

Travis 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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July 31, 2019



Contents

Survey and Management Summary	1
Introduction.....	2
Reservoir Description	2
Angler Access.....	2
Management History	2
Methods.....	4
Results and Discussion.....	4
Fisheries Management Plan for Travis Reservoir, Texas.....	7
Objective-Based Sampling Plan and Schedule (2019–2023).....	8
Literature Cited.....	10
Tables and Figures	11
Water Level	11
Reservoir Characteristics	11
Boat Ramp Characteristics.....	12
Harvest Regulations	12
Stocking History.....	14
Objective-Based Sampling Plan for 2012-2013	16
Structural Habitat Survey.....	17
Aquatic Vegetation Survey	17
Percent Directed Angler Effort per Species.....	18
Total Fishing Effort and Fishing Expenditures.....	18
Gizzard Shad.....	19
Redbreast Sunfish	20
Bluegill	21
Blue Catfish	22
Channel Catfish	23
White Bass.....	26
Striped Bass	27
Largemouth Bass	29
White Crappie	33
Proposed Sampling Schedule	34
APPENDIX A.....	35
APPENDIX B.....	36
APPENDIX C	37

Survey and Management Summary

Fish populations in Travis Reservoir were surveyed in 2018 using electrofishing and in 2019 using gill netting. Anglers were surveyed from September 2017 through August 2018 with a creel survey. 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: Travis Reservoir is an 18,622-acre impoundment of the Colorado River located in Travis and Burnet Counties, approximately 12 miles northwest of Austin, Texas. It was constructed in 1942 by the Lower Colorado River Authority (LCRA) for purposes of flood control, municipal and industrial water supplies, irrigation, and hydroelectric power. Travis Reservoir has a shoreline development index of 18.3. The basin is steep-sided with relatively few shallow coves and shoal areas. This reservoir experiences extreme water level fluctuations and lies within the Edwards Plateau ecological area. Land use is predominantly ranching in the upper reservoir, with residential properties common in the lower reservoir. Significant stands of aquatic vegetation have never been documented in the reservoir. In June 2017, zebra mussels *Dreissena polymorpha* were discovered in the reservoir, and since have established a sustained population.

Management History: The sport fish composition includes White Bass, Striped Bass, Largemouth Bass, crappies, and catfishes. Florida Largemouth Bass were originally stocked in the reservoir in the late 1980's to increase Florida Largemouth Bass genetic influence in the population. Blue and Channel Catfish were stocked in the 1970's to help establish a sustainable population. Striped Bass have often been stocked since 1973. The lake is managed under statewide regulations.

Fish Community

- **Prey species:** Threadfin Shad, Gizzard Shad, Bluegill, and Redbreast Sunfish were the predominant prey species. Overall, the forage base was adequate to support sport fish.
- **Catfishes:** Blue Catfish were the predominant species of catfish surveyed in 2019. Large Flathead Catfish and Blue Catfish were available to anglers. Channel Catfish abundance improved since the previous survey. Directed effort for catfishes was approximately 6% of the total angler effort for the reservoir.
- **Temperate basses:** White Bass and Striped Bass were present in the reservoir. White Bass fishing becomes popular during the spring spawning run up the Pedernales and Colorado rivers. Angler effort for White Bass was 1.4% of the total directed effort on the reservoir. Striped Bass abundance continued to decline. Angling effort was not captured for Striped Bass during the creel survey, but anecdotal reports of directed effort outside the creel survey hours (night) were seasonal.
- **Black Basses:** Largemouth Bass abundance rebounded from historic lows during the last survey, caused by extreme drought conditions. Plenty of legal-size fish were available to anglers due to reservoir flooding in 2015 and population boom. More than 70% of all anglers at Travis Reservoir fished for black basses (Largemouth and Guadalupe Bass).
- **Crappies:** Black and White Crappie were present in the reservoir. Angling effort for crappies accounted for 2.4% of the total directed effort.

Management Strategies: Discontinue Striped Bass stocking regime. Temporarily discontinue Florida Largemouth Bass stockings, monitor water quality as it relates to productivity, and monitor Largemouth Bass performance. Educate the public about the negative impacts of aquatic invasive species, monitor and record potential impacts of zebra mussels on sport fish in the reservoir. Conduct bass-only electrofishing survey in 2022 and general monitoring electrofishing survey in 2022. Access and vegetation surveys will be conducted in 2022. Conduct a full-reservoir creel survey in 2021-2022.

Introduction

This document is a summary of fisheries data collected from Travis 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

Travis Reservoir is a 18,622-acre impoundment of the Colorado River located in Travis and Burnet Counties, approximately 12 miles northwest of Austin, Texas. It was constructed in 1942 by the Lower Colorado River Authority (LCRA) for purposes of flood control, municipal and industrial water supplies, irrigation, and hydroelectric power. Travis Reservoir has a shoreline development index of 18.3. The basin is steep-sided with relatively few shallow coves and shoal areas. This reservoir experiences extreme water level fluctuations. The reservoir experienced extreme drought conditions from 2011 to 2015, with reduced water levels of more than 50 feet. Since then, consistently wet conditions have kept the reservoir above or close to conservation pool (Figure 1). The reservoir lies within the Edwards Plateau ecological area and is mesotrophic with a mean TSI chl-*a* of 41.58, and a 10-year change of -0.14 (Texas Commission on Environmental Quality 2018). Land use is predominantly ranching in the upper reservoir, with residential properties common in the lower reservoir. Littoral habitat at time of sampling consisted primarily of natural and rocky shorelines with piers and docks. In 2014, the non-native species hydrilla *Hydrilla verticillata* was documented (13.9 acres) but persisted shortly. No aquatic vegetation has been detected since. In June 2017, zebra mussels *Dreissena polymorpha* were discovered in the reservoir, and since have established a sustained population. The rocky nature of the lake and hard water provide preferred conditions for this species to thrive, impacting stakeholders. Water fluctuations will likely become more prominent with the accelerated population growth around Austin, which will increase water demands from this reservoir. Other descriptive characteristics for Travis Reservoir are in Table 1.

Angler Access

Availability of boat access on Travis Reservoir is highly sensitive to water level variation (Daugherty et al. 2011). At water levels above 667 msl, angler access was excellent for boat anglers. Eleven concrete public boat ramps were available when water level exceeded this level. As water level falls due to general releases, water consumption, and evaporation, the boat access availability declines. Under low-water conditions (<650 msl) boat access was poor and only two public boat ramps were available, although anglers frequently launch boats from the shoreline using four-wheel drive vehicles. Increased municipal water demand and potential effects of climate change (i.e., less rainfall) may make future recreational boating access to Travis Reservoir difficult (Daugherty et al. 2011). Bank fishing was vastly available at 18 public parks. Americans with Disabilities Act (ADA) accessibility was poor with no specifically-designated fishing sites available. Additional boat ramp characteristics are in Table 2.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Farooqi and De Jesus 2015) included:

1. Continue to request annual stockings of Striped Bass fingerlings at a rate of 5/acre. Conduct an additional gill net survey in spring 2017 to monitor the Striped Bass population. Conduct a year-long creel survey to determine angling effort, catch rate, harvest, and angler opinion regarding the fishery and future stockings.

Action: Striped Bass fingerlings were stocked at 5/acre in 2016 and 2017. An additional gill netting survey was conducted in 2017 and a year-long creel survey was conducted in 2017-18.

2. Request Florida Largemouth Bass fingerling stocking at 25/acre if water level exceeds 660 ft. above msl by May 2016.

Action: Florida Largemouth Bass were requested and stocked in 2015, 2016, and 2019 when the criteria was met.

3. Address suite of strategies to develop awareness and prevent the spread of invasive species, particularly, zebra mussels, present in Travis reservoir.

Action: We worked with local authorities to install ramp stencils and signage to make boaters aware that the lake became infested with zebra mussels. Delivered educational workshops with marinas to help them deal with incoming and outgoing boat traffic. Wrote press releases and conducted news media interviews to educate the public of the newly-infested reservoir.

Harvest regulation history: The lake has historically been managed with statewide harvest regulations. White Bass were managed under an experimental 12-inch minimum length limit from 1995 to 2003. This was reduced to the statewide minimum length limit of 10 inches in September 2003, as analyses suggested that population densities were probably determined by environmental factors (inflow and water level) rather than angler harvest. Current regulations are found in Table 3.

Stocking history: Florida Largemouth Bass, Striped Bass, Blue Catfish, and Channel Catfish have been important species stocked in the reservoir. Annual Striped Bass stockings at a rate of 5/acre have been often stocked since 2002 to maintain a fishery. Florida Largemouth Bass were introduced in 1988, 2008, 2011, 2015, 2016, and 2019 to increase Florida Largemouth Bass genetic influence. Blue Catfish were stocked in 1979 and a self-sustaining population is now present. The complete stocking history is in Table 4.

Vegetation/habitat management history: Significant stands of aquatic vegetation have never been documented in the reservoir probably due to extended periods of low-water levels and predominance of steep sided banks. Most of the shoreline habitat was comprised of rocky shoreline/bluff with piers and docks, and natural shoreline. Water levels at Travis Reservoir fluctuated widely, but shoreline habitat in the middle and lower portions of the reservoir change very little because the shorelines were generally steep-sided.

Water transfer: Travis Reservoir is primarily used for flood control, municipal and agricultural water supply, and recreation. The reservoir forms part of the chain of "Highland Lakes" on the Colorado River, receiving water from Marble Falls Reservoir and discharging into Austin Reservoir. There are no inter-basin transfers.

Methods

Surveys focused on achieving objectives in accordance with the objective-based sampling (OBS) plan for Travis 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. Ages for Largemouth Bass were determined using otoliths from 13 randomly-selected fish (range 13.0 to 14.9 inches) captured during a spring gill netting survey.

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).

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 – An annual roving creel survey was conducted from 2017 through 2018. The creel period was 1 September 2017 through 31 August 2018. Angler interviews were conducted on 5 weekend days and 4 weekdays per quarter to assess angler use and fish catch/harvest statistics in accordance with the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2017). The creel survey was spatially stratified to cover the lower two thirds of the reservoir, covering 12,522 acres (67% at full pool).

Habitat – A structural habitat survey and aquatic vegetation survey were conducted in 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 Lower Colorado River Authority (LCRA 2019).

Results and Discussion

Habitat: Littoral zone structural habitat consisted primarily of natural shoreline and shorelines with rocky features, with and without piers and docks (Table 6). The rocky, steep-sided nature of the reservoir, along with water level fluctuations, makes it difficult for aquatic vegetation to establish. No aquatic vegetation was sampled during the survey.

Creel: Directed fishing effort by anglers was highest for Largemouth Bass (49.2%) and black bass in aggregate (21.2%), followed by anglers fishing for anything (14.7%; Table 7). Total fishing effort for all species was estimated at 97,930 hours and direct expenditures at \$768,000 for Travis Reservoir for the creel survey year (Table 8). Most anglers travelled within 25 miles to fish Travis Reservoir (Appendix C).

Prey species: Electrofishing catch rates of Gizzard Shad and Threadfin Shad were 64.5/h and 96.0/h, respectively (Appendix A). Index of Vulnerability (IOV) for Gizzard Shad was poor, indicating that only

7% of Gizzard Shad were available to existing predators; this was lower than IOV estimates in previous years (Figure 2). Total CPUE of Gizzard Shad was considerably lower in 2018 compared to the 2014 survey, possible due to the invasion of zebra mussels and large numbers of stocked predators when the reservoir water levels rose in 2015. Total CPUE (52.5/h) of Redbreast Sunfish in 2018 was similar to 2014 (53.3/h), during extreme drought conditions, and lower than in 2010 (112.5/h), during high water. Size structure continued to be dominated by mid-sized individuals between 5 to 8 inches (Figure 3). Total CPUE (95.5/h) of Bluegill in 2018 was not much higher than in 2014 (74.7/h), during extreme drought conditions, and lower than in 2010 (204.5/h), during high water. Size structure continued to be dominated by smaller individuals (Figure 4).

Catfishes: Catfish species were not sampled with set objectives; however, their presence was documented during gill netting efforts, directed towards Striped Bass. The gill net catch rate of Blue Catfish and Channel Catfish was 2.6/nn and 1.5/nn, respectively in 2019. Relative abundance for both species increased from previous surveys, exhibiting good condition, as relative weights (W_r) for most inch-groups were above 90% (Figure 5 and 6). While large Blue Catfish were available to anglers, few anglers targeted them during the creel survey. Directed fishing effort, catch per hour, and total harvest for both species showed a minimal catfish fishery (Table 9). Both species offered somewhat a harvest-oriented fishery as low percentages of the legal-sized fish were released (Table 9). Observed harvest from 2017-18 showed good angler compliance (Figure 7 and 8). Flathead Catfish were also present in low relative abundance (1.0/nn) in 2019.

Temperate Basses: White Bass were not sampled with set objectives; however, their presence was documented during gill netting efforts, directed towards Striped Bass. The gill net catch rate of White Bass was 1.7/nn in 2019, similar to previous surveys (Figure 9). Directed fishing effort and total harvest for White Bass was extremely low (Table 10). This is likely underrepresented since the creel survey didn't capture the popular spring run fishery up the Pedernales and Colorado rivers, as these segments were not included in the creel survey. Even so; it is likely that White Bass present a small percentage of fishing effort at Travis Reservoir.

Striped Bass were targeted without objectives due to poor historic catches in gill nets surveys. The survey was set as an insert to the creel survey in detecting the significance of this fishery. As usual, Striped Bass were collected at a low catch rate of 0.2/nn in 2019 and 0.4/nn in 2017, declining from 2015 (1.9/nn). Large individuals (>25 inches) were available to anglers and condition was sub-optimal, as relative weights (W_r) were below 90% (Figure 10). The three fish caught were aged, but the sample size was not enough to determine growth rates with confidence. Directed fishing effort and total harvest for Striped Bass portrayed a non-existent fishery (Table 10). However, reports of angler effort and catches were sent to us outside the creel surveys via social media and messaging apps. These reports confirmed historical anecdotal evidence that Striped Bass anglers on Travis Reservoir fish for this species seasonally (summer) and mostly at night, when the creel surveys are not conducted. Many fish pictured were of large sizes. Furthermore, supplemental questions asked during the creel survey indicated some level of directed effort for Striped Bass at Travis Reservoir. When asked "In the last year, have you ever made a trip to Travis Reservoir to specifically target Striped Bass?"; 37 (9.7%) replied "Yes" and 344 (90.3%) replied "No." To the 37 individuals that replied "Yes," we asked, "What percent of your fishing trips to Travis Reservoir in the last year did you specifically target Striped Bass?" The responses ranged from 1% to 100% (Mean = 21.8%; SD = 25.3%). The third question asked, "In the last year, have you ever caught Striped Bass while targeting other species at Travis Reservoir? Out of all 388 respondents, 112 (29.4%) replied "Yes" and 269 (70.6%) said "No"

Black Basses: The electrofishing catch rate of stock-length Largemouth Bass was 106.0/h in 2018, higher than the 11.3/h in 2014, when the lake was extremely low due to drought conditions (Figure 11). Size structure was adequate for a quality fishery, as PSD was 75, similar to the 71 recorded in 2014 (Figure 11). Body condition in 2018 was unexpectedly poor (relative weight under 90) for nearly all inch-classes of fish (Figure 11). The large amounts of flooded habitat after 2015 rain events, should have produced a boom in numbers and condition after 3 years. This brings to question whether the invasion of zebra mussels in 2017 counteracted the "new-lake effect" of the flood events. Directed fishing effort

(including tournament anglers), catch per hour, and total harvest for black basses was 69,279 h, 1.7/h, and 5,141 fish, respectively, from September 2017 through August 2018 (Table 11). Eighty-three percent of legal Largemouth Bass caught were released (Table 11). Harvest of Largemouth Bass was low, and most of the harvested fish ranged in length from 14 to 15 inches (Figure 12). Growth of Largemouth Bass in Travis Reservoir was poor; average age at 14 inches (13.0 to 14.9 inches) was over 4 years (N = 11; range = 3 – 4 years). The aging sample was collected during the spring gill netting survey due to failure to collect them during the standard fall electrofishing survey. Florida Largemouth Bass influence has remained relatively constant as Florida alleles have ranged from 51 to 61%. No pure Florida Largemouth Bass were collected (Table 12). In 2018, Travis Reservoir hosted the Toyota Bassmaster Texas Fest (TBTF), where professional bass anglers set a record for numbers of fish caught at the time. Their challenge was catching larger fish through the booming recruiting year-class from the recent rises in water levels in 2015 and 2016.

Guadalupe Bass were present in Travis Reservoir and are an important part of the black bass fishery. Total electrofishing CPUE was 17.0/h (Appendix A) and directed angler effort was low, though some tournament directed effort and harvest were recorded (Table 11). A couple of moderate-sized organized fishing tournaments take place at Travis Reservoir targeting the state fish of Texas, Guadalupe Bass. These fish were showcased nationally during the 2018 TBTF, hosted at Travis Reservoir.

Crappie: Both Black Crappie and White Crappie are present in Travis Reservoir. We only monitored them through the creel survey in 2017-18. Directed effort for White Crappie was 1,163 hours per year, caught at a rate of 0.2/h, and estimated total harvest was 1,409 fish (Table 13). Angler compliance was excellent, and all legal fish caught were harvested (Figure 13).

Fisheries Management Plan for Travis Reservoir, Texas

Prepared – July 2019

ISSUE 1: Striped Bass have been a part of the fishery at Travis Reservoir since 1973. Annual stocking of Striped Bass has been required to sustain the population and maintain a fishery. The creel survey in 2017-18 revealed that directed effort for this species was undetected. Efforts by anglers to report effort and catches outside the creel survey revealed that there is some affinity for Striped Bass. However, we need to consider matching our stocking efforts to the magnitude of the fishery. The establishment of zebra mussels has created a competitive disadvantage for the forage base, likely reflected in the condition and growth of the primary sport fish, Largemouth Bass. Reducing predator competition may help improve Largemouth Bass performance.

MANAGEMENT STRATEGY

1. Terminate the Striped Bass stocking regime at Travis Reservoir.

ISSUE 2: Largemouth Bass growth and condition has not met expectations after the flooding events since 2015. High supplemental stocking rates and the infestation of zebra mussels in 2017 may have impacted this performance. While angler catch rates have been phenomenal in past years, many complain of most being undersized.

MANAGEMENT STRATEGIES

1. Temporarily discontinue stocking Florida Largemouth Bass to reduce crowding potential of young-of-year fish
2. Work with the LCRA to gather historic water quality data to determine trends pre- and post-zebra mussels.
3. Conduct an additional bass-only electrofishing survey in fall 2020 to monitor growth and condition.
4. Conduct a Category-3 age-and-growth evaluation on Largemouth bass during both scheduled electrofishing surveys in the OBS plan.
5. Conduct a creel survey in 2021-2022 to evaluate catch data.

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*), which have infested Travis Reservoir, have been multiplying rapidly and attaching themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches, and plugging engine cooling systems. Other invasive species can interfere 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 continue posting appropriate signage at access points around the reservoir.
2. 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. Educate the public about invasive species through the use of media and the internet.
4. 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.
6. Document any potential negative impacts to the fishery if determined, as these impacts have never been documented in Texas.

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

Sport fish, forage fish, and other important fishes

Sport fishes in Travis Reservoir include Largemouth Bass, Guadalupe Bass, Striped Bass, White Bass, White Crappie, Black Crappie, Channel Catfish, Blue Catfish, and Flathead Catfish. Predominant forage fish species include Gizzard Shad, Threadfin Shad, Redbreast Sunfish, and Bluegill.

Underutilized or low-density fisheries

Channel Catfish: Channel Catfish are present in low density at Travis Reservoir, based on relative abundance estimates from our monitoring program. The gill netting catch rate of stock-size Channel Catfish ranged between 0.2/nn to 2.4/nn since 2003, with the lowest in 2015. However, directed effort for this species was low during the 2017-18 angler creel survey. General monitoring will be conducted using creel surveys.

Blue Catfish: Blue Catfish are present in low to moderate density at Travis Reservoir, based on relative abundance estimates from our monitoring program. The gill netting catch rate of stock-size Blue Catfish ranged between 0.8/nn to 2.6/nn since 2003, with the highest in 2019. However, directed effort for this species was low during the 2017-18 angler creel survey. General monitoring will be conducted using creel surveys.

Flathead Catfish: Flathead Catfish are present in low to moderate density at Travis Reservoir, based on relative abundance estimates from our monitoring program. The gill netting catch rate of stock-size Flathead Catfish ranged between 0.4/nn to 1.9/nn since 2003, with the lowest in 2017. However, directed effort for this species was low during the 2017-18 angler creel survey. General monitoring will be conducted using creel surveys.

Crappie: White and Black Crappie are present at Travis Reservoir. Historic trap netting surveys have failed to capture enough fish to generate a confident estimate. However, directed effort for this species was low during the 2017-18 angler creel survey. General monitoring will be conducted using creel surveys.

Guadalupe Bass: Guadalupe Bass are present in low to moderate density in Travis Reservoir, based on historic catch rates generated by electrofishing surveys. The electrofishing catch rates of Guadalupe Bass ranged between 17.5/h to 40.5/h since 2003. However, directed effort for this species was low during the 2017-18 angler creel survey. General monitoring with no established sampling objectives during targeted electrofishing for Largemouth Bass will be sufficient for this species.

White Bass: White Bass relative abundance has remained stable, based on historic gill netting surveys. The gill netting catch rate of stock-size White Bass ranged between 0.7/nn to 4.0/nn since 2003. White Bass offer seasonal fishing opportunities at Travis Reservoir. The spring spawning run up the Pedernales and Colorado rivers has been known as a popular option for local anglers. However, directed effort for this species was low during the 2017-18 angler creel survey. Extending the creel survey boundaries to include the upper portion of the reservoir will likely capture springtime effort. General monitoring will be conducted using creel surveys.

Survey objectives, fisheries metrics, and sampling objectives

Largemouth Bass: Largemouth Bass is the most targeted species by anglers at Travis Reservoir, based on the 2017-18 angler creel survey. More than 70% of anglers targeted black bass in Travis Reservoir. The reservoir attracts many black bass tournaments, that reveal commonly caught quality- to trophy-size individuals. However, recent poor growth and condition have prompted extra effort to monitor this population. After reviewing historical data, electrofishing catch rates of stock-size Largemouth Bass since 1998 were sufficient to meet minimal objectives in 24 stations, which should result in a mean weighted CV of 0.25 or less. A minimum of 24 randomly selected 5-min electrofishing sites will be sampled in fall 2020 and 2022 to determine relative abundance, size structure, condition, and growth; but, sampling will continue at random sites until 50 stock-size fish are collected or the RSE of CPUE-S is ≤ 25 . Exclusive of the original 24 random stations, 6 additional random stations will be pre-determined in the event some extra sampling is necessary the same evening. If failure to achieve either objective has occurred after 30 stations, no other efforts will be expended for this species.

An age and growth sample of 200 fish above 150 mm in length (10 per 10 mm-group) will be collected to assess the time required for Largemouth Bass to grow to the minimum length limit (Category 3 evaluation, TPWD, Inland Fisheries Division, unpublished manual revised 2017).

Gizzard Shad, Threadfin Shad, and sunfishes: Gizzard Shad, Threadfin Shad, Redbreast Sunfish, and Bluegill are the primary forage at Travis Reservoir. Like Largemouth Bass, trend data on CPUE and size structure of these sunfish have been collected every four years since 1998. Abundance of Threadfin Shad was also measured as a function of CPUE during those surveys and will remain the main sampling objective to measure Threadfin Shad abundance. Continuation of sampling, as per Largemouth Bass above, will allow for monitoring of large-scale changes in sunfish relative abundance and size structure. No additional effort will be expended to achieve an RSE-25 for CPUE of sunfish. Instead, Largemouth Bass body condition could indirectly gauge forage availability.

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Tables and Figures

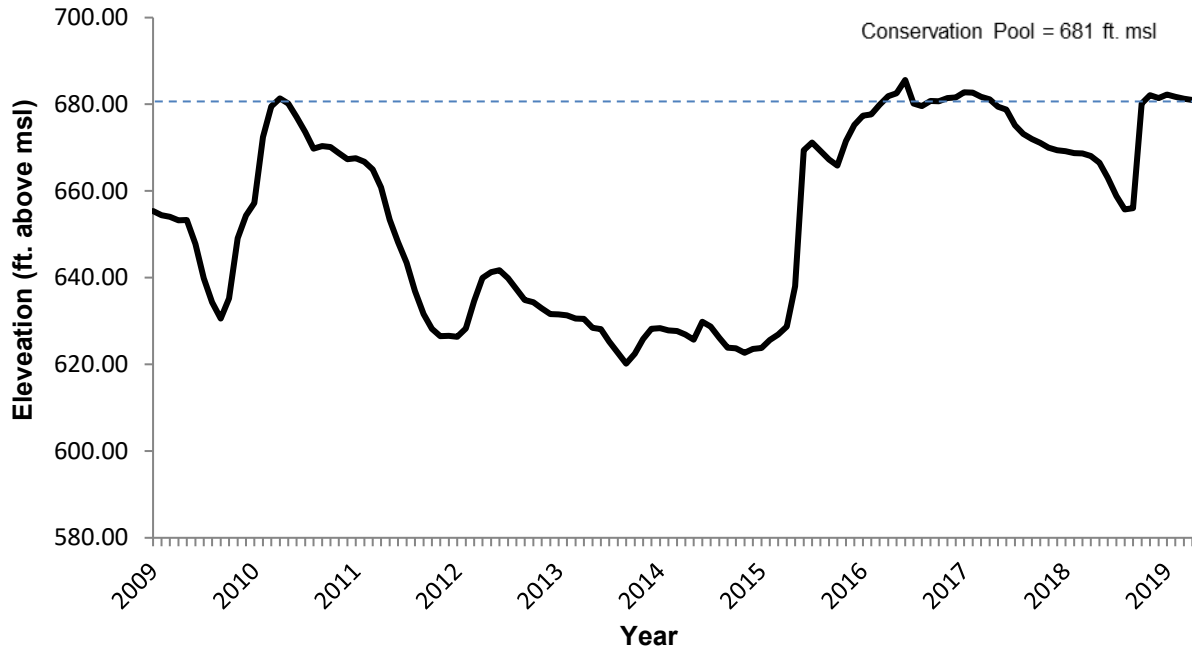


Figure 1. Mean monthly water level elevations in feet above mean sea level (MSL) recorded for Travis Reservoir, Texas.

Table 1. Characteristics of Travis Reservoir, Texas.

Characteristic	Description
Year constructed	1942
Controlling authority	Lower Colorado River Authority
County	Burnett and Travis
Reservoir type	Mainstream: Colorado River
Shoreline Development Index	18.3
Conductivity	315 μ S/cm

Table 2. Boat ramp characteristics for Travis Reservoir, Texas, August 2018. Reservoir elevation at time of survey was 655 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Closure Elevation (ft.)	Condition
Arkansas Bend	30.402735 - 97.952565	Y	15	661	Unimproved
Bob Wentz at Windy Point	30.413122 - 97.896830	Y	30	653	Unimproved-sailboats only
Camp Creek Park	30.563203 - 98.191203	Y	10	NA	Good
Camp Pedernales	30.427056 - 98.089623	Y	20	NA	Good
Cypress Creek Park	30.426549 - 97.872510	Y	15	667	Good
Dink Pearson Park	30.385470 - 97.984830	N	12	653	Unimproved
Gloster Bend	30.466324 - 98.076702	N	10	662	Good
Hippie Hollow	30.409322 - 97.877576	Y	17	653	Good
Jones Brothers Park	30.487351 - 97.925711	Y	>100	645	New 2-lane ramp; Other two ramps unimproved
Mansfield Dam Park	30.397921 - 97.908991	Y	112	633	Good
Pace Bend, Collier Cove	30.461510 - 98.029834	Y	30	653	Good
Pace Bend, Tatum Cove	30.452896 - 98.016154	Y	15	653	Good
Pace Bend, Tournament Point	30.475220 - 98.007220	Y	100	633	New low- water ramp, no paved parking or turnaround
Sandy Creek Park	30.467337 - 97.907217	Y	15	648	Good
The Narrows	30.523072 - 98.147638	Y	29	NA	Good

Table 3. Harvest regulations for Travis Reservoir, Texas.

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	5	18-inch minimum
Bass, Largemouth	5 ^a	14-inch minimum
Bass, 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 and Guadalupe Bass = 5 fish in any combination.

Table 4. Stocking history of Travis Reservoir, Texas. FRY = fry; FGL = fingerling; AFGL = advanced fingerling; ADL = adults; UNK = unknown life stage/size.

Species	Year	Number	Life Stage
Blue Catfish	1979	101,313	UNK
	Total	<u>101,313</u>	
Channel Catfish	1971	13,000	AFGL
	1972	87,000	AFGL
	2005	457	ADL
	2008	400	ADL
	2018	617	ADL
	Total	<u>101,474</u>	
Florida Largemouth Bass	1988	474,535	FRY
	2008	464,568	FGL
	2011	232,106	FGL
	2015	424,979	FGL
	2016	347,287	FGL
	2019	311,087	FGL
	Total	<u>2,254,562</u>	
Largemouth Bass	1967	238,000	UNK
	Total	<u>238,000</u>	
Smallmouth Bass	1977	211,400	UNK
	1978	196,050	UNK
	1979	343,940	UNK
	Total	<u>751,390</u>	
Striped Bass	1973	206,285	FGL
	1974	163,611	FGL
	1976	175,854	UNK
	1978	90,250	UNK
	1981	180,000	UNK
	1983	183,699	UNK
	1991	94,600	FGL
	2002	110,490	FGL
	2005	96,000	FGL

Species	Year	Number	Life Stage
Striped Bass (Cont.)	2006	98,842	FGL
	2007	103,569	FGL
	2008	94,734	FGL
	2009	101,813	FGL
	2010	99,097	FGL
	2013	87,425	FGL
	2013	579,363	FRY
	2014	88,509	FGL
	2015	63,021	FGL
	2015	442,047	FRY
	2016	454,767	FRY
	2017	86,326	FGL
	Total	3,600,302	
Walleye	1976	190,000	FRY
	1977	3,666,925	FRY
	1978	4,391,640	FRY
	1979	4,503,500	FRY
	Total	12,752,065	

Table 5. Objective-based sampling plan components for Travis 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	Length frequency	$N \geq 50$
	Prey availability	IOV	$N \geq 50$
<i>Gill netting</i>			
Striped Bass	Abundance	CPUE–Total	Exploratory
	Size structure	PSD, length frequency	Exploratory
	Age-and-growth	Age at 18 inches	Max 10 per inch-group
	Condition	W_r	Exploratory

^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.

Table 6. Survey of structural habitat types, Travis Reservoir, Texas, 2018. Shoreline habitat type units are in miles and standing timber is acres. The lake was 26 feet below conservation pool (681 ft msl) at the time of survey.

Habitat type	Estimate	% of total
Bulkhead	0.4 miles	0.1
Gravel shoreline	10.0 miles	3.1
Gravel with piers and docks	0.8 miles	0.3
Rocky shoreline	44.3 miles	13.8
Rocky with piers and docks	49.1 miles	15.3
Rocky bluff	50.9 miles	15.8
Rocky bluff with piers and docks	78.8 miles	24.5
Natural shoreline	80.1 miles	24.9
Natural with piers and docks	7.3 miles	2.3

Table 7. Percent directed angler effort by species for Travis Reservoir, Texas, 2017–2018. Survey periods were from 1 September through 31 August.

Species	2017/2018
Blue Catfish	1.7
Channel Catfish	0.7
White Bass	1.5
Bluegill	0.3
Largemouth Bass	49.2
Guadalupe Bass	3.6
White Crappie	1.2
Anything	14.7
Black Basses	21.2
Crappies	2.1
Catfishes	3.7
Temperate Basses	0.2
Tournaments*	8.1

* Tournament effort derived separately from the Largemouth Bass and Guadalupe Bass directed effort listed above.

Table 8. Total fishing effort (h) for all species and total directed expenditures at Travis Reservoir, Texas, 2017-2018. Survey periods were from 1 September through 31 August. Relative standard error is in parentheses.

Creel statistic	2017/2018
Total fishing effort	97,930.45 (13)
Total directed expenditures	\$768,000 (23)

Gizzard Shad

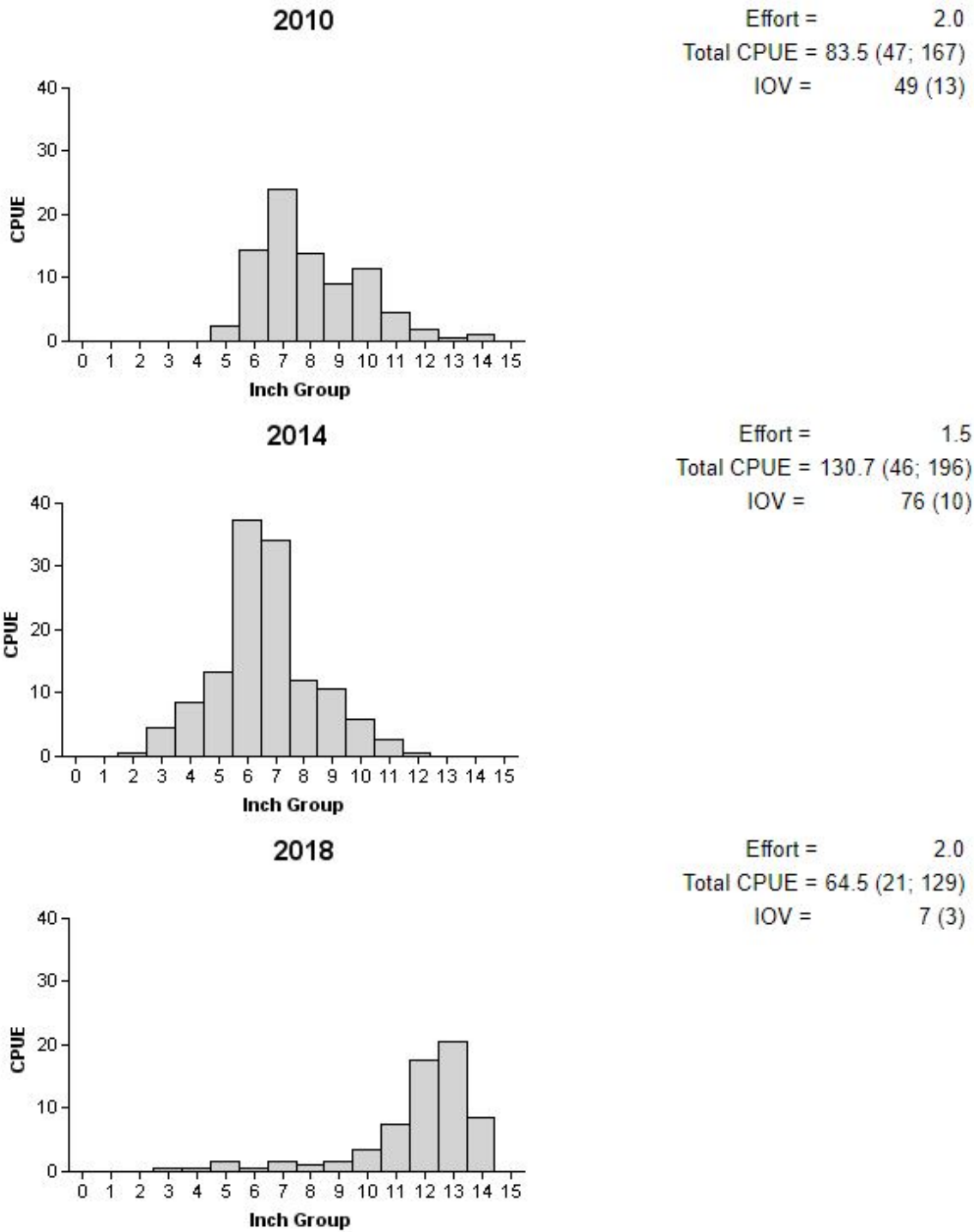


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Travis Reservoir, Texas, 2010, 2014, and 2018.

Redbreast Sunfish

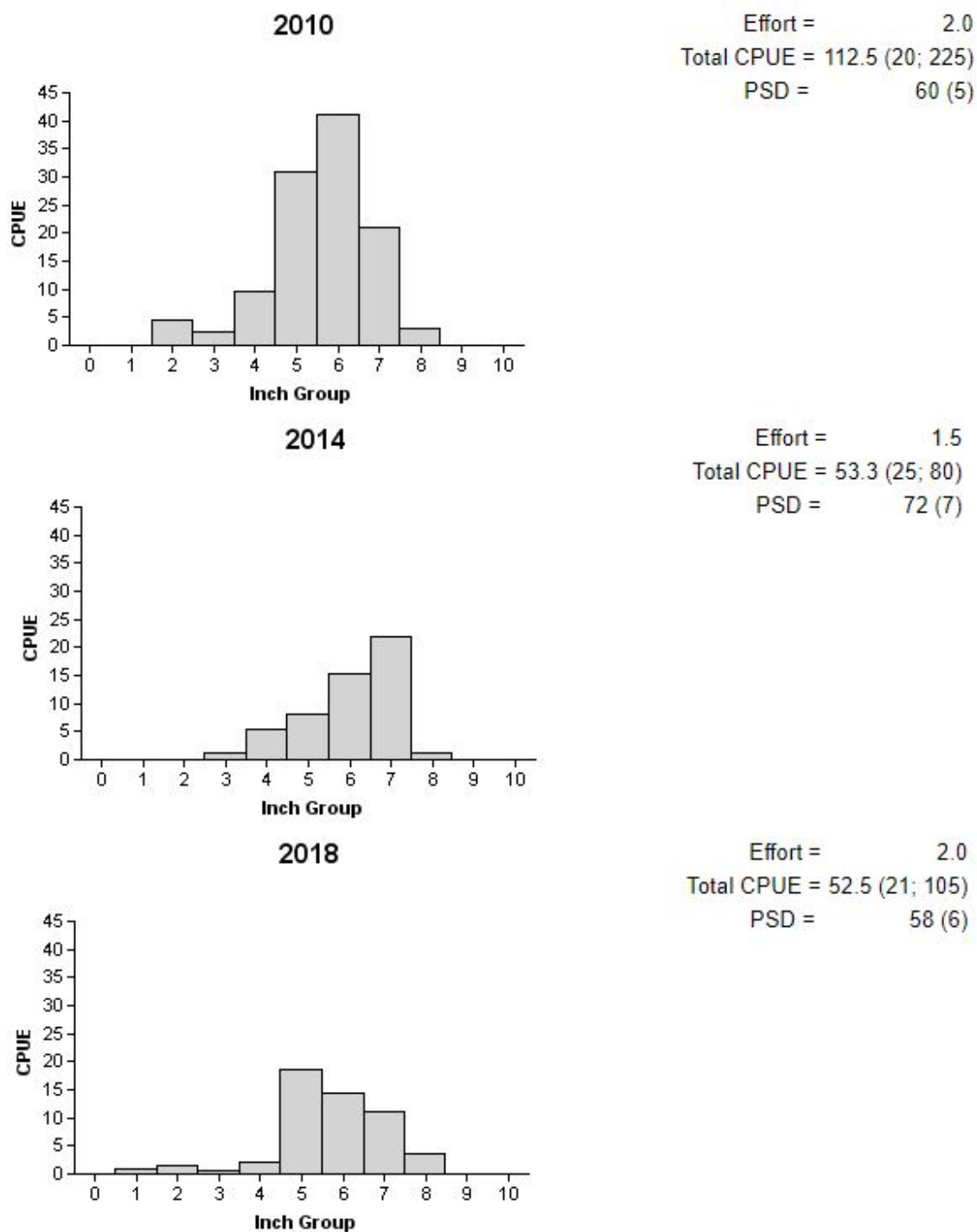


Figure 3. Number of Redbreast Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Travis Reservoir, Texas, 2010, 2014, and 2018.

Bluegill

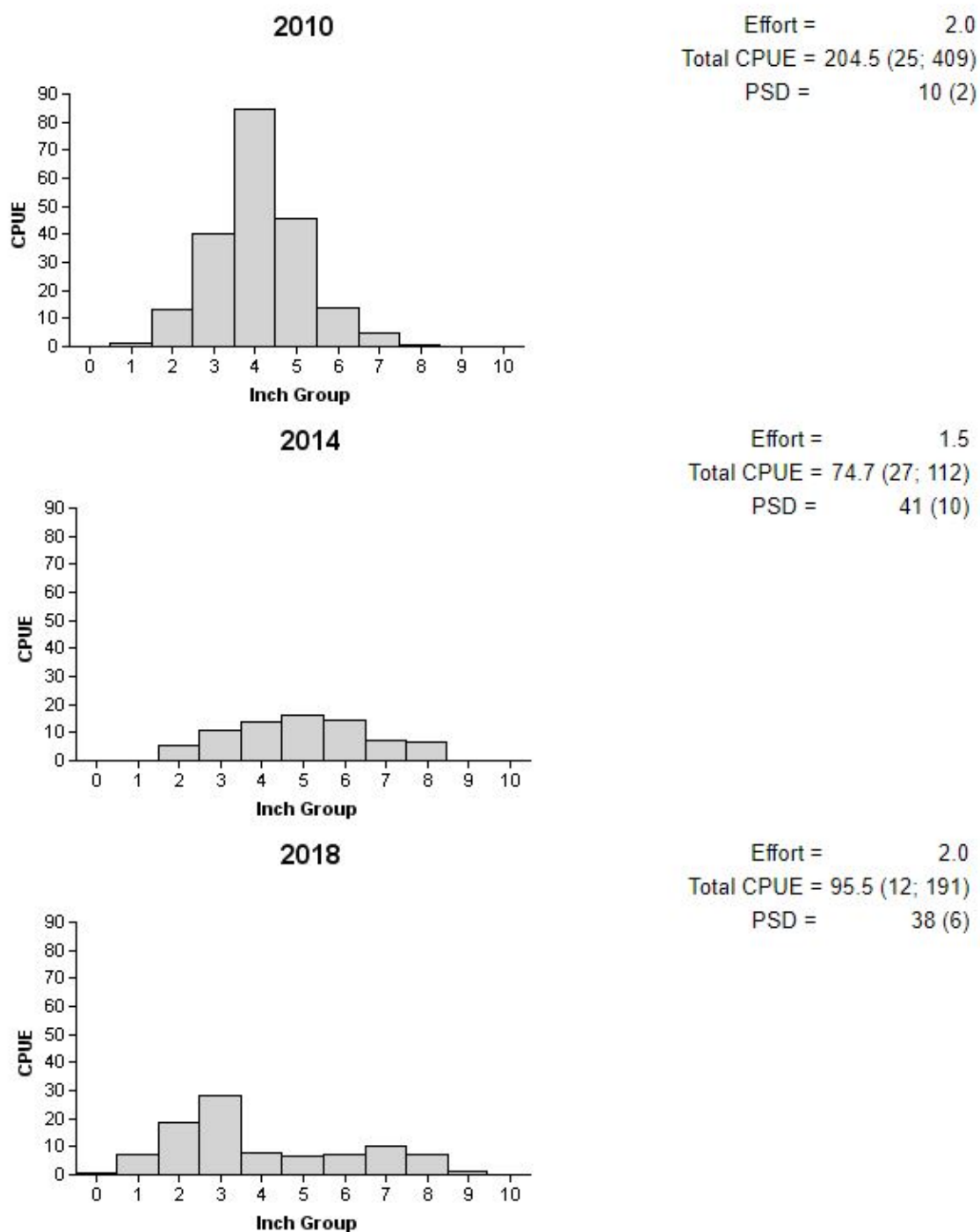


Figure 4. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Travis Reservoir, Texas, 2010, 2014, and 2018.

Blue Catfish

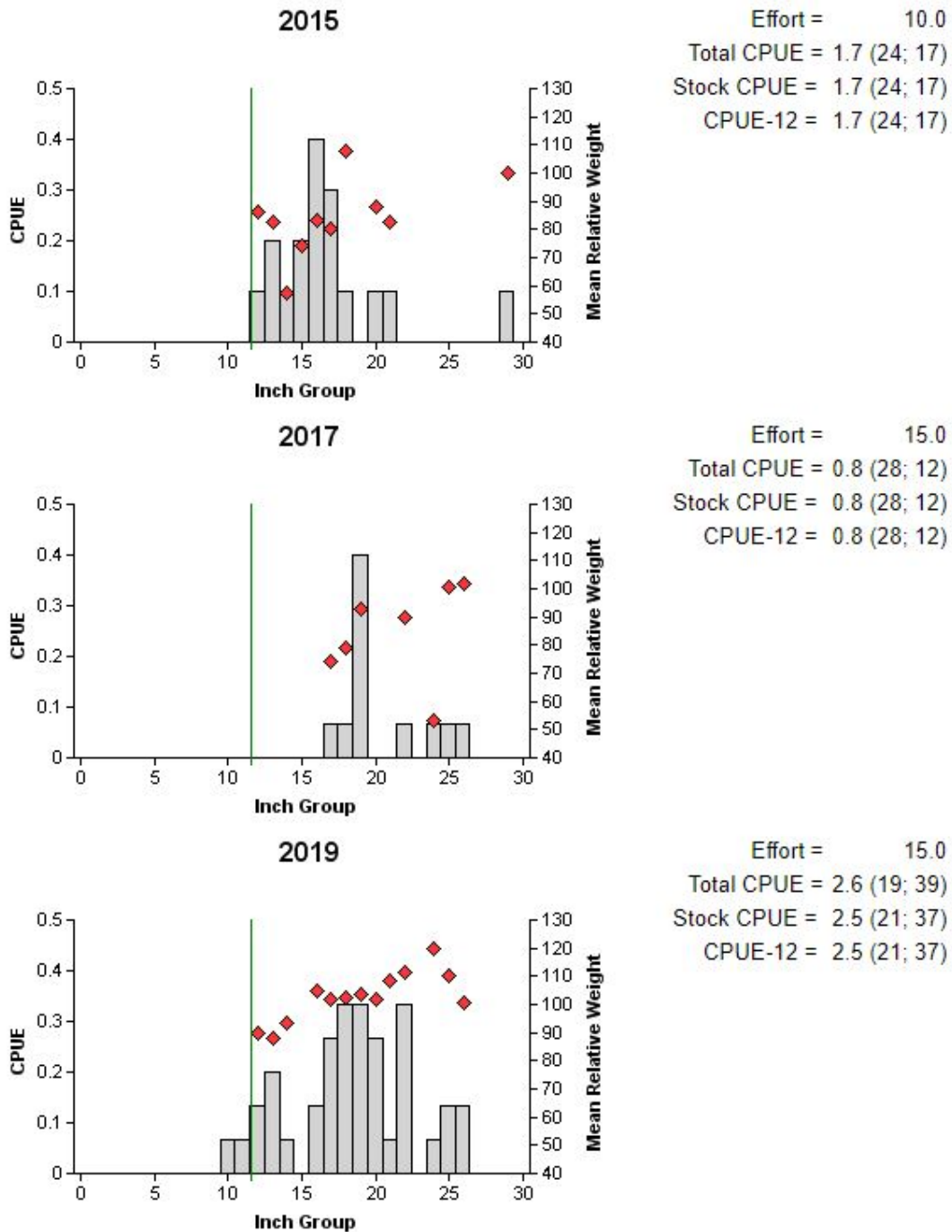


Figure 5. Number of Blue Catfish caught per net night (CPUE), population indices (RSE and N for CPUE and SE for size structure are in parentheses), and mean relative weights (diamonds) for spring gill net surveys, Travis Reservoir, Texas, 2015, 2017, and 2019. Vertical line represents the minimum length limit at the time of survey.

Channel Catfish

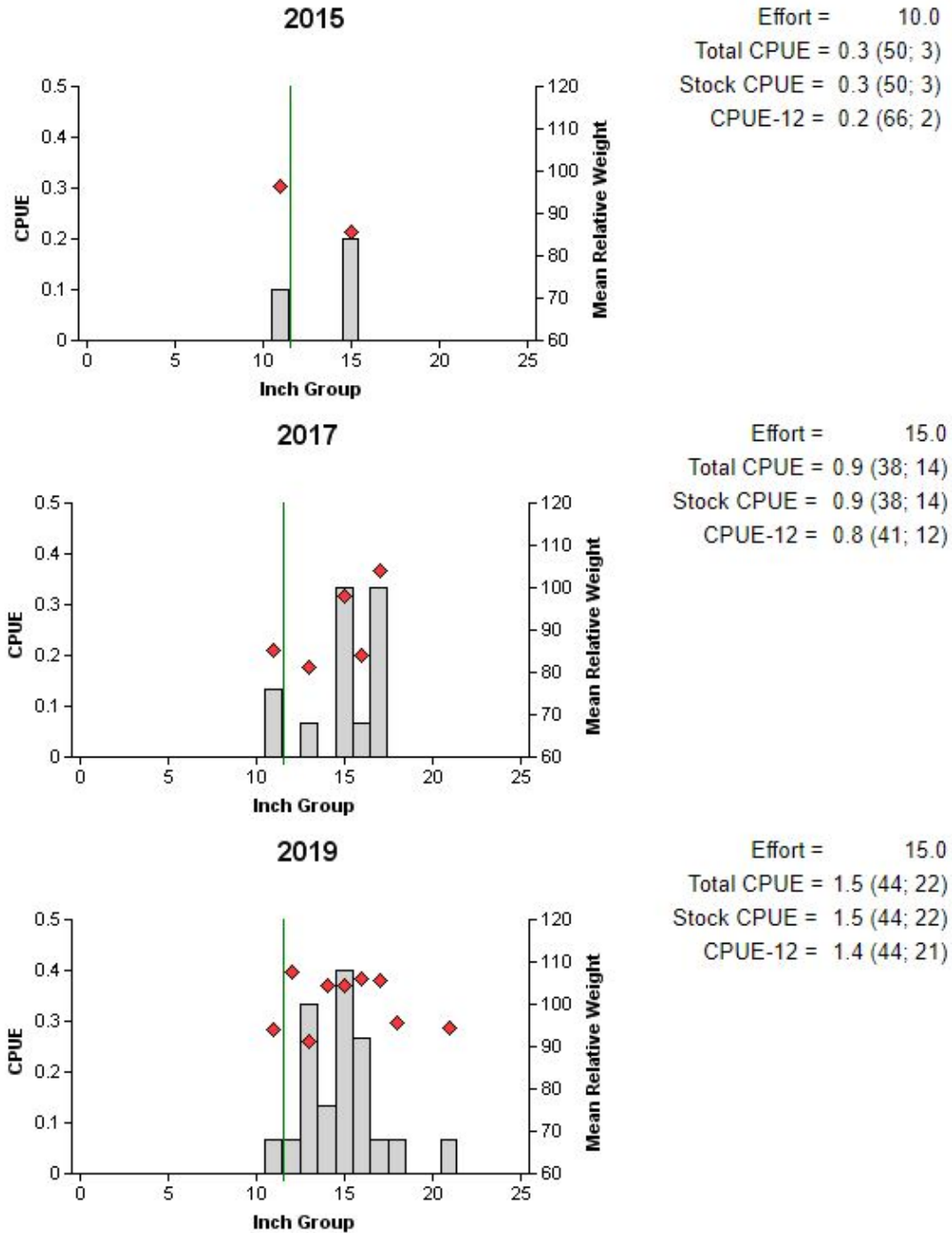


Figure 6. Number of Channel Catfish caught per net night (CPUE), population indices (RSE and N for CPUE and SE for size structure are in parentheses), and mean relative weights (diamonds) for spring gill net surveys, Travis Reservoir, Texas, 2015, 2017, and 2019. Vertical line represents the minimum length limit at the time of survey.

Table 9. Creel survey statistics for Catfishes at Travis Reservoir, Texas, from September 2017 through August 2018. Total catch per hour is for anglers targeting catfishes and total harvest is the estimated number of individual species of catfishes harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year
	2017/2018
Surface area (acres)	12,522
Directed effort (h)	5,990 (23)
Directed effort/acre	0.5 (23)
Total catch per hour	0.1 (134)
Total harvest	1,911
Blue Catfish	1,175 (62)
Channel Catfish	714 (72)
Flathead Catfish	22 (493)
Harvest/acre	0.2
Blue Catfish	0.1 (62)
Channel Catfish	0.1 (72)
Flathead Catfish	0.0 (493)
Percent legal released	23.0

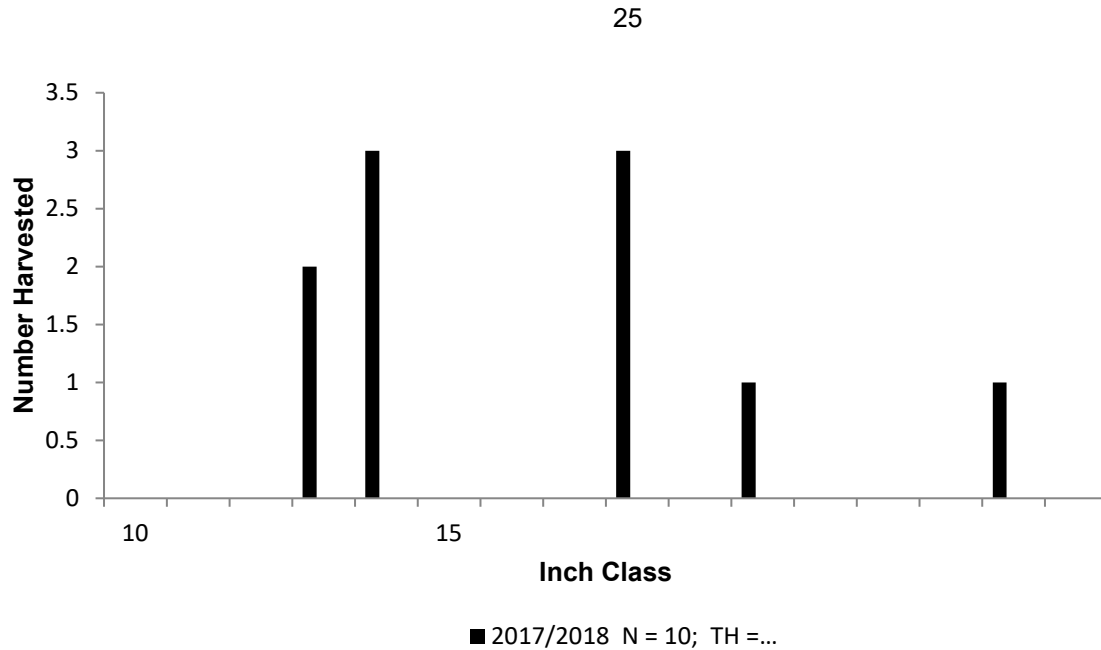


Figure 7. Length frequency of harvested Blue Catfish observed during creel surveys at Travis Reservoir, Texas, September 2017 through August 2018, all anglers combined. N is the number of harvested Blue Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period.

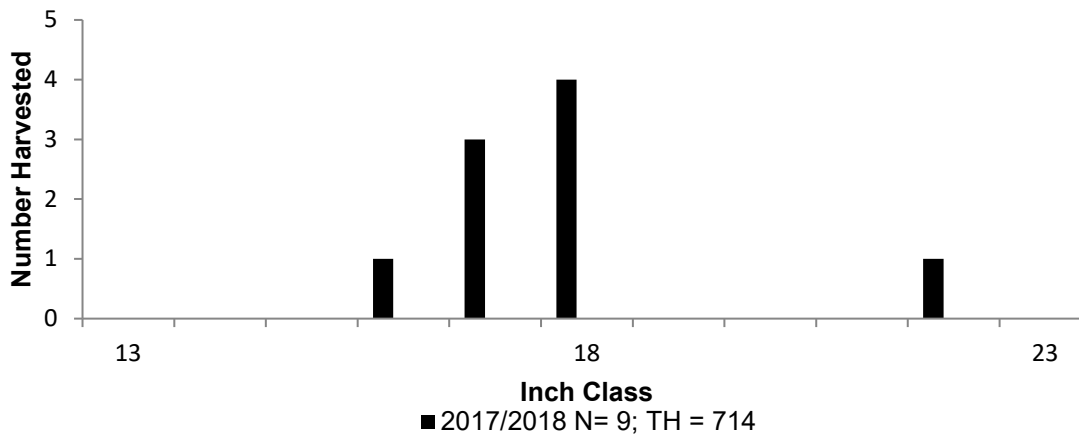


Figure 8. Length frequency of harvested Channel Catfish observed during creel surveys at Travis Reservoir, Texas, September 2017 through August 2018, all anglers combined. N is the number of harvested Channel Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period.

White Bass

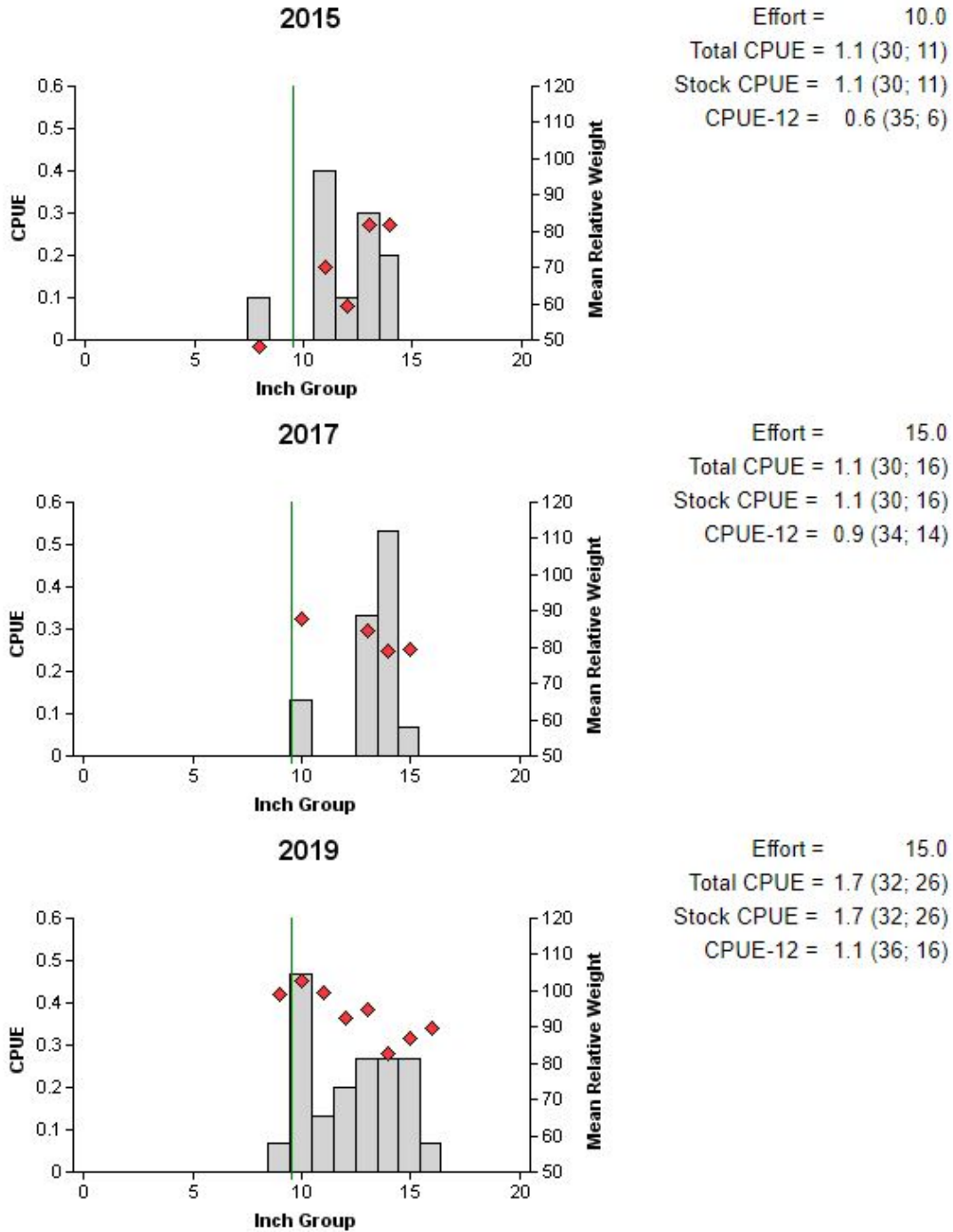


Figure 9. Number of White Bass caught per net night (CPUE), population indices (RSE and N for CPUE and SE for size structure are in parentheses), and mean relative weights (diamonds) for spring gill net surveys, Travis Reservoir, Texas, 2015, 2017, and 2019. Vertical line represents the minimum length limit at the time of survey.

Striped Bass

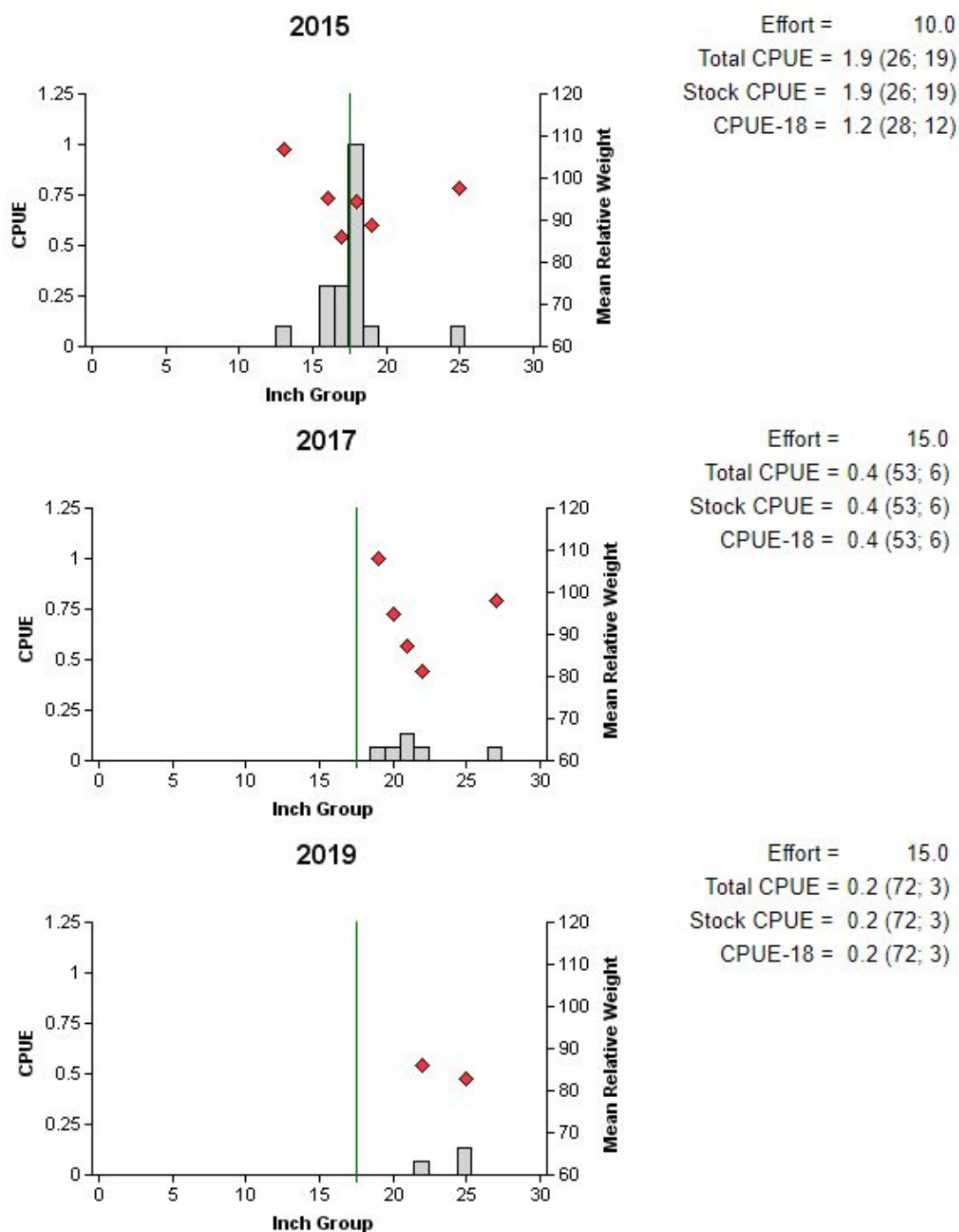


Figure 10. Number of Striped Bass caught per net night (CPUE), population indices (RSE and N for CPUE and SE for size structure are in parentheses), and mean relative weights (diamonds) for spring gill net surveys, Travis Reservoir, Texas, 2015, 2017, and 2019. Vertical line represents the minimum length limit at the time of survey.

Table 10. Creel survey statistics for temperate basses at Travis Reservoir, Texas, from September 2017 through August 2018. Total catch per hour is for anglers targeting temperate basses and total harvest is the estimated number of individual species of temperate basses harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year
	2017/2018
Surface area (acres)	12,522
Directed effort (h)	1,622 (50)
Directed effort/acre	0.1 (50)
Total catch per hour	N/A (-)
Total harvest	44.6 (250)
White Bass	44.6 (250)
Striped Bass	0.0 (-)
Harvest/acre	0.0 (250)
White Bass	0.0 (250)
Striped Bass	0.0 (-)
Percent legal released	93

Largemouth Bass

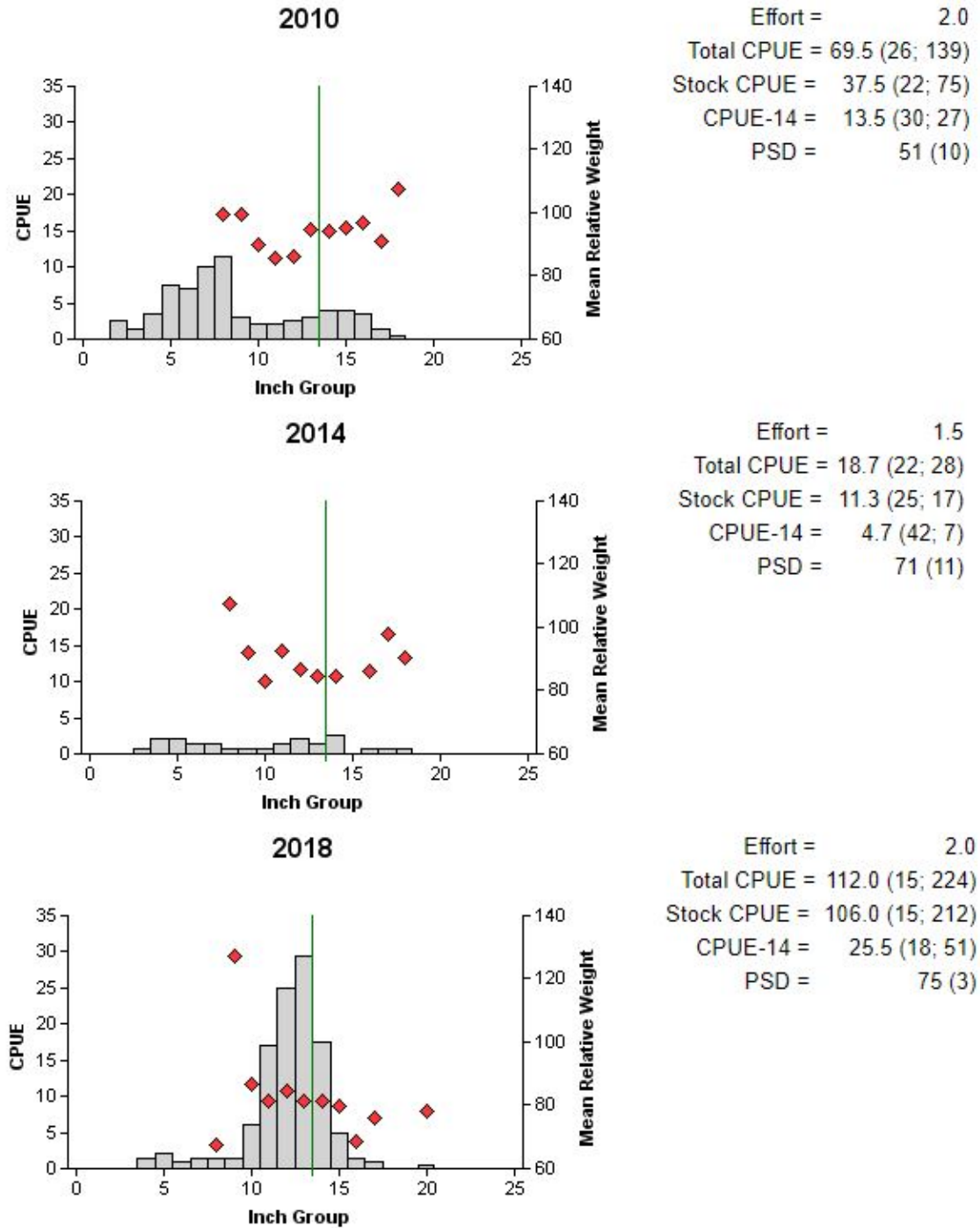


Figure 11. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Travis Reservoir, Texas, 2010, 2014, and 2018. Vertical line represents the minimum length limit at the time of survey.

Table 11. Creel survey statistics for Black Basses at Travis Reservoir, Texas, from September 2017 through August 2018. Catch rate is for all anglers targeting Black Bass. Harvest is partitioned by the estimated number of Largemouth Bass and Guadalupe Bass harvested by non-tournament anglers and the number of fish retained by tournament anglers for weigh-in and release. The number of fish harvested by Guadalupe Bass specific tournaments is also listed. The percent of legal-size fish released is reported for Largemouth Bass. Relative standard errors (RSE) are in parentheses.

Statistic	2017/2018
Surface area (acres)	12,522
Directed angling effort (h)	
Tournament (Black Bass)	10,447 (23)
Tournament (Guadalupe Bass)	3,196 (35)
Non-tournament	58,832 (15)
All black bass anglers combined	72,475 (15)
Angling effort/acre	5.8 (15)
Catch rate (number/h)	1.7 (16)
Harvest	
Largemouth Bass (Non-tournament)	5,141 (56)
Guadalupe Bass (Non-tournament)	723 (86)
Harvest/acre	0.5 (60)
Tournament weigh-in and release	680 (51)
Guadalupe Bass tournament harvest	1,224 (58)
Percent legal released (non-tournament)	83

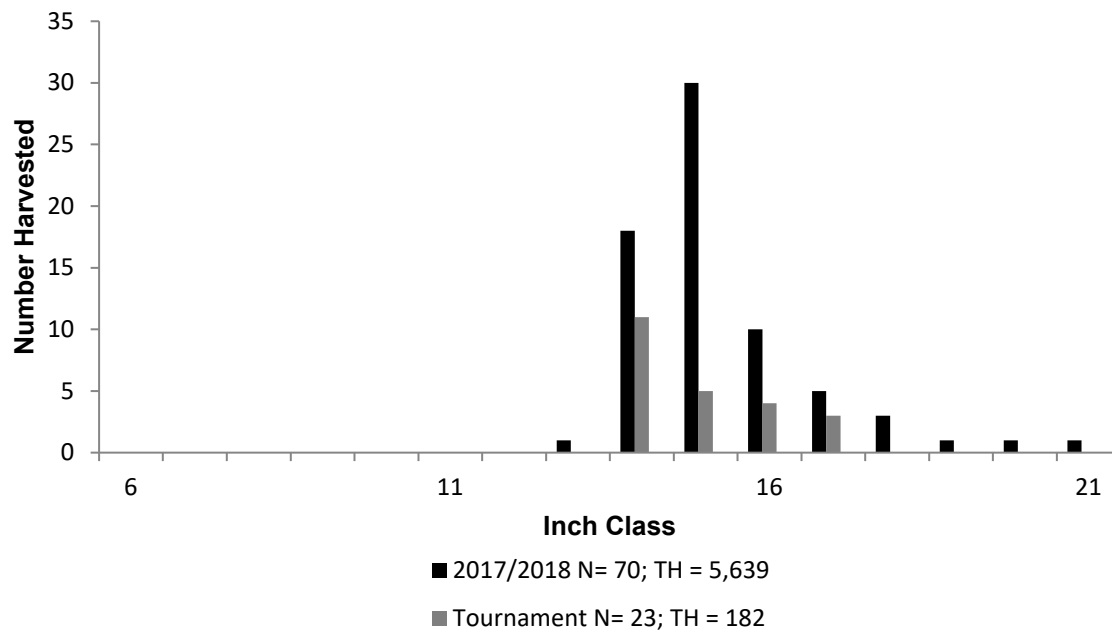


Figure 12. Length frequency of harvested Largemouth Bass observed during creel surveys at Travis Reservoir, Texas, September 2017 through August 2018, all anglers combined. N is the number of harvested Largemouth Bass observed during creel surveys, and TH is the total estimated harvest for the creel period.

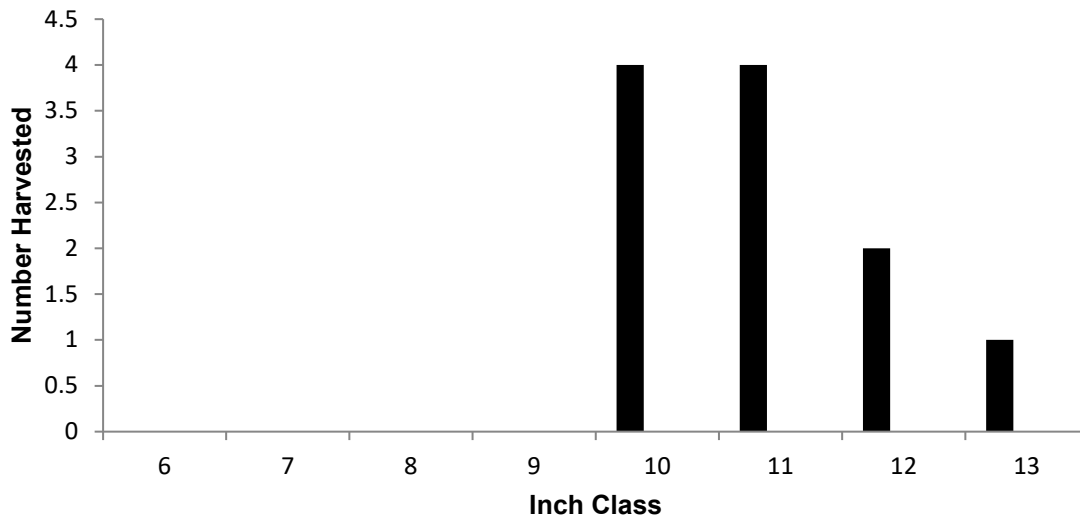
Table 7. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Travis Reservoir, Texas, 2010, 2014, and 2018. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB. Genetic composition was determined with micro-satellite DNA analysis.

Year	Sample size	Number of fish			% FLMB alleles	% FLMB
		FLMB	Intergrade	NLMB		
2010	30	1	28	1	61.0	3.0
2014	28	0	28	0	51.0	0.0
2018	29	0	29	0	57.0	0.0

White Crappie

Table 13. Creel survey statistics for White Crappie at Travis Reservoir, Texas, from September 2017 through August 2018. Total catch per hour is for anglers targeting White Crappie and total harvest is the estimated number of White Crappie harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year
	2017/2018
Surface area (acres)	12,522
Directed effort (h)	1,163.00 (49)
Directed effort/acre	0.09 (49)
Total catch per hour	0.18 (-)
Total harvest	1,408.92 (70)
Harvest/acre	0.11 (70)
Percent legal released	0.00



■ 2017/2018 N= 11; TH = 1,408

Figure 13. Length frequency of harvested White Crappie observed during creel surveys at Travis Reservoir, Texas, September 2017 through August 2018, all anglers combined. N is the number of harvested White Crappie observed during creel surveys, and TH is the total estimated harvest for the creel period.

Proposed Sampling Schedule

Table 8. Proposed sampling schedule for Travis Reservoir, Texas. Survey period is June through May. Electrofishing surveys are conducted in the fall. Standard survey denoted by S and additional survey denoted by A.

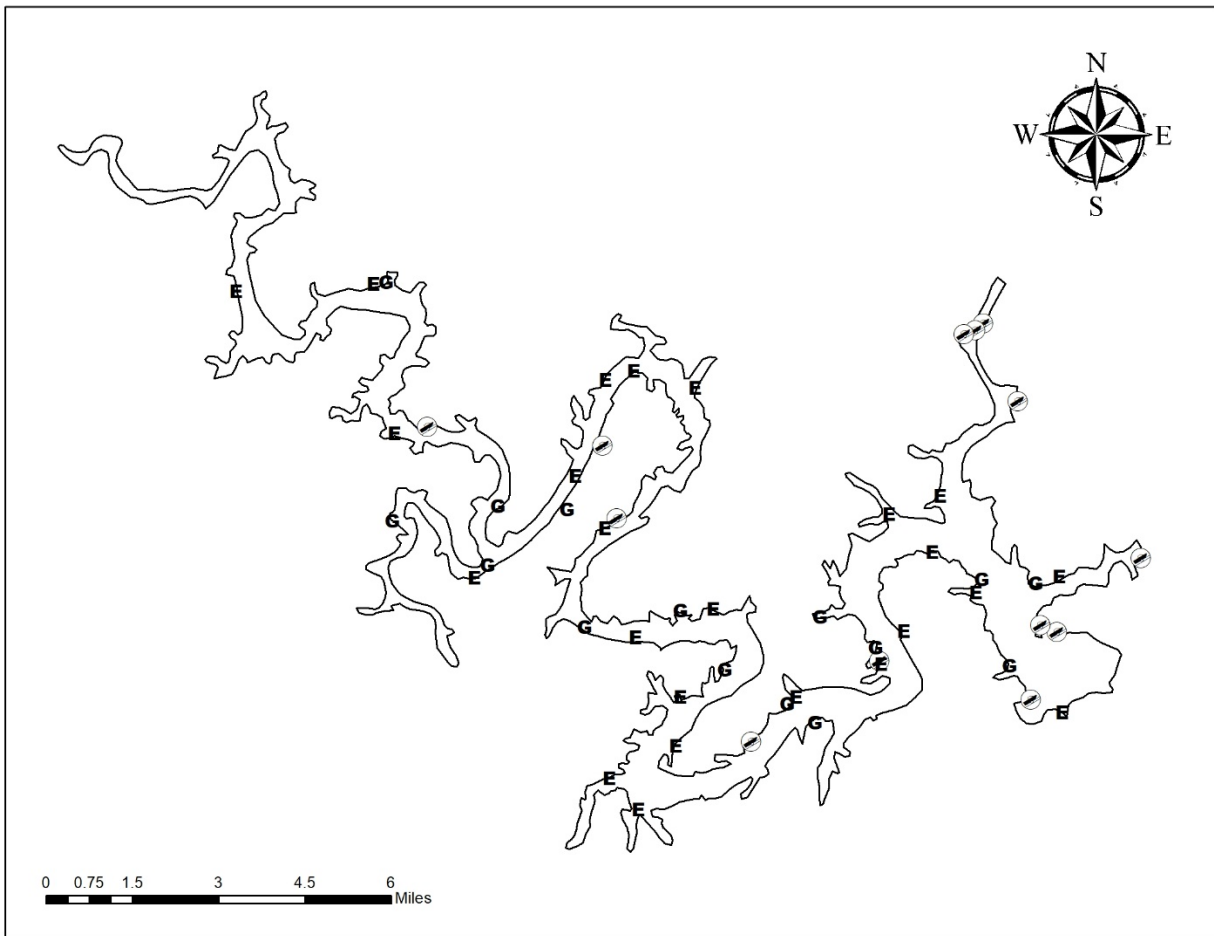
	Survey year			
	2019-2020	2020-2021	2021-2022	2022-2023
Angler Access				S
Structural Habitat				S
Vegetation				S
Creel			S	
Electrofishing – Fall		A		S
Report				S

APPENDIX A

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

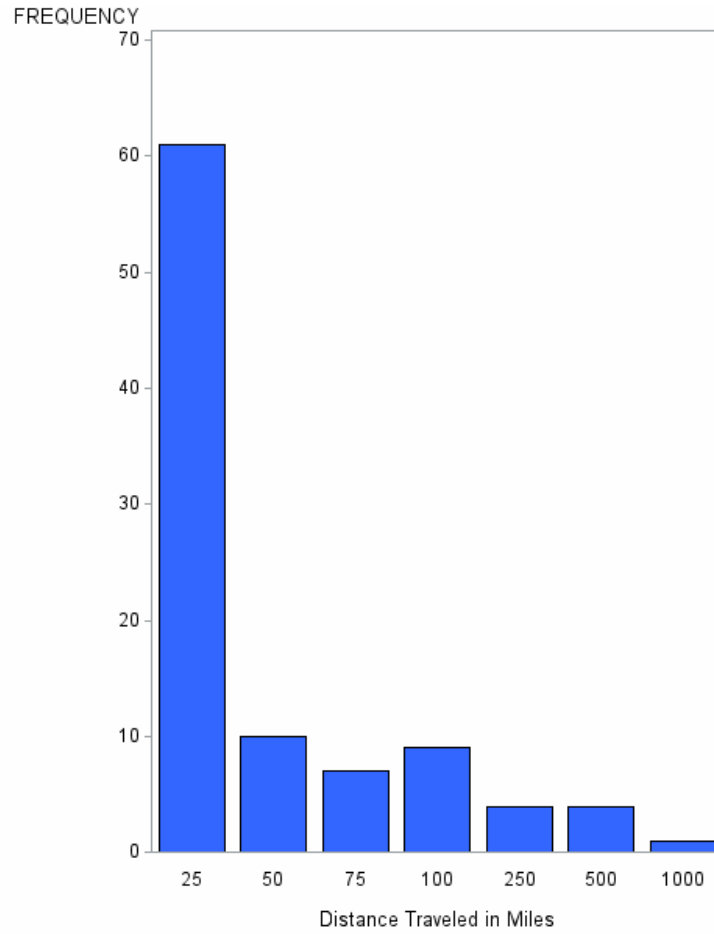
Species	Gill Netting		Electrofishing	
	N	CPUE	N	CPUE
Gizzard Shad			129	64.5 (21)
Threadfin Shad			192	96.0 (55)
Blue Catfish	39	2.6 (19)		
Channel Catfish	22	1.5 (44)		
Flathead Catfish	15	1.0 (29)		
White Bass	26	1.7 (32)		
Striped Bass	3	0.2 (72)		
Redbreast Sunfish			105	52.5 (21)
Green Sunfish			11	5.5 (39)
Warmouth			4	2.0 (78)
Bluegill			191	95.5 (12)
Redear Sunfish			1	0.5 (100)
Largemouth Bass			224	112.0 (15)
Guadalupe Bass			34	17.0 (28)
Rio Grande Cichlid			9	4.5 (39)
Blue Tilapia			2	1.0 (69)

APPENDIX B



Location of sampling sites, Travis 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



Frequency of anglers that traveled various distances (miles) to Travis Reservoir, Texas, as determined from the September 2017 through August 2018 creel survey.



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