

PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2015 Fisheries Management Survey Report

Cedar Creek Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Cedar Creek Reservoir were surveyed in 2015 using electrofishing and trap netting and in 2016 using gill netting. Anglers were surveyed from June 2015 through May 2016 with a creel survey. Historical data are presented with the 2015/2016 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:** Cedar Creek Reservoir is a 32,623-acre impoundment of Cedar Creek, a tributary of the Trinity River approximately 14 miles northeast of Athens, Texas. The reservoir was constructed by the Tarrant Regional Water District in 1965 to provide water for municipal and industrial use. Boat access is adequate, but public access for bank anglers is limited. Littoral habitat varies with water level, but currently contains abundant flooded terrestrial vegetation.
- **Management History:** Important sportfish include Hybrid Striped Bass, White Bass, Largemouth Bass, Blue Catfish, Channel Catfish, and White and Black Crappies. The management plan from the 2012 survey report included stocking Hybrid Striped Bass at 10/acre and periodic stocking of Florida Largemouth Bass at 15/acre to improve large fish numbers. Hybrid Striped Bass were stocked in 2013-2015 at ~5/acre and Florida Largemouth Bass were stocked in 2015 at ~0.9/acre.
- **Fish Community**
 - **Prey species:** Threadfin Shad were present in the reservoir. Electrofishing catch of Gizzard Shad was high, and most were available as prey to sport fish. Bluegill were also abundant, and over 50% were less than four inches long.
 - **Catfishes:** Historically, catfish have been a popular fishery on Cedar Creek. Flathead, Blue and Channel Catfish are all present within the reservoir. Blue Catfish continue to be the most abundant and sought after catfish species.
 - **Temperate basses:** White Bass and Hybrid Striped Bass were present in the reservoir. Hybrid Striped Bass numbers fluctuated over the previous gill net surveys, reflective of inconsistent stocking densities.
 - **Largemouth Bass:** Largemouth Bass were the most sought after species at Cedar Creek, accounting for 41% of all directed effort. Largemouth Bass displayed fast growth (mean age at 14 inches long was 1.8 years)
 - **Crappie:** Both Black and White Crappie are present in Cedar Creek reservoir and remained a popular fishery; anglers harvested an estimated 37,335 crappie from June, 2015-May, 2016. Black Crappie displayed fast growth (most reached legal length by age 1).

Management Strategies: Continue stocking Hybrid Striped Bass at 15 fish/acre and Florida Largemouth fingerlings at 1000/km of shoreline. Inform the public about the negative impacts of aquatic invasive species. Conduct additional gill net survey in 2018, and general monitoring surveys with trap nets, gill nets, and electrofishing surveys in 2019/2020. Access and vegetation surveys should be conducted in 2019.

INTRODUCTION

This document is a summary of fisheries data collected from Cedar Creek Reservoir in 2015/2016. 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 2015/2016 data for comparison.

Reservoir Description

Cedar Creek Reservoir is a 32,623-acre impoundment of Cedar Creek, a tributary of the Trinity River approximately 14 miles northeast of Athens, Texas. The reservoir was constructed by the Tarrant Regional Water District (TRWD) in 1965 to provide water for municipal and industrial use. Primary water uses included municipal water supply and recreation. Cedar Creek Reservoir is hyper-eutrophic with a mean TSI chl-a of 61.2 (Texas Commission on Environmental Quality 2005). Habitat at time of sampling consisted primarily of flooded terrestrial vegetation and alligatorweed. A small patch of water hyacinth was discovered and the controlling authority was notified of its location. Water levels fluctuated from 2010-2014 and averaged 2-8 ft. below conservation pool (cp); elevation has remained at or within 2 ft. of cp since January, 2015 (Figure 1). Other descriptive characteristics for Cedar Creek Reservoir are in Table 1.

Angler Access

Cedar Creek Reservoir has two public boat ramps (Chamber Island and County Ramp) and many private ramps. Both public ramps were accessible during the most recent survey period. Shoreline access is limited to the public boat ramp area of County Ramp and the fishing pier located at Chamber Island. Chamber Island is also ADA accessible. Additional boat ramp characteristics are in Table 2.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Ott and Bennett 2012) included:

1. Request periodic stocking of FLMB (500,000 fingerlings) to maintain/improve large fish numbers. Examine Largemouth Bass growth every four years and assess allele frequency of FLMB in 2015.
Action: Approximately 29,700 FLMB fingerlings were stocked in 2015. The population was surveyed via electrofishing in the fall of 2015; a subsample of fish was collected for age/growth and genetic analysis.
2. Request Hybrid Striped Bass (HSB) at 10 fish/acre annually to maintain fishery. Conduct gill netting in 2014 and 2016 to monitor Hybrid Striped Bass (HSB) population and conduct harvest assessment of HSB during 2015/2016 creel survey.
Action: HSB (Palmetto Bass and/or Sunshine Bass as available) were stocked at rates of 3-7 fish/acre since 2011 and gill net surveys were conducted as prescribed.
3. Monitor presence of exotic species in reservoir through vegetation surveys.
Action: A comprehensive vegetation survey was conducted in 2015. Water hyacinth was identified and its location reported to TRWD.
4. Promote Cedar Creek angling opportunities via news releases and presentations to angling clubs.
Action: District Facebook page is utilized when appropriate to promote Cedar Creek fishery.

Harvest regulation history: All sport fishes in Cedar Creek Reservoir are currently managed with statewide harvest regulations (Table 3).

Stocking history: Since 2002, Cedar Creek Reservoir has been stocked annually (with the exception of 2010 and 2012) with Hybrid Striped Bass. Florida Largemouth Bass have been periodically stocked; 29,700 fingerlings stocked in 2015. The complete stocking history is in Table 4.

Water transfer: Cedar Creek Reservoir was built by TRWD for municipal water supply. TRWD is currently a water wholesaler to more than ten counties in the Dallas and Fort Worth (DFW) Metroplex. Raw water is transferred from Cedar Creek through the East Texas Pipeline and converges with water from Richland Chambers near Waxahachie, Texas. Water from the pipeline is available along a grid system to multiple water treatment plants in the DFW area and has the potential to be introduced directly or indirectly into Richland Chambers Reservoir, Lake Halbert, Lake Bardwell, Lake Benbrook, Joe Pool Reservoir, Mountain Creek Reservoir, Lake Arlington, Eagle Mountain Reservoir and Lake Worth. The TRWD and the City of Dallas Water Utilities have partnered to construct an Integrated Pipeline Project, which will create further connections between municipalities and reservoirs, including Lake Palestine.

METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Cedar Creek 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 (1.9 hours at 23, 5-min stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing. Ages for Largemouth Bass were determined using otoliths from 13 randomly-selected fish (range 13.1 to 14.8 inches).

Trap netting – Crappie were collected using trap nets (20 net nights at 20 stations). CPUE for trap netting was recorded as the number of fish caught per net night (fish/nn). Ages for Black Crappie were determined using otoliths from 13 randomly-selected fish (range 9.2 to 10.8 inches).

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

Genetics – Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015). Micro-satellite DNA analysis was used to determine genetic composition of individual fish.

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

Creel survey – An access-point creel survey was conducted from 2015 through 2016. 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 vegetation survey was conducted in 2015. 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 2016).

RESULTS AND DISCUSSION

Habitat: Ott and Beck (2008) reported 60% of the structural habitat was bulkhead with boat docks; there has been minimal fluctuation in habitat in recent years. Currently, vegetation occupies less than 1% of the total surface acreage of Cedar Creek (Table 6). Flooded terrestrial vegetation (black willow) accounted for most of the habitat (223 acres), followed by alligatorweed (48 acres), giantacres), cutgrass (8 acres) and giant bulrush (5 acres). Several other species were identified, but occupied less than 0.05 acres including bulltongue, cattail, giant reed, American lotus, soft rush, and American waterwillow. A small patch of water hyacinth was identified north of the 334 bridge. The TRWD elected to not pursue treatment options.

Creel: Directed fishing effort by anglers was highest for Largemouth Bass (41%), followed by anglers seeking catfish and crappies (Table 7). Total fishing effort (109,102 h) for all species and directed expenditures (\$1,053,162) were down from the previous creel survey in 2007/2008 (272,047 h and \$1,630,227, respectively) (Table 8). Low water in 2011 reduced the scheduled year-long creel to the summer and fall quarters (Ott and Bennett 2012); 2011 data was not included in this report as relevant comparisons could not be made between full-year creel data and the partial 2011 creel.

Prey species: Gizzard Shad, Threadfin Shad, and Bluegill are important prey species within Cedar Creek Reservoir. Electrofishing catch rates of Bluegill and Gizzard Shad were 238.4/h and 190.5/h, respectively. Index of vulnerability (IOV) for Gizzard Shad was high, indicating that 80% of Gizzard Shad were available to predators (Figure 2). Total CPUE of Bluegill in 2015 was lower than the previous night time survey (2007; 336.5), and size structure continued to be dominated by small individuals (Figure 3).

Catfish: The 2016 gill net catch rate of Blue Catfish (7.6/nn) was lower than the previous two surveys conducted in 2014 and 2012 (23.9/nn and 24.6 /nn, respectively) (Figure 4). Size structure has been consistent over the last three surveys, composed primarily of fish from 10 to 20 inches (PSD range: 7-21). Body condition has remained moderate and fairly stable, with most size classes displaying an average WR of 85-95. The lower catch rate for Catfish in 2016 could be attributed to above average winter rainfall (Figure 1). The Cedar Creek watershed was flooded for much of winter 2015/2016 resulting in increased flow entering the reservoir through its larger tributaries. It is plausible that the incoming flow concentrated large amounts of bait, and subsequently predator species as well, resulting in a non-randomly distributed population throughout the reservoir. The majority of the randomly generated gill net sites fell primarily within the lower, main lake region, away from the inflowing tributaries (Appendix 2). While Blue Catfish were the dominant species, Channel Catfish were still present within the reservoir, with catch rates of 10.3, 7.9 and 2.5 over the last three surveys (Figure 5). Due to the small sample size during the initial gill net survey, additional gill netting was not conducted and the Channel Catfish sample objectives of the OBS could not be met without excessive effort.

Catfish were the second most popular fishery on Cedar Creek Reservoir, accounting for 27% (29,550 h) of all directed angler effort (Tables 7 & 9). Previously, catfish were the most popular fishery, accounting for 41% (127,776 h) of directed effort (2007/2008). Angling catch rate also declined from 1.8 fish/h to 0.98 fish/h in the most recent creel period. Anglers harvested an estimated 37,335 catfish, down from an estimated 93,073 in 2007/2008. Blue Catfish accounted for 93% of harvested catfish. The percent of legal released fish continued to be less than 12%. Observed harvest of Blue Catfish from 2007 through 2016 ranged in size from 10 to 30 inches in length (Figure 6); harvested Channel Catfish ranged in size from 11 to 22 inches in length (Figure 7).

Temperate bass: The 2016 gill net survey indicated White Bass and HSB were still present within the reservoir (Figures 8 and 9). Similar to Channel Catfish, small sample sizes collected during the initial gill net survey suggested additional gill netting would not meet the sampling goals of the OBS plan, and no additional gill netting was conducted. Temperate bass accounted for 8% of directed angler effort (Table 7). Directed fishing effort, catch rate and total harvest for temperate bass was 8,877 h, 2.5 fish/h and 10,021 fish, respectively, over the last creel period (Table 10). Observed harvest of White Bass from 2007 through 2016 ranged in size from 10 to 15 inches in length (Figure 10); harvested HSB ranged in size from 17 to 23 inches in length (Figure 11).

Largemouth Bass: The electrofishing catch rates of Largemouth Bass during the last two night-time surveys (2015 and 2007) were similar (81.9/h and 80.0, respectively) and double that of the 2003 survey (41.5/h; Figure 12). Size structure was below the target range (PSD = 40-70; Willis et al. 1993) and varied from 31 to 38 since 2006. However, growth of Largemouth Bass collected in the 2015 survey was fast; average age at 14 inches (13.1 to 14.9 inches) was 1.8 years (N = 13; range = 1 – 3 years). Body condition in 2015 was good; relative weights averaged 90 - 110 for all size classes of fish and was similar

to body condition of previous surveys. Florida Largemouth Bass influence has remained relatively constant; Florida alleles have ranged from 33% to 43% (Table 12). Pure Northern Largemouth Bass accounted for 20% of fish from the 2015 analysis, up from 10% and 7% in 2011 and 2006, respectively.

Directed fishing effort, catch per hour, and total harvest for Largemouth Bass was 45,088 h, 0.7fish/h, and 506 fish, respectively, over the last creel period (Table 11). Both angler effort and catch rate were similar between the 2007/2008 and 2015/2016 creel surveys (Table 11). Most legal Largemouth Bass were released, ranging from 83% to 87% (Table 11). Observed harvest of Largemouth Bass from 2007 through 2016 ranged in size from 14 to 19 inches in length (Figure 13).

Crappie: The 2015 trap net survey indicated both White and Black Crappie were still present within the reservoir (Figures 14 and 15). White Crappie size structure varied over the last three surveys; PSD = 39, 97 and 40 in in 2007, 2011 and 2015, respectively (Figure 18). Black Crappie PSD was more consistent, ranging from 82-93 over the same survey period. Mean relative weight was good for both species, averaging between 90 and 110 for most size classes. Black Crappie growth rate in 2015 was fast; average age at 10 inches (9.2 to 10.9 inches) was 1.2 years (N = 13; range = 1 – 3 years).

Directed fishing effort, catch per hour, and total harvest for Crappie was 22,941 h, 1.5 fish/h, and 38,973 fish, respectively, over the last creel period (Table 13). These estimates are comparable to the 2007/2008 creel survey. Black Crappie accounted for 88% of all crappie harvested in the most recent creel survey, as opposed to 47% in 2007/2008. The most recent survey indicated crappie were a harvest-oriented species; only 2% of legal length fish were released (Table 13). Observed harvest of White Crappie from 2007 through 2016 ranged in size from 10 to 16 inches in length (Figure 16); harvested Black Crappie ranged in size from 9 to 15 inches in length (Figure 17).

Fisheries management plan for Cedar Creek Reservoir, Texas

Prepared – July 2016.

ISSUE 1: Hybrid Striped Bass are an important fishery at Cedar Creek Reservoir; inconsistency in annual stocking frequency and densities have resulted in unreliable availability and a fishery with unrealized potential. Annual stocking of HSB (Palmetto Bass and/or Sunshine Bass) is required to sustain the population and maintain a fishery.

MANAGEMENT STRATEGIES

1. Stock HSB (Palmetto Bass, Sunshine Bass, or combination of both to meet stocking request) annually at 15 fish/acre.
2. Monitor HSB presence and size distribution through gill net surveys in 2018 and 2020, and monitor catch, harvest, and fishing effort through a creel survey in 2019/2020.

ISSUE 2: The Largemouth Bass fishery at Cedar Creek Reservoir continues to be popular (as apparent through creel data and anecdotal tournament results). Several years of drought resulted in very poor littoral habitat, and likely very poor year classes of Largemouth Bass. The rebounding lake levels over the last two years resulted in expansive flats of inundated terrestrial vegetation that provided excellent habitat for juvenile fish. Cedar Creek will likely experience a new lake effect over the next several years, offering improved survival and recruitment of Largemouth Bass.

MANAGEMENT STRATEGIES

1. Stock Florida Largemouth Bass annually at 1,000/km of shoreline to take advantage of current flooded habitat.
2. Monitor the LMB population (abundance, size structure, condition, growth and genetic composition) every four years with night-time electrofishing and fishing effort through a creel survey in 2019/2020.

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 for Cedar Creek Reservoir 2016 - 2020

Sport fishes in Cedar Creek Reservoir include Blue and Channel Catfish, White and Hybrid Striped Bass, Largemouth Bass, Black and White Crappie. Important prey species include Gizzard and Threadfin Shad, and sunfishes.

Survey objectives, fisheries metrics, and sampling objectives

Crappie: Crappie represented 21% of the directed angler effort during the most recent creel survey at Cedar Creek Reservoir. While CPUE was relatively high, the confidence intervals surrounding estimates of abundance and size structure fluctuated considerably. Based on bootstrap analysis of historical data it would take a minimum of 20 trap nets to accurately estimate size structure (PSD: $N > 50$ stock-length fish) at least 80% of the time. The historically variable catch rates suggest it would take a minimum of 35 trap nets to estimate relative abundance of stock size fish with acceptable precision ($RSE-S < 25$). Crappie size structure, body condition, and growth (PSD, W_r , mean age at 10 inches) will continue to be monitored every four years in order to detect any larger scale population fluctuations. In the fall of 2019 a minimum of 10, randomly selected single-cod shoreline trap net sites will be sampled, and up to 10 additional nets will be set, if needed, to collect at least 50 stock-size individuals. We believe that the level of sampling proposed will provide our secondary sampling objective of 13 specimens between 9.0 and 10.9 inches for age and growth.

Blue Catfish: Catfishes accounted for 27% of directed angler effort during the last creel survey (June 2015-May 2016). Bootstrap analysis of historical gill net data suggest population indices (CPUE, PSD, W_r) can be estimated with acceptable precision ($RSE < 25$) and sample size ($N \geq 50$ stock-size fish) with only 10 nights of gill net effort at least 80% of the time. Population trend data (CPUE and PSD) will be monitored every two years in order to detect any large scale fluctuations. In the spring of 2018 and 2020, 10 gill nets will be set, with up to 10 additional nets set, in order to achieve a precise estimate ($RSE < 25$) of abundance and an acceptable size-structure estimate ($N \geq 50$ stock-size fish).

Channel Catfish: Channel Catfish gill net catch rate from the last three surveys has ranged from 2.5 - 10.3 fish/nn, however precision around the estimate has varied. Based on bootstrap analysis of historical data it would take a minimum of 63 gill nets to estimate relative abundance with acceptable precision ($RSE < 25$) and 33 gill nets to estimate size structure from an appropriate sample size ($N=50$). Due to the large amount of effort required to estimate Channel Catfish population indices, they will be monitored only for presence/absence in future surveys; catch data will continue to be reported. The effort required for Blue Catfish sample objectives will be sufficient to document the presence of Channel Catfish. No additional effort will be expended if Channel Catfish have not been collected after 20 gill nets.

Hybrid Striped Bass: HSB represented 8% (total temperate bass) of the directed angler effort during the most recent creel survey at Cedar Creek Reservoir. The last three gill net catch rates have been low and varied from 0.1 – 1.3 fish/nn; likely the result of inconsistent stocking rates. Bootstrap analysis of historical data (2012, 2014) suggest a large amount of effort (≥ 95 randomly-selected gill net nights) would be required to obtain precise CPUE estimates (i.e. $RSE < 25$) and adequate stock-size fish ($N \geq 50$) to estimate size structure. While trend data will be extremely difficult to estimate, it will still be necessary to document the survival of stocked HSB within the reservoir and the overall body condition. In accordance with the catfish sampling objectives, 10 gill nets will be set in the spring of 2018 and 2020 with up to 10 more, if necessary, in order to document the presence of HSB year classes and estimate W_r ; catch data will still be reported. No additional effort will be expended if HSB have not been collected after 20 gill nets.

White Bass: The last three White Bass gill net catch rates have been low and varied from 0.1 – 1.4 fish/nn; likely a result of drought and reduced inflow from tributaries during the spawning season. Bootstrap analysis of historical data suggest an impractical amount of effort (≥ 48 randomly-selected gill

net nights) would be required to obtain precise CPUE estimates (i.e. $RSE < 25$) and adequate stock-size fish ($N \geq 50$) to estimate size structure. In accordance with the catfish sampling objectives, 10 gill nets will be set in the spring of 2018 and 2020 with up to 10 more, if necessary, in order to document the presence of White Bass and estimate W_r ; catch data will still be reported. No additional effort will be expended if HSB have not been collected after 20 gill nets.

Largemouth Bass: Largemouth Bass accounted for 60% of total directed angler effort during the last creel survey. Electrofishing surveys conducted every four years from 2003-2015 produced CPUEs ranging from 41.5 to 81.9 fish/h. Bootstrap analysis of this data suggests estimating reliable population metrics (CPUE; $RSE < 25$, PSD; $N > 50$ stock size individuals) would require at least 37 randomly selected 5-minute electrofishing stations, or 22 stations to just estimate relative abundance. Population trend data (CPUE, PSD, W_r and genetics), along with age and growth samples, will be monitored every four years in order to detect any large scale population fluctuations. In the fall of 2019, up to 24 randomly selected 5-minute electrofishing stations will be conducted to estimate both relative abundance with an $RSE < 25$ and size structure of at least 50 stock-size fish. Up to 12 additional biologist-selected stations will be conducted if necessary, to collect the minimum 50 stock-length fish. The Florida Largemouth Bass allele frequency within the population will be monitored through microsatellite DNA analysis in 2019 by a subsample of 30 fish (any size). The average age of Largemouth Bass between 330 and 381 mm (Category 2; $N = 13$) will be estimated in 2019, and every four years thereafter.

Gizzard Shad and Bluegill: Relative abundance and IOV have been estimated for Gizzard Shad every four years since 1997, and have remained relatively stable. Gizzard Shad CPUE and IOV will continue to be monitored every four years with up to 24 randomly selected 5-minute electrofishing stations. Bluegill and other sunfish species are another prey source for predator species in Cedar Creek; catch rates have been historically variable and appear to be directly related to reservoir elevation. Sunfish relative abundance and size structure will be estimated every four years with up to 24 randomly selected 5-minute electrofishing stations. However, no additional stations will be conducted for sunfish species if target precision ($RSE < 25$ for CPUE) and at least 50 stock-size individuals are not collected after two hours of effort. The Largemouth Bass population estimates will determine if all 24 stations are necessary. If bass catch rate and size structure targets are met with fewer stations, the survey will be complete, and W_r 's from Largemouth Bass will be used as a secondary indicator to prey availability.

Angler Data: Historically, the Cedar Creek fishery has been monitored through angler creel surveys in order to monitor angling trends (species targeted, effort, catch and directed expenditures). Angler trend data will continue to be monitored with year-long (4 quarter) creel from June, 2019 through May, 2020. Each quarter of the creel will consist of 5 randomly selected weekend creel days and 4 randomly selected weekday creel days.

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Water Level

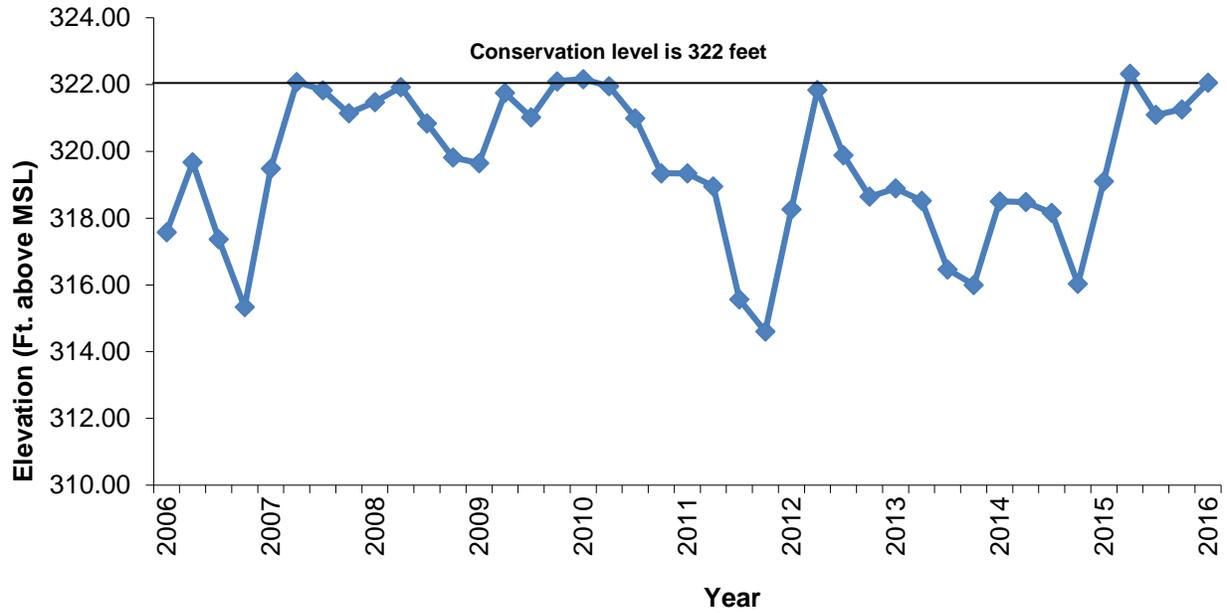


Figure 1. Quarterly water level elevations in feet above mean sea level (msl) recorded for Cedar Creek Reservoir, Texas

Table 1. Characteristics of Cedar Creek Reservoir, Texas.

Characteristic	Description
Year constructed	1965
Controlling authority	Tarrant Regional Water District
Counties	Henderson (dam), Kaufman
Reservoir type	Water Supply
Shoreline Development Index (SDI)	1.9
Conductivity	280 $\mu\text{S}/\text{cm}$

Table 2. Boat ramp characteristics for Cedar Creek Reservoir, Texas, August, 2015. Reservoir elevation at time of survey was 322 feet above mean sea level (conservation pool).

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft.)	Condition
Chamber Island	32.32930 -96.17042	Y	75	317	Good
Sandy Shores Marina	32.32866 -96.15995	N	70	314.5	Good
Lone Star Marina	32.26172 -96.15341	N	50	317	Good
Log Cabin	32.21733 -96.01523	N	100	317	Good
County Ramp	32.20874 -96.02556	Y	40	319	Good
Fisherman's Wharf	32.18871 -96.03118	N	40	318	Good

Table 3. Harvest regulations for Cedar Creek 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, Hybrid 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 Cedar Creek Reservoir, Texas. FGL = fingerling; ADL = adults; UNK = unknown

Species	Year	Number Stocked	Size
Threadfin Shad	1984	7,015	ADL
Channel Catfish	1966	7,600	UNK
	1973	<u>125</u>	UNK
	Total	7,725	
Palmetto Bass	1977	169,900	UNK
	1979	172,425	UNK
	1983	143,332	UNK
	1984	452,940	FGL
	1991	1,033,577	FRY
	1991	175,232	FGL
	1992	521,494	FGL
	1993	889,000	FRY
	1993	114,757	FGL
	1994	518,259	FGL
	1995	531,200	FGL
	1996	516,724	FGL
	1997	290,540	FGL
	1998	514,907	FGL
	1999	265,310	FGL
	2002	258,467	FGL
	2003	244,723	FGL
	2004	326,988	FGL
	2005	215,660	FGL
	2006	132,664	FGL
	2007	170,396	FGL
	2007	1,054,822	FRY
2008	308,108	FGL	
2009	124,836	FGL	
2011	101,341	FGL	
2013	155,431	FGL	
2014	166,620	FGL	
2015	<u>224,957</u>	FGL	
Total		9,794,610	
Largemouth Bass	1966	<u>690,000</u>	UNK
	Total	690,000	
Florida Largemouth Bass	1976	343,000	FGL
	1977	20,000	FGL

Table 4. Stocking history continued

	1978	398,837	FGL
	1997	343,012	FGL
	1998	453,072	FGL
	1999	342,424	FGL
	2000	57,986	FGL
	2004	501,870	FGL
	2005	496,806	FGL
	2008	185,016	FGL
	2009	531,063	FGL
	2015	<u>29,700</u>	FGL
	Total	3,702,786	
Sunshine Bass	2014	197,733	FGL
Walleye	1975	1,650,000	UNK
	1976	1,852,000	UNK
	1977	<u>2,100,000</u>	UNK
	Total	5,602,000	

Table 5. Objective-based sampling plan components for Cedar Creek Reservoir, Texas 2015/2016.

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
	Age-and-growth	Age at 14 inches	N = 13, 13.0 – 14.9 inches
	Condition	W_r	10 fish/inch group (max)
	Genetics	% FLMB	N = 30, any age
Bluegill ^a	Abundance	CPUE – stock	
	Size structure	PSD, length frequency	N \geq 50
Gizzard Shad ^a	Abundance	CPUE – Total	
	Prey availability	IOV	N \geq 50
<i>Trap netting</i>			
Crappie	Size structure	PSD, length frequency	N = 50
	Condition	W_r	10 fish/inch group (max)
	Age-and-growth	Age at 10 inches	N = 13, 9.0 – 10.9 inches
<i>Gill Netting</i>			
Blue Catfish	Abundance	CPUE – stock	RSE-Stock \leq 25
	Size structure	PSD, length frequency	N = 50
	Condition	W_r	10 fish/inch group (max)
Channel Catfish ^b	Size structure	PSD, length frequency	N = 50
	Condition	W_r	10 fish/inch group (max)
White Bass ^b	Condition	W_r	10 fish/inch group (max)
	Age-and-growth	Age at 10 inches	N = 13, 9.0 – 10.9 inches
Hybrid Striped Bass ^b	Presence/Absence		Practical effort
	Condition	W_r	10 fish/inch group (max)
	Age-and-growth	Age at 18 inches	N = 13, 9.0 – 10.9 inches

^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.

^b No additional effort will be expended to meet and evaluate survey objectives if not reached by necessary effort to evaluate Blue Catfish.

Table 6. Survey of aquatic vegetation, Cedar Creek Reservoir, Texas, 2003, 2007 and 2015. Surface area (acres) is listed with percent of total reservoir surface area in parentheses.

Vegetation	2003	2007	2015
Native emergent			
Bulrush			5 (<1)
Maidencane	7 (<1)		
Cutgrass			8 (<1)
Native submersed			
Pondweed	100 (<1)		
Native floating			
American lotus	111 (<1)		
Duckweed	16 (<1)		
Non-native			
Alligatorweed (Tier III)*		448 (1.4)	47 (<1)
Hydrilla (Tier III)*	<1 (<1)		
Water hyacinth (Tier III)*		197 (<1)	< 1 (<1)

*Tier III is Watch Status

Table 7. Percent directed angler effort by species for Cedar Creek Reservoir, Texas, 2007 – 2016. Survey periods were from 1 June through 31 May.

Species	2007/2008	2015/2016
Catfishes	41.0	27.1
Temperate Basses	9.0	8.1
Sunfishes	-	0.3
Largemouth Bass	19.0	41.3
Crappies	8.0	21.0
Anything	23.0	2.1

Table 8. Total fishing effort (h) for all species and total directed expenditures at Cedar Creek Reservoir, Texas, 2007-2016. Survey periods were from 1 June through 31 May. Relative standard error is in parentheses.

Creel statistic	2007/2008	2015/2016
Total fishing effort	272,047 (17)	109,102 (27)
Total directed expenditures	\$1,630,227	\$1,053,162

Gizzard Shad

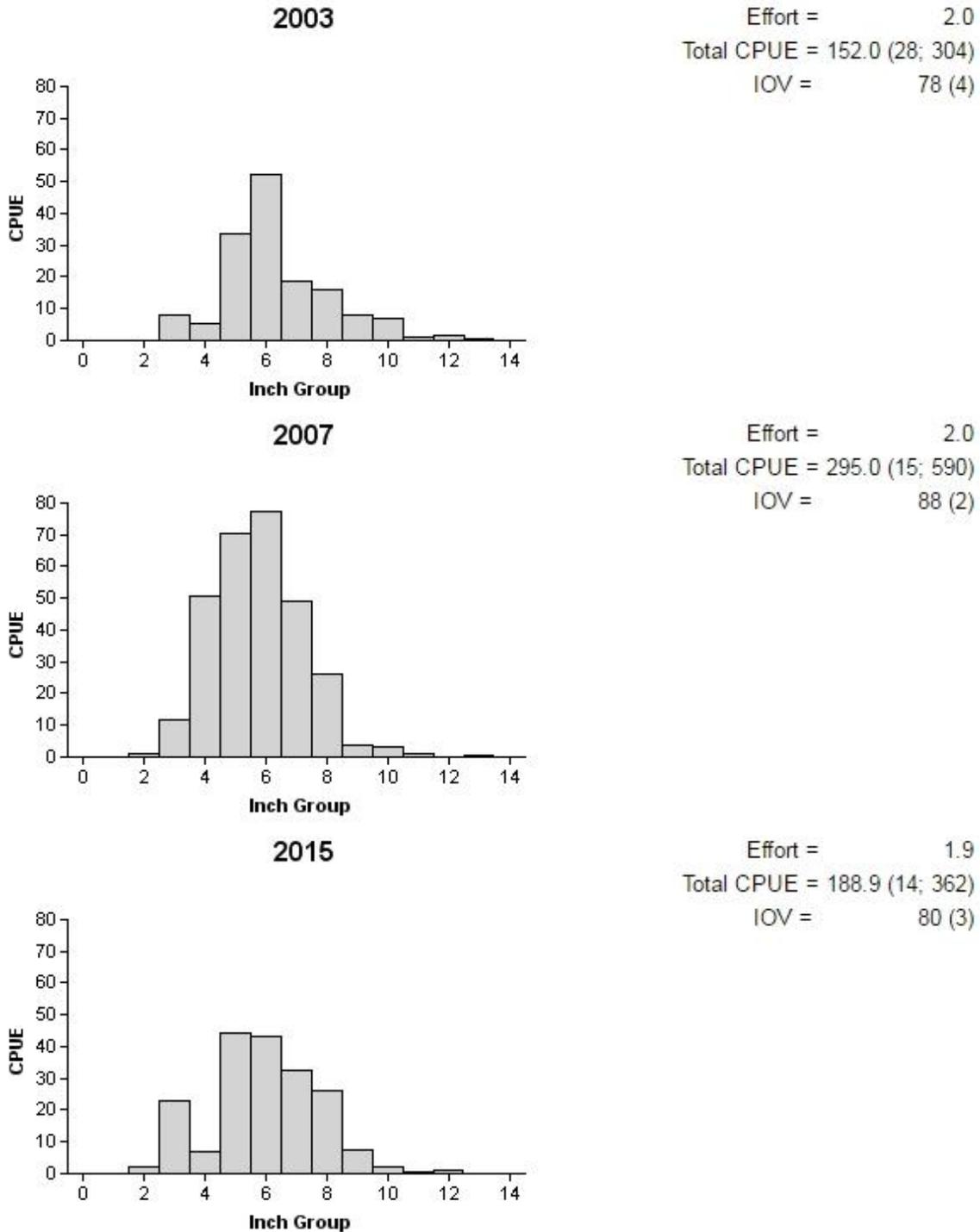
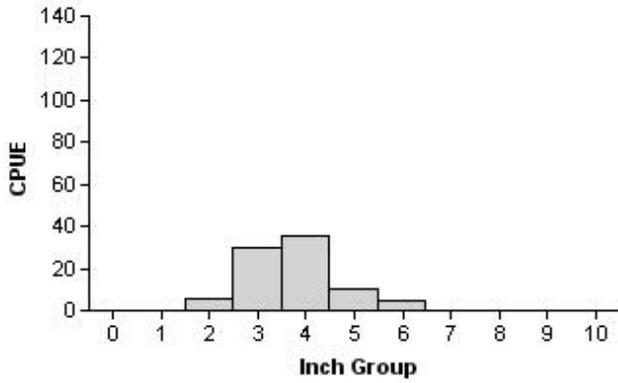


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall nighttime electrofishing surveys, Cedar Creek Reservoir, Texas, 2003, 2007 and 2015.

Bluegill

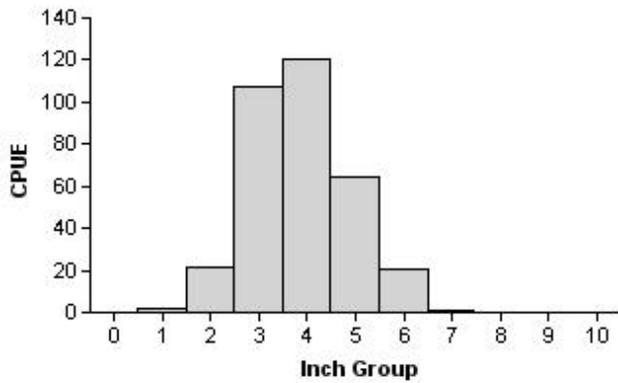
2003

Effort = 2.0
 Total CPUE = 86.0 (33; 172)
 PSD = 6 (4)



2007

Effort = 2.0
 Total CPUE = 336.5 (26; 673)
 PSD = 7 (5)



2015

Effort = 1.9
 Total CPUE = 236.3 (29; 453)
 PSD = 8 (2)

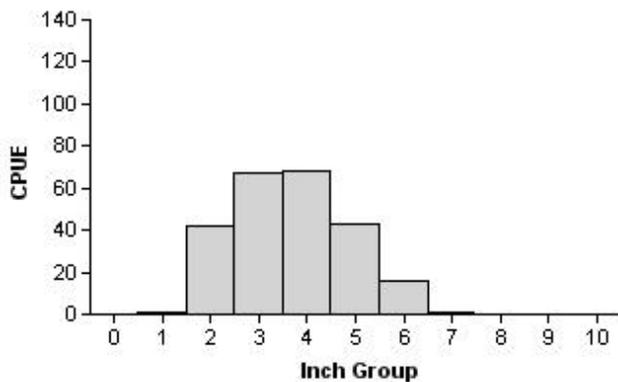


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall nighttime electrofishing surveys, Cedar Creek Reservoir, Texas, 2003, 2007 and 2015.

Blue Catfish

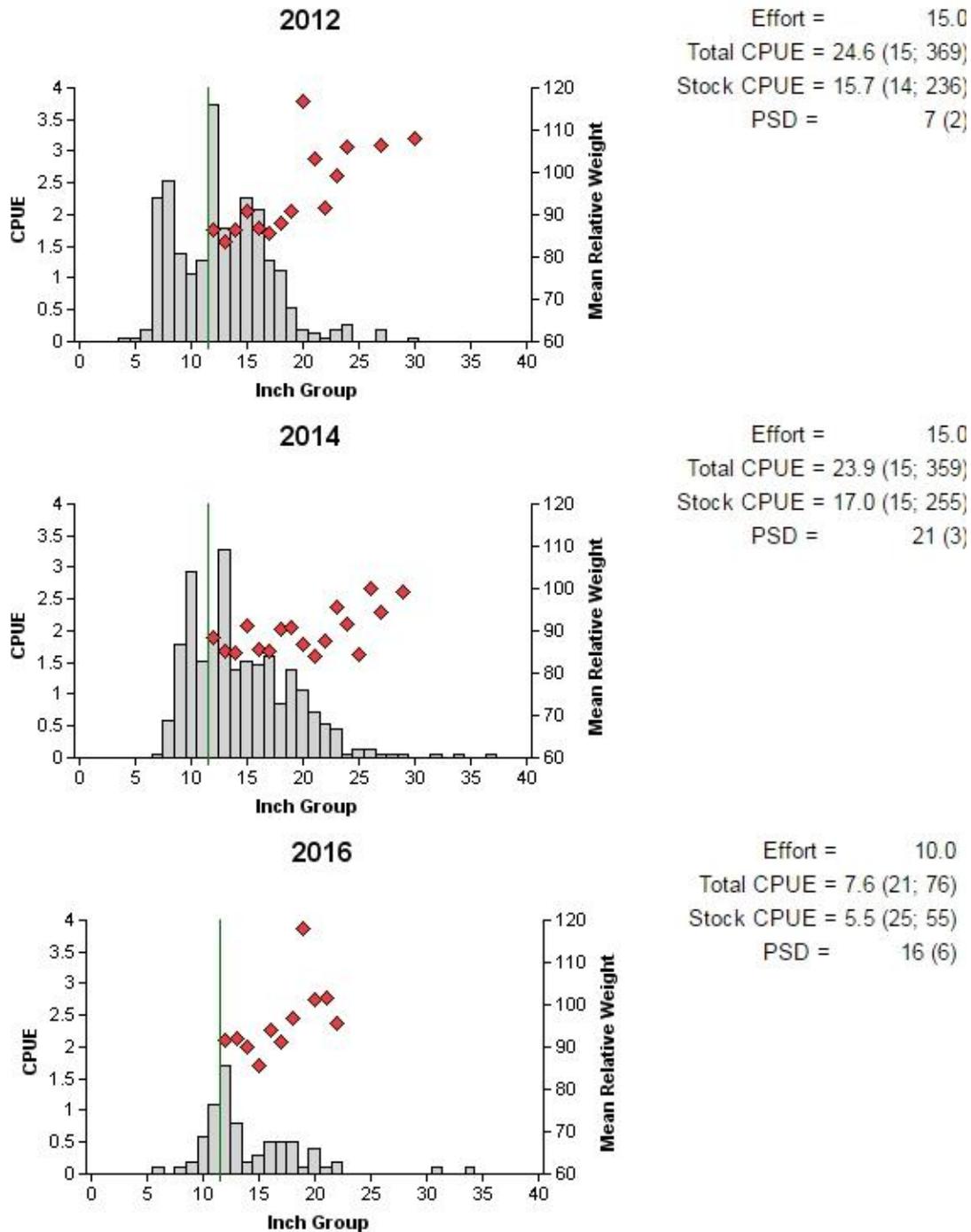


Figure 4. Number of Blue Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Cedar Creek Reservoir, Texas, 2012, 2014 and 2016. Vertical line represents minimum length limit.

Channel Catfish

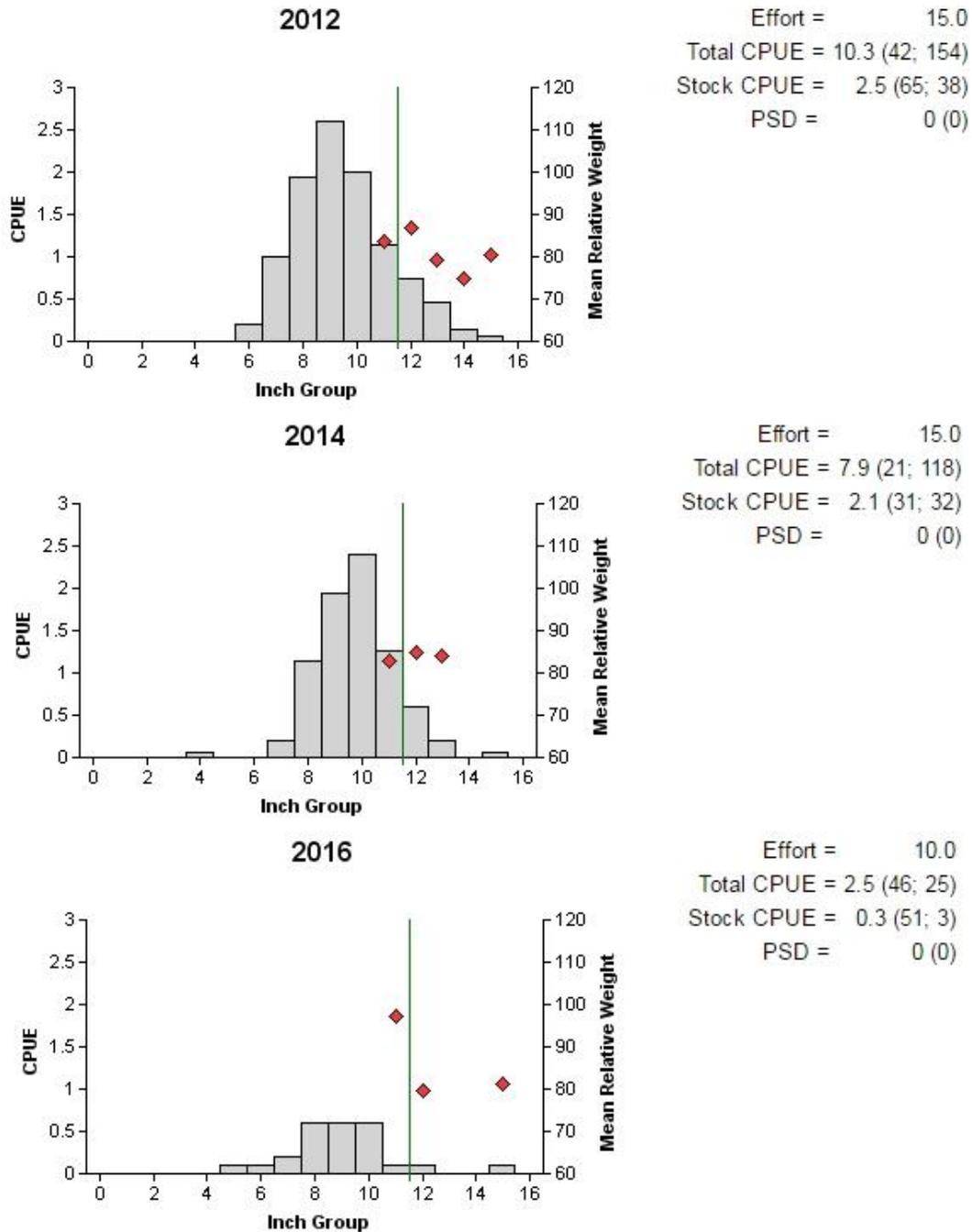


Figure 5. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Cedar Creek Reservoir, Texas, 2012, 2014 and 2016. Vertical line represents minimum length limit.

Catfish

Table 9. Creel survey statistics for catfish at Cedar Creek Reservoir, Texas, from June 2007 through May 2008 and June 2015 through May 2016. Total catch per hour is for anglers targeting all catfish and total harvest is the estimated number of harvested catfish by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year	
	2007/2008	2015/2016
Surface area (acres)	31,813	32,132
Directed effort (h)	127,776 (137)	29,550 (32)
Directed effort/acre	4.02 (137)	0.92 (32)
Total catch per hour	1.8 (52)	0.98 (32)
Total harvest	93,073 (31)	37,335 (49)
Blue Catfish	58,547 (30)	34,890 (44)
Channel Catfish	34,526 (34)	2,445 (113)
Harvest/acre	2.7 (31)	1.2 (49)
Percent legal released	12	7

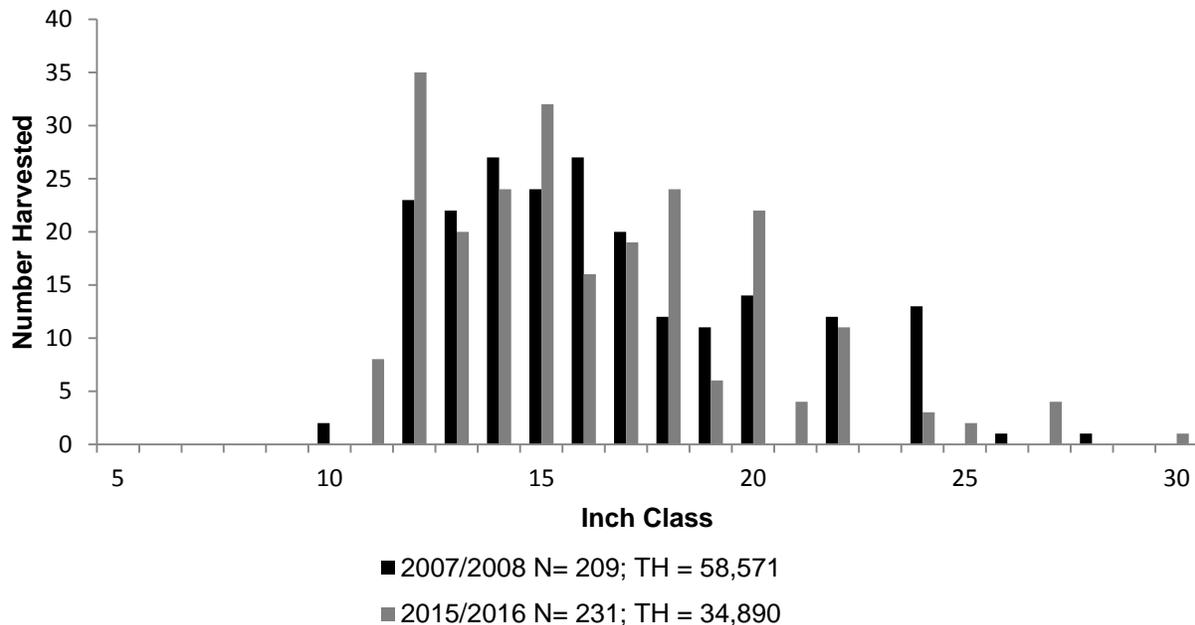


Figure 6. Length frequency of harvested Blue Catfish observed during creel surveys at Cedar Creek Reservoir, Texas, June 2007 through May 2016, all anglers combined. N is the number of harvested Blue Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period.

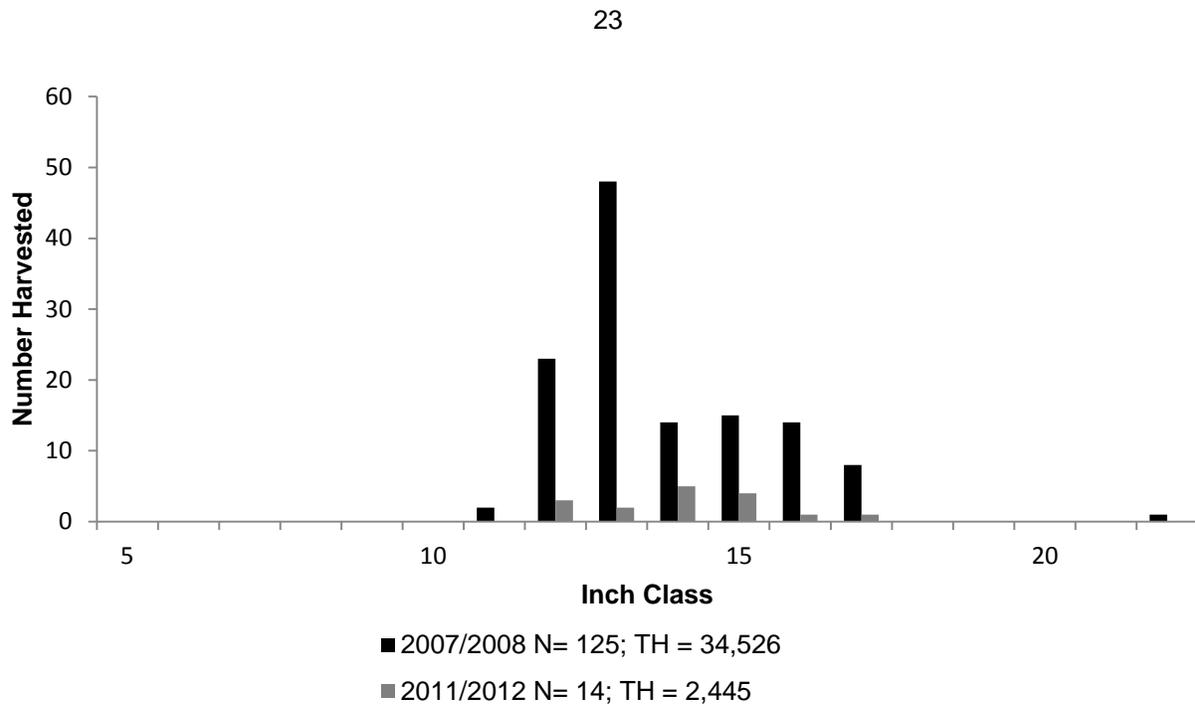


Figure 7. Length frequency of harvested Channel Catfish observed during creel surveys at Cedar Creek Reservoir, Texas, June 2007 through May 2016, all anglers combined. N is the number of harvested Channel Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period.

White Bass

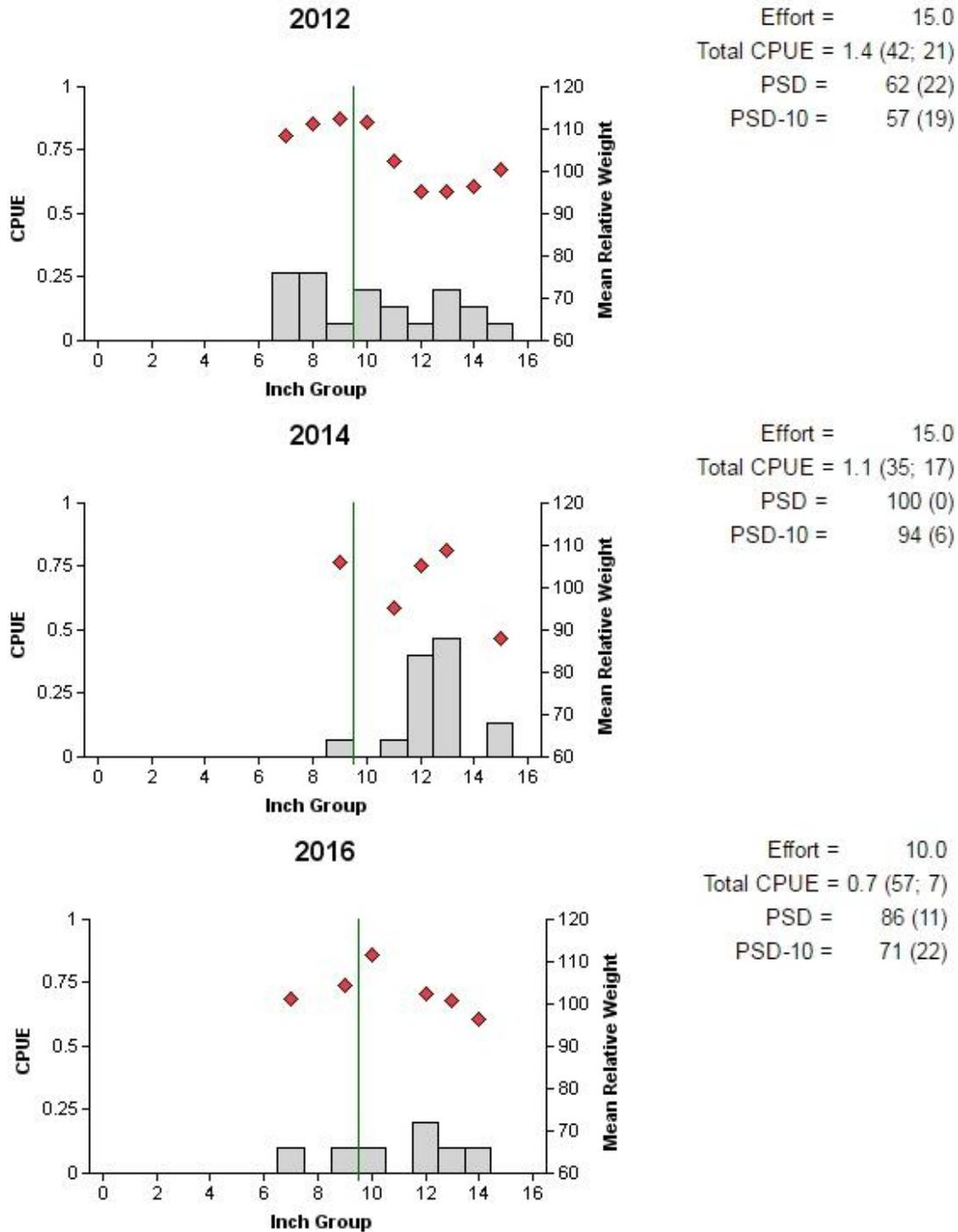


Figure 8. Number of White Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Cedar Creek Reservoir, Texas, 2012, 2014 and 2016. Vertical line represents minimum length limit.

Hybrid Striped Bass

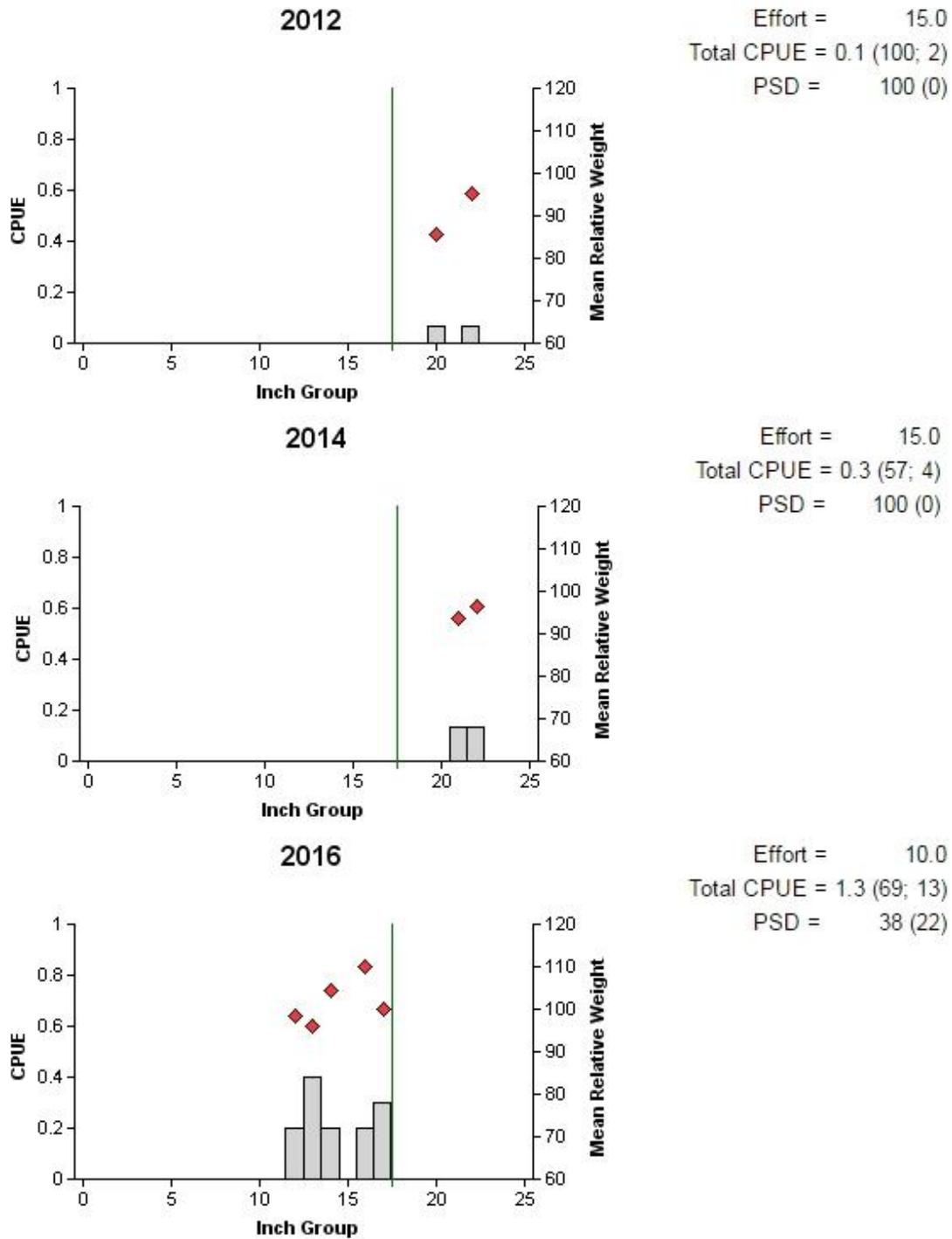


Figure 9 . Number of Hybrid Striped Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Cedar Creek Reservoir, Texas, 2012, 2014 and 2016. Vertical line represents minimum length limit.

Temperate Bass

Table 10. Creel survey statistics for temperate bass at Cedar Creek Reservoir, Texas, from June 2007 through May 2008, June 2011 through November 2011, and June 2015 through May 2016. Total catch per hour is for anglers targeting temperate bass and total harvest is the estimated number of harvested temperate bass by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year	
	2007/2008	2015/2016
Surface area (acres)	31,813	32,132
Directed effort (h)	23,416 (37)	8,877 (37)
Directed effort/acre	0.7 (37)	0.3 (37)
Total catch per hour	2.5 (47)	2.5 (39)
Total harvest	18,239 (58)	10,021 (82)
White Bass	16,547 (46)	8,964 (66)
Hybrid Striped Bass	1,692 (172)	1,057 (217)
Harvest/acre	0.6 (58)	0.31 (82)
Percent legal released		44

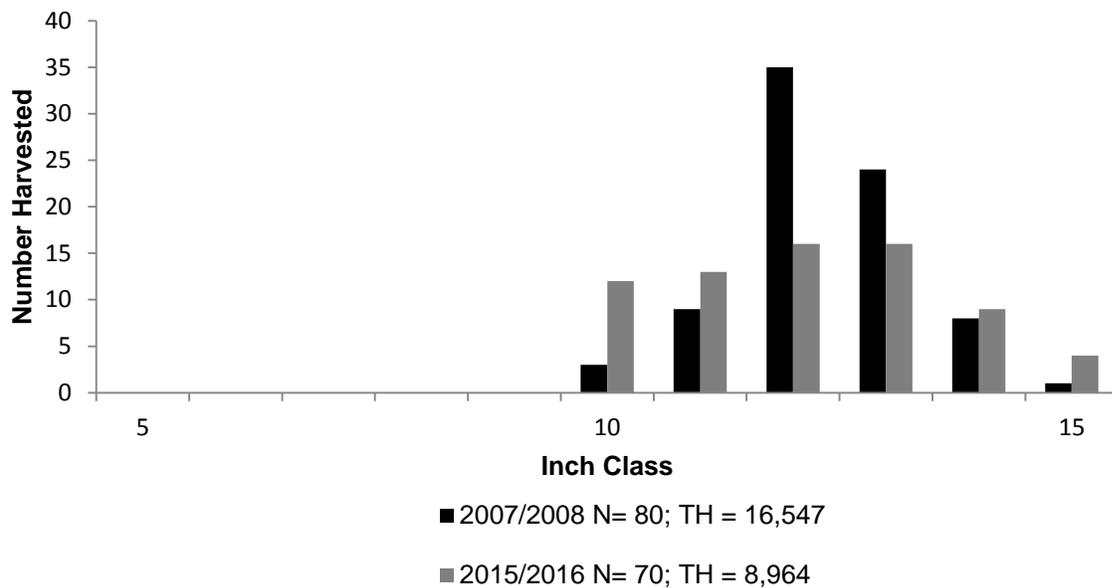


Figure 10. Length frequency of harvested White Bass observed during creel surveys at Cedar Creek Reservoir, Texas, June 2007 through May 2016, all anglers combined. N is the number of harvested White Bass observed during creel surveys, and TH is the total estimated harvest for the creel period.

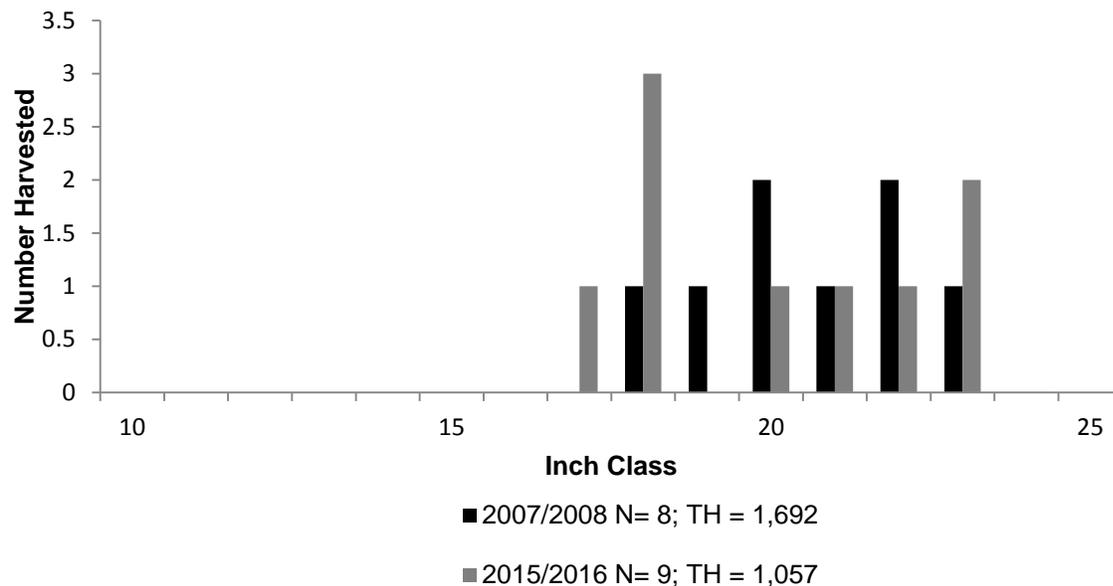


Figure 11. Length frequency of harvested Hybrid Striped Bass observed during creel surveys at Cedar Creek Reservoir, Texas, June 2007 through May 2016, all anglers combined. N is the number of harvested Hybrid Striped Bass observed during creel surveys, and TH is the total estimated harvest for the creel period.

Largemouth Bass

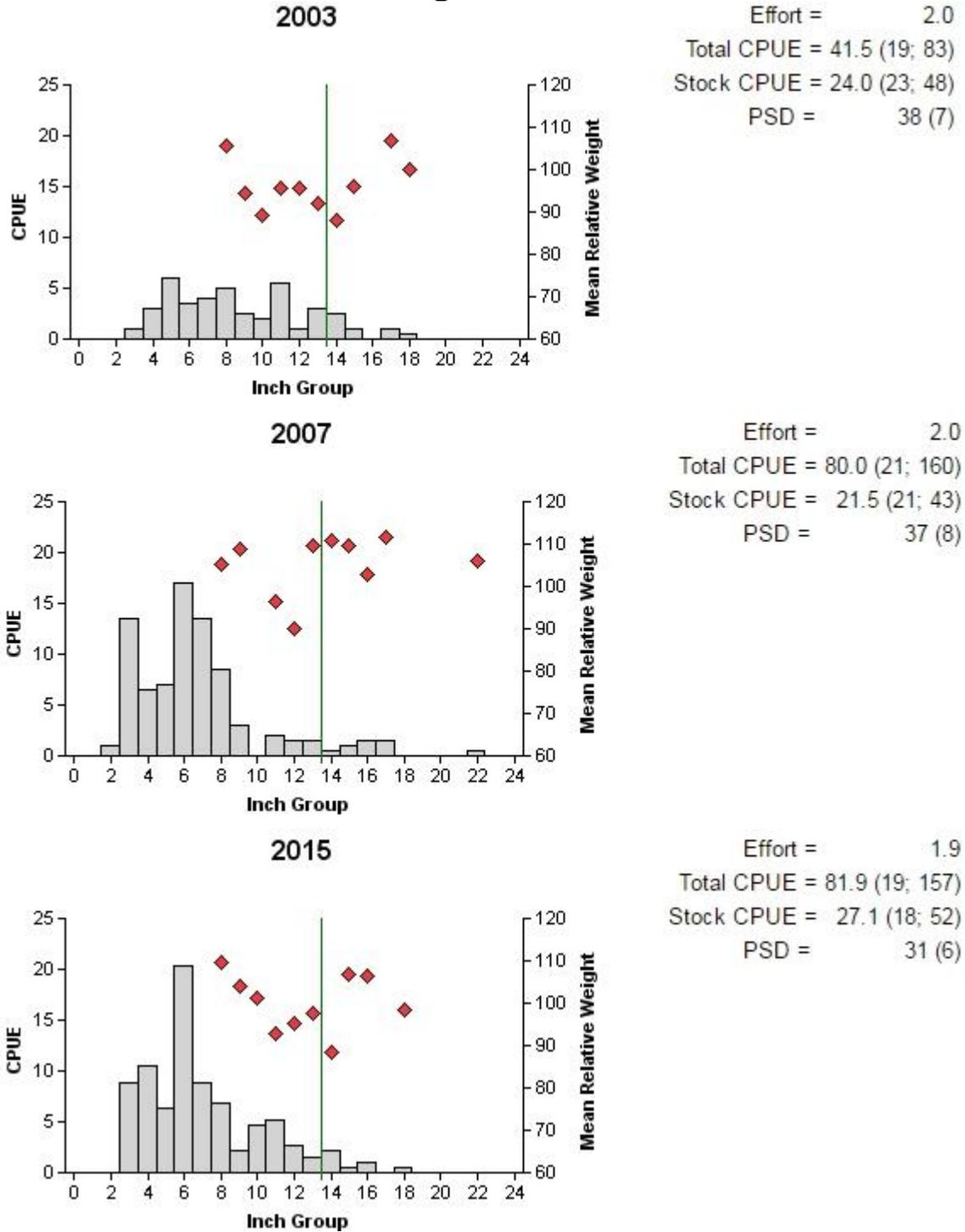


Figure 12. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall nighttime electrofishing surveys, Cedar Creek Reservoir, Texas, 2003, 2007 and 2015. Vertical line represents minimum length limit.

Largemouth Bass

Table 11. Creel survey statistics for Largemouth Bass at Cedar Creek Reservoir, Texas, from June 2007 through May 2008, June 2011 through November 2011, and June 2015 through May 2016. 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	2007/2008	2015/2016
Surface area (acres)	31,813	32,132
Directed angling effort (h)		
Tournament		12,046 (53)
Non-tournament		33,042 (30)
All black Bass anglers combined	51,852 (25)	45,088 (29)
Angling effort/acre	1.6 (25)	1.4 (29)
Catch rate (number/h)	0.6 (25)	0.7 (23)
Harvest		
Non-tournament harvest	1,404 (48)	506 (249)
Harvest/acre	0.3 (48)	<0.1 (249)
Tournament weigh-in and release	7,373 (48)	3,050 (88)
Release by weight		
<4.0 lbs		23,216 (79)
4.0-6.9 lbs		1,402 (88)
7.0-9.9 lbs		126 (106)
≥10.0 lbs		0 (0)
Percent legal released (non-tournament)	83	87

Largemouth Bass

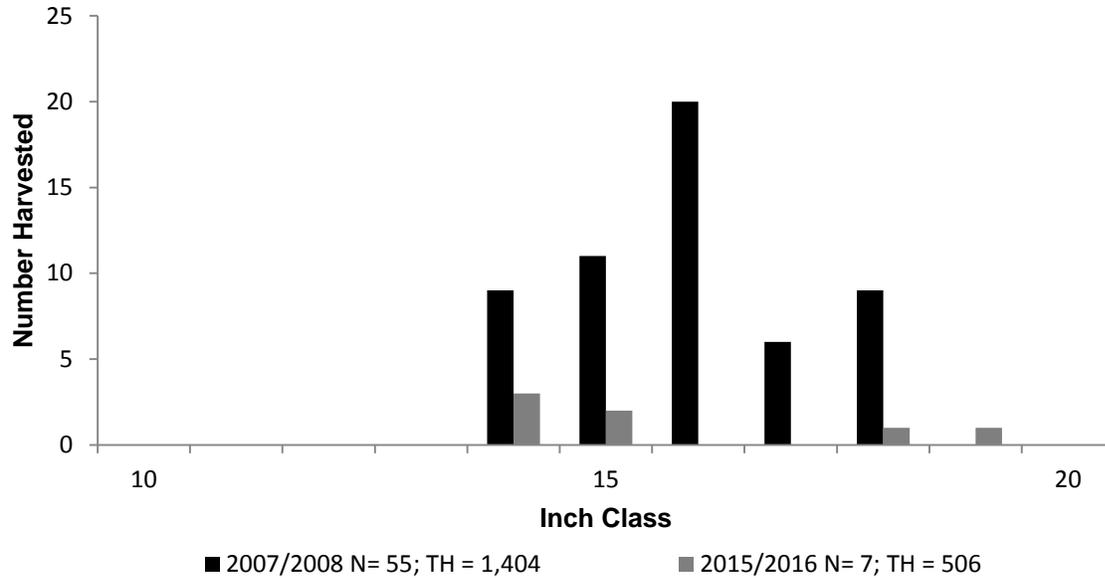


Figure 13. Length frequency of non-tournament harvested Largemouth Bass observed during creel surveys at Cedar Creek Reservoir, Texas, June 2007 through May 2016, all anglers combined. N is the number of harvested Largemouth Bass observed during creel surveys, and TH is the estimated non-tournament harvest for the creel periods.

Table 12. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Cedar Creek Reservoir, Texas. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, F1 = first generation hybrid between a FLMB and a NLMB, Fx = second or higher generation hybrid between a FLMB and a NLMB. Genetic composition was determined with micro-satellite DNA analysis.

Year	Sample size	Number of fish			% FLMB alleles	% pure FLMB
		FLMB	Intergrade	NLMB		
2006	30	1	27	2	43.5	3.3
2011	30	1	26	3	33.0	3.0
2015	30	0	F1	Fx	38.0	0
			2	22		

White Crappie

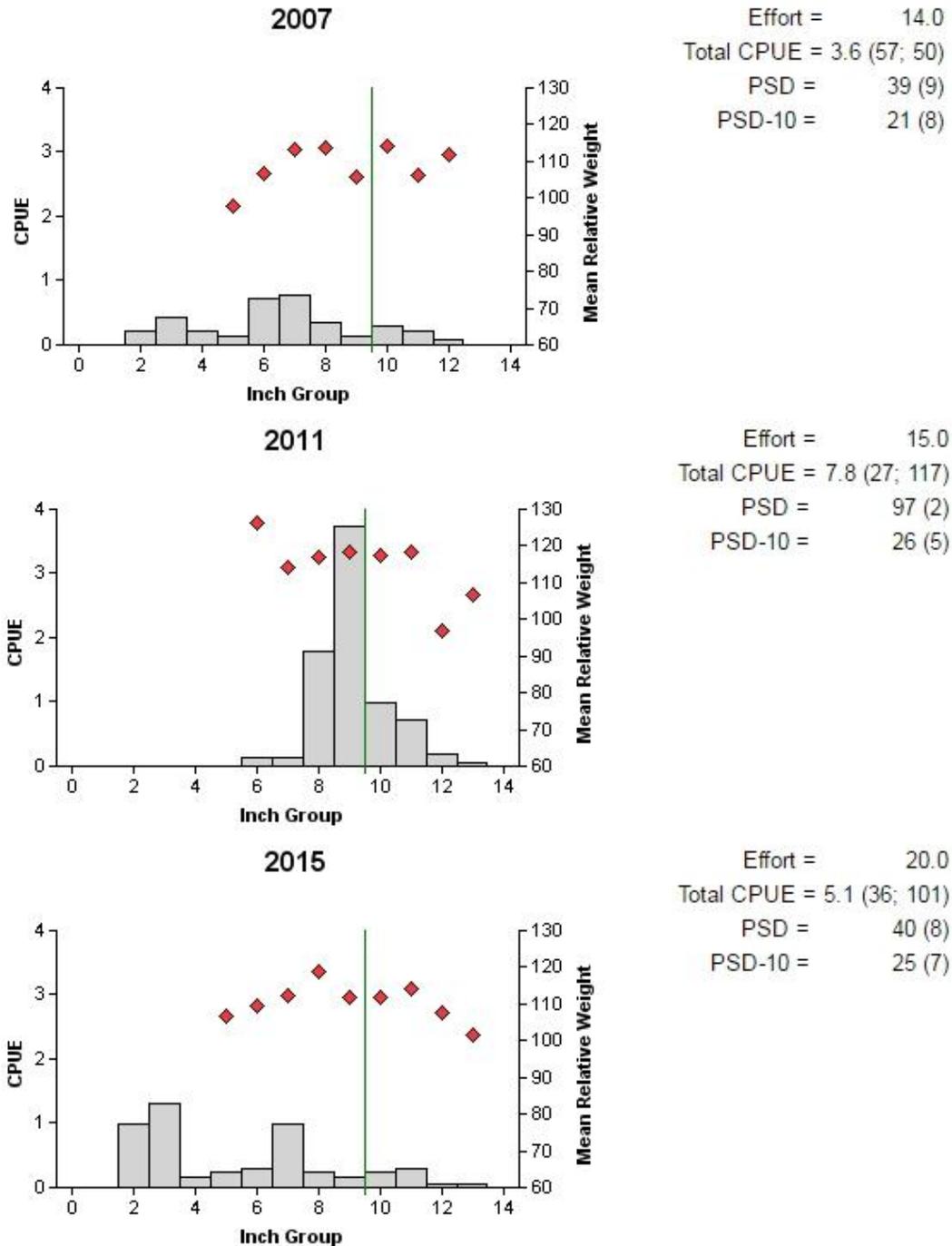


Figure 14. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, Cedar Creek Reservoir, Texas, 2007, 2011 and 2015. Vertical line indicates minimum length limit.

Black Crappie

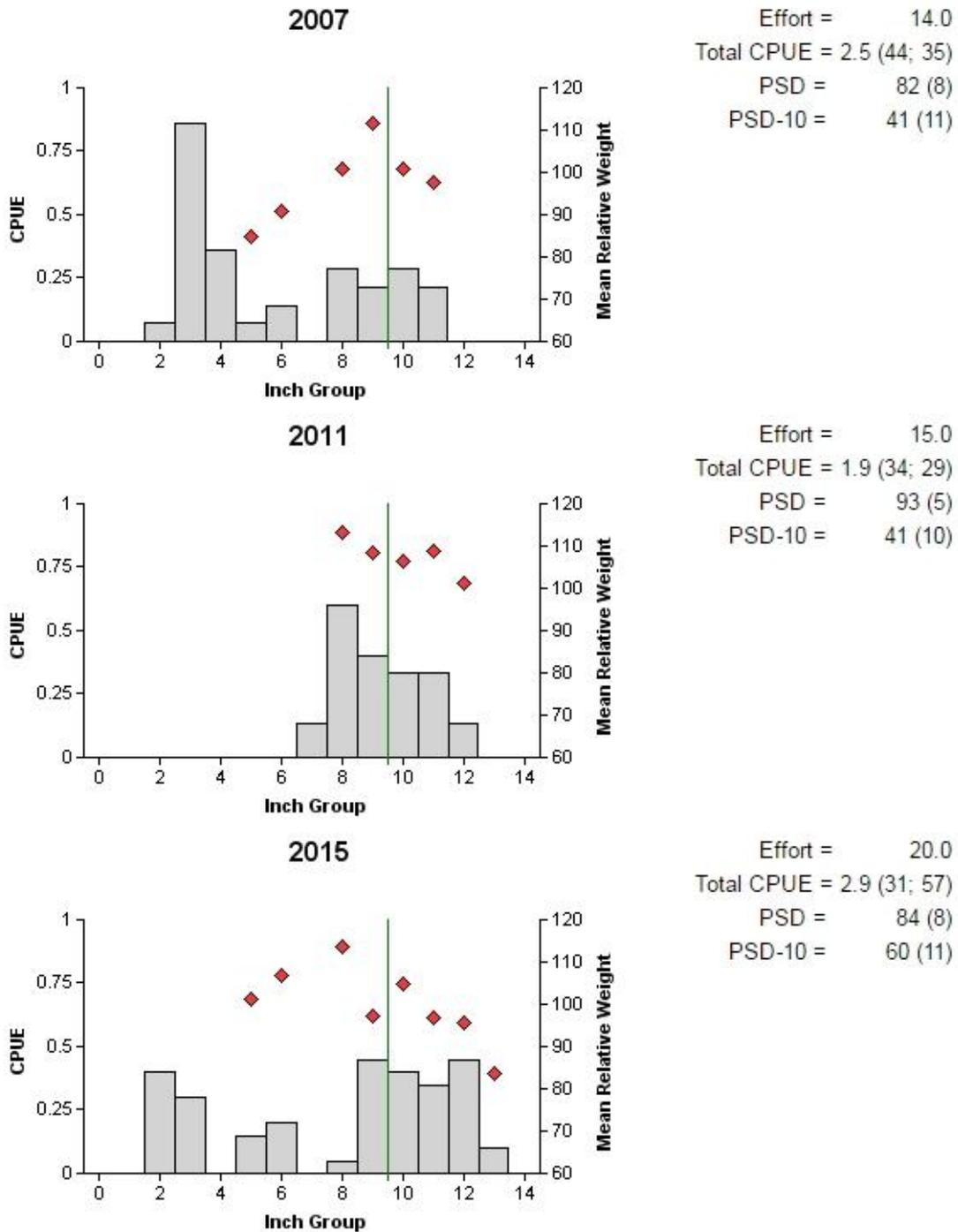


Figure 15. Number of Black Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, Cedar Creek Reservoir, Texas, 2007, 2011 and 2015. Vertical line indicates minimum length limit.

Crappie

Table 13. Creel survey statistics for crappie at Cedar Creek Reservoir, Texas, from June 2007 through May 2008, June 2011 through November 2011, and June 2015 through May 2016. Total catch per hour is for anglers targeting crappie and total harvest is the estimated number of harvested crappie by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year	
	2007/2008	2015/2016
Surface area (acres)	31,813	32,132
Directed effort (h)	22,781 (25)	22,941 (31)
Directed effort/acre	0.7 (25)	0.7 (31)
Total catch per hour	1.3 (68)	1.5 (31)
Total harvest	22,051 (79)	38,973 (65)
White Crappie	11,578 (76)	4,702 (87)
Black Crappie	10,473 (82)	34,271 (62)
Harvest/acre	0.7 (44)	1.2 (65)
Percent legal released	54	2

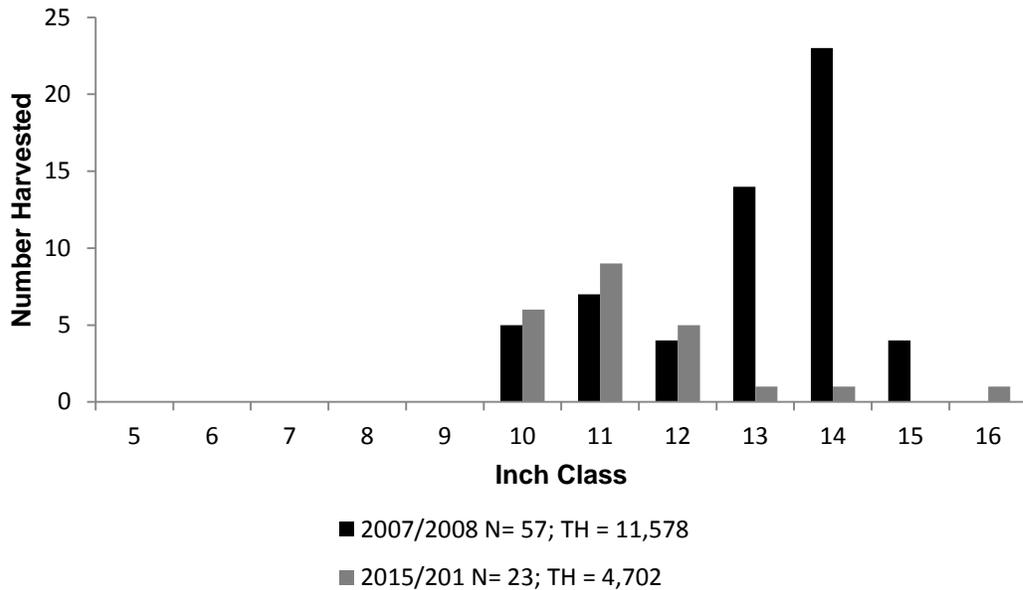


Figure 16. Length frequency of harvested White Crappie observed during creel surveys at Cedar Creek Reservoir, Texas, June 2007 through May 2016, all anglers combined. N is the number of harvested White Crappie observed during creel surveys, and TH is the total estimated harvest for the creel period.

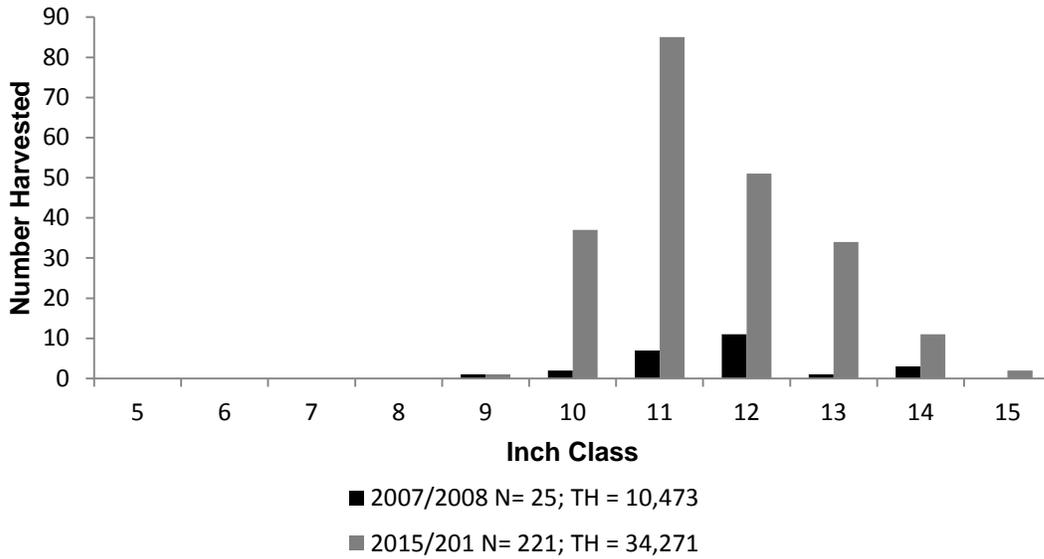


Figure 17. Length frequency of harvested Black Crappie observed during creel surveys at Cedar Creek Reservoir, Texas, June 2007 through May 2016, all anglers combined. N is the number of harvested Black Crappie observed during creel surveys, and TH is the total estimated harvest for the creel period.

Table 14. Proposed sampling schedule for Cedar Creek 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.

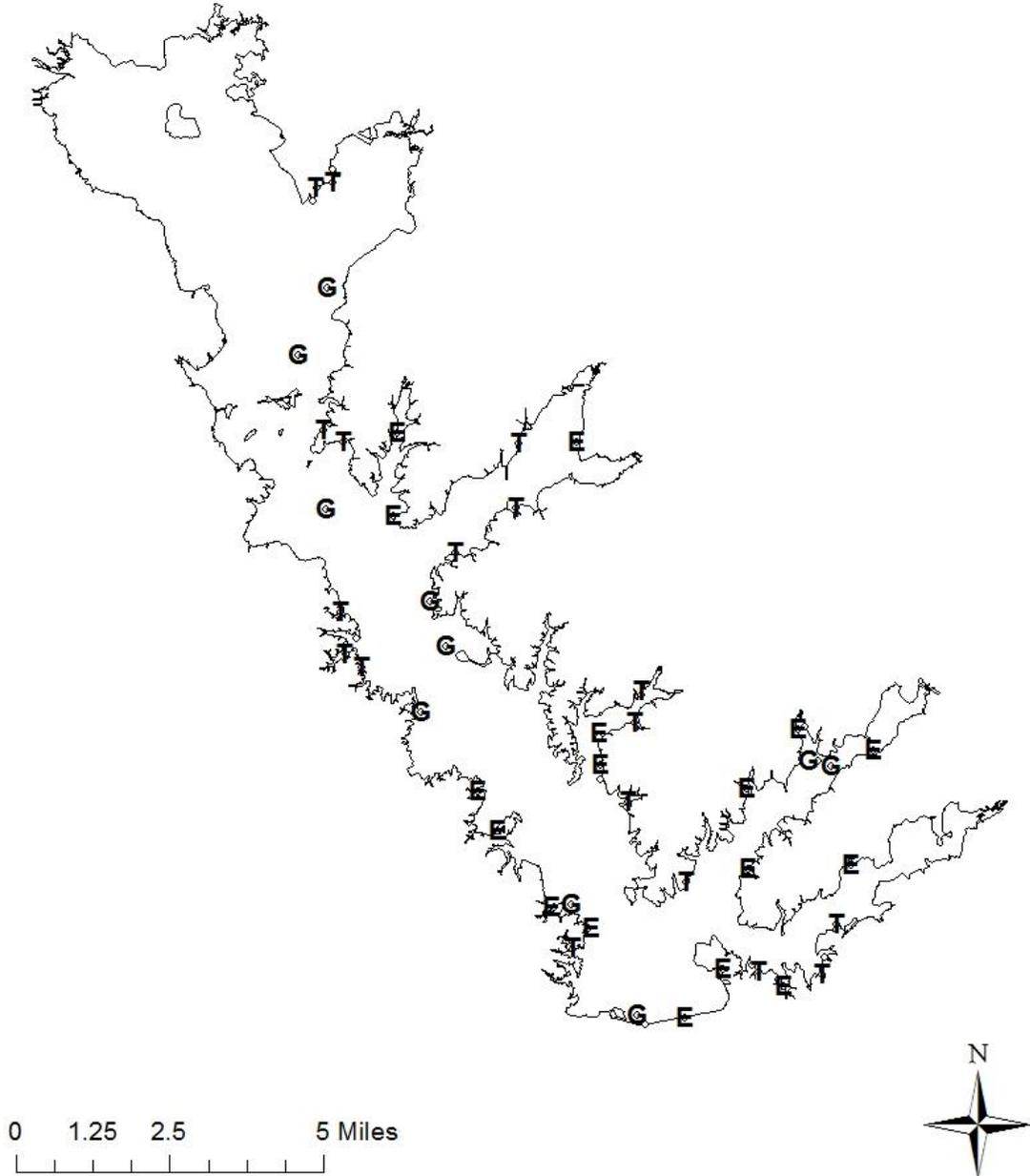
Survey year	Electrofishing	Trap net	Gill net	Habitat			Creel survey	Report
				Structural	Vegetation	Access		
2016/2017								
2017/2018			A					
2018/2019								
2019/2020	S	S	S		S	S	A	S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Cedar Creek Reservoir, Texas, 2015/2016. Sampling effort was 10 net nights for gill netting, 20 net nights for trap netting, and 1.9 hours for electrofishing.

Species	Gill Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					362	190.5
Threadfin Shad					911	479.5
Blue Catfish	76	7.6				
Channel Catfish	25	2.5				
White Bass	7	0.7				
Hybrid Striped Bass	13	1.3				
Redbreast Sunfish					8	4.2
Warmouth					12	12.0
Bluegill					453	238.4
Longear Sunfish					84	44.2
Redear Sunfish					8	4.2
Largemouth Bass					157	82.6
Black Crappie			57	2.9		
White Crappie			101	5.1		

APPENDIX B



Location of sampling sites, Cedar Creek Reservoir, Texas, 2015/2016. Trap net, gill net, and electrofishing stations are indicated by T, G, and E, respectively. Water level was near conservation pool at time of sampling.