

Buffalo Springs 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 Buffalo Springs Reservoir were surveyed in 2017 and 2019 using tandem hoop netting, in 2020 using electrofishing, and in 2021 using gill netting. Anglers were surveyed from April 2019 through September 2019 with a creel survey. 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: Buffalo Springs Reservoir is a 225-acre impoundment constructed in 1960 on Yellowhouse Draw, a tributary of the North Fork of the Double Mountain Fork of the Brazos River, approximately 5 miles southeast of Lubbock, Texas. It is controlled and operated by the Lubbock County Water Control and Improvement District Number 1 and used for recreational purposes. Water level was stable and nutrient levels in the reservoir are extremely high. Fish habitat consists primarily of native emergent vegetation, boulders, and artificial fish habitats.

Management History: The sport fish populations have been managed with statewide regulations. Intensive Striped Bass stocking has been used to manage an overabundant Gizzard Shad population with good success.

Fish Community

- **Prey species:** Electrofishing catch of Gizzard Shad was high, and most Gizzard Shad were available as prey to most sport fish. Electrofishing catch of Bluegill was also high, and most Bluegill were 6-inches long or smaller.
- **Catfishes:** The Channel Catfish population had many legal-sized fish available to anglers; the 2019 creel survey indicated a good catch rate, and 56% of all catfish caught were of legal size.
- **Striped bass:** Striped Bass abundance has improved due to regular stockings. Angling effort was low for Striped Bass.
- **Largemouth Bass:** While overall Largemouth Bass abundance has declined, the number of legal-sized has remained consistent. Sampled fish sizes ranged from 4 to 18 inches and were healthy with good body condition. About 99% of all Largemouth Bass caught by anglers were released.
- **White Crappie:** White Crappie were the 3rd most sought after fish species category in the reservoir. An estimated 2,812 fish were harvested during the April to September 2019 creel period.

Management Strategies: Based on current information, the reservoir should continue to be managed with existing regulations. Continue stocking Striped Bass to help maintain control of the Gizzard Shad population. Striped Bass fingerlings should be stocked on an alternating basis at a rate of 15/acre and 40/acre in two consecutive years and then two years of no stocking based on protocols used during research conducted by Schramm et al. (2000). The reservoir should be monitored for *P. parvum* and associated fish kills. Mitigation of kills by stocking should be conducted as soon as practical.

Introduction

This document is a summary of fisheries data collected from Buffalo Springs Reservoir from 2017-2021. 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 2017-2021 data for comparison.

Reservoir Description

Buffalo Springs is a 225-acre reservoir impounded in 1960 on Yellowhouse Draw, a tributary of the North Fork of the Double Mountain Fork of the Brazos River, located 5 miles southeast of Lubbock, Texas. It is owned by the Lubbock County Water Control and Improvement District Number 1 and used for recreational purposes. The City of Lubbock, TX discharges its treated effluent into Yellowhouse Draw which allows water level in the lake to remain stable; however, nutrient levels are extremely high. Buffalo Springs is characterized as a eutrophic lake with a mean Trophic State Index chl-a of 67.08 (Texas Commission on Environmental Quality 2020). Bank and boat access were good, and ADA compliant facilities were available. The reservoir experienced a significant *Prymnesium parvum* (golden algae) kill during 2003 which had a major impact on the fisheries. The reservoir experienced another kill in 2005 and small kills since. Additional reservoir characteristics are presented in Table 1.

Angler Access

Buffalo Springs Reservoir has three public boat ramps. Due to stable water level all boat ramps were available to anglers. Additional boat ramp characteristics are listed in Table 2. Shoreline access is good; fishing is allowed in all open areas of the shoreline on the reservoir, except for the bridge located near the marina. There is also a covered fishing dock located near the marina bridge and several small public fishing docks located around the reservoir. Most fishing docks have access ramps or are constructed at ground level making them more accessible to people with disabilities.

Management History

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

1. Stock fingerling Striped Bass on an alternating basis where they are stocked at a rate of 15/acre and 40/acre in two consecutive years followed by two years of no stocking.

Action: Buffalo Springs was stocked with Striped Bass at a rate of approximately 17/acre in 2018 and 52/acre in 2019. Striped Bass were not stocked in 2020 or 2021.
2. Monitor the reservoir for *P. parvum* blooms by maintaining contact with the reservoir management authority and by collecting quarterly water samples from the reservoir.

Action: A strong working relationship has been maintained with the lake manager and staff, and water samples have been routinely evaluated.
3. Install a variety of artificial habitat and plant a variety of native aquatic vegetation to provide natural habitat and increase the complexity of the habitat.

Action: Six test locations were planted with a variety of aquatic plants (Water Willow, White Water Lily, and American Pond Weed) were planted in 2018. Only one location of White Water Lily was successful in becoming established. Approximately 280 artificial fish habitats have been placed in several locations around the reservoir (130 Fishing structures, 50 Georgia Cubes, 50 Spider Blocks, and 50 Crappie Condos).
4. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir; contact and educate marina owners about invasive species, and provide them with posters, literature, etc... so that they can in turn educate their customers; educate the

public about invasive species through the use of media and the internet; and make a speaking point about invasive species when presenting to constituents and user groups.

Action: Presentations have been given to the Regional water planning group, the Buffalo Springs Board of Directors, and various area civic groups and school groups. Interviews and new releases concerning invasive species have been done for area newspapers. Stories and posts have been added to the district Facebook page. Invasive species literature has been sent to the Buffalo Springs controlling authority and placement of signage has been advised.

Harvest regulation history: Sport fishes in Buffalo Springs Reservoir have been and continue to be managed with statewide regulations (Table 3).

Stocking history: Buffalo Springs Reservoir has been stocked with Blue Catfish, Channel Catfish, Striped Bass, Bluegill, and Florida Largemouth Bass multiple times since 2003 in an effort to mitigate the effects of fish kills and reestablish populations. The reservoir was experimentally stocked with walleye (1978-1981) Red Drum (1983), and Northern Pike (1975-1976) with limited success. The reservoir was last stocked in 2019 with Striped Bass. The complete stocking history is in Table 4.

Vegetation/habitat management history: Vegetation in Buffalo Springs Reservoir is limited to mainly cattail and a small amount of bulrush. To maintain shoreline fishing access, the water authority has periodically removed problematic vegetation with the use of an excavator and herbicides. In May 2016, 131 artificial habitats were installed adjacent to 14 public access areas on the West side of the reservoir. In June 2020, 50 Georgia Cubes, 50 Spider Blocks, and 50 Crappie Condos were placed around the Crappie House and around three public access areas on the East side of the reservoir.

Water transfer: Buffalo Springs Reservoir is primarily used for recreation. No interbasin 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 Buffalo Springs Reservoir (Clayton and Munger 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).

Electrofishing – Largemouth Bass, White Crappie, sunfishes, and Gizzard Shad were collected by electrofishing (1 hour at 12, 5-min stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing.

Gill netting – Channel Catfish and Striped Bass were collected by gill netting (4 net nights at 4 stations). Five gill nets were set at 5 stations, but local law enforcement staff mistakenly removed one gill net. CPUE for gill netting was recorded as the number of fish caught per net night (fish/nn).

Tandem hoop nets – Channel Catfish were collected using 5 tandem hoop-net series at 5 stations. Nets were baited with soap and deployed for 2-night soak durations. CPUE for tandem hoop netting was recorded as the number of fish caught per tandem hoop net series (fish/series).

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 ($RSE = 100 \times SE$ of the estimate/estimate) was calculated for all CPUE and creel statistics.

Creel survey – A roving creel survey was conducted in 2019 from April through September. 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).

Habitat – A structural habitat survey and a vegetation survey was conducted in August 2020. Habitat was assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

Water level – There is no water level gauge on the reservoir; however, the lake maintains a constant level at conservation pool due to a constant flow of treated effluent from the City of Lubbock, TX.

Results and Discussion

Habitat: Primary habitat was natural shoreline (75%) followed by bulkhead (18.7%) (Table 6). Aquatic vegetation was mainly limited to cattail and bullrush, primarily along natural shoreline areas (Table 7). The planted area for White Water Lilly has expanded from 3 plants to an area of approximately 100 sq ft.

Creel: Buffalo Springs Reservoir is a unique reservoir in that the majority of angler effort is dominated by bank anglers. During the 2019 creel survey, the 225-acre reservoir had a total of 53,504 hours of angler effort, and 44,852 of those hours (83.8%) were from bank anglers. Directed fishing effort by anglers was highest for anglers fishing for anything (33% = 17,657 hours), followed by anglers fishing for Channel Catfish and White Crappie (Table 8). Total angler effort for the Spring quarter has experienced a large increase from 18,810 hours in 1993 (Munger 1994) to 32,353 hours in 2019 with direct expenditures for the 2019 spring and summer creel totaling \$402,202 (Table 9). Overall, 2019 creel results indicate that Buffalo Springs Reservoir is mainly a harvest-oriented fishery. Of all fish species targeted and harvested during the creel period, percent of legal sized fish released ranged from 29% to 46%, except for Largemouth Bass in which 99% of legal sized fish were released.

Prey species: Electrofishing catch rates of Gizzard Shad and Bluegill were 445.0/h and 380.0/h, respectively. Index of Vulnerability (IOV) for Gizzard Shad was good, indicating 80% of Gizzard Shad were available to existing predators; this was similar to previous years (Figure 1). Total CPUE of Gizzard

Shad was considerably higher in 2020 compared to the 2018 survey and slightly lower than the 2016 survey (Figure 1). Total CPUE of Bluegill in 2020 was similar to total CPUE in 2018 and slightly lower than 2016 (Figure 2).

Channel Catfish: The gill net catch rate of Channel Catfish was 7.3/nn in 2021; similar to previous surveys. The relative abundance appears high and most fish sampled were above the minimum legal length limit; fish over 20 inches were sampled. Body condition (W_r) for all sizes classes was near or greater than 100 (Figure 3). Hoop net catch rate in 2019 (July – Total CPUE= 6.2/series) was considerably less than in 2017 (June – Total CPUE=48.8/series); this could be attributed to timing of the survey or poor site selection (Figure 4). In the 2019 creel survey, Channel Catfish were the second most sought after fish species category in the reservoir (23.5% directed effort). Directed fishing effort (12,560 hours = 24%), total catch (8,734 fish), and total harvest (3,494 fish) indicate a popular catfish fishery (Table 10). Channel Catfish were a harvest-oriented fish as only 29% of the legal-sized fish were released. Observed harvest during the creel period showed fair angler compliance with only two fish below the minimum length limit harvested. Harvested fish ranged in length from 10 to 23 inches (Figure 5).

Striped Bass: The gill net catch rate of Striped Bass was 19.8/nn in 2021; this is much higher than 2015 and 2017 (Figure 6). Increased catch rate of fish less than 20 inches is attributed to consistent stocking of Striped Bass in 2018 and 2019. Directed fishing effort, total catch, and total harvest for Striped Bass was 1,582 h, 684 fish, and 131 fish, respectively, from April 2019 through September 2019 (Table 11). Historically, Striped Bass were more highly sought after by anglers; they accounted for 10% of total angler effort in 1993 spring quarter (Munger 1994) vs. 3% of effort in 2019 spring quarter. Of the 244 legal-sized fish caught 46% were released. Observed harvest during the creel period showed good angler compliance, and harvested fish ranged in length from 18 to 25 inches (Figure 7).

Largemouth Bass: The electrofishing catch rate of stock-length Largemouth Bass was 54.0/h in 2020, lower than 75.0/h in 2018 and 107.0/h in 2016. Overall abundance has declined throughout the survey period; however, with the majority of abundance of legal-sized fish has remained consistent with a CPUE-14 ranging from 19.0 to 16.0. PSD varied from 39 to 67 during the survey periods (Figure 8). Body condition in 2021 was good (relative weight over 90) for nearly all size classes of fish and was similar to body condition in previous surveys (Figure 8). Directed fishing effort, total fish caught, and total harvest for Largemouth Bass was 8,364 h, 5,352 fish, and 17 fish, respectively, from April 2019 through September 2019 (Table 12). Most legal Largemouth Bass were released, 99% (Table 13). Harvest of Largemouth Bass was insignificant during the creel period, with only one 15-inch fish documented (Figure 9).

White Crappie: The crappie population appeared to fluctuate greatly since *P. parvum* blooms began in 2003. Trap net catch rates are highly variable from year to year. Due to high variability, trap net catch rates for Buffalo Springs Reservoir provide little more than presence/absence data. It was determined that presence/absence data could also be obtained through other survey techniques. During the 2020 electrofishing survey, when White Crappie were observed, they were measured to the nearest inch class. A total of 15 White Crappie, ranging from 4 to 12 inches were measured. Seventeen White Crappie were also observed during the 2021 gill net survey. White Crappie were the 3rd most sought after fish species category in the reservoir with 18.3% of the directed angler effort. From April 2019 to September 2019 directed effort for White Crappie was 9,783 hours, and estimated total harvest was 2,812 fish (Table 13). White Crappie were a harvest-oriented species with 31% legal-release. Size of harvested White Crappie ranged from 10 to 14 inches in total length (Figure 10).

Fisheries Management Plan for Buffalo Springs Reservoir, Texas

Prepared – July 2021

ISSUE 1: Striped Bass are an important top-level predator in Buffalo Springs Reservoir, and they provide additional recreation to anglers. Historically, Buffalo Springs was characterized as having an overabundant Gizzard Shad population comprised mostly of adult shad too large to be used as prey. Schramm, et al. (2000) found that the Gizzard Shad population in Buffalo Springs could be restructured to be more conducive to predation by stocking large numbers of Striped Bass. Striped Bass do not reproduce in Buffalo Springs and stocking is required to maintain their abundance. The recent IOV's for Gizzard Shad indicate that the consistent stockings of Striped Bass have stabilized the size structure of Gizzard Shad making the majority of them more available to predators.

MANAGEMENT STRATEGY

1. Stock fingerling Striped Bass on an alternating basis where they are stocked at a rate of 15/acre and 40/acre in two consecutive years followed by two years of no stocking.

ISSUE 2: The reservoir experienced a severe fish kill in 2003 due to *P. parvum*. There have been repeated smaller kills in the years following the initial kill, but these have been much smaller and primarily restricted to the upper reservoir.

MANAGEMENT STRATEGIES

1. Maintain contacts with reservoir management authority to monitor for fish kills.
2. Conduct *P. parvum* sampling If notified of a fish kill, to determine if kill is *P. parvum* related.

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

MANAGEMENT STRATEGIES

1. Cooperate with the controlling authority to post 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.

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

Sport fish, forage fish, and other important fishes

Sport fishes in Buffalo Springs Reservoir have historically included Channel Catfish, Striped Bass, Largemouth Bass and White Crappie. The primary forage is Gizzard Shad and Bluegill.

Low-density fisheries

Blue Catfish are typically collected in gill nets at a rate of 0.2/nm or lower, and the 2019 creel survey have indicated no directed effort toward this species.

Survey objectives, fisheries metrics, and sampling objectives

Channel Catfish: Prior to conducting the 2019 creel survey, direct angler effort for Channel Catfish was essentially unknown. In 1993, a Spring quarter creel survey showed that Channel Catfish were the most sought-after fish species category in the reservoir with 8,613 hours of effort (46% of total effort) (Munger 1994). The 2019, creel survey indicates that Channel Catfish are still highly sought after with 12,560 hours of angler effort (23% of total effort); however, they are now the second most sought after species category, behind Anything anglers (17,657 hours = 33% of effort). However, visual observance of interviewed Anything anglers, during the 2019 creel period, suggests that the majority were utilizing angling techniques associated with catfish angling. Channel Catfish populations have been impacted by golden algae since 2003, and trend data on relative abundance and size structure of Channel Catfish has been collected biennially since 2005. Continuation of trend data will allow for general monitoring of large-scale changes in relative abundance and size structure. Catch rates have been highly variable ranging from a low of 0/nm in 2009 to 10.4/nm in 2013. Based upon 2015, 2017, and 2021 survey results, gill net sampling effort needed to achieve sampling objectives for relative abundance (CPUE-S; $RSE \leq 25$ with 80% confidence), and effort for size structure estimation (PSD; 50 fish minimum with 80% confidence) is approximately 7 random gill net stations. Effort needed to achieve the same objectives using baited hoop nets could require 14 or more stations. Because this reservoir is a small, harvest-oriented fishery, general monitoring on a biennial bases is adequate for observing large scale changes in trend data for the population. For 2023 and 2025 a total of 7 random gill net stations will be sampled each year; no additional effort will be expended to improve precision.

Striped Bass: Striped Bass populations have been impacted by golden alga since 2003, and trend data on relative abundance of Striped Bass has been collected biennially since 2005. Continuation of trend data will allow for general monitoring of any large-scale changes in relative abundance. Catch rates have been highly variable ranging from a low of 0.4/nm (2009, 2013, 2015) to 19.8/nm (2021). Based upon 2015, 2017, and 2021 survey results, achieving a relative abundance precision of $RSE \leq 25$ of CPUE-S with 80% confidence could require as many as 45 random gill net stations, and effort for size structure estimation (PSD; 50 fish minimum with 80% confidence) exceeds 25 random stations. As Buffalo Springs Reservoir has a total surface area of 225 acres, this amount of effort would equate to more than one gill net station per 10 acres. Continuing the recent consistent stocking will most likely result in better catch rates and increased fishing pressure in the future. For the 2021-2025 survey period Striped Bass data will be collected biennially using the Channel Catfish gill net sampling strategy of 6 random gill nets in 2023 and 2025.

Largemouth Bass: Largemouth Bass populations have been impacted by golden algae since 2003; however, trend data on relative abundance and size structure of Largemouth Bass has been collected biennially since 1996 with fall nighttime electrofishing. Continuation of trend data will allow for general monitoring of any large-scale changes in the Largemouth Bass population that may spur further investigation. Analysis of the past two surveys (2018 and 2020) indicated that it would require 12 electrofishing sites to achieve a relative abundance precision of CPUE-S with $RSE \leq 25$. Effort for size structure estimation (PSD; 50 fish minimum with 80% confidence) would also require 12 random sites.

Twelve randomly selected 5-min electrofishing sites will be sampled in 2022 and 2024. No additional effort will be expended to improve precision.

White Crappie: White Crappie populations have been impacted by golden algae since 2003. Trap net catch rates of White Crappie have been highly variable. Trend data, using trap nets, has only been able to determine presence/absence of the species; in 2012 only one White Crappie was sampled. Due to potential future golden algae impacts, general monitoring on a quadrennial basis will allow for the evaluation of presence/absence of White Crappie. To determine presence/absence we will document any White Crappie observed in the 2022 and 2024 electrofishing surveys. In order to evaluate the usefulness of biologist selected stations and impact of recently installed artificial habitats, additional effort will include five biologist selected trap net stations. Stations will be selected based upon historic catch rates from previous surveys.

Prey species: Gizzard Shad and Bluegill are the primary forage at Buffalo Springs Reservoir. Trend data has been collected biennially since 1996. Continuation of sampling, as per Largemouth Bass above, will allow for general monitoring of large-scale changes in relative abundance and size structure. No additional effort will be extended beyond what is used for Largemouth Bass sampling.

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Tables and Figures

Table 1. Characteristics of Buffalo Springs Reservoir, Texas.

Characteristic	Description
Year constructed	1960
Controlling authority	Lubbock County WC&ID No. 1
County	Lubbock
Reservoir type	Tributary
Shoreline Development Index	3.56
Conductivity	1,577 $\mu\text{S/cm}$

Table 2. Boat ramp characteristics for Buffalo Springs Reservoir, Texas, August 2020.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Marina Ramp	33.53056 -101.70933	Y	30	Unknown	Excellent, no access issues
Water Park Ramp	33.53255 -101.70460	Y	15	Unknown	Excellent, no access issues
Old Gate Ramp	33.53241 -101.72361	Y	30	Unknown	Excellent, no access issues

Table 3. Harvest regulations for Buffalo Springs Reservoir, Texas.

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

Table 4. Stocking history of Buffalo Springs Reservoir, Texas. FRY = fry; FGL = fingerling; ADL = adults; UNK = unknown.

Species	Year	Number	Size
Northern Pike	1975	2,719	UNK
	1976	5,940	UNK
	Total	8,659	
Blue Catfish	1984	13,120	UNK
	2003	5,635	FGL
	2007	25,164	FGL
	2009	24,432	FGL
	Total	68,351	
Channel Catfish	1966	12,500	UNK
	1967	13,000	UNK
	1968	12,000	UNK
	1969	5,500	UNK
	1970	12,540	UNK
	1971	15,000	UNK
	1972	10,500	UNK
	1973	10,000	UNK
	1974	5,000	UNK
	1975	5,000	UNK
	1977	5,000	UNK
	2005	58	ADL
	Total	106,098	
	Flathead Catfish	1973	1,500
Striped Bass	1983	11,450	UNK
	1984	11,000	FGL
	1986	13,500	FGL
	1988	2,416	FGL
	1988	25,000	FRY
	1989	28,400	FRY
	1990	5,110	FGL
	1991	4,500	FGL
	1992	39,566	FGL
	1992	11,055	FRY
	1993	50,450	FGL
	1998	3,486	FGL
	1999	9,487	FGL
	2002	3,428	FGL
	2003	9,752	FGL
	2005	3,686	FGL
	2006	11,619	FGL
	2008	3,988	FGL
	2013	3,705	FGL
	2015	8,351	FGL
2017	5,200	FGL	
2018	3,830	FGL	
2019	11,664	FGL	
Total	280,643		

Table 4. Stocking history continued

Species	Year	Number	Size
Green X Redear Sunfish	1970	5,000	UNK
Bluegill	2004	64,550	FGL
	2007	24,597	FGL
	Total	89,147	
Largemouth Bass	1966	36,000	FGL
	1967	10,500	FGL
	1968	6,450	FGL
	1969	5,000	FGL
	1970	10,000	FGL
	1971	7,000	FGL
	1991	3,050	FGL
	Total	78,000	
Florida Largemouth Bass	1982	3,000	FGL
	1983	10,500	FGL
	1984	2,400	FRY
	1985	2,000	FGL
	2003	24,316	FGL
	2004	25,019	FGL
	2005	25,105	FGL
	2007	24,361	FGL
	2009	24,008	FGL
	2011	24,141	FGL
Total	164,850		
Walleye	1978	1,124,775	FRY
	1979	500,000	FRY
	1980	1,102,500	FRY
	1981	2,345,000	FRY
	Total	5,072,275	
Red Drum	1983	27,900	UNK

Table 4. Objective-based sampling plan components for Buffalo Springs Reservoir, Texas 2017–2021.

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing</i>			
Largemouth Bass	Abundance Size Structure	CPUE - Stock PSD, length frequency	RSE – Stock ≤ 25 N ≥ 50 Stock
Bluegill ^a	Abundance Size Structure	CPUE - Total PSD, length frequency	RSE ≤ 25 N ≥ 50
Gizzard Shad ^a	Abundance Size Structure Prey availability	CPUE - Total PSD, length frequency IOV	RSE ≤ 25 N ≥ 50 N ≥ 50
White Crappie	Abundance	Presence/Absence	Practical Effort
<i>Gill netting</i>			
Channel Catfish	Abundance Size Structure	CPUE – Stock PSD, length frequency	RSE – Stock ≤ 25 N ≥ 50 Stock
Striped Bass	Abundance Size Structure	CPUE – Stock PSD, length frequency	RSE – Stock ≤ 25 N ≥ 50 Stock
<i>Tandem hoop netting</i>			
Channel Catfish	Abundance Size structure	CPUE–stock PSD, length frequency	RSE-Stock ≤ 25 N ≥ 50 stock

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

Table 5. Survey of structural habitat types, Buffalo Springs Reservoir, Texas, 2020. Shoreline habitat type units are in miles.

Habitat type	Estimate	% of total
Natural shoreline	6.0 miles	75
Bulkhead	1.5 miles	18.7
Rock shore	0.4 miles	5
Bulkhead + piers	0.1 miles	1.3

Table 6. Survey of aquatic vegetation, Buffalo Springs Reservoir, Texas, 2008–2020. Surface area (acres) is listed with percent of total reservoir surface area in parentheses.

Vegetation	2008	2012	2016	2020
Native emergent	4.6 (1.9%)	5.6 (2.3%)	6.1 (2.8%)	6.1 (2.8%)
Native floating-leaved				<1.0 (<1%)

Table 7. Percent directed angler effort by species for Buffalo Springs Reservoir, Texas, 2019. Survey period was from 1 April through 30 September in 2019.

Species	2019
Common Carp	2.7
Black Bullhead	0.3
Channel Catfish	23.5
Striped Bass	3.0
Bluegill	3.2
Largemouth Bass	15.6
White Crappie	18.3
Anything	33.0
Catfish	0.4

Table 8. Total fishing effort (h) for all species and total directed expenditures at Buffalo Springs Reservoir, Texas, 2019. Spring survey period was from 1 April through 30 June, and Summer survey period was from 1 July through 30 September. Relative standard error is in parentheses.

Creel statistic	2019 Spring	2019 Summer	2019 Total
Total fishing effort (h)	32,353 (19)	21,151 (22)	53,504 (15)
Total directed expenditures	\$270,022 (46)	\$132,180 (62)	\$402,202 (37)

Gizzard Shad

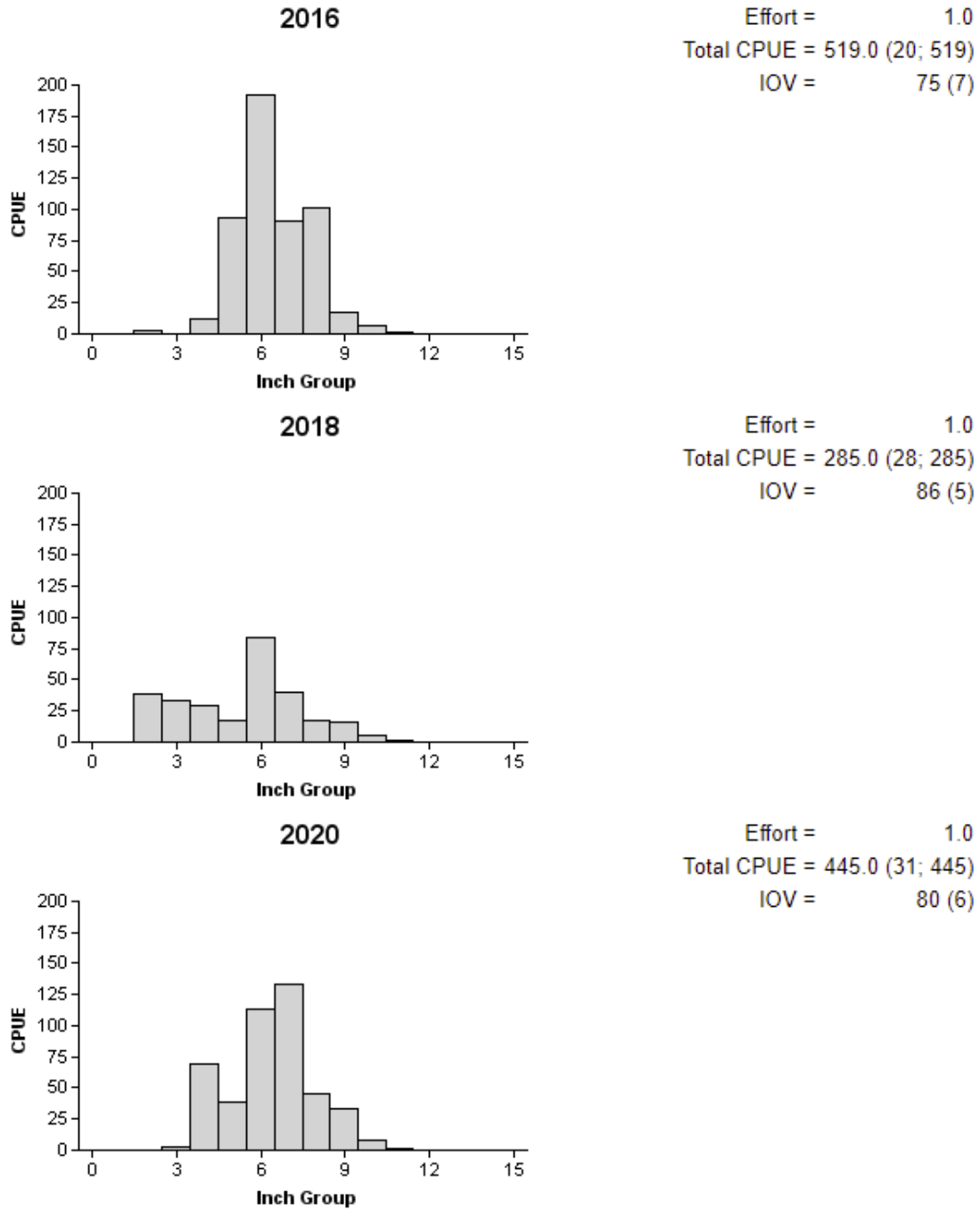


Figure 1. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Buffalo Springs Reservoir, Texas, 2016, 2018, and 2020.

Bluegill

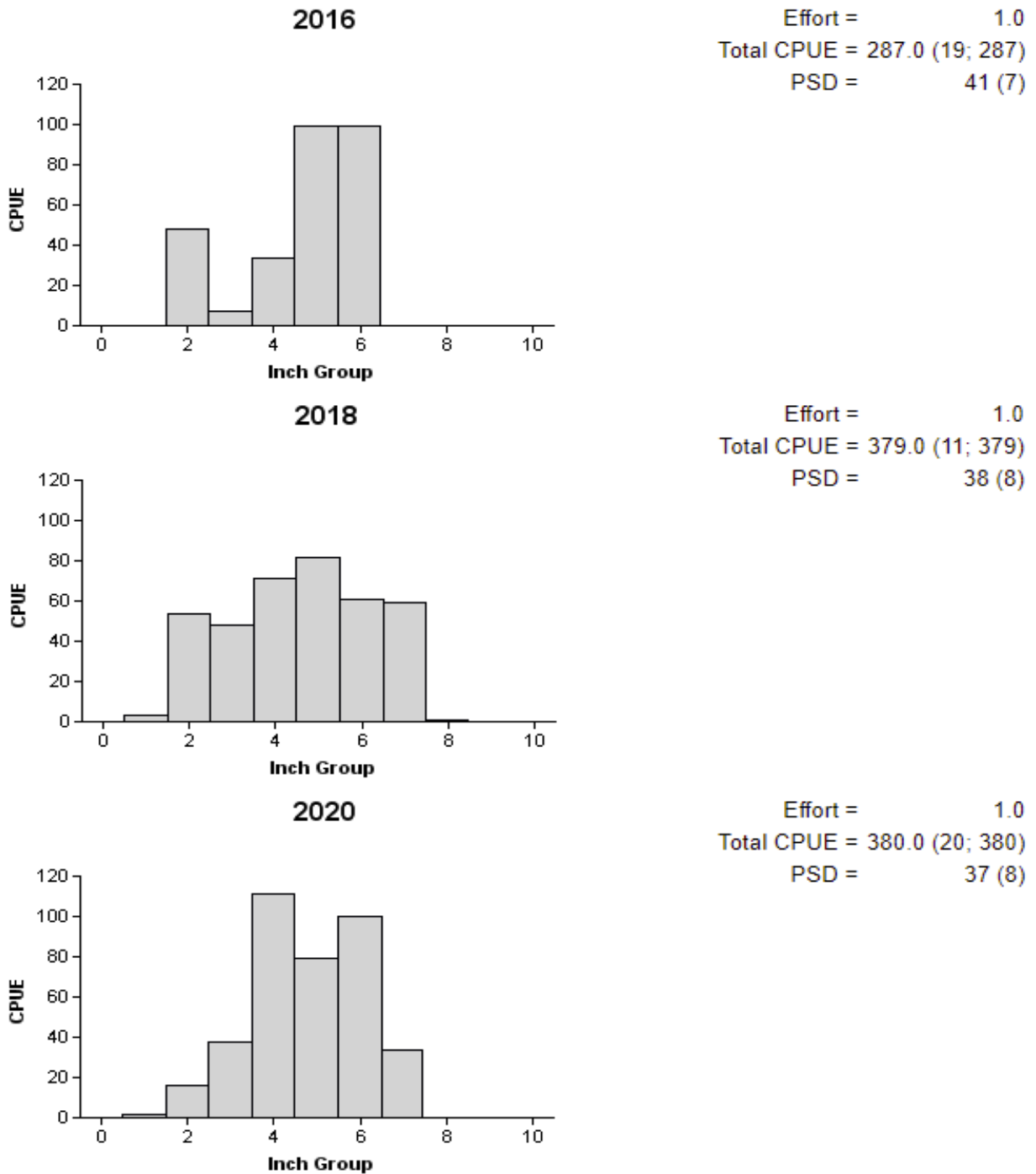


Figure 2. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Buffalo Springs Reservoir, Texas, 2016, 2018, and 2020.

Channel Catfish

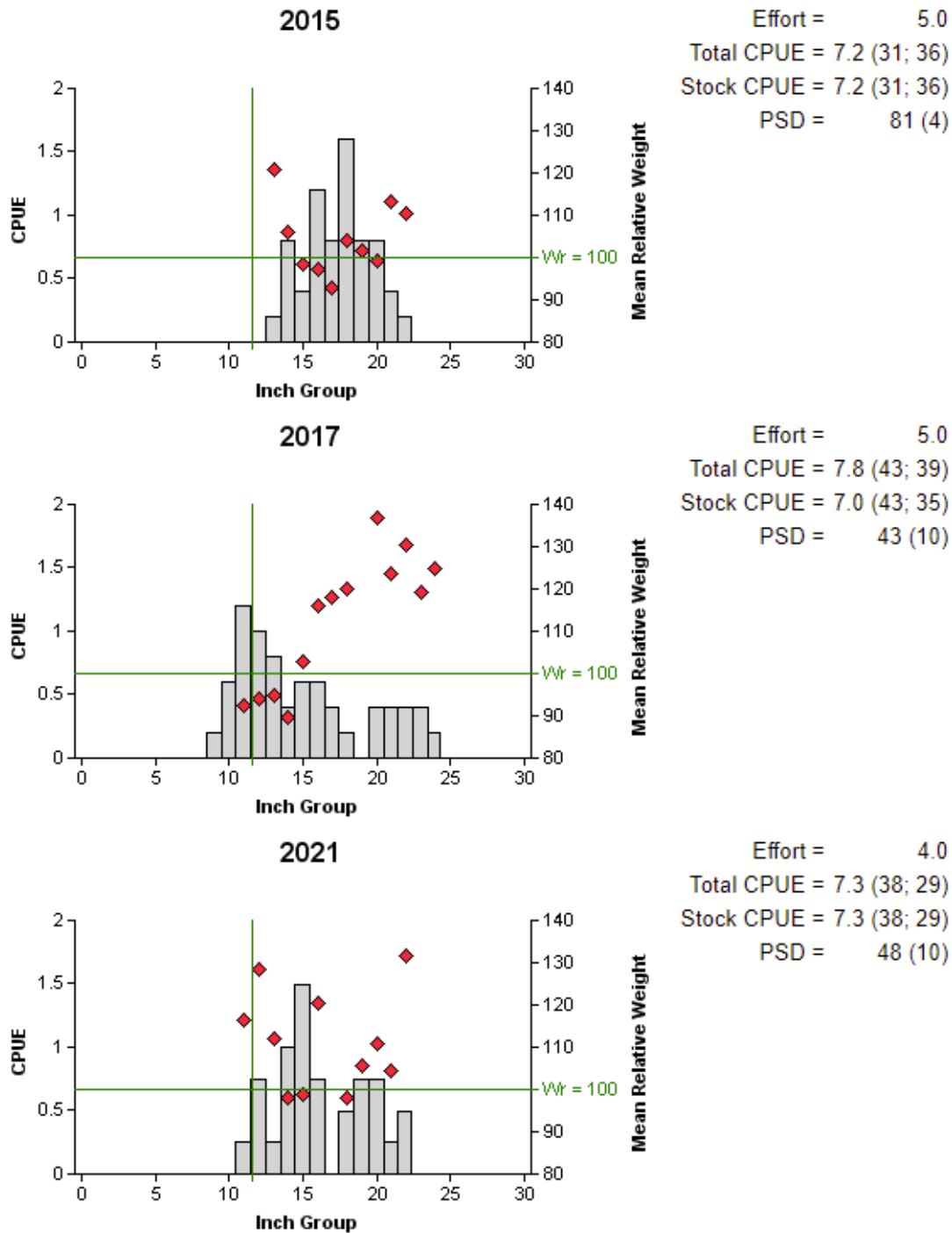


Figure 3. Number of Channel Catfish caught per net night (CPUE) mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Buffalo Springs Reservoir, Texas, 2015, 2017, and 2021. Vertical line represents minimum length limit of 12 inches, and horizontal line represents relative weight of 100.

Channel Catfish

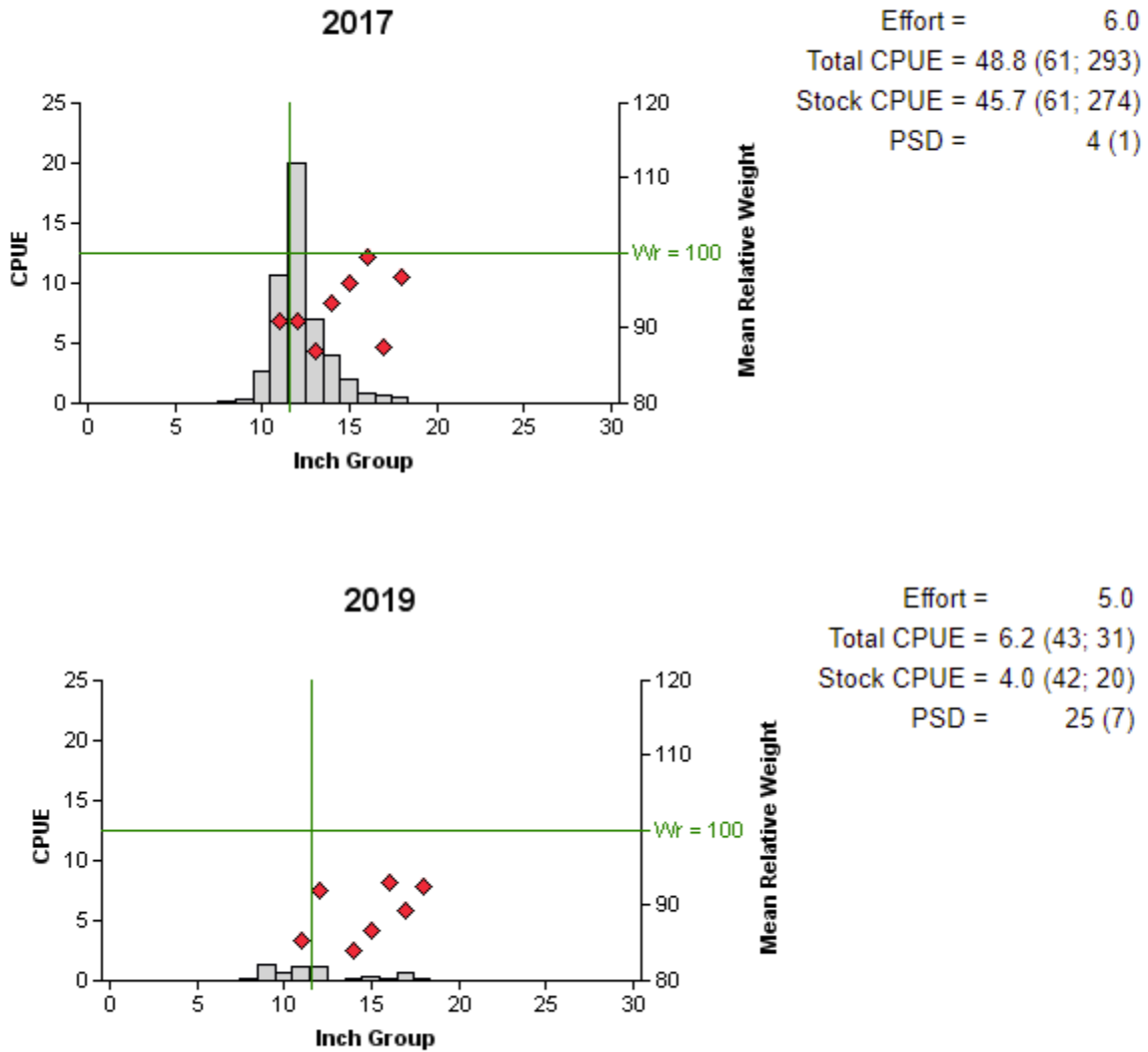


Figure 1. Number of Channel Catfish caught per net night (CPUE) mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for summer hoop net surveys, Buffalo Springs Reservoir, Texas, 2017 and 2019. Vertical line represents minimum length limit of 12 inches, and horizontal line represents relative weight of 100.

Table 9. Creel survey statistics for Channel Catfish at Buffalo Springs Reservoir, Texas, from 1 April through 30 September 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
	2019
Surface area (acres)	225
Directed effort (h)	12,595.75 (22)
Directed effort/acre	55.98 (22)
Total catch per hour	0.35 (38)
Total harvest	3,493.76 (46)
Harvest/acre	15.45 (46)
Percent legal released	29

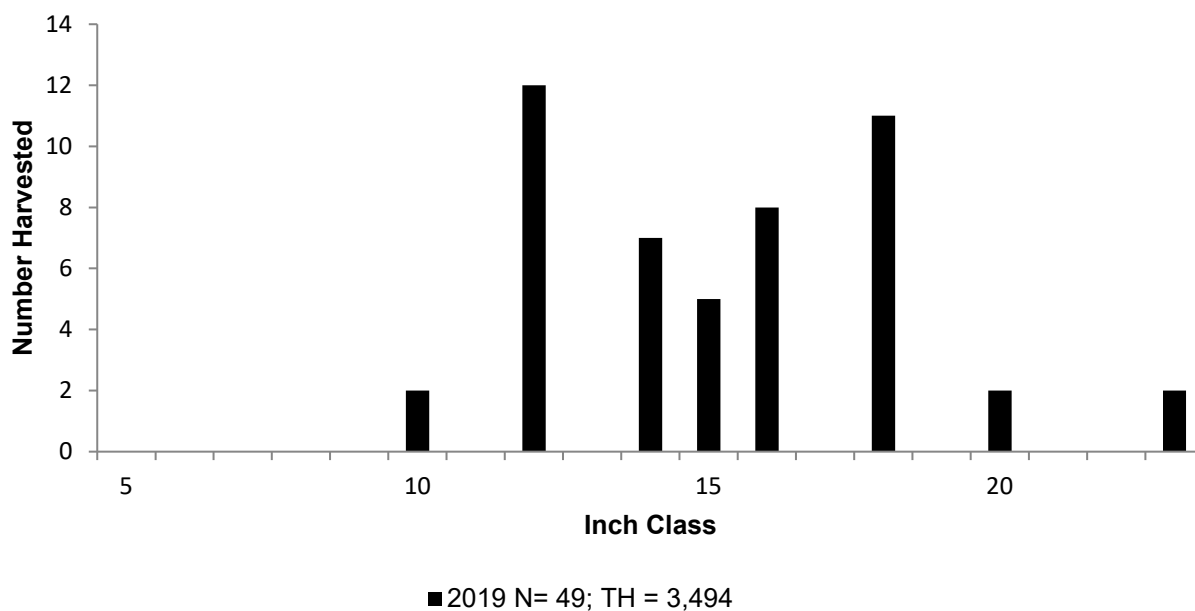


Figure 2. Length frequency of harvested Channel Catfish observed during creel survey at Buffalo Springs Reservoir, Texas, 1 April 2019 through 30 September 2019, all anglers combined. N is the number of harvested Channel Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period.

Striped Bass

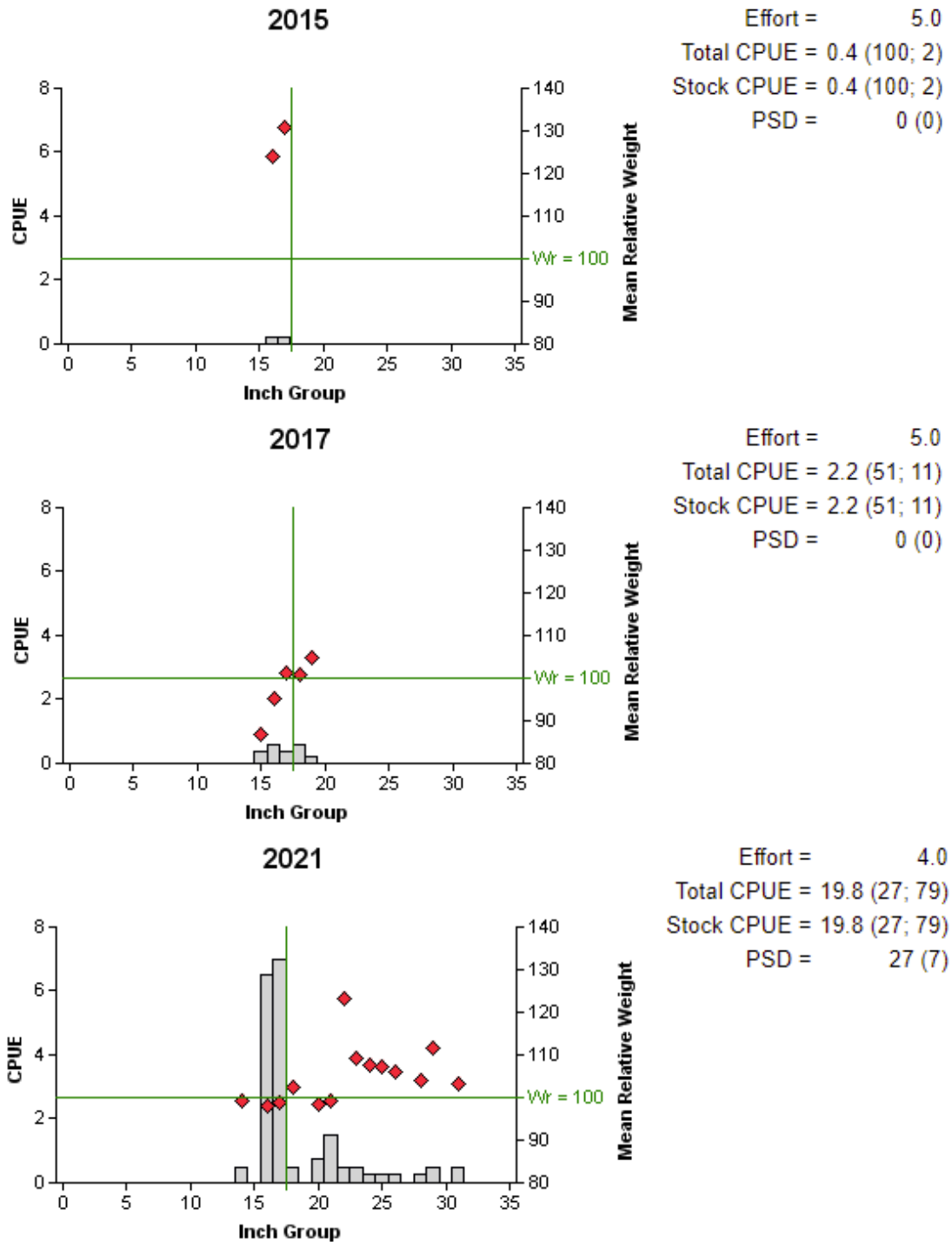


Figure 3. Number of Striped Bass caught per net night (CPUE) mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Buffalo Springs Reservoir, Texas, 2015, 2017, and 2021. Vertical line represents minimum length limit of 18 inches, and horizontal line represents relative weight of 100.

Table 10. Creel survey statistics for Striped Bass at Buffalo Springs Reservoir, Texas, from 1 April through 30 September 2019. Total catch per hour is for anglers targeting Striped Bass and total harvest is the estimated number of Striped Bass harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year
	2019
Surface area (acres)	225
Directed effort (h)	1,582.08 (40)
Directed effort/acre	7.03 (40)
Total catch per hour	0.00 (N/A)
Total harvest	131.16 (298)
Harvest/acre	0.58 (298)
Percent legal released	46

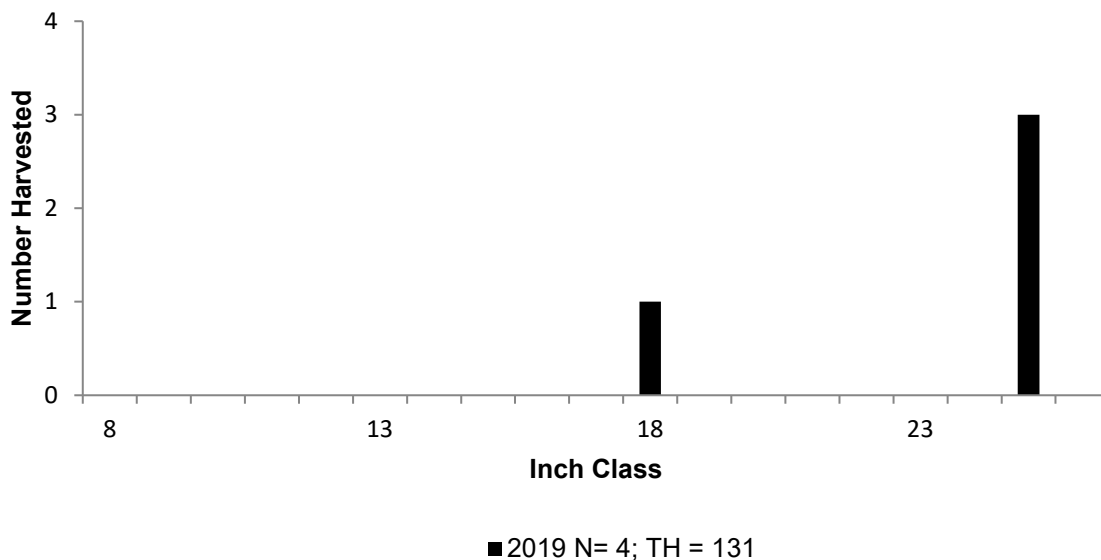


Figure 4. Length frequency of harvested Striped Bass observed during creel surveys at Buffalo Springs Reservoir, Texas, 1 April through 30 September 2019, all anglers combined. N is the number of harvested Striped Bass observed during creel surveys, and TH is the total estimated harvest for the creel period.

Largemouth Bass

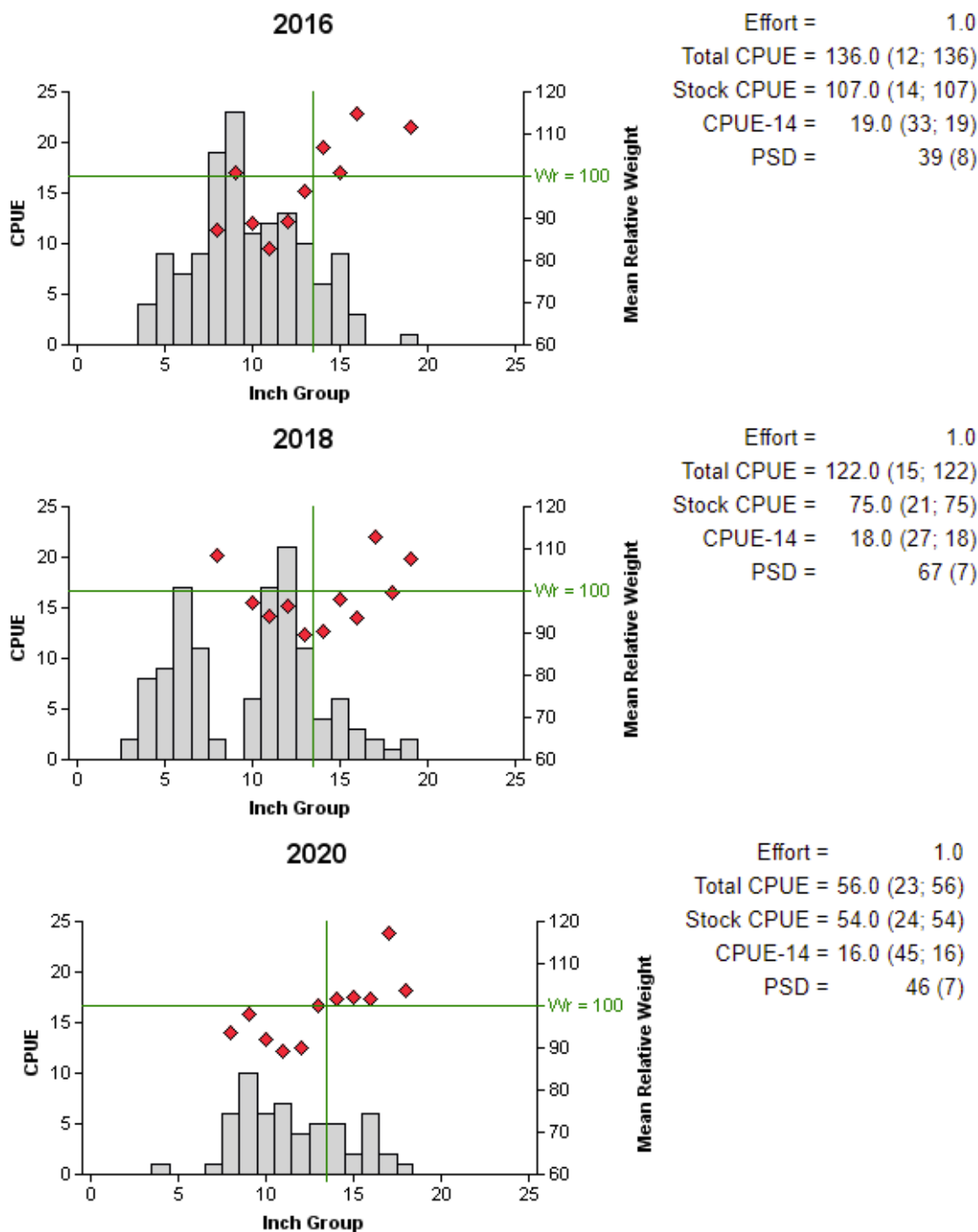


Figure 8. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Buffalo Springs Reservoir, Texas, 2016, 2018, and 2020. Vertical line represents minimum length limit of 14 inches, and horizontal line represents relative weight of 100.

Table 11. Creel survey statistics for Largemouth Bass at Buffalo Springs Reservoir, Texas, from 1 April through 30 September 2019. Total catch per hour 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 Statistics	Year
	2019
Surface area (acres)	225
Directed effort (h)	8,364.09 (21)
Directed effort/acre	37.17 (21)
Total catch per hour	0.26 (56)
Total harvest	16.94 (271)
Harvest/acre	0.08 (271)
Percent legal released	99

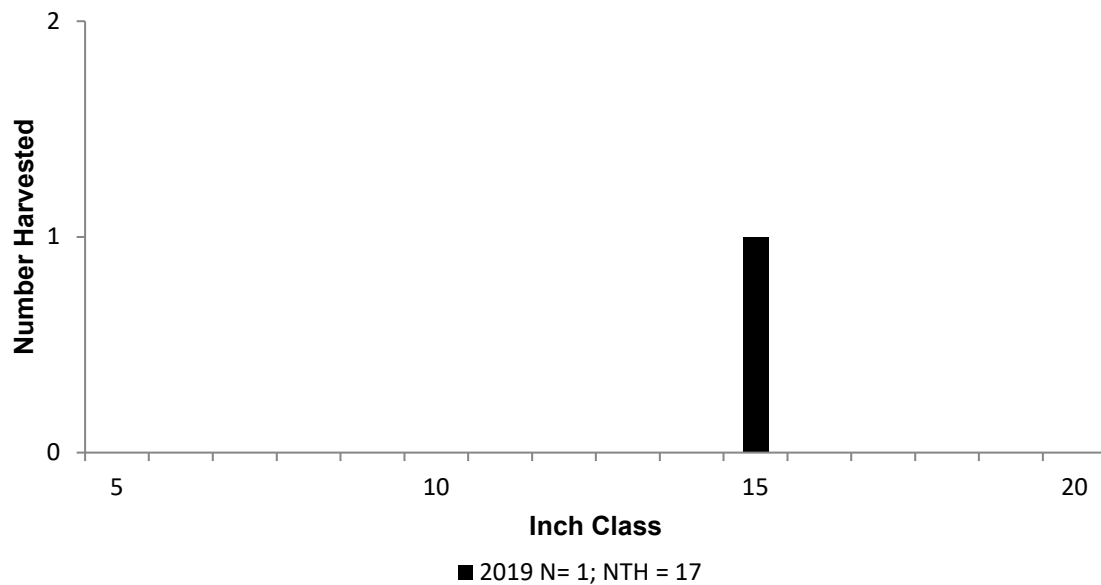


Figure 5. Length frequency of non-tournament harvested Largemouth Bass observed during creel surveys at Buffalo Springs Reservoir, Texas, 1 April through 30 September 2019, all anglers combined. N is the number of harvested Largemouth Bass observed during creel surveys, and NTH is the estimated non-tournament harvest for the creel period.

Table 12. Creel survey statistics for White Crappie at Buffalo Springs Reservoir, Texas, from 1 April through 30 September 2019. 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
	2019
Surface area (acres)	225
Directed effort (h)	9,782.81 (20)
Directed effort/acre	43.48 (20)
Total catch per hour	1.32 (25)
Total harvest	2,877.72 (40)
Harvest/acre	12.79 (40)
Percent legal released	31

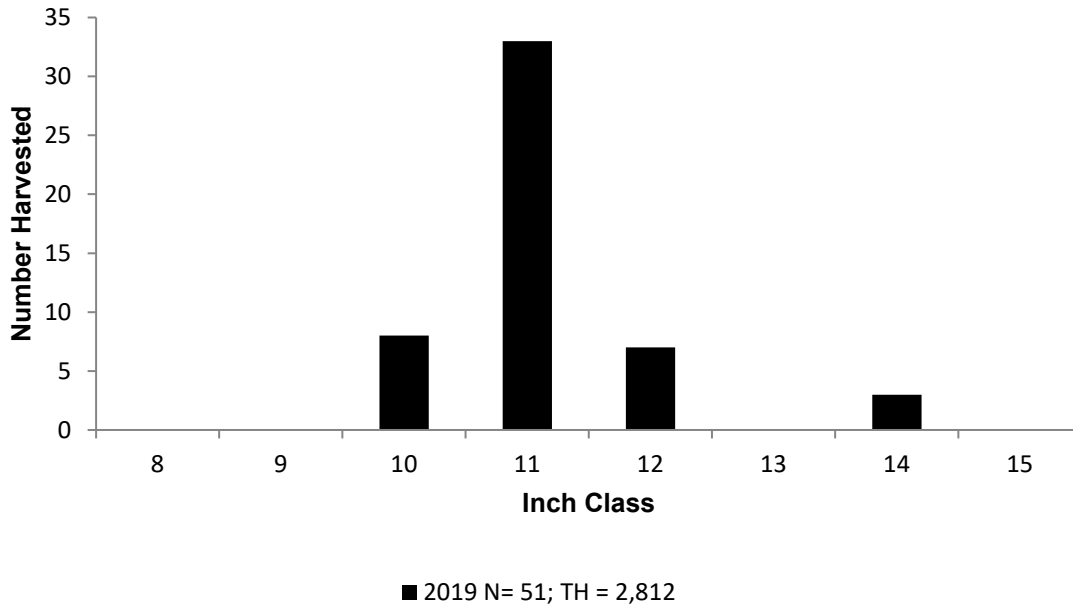


Figure 10. Length frequency of harvested White Crappie observed during creel surveys at Buffalo Springs Reservoir, Texas, 1 April through 30 September 2019, all anglers combined. N is the number of harvested White Crappie observed during creel surveys, and TH is the total estimated harvest for the creel period.

Proposed Sampling Schedule

Table 14. Proposed sampling schedule for Buffalo Springs Reservoir, Texas. Survey period is June through May. Gill netting surveys are conducted in the spring, while electrofishing and trap netting surveys are conducted in the fall.

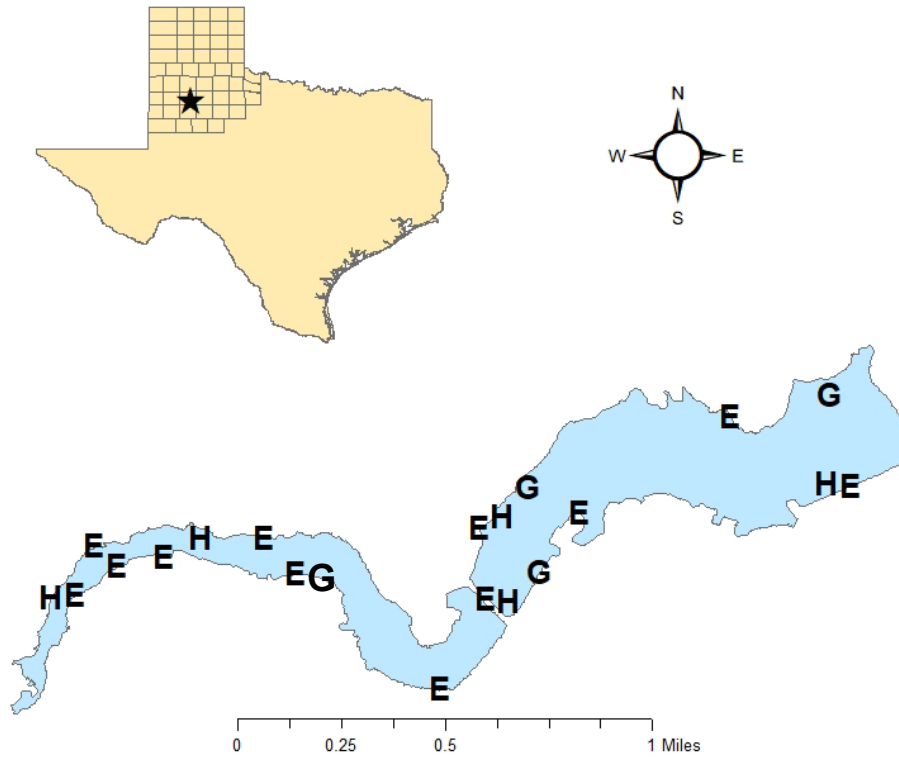
	Survey year			
	2021-2022	2022-2023	2023-2024	2024-2025
Angler Access				X
Structural Habitat				X
Vegetation				X
Electrofishing – Fall		X		X
Electrofishing – Spring				
Electrofishing – Low frequency				
Trap netting				X
Gill netting		X		X
Baited tandem hoop netting				
Creel survey				
Report				X

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

Number (N) and catch rate (CPUE) (RSE in parentheses) of all target species collected from all gear types from Buffalo Springs Reservoir, Texas, 2020-2021. Sampling effort was 4 net nights for gill netting, 5 net nights for baited hoop netting, and 1 hour for electrofishing.

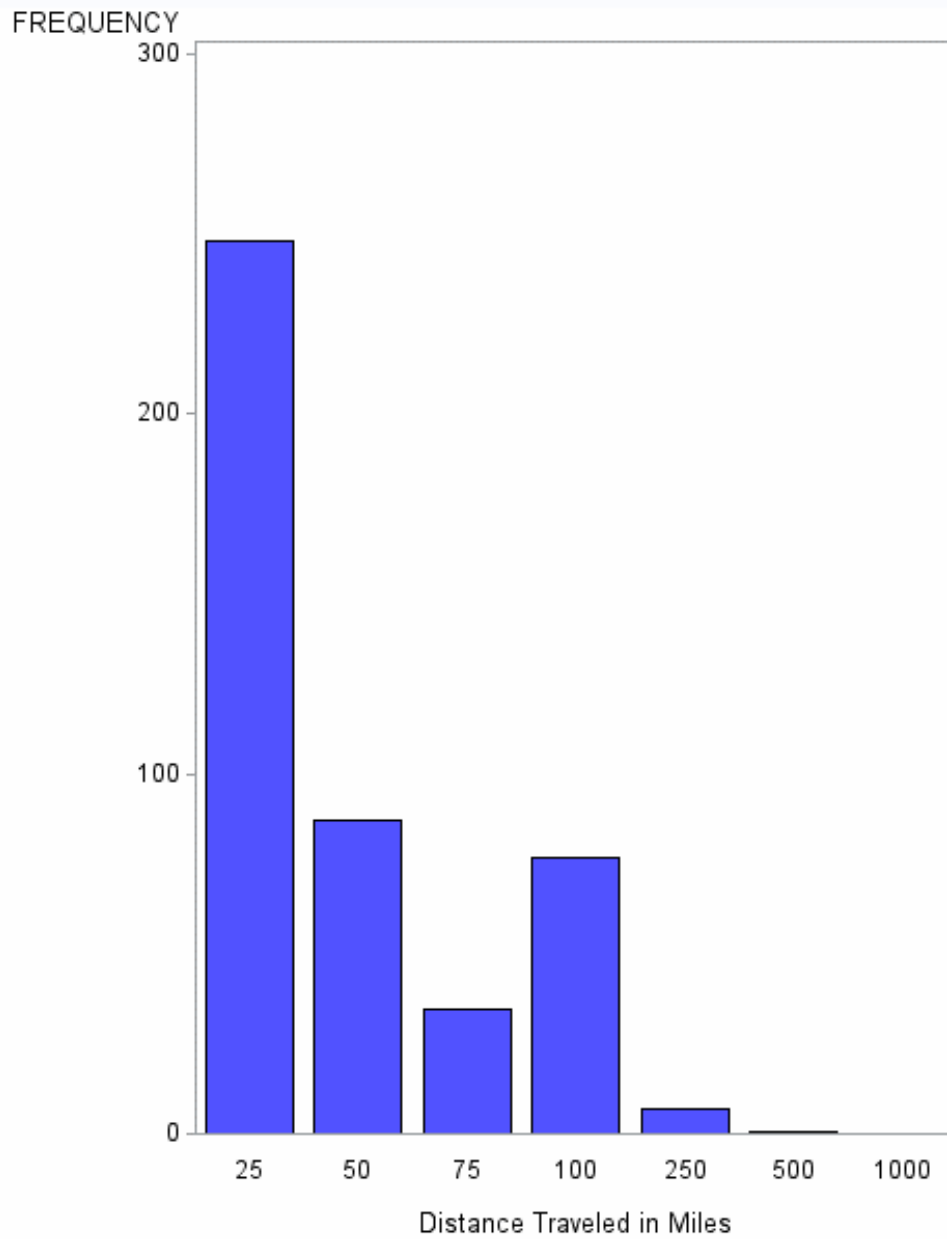
Species	Gill Netting		Hoop Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad	353	88.3 (31)	7	1.4 (36)	445	445.0 (31)
Common Carp	60	15.0 (27)	2	0.4 (61)	170	170.0 (20)
Black Bullhead	21	5.3 (25)	85	17.0 (56)	17	17.0 (31)
Channel Catfish	29	7.3 (38)	31	6.2 (43)	1	1.0 (100)
Striped Bass	79	19.8 (27)				
Green Sunfish			2	0.4 (61)	103	103.0 (34)
Bluegill	10	2.5 (48)	54	10.8 (56)	380	380.0 (20)
Longear sunfish	1	0.3 (100)			56	56.0 (23)
Largemouth Bass	5	1.3 (76)			56	56.0 (23)
White Crappie	17	4.3 (55)	21	4.2 (51)	15	15.0 (28)

APPENDIX B – Map of sampling locations



Location of sampling sites, Buffalo Springs Reservoir, Texas, 2020-2021. Hoop net, gill net, and electrofishing stations are indicated by H, G, and E, respectively. Water level was at full pool at time of sampling.

APPENDIX C – Reporting of creel ZIP code data



Frequency of anglers that traveled various distances (miles) to Buffalo Springs Reservoir, Texas, as determined from the 1 April through 30 September 2019 creel survey.



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