked since 2011. Previous sampling surveys (gill netting and electrofishing) indicate a declining trend in relative abundance since the termination of the Saugeye stocking program. During electrofishing surveys from 2009-2016, the CPUE of Saugeye has declined from 51.0/h to 1.0/h in 2013, and no individuals were caught in the 2016 or 2017 survey. Similar trends were apparent in spring gill netting surveys in Kirby Reservoir. In 2010 CPUE of Saugeye was 13.0/nn and was 0.6/nn in 2014. During the past creel survey (September 2013-May 2014), anglers did not report any directed effort towards Saugeye, and no individuals were caught (Homer and Amoroso 2014).

Survey objectives, fisheries metrics, and sampling objectives:

Prey Species: Gizzard Shad, sunfishes (e.g., Bluegill, Green Sunfish, and Longear Sunfish), and small Common Carp (≤6 inches) have been the predominant prey species in the reservoir. Traditional monitoring of prey species has been conducted by evening electrofishing for 1.0 hour at 12, 5-minute randomly selected stations. Sampling for one hour has afforded desirable precision of RSE≤25 particularly for Gizzard Shad and Bluegill. Electrofishing will be conducted during fall 2021 to monitor prey species' relative abundance (i.e., CPUE-Total) and size structures. To obtain a current estimate for Index of Vulnerability for Gizzard Shad, ≥50 fish will be collected. To evaluate the size structure for Bluegill as Proportional Size Distribution (PSD), 50≤ stock-sized fish will be attempted to be collected. Common Carp <6 inches provide an important prey source for catfishes in the reservoir and will be sampled with no target levels of precision for relative abundance. If desired precision for Bluegill and Gizzard Shad relative abundance estimates and/or sample sizes are not achieved, no additional sampling will be conducted.

Catfishes: Catfishes (i.e., Blue Catfish, Channel Catfish, and Flathead Catfish) are the most targeted sport fish group by anglers at Kirby Reservoir. Anglers directed more angling effort towards catfishes than any other species group during September 2010 – May 2011 (56% of overall effort) and September 2013 – May 2014 (80% overall effort) creel survey periods (Homer and Amoroso 2014). Prior to 2011, Neely and Dumont (unpublished data) conducted a mark-recapture and exploitation study for Blue Catfish, which exploitation was estimated to be 5-15%. During fall 2011, a new harvest regulation was developed to improve growth of Blue and Channel catfishes by reducing intra-and interspecific competition by allowing increased harvest of smaller fish of both species, while restricting harvest on quality-size and larger individuals. Specifically, the enacted regulation increased the daily limit for Blue and Channel catfishes from 25 to 50 fish/day (in combination) with no more than five ≥20 inches in total length. Exploitation of catfishes has not been reevaluated since the new regulation has been in effect. Furthermore, in fall 2016 the City of Abilene removed an ordinance that restricted fishing to two poles as well as banned the use of trot lines and jug lines at the reservoir. Sampling objectives for monitoring catfishes are described by species below.

Blue Catfish: Of all catfishes found in Kirby Reservoir, Blue Catfish are most targeted by anglers and are abundant in the reservoir (Homer and Amoroso 2014). A mark-recapture study conducted from November 2010- April 2011 by Neely and Dumont (unpublished data) indicated high abundance (N=4,517; 95% CI =

±2,944) of Blue Catfish and an exploitation rate of 5-15%. Another mark-recapture study has not been conducted since. Monitoring data have been collected by biennial gill netting and low-frequency electrofishing surveys to monitor relative abundance. Greater total catch of Blue Catfish has been achieved with late spring or early summer low-frequency electrofishing surveys. Specifically, catches in low-frequency electrofishing surveys have fluctuated from 176.0/h in 2010, to 275.0/h in 2011, and to 67.0/h in 2012. Gill netting catch rates were similar in 2010 (10.4/nn) and 2014 (22.4/nn). Further, size structures found in samples in both gill netting and low-frequency electrofishing surveys have been variable. Historical gill netting surveys have yielded poor representation of larger-sized (>20 inches) fish. Bodine et al. (2013) noted that low frequency electrofishing is the most efficient gear type for sampling Blue Catfish. Daytime low-frequency electrofishing will be used to monitor Blue Catfish in the reservoir. Historical low-frequency electrofishing surveys have been 1-hour in total duration (20, 3-minute stations) and have achieved relative standard errors (RSE) ranging from 23-31%. During late spring or early summer 2019 and 2021, 10, 3-minute random stations will be sampled at a time to prevent overlap of stations during sampling, and CPUE-Total, Stock CPUE will be determined with a target precision of RSE≤25 with 85% confidence. Historical low-frequency electrofishing has yielded imprecise estimates (RSE≥25) of relative abundance of fish >20 inches; therefore, target precision for CPUE-20 will be RSE≤30. Fifty Blue Catfish ≥stock-size will be sampled to evaluate size structure (i.e., PSD), and ≥five fish per represented inch group will be needed to assess body condition (i.e., relative weight). Up to two hours of electrofishing will be conducted to achieve objectives. Age and growth will only be evaluated once during the monitoring period by collecting a Category II age sample at both stock-size (11.0-12.9 inches) and quality-size (19.0-20.9 inches). Jug lining will only be conducted to monitor larger Blue Catfish if RSE≥30 for CPUE-20, 50 fish ≥20 inches, or if the age sample for quality-size fish are not achieved during low-frequency electrofishing. If jug lining is conducted, jug lines baited with cut Common Carp on either two 5/0 or 7/0 circle hooks will be set in pairs at 50 random stations overnight for 18-24 hours and retrieved. Relative abundance (CPUE-Total and CPUE-20 as fish/jug pair) will be calculated for Blue Catfish caught; no target level of precision will be attempted. A target sample of five fish per represented inch group will be attempted to evaluate relative weight.

Channel Catfish: Channel Catfish are relatively abundant in Kirby Reservoir, and they support the popular catfish fishery at the reservoir. The gill net catch rates have been variable for Channel Catfish. In 2014 catch rate was 20.8/nn, which was an increase from the rates 7.0/nn in 2012 and 4.8/nn in 2010. Tandem hoop netting surveys have consisted of deploying 3-9 tandem series over two nights, and surveys have yielded greater sample sizes but variable catches (37.7-101.3/tandem series) and levels of precision (RSE=10-53%). Despite the variable catch rates and levels of precision for relative abundance estimates, tandem hoop net sampling has been effective in providing adequate samples to evaluate size structure and relative weights. Tandem hoop net surveys in Kirby Reservoir have often caught more Channel Catfish than gill nets and have had similar representations of size structures. Bodine et al. (2013) suggested that tandem hoop nets are more efficient at sampling Channel Catfish than any other gear. Increased sampling effort with tandem hoop nets may yield improved precision of relative abundance estimates. Tandem hoop netting was conducted in summer 2017 to monitor relative abundance and size structure of Channel Catfish in the reservoir. Baseline trend data was collected by use of tandem hoop nets baited with soap bait because prior sampling was conducted with cheese logs as bait. Future sampling will be conducted with tandem hoop nets baited with soap. In summer 2019 and 2021, five tandem series baited with soap will be set to achieve an RSE≤25 with 85% confidence for CPUE-Total. Sampling efforts will be an attempt to collect a minimum of 50 fish ≥stock-length to evaluate size structure as PSD, and five fish from each represented inch group ≥stock size will be collected to evaluate body condition (i.e., mean relative weights). If additional sampling is warranted to achieve the previously

mentioned objectives, up to four additional tandem series may be set. Monitoring of Channel Catfish will not be conducted by use of gill nets unless gill netting is attempted to monitor other species in the reservoir.

Flathead Catfish: Flathead Catfish are managed with the statewide 18-inch MLL and five-fish daily bag limit. Previous creel surveys have suggested that anglers seldom target Flathead Catfish. However, because many anglers at Kirby Reservoir target catfishes (56-80%), Flathead Catfish likely provide an excellent fishing resource for anglers to catch quality- to trophy-sized catfish from the reservoir. A mark-recapture study was conducted from fall 2014-spring 2015. Flathead Catfish were sampled by daytime low-frequency electrofishing at 50 random stations over two separate events (25 stations per sampling event). After poor sampling returns by random stations, non-random sampling was conducted to sample individuals. Sampling was conducted over one initial marking event for individuals captured, three marking and recapture events with replacement, and one final recapture event with replacement. All captured fish were marked by clipping their adipose fins and left pectoral spines. During the study, 96 fish were marked, and six individuals were recaptured. The population was estimated to have 512 individuals (95% CI= ±450) ≥20 inches by using the Schnabel population estimator. Future monitoring for Flathead Catfish will be conducted by non-random sampling for 1 hour at, 20, 3-minute stations during late spring-early summer 2020. A target precision of RSE≤30 will be attempted for CPUE-Total, and a sample size of at least 50 stock-sized individuals will be collected to assess PSD. If objectives are not achieved, up to one hour of additional sampling may be conducted.

Largemouth Bass: Largemouth Bass support a small fishery at the reservoir. Anglers reported allocating 2.1% of the overall directed fishing effort in the 2010-2011 creel survey and 2.5% in the 2013-2014 creel survey. Largemouth Bass support the second-most popular fishery for boat anglers, which 17.0% of the directed fishing effort was used targeting bass. While the directed fishing effort is low for Largemouth Bass, 12% of anglers surveyed in the 2013-2014 creel survey reported fishing for “anything”. Largemouth Bass likely provide fishing opportunities for these “anything” anglers, especially since a large majority of anglers are bank anglers. Electrofishing CPUE-Total fluctuated from 94.0/h 2009 to 286.0/h in 2011 to 35.0/h in 2013. Florida Largemouth Bass (FLMB) fingerlings were stocked in spring 2014 and spring 2016. Electrofishing catch rates after the 2014 stocking were low and the size structure of the sample was dominated by larger fish (CPUE-Total= 25.0/h; PSD=100), which suggested that the stocking success was poor. Electrofishing from fall 2016 yielded a similarly low catch rate, but the size structure was comprised of mostly smaller fish (CPUE-Total=26.0/h; PSD=12). Genetic analysis from fin clip samples taken during 2016 had 66.7% prevalence of FLMB alleles. Both the increased catch rate of smaller fish and higher prevalence of FLMB alleles suggested improved recruitment and stocking success. Monitoring relative abundance is necessary for maintaining trend information for this population as well as to inform anglers on the status of the fishery. During fall 2021, sampling will be conducted at 12, 5-minute randomly selected stations for a total of one hour of sampling effort. Relative abundance (CPUE-Total, Stock CPUE, and CPUE-14) will be calculated, but no target levels of precision will be attempted. Body condition (i.e., relative weight) will be evaluated if a sample of ≥five fish per inch group ≥stock-size is obtained. Evaluation of size structure by determining PSD will be attempted if sample size of ≥50 stock-sized fish is achieved. Given that this is a lower priority fishery for this reservoir, additional sampling will not be conducted if sample sizes for evaluating size structure and body condition are not achieved.

White Crappie: Prior to Kirby Reservoir going completely dry in 2000, the reservoir supported a productive White Crappie fishery. However, after the reservoir refilled, White Crappie production has been low, and catch rates in trap net surveys have also been poor. From 2009-2013, CPUE-Total declined from 4.1/nn to 1.1/nn; a similar decline was observed for stock-sized fish. However, catch rate improved in 2017.

Abundance of White Crappie seems related to water level and habitat availability. In most recent creel survey, anglers have indicated that they allocated meager effort to target them. In the 2013-2014 creel survey, anglers reported directing only 2.4% of the overall fishing effort to target White Crappie. Despite the low directed effort and poor catch rates, periodically monitoring the trends of relative abundance will allow for TPWD fish biologists to better inform constituents on the status of the fishery. To monitor White Crappie, a trap netting survey will be conducted during fall 2021 by deploying single-cod trap nets among 10 randomly selected stations for one night and retrieved the following day. Relative abundance (CPUE-Total, Stock CPUE, and CPUE-10) will be calculated without a target for precision. A sample of 50 ≥stock size will be collected to evaluate size structure (i.e. PSD). At least five fish per inch group ≥stock size will be weighed to evaluate body condition as relative weight. Additional sampling will not be conducted if objectives are not met.

Creel: A roving creel survey was last conducted from June 2013-May 2014. Now that the ordinance has been lifted to allow the statewide regulations to be recognized fully by constituents, there are some concerns regarding the passive gear pressure that may be occurring at the reservoir. A creel survey is necessary to understand how the constituents are utilizing the fisheries resources at Kirby Reservoir. Therefore, a roving creel survey will be conducted from December 1, 2018, November 30, 2019. During the surveys, data for passive gear effort by anglers will be attempted to be collected.

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Tables and Figures

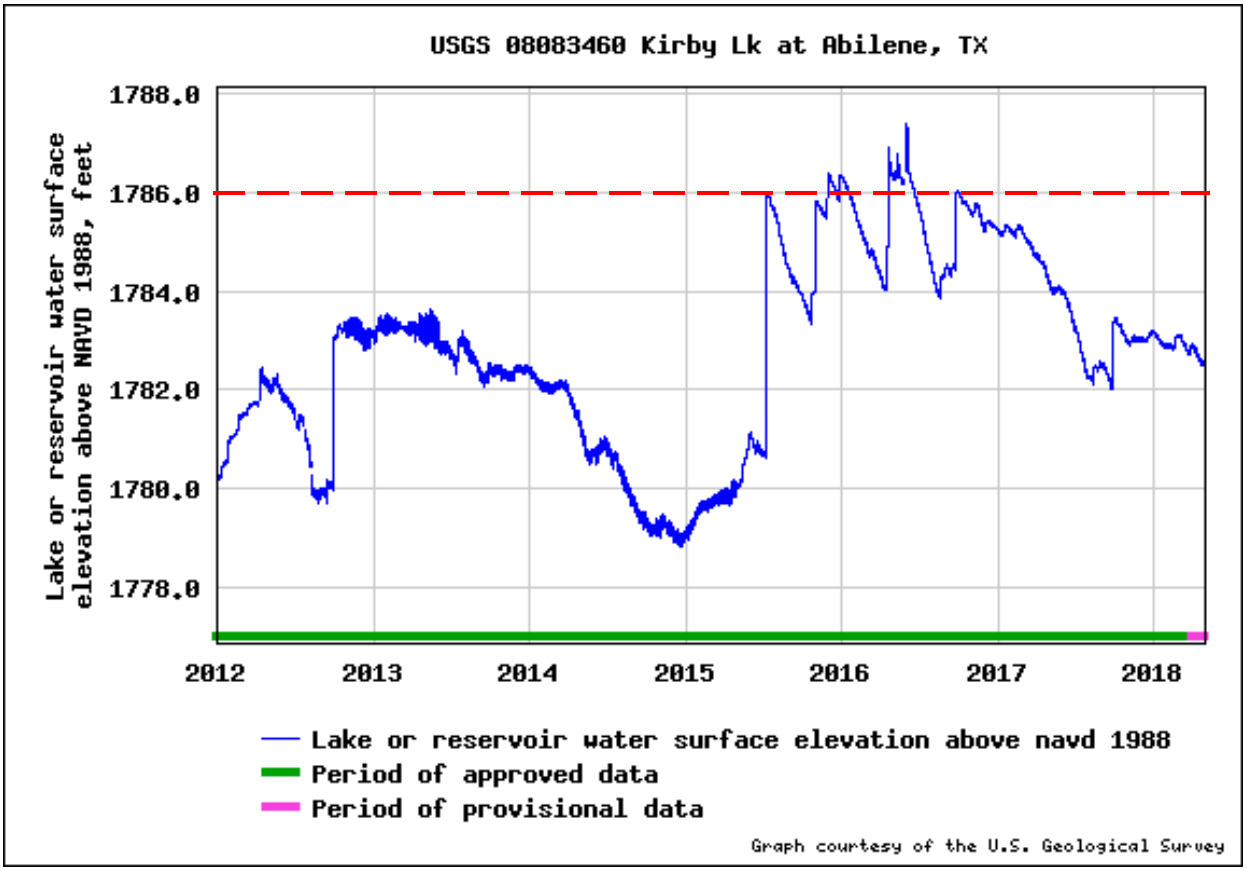


Figure 1. Daily water level elevations in feet above mean sea level (MSL) recorded for Kirby Reservoir, Texas, January 1, 2012- May 1, 2018 (USGS 2018). Dashed line represents conservation pool elevation.

Table 1. Characteristics of Kirby Reservoir, Texas.

Characteristic	Description
Year Constructed	1928
Controlling Authority	City of Abilene
County	Taylor
Reservoir Type	Tributary
HUC River Basin[1]	Brazos (120601)
HUC Sub-basin[1]	Upper Clear Fork Brazos (12060102)
Watershed[1]	Elm Creek (1206010207)
Sub-watershed[1]	Upper Cedar Creek (120601020708)
Conservation Pool Elevation	1,786 ft above mean sea level
Maximum Depth	18.0 ft
Average Depth	6.5 ft
Conductivity Range[2]	902 – 3,123 µS/cm
Secchi Disc Range	0.6-1.7 ft

[1]UGSG Hydrologic Unit Code (HUC)
[2]Conductivity was inversely related to water level.

Table 2. Boat ramp characteristics for Kirby Reservoir, Texas, April, 2018. Reservoir elevation at time of survey was three feet below conservation pool elevation.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	End of Ramp Elevation (ft. above MSL)	Condition
Kirby Park Ramp #1	32.38335º -99.72982º	Y	10	1,775	Accessible; good condition
Kirby Park Ramp #2	32.38018º -99.72960º	Y	5	1,779	Inaccessible; repair needed

Table 3. Harvest regulations for Kirby Reservoir, Texas.

Species	Bag limit	Length limit
Catfish: Channel and Blue, their hybrids and subspecies	50; no more than 5 ≥ 20-inches (in any combination)	None
Catfish, Flathead	5	18-inch minimum
Bass, Largemouth	5	14-inch minimum
Crappie: White and Black, their hybrids and subspecies	25 (in any combination)	10-inch minimum
Saugeye	3	18-inch minimum

Table 4. Stocking history of Kirby Reservoir, Texas, 2000-2018. FRY = fry; FGL = fingerling; AFGL = advanced fingerling; ADL = adults.

Species	Year	Number	Size
Threadfin Shad	2002	300	ADL
Golden Shiner	2000	100	ADL
Bluegill	2001	475	ADL
	2001	370,196	FGL
	Total	370,671	
Fathead Minnow	2000	500	ADL
Inland Silverside	2001	200	ADL
Blue Catfish	2001	74,000	FGL
Channel Catfish	2001	73,794	FGL
	2004	1,621	AFGL
	Total	75,415	
Flathead Catfish	2003	44	ADL
Saugeye	2001	704,701	FRY
	2002	143,101	FRY
	2002	8,410	FGL
	2004	37,425	FGL
	2005	15,806	FGL
	2006	12,134	FGL
	2008	58,500	FGL
	2009	108,815	FGL
	2011	23,919	FGL
	Total	1,112,811	
Florida Largemouth Bass	2002	51,315	FGL
	2014	75,451	FGL
	2016	40,000	FGL
	Total	166,766	
Largemouth Bass	2003	8,775	FGL
	2004	76,290	FGL
	Total	85,065	

Table 5. Objective-based sampling plan components for Kirby Reservoir, Texas 2017–2018.

Gear/Target Species	Survey Objective	Metrics	Sampling Objective
Electrofishing			
Gizzard Shad [a]	Relative Abundance	CPUE-Total	Practical effort
	Size Structure	Length frequency	Practical Effort
	Prey Availability	IOV	N ≥ 50
Bluegill [a]	Determine Trends in Relative Abundance	CPUE-Total	Practical effort
	Size Structure	PSD, Length frequency	N ≥ 50 stock
Largemouth Bass	Determine Trends in Relative Abundance	CPUE-Total and Stock-CPUE	Practical effort
	Size Structure	PSD, Length frequency	N ≥ 50 stock
	Body Condition	W_r	5 fish/inch group
Low-frequency electrofishing			
Blue Catfish	Determine Trends in Relative Abundance	CPUE-Total; CPUE-12; and CPUE-20	RSE≤25
	Size Structure	PSD, Length frequency	N ≥ 50 stock
	Body Condition	W_r	5 fish/inch group
	Age and growth	Age at length	5 fish per inch group, 12-20 inches
Jug lining			
Blue Catfish	Determine Trends in Relative Abundance	CPUE-Total; Stock CPUE; CPUE-20	Practical effort
	Size Structure	PSD, Length frequency	N ≥ 50 stock
	Age and Growth	Growth to Stock to Quality length (12-20 inches)	5 fish per inch group, 12.0-20.9 inches
Trap netting			
White Crappie	Determine Trends in Relative Abundance	CPUE-Total; Stock-CPUE; CPUE-10	Practical effort
	Size Structure	PSD, Length frequency	N ≥ 50 stock
	Body Condition	W_r	5 fish/inch group

[a] No additional effort was expended to achieve an RSE ≤ 25 for CPUE of Bluegill and Gizzard Shad if not reached from designated Largemouth Bass sampling effort. Instead, Largemouth Bass body condition can provide information on forage abundance, vulnerability, or both relative to predator density.

Table 6. Survey of structural habitat types, Kirby Reservoir, Texas, 2017. Shoreline habitat type units are in miles. Water level at the time of the survey was approximately 3 feet below conservation pool elevation.

Habitat type	Estimate	% of total
Natural Shoreline	4.8 miles	36.2
Boat Docks/Ramps	<0.1 miles	0.3
Rocky and Gravel	8.4 miles	63.5

Table 7. Percent occurrence with lower and upper 95% confidence limits (CL) of shoreline structural habitat at 182 random sites in Kirby Reservoir, Texas, 2017. Water level at time of survey was about 3 feet below conservation pool elevation.

Habitat Type	Percent Occurrence (%)	Lower 95% CL (%)	Upper 95% CL (%)
Vegetation			
Flooded Terrestrial Vegetation	10.4	6.8	15.7
Salt Cedar	4.4	2.2	8.4
Giant Bulrush	3.8	1.9	7.7
Black Willow	1.1	<0.1	3.9
Structural Habitat			
Featureless	77.5	71.0	83.0
Pebbles (0.1-2.5 in.)	8.2	5.1	13.2
Cobble (2.5-10.0 in.)	6.0	3.4	10.5
Small Boulders (10.0-24.0 in.)	1.6	<0.1	4.7
Standing Timber	1.1	<0.1	3.9
Woody Debris/Logs	0.5	<0.1	3.0
Large Boulders (24.0+ in.)	0.5	<0.1	3.0
Rip-rap	0.5	<0.1	3.0

Gizzard Shad

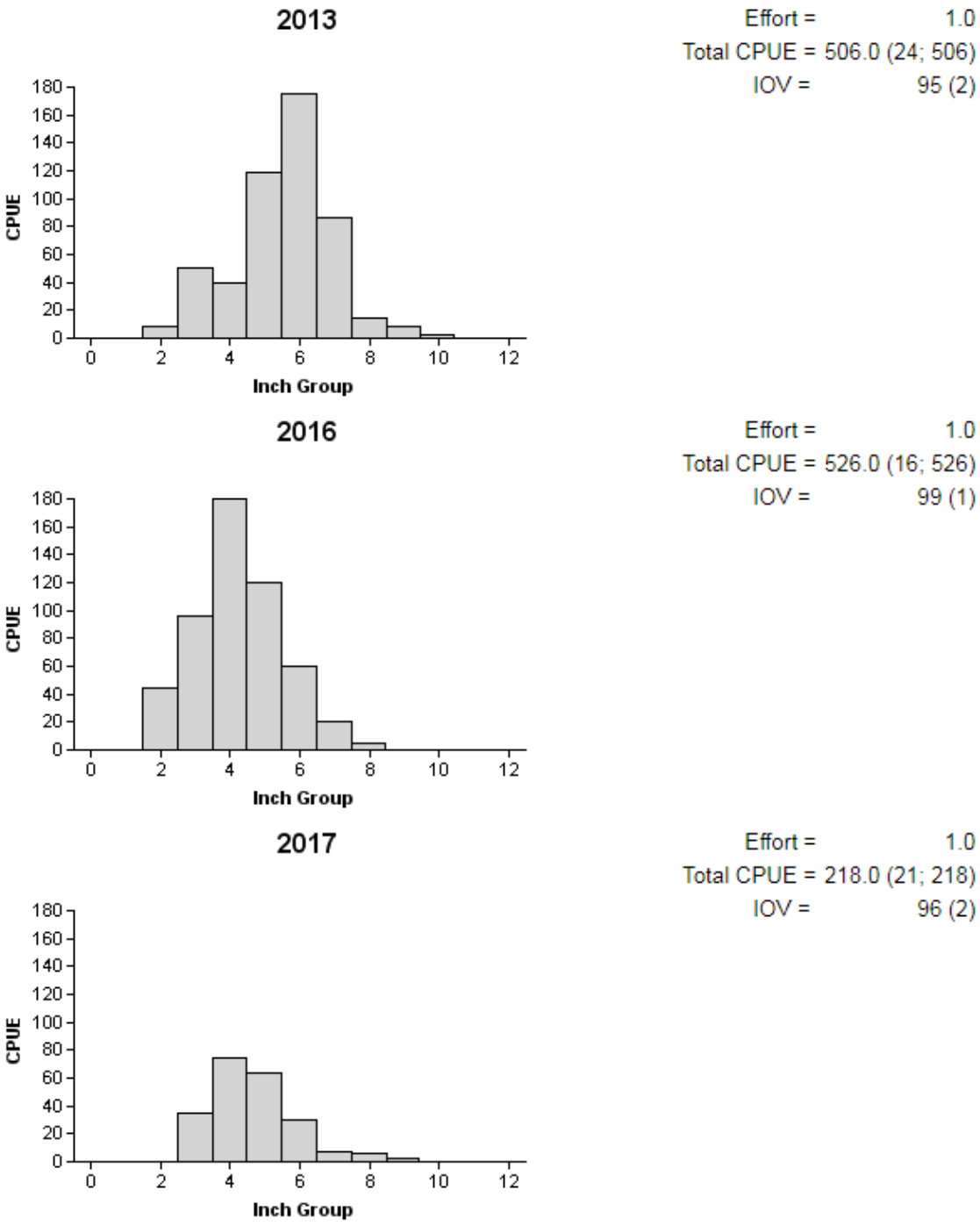


Figure 2. Number of Gizzard Shad caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Kirby Reservoir, Texas, 2013, 2016, and 2017.

Bluegill

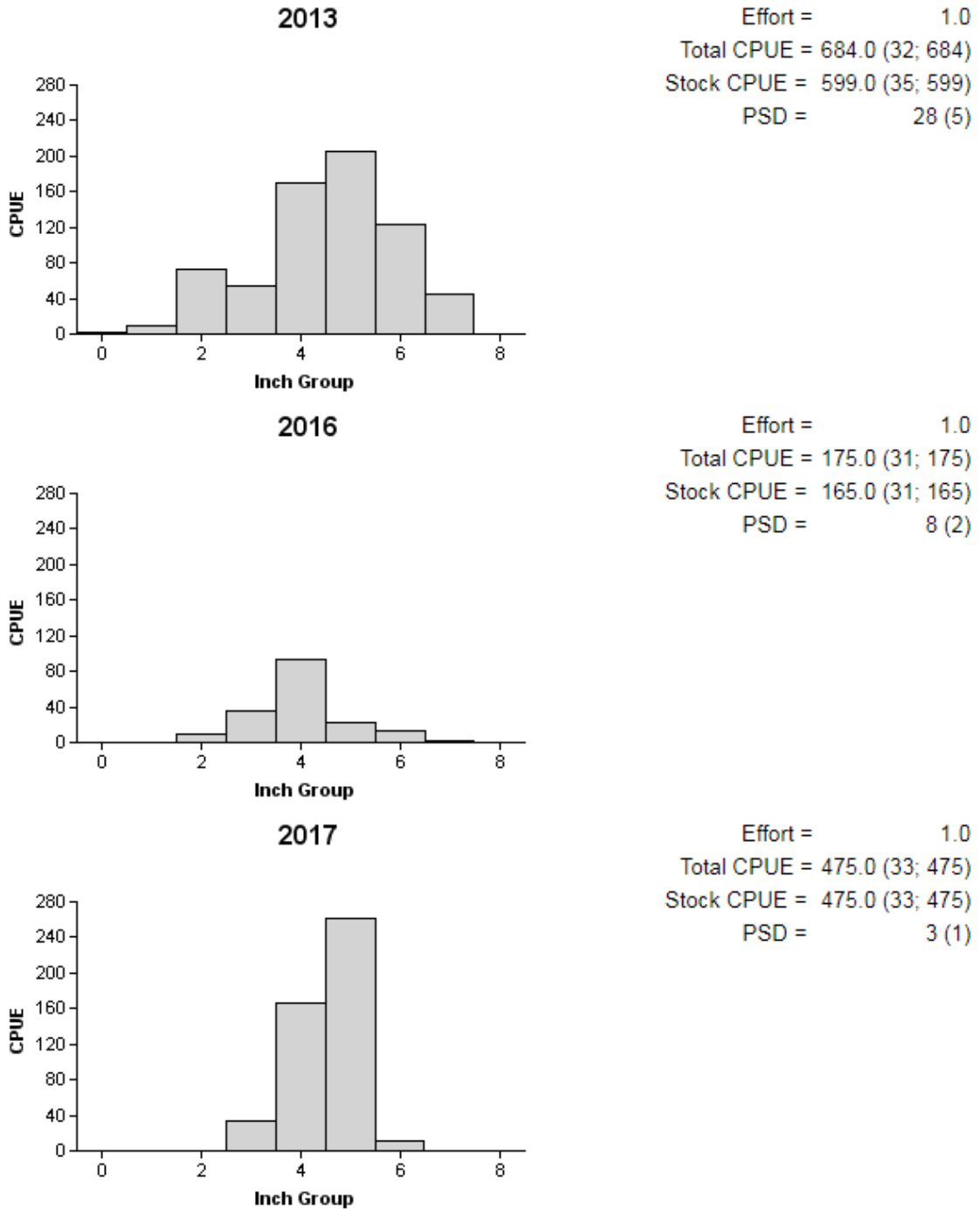


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Kirby Reservoir, Texas, 2013, 2016, and 2017.

Green Sunfish

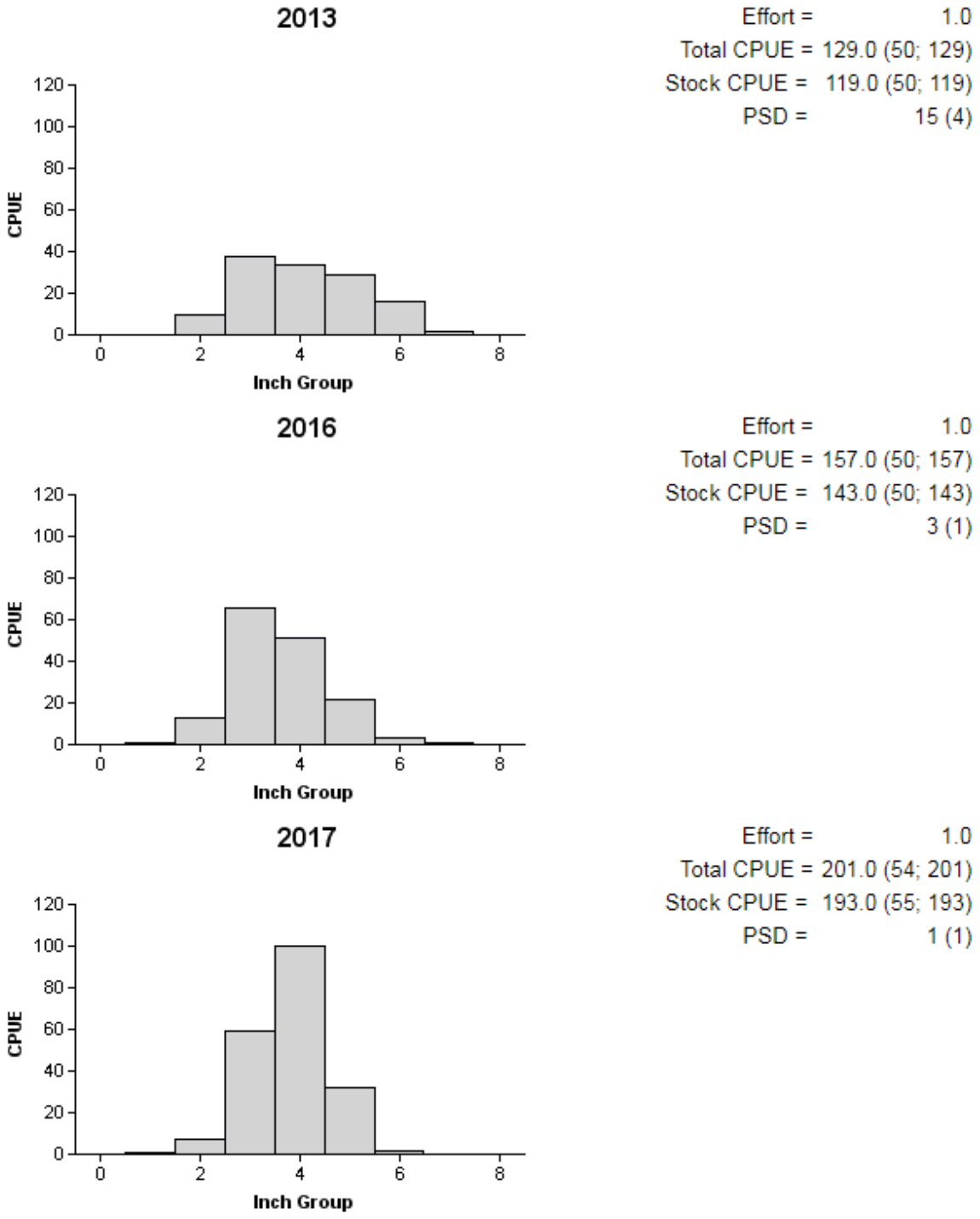


Figure 4. Number of Green Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Kirby Reservoir, Texas, 2013, 2016, and 2017.

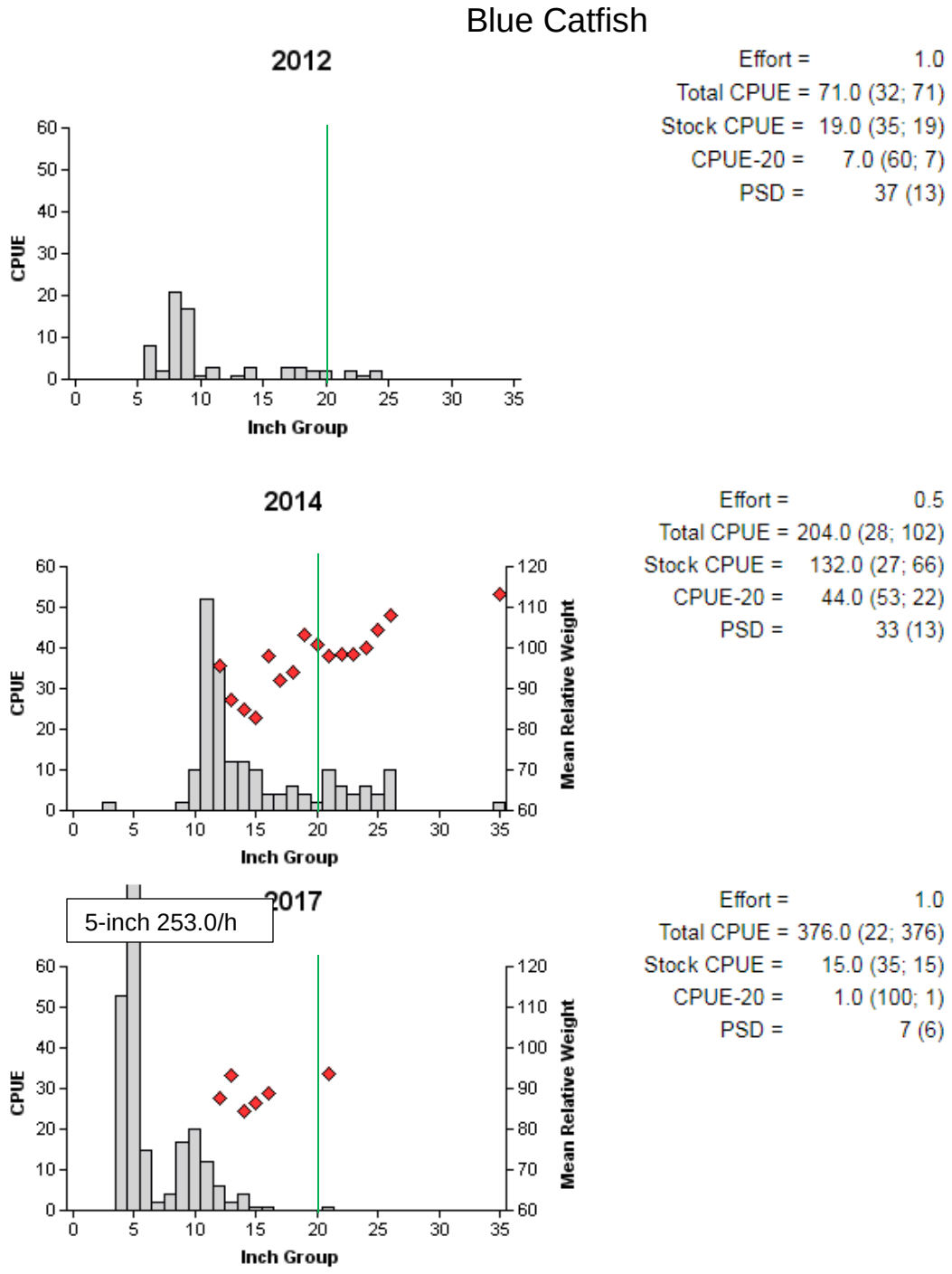


Figure 5. Number of Blue Catfish caught per hour (CPUE, bars), population indices (RSE and N for CPUE and SE for size structure are in parentheses) and mean relative weight (diamonds) for low-frequency electrofishing surveys, Kirby Reservoir, Texas, 2012, 2014, and 2017. Vertical line represents the length limit demarcation.

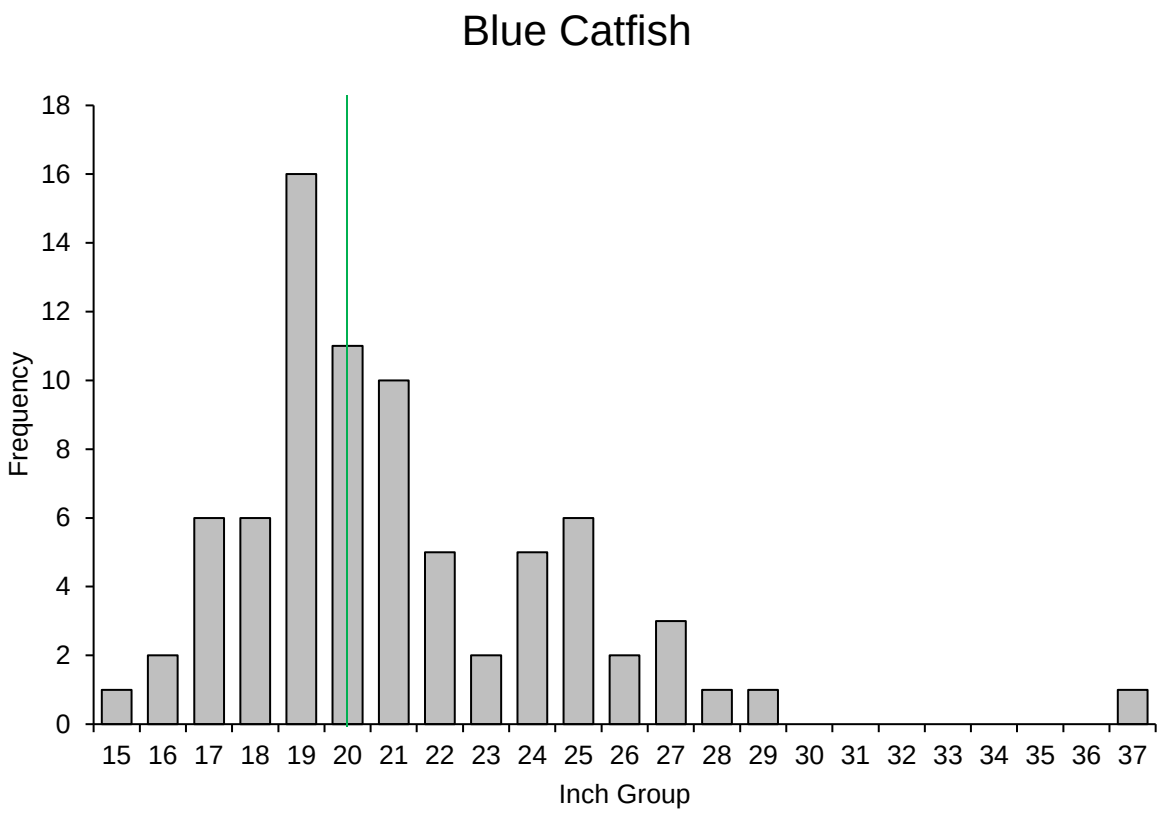


Figure 6. Length frequency distribution for Blue Catfish sampled by jugline pairs during winter 2018, Kirby Reservoir, Texas. Vertical line denotes the length limit demarcation.

Channel Catfish

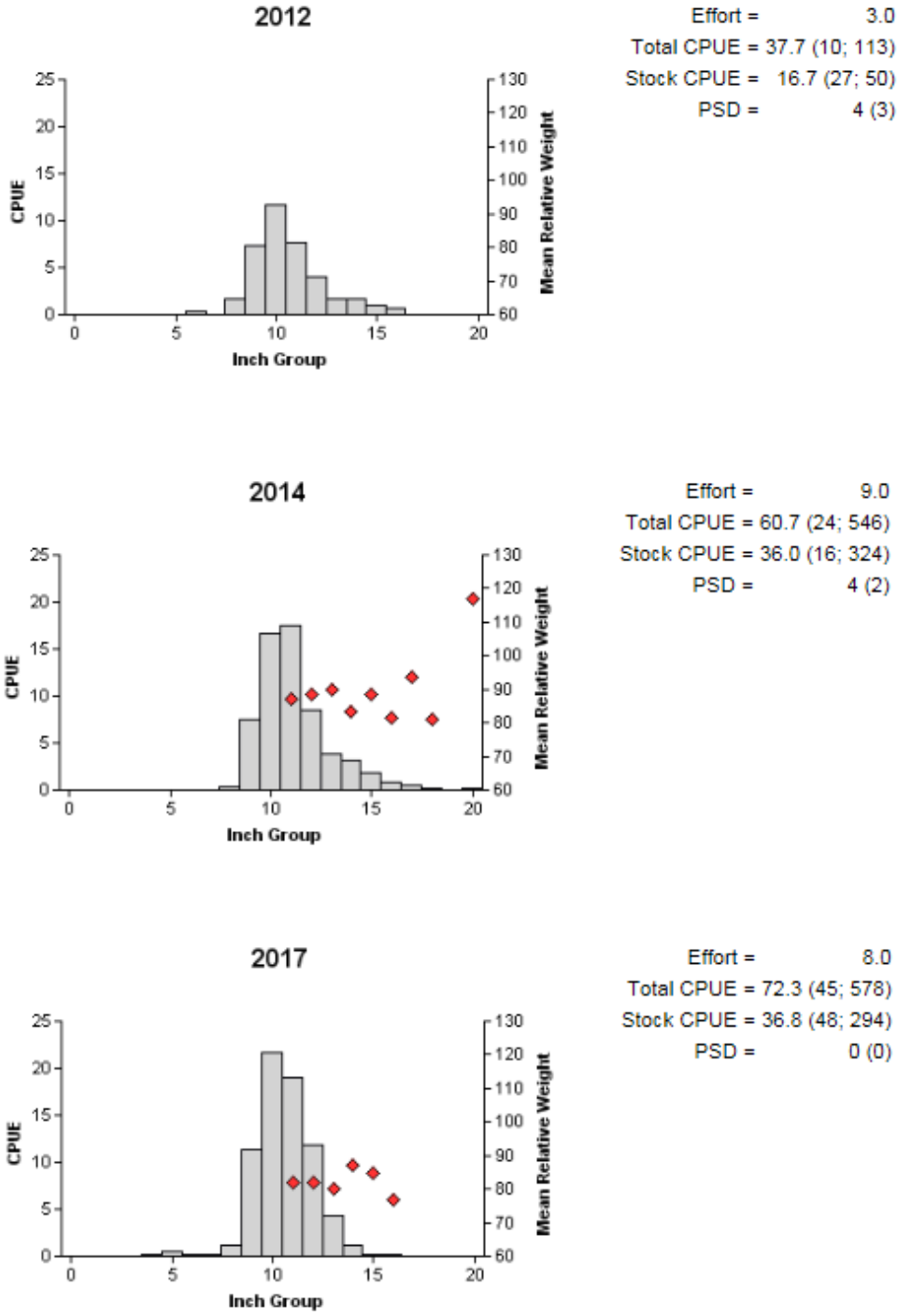


Figure 7. Number of Channel Catfish caught per tandem series (CPUE, bars), population indices (RSE and N for CPUE and SE for size structure are in parentheses) and mean relative weight (diamonds) for tandem hoop netting surveys, Kirby Reservoir, Texas, 2012, 2014, and 2017. During 2012 and 2014, nets were set with cheese log bait, whereas nets set in 2017 were baited with soap.

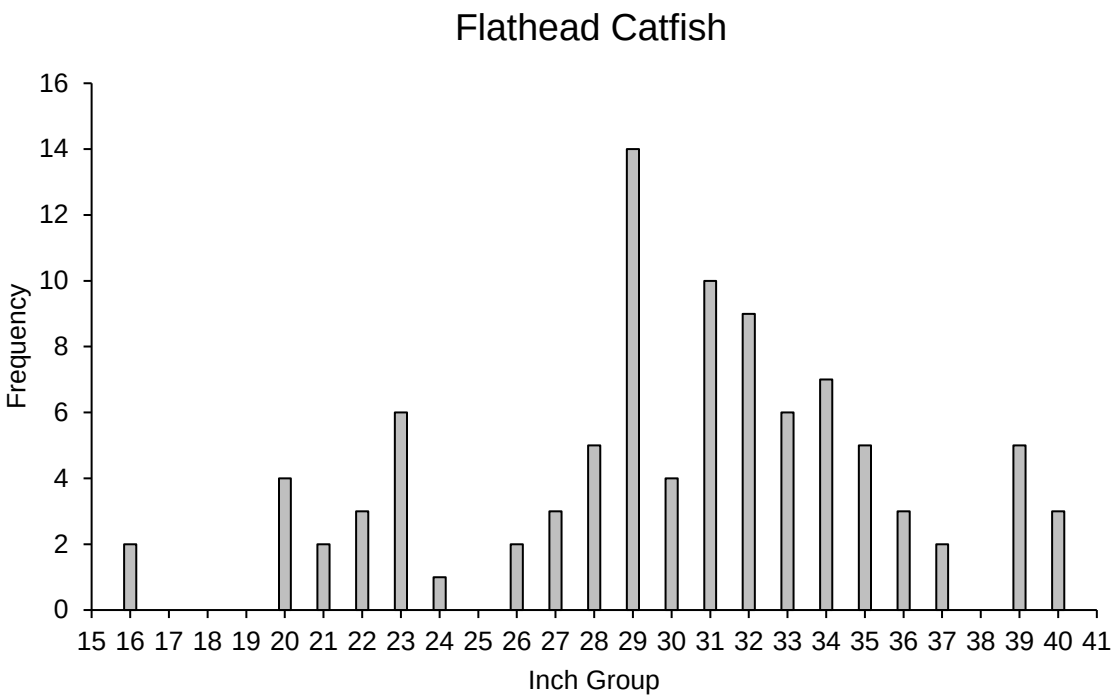


Figure 8. Length frequency distribution of Flathead Catfish sampled during the fall 2014- spring 2015 mark-recapture study at Kirby Reservoir, Texas. The six recaptured fish were omitted from this distribution.

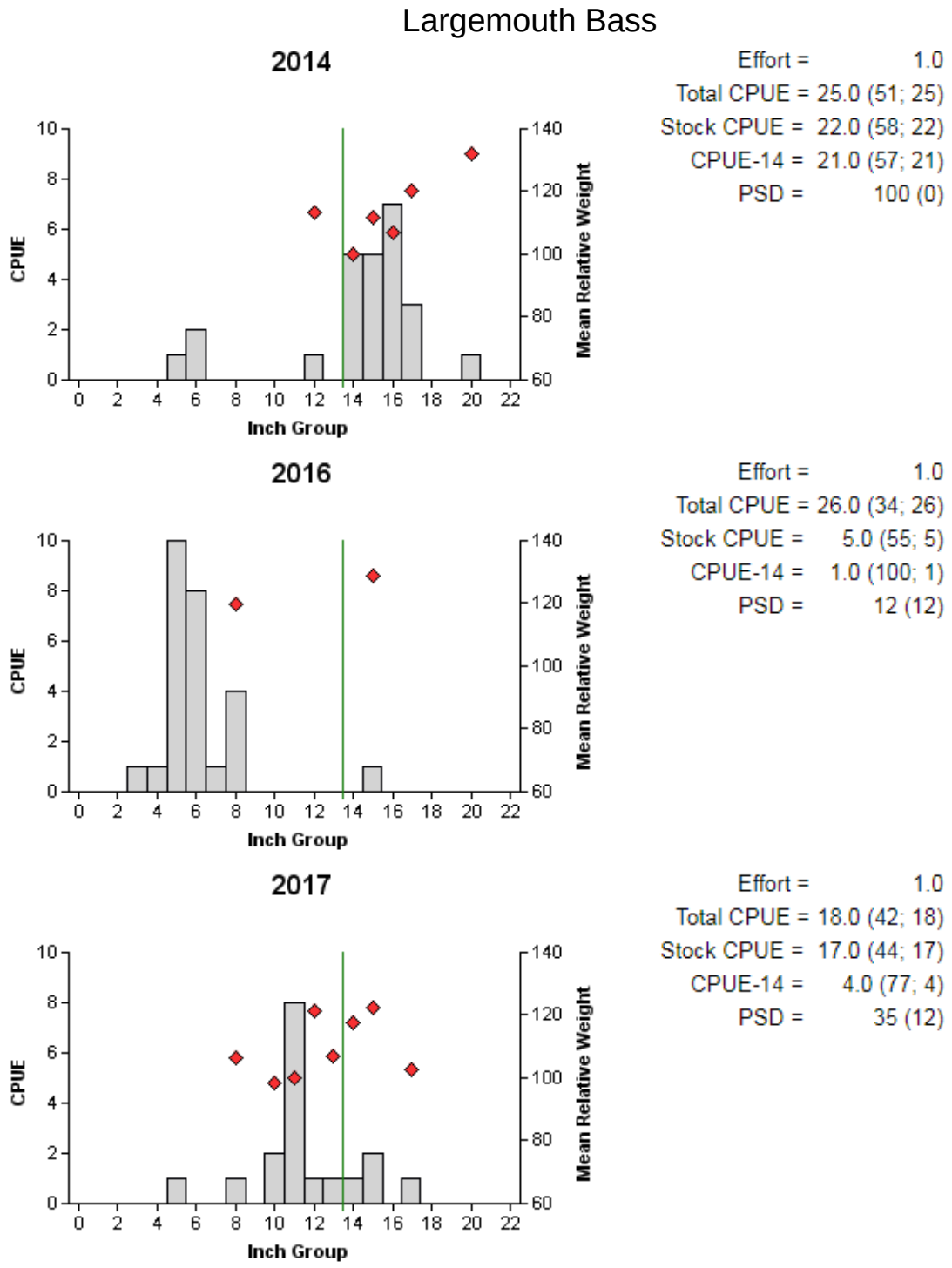


Figure 9. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Kirby Reservoir, Texas, 2014, 2016, and 2017. The vertical line indicates the minimum length limit.

Table 8. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Kirby Reservoir, Texas, 2005, 2007, 2013 and 2016. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB. Genetic composition was determined by micro-satellite DNA analysis.

		Number of fish				
Year	Sample size	FLMB	Intergrade	NLMB	% FLMB alleles	% FLMB
2005	31	16	15	0	81.6	51.6
2007	30	12	15	3	70.1	40.0
2013	30	2	25	3	61.9	6.7
2016	30	20	7	3	79.7	66.7

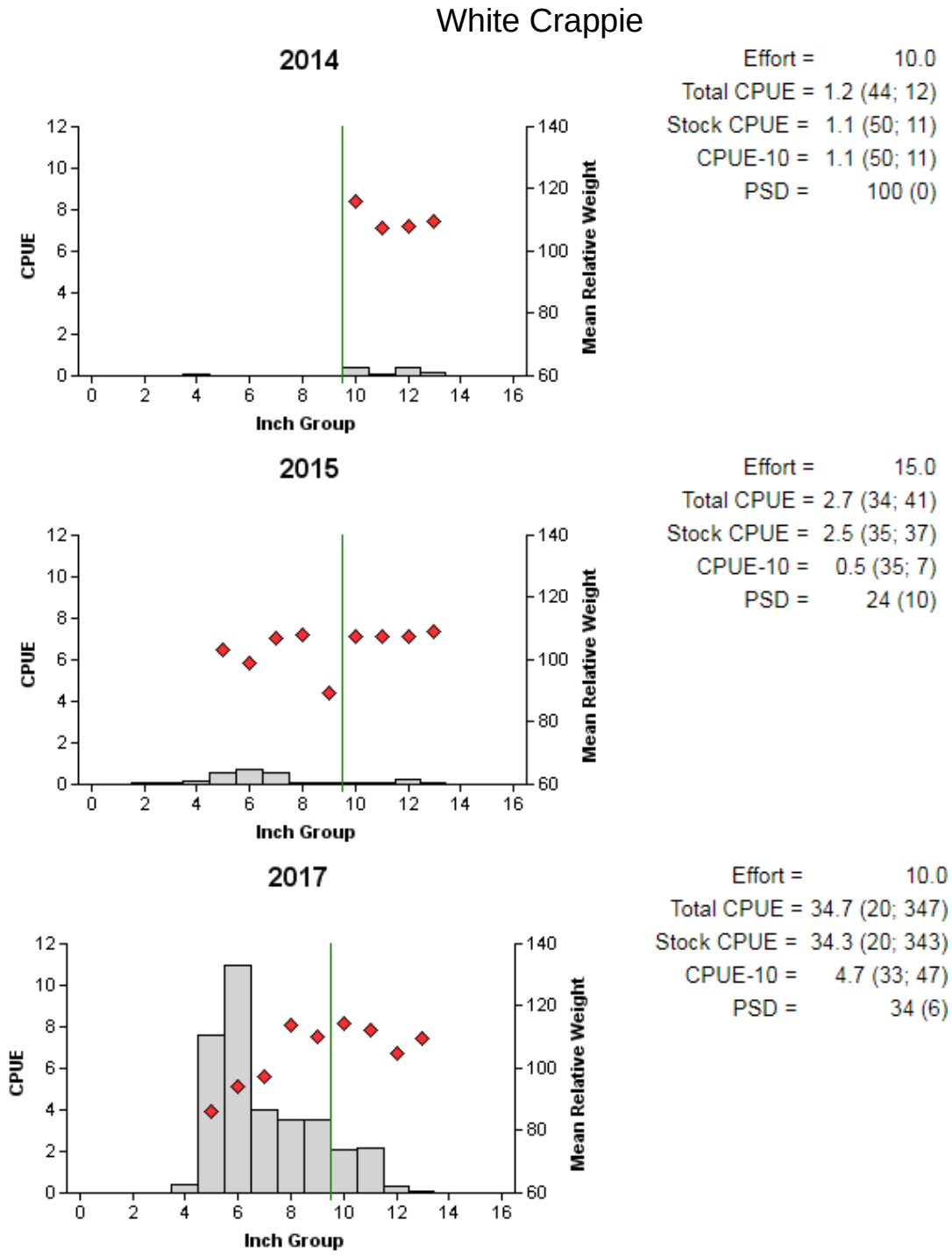


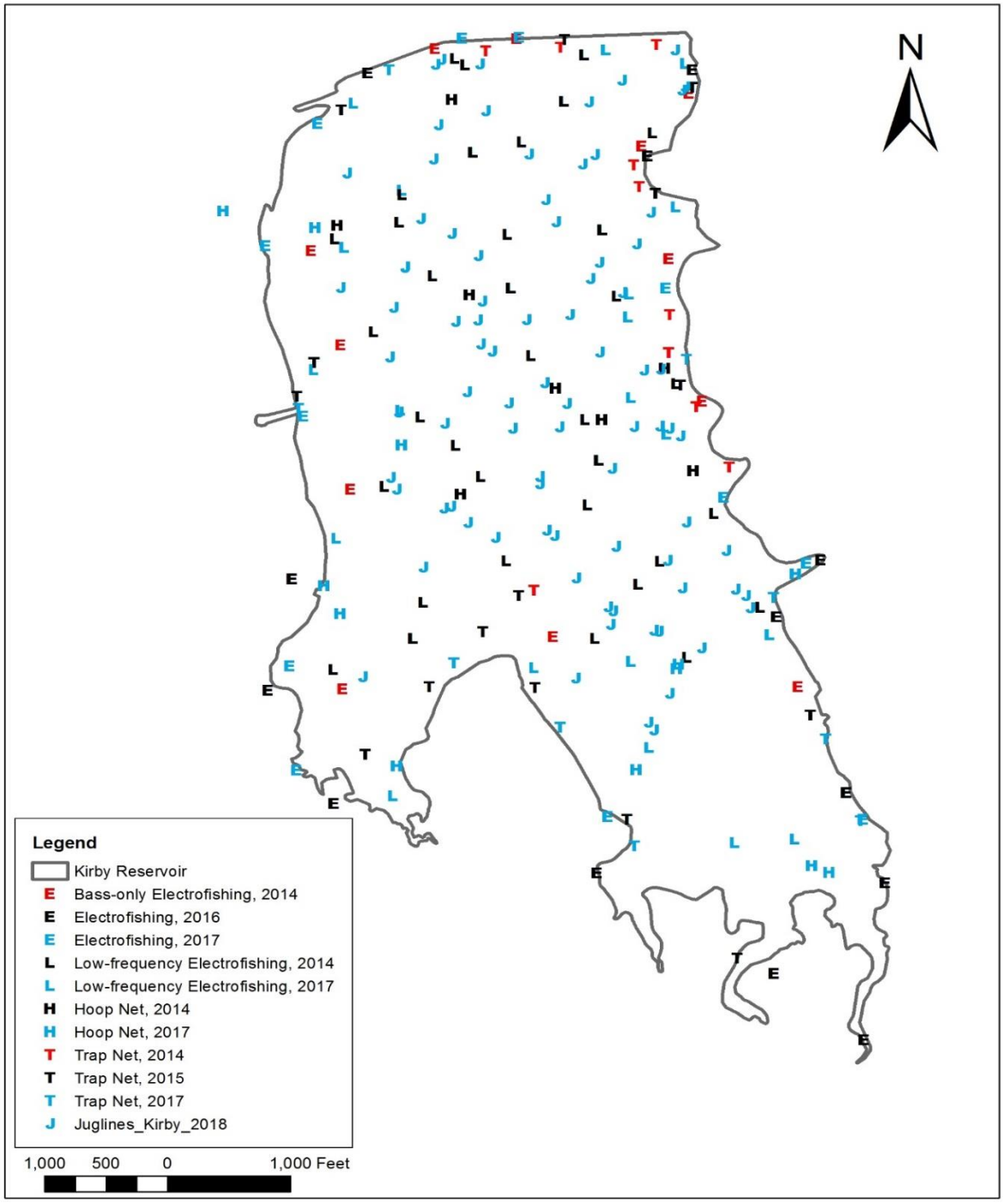
Figure 10. Number of White Crappie caught per net night (CPUE, bars), population indices (RSE and N for CPUE and SE for size structure are in parentheses) and mean relative weight (diamonds) for fall trap netting surveys, Kirby Reservoir, Texas, 2014, 2015, and 2017. Vertical line indicates minimum length limit.

Proposed Sampling Schedule

Table 9. Proposed sampling schedule for Kirby Reservoir, Texas. Survey period is June through May. Gill netting surveys are conducted in the spring, while electrofishing and trap netting surveys are conducted in the fall, and low frequency electrofishing and baited tandem hoop netting is in the summer. Standard survey denoted by S and additional survey denoted by A

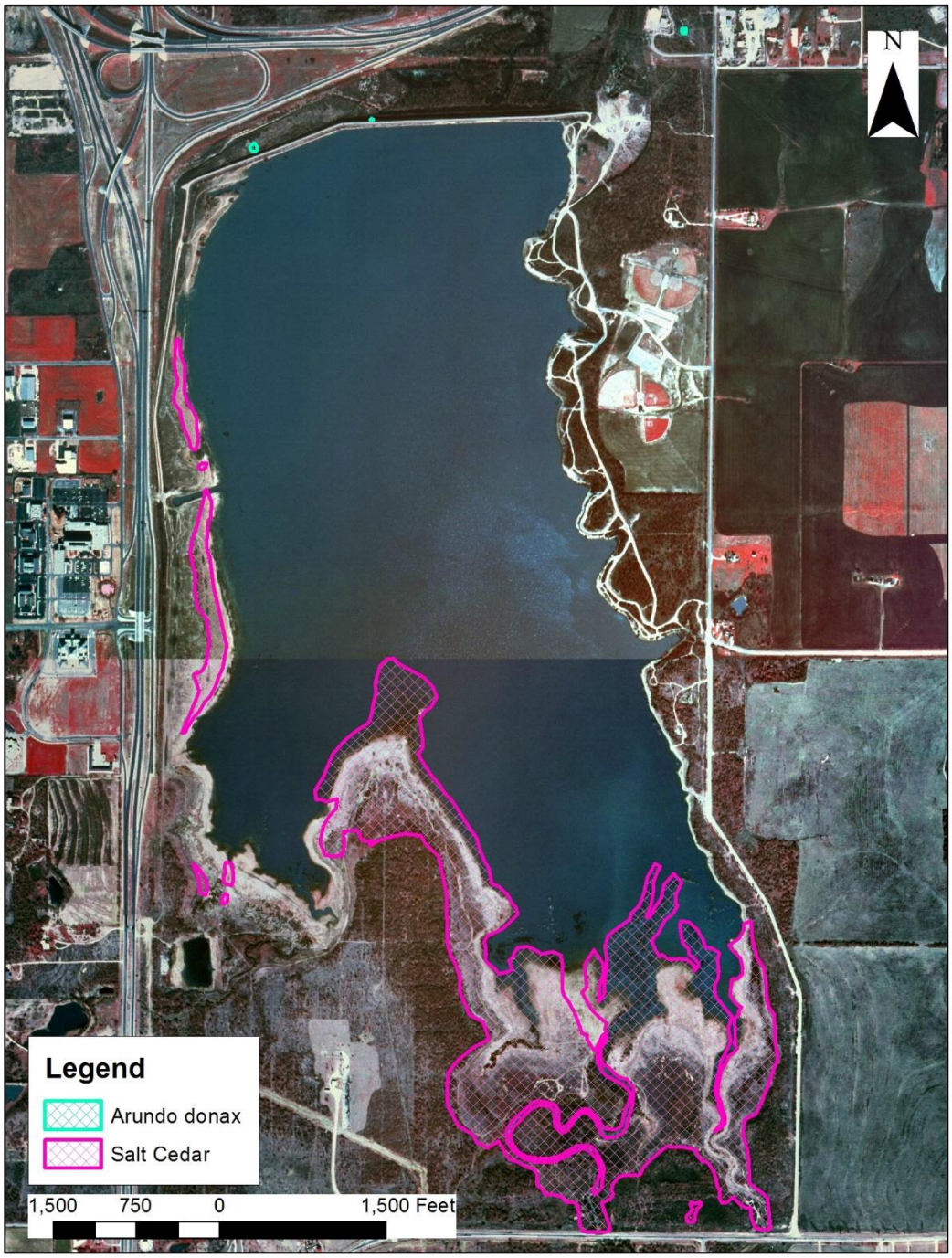
	Survey year			
	2018-2019	2019-2020	2020-2021	2021-2022
Angler Access				S
Structural Habitat				
Vegetation				S
Electrofishing – Fall				S
Electrofishing – Spring				
Electrofishing – Low frequency (Blue Catfish)		A		S
Electrofishing – Low frequency (Flathead Catfish)			A	
Trap netting				S
Gill netting				
Baited tandem hoop netting		A		S
Creel survey		A		
Report				S

APPENDIX A – Map of sampling locations



Map of all sampling locations by gear type at Kirby Reservoir, Texas, 2014-2018. Water level at the time of sampling during 2017 was about 3 feet below conservation pool elevation.

APPENDIX B – Map of exotic species survey



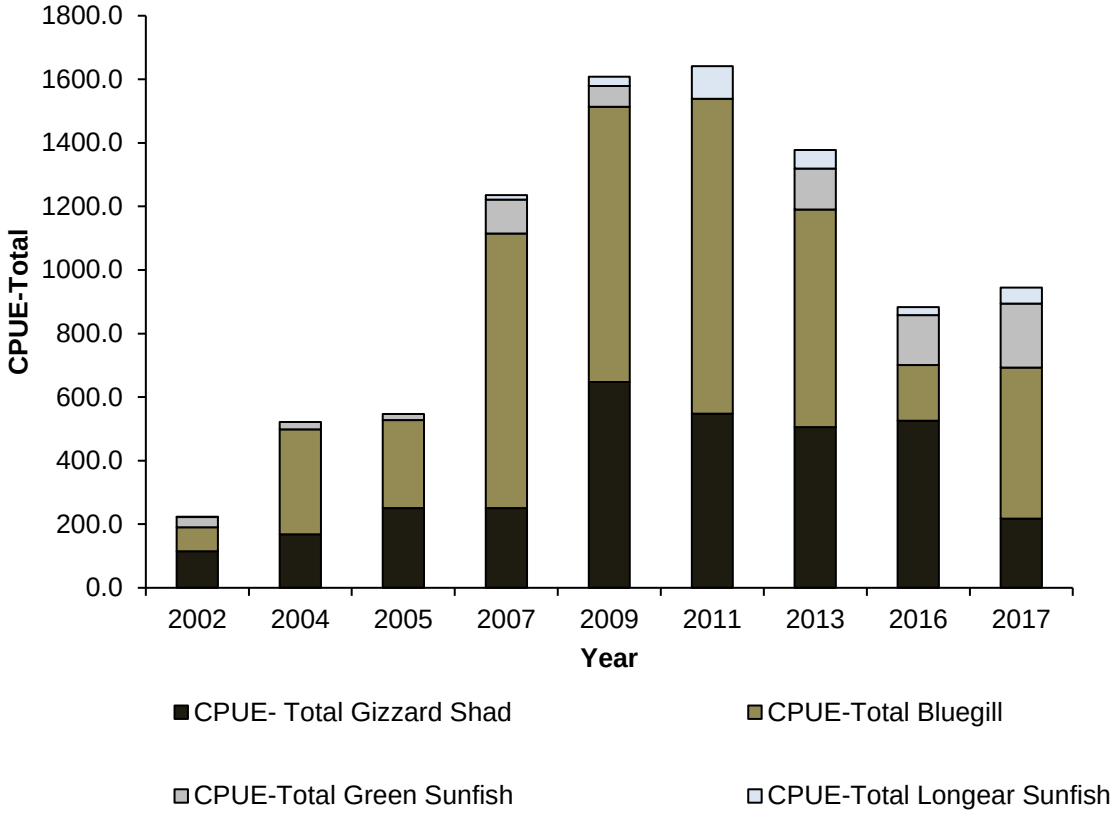
Map of coverage of exotic salt cedar (*Tamarix* sp.) and giant reed (*Arundo donax*) at Kirby Reservoir, Texas, July 2017.

APPENDIX C – Catch rates for all species from all gear types

Number (N) and catch per unit effort (CPUE; RSE in parentheses) of all target species collected from all gear types from Kirby Reservoir, Texas, 2017-2018. Sampling effort was 8 tandem series for hoop netting, 1 hour for both low-frequency and high-frequency electrofishing, and 10 net nights for trap netting.

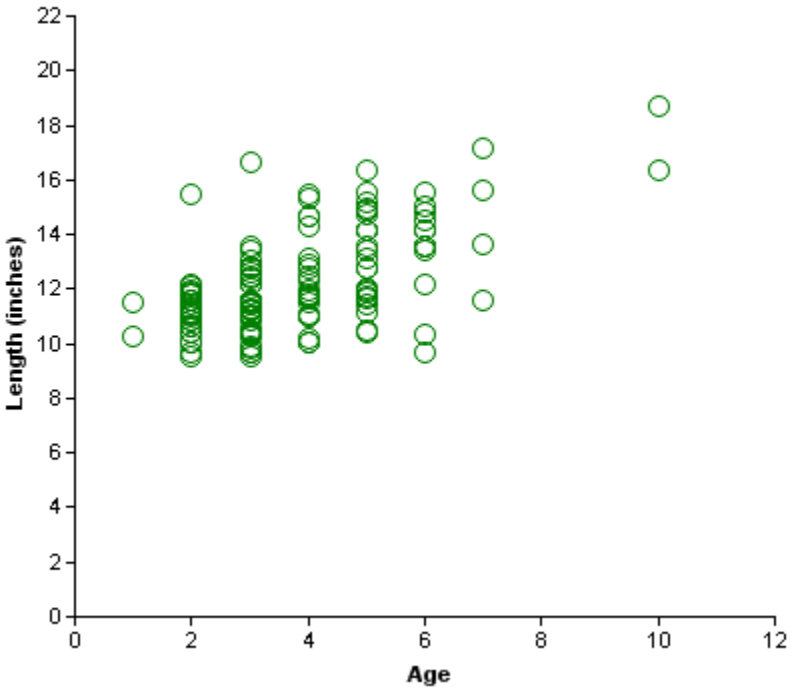
Species	Hoop Netting		Low-frequency Electrofishing		Electrofishing		Trap Netting	
	N	CPUE	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					218	218.0 (21)		
Inland Silverside					2	2.0 (67)		
Blue Catfish			376	376.0 (22)				
Channel Catfish	578	72.3 (45)						
Green Sunfish					201	201.0 (54)		
Orangespotted Sunfish					2.0	2.0 (100)		
Bluegill					475	475.0 (33)		
Longear Sunfish					51	51.0 (38)		
Largemouth Bass					18	18.0 (42)		
Hybrid Sunfish					3	3.0 (52)		
White Crappie							347	34.7 (70)
Saugeye							1	0.1 (100)

APPENDIX D – Catch rates of common prey species in fall electrofishing surveys



Catch rates of the most common prey species encountered in fall electrofishing surveys, Kirby Reservoir, Texas, 2002-2017.

APPENDIX E. – Age data for Channel Catfish



Length at age for Channel Catfish collected from tandem hoop nets at Kirby Reservoir, Texas, summer 2014.

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