PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2014 Fisheries Management Survey Report

Lake Bardwell

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lake Bardwell were surveyed in 2014 using electrofishing and trap netting and in 2015 using gill netting. Historical data are presented with the 2014-2015 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. Water level has mostly been within 2-4 feet of spillway elevation since 2005. Lake Bardwell is classified as hyper-eutrophic. Habitat consists of featureless shoreline, eroded bank, and small amounts of native submersed, and 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 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, marinas. The controlling authority was consulted with in regards to funding a native plant introduction project, however, funding and manpower was not available.

- **Fish Community**
  - **Prey species:** Threadfin Shad were present in the reservoir. Electrofishing catch of Gizzard Shad was good, and most were available as prey to sport fish. Electrofishing catch of Bluegill was low, however all were under 4 inches and available to most sport fish.

  - **Catfishes:** Blue Catfish and Channel Catfish were present in the 2015 gill netting survey. A few Blue Catfish exceeded 30 inches.

  - **Temperate Basses:** White Bass and Palmetto Bass were abundant in the 2015 gill netting survey. However, the majority of both White and Palmetto Bass collected had not yet reached harvestable size.

  - **Largemouth Bass:** Largemouth Bass remain in Lake Bardwell at a low density comprised primarily of small individuals (< 14 inches).

  - **Crappie:** White Crappie were more numerous than Black Crappie in 2014. The majority of White Crappie collected were legal size and exhibited fast growth, reaching legal size within two years.

- **Management Strategies:** Request annual stocking of Palmetto Bass fingerlings at 15 fish/acre and one additional stocking of Blue Catfish at 50/acre. Continue to monitor White Bass and Palmetto Bass through additional gill netting in 2017 and standard gill netting in 2019. Conduct general monitoring surveys with trap nets and electrofishing surveys in 2018. Inform the public about the negative impacts of aquatic invasive species. Access and vegetation surveys will be conducted in 2018.

INTRODUCTION

This document is a summary of fisheries data collected from Lake Bardwell in 2014-2015. 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 2014-2015 data for comparison.

Reservoir Description

Lake Bardwell is a 3,138-acre impoundment constructed in 1965 on Waxahachie Creek. It is located 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 and recreation. Lake Bardwell is classified as hyper-eutrophic with a Carlson's TCI chlorophyll [a] index of 58.04*;* ranking 77th highest of 102 Texas reservoirs (TCEQ 2010). Habitat consisted of featureless shoreline, eroded bank, and small amounts of native submersed and emergent vegetation. Water level has primarily been below conservation pool, averaging 2-4 ft. low (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 accessible over the last survey period (2010-2015). Additional boat ramp characteristics are in Table 2. High View Park, located south west of the HW 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 (Ott and Bennett 2011) included:

1. Seek additional opportunities to implement habitat introduction projects at Lake Bardwell.
   Action: Aquatic vegetation was not planted due to fluctuating water levels. Local fishing groups were sought after to partner with an artificial habitat project, however no groups expressed interest.
2. Request Blue Catfish fingerlings at 100/acre in 2012 and 2013 and continue monitoring Blue Catfish abundance and size distribution through a supplemental gill net survey in 2013 and standard sampling in 2015.
   Action: No fish were stocked in 2012 and 2013 but are scheduled to be stocked in 2015; gill netting was conducted in 2013 and 2015.
3. Request Palmetto Bass fingerlings based on a 10 fish/acre annual stocking rate and continue monitoring success of Palmetto Bass stockings through gill netting in 2013 and 2015.
   Action: Palmetto Bass fingerlings were stocked in 2011, 2013 and 2014, but at a reduced rate. Approximately 1,930,500 Palmetto Bass fry were stocked in 2010. Gill netting was conducted in 2013 and 2015.
4. Coordinate outreach efforts to advise anglers and businesses regarding the dangers of water borne exotic invasive species.
   Action: U.S. Army Corps of Engineers (USCOE) staff have been provided with information regarding the potential for zebra mussel *(Dreissena polymorpha)* infestation. Clean-Drain-Dry posters have been distributed to major outdoor equipment retailers in the area and reservoir boat ramps.

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 in 1992 and was restocked in 1998 (Table 4). Striped Bass were intermittently stocked from 1967 through 1983 then discontinued; Palmetto Bass were first stocked in 1975 with subsequent annual stockings from 1995-1998, 2002-2005, in 2007, 2010, 2011, 2013 and 2014.

Vegetation/habitat management history: Historically the aquatic vegetation community at Lake Bardwell has been low in diversity and abundance. In previous surveys (when water levels remained stable) native emergent species covered < 1% of the perimeter of the upper end of the reservoir. Hydrilla has been 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 by 2006 (Beck and Ott 2007) and was not present in the 2010 survey. 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 USCOE commercial and residential shoreline development are not permitted.

Water transfer: No interbasin transfers are known to exist.

METHODS

Fishes were collected by electrofishing (1 hour at 12, 5-min stations), gill netting (10 net nights at 10 stations), and trap netting (15 net nights at 15 stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing and, for gill and trap nets, as the number of fish per net night (fish/nn). Surveys were conducted to achieve survey and sampling objectives in accordance with objective-based sampling (OBS) plan (Appendix C). All survey sites were randomly selected and all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2014).

Vegetation surveys were conducted in August 2014 to monitor the aquatic macrophyte community. Habitat was assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2014).

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. Palmetto Bass ages were determined using otoliths from 5 to 10 fish per inch group. White and Black Crappie ages were determined using otoliths from 13 specimens ranging from 9.2-10.8 inches and 8.9-10.0 inches, respectively.

Source for water level data was the United States Geological Survey (USGS 2015).

RESULTS AND DISCUSSION

Habitat: A survey of aquatic vegetation in the littoral zone was conducted in August 2014. Native emergent and submerged vegetation identified in trace amounts were not widely distributed and comparable to the previous survey (Ott and Bennett 2011). Pondweed was the only native submersed species identified (Table 5). Emergent vegetation was composed of American lotus, smartweed cattail and water willow. Collectively, all area occupied was <0.1 acre. Fluctuating water level, turbidity, and

wind action limit the expansion of the aquatic plant community in this reservoir. Hydrilla (reported in previous surveys) was not identified in the current survey.

Prey species: Gizzard Shad have remained the dominant prey species in Lake Bardwell; electrofishing catch rates from the 2010 and 2014 surveys were 215/h and 286/h, respectively (Figure 2). High index of vulnerability (IOV) (94 and 98, respectively) indicates the majority of Gizzard Shad present are available to predators. Other prey species identified during the 2010 and 2014 electrofishing surveys included Threadfin Shad, Bluegill, Redear Sunfish and Longear Sunfish (Appendix A).

Catfish: Blue Catfish were collected in the 2015 gill net survey but catch rate was low. Anecdotal information from local anglers suggests Lake Bardwell has the potential for trophy Blue Catfish; this was apparent both through photographs and fish > 50 lbs. caught by anglers while the 2015 gill net survey was being conducted. Channel Catfish gill net catch rate was 3.5/nn and was comprised primarily of small individuals (PSD = 0). Relative weights were moderate (Wr ≥ 85). Despite doubling the normal effort (5nn to 10 nn), a CPUE with RSE < 25 and at least 50 stock-length fish were not obtained as it was determined in the OBS plan and extra effort to reach those goals was not feasible.

White Bass: The gill net catch rate of White Bass was 25.3/nn in 2015 (Figure 3). However, the size structure was comprised of primarily small, sublegal fish (PSD = 17). Relative weights were moderate to above average across all size classes (*Wr* = 90 – 105) and decreased with increasing fish length. Previous surveys (2011, 2013) did not exhibit sufficient precision to make sound comparisons (RSE > 25 for CPUE, N < 50 stock length fish). White Bass ages were not determined due to an insufficient sample size of fish 9.0-10.9 inches in length.

Palmetto Bass: The gill net catch rate of Palmetto Bass was 21.0/nn in 2015 (Figure 4). Size structure was comprised primarily of smaller individuals (PSD = 11) and body condition was good (≥ 90) for all but one 17 inch fish, suggesting adequate prey availability. The Palmetto Bass in Lake Bardwell were part of a state wide study evaluating the utility of fry stocked Hybrid Striped Bass. In accordance with the project and the OBS plan for Lake Bardwell, 82 Palmetto Bass (10 per inch class) were aged to identify the year classes present within the reservoir (Figure 5). Of the 82 fish, 40 were from the 2013 stocking (average length = 13.3 inches), 24 were stocked in 2014 (average length = 9.4 inches) and 18 were stocked in 2011 (average length = 19.3 inches). These results suggest limited recruitment of fry stocked in 2010 to age 5. Palmetto Bass were not available for stocking in 2012, which explains the absence of age 3 specimens. The high abundance of age 1 and 2 fish suggests the potential for a strong Palmetto Bass fishery in the upcoming years.

Largemouth Bass: The electrofishing catch rate of stock-length Largemouth Bass was 46.0/h in 2014 (Figure 6); the majority of the population consisted of sublegal fish (PSD = 44). The low number of stock-length fish (N=16) sampled suggested collecting ≥ 50 specimens per the OBS plan was not obtainable within a reasonable amount of sampling effort. Relative weights were moderate to good (Wr ≥ 90), suggesting adequate prey availability. Low precision of 2010 data (RSE < 25 for CPUE, N > 50 stock-length fish); limits statistical comparisons of population trend data, however overall trends of low catch rate are apparent. Age and growth analysis was not conducted as prescribed in the OBS plan; the extra effort required to obtain 13 fish 13.1-14.9 inches in length was not feasible.

Crappie: The trap net catch rate of White Crappie was 7.5/nn in 2014 (Figure 7). Size structure was good (PSD= 85) ; 61% of White Crappie collected were of legal length. Body condition (W_r) was > 95 for all length groups, indicating adequate prey availability. Black Crappie have historically been present at very low densities in Lake Bardwell; typically < 5 individuals were collected per survey (5 net nights). The sampling effort was tripled in 2014 and 30 Black Crappie were collected however high precision (RSE 30-100) of CPUE limits comparisons between years. Growth of White and Black Crappie was good; average age at 10 inches (White Crappie: 9.2-10.8 inches, Black Crappie: 8.9-10.0 inches) was 2.0 years (N = 13; range = all fish were age 2).

Fisheries management plan for Lake Bardwell, Texas

Prepared – July 2015.

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

MANAGEMENT STRATEGY

1. Stock Palmetto Bass annually at 15 fish/acre. If Palmetto Bass are unavailable, Sunshine Bass are acceptable.
2. Monitor Palmetto Bass abundance and size distribution through supplemental gill net survey in 2017.

ISSUE 2: Gill net surveys routinely yield low catch rates of Blue Catfish, suggesting poor recruitment. 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 apparent low density population could potentially be driven by the lack of suitable spawning cavities.

MANAGEMENT STRATEGIES

1. Stock Blue Catfish fingerlings at 50 fish/acre in 2016 to follow up the 2015 stocking request.
2. Consult with Lake Bardwell US Army Corps of Engineers staff about creating artificial catfish spawning habitat throughout Lake Bardwell.
3. 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)
4. Monitor Blue Catfish abundance and size distribution through supplemental gill net survey in 2017 and standard sampling in 2019.

ISSUE 3: Many invasive species threaten aquatic habitats and organisms in Texas and can adversely affect the state ecologically, environmentally, and economically. For example, zebra mussels can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches and plugging engine cooling systems. Giant salvinia and other invasive vegetation species can form dense mats, interfering with recreational activities like fishing, boating, skiing and swimming. The financial costs of controlling and/or eradicating these types of invasive species are significant. Additionally, the potential for invasive species to spread to other river drainages and reservoirs via watercraft and other means is a serious threat to all public waters of the state.

MANAGEMENT STRATEGIES

1. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir.
2. 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 through the use of 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

Sport fish, forage fish, and other important fishes

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 sunfishes.

Survey objectives, fisheries metrics, and sampling objectives

Crappie: Crappie represented 55% (6.1 hours/acre) of the directed angler effort during the most recent creel survey at Lake Bardwell. While CPUE was relatively high, the confidence intervals surrounding estimates of abundance and PSD fluctuated considerably. Based on bootstrap analysis of historical data, along with 2014 trap net data, it would take 15 trap nets to attain acceptable precision (RSE < 25 for CPUE, N > 50 stock-length fish) at least 80% of the time. White Crappie trend data (CPUE, PSD, *Wr*) will continue to be monitored every four years 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 for CPUE and at least 50 stock size individuals are collected. We believe that the level of sampling proposed will provide our secondary sampling objective of 13 specimens between 9.0 and 10.9 inches for aging. If this number of specimens is not achieved we will obtain additional sets of otoliths from angler volunteers at the fishing barge.

Palmetto Bass: Palmetto Bass represented 9% (total temperate bass) of the directed angler effort during the most recent creel survey at Lake Bardwell. Previous gill net catch rates have varied from over 10.0 fish/nn, to less than 1.0 fish/nn and have directly fluctuated with increased/decreased stocking frequency and rate. The two highest gill net catch rates for Palmetto Bass on Lake Bardwell were 10.6 fish/nn (N = 53) and 21.0 fish/nn (N = 210) recorded in 2005 and 2014, respectively. Both of these occurred following multiple, consecutive years of stocking Palmetto Bass. In order to maintain a fishery, Palmetto Bass fingerlings will be requested for stocking annually at the rate of 15 fish/ac. Palmetto Bass trend data (CPUE, PSD, Wr) will continue to be monitored every two years (2017 and 2019) in order to detect any larger scale population fluctuations. A minimum of 10, randomly selected gill 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.

White Bass: White Bass are present within the reservoir and directed angling effort was documented in the most recent creel survey, bootstrap analysis of historical data (2011, 2013) suggest a large amount of effort (≥ 30 randomly-selected ~~t~~ gill net nights) would be required to obtain reliable CPUE values (i.e. RSE < 25). A strong year class present in the 2015 gill net survey produced much higher catch rates than historic surveys, potentially allowing for adequate sample size and precision in futures surveys. White Bass trend data (CPUE, PSD, *Wr*) will be monitored every two years (2017 and 2019) in order to detect any larger scale population fluctuations. A minimum of 10, randomly selected gill net sites will be sampled, and 5 additional nets will be set, if needed, to collect trend data with an RSE < 25 (for CPUE) and at least 50 stock size individuals are collected. We believe that the level of sampling proposed will provide our sampling objective of 13 specimens between 9.0 and 10.9 inches for aging. However, if this number of specimens is not achieved no additional collection will be conducted.

Blue Catfish: Blue and Channel Catfishes 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 ten years, however catch rates have not been sufficient to calculate CPUE and PSD with the desired level of precision (N> 50, RSE <25). Bootstrap analysis of this data predicts it would

require ≥ 45 randomly set gill nets to reach desired population estimates. Therefore, the presence/absence of Blue Catfish will continue to be monitored every two years in the spring with the gill netting methods described for Palmetto Bass and White Bass.

Channel Catfish: Channel Catfish gill net catch data from the last two surveys has displayed reliable population metrics (e.g. CPUE 5.5 – 7.5/nn; RSE <25) with 5 net nights of effort. Continuation of population trend data (i.e. CPUE, PSD, Wr) with gill net sampling in the spring of 2017 and 2019 will allow for the detection of any large scale fluctuations in the Channel Catfish population. 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. In accordance with the Palmetto and White Bass procedures, 5 additional gill nets will be set, if needed, to achieve an RSE < 25 for CPUE and at least 50 stock size individuals are collected.

Largemouth Bass: Largemouth Bass abundance is limited by turbidity and minimal aquatic vegetation. Although a fishery for Largemouth Bass does exist, angler effort is low at Lake Bardwell and this species accounting for only approximately 2% of the total directed angling effort during the December 2006-May 2007 creel survey. Electrofishing surveys conducted every four years from 1997-2014 produced CPUE's ranging from 21.0 to 84 fish/h (with RSE's from 21 to 59) and estimates were highly related to reservoir elevation at the time of sampling. Bootstrap analysis of this 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 will be monitored in the fall of 2018 as presence/absence only with 12 randomly selected 5-minute electrofishing stations. The high turbidity in Lake Bardwell minimizes any benefit of night-time electrofishing and therefore the 2018 survey will be conducted during daylight hours.

Gizzard Shad and Bluegill: Gizzard and Threadfin Shad, and to a lesser extent bluegill are the primary forage species at Lake Bardwell. Relative abundance, size distribution, PSD, and IOV have been collected every four years since 1997. Gizzard Shad CPUE has been relatively consistent ranging from 138 to 350 fish/h with IOV in the 90's. Bluegill CPUE has been more variable and like Largemouth Bass appears to be related to reservoir elevation (ranging from 125 to 15/h). Gizzard Shad CPUE (RSE < 30) and IOV will continue to be monitored every four years for trend information on relative abundance and vulnerability with 12 randomly selected 5-minute electrofishing stations, with up to 12 additional stations if necessary, to reach target sampling precision. The high turbidity in Lake Bardwell minimizes any benefit of night-time electrofishing and therefore the 2018 survey will be conducted during daylight hours. Bluegill will be monitored for presence/absence due to historically low catch rate.

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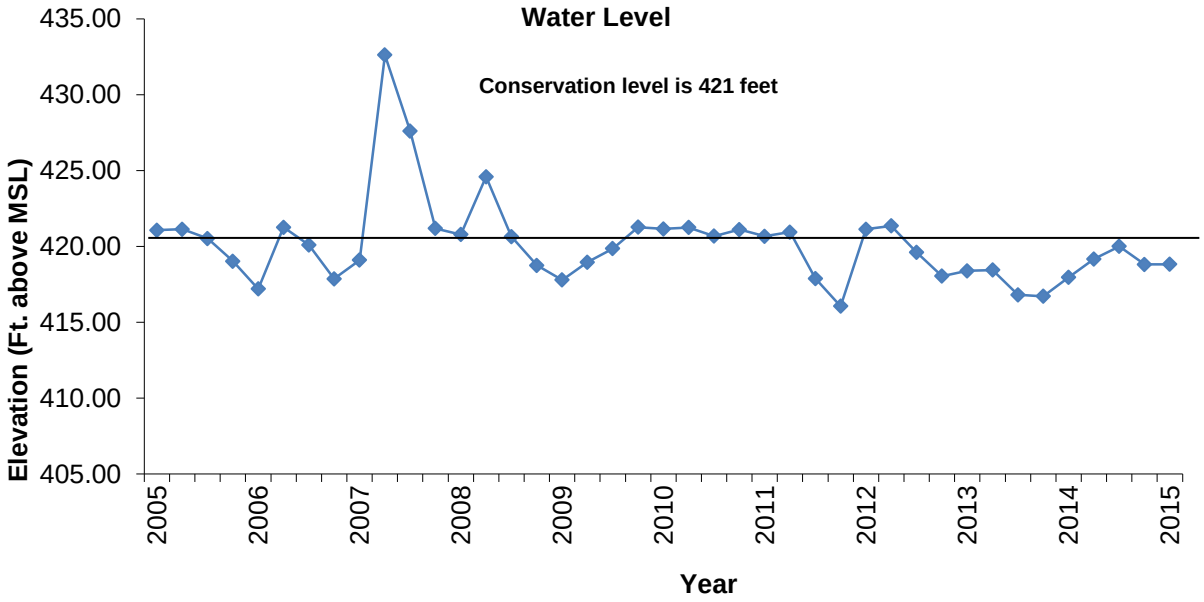


Figure 1. Quarterly water level elevations in feet above mean sea level (MSL) recorded for Lake Bardwell, Texas.

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 µS/cm

Table 2. Boat ramp characteristics for Lake Bardwell, Texas, August, 2014. Reservoir elevation at time of survey was 419.5 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 - No Limit
Catfish, Flathead	5	18 - No Limit
Bass, White	25	10 - No Limit
Bass, Palmetto	5	18 - No Limit
Bass, Largemouth	5	14 – No Limit
Crappie: White and Black Crappie, their hybrids and subspecies	25 (in any combination)	10 – No Limit

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

Species	Year	Number	Size
Blue Catfish	1966	7,000	FGL
		7,000	
Channel Catfish	1966	22,000	FGL
	1972	2,000	FGL
		24,000	
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
		429,993	
Palmetto Bass	1975	20,000	
	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
		2,553,608	

Table 4. Stocking history continued.

Species	Year	Number	Size
Green x Redear Sunfish	1966	3,400	FGL
	1972	1,000	FGL
		4,400	
Largemouth Bass	1966	670,000	FGL
		670,000	
Florida Largemouth Bass	1992	178,111	FGL
	1998	178,500	FGL
		357,500	

Table 5. Survey of aquatic vegetation, Lake Bardwell, Texas, 2010 – 2014. Surface area (acres) is listed with percent of total reservoir surface area in parentheses; tr = trace amount.

Vegetation	2010	2014
Native submersed		
Pondweed	<0.1(<0.1)	tr
Native emergent		
American lotus	<0.1(<0.1)	tr
Bull tongue	<0.1(<0.1)	tr
Cattail	<0.1(<0.1)	tr
Smartweed		tr

Gizzard Shad

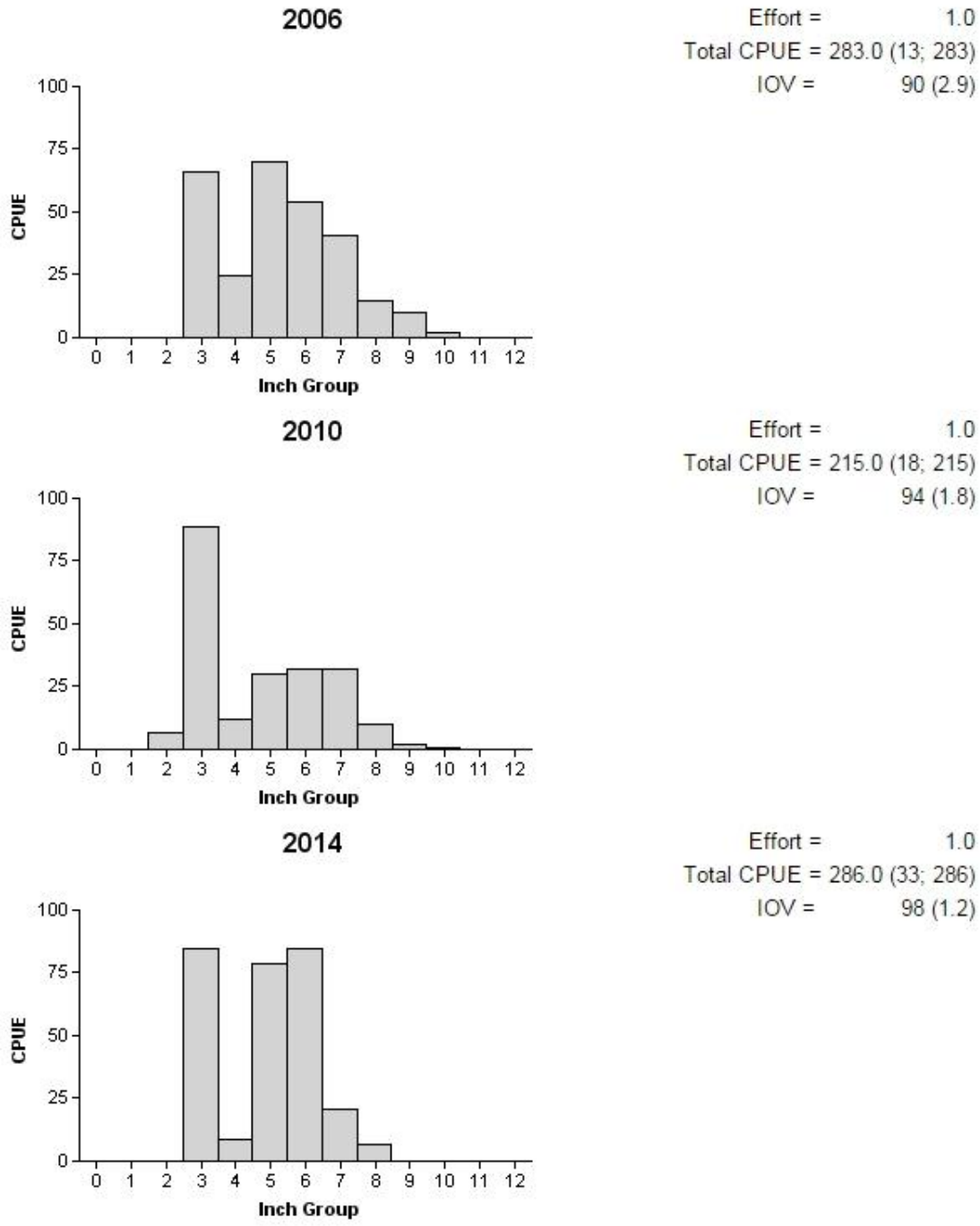


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Bardwell, Texas, 2006, 2010, and 2014.

Channel Catfish

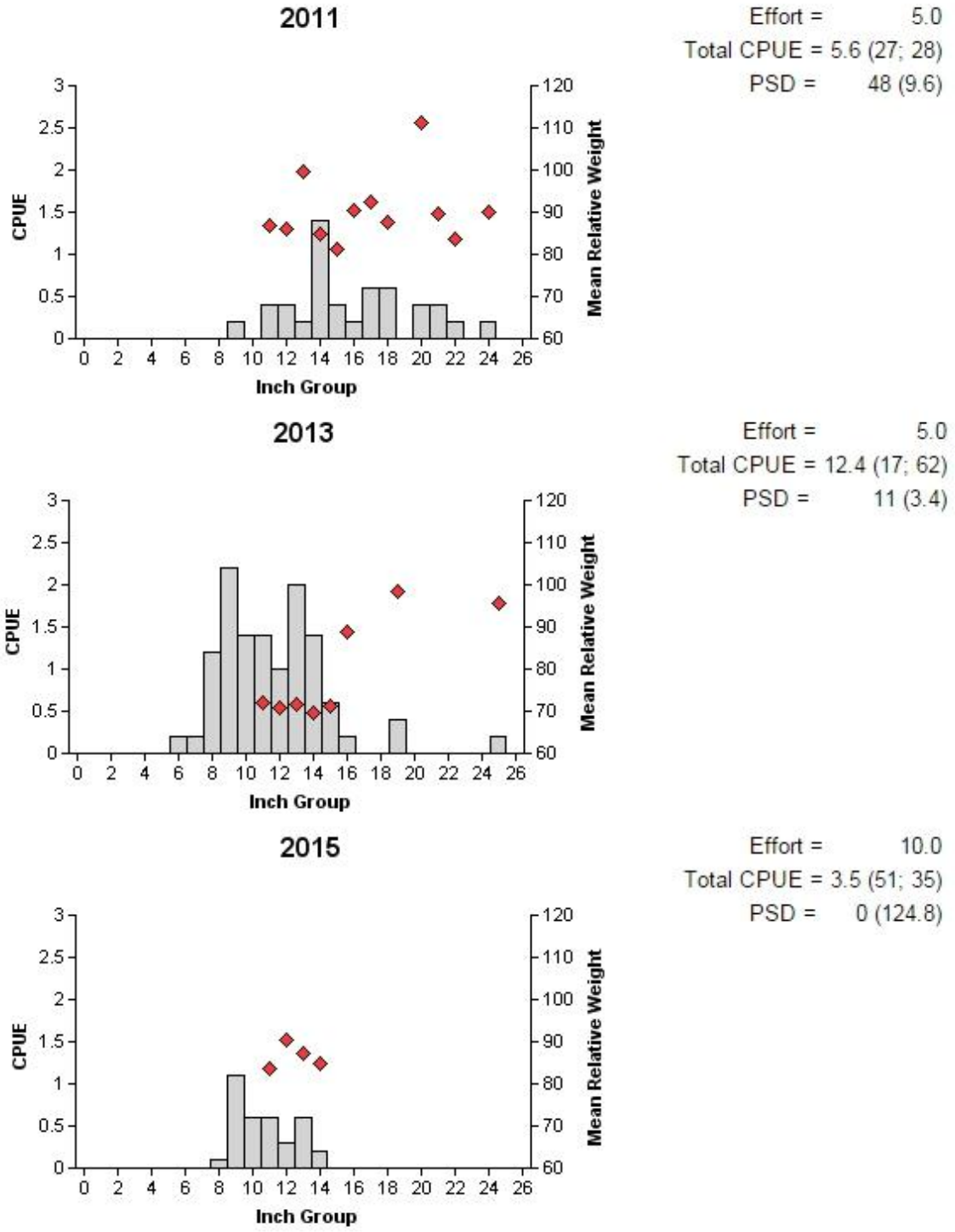


Figure 3. Number of Channel Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Bardwell, Texas, 2011, 2013, and 2015.

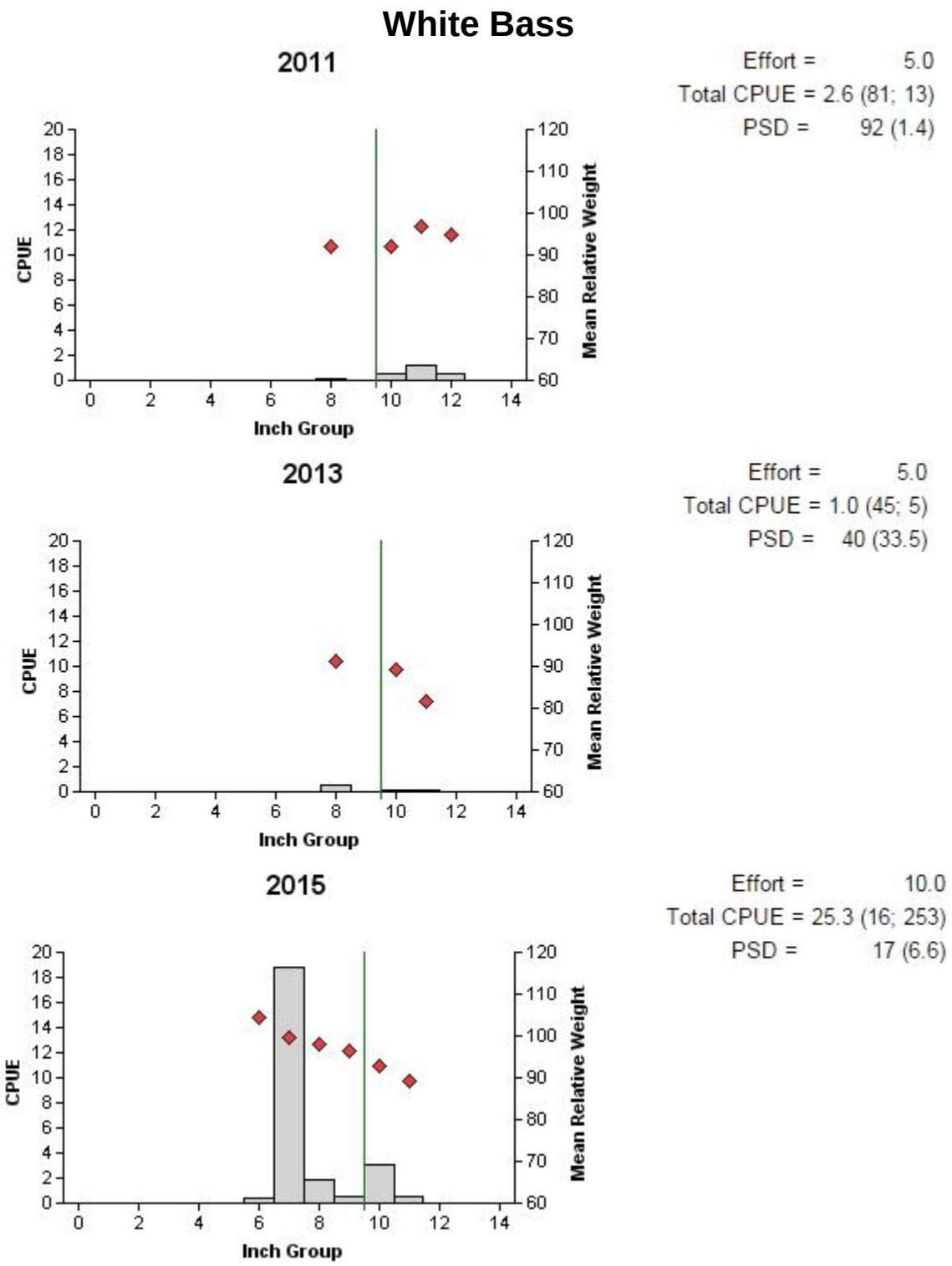


Figure 4. Number of White Bass caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Bardwell, Texas, 2011, 2013, and 2015.

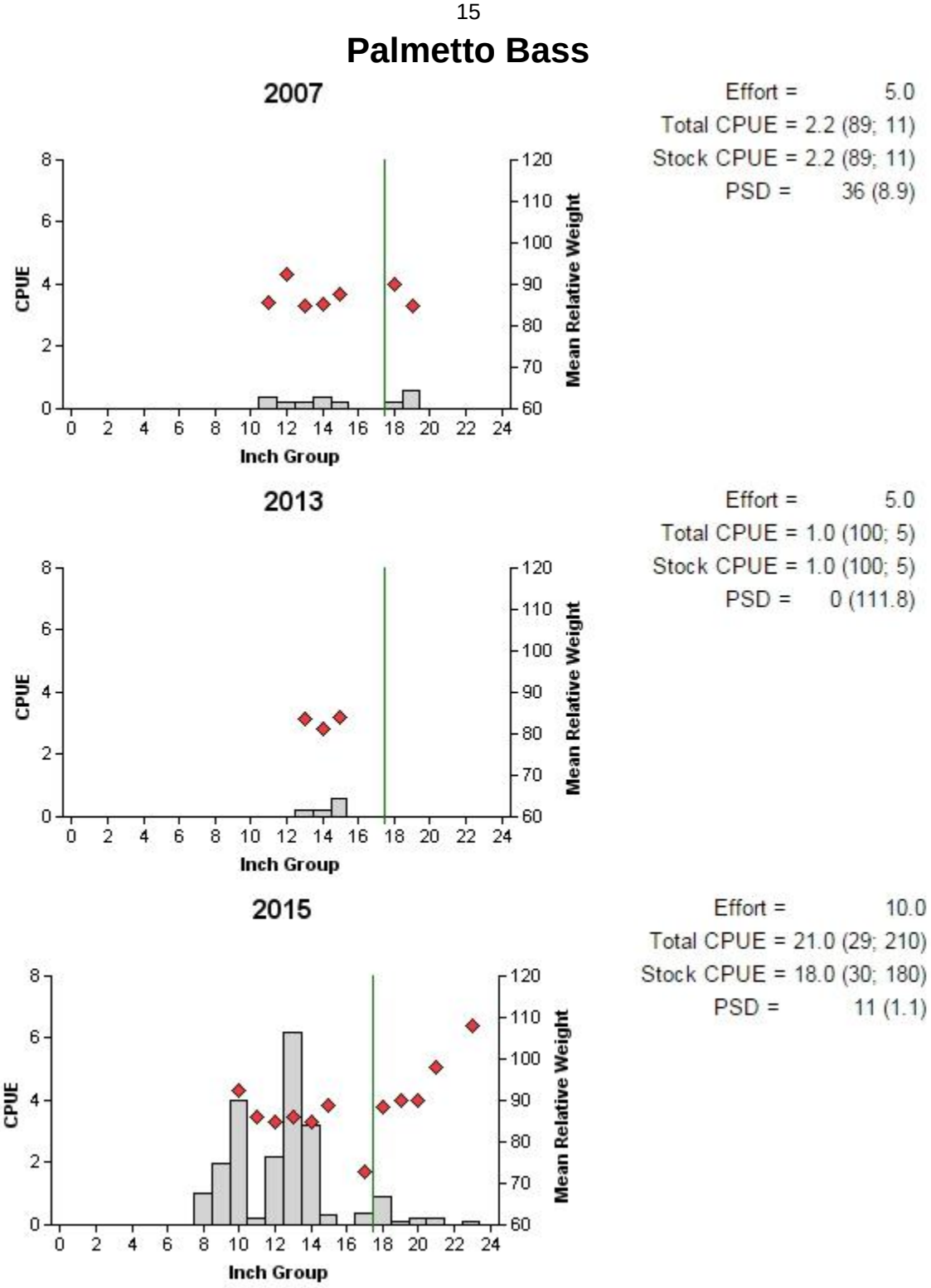


Figure 5. Number Palmetto Bass caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Bardwell, Texas, 2011, 2013, and 2015.

Palmetto Bass

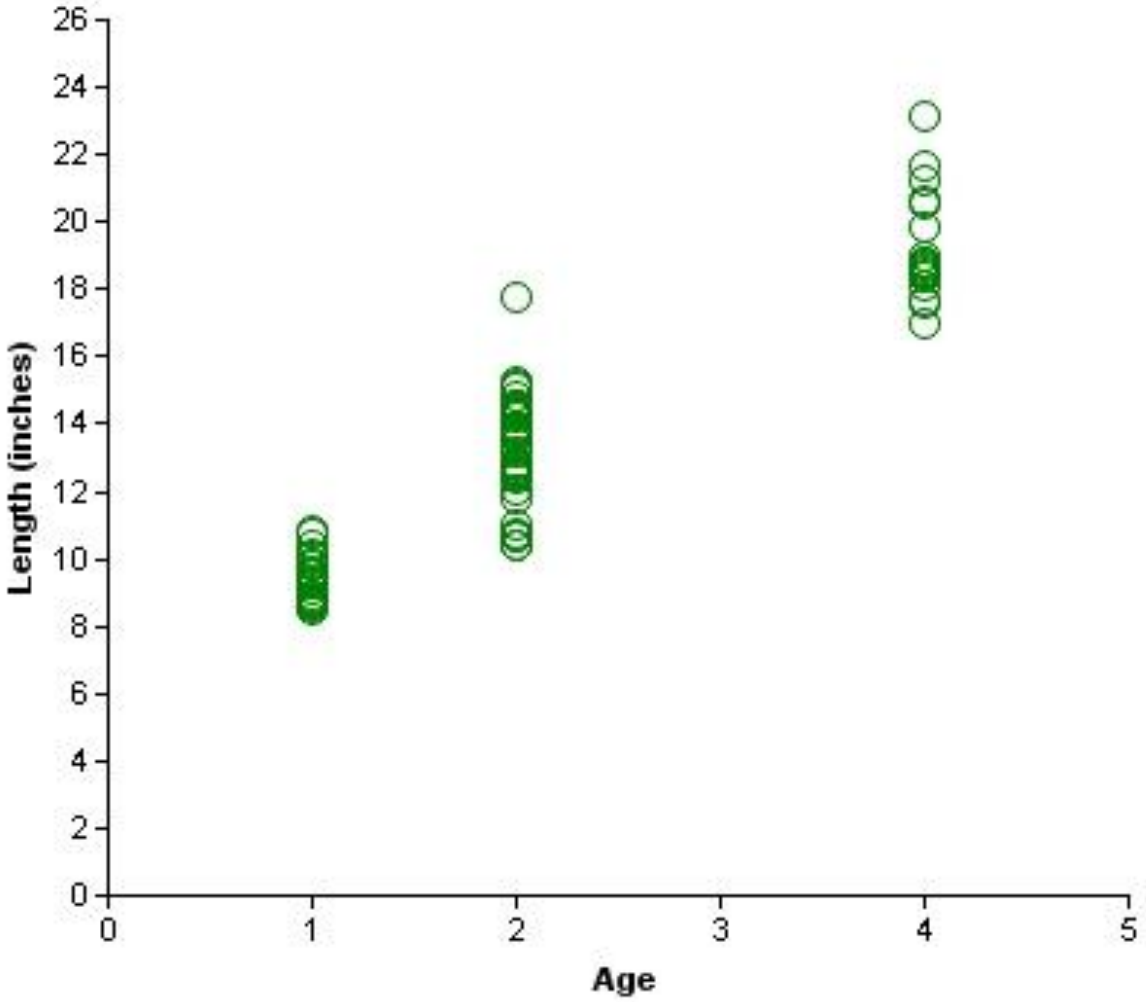


Figure 6. Length at age for Palmetto Bass collected from gill nets at Lake Bardwell, Texas, March 2015.

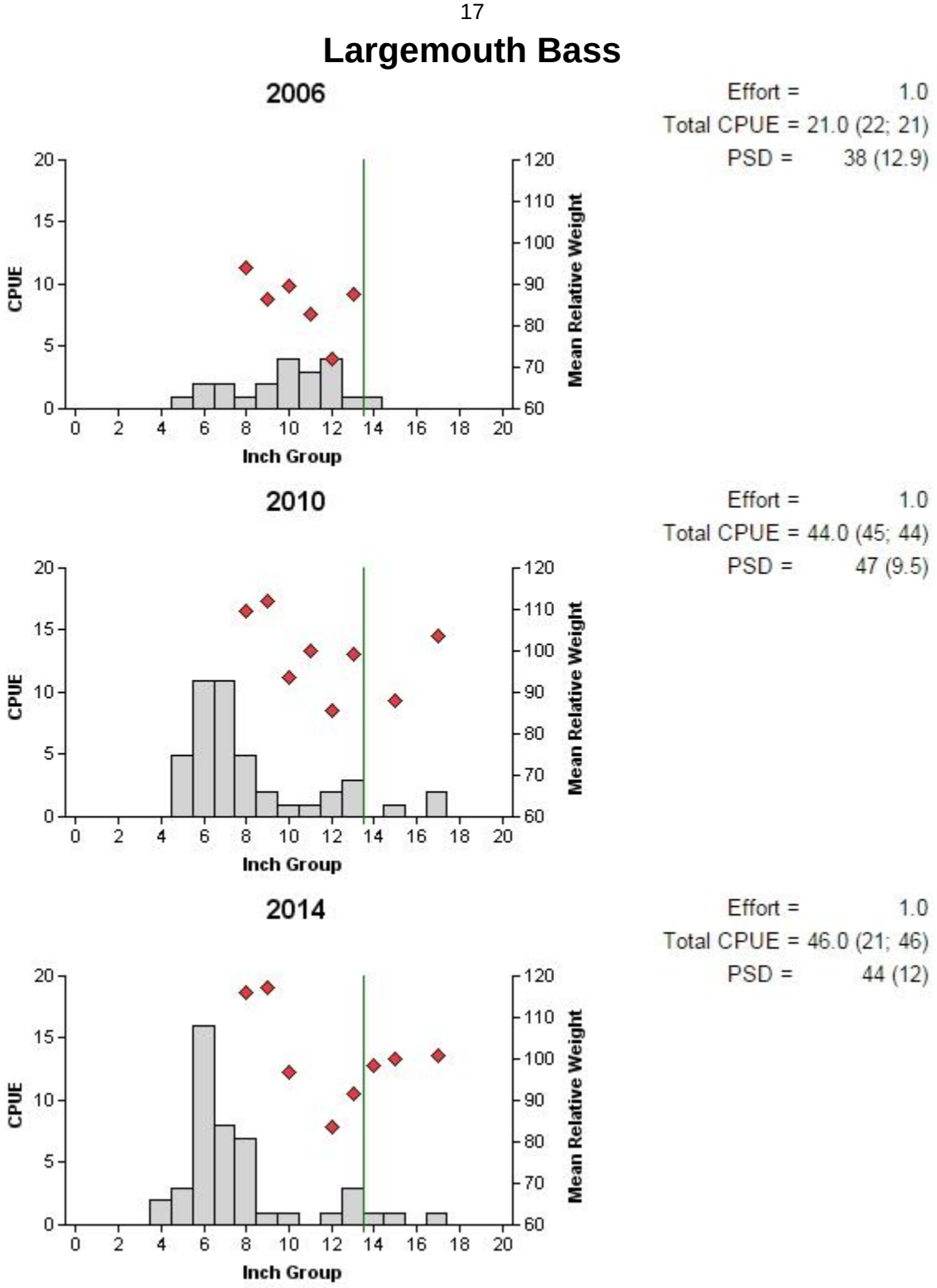


Figure 7. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Bardwell, Texas, 2006, 2010, and 2014.

White Crappie

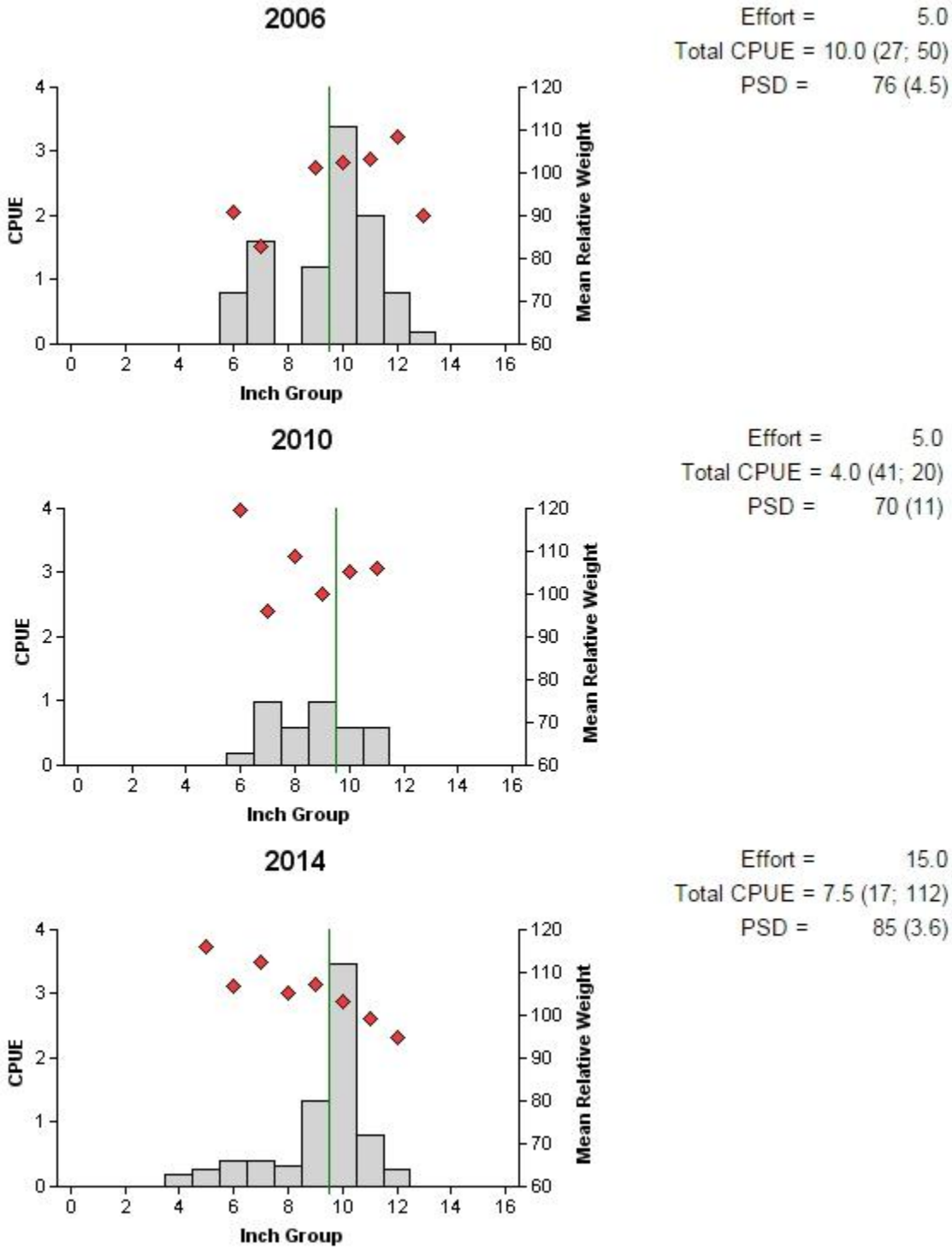


Figure 8. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Lake Bardwell, Texas, 2006, 2010 and 2014.

Black Crappie

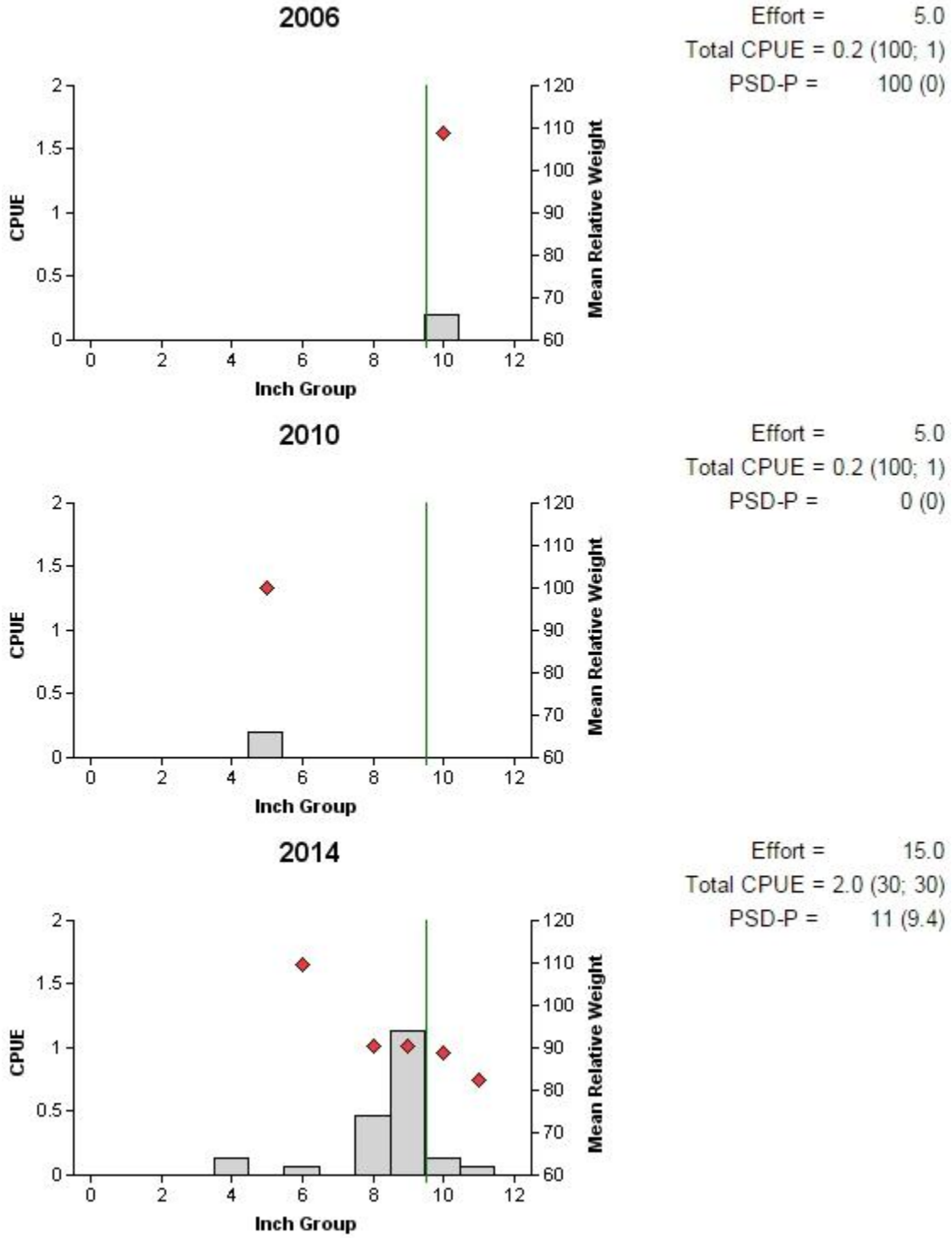


Figure 9. Number of Black Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Lake Bardwell, Texas, 2006, 2010 and 2014.

Table 6. 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

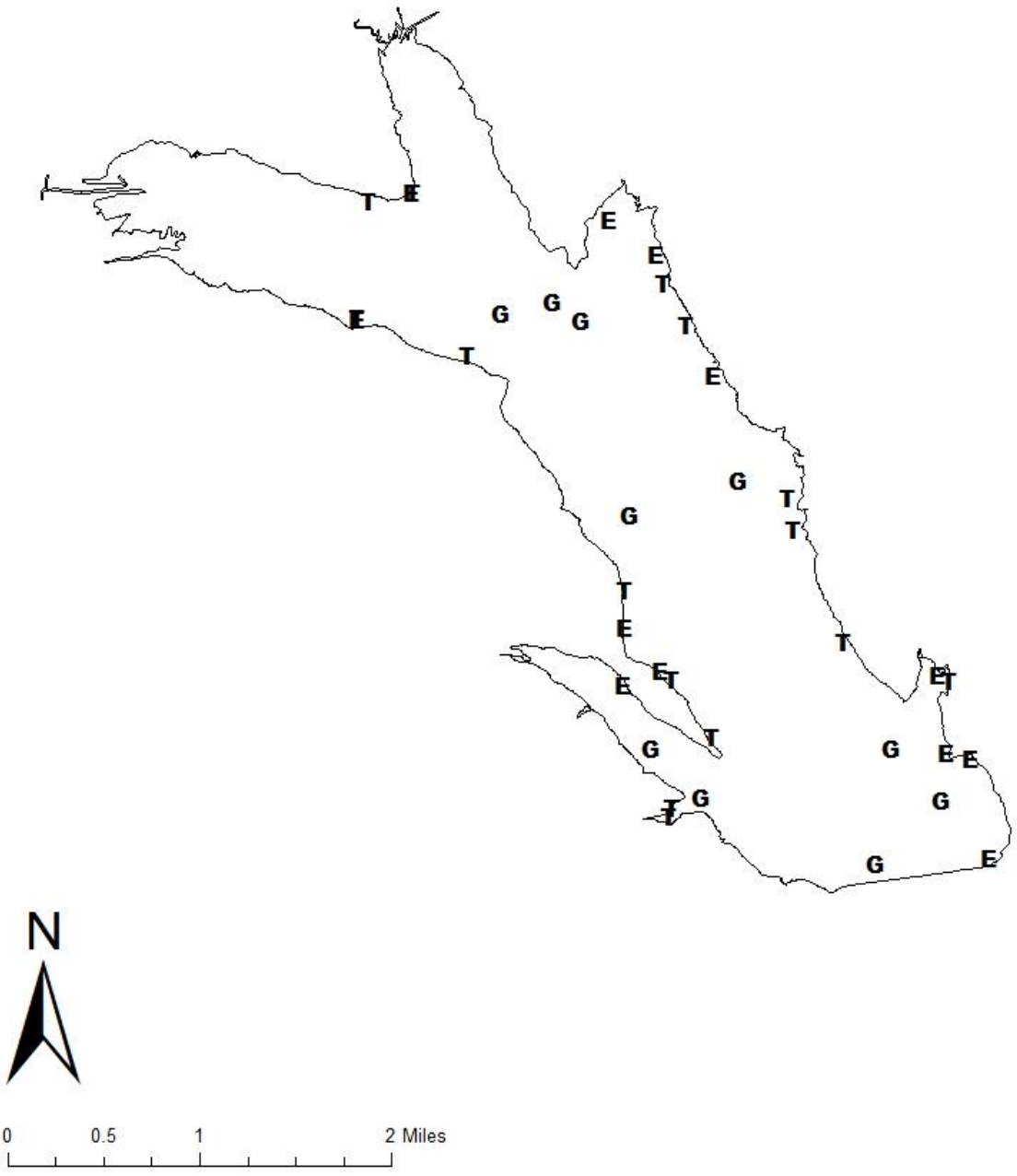
Survey year	Electrofish	Trap net	Gill net	Vegetation	Access	Report
2015-2016						
2016-2017			A			
2017-2018						
2018-2019	S	A	S	S	S	S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Lake Bardwell, Texas, 2014-2015. Sampling effort was 10 net nights for gill netting, 15 net nights for trap netting, and 1 hour for electrofishing.

Species	Gill Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					286	286.0
Threadfin Shad					25	25.0
Channel Catfish	35	3.5				
Blue Catfish	10	1.0				
White Bass	253	25.3				
Palmetto Bass	210	21.0				
Bluegill					20	20.0
Longear Sunfish					13	13.0
Redear Sunfish					6	6.0
Largemouth Bass					46	46.0
White Crappie			112	7.5		
Black Crappie			30	2.0		

APPENDIX B



Location of sampling sites, Lake Bardwell, Texas, 2014-2015. Trap net, gill net, and electrofishing stations are indicated by T, G, and E, respectively. Water level was approximately two feet low at time of sampling.

APPENDIX C

Objective-Based Sampling Plan for Lake Bardwell

2014 – 2015

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.

Negligible 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 crappies 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 2014 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. We believe that the level of sampling proposed will provide our secondary sampling objective of 13 specimens between 9.0 and 10.9 inches for aging. If this number of specimens is not achieved we will obtain additional sets of otoliths from angler volunteers at the fishing barge.

Palmetto Bass: Lake Bardwell has been selected as a study site for a research project aimed at determining survival and recruitment of previously stocked Palmetto Bass fry. In 2010, Lake Bardwell received approximately 2,000,000 Palmetto Bass fry, but no fingerlings. Identifying the survival and recruitment of the fry stocked in 2010 will be conducted through gill net surveys and subsequent aging of all stock-sized Palmetto Bass collected. Previous gill net catch rates have varied from over 10 fish/net night, to less than 1 fish/net night and have directly fluctuated with 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). Initially, ten randomly-selected gill net sites will be sampled in the spring of 2015, with up to an additional 20 biologist selected stations sampled, in order to collect 50 stock size Palmetto Bass. Additional biologist selected stations will be set in increments of 10, and adjusted (set) accordingly using the results of the 10 randomly selected sample sites. In order to limit bycatch mortality and excessive (costly) sampling, the survey will be concluded after 20 additional net nights even if goal of $\geq$ 50 specimens is not reached. In accordance with historical CPUE data, a sample of $\geq$ 50 stock size Palmettos Bass should prove adequate to determine the presence/absence of any fry stocked in 2010, with an acceptable false negative rate.

White Bass: White Bass are present within the reservoir and directed angling effort has been documented in creel surveys (2006-2007: 9% directed effort towards temperate Bass), however bootstrap analysis of data from the last two surveys (2011, 2013) suggest a large amount of effort ($\geq$ 30 randomly-selected gill net nights) would be required to obtain reliable CPUE values (i.e. RSE < 25). However, general structural indices (i.e. PSD and Wr) will still be collected in the spring of 2015. In accordance with the Palmetto Bass sampling efforts, up to 30 gill net sites will be sampled (10 random, +20 non-random),

resulting in adequate numbers of stock sized white Bass (N = 50 with 80% confidence). We believe that the level of sampling proposed will provide our sampling objective of 13 specimens between 9.0 and 10.9 inches for aging. However, if this number of specimens is not achieved no additional collection will be conducted.

Blue Catfish: Blue and Channel catfishes 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 ten years, however catch rates have not been sufficient to calculate CPUE and PSD with the desired level of precision (N> 50, RSE <25). Bootstrap analysis of this data predicts it would require $\geq$ 45 randomly set gill nets to reach desired population estimates. Because the priority of the Palmetto Bass research project will limit the available time to conduct the additional surveys necessary to calculate appropriate trend data, no additional random sampling will be conducted. Therefore, the presence/absence of Blue Catfish will continue to be monitored in the spring of 2015 with the gill netting methods described for Palmetto Bass**.**

Channel Catfish: Channel Catfish gill net catch data from the last two surveys has displayed reliable population metrics (e.g. CPUE 5.5 – 7.5/nn; RSE <25) with 5 net nights of effort. Continuation of population trend data (i.e. CPUE, PSD, Wr) with gill net sampling in the spring of 2015 will allow for the detection of any large scale fluctuations in the channel catfish population. 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. Because the priority of the Palmetto Bass research project will limit the available time, no additional random sampling will be conducted if target indices are not met.

Largemouth Bass: Largemouth Bass abundance is limited by turbidity and commensurate lack of submersed aquatic vegetation. Although a fishery for Largemouth Bass does exist, angler effort is low at Lake Bardwell and this species accounting for only approximately 2% of the total directed angling effort during the December 2006-May 2007 creel survey. Electrofishing surveys conducted every four years from 1997-2010 produced CPUE's ranging from 21.0 to 84 fish/h (with RSE's from 22 to 59) 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 2014 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. Additional biologist selected sites will be sampled for largemouth Bass only in an attempt to collect 13 specimens 13.0-14.9 inches in length to estimate mean age at legal length.

Gizzard Shad and Bluegill: Gizzard and Threadfin Shad, and to a lesser extent 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 138 to 350 fish/h with IOV in the 90's. Bluegill CPUE has been more variable and like largemouth Bass appears to be related to reservoir elevation (ranging from 125 to15 /h). RSE for Bluegill has been higher than that for Largemouth Bass ranging from 40-76. Sampling Gizzard Shad and Bluegill at the same intensity as is proposed for Largemouth Bass will 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.