

PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2016 Fisheries Management Survey Report

**Lake Holbrook**

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## SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lake Holbrook were surveyed in 2016 using electrofishing, and in 2017 using baited hoop nets. A roving creel survey was conducted between March 1, 2017 and May 31, 2017 to assess angler utilization. Access and aquatic vegetation surveys were conducted in July 2016. Historical data are presented with the 2016-2017 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:** Lake Holbrook is a 650-acre impoundment located in Wood County, Texas, on Lankford Creek, a tributary of the Sabine River. The reservoir was constructed by Wood County in 1962 for flood control and recreation. Aquatic vegetation is limited in the reservoir amounting to less than 5% of reservoir surface area. The aquatic vegetation community consists of a mixture of native submersed and native emergent species.
- **Management History:** Largemouth Bass and crappies are the most prominent sport fishes present. Florida Largemouth Bass were most recently stocked in 2014 and 2015. Work began in 2006 to establish native emergent vegetation in Lake Holbrook to enhance littoral habitat. District personnel collaborated with the Holbrook Association to construct and deploy fish attractors constructed from brush (2007 and 2008) and bamboo (2009, 2012, and 2014). District staff created a map for use by anglers, which is available for download from the agency website showing geo-referenced locations of fish attractors.
- **Fish Community**
  - **Prey Species:** The predominant prey species include Bluegill, and other less abundant sunfish species. Gizzard and Threadfin Shad were also present, though they were low in abundance.
  - **Catfishes:** Channel Catfish abundance has historically been low and directed angling effort accounted for 1% of total effort.
  - **Black Basses:** Largemouth Bass were moderately abundant. The size distribution of the population has improved and Florida Largemouth Bass (FLMB) allele frequency has increased to 38% following stockings of FLMB in 2014 and 2015. Largemouth Bass growth rates were fast and fish exhibited good body condition, indicating adequate prey availability. Largemouth Bass angling accounted for 50% of directed angling effort in spring 2017 divided almost equally between live-release tournaments (26%) and non-tournament anglers (24%). Spotted Bass were collected, though at much lower abundances than Largemouth Bass.
  - **Crappies:** Crappies accounted for 27% of total directed fishing effort in the spring 2017 creel. Both White and Black Crappie were documented in hoop net catches and an age and growth sample of Black Crappie was collected in supplemental gill netting. Black Crappie grew to legal length in about 3 years.

**Management Strategies:** Stock FLMB to increase FLMB alleles. Document catch of big LMB (> 8 pounds). Continue working with the local homeowner's association to enhance fish habitat in the lake by supplementing existing fish attractors and constructing new ones as opportunities arise. Improve fish habitat by planting more aquatic vegetation. Inform the public about the threat of aquatic invasive species.

## INTRODUCTION

This document is a summary of fisheries data collected from Lake Holbrook from June 2016 through May 2017. 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 2016 and 2017 data for comparison.

### *Reservoir Description*

Lake Holbrook is a 650-acre impoundment constructed in 1962 on Lankford Creek, a tributary of the Sabine River. The reservoir is in Wood County approximately 24 miles northwest of Tyler, Texas, and is operated and controlled by Wood County. Primary water uses include flood control and recreation. Natural shoreline, dead trees, and piers and docks dominated habitat at time of sampling. Boat access consists of three public boat ramps. Other descriptive characteristics for Lake Holbrook are in Table 1.

### *Angler Access*

Lake Holbrook has three public boat ramps. Bank fishing access is limited to areas near public boat ramps, in the county parks, and along short road right-of-ways. Additional boat ramp characteristics are presented in Table 2.

### *Management History*

**Previous management strategies and actions:** Management strategies and actions from the previous survey report (Storey and Bennett 2013) included:

1. Monitor largemouth bass abundance, condition, population size structure, growth rate, and genetic composition.  
**Action:** Lake Holbrook was sampled using electrofishing in fall 2014 and 2016. Genetic analysis of Largemouth Bass was conducted in 2016 and an age and growth assessment was conducted in fall 2016. A roving creel survey was completed in spring 2017. Florida Largemouth Bass fingerlings were stocked at 100/acre in 2014 and 2015. District staff were unable to obtain tournament information from the Grand Saline Bass Club for the period 2013 through 2016.
2. Work cooperatively with the Lake Holbrook Association to enhance existing fish attractors and create new structures as opportunities arise.  
**Action:** In April 2014, District staff worked with volunteers from the Lake Holbrook Association to construct and deploy 30 bamboo fish attractors at eight existing brush piles. In July 2016, District staff submitted a proposal of \$2,100 to underwrite the purchase of materials to construct 20 Georgia-style PVC fish attractors through the TPWD Conservation License Plate fund but the proposal was not funded.
3. Expand efforts to establish native aquatic species and to increase the diversity of aquatic plant communities.  
**Action:** In June 2013, American pondweed, Illinois pondweed, and waterstargrass plants were planted in enlarged enclosures at three sites for each species. In June 2014 and July 2015, the performance of the colonies was assessed but no new plantings were conducted. Enclosure cages were removed from colonies that exhibited vigorous growth outside the cages as well as colonies where survival was poor. In 2016, Illinois pondweed was planted in six enclosures. Illinois pondweed exhibited the most vigorous growth and established substantial colonies outside the protective enclosures. Annual assessments of waterwillow were discontinued because establishment of other native aquatic species made measurement difficult.

4. Assess the crappie populations in Lake Holbrook.

**Action:** The fishery was assessed through a roving creel survey in spring 2017 and the populations were sampled using experimental hoop netting in spring 2017. An age and growth sample of Black Crappie was collected in gill netting in February 2017.

**Harvest regulation history:** Sport fishes in Lake Holbrook are currently managed with statewide regulations (Table 3).

**Stocking history:** Florida Largemouth Bass (FLMB) were initially introduced as advanced fingerlings in 1978. Additional stockings have taken place periodically from 1980 through 2008, and more recently FLMB were stocked in 2014 and 2015. Blue Catfish were introduced in 1982, but failed to produce a self-sustaining population. Channel Catfish were introduced in 1992 but have failed to develop a significant fishery. Black Crappie, exhibiting the “black-stripe” trait, were purchased by the Lake Holbrook Association and stocked by TPWD staff in 2003 as part of a research project. The presence of the “black-stripe” variation was later determined to pre-date the stocking and the research project was terminated. Threadfin Shad were also stocked in 2004 to enhance prey fish populations. The complete stocking history is in Table 4.

**Vegetation/habitat management history:** Native vegetation enhancement projects initiated by District staff have resulted in localized improvements of aquatic vegetation communities. American waterwillow was initially introduced in 2006 and 2007 and plant colonies which have not required any protection from herbivory, have increased in coverage and spread to new areas throughout the reservoir (Storey and Bennett 2013). In 2013, experiments began with the submersed aquatics, American pondweed, Illinois pondweed, and waterstargrass. Colonies were planted in wire exclosures at three sites for each species. The performance of the colonies was assessed in 2014 and 2015 and no new plantings were conducted. After one or two years of growth, exclosure cages were removed from colonies where survival was poor and from those that exhibited vigorous growth outside the cages. In 2016, additional plantings of Illinois pondweed were made because this species showed the most vigorous growth and colonies persisted following removal of protective exclosures. Tyler North District staff and volunteers from the Holbrook Association have assembled and deployed fish attractors consisting of brush in 2007 and 2008 to provide habitat for bass, crappie and sunfishes. In 2009, 2012, and 2014 fish attractors were constructed employing bamboo because it was lighter to work with, provided increased vertical structure, and the material is reportedly more resistant to decay than traditionally-used materials.

**Water transfer:** Lake Holbrook was constructed by Wood County for recreation and flood control. There are no pump stations on the reservoir and no inter-basin transfers exist.

## METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Lake Holbrook (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, Spotted Bass, Sunfishes, Gizzard Shad, and Threadfin Shad were collected by electrofishing in fall 2016 (1.5 h at 18, 5-min stations). An optional additional survey for Largemouth Bass and Spotted Bass was conducted in fall 2014 (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. Ages for Largemouth Bass were determined using otoliths from 56 fish subsampled at 5 per inch class strata (range 6.2 to 18.5 inches).

*Tandem hoop nets* – Crappie were collected using 5 tandem hoop-net series at 5 stations in April 2017. 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). Ages for Black Crappie were determined using otoliths from 11 randomly-selected fish collected in supplemental gill net sampling conducted expressly to collect a Crappie sample in February 2017 (range 9.2 to 10.9 inches).

*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 30 individual fish collected in electrofishing in fall 2016.

*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 ( $W_t$ )] were calculated for target fishes according to Anderson and Neumann (1996). Index of vulnerability (IOV) was calculated for Gizzard Shad (DiCenzo et al. 1996). Standard error (SE) was calculated for structural indices and IOV. Relative standard error (RSE = 100 X SE of the estimate/estimate) was calculated for all CPUE and creel statistics.

*Creel survey* – An annual access-point creel survey was conducted from March through May 2017. Angler interviews were conducted on 5 weekend days and 4 weekdays 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* – An aquatic vegetation survey was performed according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2011). Shoreline distances and areas of vegetation were estimated using ESRI ArcGIS software.

*Access survey* – An access survey was conducted in July 2016 to characterize angler access.

*Water level* – There is no gauging station on Lake Holbrook. Elevation data presented are based on estimates measured at the lake outflow at the time of surveys.

## RESULTS AND DISCUSSION

**Habitat:** In the past, Lake Holbrook contained substantial amounts of native submersed aquatic vegetation. Following a drawdown in 1980 to repair and expand the dam, the vegetation declined. Although coverage of aquatic vegetation in Lake Holbrook has gradually increased from 2004 to 2016 current levels represent less than 5% of reservoir surface area (Table 6). The invasive aquatic species alligatorweed has been documented in the past in small quantities but it has never warranted control. No alligatorweed was observed in the most recent assessment. Structural habitat in 2012 consisted primarily of natural shoreline (89%), dead trees (40%), and piers and docks (34%) (Storey and Bennett 2013).

**Creel:** Total fishing effort at Lake Holbrook in spring 2017 was estimated at 17,986 h. Largemouth Bass represented 50% of this total with tournament angling accounting for 26% of effort and non-tournament angling responsible for 24%. Crappie anglers contributed the second highest effort (27%), followed by anglers fishing for any species (18%), sunfish (4%) and catfish (1%) (Table 7). Total directed expenditures from March through May 2017 were estimated at \$132,129 (Table 8), somewhat higher than the estimate of \$98,944 on Lake Winnsboro, a neighboring reservoir approximately 30% larger in area, in spring 2015 (Bennett and Storey 2015). Anglers interviewed in the creel survey were mainly from East Texas where they traveled less than 50 miles. Another group from the Dallas Fort Worth Metroplex and surrounding cities traveled >50 miles and <100 miles to fish Lake Holbrook. Few anglers traveled more than 100 miles (Appendix C).

**Prey species:** The prey base in Lake Holbrook was dominated by sunfishes, with Bluegill being the most abundant species (Appendix A). Electrofishing CPUE of Bluegill, Redear Sunfish, and Longear Sunfish were 577.3 fish/h, 106.0 fish/h, and 27.3 fish/h, respectively (Appendix A). Total CPUEs of Gizzard Shad (26.7/h) and Threadfin Shad (28.7/h) (Appendix A) were low and 18% of Gizzard Shad sampled were of appropriate size for predators (Figure 1). Total electrofishing CPUE of Bluegill in 2016 (577.3/h) was higher than in 2012 (306.0/h) and 2008 (389.0/h) (Figure 2). Redear Sunfish CPUE was also highest in 2016 (106.0/h) as compared with 2012 (44.0/h) and 2008 (52.0/h) (Figure 3). Directed angling effort for sunfishes accounted for 4% of total effort from March to May 2017 (Table 7) and harvest of combined species was estimated at 3,765 fish (Table 9) with Bluegill and Redear Sunfish over 6 inches representing most of the harvested fish (Figure 4).

**Channel Catfish:** Historical data indicate the Channel Catfish population in Lake Holbrook is low in abundance and characterized by limited recruitment (Storey and Bennett 2013). Consequently, gill net sampling was discontinued after spring 2013. In the spring 2017 creel survey, directed fishing effort accounted for 1% of total effort (Table 7) and few fish were harvested. Experimental hoop netting was conducted in April 2017 but no Channel Catfish were caught.

**Temperate Basses:** There was no directed effort observed for Yellow Bass in the spring 2017 creel survey although an estimated 1,439 fish were harvested, ranging in length from 7 to 10 inches.

**Black Basses:** Largemouth Bass were moderately abundant (Figure 5). The electrofishing CPUE of Largemouth Bass in 2016 (75.3/h) was similar in 2012 (83.0 fish/h) but lower than in 2014 (134.0). Although the size structure of the population appears to have improved through increases in PSD (45) and PSD-14 (23), catch rate of 14-inch fish has remained the same. The elevated catch rate in 2014 was in response to recovery from drought resulting in improved aquatic habitat and associated increased recruitment. Relative weights in 2016 for most inch classes exceeded 90 indicating adequate prey availability. Growth of Largemouth Bass in Lake Holbrook was good. The average lengths of Age 1 fish and Age 2 fish were 9.6 inches and 13.6 inches respectively (Figure 6). Fish grew to legal length (range=13.1-14.9 mean=14.0) in 2.3 years.

Live-release tournament fishing for Largemouth Bass accounted 26% of total directed fishing effort (Table 7, 10), and Non-tournament fishing effort accounted for a further 24%. Total angler catch rate for Largemouth Bass was 0.5/h. During the spring 2017 creel survey, anglers released 2,947 Largemouth Bass <4 lbs, 136 in the range 4.0 to 6.9 lbs and 45 fish from 7.0 to 9.9 lbs (Table 10). Most fish harvested during the creel survey were retained by anglers participating in live-release tournaments (Table 10, Figure 7). The FLMB allele frequency increased from 27% in 2012 to 38% in 2016 (Table 11, Figure 8), but 67% of the fish analyzed in 2016 were hybrids between FLMB and NLMB with more than half their alleles derived from the NLMB lineage.

Spotted Bass were collected in the last three electrofishing surveys on Lake Holbrook and their total CPUEs (6.0/h – 8.0/h) were much lower than for Largemouth Bass (Figure 9). Spotted bass are periodically included in live-release tournament bags.

**Crappies:** Both White and Black Crappies were collected in tandem hoop net sampling conducted in April 2017. This experimental method was employed as an alternative to fall trap netting because historical catches have been low despite anecdotal reports of good crappie fishing in Lake Holbrook. Catches of Black Crappie (5.8/series, Figure 11) were markedly higher than White Crappie (1.2/series, Figure 10) and 69% of Black Crappie collected were of legal size. Black Crappie grew to an average length of 9.7 inches (N=11, range 9.2 to 10.9 inches) in 2.9 years as assessed from a sample collected in gill netting conducted in February 2017. Crappies are the second most popular species group in Lake Holbrook accounting for 4,964 h of directed effort in spring 2017 (Table 12) representing 27% of total angler effort

(Table 7). Angler catch rate was 1.3/h and anglers harvested more Crappie, 5,645, than any other species group. Most harvested fish were Black Crappie (Figure 12) and 6% of legal-sized Crappie were released (Table 13).

## Fisheries management plan for Lake Holbrook, Texas

Prepared – July 2017

**ISSUE 1:** Largemouth Bass in Lake Holbrook are the dominant fishery accounting for 50% of total fishing effort with live-release tournaments accounting for 52% of fishing effort for Largemouth Bass. Applied management actions can improve the quality of the most popular fishery at Lake Holbrook. The most recent stockings of FLMB occurred in 2014 and 2015 and since that time the FLMB allele frequency has increased from 27% in 2012 to 38% in 2016. This rise indicates that FLMB allele frequency has room for continued increase. Documenting catches of fish over 8 lbs will help determine big-fish potential. Littoral habitat and structural habitat for young and adult Largemouth Bass, respectively, is limited.

### MANAGEMENT STRATEGIES

1. Collect information on catches of big (fish over 8 pounds) Largemouth Bass from fishing tournaments at Lake Holbrook.
2. Recommend stockings of FLMB at 100/acre in 2019 and 2020 based on the potential to further increase FLMB alleles.
3. Supplement structural and vegetative habitat as described below.

**ISSUE 2** Structural habitat in Lake Holbrook is limited.

### MANAGEMENT STRATEGIES

1. Recently members of the Holbrook Association have expressed interest in assisting with the purchase and construction of Georgia-style PVC fish attractors. Continue to work cooperatively on habitat enhancement projects with the Holbrook Association as opportunities present themselves.
2. Supplement eight existing brush reefs and consider expansion of project as appropriate.
3. Continue to update map showing the locations of brush reefs as changes are made

**ISSUE 3** Aquatic vegetation in Lake Holbrook is limited (<5% reservoir surface area) and dominated by native emergent types.

### MANAGEMENT STRATEGIES

1. Continue to experiment with introduction of a mixture of American pondweed and Illinois pondweed inside welded wire herbivore exclosures at new sites in Lake Holbrook in 2017.
2. Annually monitor plant survival within and spread outside the exclosures. After 2 to 3 years, sites where significant colonization outside the exclosures has taken place will have their protective cages removed to test their ability to persist.

**ISSUE 4:** 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 controlling authority to post appropriate signage at access points around the reservoir.
2. Educate the public about invasive species through media and the internet.
3. Make a speaking point about invasive species when presenting to constituent and user groups.

## Lake Holbrook Objective-Based Sampling Plan and Schedule

### Sport fish, forage fish, and other important fishes

Sport fishes in Lake Holbrook include Largemouth Bass, Crappies, sunfishes, and Channel Catfish. Sunfish and Shad are the primary prey species for sport fishes.

### Low-density fisheries

**Channel Catfish:** Population abundance of Channel Catfish in Lake Holbrook is low. Catches per unit effort (CPUE) of Channel Catfish from gill netting surveys in 2001, 2005, 2009, and 2013 were 1.2/nn, 3.2/nn, 1.8/nn, and 1.8/nn respectively. Gill net sampling of this population yields little information and sampling using this gear was discontinued after the spring 2013 survey. Information collected through the 2017 creel survey indicated low fishing effort, catch and harvest rates of catfish. Angler-related estimates will be updated during a roving creel survey in spring 2021.

**Spotted Bass:** Spotted Bass are present in Lake Holbrook although they are low in abundance. CPUE from electrofishing surveys in 2012, 2014, and 2016 were 6.0/h, 8.0/h, and 6.7/h respectively. This species does not provide a significant fishery. Any incidental data on Spotted Bass collected during future sampling for Largemouth Bass during creel and electrofishing surveys will be recorded.

### Survey objectives, fisheries metrics, and sampling objectives

**Largemouth Bass:** Lake Holbrook supports a moderately abundant Largemouth Bass population managed with the statewide 14-inch minimum length regulation.

Sampling on the Lake Holbrook's Largemouth Bass fishery will be to monitor general trends in relative abundance, size structure, body condition, growth, and FLMB influence (to assess if FLMB stockings resulted in continued increase in FLMB alleles). These data will allow for determination of any large-scale changes in the Largemouth Bass population (as measured with CPUE, PSD,  $W_r$ , and mean age at length) that may initiate further investigation. Analysis of electrofishing data predicts a sample of 50 stock-sized Largemouth Bass can be obtained at the 80<sup>th</sup> percentile by sampling between 10 and 20 stations, yielding an  $RSE_{\leq 25}$  at the 80<sup>th</sup> percentile. A minimum effort of 12 randomly-selected nighttime electrofishing stations will be conducted and an additional six random stations will also be generated in the event additional sampling is required to meet OBS plan objectives for Largemouth Bass in fall 2018 and 2020. Directed effort, angler catch and harvest statistics of the fishery will be assessed through a roving creel survey from March to May 2021. Data on the catch of big Largemouth Bass (> 8 pounds) will be sought to augment existing data collected from 2009-2012 in Wednesday evening tournaments by the Grand Saline Bass Club to determine big-fish potential.

**Crappie:** White and Black Crappie are both present in Lake Holbrook. Trap net sampling was discontinued after 2008 because catches were insufficient to assess the fishery. Crappies were found to be the second most popular species group in Lake Holbrook accounting for 27% of total directed fishing effort. More Black Crappie, 5,372, were harvested by anglers than any other species. Data from a roving creel survey scheduled in spring 2021 will be used to monitor trends in directed effort, and angler catch and harvest. Baited, tandem hoop nets were found to be an effective gear for crappie. Between 10 and 15 baited hoop net series in spring 2021 will be used to further explore this alternative gear to monitor size structure and relative abundance of crappie.

**Sunfish and other prey species:** Bluegill, Redear Sunfish, Gizzard Shad and Threadfin Shad are the primary prey species in Lake Holbrook. Larger members of the Bluegill and Redear Sunfish support a directed fishery responsible for 4% of total fishing effort. Long-term monitoring trend data is desired for these populations to evaluate their relative abundance (CPUE) and size structure (PSD). Relative weights of the Largemouth Bass population, along with size structure of the sunfish and the IOV of Gizzard Shad,

will be used to gauge prey fish availability for sport fishes. No sampling objectives will be set for prey species.

## LITERATURE CITED

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Table 1. Characteristics of Lake Holbrook, Texas.

Characteristic	Description
Year constructed	1962
Controlling authority	Wood County
Surface area	650 acres
Counties	Wood
Reservoir type	Tributary
Mean depth	8.0 ft.
Maximum depth	30.0 ft.
Shoreline Development Index (SDI)	4.96
Conductivity	155 $\mu$ mho / cm
Secchi disc range	4 – 6 ft.

Table 2. Boat ramp characteristics for Lake Holbrook, Texas, July 2016. Reservoir elevation at time of survey was at conservation pool elevation.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Depth at end of boat ramp (ft)	Condition
CR 2260	32.690179 -95.544251	Y	20	-5.5	Excellent, no access issues
CR 2298	32.699644 -95.55613	Y	20	-4.5	Excellent, no access issues
CR 2275	32.713134 -95.53959	Y	6	-5.0	Good, no access issues

Table 3. Harvest regulations for Lake Holbrook.

Species	Bag limit	Length limit (inches)
Catfish: Channel and Blue Catfish, their hybrids and subspecies	25 (in any combination)	12-inch minimum
Catfish: Flathead	5	18-inch minimum
Bass: Largemouth	5 (in any combination with Spotted Bass)	14-inch minimum
Bass: Spotted	5 (in any combination with Largemouth Bass)	No limit
Crappie: White and Black crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

Table 4. Stocking history of Lake Holbrook, Texas. Size categories are: FGL = fingerling; AFGL = advanced fingerling, and ADL = adults.

Year	Number	Size
<u>Threadfin Shad</u>		
<u>2004</u>	<u>5,500</u>	ADL
Species total	5,500	
<u>Blue Catfish</u>		
<u>1982</u>	<u>54,154</u>	FGL
Species total	54,154	
<u>Channel Catfish</u>		
<u>1992</u>	<u>10,526</u>	AFGL
Species total	10,526	
<u>Florida Largemouth Bass</u>		
1978	1,085	AFGL
1980	39,845	FGL
1983	52,902	FGL
1999	106,197	FGL
2000	105,080	FGL
2005	211	ADL
2007	67,769	FGL
2008	65,058	FGL
2014	65,397	FGL
<u>2015</u>	<u>66,244</u>	FGL
Species total	569,788	
<u>Black Crappie</u>		
<u>2003</u>	<u>10,800</u>	FGL
Species total	10,800	

Table 5. Objective-based sampling plan components for Lake Holbrook, Texas for 2016 – 2017.

Gear/ target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing – Fall 2016</i>			
<i>(Effort =12 – 18 stations)</i>			
Largemouth Bass	<i>Monitor trend in:</i>		
	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
	Age-and-growth	Category 3	N = 200, subsampled at 5 fish per 10 mm strata
Bluegill <sup>a</sup>	Abundance	CPUE – Total	RSE $\leq 25$
	Size structure	PSD, length frequency	N $\geq 150$ total
Redear Sunfish <sup>a</sup>	Abundance	CPUE – Total	
	Size structure	PSD, length frequency	
Gizzard Shad	Abundance	Presence/ Absence	
<i>Creel survey</i>			
<i>(March – May 2017)</i>			
Largemouth Bass	Characterize fishery and document trophy potential	Directed effort, angler CPUE, harvest, and release of fish by weight categories	
Catfish & Crappies	Characterize fishery	Directed effort, angler CPUE, harvest	

<sup>a</sup> No additional effort will be expended to achieve an RSE  $\leq 25$  for CPUE of Bluegill if not reached from designated Largemouth Bass sampling effort. Instead, Largemouth Bass body condition can provide information on forage abundance, vulnerability, or both relative to predator density

Table 6. Survey of aquatic vegetation, Lake Holbrook, Texas, 2004, 2008, 2012, and 2016. Surface area (acres) is listed with percent of total reservoir surface area in parentheses. Reservoir was estimated to be at conservation pool elevation at time of survey in July 2016. Individual native species observed during surveys are listed in footnotes.

Vegetation	2004	2008	2012	2016
Native emergent	6.4 (1.0) <sup>1</sup>	10.6 (1.6) <sup>3</sup>	14.8 (2.3) <sup>5</sup>	13.8 (2.1) <sup>7</sup>
Native submersed	0.4 (0.1) <sup>2</sup>	2.0 (0.3) <sup>4</sup>	2.5 (0.4) <sup>6</sup>	16.5 (2.5) <sup>8</sup>
Sub-total Native sp.	6.8 (1.0)	12.6 (1.9)	17.3 (2.7)	30.3 (4.7)
Invasive				
<i>Alligatorweed</i>		<0.1 (<0.1)	0.8 (0.1)	
Total	6.8 (1.0)	12.7 (2.0)	18.1 (2.8)	30.3 (4.7)

<sup>1</sup> *Cattail, maidencane, spikerush*

<sup>2</sup> *Muskgrass, stonewort*

<sup>3</sup> *Cattail, giant cutgrass, maidencane, pickerelweed, waterwillow*

<sup>4</sup> *Muskgrass*

<sup>5</sup> *American lotus, cattail, giant cutgrass, maidencane, pickerelweed, spikerush, waterprimrose, waterwillow*

<sup>6</sup> *Bushy pondweed, muskgrass*

<sup>7</sup> *Cattail, giant cutgrass, maidencane, smartweed, waterprimrose, waterwillow, white waterlily*

<sup>8</sup> *Illinois pondweed, muskgrass*

Table 7. Percent directed angler effort by species for Lake Holbrook, Texas, spring 2017. Survey period was from 1 March through 31 May 2017. For Largemouth Bass, percent tournament effort is in parentheses.

Species	Spring 2017
Channel Catfish	1
Sunfishes	4
Largemouth Bass	50 (26)
Crappie	27
Anything	18

Table 8. Total fishing effort (h) for all species and total directed expenditures at Lake Holbrook, Texas, spring 2017. Survey periods were from 1 March through 31 May 2017. Relative standard error is in parentheses.

Creel statistic	Spring 2017
Total fishing effort	17,986 (25)
Total directed expenditures	\$132,129 (78)

## Gizzard Shad

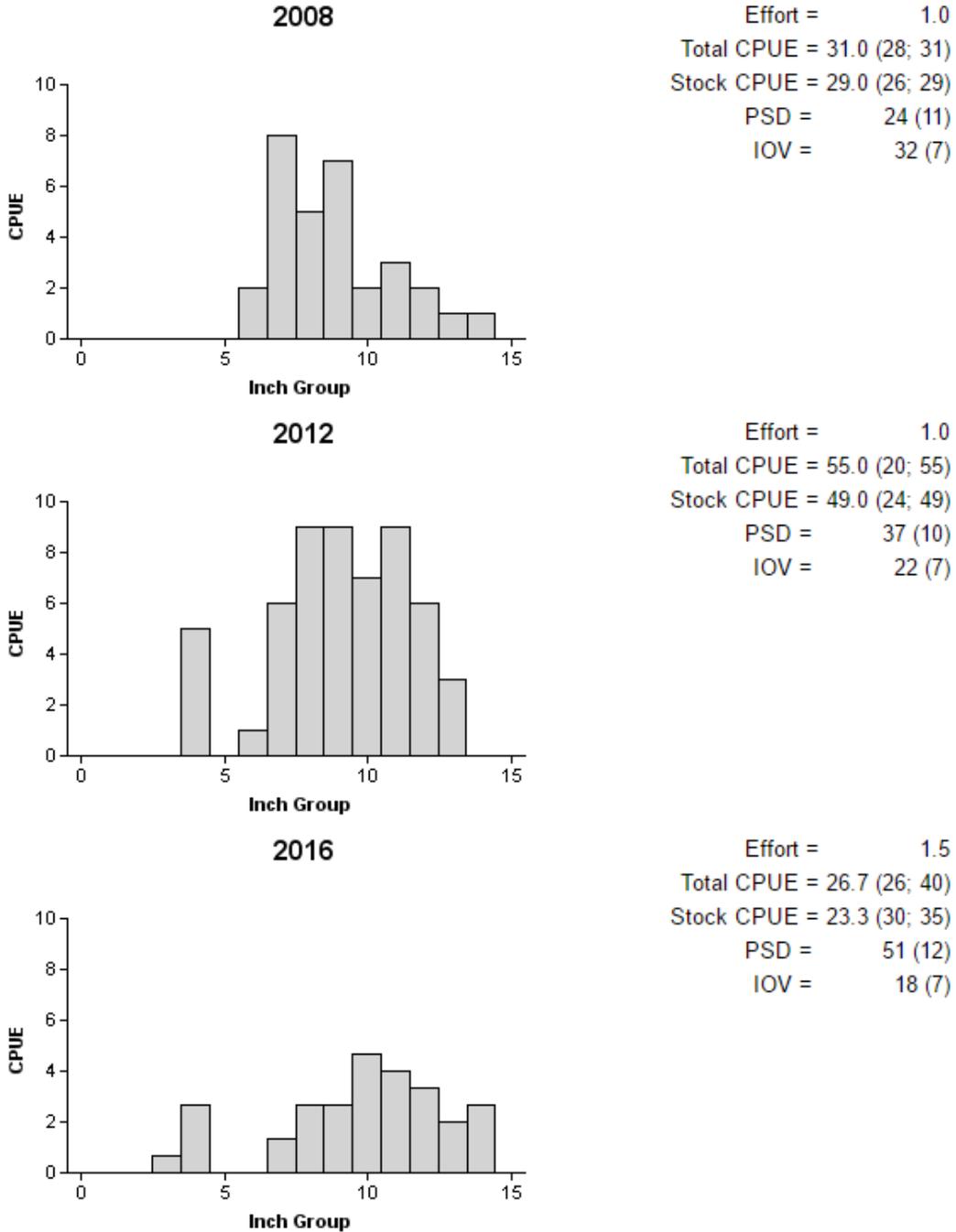


Figure 1. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Holbrook, Texas, 2008, 2012 and 2016.

## Bluegill

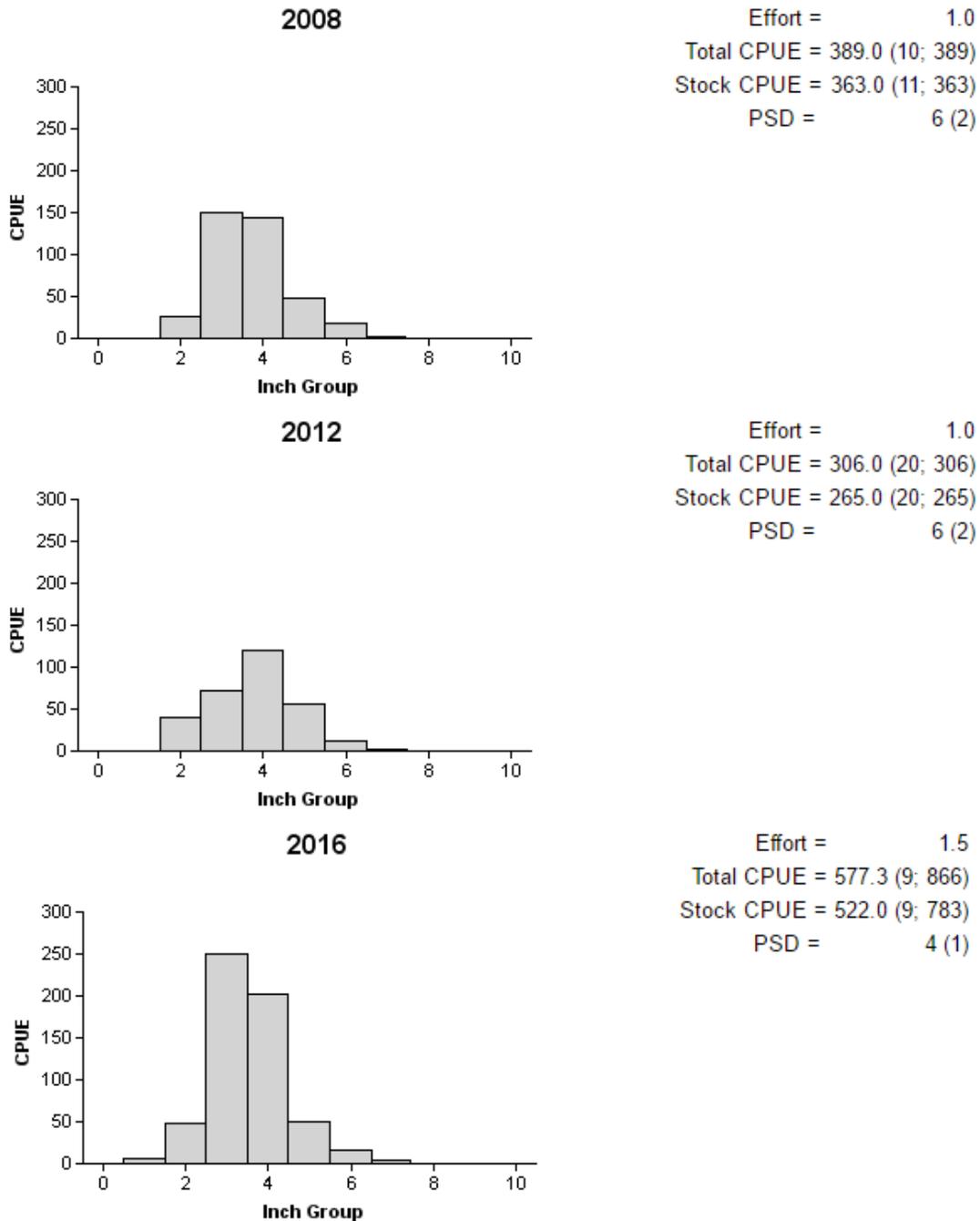


Figure 2. Number of Bluegill caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Holbrook, Texas, 2008, 2012, and 2016.

## Redear Sunfish

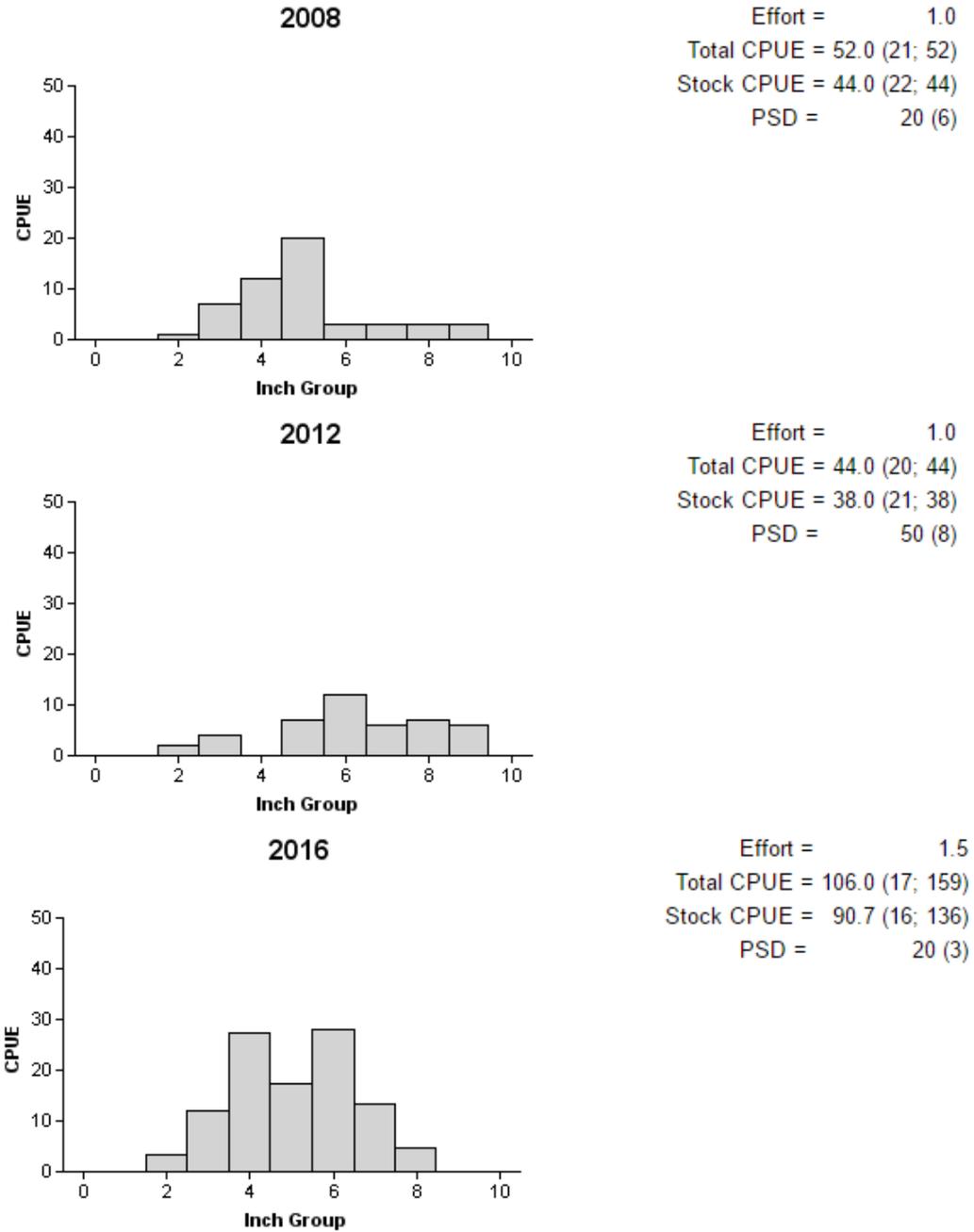


Figure 3. Number of Redear Sunfish caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Holbrook, Texas, 2008, 2012, and 2016.

## Sunfishes

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

Creel survey statistic	Spring 2017
Surface area (acres)	650
Directed effort (h)	778 (51)
Directed effort/acre	1.2 (51)
Total catch per hour	3.0 (100)
Total harvest	3,765 (71)
Harvest/acre	5.8 (71)
Percent legal released	100%

## Sunfishes

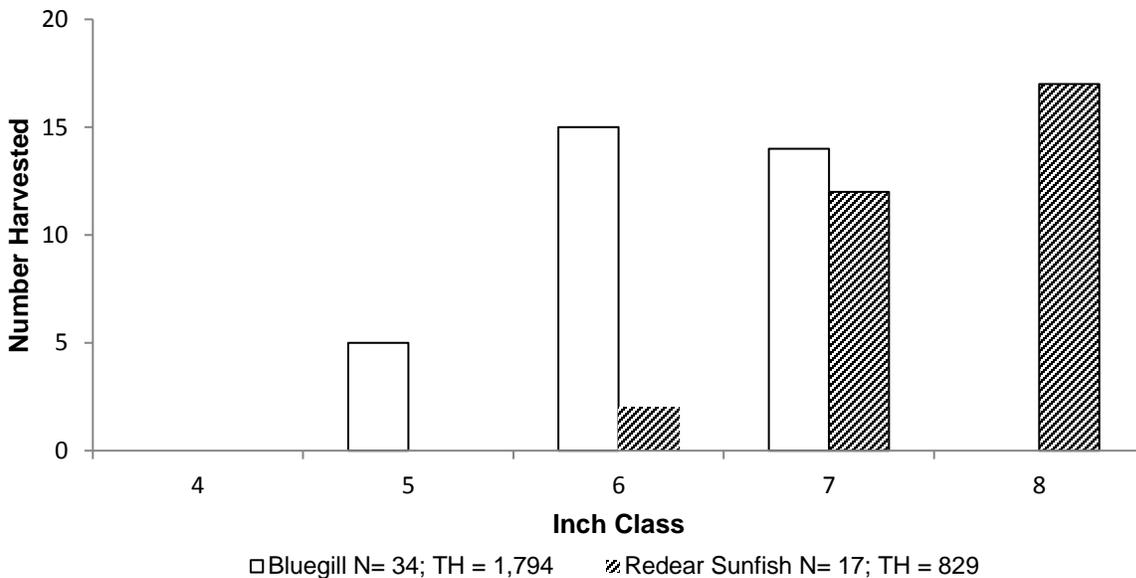


Figure 4. Length frequency of harvested Sunfishes (Bluegill and Redear Sunfish) observed during creel survey at Lake Holbrook, Texas, March through May 2017, all anglers combined. N is the number of harvested Sunfishes observed during creel surveys, and TH is the total estimated harvest for the creel period.

## Largemouth Bass

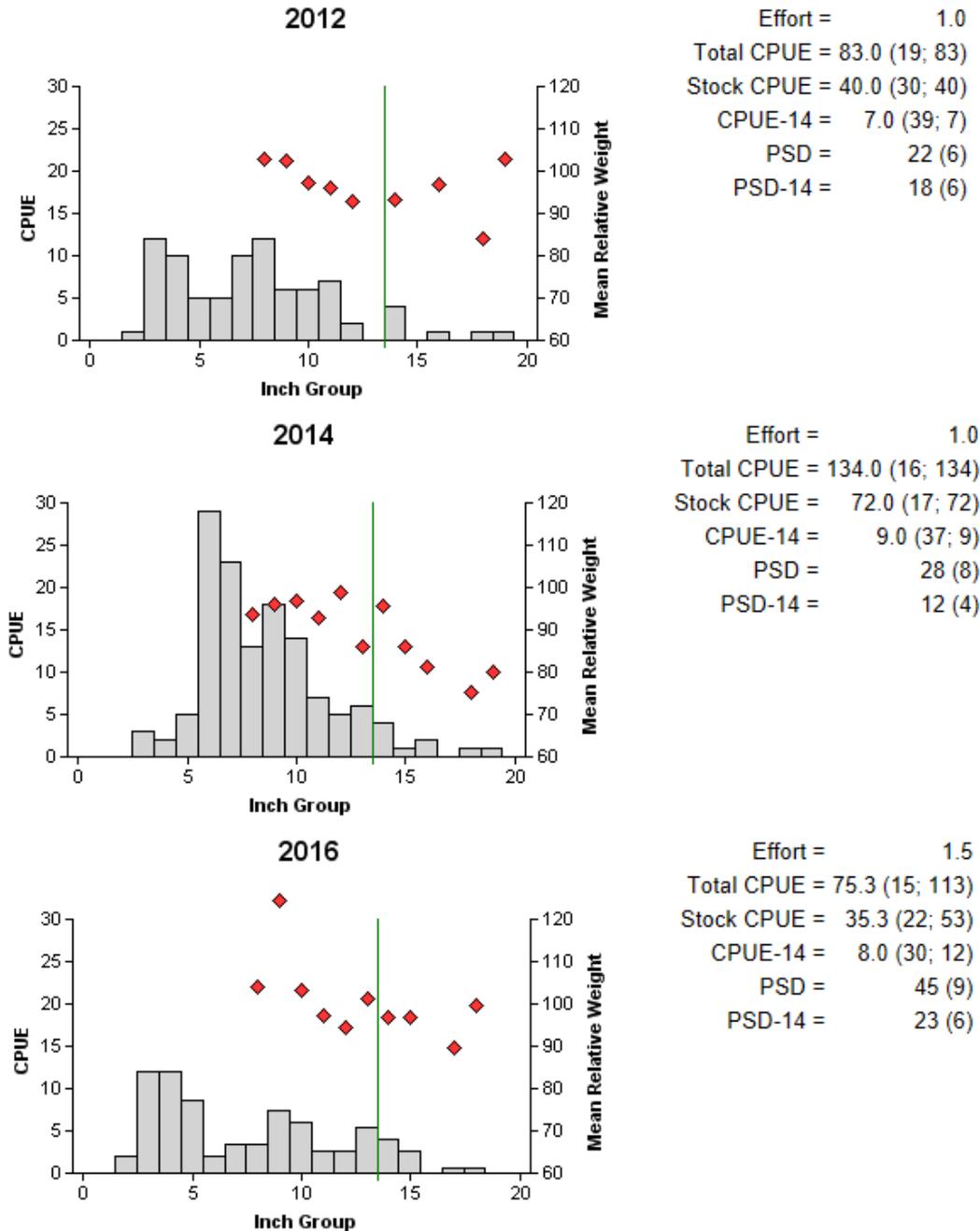
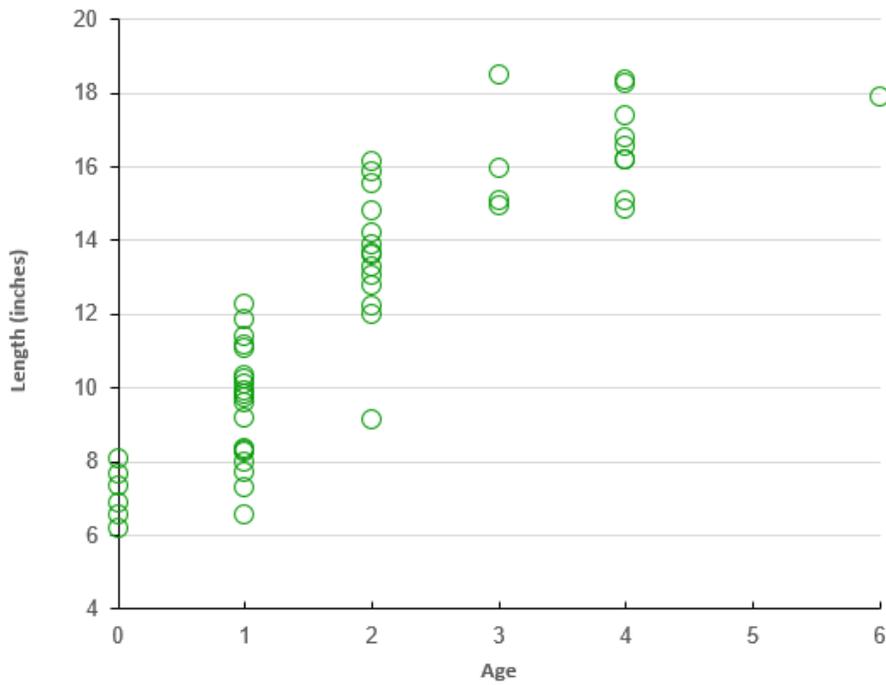


Figure 5. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Holbrook, Texas, 2012, 2014, and 2016. Vertical lines indicate minimum length limit at time of survey.

## Largemouth Bass



Age Class	0	1	2	3	4	6
Average Length (in)	7.1	9.6	13.6	16.1	16.6	17.9
N	6	20	14	4	9	1

Figure 6. Length-at-age for Largemouth Bass collected from electrofishing at Lake Holbrook, Texas, October 2016.

## Largemouth Bass

Table 10. Creel survey statistics for Largemouth Bass at Lake Holbrook, Texas, from March through May 2017. 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	Spring 2017
Directed angling effort (h)	
Tournament	4,616 (28)
Non-tournament	4,356 (27)
All black bass anglers combined	8,972 (23)
Angling effort/acre	13.8 (23)
Catch rate (number/h)	0.5 (19)
Harvest	
Non-tournament harvest	46 (489)
Harvest/acre	0.1 (489)
Tournament weigh-in and release	1,049 (79)
Release by weight	
<4.0 lbs	2,947 (47)
4.0-6.9 lbs	136 (63)
7.0-9.9 lbs	45 (87)
≥10.0 lbs	0
Percent legal released (non-tournament)	99%

## Largemouth Bass

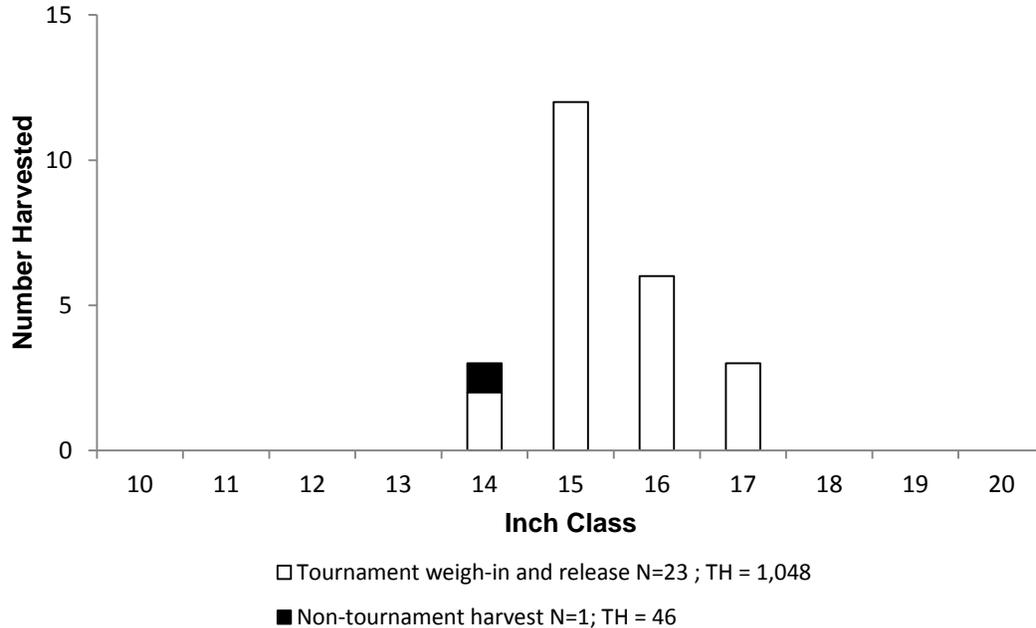


Figure 7. Length frequency of non-tournament and tournament-retained Largemouth Bass observed during creel surveys at Lake Holbrook, Texas, March through May 2017, all anglers combined. N is the number of Largemouth Bass observed during creel surveys, TH is the estimated non-tournament harvest, and TR is estimated number of fish temporarily retained during tournaments for the creel period.

Table 11. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Lake Holbrook, Texas, 2012 and 2016. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, F1 = first generation hybrid between a FLMB and a NLMB, Fx = hybrids with half of their alleles derived from each lineage, Fx-F/Fx-N=hybrids with more than half their alleles derived from the FLMB/ NLMB lineage. Genetic composition was determined with micro-satellite DNA analysis

## Largemouth Bass

Year	Sample size	Genotype						% FLMB alleles	% pure FLMB
		FLMB	F1	Fx	Fx-F	Fx-N	NLMB		
2012	30	0	1	27	-	-	2	27	0
2016	30	0	0	0	8	20	2	38	0

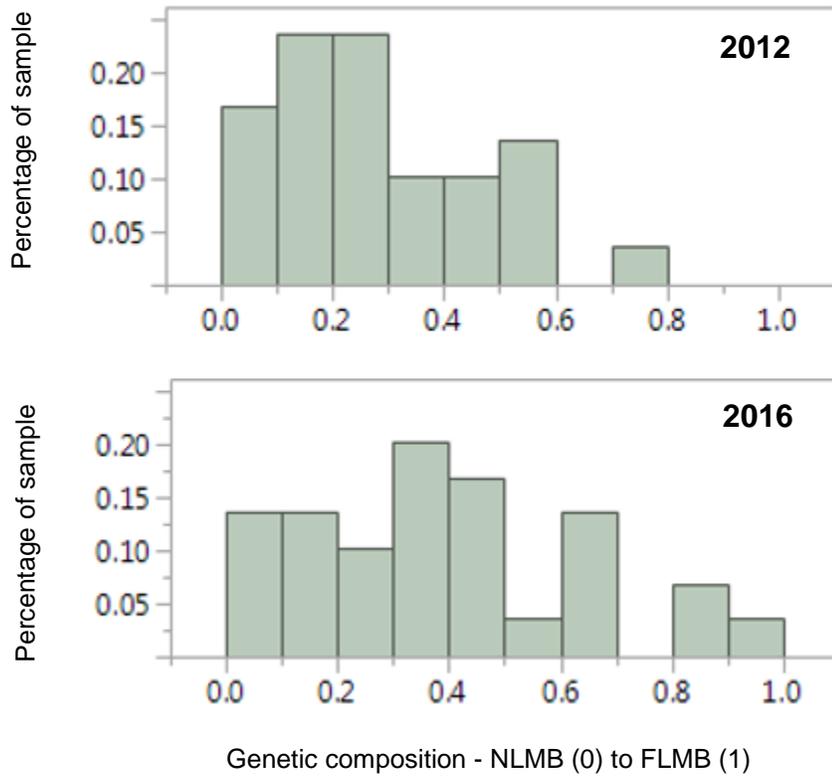


Figure 8. Distribution of genetic composition of Largemouth Bass in Lake Holbrook in 2012 and 2016.

## Spotted Bass

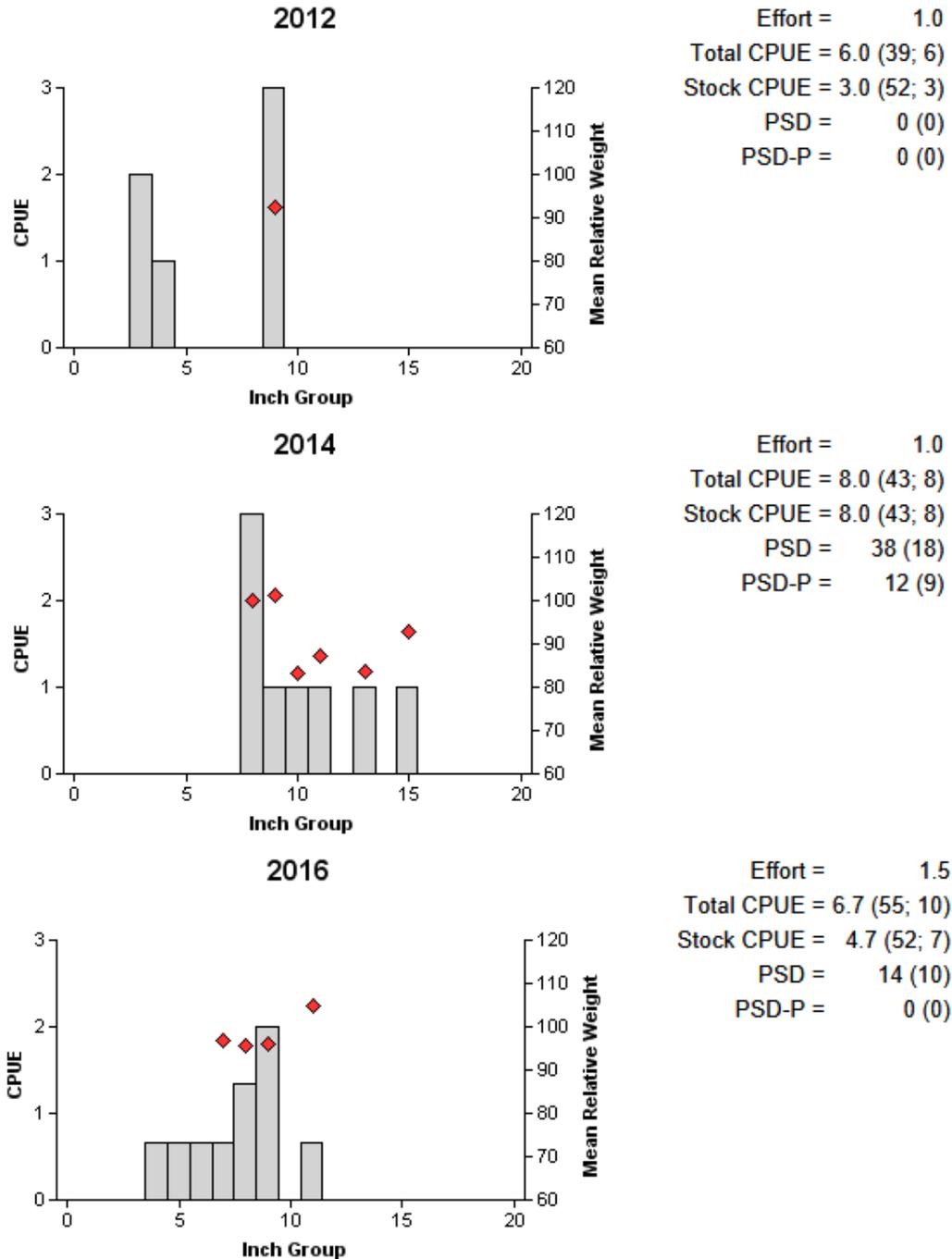


Figure 9. Number of Spotted Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Holbrook, Texas, 2012, 2014, and 2016.

## White Crappie

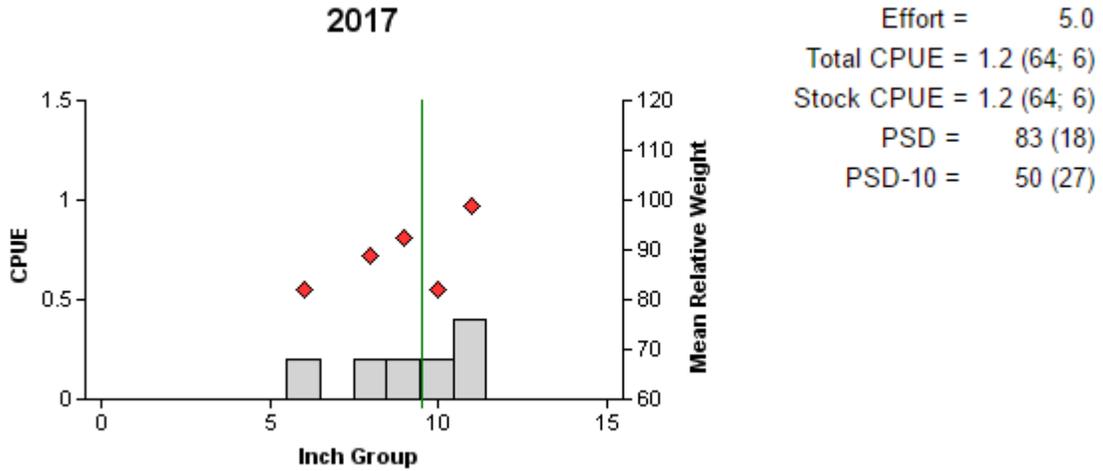


Figure 10. Number of White Crappie caught per series net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for tandem hoop net surveys, Lake Holbrook, Texas, April 2017

## Black Crappie

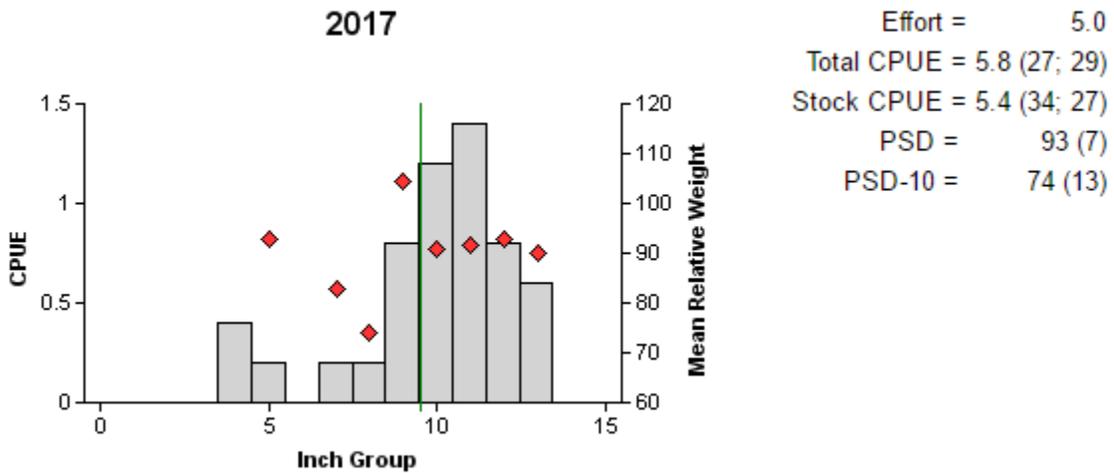


Figure 11. Number of Black Crappie caught per series net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for tandem hoop net surveys, Lake Holbrook, Texas, April 2017.

## Crappies

Table 12. Creel survey statistics for crappie at Lake Holbrook, Texas, from March through May 2017. Total catch per hour is for anglers targeting crappie and total harvest is the estimated number of crappie harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Spring 2017
Directed effort (h)	4,918 (26)
Directed effort/acre	7.6 (26)
Total catch per hour	1.3 (40)
Total harvest	5,645 (52)
Harvest/acre	8.7 (52)
Percent legal released	4%

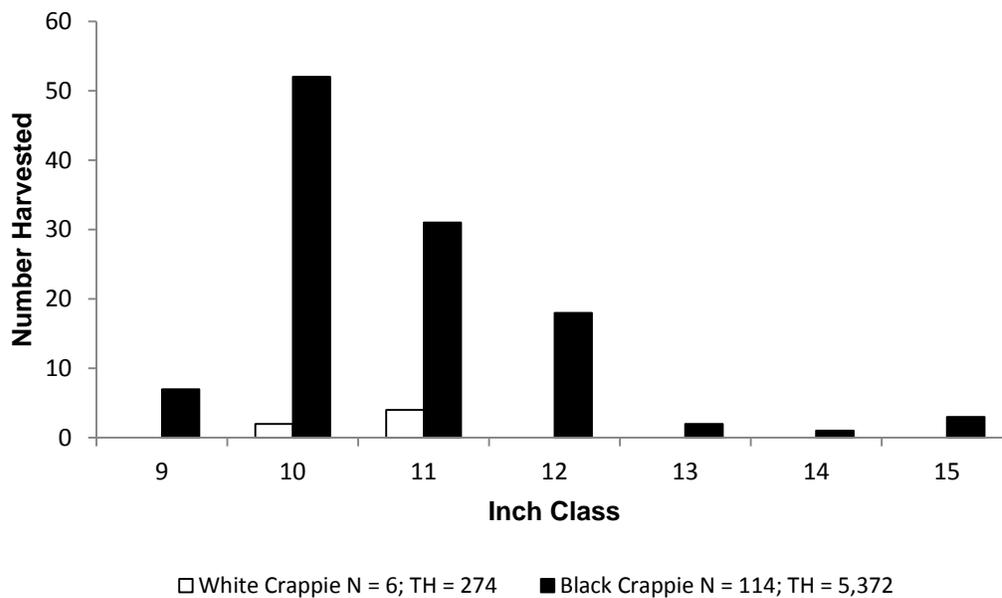


Figure 12. Length frequency of harvested White and Black Crappie observed during creel surveys at Lake Holbrook, Texas, March through May 2017, all anglers combined. N is the number of harvested crappie observed during creel surveys, and TH is the total estimated harvest for the creel period.

Table 13. Proposed sampling schedule for Lake Holbrook, Texas. Gill netting surveys are conducted in the spring, while electrofishing is conducted in the fall. Standard survey denoted by S and additional survey denoted by A.

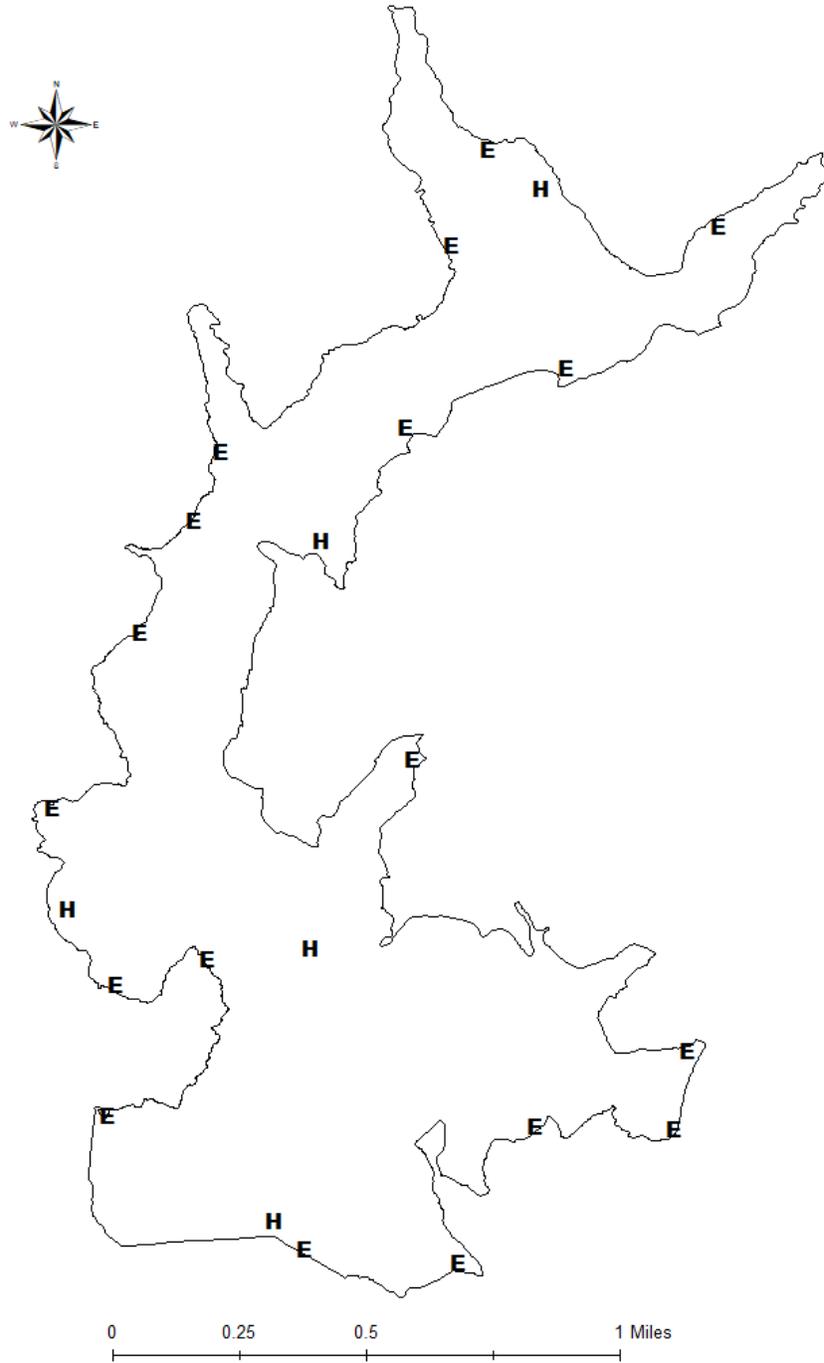
Survey year	Electrofish Fall	Hoop net	Vegetation	Access	Creel survey	Report
2017-2018						
2018-2019	A					
2019-2020						
2020-2021	S	A	S	S	A	S

**APPENDIX A**

Number (N) and catch rate (CPUE) of all target species collected by fall electrofishing, and spring baited hoop netting from Lake Holbrook, Texas, 2016-2017.

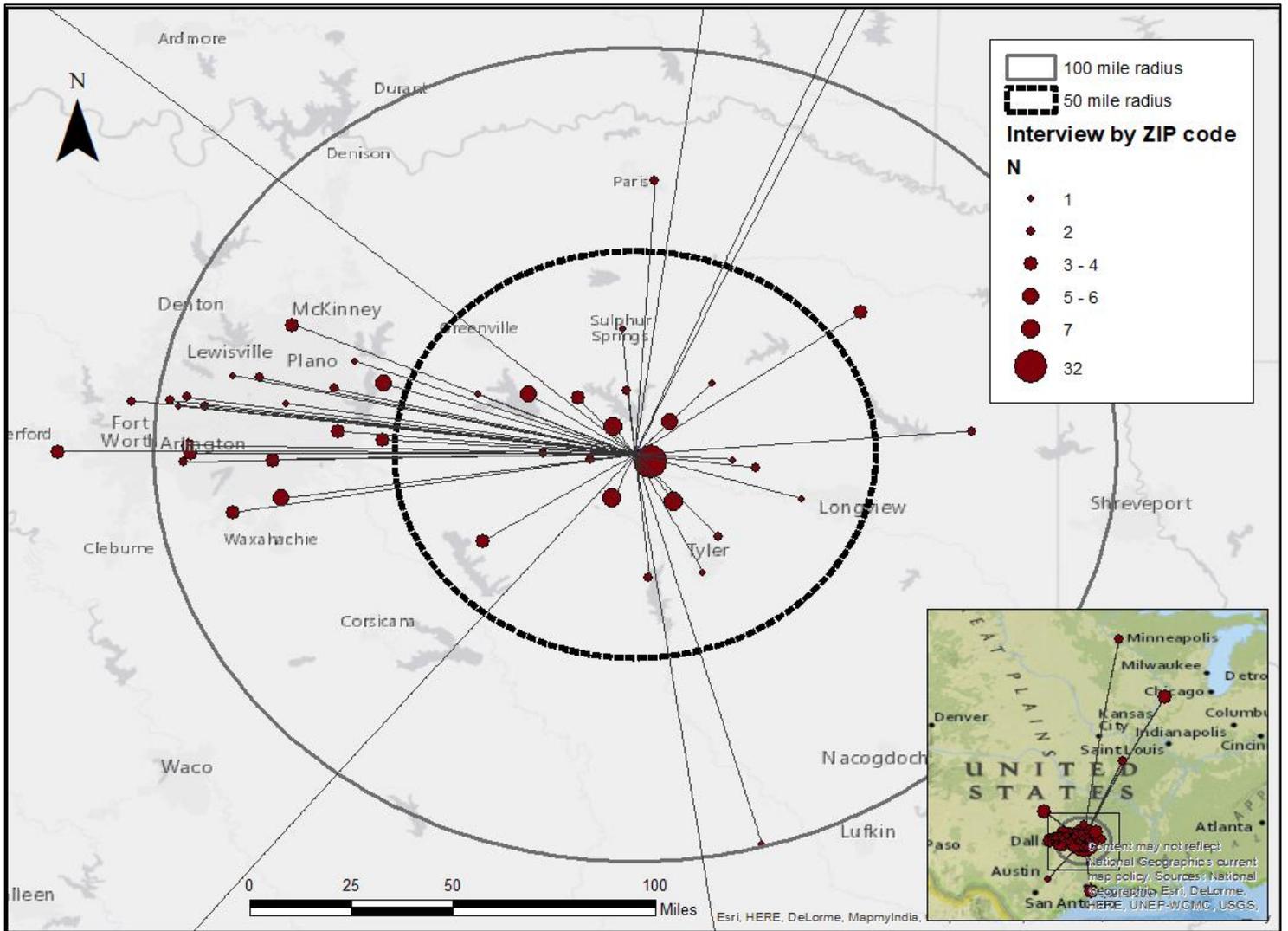
Species	Electrofishing		Hoop netting	
	N	CPUE	N	CPUE
Gizzard Shad	40	26.7		
Threadfin Shad	43	28.7		
Warmouth	38	25.3		
Bluegill	866	577.3		
Longear Sunfish	41	27.3		
Redear Sunfish	159	106.0		
Spotted Bass	10	6.7		
Largemouth Bass	113	75.3		
White Crappie			6	1.2
Black Crappie			29	5.8

APPENDIX B



Location of electrofishing (E) and hoop netting (H) sites, Lake Holbrook, Texas, 2016-2017.

APPENDIX C



Location, by ZIP code, and frequency of anglers interviewed in the creel survey at Lake Holbrook, Texas, from March through May 2017. Circles indicate 50-mile and 100-mile radiuses around Lake Holbrook.

## APPENDIX D

Objective-based sampling plan components for Lake Holbrook, Texas for 2017 – 2021.

Gear/ target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing – Fall 2018</i>			
<i>(Effort =12 – 18 stations)</i>			
Largemouth Bass	<i>Monitor trend in:</i>		
	Abundance	CPUE – stock	RSE-Stock $\leq$ 25
	Size structure	PSD, length frequency	N $\geq$ 50 stock
	Condition	$W_r$	10 fish/inch group (max)
<i>Electrofishing – Fall 2020</i>			
<i>(Effort =12 – 18 stations)</i>			
Largemouth Bass	<i>Monitor trend in:</i>		
	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
	Age-and-growth	Category 2	Estimate mean age of 14-inch fish
Bluegill <sup>a</sup>	Abundance	CPUE – Total	
	Size structure	PSD, length frequency	
Redear Sunfish <sup>a</sup>	Abundance	CPUE – Total	
	Size structure	PSD, length frequency	
Gizzard Shad <sup>a</sup>	Size structure	PSD, length frequency	
	Prey availability	IOV	
<i>Creel survey- March – May 2021</i>			
Largemouth Bass	Characterize fishery and document trophy potential	Directed effort, angler CPUE, harvest, and release of fish by weight categories	
Crappies & Catfish	Characterize fishery	Directed effort, angler CPUE, harvest	
<i>Tandem hoop netting – March – April 2021</i>			
<i>(Effort=10 -15 net series)</i>			
Crappies	<i>Monitor trend in:</i>		
	Abundance	CPUE– stock	RSE-Stock $\leq$ 25
	Size structure	PSD, length frequency	N $\geq$ 50 stock
	Condition	$W_r$	10 fish/inch group (max)
	Age-and-growth	Category 2	Estimate mean age of 10-inch fish

<sup>a</sup> No sampling objectives have been set for prey species so no additional sampling effort beyond that designated for Largemouth Bass will be conducted. Instead, Largemouth Bass body condition can provide information on forage abundance, vulnerability, or both relative to predator density.