

Lake Bardwell

2018 Fisheries Management Survey Report

PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-3

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

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Survey and Management Summary

Fish populations in Lake Bardwell were surveyed in 2018 using electrofishing, and in 2019 using gill netting. Historical data are presented with the 2018-2019 data for comparison. This report summarizes the results of the surveys and contains a management plan for the reservoir based on those findings.

Reservoir Description: Lake Bardwell is a 3,138-acre impoundment located on Waxahachie Creek in the Trinity River Basin approximately 3 miles southwest of Ennis, Texas. Normal annual water level fluctuation is within 2-4 feet of spillway elevation; however, significant flood events occurred in 2015, 2016, and 2018. Habitat consisted of featureless shoreline, eroded bank, and small amounts of native emergent vegetation. Angler access and facilities are very good with five public access areas and one commercial marina.

Management History: Important sport fish include White Bass, Palmetto Bass, Largemouth Bass, White Crappie, and catfish. The management plan from the 2010 survey report (Ott and Bennett 2011) included requested stockings of Palmetto Bass fingerlings at 10 fish/acre annually, and subsequent bi-annual gill netting to monitor the population. Because Palmetto Bass fingerlings were not available in 2010, fry were stocked at 615/acre. Reservoir regulations posters were distributed to local businesses and marinas. The controlling authority was consulted about funding a native plant introduction project; however, funding and manpower was not available.

Fish Community

- **Prey species:** Gizzard and Threadfin Shad were the primary prey species. All Gizzard Shad collected in 2018 were available as prey to sport fish. Electrofishing catch of Bluegill and Longear Sunfish was low, but most were small enough to provide prey.
- **Catfishes:** Supplemental stocking of Blue Catfish in 2015 and 2016 was successful but no evidence of natural reproduction or recruitment was documented. Trophy-size Blue Catfish were still available to anglers. Channel Catfish were less abundant than Blue Catfish but continue to reproduce and recruit successfully.
- **Temperate basses:** White Bass were still abundant and size distribution is good. Palmetto Bass were present in the reservoir but in low abundance and only one age class was collected. Continued existence of a fishery is dependent on consistent stocking.
- **Largemouth Bass:** Largemouth Bass were present, but abundance was low. Size distribution of the few fish collected was good and relative weight was adequate. However, high RSE of the estimate questions reliability of results. Centrarchid reproduction and recruitment was likely habitat limited.
- **White Crappie:** White Crappie have historically provided a very good fishery. However, crappie were not sampled during the current survey period due to extreme fluctuations in reservoir elevation.

Management Strategies: Continue stocking Palmetto Bass at 10-15 fish/acre annually. Conduct supplemental stocking of Blue Catfish fingerlings at 50/acre in 2020 and 2021. Investigate the possibility of introducing catfish spawning structures. Continue public outreach regarding the negative impacts of aquatic invasive species.

Introduction

This document is a summary of fisheries data collected from Lake Bardwell in 2018-2019. 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 2018-2019 data for comparison.

Reservoir Description

Lake Bardwell is a 3,138-acre impoundment constructed in 1965 on Waxahachie Creek. It is in Ellis County approximately 3 miles southwest of Ennis and is operated and controlled by the US Army Corps of Engineers. Primary water uses include municipal water supply, flood control, and recreation. Lake Bardwell is classified as hyper-eutrophic with a Carlson's TCI chlorophyll ^a index of 59.7; ranking 79th highest of 102 Texas reservoirs (TCEQ 2018). Habitat consisted of featureless shoreline, eroded bank, and small amounts of emergent vegetation. Water level has historically been below conservation pool with occasional flood pulses (Figure 1). Other descriptive characteristics for Lake Bardwell are in Table 1.

Angler Access

Lake Bardwell has five public boat ramps and no private boat ramps. All five ramps were generally accessible over the most recent survey period (2015-2019). However, temporary closures were conducted due to flood events in 2015, 2016, and fall 2018. Additional boat ramp characteristics are presented in Table 2. High View Park, located southwest of the HWY 34 bridge, has adequate shoreline access for anglers, plus two enclosed fishing piers (available for a daily fee).

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Norman and Ott 2015) included:

1. Annual stocking with Palmetto *Morone chrysops* x *M. saxatilis* or Sunshine Bass *M. saxatilis* x *M. chrysops* with recruitment assessment by gill netting in 2017 and 2019.

Action: Stocking was requested at 10/acre annually from 2015 through 2019. However, due to limitations in hatchery production full stocking was only achieved in 2015 and 2016; half rate stocking was conducted in 2017 and no stocking in 2018. Gill net sampling was conducted in 2017 and 2019; variable recruitment reflected the inconsistency in stocking rate across years (i.e., 0 – 10/acre).
2. Continue restocking of Blue Catfish *Ictalurus furcatus* (initiated in 2015) Conduct assessment of Blue Catfish recruitment, resulting from stocking, during 2017 and 2019 gill net sampling. Continue consultation with USACE personnel regarding development of Blue Catfish spawning structure and to assess/gauge angler utilization.

Action: Fingerling stocking was conducted at 50/acre in 2016. Gill net sampling in 2017 and 2019 suggested survival from stocking. USACE staff confirmed continued angler activity using passive gear directed toward Blue Catfish. No spawning habitat was introduced.
3. Provide signage to USACE regarding invasive species prevention, consult with staff regarding ramp inspections for zebra mussels and, provide outreach products to park and marina personnel.

Action: Signage has been distributed, staff is continuing to conduct ramp inspections and outreach material has been provided.

Harvest regulation history: All sport fishes in Lake Bardwell are managed with statewide harvest regulations (Table 3). Regulations have not changed since the last survey.

Stocking history: Lake Bardwell was first stocked with Florida Largemouth Bass *Micropterus salmoides floridanus* in 1992 and again in 1998 (Table 4). Striped Bass were intermittently stocked from 1967 through 1983, then discontinued. Palmetto or Sunshine Bass were first stocked in 1975; annual stockings were requested from 1995-2018 and stocking was conducted as available. Blue catfish were initially stocked in 1966 with supplemental stockings in 2015 and 2016.

Vegetation/habitat management history: Historically, the aquatic vegetation community at Lake Bardwell has been low in diversity and abundance. Hydrilla *Hydrilla verticillata* was present in the past, increasing from trace amounts in 1997 to 15 acres in 2002 (Ott and Bister 2003), but declined to <0.5 acres without treatment by 2006 (Beck and Ott 2007) and has not been observed since then. Physical habitat characteristics were reported by Ott and Bister (2003) and are not believed to have changed substantially since then. Because Lake Bardwell is managed by the USACE, commercial and residential shoreline development are not permitted.

Water transfer: No inter-basin transfers exist.

Methods

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Lake Bardwell (Norman and Ott 2015). 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 2017).

Electrofishing – Largemouth Bass *M. salmoides*, sunfishes, Gizzard Shad *Dorosoma cepedianum*, and Threadfin Shad *D. petenense* were collected by electrofishing (1 hour at 12, 5-min stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fishes caught per hour (fish/h) of actual electrofishing.

Trap netting – *Trap netting was not conducted as planned in fall 2018 due to high water conditions (Appendix C) leading to closure of the park and boat ramps.*

Gill netting – Catfishes *Ictalurus spp.*, and temperate basses *Morone spp.* 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 White Bass were determined using otoliths from 13 randomly-selected fish (range 10.0 to 10.7 inches).

Statistics – Sampling statistics (CPUE for various length categories), structural indices [Proportional Size Distribution (PSD), terminology modified by Guy et al. 2007], and condition indices [relative weight (W_r)] were calculated for target fishes according to Anderson and Neumann (1996). Palmetto Bass PSD was calculated according to Dumont and Neely (2011). Index of Vulnerability (IOV) was calculated for Gizzard Shad (DiCenzo et al. 1996). Standard error (SE) was calculated for structural indices and IOV. Relative standard error (RSE = 100 X SE of the estimate/estimate) was calculated for all CPUE statistics.

Habitat – Physical habitat characteristics were reported by Ott and Bister (2003). A comprehensive vegetation survey was conducted in 2018 using the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

Water level – Source for water level data was the United States Geological Survey (USGS 2019).

Results and Discussion

Habitat: Lake Bardwell acts as a flood control reservoir with frequent, extreme water-level fluctuation (Figure 1 and Appendix C). Wind and wave energy exacerbate this situation through shoreline erosion resulting in low sunlight penetration due to turbidity from suspended clay particles. Combined environmental perturbations limit the survival of terrestrial and emergent aquatic plant species and they occupied less than 2.5% of the reservoir area in summer 2018 (Table 6). No submersed plant species (native or exotic) were detected.

Prey species: Gizzard Shad and Threadfin Shad continued to be the dominant prey species in Lake Bardwell; electrofishing catch rates from the 2018 survey were 180/h and 144/h, respectively (Figure 2, Appendix A). High index of vulnerability (2018 IOV = 100) indicates the availability of Gizzard Shad to predators (Figure 2). Other prey species identified during the 2018 electrofishing surveys included Bluegill *Lepomis macrochirus*, and Longear Sunfish *M. megalotis* (Figures 2 & 3, Appendix A) but relative abundance is low; likely due to poor littoral habitat.

Catfish: Supplemental stocking of Blue Catfish fingerlings was conducted in 2015 and 2016 (Table 4). Survival of stocked Blue Catfish was documented in the 2017 gill net sample (Figure 4) and by 2019 those fish had recruited to the fishery. However, although anecdotal information provided by USACE personnel suggests Lake Bardwell still supports a trophy Blue Catfish fishery, and the current gill net survey produced numerous specimens of adult size, there is little evidence of current natural reproduction. This suggests that spawning habitat is limited.

Consistent natural reproduction and recruitment of Channel Catfish *I. punctatus* is evident (Figure 5). Although gill net catch rate in 2017 (8.1/nn) was over twice what was recorded in 2015 (3.5/nn) by 2019 catch rate (4.5/nn) was similar to the 2015 estimate. Relative weights were good ($Wr \geq 90$) and suggest availability of food is not limiting.

White Bass: The gill net catch rate of White Bass *M chrysops* has been variable through the three most recent samples from a high of 25.3/nn in 2015 to a low of 6.4/nn in 2017 and finally 19.6/nn in 2019 (Figure 6). Size structure has been good over the past two surveys with PSD's of 83, and 65 respectively and RSD-P's over 10. Relative weight (Wr) was above 100 for all size classes and are indicative of adequate prey availability. Growth was excellent; average age of White Bass at 10 inches (10.0-10.7) was 1.1 years (N=13, range 1-2 years).

Palmetto Bass: Only five Palmetto Bass (0.5/nn) were collected in 10 net nights of effort in 2019 (Figure 7). Size distribution was comprised entirely of individuals 14-17 inches in length and these fish were likely carry-over from the reduced rate stocking in 2017 (Table 4); no stocking was conducted in 2018. The high catch rate (21.0/nn) and broader size distribution (8-23 inches) reported in 2015 reflect the more consistent stocking carried out in previous years and reiterates the need for annual stocking to maintain the fishery.

Largemouth Bass: The electrofishing catch rate of Largemouth Bass was 17.0/h in 2018 (Figure 8). Although PSD was high (100) the low number of stock-length fish (N=11) and high RSE (45) limit the reliability of the estimate. Unusually low catch of Largemouth Bass relative to prior surveys was likely related to poor littoral habitat (Table 6) and rapidly rising water level occurring during the survey (Appendix C). Relative weights were moderate ($Wr \geq 85$), suggesting adequate prey availability.

Crappie: Lake Bardwell has traditionally supported a crappie *Pomoxis spp.* fishery with both Black *P. nigromaculatus* and White Crappie *P. annularis* present (Norman and Ott, 2015), (Figure 9). The Objective-Based Sampling Plan for Lake Bardwell called for setting 10 trap nets, each deployed for one night during fall 2018. However, flood conditions and closure of the parks and boat ramps through January 2019 (Appendix C), prevented trap net sampling.

Fisheries Management Plan for Lake Bardwell Reservoir, Texas

Prepared – July 2019

ISSUE 1: Palmetto Bass are an important fishery at Lake Bardwell; however, irregularities in annual stocking frequency and densities have likely resulted in unreliable and at times, poor fishery quality. Annual stocking of Palmetto Bass is required to sustain the population and maintain a fishery.

MANAGEMENT STRATEGY

1. Request and stock Palmetto Bass annually at 10-15 fish/acre. If Palmetto Bass are unavailable, Sunshine Bass are acceptable.
2. Monitor Palmetto Bass year class success and size distribution through standard gill net survey in 2023.

ISSUE 2: Gill net surveys do not routinely detect small Blue Catfish at Lake Bardwell except when supplemental stocking has occurred; suggesting poor reproduction. However, a few large fish (>30 inches) have been collected, and anecdotal information from local anglers suggest Lake Bardwell has the potential to produce trophy Blue Catfish. The poor reproductive success could potentially be driven by the lack of suitable spawning cavities.

MANAGEMENT STRATEGIES

1. Stock Blue Catfish fingerlings at 50 fish/acre in 2020 and 2021 to follow up the 2015-2016 stocking.
2. Consider change to Blue and Channel Catfish harvest regulations from the current 12 inch minimum-length 25 fish daily bag limit to a higher minimum-length limit and lower bag limit (as standardized by the catfish management committee).
3. Consult with Lake Bardwell US Army Corps of Engineers staff about creating artificial catfish spawning habitat throughout Lake Bardwell.
4. Work with Lake Bardwell US Army Corps of Engineers park staff to collect contact information of anglers targeting Blue Catfish with passive gears (i.e. jug lines and trot lines)
5. Monitor Blue Catfish abundance and size distribution through standard gill net survey in 2023 to assess stocking success.

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 *Dreissena polymorpha* can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches, and plugging engine cooling systems. Giant salvinia *Salvinia molesta* and other invasive vegetation species can form dense mats, interfering with recreational activities like fishing, boating, skiing, and swimming. The financial costs of controlling and/or eradicating these types of invasive species are significant. Additionally, the potential for invasive species to spread to other river drainages and reservoirs via watercraft and other means is a serious threat to all public waters of the state.

MANAGEMENT STRATEGIES

1. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir.
2. Coordinate with USCOE staff to periodically inspect all public boat ramps at Lake Bardwell for zebra mussels. Contact staff every six months for updates.
3. Contact and educate marina operators about invasive species, and provide them with posters, literature, etc... so that they can in turn educate their customers.
4. Educate the public about invasive species using media and the internet.
5. Make a speaking point about invasive species when presenting to constituent and user groups.
6. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.

Objective-Based Sampling Plan and Schedule (2019–2023)

Sport fishes in Lake Bardwell include Blue and Channel Catfish, White and Palmetto Bass, Largemouth Bass; both Black and White Crappie are present but White Crappie predominate. Important forage species include Gizzard and Threadfin Shad, and Bluegill.

Low-density or underutilized fisheries”

All sport species at Lake Bardwell contribute to the overall fishery and justify sampling effort.

Survey objectives, fisheries metrics, and sampling objectives

Crappie: During the December 2006 through May 2007 creel survey crappie represented 55% (6.1 hours/acre) of the directed angler effort at Lake Bardwell and was the most popular fishery. Although both White and Black Crappie were harvested White Crappie were the most abundant in angler creels. Historically, crappie have been sampled every four years with 5 single-cod, shoreline set trap nets in late fall, with catch rates ranging from 4.0 – 17.4 (2002 – 2010). While CPUE was relatively high, the confidence intervals surrounding estimates of abundance and PSD fluctuated considerably. Based on bootstrap analysis of historical data, it would take 15 trap nets to attain acceptable precision ($RSE < 25$, $N > 50$) at least 80% of the time. White Crappie trend data (CPUE, PSD, Wr) will continue to be monitored during the fall of 2022 in order to detect any larger scale population fluctuations. A minimum of 10, randomly selected single-cod shoreline trap net sites will be sampled, and 5 additional nets will be set, if needed, to achieve an $RSE < 25$ and at least 50 stock size individuals are collected. This level of sampling should provide the secondary sampling objective of 13 specimens between 9.0 and 10.9 inches for aging. If this number of specimens is not achieved, additional sets of otoliths will be obtained from angler volunteers at the fishing barge.

Palmetto Bass: Angling effort for Palmetto Bass has been documented in creel surveys (2006-2007: 9% directed effort towards temperate basses), however bootstrap analysis of data from the last two surveys (2015, 2017) suggest a large amount of effort (≥ 37 randomly-selected gill net nights) would be required to obtain reliable (i.e. $RSE < 25$) CPUE values. Previous gill net catch rates have varied from over 10 fish/net night, to less than 1 fish/net night and have correlated to increased/decreased stocking frequency and rate. The highest gill net catch rate for Palmetto Bass on Lake Bardwell was 10.6 fish/net night ($N = 53$) recorded in 2005, following three consecutive years of meeting the stocking request (10 fish/ac). Therefore, ten randomly-selected gill net sites will be sampled in the spring 2023 to detect presence/absence of Palmetto Bass and document stocking success.

White Bass: White Bass are present in the reservoir and directed angling effort has been documented in creel surveys (2006-2007: 9% directed effort towards temperate basses), however bootstrap analysis of data from the last two surveys (2015, 2017) suggest 13 randomly-selected gill net nights) would be required to obtain reliable CPUE values (i.e. $RSE < 25$). However, reliable estimates of general structural indices (i.e. PSD and Wr) could be obtained with as few as 8 net nights. Therefore, in accordance with the Palmetto Bass sampling effort, 10 gill net sites will be sampled in spring 2023. This level of sampling should provide the sampling objective of 13 specimens between 9.0 and 10.9 inches for aging. If this number of specimens is not achieved no additional collection will be conducted.

Blue Catfish: Blue and Channel Catfish combined accounted for 7% of directed angler effort during the last creel survey (December 2006-May 2007). Blue Catfish have been collected in biennial gill net surveys over the last four years, however catch rates have not been sufficient to calculate CPUE and PSD with the desired level of precision ($N > 50$, $RSE < 25$). Ten gill net nights of effort achieved the target precision in spring 2019. Therefore, the relative absence and stock distribution of Blue Catfish will continue to be monitored in the spring of 2023 with the same sampling intensity as described for Palmetto Bass.

Channel Catfish: Channel Catfish gill net catch data from past surveys have displayed reliable

population metrics (e.g. CPUE 3.5 – 8.1/nn; RSE <25) with 10 net nights of effort. Bootstrap analysis of historical data predicts 10 randomly set gill nets will collect an adequate sample to accurately calculate CPUE (RSE<25) plus PSD and *Wr* (N>50 stock size individuals) with > 80% confidence. Therefore, the sampling intensity for Channel Catfish will be monitored in the spring 2023 at the same sampling intensity as described for Palmetto Bass.

Largemouth Bass: Largemouth Bass relative abundance is limited by turbidity plus water level fluctuation and commensurate lack of suitable littoral habitat. Although a fishery for Largemouth Bass does exist, angler effort is low at Lake Bardwell and this species accounted for only approximately 2% of the total directed angling effort during the December 2006-May 2007 creel survey. Electrofishing surveys conducted in 2010 and 2014 produced stock-size CPUEs ranging from 16 to 17 fish/h (with RSE's from 27 to 47) and estimates were highly related to reservoir elevation at the time of sampling. Bootstrap analysis of these data suggests reliable population metrics (CPUE;RSE<25, PSD and *Wr*; N>50 stock size individuals) would require > 25 randomly selected 5-minute electrofishing stations. Therefore, Largemouth Bass population trend data will be monitored in the fall of 2022 with 12, 5-minute stations as presence/absence, size structure, and condition only. All specimens stock length and greater will be individually measured and weighed. Length data will be used to describe PSD; weight data will be used to estimate *Wr* by inch-group.

Gizzard Shad and Bluegill: Gizzard and Threadfin Shad and Bluegill are the primary forage species at Lake Bardwell. Relative abundance, size distribution, PSD, and IOV have been collected for every four years since 1997. Gizzard Shad CPUE has been relatively consistent ranging from 180 to 286 fish/h with IOV > 90 in the past three surveys. Bluegill CPUE has been more variable (ranging from 20 to 125 fish/h) during the same period and like Largemouth Bass appears to be related to reservoir elevation. RSE for Bluegill has been higher than that for Largemouth Bass ranging from 50-60. Sampling Gizzard Shad and Bluegill will be conducted in fall 2022 at the same intensity as is proposed for Largemouth Bass to provide documentation of presence/absence. All specimens stock length and greater will be individually measured. Length data will be used to describe PSD and IOV. Relative weight estimates for Largemouth Bass will be used for supplemental qualitative assessment of prey suitability.

Habitat: Hydrilla is the only non-native macrophyte ever detected at Lake Bardwell. It was present in trace amounts in 1997, increased to 15 acres in 2002 but declined to <0.5 acres without treatment by 2006. Cover of other native aquatic species has historically been low. A complete-reservoir comprehensive vegetation survey will be conducted every four years, beginning in 2022, to monitor the littoral habitat within the reservoir.

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Tables and Figures

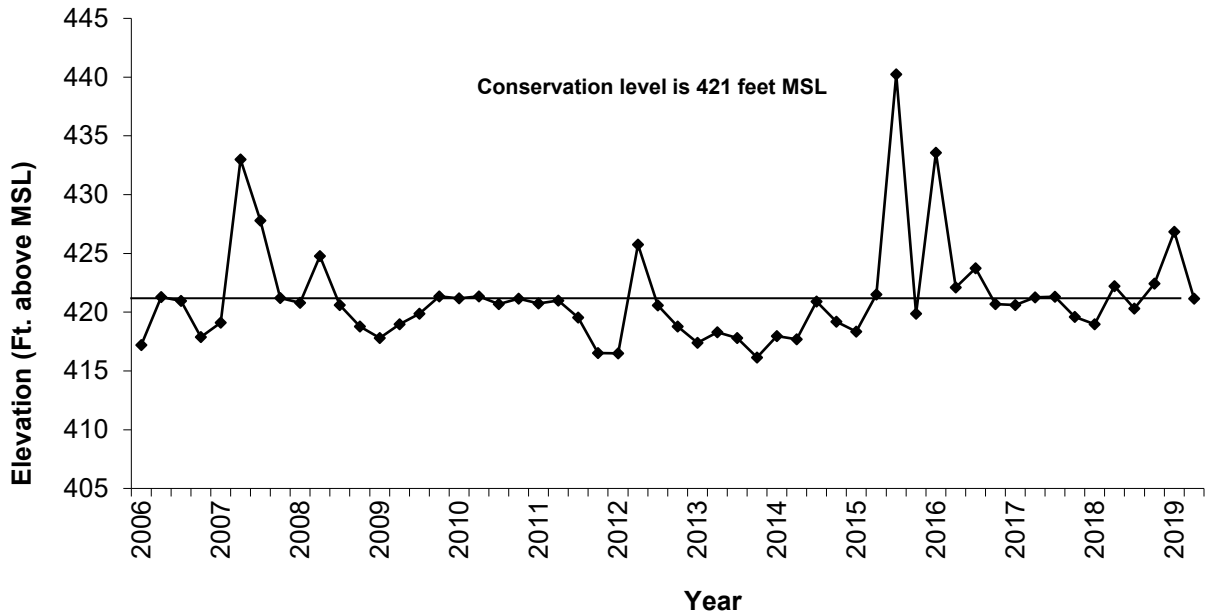


Figure 1. Quarterly water level elevations in feet above mean sea level (MSL) recorded for Lake Bardwell, Texas. *Note: Reservoir elevation temporarily spiked to 437.5 ft (MSL) in November 2018.*

Table 1. Characteristics of Lake Bardwell, Texas.

Characteristic	Description
Year constructed	1965
Controlling authority	U.S. Army Corps of Engineers
County	Ellis
Reservoir type	Tributary
Shoreline Development Index (SDI)	2.9
Conductivity	330 $\mu\text{S/cm}$

Table 2. Boat ramp characteristics for Lake Bardwell, Texas, August 2018. Reservoir elevation at time of survey was 420.5 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Mustang	32.299838 -96.670085	Y	20	416.5	Excellent, no access issues
Love Park	32.265512 -96.641254	Y	20	414.5	Excellent, no access issues
Waxahachie Creek	32.290374 -96.678326	Y	40	417.0	Excellent, no access issues
Mott Park	32.256965 -96.659408	Y	20	414.5	Excellent, no access issues
Highview Park	32.264207 -96.658731	Y	20	413.5	Excellent, no access issues

Table 3. Harvest regulations for Lake Bardwell, Texas.

Species	Bag limit	Length limit
Catfish: Channel and Blue Catfish, their hybrids and subspecies	25 (in any combination)	12-inch minimum
Catfish, Flathead	5	18-inch minimum
Bass, White	25	10-inch minimum
Bass, Palmetto	5	18-inch minimum
Bass, Largemouth	5	14-inch minimum
Crappie: White and Black crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

^a Daily bag for Largemouth Bass, Spotted Bass, and Guadalupe Bass = 5 fish in any combination.

Table 4. Stocking history of Lake Bardwell, Texas. FGL = fingerling.

Species	Year	Number	Size
Blue Catfish	1966	7,000	FGL
	2015	158,294	FGL
	2016	157,983	FGL
		<u>323,277</u>	
Channel Catfish	1966	22,000	FGL
	1972	2,000	FGL
		<u>24,000</u>	
Striped Bass	1967	300,000	FRY
	1968	15,150	FGL
	1969	20,470	FGL
	1970	23,400	FGL
	1981	35,023	FGL
	1983	35,950	FGL
		<u>429,993</u>	
Palmetto/Sunshine Bass	1975	20,000	FGL
	1995	61,700	FGL
	1996	53,600	FGL
	1997	53,692	FGL
	1998	41,017	FGL
	2002	35,909	FGL
	2003	47,000	FGL
	2004	47,338	FGL
	2005	47,610	FGL
	2007	32,098	FGL
	2010	1,930,469	FRY
	2011	34,211	FGL
	2013	49,109	FGL
	2014	22,303	FGL
	2015	32,862	FGL
	2016	47,393	FGL
	2017	11,199	FGL
	2018	0	
2019	0		
	<u>2,567,510</u>		

Table 5. Objective-based sampling components for Lake Bardwell, Texas 2018–2019.

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing</i>			
Largemouth Bass	Presence/absence	CPUE–total	
	Size structure	PSD, length frequency	
	Body condition	W_r	10 fish/inch group (max)
Bluegill ^a	Presence/absence	CPUE–total	
	Size structure	PSD, length frequency	$N \geq 50$
Gizzard Shad ^a	Presence/absence	CPUE–Total	
	Prey availability	IOV	$N \geq 50$
<i>Trap netting</i>			
Crappie	Relative abundance	CPUE-total	
	Size structure	PSD, length frequency	$N \geq 50$
	Body condition	W_r	10 fish/inch group (max)
	Age-and-growth	Age at 10 inches	$N = 13, 9.0 - 10.9$ inch
<i>Gill netting</i>			
White Bass	Relative abundance	CPUE – total	
	Size structure	PSD, length frequency	$RSE\text{-stock} \leq 25$
Palmetto Bass	Presence/absence		
	Size structure	PSD, length frequency	
Blue Catfish	Relative abundance	CPUE – stock	$RSE\text{-stock} \leq 25$
	Size structure	PSD, length frequency	$N \geq 50$
Channel Catfish	Relative abundance	CPUE-stock	$RSE\text{-stock} \leq 25$
	Size structure	PSD, length frequency	$N \geq 50$

Table 6. Survey of aquatic vegetation, Lake Bardwell, Texas, 2010, 2014, and 2018. Surface area (acres) is listed with percent of total reservoir surface area in parentheses. Tr indicates trace amount.

Vegetation	2010	2014	2018
Native submersed			
Pondweed	<0.1 (<0.1)	Tr	
Native emergent			
American lotus	<0.01 (<0.1)	Tr	
Bull tongue	<0.1 (<0.1)	Tr	
Cattail	<0.1 (<0.1)	Tr	
Smartweed	<0.1 (<0.1)	Tr	1.4 (<0.1)
Rattle box			59.4 (1.9)
Black willow			8.4 (0.3)

Gizzard Shad

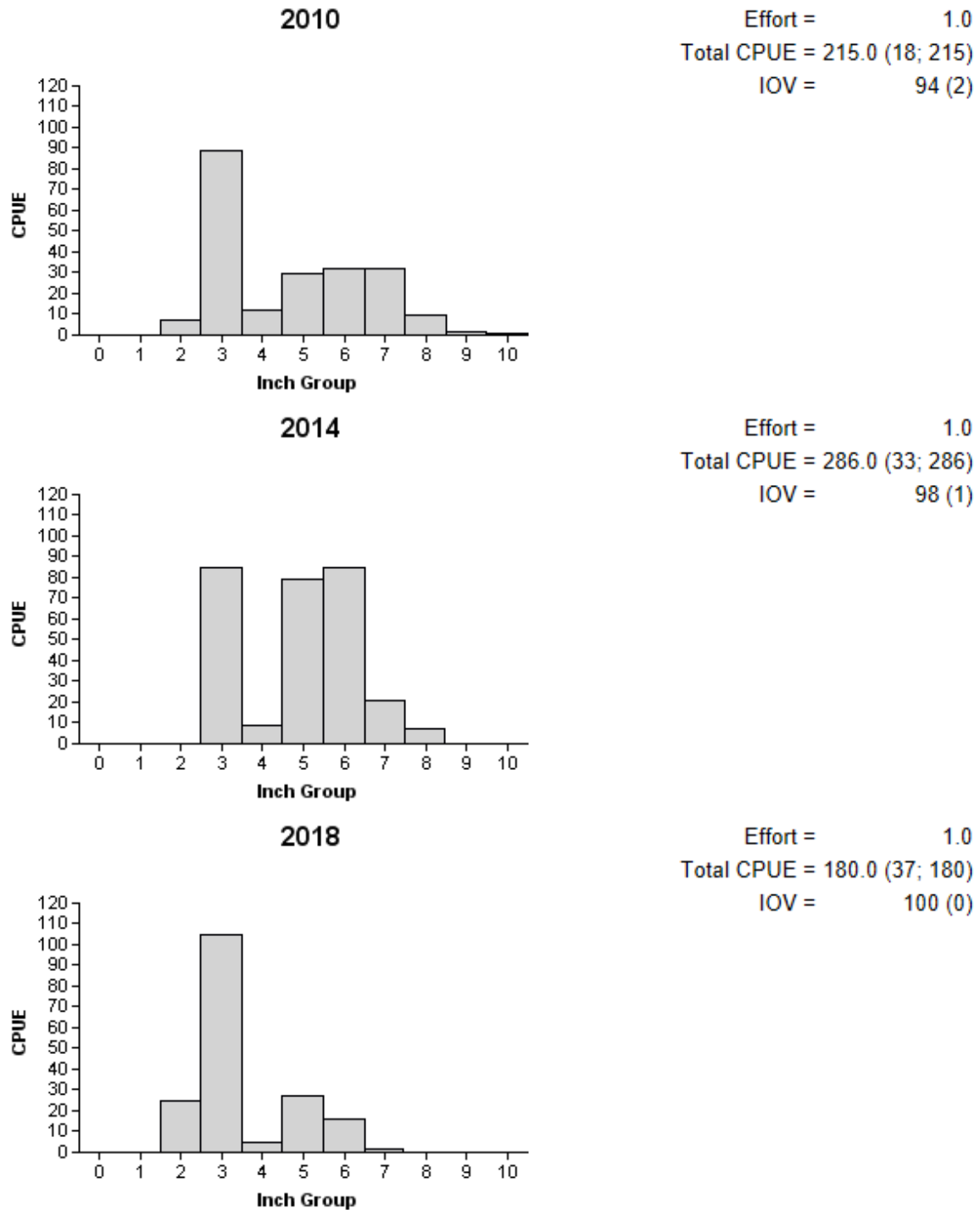


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Bardwell, Texas, 2010, 2014, and 2018.

Bluegill

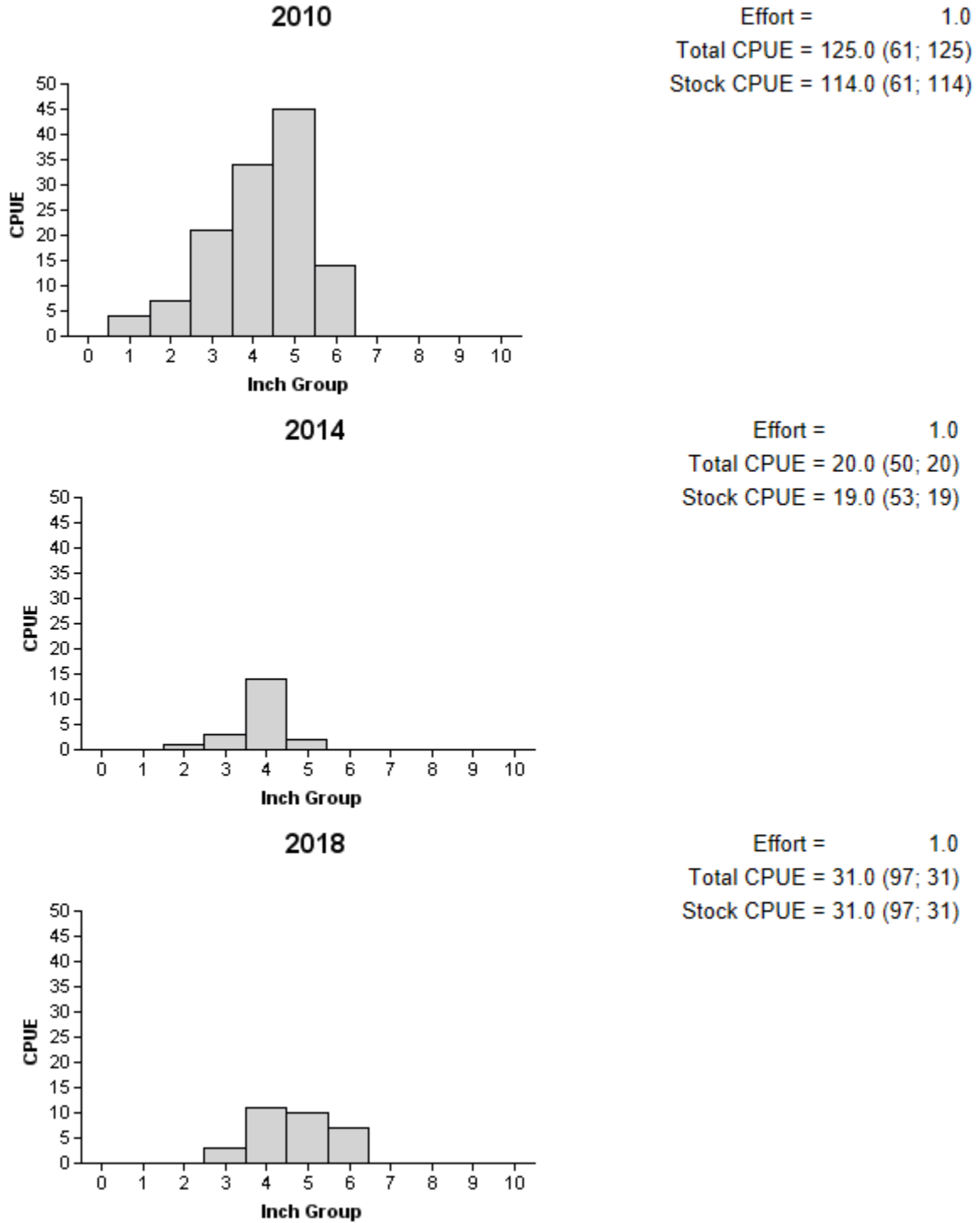


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Bardwell, Texas, 2010, 2014, and 2018.

Blue Catfish

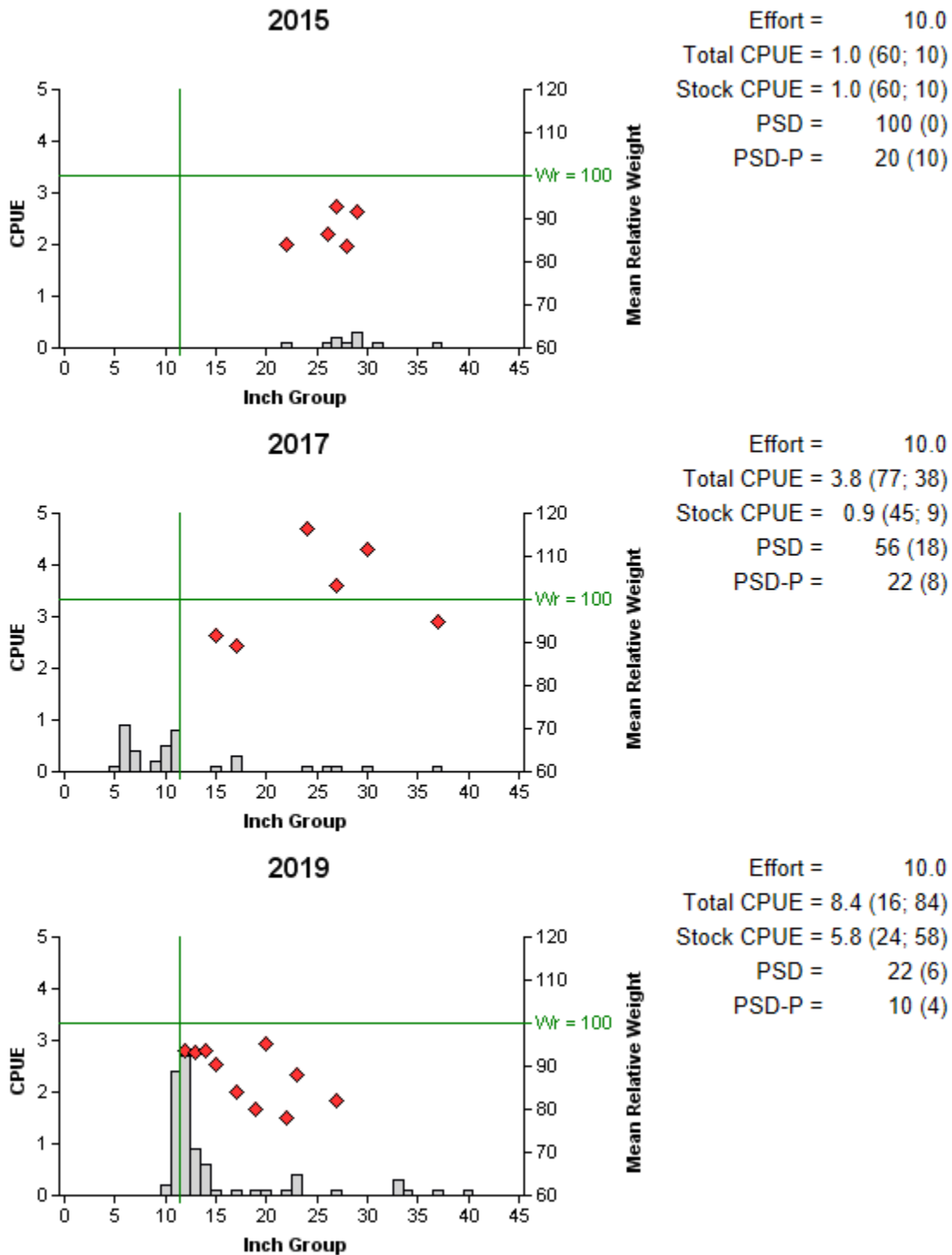


Figure 4. Number of Blue Catfish caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Bardwell, Texas, 2015, 2017, and 2019. Vertical line represents minimum-length limit.

Channel Catfish

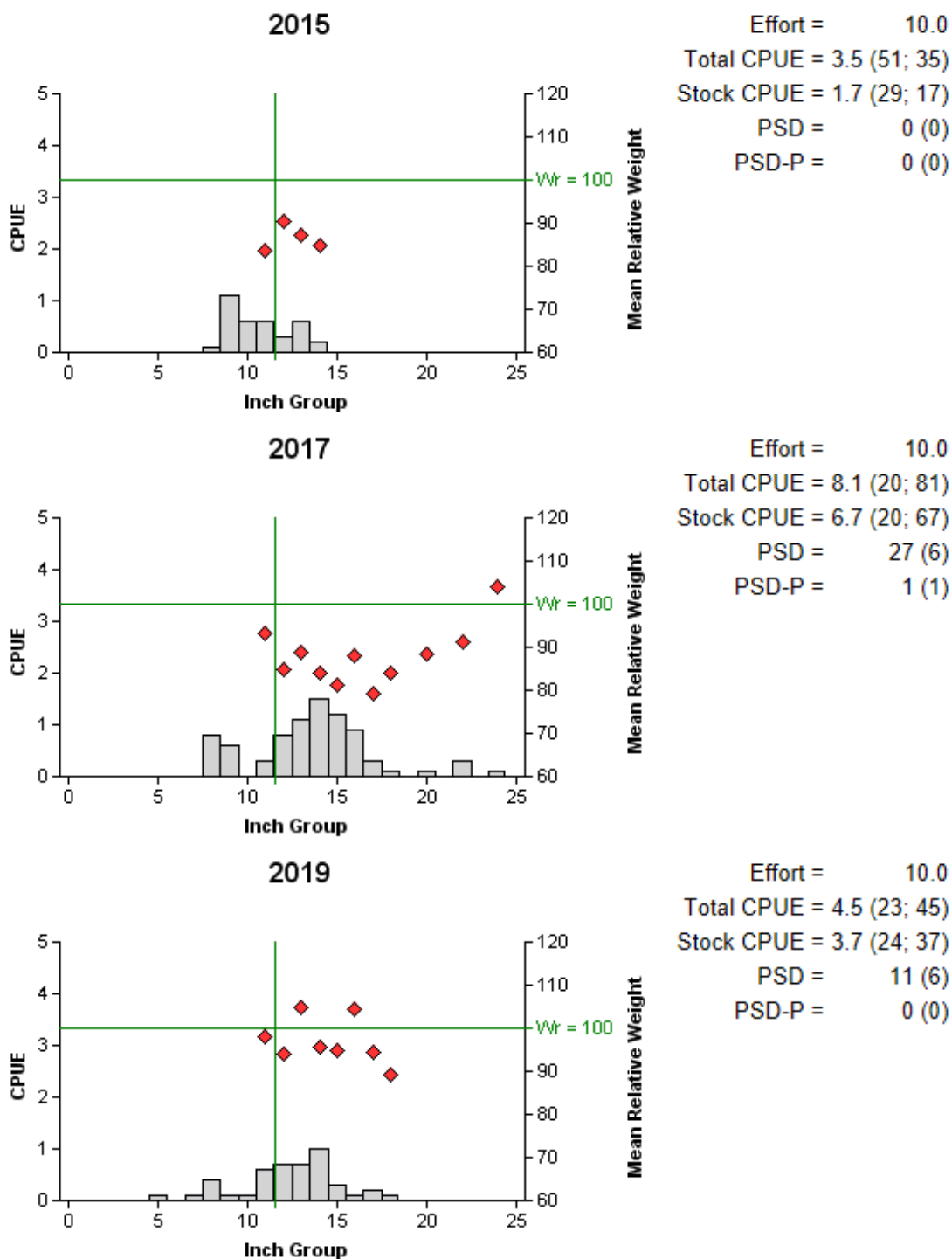


Figure 5. Number of Channel Catfish caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Bardwell, Texas, 2015, 2017, and 2019. Vertical line represents minimum-length limit.

White Bass

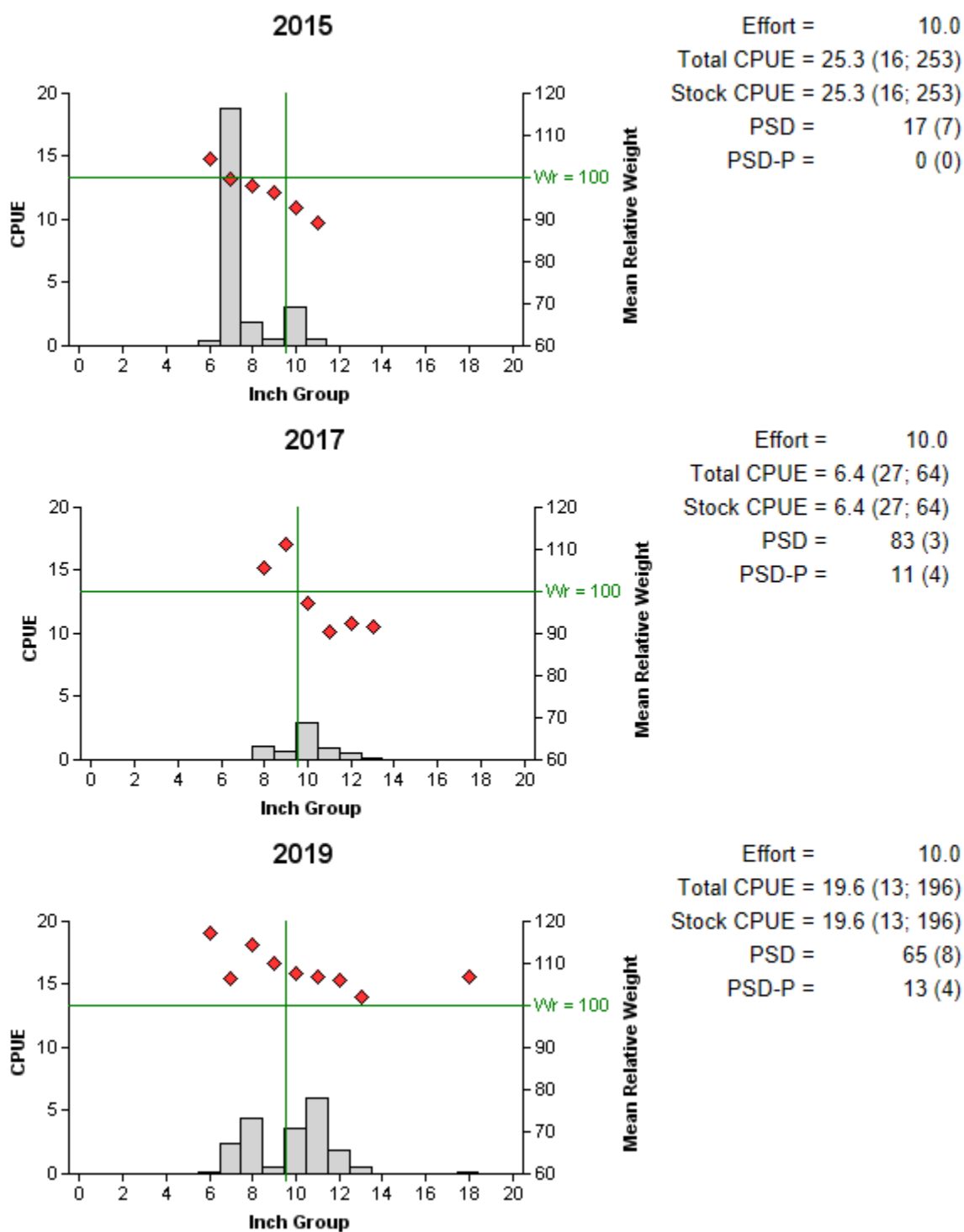


Figure 6. Number of White Bass caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Bardwell, Texas, 2015, 2017, and 2019. Vertical line represents minimum-length limit.

Palmetto Bass

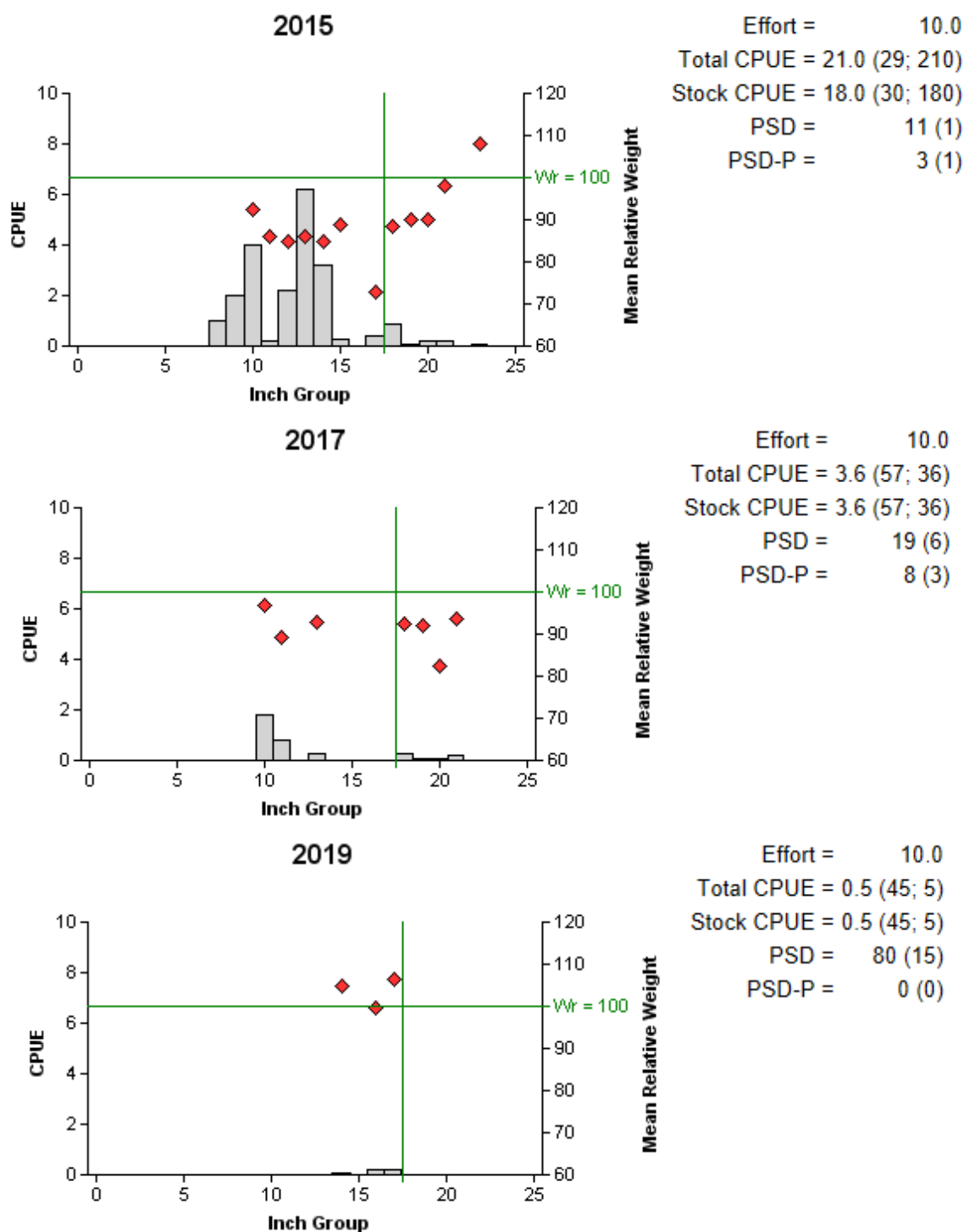


Figure 7. Number of Palmetto Bass caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Bardwell, Texas, 2015, 2017, and 2019. Vertical line represents minimum-length limit.

Largemouth Bass

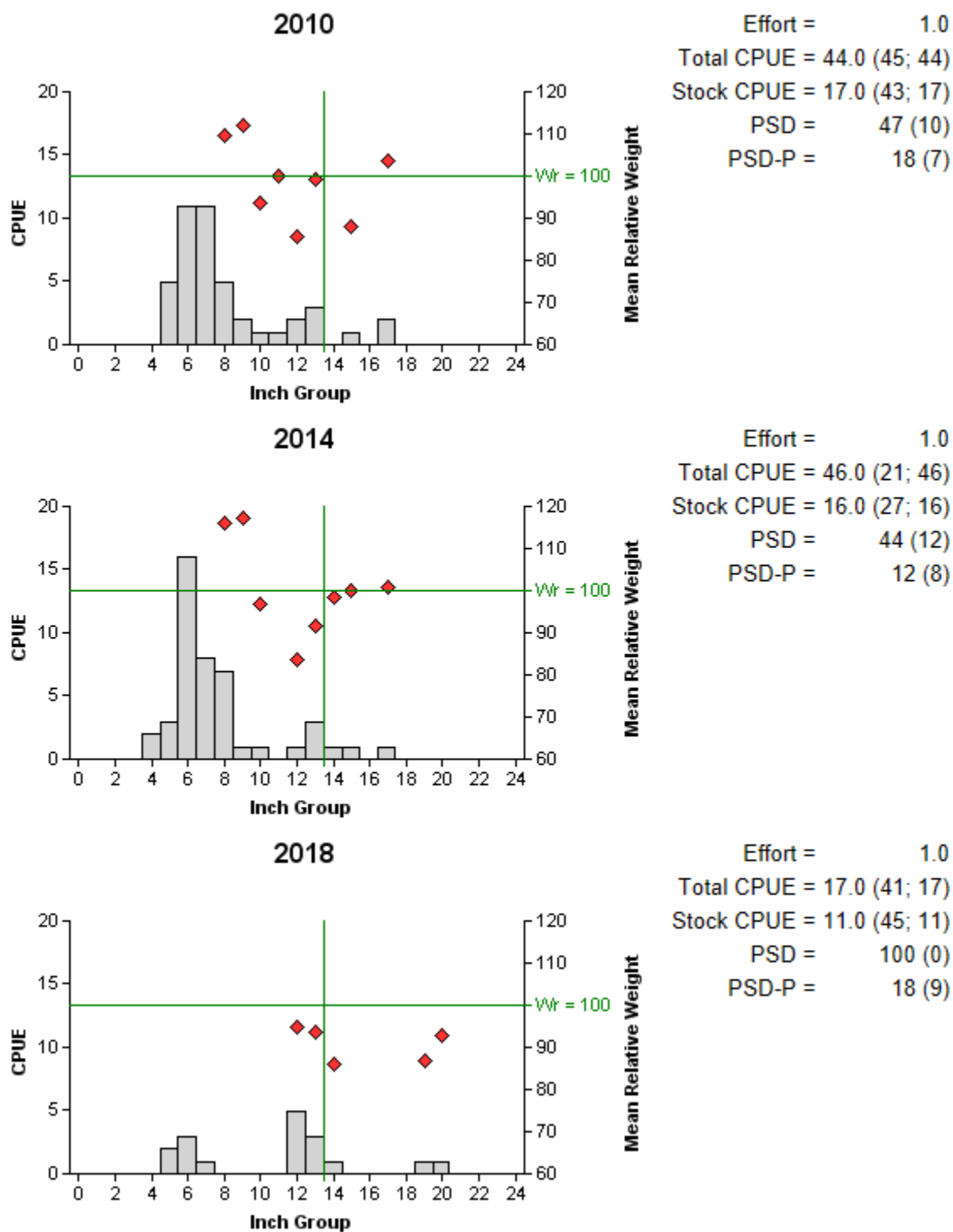


Figure 8. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Bardwell, Texas, 2010, 2014, and 2018. Vertical line represents minimum-length limit.

White Crappie

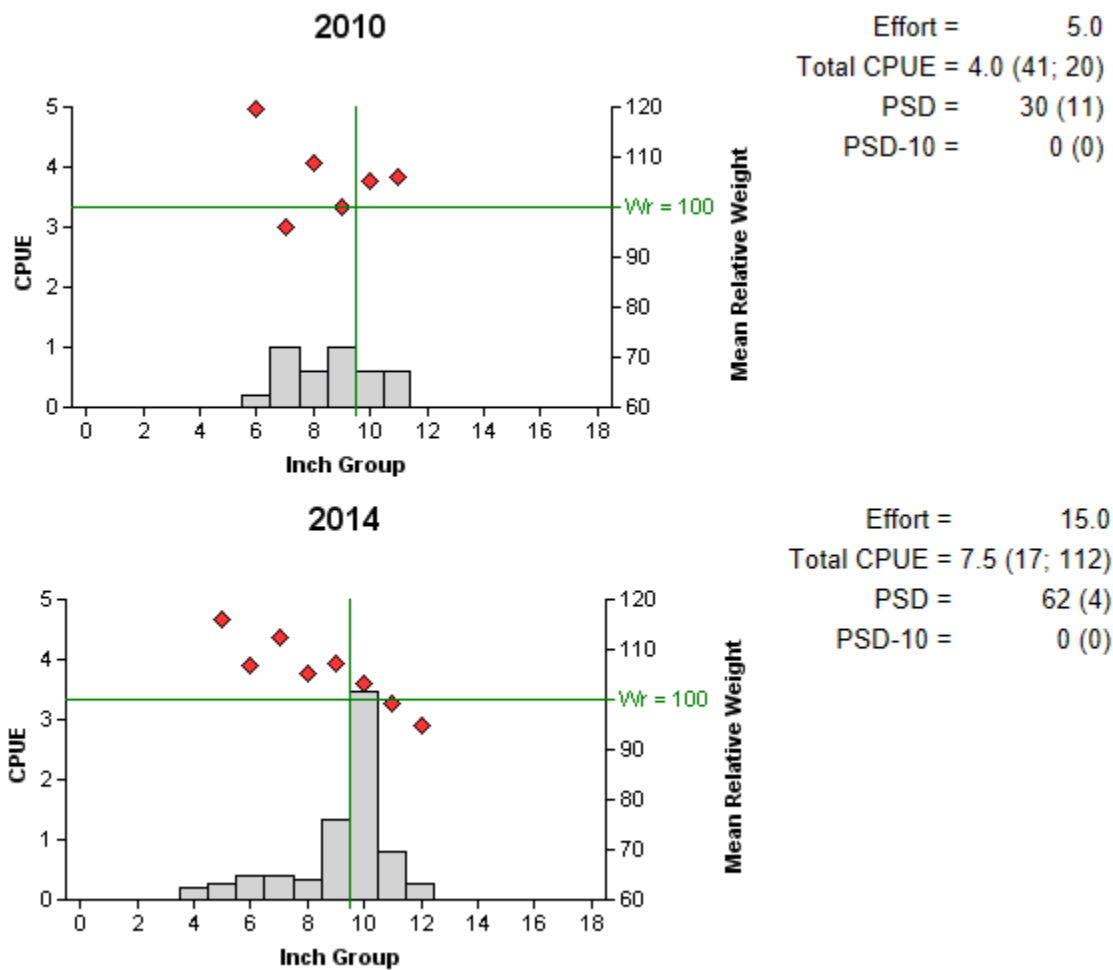


Figure 9. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, Lake Bardwell, Texas, 2010 and 2014; no sampling in 2018 due to flooding. Vertical line indicates minimum-length limit.

Proposed Sampling Schedule

Table 7. Proposed sampling schedule for Lake Bardwell, 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.

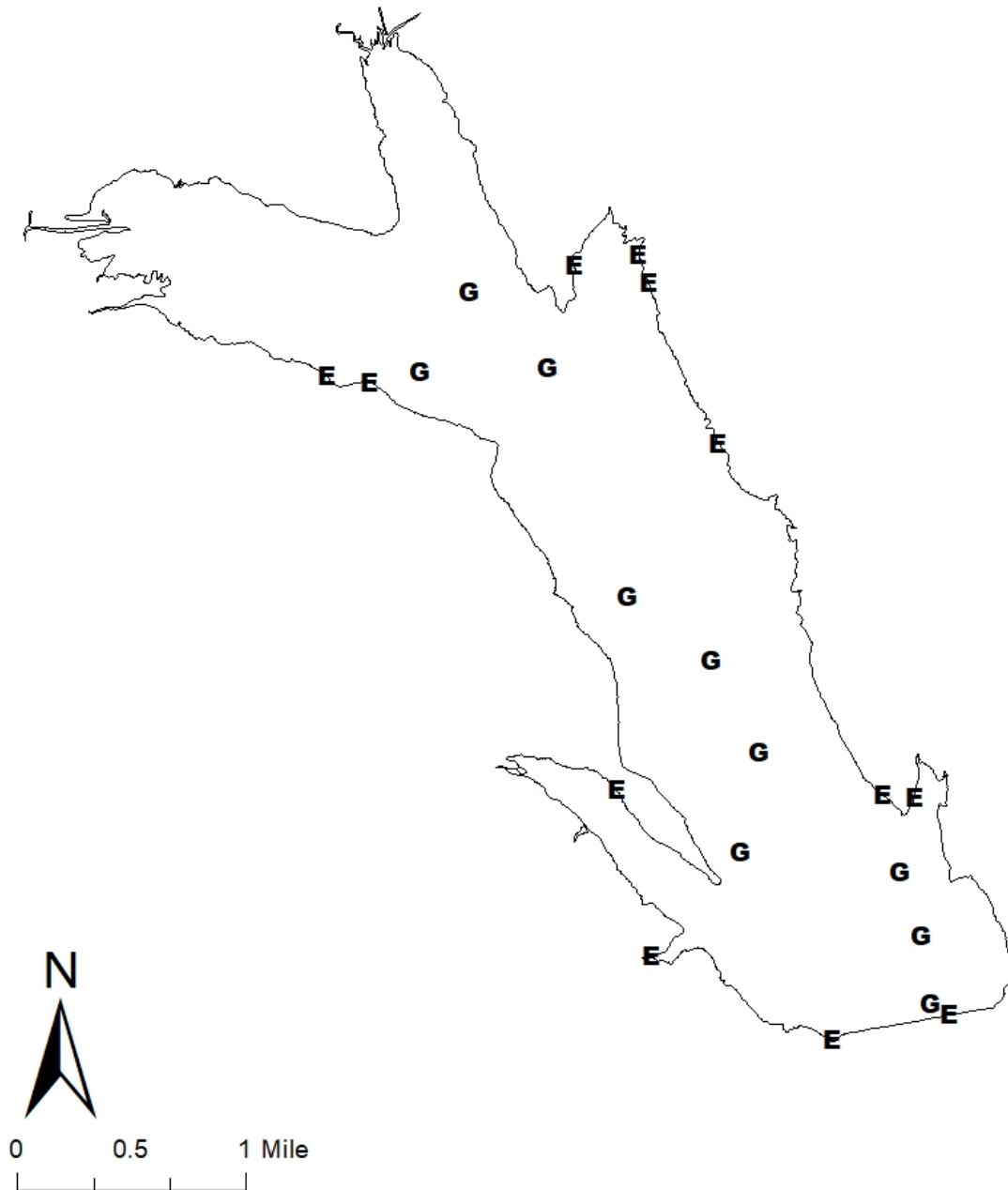
	Survey year			
	2019-2020	2020-2021	2021-2022	2022-2023
Angler Access				S
Vegetation				S
Electrofishing – Fall				S
Trap netting				A
Gill netting				S
Report				S

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

Number (N) and catch rate (CPUE) (RSE in parentheses) of all target species collected from all gear types from Lake Bardwell, Texas, 2018-2019. Sampling effort was 10 net nights for gill netting, and 1 hour for electrofishing.

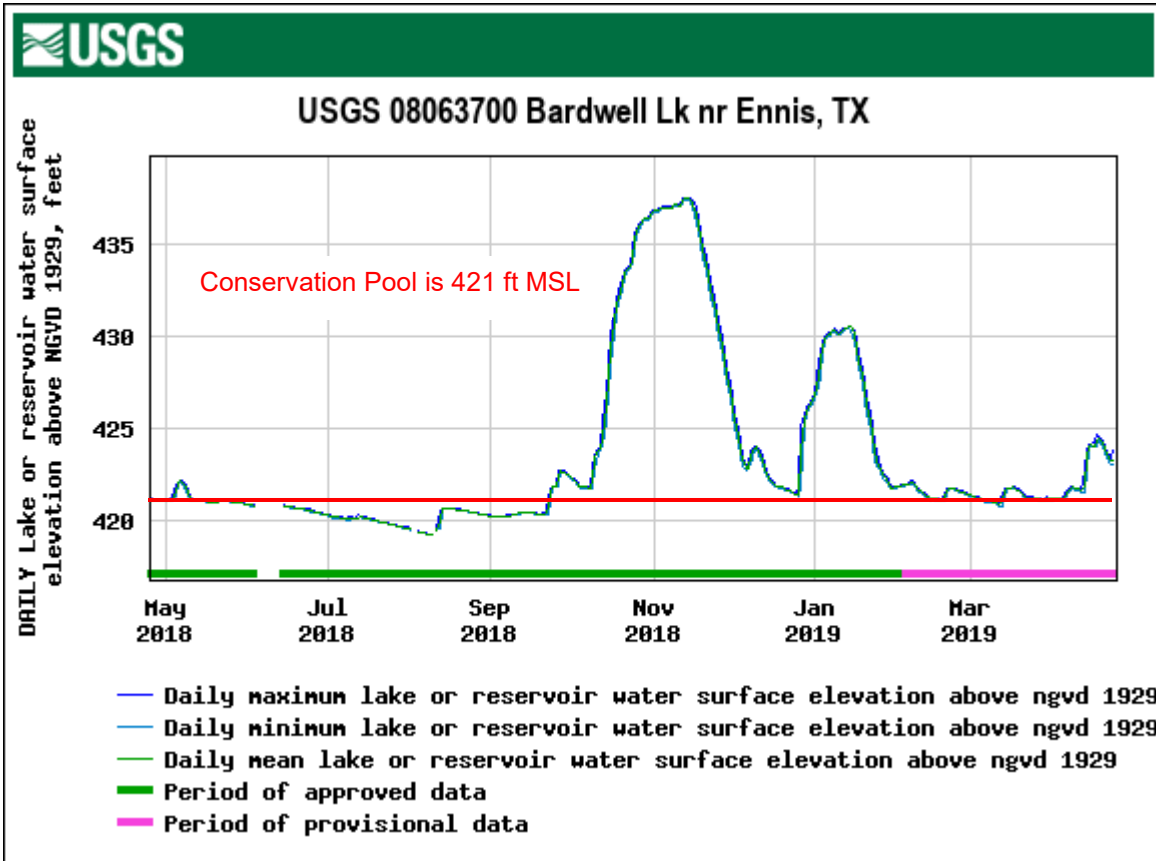
Species	Gill Netting		Electrofishing	
	N	CPUE	N	CPUE
Gizzard Shad			180	180 (37)
Threadfin Shad			144	144 (30)
Blue Catfish	84	8.4 (16)		
Channel Catfish	45	4.5 (23)		
White Bass	196	19.6 (13)		
Palmetto Bass	5	0.5 (45)		
Bluegill			31	31 (97)
Longear Sunfish			7	7 (61)
Largemouth Bass			17	17 (41)

APPENDIX B – Map of sampling locations



Location of sampling sites, Lake Bardwell, Texas, 2018-2019. Gill net and electrofishing stations are indicated by G and E, respectively. Water level was at or above full pool at time of sampling.

APPENDIX C – Detail of water level for Lake Bardwell during Survey Period



Monthly water level elevations in feet above mean sea level (MSL) recorded for Lake Bardwell, Texas.



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