

Brushy Creek

2018 Fisheries Management Survey Report

PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

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Survey and Management Summary

The fish population of Brushy Creek was surveyed in the fall of 2018 and the spring of 2019 using boat electrofishing (lotic portions) and backpack electrofishing (lentic portions) of the system. Roving creel surveys were conducted in fall of 2018 and spring of 2019. There are no known previous creel or angler utilization surveys for the Brushy Creek system. This report summarizes the results of the surveys and contains a management plan for Brushy Creek based on the findings.

Stream Description:

Brushy Creek is located within the Brazos River basin. Brushy Creek originates west of Cedar Park, Texas in Williamson County and flows east through Williamson and Milam for approximately 75 miles before its confluence with the San Gabriel River in eastern Milam County. Within Milam County, the San Gabriel River joins the Little River which flows a short distance to the Brazos River. In total, Brushy Creek has a watershed of approximately 380,000 acres. This report covers approximately 10 miles of Brushy Creek within the vicinity of Cedar Park and Round Rock, Texas. The surface area of this segment is approximately 82.5 acres. The total watershed contributing to this stretch of the stream is approximately 98,000 acres.

Management History:

Management efforts within this stream stretch have historically been limited to Brushy Creek Reservoir. The reservoir is currently managed under community fishing lakes regulations, with an exception for Largemouth Bass having an 18-inch minimum length limit. Adult Florida Largemouth Bass were stocked in 2014 and Channel Catfish sub-adults stocked intermittently since 2001. Native aquatic vegetation plantings were conducted to improve sunfish habitat in 2014.

Important angling species for Brushy Creek Reservoir include Largemouth Bass, White Crappie, Channel Catfish, Common Carp, Guadalupe Bass, Rio Grande Cichlid, and various sunfishes (Bluegill, Redbreast Sunfish, Longear Sunfish, Green Sunfish, Warmouth).

Fish Community

- **Prey species:** Primary prey species include Gizzard Shad, various sunfishes, and shiners. Within the lotic portions, Blacktail Shiners and Central Stonerollers were the most common prey species.
- **Common Carp:** Common Carp are present throughout the system with the highest abundance in the impounded areas.
- **Catfishes:** Channel and Flathead Catfish are present in the impounded and the stream portions of Brushy Creek but relative abundance was low. The use of a boat and backpack electrofishing during this study may have played a role in the low number of catfish collected due to gear bias.
- **Black basses:** Largemouth Bass and Guadalupe Bass are present throughout the system. Guadalupe Bass tend to relate strictly to lotic portions.

Management Strategies:

Propose extending the same harvest regulations for Brushy Creek Reservoir to the entire Brushy Creek system in Williamson County. Propose the prohibition of cast netting on the entire Brushy Creek system in Williamson County. Inform the public about the negative impacts of aquatic invasive species. Perform vegetation survey of Brushy Creek Reservoir in 2020. Conduct standard surveys including boat and backpack electrofishing and angler access surveys in 2022/2023 and baited hoop nets in Brushy Creek Reservoir in Spring 2023. Conduct a spring creel survey in 2023.

Introduction

This document is a summary of fisheries data collected from Brushy Creek in the fall of 2018 and spring of 2019. The study area encompasses the stream from the Brushy Creek Sports Complex in Cedar Park and goes east for approximately 10 miles to Play for All / Rabb Park (Rabb) in Round Rock. Fish populations were surveyed using boat and backpack electrofishing in fall and spring, as well as an angler creel survey was conducted in the fall and spring. 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 is presented with the 2018/2019 data for comparison.

Stream Description

Brushy Creek is located within the Brazos River basin and originates west of Cedar Park in Williamson County. From its origin, Brushy Creek flows east through Williamson and Milam Counties for approximately 75 miles before its confluence with the San Gabriel River in eastern Milam County. Within Milam County, the San Gabriel River joins the Little River which flows a short distance to the Brazos River. In total, Brushy Creek has a watershed of approximately 380,000 acres. However, this report covers approximately 10 miles of Brushy Creek within the vicinity of Cedar Park and Round Rock. The surface area of this segment is approximately 82.5 acres. This survey segment also includes several impounded areas (including Brushy Creek Reservoir and Veterans Park Pond). Brushy Creek Reservoir is a 30-acre flood control reservoir located in Cedar Park on the South Fork Brushy Creek. Veterans Park Pond is an approximately 5-acre impoundment located adjacent to downtown Round Rock on the main stem of Brushy Creek. The survey area begins immediately upstream of Brushy Creek Reservoir on the South Fork Brushy Creek (adjacent to the Brushy Creek Sports Complex). The survey area continues downstream beyond the confluence with the main stem of Brushy Creek ending at Rabb Park directly east of A.W. Grimes Boulevard in Round Rock. Within the western or upper portion of the survey area, the creek flows through the Edwards Plateau Ecoregion and the eastern or lower portion within the Blackland Prairie Ecoregion. The watershed area contributing to the surveyed stretch of stream is approximately 98,000 acres and has become highly urbanized in last 10-20 years.

Apart from four naturally and artificially impounded segments within the survey area (including Brushy Creek Reservoir and Veterans Park), Brushy Creek is predominantly a shallow, clear water, narrow and fast flowing stream with a narrow riparian zone along its course. A Texas Commission of Environmental Quality (TCEQ) Recreation Use Attainability Analyses report evaluated a portion of Brushy Creek in the surveyed area and documented the average thalweg depth at 2.5 feet and the average width at 47.5 feet (Guillen and Wrast 2010). The dominant substrate along the survey area was generally composed of limestone bedrock, cobble, and gravel in upstream segments. Mud, clay, sand and silt substrate dominated the segments east of Interstate 35. The stream itself is state owned property, including the stream bottom, however the Upper Brushy Creek Water Control and Improvement District (WCID) is responsible for operation and maintenance of 23 flood control structures, including Brushy Creek Reservoir, within the Upper Brushy Creek watershed. Brushy Creek Reservoir was constructed in the 1960s by the U.S. Soil Conservation Service, and the dam underwent major structural improvements in 2016-2017 to improve its flood mitigation capabilities.

Williamson County including the area within the Brushy Creek watershed continues to experience unprecedented population growth with an estimated 34% increase in population from 2010 through July 2018 (U.S. Census Bureau 2019) making it one of the fastest growing areas in the country. Further, 88% of the population of Cedar Park and Round Rock and 84% of the population of Leander is within the Brushy Creek watershed (WCID 2017).

Brushy Creek is susceptible to large water fluctuations due to runoff from periodic heavy rain events (Figure 1). Although high flow pulse events generally provide positive ecological impacts to stream health, these pulse flood events can prevent anglers from safely accessing and fishing the stream. Other characteristics of Brushy Creek are presented in Table 1.

Angler Access

Public access to Texas rivers can be complicated by many factors including: variability of access conditions, poorly defined access areas, remote locations, extent of privately-owned land, conflict between landowners and recreational users, legal entry and liability concerns, logistics for entry and exit points, and overnight camping (Baker 1998). In a web-based survey conducted by Texas Tech University, river and stream anglers were asked “What is the most important thing that Texas Parks and Wildlife Department (TPWD) could do to get more people out fishing rivers and streams?” Respondents recommended increasing secure parking areas, increasing safe access, providing more public access in general, and providing more information about available access (Thomas et al. 2015).

This stretch of Brushy Creek has numerous public access points for angling along with sufficient parking areas (Table 2). Further, the Brushy Creek multi-use trail links these parking and public access points allowing access to long swaths of the stream to anglers capable and willing to walk / bike the trail. The Brushy Creek Regional Trail system has planned expansions and new connections to parks in the coming years which will ultimately create additional public angling access to the stream.

The best available kayak fishing public access was at Brushy Creek Reservoir and Veterans Park Pond where deeper water and parking near the water is available. Further, Brushy Creek Reservoir has a kayak rental station along with a kayak launch at the park. At both locations parking was close in proximity to deeper water. Both locations also provide abundant shoreline angling access as well as a fishing pier at Brushy Creek Reservoir. The other areas of Brushy Creek (predominantly the stream areas) generally have a thick wooded riparian buffer along the creek margins. Access to these areas is available mostly through primitive and undeveloped foot trails established by anglers to the various creek sections. Stream access is readily available to anglers capable and willing to wade in the shallow stretches.

Management History

Previous management strategies and actions: No previous fisheries management strategies or actions are present for the areas of Brushy Creek outside of Brushy Creek Reservoir. Management strategies and actions for Brushy Creek Reservoir from a 2013 assessment (Farooqi and De Jesus 2013) included:

1. Investigate the feasibility of conducting habitat improvement projects (e.g., shoreline vegetation plantings and installation of gravel beds to promote the sunfish population and benefit other species.

Action: In June of 2014, a total of 144 colonizing plants representing four species (American water-willow, arrowhead, square-stem spikerush and flat-stem spikerush) were planted in the littoral zone at the upper end of Brushy Creek Reservoir. These sites have not been evaluated since the plantings. The feasibility of installing gravel beds has yet to be determined.

2. Request stockings of 9-inch Channel Catfish for fall 2014

Action: 1,083 Channel Catfish were stocked in 2014. Similar numbers were stocked in 2016, 2017, and 2018.

Harvest regulation history: Currently, sportfish species in the Brushy Creek system are managed under two sets of regulations.

Brushy Creek Reservoir has been regulated under TPWD’s Community Fishing Lake (CFL) designation since 2002 when the City of Cedar Park developed an approximately 51-acre public city park adjacent to Brushy Creek Reservoir. In anticipation of increased angler utilization of Brushy Creek Reservoir, the Largemouth Bass harvest regulation was set at 18-inch minimum length limit and a five fish daily bag limit. This regulation remains effective. There is no minimum length limit for Channel Catfish and a bag

limit of 5 fish. Statewide bag and length limit harvest regulations apply for other species. Fishing is by pole and line only (use of cast nets prohibited), and only two poles may be used at a time per angler.

The remaining areas of Brushy Creek (stream portion along with Veterans Park Pond) are managed under statewide bag and length limit harvest regulations for all sportfish. Largemouth Bass have a 14-inch minimum length limit and a 5 fish bag limit and Channel Catfish have a 12-inch minimum length limit and a 25-fish bag.

Current regulations are summarized in Table 3.

Stocking history: Brushy Creek Reservoir has been stocked with 9-inch Channel Catfish in 2001, 2013, 2014, 2016, 2017, and 2018. Adult Florida Largemouth Bass were stocked in 2014. The complete stocking history is in Table 4. There is no record of stocking by TPWD within the other portions of the Brushy Creek system. However, numerous upgradient ponds and flood control reservoirs likely contribute fish to the Brushy Creek system during periods of high flow.

Vegetation/habitat management history: Aquatic vegetation within Brushy Creek Reservoir and the stream portions of Brushy Creek appears to be minimal. In 2014, TPWD initiated planting of native aquatic vegetation in the upper end of Brushy Creek Reservoir to help stimulate an increase in forage fish species in the water body. These planted areas have not been officially evaluated by TPWD since their installation.

Instream Flow: Brushy Creek is considered a gaining stream within the Edwards Aquifer recharge zone where the base flow is fed by aquifer spring flow (SWCA 2015). Median flow in Brushy Creek is approximately 55 cubic feet per second (CFS) over the course of a full year. However, low-flow conditions during summer may dip below 5 CFS for extended periods. Contrasting with low-flow periods, surface runoff from the watershed during rainfall events can rapidly and substantially increase stream discharge through the system often resulting in flash flooding. These high flow events in the system may be increasing in frequency and magnitude due to urbanization in the watershed through the increase of impervious surfaces. This process can serve to accelerate the removal of water from some locations but to deliver larger, faster flows downstream to points where the capacity to receive higher stream flows does not exist (Berg 2018). High stream flow events exceeding 2,000 CFS have occurred on 14 separate occasions in the last five years. Although high stream flows events generally provide positive ecological impacts to stream health, such events can severely reduce angler utilization of Brushy Creek.

During periods where watershed runoff is insufficient to provide consistent flow through the system and groundwater discharge is also reduced, treated wastewater effluent likely plays a vital role in maintaining stream flow. Within the vicinity of the study area, there are two wastewater treatment plants (WWTPs) that discharge treated effluent directly into Brushy Creek. The Cedar Park WWTP, approximately 1.5 miles upgradient of Brushy Creek Reservoir, discharges approximately 3.5 CFS of effluent into South Brushy Creek at a near constant rate. The Brushy Creek WWTP, located approximately 1.8 miles downgradient of Rabb Park discharges approximately 25.5 CFS of treated effluent into Brushy Creek at a constant rate (EPA ECHO 2019). A map showing the locations of the WWTPs is provided in Appendix C. By maintaining flow through the system, these effluent discharges play a major role in maintaining lateral and longitudinal connectivity of stream habitats and the fishery that depends on them.

Methods

Fishery surveys were conducted to achieve sampling objectives in accordance with the objective-based sampling (OBS) plan for Brushy Creek (TPWD unpublished). Primary components of the OBS plan are listed in Table 5. All survey sites were selected to most accurately represent the available habitat types present. All surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

Electrofishing –Fish sampling efforts were performed using boat electrofishing on the lentic/impounded portions of the survey area (Brushy Creek Reservoir and Veterans Park) and backpack electrofishing on the lotic / flowing portions.

Boat Electrofishing – For Brushy Creek Reservoir and Veterans Park (lentic / impounded areas of the stream), all fish were collected by night boat electrofishing (low voltage, 8-10 amps and 60 pulses per second, 0.4 hours at 5 stations at 5 minutes each) in the fall of 2018.

Backpack electrofishing (4 amps, adjustable voltage, two netters) on the stream portions of Brushy Creek was performed in fall 2018 and spring 2019. The purpose of backpack electrofishing for two sequential seasons was to document any fish community changes that may occur between the two seasons. Effort was 0.33 hours (i.e., 4 stations at 5 minutes each) in the fall of 2018 and 0.42 hours (i.e., 5 stations at 5 minutes each) in spring 2019.

For both boat and backpack electrofishing, catch-per-unit effort (CPUE) was recorded as the number of fish caught per hour (fish/h) of actual electrofishing. All electrofishing stations were chosen by the biologist to represent the various habitats available on Brushy Creek and their proximity to public angling access points.

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 and creel statistics.

Creel survey – Roving creel surveys were performed during the fall (September through November) 2018 and spring (March through May) 2019 to assess the fall and spring fishery characteristics and angler opinions within the entire study area of Brushy Creek. Fifteen survey days were conducted during each of the two quarters to assess angler use and fish catch/harvest statistics in accordance with the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2017). Additional questions regarding angler satisfaction of the fishery and how often anglers fished Brushy Creek were also included. Further, spatial location data of interviewed anglers as well as if the angler was fly fishing was also recorded. Analysis of spatial location data will help determine high angler concentration areas on the system, and the fly angler data will help establish baseline abundance of this potentially growing user group. This data can also be used to influence future public access locations.

Habitat: No standard habitat surveys have been conducted on the entire stretch of Brushy Creek in the study area by TPWD. Habitat parameters were documented within the backpack electrofishing survey sampling areas.

Hydrograph – The source for water discharge data was the United States Geological Survey (USGS) streamflow gauge 08105883 on Brushy Creek at Interstate 35, Round Rock, Texas.

Results and Discussion

Habitat: A comprehensive mesohabitat survey has not been performed on Brushy Creek. However, within the backpack electrofishing stations, habitat parameters were recorded per the Texas Inland Fishery Assessment Procedures River/Stream Survey Methods. In summary, the backpack electrofishing stations covered the entire range of available habitat types in Brushy Creek including riffles, runs, glides, and pools. Further, substrate typically consisted of gravel and bedrock in the upper reaches and mud, silt, and bedrock in the lower reaches (e.g. Rabb Park area east of Interstate 35).

Creel: A roving creel survey was conducted from September through November 2018 and March through May 2019 to establish baseline data for fisheries management decisions. During the creel surveys of fall 2018 and spring 2019, a total of 131 and 222 anglers were intercepted, respectively. Total fishing effort for all species during the fall 2018 was 7,568 angler hours and during the spring of 2019 was 13,390 angler hours for a two-quarter total of 20,958 angler hours. (Table 6). This total is comparable to the findings on the Lower Colorado River, Texas during two creel quarters in which 21,560 angler hours were calculated (Cummings and De Jesus 2017). However, the angler effort on Brushy Creek is much higher on a per-mile basis due to a 9.5-mile survey area compared to the 151 miles of the Colorado River surveyed.

The increase in angler hours from the fall of 2018 to the spring of 2019 corresponds with an increase in direct expenditures during the same time. Direct expenditures were estimated at \$20,572 in the fall of 2018 and \$37,798 in the spring of 2019 (Table 7). The increase in angling hours and expenditures may be a consequence of multiple creel days in the fall occurring on days with heavy rain and high stream flow which deters angling on Brushy Creek.

In fall 2018 and spring 2019, 37% and 19% of angler directed effort was toward “anything”, respectively. Additionally, 28.9% (fall 2018) and 45.8% (spring 2019) of direct angler effort was toward the “black basses”, which for Brushy Creek would include Largemouth Bass and Guadalupe Bass, and situations in which the angler is targeting any of the species of black bass (Table 6). The data indicate that Largemouth Bass fishing increased in popularity in the spring season. For both quarters, 18% of total effort was toward Common Carp and approximately 9% was toward any species of catfish.

Channel Catfish and Common Carp were the most harvested species on Brushy Creek in fall 2018 and spring 2019. An estimated 1,467 Channel Catfish were harvested during two quarters comprising 55% of total harvest. An estimated 367 Common Carp were harvested during two quarters comprising 14% of total harvest. Very little harvest was documented for black bass and crappie.

Most anglers were local, with 85% traveling less than 25 miles to reach Brushy Creek. Three ZIP codes from the Round Rock and Cedar Park area represented 41% of anglers surveyed. An angling party from Massachusetts were the only out-of-state anglers. Zip code data is presented in Appendix D.

Additional information was gathered related to gear type (fly or conventional rod/reel and spatial location on the system) and angler opinion. In total, 10% of all anglers intercepted during creels on Brushy Creek were fly anglers and the remaining 90% utilized conventional rod and reel gear. Further, 47% of all anglers surveyed were at Brushy Creek Reservoir, 16% Veterans Park, 12% Champion Park, and the remaining 25% were located relatively evenly across the six other access points (Appendix C). Angler opinions were assessed regarding their satisfaction of the overall Brushy Creek fishery. 57% of respondents indicated they were very satisfied with the fishery and only 11% indicated they were unsatisfied. The remaining 33% had a neutral opinion (neither satisfied or unsatisfied) with the fishery. Respondents with a high degree of satisfaction indicated that they enjoyed the convenience and scenery of the stream while those who had a low degree of satisfaction indicated that the fish were too hard to catch.

Prey species: Boat electrofishing catch rate for Gizzard Shad on the lentic areas was 76.8 fish/hour with an IOV of 41. The IOV for Gizzard Shad was 41% indicating many Gizzard Shad in the reservoir are too large for Largemouth Bass to consume (Figure 2). Boat electrofishing catch rates for Redbreast Sunfish was 28.8 fish/h with a PSD of 100 (Figure 3). For backpack electrofishing, Redbreast Sunfish CPUE for both quarters was 462.0 fish/h with many fish ranging from 6 to 8 inches. (Figure 4). Boat electrofishing CPUE of Bluegill in fall 2018 was 50.4 fish/h and a PSD of 6 with most fish ≤ 4 inches in length (Figures 5). For backpack electrofishing, Bluegill CPUE for both quarters was 214.0 fish/h with an abundance of small (≤ 4 -inch) fish (Figure 6). Longear Sunfish CPUE for backpack electrofishing for both quarters was 112 fish/h with an abundance of 4 to 5-inch fish (Figure 7).

Backpack electrofishing on the stream portions of Brushy Creek indicated an abundance of additional small prey fish. Blacktail Shiners were the most abundant minnow (Cyprinid) species throughout the system with an average CPUE for the two quarters at 140 fish/h (Appendix A). Rio Grande Cichlids, though not well represented in the backpack electrofishing sample, are present in Brushy Creek and are popular amongst fly anglers. Other available fish forage collected in lower numbers included Western Mosquitofish, Green Sunfish, Warmouth, Central Stoneroller, Rio Grande Cichlid, Sailfin Molly, and Orangethroat Darter.

Common Carp: Common Carp boat electrofishing catch rate in fall 2018 was 76.0 fish/h with numerous fish between 16 and 20 inches (Figure 8). Common Carp were seen throughout the system but were difficult to collect using the backpack electrofishing gear. Common Carp were the third most targeted by anglers with 17.8% of all directed effort toward this species (Table 6). There was some harvest of Common Carp documented with an estimated 366.6 fish harvested over the two-quarter period (Table 9). Harvested Common Carp ranged from 16 to 24 inches (Figure 9). Though most anglers targeting Common Carp utilized traditional rod and reel gear, multiple fly-fishing anglers targeting Common Carp were intercepted during the creel surveys.

Channel Catfish: No Channel Catfish were collected during the boat electrofishing surveys and only 6 small (< 8 inches) catfish were collected during both backpack electrofishing surveys. The use of electrofishing during this study may have played a role in the low number of catfish collected due to gear bias. However, the roving creel survey during both quarters indicated that legal-sized catfish were present throughout the system, and anglers were harvesting these fish. Only 0.8% of anglers were specifically targeting Channel Catfish, however, 8.8% of anglers were targeting any species of catfish thus making catfish the fourth most targeted group in Brushy Creek (Table 6). Harvest of Channel Catfish was also documented with an estimated total harvest of 1,467 legal fish over the two-quarter period (Table 9) with fish ranging in size from 12 to 22 inches in length (Figure 10). Consistent stocking of Channel Catfish into Brushy Creek Reservoir has been performed by TPWD since 2002.

Largemouth Bass: The boat electrofishing survey revealed a moderate- to high density Largemouth Bass population. Total catch rate for Largemouth Bass was 91.0 fish/h; with a catch rate of fish over 18 inches at 4.8 fish/h and over 14 inches at 24 fish/h (Figure 11). Population size structure was good; population indices (PSD = 54 and PSD-P = 29) were close to the expected range (PSD 40 to 70, PSD-P 10 to 40) for a balanced population (Gabelhouse 1984). The largest bass measured 19 inches in length. Body condition for most Largemouth Bass was acceptable as average relative weights (W_r) for adult inch-groups ranged from 80% to 110%. (Figure 11). Although it was not the case for this survey, mean relative weights below 85%, for a majority of size groups, would be indicative of poor condition. Largemouth Bass were the most targeted species with 35.6% of angler effort going toward this species for the two-quarter period (Table 6). Harvest was very low for Largemouth Bass on Brushy Creek with an 88.9% legal fish release rate (Table 10). Only one angler harvesting Largemouth Bass was intercepted during the creels. This angler had harvested two fish (19 and 20 inches) from Brushy Creek Reservoir where there is an 18-inch minimum length limit (Figure 13).

For the stream portions of Brushy Creek, the backpack electrofishing catch rate for Largemouth Bass was 51.0 fish/h in the fall of 2018 and 38.4 fish/h in spring of 2019 (Figure 13). Relative weight was moderate for both sampling quarters, ranging from 80 to 100.

Guadalupe Bass: Backpack electrofishing catch rate for Guadalupe Bass was 27.0 fish/h in fall 2018 and 14.4 fish/h in spring 2019. The size range of Guadalupe Bass collected was 4 to 9 inches (Figure 14). Only 2% of anglers during the creel stated they were specifically targeting Guadalupe Bass while nearly 46% targeted black bass in general.

Guadalupe Bass have been listed as a species of special concern (Hubbs et al. 2008), mainly due to hybridization with Smallmouth Bass (Garrett 1991). Guadalupe Bass also hybridize with Spotted Bass in certain areas of Texas but this hybridization is considered a natural occurrence in areas of range overlap (Lutz-Carrillo et al. 2018). The San Gabriel River, which is hydrologically connected to Brushy Creek and is within the native range of Spotted Bass, showed high introgression of Spotted Bass and Guadalupe Bass (TPWD unpublished). However, hybridization does not appear to be an issue in Brushy Creek as 8 out of 9 fin clips submitted from the fall 2018 backpack electrofishing sample revealed to be pure Guadalupe Bass. The single non-pure Guadalupe Bass showed to have 91% Guadalupe Bass alleles (with the remaining being either Largemouth or Spotted Bass) (Table 11). Further, all Guadalupe Bass collected during the Brushy Creek surveys occurred downgradient of Brushy Creek Reservoir. No Guadalupe Bass were collected in Brushy Creek Reservoir or in the upgradient stream. Based on the known data, Brushy Creek may provide unique and important habitat / refuge for Guadalupe Bass within the San Gabriel River watershed.

Fisheries Management Plan for Brushy Creek, Williamson County, Texas

Prepared – July 2019

ISSUE 1: This segment of Brushy Creek hosts a tremendous amount of fishing pressure within a complex metropolitan area. The stream itself fishes small, with a flow heavily supported by localized effluents from water treatment plants. Brushy Creek is truly an urban fishery with its multiple public access sites through city parks and right-of-ways. The creel surveys revealed that the angler base is very diverse, with harvest apparent for certain species. The creek lies within one of the fastest growing metropolitan areas in the country, potentially negatively impacting fishing experiences if harvest increases. Brushy Creek Reservoir, which is regulated under Community Fishing Lake regulations, while the other portions of Brushy Creek are managed under statewide regulations. This discrepancy may be confusing to anglers who access different segments of the Brushy Creek area. Regulating this creek segment uniformly would improve understanding and enforcement of harvest regulations and protect the quality of the fishery.

MANAGEMENT STRATEGIES

1. Propose that the same regulations on Brushy Creek Reservoir be applied throughout the entire creek system within Williamson County. Remove the 18-inch Largemouth Bass regulation on Brushy Creek Reservoir and apply the statewide Largemouth Bass harvest regulation (minimum length limit of 14-inches) throughout the Brushy Creek system.
2. Work with the managing authorities of the parks (cities, counties, other entities) on posting signage at angling access areas that convey the regulations.

ISSUE 2: Many cast netters were documented to be present on Brushy Creek throughout the creel surveys. It is likely that cast nets have a negative impact on forage and sport fishes of Brushy Creek, particularly sunfish. Creel surveys revealed black basses as the most sought-after species in the segment. Sunfish are an important forage for black basses in this system. Furthermore, we observed quality-size sunfish and Rio Grande Cichlids that provide small water anglers with nice pan fishing opportunities. In Brushy Creek Reservoir, we have made efforts with partners to improve aquatic vegetation habitat to address poor sunfish abundance. Currently, cast nets are prohibited for use on Brushy Creek Reservoir and this could be extended to the entire Brushy Creek system within Williamson County.

MANAGEMENT STRATEGY

1. Ensure that the “no cast netting” rule included in the CFL regulations transfers with the other regulations in Issue 1. This verbiage should be included on regulation signage at all access sites.

ISSUE 3: 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. Appropriate signage has been located at the boat ramp but should be maintained if need arises.
2. Continue educate efforts about invasive species through the use of media and the internet.
3. Continue speaking about invasive species when presenting to constituent and user groups.

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

Sport fish, forage fish, and other important fishes

An exploratory standardized fishery survey was performed on Brushy Creek in the fall of 2018 and spring of 2019. Multiple electrofishing surveys have been performed on Brushy Creek Reservoir (lentic portion of the stream system) in 2000, 2003 and 2013. Sport fishes in Brushy Creek Reservoir include Largemouth Bass, White Crappie, and Channel Catfish. Sport fishes in the lotic portions of Brushy Creek likely include Largemouth Bass, Guadalupe Bass, and Channel Catfish. Known forage species in Brushy Creek Reservoir include Bullhead Minnow, Gizzard Shad, Inland Silverside, Green Sunfish, Bluegill, Redear Sunfish, and Longear Sunfish. Forage species in the lotic portions of Brushy Creek include Gizzard Shad, Redbreast Sunfish, Bluegill, Rio Grande Cichlid along with various species in the family Cyprinidae.

Possibly Low-density/underutilized fisheries

Crappie: White Crappie are present in the Brushy Creek Reservoir portion of Brushy Creek. They may also be present in other pooled areas of Brushy Creek. General monitoring with no established sampling objectives during fall electrofishing (boat electrofishing and backpack electrofishing) will be sufficient for this species. An angler creel survey in 2018-19 confirmed directed effort for White Crappie at 1.6 hours over two quarters.

Survey objectives, fisheries metrics, and sampling objectives

Channel Catfish: Channel Catfish are likely present throughout Brushy Creek. General monitoring trend data for Brushy Creek Reservoir and baseline monitoring data for the lentic and lotic portions of Brushy Creek (without precision or sample size requirements) can be gathered for this species through electrofishing sampling effort (both boat and backpack electrofishing). Additionally, baited hoop nets will be utilized in 2023 to gain more insight into this population. An angler creel survey in fall 2018 and spring 2019 confirmed directed effort for Channel Catfish at 166.5 hours for both quarters combined. However, anglers targeting all catfish had a directed effort of 985.1 hours for both quarters suggesting that catfish are an important component of this fishery. Channel Catfish have been stocked in previous years in Brushy Creek Reservoir. Channel Catfish also likely enter the Brushy Creek system via tributary streams that are hydrologically connected to upgradient ponds on private property.

Largemouth Bass: In the Brushy Creek Reservoir portion of the system, Largemouth Bass is the species most targeted by anglers. Trend data of CPUE, size structure, and body condition have been collected in 2000, 2003, and 2013 for Brushy Creek Reservoir. In 2018 and 2019, boat electrofishing and backpack electrofishing data revealed moderate- to high-density Largemouth Bass population throughout the survey area. Total catch rate for Largemouth Bass was 116.0 fish/h; with a catch rate for legal-size fish (≥ 18 inches) at 16.0 fish/h. Population size structure was good; population indices (PSD= 73, PSD-P=35, PSD-M=4) were close to the expected range (PSD 40 to 70, PSD-P 10 to 40, PSD-M 0 to 10) for a balanced population (Gabelhouse 1984). Body condition for most Largemouth Bass was sub-optimal, but acceptable, as average relative weights (W_r) for adult inch-groups were mostly above 90%. No baseline data exists for Largemouth Bass on the lotic portions of Brushy Creek.

The boat electrofishing survey revealed a moderate- to high density Largemouth Bass population. Total catch rate for Largemouth Bass was 91.0 fish/h; with a catch rate of over (18 inches) at 4.8 fish/h and fish over 14 inches at 24 fish/h. Population size structure was good; population indices (PSD = 54 and PSD-P = 29). The largest bass measured 19 inches in length. Body condition for most Largemouth Bass was acceptable as average relative weights (W_r) for adult inch-groups ranged from 80% to 110%. Harvest was very low for Largemouth Bass on Brushy Creek with an 88.9% legal fish release rate.

General monitoring with no established sampling objectives during all electrofishing (boat electrofishing and backpack electrofishing) will be sufficient for this species. Daytime backpack electrofishing will occur in spring of 2023 at five, 5-minute stations that will be located in the same sampling areas as the spring

2019 sites. Boat electrofishing will occur at an additional three, 5-minute stations in the fall of 2023 in Brushy Creek Reservoir and two, 5-minute stations at Veterans Park. Data for Largemouth Bass including CPUE, size structure, and body condition will be collected for all of the survey area in Brushy Creek. An angler creel survey in spring 2023 will document any change in directed angler effort toward this species since the 2018/2019 roving creel survey. The angler creel survey will be identical to the 2018/2019. A roving creel in which the creel clerk traveled by vehicle and then on foot upon arriving to the location, the known access points from Rabb Park (lowest end of Brushy Creek) to the Cedar Park Sports Complex (upper end of Brushy Creek). At the access points, the creel clerk traveled on foot upstream and downstream and attempt to visit as many potential angler-use areas as possible. The creel survey will be defined into three distinct time frames of 3.5 hours each to increase the prospect of intercepting and counting potential early morning, “before-work” anglers and late afternoon, “after-work” anglers. The standard TPWD creel interview form will be utilized with additional information requests added to the bottom of the sheet. Of particular interest is to document any increase or decrease in fly fishing on Brushy Creek.

Guadalupe Bass: Electrofishing in 2018/2019 showed the presence of Guadalupe Bass in Brushy Creek. The 2018/2019 creel survey indicated low directed effort towards this species. However, general monitoring with no established sampling objectives during boat and backpack electrofishing in fall 2022 and backpack electrofishing in spring 2023 will be sufficient for this species. An angler creel survey in spring 2023 will document any increase or decrease in directed angler effort toward Guadalupe Bass. A genetic sample from all fish that phenotypically resemble Guadalupe Bass from the entire extent of the sampled areas of Brushy Creek will be collected to determine the percentage of pure Guadalupe Bass, Guadalupe Bass x Spotted Bass / Largemouth Bass hybrids. This genetic data will be compared to the findings of the fall 2018 data collected on Brushy Creek. Data for Guadalupe Bass including CPUE, size structure, and body condition will be collected for the entire survey area of Brushy Creek.

Gizzard Shad, Rio Grande Cichlids, and sunfishes: Gizzard Shad, Rio Grande Cichlid, Redbreast Sunfish, Green Sunfish, Bluegill, Longear Sunfish, and other sunfish are important forage species in Brushy Creek. For Brushy Creek Reservoir and other impounded areas, fall boat electrofishing will allow for the collection of baseline data for sunfish and Gizzard Shad relative abundance and size structure (PSD and IOV). No additional effort will be expended to achieve an RSE ≤ 25 for CPUE of various sunfish and Gizzard Shad. Body condition of Largemouth Bass can provide information on forage abundance, vulnerability, or both relative to predator density. Though no anglers were found to be targeting Rio Grande Cichlid specifically during the creel survey, many anglers targeting “anything” indicated that Rio Grande Cichlid was one of their target species. Rio Grande Cichlid will be sampled by backpack electrofishing in the lotic portions of Brushy Creek in fall 2022 and spring 2023 and relative abundance and size structure will be determined. The 2018/2019 creel survey indicated that fly fishing is practiced regularly throughout the Brushy Creek survey area and Rio Grande Cichlid and other non-game species are important targets for these anglers. An angler creel survey in spring 2023 will provide comparative data to the 2018/2019 creel data related to these species. Presence of other forage species including Cyprinid species will also be documented during electrofishing in 2022/2023.

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Tables and Figures

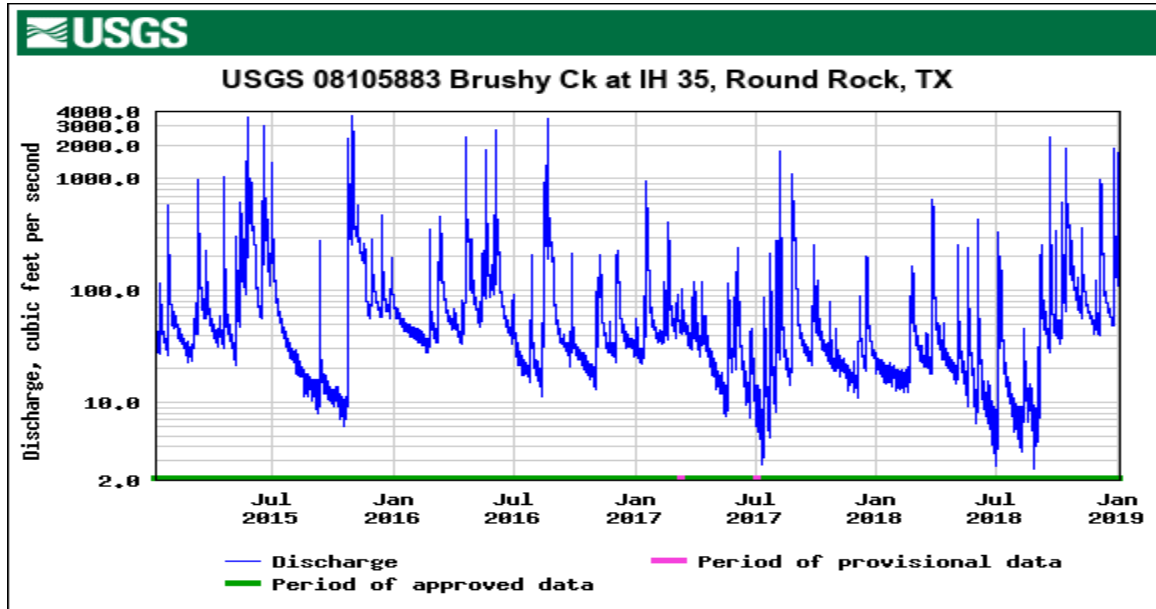


Figure 1. Daily discharge for Brushy Creek (Williamson County) recorded at gauge 08105883 at Round Rock, Texas, January 2015 – January 2019. Data were collected by the United States Geological Survey (USGS).

Table 1. Characteristics of Brushy Creek, Williamson County, Texas.

Characteristic	Description
Controlling authority	Upper Brushy Creek Water Control and Improvement District (WCID)
Count	Williamson
Stream Type	Perennial / Moderate Gradient
Median of daily mean flow 11/2014 - 5/2019 (cfs)	55.9 ¹
Dissolved oxygen (mg/L)	9.1 ²
Seasonal temperature (°C)	November 28 2018: 19.9, April 4, 2019: 14.8 ²
pH ²	7.82 ²
Specific conductance (µS/cm)	542 ²
Aquatic life use rating	High ³

¹ Calculated from USGS station 08105883 (Brushy Creek at Interstate 35) from 11/2014 - 3/2019.

² Average Value from field data collected during backpack electrofishing surveys in November 2018 and April 2019 at seven locations.

³ Brushy Creek (Williamson County - segment 1244) TCEQ Chapter 307 Texas Surface Water Quality Standards

Table 2. Public access points and descriptions for Brushy Creek, Williamson County, Texas, 2018-2019.

Access Point	Managing Entity	Latitude Longitude (dd)	Public	Parking capacity (N)	Condition
Brushy Creek Sports Complex	City of Cedar Park	30.5056, -97.7826	Y	<50	Provides over 1.5 miles of bank access to Brushy Creek upstream of Brushy Creek Reservoir.
Brushy Creek Reservoir Park	City of Cedar Park	30.5093, -97.7708	Y	<50	Provides approximately 1 mile of access to the north shoreline of Brushy Creek Reservoir. Kayak launch provided at a boat ramp as well as a fishing pier on the upper end (north shore) of the lake.
Champion Park	Williamson County	30.5117, -97.7580	Y	<50	Provides approximately 1.5 miles of stream access within the park.
Creekside Park and Pool	Brushy Creek Municipality District (MUD)	30.5225, -97.7154	Y	<25	Provides large parking area. Creek can be accessed across Brushy Creek Road through gaps in the vegetation.
Shirley McDonald Park	Brushy Creek Municipality District (MUD)	30.5210, -97.7356	Y	<20	Provides large parking area. Creek can be accessed across Brushy Creek Road through gaps in the vegetation.
Hairy Man Road Crossing	unknown	30.5225, -97.7154	Y	2	Provides narrow and unpaved parking area adjacent to the creek.
Chisholm Trail Crossing Park	City of Round Rock	30.5119, -97.6893	Y	<10	Bank access to approximately 1,400 feet of Brushy Creek shoreline. Provides access westward (under I-35) to Memorial Park.
Memorial Park	City of Round Rock	30.5123, -97.6851	Y	<10	Bank access to approximately 1,200 feet of Brushy Creek shoreline. Provides access eastward (under I-35) to Chisholm Trail Crossing Park.
Veterans Park	City of Round Rock	30.5146, -97.6756	Y	<50	Bank and kayak access on the Veterans Park Pond (<5 acres)
Rabb Park	City of Round Rock	30.5150, -97.6516	Y	<100	Provides over 1-mile of creek access within the park and along the bicycle / running trail that runs parallel to Brushy Creek.

Table 3. Current harvest regulations for Brushy Creek Reservoir and Brushy Creek (stream), Texas.

Species	Brushy Creek Reservoir ^a		Brushy Creek Stream	
	Length limit	Bag limit	Length limit	Bag limit
Catfish: Channel and Blue Catfish, their hybrids and subspecies	None	5	12-inch minimum	25
Common Carp	None	None	None	None
Crappie - White and Black Crappie, their hybrids and subspecies	10	25	10	25
Catfish, Flathead	18-inch minimum	5	18-inch minimum	5
Bass, Largemouth	18-inch minimum	5	14-inch minimum	5
Bass: Spotted and Guadalupe	None	5	None	5
Sunfish - Various species including Bluegill, Redear, Green, Warmouth, and Longear	None	None	None	None

^a Fishing is by pole and line only. Anglers may use no more than two poles while fishing.

Table 4. Stocking history for Brushy Creek Reservoir, Texas. Life stages are advanced fingerlings (AFGL), adults (ADL). Life stages for each species are defined as having a mean length that falls within the given length range. For each year and life stage the species mean total length in inches (Mean TL; in) is given. For years where there were multiple stocking events for a particular species and life stage the mean TL is an average for all stocking events combined.

Species	Year	Number	Life Stage	Mean TL (in)
Channel Catfish	2001	1,091	AFGL	9.9
	2002	1,087	AFGL	9.4
	2013	1,182	AFGL	10.5
	2014	1,083	AFGL	9.8
	2016	1,077	AFGL	10.4
	2017	1,101	AFGL	9.9
	2018	1,137	AFGL	9.4
	Total	7,758		
Florida Largemouth Bass	2014	55	ADL	15.3
	Total	55		

Table 5. Objective-based sampling plan components for Brushy Creek, Williamson County, TX, 2018-2019.

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing</i>			
Common Carp	Abundance	CPUE	General Trend Monitoring Data
	Size structure	PSD, length frequency	
Largemouth Bass	Abundance	CPUE–Stock	General Trend Monitoring Data
	Size structure	PSD, length frequency	
	Condition	W_r	
Guadalupe Bass	Abundance	CPUE–Stock	General Trend Monitoring Data
	Size structure	PSD, length frequency	
	Genetics	% Guadalupe	
Sunfishes	Abundance	CPUE–Stock	General Trend Monitoring Data
	Size structure	PSD, length frequency	
Crappies	Abundance	CPUE–Total	General Trend Monitoring Data
	Size structure	PSD, length frequency	
Catfishes	Abundance	CPUE–Stock	General Trend Monitoring Data
	Size structure	PSD, length frequency	
	Condition	W_r	

Table 6. Percent directed angler effort by species for Brushy Creek, fall 2018 and spring 2019. Survey Period for fall 2018 survey was September 1 through November 30 and Survey Period for spring 2019 was March 1 through May 31.

Species	fall 2018	spring 2019	Both Quarters
Black Basses	4.4	0.3	1.7
Largemouth Bass	23.6	42.4	35.6
Guadalupe Bass	0.9	3.2	2.3
Common Carp	9.6	22.6	17.8
Catfishes	13.0	6.4	8.8
Flathead Catfish	0.0	0.4	0.3
Channel Catfish	2.2	0.0	0.8
Crappies	3.1	1.7	2.2
Panfishes	5.8	2.6	3.8
Bluegill	0.4	1.4	1.0
Anything	37.0	19.0	25.6

Table 7. Total fishing effort in hours (h) for all species and total directed expenditures (in dollars) at Brushy Creek, Williamson County, Texas, fall 2018 and spring 2019. Survey Period for fall 2018 survey was September 1 through November 30 and Survey Period for spring 2019 was March 1 through May 31. Relative standard errors (RSE) are in parentheses.

Creel statistic	fall 2018	spring 2019	Totals
Total fishing effort	7,568 (16)	13,390 (12)	20,958
Directed expenditures	\$20,572 (36)	\$37,798 (47)	\$58,370

Gizzard Shad

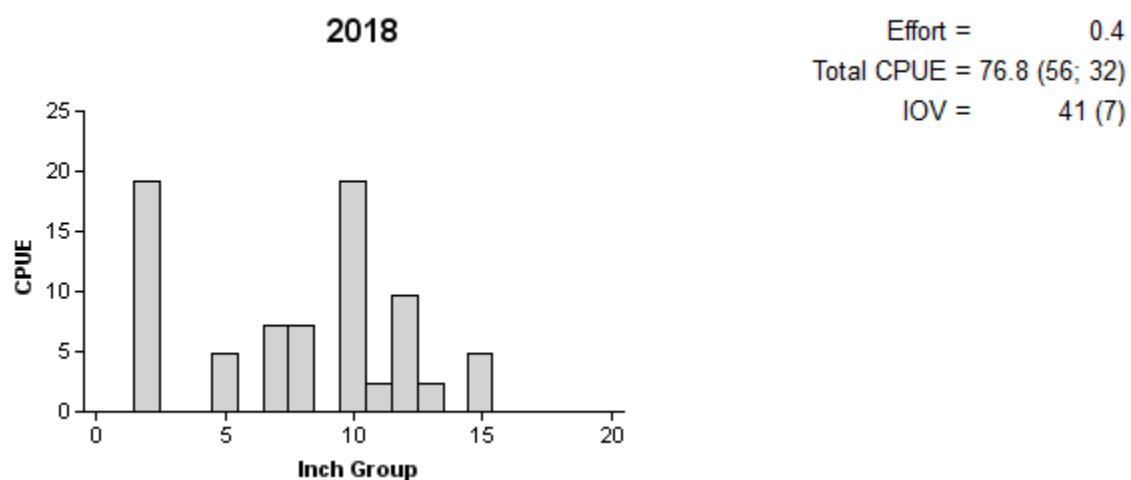


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall boat electrofishing surveys, Brushy Creek Reservoir and Veterans Park Pond (Brushy Creek), Williamson County, Texas, fall 2018.

Redbreast Sunfish

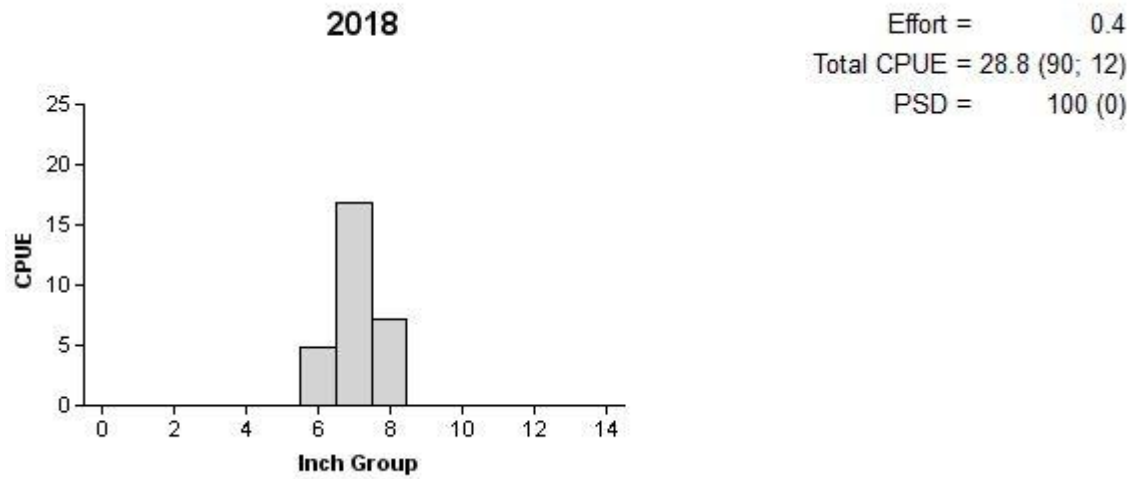


Figure 3. Number of Redbreast Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall boat electrofishing surveys, Brushy Creek Reservoir and Veterans Park Pond (Brushy Creek), Williamson County, Texas, fall 2018.

Redbreast Sunfish

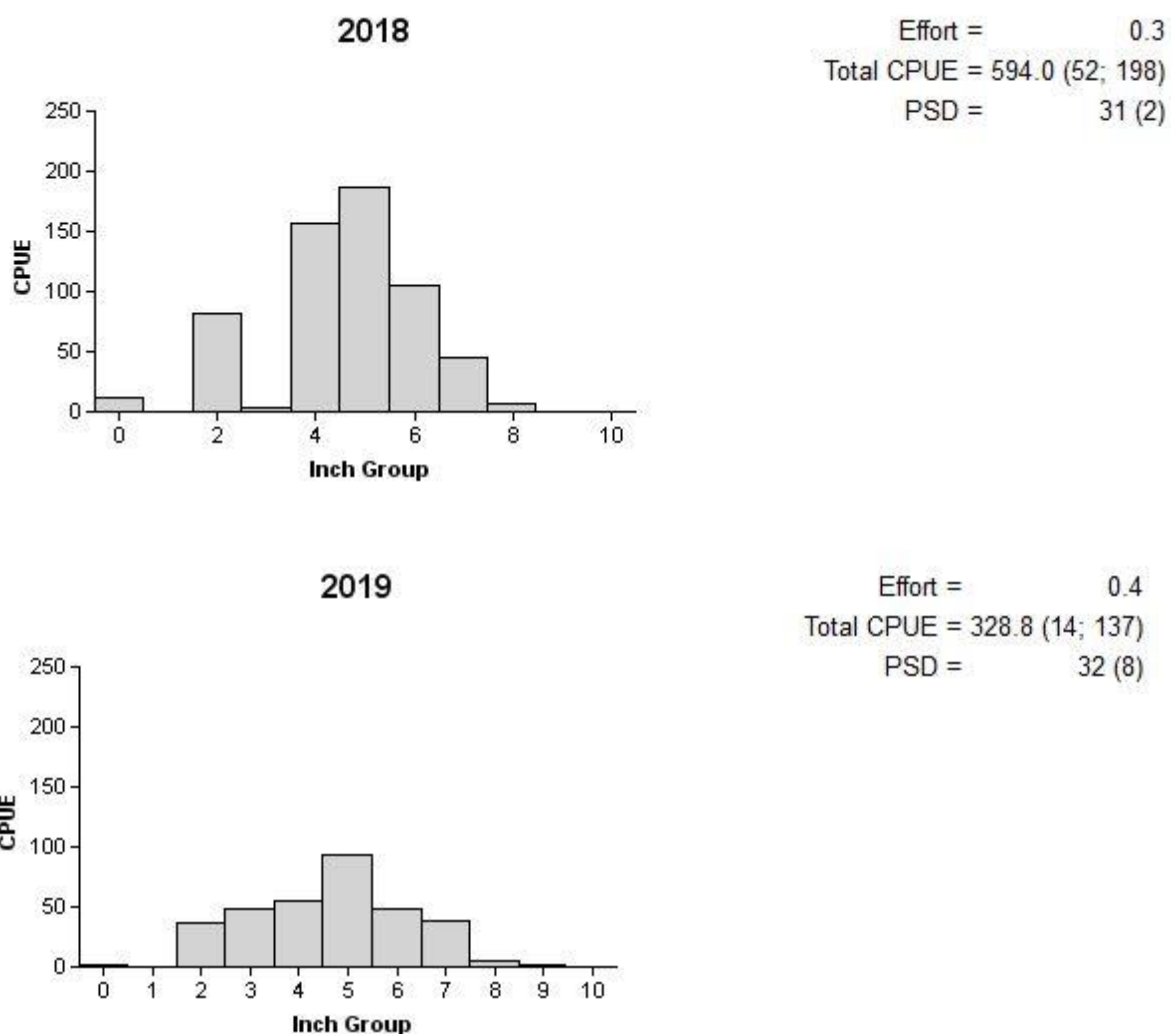


Figure 4. Number of Redbreast Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall (top) and spring (bottom) backpack electrofishing surveys, Brushy Creek, Williamson County, Texas 2018 and 2019.

Bluegill

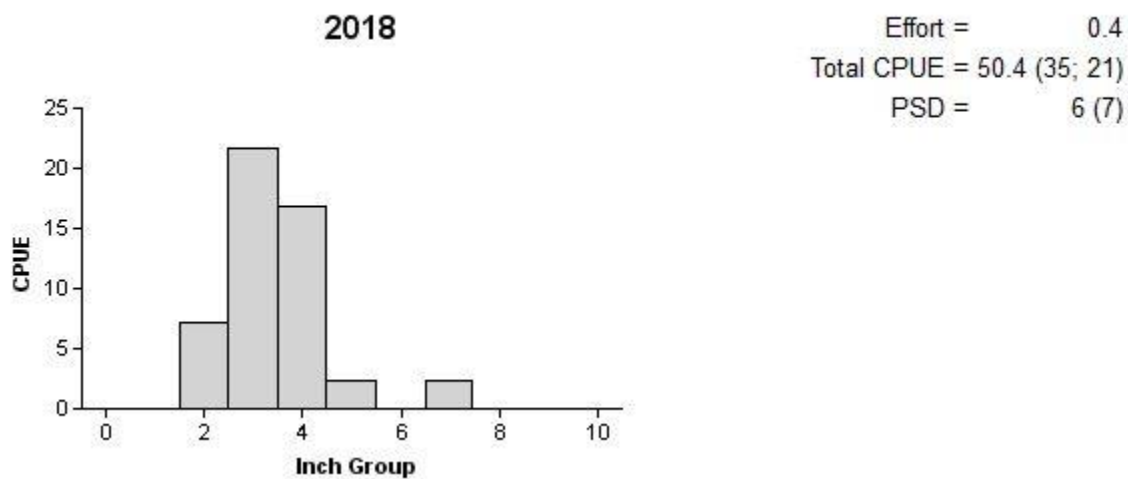


Figure 5. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall boat electrofishing surveys, Brushy Creek Reservoir and Veterans Park Pond (Brushy Creek), Williamson County, Texas, fall 2018.

Bluegill

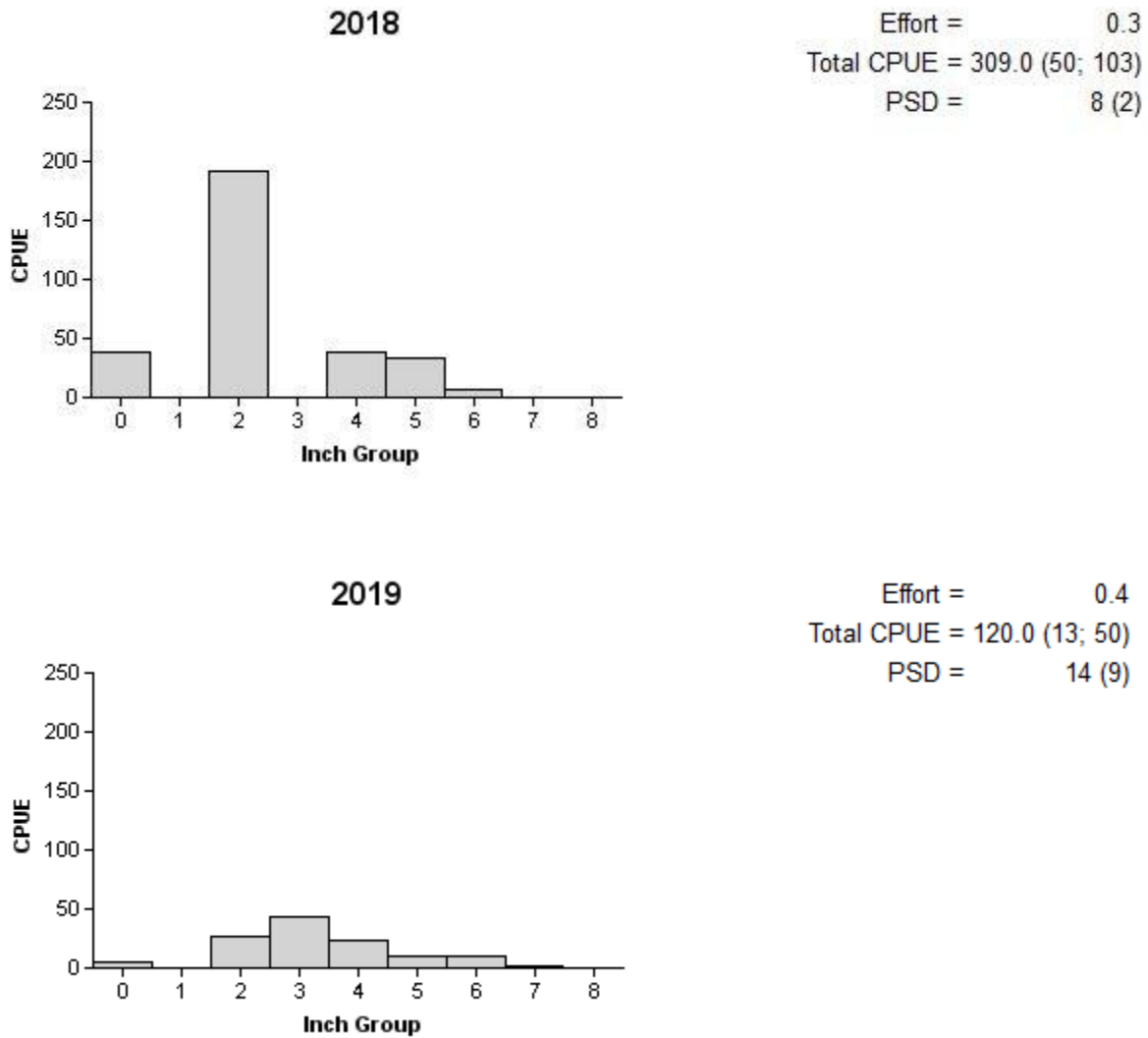


Figure 6. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall (top) and spring (bottom) backpack electrofishing surveys, Brushy Creek, Williamson County, Texas 2018 and 2019.

Longear Sunfish

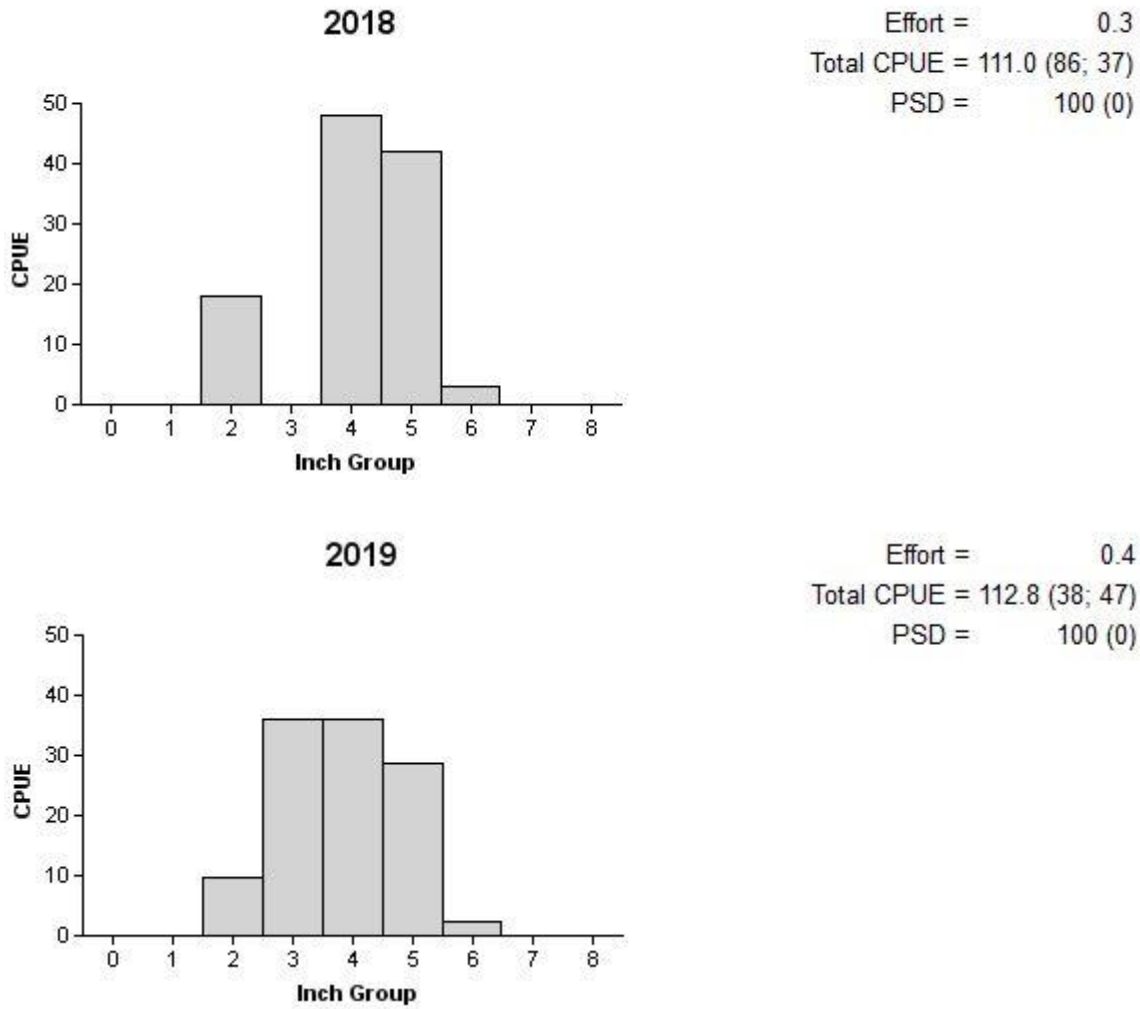


Figure 7. Number of Longear Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall (top) and spring (bottom) backpack electrofishing surveys, Brushy Creek, Williamson County, Texas 2018 and 2019.

Common Carp

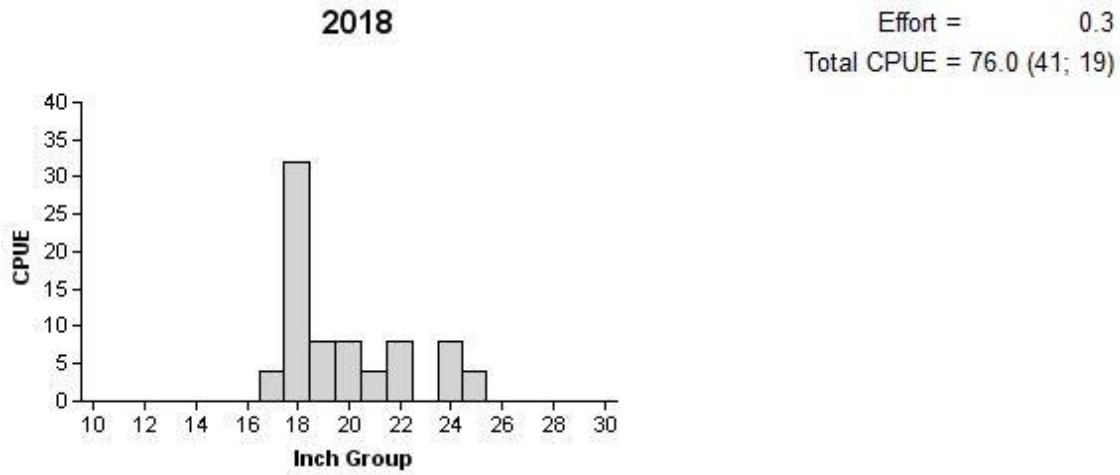


Figure 8. Number of Common Carp caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall boat electrofishing surveys, Brushy Creek Reservoir and Veterans Park Pond (Brushy Creek), Williamson County, Texas, fall 2018.

Table 9. Creel survey statistics for Common Carp on Brushy Creek, Williamson County, Texas from September through November 2018 and March through May 2019. Total catch per acre is for anglers targeting Common Carp and total harvest is the estimated number of Common Carp harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year
	2018/2019
Surface area (acres)	82.5
Directed effort (h)	3750.70 (73.9)
Directed effort/acre	45.5 (20.1)
Total catch per hour	0.09 (152.9)
Total harvest	366.6 (94.1)
Harvest/acre	4.4 (94.1)
Percent legal released	100

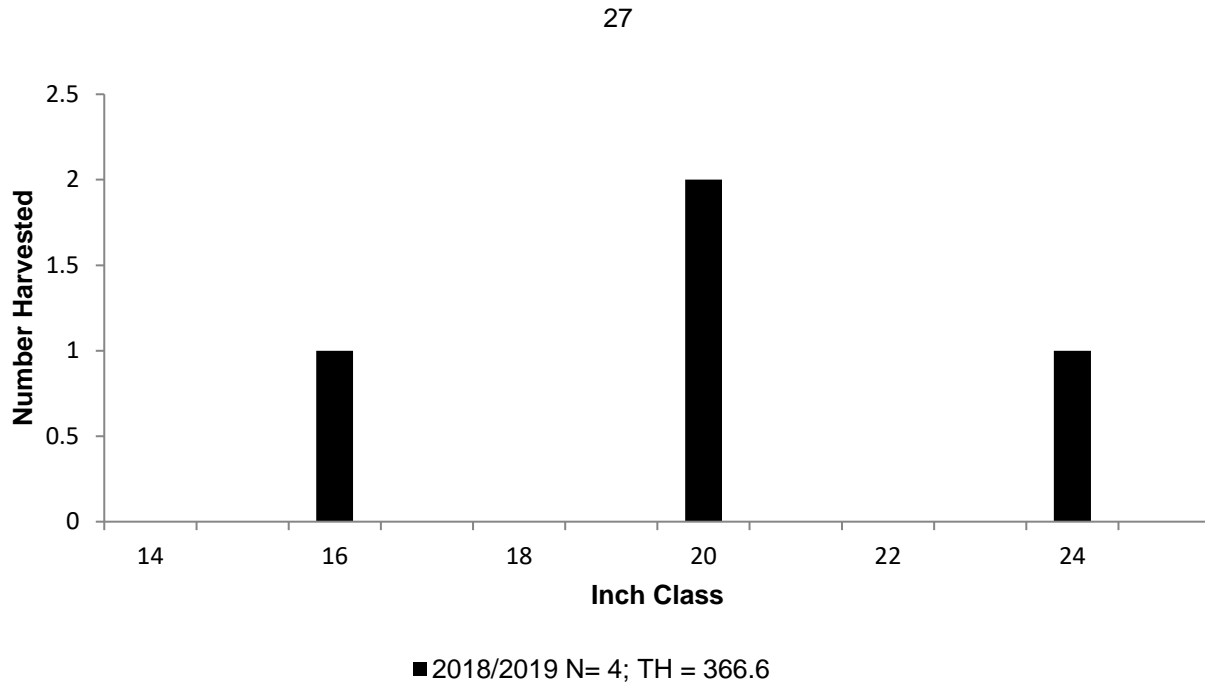


Figure 9. Length frequency of harvested Common Carp observed during creel surveys at Brushy Creek, Williamson County, Texas, fall 2018 and spring 2019, all anglers combined. N is the number of harvested Common Carp observed during creel surveys, and TH is the total estimated harvest for the creel period.

Table 8. Creel survey statistics for Channel Catfish at Brushy Creek, Williamson County, Texas, from September 2018 through November 2018 and March 2019 through May 2019. Total catch per hour is for anglers targeting Channel Catfish and total harvest is the estimated number of Channel Catfish harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year
	2018/2019
Surface area (acres)	82.5
Directed effort (h)	166.5 (73.9)
Directed effort/acre	2.0 (73.9)
Total catch per hour	2.9 (38.46)
Total harvest	1466.5 (76.0)
Harvest/acre	17.8 (76.0)
Percent legal released	32

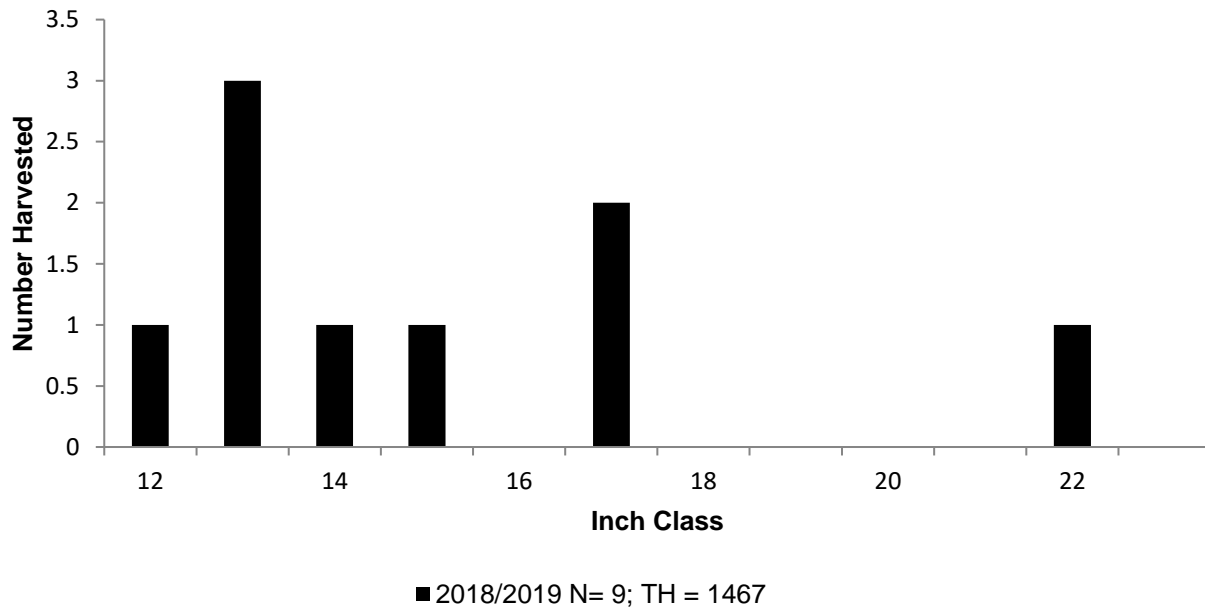


Figure 10. Length frequency of harvested Channel Catfish observed during creel surveys at Brushy Creek, Williamson County, Texas, fall 2018 and spring 2019, all anglers combined. N is the number of harvested Channel Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period.

Largemouth Bass

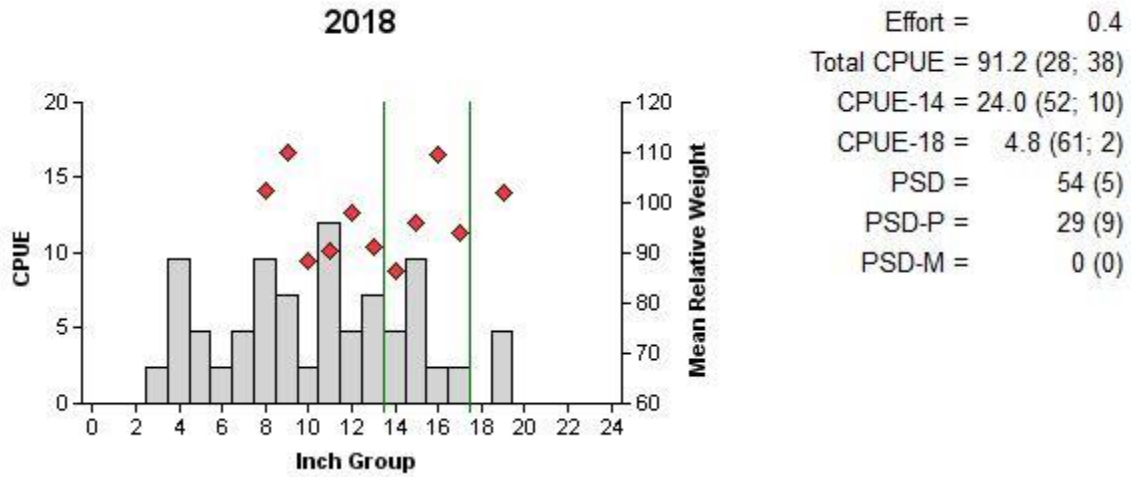


Figure 11. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall boat electrofishing surveys, Brushy Creek Reservoir and Veterans Park Pond (Brushy Creek), Williamson County, Texas, fall 2018. Vertical lines represent the two minimum length limits currently set for Brushy Creek Reservoir and the other portions of Brushy Creek.

Largemouth Bass

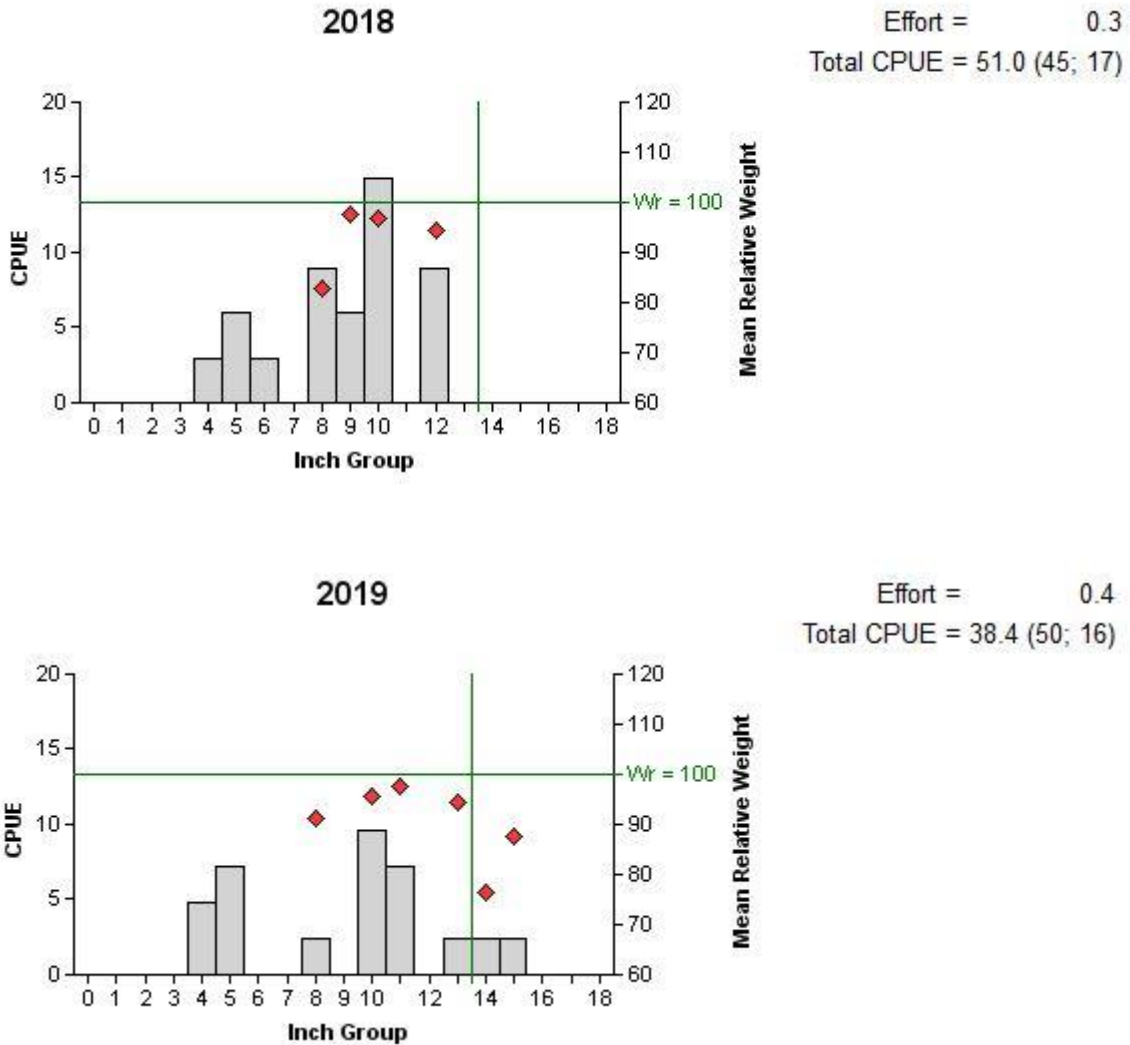


Figure 12. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall and spring backpack electrofishing surveys, Brushy Creek, Williamson County, Texas 2018 and 2019. Vertical line represents minimum length limit at the time of the survey.

Table 8. Creel survey statistics for Largemouth Bass on Brushy Creek, Williamson County, Texas from September through November 2018 and March through May 2019. Total catch per stream acre is for anglers targeting Largemouth Bass and total harvest is the estimated number of Largemouth Bass harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year
	2018/2019
Surface area (acres)	82.5
Directed effort (h)	7,460.2 (14.7)
Directed effort/acre	90.4 (14.7)
Total catch per hour	0.00 (162.9)
Total harvest	97.8 (88.1)
Harvest/acre	1.2 (88.1)
Percent legal released	88.9

¹ A single angler was harvesting fish on Brushy Creek Reservoir where there is an 18-inch minimum length limit.

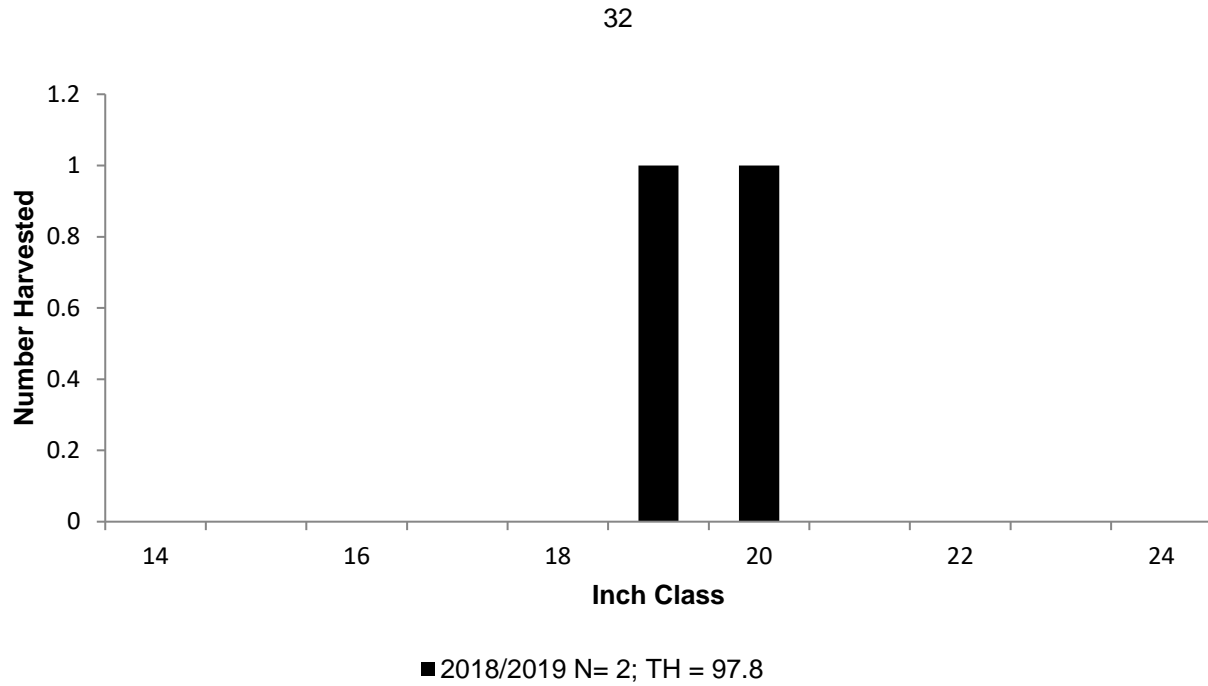


Figure 13. Length frequency of harvested Largemouth Bass observed during creel surveys at Brushy Creek, Williamson County, Texas, fall 2018 and spring 2019, all anglers combined. N is the number of harvested Largemouth Bass observed during creel surveys, and TH is the total estimated harvest for the creel period. Harvested fish came from Brushy Creek Reservoir which has a 18-inch minimum length limit.

Guadalupe Bass

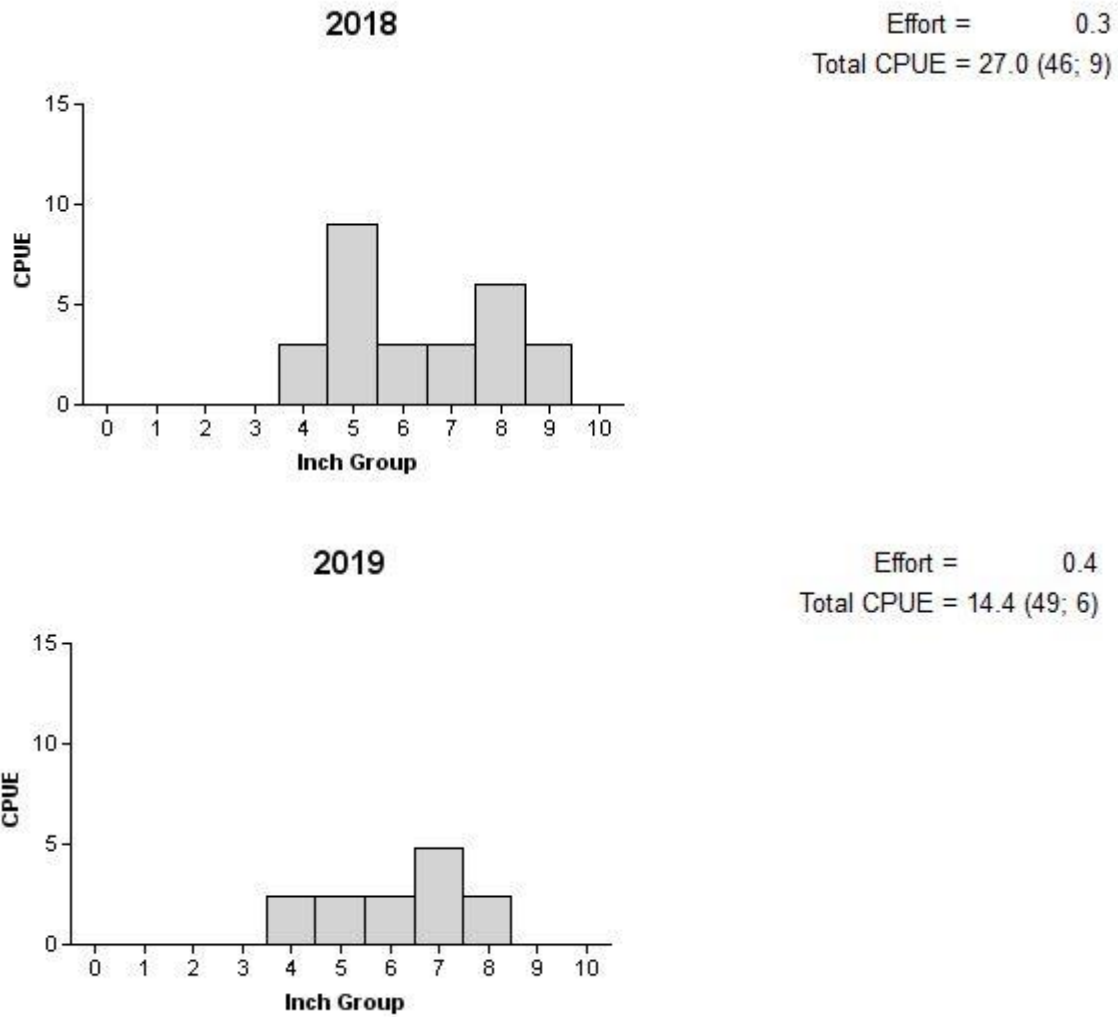


Figure 14. Number of Guadalupe Bass caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall and spring backpack electrofishing surveys, Brushy Creek, Williamson County, Texas 2018 and 2019

Table 11. Results from genetic analysis of Guadalupe Bass collected by fall electrofishing, Brushy Creek, Texas. GLB = Guadalupe Bass, LMB = Largemouth Bass, SPB = Spotted Bass. Genetic composition was determined with micro-satellite DNA analysis.

Year	Sample Size	Number of fish			% GLB alleles in Introgressed Fish	% pure GLB
		GLB	GLB intergrade with LMB/SPB			
2018	9	8	1	91	8	

Proposed Sampling Schedule

Table 12. Proposed sampling schedule for Brushy Creek, Williamson County, 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.

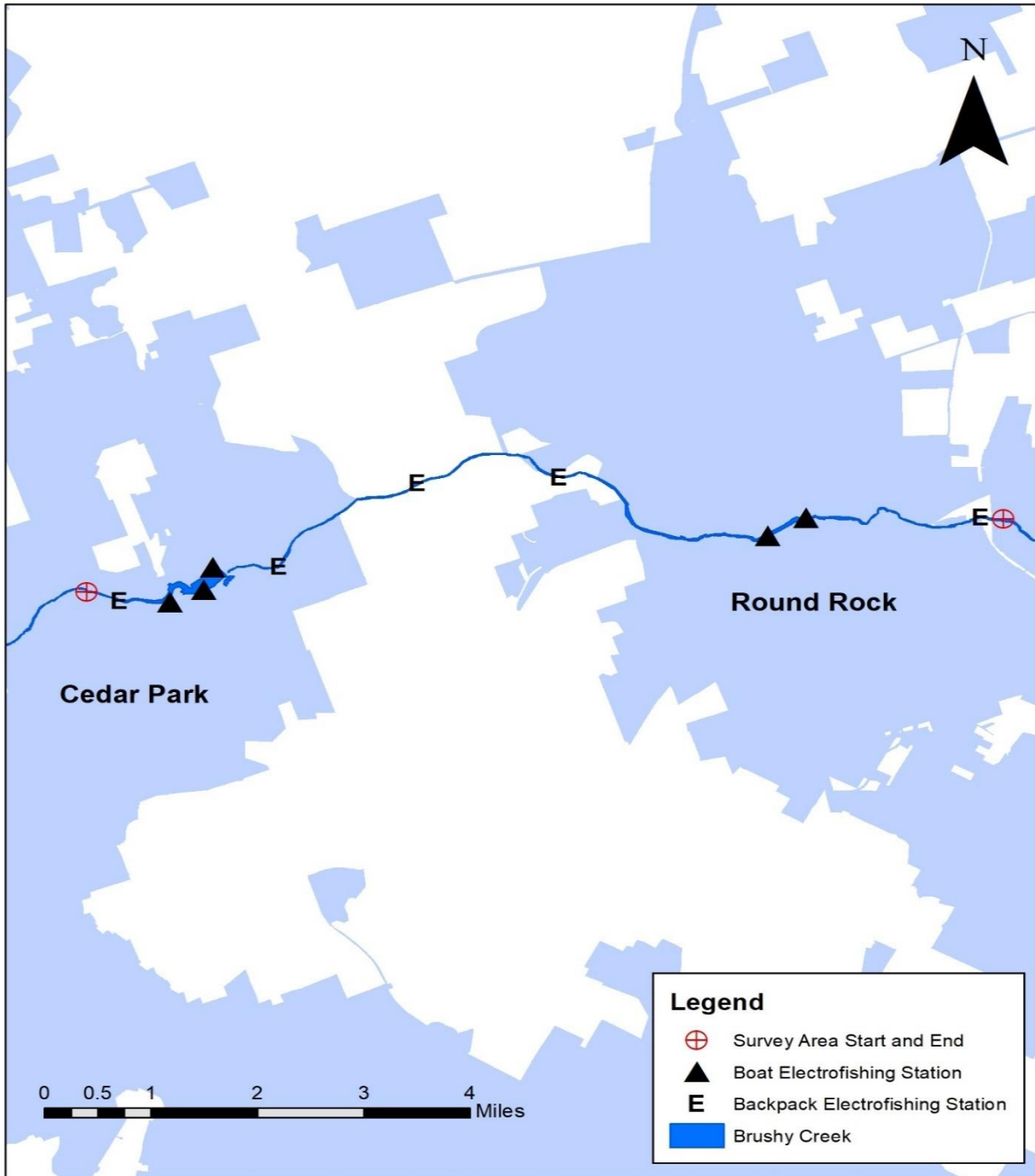
	Survey year			
	2019-2020	2020-2021	2021-2022	2022-2023
Angler Access				S
Structural Habitat				
Vegetation		A		
Electrofishing – Fall				S
Backpack Electrofishing – Fall				S
Electrofishing – Spring				
Backpack Electrofishing - Spring				S
Baited tandem hoop netting				S
Creel survey				S
Report				S

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

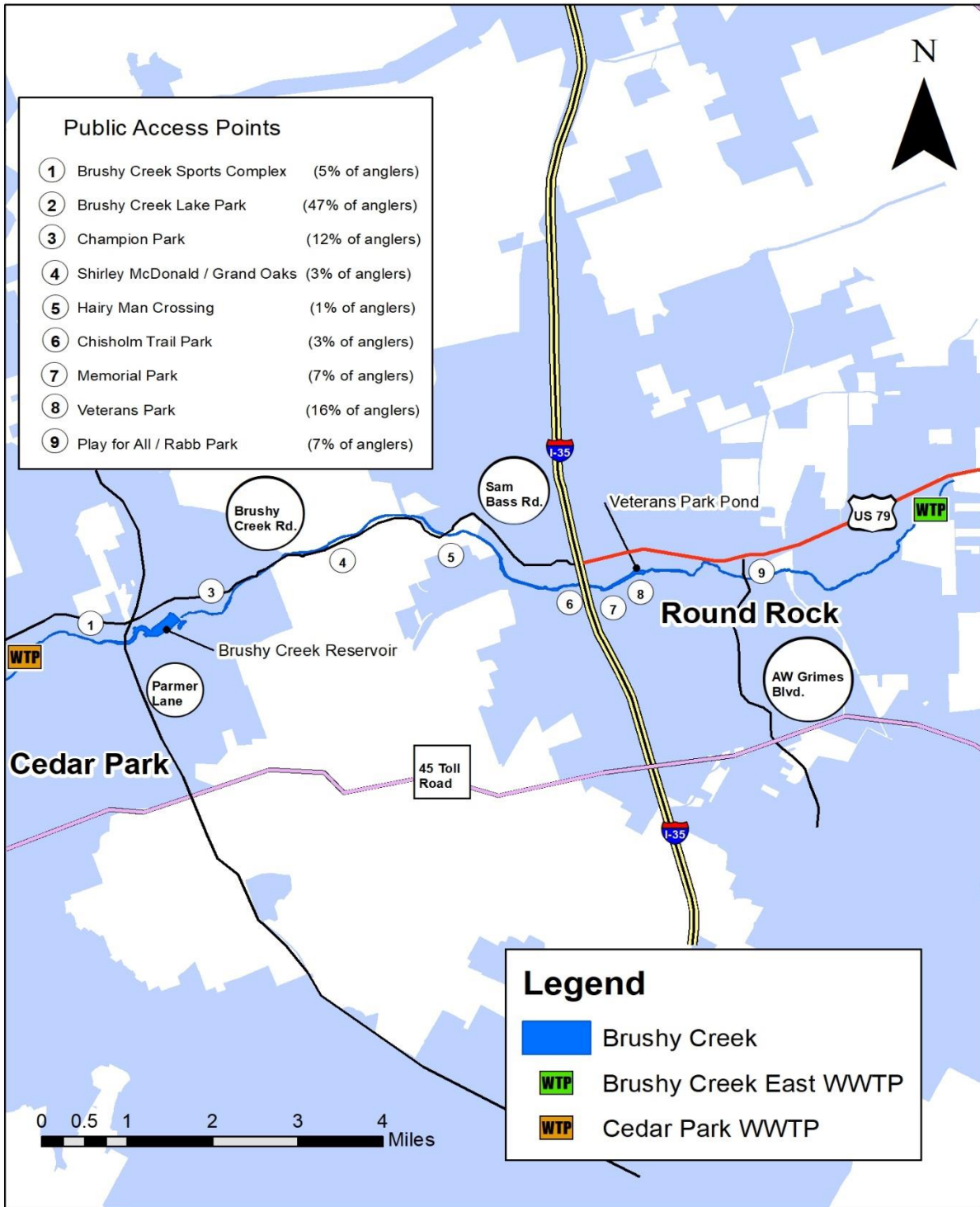
Number (N) and catch rate (CPUE) of all target species collected from all gear types from Brushy Creek, Texas, in fall 2018 and spring 2019. Sampling effort was 0.40 hour of boat electrofishing in fall 2018. Sampling effort was 0.33 hour and 0.42 hour for backpack electrofishing for fall 2018 and spring 2019 backpack electrofishing on the stream portion of Brushy Creek.

Species	Boat Electrofishing (Lentic Portions)		Backpack Electrofishing (stream)			
	Brushy Creek fall 2018		Brushy Creek fall 2018		Brushy Creek spring 2019	
	N	CPUE (fish/hr)	N	CPUE (fish/hr)	N	CPUE (fish/hr)
American Eel	1	2.4	-	-	1	2
Common Carp	26	62.4	-	-	2	5
Western Mosquitofish	-	-	2	6	-	-
Gizzard Shad	32	76.8	-	-	-	-
Blacktail Shiner	-	-	66	198	34	82
Gray Redhorse	2	4.8	8	24	8	19
Yellow Bullhead	-	-	-	-	1	2
Channel Catfish	-	-	3	9	3	7
Inland Silverside	1	2.4	-	-	-	-
Central Stoneroller	-	-	3	9	11	26
Redbreast Sunfish	12	28.8	198	594	137	329
Green Sunfish	-	-	3	9	3	7
Warmouth	-	-	1	3	4	10
Bluegill	21	50.4	103	309	50	120
Longear Sunfish	2	4.8	37	111	47	113
Redear Sunfish	-	-	-	-	2	5
Largemouth Bass	38	28	17	51	16	38
Guadalupe Bass	3	7.2	9	27	6	14
Rio Grande Cichlid	-	-	2	6	3	7
Sailfin Molly	-	-	16	48	6	14
Orangethroat Darter	-	-	3	9	5	12

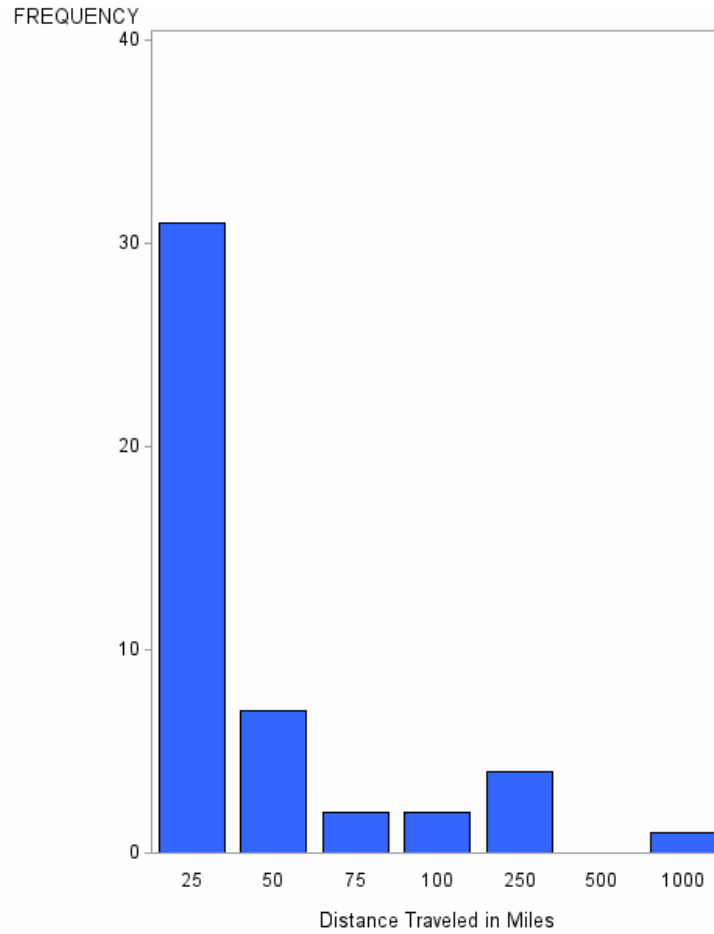
APPENDIX B – Map of sampling locations



APPENDIX C – Map of access locations and angler concentrations



APPENDIX D – Reporting of creel ZIP code data



Frequency of anglers that traveled various distances (miles) to Brushy Creek, Williamson County, Texas, as determined from the September through November 2018 and March through May 2019 creel surveys.

**Distribution by Zip Code and Distance Traveled for angler access for Lake 2403
from 01Sep2018 to 31May2019**

ZipCode	CITY	STATENAME	Count	Percent	Dist_Miles
78613	Cedar Park	Texas	61	0.1703911	4.5249319
78681	Round Rock	Texas	47	0.1312849	2.6538158
78664	Round Rock	Texas	35	0.0977654	5.1359078
78717	Austin	Texas	25	0.0698324	1.0223901
78729	Austin	Texas	14	0.0391061	3.8411911
78644	Lockhart	Texas	13	0.0363128	43.991253
78665	Round Rock	Texas	13	0.0363128	6.4101693
78641	Leander	Texas	12	0.0335196	7.4634397
78758	Austin	Texas	9	0.0251397	9.5450443
78634	Hutto	Texas	8	0.0223464	12.763216
78728	Austin	Texas	8	0.0223464	6.3882525
78726	Austin	Texas	7	0.0195531	8.2573617
78660	Pflugerville	Texas	6	0.0167598	9.0692088
78727	Austin	Texas	6	0.0167598	6.4855263
78753	Austin	Texas	6	0.0167598	10.909562
78759	Austin	Texas	6	0.0167598	7.8894403
76513	Belton	Texas	5	0.0139665	44.008282
77087	Houston	Texas	5	0.0139665	157.41269
78626	Georgetown	Texas	5	0.0139665	10.46027
75759	Cuney	Texas	4	0.0111732	176.76931
78572	Mission	Texas	4	0.0111732	299.21765
78642	Liberty Hill	Texas	4	0.0111732	15.104652
78744	Austin	Texas	3	0.0083799	25.494038

Distribution of Zip Codes Continued

ZipCode	CITY	STATENAME	Count	Percent	Dist_Miles
78780	Austin	Texas	3	0.0083799	7.8894403
78865	Austin	Texas	3	0.0083799	7.8894403
1420	Fitchburg	Massachusetts	2	0.0055866	1655.3999
76537	Jarrell	Texas	2	0.0055866	21.1765
76542	Killeen	Texas	2	0.0055866	37.053793
76550	Lampasas	Texas	2	0.0055866	45.898379
78247	San Antonio	Texas	2	0.0055866	74.59393
78636	Johnson City	Texas	2	0.0055866	42.140524
78655	Martindale	Texas	2	0.0055866	46.058176
78666	San Marcos	Texas	2	0.0055866	44.892264
78713	Austin	Texas	2	0.0055866	15.741284
78723	Austin	Texas	2	0.0055866	14.804533
78724	Austin	Texas	2	0.0055866	16.847813
78741	Austin	Texas	2	0.0055866	19.29289
78745	Austin	Texas	2	0.0055866	21.121664
78757	Austin	Texas	2	0.0055866	11.20634
78771	Austin	Texas	2	0.0055866	7.8894403
76547	Killeen	Texas	1	0.0027933	42.046373
77414	Bay City	Texas	1	0.0027933	152.3967
78109	Converse	Texas	1	0.0027933	77.800519
78313	San Antonio	Texas	1	0.0027933	74.59393
78413	Corpus Christi	Texas	1	0.0027933	196.41002
78414	Corpus Christi	Texas	1	0.0027933	197.72417
78653	Manor	Texas	1	0.0027933	18.655215
78703	Austin	Texas	1	0.0027933	15.001978
78731	Austin	Texas	1	0.0027933	11.448528
78746	Austin	Texas	1	0.0027933	14.940083
78750	Austin	Texas	1	0.0027933	7.0770836



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