

Benbrook Reservoir

2017 Fisheries Management Survey Report

PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-3

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

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Survey and Management Summary

Fish populations in Benbrook Reservoir were surveyed in 2017 using electrofishing and trap netting and in 2018 using gill netting. Anglers were surveyed from June 2017 through May 2018 with a creel survey. Historical data are presented with the 2017-2018 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: Benbrook Reservoir is a 3,635-acre impoundment located on the Clear Fork of the Trinity River approximately 10 miles southwest of Fort Worth. Water level fluctuates widely in the reservoir from year to year. Benbrook Reservoir has consistently been eutrophic. Habitat consisted of standing timber and rocks.

Management History: Important sport fishes include White Bass, Palmetto Bass, Largemouth Bass, White Crappie, and catfishes. The management plan from the 2014 survey report included stocking Palmetto Bass at 100 fry/acre and 50 fry/acre in alternating years. Efforts to mitigate the loss of fish habitat due to reservoir shoreline development have included planting water willow, cattail, and pickerel weed. However, plantings did not establish due to drastic water level fluctuations. A year-long, 36-day creel survey was conducted from June 2017 through May 2018.

Fish Community

- **Prey species:** Threadfin Shad continued to be very abundant. Electrofishing catch of Gizzard Shad was high and 92% were available as prey. Electrofishing catch of Bluegill and Longear Sunfish was lower than the previous survey.
- **Catfishes:** The catch rate of Blue Catfish increased over the previous two surveys. Condition of Blue Catfish was good. The Channel Catfish population remained similar to previous surveys. Catfishes were the fourth most sought-after species during the creel survey of 2017/2018. Total harvest of Channel Catfish decreased while harvest of Blue Catfish increased.
- **Temperate basses:** White Bass and Palmetto Bass were present in the reservoir. White Bass abundance was much lower than previous surveys. White Bass angling effort decreased. Palmetto Bass abundance continued to decline as fry stockings appear to have been unsuccessful. Directed effort for Palmetto Bass decreased as well.
- **Largemouth Bass:** Total catch of Largemouth Bass increased while catch of stock size fish remained similar. A strong year class appeared in 2017. Condition of Largemouth Bass was good. Florida genetic influence decreased slightly. Largemouth Bass were the most sought-after species during the 2017/2018 creel survey and effort more than doubled.
- **Crappies:** White Crappie abundance decreased while catch of legal-sized fish increased slightly. Mean relative weights of White Crappie were good. Black Crappie abundance increased. Crappies were the second most sought-after species and effort more than doubled. Total harvest of White and Black Crappie increased.

Management Strategies: Stock fingerling Palmetto Bass at 15 fish/acre. Inform the public about the negative impacts of aquatic invasive species. Conduct additional gill netting surveys in 2020, and general monitoring surveys with trap nets, gill nets, and electrofishing surveys in 2021-2022.

Introduction

This document is a summary of fisheries data collected from Benbrook Reservoir in 2017-2018. 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 species of fishes was collected, this report deals primarily with major sport fishes and important prey species. Historical data are presented with the 2017-2018 data for comparison.

Reservoir Description

Benbrook Reservoir is a 3,635-acre impoundment constructed in 1952 on the Clear Fork of the Trinity River. It is located in Tarrant County approximately 10 miles southwest of Fort Worth and is operated and controlled by the United States Army Corps of Engineers (USACE). Benbrook Reservoir has a drainage area of 429 square miles in Tarrant and Parker Counties. Primary water uses included municipal water supply (controlled by Tarrant Regional Water District [TRWD]) and recreation. Benbrook Reservoir was listed as eutrophic with a mean TSI chl-a reading of 61.76, which was slightly higher than the two previous samples (Texas Commission on Environmental Quality 2018). The primary habitat at time of sampling consisted of rocks and standing timber. No aquatic vegetation was observed during the habitat survey. Water level has been highly variable since 1995, and in subsequent years the water level has reached 10 or more feet below conservation pool (Figure 1). Tarrant Regional Water District began drawing more water from Benbrook Reservoir (Clear Fork) for municipal uses in 2005 to reduce the demand on the West Fork of the Trinity River Reservoirs (e.g., Bridgeport, Eagle Mountain, and Worth). Other descriptive characteristics for Benbrook Reservoir are in Table 1.

Angler Access

Benbrook Reservoir has 16 public boat ramps within six public parks, but when water levels drop to approximately 10 feet low, none are useable. Bank fishing access was available at Holiday Park, Mustang Park, Rocky Creek Park, and Longhorn Park. Additional boat ramp characteristics are in Table 2.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Hungerford and Brock 2014) included:

1. Maintain a quality Palmetto Bass fishery through annual stocking.
Action: Palmetto Bass fry were stocked in 2014, 2015, 2016, 2017, and 2018. Gill net surveys were conducted in 2016 and 2018.
2. Request American water-willow from new TPWD aquatic plant nursery site in Athens for test planting in several shoreline areas. If test plots are successful, the strategy will be expanded to other portions of the reservoir.
Action: Planted American water-willow in several shoreline areas in summer of 2013. We also planted some cattail, bulrush, and pickerel weed. Drastic water-level fluctuations occurred and no plants were observed following the extremely high water in 2015.
3. Creel data were last collected in 2000-2001.
Action: A year-long, 36-day creel survey was conducted from June 2017 through May 2018.
4. Communicate with the USACE and TRWD regarding posting of signs educating the public about the spread of aquatic nuisance species. Contact marina operators and emphasize the importance of cleaning, draining, and drying vessels when leaving all reservoirs to reduce risk of spreading zebra mussels.
Action: Signs were distributed to USACE for distribution at public access points. We made a speaking point when talking to the public the importance of cleaning, draining,

and drying vessels prior to launching at other reservoirs. Since Benbrook does receive water from a pipeline connected to two other reservoirs, TRWD was informed of the risk of zebra mussel movement as well.

Harvest regulation history: Sport fishes in Benbrook Reservoir are currently managed with statewide harvest regulations (Table 3).

Stocking history: Benbrook Reservoir has been stocked periodically with Palmetto Bass since the early 1990s and annually since 2002. Threadfin Shad were stocked in 1984, Blue Catfish in 1990, and Florida Largemouth Bass in 2007. The complete stocking history is in Table 4.

Vegetation/habitat management history: Negligible amounts of American water-willow were observed during the summer of 2017. No aquatic vegetation was observed in Benbrook Reservoir during the 2009 habitat survey. Historically, native emergent aquatic vegetation (cattail and American water-willow) was observed (Brock 2002). Drastic water level fluctuations since 1995 are likely the cause for their disappearance.

Water transfer: Benbrook Reservoir is primarily used for municipal water supply, recreation, and to a lesser extent, flood control. There is currently one permanent pumping station on the reservoir which connects to a raw water treatment plant for municipal use. There is also an outfall from a pipeline operated by TRWD that transfers water to Benbrook Reservoir from Richland Chambers and Cedar Creek Reservoirs in East Texas. According to TRWD staff, the water is mixed with approximately 66.7% Richland Chambers water and 33.3% from Cedar Creek.

Methods

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Benbrook 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 2015).

Electrofishing – Largemouth Bass, sunfishes, Gizzard Shad, and Threadfin 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.

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 – Channel Catfish, White Bass, and Palmetto Bass were collected by gill netting (5 net nights at 5 stations). CPUE for gill netting was recorded as the number of fish caught per net night (fish/nn). Ages were determined using otoliths for all Palmetto Bass collected.

Genetics – Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015). Micro-satellite DNA analysis was used to determine genetic composition of individual fish from 2005 through 2012 and by electrophoresis for previous years.

Statistics – Sampling statistics (CPUE for various length categories), structural indices [Proportional Size Distribution (PSD), terminology modified by Guy et al. 2007], and condition indices [relative weight (W_r)] were calculated for target fishes according to Anderson and Neumann (1996). Palmetto Bass PSD was calculated according to Dumont and Neely (2011). 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 – A year-long, access-point creel survey was conducted from 2017-2018. The creel period was June through May. 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 2015).

Habitat – A structural habitat survey was last conducted in 2009. Habitat was assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Water level – Source for water level data was the United States Geological Survey (USGS 2018) and from the Tarrant Regional Water District.

Results and Discussion

Habitat: The last structural habitat survey was conducted in 2009 and littoral zone habitat consisted primarily of natural shoreline and standing timber (Hungerford and Brock 2010). Large water level fluctuations beginning in 1995 have been detrimental to the littoral habitat in Benbrook Reservoir. Native emergent vegetation (cattail and American water-willow) was present prior to drastic water level fluctuations (Brock 2002).

Creel: Directed fishing effort by anglers was highest for Largemouth Bass (36%), followed by anglers fishing for Crappies and anything (Table 6). Total fishing effort for all species and direct expenditures at Benbrook Reservoir decreased slightly since 2000/2001 (Table 7).

Prey species: Electrofishing catch rates of Bluegill and Gizzard Shad were 172.0/h and 372.0/h, respectively. Index of Vulnerability (IOV) for Gizzard Shad was good, indicating that 92% of Gizzard

Shad were available to existing predators; this was higher than IOV estimates in previous years (Figure 2). Total CPUE of Threadfin Shad was very high (1,020.0/h) during the 2017 survey (Appendix A). Total CPUE of Bluegill (172.0/h) in 2017 was lower than total CPUE from surveys in 2010 and 2013, and size structure appeared to shift slightly towards larger individuals (Figure 3).

Catfishes: The gill net catch rate of Blue Catfish was 9.6/nn in 2017, which is higher than the previous two surveys (Figure 4.) All Blue Catfish collected were above 12 inches and mean relative weight was between 90 and 110. No directed angling effort was documented for Blue Catfish during the 2017/2018 creel survey, but total harvest was estimated to be 494 (Figure 5). The gill net catch rate of Channel Catfish was 3.2/nn in 2017. The Channel Catfish population continued to have low relative abundance with a slight increase in the size structure as compared to the 2014 and 2016 surveys (Figure 6). Directed angling effort for catfishes increased as compared to the 2000/2001 creel survey (Table 8). Total harvest of Channel Catfish was estimated at 161 and all fish observed were ≥ 12 inches (Figure 7).

White Bass: Only two White Bass were collected in the 2018 gill net survey (CPUE= 0.4/nn). Catch rates of White Bass decreased from the previous two surveys (Figure 8). Objectives stated in the sampling plan were not achieved. Effort required to obtain objectives would have been unrealistic. Directed angling effort for White Bass decreased from 9,379 h in 2000/2001 to 1,551 h in 2017/2018 (Table 9). Total harvest of White Bass also decreased sharply since the 2000/2001 survey and all fish observed in the creel were ≥ 10 inches (Figure 9).

Palmetto Bass: No Palmetto Bass were collected during the 2018 gill netting survey. Only 5 were collected in the 2016 survey (Figure 10). Fry have been stocked annually since 2013, and this stocking strategy has resulted in reduced abundance. Several factors may be responsible for the fry stockings failure, including poor survival of fry in bags and predation by Yellow Bass (Appendix C). Since no Palmetto Bass were collected in 2018, we reached out to Benbrook anglers on our District Facebook page for reports and photos of any Palmetto Bass caught. We received some with fish from 12 to 16 inches, which based on previous growth data, should be within the range of fry-only stockings. Objectives from the sampling plan were not met and since we could not collect any Palmetto Bass, the effort required to obtain them was deemed unrealistic. A single 10-year old Palmetto Bass was collected in the 2016 gill net survey (Figure 11). Directed fishing effort for Palmetto Bass was 856 h for 2017/2018, a sharp decrease from the 2000/2001 survey (Table 10). Given the decline in the Palmetto Bass population, this is not a surprise. No harvest of Palmetto Bass was documented in 2017/2018 (Figure 12).

Largemouth Bass: The electrofishing catch rate of stock-length Largemouth Bass was 34.0/h in 2018, which is similar to the 35.0/h in 2013. Size structure in 2018 indicated a strong year class with an abundance of 6-to-8-inch fish (Figure 13). Body condition in 2017 was good (mean relative weights between 90 and 110) for nearly all size classes of fish and was higher than in previous surveys (Figure 13). Directed fishing effort for Largemouth bass was 5.4 h/acre, which is an increase since the 2000/2001 creel survey (Table 11). Some tournament effort was also documented. Total non-tournament harvest was estimated at 21 and all fish observed were ≥ 14 inches (Figure 14). Florida Largemouth Bass influence has remained relatively constant as Florida alleles have ranged from 55 to 63% since 2009 (Table 12).

Crappies: The trap net catch rate of White Crappie was 13.8/nn in 2017, slightly lower than in 2013 (17.2/nn) and similar to 2009 (11.0/nn). Catch per unit effort of White Crappie over 10 inches (i.e., legal to harvest) was 5.8/nn in 2017 which was a slight increase over the previous two surveys (Figure 15). The PSD was 75 which was lower than both the 2009 and 2013 surveys. Mean relative weight was over 90 for all size classes in 2017 and was similar to values observed in 2013 and 2009 (Figure 15). Total directed effort for crappies was nearly double that of the 2000/2001 survey (Table 13). Total harvest of White Crappie was 5,915 in 2017/2018 and all fish observed were ≥ 10 inches (Figure 16). The trap net catch rate of Black Crappie was 3.8/nn in 2017, slightly higher than the two previous surveys (Figure 17). Mean relative weight was between 85 and 95. Total harvest of Black Crappie was estimated to be 1,211 fish (Table 14) with all Black Crappie observed in the creel being ≥ 10 inches (Figure 18).

Fisheries Management Plan for Benbrook Reservoir, Texas

Prepared – July 2018

ISSUE 1: Palmetto Bass have been a part of the fishery at Benbrook Reservoir since the late 1970s. Annual stocking of Palmetto Bass is required to sustain the population and maintain a fishery. The annual fry stockings of Palmetto Bass do not appear to have been very successful since 2013 as very few were observed during the 2016 and 2018 gill net surveys.

MANAGEMENT STRATEGIES

1. Stock Palmetto Bass fingerlings annually at 15 fish/acre.
2. Monitor Palmetto Bass stockings through gill netting every other year. An additional 5 net nights will be conducted in 2020 and 2022 (10 net nights per survey).

ISSUE 2: Many invasive species threaten aquatic habitats and organisms in Texas and can adversely affect the state ecologically, environmentally, and economically. For example, zebra mussels (*Dreissena polymorpha*) can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches, and plugging engine cooling systems. Giant salvinia (*Salvinia molesta*) and other invasive vegetation species can form dense mats, interfering with recreational activities like fishing, boating, skiing, and swimming. The financial costs of controlling and/or eradicating these types of invasive species are significant. Additionally, the potential for invasive species to spread to other river drainages and reservoirs via watercraft and other means is a serious threat to all public waters of the state.

MANAGEMENT STRATEGIES

1. Cooperate with the USACE 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 (2019–2022)

Sport fish, forage fish, and other important fishes

Important sport fishes in Benbrook Reservoir include Largemouth Bass, Channel and Blue Catfish, White Bass, Hybrid Striped Bass and White Crappie. Known important forage species include Bluegill, Longear Sunfish, and Threadfin and Gizzard Shad.

Low density fisheries

Flathead Catfish: Flathead Catfish are present in Benbrook Reservoir; but, they are rarely captured in gill nets. Only one individual specimen has been collected since 2010. Sampling this population is not a priority moving forward. Data on CPUE and size structure will be recorded from all Flathead Catfish collected by gill nets targeting Palmetto Bass, White Bass and Blue and Channel Catfish.

Survey objectives, fisheries metrics, and sampling objectives

Catfishes: The popularity of catfish fishing at this reservoir warrant sampling time and effort. A gillnet survey consisting of 10 gillnet net nights at 10 randomly selected stations will be conducted in spring of 2020 and 2022 to determine CPUE and size structure of Channel and Blue Catfish. Based on past catch rates, this should be adequate to obtain an RSE of $CPUE-S \leq 25$ for Blue Catfish (not Channel Catfish) but not adequate to obtain confidence in size structure (PSD; 50 fish minimum at 10 stations with 80% confidence). If RSE objectives are not met no additional gillnetting will be conducted. No objective will be set for size structure information.

Temperate Basses: Data on White Bass will be collected when the gillnet survey is conducted in the spring of 2020 and 2022 using 10 gillnet net nights at 10 randomly selected stations throughout Benbrook Reservoir. Sampling will be limited to general monitoring trend data (without precision or sample size requirements). This should give an idea of the population status when compared to past surveys. Palmetto Bass are a popular sport fish in Benbrook Reservoir, thus fry stockings have occurred annually since 2013. As with White Bass, data on Palmetto Bass will be collected when the gillnet survey is conducted in the spring of 2020 and 2022. Target sample sizes to evaluate size structure, stocking success, and age and growth for Palmetto Bass will be 30 stock-length fish. If 30 fish are not collected to provide adequate confidence in size structure (PSD; 30 fish minimum at 10 stations with 80% confidence), no additional gill netting (beyond the 10 nets) will be conducted. Additional fish will be collected via angling or with assistance from a fishing guide until the target number of fish are obtained (only to be used for age and growth data). If collection of 30 fish becomes difficult, sampling via angling will cease once a reasonable effort has been expended.

Largemouth Bass: Trend data on CPUE, size structure, and body condition have been collected frequently for over two decades with fall nighttime electrofishing. To continue monitoring of Largemouth Bass, fall nighttime electrofishing will be conducted. A minimum of 12 randomly selected 5-min electrofishing sites will be sampled in 2021. Based on past catch rates, this should be adequate to obtain an RSE of $CPUE-S \leq 25$ (the anticipated effort to meet both sampling objectives is 12 stations with 80% confidence). If the RSE objective is not met, additional electrofishing sampling will only continue if 35 stocked sized fish or larger are not captured in the 12 sample sites. A maximum of 18 sites will be sampled. Fin clips from 30 Largemouth Bass (of all sizes) will be collected in 2021 to assess Florida Largemouth Bass stockings.

Crappie: Trend data on Crappie CPUE, size structure, and body condition will be collected using 5 shoreline-set single-cod trap nets at 5 randomly selected locations in fall of 2021. This level of effort

should be sufficient to collect 50 stock size fish for size structure estimation. Based on past surveys, it is unlikely an RSE of CPUE-S < 25 will be met and no objectives will be set for precision of CPUE estimates. No additional sampling will be conducted if objectives are not met in 5 trap net sets.

Bluegill, Longear Sunfish, and Threadfin and Gizzard Shad: Bluegill, Longear Sunfish, and Threadfin, and Gizzard Shad are the primary forage in Benbrook Reservoir. Like Largemouth Bass, trend data on CPUE and size structure have been collected with fall nighttime electrofishing. Sampling, as with Largemouth Bass above, will allow for monitoring of large-scale changes in Bluegill, Longear Sunfish, and Threadfin and Gizzard Shad relative abundance and size structure. Sampling effort based on achieving sampling objectives for Largemouth Bass will result in sufficient numbers of Bluegill, Longear Sunfish, Threadfin and Gizzard Shad for size structure estimation (PSD and IOV; 50 fish minimum at 12 stations with 80% confidence).

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Tables and Figures

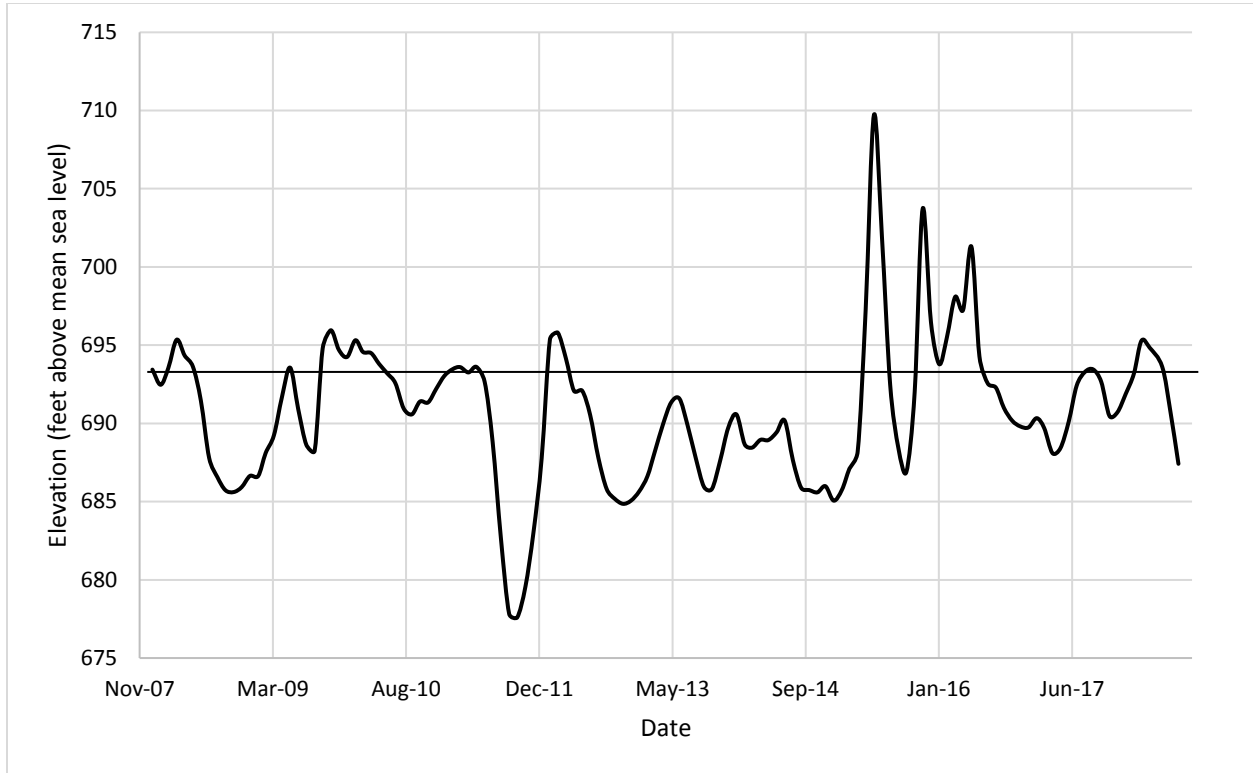


Figure 1. Monthly water level elevations in feet above mean sea level (MSL) recorded for Benbrook Reservoir, Texas. Conservation pool is 694 ft. MSL.

Table 1. Characteristics of Benbrook Reservoir, Texas.

Characteristic	Description
Year constructed	1952
Controlling authority	U.S. Army Corps of Engineers
County	Tarrant
Reservoir type	Mainstream
Shoreline Development Index	4.48
Conductivity	320 $\mu\text{S}/\text{cm}$

Table 2. Boat ramp characteristics for Benbrook Reservoir, Texas, Fall 2013. Reservoir elevation at time of survey was 689.1 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Benbrook Marina	32.65592 -97.47547	Y	75	688.0	Good.
North Holiday Park (Hobie Point)	32.65239 -97.47014	Y	25	685.0	Good.
North Holiday Park (Swimming Beach)	32.64272 -97.47086	Y	25	691.0	Poor slope.
North Holiday Park (Mercer Day Use)	32.63153 -97.47772	Y	25	685.0	Poor slope.
Holiday Park (Mercer Camping)	32.62928 -97.48100	Y	15	688.0	Poor slope. Only open to campers.
Holiday Park (Holiday Camping)	32.62364 -97.48497	Y	15	691.0	Good. Only open to campers.
Holiday Park (Double Ramp)	32.61644 -97.49547	Y	20	687.0	Good.
Bear Creek Campground (Bear Creek Ramp)	32.60347 -97.49881	Y	10	688.0	Poor slope. Only open to campers.
Bear Creek Campground (Double Ramp)	32.61167 -97.48847	Y	10	689.0	Good. Only open to campers.
Mustang Park (Mustang Creek)	32.60728 -97.47253	Y	10	690.0	Poor slope.
Mustang Park (Mustang Point)	32.61039 -97.47056	Y	40	682.0	Good.
Longhorn Park	32.64711 -97.44630	Y	11	689.0	Good.
Rocky Creek Park (Double Ramp)	32.60233 -97.45958	Y	25	689.0	Poor slope.
Rocky Creek Park (South Creek)	32.59458 -97.45347	Y	15	690.0	Poor slope.

Table 3. Harvest regulations for Benbrook 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, Palmetto	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 Benbrook Reservoir, Texas. Life stages are fry (FRY), fingerlings (FGL), advanced fingerlings (AFGL), and unknown (UNK). Life stages for each species are defined as having a mean length that falls within the given length range.

Year	Number	Size	Year	Number	Size
<u>Threadfin Shad</u>			<u>Palmetto Bass</u>		
1984	1,000	AFGL	1978	19,980	UNK
<u>Blue Catfish</u>			1979	38,190	UNK
1990	38,246	FGL	1982	30,000	UNK
1991	37,446	FGL	1991	59,600	FRY
Species Total	75,692		1992	30,126	FGL
<u>Channel Catfish</u>			1994	57,133	FGL
1970	15,000	AFGL	1995	97,887	FGL
1972	9,374	AFGL	1996	59,212	FGL
Species Total	23,374		1997	57,000	FGL
<u>Florida Largemouth Bass</u>			1998	57,423	FGL
1974	20,800	FGL	1999	32,244	FGL
1974	48,000	FRY	2002	18,954	FGL
1976	180,000	FRY	2003	33,760	FGL
1992	38,271	FGL	2004	38,050	FGL
1992	151,318	FRY	2005	54,628	FGL
1997	190,546	FGL	2006	36,336	FGL
2002	181,438	FGL	2008	26,209	FGL
2007	182,472	FGL	2009	27,847	FGL
2018	66,216	FGL	2011	44,990	FGL
Species Total	1,089,061		2013	363,501	FRY
<u>Largemouth Bass</u>			2014	181,760	FRY
1968	115,000	UNK	2015	326,594	FRY
1969	98,000	UNK	2016	181,902	FRY
Species Total	213,000		2017	718,240	FRY
			2018	380,000	FRY
			Species Total	2,971,566	

Table 5. Objective-based sampling plan components for Benbrook Reservoir, Texas 2017–2018.

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing</i>			
Largemouth Bass	Abundance	CPUE – stock	RSE-Stock \leq 25
	Size structure	PSD, length frequency	N \geq 50 stock
	Condition	W_r	10 fish/inch group (max)
	Genetics	% FLMB	N = 30, any age
Bluegill ^a	Abundance	CPUE – Total	RSE \leq 25
	Size structure	PSD, length frequency	N \geq 50
Gizzard Shad ^a	Abundance	CPUE – Total	RSE \leq 25
	Size structure	PSD, length frequency	N \geq 50
<i>Trap netting</i>			
Crappie	Size structure	PSD, length frequency	N = 50
<i>Gill netting</i>			
Blue Catfish	Abundance	CPUE	N \geq 50
	Size structure		N \geq 50 stock
Channel Catfish ^b	Abundance	CPUE– stock	RSE-Stock \leq 25
White Bass	Abundance	CPUE-stock	N \geq 50
	Size structure	PSD, length frequency	N \geq 50 stock
Palmetto Bass ^b	Abundance	CPUE-total	N \geq 25
	Size structure	PSD, length frequency	N \geq 25
	Age-and-growth	Length at age	All fish collected

^a No additional effort will be expended to achieve an RSE \leq 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.

^bNo additional effort will be expended to achieve an RSE \leq 25 for CPUE of Channel Catfish if not reached from designated Palmetto Bass and Blue Catfish sampling effort.

Table 6. Percent directed angler effort by species for Benbrook Reservoir, Texas, 2000/2001 and 2017/2018. Survey period was from 1 June through 31 May.

Species	2000/2001	2017/2018
Catfishes	13.4	10.3
White Bass	18.2	3.7
Palmetto Bass	11.9	2.1
Largemouth Bass	15.8	36.0
Crappies	9.3	23.0
Anything	25.8	12.8

Table 7. Total fishing effort (h) for all species and total directed expenditures at Benbrook Reservoir, Texas, 2000-2001 and 2017-2018. Survey periods were from 1 June through 31 May. Relative standard error is in parentheses.

Creel statistic	2000/2001	2017/2018
Total fishing effort	51,660 (11)	41,663 (19)
Total directed expenditures	\$204,832 (49)	\$170,264 (37)

Gizzard Shad

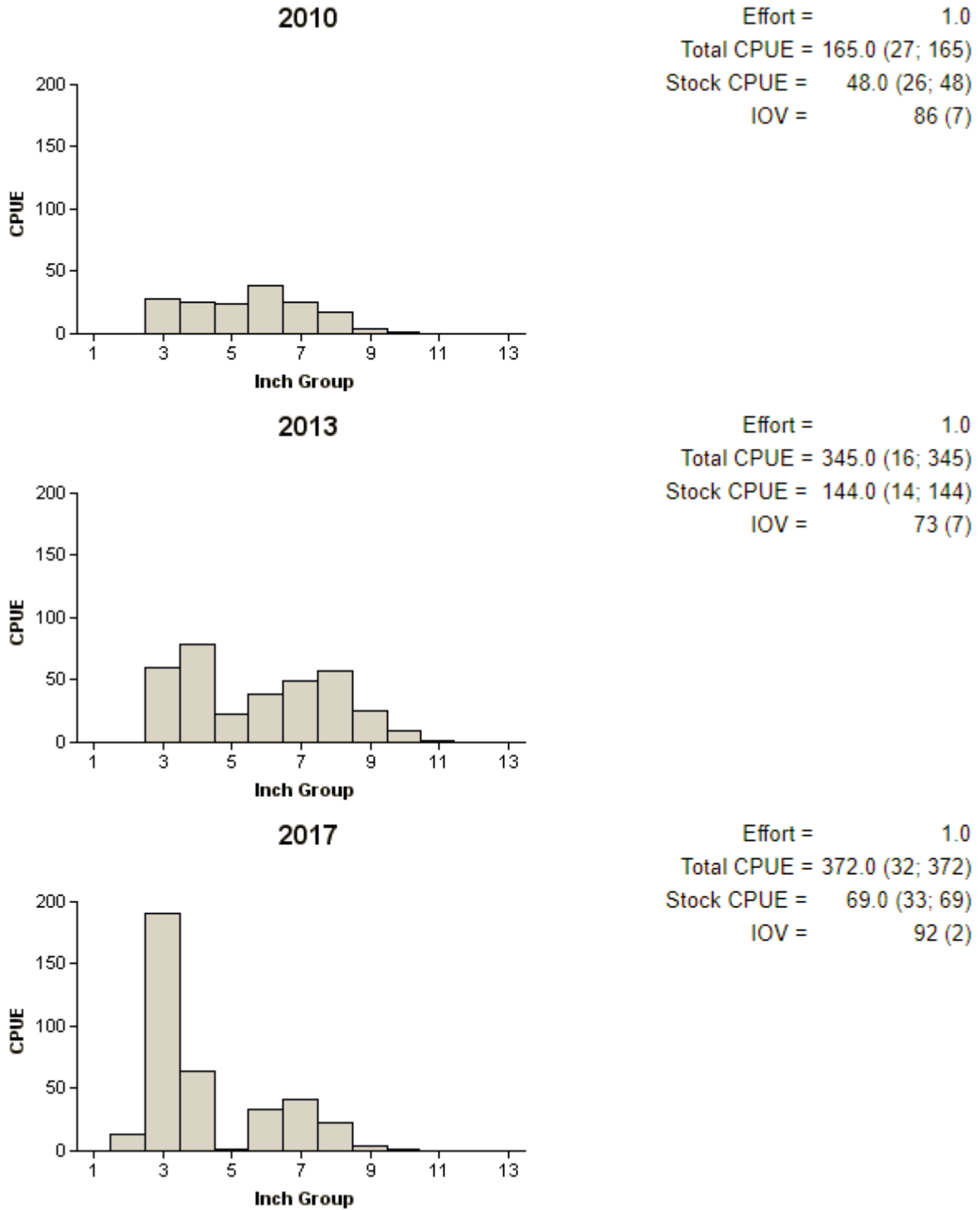


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Benbrook Reservoir, Texas, 2010, 2013, and 2017.

Bluegill

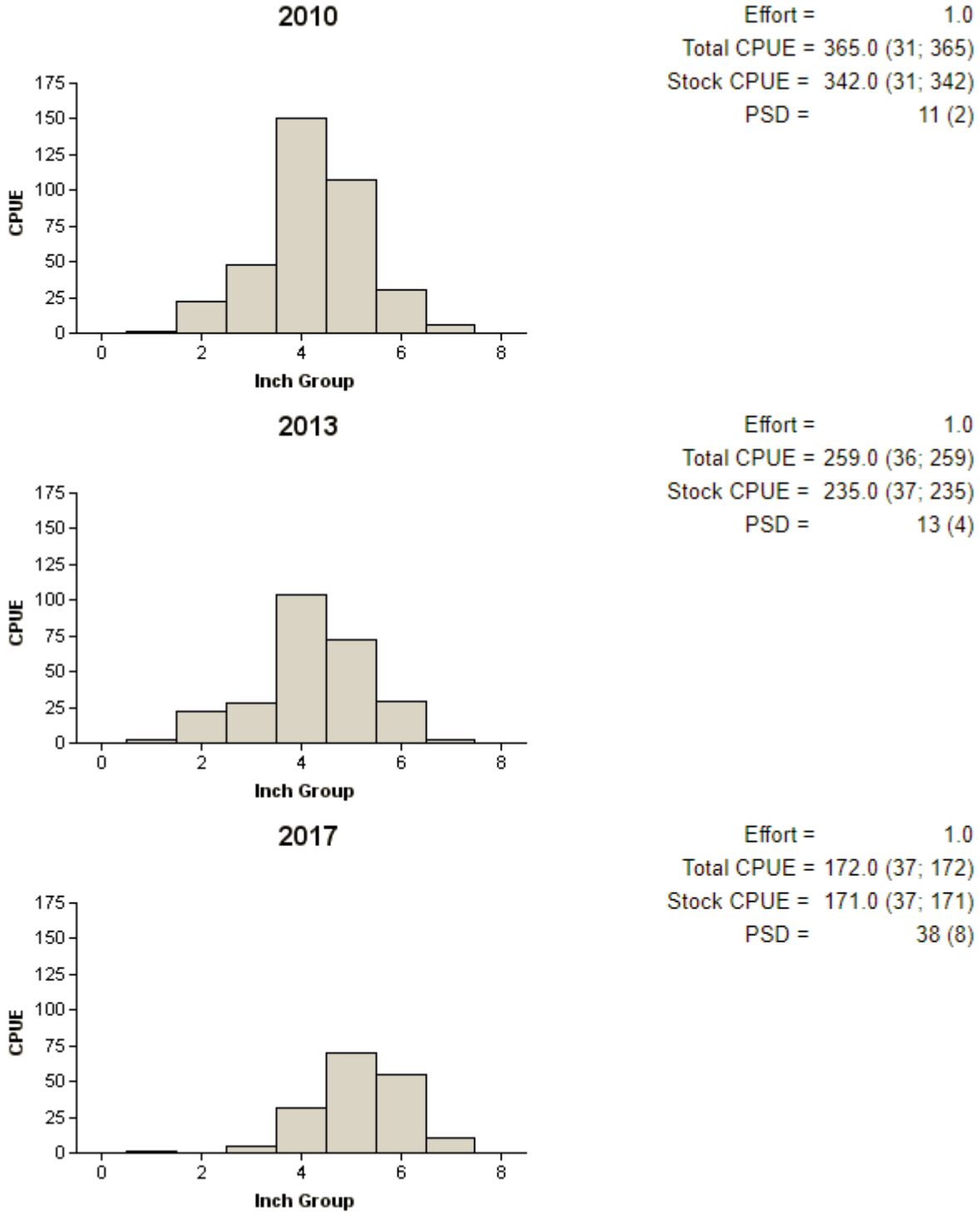


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Benbrook Reservoir, Texas, 2010, 2013, and 2017.

Blue Catfish

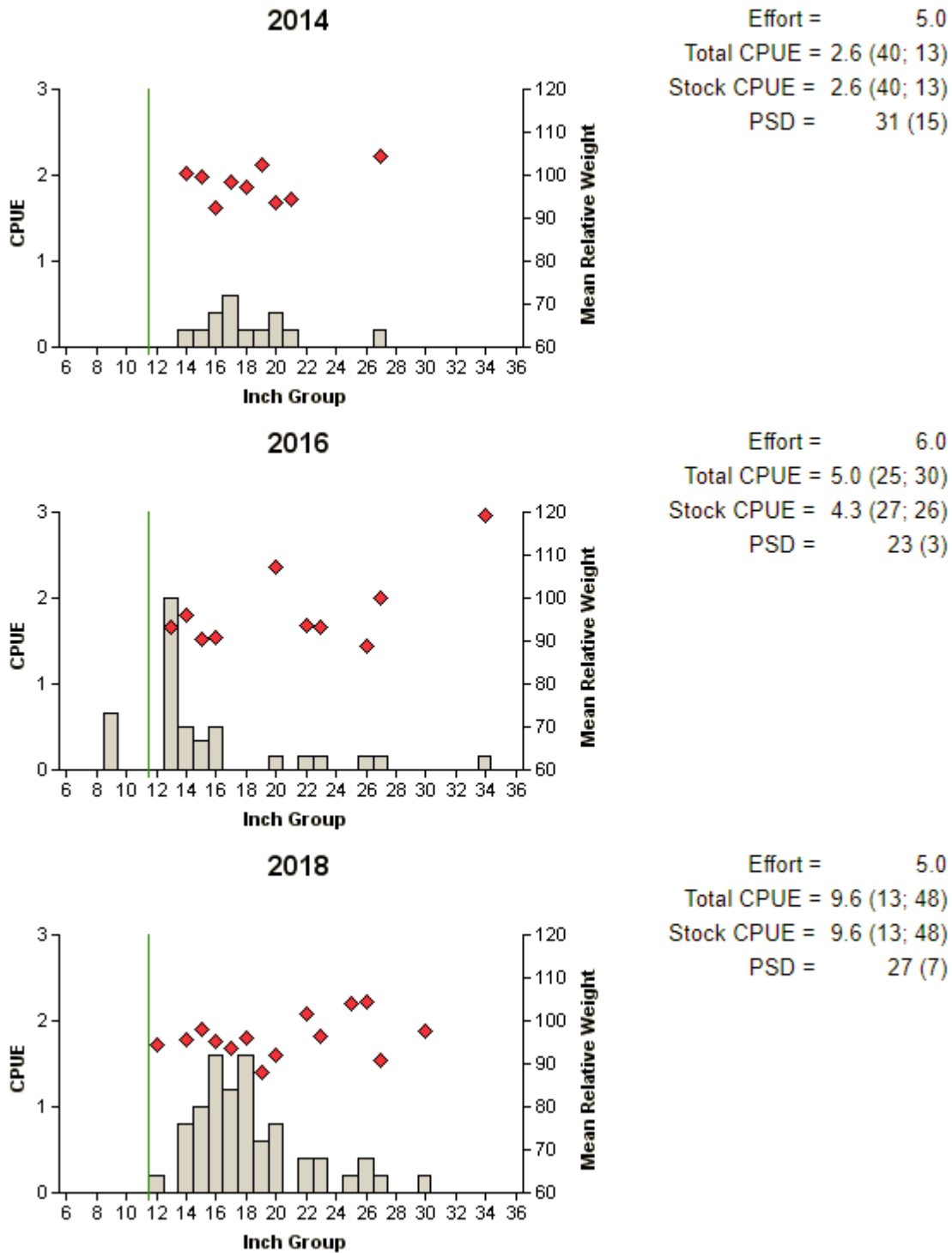


Figure 4. Number of Blue Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Benbrook Reservoir, Texas, 2014, 2016, and 2018. Solid vertical lines indicate minimum length limit at time of sampling.

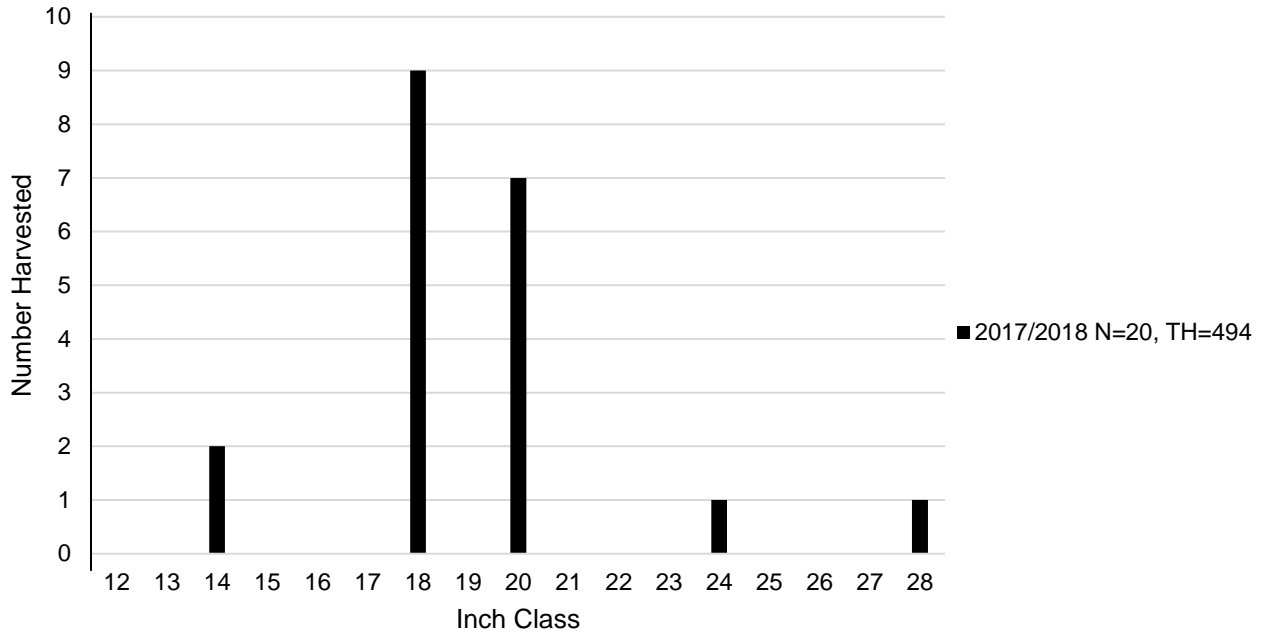


Figure 5. Length frequency of harvested Blue Catfish observed during creel surveys at Benbrook Reservoir, Texas, June 2017 through May 2018, all anglers combined. No harvest of Blue Catfish was recorded in the 2000/2001 creel survey. N is the number of harvested Blue Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period. Solid vertical line indicates minimum length limit at time of sampling.

Channel Catfish

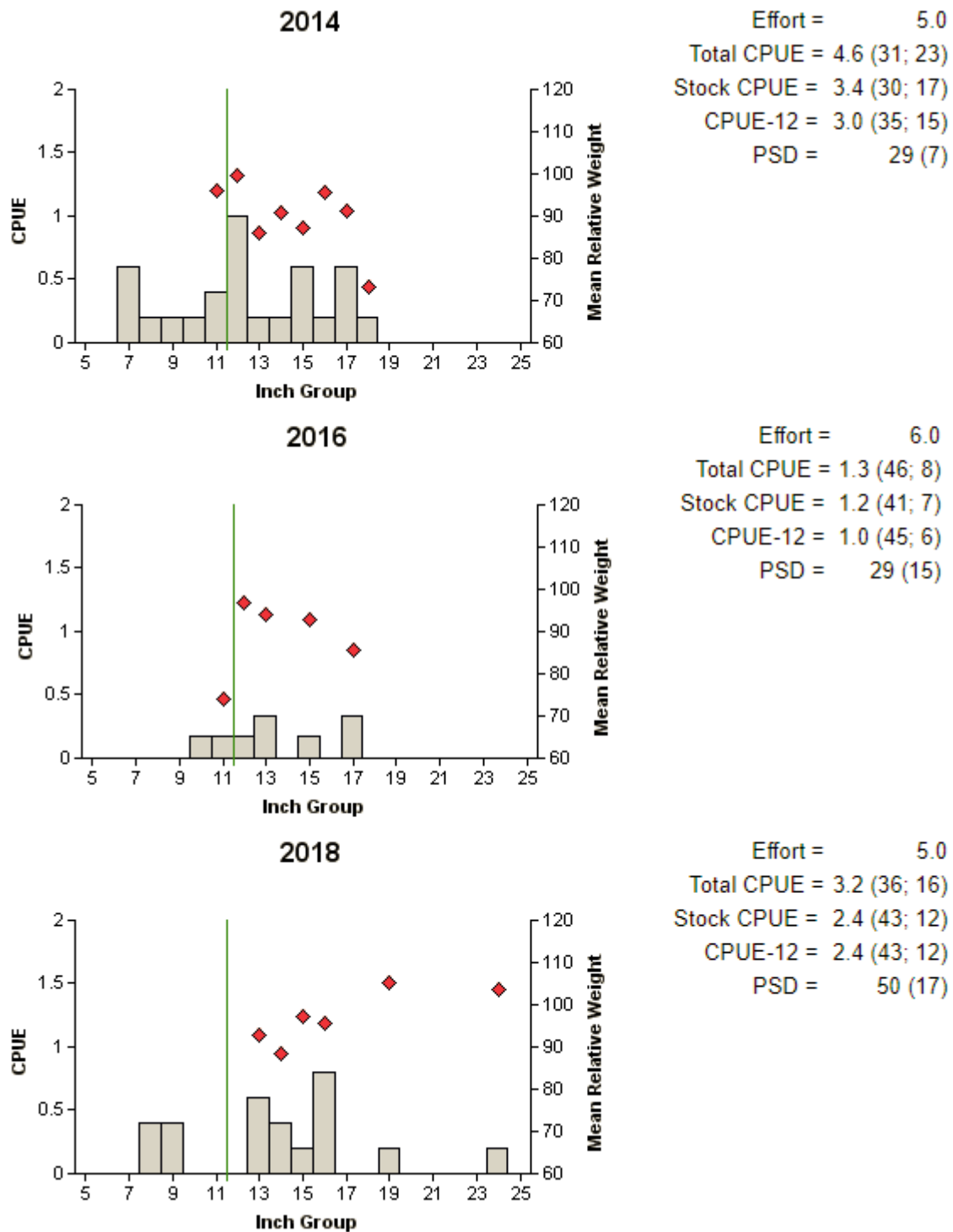


Figure 6. Number of Channel Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Benbrook Reservoir, Texas, 2014, 2016, and 2018. Solid vertical lines indicate minimum length limit at time of sampling.

Table 8. Creel survey statistics for Catfishes at Benbrook Reservoir, Texas, from June 2000 through May 2001 and from June 2017 through May 2018. Total catch per hour is for anglers targeting Catfishes 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	
	2000/2001	2017/2018
Surface area (acres)	3,635	3,635
Directed effort (h)	2,327 (56)	4,281 (33)
Directed effort/acre	0.68 (56)	1.18 (33)
Total catch per hour	0.40 (128)	0.20 (88)
Total harvest	1246 (9) ^a	144 (155) ^a 494 (104) ^b
Harvest/acre	0.34 (9) ^a	0.04 (155) ^a 0.14 (104) ^b
Percent legal released	19.8 ^a	52.9 ^a 0.0 ^b

^aChannel Catfish

^bBlue Catfish

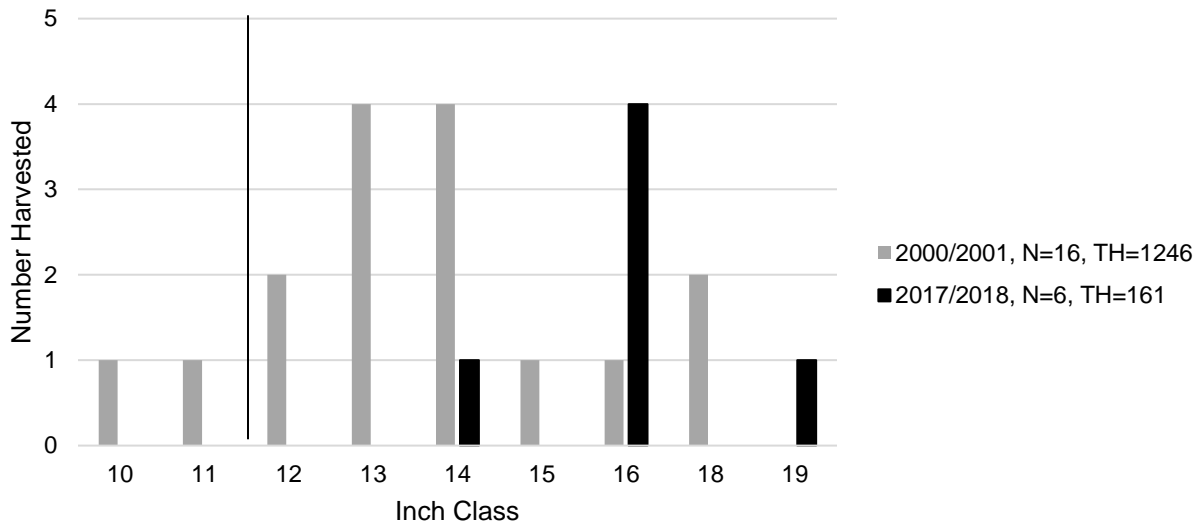


Figure 7. Length frequency of harvested Channel Catfish observed during creel surveys at Benbrook Reservoir, Texas, June 2000 through May 2001 and June 2017 through May 2018, all anglers combined. N is the number of harvested Channel Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period. Solid vertical line indicates minimum length limit at time of sampling.

White Bass

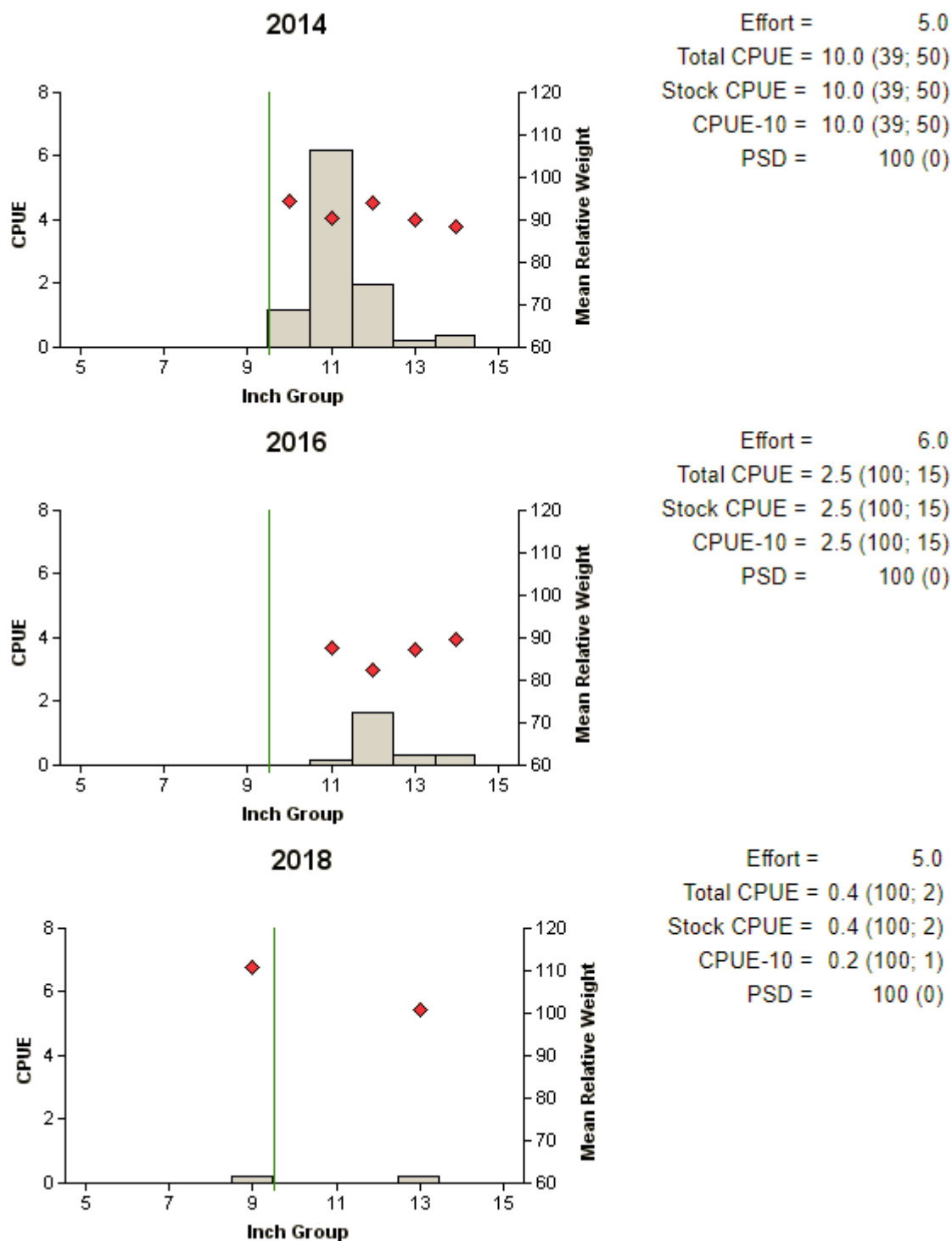


Figure 8. Number of White Bass caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Benbrook Reservoir, Texas, 2014, 2016, and 2018. Solid vertical lines indicate minimum length limit at time of sampling.

Table 9. Creel survey statistics for White Bass at Benbrook Reservoir, Texas, from June 2017 through May 2018. Total catch per hour is for anglers targeting White Bass and total harvest is the estimated number of White Bass harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year	
	2000/2001	2017/2018
Surface area (acres)	3,635	3,635
Directed effort (h)	9,379.13 (32)	1,550.51 (44)
Directed effort/acre	2.58 (32)	0.43 (44)
Total catch per hour	0.80 (47)	0.00 (N/A)
Total harvest	6,868 (54)	251 (128)
Harvest/acre	1.89 (54)	0.07 (128)
Percent legal released	11.3	22.1

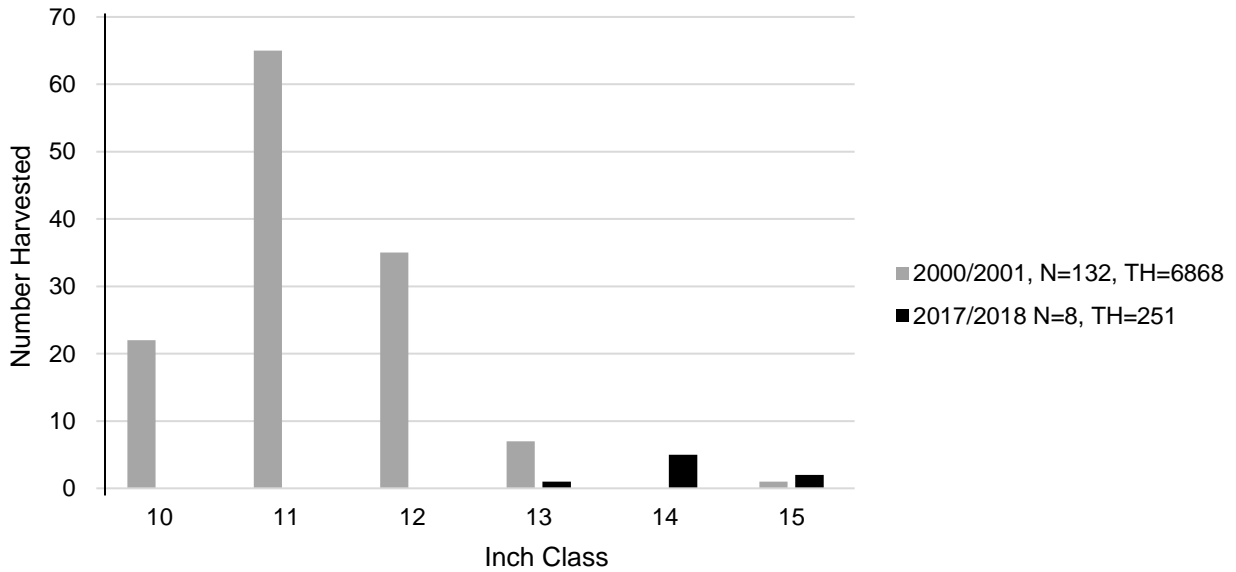


Figure 9. Length frequency of harvested White Bass observed during creel surveys at Benbrook Reservoir, Texas, June 2000 through May 2001 and June 2017 through May 2018, all anglers combined. N is the number of harvested White Bass observed during creel surveys, and TH is the total estimated harvest for the creel period. Solid vertical line indicates minimum length limit at time of sampling.

Palmetto Bass

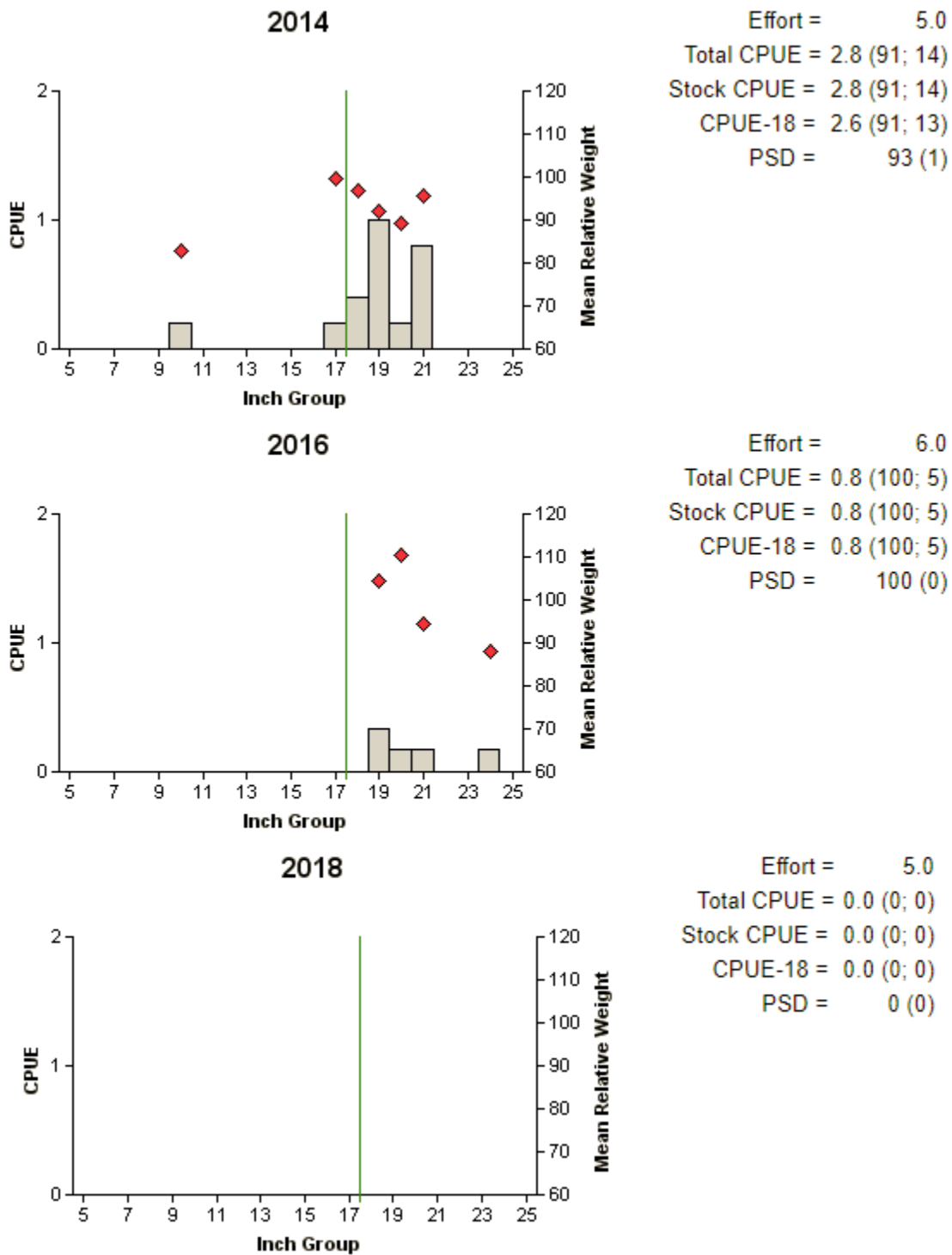


Figure 10. Number of Palmetto Bass caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Benbrook Reservoir, Texas, 2014, 2016, and 2018. Solid vertical lines indicate minimum length limit at time of sampling.

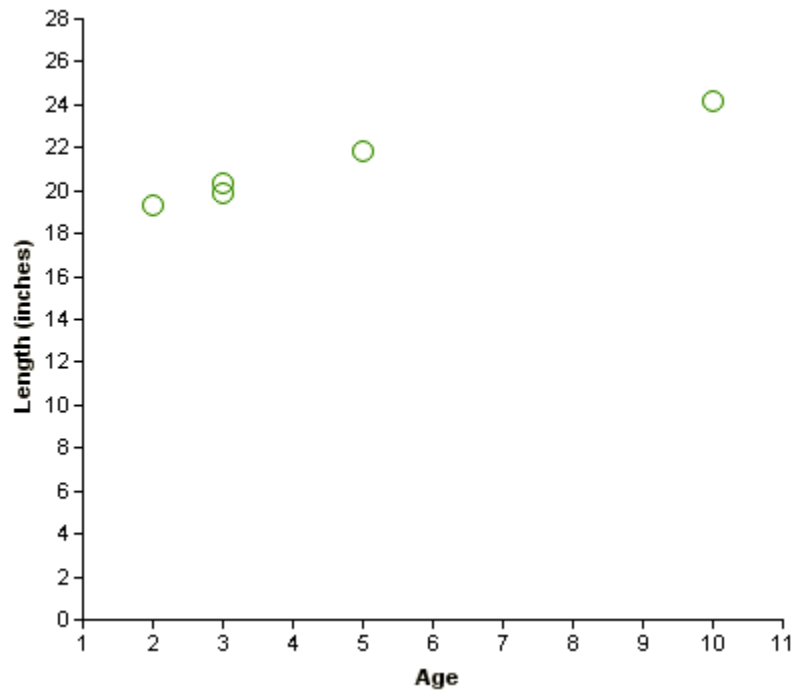


Figure 11. Length at age for Palmetto Bass (sexes combined) collected from gill nets at Benbrook Reservoir, Texas, 2016 (N=5).

Table 10. Creel survey statistics for Palmetto Bass at Benbrook Reservoir, Texas, from June 2000 through May 2001 and June 2017 through May 2018. Total catch per hour is for anglers targeting Palmetto Bass and total harvest is the estimated number of Palmetto Bass harvested by all anglers. Relative standard errors (RSE) are in parentheses

Creel survey statistic	Year	
	2000/2001	2017/2018
Surface area (acres)	3,635	3,635
Directed effort (h)	6,185.76 (44)	856.00 (61)
Directed effort/acre	1.70 (44)	0.24 (61)
Total catch per hour	0.45 (54)	0.13 (110)
Total harvest	433.36 (168)	0.00 (N/A)
Harvest/acre	0.11 (168)	0.00 (N/A)
Percent legal released	77.7	N/A

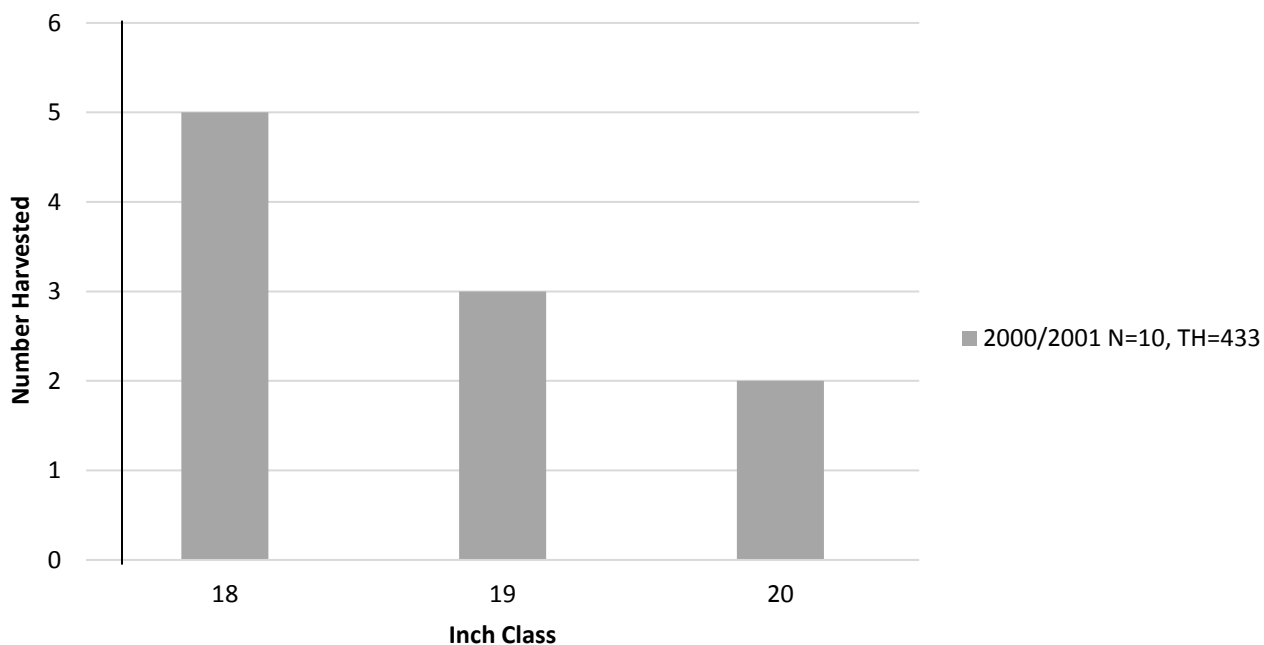


Figure 12. Length frequency of harvested Palmetto Bass observed during creel surveys at Benbrook Reservoir, Texas, June 2000 through May 2001, all anglers combined. No harvest of Palmetto Bass was observed during the 2017/2018 creel survey. N is the number of harvested Palmetto Bass observed during creel surveys, and TH is the total estimated harvest for the creel period. Solid line indicates minimum length limit at the time of the survey.

Largemouth Bass

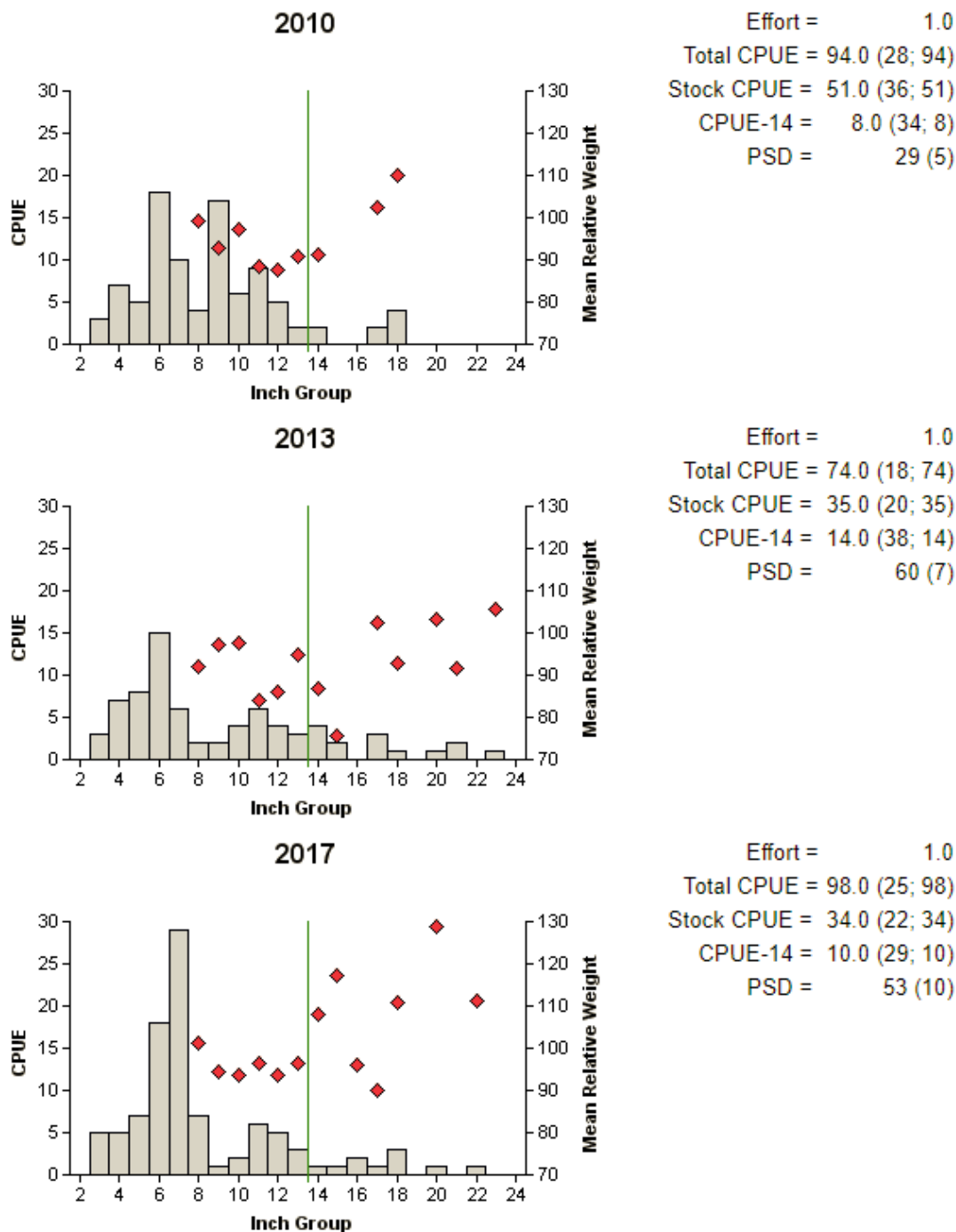


Figure 13. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure) for fall electrofishing surveys, Benbrook Reservoir, Texas, 2010, 2013, and 2017. Solid vertical lines indicate minimum length limit at time of sampling.

Table 11. Creel survey statistics for Largemouth Bass at Benbrook Reservoir, Texas, from June 2017 through May 2018. Catch rate is for all anglers targeting Largemouth Bass. Harvest is partitioned by the estimated number of fish harvested by non-tournament anglers and the number of fish retained by tournament anglers for weigh-in and release. The estimated number of fish released by weight category is for anglers targeting Largemouth Bass. Relative standard errors (RSE) are in parentheses.

Statistic	2000/2001	2017/2018
Surface area (acres)	3,635	3,635
Directed angling effort (h)		
Tournament	N/A	4,781.58 (43)
Non-tournament	N/A	14,986.57 (18)
All black bass anglers combined	8,161.63 (34)	19,768.15 (20)
Angling effort/acre	2.2 (34)	5.4 (20)
Catch rate (number/h)	0.2 (49)	0.5 (19)
Harvest		
Non-tournament harvest	N/A	21 (200)
Harvest/acre	0.3 (94)	>0.0 (200)
Tournament weigh-in and release	N/A	528 (55)
Percent legal released (non-tournament)	32 ^a	99.1

^aTournament effort was not separated out during the 2000/2001 creel survey.

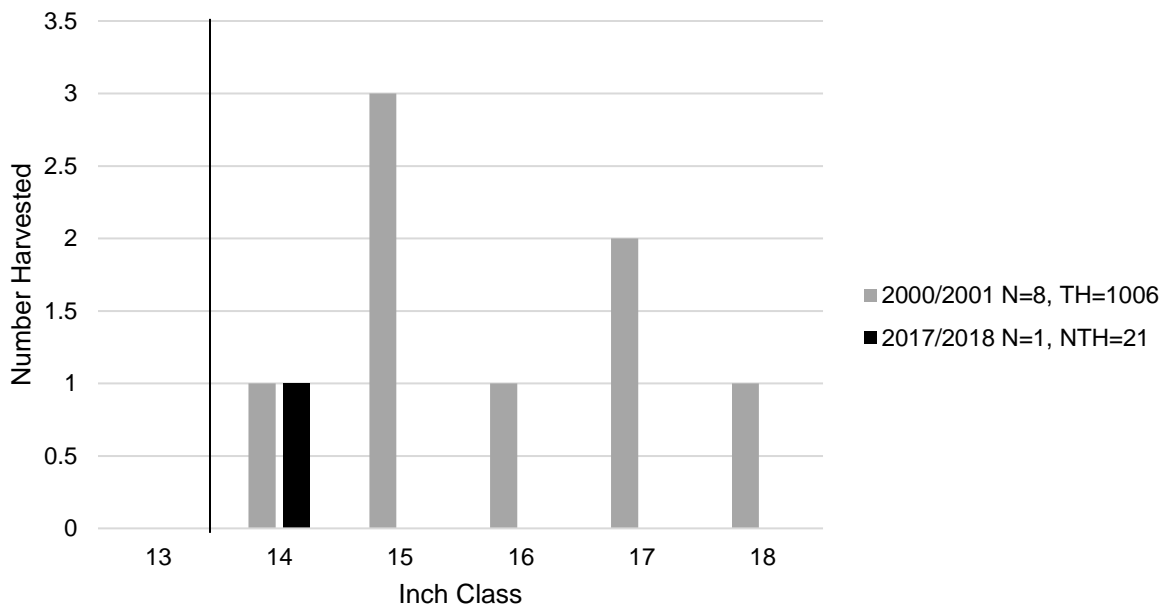


Figure 14. Length frequency of non-tournament harvested Largemouth Bass observed during creel surveys at Benbrook Reservoir, Texas, June 2000 through May 2001 and June 2017 through May 2018, all anglers combined. N is the number of harvested Largemouth Bass observed during creel surveys, TH is estimated total harvest during the 2000/2001 survey, and NTH is the estimated non-tournament harvest for 2017/2018 survey period. Solid line represents minimum length limit at the time of the surveys. Tournament effort was not separated out during the 2000/2001 creel survey.

Table 12. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Benbrook Reservoir, Texas, 1996, 1999, 2001, 2009, 2013, and 2017. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB. Genetic composition was determined by electrophoresis prior to 2005 and with micro-satellite DNA analysis since 2005.

Year	Sample size	Number of Fish			% FLMB alleles	% FLMB
		FLMB	Intergrade	NLMB		
1996	26	5	16	5	50.1	19.2
1999	30	3	21	6	48.3	10.0
2001	29	5	20	4	52.6	17.2
2009	25	0	25	0	63.0	0.0
2013	30	0	30	0	60.0	0.0
2017	30	0	27	3	55.0	0.0

White Crappie

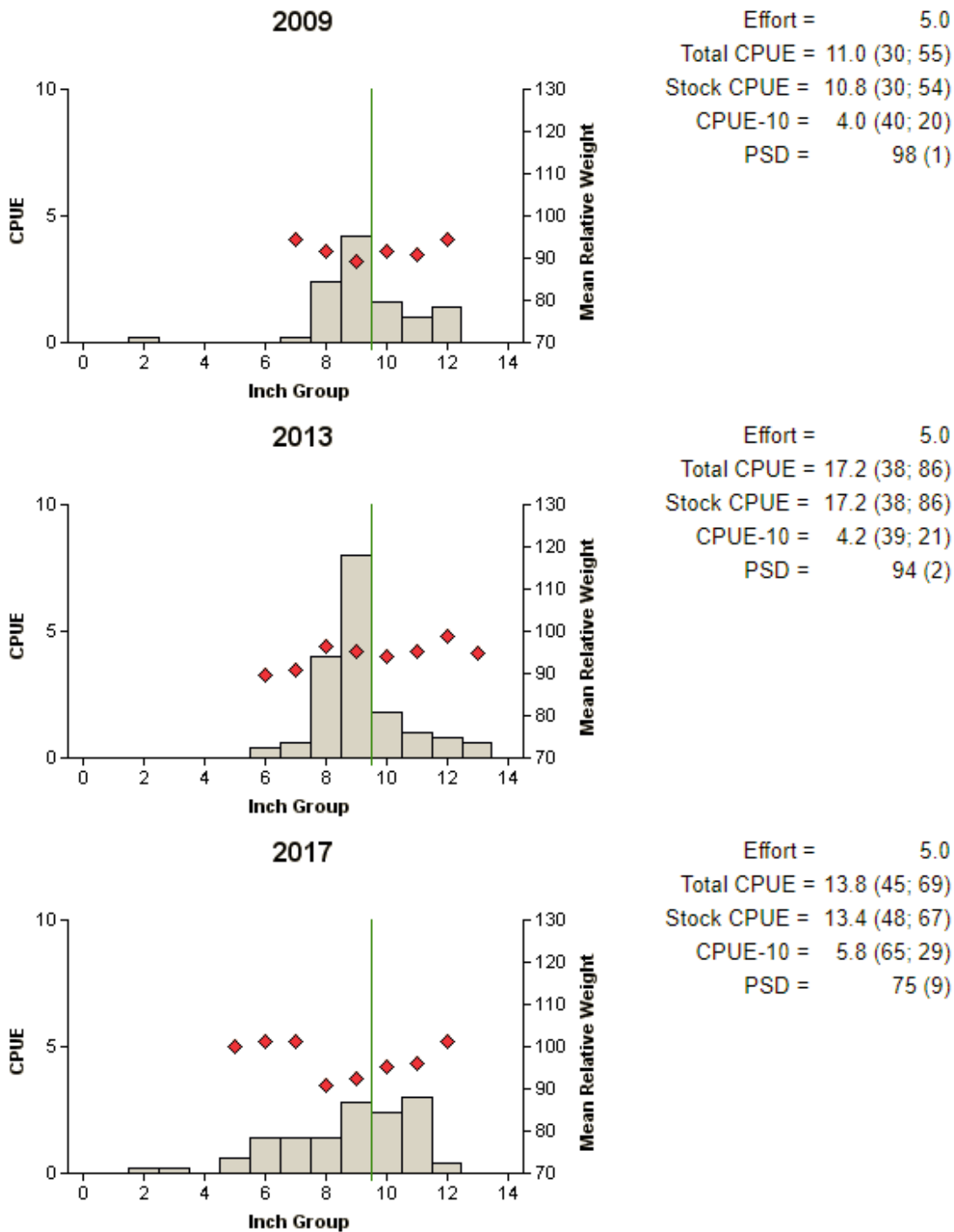


Figure 15. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, Benbrook Reservoir, Texas, 2009, 2013, and 2017. Vertical line indicates minimum length limit.

Table 13. Creel survey statistics for Crappie at Benbrook Reservoir, Texas, from June 2000 through May 2001 and June 2017 through May 2018. Total catch per hour is for anglers targeting 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	
	2000/2001	2017/2018
Surface area (acres)	3,635	3,635
Directed effort (h)	4,839.53 (54)	9,591.37 (26)
Directed effort/acre	1.33 (54)	2.64 (26)
Total catch per hour	0.57 (78)	1.08 (47)
Total harvest	3,198 (51)	5,915 (42)
Harvest/acre	0.88 (51)	1.63 (42)
Percent legal released	5.8	10.6

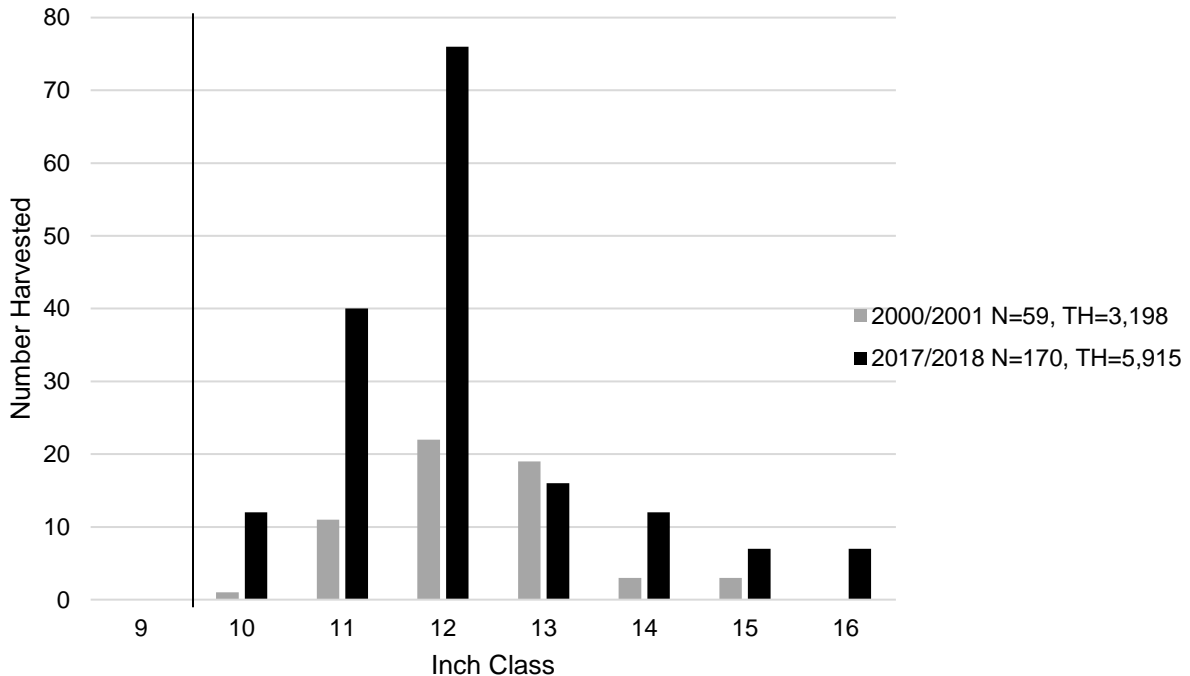


Figure 16. Length frequency of harvested White Crappie observed during creel surveys at Benbrook Reservoir, Texas, June 2000 through May 2001 and June 2017 through May 2018, all anglers combined. N is the number of harvested White Crappie observed during creel surveys, and TH is the total estimated harvest for the creel period. Solid line indicates minimum length limit at the time of the survey.

Black Crappie

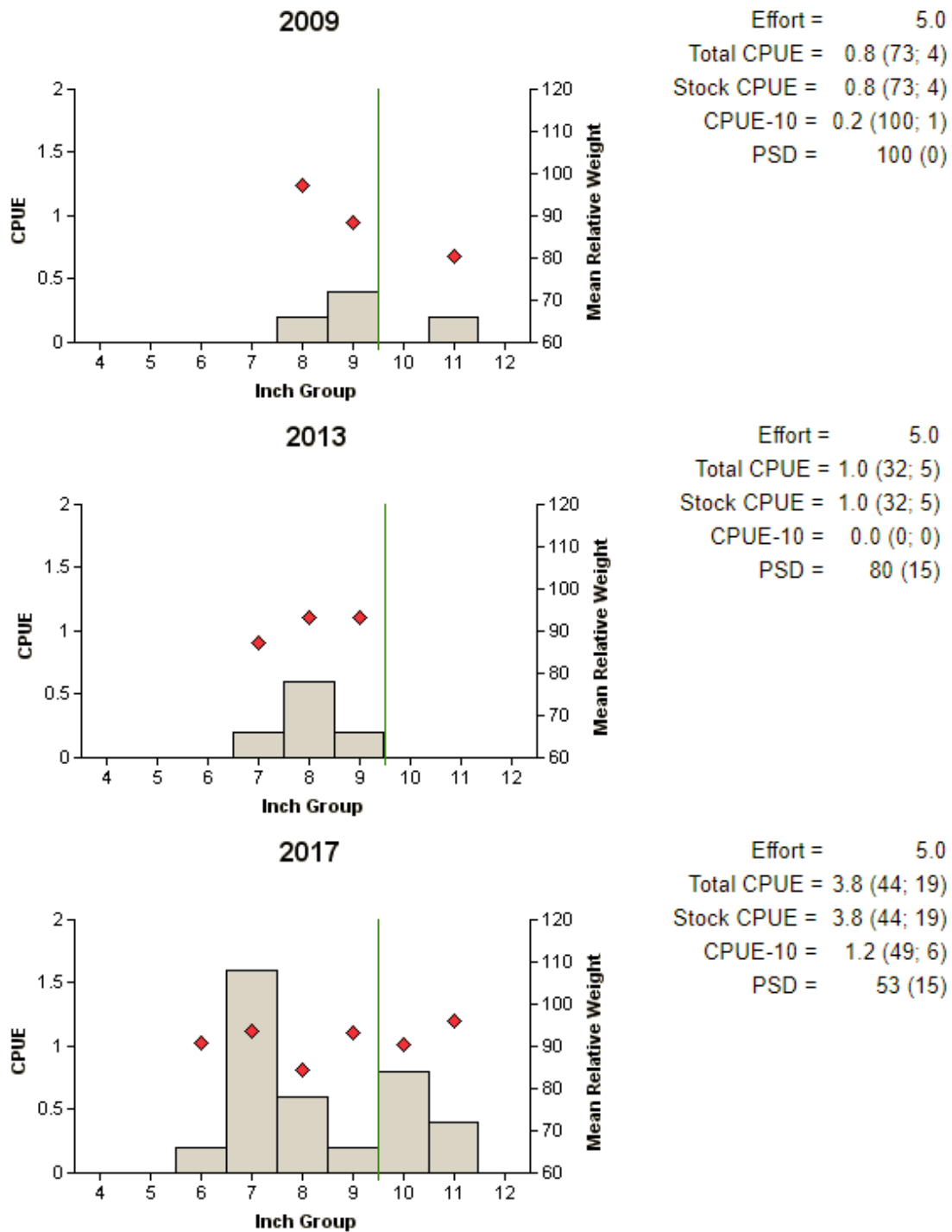


Figure 17. Number of Black Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, Benbrook Reservoir, Texas, 2009, 2013, and 2017. Vertical line indicates minimum length limit.

Table 14. Creel survey statistics for Black Crappie at Benbrook Reservoir, Texas, June 2017 through May 2018. Total catch per hour is for anglers targeting Crappie and total harvest is the estimated number of Black Crappie harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year	
	2000/2001 ^a	2017/2018
Surface area (acres)	3,635	3,635
Directed effort (h)	4,839.53 (54)	9,591.37 ^b (26)
Directed effort/acre	1.33 (54)	2.64 ^b (26)
Total catch per hour	0.57 (78)	0.67 (N/A)
Total harvest	3,198 (51)	1,211 (90)
Harvest/acre	0.88 (51)	0.33 (90)
Percent legal released	5.8	0.0

^aThe 2000/2001 creel survey did not include any data on Black Crappie so all data listed were for White Crappie.

^bEffort is for all crappie combined.

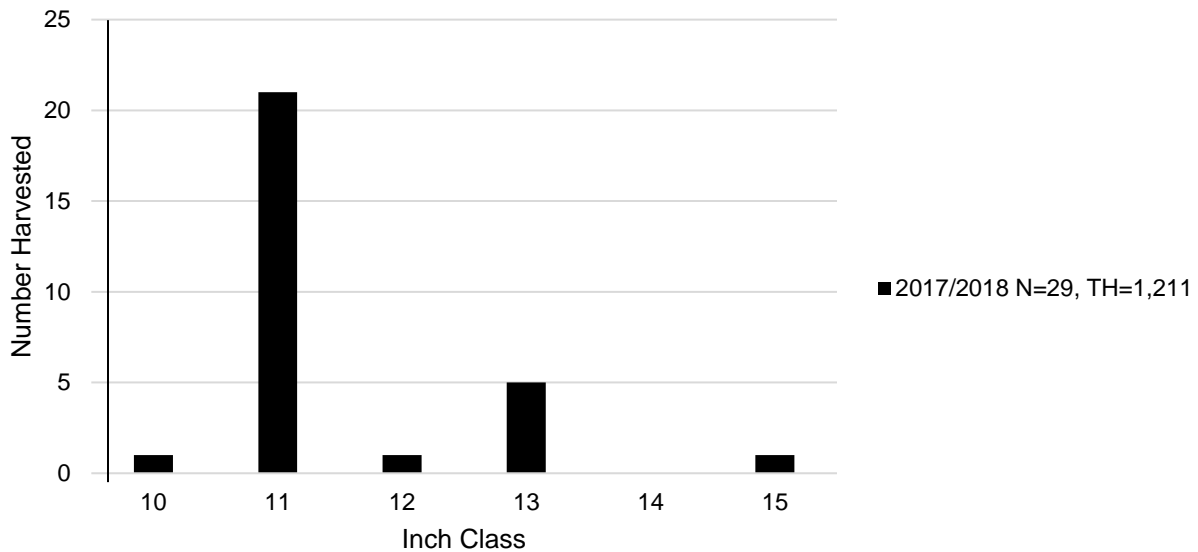


Figure 18. Length frequency of harvested Black Crappie observed during creel surveys at Benbrook Reservoir, Texas, June 2017 through May 2018, all anglers combined. N is the number of harvested Black Crappie observed during creel surveys, and TH is the total estimated harvest for the creel period. Solid line indicates minimum length limit at the time of the survey.

Proposed Sampling Schedule

Table 15. Proposed sampling schedule for Benbrook Reservoir, Texas. Survey period is June through May. Gill netting surveys are conducted in the spring, while electrofishing and trap netting surveys are conducted in the fall. Standard survey denoted by S and additional survey denoted by A.

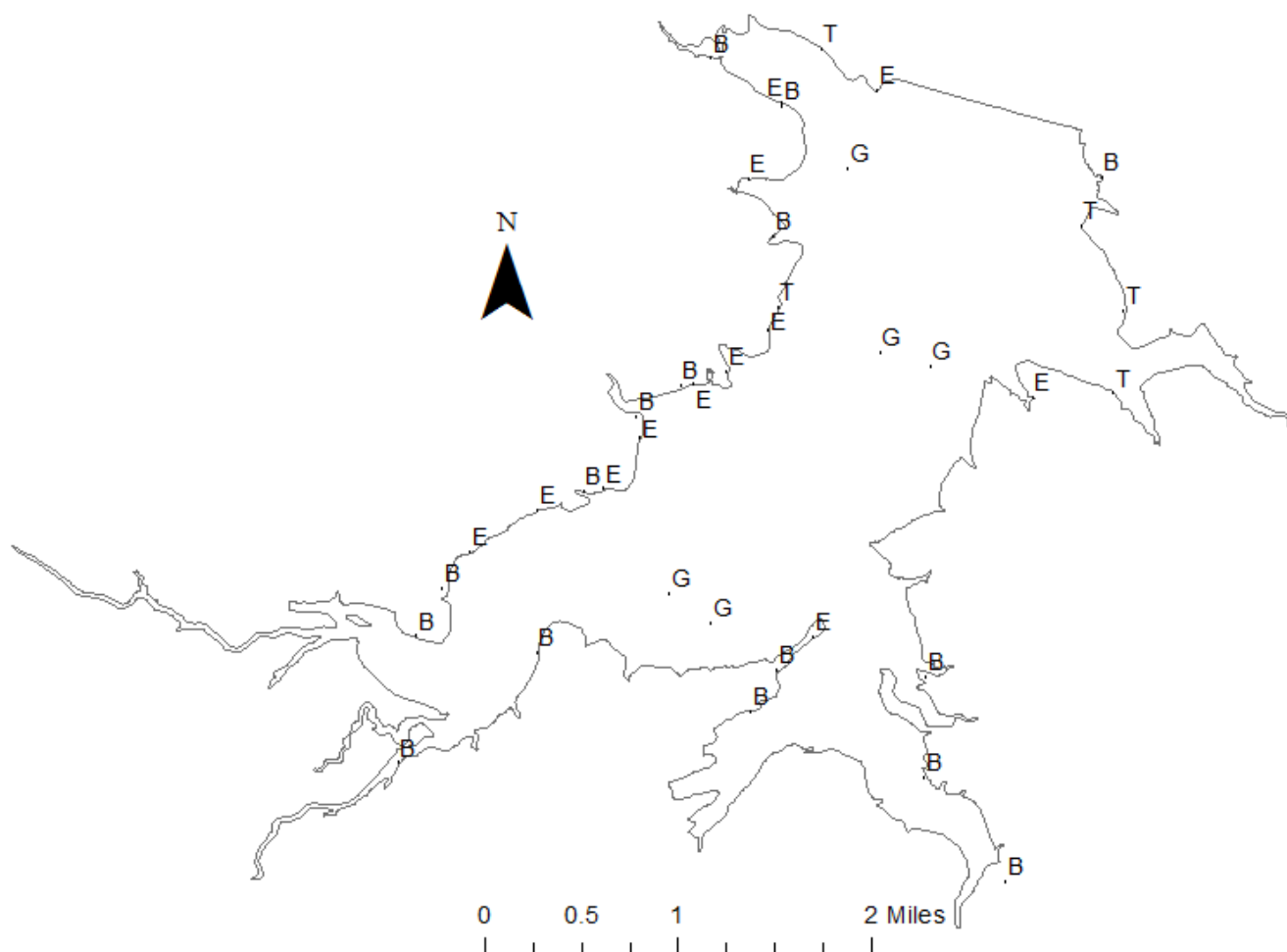
	Survey year			
	2018-2019	2019-2020	2020-2021	2021-2022
Angler Access				S
Structural Habitat				
Vegetation				
Electrofishing – Fall				S
Electrofishing – Low frequency				
Trap netting				S
Gill netting		A		S
Creel survey				
Report				S

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

Number (N) and catch rate (CPUE; RSE in parentheses) of all target species collected from all gear types from Benbrook Reservoir, Texas, 2017-2018. Sampling effort was 5 net nights for gill netting, 5 net nights for trap netting, and 1 hour for electrofishing.

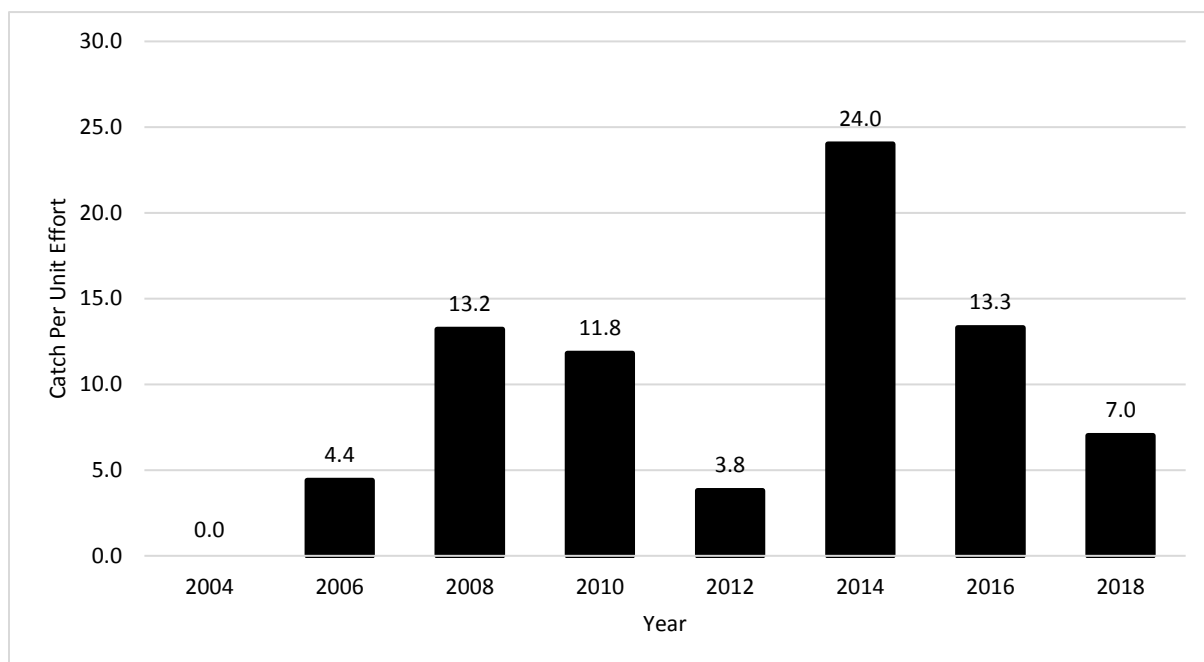
Species	Gill Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					372	372.0 (32)
Threadfin Shad					1,020	1,020.0 (61)
Channel Catfish	16	3.2 (36)				
Blue Catfish	48	9.6 (13)				
White Bass	2	0.4 (100)				
Palmetto Bass	0	0.0 (100)				
Bluegill					172	172.0 (37)
Longear Sunfish					85	85.0 (36)
Redear Sunfish					3	3.0 (52)
Largemouth Bass					98	98.0 (25)
White Crappie			69	13.8 (45)		
Black Crappie			19	3.8 (44)		

APPENDIX B – Map of sampling locations



Location of sampling sites, Benbrook Reservoir, Texas, 2017-2018. Trap net, gill net, and electrofishing stations are indicated by T, G, and E, respectively. Boat ramps are indicated with a B. Water level was near full pool at time of sampling.

Appendix C – Historical catch rates of Yellow Bass



Historical gill netting catch rates of Yellow Bass in Benbrook Reservoir. Prior to 2006, Yellow Bass were never collected in Benbrook. Their introduction is likely the result of a raw-water pipeline that moves water from Richland Chambers and Cedar Creek Reservoirs in East Texas.



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