

Brownwood Reservoir

2020 Fisheries Management Survey Report

PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-4

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

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Survey and Management Summary

Fish populations in Brownwood Reservoir were surveyed in 2018 and 2020 by electrofishing, 2020 by trap netting, and in 2021 by gill netting. Historical data are presented with the 2017-2021 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: Brownwood Reservoir is a 6,814-acre impoundment constructed on Pecan Bayou and its tributary, Jim Ned Creek, in the Colorado River Basin about 70 miles southeast of City of Abilene and about 6 miles north of the City of Brownwood, Texas. The reservoir was constructed in 1933 and is used for municipal water supply, flood control, and recreation. The reservoir is controlled by the Brown County Water Improvement District. Rainfall during 2015-2016 refilled the reservoir and increased water level to over conservation pool elevation. Subsequently, water level fluctuated between 7 feet below to slightly over conservation pool. During the habitat survey, the areas surveyed in the reservoir were primarily featureless, though observed vegetation was mostly inundated terrestrial vegetation and shoreline habitat was typically rocky. Boater access was available at all public ramps during the survey period, and bank angler access was limited to areas near the boat ramps and Lake Brownwood State Park.

Management History: Palmetto Bass were regularly stocked from the 1980's through mid-1990's, but stockings were discontinued because of the lack of directed fishing effort. Largemouth Bass harvest was managed with a 16-inch minimum length limit (MLL) from 1 September 1992 to 31 August 1999. Thereafter, the regulation was changed to a 14-inch MLL. Blue Catfish were stocked in 2007, 2010, and 2016 to improve the catfish fishery.

Fish Community

- **Prey Species:** Bluegill, Gizzard Shad, Threadfin Shad, and Longear Sunfish comprised a majority of the prey species community. Shad and sunfish were available as prey to most sport fish, and Bluegill were the predominant prey in 2020.
- **Catfishes:** Blue, Channel, and Flathead catfishes were present in the reservoir. Relative abundance of Blue Catfish remained low in monitoring surveys. Similar to previous gill netting surveys, most Blue Catfish sampled were legal size. Flathead Catfish and Channel Catfish were not enumerated in the gill netting surveys, and low frequency electrofishing could not be conducted for Flathead Catfish because of constraints attributed to the COVID-19 pandemic.
- **Largemouth Bass:** Largemouth Bass catch rates fluctuated during the survey period but catch indicated adequate reproduction similar to other recent surveys. Catches of legal length fish was similar during the survey period. No pure Florida Largemouth Bass were found in the genetics sample, but the percentage of Florida alleles remained consistent to prior surveys.
- **White Crappie:** White Crappie catch was poor in 2020. Sampling effort was reduced from that used in prior surveys. The intended sampling effort for the 2020 survey was not completed because of conflicts arising from the COVID-19 pandemic and poor sampling conditions.

Management Strategies: Continue developing and maintaining partnerships for improving fish habitat within the reservoir. Continue to monitor for zebra mussels and work with controlling authority and stakeholders to identify potential preventative and control measures. Conduct electrofishing and trap netting in fall 2024 and gill netting during spring 2025. Conduct a roving creel survey from summer 2024 – spring 2025.

Introduction

This document is a summary of fisheries data collected from Brownwood Reservoir in 2017-2021. The purpose of the document is to provide fisheries information and make management recommendations to protect and improve existing sport fisheries. While information on other fisheries was collected, this report deals primarily with major sport fishes and important prey species. Historical data are presented with the 2017-2021 data for comparison.

Reservoir Description

Brownwood Reservoir is a 6,814-acre impoundment constructed on Pecan Bayou and its tributary, Jim Ned Creek, in the Colorado River Basin about 70 miles southeast of City of Abilene and about 6 miles north of the City of Brownwood, Texas. The reservoir was constructed in 1933 and is used for municipal water supply, flood control, and recreation. The reservoir is controlled by the Brown County Water Improvement District. Land use within the watershed is primarily agricultural, residential, and ranching. The Carlson Trophic State Index for Brownwood Reservoir is 52.3 and is considered eutrophic (Texas Commission on Environmental Quality 2020). Rainfall during 2015-2016 refilled the reservoir and increased water level to over conservation pool elevation. Subsequently, water level fluctuated between 7 feet below and slightly over conservation level (Figure 1). Additional reservoir characteristics are displayed in (Table 1).

Angler Access

Brownwood Reservoir has four public boat ramp sites (Table 2). During the survey period, all ramps were open. Public shoreline access was limited to the area around the boat ramps within Lake Brownwood State Park.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Homer and Goldstrohm 2017) included:

1. Continue to establish and maintain partnerships to conduct fisheries habitat and enhancement projects.

Action: TPWD partnered with Lake Brownwood State Park to enhance the fishing area around the fishing pier with artificial habitat structures and a pier lighting system for improved access.

2. Map coverage of salt cedar and discuss control measures with the controlling authority.

Action: Following the reservoir inundating from heavy rains in 2015 and 2016, a majority of salt cedar in the lakebed was inundated. Given the substantial reduction in coverage, salt cedar was surveyed in conjunction with surveys for structural habitat and other aquatic vegetation. Coverage of salt cedar was sparse following 2016, thus locations were not mapped. Waypoints of points where salt cedar occurred were recorded.

3. Conduct a roving creel survey and request tournament weigh-in data to monitor trends in bag weights and lengths for Largemouth Bass.

Action: A roving creel survey was not conducted because of COVID-19 restrictions and will be rescheduled for the upcoming monitoring period. Tournament weigh-in data was requested from four local bass clubs, but only one club periodically provided it. Given the lack of data submission, we were unable to evaluate any possible trends in catch and sizes of tournament fish.

4. Educate public about invasive species and associated threats to Texas water bodies.

Action: Various efforts have been made to educate several groups and individuals about invasive species. Examples include social media posts, popular press articles, providing literature, posting signage at boat ramps, and making speaking points while speaking to groups and individuals.

Harvest regulation history: Prior to 1992, all species were managed with statewide fishing regulations. From 1 September 1992 to 31 August 1999, Largemouth Bass were managed with a 16-inch MLL. However, the regulation reverted to the statewide 14-inch MLL on 1 September 1999 because no improvement in growth rates were observed with the prior regulation. Other species have always been managed with statewide regulations (Table 3).

Stocking History: Historical stockings included Threadfin Shad, Walleye, Hybrid Green x Redear Sunfish, Palmetto Bass (1980-2022), and Largemouth Bass (1969-1996). Florida Largemouth Bass were initially stocked in 1975 and last stocked in 2018. Blue Catfish were stocked in 2007, 2010, and 2016. The complete stocking history for Brownwood Reservoir is displayed in Table 4.

Vegetation/habitat management history: A collaborative artificial fish habitat enhancement project was completed during fall 2015. Additional artificial fish habitat structures and an underwater pier lighting system were installed at Lake Brownwood State Park to enhance the fishing pier in 2017.

Water transfer: No interbasin water transfers are known to exist.

Methods

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Brownwood Reservoir (Homer and Goldstrohm 2017). 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).

Low-frequency electrofishing – Low-frequency electrofishing was supposed to be conducted during spring 2020 (Homer and Goldstrohm 2017) but was not because of COVID-19 associated constraints. Sampling will be rescheduled for the next monitoring cycle.

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.

Trap netting – Crappie were collected using trap nets (5 net nights at 5 stations). CPUE for trap netting was recorded as the number of fish caught per net night (fish/nn).

Gill netting – Blue Catfish, Channel Catfish, and White Bass were collected by gill netting (10 net nights at 10 stations), and CPUE for gill netting was recorded as the number of fish caught per net night (fish/nn).

Genetics – Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2017). Micro-satellite DNA analysis was used to determine genetic composition of individual fish since 2005. Electrophoresis analysis was used prior to 2005.

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.

Habitat – A vegetation and structural habitat surveys were conducted in summer 2020 by using the random point method (TPWD unpublished manual, TPWD 2017). A total of 450 random points throughout the reservoir, and presence/absence was determined for vegetative and structural habitat types identified at or below the waterline at all stations. 68 stations were discarded because they occurred in inaccessible areas of the reservoir or were on dry land. All remaining points (N=382) were sampled for the vegetation survey wherein presence/absence of aquatic vegetation species was recorded. Structural habitat type was additionally recorded for those points located at the land-water interface (N=237). Percent occurrence (%) = [number of stations with habitat present / total stations sampled] X 100 and associated 95% confidence

intervals (Ausvet 2021) were calculated for each habitat feature type (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

Water level – Source for water level data was the United States Geological Survey (USGS 2021).

Results and Discussion

Habitat: Most of the reservoir shoreline was rocky (68.4%) with sections of natural shoreline (22.4%; Table 6). A majority of the points surveyed within the reservoir were featureless (94.5%), and the minimal vegetation observed included flooded terrestrial vegetation (3.4%), waterwillow (1.4%), and standing timber (0.7%; Table 7). Salt Cedar was not encountered at any of the random locations surveyed.

Prey species: Bluegill, Gizzard Shad, Threadfin Shad and Longear Sunfish comprised a majority of the prey observed during the fall 2020 survey. Inland Silversides were also numerous, but they could not be effectively collected with the standardized sampling gear. Other prey species observed included Green Sunfish, Redear Sunfish, Warmouth, Orangespotted Sunfish, Bigscale Logperch and a variety of hybrid sunfishes. Gizzard Shad catch declined from 267.0/h in 2016 to 120.5/h in 2018 to 105.0/h in 2020 (Figure 2). Index of Vulnerability fluctuated from 46 in 2016 to 89 in 2018 to 69 in 2020. Overall, Gizzard Shad relative abundance appeared adequate and most individuals were optimal prey size. Threadfin Shad were caught at 97.5/h in fall 2020 (see Appendix A) which was substantially greater than in 2016 (5.0/h). Bluegill was the predominant species in the survey. Bluegill CPUE was 465.0/h in fall 2020, which was an increase since surveys in 2016 (330.5/h) and 2018 (378.0/h; Figure 3). Individuals ranged from 1-8 inches total length (TL) among the surveys, and PSD remained consistently low. However, the greater representation of sub-quality sized Bluegill suggested that most were optimal prey sizes. Longear Sunfish increased from 66.0/h in 2016 to 122.0/h in 2020, and individuals have consistently ranged from 1-5 inches TL (Figure 4). Overall, prey relative abundance was ample to support the existing sport fish community in Brownwood Reservoir (see Appendix C).

Catfishes: Channel Catfish, Blue Catfish, and Flathead Catfish were present in surveys, though Channel Catfish and Flathead Catfish were not enumerated in the 2021 gill netting survey. Blue Catfish CPUE in the spring 2021 gill netting survey (2.6/nn) was similar to the surveys in 2013 (2.9/nn) and 2017 (2.2/nn; Figure 5). Catch of legal length fish was also similar among survey years ranging from 2.0-2.2/nn. Target sample size to sufficiently assess trends in size structure was not met. The PSDs in the samples collected fluctuated from greater representation of sub-stock fish (PSD=27) in 2013, to the majority of fish being \geq stock length in 2017 (PSD=75), and shifting to more sub-stock fish being present in the 2021 sample (PSD=36). The presence of few sub-stock length fish suggests limited reproduction is occurring in Lake Brownwood. Furthermore, prior stockings in 2007 and 2010 may have not seen much recruitment likely attributed to periods of drought that occurred shortly after them. Low-frequency electrofishing was not conducted because of constraints attributed to the COVID-19 pandemic.

Largemouth Bass: Largemouth Bass catch rates have fluctuated during the survey period from 94.0/h in fall 2016 to 123.0/h in 2018 to 91.0/h in 2020 (Figure 6). Catch rates for legal fish were similarly low among the surveys (8.0-12.0/h), while Stock CPUE decreased from 98.0/h to 54.0/h during the same period. Size structure as represented by PSD observed during the survey period saw an increase of more quality length fish from 2016 (PSD=23) to 2020 (PSD=41). Historical trends in relative abundance of Largemouth Bass are likely influenced by water level and suitable habitat availability (see Appendix D). Periodic water level increases following periods of drought at Brownwood Reservoir often resulted in increased production of Largemouth Bass, but these periods of higher reproduction were generally short in duration and seldom resulted in substantial changes in relative abundance of legal fish. Mean relative weights for the represented inch groups in the 2020 sample were poor to fair (82 – 93) and were consistent with prior surveys in 2016 and 2018. Brownwood Reservoir's Largemouth Bass population has a history of poor body condition, increased natural mortality, and possible higher rates of exploitation that has led to slow body growth and few fish reaching sizes >14 inches (Dumont and Neely 2009). No pure Florida Largemouth Bass were identified in the 2020 sample, and the allele frequency for Florida Largemouth Bass was 41.1% (Table 8). Stockings in 2016 and 2018 did not appear to result in greater Florida Largemouth Bass genetic introgression. Two Northern Largemouth Bass were observed in the 2020 sample and the remaining fish

were intergrade Florida x Northern Largemouth Bass. In 2020, a ShareLunker Bass weighing 13.58 lbs. was caught by an angler.

Crappie: White Crappie catch was poor during the fall 2020 sample, which only six were sampled. Even with the 50% reduction in sampling effort, the catch rate (1.2/nn) was substantially lower than reported in 2016 (28.6/nn) and 2012 (7.3/nn; Figure 7). Historical trends in relative abundance of White Crappie are likely influenced with water level and suitable habitat availability (see Appendix E). Sampling effort was limited because of conflicts associated with the COVID-19 pandemic and poor sampling conditions. Thus, objectives for assessing White Crappie relative abundance, size structure, and body conditions were not met. Crappie sampling with increased sampling effort will be conducted during fall 2024.

Fisheries management plan for Brownwood Reservoir

Prepared – July 2021

ISSUE 1: Brownwood Reservoir experienced extreme water level fluctuations attributed to prolonged droughts and flooding. During periods of drought and low water level, vegetation and structural habitat become unavailable to popular sport fish and their prey.

MANAGEMENT STRATEGY

1. Continue to establish and maintain partnerships to conduct fisheries habitat enhancement projects.

ISSUE 2: A creel survey at Brownwood Reservoir was last conducted in 1996. The creel survey scheduled for June 2020-May 2021 had to be rescheduled because of other district survey needs and the COVID-19 pandemic. Prioritization for fisheries management at the reservoir can be improved with collection of current creel data.

MANAGEMENT STRATEGY

1. Conduct a year-long roving creel survey from June 2024-May 2025 to estimate angler effort, fish harvest and catch, and angler expenditures at Brownwood Reservoir.

ISSUE 3: Blue Catfish were initially stocked in 2007 to develop a fishery and were subsequently stocked again in 2010 and 2016. Monitoring of Blue Catfish has resulted in low catch rates, and data suggest that the population may have low natural reproduction and poor recruitment of fish to legal size.

MANAGEMENT STRATEGIES

1. Stock Blue Catfish in spring 2022 and 2023.
2. Continue monitoring Blue Catfish relative abundance and size structure with low-frequency electrofishing in spring 2024 and gill netting in spring 2025.
3. Collect an age sample to evaluate growth of Blue Catfish and to assess what year classes are present.

ISSUE 3: Zebra mussel veligers were identified in plankton samples collected from two locations in the reservoir during fall 2020, and adult mussels were collected in June 2021 at a private marina. Zebra mussels can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches, and plugging engine cooling systems. Biological impact and financial costs associated with zebra mussels can be 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 Brown County Water Improvement District to maintain appropriate signage at access sites and discuss other prevention measures for zebra mussel threats and spread.
2. Continue to monitor for zebra mussel presence with settlement structures and shoreline checks.
3. Contact and educate marina owners about invasive species, and provide them with posters, literature, and other informative materials so that they can in turn educate their customers.
4. Educate the public about invasive species through the use of media and the internet.
5. Discuss invasive species when presenting and or interacting with constituents.
6. Track any future interbasin water transfers to facilitate potential invasive species responses.

Objective-Based Sampling Plan and Schedule (2021–2025)

Sport fish, prey fish, and other important fishes: Important sport fishes present in Brownwood Reservoir include Largemouth Bass, Blue Catfish, and White Crappie. Important prey species include Bluegill, Gizzard Shad, Threadfin Shad and Longear Sunfish. Proposed sampling is displayed in Table 9.

Low-density fisheries: Channel Catfish and White Bass are present in the reservoir, but they have been in low relative abundance in previous monitoring surveys. Hybrid Striped Bass have not been stocked into Brownwood Reservoir since 2002, but some individuals have moved from Coleman Reservoir downstream through Pecan Bayou into the reservoir during flood events. Hybrid Striped Bass will not be included in future management reports given the most recent stocking will have surpassed the oldest documented individuals. Monitoring of CPUE-Total for Channel Catfish, Flathead Catfish, White Bass, and Hybrid Striped Bass will be conducted during sampling efforts for Blue Catfish.

Survey objectives, fisheries metrics, and sampling objectives

Prey Species: Sunfishes (i.e., Bluegill and Longear Sunfish), Gizzard Shad, and Threadfin Shad are the primary prey species at Brownwood Reservoir. Electrofishing surveys for prey have traditionally been conducted biennially while targeting Largemouth Bass. Historical sampling effort of 1.5-2.0 hours has yielded desirable precision ($RSE \leq 25$) for relative abundance estimates as well as sample sizes for evaluating the size structure for prey species. The next electrofishing survey will be conducted in fall 2024 at 24, 5-minute randomly selected stations for a total of two hours of sampling effort. Trend data for CPUE and size structure will be collected. During sampling, target precision will be $RSE \leq 25\%$ for CPUE-Total. A target of ≥ 50 fish will be collected to assess length frequency of sunfishes. Index of Vulnerability will be calculated for Gizzard Shad to assess the relative proportion of individuals in the population that are of suitable prey sizes for sport fish. A target of 50 Gizzard Shad will be sampled to evaluate IOV. If sample size and estimate precision targets are not achieved, additional sampling will not be conducted.

Blue Catfish: The Blue Catfish population is likely still developing, and the population does support a fishery. Stockings in 2007, 2010, and 2016 have resulted in limited natural reproduction and recruitment of legal fish. Likely, the 2007 and 2010 stockings had poor recruitment of individuals because they were stocked during periods when droughts occurred shortly after. Typical catch rates of Blue Catfish have been $2.0-2.2/n$, though most have been legal fish. Low-frequency electrofishing in 2014 resulted in only five captured Blue Catfish, and the utility of this gear for future surveys is questionable. Gill netting will be conducted to monitor Blue Catfish during spring 2025 at 15 randomly selected stations. No target precision will be set for relative abundance estimates. Should ≥ 50 stock-length fish be collected, PSD will be determined. A low-frequency electrofishing survey was supposed to be conducted during spring 2020, but it was not as a result of the COVID-19 pandemic and poor sampling conditions. An exploratory low-frequency electrofishing survey during spring 2023 or 2024 will be attempted. CPUE-Total and CPUE-12 will be reported without any target level of precision and practical effort. Otoliths will also be retained from sampled individuals (i.e., $n=30$) to assess what year classes are present. In conjunction with Blue Catfish sampling, relative abundance data for Flathead Catfish will also be reported.

Largemouth Bass: Largemouth Bass historically supported most of the directed angler effort at the reservoir. Further, the reservoir is a popular destination for Largemouth Bass fishing tournaments. Traditionally, sampling for Largemouth Bass has been conducted biennially. However, electrofishing every 4 years may be adequate to monitor substantial changes in the Largemouth Bass fishery. During this period, sampling will only occur during fall 2024. Sampling will be conducted for 2.0 hours at 24, 5-minute stations. The prescribed sampling effort has yielded suitable levels of precision for relative abundance estimates and sample sizes for evaluating size structure, body condition, and age and growth during prior surveys. Target precision will be $RSE \leq 25$ for CPUE-Total and Stock CPUE. A target sample of ≥ 50 stock-length fish will be sampled to determine size structure. Lengths and weights will be measured from a target of five fish per represented inch group $>$ stock length to calculate mean relative weights. A random sample of 30 bass will be evaluated for prevalence of Florida Largemouth Bass and Northern Largemouth Bass alleles. A Category III age sample will be retained to growth of individuals in this population. If objectives are not

achieved, up to one hour of additional electrofishing may be conducted to improve data precision and/or sample size.

White Crappie: White Crappie support a fishery at Brownwood Reservoir. Monitoring White Crappie every four years has been adequate to evaluate trends in relative abundance, size structure, body condition, and growth. Trap netting for the last monitoring period was not completed with the intended effort, though catch rates were also low. Trap netting will be conducted in fall 2024 at 10 randomly selected stations to assess trends in relative abundance, size structure, and body conditions. Target precision will be $RSE \leq 25$ for CPUE-Total and Stock CPUE. At least 50 fish \geq stock-size will be collected to evaluate size structure by calculating PSD. Measurements of length and weight for ≥ 5 fish per inch group will be taken to assess body condition. Up to five additional trap nets may be set if desired precision and/or sample size are not met if deemed feasible. Crappie relative abundance (CPUE-Total and Stock CPUE) will also be monitored in spring 2025 gill netting, without target levels of precision and practical effort.

Creel Survey:

The last creel survey was last conducted from January – May 1996. The previous creel data is dated and likely does not accurately represent the current fishery. The creel survey scheduled for the 2017-2021 monitoring schedule had to be rescheduled because of the COVID-19 pandemic. A creel survey is necessary to assess directed angling effort, angler harvests and catch, and angler demographics to prioritize management efforts. A year-long roving creel survey will be conducted from June 2024–May 2025 for a minimum of five weekend days and four 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).

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Tables and Figures

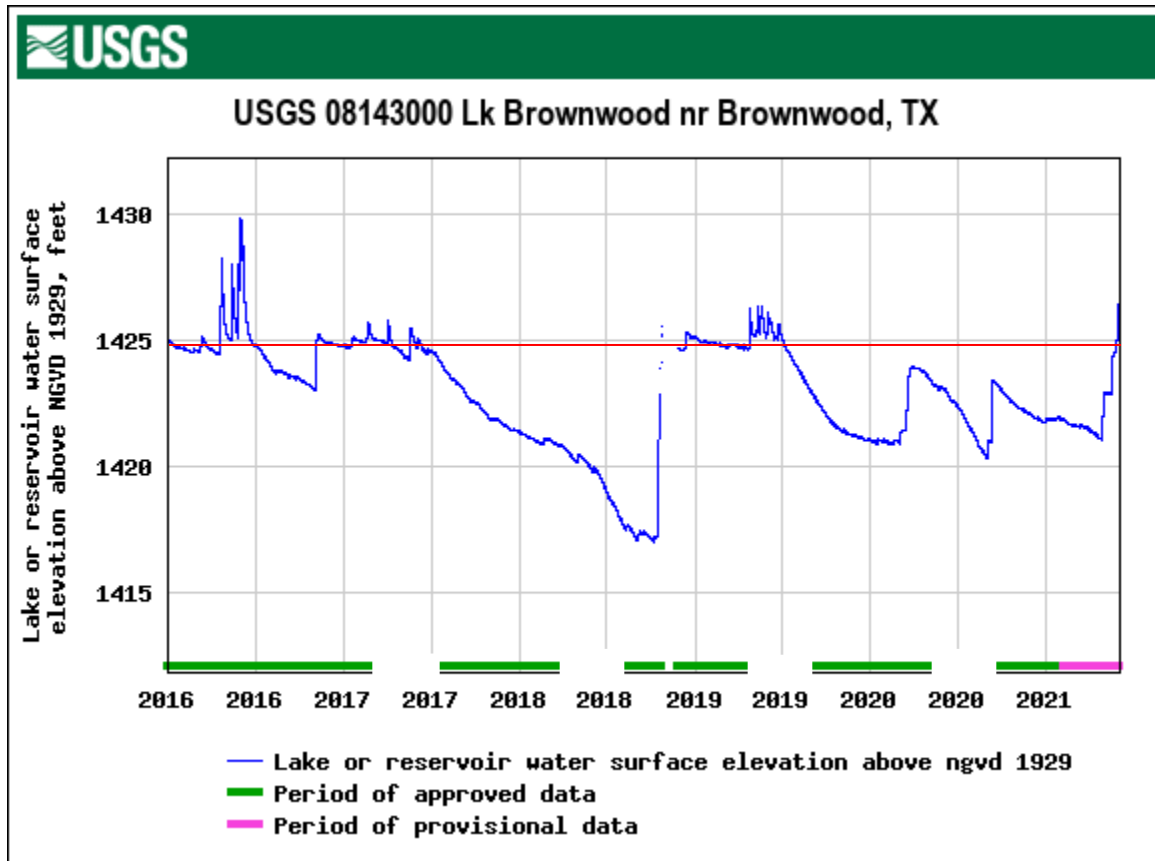


Figure 1. Mean daily water level for Brownwood Reservoir, Texas, April 1, 2016 - April 1, 2021. The red line indicates the reservoir's conservation water level elevation.

Table 1. Reservoir characteristics for Brownwood Reservoir, Texas.

Characteristic	Description
Year Constructed	1933
Controlling Authority	Brown County Water Improvement District
County	Brown
Reservoir Type	Tributary
Conservation Pool Elevation (feet above mean sea level)	1,424.6
River Basin	Colorado
USGS 8- Digit Hydrologic Unit Code Watersheds	12090108 (Jim Ned) 12090107 (Pecan Bayou)

Table 2. Boat ramp characteristics for Brownwood Reservoir, Texas, April 2020. Water level at the time of the access survey was approximately 3 feet below conservation pool elevation.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	No. of Lanes	Elevation at end of boat ramp (feet)	Condition
Lake Brownwood State Park Ramp 1	31.86161° -99.01931°	Y	10	1	1,412	Accessible
Lake Brownwood State Park Ramp 2	31.86186° -99.01958°	Y	10	1	1,418	Accessible
Lake Brownwood State Park Ramp 3	31.86161° -99.01993°	Y	10	1	1,421	Accessible
Flat Rock Park	31.82419° -99.05103°	Y	20	1	1,417	Accessible
Dam	31.84161° -99.00350°	Y	35	1	1,410	Accessible

Table 3. Harvest regulations for Brownwood Reservoir, Texas.

Species	Bag limit	Length limit
Catfish: Channel and Blue, their hybrids and subspecies	25 (in any combination)	12-inch minimum
Catfish, Flathead	5	18-inch minimum
Bass, White	25	10-inch minimum
Bass, Hybrid Striped	5	18-inch minimum
Bass, Largemouth	5	14-inch minimum
Crappie: White and Black, their hybrids and subspecies	25 (in any combination)	10-inch minimum

Table 4. Stocking history for Brownwood Reservoir, Texas. FGL=fingerlings; FRY=fry; ADL=adults; UNK = Unknown.

Species	Year	Number	Size
Threadfin Shad	1984	1,000	ADL
Blue Catfish	1988	17	ADL
	2007	326,174	FGL
	2010	325,761	FGL
	2016	324,616	FGL
	Total	976,568	
Channel Catfish	1972	72,000	ADL
	1980	150	UNK
	2005	304	ADL
	2006	300	ADL
	2007	556	ADL
	2008	300	ADL
	2009	301	ADL
	2010	300	ADL
	2011	302	ADL
	2012	300	ADL
	2013	301	ADL
	2014	306	ADL
	2015	321	ADL
	2016	305	ADL
	2017	322	ADL
	2018	316	ADL
2019	311	ADL	
	Total	76,995	
Green x Redear Hybrid Sunfish	1971	5,000	UNK
	1972	22,500	UNK
	1978	7,000	UNK
	1980	150	UNK
	Total	34,650	
Florida Largemouth Bass	1975	200,956	FGL
	1976	118,000	FRY
	1976	238,000	FGL
	1977	367,545	FGL
	1978	218,975	FGL
	1996	177,163	FGL
	2007	326,520	FGL
	2012	327,352	FGL
	2016	141,355	FGL
	2018	77,017	FGL
	Total	2,192,833	
Largemouth Bass	1969	10,000	UNK
	1970	500,000	FRY
	1994	169	ADL
	1995	86	ADL
	1996	50	ADL
	Total	510,305	

Table 4. Stocking history for Lake Brownwood, Texas (continued).

Smallmouth Bass	1980	72,950	UNK
	1982	70,000	UNK
	Total	142,950	
Palmetto Bass	1980	73,850	UNK
	1983	75,600	UNK
	1986	145,601	FGL
	1987	145,101	FGL
	1988	148,325	FGL
	1989	154,470	FGL
	1991	39,600	FGL
	1992	40,500	FGL
	1994	45,006	FGL
	1995	89,970	FGL
	1996	36,869	FGL
	2002	36,680	FGL
	Total	1,031,572	
Walleye	1976	75,000	FRY
	1977	1,500,000	FRY
	1978	1,550,000	FRY
	Total	3,125,000	

Table 5. Objective-based sampling plan (OBS) for Brownwood Reservoir, Texas, 2017-2021.

Gear/target species	Survey Objective	Metrics	Sampling Objective
Electrofishing			
Gizzard Shad ^a	Relative Abundance	CPUE-Total	RSE \leq 25
	Size Structure	Length frequency	N \geq 50
	Prey Availability	IOV	N \geq 50
Threadfin Shad ^a	Relative Abundance	CPUE-Total	RSE \leq 25
Bluegill ^a	Relative Abundance	CPUE-Total	RSE \leq 25
	Size Structure	Length frequency, PSD	N \geq 50 stock
Longear Sunfish ^a	Relative Abundance	CPUE-Total	RSE \leq 25
Largemouth Bass	Relative Abundance	CPUE-Total and Stock CPUE	RSE \leq 25
	Size Structure	Length frequency, PSD	N \geq 50 stock
	Body Condition	W_r	5 fish / inch group
	Genetics	% FLMB	N = 30
Low-frequency electrofishing			
Blue Catfish	Relative Abundance	CPUE-Total and CPUE-12	RSE \leq 25
	Size Structure	PSD	N \geq 50 stock
	Age and Growth	Age at legal length	N= 13, 11.0-12.9 inches
Flathead Catfish	Relative Abundance	CPUE-Total and CPUE-18	RSE \leq 25
	Size Structure	PSD	N \geq 50 stock
	Age and Growth	Age at legal length	N= 13, 17.0-18.9 inches
Gill netting			
Blue Catfish	Relative Abundance	CPUE-Total; CPUE-12	Practical effort
	Size Structure	Length frequency, PSD	Practical Effort
Channel Catfish	Presence/Absence	CPUE-Total	Practical effort
White Bass	Presence/Absence	CPUE-Total	Practical effort
Trap netting			
White Crappie	Relative Abundance	CPUE-Total; Stock CPUE, CPUE-10	RSE \leq 25
	Body Condition	W_r	5 fish / inch group
	Size Structure	Length frequency, PSD	N \geq 50 stock

^a No additional effort will be expended to achieve an RSE \leq 25 for CPUE for prey species 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 prey density.

Table 6. Survey of structural habitat types, Brownwood Reservoir, Texas, July 2020. Percent occurrence with lower and upper 95% confidence limits (CL) of shoreline structural habitat at 237 random sites. Water level at time of survey was 1.4 feet below conservation pool elevation.

Structural Habitat Type	Percent occurrence	Lower CL	Upper CL
Rocky Shoreline	68.4	62.2	73.9
Natural Shoreline	25.7	20.6	31.7
Boat Docks/Ramps	8.8	6.2	13.7
Rock Bluff	2.1	0.9	4.8
Gravel	2.1	0.9	4.8
Bulkhead	1.7	0.7	4.3

Table 7. Percent occurrence with lower and upper 95% confidence limits (CL) of vegetation at 145 random sites throughout the reservoir and 237 sites along the shoreline in Brownwood Reservoir, Texas, July, 2020. Water level at time of survey was 1.4 feet below conservation pool elevation.

Structural Habitat	Throughout the Reservoir			Shoreline		
	Percent Occurrence	Lower CL	Upper CL	Percent Occurrence	Lower CL	Upper CL
Open Water/Featureless	94.5	89.5	97.2	14.3	10.5	19.4
Flooded Terrestrial Brush	3.4	1.5	7.8	70.9	64.8	76.3
Standing Timber	0.7	0.1	3.8	5.5	3.2	9.2
American Lotus	0.0	0.0	0.0	4.2	2.3	7.6
Water Primrose	0.0	0.0	0.0	0.8	0.2	3.0
Logs/Fallen Timber	0.0	0.0	0.0	0.4	0.0	2.4
Common Buttonbush	0.0	0.0	0.0	1.7	0.7	4.3
Water-Willow	1.4	0.4	4.9	28.7	23.3	34.8
Cattail	0.0	0.0	0.0	0.4	0.0	2.4
Bullrush	0.0	0.0	0.0	2.5	1.2	5.4

Gizzard Shad

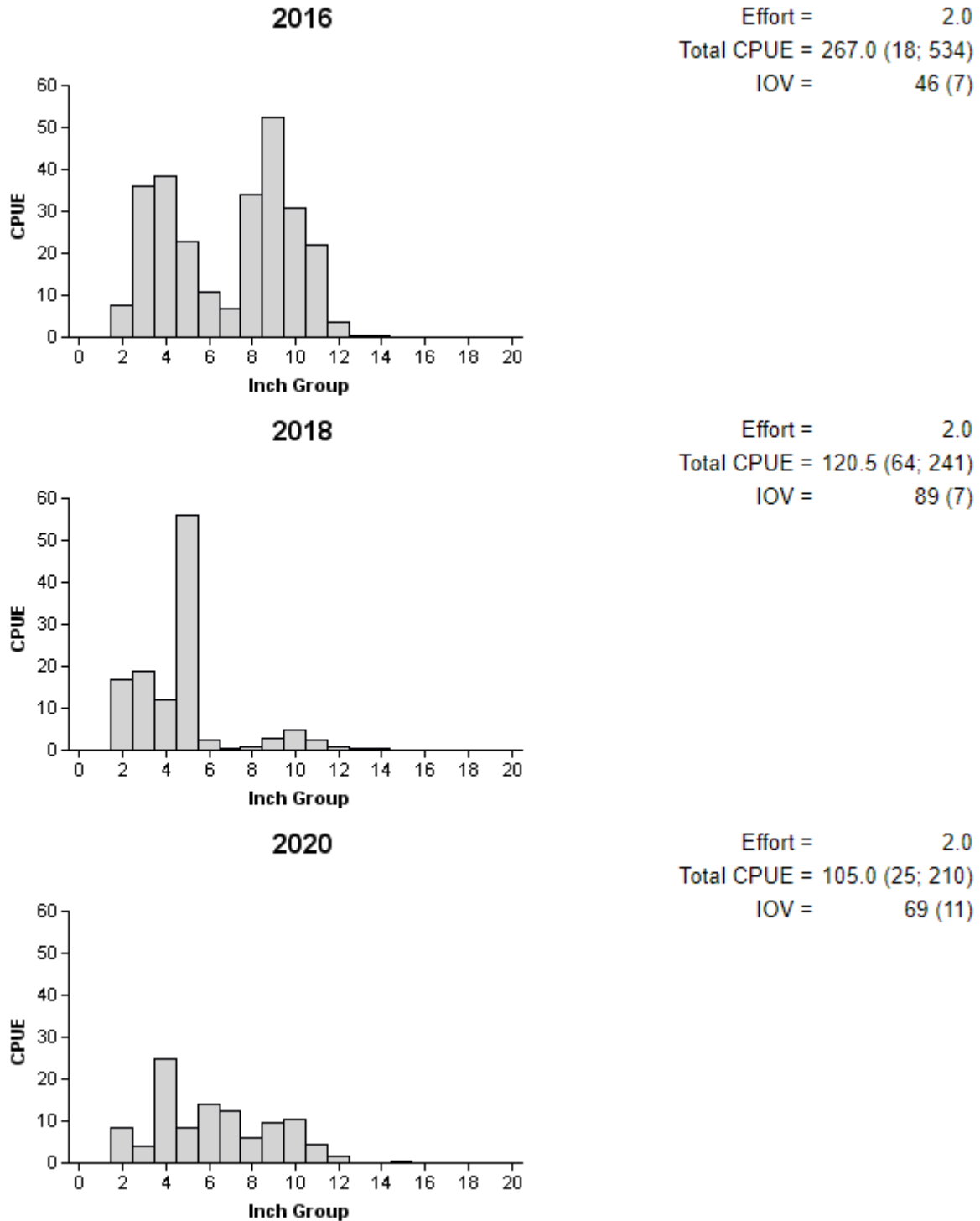


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Brownwood Reservoir, Texas, 2016, 2018, and 2020.

Bluegill

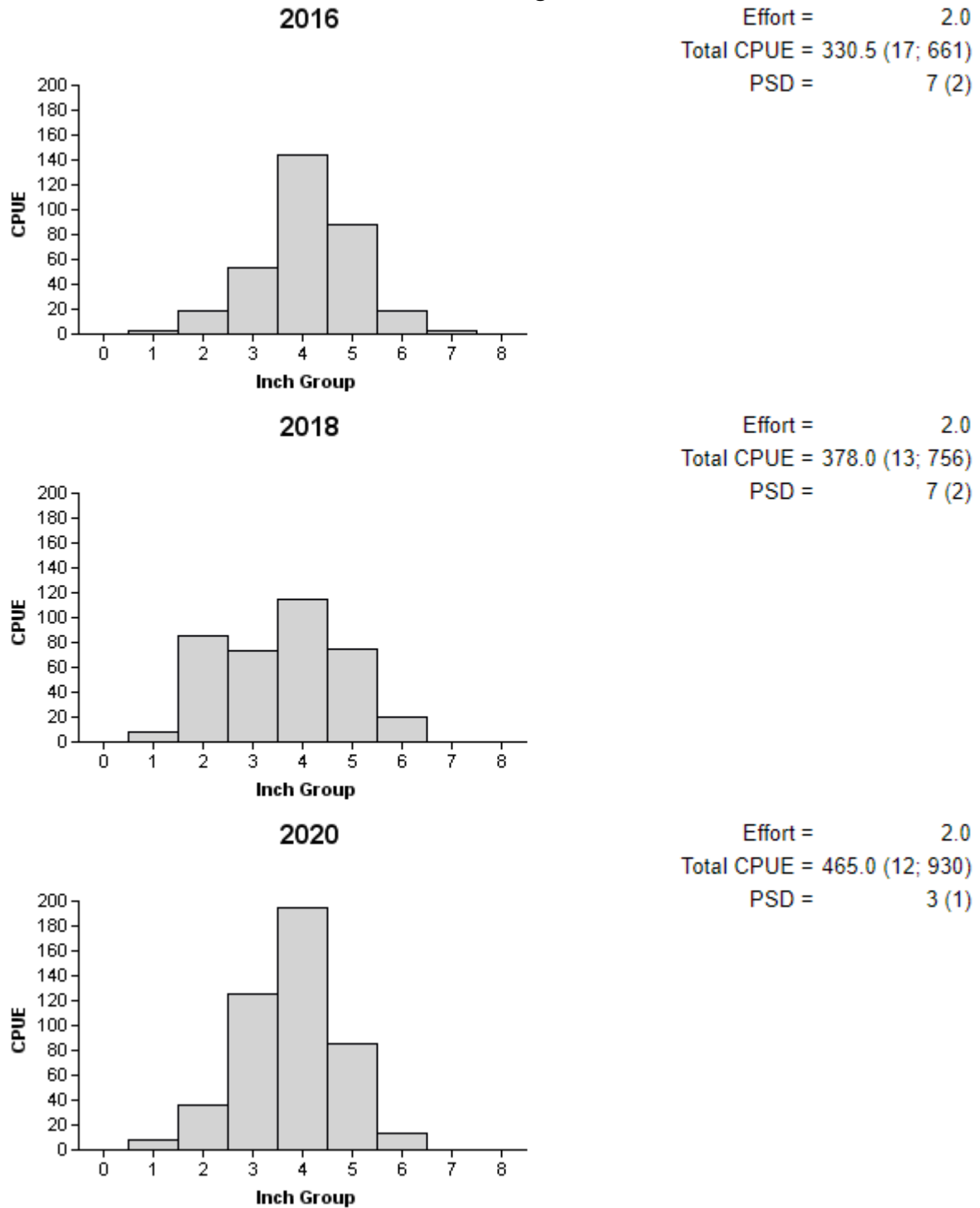


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for PSD are in parentheses) for fall electrofishing surveys, Brownwood Reservoir, Texas, 2016, 2018, and 2020.

Longear Sunfish

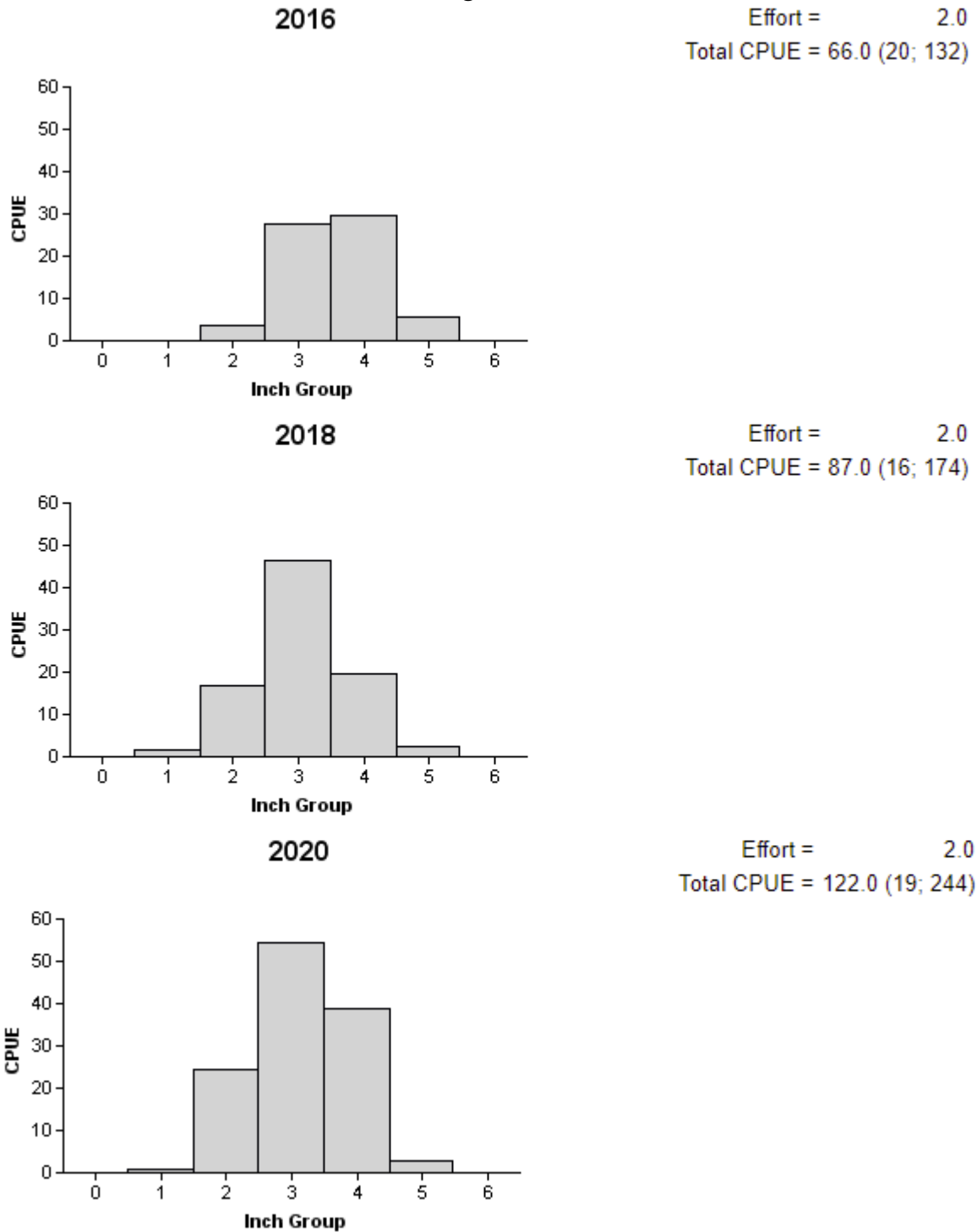


Figure 4. Number of Longear Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE) for fall electrofishing surveys, Brownwood Reservoir, Texas, 2016, 2018, and 2020.

Blue Catfish

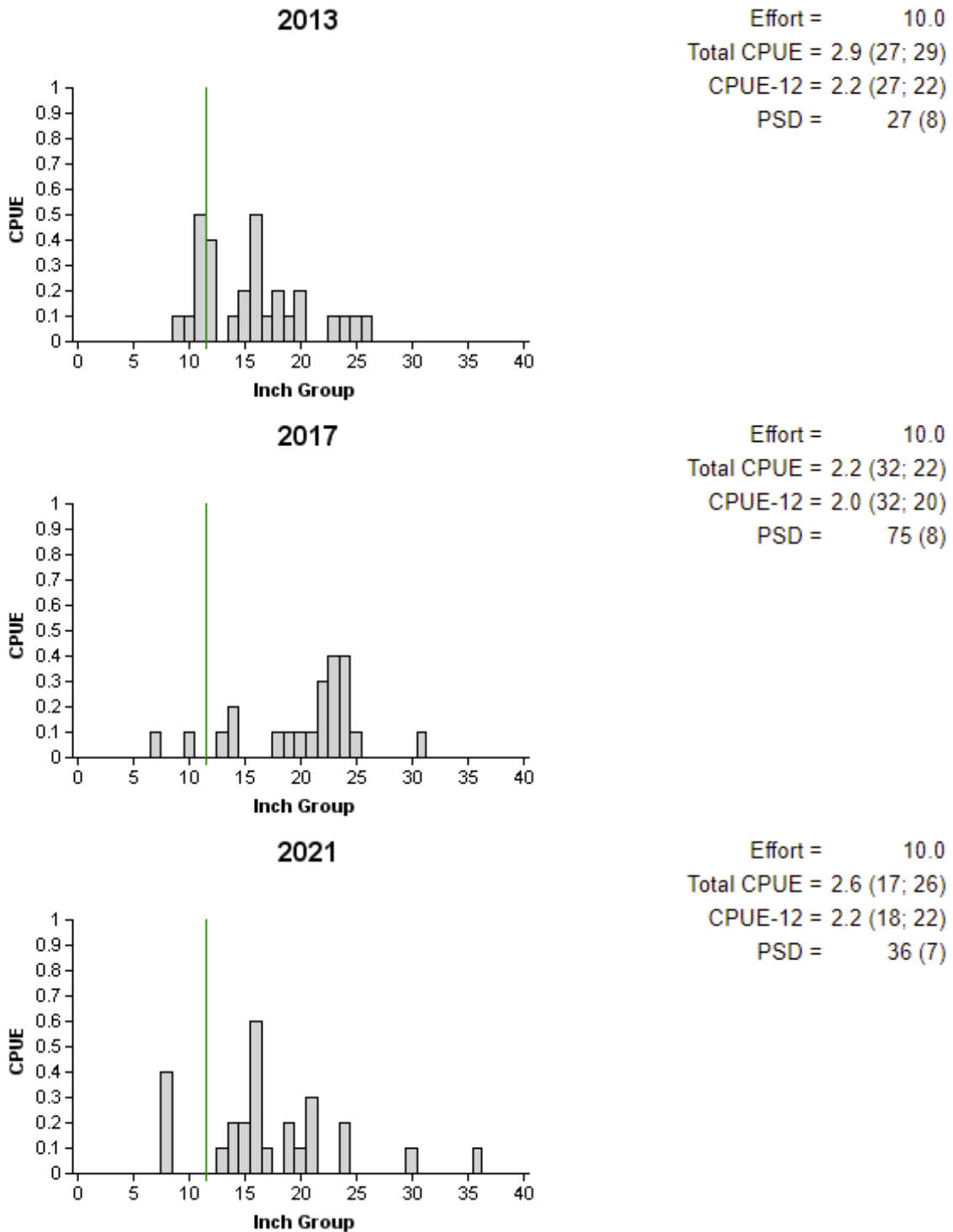


Figure 5. Number of Blue Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Brownwood Reservoir, Texas, 2013, 2017 and 2021. The vertical green line indicates the 12-inch minimum length limit.

Largemouth Bass

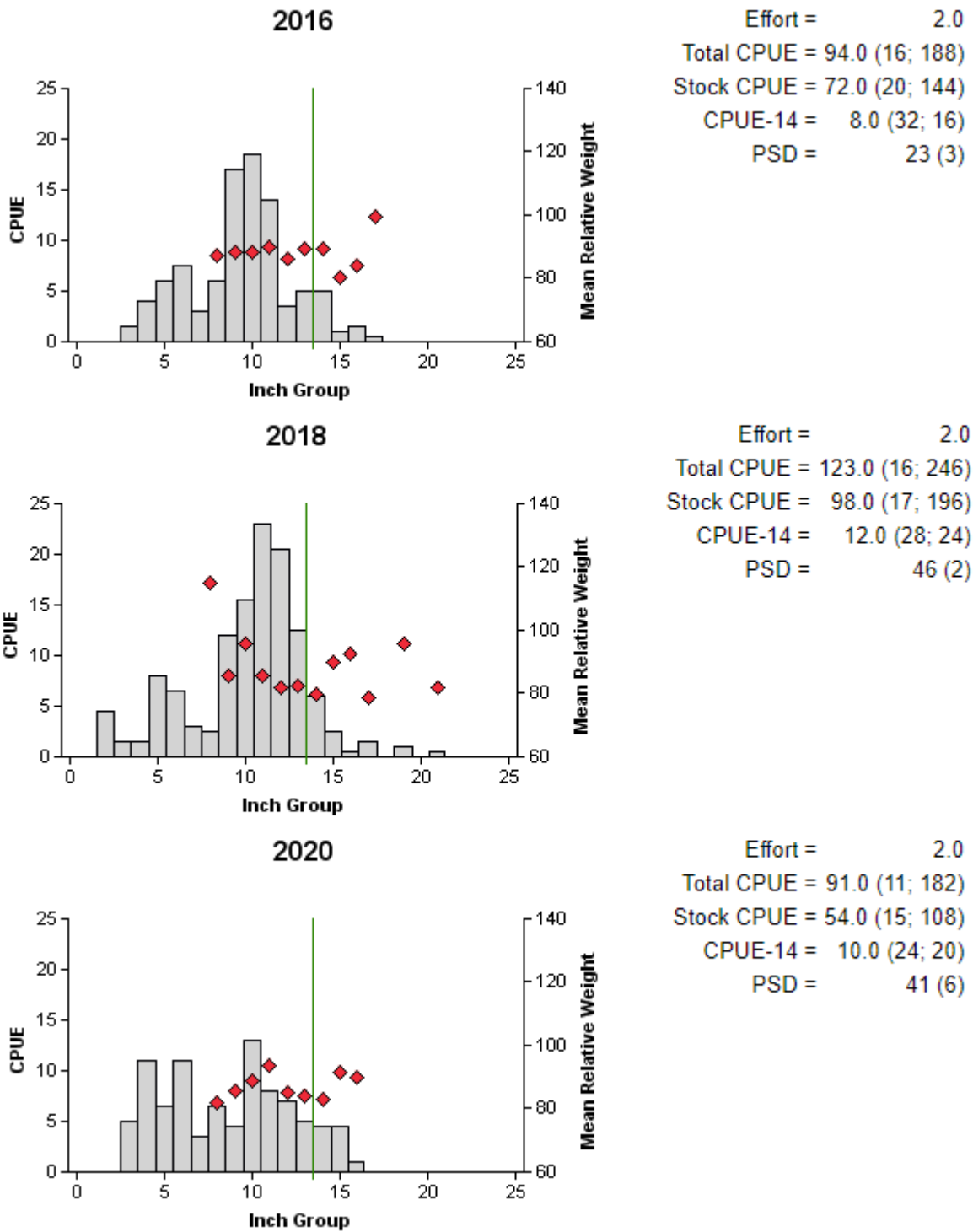


Figure 6. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weights by inch group (red diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Brownwood Reservoir, Texas, 2016, 2018, and 2020. The vertical green line indicates the 14-inch minimum length limit.

Largemouth Bass

Table 8. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Brownwood Reservoir, Texas. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, F1 = first generation hybrid between a FLMB and a NLMB, Fx = second or higher generation hybrid between a FLMB and a NLMB. NA = F1 hybrids were not determined in samples from 1997-2006. Genetic composition was determined by electrophoresis prior to 2005 and with micro-satellite DNA analysis since 2005.

Year	Sample size	FLMB	F1	Fx	NLMB	% FLMB alleles	% pure FLMB
1997	24	2	NA	20	2	45.8	8.3
2000	60	8	NA	47	5	47.4	13.3
2002	31	4	NA	20	7	44.4	12.9
2006	30	0	NA	30	0	41.0	0.0
2014	30	2	1	27	0	51.5	6.7
2016	30	1	1	27	1	40.6	3.3
2020	29	0	2	25	2	41.1	0.0

White Crappie

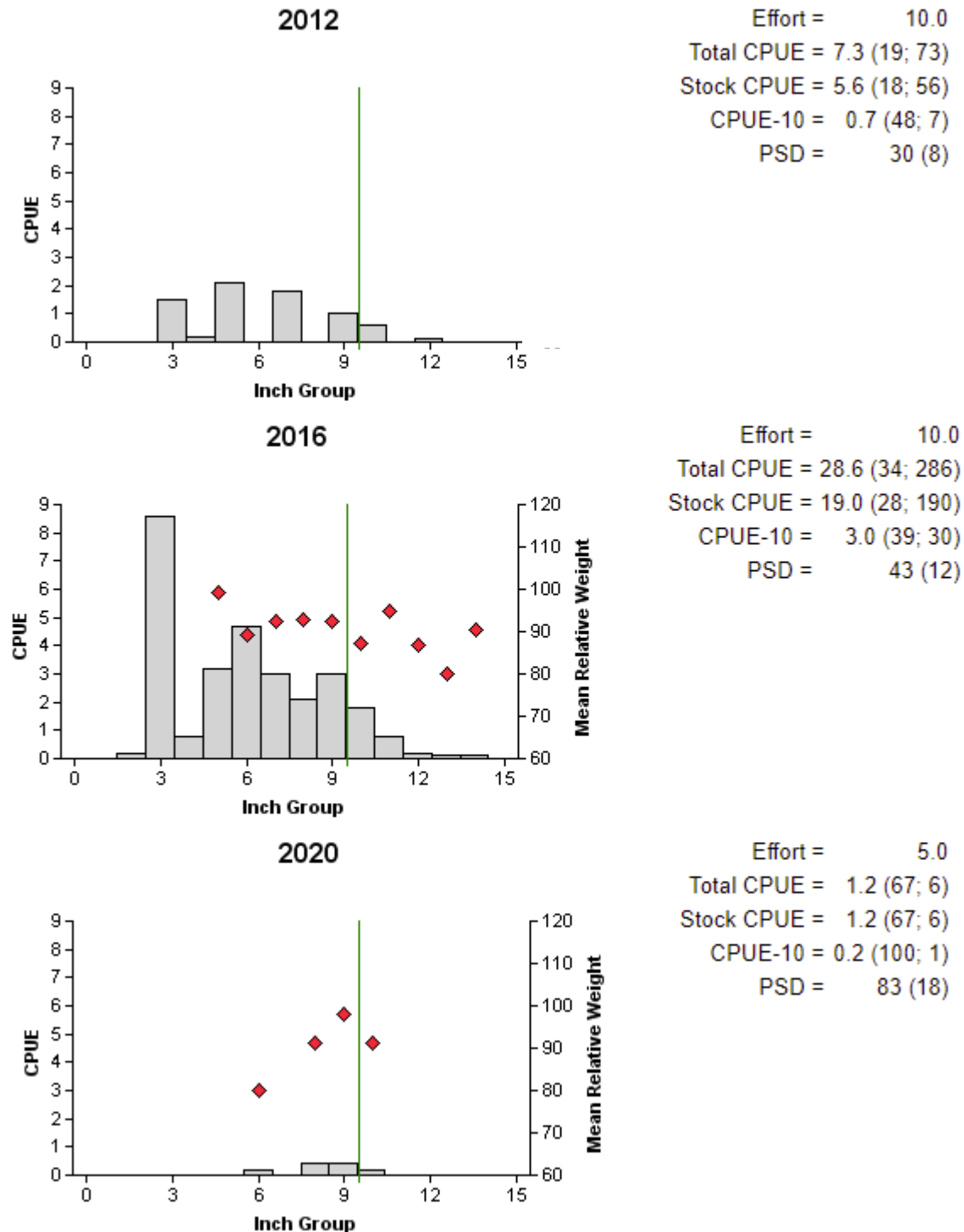


Figure 7. Number of White Crappie caught per net night (CPUE, bars), mean relative weights by inch group (red diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Brownwood Reservoir, Texas, 2012, 2016, and 2020. The vertical green line indicates the 10-inch minimum length limit.

Proposed Sampling Schedule

Table 9. Proposed sampling schedule for Brownwood Reservoir, Texas. Survey period is June through May. Gill netting surveys are conducted in the spring, while low-frequency electrofishing is conducted in the summer, and electrofishing and trap netting surveys are conducted in the fall. Surveys and reports to be completed are labeled as X.

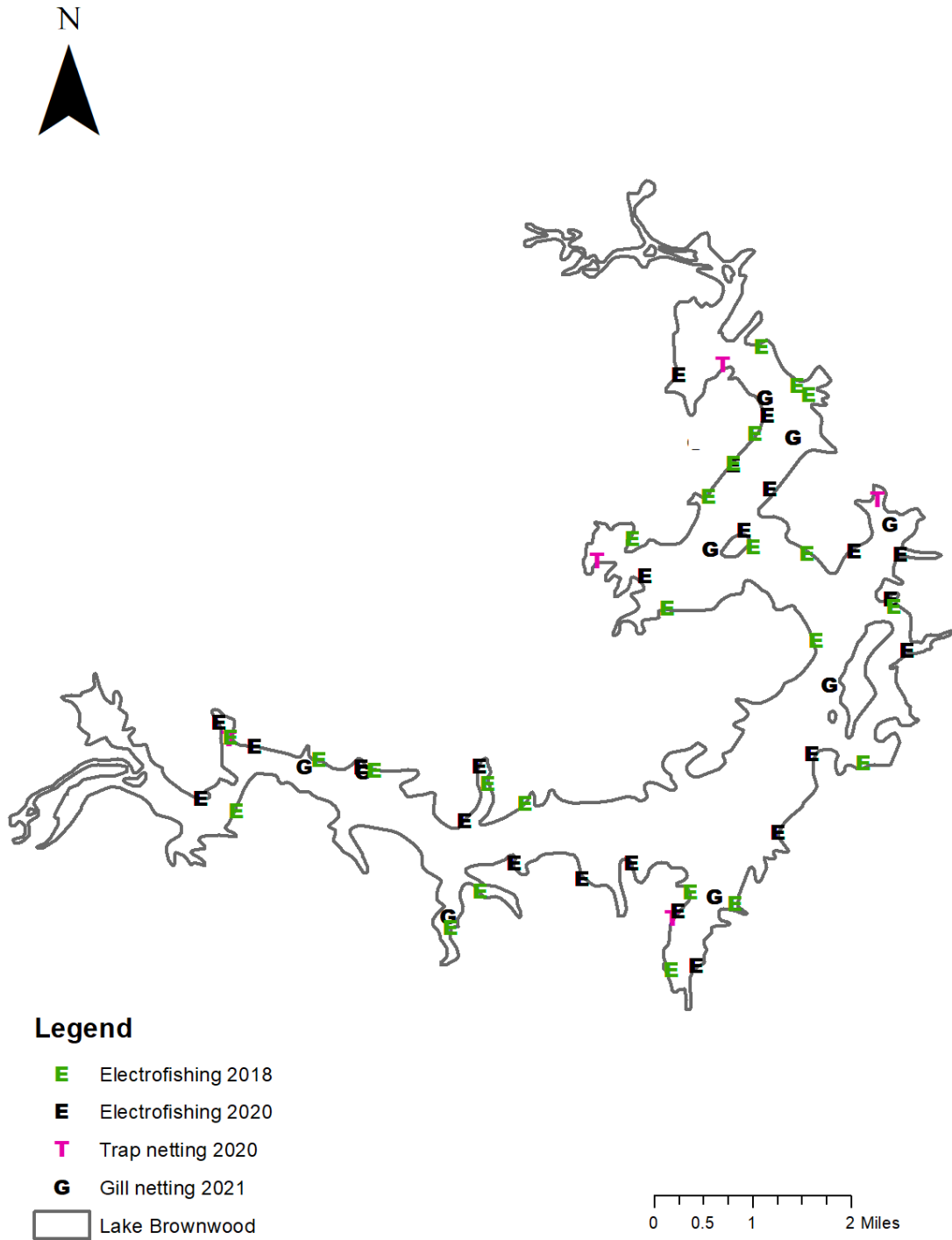
Survey Type	Survey year			
	2021-2022	2022-2023	2023-2024	2024-2025
Angler Access				X
Vegetation				X
Electrofishing – Fall				X
Low-frequency Electrofishing			X	
Trap Netting				X
Gill Netting				X
Creel				X
Report				X

APPENDIX A – Catch Rates for All Species and All Gears

Number (N) and catch rate (CPUE) and associated relative standard error (RSE) in parentheses for all species enumerated from all gear types from Brownwood Reservoir, Texas, 2020-2021. Sampling effort was, 2 hours for electrofishing, 5 net nights for trap netting, and 10 net nights for gill netting. Water level at the time of sampling was about 3 feet below conservation pool elevation.

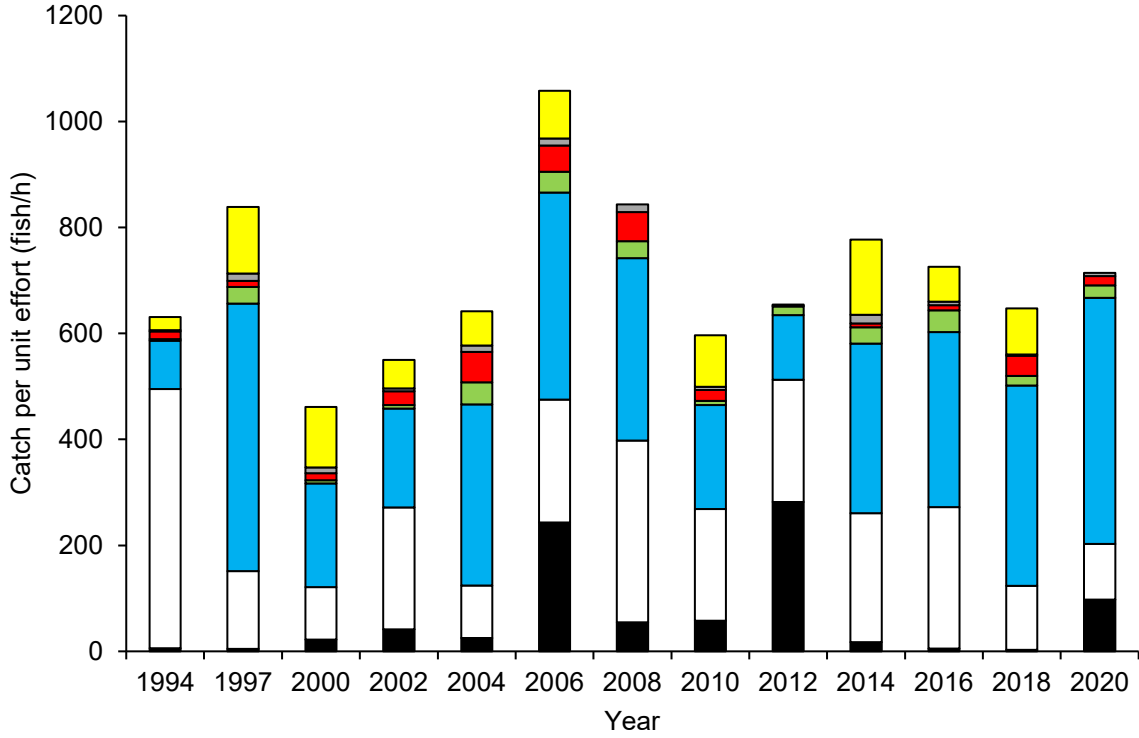
Species	Electrofishing		Gill Netting		Trap Netting	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad	210	105.0 (25)				
Threadfin Shad	195	97.5 (58)				
Blue Catfish			26	2.6 (17)		
Green Sunfish	46	23.0 (29)				
Warmouth	12	6.0 (50)				
Orangespotted Sunfish	5	2.5 (50)				
Bluegill	930	465.0 (12)				
Longear Sunfish	244	122.0 (19)				
Redear Sunfish	36	18.0 (42)				
Largemouth Bass	182	91.0 (11)				
White Crappie					6	1.2 (67)
Hybrid Sunfish	8	4.0 (71)				

APPENDIX B – Sampling Locations (2018-2021)



Locations of electrofishing (E), trap netting (T), and gill netting (G) sampling sites, Brownwood Reservoir, 2017-2021. Water level at the time of sampling was about 3 feet below conservation pool elevation.

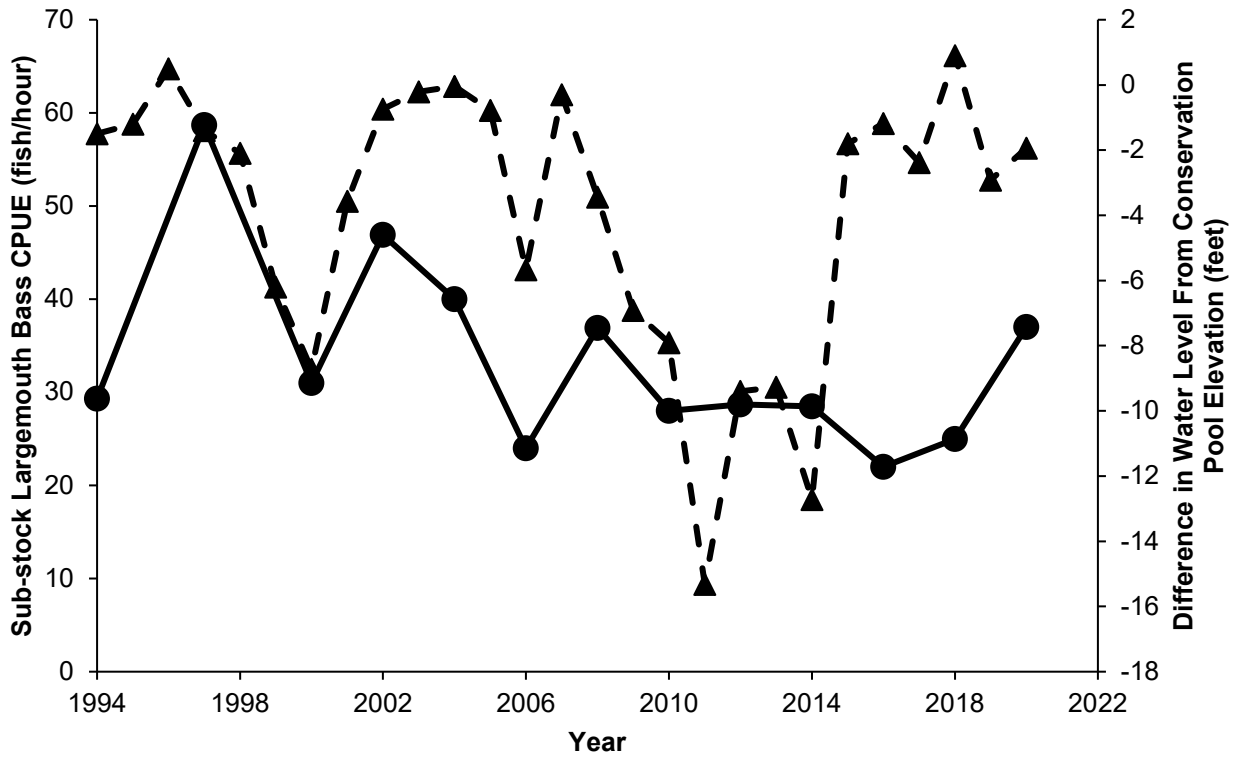
APPENDIX C – Historical Catch Rates for Commonly Sampled Prey Species



- Threadfin Shad □ Gizzard Shad ■ Bluegill ■ Green Sunfish
- Redear Sunfish ■ Warmouth ■ Longear Sunfish

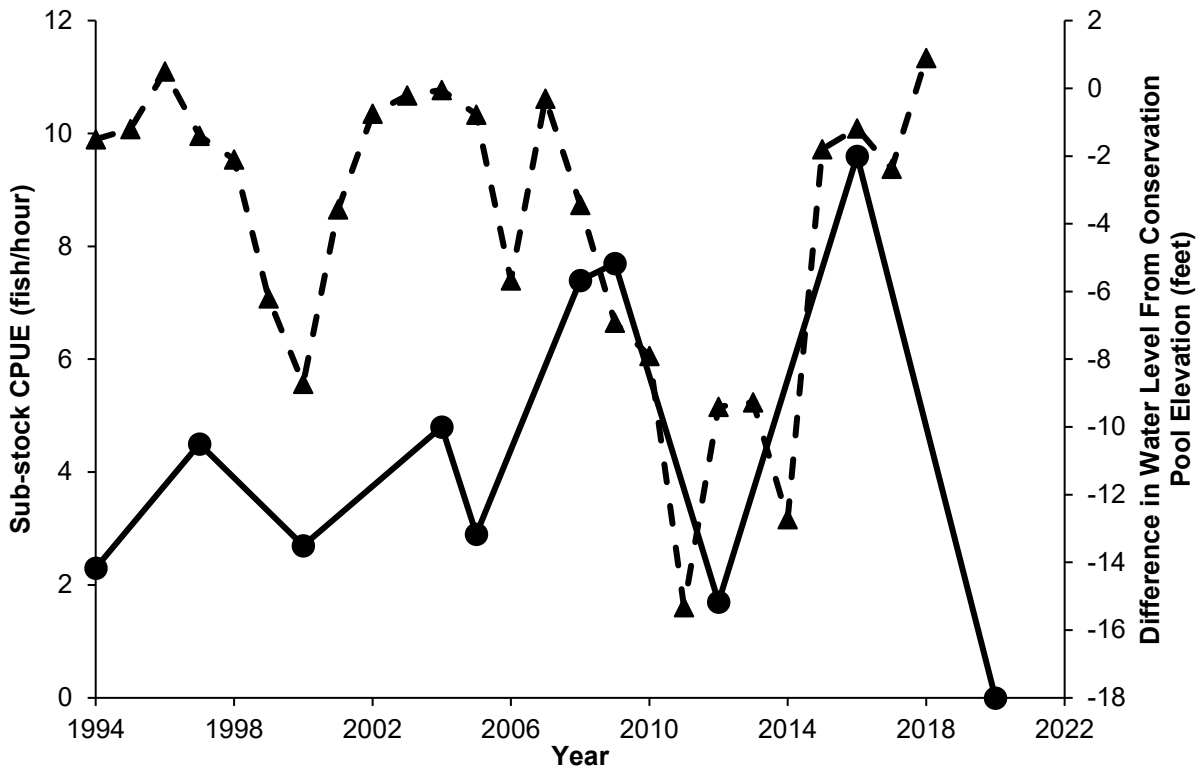
Total catch per unit effort for commonly sampled prey species in Brownwood Reservoir, Texas, 1994-2020.

APPENDIX D – Trends in Catch Rates of Largemouth Bass with Concurrent Difference in Water Level



Sub-stock CPUE of Largemouth Bass (fish/h; solid line) caught during fall electrofishing surveys and difference between beginning October water level elevation and conservation pool elevation (feet; dashed line), Brownwood Reservoir, Texas, 1994-2020.

APPENDIX E – Trends in Catch of White Crappie with Concurrent Difference in Water Level



Sub-stock CPUE of White Crappie (fish/h; solid line) caught during fall trap netting surveys and difference between beginning October water level elevation and conservation pool elevation (feet; dashed line), Brownwood Reservoir, Texas, 1994-2020.



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