Granbury Reservoir

2017 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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July 31, 2018

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Survey and Management Summary

Fish populations in Granbury Reservoir were surveyed in 2017 using electrofishing and trap netting, and in 2018 using trap netting and gill netting. Historical data are presented with the 2017-2018 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: Granbury Reservoir is an 8,700-acre impoundment located near the City of Granbury, Hood County, Texas and is operated by the Brazos River Authority (BRA). Primary water uses include storage of flood and storm waters, municipal water supply, power plant cooling, and recreation. Bank and boat access are adequate. Habitat features consisted mainly of bulk heading, natural shoreline, boat docks and piers and emergent aquatic vegetation. Water level has been near conservation pool since June 2015.

Management History: Important sport fish include Largemouth Bass, Channel Catfish, White Bass and Striped Bass. Sport fishes are currently managed with statewide regulations with the exception of a 16-inch minimum length limit on Largemouth Bass. Sport fishes were affected by frequent, toxic Golden Alga (GA) blooms from 2001 through 2012. Efforts to mitigate these losses included increasing sampling effort, stocking Striped Bass annually, and stocking Florida Largemouth Bass to supplement the population. Golden alga blooms have not caused any major fish kills in recent years. Trap netting became optional in 2009. In 2013, management efforts began focusing on supporting the statewide public relations campaign “Clean. Drain. Dry”, and posting appropriate aquatic invasive species (AIS) signage at access points to try and prevent the spread of zebra mussels into the reservoir. In 2016, the BRA funded a cooperative effort (including several local partners) to build and deploy fish attracting structures (i.e., 28 crappie condos and 16 Mossback Safe Haven structures) near mid-reservoir, to begin to enhance fish habitat reservoir-wide. Recent management efforts include aquatic vegetation and boater access surveys conducted during summer 2017, a tier III Largemouth Bass age and growth sample during fall 2017, trap netting in winter 2017, and additional trap netting and standard gill netting during spring 2018.

Fish Community

- **Prey species:** Threadfin Shad were present in the reservoir in low abundance. Gizzard Shad were abundant while most sunfishes were only collected in fair numbers.
- **Catfishes:** Channel Catfish were abundant and body condition improved with increasing size; most were of legal-length. Blue and Flathead Catfish were present in low numbers.
- **Temperate basses:** White and Striped Bass were collected in fair to good quantities. Most of the White Bass were of legal-length. Striped Bass recruitment (from recent stockings) appeared to be good, and about one-third of the sampled fish were of legal-length for anglers.
- **Largemouth Bass:** Largemouth Bass were abundant and the catch rate was the highest observed since 2003. Legal-length fish comprised over 40% of the sample. Body condition was very good across all size classes.
- **White Crappie:** White Crappie were observed during winter and spring trap netting, and during spring gill netting. Fifty-four to 79% of sampled fish were of legal length for anglers, while body condition was good to excellent across seasons and gear types.

Management Strategies: The sport fishes in Granbury Reservoir will continue to be managed with existing regulations except the Largemouth Bass regulation will soon be reverting to the statewide length and bag limit as part of a statewide effort to simplify regulations for this species. We will continue to maintain AIS signage at access points and inform the public about the negative impacts of AIS. Access and vegetation surveys will be conducted in summer 2021, and electrofishing and gill netting surveys will be conducted in 2021 and 2022.

Introduction

This document is a summary of fisheries data collected from Granbury Reservoir in 2017-2018. The purpose of the document is to provide fisheries information and make management recommendations to protect and improve the sport fishery. While information on other fishes was collected, this report deals primarily with major sport fishes and important prey species. Historical data are presented with the 2017-2018 data for comparison.

Reservoir Description

Granbury Reservoir is an 8,700-acre impoundment located near the City of Granbury, Hood County, Texas and is operated by the Brazos River Authority (BRA). Primary water uses include storage of flood and storm waters, municipal water supply, power plant cooling, and recreation. Granbury Reservoir is eutrophic with a mean and maximum depth of 18.0 and 75.0 feet respectively. Habitat features consisted mainly of bulk heading, natural shoreline, boat docks and piers and emergent aquatic vegetation. Littoral vegetation was dominated by stands of giant reed (*Arundo donax*), cattail (t*ypha spp*.), American water-willow (*Justicia americana*), and bulrush (s*cirpus spp*.). Water level dropped to 10 feet below conservation pool by January 2015, but then rebounded and has been within 2 feet of conservation pool since June 2015 (Figure 1). Other descriptive characteristics for Granbury Reservoir are in Table 1.

Angler Access

Boat access on Granbury Reservoir was adequate and consisted of five public boat ramps and many private ramps. Recent BRA efforts to extend and widen public boat ramps have greatly improved public access during drought periods however, 4 of the 5 public boat ramps still aren't useable when the reservoir level drops to 10 feet below conservation pool. Four fishing piers were available to bank anglers: Hunter Park, Hewlett Park, Rough Creek Park and DeCordova Bend Park. See Table 2 for additional boat ramp characteristics.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Tibbs and Baird 2013) included:

1. Discuss the possibility of extending ramps further with the Brazos River Authority (BRA).

   Action: The Waco Team communicated with the BRA in August 2016 about the possibility of additional boat ramp extensions, pier replacements and locations for fish attractor sites. It was determined that additional public ramps could not be extended, but several fishing piers have been restored. Artificial fish habitat structures were placed at four sites near mid-reservoir in October 2016. Details about these sites can be found in this report.

2. Cooperate with the BRA to post/maintain AIS signage at access points, provide technical support/informational materials for the "Clean, Drain and Dry" campaign, and educate business owners about invasive species through verbal and written means, so that they can in turn educate their customers. Keep track of existing and future interbasin water transfers to facilitate potential invasive species responses.

   Action: Invasive species signage was posted at Granbury Reservoir access points during summer 2013. District biologists have made a speaking point about AIS, how to prevent their spread, and potential effects on Granbury Reservoir while speaking to business owners and constituent groups such as the Central Texas Flyrodders, Legacy Outfitters and Brazos River Sportsman's Club over the past several years. Interbasin transfer is a permanent section in all formal reports now, and is part of this report.

3. Pending the number and severity of GA fish kills and water levels over the next three years, obtain a category 3 age and growth sample on Largemouth Bass in 2017.

Action: A Largemouth Bass category III age and growth sample was conducted during fall 2017 electrofishing; those data are included in this report.

Harvest regulation history: Sport fishes are currently managed with statewide regulations with the exception of a 16-inch minimum length limit on Largemouth Bass. Current regulations are found in Table 3.

Stocking history: Striped Bass fingerlings have been stocked nearly annually at 5 to 15/acre since 1972. Contemporary stockings of this species have used fry to supplement fingerling stockings, based on recent Palmetto Bass research comparing fry and fingerling stocking success in Belton Reservoir (Tibbs and Baird 2015). Florida Largemouth Bass were stocked in 2008, 2017 and 2018 to mitigate cumulative losses from fish kills associated with GA and to supplement the population. The complete stocking history is in Table 4.

Vegetation/habitat management history: No problematic species of aquatic vegetation currently exists in the reservoir. Habitat management work began in October 2016 when 28 crappie condos and 16 Mossback Safe Haven structures, funded by BRA, were placed at four sites near mid-reservoir to enhance fish habitat in the reservoir. The *Cameron Complex* is located along the riprap, to the left of the Highway 144 bridge as you approach it from the reservoir. This site is in 8 to 14 feet of water and consists of eight crappie condos and four Mossback Safe Haven structures. The *Rough Creek Complex* is located to the left and right of the Rough Creek Park fishing pier, in 7 to 15 feet of water, and consists of 20 crappie condos and 12 Mossback Safe Haven structures. The *Hewlett Complex* is located below and out-from the Hewlett Park fishing pier, in 10 to 16 feet of water, and consists of 20 crappie condos and 12 Mossback Safe Haven structures. Lastly, *Tiffany's Tree Complex* is located immediately next to a giant dead tree on the left side of the channel when heading up-reservoir towards the business 377 bridge. This complex is in 12 to 14 feet of water, and consists of 22 crappie condos. Maps, additional information and GPS coordinates can be found on the TPWD website; Fishing>Fisheries Management>Habitat projects>Granbury.

Water transfer: Granbury Reservoir is primarily used for storage of flood and storm waters, municipal water supply, power plant cooling, and recreation. There are currently two major pumping stations on the reservoir which transfer water to other sites. The first is operated by Luminant, which uses untreated water from Granbury for nuclear power plant operations on Squaw Creek Reservoir. The other is operated by the Authority's Lake Granbury Surface Water and Treatment System (SWATS), which supplies treated water to several municipalities in Hood and Johnson Counties. No additional diversions are known at this time.

Methods

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

Electrofishing – Largemouth Bass, sunfishes, Gizzard Shad and Threadfin Shad were collected by daytime electrofishing (2.5 h at 30, 5-min stations). The 2017 survey is the first standard daytime electrofishing survey completed on Granbury Reservoir. Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing. Ages for Largemouth Bass were determined by a category 3 evaluation (N of 200 fish) using otoliths from individuals greater than 8 inches in length (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Trap netting – White Crappie were collected by winter and spring (non-standard) trap netting (15 net nights at 15 stations per season) to try and determine seasonal differences in catch rates for White Crappie. Spring trap netting and gill netting data were also compared to try and determine which gear produces the best sampling results for the species. Catch per unit effort for trap netting was recorded as the number of fish caught per net night (fish/nn).

Gill netting – Channel Catfish, White Bass, Striped Bass and White Crappie were collected by gill netting (15 net nights at 15 stations). Catch per unit effort for gill netting was recorded as the number of fish caught per net night (fish/nn).

Genetics – Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015). Micro-satellite DNA analysis was used to determine genetic composition of individual fish from 2005 through 2012 and by electrophoresis for previous years.

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

Habitat – A structural habitat survey was conducted in 2009. The 2017 vegetation survey was conducted using an adaptation of the point method (TPWD, Inland Fisheries Division, unpublished manual revised 2015). One hundred and sixty-eight points were randomly generated on the shoreline and averaged a minimum of one point per shoreline mile. A transect was made from each point out to deep water, and all encountered vegetation on that transect was recorded.

Water level – Source for water level data was the United States Geological Survey (USGS 2018).

Results and Discussion

Habitat: Granbury Reservoir is a eutrophic reservoir with a Secchi range from two to three feet. A habitat survey was last conducted in 2009 (Baird and Tibbs 2010; Table 6). A full vegetation survey conducted during summer 2017 found dominant vegetation to be giant reed (*Arundo donax*), cattail (t*ypha spp.*) and American water-willow (Justicia americana) (Table 7).

Creel: No creel surveys have been conducted on Granbury Reservoir to date.

Prey species: Threadfin and Gizzard Shad were collected with day-time electrofishing at 6.4 fish/h and 226.4 fish/h respectively in 2017 (Figure 2; Appendix A). The IOV for Gizzard Shad was poor as only 39% of the population was available to existing predators as forage; this was lower than the previous two

IOV estimates (Figure 2). The catch rate for Gizzard Shad was among the highest on record (Figure 2). The catch rate of Bluegill was 45.6 fish/h and size structure was dominated by smaller individuals (Figure 3; Appendix A). Other forage species collected were Longear Sunfish, Redear Sunfish, Green Sunfish and Warmouth (Appendix A).

Channel Catfish: Channel Catfish were collected with gill nets at a rate of 11.0 fish/nn in 2018 (Figure 4). This is nearly twice the previous catch rate, and the second highest catch rate on record. The OBS goal for this species, general monitoring to collect abundance (CPUE – Total; RSE ≤ 25) and size structure (PSD and length-frequency; N ≥ 50) data, was achieved with 165 individuals and an RSE of 11. The PSD was high (i.e., 80) perhaps suggesting an imbalance in the population structure – either by inadequate recruitment or a high percentage of larger individuals in the sample; both of which are apparent. Individual body condition was good to excellent and improved with increasing size.

Blue Catfish and Flathead Catfish were not targeted during the 2018 gill net survey, but were caught at rates of 1.5 fish/nn and 0.4 fish/nn respectively (Appendix A).

Temperate Basses: White Bass were collected with gill nets at a rate of 2.2 fish/nn in 2018 (Figure 5). The OBS goal for this species, general monitoring to collect abundance (CPUE – Total; RSE ≤ 25) and size structure (PSD and length-frequency; N ≥ 50) data, was not achieved as only 33 individuals were collected; RSE = 30. Most of the sampled individuals were legal size or bigger, hence the high PSD (67). Individual body condition was good to poor and decreased with increasing size.

The gill net catch rate of Striped Bass was 2.3 fish/nn in 2018, up from 0.1/nn in 2012 (Figure 6). The OBS goal for this species, general monitoring to collect abundance (CPUE – Total; RSE ≤ 25) and size structure (PSD and length-frequency; N ≥ 50) data, was not achieved as only 34 individuals were collected; RSE = 39. Size structure was fair and about 30% of the population was of legal size for anglers. Individual body condition was good to excellent and improved with increasing size. Stockings appear to have improved recruitment in recent years, but it is unknown whether fry or fingerling stockings are responsible since in recent years, fry have always been stocked in the same year as fingerlings (Table 4). Age and growth data for this species were last collected in 2002 (Tibbs and Baird 2002).

Largemouth Bass: Largemouth Bass were collected by day-time electrofishing at a rate of 52.4 fish/h in 2017 and this is higher than all night-time electrofishing catch rates observed since 2003 (Figure 7). The OBS goal for this species, general monitoring to collect abundance (CPUE – Stock; RSE ≤ 25) and size structure (PSD and length-frequency; N ≥ 50) data, was achieved with 131 individuals and an RSE of 15. The current PSD (74) is higher than that of the previous survey, and the current population size structure is good. The percentage of legal-size fish (PSD-14; i.e., 14 inches) is also similar to the previous survey, and indicates good numbers of legal size fish for angler harvest. Individual body condition ranged from good to excellent across size classes.

Largemouth Bass growth was excellent (Table 8) with quality-length and larger fish represented mostly by recruitment in 2015 and 2016. This is likely due to the protracted drought that ended in early 2015. The Largemouth Bass population is poised for even more improvement over the next few years due to these young, fast-growing fish.

The legal length limit for Largemouth Bass will revert to the statewide 14 inch minimum on September 1, 2018. This was part of a larger statewide effort to simplify Largemouth Bass regulations and remove those which had not demonstrated an effect on the population. No impact is expected to the Largemouth Bass population from this change, nor is a significant increase in tournament activity expected.

Florida Largemouth Bass genetics were collected in Fall, 2017 (Table 9). Only sub-stock fish were collected to evaluate the impact of Florida Largemouth Bass stocking in Spring, 2017. Florida genetic influence in the sample (52%) remained similar to 2013 (49%) and only a single pure Florida Largemouth Bass was collected in the sample of 30 fish. Based on the past five genetic evaluations and stocking efforts, it appears that about 50% introgression of Florida alleles is the best that can be expected for the reservoir.

White Crappie: White Crappie were collected with winter trap nets (2.9 fish/nn), spring trap nets (5.5 fish/nn) and spring gill nets (2.3 fish/nn) (Figure 8). The OBS goal for the standard survey (winter trap nets), general monitoring to collect abundance (CPUE – Stock; RSE ≤ 25) and size structure (PSD and length-frequency; N ≥ 50) data, was not achieved as only 43 individuals were collected; RSE = 38. The non-standard, spring trap net survey would have achieved the OBS goals, since 82 individuals were collected with an RSE of 19. Thirty-four individuals were collected with gill nets; RSE = 30. All three surveys showed good to excellent individual body condition.

Fall trap nets appeared to reflect the young-of-year class strength of White Crappie since length classes from 2 to 6-inches were well represented in that sample. Spring gill nets showed the highest percentage of legal-length fish, but no recent recruitment. Spring trap nets collected more individuals than the other two surveys combined, showed a high percentage of legal-length fish, and evidence of recent recruitment. Based on the population structures presented by these surveys, spring trap nets seem to show the most promise for future sampling of White Crappie on Granbury Reservoir.

Black Crappie were not targeted during the above-mentioned surveys, but were collected with winter trap nets at 0.3 fish/nn, with spring trap nets at 0.5 fish/nn and with spring gill nets at 1.3 fish/nn (Appendix A).

Fisheries Management Plan for Granbury Reservoir, Texas

Prepared – July 2018

ISSUE 1: White Crappie were collected by winter trap netting (2017), spring trap netting (2018) and spring gill netting (2018) to determine seasonal differences in catch rates and to evaluate which gear or gear/season combination produces the best sampling results for the species. Based on the results of this evaluation spring trap nets seem to show the most promise for future sampling of White Crappie but an additional year of comparison seems prudent.

MANAGEMENT STRATEGIES

1. Use trap nets to sample White Crappie on Granbury again during spring 2022. These will be compared to fall trap netting and spring gill netting.
2. Pending results of the evaluation, consider spring trap netting for all future White Crappie surveys on this reservoir.

ISSUE 2: Striped Bass have been a part of the fishery at Granbury Reservoir since the early 1970s, but the most recent age and growth data available for the species was collected in 2002. In addition, the 2018 stocking consisted of only fry, and determining the success of that stocking is important to future Striped Bass stocking strategies in the reservoir

MANAGEMENT STRATEGY

1. Collect a category 3 age and growth sample for Striped Bass in 2022.

ISSUE 3: Although recently flooded timber can provide good fisheries habitat, its usefulness declines as a reservoir ages. Artificial fish structures deployed into Granbury Reservoir in 2016 with the help of BRA and other partners received a lot of good publicity and created new areas for anglers to fish. The fishery at Granbury Reservoir could benefit from more projects like this.

MANAGEMENT STRATEGY

1. Work with the BRA to use dedicated habitat funding to install new artificial fish reefs throughout the reservoir.

ISSUE 4: Many AIS 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 AIS are significant. Additionally, the potential for AIS 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 BRA to post appropriate signage at access points around the reservoir.

2. Contact and educate marina owners about AIS, and provide them with posters, literature, etc. so that they can in turn educate their customers.
3. Educate the public about AIS through the use of media and the internet.
4. Make a speaking point about AIS 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 and Schedule (2018–2022)

Important sport and forage fishes: Abundant and/or important sport fishes in Granbury Reservoir include Largemouth Bass, Channel Catfish, White Crappie, White Bass and Striped Bass. Important forage species include Gizzard Shad, Threadfin Shad, Bluegill and Longear Sunfish.

Fishes with low-density populations: Flathead Catfish, Blue Catfish and Black Crappie occur in low abundance in Granbury Reservoir and are generally caught incidentally to targeted species. We will continue collecting and reporting data for these species, and upgrade their status if appropriate.

Survey objectives, fisheries metrics, and sampling objectives

Fall Electrofishing: This survey will be used to evaluate Largemouth Bass and primary forage species (Gizzard Shad, Bluegill Sunfish and Longear Sunfish). Largemouth Bass are one of the predominant sport fish in the reservoir, and their popularity justifies sampling time and effort. The fall 2017 daytime electrofishing catch rate was 52.4 fish/h (N =131; RSE = 15), and required 30, five-minute electrofishing stations to achieve. Age and growth data collected in fall 2017 showed a young population strongly affected by drought through 2014 followed by a full reservoir from 2015 through the date of this report. A minimum of 18, random five-minute day-time electrofishing stations will be sampled in fall 2021. The goals of the Largemouth Bass survey will be general monitoring (using CPUE, size structure and relative weight as metrics) to characterize the Largemouth Bass population and make comparisons with the fall 2017, and future, day-time electrofishing data. Catch per unit effort target precision will be an RSE < 25. Target sample size will be an N ≥ 50 stock-size fish to determine population size structure, allowing us to calculate proportional size distribution with 80% confidence. If sampling objectives aren't achieved with the initial 18 stations and if catch rates indicate collecting our size structure target is reasonable, sampling will continue at random stations until that target is reached.

The goals of the forage species surveys will be general monitoring (using CPUE and size structure as metrics) to characterize Gizzard Shad, Bluegill Sunfish and Longear Sunfish populations and make comparisons with historical and future data. Since trend data show large variations in catch of forage species, no catch per unit effort target precision, target sample sizes or relative weights will be assigned. Index of Vulnerability (IOV) will be calculated for Gizzard Shad to assess the relative proportion of individuals in the population suitable as prey for sport fish.

Winter Trap Netting: This survey will be used to help evaluate White Crappie, which is the dominant Crappie species in Granbury Reservoir. White Crappie were last sampled with trap netting in winter 2017 (2.9 fish/nn) and spring 2018 (5.5 fish/nn) to try and determine seasonal differences in catch rates and to determine which season produces the best sampling results for the species.

A minimum of 15 random trap netting stations will be sampled in winter 2021. The goal of the White Crappie survey will be general monitoring (using CPUE, size structure and relative weight as metrics) to characterize the White Crappie population and make comparisons with historical and future data. Catch per unit effort target precision will be an RSE ≤ 25. Target sample size will be an N ≥ 50 stock-size fish to determine population size structure, allowing us to calculate proportional size distributions with 80% confidence. If sampling objectives aren't met and if catch rates from the first fifteen nets indicate collecting our size structure target is reasonable, sampling will continue at random stations until that target is reached.

Spring Gill and Trap Netting: The gill net survey will be used to evaluate Channel Catfish, White Bass Striped Bass and White Crappie and the trap net survey will be used to evaluate White Crappie only. White Bass, Channel Catfish and Striped Bass catch rates have historically averaged 2.6 fish/nn, 7.6 fish/nn and 0.9 fish/nn respectively. The spring 2018 gill netting survey observed catch rates of 2.2 fish/nn, 11.0 fish/nn and 2.3 fish/nn for the same three species, respectively. White Crappie were last sampled with trap netting in winter 2017 (2.9 fish/nn) and spring 2018 (5.5 fish/nn). The spring 2022 White Crappie gill net data will be compared with the winter 2021 and spring 2022 trap net data to

characterize differences among White Crappie samples obtained with two different gears at the same time and the same gear (trap netting) in two different seasons.

A minimum of 15 random gill netting stations and 15 trap netting stations will be sampled in spring 2022, with the total of each gear equaling the winter trap netting effort to facilitate seasonal comparisons. In addition, the goal of the gill netting survey will be general monitoring (using CPUE, size structure and relative weight as metrics) to characterize Channel Catfish populations and make comparisons with historical and future data. Catch per unit effort target precision will be an RSE < 25. Target sample size will be an $N \geq 50$ stock-size fish to determine population size structure, allowing us to calculate proportional size distributions with 80% confidence. Striped and White Bass gill netting catch rates have historically been too low to expect to collect data with sufficient precision with 15 gill nets. Nonetheless, in an effort to obtain enough Striped Bass to comprise a meaningful age data set, up to 15 additional gill nets will be set in spring 2022. These will be placed to optimize catch of Striped Bass. In addition, all gill netting will take place in February or earlier, which has been shown to increase catch rates of Morone species.

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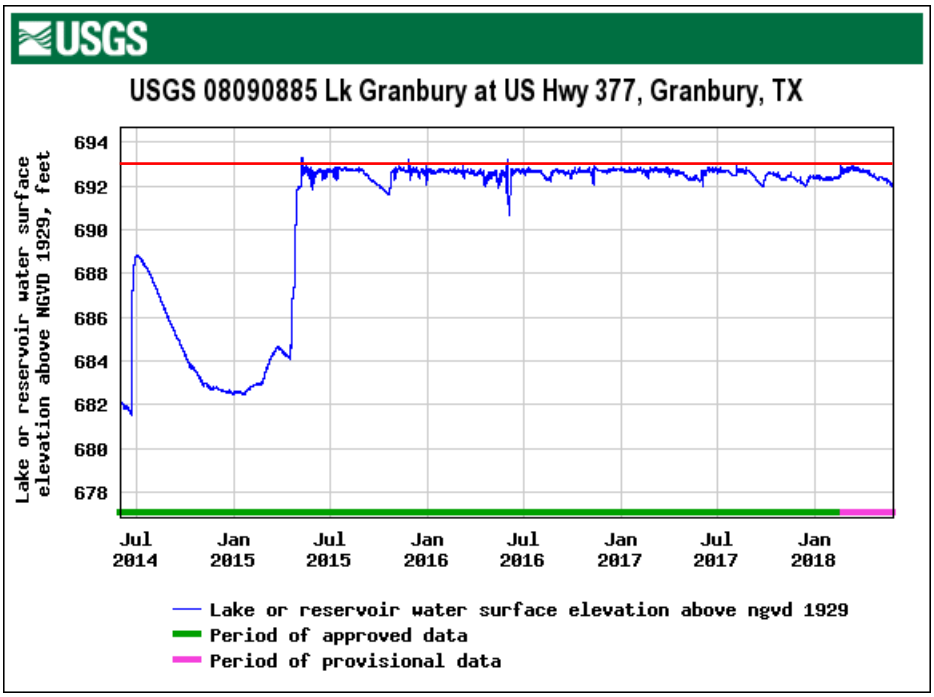
Tables and Figures



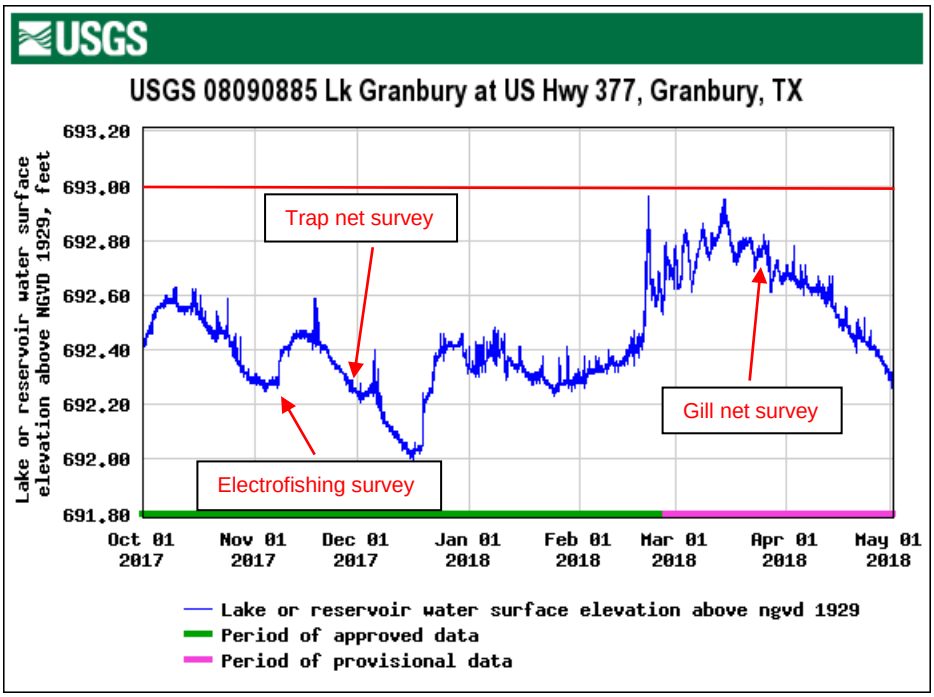


Figure 1. Daily mean water level elevations in feet above mean sea level (MSL; red horizontal line) recorded for Granbury Reservoir, Texas, July 1, 2014 through July 1, 2018 (top figure) and October 1, 2017 through May 1, 2018 (bottom figure).

Table 1. Characteristics of Granbury Reservoir, Texas.

Characteristic	Description
Year constructed	1969
Controlling authority	Brazos River Authority
County	Hood
Reservoir type	Mainstem
Shoreline Development Index	8.4
Conductivity	2,400 µS/cm

Table 2. Boat ramp characteristics for Granbury Reservoir, Texas, 2017 - 2018. The water level was one foot below conservation pool (i.e., 692' above mean sea level) during the 2017 access survey.

Boat ramp	Latitude Longitude (dd)	Trailer Parking capacity (N)	Elevation at end of boat ramp	Condition
Thorp Spring	32.4734/-97.8148	24	687	1 lane ramp; good
Hunter Park	32.4778/-97.7954	18	687	1 lane ramp; good
City Park	32.4439/-97.7710	44	686	3 lane ramp; good
Rough Creek	32.4181/-97.7863	27	681	4 lane ramp; good
DeCordova Bend	32.3773/-97.6916	24	685	3 lane ramp; good

Table 3. Harvest regulations for Granbury Reservoir, Texas, 2017 - 2018.

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, Striped	5	18-inch minimum
Bass, Largemouth	5[a]	16-inch minimum
Bass: Spotted and Smallmouth	5[a]	No minimum
Crappie: White and Black crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

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

Table 4. Stocking history for Granbury, 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	1991	86,343	FGL	2.5
	Total	86,343		
Channel Catfish	1969	374,675	AFGL	7.9
	1993	300	AFGL	4.9
	Total	374,975		
Florida Largemouth Bass	1986	8,178	FRY	0.9
	1989	212,290	FGL	1.3
	1989	212,234	FRY	0.9
	1994	435,331	FGL	1.1
	1995	435,924	FGL	1.4
	2003	425,723	FGL	1.3
	2004	214,164	FGL	1.6
	2008	208,273	FGL	1.5
	2017	176,283	FGL	1.5
	2018	168,336	FGL	1.8
	Total	2,496,736		
Largemouth Bass	1969	126,640	UNK	UNK
	1970	1,700,000	FRY	0.7
	1972	30,160	UNK	UNK
	1993	200	AFGL	4.9
	Total	1,857,000		
Striped Bass	1972	27,250	FGL	1.7
	1973	172,970	FGL	1.7
	1974	85,000	FGL	1.7
	1975	39,998	UNK	UNK
	1976	86,154	UNK	UNK
	1979	85,791	UNK	UNK
	1981	100,502	UNK	UNK
	1983	176,332	UNK	UNK
	1989	87,000	FGL	1.5
	1990	93,315	FGL	1.5
	1994	143,656	FGL	1.2

Table 4. Stocking history for Granbury, 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)
	1995	43,807	FGL	1.3
	1997	87,068	FGL	1.3
	1998	88,206	FGL	1.3
	1999	88,121	FGL	1.4
	2000	44,000	FGL	1.4
	2001	2,100,000	FRY	0.8
	2002	174,657	FGL	1.6
	2003	85,444	FGL	1.5
	2004	43,271	FGL	1.5
	2005	125,155	FGL	1.7
	2006	127,280	FGL	1.6
	2007	125,278	FGL	1.4
	2008	126,079	FGL	1.8
	2009	44,864	FGL	1.8
	2010	46,165	FGL	1.9
	2010	415,763	FRY	0.2
	2013	66,462	FGL	2.1
	2013	400,000	FRY	0.2
	2014	38,186	FGL	1.5
	2015	27,829	FGL	1.9
	2015	375,740	FRY	0.2
	2017	88,896	FGL	2.0
	2018	629,419	FRY	0.2
	Total	6,489,658		

Table 5. Objective-based sampling plan components for Granbury Reservoir, Texas 2017–2018.

Gear/target species	Survey objective	Metrics	Sampling objective
Electrofishing			
Largemouth Bass	Population dynamics	Age, growth, mortality	200 total fish sample
	Abundance	CPUE–Stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Condition	W_r	10 fish/inch group (max)
	Genetics	% FLMB	N = 30, any age
Bluegill [a]	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
Longear Sunfish [a]	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
Gizzard Shad [a]	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
	Prey availability	IOV	N ≥ 50
Trap netting			
White Crappie	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
	Condition	W_r	10 fish/inch group (max)
Gill netting			
White Bass	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
	Condition	W_r	10 fish/inch group (max)
Striped Bass	Abundance	CPUE-Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
	Condition	W_r	10 fish/inch group (max)
Channel Catfish	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
	Condition	W_r	10 fish/inch group (max)
White Crappie	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
	Condition	W_r	10 fish/inch group (max)

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

Table 6. Survey of structural habitat types, Granbury Reservoir, Texas, 2009. Shoreline habitat type units are in miles and standing timber is acres.

Habitat type	Estimate	% of total
Bulkhead	81.5 miles	50.0
Gravel shoreline (rocks < 4 inches)	0.1 miles	0.1
Rocky shoreline (rocks > 4 inches)	25.0 miles	13.2
Natural shoreline	61.9 miles	32.6
Boat docks/piers	7.0 acres	3.7

Table 7. Survey of aquatic vegetation, Granbury Reservoir, Texas, 2010, 2013 and 2017. Percent of total reservoir surface area is listed for 2010 and 2013, while percent of randomly-selected points where each species occurred, is listed for 2017. Reservoir elevation at time of survey was 692.3 feet above MSL (0.7 feet below conservation pool).

Vegetation	2010	2013	2017
Native emergent			
Bulrush (*Scirpus spp.*)			1.2% (2 of 168)
Cattail (*Typha spp.*)			9% (15 of 168)
American water-willow (*Justicia americana*)			6% (10 of 168)
Non-native			
Giant reed (*Arundo donax*)			12% (20 of 168)
Native emergent	20.3 (0.23)	trace	

Gizzard Shad

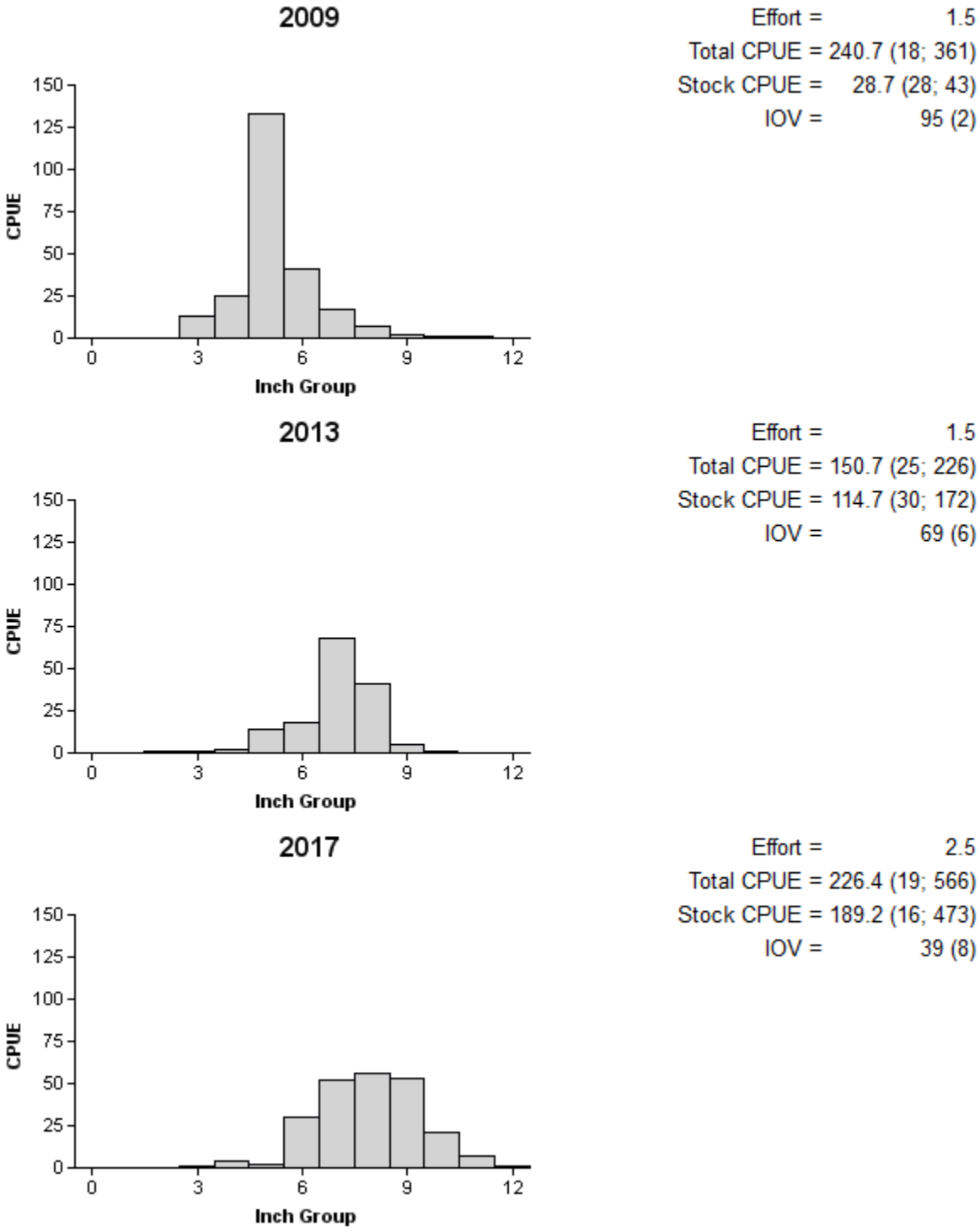


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Granbury Reservoir, Texas, 2009 (night-time), 2013 (night-time), and 2017 (day-time).

Bluegill

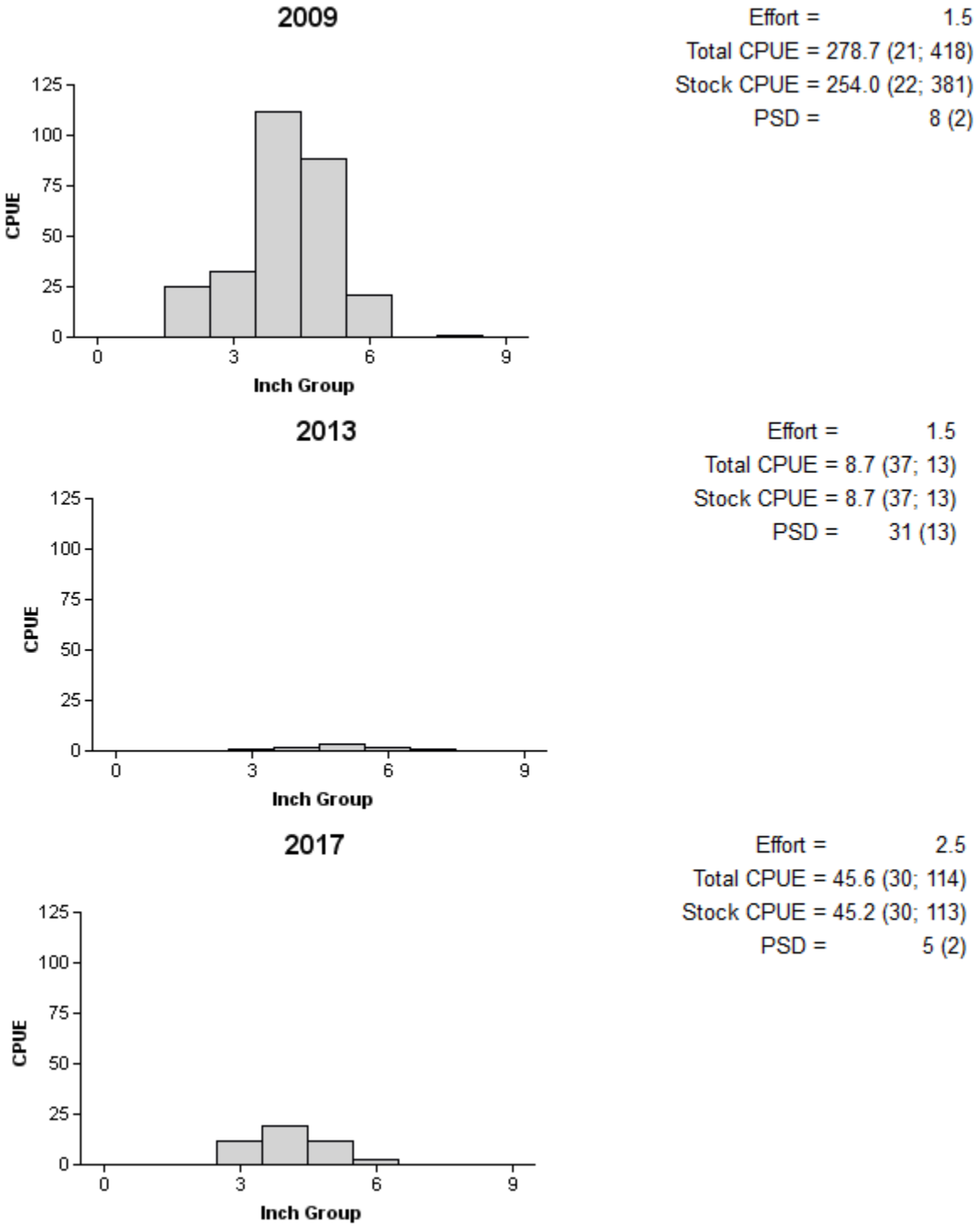


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Granbury Reservoir, Texas, 2009 (night-time), 2013 (night-time), and 2017 (day-time).

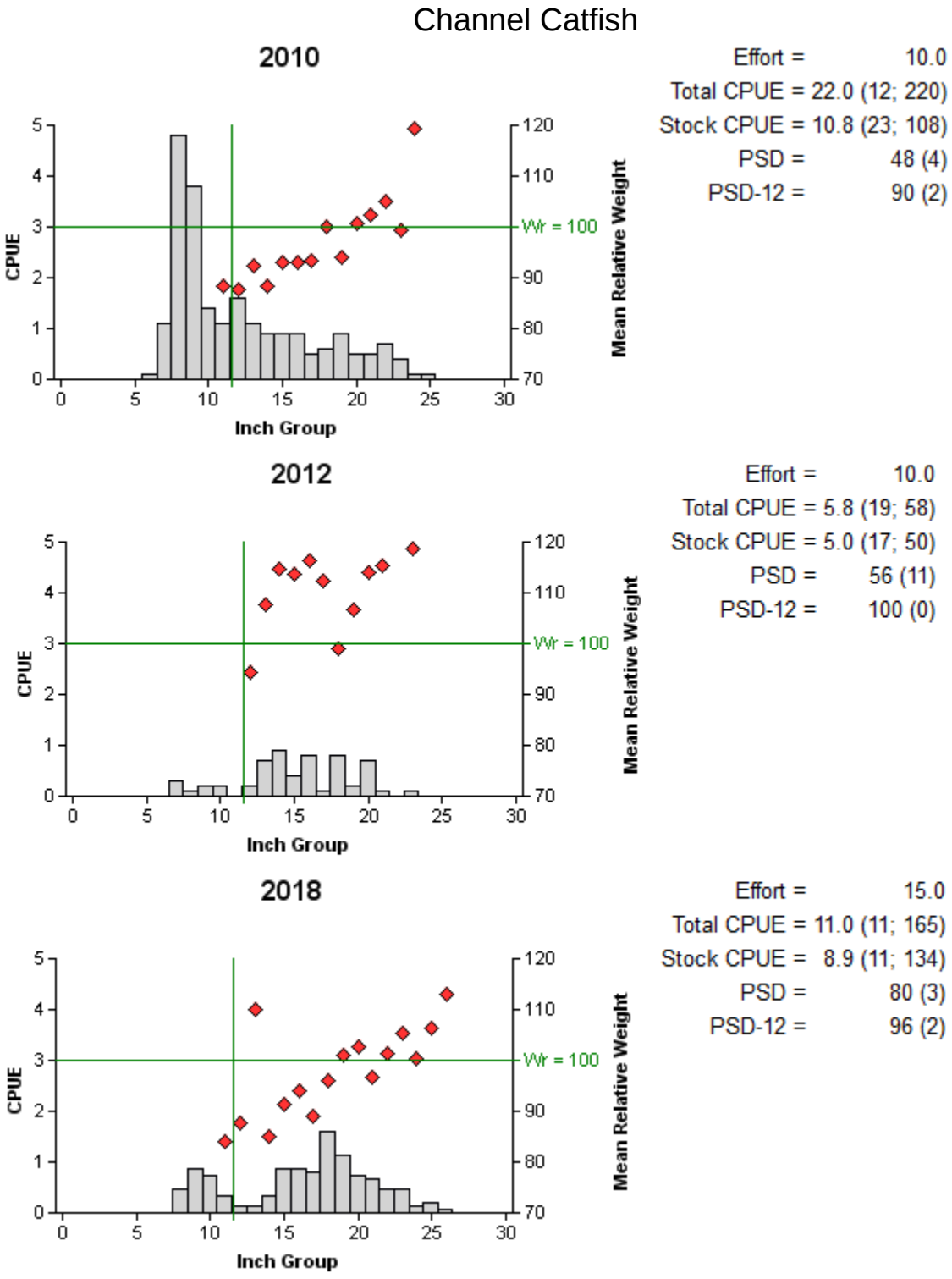


Figure 4. Number of Channel Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Granbury Reservoir, Texas, 2010, 2012, and 2018. Vertical line indicates minimum length limit and horizontal line represents optimal condition.

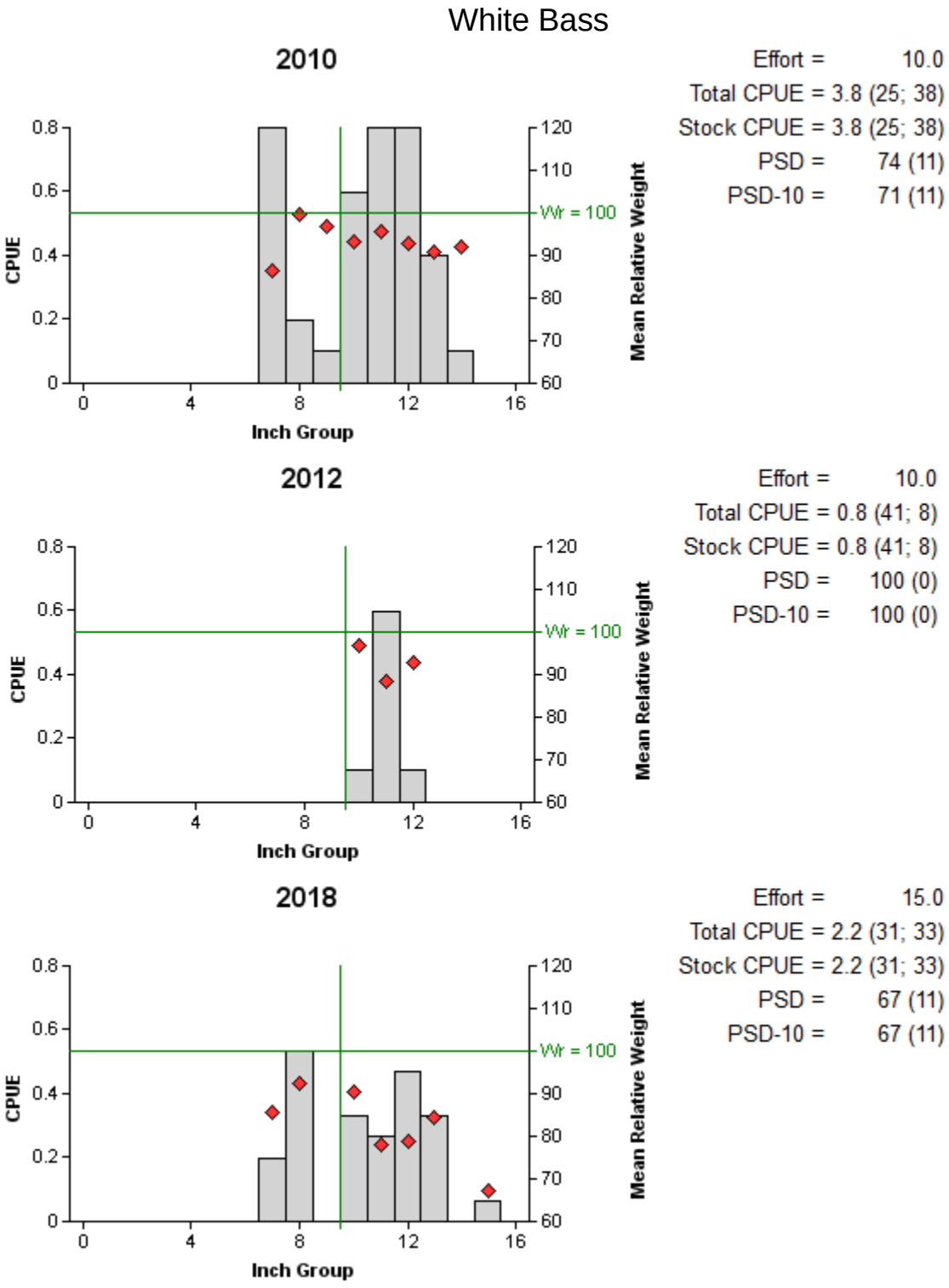


Figure 5. Number of White Bass caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Granbury Reservoir, Texas, 2010, 2012, and 2018. Vertical line indicates minimum length limit and horizontal line represents optimal condition.

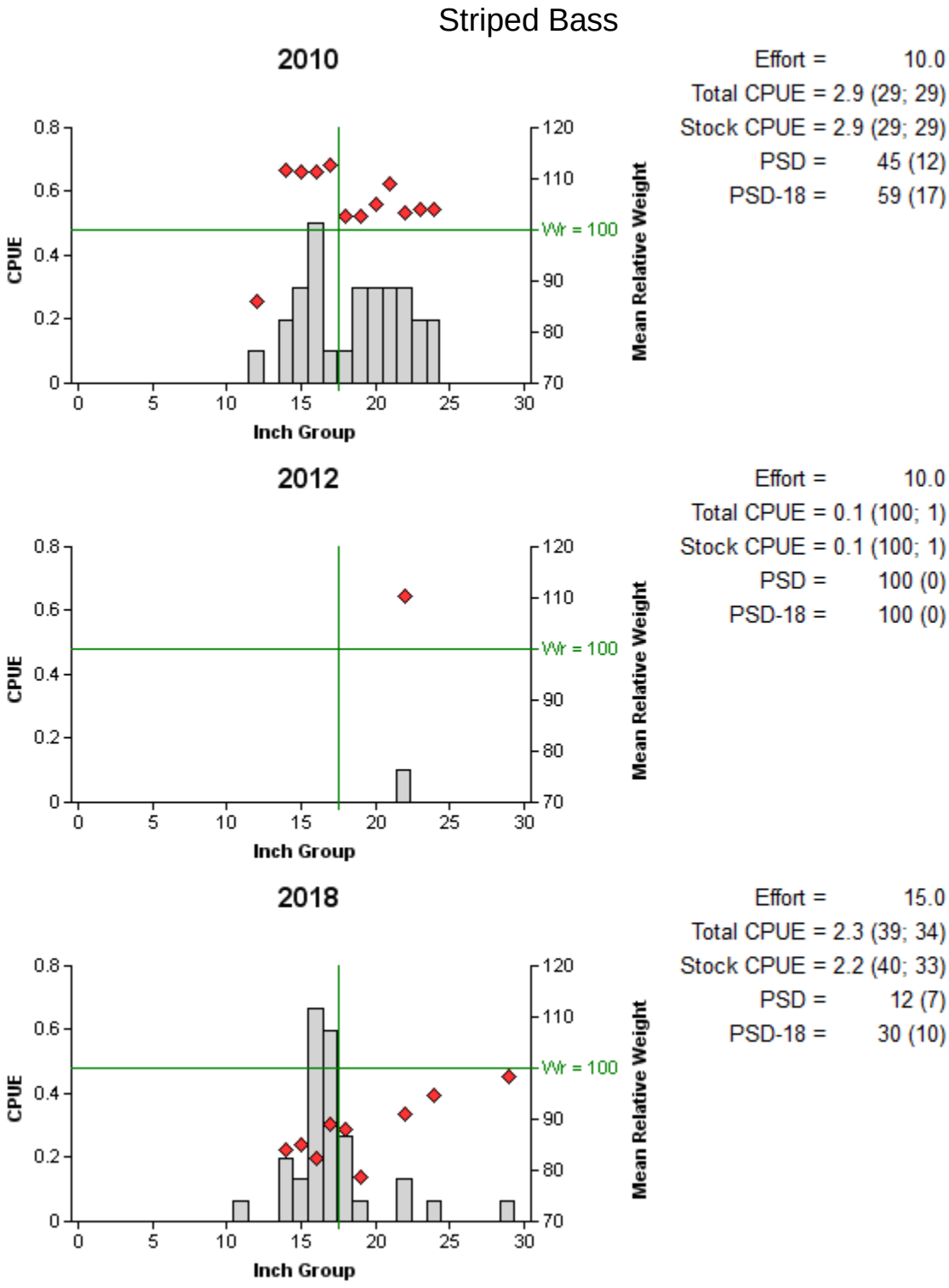


Figure 6. Number of Striped Bass caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Granbury Reservoir, Texas, 2010, 2012, and 2018. Vertical line indicates minimum length limit and horizontal line represents optimal condition.

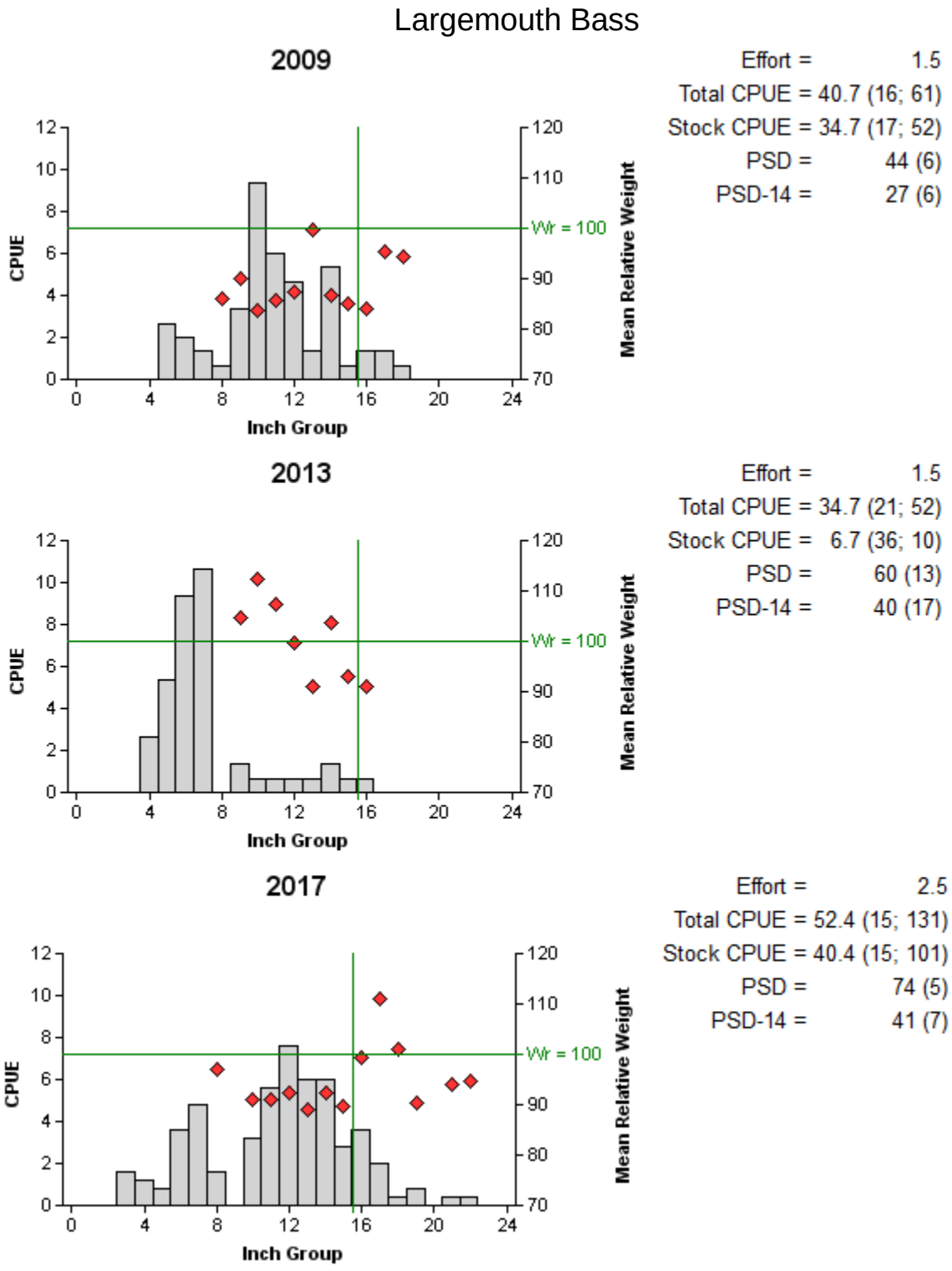


Figure 7. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Granbury Reservoir, Texas, 2009 (night-time), 2013 (night-time), and 2017 (day-time). Vertical line indicates minimum length limit and horizontal line represents optimal condition.

Table 8. Average length at age of capture for Largemouth Bass (sexes combined) collected by daytime electrofishing, Granbury Reservoir, Texas, 2017. Lengths are followed by the sample size in parenthesis.

	Length (inches) at capture for age			
Sampling date	1	2	3	4
11/6/2017	11.6 (22)	14.0 (45)	16.4 (3)	16.7 (1)

Table 9. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Granbury Reservoir, Texas, 2003, 2005, 2007, 2013 and 2017. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB.

		Number of fish				
Year	Sample size	FLMB	Hybrid	NLMB	% FLMB alleles	% FLMB
2003	30	0	26	4	39	0
2005	28	1	26	1	51	4
2007	23	0	20	3	26	0
2013	29	0	30	0	49	0
2017	30	1	29	0	52	3

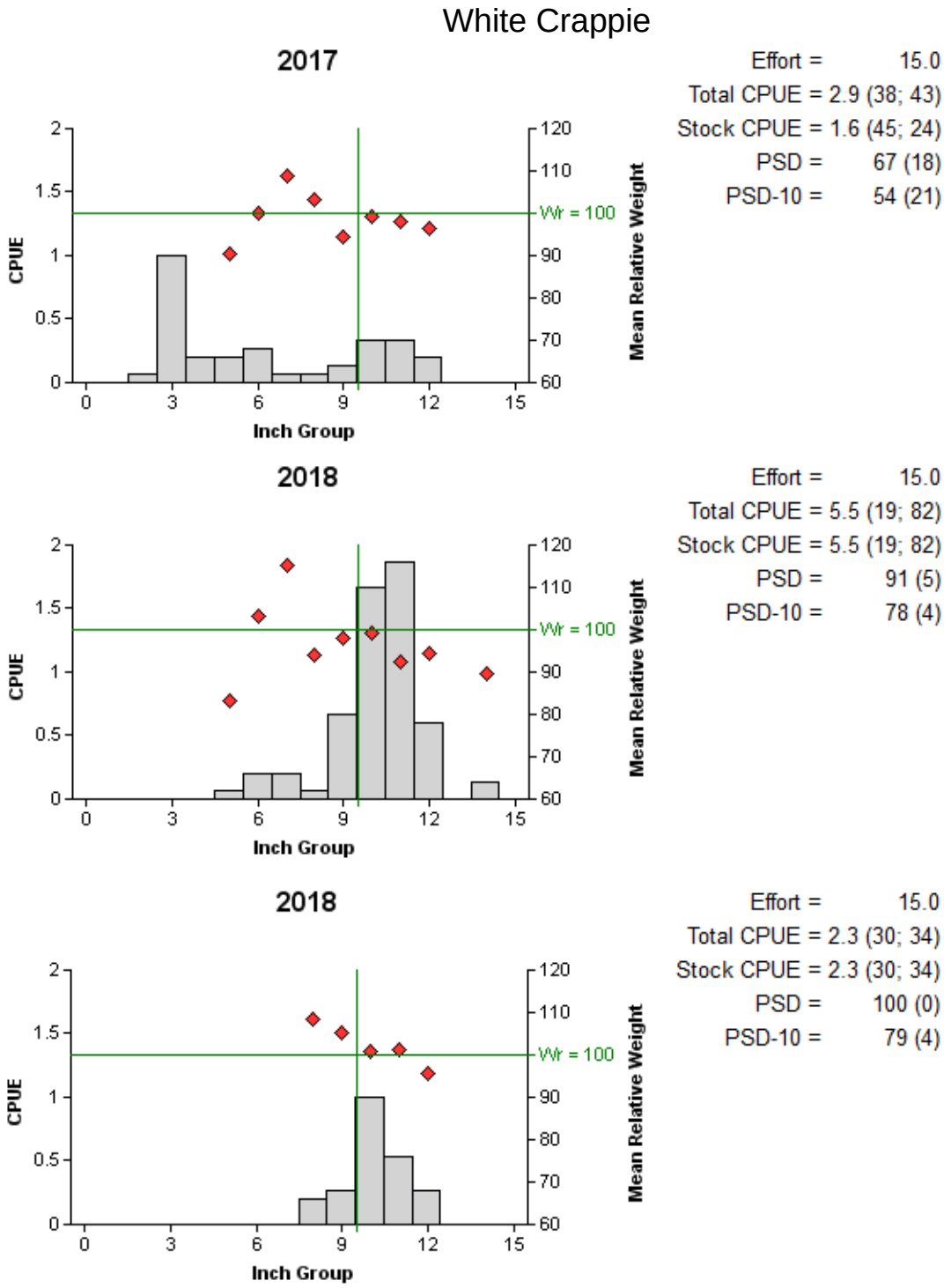


Figure 8. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for 2017 winter trap netting (top figure), 2018 spring trap netting (middle figure) and 2018 spring gill netting (bottom figure), Granbury Reservoir, Texas. Vertical line indicates minimum length limit and horizontal line represents optimal condition.

Proposed Sampling Schedule

Table 10. Proposed sampling schedule for Granbury Reservoir, Texas. Survey period is June through May. Gill netting surveys are conducted in the spring, while electrofishing and trap netting surveys are conducted in the fall. Standard survey denoted by S and additional survey denoted by A.

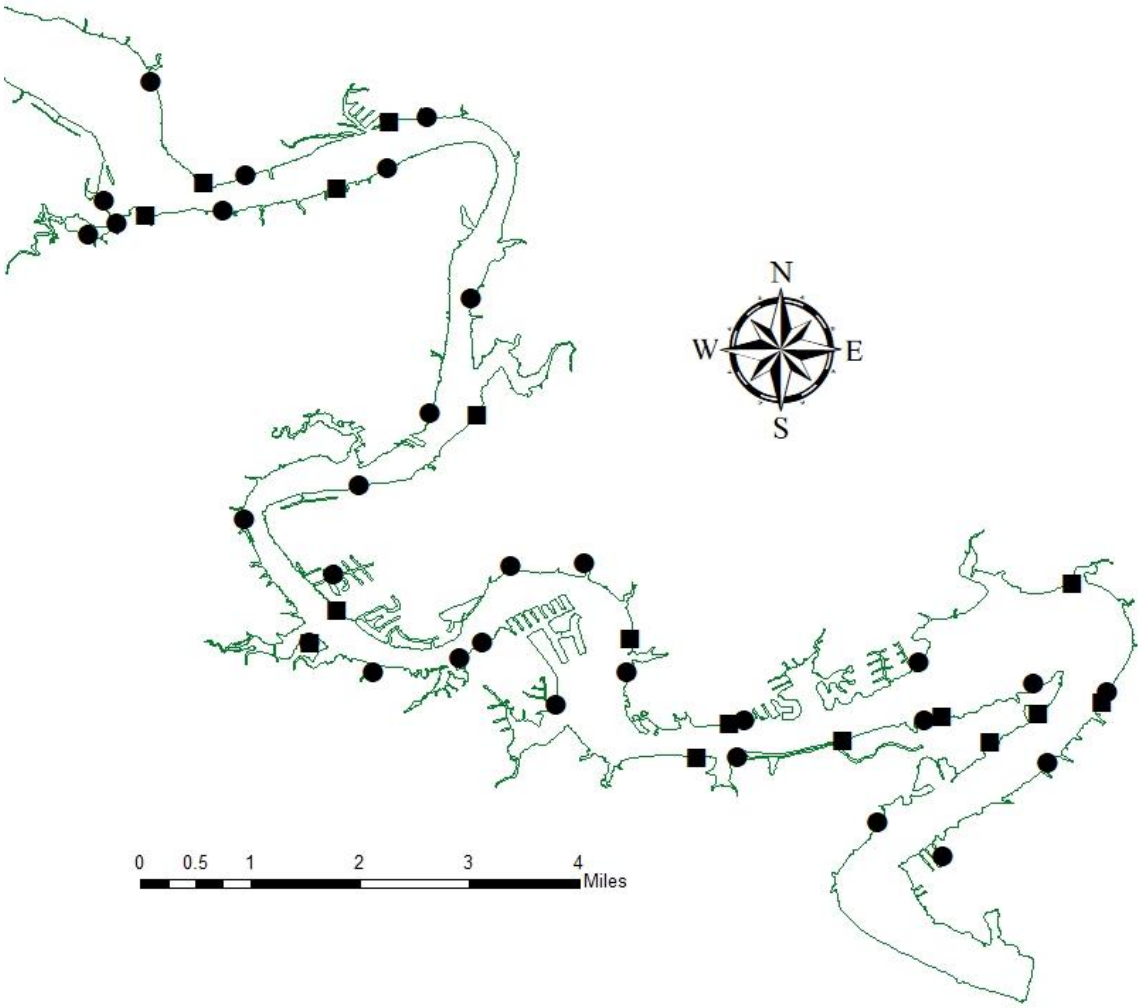
	Survey year			
	2018-2019	2019-2020	2020-2021	2021-2022
Angler Access				S
Structural Habitat				S
Vegetation				S
Electrofishing – Fall				S
Trap netting				S, A
Gill netting				S
Report				S

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 standard gear types from Granbury Reservoir, Texas, 2017-2018. Sampling effort was 2.5 hours for electrofishing, 15 net nights for fall trap netting and 15 net nights for spring gill netting. There were also 15 net nights for spring trap netting in which 5.5/nn White Crappie and 0.5/nn Black Crappie were collected.

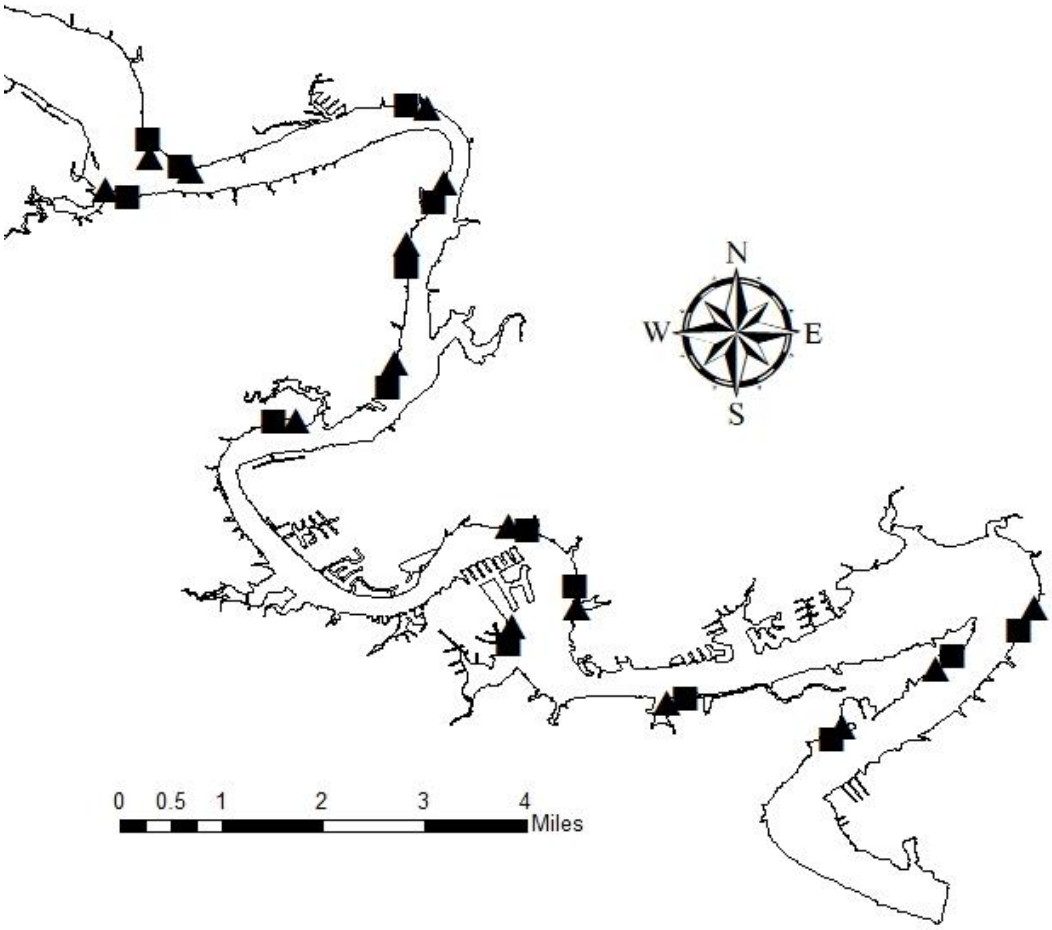
Species	Gill Netting		Trap Netting (Winter)		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					566	226.4 (19)
Threadfin Shad					16	6.4 (76)
Blue Catfish	23	1.5 (44)				
Channel Catfish	165	11.0 (11)				
Flathead Catfish	6	0.4 (48)				
White Bass	33	2.2 (31)				
Striped Bass	34	2.3 (39)				
Green Sunfish					19	7.6 (40)
Warmouth					12	4.8 (31)
Bluegill					114	45.6 (30)
Longear Sunfish					23	9.2 (28)
Redear Sunfish					25	10.0 (29)
Spotted Bass					2	0.8 (69)
Largemouth Bass					131	52.4 (15)
White Crappie*	34	2.3 (30)	43	2.9 (38)		
Black Crappie*	19	1.3 (31)	5	0.3 (48)		

APPENDIX B – Map of fall and winter sampling locations



Location of sampling sites, Granbury Reservoir, Texas, 2017. Electrofishing and trap netting stations are indicated by circles and squares, respectively. Water level was within one foot of conservation pool at time of sampling.

APPENDIX C – Map of spring sampling locations



Location of sampling sites, Granbury Reservoir, Texas, 2018. Gill netting and trap netting stations are indicated by triangles and squares, respectively. Water level was within one foot of conservation pool at time of sampling.

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