PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2015 Survey Report

Ray Roberts Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Ray Roberts Reservoir were surveyed in 2015 using electrofishing and trap nets, and in 2016 using gill nets. Habitat and vegetation surveys were conducted in 2015. This report summarizes the survey results and contains a management plan for the reservoir based on those findings.

- **Reservoir Description:** Ray Roberts Reservoir is a 25,600-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. Ray Roberts Reservoir is moderately productive. 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 White Crappie. 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. Florida Largemouth Bass fingerlings were stocked in 2011 and 2013. Statewide fish harvest regulations apply to all sport fishes in Ray Roberts Reservoir.

- **Fish Community**

  - **Prey species:** Threadfin Shad were high in abundance and catch rate of prey size (<7 inch) Gizzard Shad was above average. Sunfishes such as Bluegill and Longear also provided forage for sport fishes.
  - **Catfishes:** Abundance of Channel Catfish continues to gradually decline, while abundance of Blue Catfish continues to increase. Flathead Catfish are also present.
  - **White Bass:** White Bass were abundant, and catch rate increased by 50% in each of the past two surveys.
  - **Black basses:** Although not stocked by TPWD, two lake-record Smallmouth Bass were caught by anglers in 2010 and 2011, and a small number have been collected during fisheries surveys. Spotted Bass are also present in moderate abundance. The Largemouth Bass population was dominated by sub-stock fish in 2015. The reservoir has produced catches of trophy Largemouth Bass.
  - **White Crappie:** White and Black Crappie are present in the reservoir; although, White Crappie are higher in abundance.

  Management strategies: Conduct additional bass-only electrofishing survey in spring 2018 to monitor abundance of larger bass (≥14 inches). Conduct standard monitoring in 2019 with electrofishing and trap nets, and gill nets in 2020. Conduct a vegetation survey in 2019.

INTRODUCTION

This document is a summary of fisheries data collected from Ray Roberts 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 species of 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

Ray Roberts Reservoir is a 25,600-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 for municipal water supply, flood control and recreation. Ray Roberts Reservoir was borderline mesotrophic-eutrophic with a mean TSI chl-*a* of 45.92 (Texas Commission on Environmental Quality. 2011). Habitat at the time of sampling consisted of rocky shoreline, dead trees, and riprap along with emergent vegetation. Other descriptive characteristics for Ray Roberts Reservoir are in Table 1.

Angler Access

Public access consisted of seven public boat ramps, and bank access at eight bridge crossings (Table 2). Boat access is generally excellent; however, high lake levels in recent years have resulted in temporary ramp closures. With the exception of 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 $5.00 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.

Management History

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

1. Recommended Florida Largemouth Bass fingerlings in 2013 at a rate of 25 fish/acre to improve the trophy potential of the reservoir.
   Action: 521,526 Largemouth Bass fingerlings were stocked in 2013.
2. Monitor black bass populations to evaluate the 2009 regulation change.
   Action: Electrofishing was conducted in fall 2015 and a genetic sample was evaluated.
3. Promote the improved Blue Catfish, White Bass, and White Crappie populations.
   Action: Fisheries were promoted whenever possible, and shared via the lake webpage, popular articles, and social media.
4. Educate stakeholders regarding invasive species concerns and monitor for invasive species.
   Action: Monitoring for zebra mussels and non-native vegetation was conducted. Information and signage was shared with state park staff and controlling authorities. Opportunities to inform and educate the public about invasive species were taken.

Harvest regulation history: The 14- to 24-inch slot length limit and 5 fish daily bag limit for Largemouth Bass was replaced with the statewide 14-inch minimum length limit and 5 fish daily bag limit September 1, 2009. Sportfishes in Ray Roberts Reservoir are currently managed with statewide regulations (Table 3).

Stocking history: The most recent stocking of Ray Roberts Reservoir occurred in 2013 when 521,526 Florida Largemouth Bass fingerlings were stocked. ShareLunker fingerlings were also stocked in 2012.

A complete stocking history is included in Table 4.

Vegetation/habitat history: Historically, flooded timber (dead trees and stumps) provided the bulk of pelagic habitat in Ray Roberts Reservoir (Table 6). Native submersed vegetation along with non-native Eurasian watermilfoil and hydrilla have historically provided some habitat in the reservoir. However, water level fluctuations have resulted in minimal submerged habitat in recent years (Table 7).

Water Transfer: Ray Roberts Reservoir is primarily used for municipal water supply, recreation and flood control. 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 (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 – Black basses, Sunfishes, Gizzard Shad, and Threadfin Shad were collected by electrofishing (2 hours at 24, 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. An insufficient sample size (N=3) of Largemouth Bass between 13.0 and 14.9 inches was collected so mean age at legal length (14 inches) was not determined.

Trap netting – Crappie were collected using trap nets (15 net nights at 15 stations). CPUE for trap netting was recorded as the number of fish caught per net night (fish/nn). Ages of White Crappie were determined using otoliths from 13 randomly-selected fish (range 9.7 to 10.9 inches).

Gill netting – Blue Catfish, Channel Catfish, and White Bass were collected by gill netting (20 net nights at 20 stations). CPUE for gill netting was recorded as the number of fish caught per net night (fish/nn). Sample sizes of Blue Catfish and Channel Catfish collected near the minimum length limit (11.0 to 12.9 inches) were small; however, ages were determined for fish collected. Ages for Blue Catfish were determined from six randomly-selected fish (range 11.5 to 12.8 inches). Ages for Channel Catfish were determined from five randomly-selected fish (range 11.4 to 12.5). Ages for White Bass were determined using otoliths from 13 randomly-selected fish (range 9.0 to 10.9 inches)

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

Habitat – A structural habitat survey and 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: Habitat features consisted mainly of natural shoreline (94%), dead trees and stumps (3,000 acres), and riprap (6%) along the dam and railroad bridges (Table 6). Emergent vegetation accounted for 98 acres in 2015 (Table 7). Water level fluctuations (Figure 1) resulted in an overall decline of submerged vegetation since 2003, when native and non-native submerged vegetation occupied some 2,200 acres (Hysmith and Moczygemba 2008). Non-native Eurasian watermilfoil and hydrilla have historically been present in the reservoir; however, only hydrilla was observed in trace amounts during the 2015 vegetation survey.

Prey species: Electrofishing total CPUE (CPUE-T) of Gizzard Shad (273.0/h) and Bluegill (170.5) were above average in 2015 (Figures 2 and 3; Appendix C). Both species have provided an excellent prey base since 1995 (Appendix C). Gizzard Shad abundance increased, and IOV increased to 84 aided by high catch rates of 4 and 5-inch fish. Threadfin Shad CPUE-T reached a historical high with a current electrofishing CPUE of 1,123.0/h, compared to 65.0/h and 339.0/h in 2011 and 2007, respectively (Appendix C). The Bluegill population was dominated by 3 to 5-inch Bluegill, ideal size prey (Figure 3). Longear and Redear Sunfish also contributed to the forage base (Appendix C).

Catfishes: The gill net CPUE of Blue Catfish was 3.7/nn in 2012 and 2016 (Figure 4), which is the highest catch rate on record. Though not stocked by TPWD, Blue Catfish are present and continue to replace Channel Catfish as the dominant catfish species. Relative weights above 80 suggested good body condition for fish $\geq$ 12 inches and recruitment of legal-size fish was consistent. Blue Catfish collected in 2016 surveys grew to 12 inches in about 3.5 years (N = 6; range = 3 to 4 years).

The gill net CPUE of Channel Catfish was 1.4/nn in 2016, down from 2.3/nn in 2012 and 5.5/nn in 2008 (Figure 5). Relative weights for Channel Catfish suggested adequate body condition. All Channel Catfish collected for age analysis reached 12 inches in 4 years (N = 5).

White Bass: Gill net CPUE of White Bass increased by approximately 50% over the last three surveys to 15.0/nn (Figure 6). Relative weight was >85 for all size groups which showed a slight improvement from the previous survey. All White Bass in age samples grew to 10 inches in 1 year (N =13); 42% of the sample population was $\geq$ 10 inches. Two-hundred and ninety-nine stock-size White Bass were collected; although, RSE of CPUE-S was 26 with an effort of 20 net nights.

Black basses: Although not stocked by TPWD, multiple Smallmouth Bass have been submitted as waterbody records for the reservoir. Smallmouth Bass were likely introduced into the reservoir; non-permitted introductions such as this may have also resulted in introduction of zebra mussels. Smallmouth Bass were last collected during 2011 electrofishing samples.

The electrofishing total CPUE of Spotted Bass was 45.0/h in 2015, and has remained consistent since 2011 (53.5/h; Figure 7). CPUE-T exceeded the average catch rate for the last two survey years (Appendix C). Relative weights indicated robust, healthy fish.

The electrofishing CPUE-T of Largemouth Bass was high (192.0/h) in 2015, and similar to the 2007 CPUE-T (227.0/h; Figure 8). Substantial rises in water level in both years contributed to an abundance of sub-stock fish. High mean relative weights indicated abundant forage, also reflective of the rise in water level. Stated objectives from the 2015 objective based sampling plan were met with the exception of collecting data to calculate mean age at legal length (14 inches). Despite collecting 156 stock-size Largemouth Bass, an insufficient sample of fish 13.0 to 14.9 inches (N = 3) was collected, so mean age at legal length could not be determined. Largemouth Bass PSD appeared to decline from 25 and 39 in 2007 and 2011, respectively, to a PSD of 6 in 2015. This apparent decline may be influenced by above average abundance of 8 to 10-inch fish in 2015, as well as drought conditions in preceding years.

Traditional harvest and tournament retention of fish previously protected by the 14- to 24- inch slot-limit has increased since the slot was removed in September 2009. Tournament retained Largemouth Bass accounted for 93% of fish measured in a 2010 creel survey (Hysmith and Moczygemba 2012). The ratio of tournament retained Largemouth Bass to traditionally harvested fish during a 2010 creel survey was 14:1. Allen et al. (2004) suggested that ratios of tournament weighed in fish to non-tournament harvested fish above 3:1 warranted more detailed study because tournament associated mortality of 20-30% could cause 5-12% declines in the abundance of quality-length and larger Largemouth Bass. Although the proportion of legal-sized fish in the population has historically been low (Hysmith and Moczygemba 2012), it will be important to monitor for a developing trend. Genetic analysis of Largemouth Bass indicated Florida Largemouth Bass influence was 43.0% (Table 8), and was consistent following FLMB fingerling stockings in 2011 and 2013.

White Crappie: The trap net CPUE of White Crappie was above average (7.4/nn) in 2015, yet below a catch of record (30.7/nn) in 2011 (Figure 9; Appendix C). Relative weights ($\geq$95) showed evidence of a healthy population. Thirty percent of the sample population was $\geq$ 10 inches and all fish aged reached legal length in one year (N = 13).

Zebra mussels: Routine sampling of the waters of Ray Roberts Reservoir by the University of Texas at Arlington over the past several years have indicated that the zebra mussel (*Dreissena polymorpha*) population may have declined substantially following a peak in previous years. This apparent population decline is similar to patterns observed following zebra mussel introductions in other Texas reservoirs (R. McMahon Ph.D., personal communication, May 26, 2016).

Fisheries management plan for Ray Roberts Reservoir, Texas

Prepared – July 2016.

ISSUE 1: The recent genetic analysis indicated 43% of the Largemouth Bass exhibited Florida Largemouth Bass alleles, and one pure Florida Largemouth Bass was collected during this survey. Ray Roberts Reservoir has produced six ShareLunkers; most recently in March 2015.

MANAGEMENT STRATEGIES

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.
2. Conduct a genetic sample of the Largemouth Bass population in 2019.

ISSUE 2: Although not stocked, Smallmouth Bass were collected during 2011 electrofishing samples to include a sub-adult, and multiple Smallmouth Bass as well as Spotted/Smallmouth Bass hybrids have been submitted as waterbody records for the reservoir. The Largemouth Bass population has a history of producing trophy bass and needs to be monitored after the regulation change of 2009.

MANAGEMENT STRATEGY

1. Conduct a bass-only electrofishing survey in spring 2018 and a standard electrofishing survey in the fall of 2019 to monitor black bass populations.
2. Conduct a category 3 age and growth sample of the Largemouth Bass population in fall 2019.

ISSUE 3: The sport fishery in Ray Roberts Reservoir, especially Blue Catfish, White Bass, and White Crappie has continued to improve.

MANAGEMENT STRATEGY

1. Incorporate these improvements on the TPWD web site and publicize in appropriate media.

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. Zebra mussels have been found at Ray Roberts Reservoir. Illegal introductions of Smallmouth Bass and Blue Catfish are suspected to have occurred at Ray Roberts, and may have contributed to the introduction of zebra mussels or other invasive species.

MANAGEMENT STRATEIES

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.
6. Monitor the zebra mussel population as needed.
7. Monitor hydrilla and Eurasian milfoil infestations.

Objective-Based Sampling Plan for Ray Roberts Reservoir

Sport fish, forage fish, and other important fishes

Sport fishes in Ray Roberts Reservoir include Blue and Channel Catfish, White Bass, Spotted Bass, Smallmouth Bass, Largemouth Bass, and White Crappie. Known important forage species include Gizzard and Threadfin Shad and Bluegill.

Survey objectives, fisheries metrics, and sampling objectives

Catfishes: Using general monitoring trend data collected at four-year intervals, we will sample Blue and Channel Catfish using gill netting at 15 random sample stations. Sampling will continue using additional sampling stations until precision (RSE) of CPUE-S is ≤25 and 50 stocked-sized fish are collected. Because the Channel Catfish population abundance is declining, additional sampling effort for Channel Catfish will not be conducted beyond that which is necessary to achieve sampling objectives for Blue Catfish. Considering the RSE of CPUE-S for Blue Catfish was 20 in 2012, additional samples may not be necessary; however, 20 random sampling stations were needed to meet sampling objectives in 2016.

White Bass: White Bass will be collected along with catfish using gill netting at 15 random sample stations or until sampling precision (RSE) of CPUE-S is ≤25 and 50 stock-sized fish are collected. Additional sampling will likely be necessary to achieve objectives for White Bass, and additional sampling will be considered along with sampling objectives for catfish species.

Black Basses: Largemouth Bass will be sampled at four-year intervals using fall nighttime electrofishing to collect general monitoring trend data on CPUE, size structure, and body condition. Because CPUE-14 was low in 2015, an additional bass-only spring electrofishing survey will be conducted in spring 2018 to collect data on larger fish. We will sample Largemouth Bass at 24 random, five-minute sampling stations or until precision (RSE) of CPUE-S is ≤ 25 and a minimum of 50 stock-size fish are collected.

Smallmouth Bass and Spotted Bass are present in low abundance, and since they are vulnerable to electrofishing they will be sampled along with Largemouth Bass during fall nighttime electrofishing. Presence/absence of both species will be documented.

White Crappie: We will collect general monitoring trend data for White Crappie at four-year intervals using fall shoreline trap netting. We will sample White Crappie using 15 random trap net sampling stations or until precision (RSE) of CPUE-S is ≤ 25 and a minimum of 50 stock-size fish are collected. An additional five trap net sampling stations will be conducted if it is determined objectives can be reached with reasonable additional effort.

Gizzard and Threadfin Shad and Bluegill: Bluegill and Gizzard and Threadfin Shad are the primary

forage at Ray Roberts Reservoir. Fall nighttime electrofishing conducted every four years will allow for determination of any large-scale changes in the Gizzard and Threadfin Shad and Bluegill populations that may invite further investigation. A minimum of 24 randomly selected five-minute electrofishing sites will be sampled in 2015, but sampling will continue in conjunction with Largemouth Bass sampling until sufficient numbers for calculation of PSD and IOV (50 fish) have been collected. No additional effort will be expended to achieve an RSE≥25 for CPUE of Bluegill and Gizzard and Threadfin Shad beyond that expended for Largemouth Bass. Instead, Largemouth Bass body condition can provide information on forage abundance relative to predator density.

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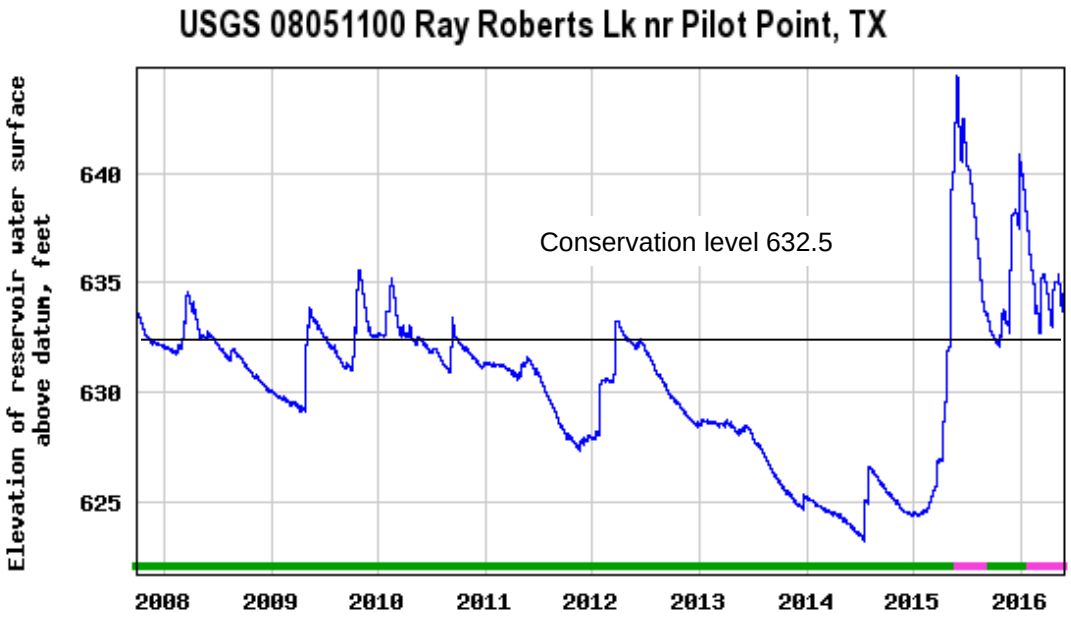


Figure 1. Daily mean average water level elevations in feet above mean sea level (MSL) recorded for Ray Roberts Reservoir (U.S. Geological Survey 2016). USGS real time water data for USGS 08051100 Ray Roberts Lk near Pilot Point, Texas. http://waterdata.usgs.gov/nwis/dv), Texas, October 2007 to May, 2016.

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
Shoreline development index	8.63
Conductivity	316 µmhos/cm

Table 2. Boat ramp characteristics for Ray Roberts Reservoir, Texas, September, 2015. Reservoir elevation at time of survey was 632.7 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.

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

[a] Daily bag for Largemouth Bass, Spotted Bass, and Smallmouth Bass = 5 fish in any combination.

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

Year	Number	Size
	Channel Catfish	
1986	50,004	AFGL
Total	50,004	
	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
Total	3,154,060	
	ShareLunker Largemouth Bass	
2005	14,839	FGL
2012	15,285	FGL
Total	30,124	
	Threadfin Shad	
1985	1,200	ADL
Total	1,200	

Table 5. Objective-based sampling plan components for Ray Roberts Reservoir, Texas 2015 – 2016.

Gear/target species	Survey objective	Metrics	Sampling objective
Electrofishing			
Largemouth Bass	Abundance	CPUE – stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Age-and-growth	Mean length at age 1-3.	N = 5 fish per 10 mm strata (150mm to 500mm)
	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
Trap netting			
White Crappie	Size structure	PSD, length frequency	N = 50
	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)
Channel 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] A minimum of 50 individuals of each species will be collected to determine PSD of Bluegill and IOV of Gizzard Shad. 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. Survey of structural habitat types, Ray Roberts Reservoir, Texas, 2015. Shoreline habitat type units are in miles and standing timber and Piers, boat docks, marinas is acres.

Habitat type	Estimate	% of total
Standing timber	3000.0 acres	11
Piers, boat docks, marinas	6.0 acres	<0.1
Rocky	12.0 miles	6.0
Natural	195.0 miles	94.0

Table 7. Survey of aquatic vegetation, Ray Roberts Reservoir, Texas, 2003 – 2015. Surface area (acres) is listed with percent of total reservoir surface area in parentheses.

Vegetation	2003	2007**	2011	2015
Native emergent	5.5(<0.1)		<0.1(<0.1)	98(<0.1)
Native submersed	1200.0(3.4)		2.2(<0.1)	
Native floating	12.0(<0.1)			
Non-native				
Hydrilla (Tier III)*	300.0(0.8)		1.3(<0.1)	<0.1(<0.1)
Eurasian watermilfoil (Tier III)*	752.7(2.1)		6.0(<0.1)	

*Tier III is watch status.
**Flooding prevented habitat survey from being conducted.

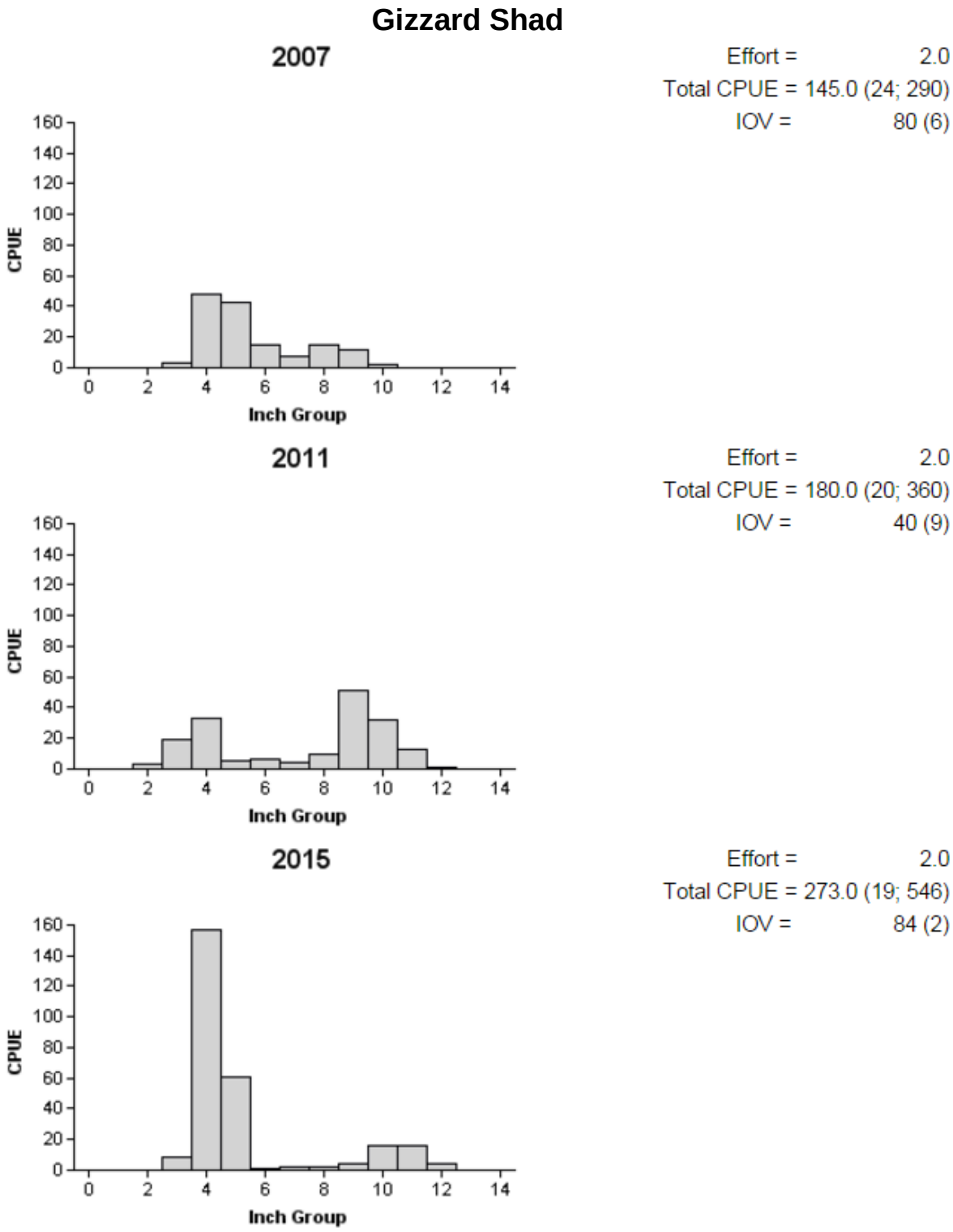


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Ray Roberts Reservoir, Texas 2007, 2011, and 2015.

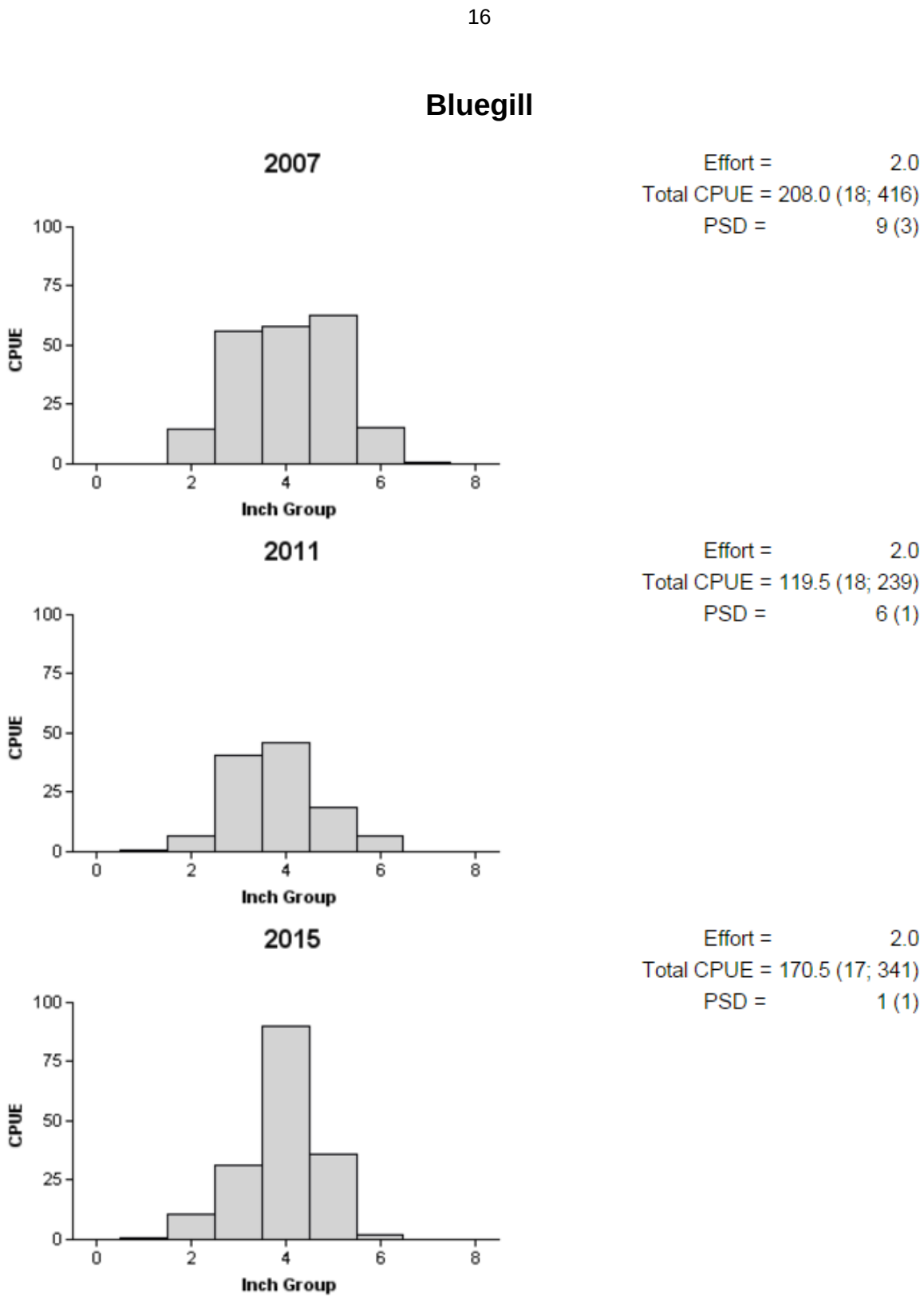


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Ray Roberts Reservoir, Texas, 2007, 2011, and 2015.

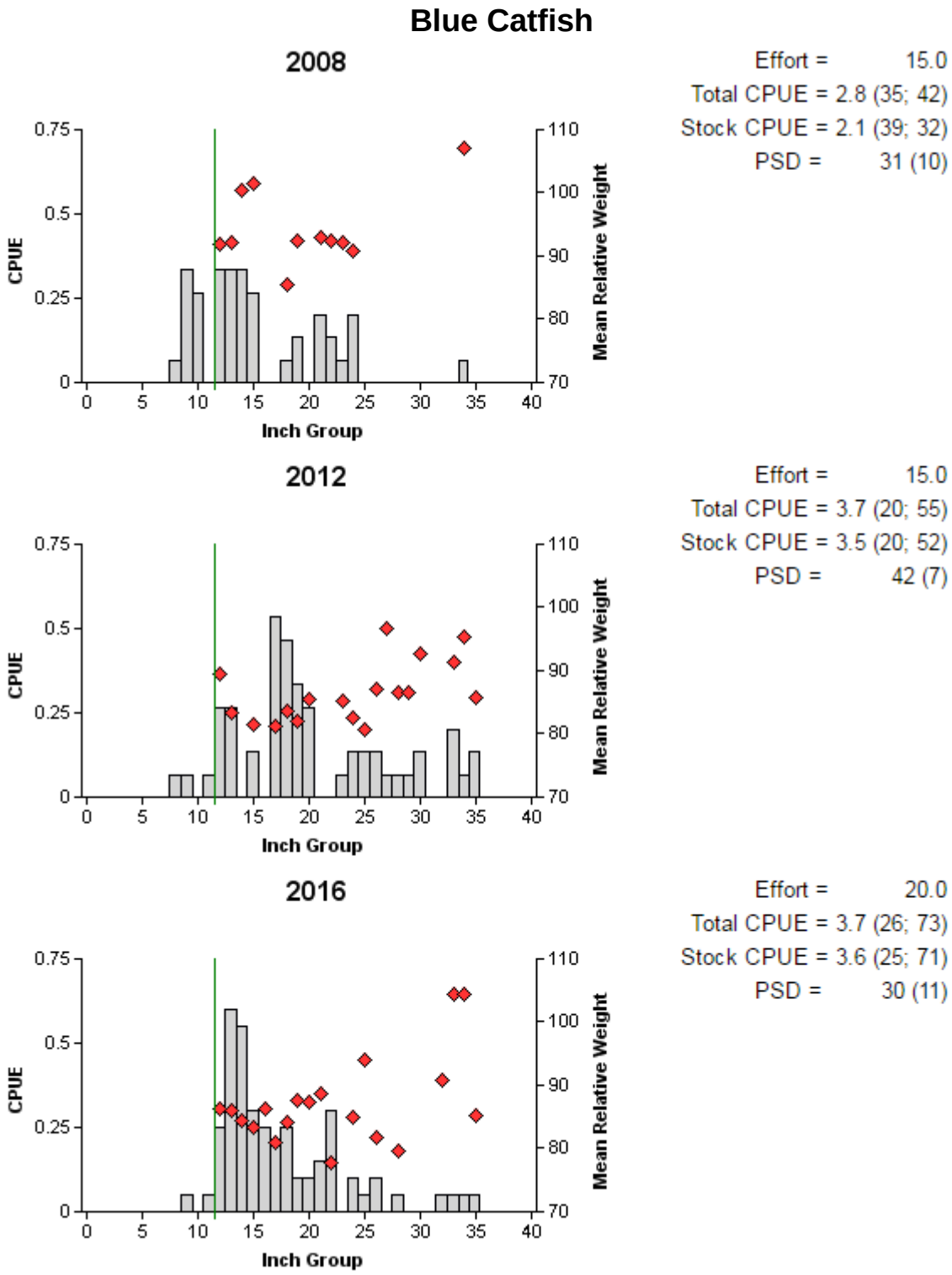


Figure 4. Number of Blue Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Ray Roberts Reservoir, Texas, 2008, 2012, and 2016. Vertical lines represent length limit at time of collection.

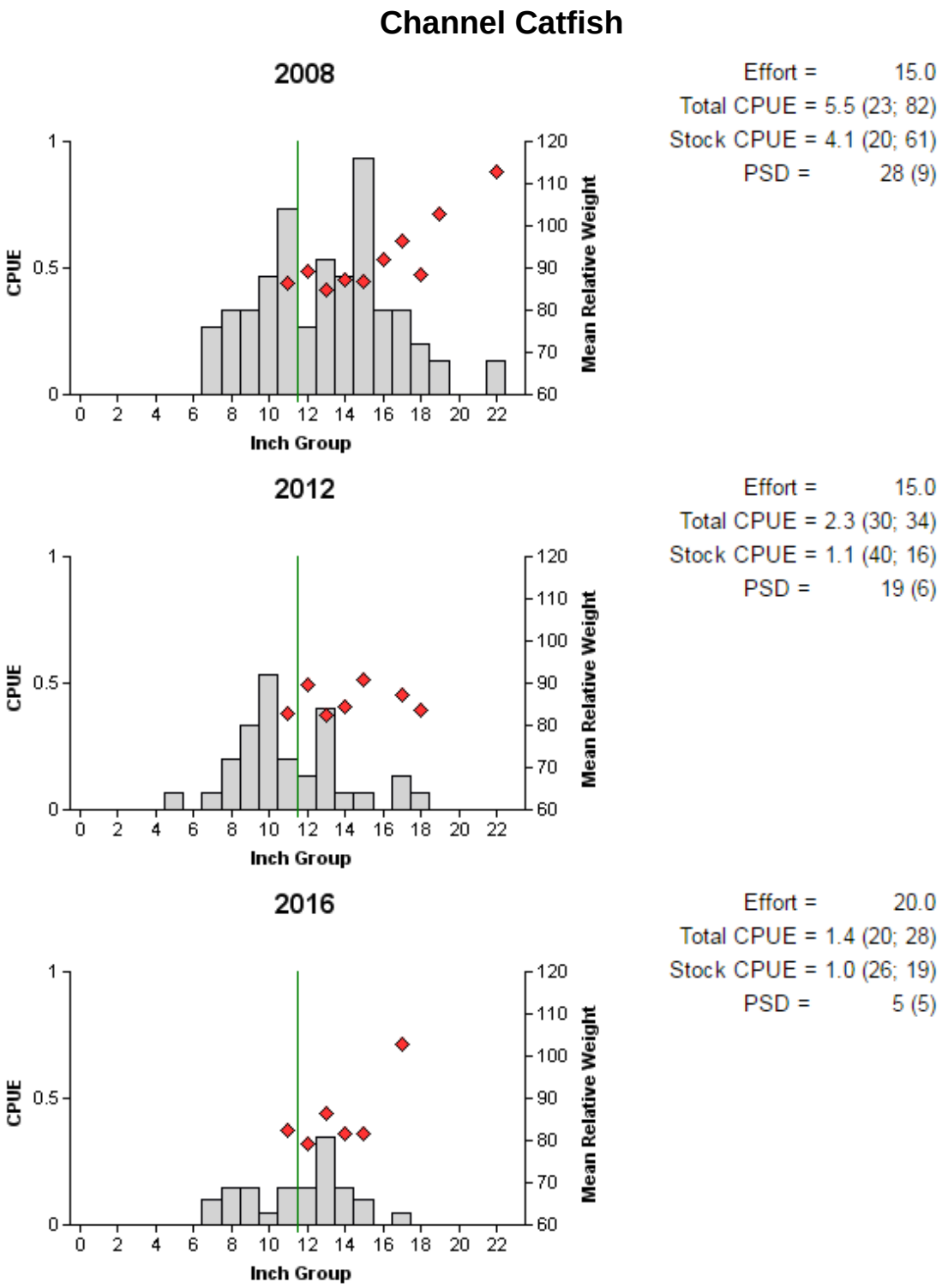


Figure 5. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Ray Roberts Reservoir, Texas, 2008, 2012, and 2016. Vertical lines represent length limit at time of collection.

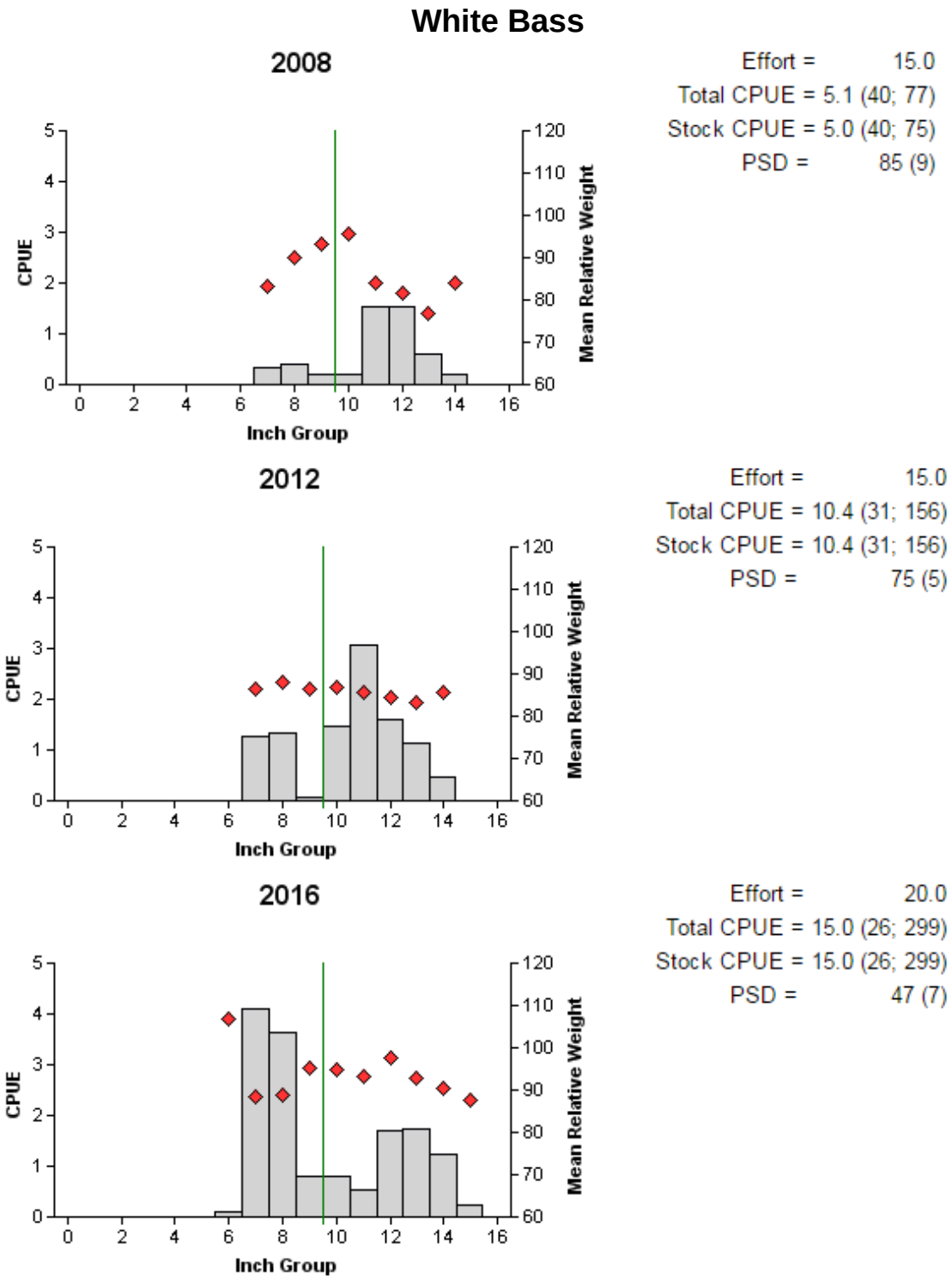


Figure 6. Number of White Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Ray Roberts Reservoir, Texas, 2008, 2012, and 2016. Vertical lines represent length limit at time of collection.

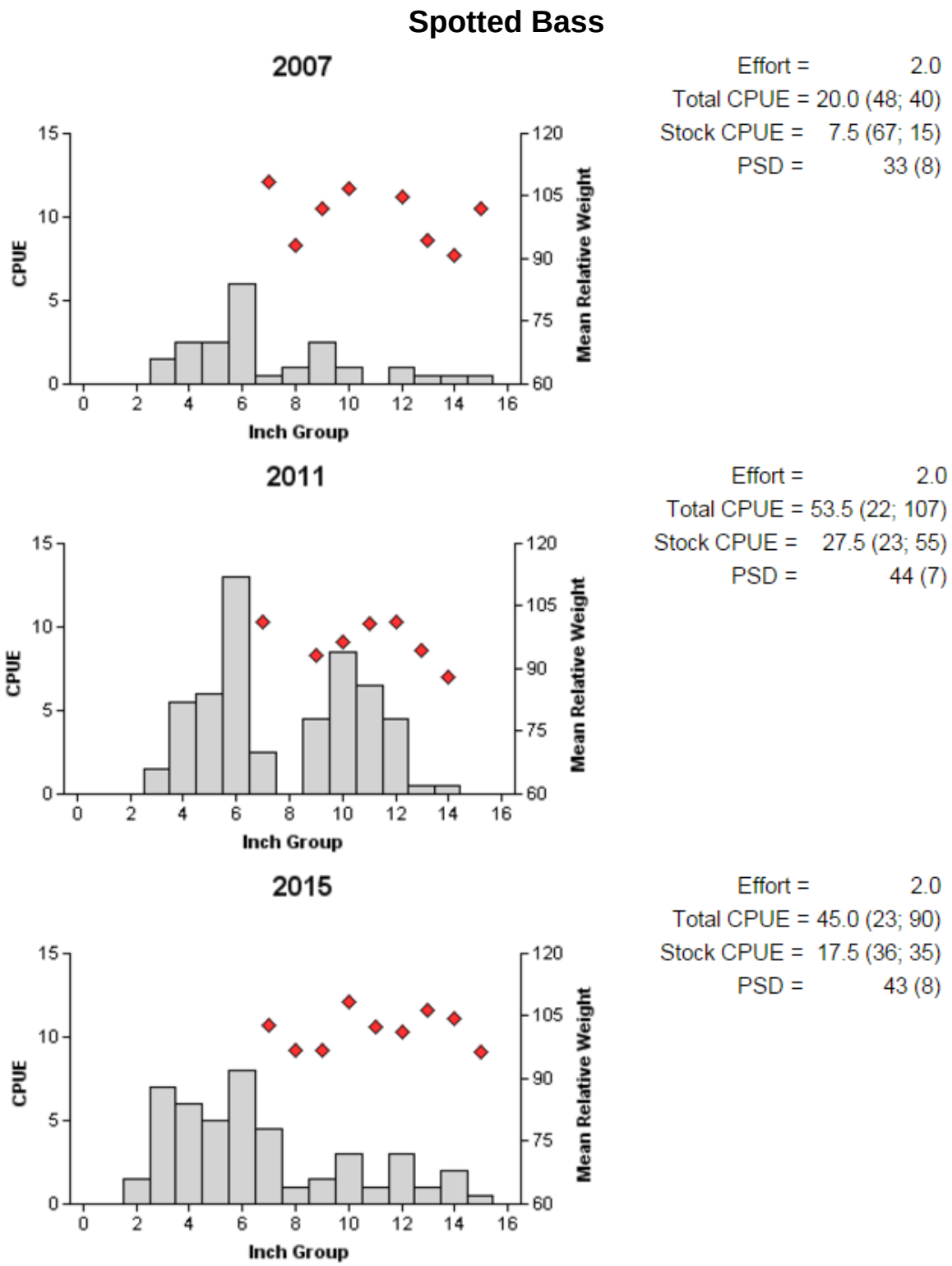


Figure 7. Number of Spotted Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Ray Roberts Reservoir, Texas, 2007, 2011, and 2015.

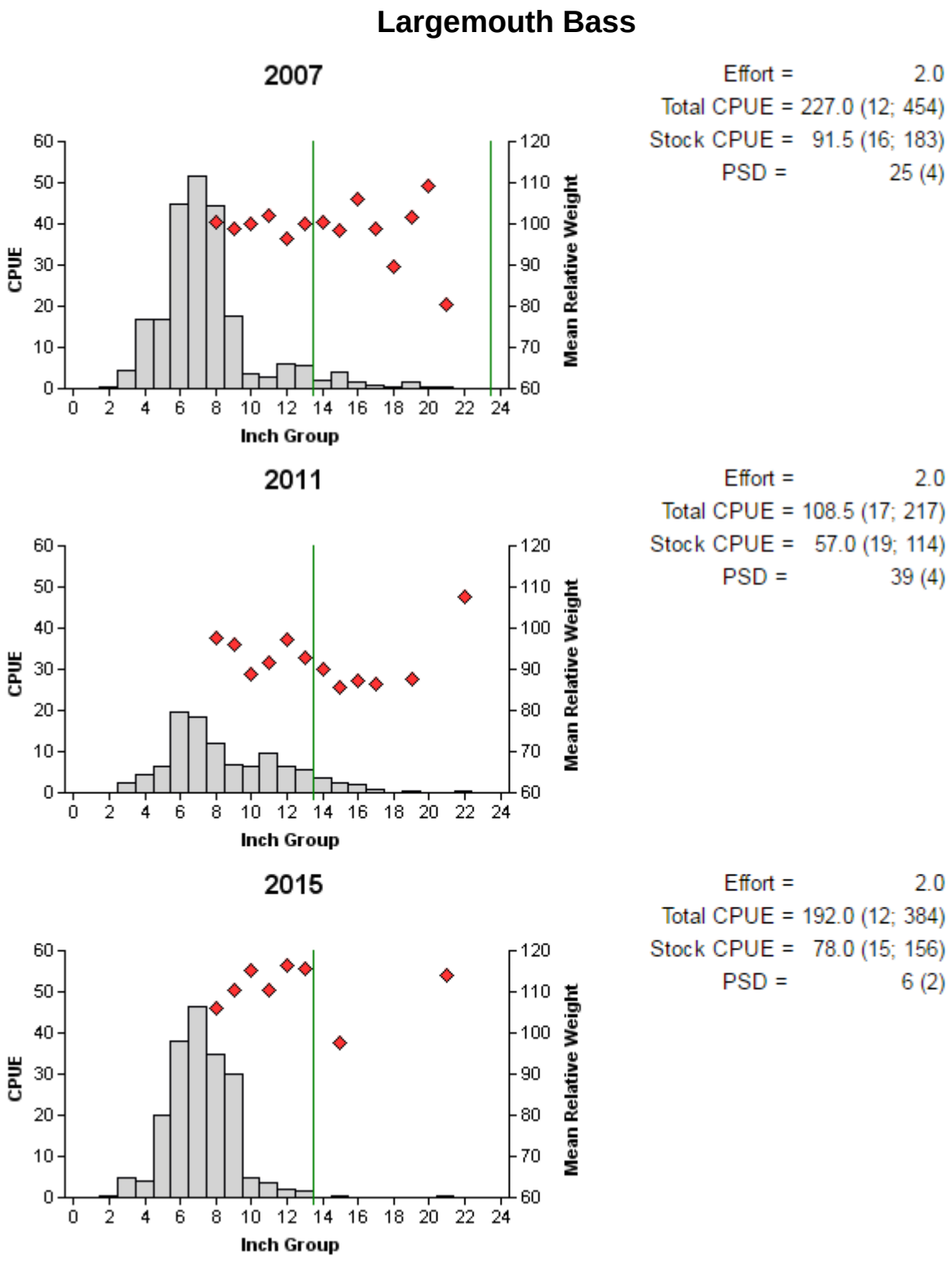


Figure 8. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Ray Roberts Reservoir, Texas, 2007, 2011, and 2015. Vertical lines represent slot length limit or length limit at time of collection.

Table 8. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Ray Roberts Reservoir, Texas, 2007, 2011, and 2015. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB.

		Number of fish				
Year	Sample size	FLMB	Intergrade	NLMB	% FLMB alleles	% FLMB
2007	30	0	28	2	37.3	0
2011	30	0	23	7	44.0	0
2016	30	1	21	8	43.0	3

White Crappie

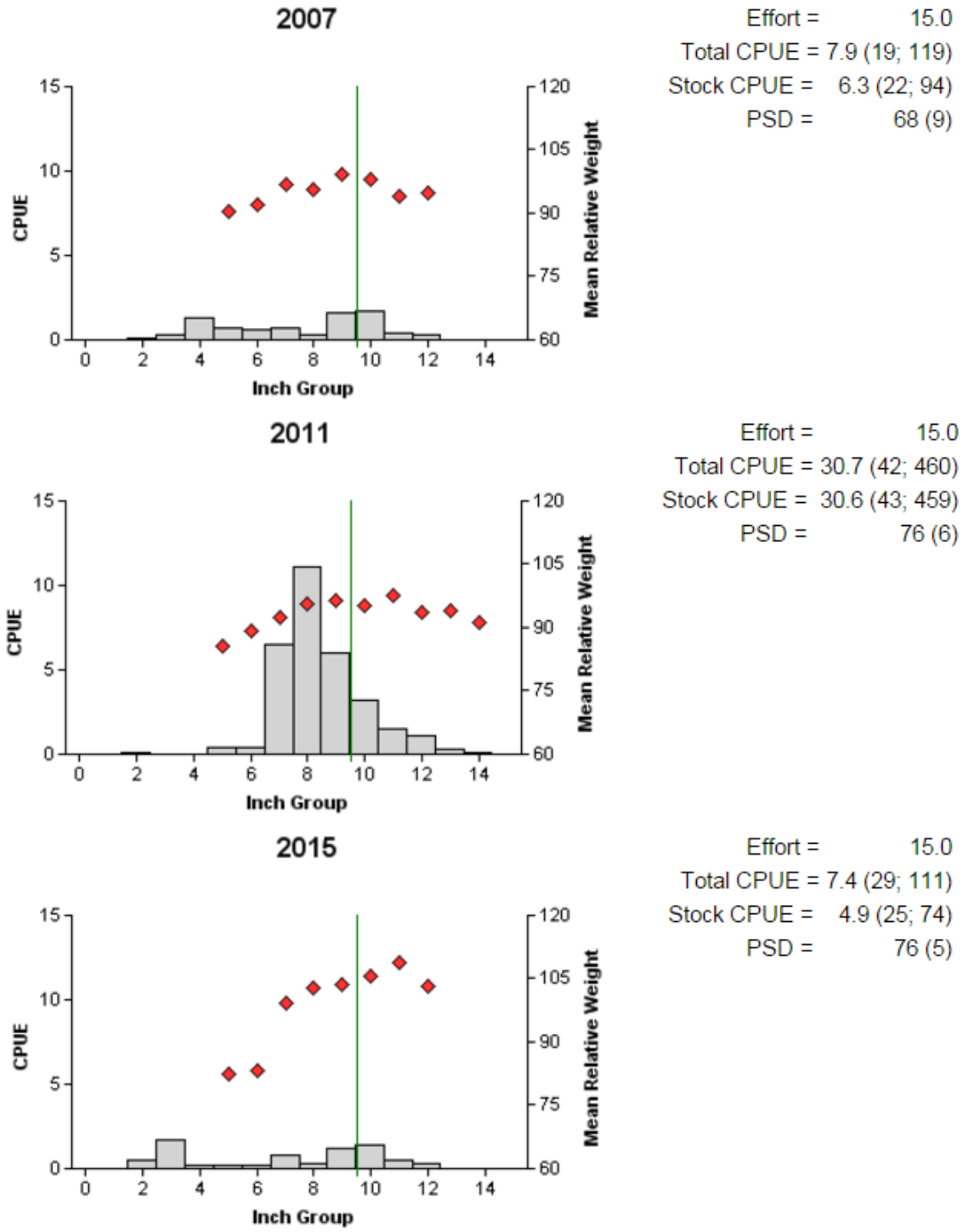


Figure 9. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, Ray Roberts Reservoir, Texas, 2007, 2011, and 2015. Vertical lines represent length limit at time of collection.

Table 9. Proposed sampling schedule for Ray Roberts Reservoir, Texas. Electrofishing and trap netting surveys are conducted in the fall, while gill netting surveys are conducted during the following spring. Additional survey denoted by A. Standard survey denoted by S.

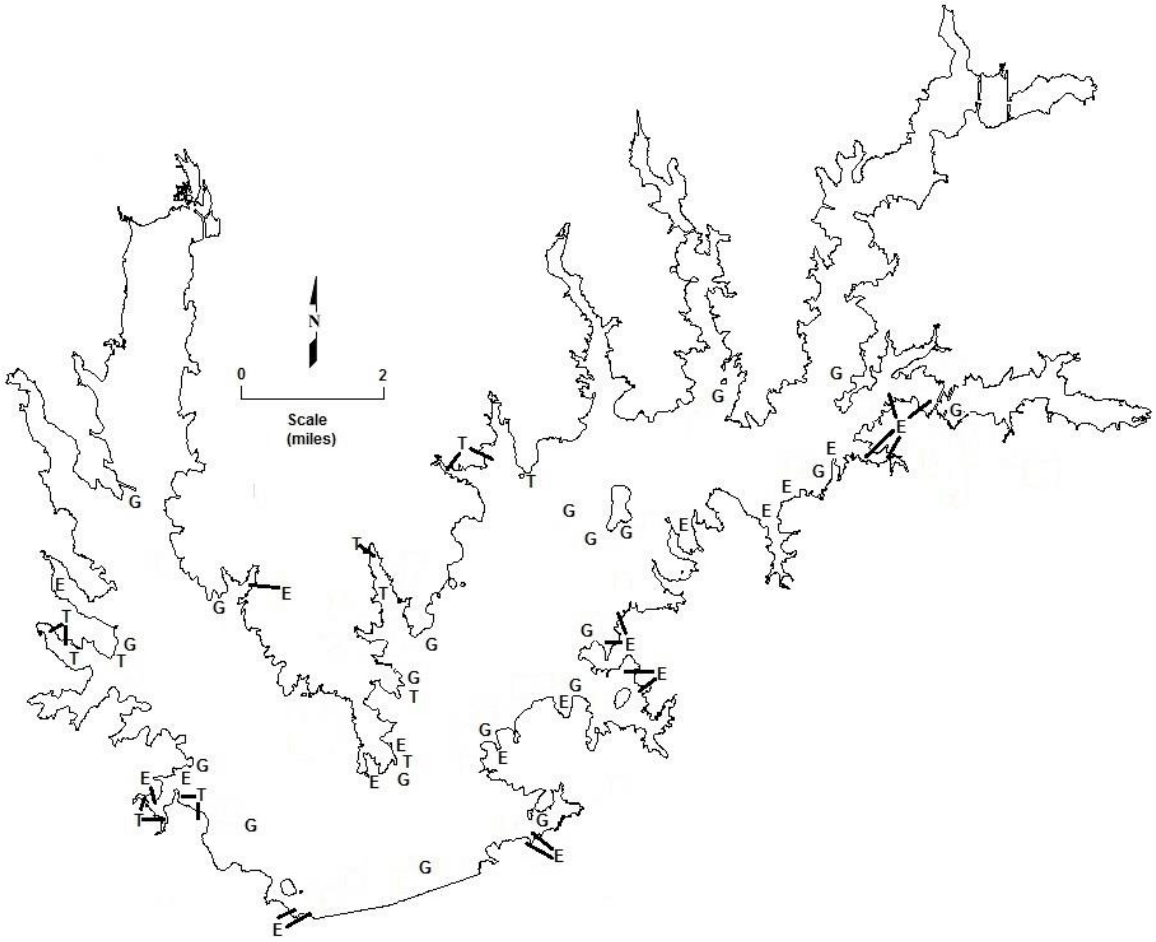
Survey year	Electrofish Fall(Spring)	Trap net	Gill net	Habitat		Access	Creel survey	Report
				Structural	Vegetation			
2016-2017								
2017-2018	(A)							
2018-2019								
2019-2020	S	S	S		S	S		S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Ray Roberts Reservoir, Texas, 2015-2016.

	Gill Netting		Trap Netting		Electrofishing	
Species	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					546	273.0
Threadfin Shad					2246	1123.0
Blue Catfish	73	3.7				
Channel Catfish	28	1.4				
Flathead Catfish	2	0.1				
White Bass	299	15.0				
Green Sunfish					152	76.0
Warmouth					27	13.5
Orangespotted Sunfish					7	3.5
Bluegill					341	170.5
Longear Sunfish					389	194.5
Redear Sunfish					18	9.0
Spotted Bass					90	45.0
Largemouth Bass					384	192.0
White Crappie			111	7.4		
Black Crappie			3	0.2		

APPENDIX B



Location of sampling sites, Ray Roberts Reservoir, Texas, 2015-2016. Trap netting, gill netting, and electrofishing stations are indicated by T, G, and E, respectively. Water level was 5 ft. below conservation level during electrofishing and trap netting surveys, and 2 ft. below conservation level during gill netting.

APPENDIX C

Catch rates (CPUE) of targeted species by gear type for Ray Roberts Reservoir, Texas, 1998, 2000, 2001, 2002, 2003, 2004, 2007, 2008, 2011, 2012, 2015 and 2016.

Gear	Species	Year								
		1998[b]	2000[b,c]	2001[b,d]	2002[b,d]	2003-2004[b]	2007-2008[b,d]	2011-2012[b]	2015-2016[b]	**Avg**
Gill Net	Blue Catfish	0.3				1.7	2.8	3.7	3.7	**2.4**
(fish/net night)	Channel Catfish	4.5				8.2	5.5	2.3	1.4	**4.4**
	Flathead Catfish	0.1				0.0	0.1	0.1	0.1	**0.1**
	White Bass	3.3				4.5	5.1	10.4	15.0	**7.7**
Electrofisher	Gizzard Shad	156.5				127.0	145.0	180.0	273.0	**176.3**
(fish/hour)	Threadfin Shad	61.0				189.5	339.0	65.0	1123.0	**355.5**
	Green Sunfish	2.5				2.5	48.0	146.5	76.0	**40**
	Warmouth	12.0				5.5	33.0	7.0	13.5	**14.2**
	Orangespotted Sunfish	0.0				1.0	3.0	0.0	3.5	**1.5**
	Bluegill	160.5				123.0	208.0	119.5	170.5	**156.3**
	Longear Sunfish	42.0				77.5	254.5	187.5	194.5	**151.2**
	Redear Sunfish	6.0				3.5	18.0	1.0	9.0	**7.5**
	Smallmouth Bass	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	**0.1**
	Spotted Bass	0.0	0.0	5.0	14.5	15.0	20.0	53.5	45.0	**30.6**
	Largemouth Bass	77.5	48.0	108.5	57.5	85.0	227.0	108.5	192.0	**180.8**
Trap Net	White Crappie	2.7	4.0			8.6	7.9	30.7	7.4	**5.1**
(fish/net night)	Black Crappie	0.1	0.2			0.3	0.3	1.1	0.2	**0.1**

[a] All sampling stations for all gear were subjectively selected.
[b] All sampling stations for all gear were randomly selected.
[c] Bass and shad only electrofishing survey.
[d] Electrofishing survey was conducted using a Smith-Root 7.5 GPP (Gas Powered Pulsator). Electrofishing surveys prior to 2007 were conducted using a Smith-Root 5.0 GPP.