Ray Roberts Reservoir

2019 Fisheries Management Survey Report

PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-4

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

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Survey and Management Summary

Fish populations in Ray Roberts Reservoir were surveyed in 2019 using electrofishing and trap netting, and in 2020 using gill netting. A bass-only spring electrofishing survey was also done in 2017. Anglers were surveyed from March through August 2018 with a roving creel survey. Historical data are presented with the 2017-2020 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: Ray Roberts Reservoir is a 28,646-acre impoundment on the Elm Fork Trinity River north of Dallas-Fort Worth in Denton, Grayson, and Cooke Counties. The conservation elevation of Ray Roberts Reservoir is 632.5 feet above mean sea level. Habitat features consisted mainly of flooded timber, rocky shoreline, native and non-native submerged vegetation, and riprap along the dam and railroad bridges.

Management History: Important sport fishes included Blue and Channel Catfish, White Bass, black basses, and Crappie. A 14- to 24-inch slot length limit, 5 fish daily bag limit for Largemouth Bass was dropped in 2009, in favor of the statewide 14-inch minimum length limit, 5 fish daily bag limit. Statewide fish harvest regulations currently apply to all sport fishes in Ray Roberts Reservoir. Florida Largemouth Bass fingerlings have been stocked periodically since 1985.

Fish Community

- **Prey species:** Threadfin Shad and Gizzard Shad provide forage for sport fish along with sunfish species dominated by Bluegill and Longear Sunfish.
- **Catfishes:** Channel Catfish and Blue Catfish are present, and the abundance of Blue Catfish continues to increase. Flathead Catfish are also present.
- **White Bass:** Young White Bass were abundant indicating good recruitment in recent years.
- **Black basses:** Black bass were the 2nd most sought after species group at Ray Roberts in spring and summer 2018. Although not stocked by TPWD, Smallmouth Bass are occasionally caught by anglers, and a small number have been collected during fisheries surveys. Spotted Bass are also present in moderate abundance. The reservoir has produced catches of trophy Largemouth Bass.
- **Crappie:** White Crappie are abundant and support the most popular fishery at Ray Roberts Reservoir. Black Crappie are also present, yet abundance is much lower than White Crappie.

Management Strategies: Inform the public about the negative impacts of aquatic invasive species. Conduct general monitoring surveys with trap nets, gill nets, and electrofishing in spring 2021 and fall 2023. Stock Florida Largemouth Bass in 2022. Access and vegetation surveys will be conducted in 2023.

Introduction

This document is a summary of fisheries data collected from Ray Roberts Reservoir in 2017-2020. The purpose of the document is to provide fisheries information and make management recommendations to protect and improve the sport fishery. While information on other fishes was collected, this report deals primarily with major sport fishes and important prey species. Historical data are presented with the 2017-2020 data for comparison.

Reservoir Description

Ray Roberts Reservoir is a 28,646-acre impoundment on the Elm Fork Trinity River north of Dallas-Fort Worth in Denton, Grayson, and Cooke Counties. It was constructed in 1987 by the U.S. Army Corps of Engineers (USACOE) for flood control, water supply, hydropower, fish and wildlife, and recreation. Ray Roberts Reservoir was border-line mesotrophic-eutrophic with a mean TSI chl-*a* of 48.46 (Texas Commission on Environmental Quality. 2020). Habitat at the time of sampling consisted of rocky shoreline, dead trees, and riprap along with some emergent and submerged vegetation. The lake level remained near or above the conservation elevation of 632.5ft above MSL during the survey period (Figure 1). Other descriptive characteristics for Ray Roberts Reservoir are in Table 1.

Angler Access

Public access consisted of seven public boat ramps (Table 2), and bank access at eight bridge crossings. Boat access is generally excellent; however, high lake levels in recent years have resulted in temporary ramp closures. Except for one privately operated marina at Sanger Park, all access to the reservoir is maintained by Texas Parks and Wildlife State Parks. Pecan Creek Park, on the Elm Fork Trinity River arm is the only area on the reservoir offering free boat ramp access; all others charge $7.00 per person or $70.00 annual fee. Further information about Ray Roberts Reservoir and its facilities can be obtained by visiting the Texas Parks and Wildlife Department (TPWD) web site at www.tpwd.texas.gov. A map indicating boat and shoreline access locations is available at:
https://tpwd.texas.gov/huntwild/hunt/public/annual_public_hunting/resources/RayRoberts_501.pdf

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Bennett and Moczygemba 2016) included:

1. Stock Florida Largemouth Bass fingerlings at the rate of 25/acre in 2017 to improve the proportion of Florida Bass alleles in individual fish in Ray Roberts Reservoir, and collect a genetic sample of the population in 2019.

   Action: Fingerling stockings were conducted in 2017 and 2019 according to the revised statewide stocking rate of 1,000/shoreline kilometer. A genetic sample was collected in 2019.

2. Monitor the Largemouth Bass population ten years post regulation change.

   Action: A bass-only electrofishing survey was conducted in spring 2017. A spring and summer creel survey was completed in 2018. A category three age and growth sample was attempted in 2019; however, our sample size fell short of our intended goal of 20 fish per age class (1 to 3 years).

3. Incorporate fishery improvements on the TPWD website and appropriate media.

   Action: Sport fish improvements were incorporated on the website and multiple media outlets featured Ray Roberts fisheries including TPWD magazine articles.

4. Educate stakeholders regarding invasive species concerns and monitor for invasive species.

Action: Monitoring for zebra mussels and non-native vegetation was conducted. Zebra mussel boat ramp stencils were refreshed. Opportunities to inform and educate the public about invasive species were taken.

Harvest regulation history: Sportfish in Ray Roberts Reservoir are now managed with statewide regulations. A 14- to 24-inch slot length limit, 5 fish daily bag limit for Largemouth Bass was changed in 2009, in favor of the statewide 14-inch minimum length limit, 5 fish daily bag limit. Current regulations are found in Table 3.

Stocking history: Ray Roberts Reservoir has been stocked with Florida Largemouth Bass since 1985, when stockings occurred in nursery ponds prior to impoundment. ShareLunker Florida Bass were stocked in in 2005 and 2012. The complete stocking history is in Table 4.

Vegetation/habitat history: Non-native hydrilla is present yet has not required intervention.

Water transfer: The Cities of Gainesville and Dallas operate one pumping station that provides 1 MGD (million gallons per day) to the City of Gainesville. There is no raw water transfer from Ray Roberts Reservoir; however, water flows downstream into the Elm Fork of the Trinity River and into Lake Lewisville.

Methods

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Ray Roberts Reservoir (Bennett and Moczygemba 2016). Primary components of the OBS plan are listed in Table 5. Spring bass-only electrofishing survey sites were subjectively selected to increase catch rates. All other survey sites were randomly selected (Appendix D), and all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

Electrofishing – Largemouth Bass were collected by spring electrofishing (2 hours at 24, 5-min stations) in 2017. Black Bass, sunfishes, Gizzard Shad, and Threadfin Shad were collected by fall electrofishing (2 hours at 24, 5-min stations) in 2019. Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing. A Category 3 age analysis was attempted for Largemouth Bass using otoliths (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

Trap netting – Crappie were collected using trap nets (10 net nights at 10 stations). CPUE for trap netting was recorded as the number of fish caught per net night (fish/nn). Ages for White Crappie were determined using otoliths from 13 randomly-selected fish (range 9.0 to 10.9 inches).

Gill netting – Blue Catfish, Channel Catfish, and White 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). Ages for Blue Catfish were determined using otoliths collected from seven fish (range 11.0 to 12.9 inches). Ages for White Bass were determined from five fish between 9.0 and 10.9 inches.

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

Statistics – Sampling statistics (CPUE for various length categories), structural indices [Proportional Size Distribution (PSD), terminology modified by Guy et al. 2007], and condition indices [relative weight (W_r)] were calculated for target fishes according to Anderson and Neumann (1996). Index of Vulnerability (IOV) was calculated for Gizzard Shad (DiCenzo et al. 1996). Standard error (SE) was calculated for structural indices and IOV. Relative standard error (RSE = 100 X SE of the estimate/estimate) was calculated for all CPUE and creel statistics.

Creel survey – A roving creel survey was conducted from March through August 2018. Angler interviews were conducted on five weekend days and four weekdays per quarter to assess angling effort and fish

catch and harvest in accordance with the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

Habitat – A structural habitat survey was last conducted in 2015. A vegetation survey was conducted in 2019. Habitat was assessed with the random point intercept (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

Water level – Source for water level data was the United States Geological Survey (Figure 1; USGS 2020).

Results and Discussion

Habitat: Structural habitat remains constant at Ray Roberts Reservoir since development is restricted by the USACOE. Shoreline habitat consists primarily of natural shoreline (94%), flooded timber (3,000 acres), with some riprap (6%) along the dam and railroad bridges (Bennett and Moczygemba 2016). A 2019 random point-intercept survey found that native submersed vegetation occurred at 8.2 percent of survey sites (Table 6), an increase in coverage due to relatively stable lake levels since 2015. Native submersed vegetation consisted primarily of American pondweed (*Potamogeton nodosus)* along with muskgrass (*chara spp.)* and milfoil (*Myriophyllum spp.).* Hydrilla (*Hydrilla verticillata)* remained in trace amounts. Emergent species water-willow (*Justicia americana)* occurred at 2.5 percent of survey sites.

Creel: A roving creel survey was conducted in the spring and summer quarters 2018 to compare angler effort and harvest trends to previous surveys before and immediately following a regulation change for Largemouth Bass in 2009. Directed fishing effort by anglers was highest for crappie (37.7%), followed by anglers fishing for black bass (35.0%). Sixteen-percent of Ray Roberts anglers targeted anything, followed by 8.8% of anglers targeting catfish. Eighty percent of Ray Robert's anglers fished from boats, and 20% fished from the bank or fishing piers. Bank anglers primarily targeted crappie and catfish. Anglers spent an estimated 1.2 million dollars associated with fishing trips to Ray Roberts Reservoir during the six-month creel period (Table 8). Most Ray Roberts anglers travel from suburban communities north of the Dallas-Fort Worth Metroplex (Appendix C). Non-compliance with length limits has been documented during all three of the previous creel surveys, and that information has been shared with local game wardens.

Prey species: Catch rates of Gizzard Shad (68.5/h) and Threadfin Shad (140.0/h; Appendix A) were below the long-term average (Appendix B); however, sampling inefficiency related to the incorporation of a new electrofishing system was subsequently suspected. The majority of Gizzard Shad were available as forage to sportfish (IOV = 69; Figure 2). Bluegill catch rate (187.0/h) remained consistent with the long-term average of 161.4/h (Appendix B). Most Bluegill were available as forage for sportfish (PSD = 5; Figure 3). Longear Sunfish (88.0/h), Redear Sunfish (4.0/h), Green Sunfish (19.0/h), Warmouth (2.5/h), and Orangespotted Sunfish (0.5/h) also contribute to the prey base (Appendix A). Sunfish were not directly targeted by anglers interviewed during the 2018 creel survey (Table 7).

Catfish: Gill net catch rate of Blue Catfish was the highest on record (10.6/nn), and the population contains many harvestable size fish between 15- and 20-inches (Figure 5). Blue Catfish reached legal length (12-inches) in 3.3 years (N = 7) and body condition was above 85 for most size classes. Few Blue Catfish over 25-inches were collected. Gill net catch rate of Channel Catfish was low (1.6/nn), below the long-term average of 3.9/nn (Appendix B) and most were below the minimum length limit MLL (Figure 4). Blue Catfish were not stocked by TPWD; the first Blue Catfish was not collected in gill nets until 1998. Catfish were relatively low in popularity considering the increasing abundance of Blue Catfish at Ray Roberts Reservoir in the last decade. Catfish accounted for 8.8% of the angling effort in the 2018 creel survey, which was comparable to 8.0% effort observed during a year-long creel in 2004 and 2005 (Table 7). Anglers harvested an estimated 9,596 Blue Catfish and 6,571 Channel Catfish during the six-month creel period (Table 9; Figure 6). Angler catch rate and harvest of catfish was similar to prior creel surveys; however, Blue Catfish currently make up a greater portion of the overall harvest.

White Bass: Gill net catch rate of White Bass (5.9/nn) declined from previous surveys and consisted primarily of sub-legal fish (PSD=29, Figure 7). Fifty-nine white bass were collected in 10 gill nets with an RSE of 32, and additional sampling was not conducted to improve sampling precision due to COVID-19 travel restrictions. Considering high flows in tributaries at the time of sampling we suspect many adult fish were migrating upstream to spawn during our gill net sampling and therefore not present in our results Adult White Bass, collected to serve as hatchery brood stock for Hybrid Striped Bass, were abundant when collected by electrofishing in a reservoir tributary one-week after our gill net survey; however, length and weight data was not recorded. White Bass were the fifth most sought-after sport fish species during the 2018 creel survey with 2.3% of anglers targeting this species (Table 7); however, we believe our creel survey did not accurately account for angler effort and harvest in the Elm Fork and other tributaries of Ray Roberts during the spring spawning migration. White Bass reached legal length (10-inches) in 1.8 years (N=5; range= 1 - 2 years). Anglers caught 0.9 fish per-hour of effort and harvested 0.6 fish per-acre during the creel survey (Figure 8; Table 10). White Bass anglers harvested an estimated 15,760 total fish during the six-month creel period; however, 43% of legal-length fish were released.

Black Bass: Spotted Bass electrofishing catch rate is typically about 25 to 50 percent of the Largemouth Bass catch rate (Bennett and Moczygemba 2016). Like the Largemouth Bass catch rate, the CPUE of Spotted bass (17.5/h) was similarly lower in 2019 than the previous two surveys in 2011 (53.5/h) and 2015 (45.0/h), which were the highest catch rates on record (Figure 9; Appendix B). Prior to the Largemouth Bass regulation change to the statewide MLL in 2009, an estimated 870 Spotted Bass were harvested between June 2004 and May 2005 (Hysmith and Moczygemba 2008). Most harvested fish were between 10- and 14-inches in length. In 2010, after the regulation change, an estimated 107 Spotted Bass were harvested in the six months between March and August (Hysmith and Moczygemba 2012). Spotted Bass were not reported harvested during the 2018 creel survey; however, some may have been incorrectly reported as Largemouth Bass by anglers.

Catch rate of Largemouth Bass (37.5/h) was the lowest on record (Appendix B) and may have been impacted by sampling inefficiency from incorporation of a new electrofishing system and improper settings in lower conductivity water. Largemouth PSD-stock (50; Figure 10) was within the target range (40 to 60); however, sampling precision and the number of stock-length or larger fish collected were below target goals. Catch rate of stock-size Largemouth Bass was just 16/h. Body condition was excellent (W_r > 90) for most sizes classes. A genetic sample was obtained in 2019, and results suggest Florida Bass stockings in recent years have increased the proportion of Florida Bass alleles in the population, as well as the proportion of F1 hybrids and pure Florida Bass (Table 12). We also attempted to collect a Category 3 age and growth sample; however, catch rates and subsequent sample sizes were low (Table 13). Our limited results suggest growth rates of Largemouth Bass ages 1 to 3 have likely remained stable. Spring sampling to collect additional Largemouth Bass for age analysis was planned in 2020; however, efforts were cancelled due to COVID19 travel restrictions. A spring bass-only electrofishing survey was conducted in 2017 and results closely mirrored a 2005 spring survey. Largemouth Bass were collected up to 24-inches in 2017 and size metrics (PSD-S = 63; PSD-P = 33) were consistent with previous results (Figure 11). Recent tournament results indicate winning weights at large tournaments ($\geq$50 participants) are consistently above a five-pound average fish weight mark for 5-fish bag limits, and big fish weights range from 8 to 10 pounds (Appendix E).

Forty-five percent of black bass anglers encountered during the creel were associated with a tournament in 2018, similar to 43% in 2010 after the slot limit was removed (Hysmith and Moczygemba 2012). Overall black bass angler effort (64,206.4 h) was also down slightly from 2010 (80,303.3 h). The proportion of anglers targeting Largemouth Bass has remained consistent since a 2004/2005 creel survey was conducted (Table 7). From March to August 2018, anglers harvested an estimated 1,135 Largemouth Bass up to 22-inches in length during the six-month creel survey, and tournament anglers temporarily retained an additional 6,043 Largemouth Bass (Table 11). Fifteen percent of all legal-length bass caught by non-tournament anglers were harvested. Some harvest of bass below the MLL was also observed in 2018, as was also the case in 2010. In the 2004/2005 survey, Largemouth Bass within the slot-length limit were also harvested. Traditional harvest of Largemouth Bass was slightly higher in 2018 (1,135) than that recorded during the six-month 2010 creel survey (754.5); however, the number of

tournament-retained bass was lower in 2018 (6,043) than in 2010 (10,432). Prior to the regulation change, in 2004 and 2005, an estimated 7,635 (0.3/ac) Largemouth Bass below the slot length limit were harvested (Hysmith and Moczygemba 2008).

Smallmouth Bass remain in low abundance, likely due to a lack of preferred habitat in the reservoir. Smallmouth Bass are seldom collected in electrofishing surveys. One 17-inch Smallmouth Bass was collected during a spring 2017 electrofishing survey, and one 20-inch Smallmouth Bass was reported as harvested in the 2018 creel survey. In recent years, record Smallmouth Bass x Spotted Bass hybrids have been submitted to the TPWD Angler Recognition Program. The current Smallmouth Bass x Spotted Bass record was caught in March 2019 and weighed 6.42 pounds, surpassing the Smallmouth Bass record (6.16 lbs.) caught in 2011.

White Crappie: Trap net catch rate of White Crappie (26.4/nn) was more than twice the long-term average of 12.1/nn; yet catch rate was highly variable between stations (RSE=51). Black Crappie (0.4/nn) catch rate was low and similar-to previous years; (Appendix B). Approximately 20% of the crappie population was of legal length (10-inches) or larger (Figure 13). White Crappie reached 10-inches (legal size) in 1.3 years (N = 13; range: 1 -2 years). Body condition was excellent (W_r > 90) for most size classes. Crappie narrowly surpassed Largemouth Bass as the most sought-after sport fish at Ray Roberts Reservoir in spring and summer 2018, with 38% of anglers targeting this species. Angler catch rate was high (3.8/h) for crappie, and they harvested approximately 77,238 crappie during the creel period (Table 14, Figure 14).

Fisheries Management Plan for Ray Roberts Reservoir, Texas

Prepared – July 2020

ISSUE 1: Traditional harvest of Largemouth Bass at Ray Roberts Reservoir is higher than what is estimated in most Texas' reservoirs and frequent tournaments are held at the reservoir. Illegal harvest of Largemouth Bass has also been documented during the last three creel surveys.

MANAGEMENT STRATEGIES

1. Continue to monitor the Black Bass population with Spring electrofishing in 2021 and Fall electrofishing in 2023.
2. Ensure current regulation signs are present at reservoir boat ramps.
3. Stock Florida Largemouth Bass in 2021 at 1,000/shoreline km to maintain the trophy potential of the reservoir.

ISSUE 2: Creel data suggests Catfish and White Bass populations in Ray Roberts Reservoir may be underutilized.

MANAGEMENT STRATEGIES

1. Update fishery improvements on the TPWD web site.
2. Promote fishing opportunities through media contacts and social media.

ISSUE 3: Habitat in the form of aquatic vegetation is limited in Ray Roberts Reservoir, primarily due to long-term droughts in the last two decades. Aquatic vegetation has not significantly expanded since water levels have been stable beginning in 2015.

MANAGEMENT STRATEGIES

1. Experiment with alternative strategies to mitigate against water level fluctuations while working to establish new native aquatic plant species using floating plant nurseries.
2. Pursue opportunities to partner with stakeholders to conduct habitat improvement initiatives.

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 STRATEIES

1. Cooperate with the controlling authority to maintain appropriate signage at access points around

the reservoir.
2. Contact and educate marina owners about invasive species, and provide them with posters, literature, and other outreach materials so that they can in turn educate their customers.
3. Educate the public about invasive species using 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) future inter-basin water transfers to facilitate potential invasive species responses.

Objective-Based Sampling Plan and Schedule (2020–2024)

Sport fish, forage fish, and other important fishes

Important sport fish in Ray Roberts Reservoir include black bass, crappie, Blue and Channel Catfish, and White Bass. Important forage species include sunfishes, Gizzard Shad, and Threadfin Shad.

Survey objectives, fisheries metrics, and sampling objectives

Largemouth Bass: Largemouth Bass ranked second in popularity among anglers during the 2018 creel survey. Sampling once every four years in the spring and fall to collect long-term monitoring trend data will allow for determination of any large-scale changes in the Largemouth Bass population that may spur further investigation.

A spring bass-only electrofishing survey will be conducted in 2021 at twelve, 10-minute, biologist-selected sampling stations. A category three age and growth sample for Largemouth Bass is desired and is more likely to be achieved with spring electrofishing. A maximum of twenty-four randomly selected 5-min electrofishing sites will be sampled in fall 2023. Sampling will continue until a minimum of 50 stock-size fish are collected with a desired precision (RSE of CPUE-S $\leq$ 25) or two-hours of electrofishing has been conducted. Thirteen Largemouth between 13.0 and 14.9 inches will be collected to estimate age at the minimum length limit (14 inches). Relative weight of Largemouth Bass $\geq$ 8" TL will be determined from their length/weight data (maximum of 10 fish weighed and measured per inch class).

Catfish: Catfish ranked fourth in popularity among anglers. Catch rates are typically low for Channel Catfish; however, sampling to achieve trend data objectives for Blue Catfish should allow detection of large-scale changes in the Channel Catfish population.

Ten randomly selected gill net stations will be generated in spring 2024. The anticipated effort to meet an RSE of CPUE-S $\leq$ 25 and collect at least 50 Blue Catfish, and 13 fish between 11.0 and 12.9 inches (to estimate age at the MLL), is between 8 and 15 stations with 80% confidence. Additional net nights may be added if we determine objectives can be met with reasonable additional effort.

Crappie: Crappie ranked slightly higher in popularity than black bass in the 2018 creel survey. White Crappie are much more abundant than Black Crappie. Data on Black Crappie will be recorded along with White Crappie. Trend data on CPUE, size structure, age and growth, and body condition of White Crappie will be collected with trap nets every four years to monitor trends in the population. We estimate that the effort required to meet sampling objectives (RSE of CPUE-S $\leq$ 25 and collect at least 50 stock-size fish) for White Crappie to be between 10 and 15 net-nights. This level of sampling should provide enough (13) White Crappie between 9.0 and 10.9 inches to estimate average age at legal length (10 inches). We plan to generate 10 random shoreline trap net stations initially; however, an additional 5 net-nights may be sampled if objectives can be met with reasonable additional effort.

White Bass: White Bass ranked low in popularity according to creel data. However, popular spring fisheries exist in the lake's tributaries, which may have been missed by the creel surveys. Gill net catch rates are variable for White Bass; however, spring gill net sampling to achieve objectives for Blue Catfish should provide enough data to detect large-scale changes in the White Bass population that may spur further investigation.

Sunfish and Shad: Bluegill and Longear Sunfish, along with Gizzard and Threadfin Shad are the primary forage species. We intend to collect trend data on abundance, size structure, and prey availability for forage species (along with sampling for Largemouth Bass) once every four years by electrofishing. Effort expended to achieve desired relative abundance estimates for Bluegill should be similar-to that required for Largemouth Bass. Additional effort will not be expended beyond that which is necessary to collect data for Largemouth Bass.

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Tables and Figures

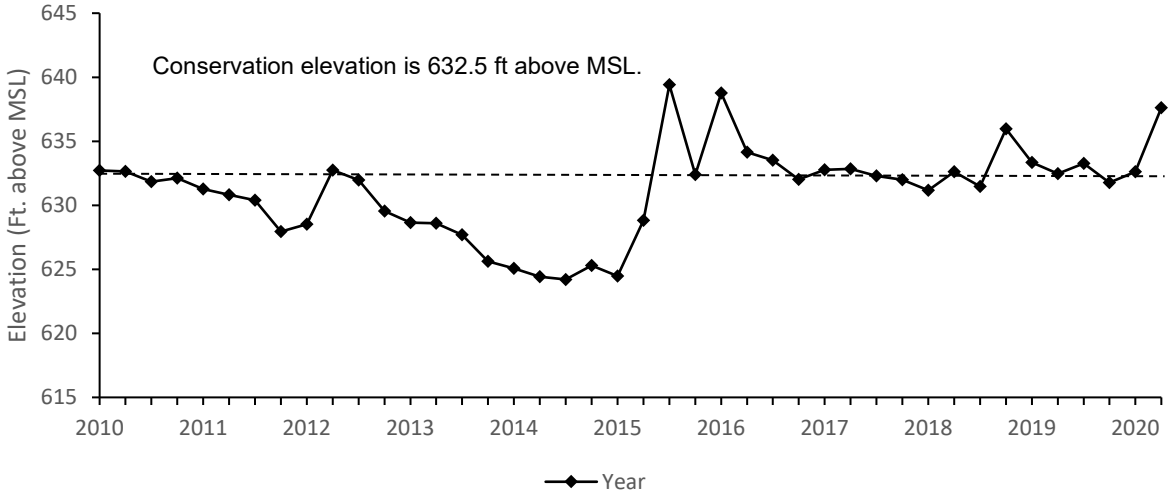


Figure 1. Quarterly water level elevations in feet above mean sea level (MSL) recorded for Ray Roberts Reservoir, Texas, 2010 to 2020.

Table 1. Characteristics of Ray Roberts Reservoir, Texas.

Characteristic	Description
Year constructed	1987
Controlling authority	U.S. Army Corps of Engineers
Counties	Cooke, Denton, and Grayson
Reservoir type	Mainstream: Elm Fork Trinity River
Shoreline Development Index	8.63
Conductivity	316 µS/cm

Table 2. Boat ramp characteristics for Ray Roberts Reservoir, Texas, September, 2019. Reservoir elevation at time of survey was 632.2 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Johnson Branch	33.40926 -97.05071	Y	100	618	Excellent, no access issues.
Isle de Bois	33.37946 -97.03163	Y	100	601	Excellent, no access issues.
Jordan Park	33.40180 -97.00460	Y	70	624	Excellent, no access issues.
Buck Creek	33.44536 -97.92559	Y	60	621	Excellent, no access issues.
Sanger Park	33.37915 -97.10577	Y	60	625	Excellent, no access issues.
Pond Creek	33.38722 -97.10722	Y	60	625	Excellent, no access issues.
Pecan Creek	33.43004 -97.10471	Y	50	627	Excellent, no access issues.

Table 3. Harvest regulations for Ray Roberts 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, Spotted	5	No limit
Bass, Largemouth and Smallmouth	(in any combination)	14-inch minimum
Crappie: White and Black Crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

Table 4. Stocking history of Ray Roberts Reservoir, Texas. FRY = fry; FGL = fingerling; AFGL = advanced fingerling; ADL = adults.

Year	Number	Size
	Threadfin Shad	
1985	1,200	ADL
Total	1,200	
	Coppernose Bluegill	
1987	234,506	AFGL
1987	110,002	FRY
Total	344,508	
	Florida Largemouth Bass	
1985	59,900	FRY
1987	78	ADL
1987	100,262	FRY
1989	733,750	FRY
1993	133,630	FGL
1994	600,809	FGL
2000	502,121	FGL
2001	522,791	FGL
2011	500,719	FGL
2013	521,526	FGL
2017	247,741	FGL
2019	170,169	FGL
Total	4,093,496	
	Channel Catfish	
1986	50,004	AFGL
Total	50,004	
	ShareLunker Largemouth Bass	
2005	14,839	FGL
2012	15,285	FGL
Total	30,124	

Table 5. Objective-based sampling plan components for Ray Roberts Reservoir, Texas 2016–2020.

Gear/target species	Survey objective	Metrics	Sampling objective
Electrofishing (Fall)			
Largemouth Bass	Abundance	CPUE–Stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Age-and-growth	Mean age at 1-3 years	N = 200
	Condition	W_r	10 fish/inch group (max)
	Genetics	% FLMB	N = 30, any age
Bluegill [a]	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
Gizzard Shad [a]	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
	Prey availability	IOV	N ≥ 50
Electrofishing (Spring)			
Largemouth Bass	Abundance	CPUE-Stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
Trap netting			
White Crappie	Abundance	CPUE-stock	RSE-Stock ≤ 25
	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
Gill Netting			
Blue Catfish	Abundance	CPUE–stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Age-and-growth	Age at 12 inches	N = 13, 11.0 – 12.9 inches
	Condition	W_r	10 fish/inch group (max)
White Bass	Abundance	CPUE – stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Age-and-growth	Age at 10 inches	N = 13, 9.0 – 10.9 inches
	Condition	W_r	10 fish/inch group (max)

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

Table 6. Percent (%) occurrence and associated 95% confidence limits (CL) for vegetation types throughout the reservoir (280 points) encountered during a summer vegetation survey, Ray Roberts Reservoir, Texas, 2019. Water level at time of survey was approximately 0.5 ft. below conservation pool level.

Vegetation type	Percent occurrence	Lower CL	Upper CL
Native emergent[a]	2.5	0.7	4.3
Native submersed[b]	8.2	5.0	11.4
Non-native			
Hydrilla (Tier III)	0.4	0.3	0.5

[a] Water-willow [b] American pondweed, Chara, watermilfoil.

Table 7. Percent directed angler effort by species for Ray Roberts Reservoir, Texas, June 2004 – May 2005, March – August 2010 and March – August 2018. Relative standard error is in parentheses.

Species	2004/2005	2010	2018
Catfish	8.0	3.3 (35)	8.8 (26)
White Bass	4.1	2.7 (39)	2.3 (45)
Common Carp	0	0.1 (207)	0
Sunfishes	0.7	0.2 (142)	0
Largemouth Bass	38.0	39.6 (24)	35.0 (19)
Crappie	26.4	37.9 (15)	37.7 (17)
Anything	22.9	16.2 (19)	16.2 (22)

Table 8. Total fishing effort (h) for all species and total directed expenditures at Ray Roberts Reservoir, Texas, June 2004 – May 2005, March – August 2010 and March – August 2018. Relative standard error is in parentheses.

Creel statistic	2004/2005	2010	2018
Total fishing effort	312,511	202,710 (16)	183,243 (15)
Total directed expenditures	$1,541,876	$1,449,582 (32)	$1,226,118 (29)

Gizzard Shad

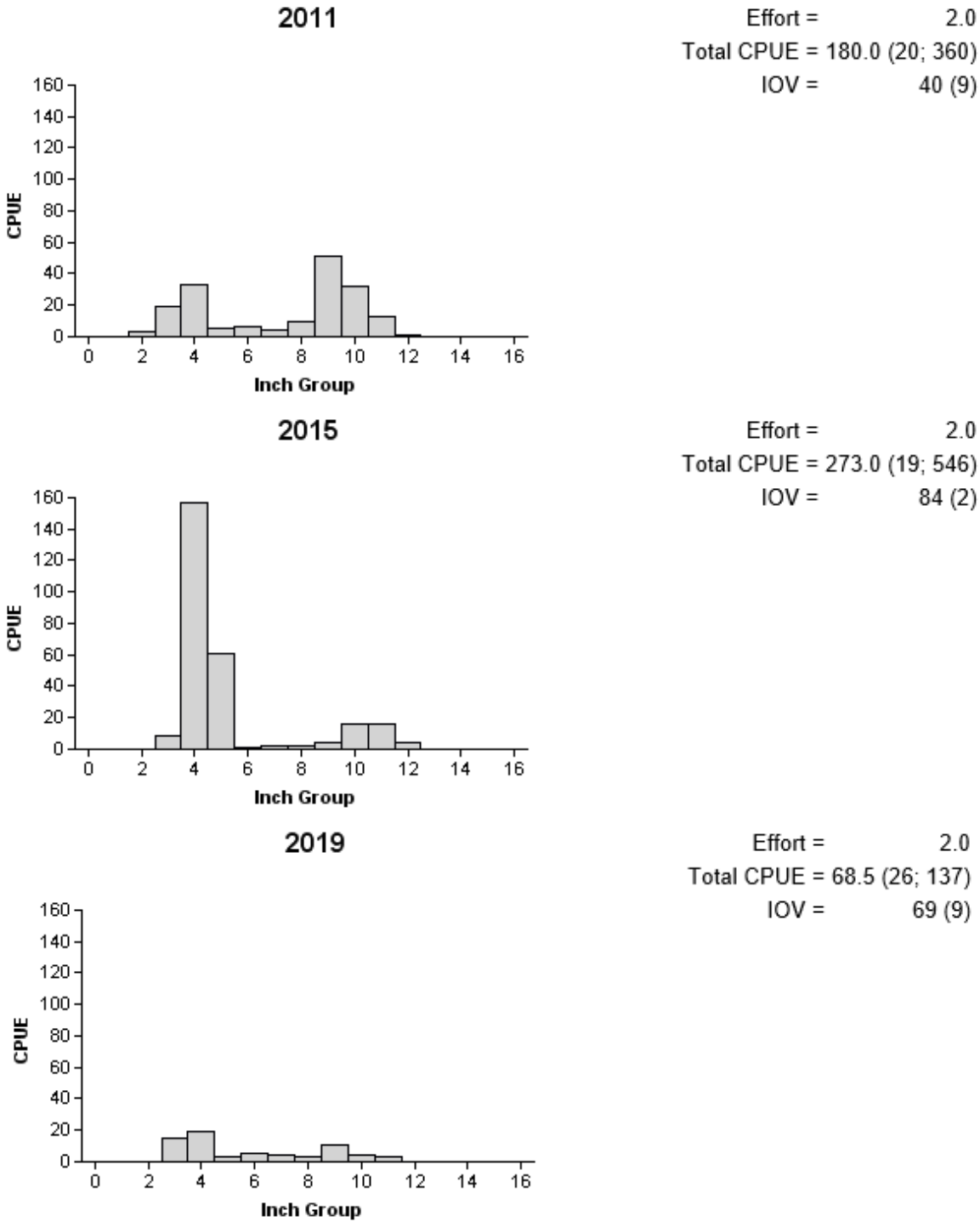


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Ray Roberts Reservoir, Texas, 2011, 2015, and 2019.

Bluegill

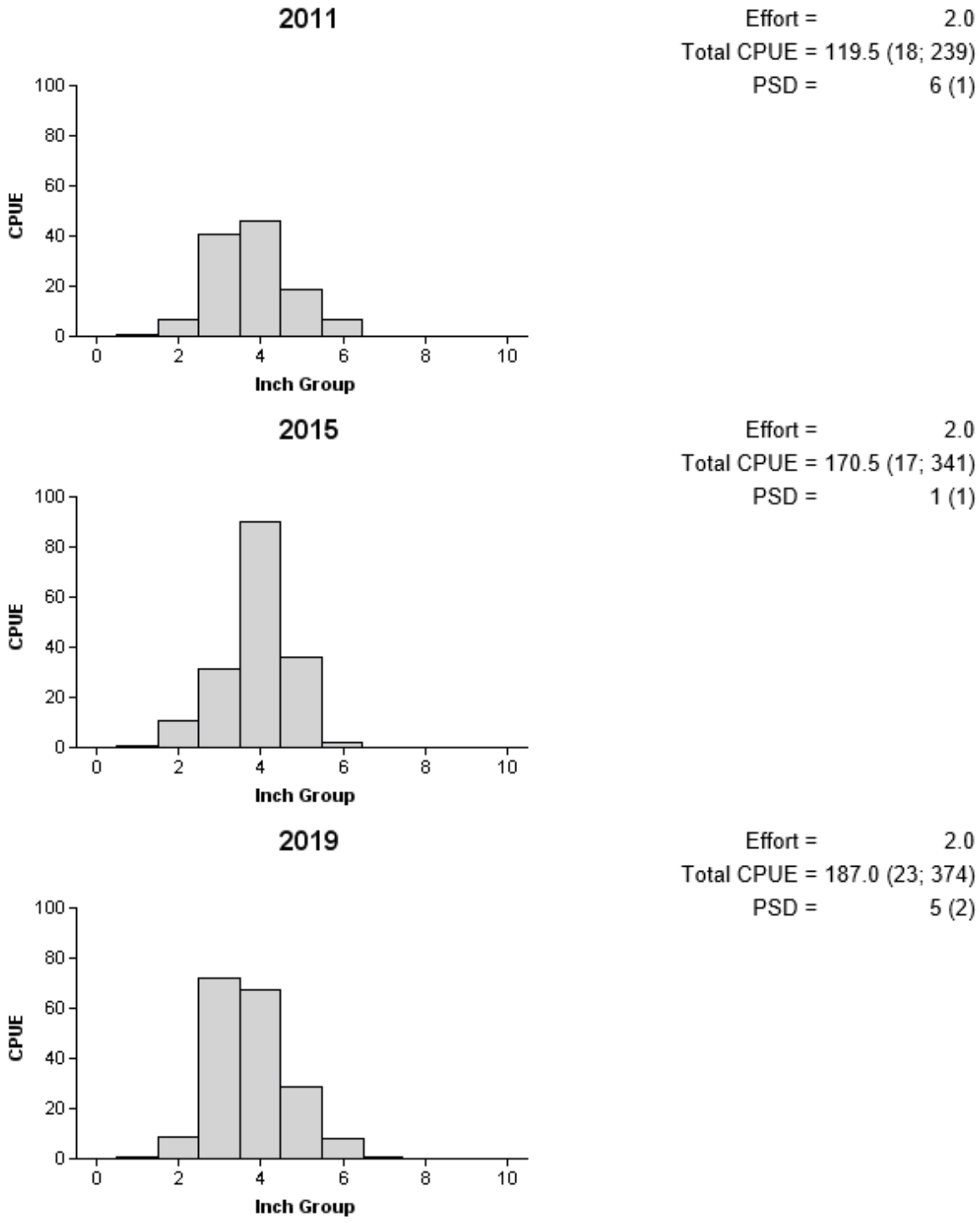


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Ray Roberts Reservoir, Texas, 2011, 2015, and 2019.

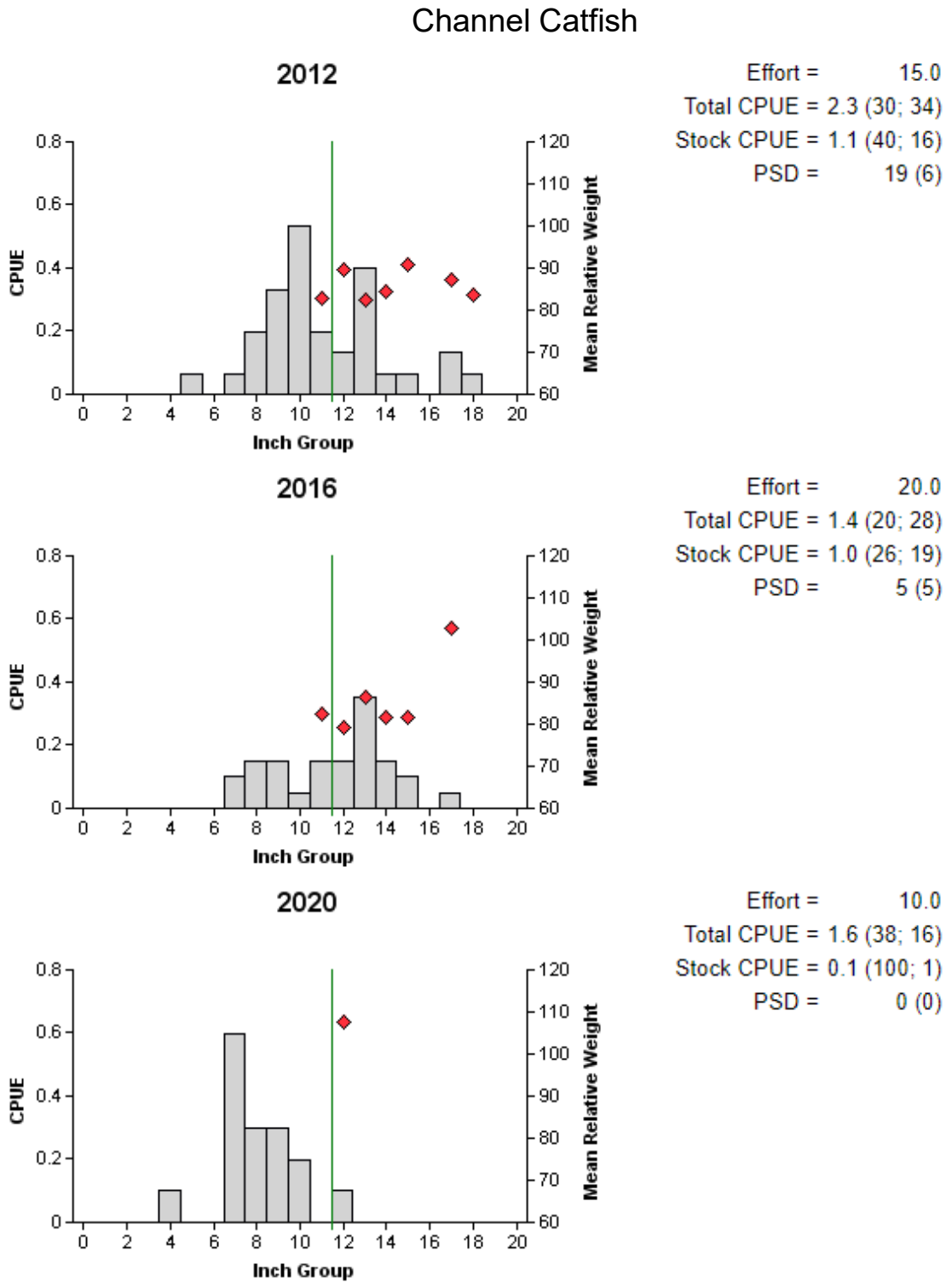


Figure 4. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Ray Roberts Reservoir, Texas, 2012, 2016, and 2020. Vertical line indicates minimum length limit.

Blue Catfish

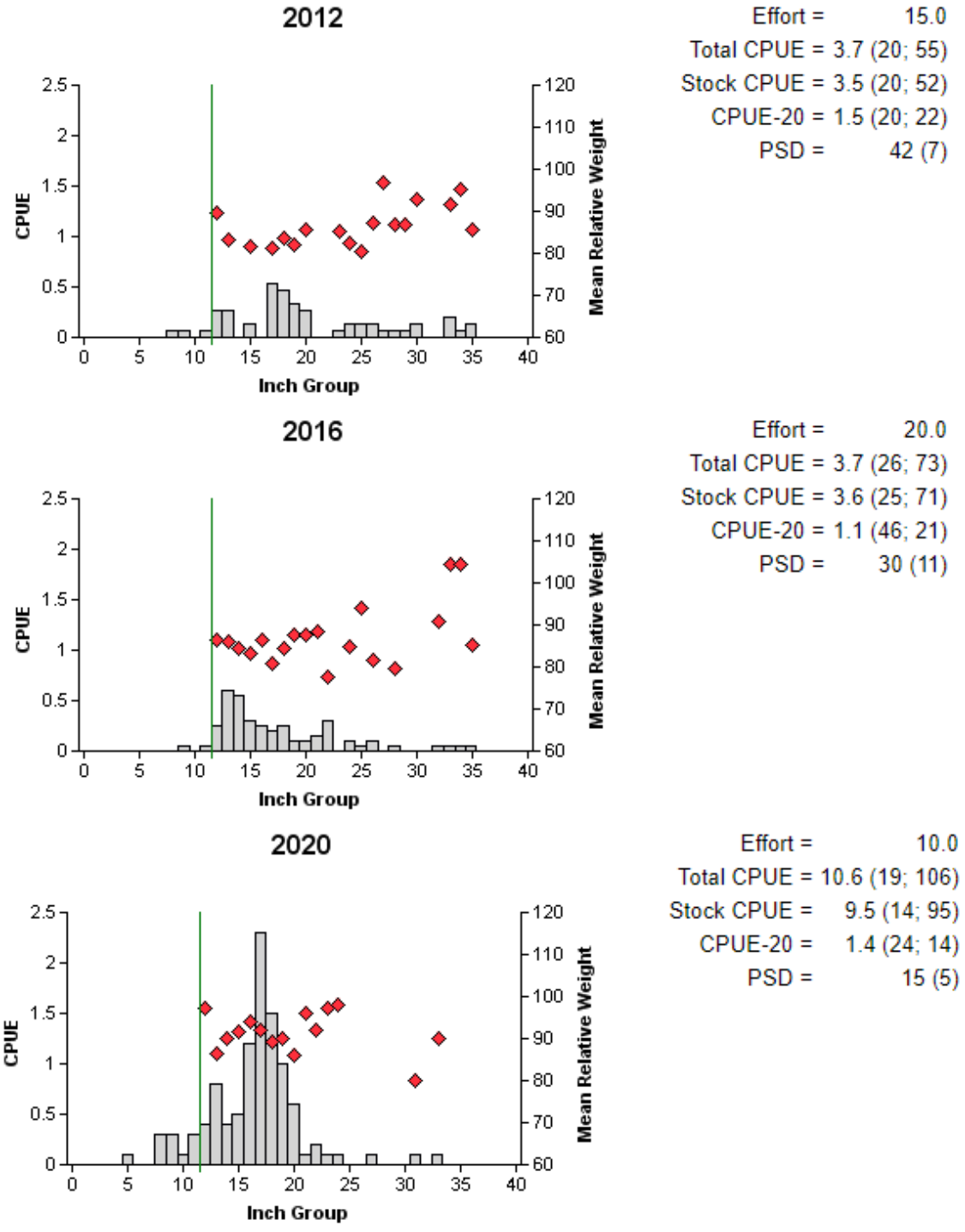


Figure 5. Number of Blue Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Ray Roberts Reservoir, Texas, 2012, 2016, and 2020. Vertical line indicates minimum length limit.

Table 9. Creel survey statistics for Blue Catfish and Channel Catfish at Ray Roberts Reservoir, Texas, from June 2004 through May 2005, from March through August 2010, and from March through August 2018. Catch rate (fish/h) is for anglers targeting catfish and total harvest is the estimated number of Blue Catfish and Channel Catfish harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year		
	2004/2005	2010	2018
Surface area (acres)	28,034	28,646	27,970
Directed effort (h)	25,142	6,637.2 (35)	16,107.2 (26)
Directed effort/acre	0.9	0.3 (35)	0.6 (26)
Catch rate (fish/h)	0.9 (97)	0.4 (111)	0.8 (62)
Total harvest			
Blue Catfish	397	444 (519)	9,596.2 (57)
Channel Catfish	17,670 (34)	5,181 (60)	6,571.2 (65)
Harvest/acre			
Blue Catfish	0.02	0.02 (519)	0.4 (57)
Channel Catfish	0.7 (34)	0.2 (60)	0.3 (65)
Percent legal released	N/A	17	15

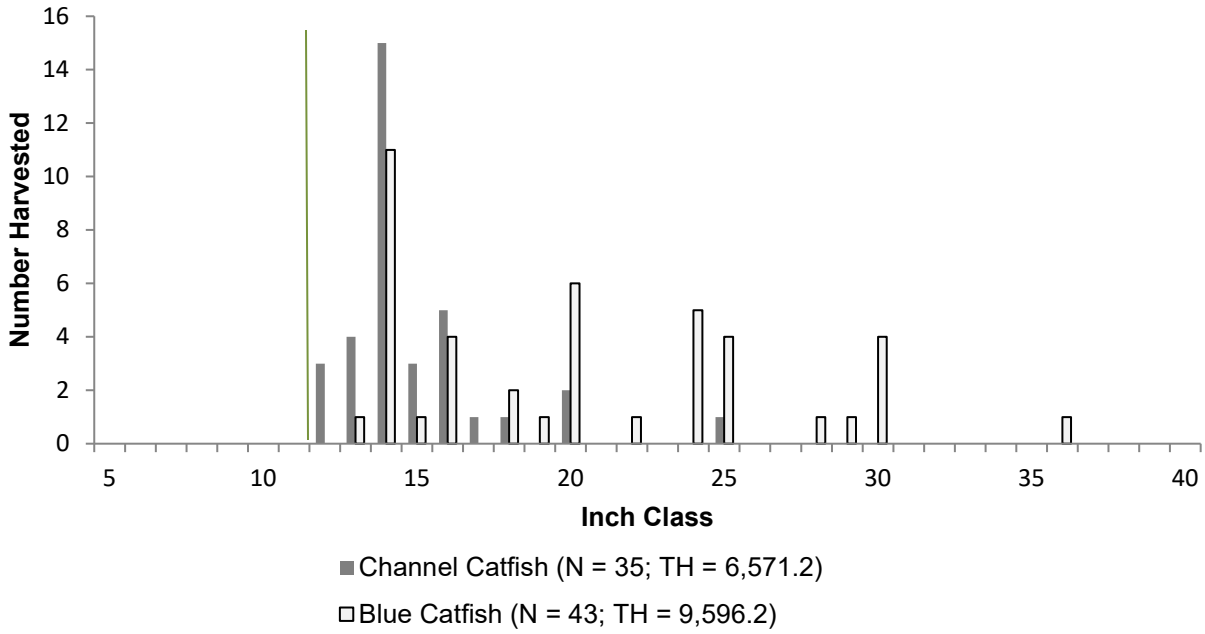


Figure 6. Length frequency of harvested Blue Catfish and Channel Catfish observed during creel surveys at Ray Roberts Reservoir, Texas, March through August 2018, all anglers combined. N is the number of harvested catfish observed during creel surveys, and TH is the total estimated harvest for the creel period. Vertical line indicates minimum length limit at time of survey.

White Bass

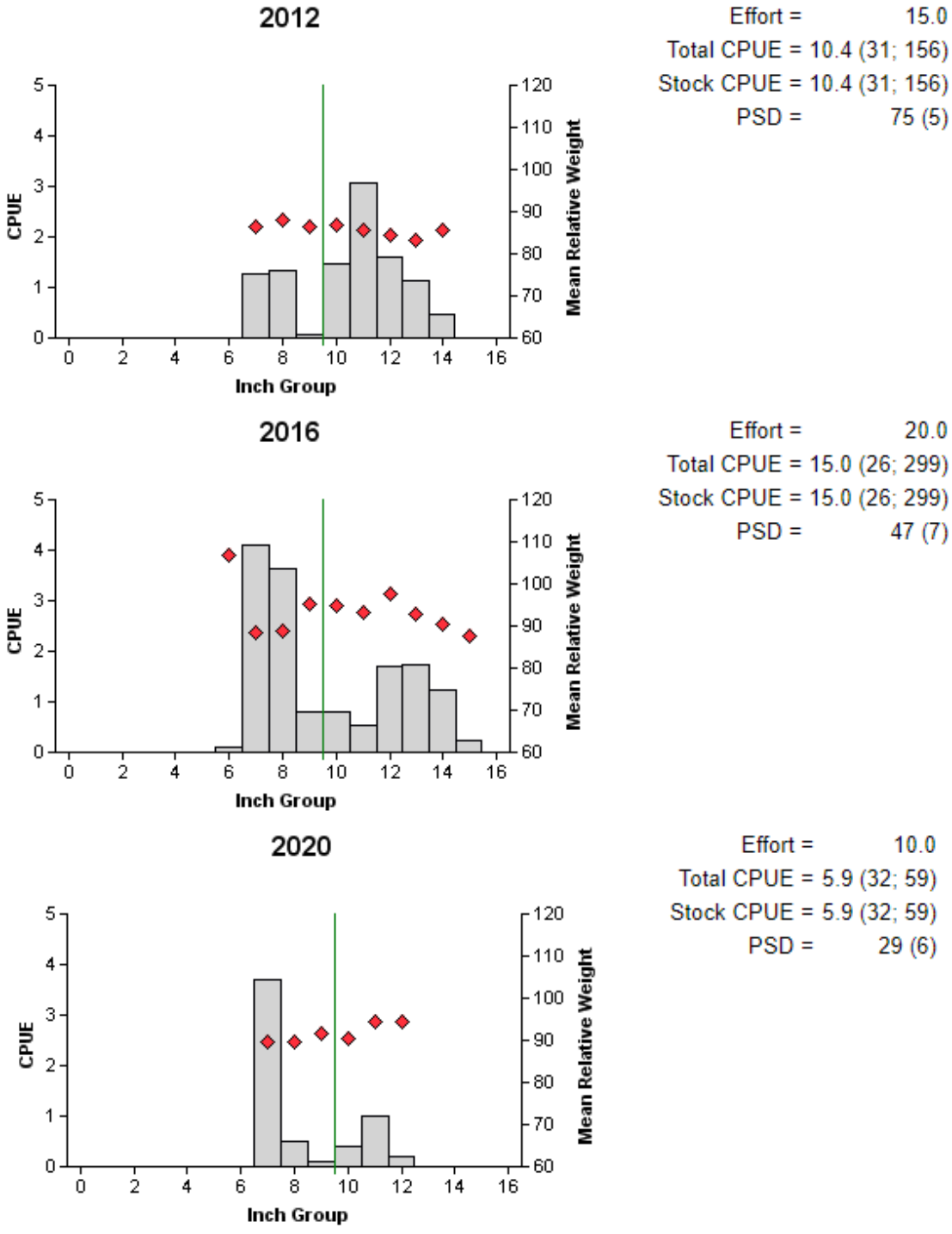


Figure 7. Number of White Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Ray Roberts Reservoir, Texas, 2012, 2016, and 2020. Vertical line indicates minimum length limit.

Table 10. Creel survey statistics for White Bass at Ray Roberts Reservoir, Texas, from June 2004 through May 2005, from March through August 2010, and from March through August 2018. Catch rate (fish/h) is for anglers targeting White Bass and total harvest is the estimated number of White Bass harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year		
	2004/2005	2010	2018
Surface area (acres)	28,034	28,646	27,970
Directed effort (h)	10,271.7 (30)	5,555.5 (39)	4,244.6 (45)
Directed effort/acre	0.4 (30)	0.2 (39)	0.2 (45)
Catch rate (fish/h)	2.9 (72)	1.9 (70)	0.9 (99)
Total harvest	23,973 (33)	8,772 (50)	15,760.2 (38)
Harvest/acre	0.9 (33)	0.3 (50)	0.6 (38)
Percent legal released	N/A	41	43

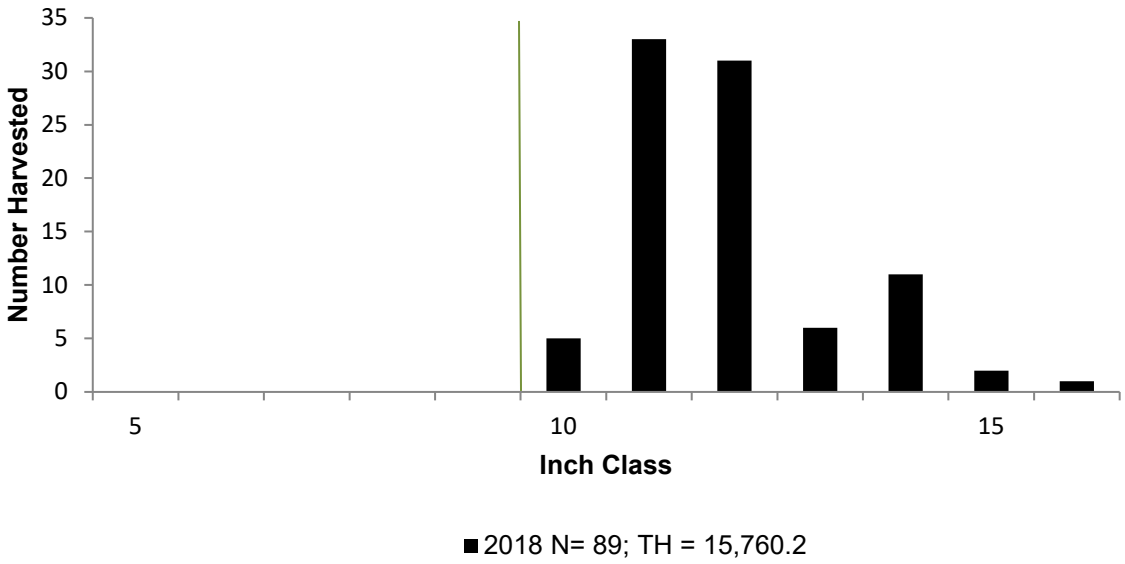


Figure 8. Length frequency of harvested White Bass observed during creel surveys at Ray Roberts Reservoir, Texas, March through August 2018, all anglers combined. N is the number of harvested White Bass observed during creel surveys, and TH is the total estimated harvest for the creel period. Vertical line indicates length limit at time of survey.

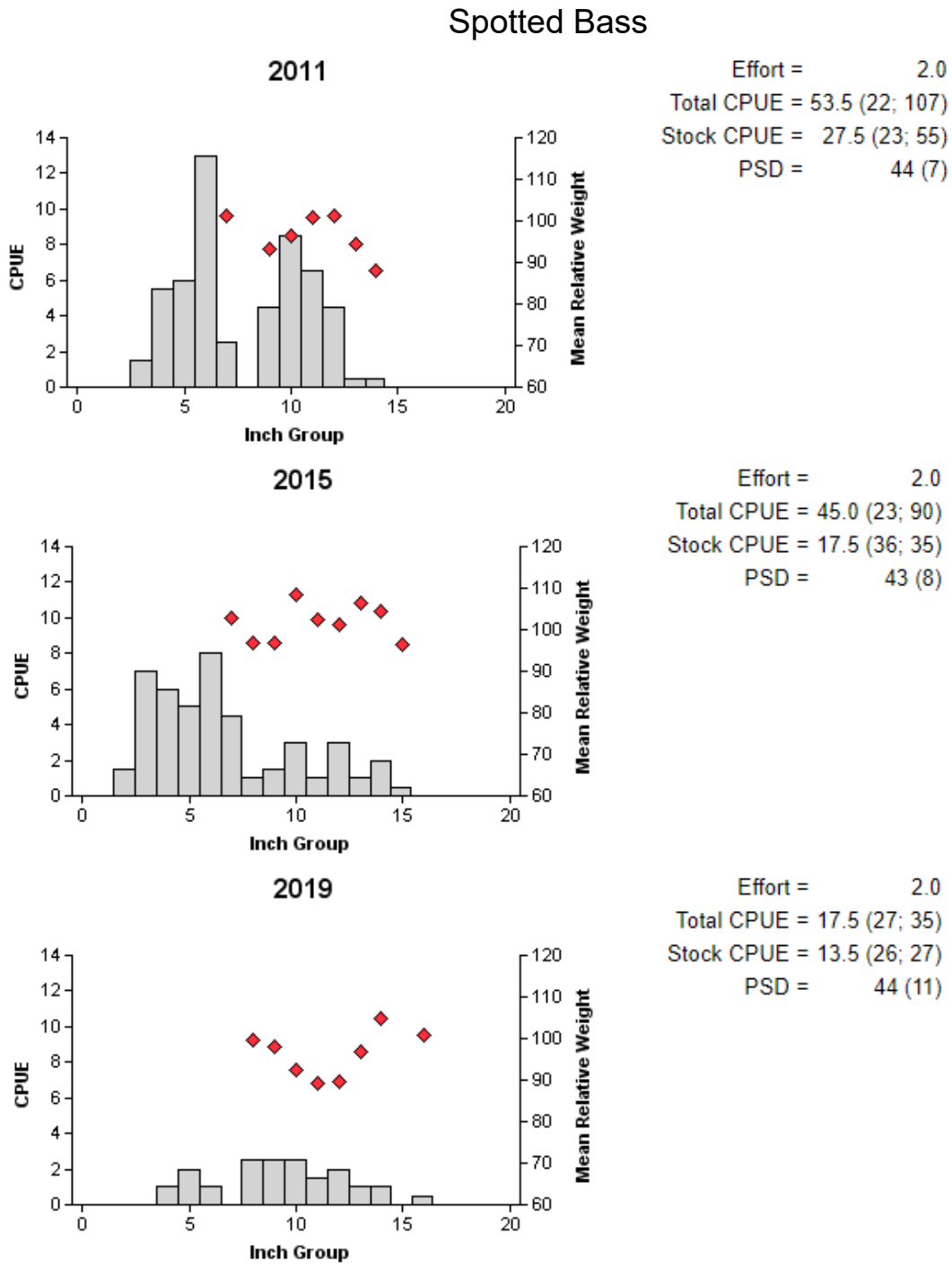


Figure 9. Number of Spotted Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Ray Roberts Reservoir, Texas, 2011, 2015, and 2019.

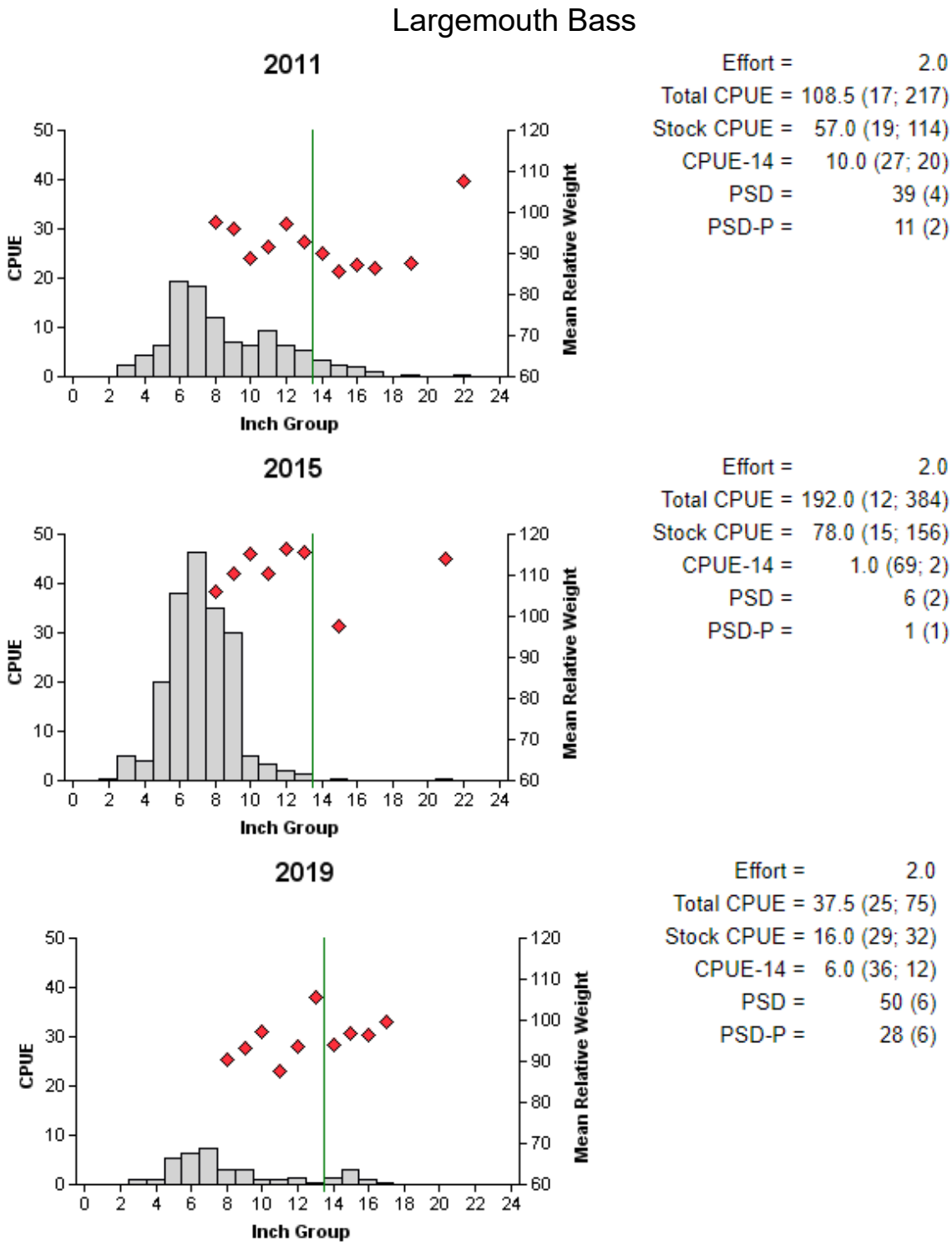


Figure 10. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Ray Roberts Reservoir, Texas, 2011, 2015, and 2019. Vertical line indicates minimum length limit.

Largemouth Bass

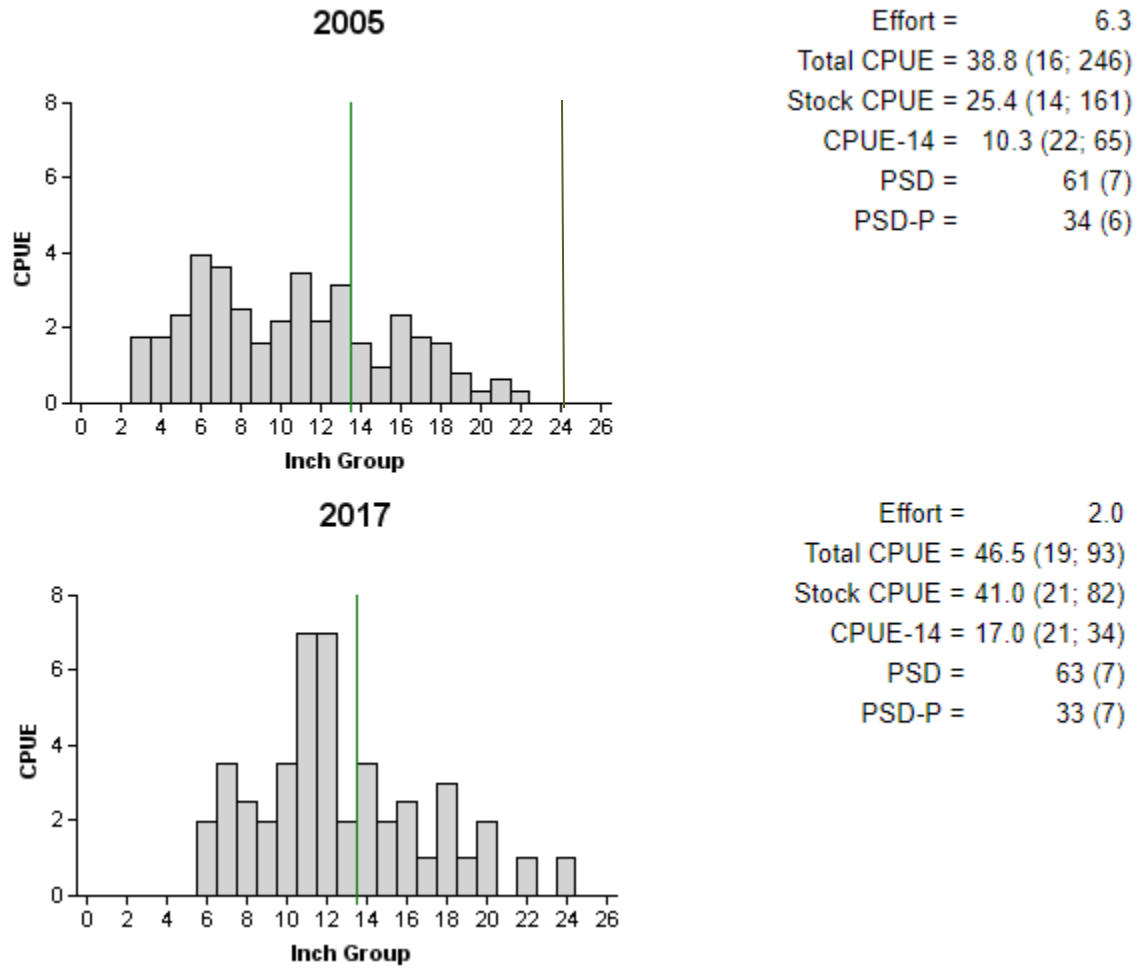


Figure 11. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Ray Roberts Reservoir, Texas, 2005 and 2017. Vertical lines indicate slot length limit in 2005 and minimum length limit in 2017.

Largemouth Bass

Table 11. Creel survey statistics for Largemouth Bass at Ray Roberts Reservoir, Texas, from June 2004 to May 2005, from March to August 2010, and from March through August 2018. Catch rate is for all anglers targeting Largemouth Bass. Harvest is partitioned by the estimated number of fish harvested by non-tournament anglers and the number of fish retained by tournament anglers for weigh-in and release. Relative standard errors (RSE) are in parentheses.

Statistic	2004/2005	2010	2018
Surface area (acres)	28,034	28,646	27,970
Directed angling effort (h)			
Tournament	N/A	34,439 (29)	29,007 (23)
Non-tournament	119,066 (14)	45,867 (23)	35,200 (21)
All black bass anglers combined	119,066 (14)	80,306 (24)	64,206 (22)
Angling effort/acre	4.7 (14)	3.1 (24)	2.5 (19)
Catch rate (fish/h)	0.3 (22)	0.4 (15)	0.3 (21)
Harvest			
Non-tournament harvest	7,635[a] (48)	754 (123)	1,135 (143)
Harvest/acre	0.3 (48)	0.03 (123)	0.04 (143)
Tournament	N/A	10,432 (66)	6,043 (74)
Percent legal released (non-tournament)	N/A	85	85

[a] Harvest in 2004/2005 was primarily fish below the 14- to 24-inch slot limit.

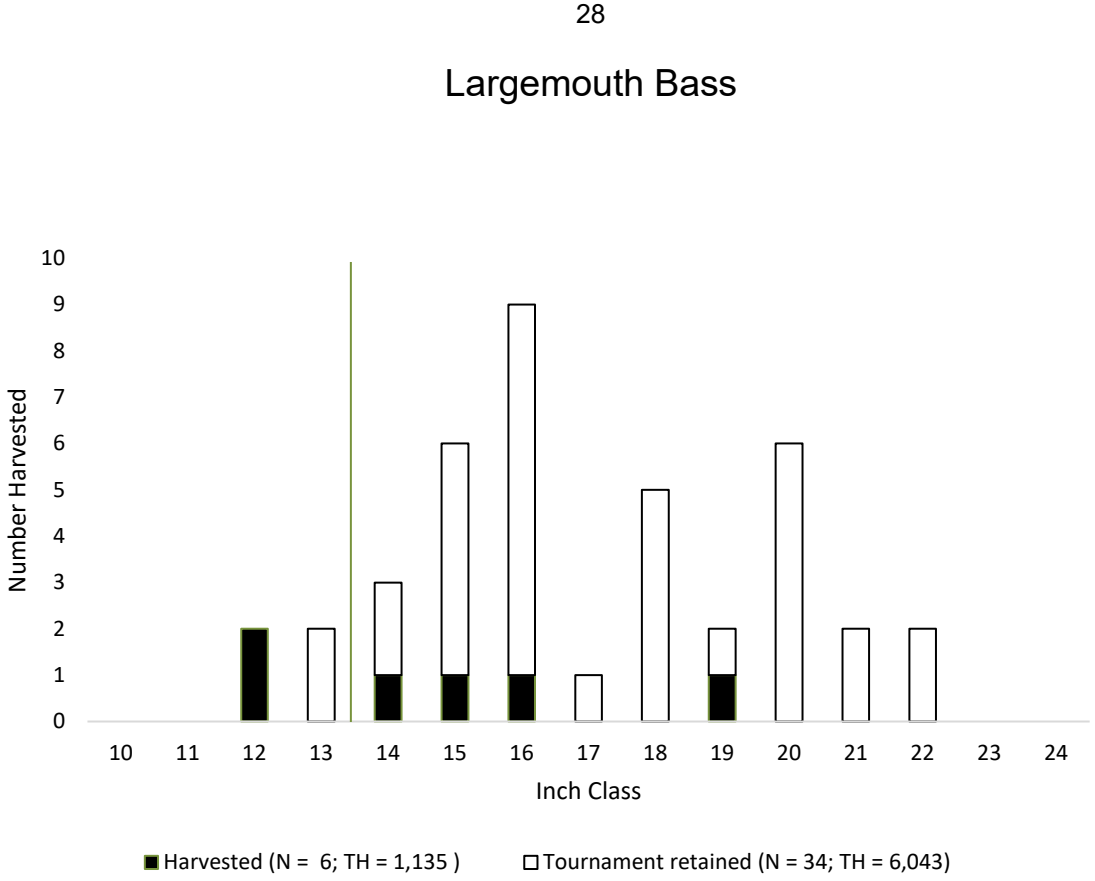


Figure 12. Length frequency of harvested Largemouth Bass observed during creel surveys at Ray Roberts Reservoir, Texas, March through August 2018, all anglers combined. N is the number of Largemouth Bass observed during creel surveys, and TH is the estimated harvest or tournament-retained bass for the creel period. Vertical line indicates minimum length limit.

Table 12. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Ray Roberts Reservoir, Texas, 2011 to 2019. 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	F1	Fx	NLMB		
2011	30	0	NA	23[a]	7	44.0	0
2016	30	1	0	22	8	43.0	3.3
2019	29	1	8	20	0	57.0	3.4

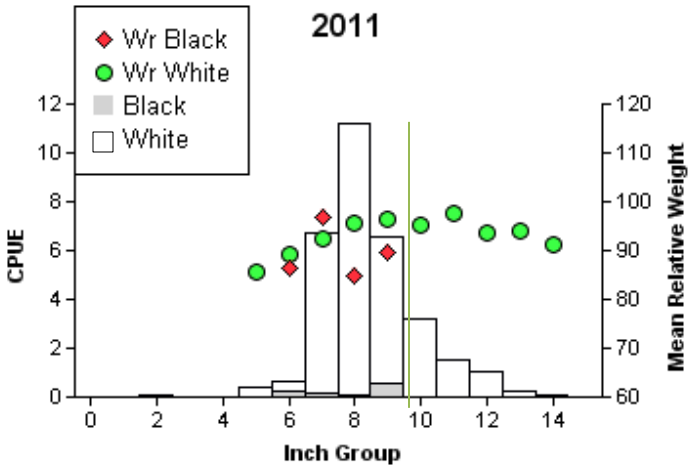
[a] Determination of hybrid status not conducted.

Largemouth Bass

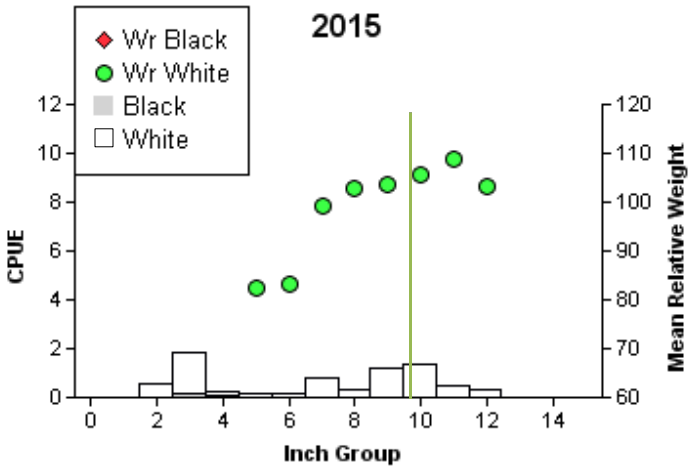
Table 13. Average length at capture for Largemouth Bass ages 1 – 3 collected in electrofishing surveys, Ray Roberts Reservoir, Texas, 1998, 2007, and 2019. Lengths are followed by the sample size and relative standard error in parenthesis (RSE; N).

Year	Length (inches) at capture for age		
	1	2	3
1998	9.7 (2.5; 40)	12.4 (2.7; 18)	14.2 (3.6; 10)
2007	13.4 (0.9; 9)	15.0 (1.4; 8)	15.3 (4.4; 8)
2019	10.9 (3.6; 7)	14.7 (2.8; 11)	16.5 (6.4; 2)

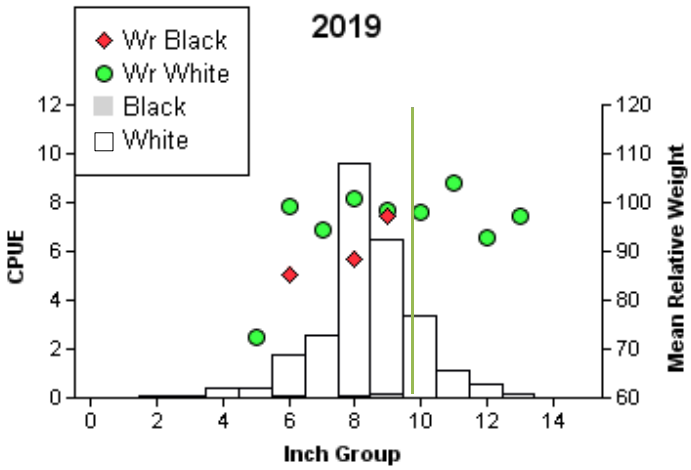
Crappie



Effort = 15.0
Total CPUE = 31.7 (41; 476)
Stock CPUE = 31.7 (41; 475)
CPUE-10 = 6.1 (52; 92)
PSD = 75 (6)



Effort = 15.0
Total CPUE = 7.6 (28; 114)
Stock CPUE = 4.9 (25; 74)
CPUE-10 = 2.2 (26; 33)
PSD = 76 (5)



Effort = 10.0
Total CPUE = 26.8 (51; 268)
Stock CPUE = 26.2 (51; 262)
CPUE-10 = 5.3 (44; 53)
PSD = 82 (2)

Figure 13. Number of 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, Ray Roberts Reservoir, Texas, 2011, 2015, and 2019. Vertical line indicates minimum length limit.

Crappie

Table 14. Creel survey statistics for crappie at Ray Roberts Reservoir, Texas, from June 2004 through May 2005, from March through August 2010, and from March through August 2018. Catch rate (fish/h) is for anglers targeting crappie and total harvest is the estimated number of crappies harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year		
	2004/2005	2010	2018
Surface area (acres)	28,034	28,646	27,970
Directed effort (h)	82,654.8 (14)	76,840.8 (15)	69,108.2 (17)
Directed effort/acre	3.2 (14)	3.0 (15)	2.7 (17)
Catch rate (fish/h)	1.9 (26)	2.3 (35)	3.8 (21)
Total harvest	66,295.0 (24)	55,595.0 (36)	77,238.2 (32)
Harvest/acre	2.6 (24)	2.2 (36)	3.0 (32)
Percent legal released	N/A	10	3

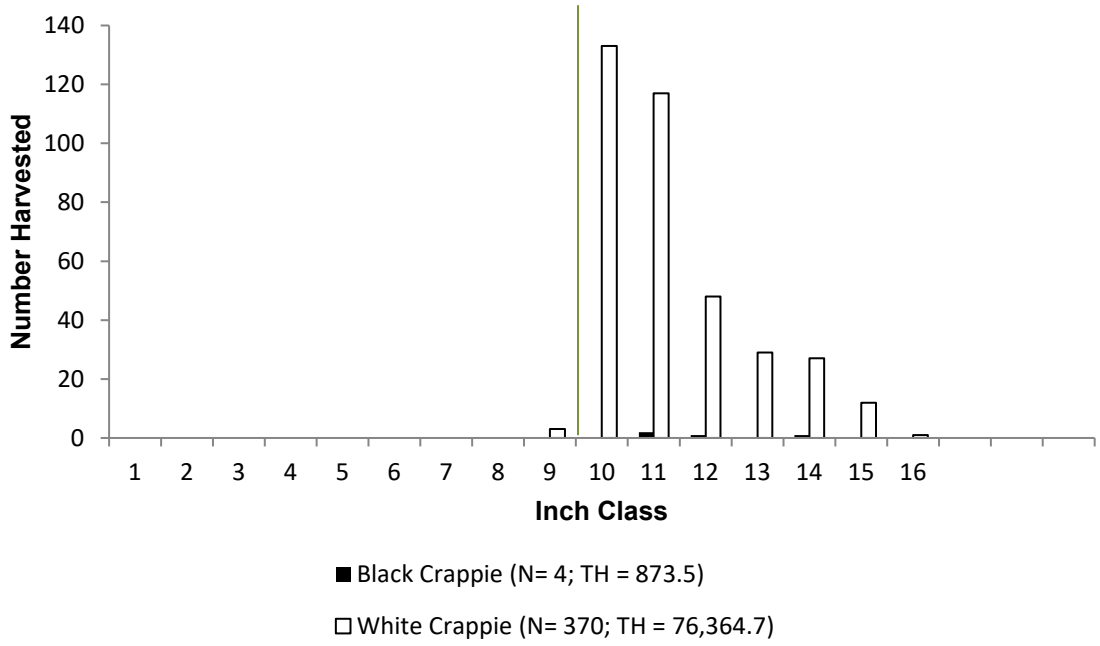


Figure 14. Length frequency of harvested crappie observed during creel surveys at Ray Roberts Reservoir, Texas, March through May 2018, all anglers combined. N is the number of harvested crappies observed during creel surveys, and TH is the total estimated harvest for the creel period. Vertical line indicates length limit at time of survey.

Proposed Sampling Schedule

Table 15. Proposed sampling schedule for Ray Roberts 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. An additional bass-only electrofishing survey will be conducted in the spring. Standard survey denoted by S and additional survey denoted by A.

	Survey year			
	2020-2021	2021-2022	2022-2023	2023-2024
Angler Access				S
Vegetation				S
Fall Electrofishing				S
Spring (Bass-only) Electrofishing		A		
Trap netting				S
Gill netting				S
Creel survey				
Report				S

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

Number (N) and catch rate (CPUE) (RSE in parentheses) of all target species collected from all gear types from Ray Roberts Reservoir, Texas, 2017-2020. Sampling effort was 10 net nights for gill netting, 10 net nights for trap netting, two hours for fall electrofishing, and two hours for spring electrofishing.

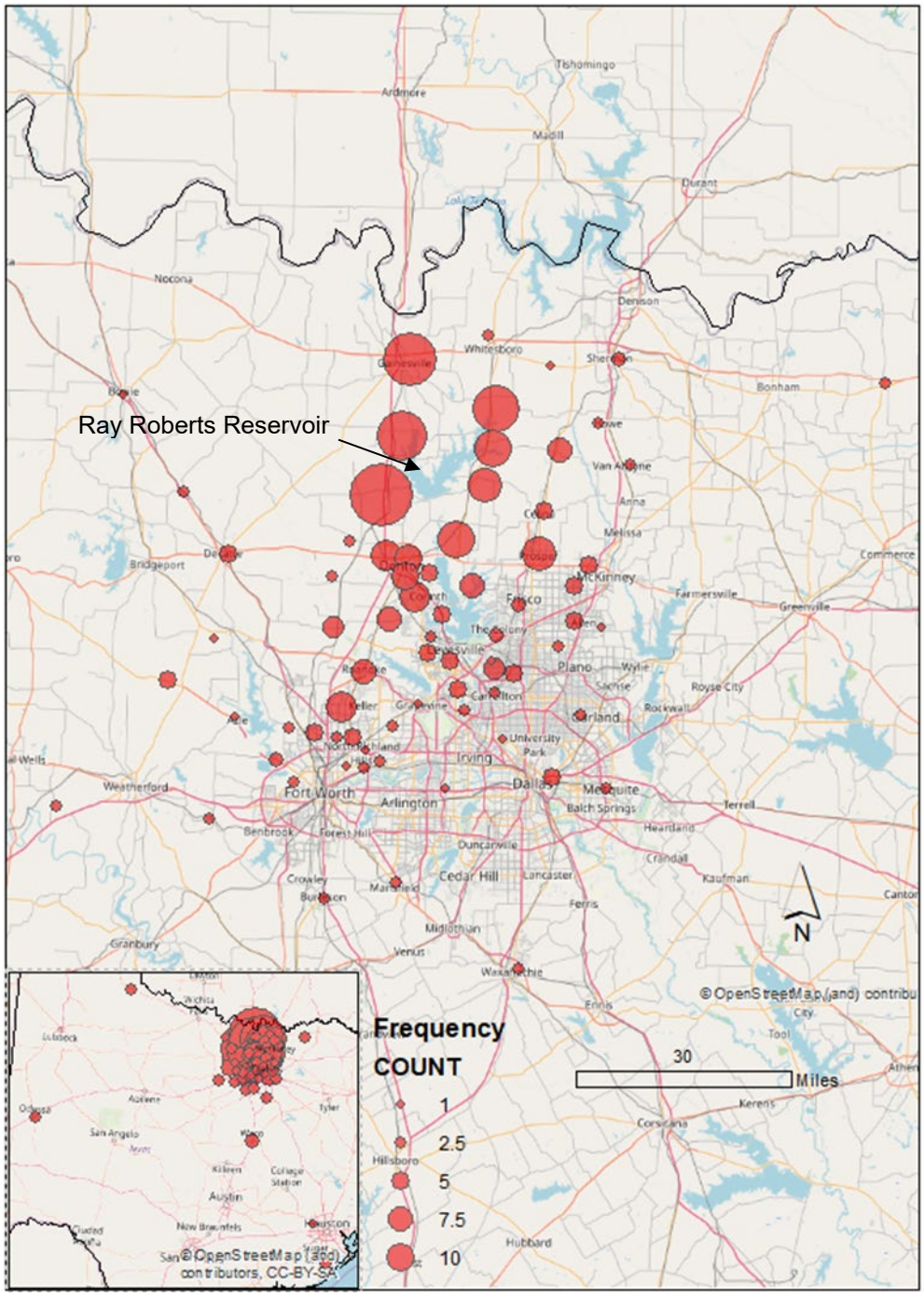
Species	Gill Netting		Trap Netting		Fall Electrofishing		Spring Electrofishing	
	N	CPUE	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					137	68.5 (26)		
Threadfin Shad					280	140.0 (33)		
Blue Catfish	106	10.6 (19)						
Channel Catfish	16	1.6 (38)						
White Bass	59	5.9 (32)						
Green Sunfish					38	19 (46)		
Warmouth					5	2.5 (41)		
Orangespotted Sunfish					1	0.5 (100)		
Bluegill					374	187.0 (23)		
Longear Sunfish					176	88.0 (30)		
Redear Sunfish					8	4.0 (39)		
Largemouth Bass					75	37.5 (25)	93	46.5 (19)
Spotted Bass					35	17.5 (27)	34	17.0 (43)
Smallmouth Bass							1	0.5 (100)
White Crappie			264	26.4 (52)				
Black Crappie			4	0.4 (55)				

APPENDIX B – Historical Catch Rates

Catch rates (CPUE) of targeted species by gear type for Ray Roberts Reservoir, Texas, 1998 through 2020.

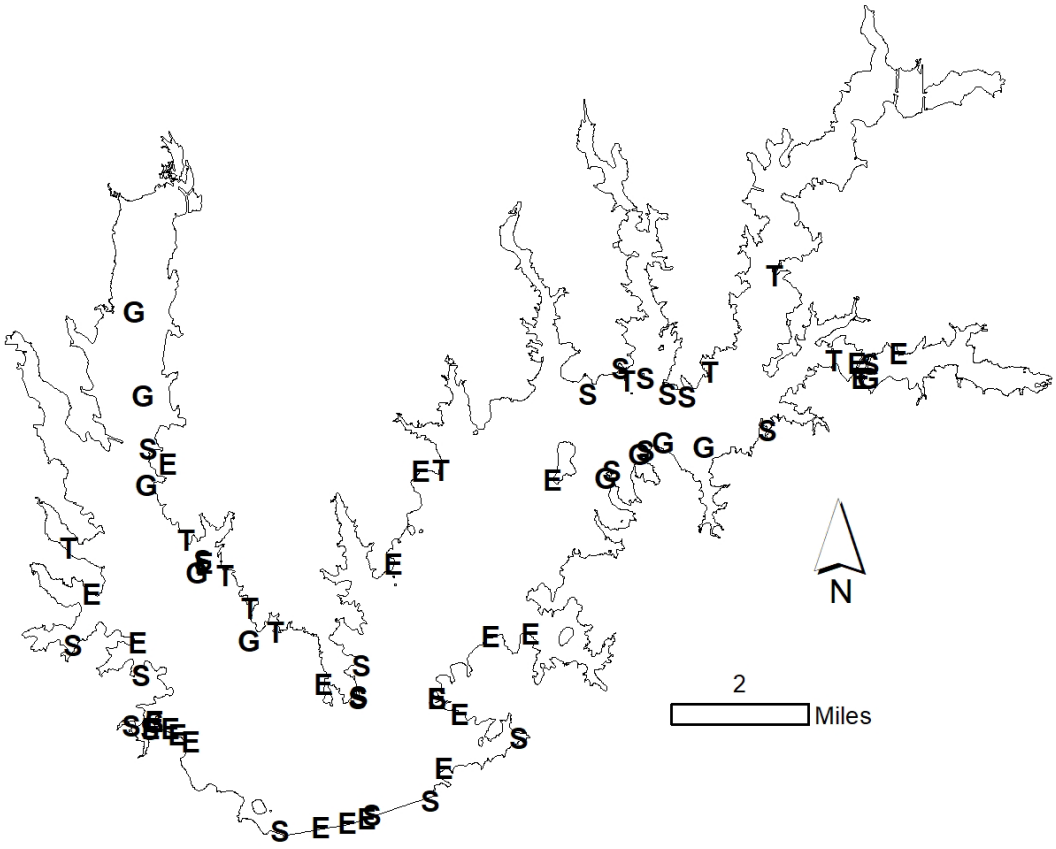
		Year						
Gear	Species	1998	2003-2005	2007-2008	2011-2012	2015-2016	2019-2020	**Avg**
Gill Net	Blue Catfish	0.3	1.7	2.8	3.7	3.7	10.6	**3.8**
(fish/net night)	Channel Catfish	4.5	8.2	5.5	2.3	1.4	1.6	**3.9**
	Flathead Catfish	0.1	0.0	0.1	0.1	0.1	0.0	**0.1**
	White Bass	3.3	4.5	5.1	10.4	15.0	5.9	**7.4**
Electrofishing	Gizzard Shad	156.5	127.0	145.0	180.0	273.0	68.5	**158.3**
(fish/hour)	Threadfin Shad	61.0	189.5	339.0	65.0	1123.0	140	**319.6**
	Green Sunfish	2.5	2.5	48.0	146.5	76.0	19	**49.1**
	Warmouth	12.0	5.5	33.0	7.0	13.5	2.5	**12.3**
	Orangespotted Sunfish	0.0	1.0	3.0	0.0	3.5	0.5	**1.3**
	Bluegill	160.5	123.0	208.0	119.5	170.5	187.0	**161.4**
	Longear Sunfish	42.0	77.5	254.5	187.5	194.5	88.0	**140.7**
	Redear Sunfish	6.0	3.5	18.0	1.0	9.0	4.0	**6.9**
	Smallmouth Bass	0.0	0.0	0.0	0.5	0.0	0.0	**0.1**
	Spotted Bass	0.0	15.0	20.0	53.5	45.0	17.5	**18.9**
	Largemouth Bass	77.5	85.0	227.0	108.5	192.0	37.5	**104.6**
Trap Net	White Crappie	2.7	8.6	7.9	30.7	7.4	26.4	**12.5**
(fish/net night)	Black Crappie	0.1	0.3	0.3	1.1	0.2	0.4	**0.4**

APPENDIX C – Location of Residence for Anglers Interviewed in Creel Survey



Location, by ZIP code centroid, and frequency of anglers that were interviewed at Ray Roberts Reservoir, Texas, during the March through May 2018 creel survey. Dot size indicates relative frequency of angler visits (N =437) from each location during the survey period.

APPENDIX D – Map of sampling locations



Location of sampling sites, Ray Roberts Reservoir, Texas, 2017-2020. Trap net, gill net, fall electrofishing, and spring electrofishing stations are indicated by T, G, E, and S respectively. Water level was near the conservation elevation at time of sampling.

APPENDIX E – Tournament Results (Black Bass)

Results from individual and team format black bass tournaments at Ray Roberts Reservoir 2018 - 2019. Only tournaments with 5-fish bag limits and ≥ 50 participants or teams were included.

Year	1st place weight	2nd place weight	3rd place weight	Big Bass weight
		Team		
2018	28.7	26.5	25.8	8.85
2018	21.7	21.7	20.63	9.35
2019	29.5	28.6	28.6	10.54
2019	29.9	27.7	25.4	8.36
		Individual		
2019	27.9	24.1	18.2	8.82

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