

PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2016 Fisheries Management Survey Report

Granger Reservoir

Prepared by:

Mukhtar Farooqi, Assistant District Management Supervisor
and
Marcos J. De Jesus, District Management Supervisor

Inland Fisheries Division
San Marcos/Austin District,
San Marcos, Texas



Carter Smith
Executive Director

Craig Bonds
Director, Inland Fisheries

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Granger Reservoir were surveyed in 2016 using electrofishing and trap netting, and in 2017 using gill netting. Historical data are presented with the 2016-2017 data for comparison. This report summarizes results of the survey and contains a fisheries management plan for the reservoir based on those findings.

- **Reservoir Description:** Granger Reservoir is a 4,009-acre impoundment of the San Gabriel River in Williamson County, Texas. The reservoir is located approximately 40 miles northeast of Austin, Texas, within the Brazos River drainage basin. It was constructed in 1980 by the U. S. Army Corps of Engineers (USACE) for purposes of flood control and water conservation. Granger Reservoir has a drainage area of approximately 709 square miles and a shoreline length of about 28 miles. High turbidity and fluctuating water levels have deterred the establishment of aquatic vegetation. Reservoir bank slope is relatively flat and small changes in water level (1-2 feet) can have a large impact on the abundance of shoreline habitat and river/reservoir connectivity.
- **Management History:** Important sport fish include White Crappie, White Bass, and Blue Catfish. A creel survey conducted in the spring of 2005 showed White Crappie was the most sought-after species (61.5% directed angler effort) followed by catfishes (16.8%), White Bass (5.1%), and Largemouth Bass (2.5%; Bonds and Magnelia 2005). Blue Catfish were stocked in 1995 and 1996 to provide additional angling opportunities and utilize an abundant shad population. No additional stocking has been conducted since 1996.

In collaboration with the Brazos River Authority (BRA), a fishery assessment (habitat availability, river/reservoir connectivity, and access at various lake levels) was conducted at Granger Reservoir for a multi-year system operating plan for the Brazos River Basin (Farooqi and De Jesus 2013). Based on these multiple assessments, threshold recommendations were provided to decrease potential impacts to the fishery during future basin-wide water level manipulations. The Granger Reservoir management threshold recommendation was 504 ft. above mean sea level (MSL), which is the same as conservation pool. A critical threshold for fisheries applications was set at 498 ft. MSL. As a consequence, other than under exceptional circumstances, water level fluctuations at Granger Reservoir will be minimal and therefore have little impact on the fishery.

Low to negligible vegetative coverage has been descriptive of Granger Reservoir.

- **Fish Community**
 - **Prey species:** Gizzard Shad, Threadfin Shad, and Bluegill were the predominant prey species in 2016. Catch rates for Gizzard Shad and Bluegill had increased since the previous survey.
 - **Catfishes:** Blue Catfish was the predominant catfish species. Total catch rate was higher than in the previous two surveys and most fish were above harvestable size. Channel Catfish and Flathead Catfish were present in low numbers.
 - **White Bass:** Total catch rate for White Bass had increased since the previous survey; fish up to 15 inches in length were present.
 - **Largemouth Bass:** Largemouth Bass were present in low numbers, as has been the case in the previous three surveys. Only two harvestable-size fish were caught.
 - **White Crappie:** White Crappie were abundant and the population size structure was good. On average, White Crappie reached harvestable size (10 inches) between age 1 and 2.

- **Management Strategies:** Based on current information, the reservoir should continue to be managed with existing regulations. White Crappie is by far the most sought-after species at this reservoir; therefore, trap net surveys will be conducted biennially to monitor the population dynamics of this species. Conduct general monitoring surveys with electrofishing and gill nets in 2020-2021. Access, shoreline structural habitat, and vegetation surveys will be conducted in 2020. Using funding from BRA under the Interlocal Agreement, install a network of 10 Fishiding Stakeout vertical crappie stake beds complexes around the reservoir to help improve crappie habitat availability and angler success. Use print and social media to inform the public about these habitat structures and their location (GPS coordinates and map).

INTRODUCTION

This document is a summary of fisheries data collected from Granger Reservoir in 2016-2017. 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 2016-2017 data for comparison.

Reservoir Description

Granger Reservoir is a 4,009-acre impoundment of the San Gabriel River in Williamson County, Texas. The reservoir is located approximately 40 miles northeast of Austin, Texas, within the Brazos River drainage basin. It was constructed in 1980 by the U. S. Army Corps of Engineers (USACE) for purposes of flood control and water conservation. Granger Reservoir is eutrophic with a mean TSI chl-a of 48.46, which was higher than previous samples (Texas Commission on Environmental Quality 2011). Hydrilla (*Hydrilla verticillata*), a non-native aquatic plant, was first discovered near Wilson Fox 2 boat ramp in 2003. It was eliminated with an herbicide applied by the USACE. Water level has fluctuated since 2006. In 2007, persistent rains caused the reservoir to increase significantly above conservation pool (Figure 1). From July 2008 to January 2014, the reservoir level remained below conservation pool for the majority of the time. Most of this can be attributed to recent drought conditions and USACE dam maintenance, which required a reduction in water level. Subsequently, the reservoir has been at or above conservation pool. Land management in the watershed and non-existent shoreline and riparian vegetation has led to increased bank erosion and siltation around the reservoir. A structural habitat survey in 2012 revealed that the majority of the shoreline was natural with large stands of flooded timber. Other descriptive characteristics for Granger Reservoir are in Table 1.

Angler Access

Boat access consisted of five public boat ramps. Bank fishing access is good within the San Gabriel Wildlife Management Area, which includes a primitive boat launch for canoes and kayaks. The USACE operates four parks with good bank access. Wilson Fox Park 2 contains a fishing pier with accommodations for the physically challenged. Additional boat ramp characteristics are in Table 2.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Farooqi and De Jesus 2013) included:

1. In the summer of 2013, work with local partners to plant waterwillow colonizing patches in hopes to establish shoreline vegetation to address habitat and erosion issues.
Action: Waterwillow was planted in five enclosures around the reservoir with the assistance of volunteers from the Sun City Hunting and Fishing Club.
2. Approach the U. S. Army Corps of Engineers to discuss the need for dredging the Willis Creek Park boat ramp area.
Action: A lack of funding and high siltation rates were cited as major hurdles towards initiating any dredging projects at Granger Reservoir for the foreseeable future. A dredging project was carried out at the Friendship Park boat ramp area, but the benefits were temporary due to rapid siltation.
3. Cooperate with the controlling authority to educate the public about invasive species through the use of print media, social media, and public engagements.
Action: Outreach efforts regarding invasive species included social media, print media, public presentations, and one-on-one interactions with constituents.

Harvest regulation history: Sport fish in Granger Reservoir have been, and are currently managed with statewide regulations (Table 3).

Stocking history: Granger Reservoir has not been stocked since 1996. Blue Catfish were stocked in 1995 and 1996. Channel Catfish were stocked in 1979, 1990, and 1996. The complete stocking history is in Table 4.

Vegetation/habitat management history: High turbidity and fluctuating water level of Granger Reservoir has made it difficult for aquatic vegetation to become established. Water clarity (Secchi depth) is typically less than 1 foot. Few aquatic plants were observed in Granger Reservoir prior to 2003. In 2003, hydrilla was discovered near Wilson Fox Park 2 boat ramp and was eliminated by the USACE with an aquatic herbicide. In 2004, water hyacinth was observed in the upper San Gabriel arm of the reservoir, but has not been documented since 2004. In 2013, waterwillow was planted in five enclosures around the reservoir with the assistance of volunteers from the Sun City Hunting and Fishing Club. However, these plantings were unable to become established.

In 2012, the Brazos River Authority (BRA), in negotiations with TPWD, asked for a fishery assessment to be provided for all eleven BRA jurisdictional reservoirs (Farooqi and De Jesus 2013). These assessments have been taken into consideration for a multi-year system operating plan for the Brazos River Basin. Assessments for Granger Reservoir included habitat availability, river/reservoir connectivity, and access at various lake levels. Based on these multiple assessments, threshold recommendations were provided to decrease potential impacts to the fishery during future basin-wide water level manipulations. The Granger Reservoir management threshold recommendation was 504 ft. above mean sea level (MSL), which is the same as conservation pool. A critical threshold for fisheries applications was set at 498 ft. above MSL. As a consequence, other than under exceptional circumstances, water level fluctuations at Granger Reservoir will be minimal and therefore have little impact on the fishery.

Water Transfer: No interbasin water transfers are known to exist at Granger Reservoir.

METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Granger Reservoir (TPWD unpublished). Primary components of the OBS plan are listed in Table 5. All survey sites (Appendix A) were randomly selected and all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Electrofishing – Largemouth Bass, sunfishes, Gizzard Shad, and Threadfin Shad were collected by electrofishing (1 hour at 12, 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.

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). Age and growth characteristics were determined using a sub-sample (maximum of 10 fish per inch class) of stock-size (≥ 5 inches) White Crappie collected (Category 1, variable sample size; TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Gill netting – Blue Catfish and White Bass were collected by gill netting (15 net nights at 15 stations). CPUE for gill netting was recorded as the number of fish caught per net night (fish/nn). Ages for White Bass were determined by a Category 2 evaluation using otoliths from 10 fish (range 9.0 to 10.9 inches; TPWD, Inland Fisheries Division, unpublished manual revised 2015).

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_t)] 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 = $100 \times \text{SE of the estimate/estimate}$) was calculated for all CPUE statistics.

Habitat – A shoreline structural habitat, access, and vegetation survey was conducted in 2016. 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 USACE Granger Reservoir website.

RESULTS AND DISCUSSION

Habitat: In 2016, littoral habitat consisted primarily of natural shoreline (77.4%; Table 6; Appendix B).

In 2013, waterwillow was planted in five enclosures around the reservoir with the assistance of volunteers from the Sun City Hunting and Fishing Club. However, these plantings were unable to become established (with the exception of a few stalks of water willow that were present in one of the enclosures in 2016) due in part, to periods of flooding. No naturally occurring aquatic vegetation was detected during the 2016 survey.

Prey species: Gizzard Shad, Threadfin Shad, and Bluegill were the predominant prey species in 2016 (Appendix C).

Gizzard Shad were the most abundant prey species caught in 2016. Total CPUE of Gizzard Shad in 2016 (290.0/h) was higher than in the 2012 (96.0/h) and 2008 (129.0/h) surveys (Figure 2). The IOV for Gizzard Shad was 86, indicating that 86% of the Gizzard Shad population (≤ 8 inches in length) were vulnerable to existing predators. High IOV values were also obtained in 2012 (99) and 2008 (91).

Threadfin Shad were collected at the rate of 99.0/h in 2016 compared to 228.0/h in 2012 and 62.0/h in 2008.

Total electrofishing CPUE for Bluegill is typically relatively low for this reservoir. In 2016, total CPUE (96.0/h) had improved since the last two surveys (2012 = 6.0/h, 2008 = 77.0/h; Figure 3). Longear Sunfish (22.0/h) were also available as forage.

Catfishes: The total gill net catch rate of Blue Catfish was 4.0/nn in 2017 and was higher than in previous years (1.4/nn in 2013 and 2.4/nn in 2009; Figure 4). Population size structure (PSD=45) had also improved. Body condition for the majority of specimens collected in 2017 were sub-optimal ($W_i < 100$). Most Blue Catfish were above harvestable size with the largest fish measuring 29 inches in length. The presence of smaller fish (6 inches in length) indicates some spawning was successful, since the last stocking of Blue Catfish was in 1996.

The Channel Catfish population continued to have low relative abundance. Gill netting catch rate for Channel Catfish was 1.7/nn in 2017 which is comparable to the catch rates in 2013 (1.2/nn) and 2009 (1.8/nn; Figure 5). The largest fish was 30 inches in length.

The total gill net catch rate of Flathead Catfish was 0.2/nn in 2017. The population continued to show low relative abundance. Catch rates from previous surveys were 0.0/nn in 2013 and 0.4/nn in both 2009 and 2005 (Figure 6). The biggest fish was 26 inches in length.

White Bass: The total gill net catch rate of White Bass was 5.2/nn in 2017. This was higher than that recorded in 2013 (3.2/nn) and similar to that obtained in 2009 (5.8/nn; Figure 7). Most individuals sampled were of legal size with the largest fish up to 15 inches in length. In the absence of age 1 fish in the sample we can infer that White Bass reached harvestable size (10 inches) between age 1 and 2 based on the results of the last survey (Farooqi and De Jesus 2013), and on the fact that the average size of 2-year old White Bass was 10.8 inches in 2017 (Figure 8).

Largemouth Bass: In 2016, the reservoir contained a low-density Largemouth Bass population relative to bass populations in other central Texas reservoirs. Total CPUE has been low for the last four surveys. The total catch rate of Largemouth Bass was 18.0/h in 2016 compared to catch rates of 5.0/h in 2012, 33.0/h in 2008 (Figure 9), and 7.0/h in 2004. In 2016, there were only two harvestable size fish caught; both were 14 inches in length. The lack of aquatic vegetation in this reservoir has likely hindered the production of a desirable Largemouth Bass population. Fluctuating water levels also impacted the Largemouth Bass population prior to 2013. However, the BRA has agreed to maintain Granger Reservoir at conservation level (except for under exceptional circumstances). Thus, water level fluctuations at Granger Reservoir will be minimal and therefore should have reduced impact on the fishery in the future.

White Crappie: A spring 2005 creel survey showed that White Crappie was the most sought-after species (61.5% directed angler effort; Bonds and Magnelia 2005), and recent anecdotal information from anglers suggests that it is the most popular species in Granger Reservoir. In addition, a new water body record (rod and reel) for White Crappie was established in 2016 (3.5 pounds, 16.25 inches). The total trap net catch rate for White Crappie decreased to 29.1/nn in 2016 from 40.3/nn in 2015 and 40.9/nn in 2014 (Figure 10). However, these catch rates are higher than in previous surveys (13.5/nn in 2013, 20.0/nn in 2012, 6.4/nn in 2011, 13.5/nn in 2010, and 9.7/nn in 2009). The trap net CPUE of harvestable White Crappie (≥ 10 inches) had also increased in recent years; CPUE-10 for the last three surveys, was 2.2/nn (2016), 3.5/nn (2015), and 5.0/nn in 2014 compared to 1.4/nn (2013), 1.7/nn (2012), 0.4/nn (2011), 0.5/nn (2010), and 0.1/nn (2009). As postulated by Farooqi and De Jesus (2012), water level increases in 2012 flooded terrestrial vegetation creating habitat that led to stronger year class, and good recruitment. Population size structure also improved in subsequent years. Relative weights were sub-optimal for most size classes in 2016, but were close to optimum in 2015 and 2014 (Figure 10). On average, White Crappie reached harvestable size (10 inches) between age 1 and 2 (Figures 11 and 12).

Fisheries management plan for Granger Reservoir, Texas

Prepared – July 2017.

ISSUE 1: Granger Reservoir offers the best crappie fishing opportunities in the district. Many anglers that want to fish Granger have a hard time catching crappie outside of spring because they are unfamiliar with underwater areas that offer cover for these fish when they move deep. Crappie anglers that are successful, fish off privately-installed brushpiles.

MANAGEMENT STRATEGIES

1. Using funding from BRA under the Interlocal Agreement, install a network of 10 Fishing Stakeout vertical crappie stake beds complexes around the reservoir to help improve crappie habitat availability and angler success.
2. Use print and electronic media to inform the public about these habitat structures and their location (GPS coordinates and map).

ISSUE 2: 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 USACE to post appropriate signage at access points around the reservoir.
2. If applicable, contact and educate marina owners about invasive species, and provide them with posters, literature, etc. so that they can in turn educate their customers.
3. Educate the public about invasive species through the use of media and the internet.
4. Make a speaking point about invasive species when presenting to constituent and user groups.
5. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.

Objective-Based Sampling Plan for Granger Reservoir

2017-2021

Sport fish, forage fish, and other important fishes

Sport fishes in Granger Reservoir include White Crappie, White Bass, Largemouth Bass, Blue Catfish, and Channel Catfish. Known important forage species include Gizzard Shad, Threadfin Shad, Bluegill, Longear Sunfish, and Inland Silverside.

Low density fisheries

Largemouth Bass: Bass angling popularity among anglers ranked fourth behind White Crappie, catfishes, and White Bass during the last creel survey (spring 2005). However, only 2.5% of all anglers targeted Largemouth Bass and they spent 0.2 hours/acre fishing for them. Too few angler interviews precluded the estimation of meaningful catch statistics for this species. Largemouth Bass total CPUE has been low for the last five surveys. Largemouth Bass CPUE in 2016, 2012, 2008, 2004, 2000, and 1997 were 18.0, 5.0, 33.3, 7.0, 4.0, and 15.3/h, respectively.

In view of limited angler interest and very low density of Largemouth Bass in Granger Reservoir, sampling will be limited to general monitoring trend data (without precision or sample size requirements). A minimum of 12 randomly selected 5-min electrofishing sites will be sampled in fall 2020.

Channel Catfish: Channel Catfish were first stocked in Granger Reservoir in 1979 and then twice in the 1990s. Recent catch rates have been relatively low. Channel Catfish CPUE in 2017, 2013, 2009, 2005, and 2003 were 1.4, 1.2, 1.8, 0.9, and 1.8/nn, respectively. In the spring 2005 creel survey 16.8% of rod-and-reel angler effort was directed for catfish, however anglers specifically targeting Blue Catfish comprised the highest portion of that percentage. Anglers targeting Channel Catfish were too few to estimate meaningful catch statistics.

Sampling the Channel Catfish population in Granger Reservoir is not a priority for the 2017-2021 survey period. We will monitor presence/absence while conducting gill netting surveys for Blue Catfish.

Flathead Catfish: Flathead catfish are present in low abundance based on gill netting surveys. Total CPUE was 0.2/nn in 2017, 0.0/nn in 2013, and 0.4/nn in both 2009 and 2005. The last creel survey was conducted in 2005; Anglers targeting Flathead Catfish were too few to calculate meaningful catch statistics. Sampling this population is not a priority for 2017-2021. We will monitor presence/absence while conducting gill netting surveys for Blue Catfish.

Forage Species

Gizzard Shad, Threadfin Shad, Bluegill, Longear Sunfish, and Inland Silverside: Gizzard Shad and Threadfin Shad are the primary forage species in Granger Reservoir. Additional forage species are present in low densities and include Bluegill, Longear Sunfish, and Inland Silverside. As with Largemouth Bass, general monitoring trend data (without precision or sample size requirements) will be gathered for these species by sampling a minimum of 12 randomly selected 5-min electrofishing sites in fall 2020.

Survey objectives, fisheries metrics, and sampling objectives

White Crappie: White Crappie are the most popular sport fish in Granger Reservoir. White Crappie accounted for 61.5% of the directed fishing effort in the last creel survey (spring, 2005). White Crappie anglers caught an estimated 55,057 (RSE = 22.0) White Crappie of which 41.8% were harvested. Of legal-sized White Crappie caught by anglers, 96.2% were harvested. The majority of White Crappie harvested were between 10 and 14 inches. White Crappie catch per unit effort in 2016, 2015, 2014 and 2013 were 29.1, 40.3, 40.9, and 13.5/nn respectively.

White Crappie will be collected annually using a minimum of 15 shoreline-set single-cod trap nets. Target sample sizes to evaluate size structure and CPUE will be 50 stock-length fish, and an RSE of CPUE-S \leq 30. Sampling will continue at random stations until a minimum of 50 stock size White Crappie have been collected. In addition to the original 15 random stations, five additional random stations will be pre-determined in the event extra sampling is necessary. Individual weights will be collected for a minimum of 10 White Crappie per inch-class to determine relative weights. Age and growth characteristics will be determined using a sub-sample (maximum of 10 fish per inch class) of stock-size (\geq 5 inches) White Crappie (Category 1, variable sample size).

Blue Catfish: Blue Catfish were stocked in Granger Reservoir in 1995 and 1996. Catfish were the second most sought after fish in Granger Reservoir (16.8% directed angler effort, 1.5 h/acre) during a spring 2005 creel survey. Anglers specifically targeting Blue Catfish comprised the highest percentage (31.4%) of that effort. Of the estimated 1,365 Blue Catfish caught, 78.3% were harvested. Ninety-four percent of legal-sized Blue Catfish were harvested. Catch per unit effort (CPUE) from gill netting surveys in 2017, 2013, 2009, and 2005 were 4.0, 1.4, 2.4, and 3.0/nn, respectively.

Target sample sizes to evaluate size structure and CPUE will be 50 stock-length fish, and an RSE of CPUE-S \leq 30. A minimum of 15 randomly selected gill net stations will be sampled in spring, 2021, but sampling will continue at random stations until a minimum of 50 stock size fish have been collected. In addition to the original 15 random stations, five additional random stations will be pre-determined in the event extra sampling is necessary.

White Bass: White Bass anglers comprised 5.1% of the total directed angling effort during the spring 2005 creel survey making it the third most sought after species in Granger Reservoir. Angler catch rate for White Bass was high (3.3 fish/h; RSE = 60.7). Of the 11,321 (RSE = 38.1) White Bass caught, 30.8% were harvested. Of the legal-sized White Bass caught, 82.2% were harvested. White Bass CPUE in 2017, 2013, 2009, 2005, and 2003 were 5.2, 3.2, 5.8, and 2.9/nn, respectively.

White Bass will be collected when sampling for Blue Catfish with gill nets. Sampling will be limited to general monitoring trend data (without precision or sample size requirements). An age and growth sample with a minimum of 13 fish between 9 and 11 inches in length will be collected from gill netting to assess the time required for White Bass to grow to the minimum length limit for harvest.

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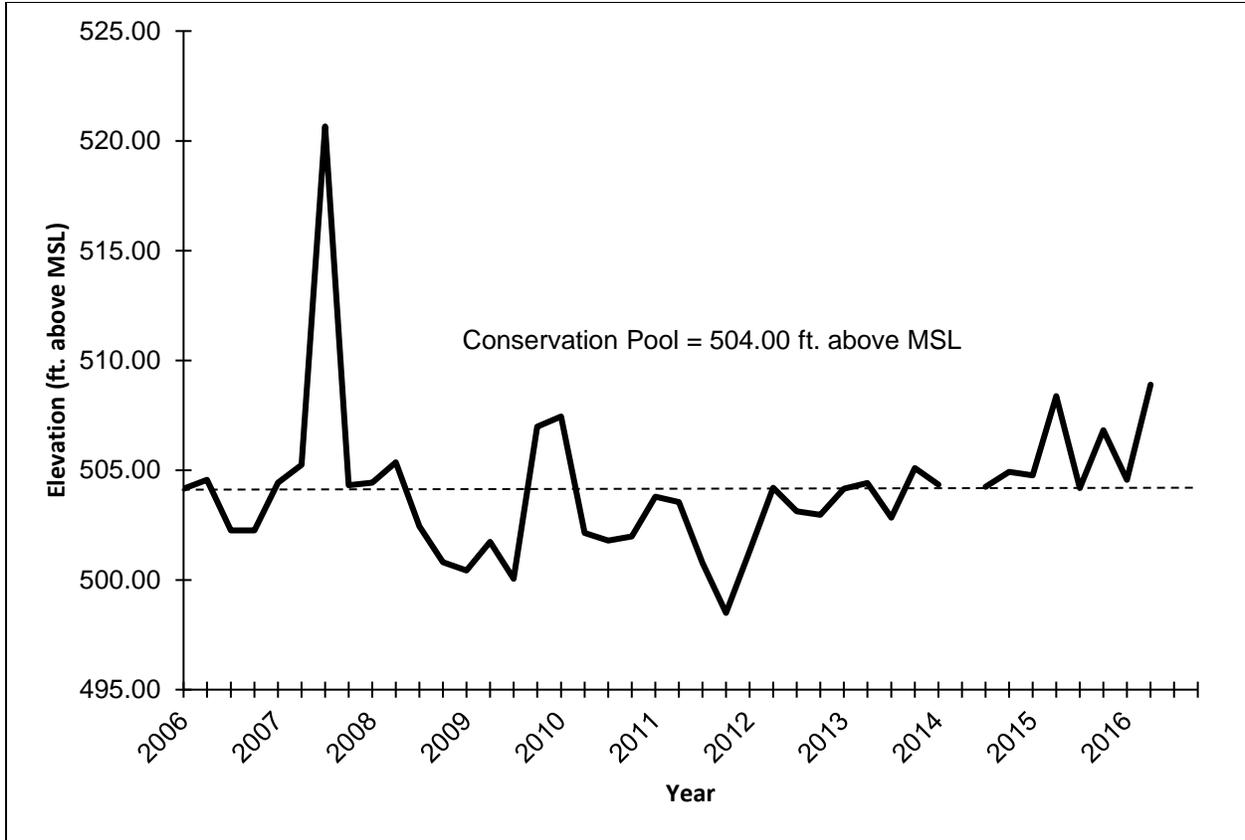


Figure 1. Monthly water level elevations in feet above mean sea level (MSL) recorded for Granger Reservoir, Texas 2006-2016.

Table 1. Characteristics of Granger Reservoir, Texas.

Characteristic	Description
Year constructed	1980
Controlling authority	United States Army Corps of Engineers
County	Williamson
Reservoir type	Mainstream: San Gabriel River
Shoreline Development Index	4.3
Conductivity	342 $\mu\text{S}/\text{cm}$

Table 2. Boat ramp characteristics for Granger Reservoir, Texas, September, 2016. Reservoir elevation at time of survey was 504 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft.)	Condition
Taylor Park	30.675756 -97.364161	Y	51	495	Good
Wilson Fox Park 1	30.683283 -97.363978	Y	20	494	Good
Wilson Fox Park 2	30.682850 -97.354486	Y	50	494	Good
Friendship Park	30.717533 -97.336525	Y	36	501	Good
Willis Creek	30.696628 -97.385142	Y	38	501	Poor (silted in)

Table 3. Harvest regulations for Granger Reservoir, Texas.

Species	Bag limit	Length limit (inches)
Channel and Blue Catfish	25 (in any combination)	12 (minimum)
Flathead Catfish	5	18 (minimum)
White Bass	25	10 (minimum)
Largemouth Bass	5	14 (minimum)
White and Black Crappie	25 (in any combination)	10 (minimum)

Table 4. Stocking history for Granger Reservoir, Texas. Life stages are fry (FRY), fingerlings (FGL), advanced fingerlings (AFGL), and unknown (UNK). Life stages for each species are defined as having a mean length that falls within the given length range. For each year and life stage the species mean total length (Mean TL; in) is given. For years where there were multiple stocking events for a particular species and life stage the mean TL is an average for all stocking events combined.

Species	Year	Number	Life Stage	Mean TL (in)
Blue Catfish	1995	247,224	FGL	1.9
	1996	<u>220,000</u>	FGL	1.7
	Total	467,224		
Channel Catfish	1979	31,860	AFGL	7.9
	1990	64,998	AFGL	4.0
	1996	<u>220,429</u>	FGL	1.8
	Total	317,287		
Coppernose Bluegill	1981	<u>100,000</u>	UNK	UNK
	Total	100,000		
Florida Largemouth Bass	1980	50,584	FRY	1.0
	1992	44,470	FGL	1.1
	1992	175,696	FRY	0.9
	1994	<u>220,976</u>	FGL	1.3
	Total	491,726		
Striped Bass	1981	110,371	UNK	UNK
	1983	<u>15,927</u>	UNK	UNK
	Total	126,298		

Table 5. Objective-based sampling plan components for Granger Reservoir, Texas 2016 – 2017

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing</i>			
Largemouth Bass	Abundance	CPUE – total	General monitoring
	Size structure	Length frequency	
	Condition	W_r	10 fish/inch group (max)
Redbreast Sunfish	Abundance	CPUE – total	General monitoring
	Size structure	Length frequency	
Bluegill	Abundance	CPUE – total	General monitoring
	Size structure	Length frequency	
Redear Sunfish	Abundance	CPUE – total	General monitoring
	Size structure	Length frequency	
Gizzard Shad	Abundance	CPUE – total	General monitoring
	Size structure	Length frequency	
	Prey availability	IOV	
<i>Trap netting</i>			
White Crappie	Abundance	CPUE – Stock	RSE-stock ≤ 30
	Size structure	PSD, length frequency	$N \geq 50$ stock
	Age-and-growth	Rough estimate of growth	10 fish/inch group (max)
	Condition	W_r	10 fish/inch group (max)
<i>Gill netting</i>			
White Bass	Abundance	CPUE – total	General monitoring
	Size structure	Length frequency	
	Age-and-growth	Age at 10 inches	$N = 13$, 9.0 – 10.9 inches
	Condition	W_r	10 fish/inch group (max)
Blue Catfish	Abundance	CPUE – Stock	RSE-stock ≤ 30
	Size structure	PSD, length frequency	$N \geq 50$ stock
	Condition	W_r	10 fish/inch group (max)

Table 6. Survey of structural habitat types, Granger Reservoir, Texas, 2016.

Habitat type	Shoreline coverage (miles)	% of total
Natural Shoreline	21.8	77.4
Gravel Shoreline	4.1	14.7
Rocky Shoreline	2.1	7.4
Rock Bluff	0.1	0.5

Gizzard Shad

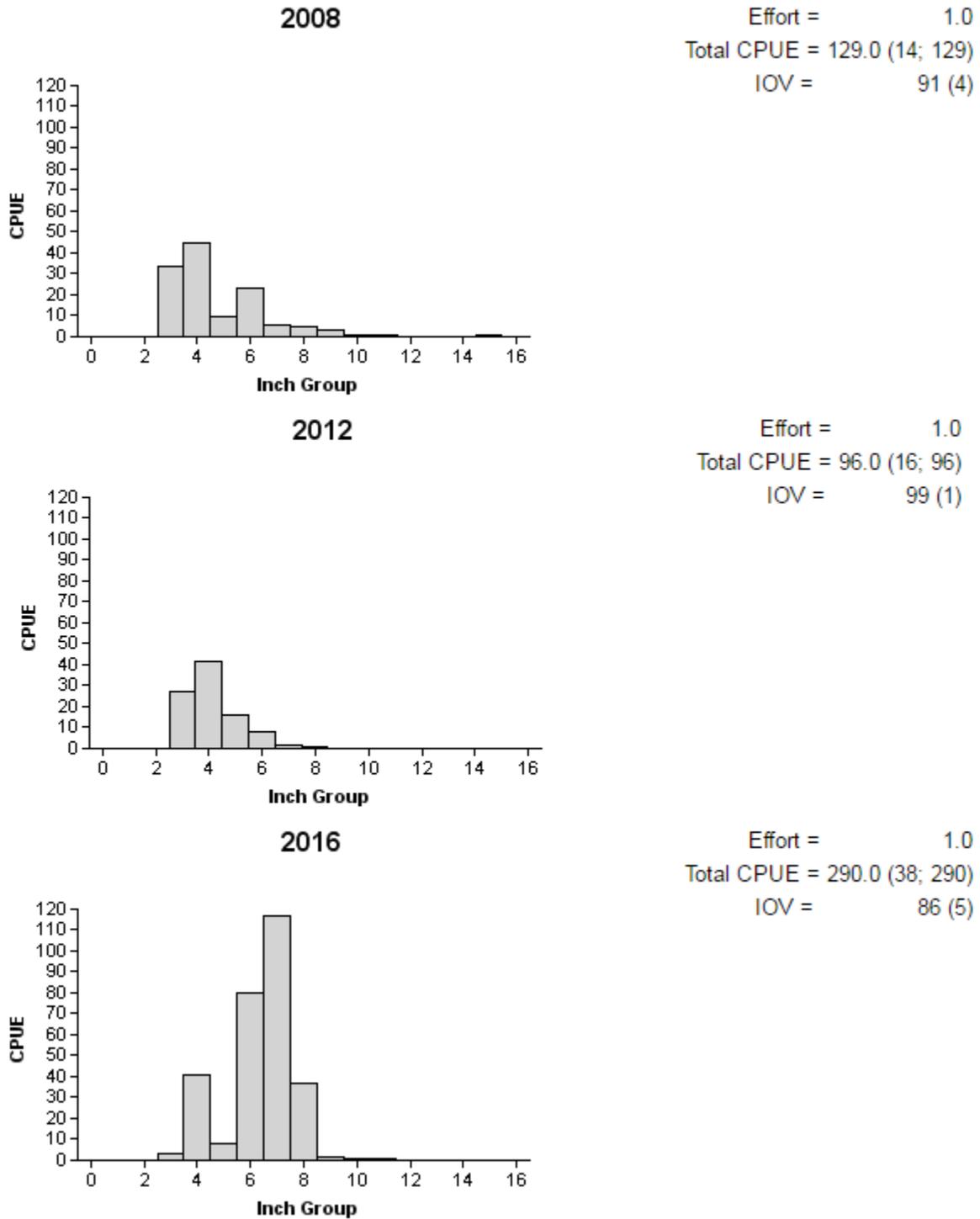


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Granger Reservoir, Texas, 2008, 2012, and 2016.

Bluegill

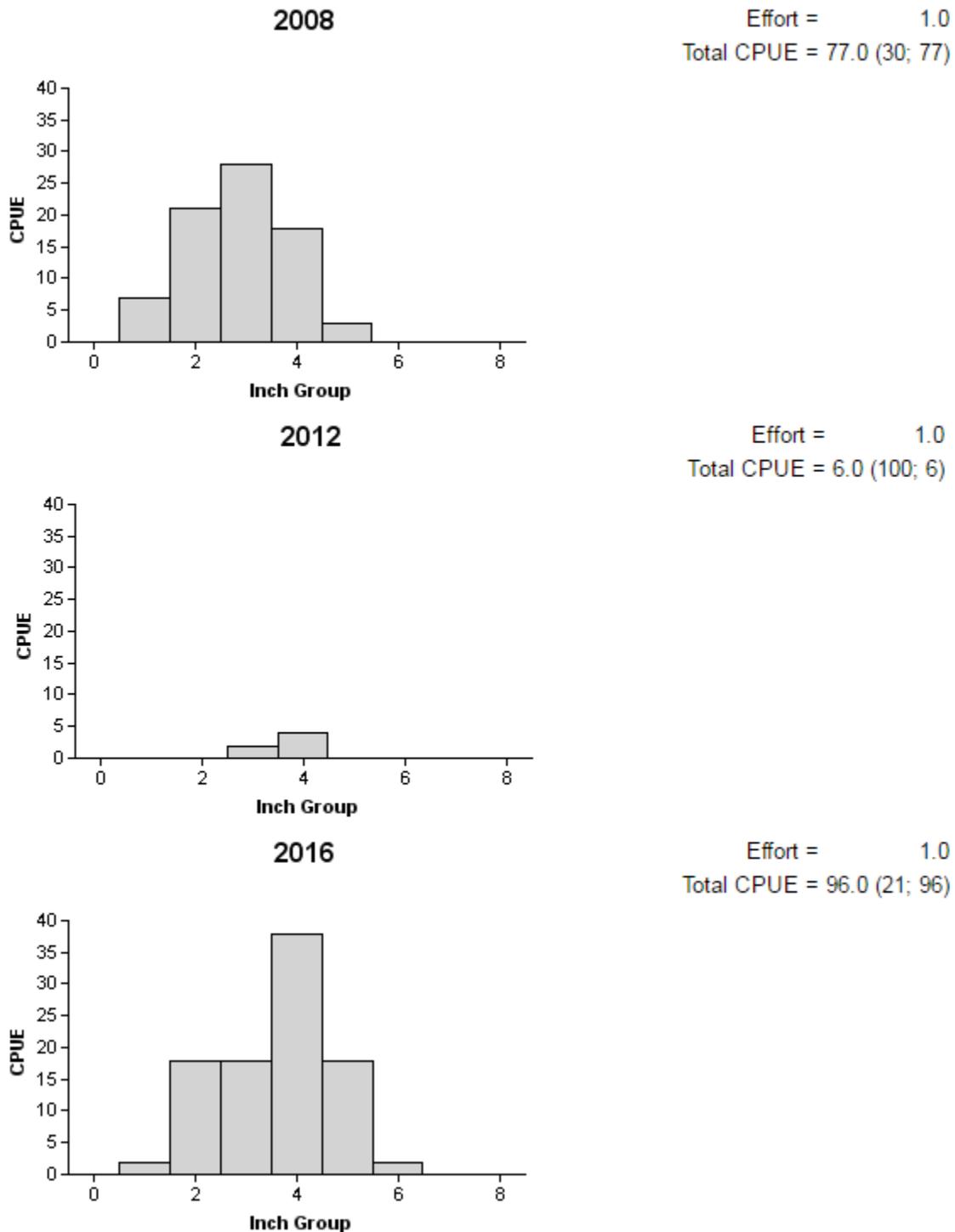


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE are in parentheses) for fall electrofishing surveys, Granger Reservoir, Texas, 2008, 2012, and 2016.

Blue Catfish

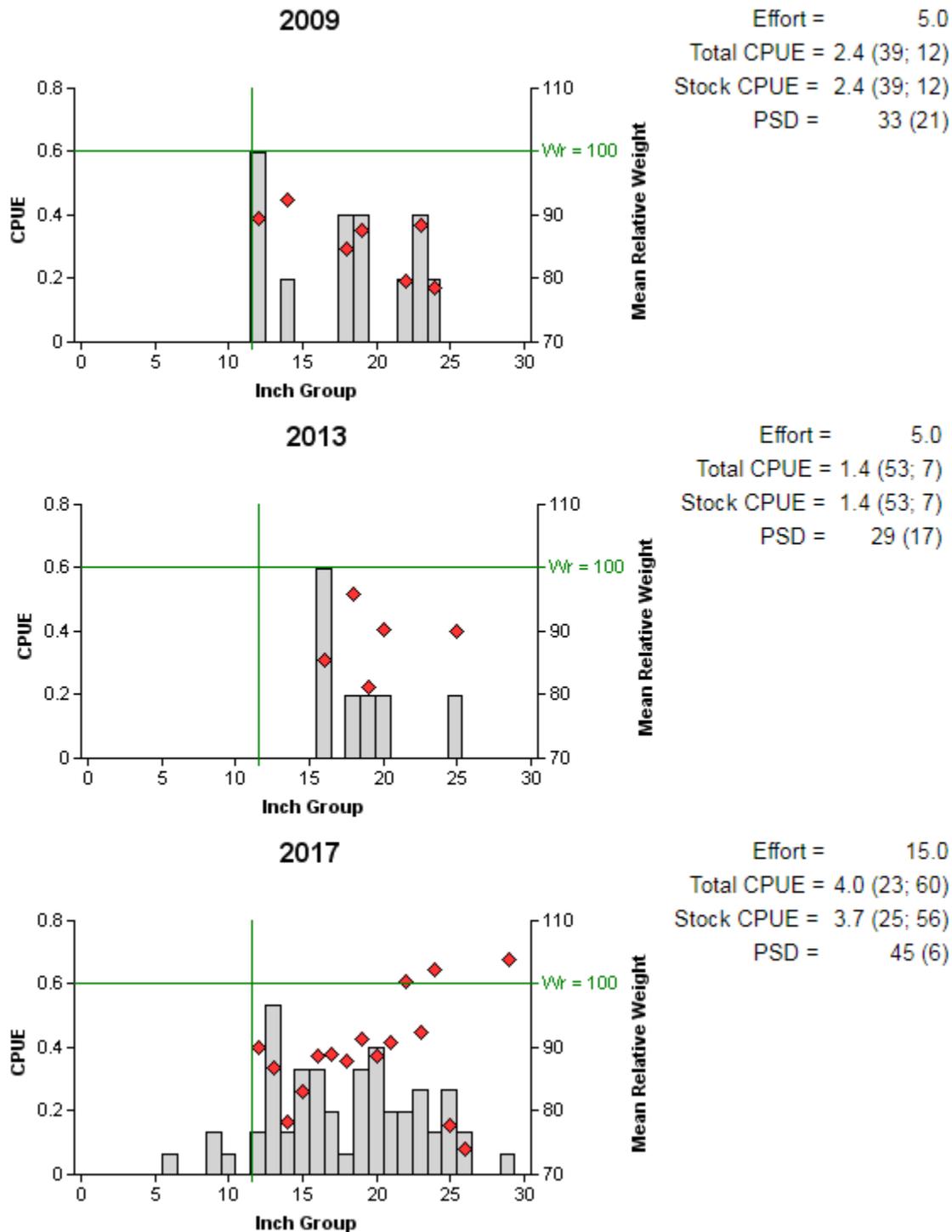


Figure 4. Number of Blue Catfish caught per net night (CPUE, bars), mean relative weight (W_r , diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Granger Reservoir, Texas, 2009, 2013, and 2017. Vertical line represents minimum length limit at the time of sampling.

Channel Catfish

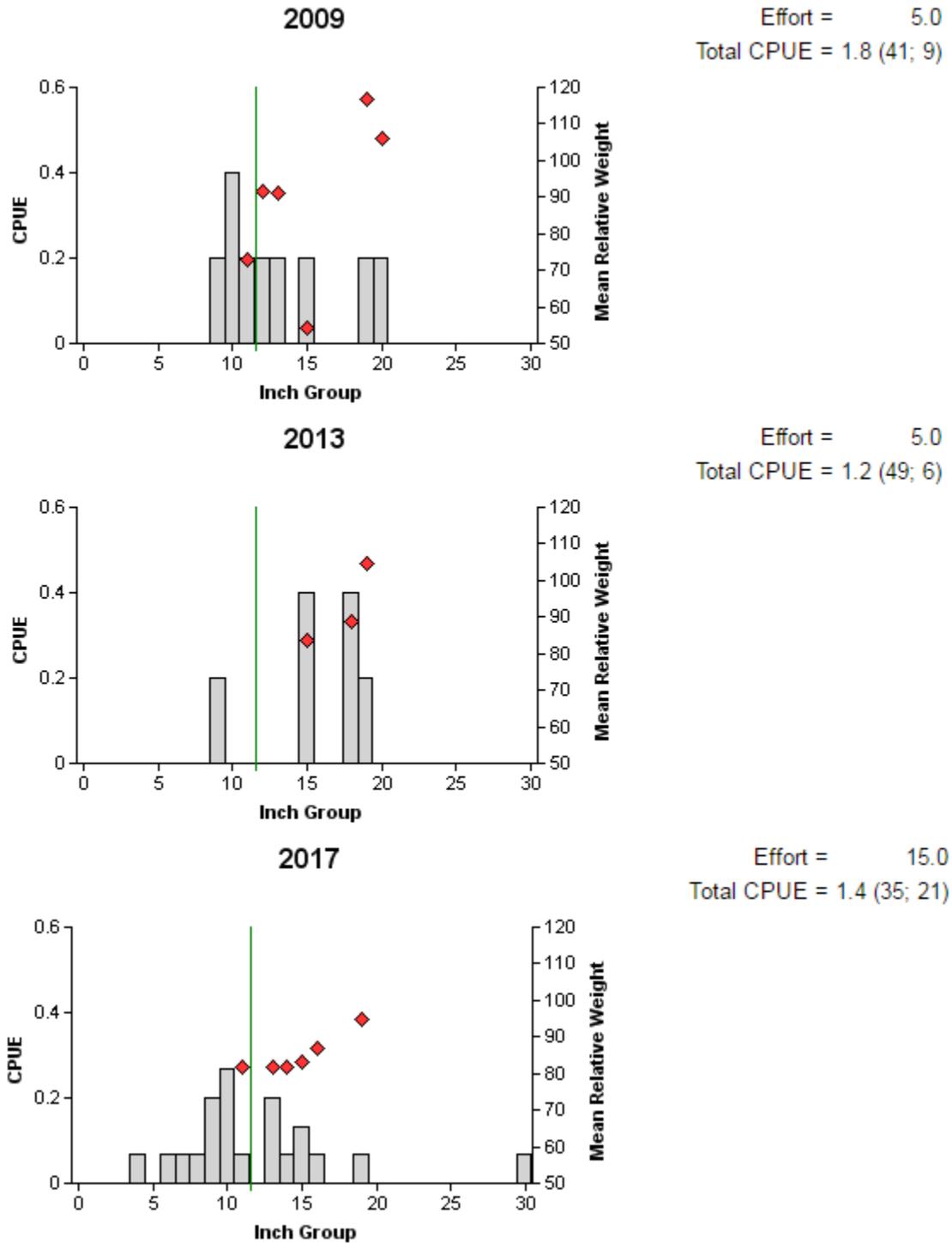


Figure 5. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Granger Reservoir, Texas, 2009, 2013, and 2017. Vertical line represents minimum length limit at the time of sampling.

Flathead Catfish

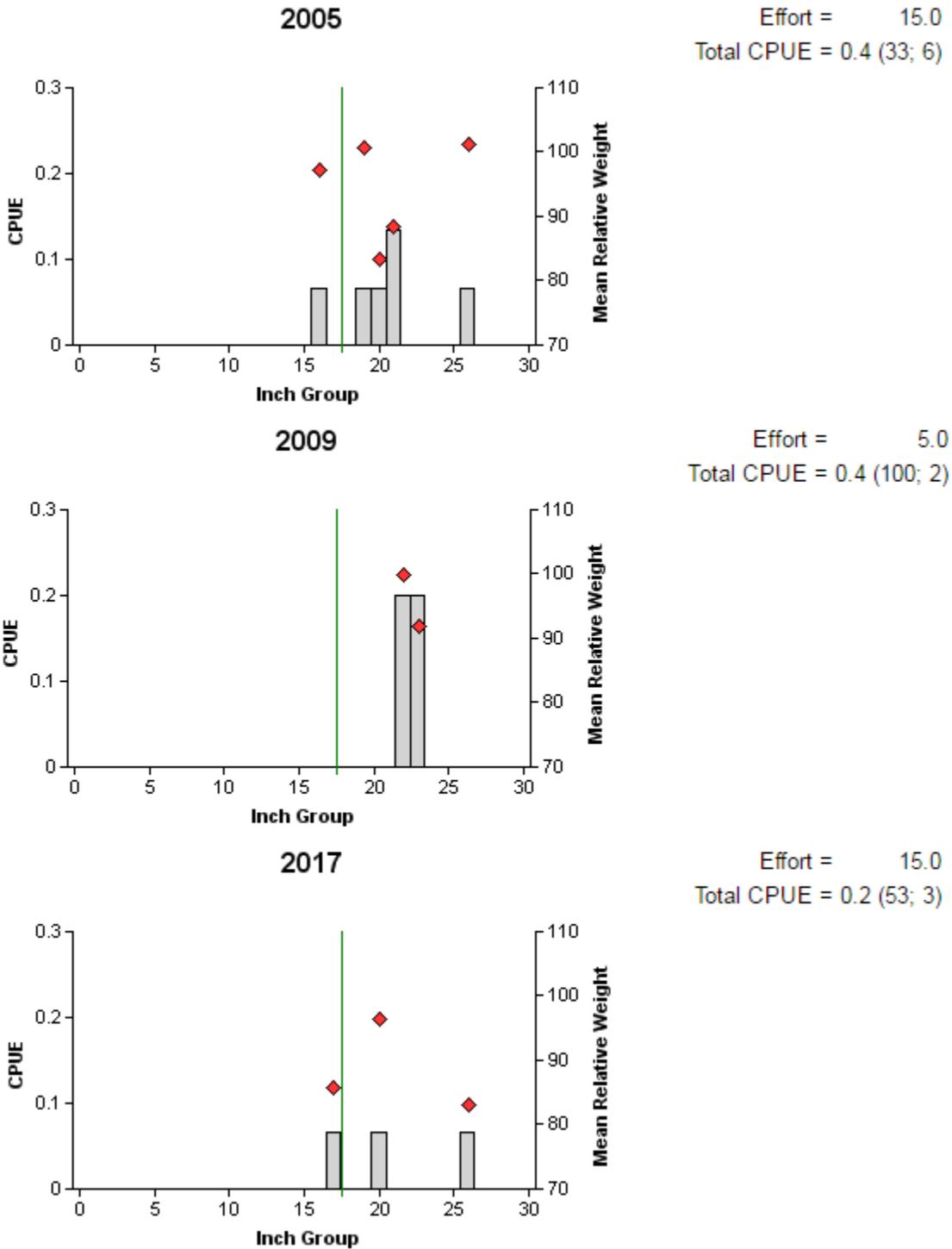


Figure 6. Number of Flathead Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Granger Reservoir, Texas, 2005, 2009, and 2017. No Flathead Catfish were caught in 2013. Vertical line represents minimum length limit at the time of sampling.

White Bass

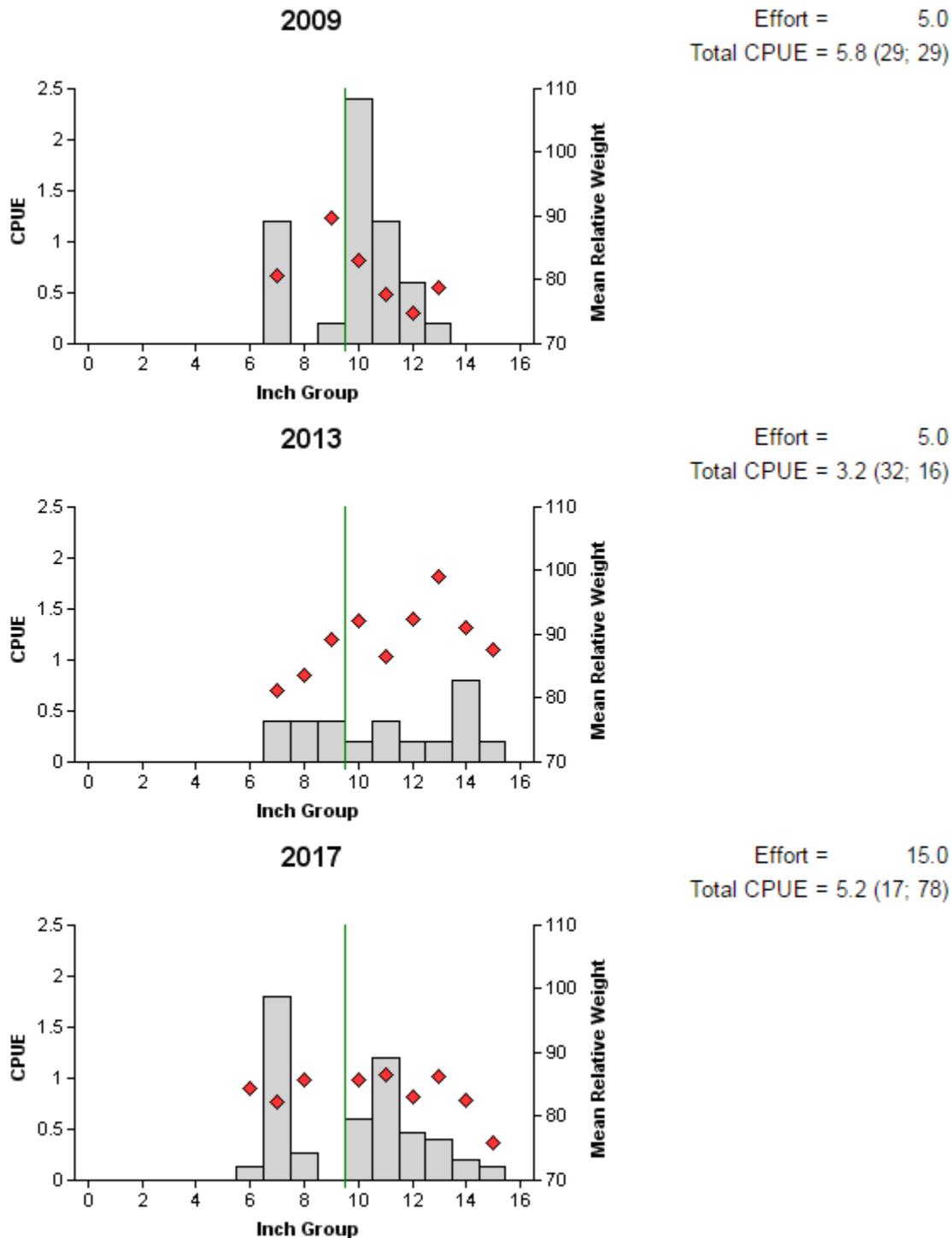


Figure 7. Number of White Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Granger Reservoir, Texas, 2009, 2013, and 2017. Vertical line represent minimum length limit at the time of sampling.

White Bass

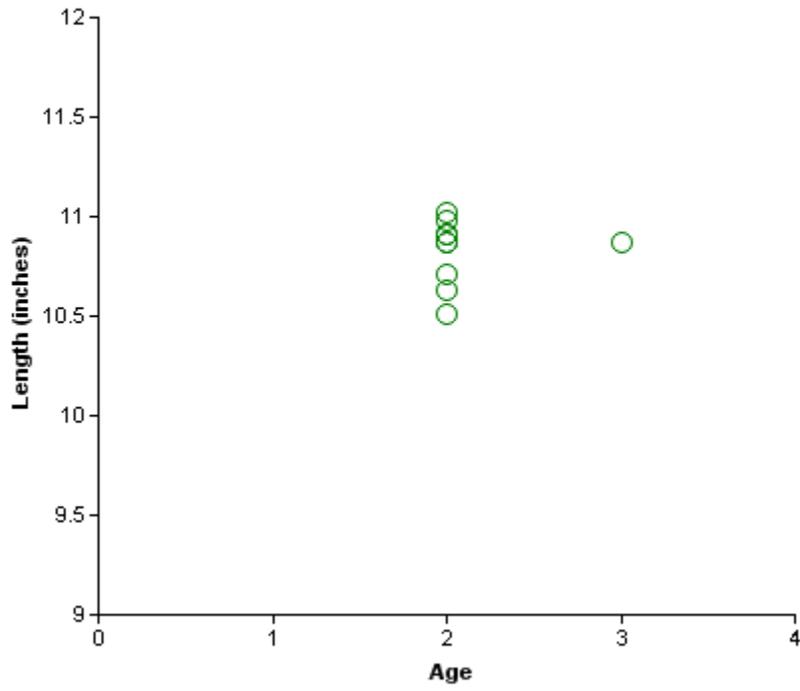


Figure 8. Length at age for White Bass (n=10) collected by gill netting at Granger Reservoir, Texas, March 2017.

Largemouth Bass

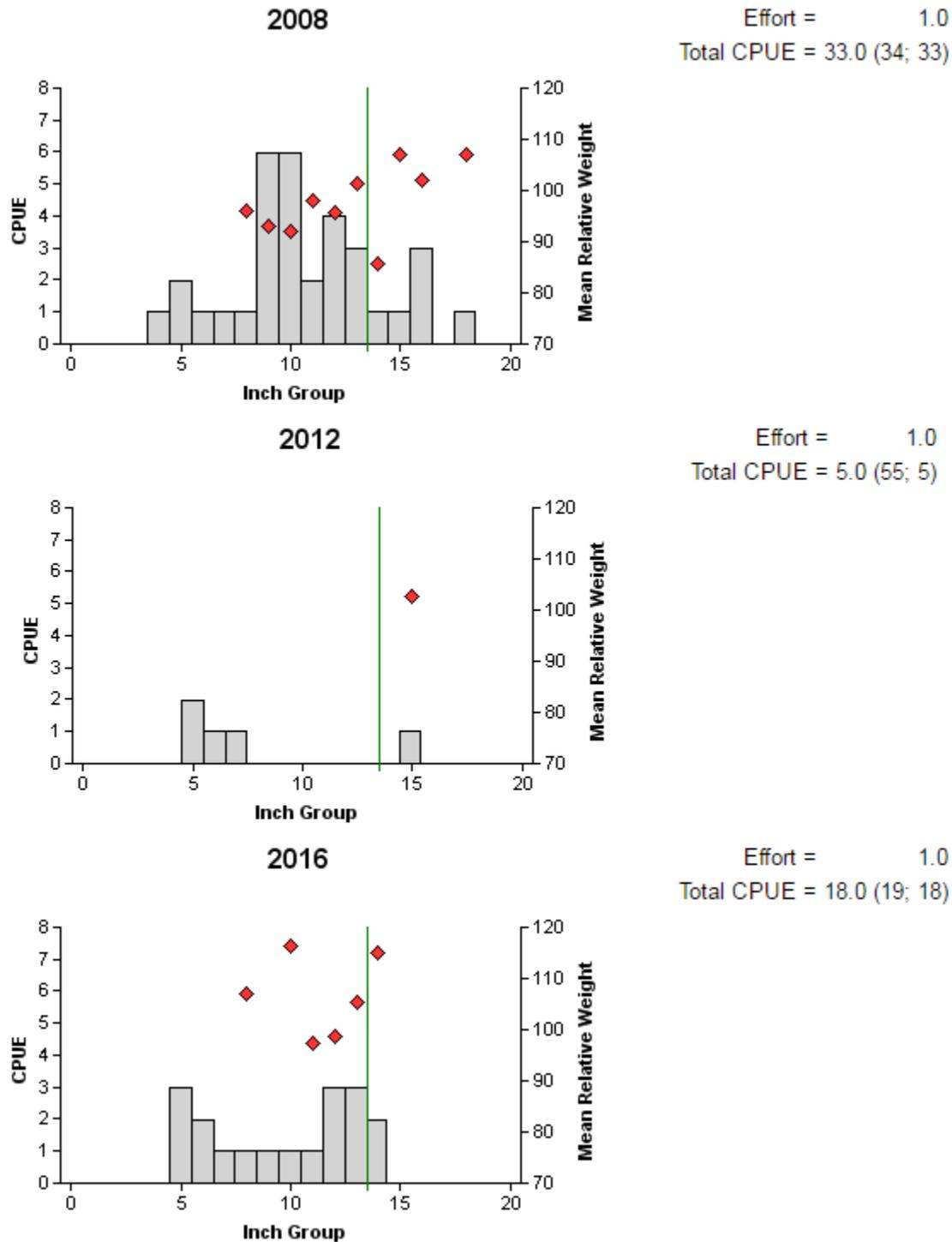


Figure 9. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Granger Reservoir, Texas, 2008, 2012, and 2016. Vertical line represents minimum length limit at the time of sampling.

White Crappie

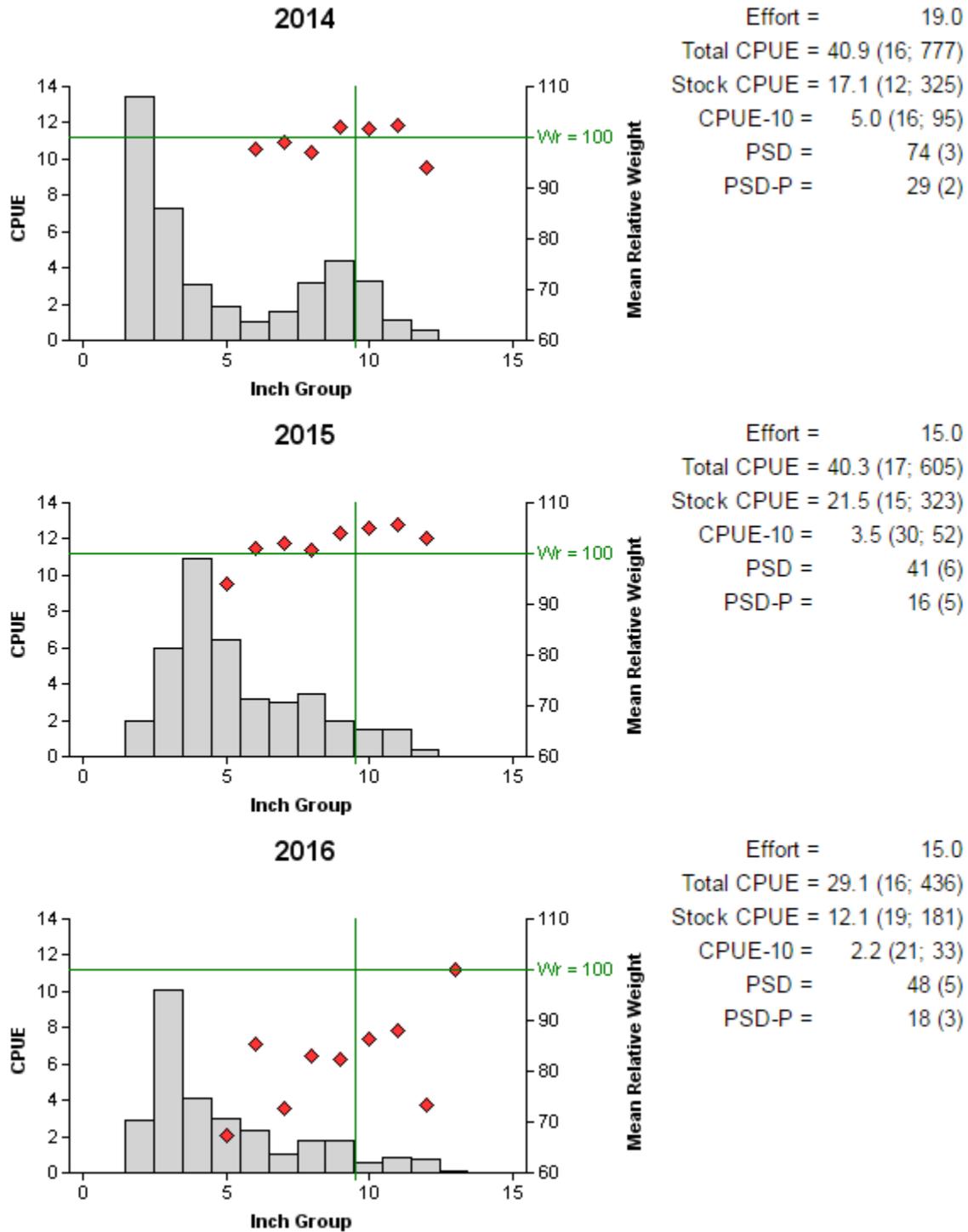


Figure 10. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (W_r , diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Granger Reservoir, Texas, 2014, 2015, and 2016. Vertical line represents minimum length limit at the time of sampling.

White Crappie

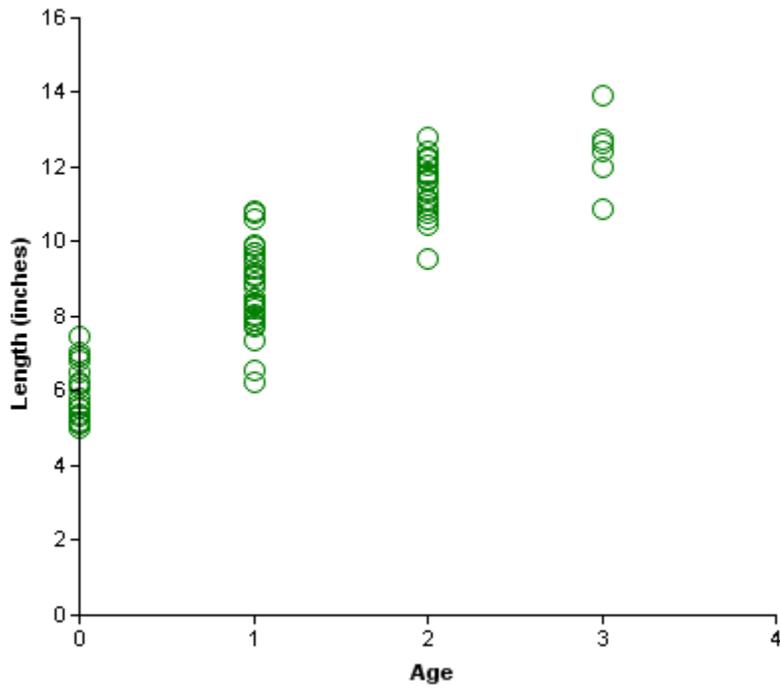
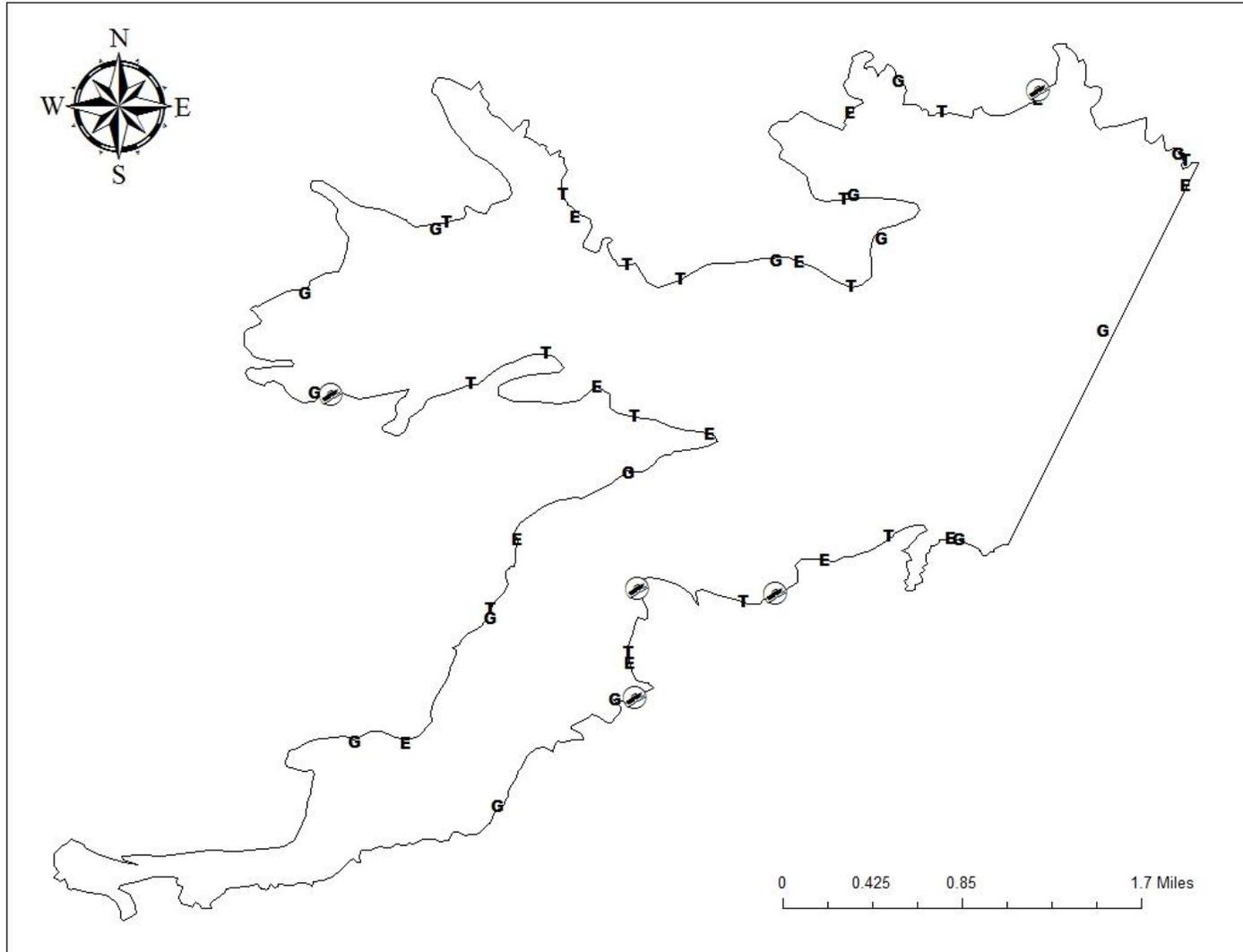


Figure 11. Length at age for White Crappie collected from trap nets at Granger Reservoir, Texas, December 2016 (N = 77).

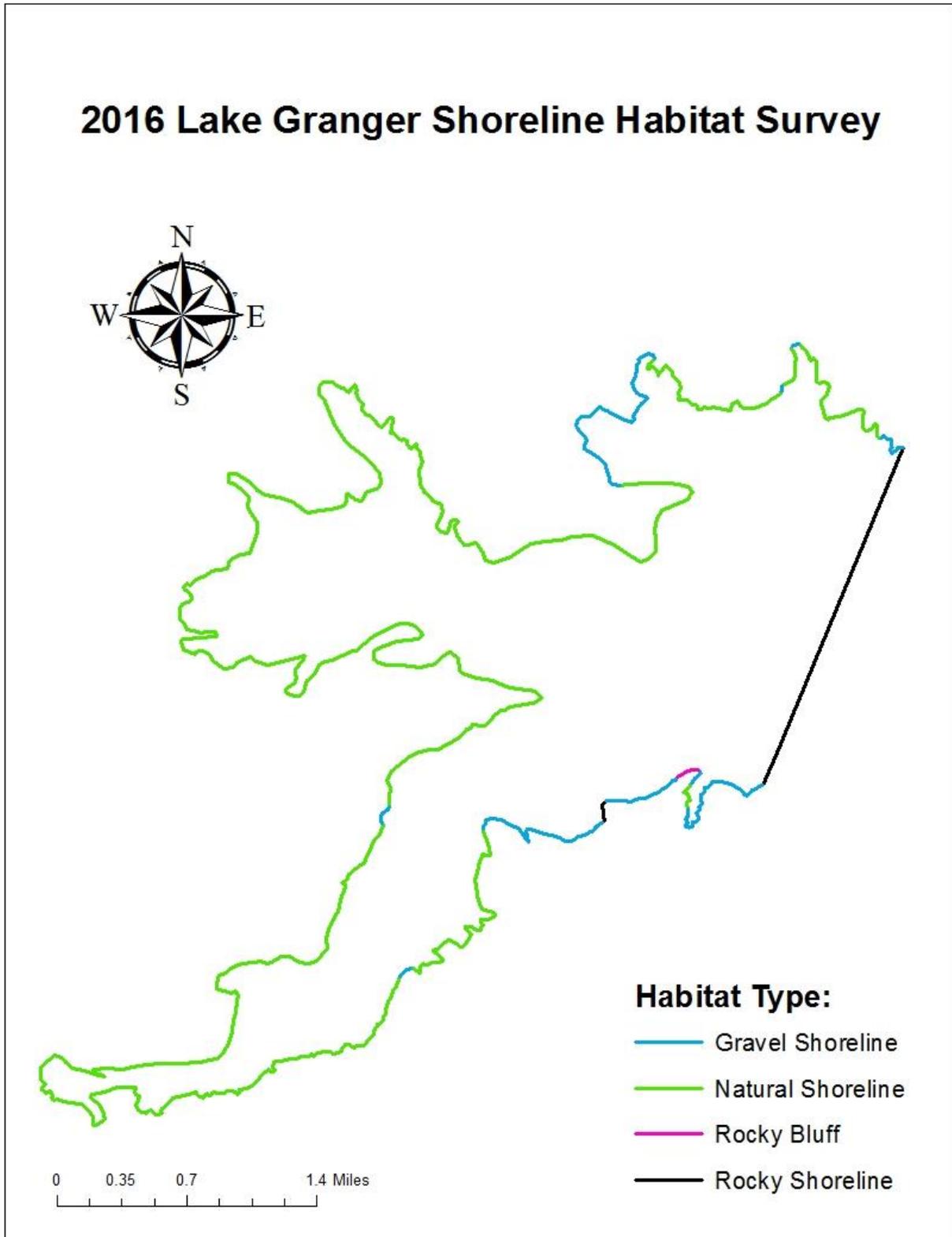
APPENDIX A

Location of sampling sites, Granger Reservoir, Texas, 2016-2017. Trap net, gill net, and electrofishing stations are indicated by T, G, and E respectively. Major boat ramps (5) are also shown.



APPENDIX B

Structural habitat survey map for Granger Reservoir, Texas, October 2016.



APPENDIX C

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Granger Reservoir, Texas, 2016-2017. Sampling effort was 15 net nights for gill netting and trap netting, and 1 hour for electrofishing.

Species	Gill Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					290	290.0
Threadfin Shad					99	99.0
Inland Silverside					1	1.0
Blacktail Shiner					1	1.0
Blue Catfish	60	4.0				
Channel Catfish	21	1.4				
Flathead Catfish	3	0.2				
White Bass	78	5.2				
Green Sunfish					1	1.0
Warmouth					1	1.0
Bluegill					96	96.0
Longear Sunfish					22	22.0
Largemouth Bass					18	18.0
Logperch					1	1.0
White Crappie			436	29.1		