

Possum Kingdom Reservoir

2018 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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Survey and Management Summary

Fish populations in Possum Kingdom Reservoir were surveyed in 2018 using electrofishing and with gill netting in 2019. Historical data are presented with the 2018-2019 data for comparison. This report summarizes the results of the surveys and contains a management plan for the reservoir based on those findings.

Reservoir Description: Possum Kingdom Reservoir is a 15,588-acre impoundment located on the Brazos River approximately 76 miles west of Fort Worth. It has a primarily rocky shoreline with many boat docks. The reservoir was within 2 feet of conservation pool (1,000 ft. above mean sea level) during the survey year. Due to prolonged drought, the reservoir water level had decreased to 15 feet below conservation pool. However, in May 2015 substantial rainfall filled Possum Kingdom to near capacity.

Management History: Important sport fish populations include catfish spp., White Bass, Striped Bass, Largemouth Bass, and crappie spp. Possum Kingdom was managed under statewide regulations until September 1, 2002 when the Largemouth Bass minimum length limit was raised to 16 inches and the Striped Bass bag limit was lowered to two per day in response to a golden alga (*Prymnesium parvum*) fish kill that occurred in early 2001. The Striped Bass bag limit was returned to the statewide bag limit on September 1, 2012. The Largemouth Bass length limit returned to the statewide 14-inch minimum on September 1, 2018. Major golden alga mortality events have occurred in 2001, 2003, 2007, and 2010.

Fish Community

- **Prey species:** Threadfin Shad were present in the reservoir. Electrofishing catch rate of Gizzard Shad was near the historical average for the reservoir, but most of the Gizzard Shad were too big for most predators to utilize. Electrofishing catch rate of Bluegill was high, with good size structure providing prey for predators and a fishery for anglers.
- **Catfishes:** The Channel Catfish relative abundance was above the reservoir historical average with many legal length catfish present for anglers. Blue Catfish catch rate was the second highest we have documented with many fish exceeding 20 inches in length. Flathead Catfish have historically been found in the reservoir, but none were caught in the current survey.
- **Temperate basses:** White Bass and Striped Bass were present in the reservoir. White Bass catch rate was below the reservoir historical average. Striped Bass relative abundance was well above the reservoir historical average and exhibited very good size distribution. Striped Bass body condition was below optimal.
- **Largemouth Bass:** Largemouth Bass electrofishing catch rate was less than the historical average. The relative abundance of legal-length bass has increased though the last few surveys. Part of this can be attributed to the length regulation changing in 2018 from a 16-inch minimum to a 14-inch minimum. Largemouth Bass age at attaining legal length (14 inches) averaged 2.1 years. Largemouth Bass body condition was below optimal.
- **Crappies:** White and Black Crappie are found in Possum Kingdom Reservoir. Historically, traditional trap netting for crappie resulted in low catch rates caused by the morphology and depth of the reservoir. Furthermore, past creel surveys found little targeted effort for crappie so trap netting was not conducted during the report years. Both species of crappies were sampled during the gill netting survey indicating they were present, somewhat abundant, and of legal length.

Management Strategies: Monitor the Striped Bass population and stock when necessary. Inform the public about the negative impacts of aquatic invasive species. Continue sampling Possum Kingdom for zebra mussels which has had positive zebra mussel DNA hits before but have never been observed in the reservoir. Conduct additional electrofishing and gill netting surveys in 2020 and 2021 respectively, and general monitoring surveys with electrofishing and gill net surveys in 2022-2023. Access and vegetation surveys will be conducted in 2022. Perform 9-month creel survey during 2020-2021. Continue artificial habitat work when funding becomes available.

Introduction

This document is a summary of fisheries data collected from Possum Kingdom Reservoir in 2018-2019. 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 2018-2019 data for comparison.

Reservoir Description

Possum Kingdom Reservoir is a 15,588-acre impoundment constructed in 1941 on the Brazos River. It is located in Palo Pinto County approximately 76 miles west of Fort Worth and is operated and controlled by the Brazos River Authority (BRA). Primary uses include flood control and recreation. Mean depth is 37 feet, shoreline development index is 14.4, and conductivity was 2,361 $\mu\text{S}/\text{cm}$ (Table 1). Primary habitats at time of sampling consisted of rocky shorelines, boat docks, and aquatic vegetation. The reservoir was within two feet of conservation pool in 2018-2019 and has been relatively constant at this elevation since rainfall in spring of 2015 brought the reservoir elevation from 15 feet below normal pool to full pool within a two-month period (Figure 1). Additional descriptive characteristics for Possum Kingdom are in Table 1.

Angler Access

At conservation pool, boat access consists of nine public boat ramps (Table 2) and 15 private ramps. At the recent low of 16 feet below conservation pool, boat access was almost exclusively limited to four low water ramps maintained by the BRA. The BRA extended the ramps or built alternative deep-water ramps at access points to maintain boat access. Two of the public boat ramps (North D&D and Sandy Beach) charged a \$3 per-person entrance fee on weekends and holidays from mid-May to mid-September. Private ramp fees ranged from free to \$35. Bank fishing was available at the public access points including the boat ramps. Two fishing piers (Possum Kingdom State Park and South D&D) were also present on the reservoir.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Lang and Mauk 2015) included:

1. The Striped Bass population had rebounded after the last golden alga-caused fish kill in 2010. Angling effort had increased including guided trips for this historically important species. Some anglers have voiced fear of over exploitation and asked for regulation changes to protect larger Striped Bass.

Action: The Striped Bass population has been surveyed every other year using gill nets. Stocking requests and rates have been adjusted based on the survey findings. The survey results indicate their relative abundance is very good and there is no justification to adjust bag limits, especially with the history of golden alga kills at this reservoir. A creel survey has been planned for 2019-200 to gather more information on the fishery.

2. The Largemouth Bass population was rebounding after the last golden alga-caused fish kill in 2010 and the drought that ended in 2015. It had frequently been stocked and it was important to monitor the population recovery. Historically, Largemouth Bass have been an important species with nearly half the anglers targeting bass and many tournaments were held at the reservoir. As a result of the multiple stockings and with the last genetic analysis of the population occurring in 2010, a new analysis is warranted. Age and growth analysis was last completed in 2010 also, so a category II age and growth analysis was warranted.

Action: Monitoring of the Largemouth Bass population occurred every other year using electrofishing. A stocking occurred in 2018 as a result of the monitoring. Genetic analysis of the population was completed in 2018. Type II age and growth was not completed

because of a low numbers of sampled Largemouth Bass between 13 and 14 inches in length. A creel survey has been planned for 2019-2020 to gather more information on the fishery.

3. Possum Kingdom has had significant habitat degradation occur over its lifetime in terms of both structural habitat and native aquatic vegetation.

Action: Staff partnered with the Hells Gate Bass Club and the Mineral Wells Bass Club to establish two Chapters of Friends of Reservoirs (FOR) who helped in deployment of artificial habitat structures and native aquatic plant reintroductions. The reservoir elevation dropped to 15 feet below normal pool following plantings in 2013 desiccating the plantings and subsequently the planned plantings in 2014 were cancelled. No new plantings have occurred at the reservoir, but aquatic vegetation has begun to rebound, possibly due to the additional seed source from our 2013 plantings. Artificial structures have routinely been added to the reservoir (107 sites, Appendix C) when funding has been available. The BRA and FOR Chapters funded these efforts.

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 the state.

Action: All marinas have been visited and given information to display for their customers. Additionally, all public ramps have signage located at the ramps. Several water samples have been collected at the reservoir to check for zebra mussel DNA and veligers. Samplers have also been placed near popular ramps to monitor for zebra mussel colonization.

Harvest regulation history: Sport fish species in Possum Kingdom Reservoir were historically managed using statewide regulations. However, on September 1, 2002, in response to the golden alga fish kill of 2001, the Largemouth Bass minimum length limit was raised from 14 to 16 inches and the Striped Bass daily bag limit was decreased from five to two fish 18 inches or greater to aid in recovery of the fishery. The Striped Bass bag limit was returned to the statewide bag limit on September 1, 2012. The Largemouth Bass length limit returned to the statewide 14 inch minimum on September 1, 2018. Current regulations are found in Table 3.

Stocking history: Since the initial golden alga fish kill in 2001, an intensive stocking program, involving multiple species, has occurred in response to golden alga caused fish kills in 2003, 2007, and 2010. Blue Catfish, Channel Catfish, Striped Bass, Smallmouth Bass, and Largemouth Bass (Northern and Florida strains) have all been stocked since 2001. The complete stocking history is in Table 4.

Vegetation/habitat management history: Possum Kingdom Reservoir has no significant vegetation/habitat management history. Noxious vegetation has not been a problem at the reservoir. Native vegetation plantings occurred in 2013 and were doing well until the reservoir elevation dropped to the point that the plants and cages were out of the water. A total of 107 sites have been received deployment of artificial structures. Georgia structures and Mossback structures were placed in the reservoir in 2013 and Mossback structures have also been deployed in 2016, 2017, and 2018.

Water transfer: No interbasin transfers are known to exist. Possum Kingdom Reservoir has been used primarily for water supply by the BRA. There were 19 entities in 2014 that had water supply contracts with

BRA that allowed them to remove water from Possum Kingdom Reservoir for different types of uses. Two of these contracts were for industrial purposes, five were for municipal purposes, four were for mining purposes, and eight were for irrigation purposes. Some lakeside property owners also used water from the reservoir for domestic purposes, and there were small water users located along the West Central Brazos Water Distribution System that used raw water pumped from Possum Kingdom Reservoir. Recently, the City of Abilene constructed a pipeline to pump water from Possum Kingdom to a treatment plant in case of drought emergency. In addition to withdrawals for water used directly from the reservoir, water has also been released downstream to pass excess runoff during high flow events, to provide for environmental flows, and for periodic water supply needs.

Methods

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Possum Kingdom Reservoir (TPWD unpublished). Primary components of the OBS plan are listed in Table 5. All survey sites were randomly selected, and all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

Electrofishing – Largemouth Bass, sunfishes, Gizzard Shad, and Threadfin Shad were collected by electrofishing (2 hours at 24, 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.

Gill netting – Blue Catfish, Channel Catfish, White Bass, and Striped Bass were collected by gill netting (15 net nights at 15 stations). CPUE for gill netting was recorded as the number of fish caught per net night (fish/nn).

Genetics – Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2017). Micro-satellite DNA analysis was used to determine genetic composition of individual fish from 2005 through 2018 and by electrophoresis for previous years.

Statistics – Sampling statistics (CPUE for various length categories), structural indices [Proportional Size Distribution (PSD), terminology modified by Guy et al. 2007], and condition indices [relative weight (W_r)] 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.

Habitat – A structural habitat survey was conducted in 2010. Vegetation surveys were conducted in 2006, 2010, 2014, and 2018. Habitat was assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

Water level – Source for water level data was the United States Geological Survey (USGS 2019).

Results and Discussion

Habitat: Littoral zone structural habitat consisted primarily of rocky and natural shoreline (Table 6). Docks and standing timber account for about 3.5% coverage in the littoral zone. Native vegetation is present and makes up less than 1% reservoir coverage (Table 7). Artificial structures along with some cut trees/brush have been placed into the reservoir since 2013 in partnership with the Friends of Reservoirs chapters Mineral Wells Bass Club and Hell's Gate Bass Club, and the BRA (Appendix C).

Prey species: Electrofishing catch rates of Gizzard Shad and Bluegill were 252.0/h and 235.0/h, respectively. Index of Vulnerability (IOV) for Gizzard Shad was poor, indicating that only 44% of Gizzard Shad were available to existing predators. The 2018 IOV estimate was lower than the 2016 survey (IOV = 80) but higher than the 2014 survey (IOV = 13; Figure 2). Total CPUE of Gizzard Shad was the highest it

has been since 2012 (Figure 2). Total CPUE of Bluegill in 2018 was higher than total CPUE from previous surveys since 2005, and size structure continues to be dominated by small individuals with a few quality Bluegill available to anglers as indicated by PSD (Figure 3). Threadfin Shad and other sunfish spp. are present in lower abundance.

Blue Catfish: The gill net catch rate of Blue Catfish was 3.4/nn in 2019 (Figure 4), the second highest catch rate documented at the reservoir and well above the historical average of 1.3/nn. The Blue Catfish population has greatly increased since the reservoir attained full pool in 2015. The population has good size structure with catfish 20 inches and longer available.

Channel Catfish: The gill net catch rate of Channel Catfish was 3.1/nn in 2019 (Figure 5). Relative abundance of Channel Catfish population has been stable over the last five surveys ranging from 2.5/nn to 3.4/nn. In 2019, body condition as measured by W_r ranged from 85 to 117 with no apparent trends among inch groups.

White Bass: The gill net catch rate of White Bass was 2.3/nn in 2019 which is lower than in 2017 (5.5/nn) but higher than 2015 (1.7/nn; Figure 6). The 2019 catch rate was less than half the reservoir historical average for this species of 5.9/nn. Historically, there has been an inverse relationship between White Bass and Striped Bass catch rates indicating competition between the two species. Body condition among inch groups was relatively stable ranging from 89 to 96 except for the 15-inch group with one representative sampled with a W_r of 83. Objective based sampling of CPUE-Total RSE ≤ 25 was not met for this species and no additional sampling was performed since abundance and precision estimates for this species are of lower priority.

Striped Bass: The gill net catch rate of Striped Bass was 4.7/nn in 2019, an improvement over the previous two surveys (Figure 7). This catch rate is well above the reservoir historical average of 3.2/nn. Size structure was considered excellent with fish from 8 to 32 inches in length being sampled. Many fish surpassed the minimum legal length of 18-inches. One concern was the W_r trend of a slight decline with increased size ranging from 80 to 96. Overall, W_r is not as good as it has been in the past. This might be caused by the size structure of Gizzard Shad which had an IOV of 40 indicating many shad were too large for predators to consume. Stocking requests for Striped Bass have been greatly reduced in recognition of the change in water inflow conditions allowing for successful natural recruitment. We determined natural recruitment occurred in spring 2016, a year we did not stock but sampled young-of-the-year fish when conducting electrofishing surveys in the fall of that year and during gill net surveys early in 2017. Conditions in 2017 and 2018 have been similar so it is possible that natural recruitment has occurred these years also, though we did stock during these years. Because W_r have declined and being uncertain if natural recruitment will occur in 2019, no stocking was requested for 2019 for this species. However, 10 adult Striped Bass broodstock were retired from the Possum Kingdom Hatchery in 2019 and stocked into the reservoir. Objective based sampling objectives were met for this species.

Largemouth Bass: The electrofishing catch rate of stock-length Largemouth Bass was 26.5/h in 2018 (Figure 8), below the 2016 rate (61.0/nn) but similar to 2014 (34.0/nn) and 2012 (23.5/nn) catch rates. Catch rates have historically been rather low since the reservoir is very steep-sided, deep, with clear water making electrofishing difficult. The sampling objective of capturing 50 stock-length bass for meaningful size structure estimation and W_r fell short with only 40 being captured. Body condition exhibited little change within the size structure ranging from 82 to 92, increasing with length. Larger bass are present in the reservoir but are seldom sampled during electrofishing surveys because of sampling issues. Evidence of these larger fish are tournament results and the ShareLunker program which had four Lunker level (8-10 lb.) and one Elite level (10-13 lb.) bass entered into the program during 2018-2019. The sampling objective of collecting 13 Largemouth Bass for age and growth was not met as only nine bass in the desired length category were sampled. However, growth rates of the sampled Largemouth Bass were good; average age at 14 inches (13.0 to 14.9 inches) was 2.1 years (N = 9; range = 1 - 3 years). Florida Largemouth Bass alleles improved from 52% in 2010 to 64% in 2018 and Florida genotype has increased from 0 to 7% during the same time period (Table 8). This was not surprising

though when examining the number of Florida Largemouth Bass that were stocked during this time period.

Crappie: White and Black Crappie were present in the reservoir but historically have seldom been targeted by anglers. Because of the morphology of the reservoir with steep banks and deep-water areas, trap netting has never resulted in meaningful catch rates. For these reasons, crappie populations were not sampled during this reporting period.

Fisheries Management Plan for Possum Kingdom Reservoir, Texas

Prepared – July 2019

ISSUE 1: Striped Bass have historically been requested and stocked annually into this reservoir. However, recent conditions have allowed natural recruitment to occur, making the need for additional stockings questionable. Future stockings in conjunction with natural recruitment may be detrimental to body condition and growth of Striped Bass.

MANAGEMENT STRATEGIES

1. Stockings requests and number requested will be based on several factors including reservoir conditions (spring reservoir elevation and flows into reservoir) that indicate a natural spawn will occur, body condition and growth of sampled Striped Bass from the 2021 gill net survey, and existing prey base as determined from a 2020 electrofishing survey.
2. Monitor the population with an additional gill net survey during 2021 and standard sampling in 2023.
3. Collect Striped Bass for age and growth during the 2021 gill net survey.

ISSUE 2: Current and meaningful creel survey information is unavailable for Possum Kingdom. The last creel survey occurred in 2011 and was influenced by a golden alga fish kill that occurred in 2010. The fishery has returned to a destination for Blue Catfish, Striped Bass, and Largemouth Bass anglers and tournaments. All previous creel surveys have occurred during or immediately after golden alga fish kill events.

MANAGEMENT STRATEGY

1. Perform a 9-month roving creel survey with the reservoir divided into three sections and surveying 12 days a quarter (7 weekend and 5 weekday) in 2020-2021. The summer quarter will not be conducted because the reservoir's extremely high recreational boating usage during the day can become somewhat dangerous and decreases sampling efficiency. Further, the high daytime recreational boating shifts angling pressure to night when we do not conduct creel surveys.

ISSUE 3: Many anglers have requested the reintroduction of Smallmouth Bass into the reservoir. This species existed in good abundance providing a fishery before the initial 2001 golden alga fish kill. The species is highly susceptible to the golden alga toxin and disappeared from the reservoir after the initial fish kill. Smallmouth Bass were reintroduced but quickly disappeared once after another golden alga fish kill occurred. Smallmouth Bass are an additional predator species that could also influence interspecific population dynamics.

MANAGEMENT STRATEGY

1. Continue monitoring the reservoir for golden alga. There has been small, localized blooms and kills that have occurred since 2010, the last major kill. The last small kill occurred in 2018 and golden alga cell counts were high in 2019 in certain locations. Stocking Smallmouth Bass is not recommended at this time. Monitoring the reservoir for golden alga blooms and interspecific fisheries population dynamics will be continued.

ISSUE 4: Habitat enhancement by deploying artificial structures has been going on since 2013 to address habitat loss in the aging reservoir, supported by two Friends of Reservoir Chapters, Hell's Gate Bass Club and Mineral Wells Bass Club, and the BRA.

MANAGEMENT STRATEGIES

1. Work with partners to continue placing artificial structure into the reservoir when funding is available.
2. Make locations public by continuing to place GPS coordinates onto the Possum Kingdom TPWD web page.

ISSUE 5: 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 the state.

MANAGEMENT STRATEGIES

1. Cooperate with the controlling authority to post and maintain appropriate signage at access points around the reservoir.
2. Continue to contact and educate marina owners about invasive species, and provide them with posters, literature, etc... so that they can in turn educate their customers.
3. Continue educating the public about invasive species through the use of media and the internet.
4. Continue to make a speaking point about invasive species when presenting to constituent and user groups.
5. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.

ISSUE 6: While zebra mussels have never been found in the reservoir, there have been positive tests for their DNA. Additional survey work has yet to identify their presence and follow up DNA analysis has had negative results. This is especially important with Possum Kingdom State Fish Hatchery located below the dam, if zebra mussels are found in the reservoir, hatchery protocols and usage would need to be altered.

MANAGEMENT STRATEGIES

1. Continue checking and maintenance of zebra mussel samplers placed throughout the reservoir.
2. Continue to work with the Aquatic Invasive Species team and the hatchery to conduct monitoring throughout the reservoir and hatchery incoming water for zebra mussel DNA analysis and veliger detection if present.

Objective-Based Sampling Plan and Schedule (2019–2023)

Sport fish, forage fish, and other important fishes

Sport fishes in Possum Kingdom Reservoir include Channel and Blue Catfish, Black and White Crappie, Striped and White Bass, and Largemouth Bass. Known important forage species include Bluegill, and Threadfin and Gizzard Shad.

Negligible fisheries

Black and White Crappie: Black and White Crappie are present in Possum Kingdom Reservoir, but population relative abundance is moderate to low. Trap net surveys from 1999-2014 showed CPUE of White Crappie ranged from 0.1 to 9.5 fish/nn with the average of 3.0/nn over this time period. Black Crappie are even less abundant according to trap nets surveys. The reservoir is steep sided and deep possibly negatively influencing trap netting results. Creel surveys in 2000-2001 and 2006-2007 indicated low directed effort (2.8 and 1.2% of total effort) and catch (0.3/hr both surveys) of White Crappie occurred. Sampling this population is unnecessary in the 2019 to 2023 sampling period.

Survey objectives, fisheries metrics, and sampling objectives

Creel: Every creel survey that has been performed at Possum Kingdom Reservoir has had the results highly influenced by a golden alga fish kill event occurring at some point during the survey period. The fishery has recovered from those events with excellent populations of catfish, Striped Bass, and Largemouth Bass existing in the reservoir. Numerous guides and tournaments are targeting these species. A nine-month creel survey using randomly chosen time periods (two periods of equal length) and three sections will be conducted. The summer quarter will not be sampled because we are confident that little daytime angling occurs during this quarter and there are safety concerns since this reservoir is highly utilized during this quarter for recreational boating.

Largemouth Bass: Largemouth Bass are one of the most popular sport fish in Possum Kingdom Reservoir. The popularity and reputation for Largemouth Bass fishing at this reservoir warrant sampling time and effort. Results from 2000-2001 and 2006-2007 creel surveys showed directed angling effort for black bass of 26.8 and 20.7% targeted effort respectively. During the 2000-2001 creel survey, besides Largemouth Bass, there were Smallmouth and Spotted Bass present. After the initial 2001 golden alga fish kill, only Largemouth Bass were found in the reservoir. Largemouth Bass had been managed with the statewide 14-inch minimum length limit regulation until Sept. 1, 2003 when it was changed to a 16-inch minimum length limit. It reverted back to the statewide 14-inch minimum length limit on September 1, 2018. Trend data on CPUE, size structure, and body condition have been collected biennially since 1996 in this clear reservoir with fall nighttime electrofishing. Age and growth was last completed in 2010 and a category II survey was planned for 2018 but sample numbers of 13 to 14-inch Largemouth Bass was not adequate so it will be attempted again in 2020. Genetics analysis was completed in 2018 so is not warranted during the report cycle. Twenty-four randomly selected 5-min electrofishing sites will be sampled in 2020 and 2022, which historically has provided CPUE-S RSE's of <25 and are expected to be enough stock-length bass for evaluating size structure and body condition. No additional sites will be completed if not enough bass are sampled.

Bluegill: Bluegill are a primary forage species at Possum Kingdom Reservoir. Like Largemouth Bass, trend data on CPUE and size structure of Bluegill have been collected every two years. Continuation of sampling, as per Largemouth Bass above, will allow for monitoring of large-scale changes in Bluegill relative abundance and size structure. Sampling effort based on achieving sampling objectives for Largemouth Bass should result in sufficient numbers of Bluegill for size structure estimation. No additional effort will be expended to achieve an RSE25 for CPUE-S of Bluegill. Instead, Largemouth Bass body condition can provide information on forage relative abundance, vulnerability, or both relative

to predator density. Relative weight of Largemouth Bass ≥ 8 " TL will be determined from their length/weight data (maximum of 10 fish weighed and measured per inch class).

Gizzard and Threadfin Shad: Shad are present in Possum Kingdom Reservoir, but population relative abundance has been moderate ranging from 117.0-252.0/h for Gizzard Shad during the previous three surveys. Shad will be collected when electrofishing for Largemouth Bass with no targeted goals or objectives.

Striped Bass: Striped Bass are one of the most popular species in the reservoir according to 2000-2001 creel survey. The population historically has been surveyed every other year and this will continue with survey work planned in 2021 and 2023. In the past, the population has been adversely affected by occasional golden alga caused fish kills which has affected both the populations and fishing for the species. But the population has rebounded since 2010 to be a premier fishery for Striped Bass once again. General monitoring for this species using 15 gill nets should provide a CPUE-S RSE of <25 based on 2017 and 2019 survey data. Given previous catch rates, this level of sampling should result in the 50-stock length needed for size structure analysis. No extra sampling will occur.

White Bass: White Bass are present in Possum Kingdom Reservoir with population relative abundance considered moderate. Recent gill net surveys from 2013, 2015, 2017, and 2019 resulted in CPUE of White Bass ranging from 1.7 to 6.4 fish/nn. Creel surveys in 2000-2001 and 2006-2007 indicated low directed effort (0.1 and 0.6/acre) for White Bass occurred. Data will be collected while sampling Striped Bass, but no targeted goals or objectives will be established.

Channel Catfish: Channel Catfish are present in Possum Kingdom Reservoir, and population relative abundance is considered moderate. The last three gill net surveys (2015, 2017, and 2019) resulted in CPUE of Channel Catfish ranged from 2.5 to 3.4 fish/nn. Creel surveys in 2000-2001 and 2006-2007 indicated no to low directed effort (0.0 and 0.1/acre) and catch (0.0/hr both surveys) of Channel Catfish occurred. Sampling this population beyond what is sampled while collecting Striped Bass data is unnecessary.

Blue Catfish Blue Catfish are present in Possum Kingdom Reservoir and population relative abundance is considered moderate. The last three gill net surveys (2015, 2017, and 2019) resulted in CPUE of Blue Catfish ranged from 2.0 to 4.7 fish/nn. Creel surveys in 2000-2001 and 2006-2007 indicated no directed effort and catch of Blue Catfish occurred. Sampling this population beyond what is sampled while collecting Striped Bass data is unnecessary.

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Tables and Figures

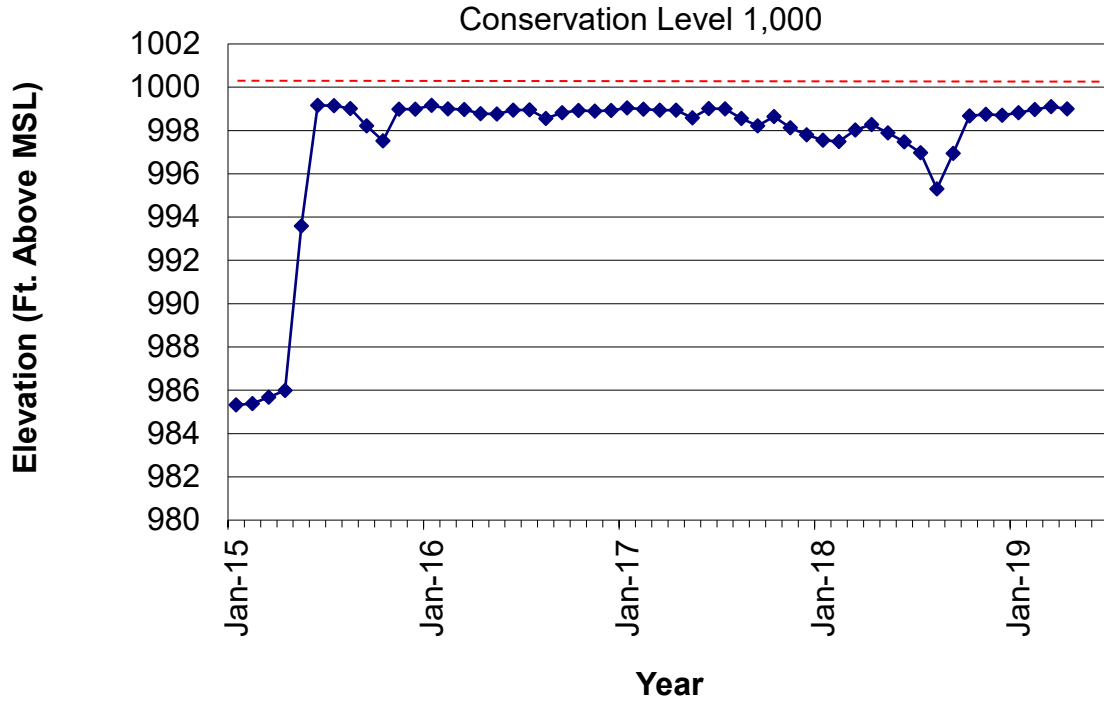


Figure 1. Quarterly water level elevations in feet above mean sea level (MSL) recorded for Possum Kingdom Reservoir, Texas.

Table 1. Characteristics of Possum Kingdom Reservoir, Texas.

Characteristic	Description
Year constructed	1941
Controlling authority	Brazos River Authority
County	Palo Pinto
Reservoir type	Mainstem
Shoreline Development Index	14.4
Conductivity	2,361 $\mu\text{S}/\text{cm}$

Table 2. Boat ramp characteristics for Possum Kingdom Reservoir, Texas, August, 2018. Reservoir elevation at time of survey was 995.8 feet above mean sea level. Most ramps have over-flow parking available beyond the parking capacity listed. Only public ramps are listed below, there are private ramps that charge a fee to launch but the majority were out of the water at time of survey.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Public Ramp	32.8913 -98.4703	Y	54	990	Good
Public Ramp Low Water	32.8921 -98.4689	Y	11	981	Good, but only usable at low water
North D & D	32.8846 -98.4892	Y	17	979	Good
Sandy Beach	32.8886 -98.5235	Y	10	988	Good
Bugs Beach	32.8754 -98.5041	Y	15	990	Good
South D & D	32.8831 -98.4863	Y	60	990	Good
Scenic Cove	32.8846 -98.4507	Y	27	992	Good
Scenic Cove Low Water	32.8884 -98.4484	Y	20	982	Good
State Park	32.8804 -98.8754	Y	20	983	Good
Elm Creek	32.9089 -98.4961	Y	15	991	Good

Table 3. Harvest regulations for Possum Kingdom Reservoir, Texas.

Species	Bag limit	Length limit
Catfish: Channel and Blue Catfish, their hybrids and subspecies	25 (in any combination)	12-inch minimum
Catfish, Flathead	5	18-inch minimum
Bass, White	25	10-inch minimum
Bass, Striped and Hybrid Striped	5	18-inch minimum
Bass, Largemouth and Smallmouth	5	14-inch minimum
Bass: Spotted and Guadalupe	5 ^a	None
Crappie: White and Black Crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

^a Daily bag for Largemouth Bass, Smallmouth Bass, Spotted Bass, and Guadalupe Bass = 5 fish in any combination.

Table 4. Stocking history of Possum Kingdom Reservoir, Texas. UNK = unknown; FRY = fry; FGL = fingerling; AFGL = advanced fingerling; ADL = adult.

Species	Year(s) Stocked	Number of Years	Number Stocked	Size
Blue Catfish	2002	1	70,955	FGL
Channel Catfish	1972-2001	2	11,492	AFGL
	2001–2013	3	605,609	FGL
Florida Largemouth Bass	1973-1978	3	475,070	FRY
	1976–2013	8	2,988,297	FGL
	2002	1	77	ADL
	2014	1	295,709	FGL
	2015	1	213,209	FGL
	2018	1	84,421	FGL
Northern Largemouth Bass	1966-1972	2	348,983	UNK
	1970-1972	2	786,640	FRY
	2005	1	223,690	FGL
Smallmouth Bass	1978	1	162,000	UNK
	1984-2001	5	303	ADL
	1998-2003	3	361,225	FGL
	2002	1	500	AFGL
Striped Bass	1976–1983	4	488,214	UNK
	1986-2013	12	19,126,505	FRY
	1986-2013	23	3,799,046	FGL
	2014	1	410,970	FGL
	2015	1	267,748	FGL
	2017	1	574,520	FRY
	2017	1	77,443	FGL
	2018	1	83,952	FGL
	2019	1	10	ADL
Threadfin Shad	1980	1	8,600	UNK
Walleye	1964-1975	5	16,100,000	FRY

Table 5. Objective-based sampling plan components for Possum Kingdom Reservoir, Texas 2018–2019.

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing</i>			
Largemouth Bass	Abundance	CPUE–Stock	RSE–Stock ≤ 25
	Size structure	PSD, length frequency	$N \geq 50$ stock
	Age-and-growth	Age at 14 inches	$N = 13$, 13.0 – 14.9 inches
	Condition	W_r	10 fish/inch group (max)
	Genetics	% FLMB	$N = 30$, any age
Bluegill ^a	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	$N \geq 50$
Gizzard Shad ^a	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	$N \geq 50$
	Prey availability	IOV	$N \geq 50$
<i>Gill netting</i>			
Blue Catfish ^b	Abundance	CPUE–Total	RSE ≤ 25
Channel Catfish ^b	Abundance	CPUE–Total	RSE ≤ 25
White Bass ^b	Abundance	CPUE–Total	RSE ≤ 25
Striped Bass	Size structure	CPUE–Stock	$N \geq 50$ stock

^a No additional effort will be 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.

^b No additional effort will be expended to achieve an RSE ≤ 25 for CPUE of Blue and Channel Catfish and White Bass if not reached from designated Striped Bass sampling effort.

Table 6. Survey of structural habitat types, Possum Kingdom Reservoir, Texas, 2018. Shoreline habitat type units are in miles and boat docks, flooded terrestrial vegetation, and standing timber is acres.

Habitat type	Estimate	% of total
Bluff	13.4 miles	9.0
Bulkhead	1.7 miles	1.1
Natural	60.2 miles	40.5
Rocky	73.4 miles	49.4
Boat docks	434.0 acres	2.7
Flooded terrestrial vegetation	124.0 acres	0.8
Standing timber	327.0 acres	2.1

Table 7. Survey of aquatic vegetation, Possum Kingdom Reservoir, Texas, 2006, 2010, 2014, and 2018. Surface area (acres) is listed with percent of total reservoir surface area in parentheses.

Vegetation	2006	2010	2014	2018
Native submersed	205.0 (1.3)	0.7 (<0.1)	0.0	30.9 (0.2)
Native floating-leaved	0.0	0.0	0.0	0.0
Native emergent	461.0 (3.9)	10.9 (0.1)	0.0	75.0 (0.5)
Non-native	0.0	0.0	0.0	0.0

Gizzard Shad

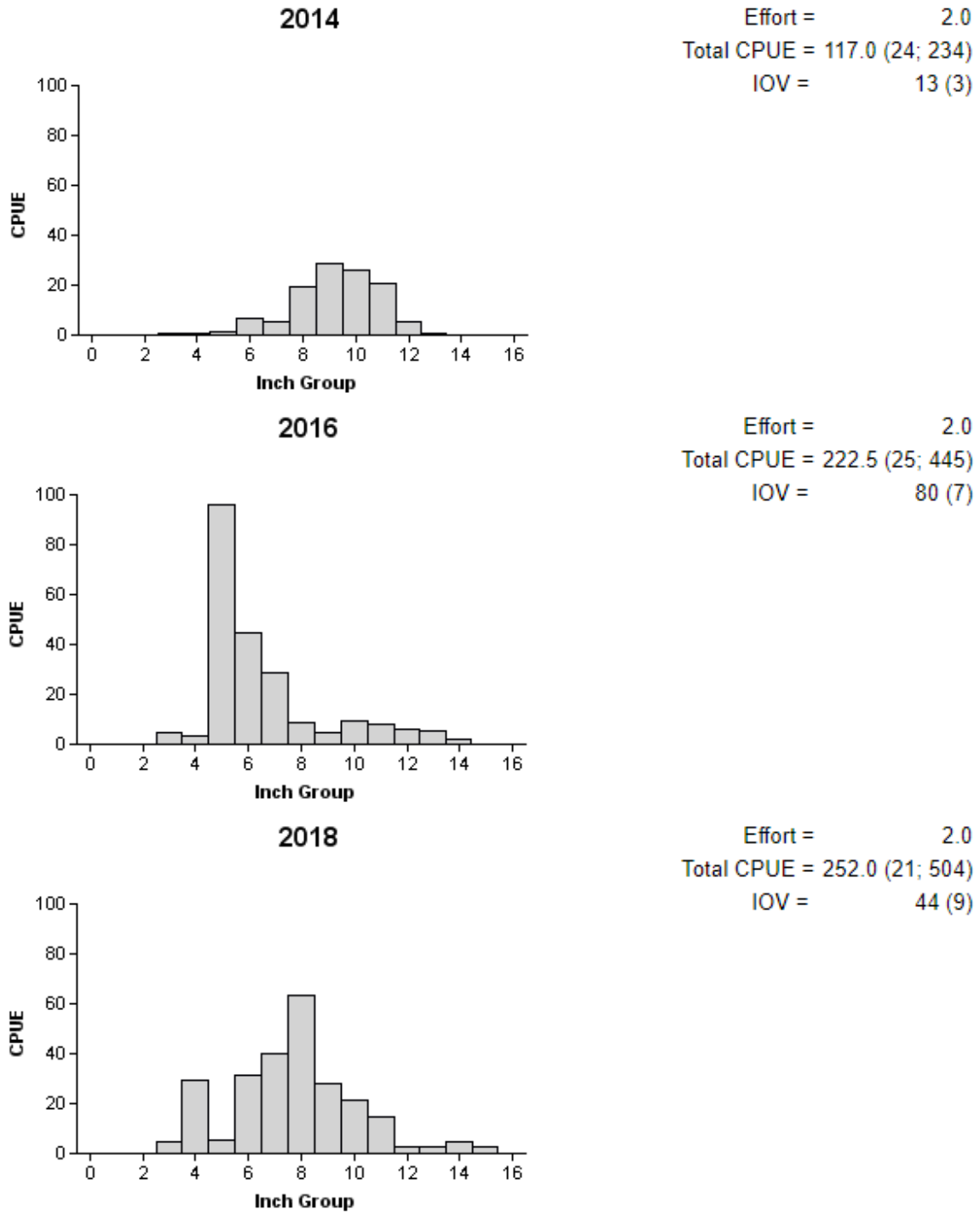
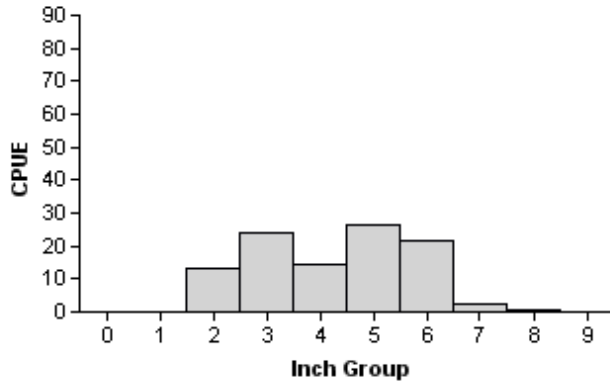


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Possum Kingdom Reservoir, Texas, 2014, 2016, and 2018.

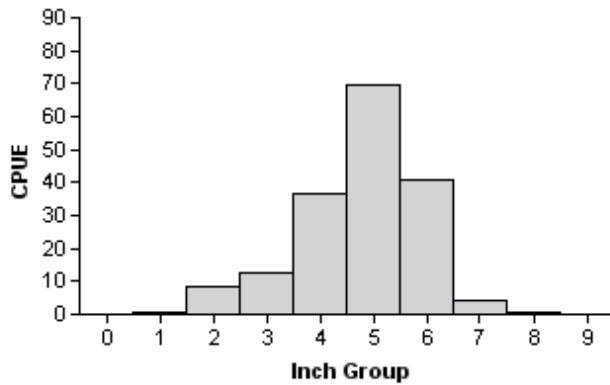
Bluegill

2014



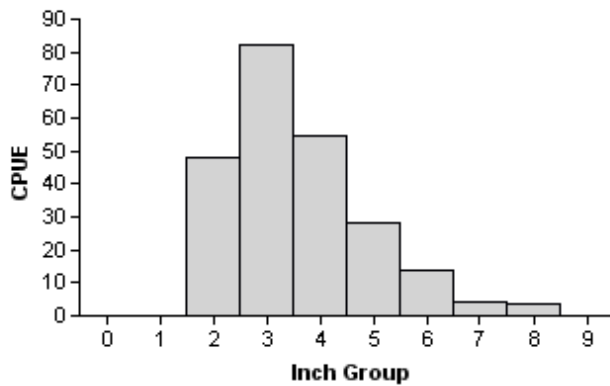
Effort = 2.0
 Total CPUE = 103.0 (18; 206)
 Stock CPUE = 89.5 (18; 179)
 PSD = 27 (4)

2016



Effort = 2.0
 Total CPUE = 173.5 (18; 347)
 Stock CPUE = 164.5 (18; 329)
 PSD = 28 (3)

2018



Effort = 2.0
 Total CPUE = 235.0 (22; 470)
 Stock CPUE = 187.0 (20; 374)
 PSD = 12 (2)

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, Possum Kingdom Reservoir, Texas, 2014, 2016, and 2018.

Blue Catfish

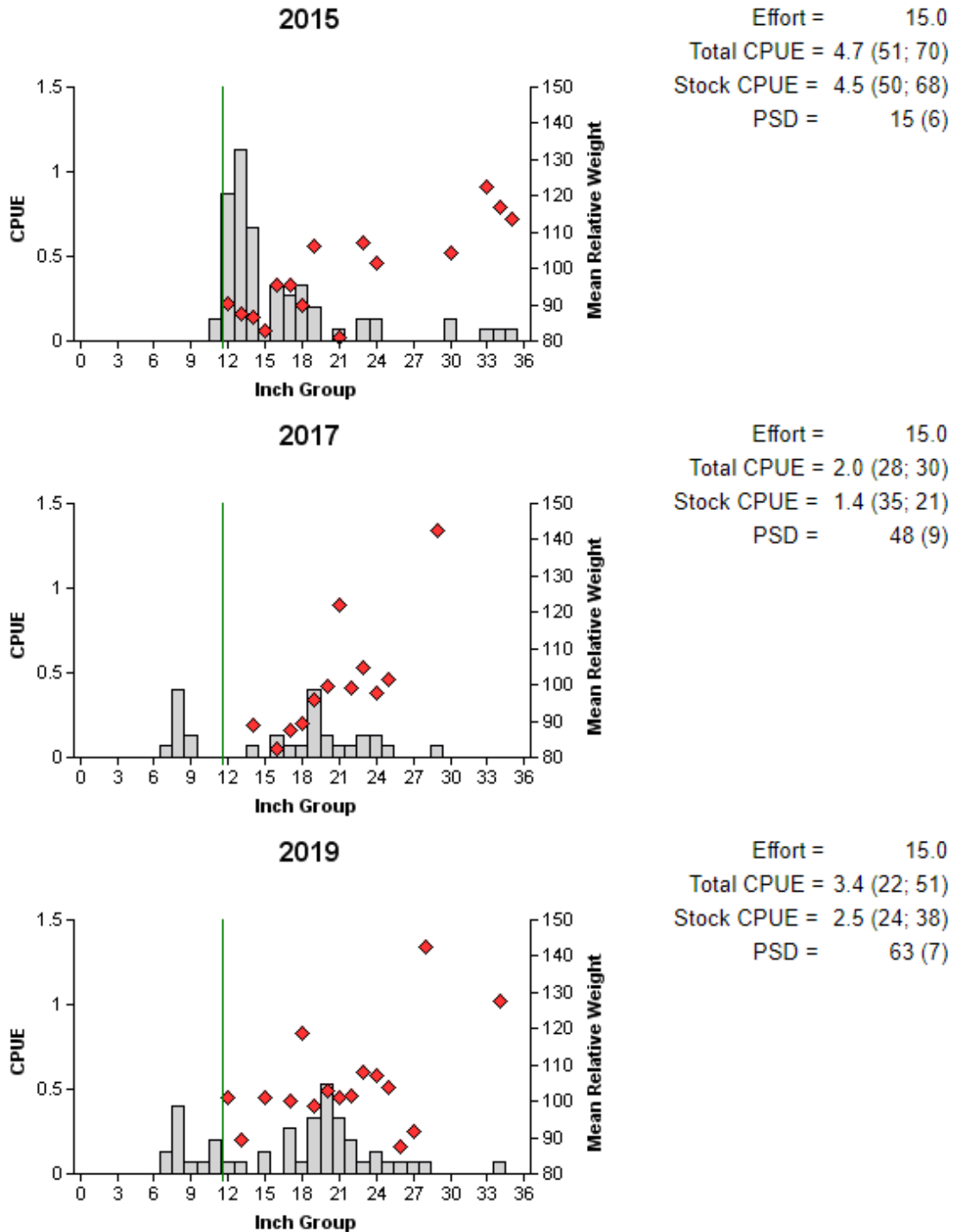


Figure 4. Number of Blue Catfish caught per net night (CPUE, bars) mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Possum Kingdom Reservoir, Texas, 2015, 2017, and 2019. Line indicates minimum length limit.

Channel Catfish

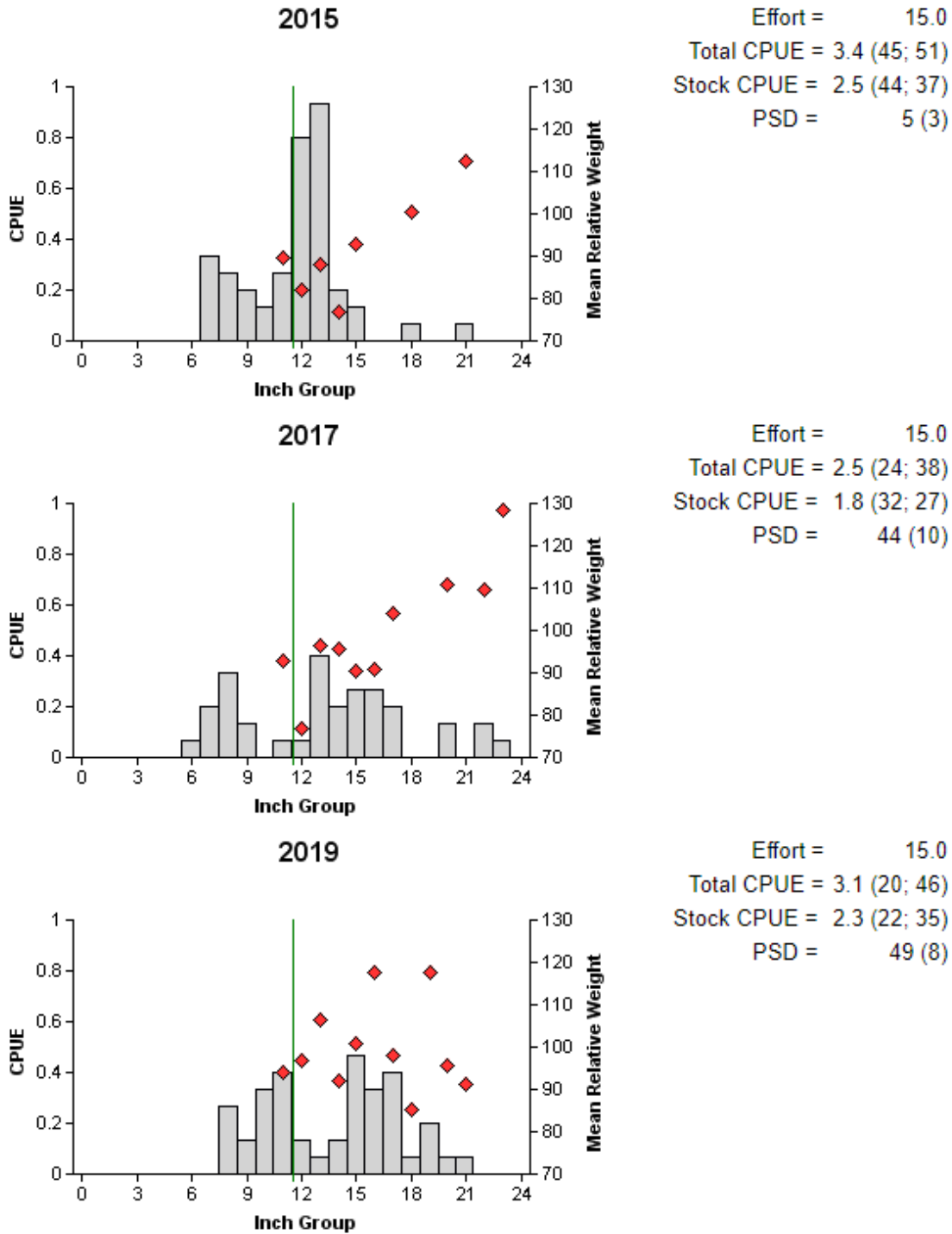


Figure 5. Number of Channel Catfish caught per net night (CPUE, bars) mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Possum Kingdom Reservoir, Texas, 2015, 2017, and 2019. Line indicates minimum length limit.

White Bass

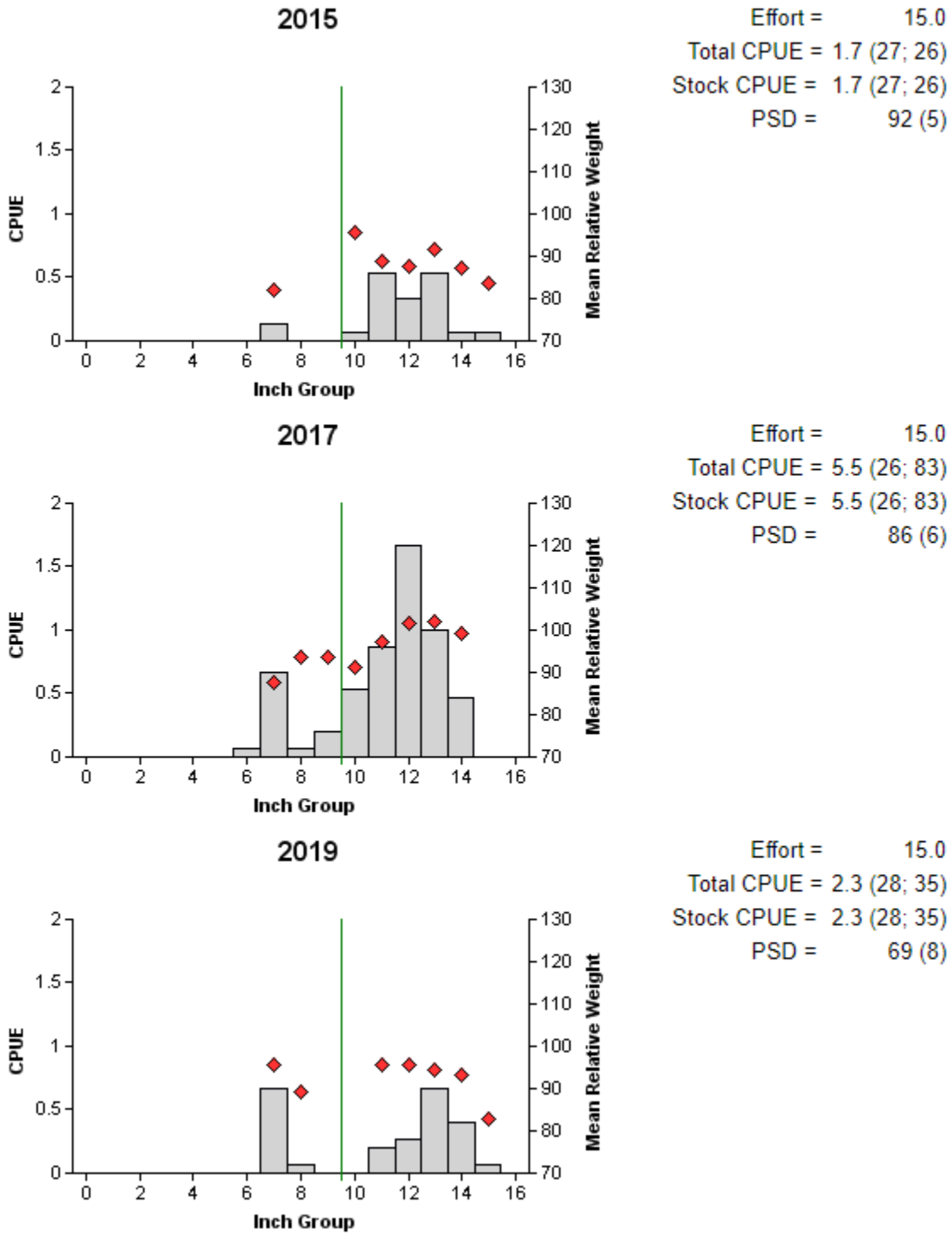


Figure 6. Number of White Bass caught per net night (CPUE, bars) mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Possum Kingdom Reservoir, Texas, 2015, 2017, and 2019. Line indicates minimum length limit.

Striped Bass

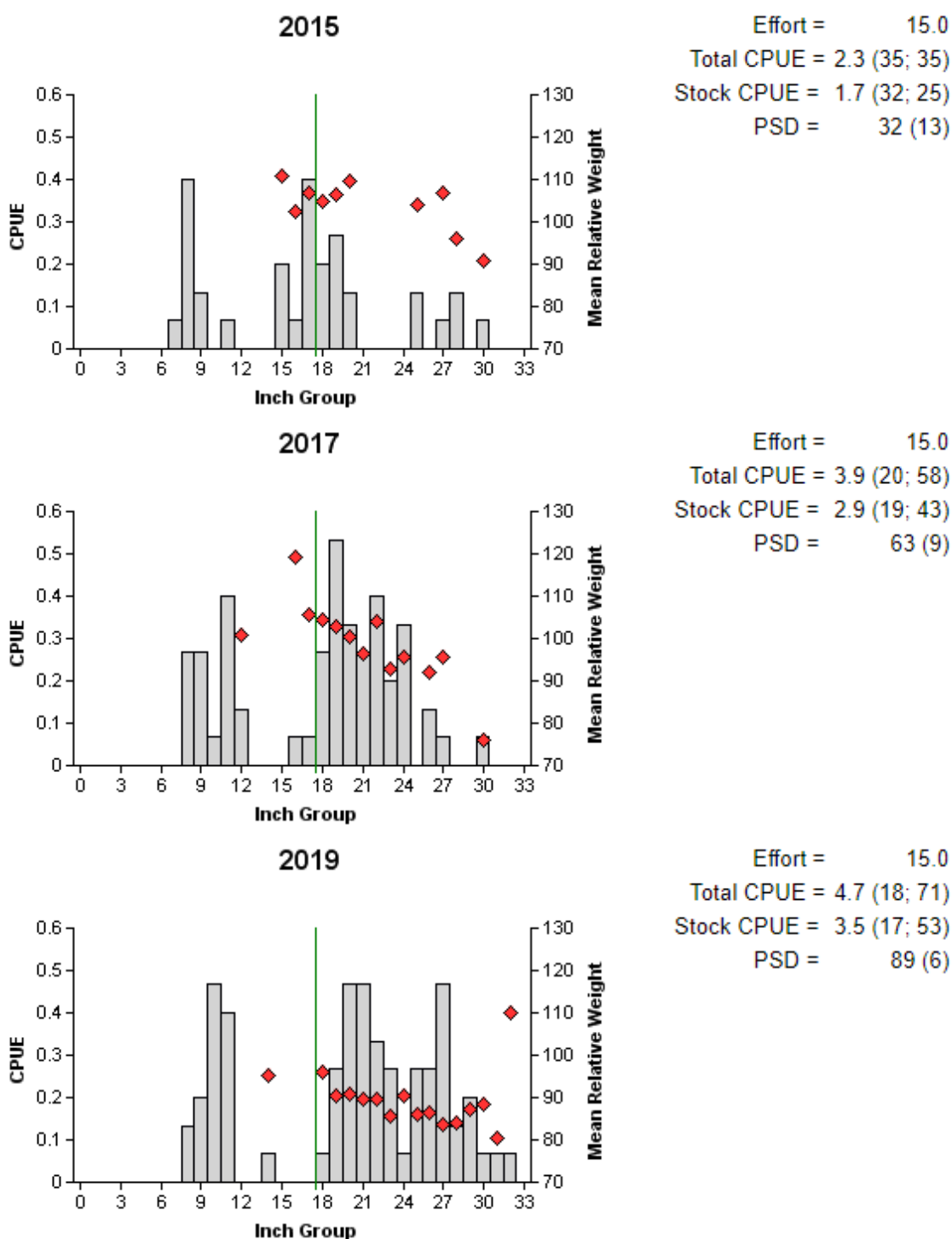


Figure 7. Number of Striped Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Possum Kingdom Reservoir, Texas, 2015, 2017, and 2019. Line indicates minimum length limit.

Largemouth Bass

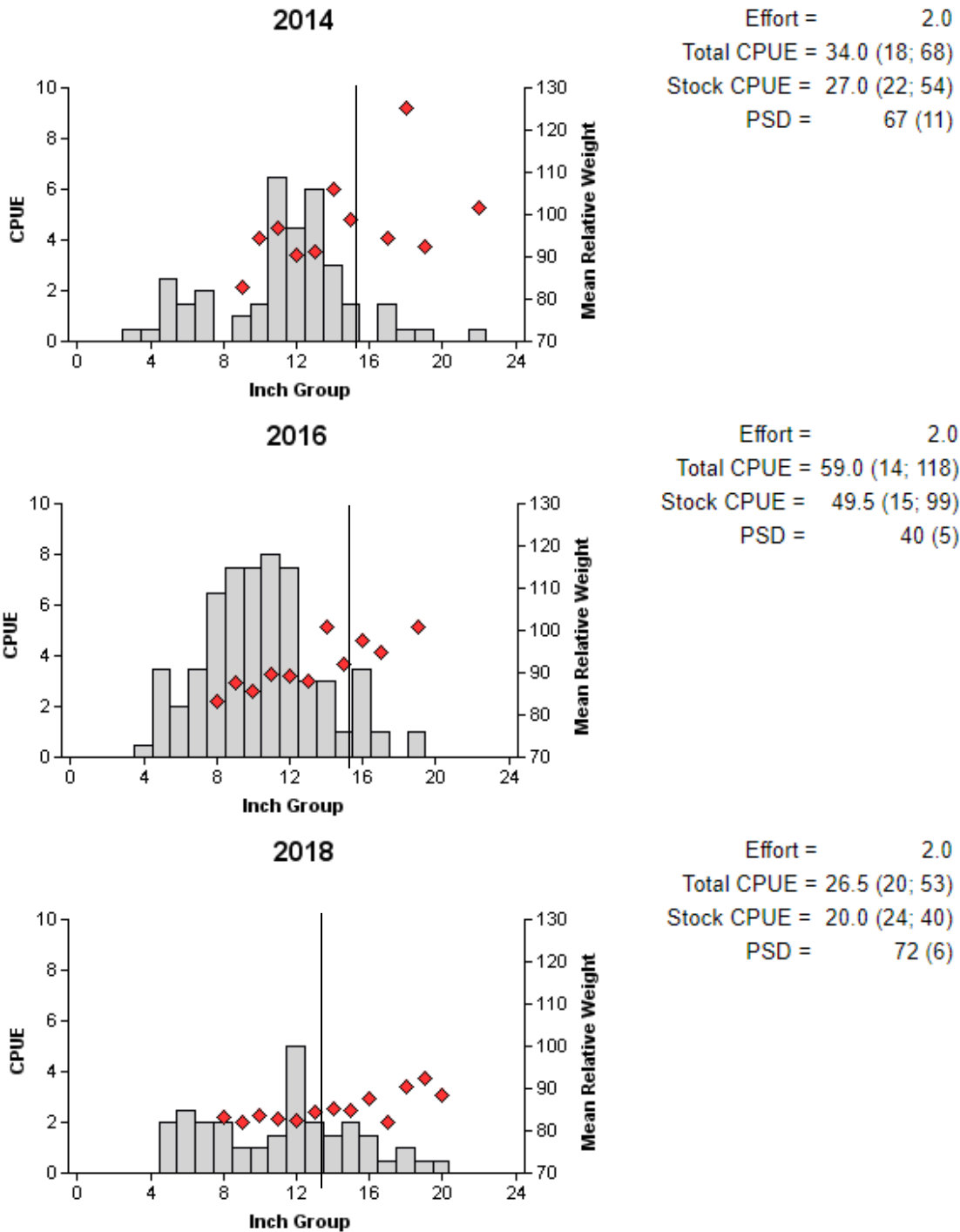


Figure 8. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Possum Kingdom Reservoir, Texas, 2014, 2016, and 2018. Line indicates minimum length limit.

Table 8. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Possum Kingdom Reservoir, Texas, 1999, 2001, 2002, 2003, 2004, 2005, 2006, 2010, and 2018. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB. Genetic composition was determined by electrophoresis prior to 2005 and with micro-satellite DNA analysis since 2005.

Year	Sample size	Number of fish			% FLMB alleles	% FLMB
		FLMB	Intergrade	NLMB		
1999	28	4	21	3	50.0	14.3
2001	30	3	21	6	40.8	10.0
2002	30	7	15	8	50.8	23.3
2003	31	21	9	1	84.7	67.7
2004	49	12	34	3	62.6	24.5
2005	2	1	1	0	75.0	50.0
2006	30	2	28	0	60.0	6.7
2010	28	0	27	1	51.9	0.0
2018	30	2	24	4	63.7	6.7

Proposed Sampling Schedule

Table 9. Proposed sampling schedule for Possum Kingdom 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. Standard survey denoted by S and additional survey denoted by A.

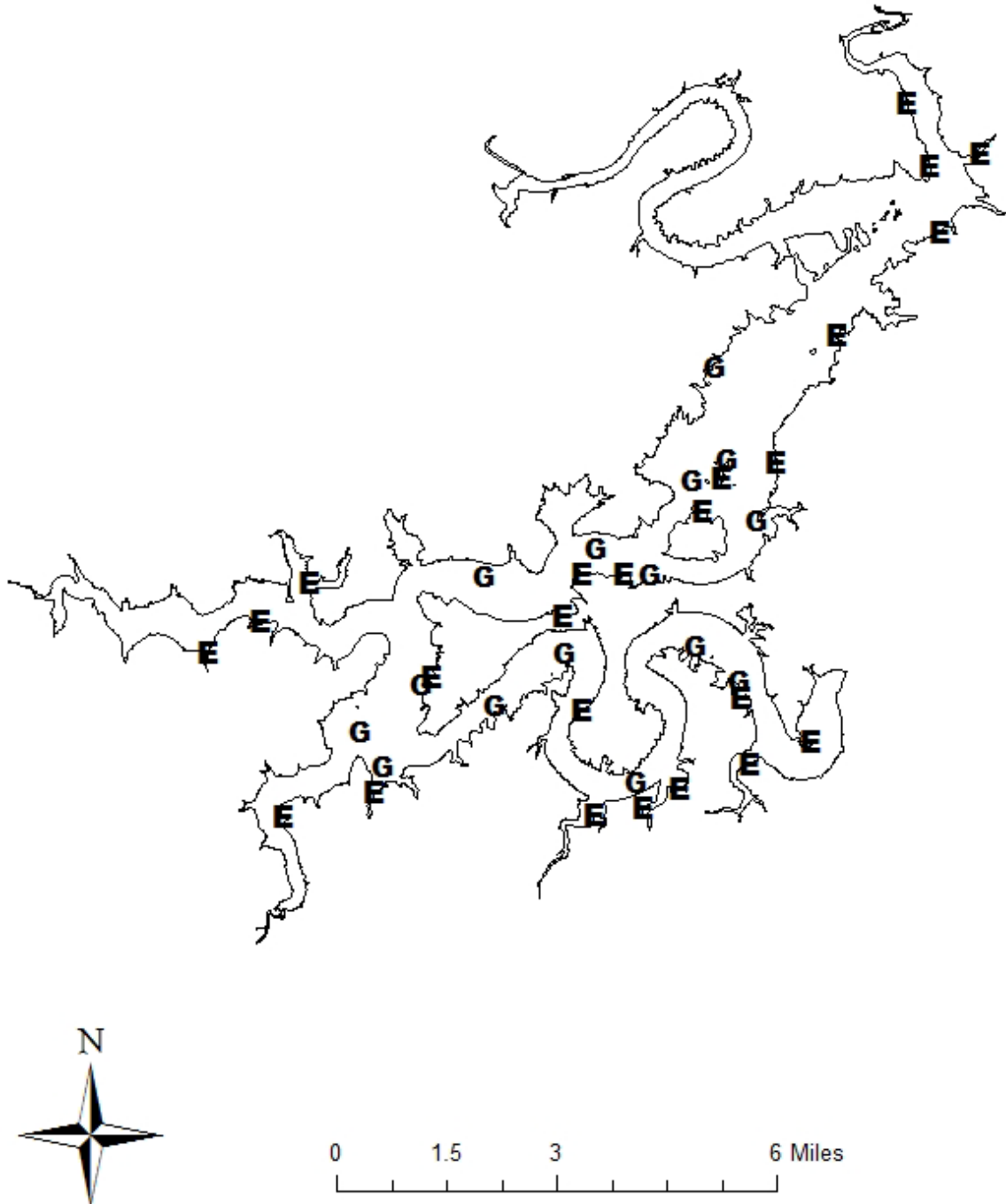
	Survey year			
	2019-2020	2020-2021	2021-2022	2022-2023
Angler Access				S
Vegetation				S
Electrofishing – Fall		A		S
Gill netting		A		S
Creel survey		A		
Report				S

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

Number (N) and catch rate (CPUE) (RSE in parentheses) of all target species collected from all gear types from Possum Kingdom Reservoir, Texas, 2018-2019. Sampling effort was 15 net nights for gill netting and 2 hours for electrofishing.

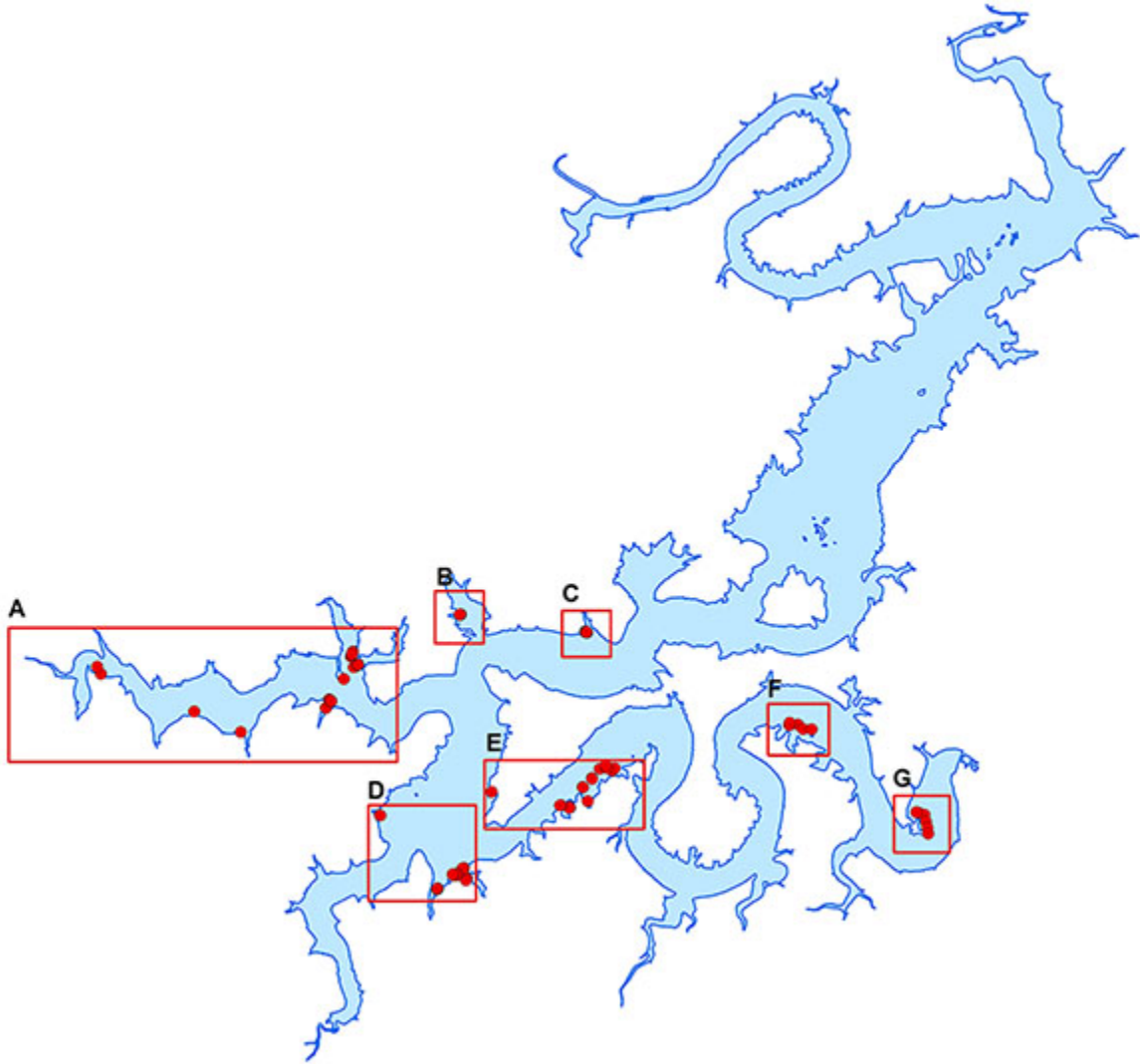
Species	Gill Netting		Electrofishing	
	N	CPUE	N	CPUE
Gizzard Shad	98	6.5 (28)	504	252.0 (21)
Threadfin Shad			12	6.0 (76)
Common Carp	19	1.3 (26)		
River Carpsucker	4	0.3 (57)		
Smallmouth Buffalo	53	3.5 (25)		
Blue Catfish	51	3.4 (22)		
Channel Catfish	46	3.1 (20)		
White Bass	35	2.3 (28)		
Striped Bass	71	4.7 (18)		
Green Sunfish			109	54.5.0 (36)
Warmouth			6	3.0 (36)
Bluegill			470	235.0 (22)
Longear Sunfish			39	19.5 (31)
Redear Sunfish			4	2.0 (47)
Largemouth Bass	6	0.4 (41)	53	26.5 (20)
White Crappie	11	0.7 (34)		
Black Crappie	3	0.2 (53)		
Freshwater Drum	1	0.1 (100)		

APPENDIX B – Map of sampling locations

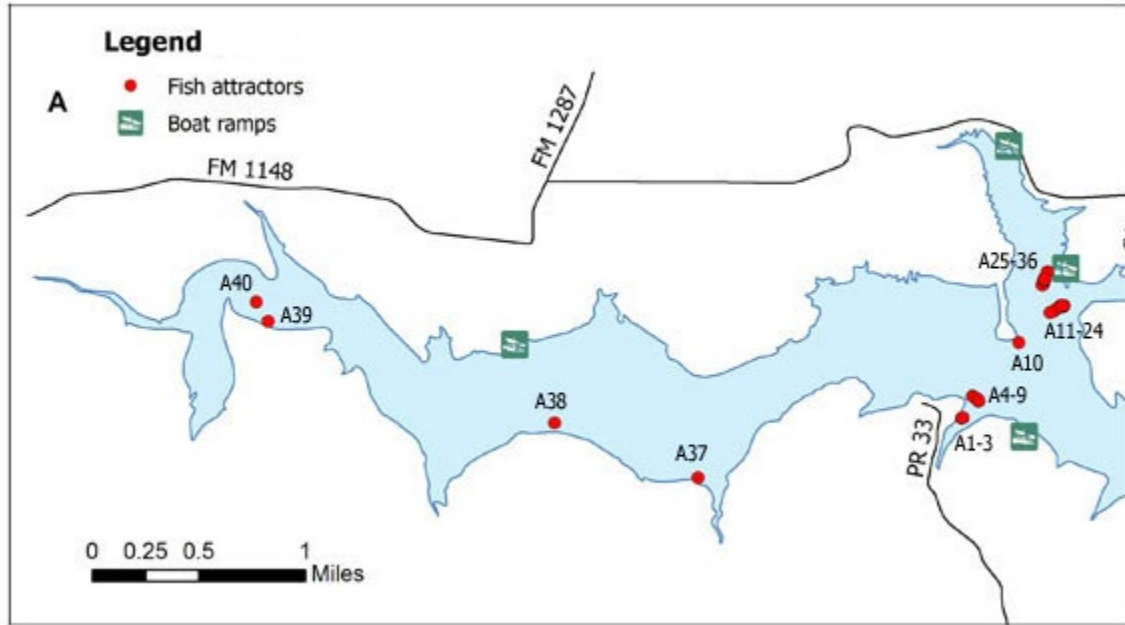


Location of sampling sites, Possum Kingdom Reservoir, Texas, 2018-2019. Gill net and electrofishing stations are indicated by G and E, respectively. Water level was near full pool at time of sampling.

APPENDIX C – Locations of habitat placement

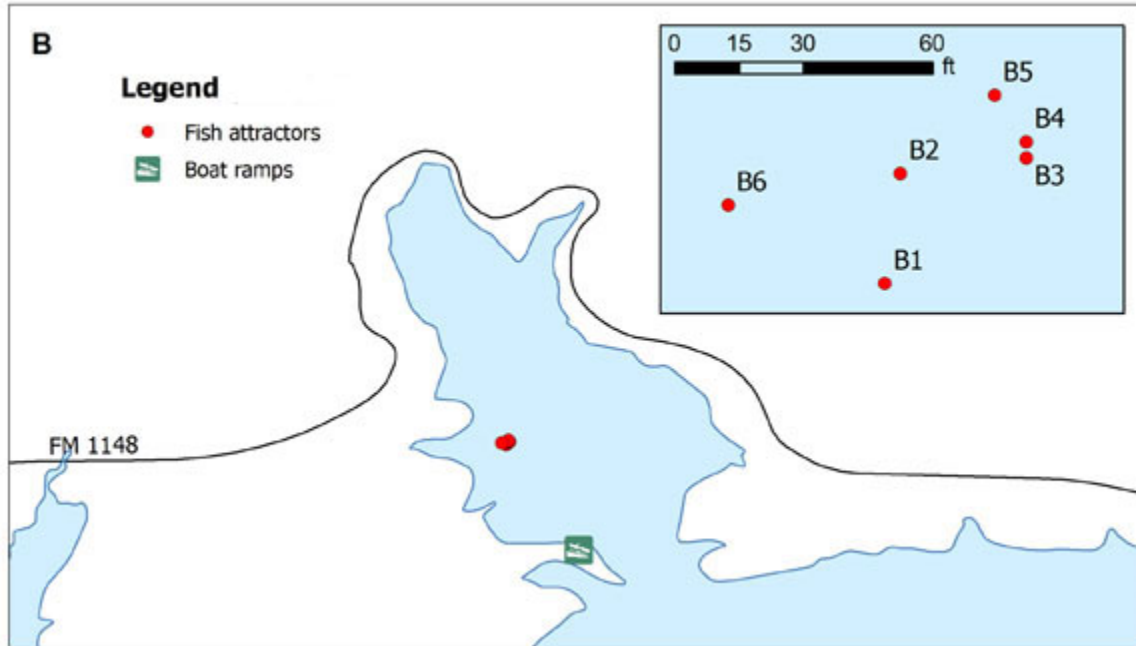


Area A - Cedar Creek Arm



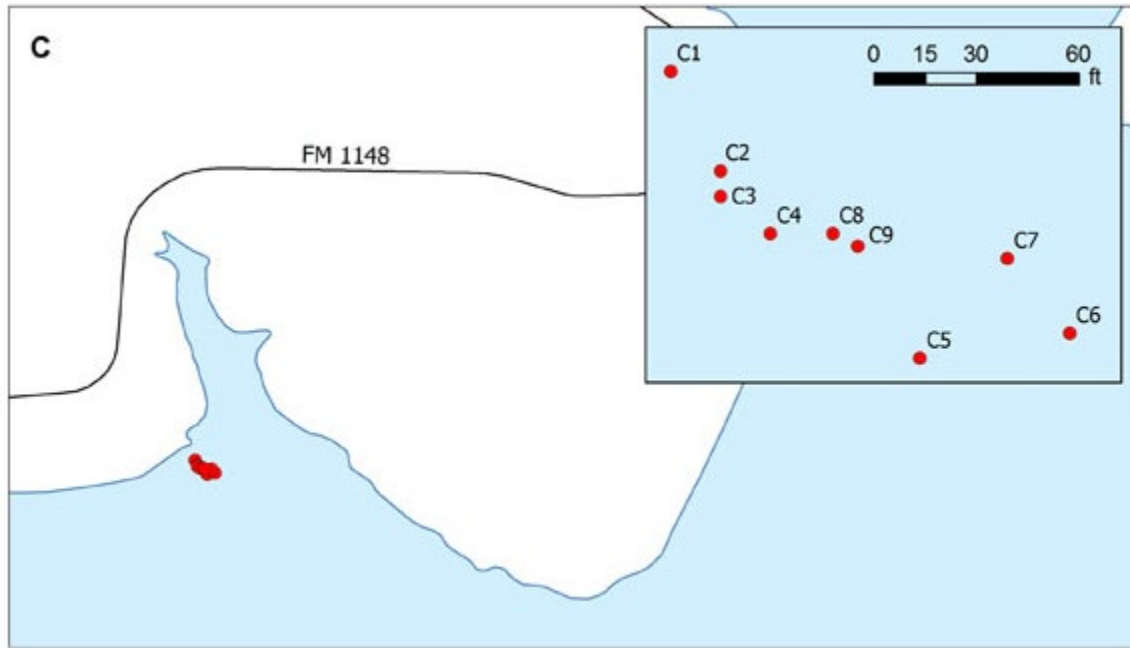
Site	Latitude	Longitude	Site	Latitude	Longitude
A1	32.88176	-98.5597	A21	32.88916	-98.55324
A2	32.88181	-98.5596	A22	32.88893	-98.55369
A3	32.88178	-98.55963	A23	32.88928	-98.553
A4	32.88326	-98.55896	A24	32.8894	-98.55285
A5	32.8829	-98.55854	A25	32.89169	-98.55384
A6	32.88323	-98.55892	A26	32.89126	-98.55406
A7	32.883	-98.55857	A27	32.89084	-98.55419
A8	32.8831	-98.55864	A28	32.89082	-98.55416
A9	32.88295	-98.55855	A29	32.89095	-98.55412
A10	32.88689	-98.55579	A30	32.89079	-98.55422
A11	32.8894	-98.55297	A31	32.89108	-98.55413
A12	32.88934	-98.55279	A32	32.89115	-98.55407
A13	32.8893	-98.55299	A33	32.89159	-98.55391
A14	32.88929	-98.55293	A34	32.89114	-98.55407
A15	32.8894	-98.55273	A35	32.89119	-98.55408
A16	32.88941	-98.55281	A36	32.8912	-98.55407
A17	32.88931	-98.55302	A37	32.87774	-98.57758
A18	32.88902	-98.55343	A38	32.88833	-98.60678
A19	32.88934	-98.55298	A39	32.88146	-98.58733
A20	32.88942	-98.5529	A40	32.88963	-98.60758

Area B - Rocky Hollow



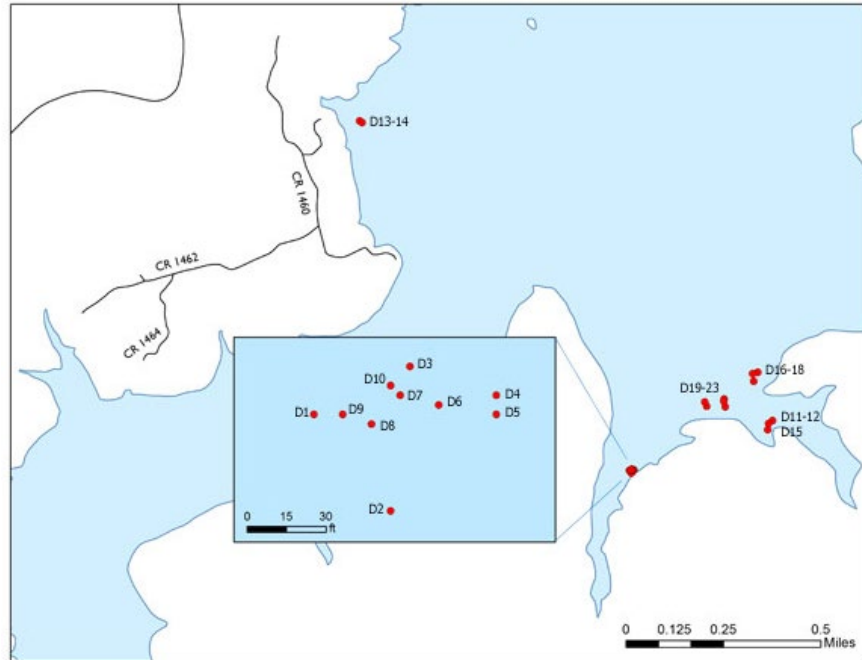
Site	Latitude	Longitude
B1	32.89794	-98.5312
B2	32.89801	-98.53119
B3	32.89802	-98.53111
B4	32.89803	-98.53111
B5	32.89806	-98.53113
B6	32.89799	-98.5313

Area C - Peanut Patch



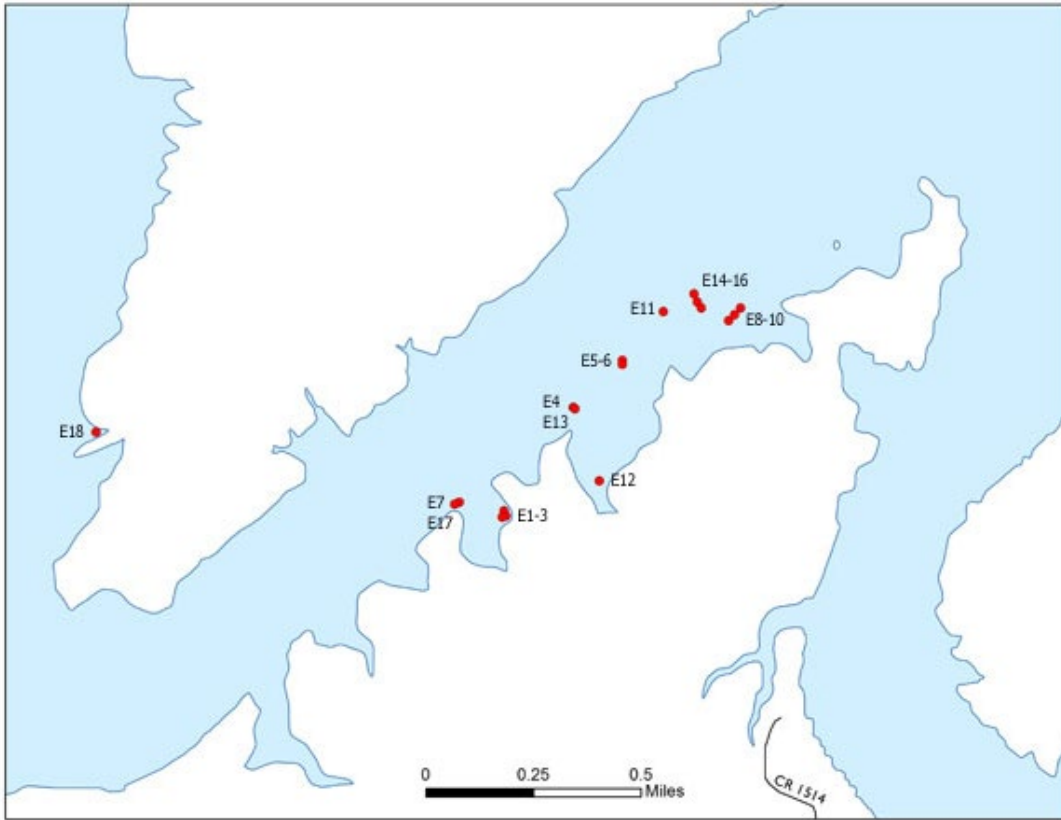
Site	Latitude	Longitude
C1	32.89472	-98.50495
C2	32.89464	-98.50491
C3	32.89462	-98.50491
C4	32.89459	-98.50487
C5	32.89449	-98.50475
C6	32.89451	-98.50463
C7	32.89457	-98.50468
C8	32.89459	-98.50482
C9	32.89458	-98.5048

Area D - Bee Creek & Long Hollow



Site	Latitude	Longitude
D1	32.84954	-98.53687
D2	32.84944	-98.53679
D3	32.84959	-98.53677
D4	32.84956	-98.53668
D5	32.84954	-98.53668
D6	32.84955	-98.53674
D7	32.84956	-98.53678
D8	32.84953	-98.53681
D9	32.84954	-98.53684
D10	32.84957	-98.53679
D11	32.851324	-98.53051
D12	32.851218	-98.530699
D13	32.862696	-98.5486
D14	32.862635	-98.548501
D15	32.850983	-98.530735
D16	32.853133	-98.531141
D17	32.8528	-98.531321
D18	32.853088	-98.531366
D19	32.851861	-98.532601
D20	32.852156	-98.532646
D21	32.852066	-98.532655
D22	32.851891	-98.533421
D23	32.85205	-98.533502

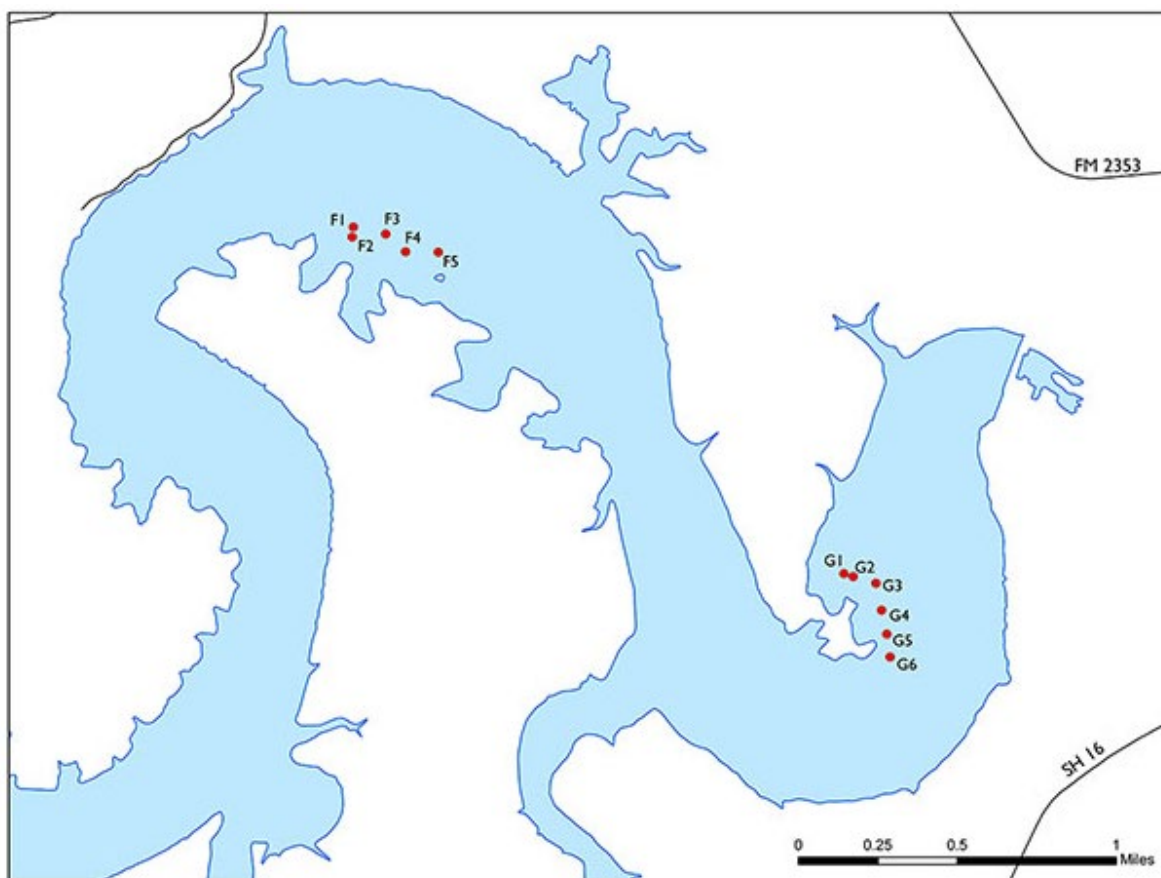
Area E - Lower Lake



Site	Latitude	Longitude
E1	32.863718	-98.508797
E2	32.863551	-98.508715
E3	32.863514	-98.508869
E4	32.867178	-98.505975
E5	32.868737	-98.503992
E6	32.868601	-98.503983
E7	32.864036	-98.510572
E8	32.870229	-98.499468
E9	32.870024	-98.499711
E10	32.870448	-98.499233
E11	32.870365	-98.502316
E12	32.864687	-98.504966
E13	32.867132	-98.505903
E14	32.870675	-98.500955
E15	32.870471	-98.500802
E16	32.87094	-98.501081
E17	32.863975	-98.510762
E18	32.866565	-98.525057

Area F - Gaines Bend

Area G - Frank Harris Bend



Site	Latitude	Longitude
F1	32.87763333	-98.46241667
F2	32.87808333	-98.46243333
F3	32.87773333	-98.46245
F4	32.87691667	-98.46246667
F5	32.87688333	-98.46248333

Site	Latitude	Longitude
G1	32.86191667	-98.4625
G2	32.86176667	-98.46251667
G3	32.86145	-98.46253333
G4	32.86023333	-98.46255
G5	32.85911667	-98.46256667
G6	32.85808333	-98.46258333



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