PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-6

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2015 Fisheries Management Survey Report

Canyon Reservoir

Prepared by:

Greg A. Cummings, District Management Biologist
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

July 31, 2016

TABLE OF CONTENTS

SURVEY AND MANAGEMENT SUMMARY

Fish populations in Canyon Reservoir were surveyed in 2015 using electrofishing and in 2016 using gill nets. Historical data are presented with the 2015-2016 data for comparison. This report summarizes results of the surveys and contains a fisheries management plan for the reservoir based on those findings.

- **Reservoir Description:** Canyon Reservoir is an 8,308-acre impoundment of the Guadalupe River located in Comal County. It was constructed in 1964 by the U.S. Army Corp of Engineers (USACE) for purposes of flood control, water conservation and recreation. Canyon Reservoir has a drainage area of approximately 1,452 square miles and a shoreline length of 90.5 miles. The reservoir lies within the Edwards Plateau ecological area.

- **Management History:** Important sport fish include Largemouth Bass, Striped Bass, White Bass and catfish species. Striped Bass were introduced in 1973 and stocked until 1983, then restocked at a lower rate (5/acre) in 1989. White Bass were managed under an experimental 12-inch minimum length limit. The regulation was rescinded in 2004 after analysis indicated environmental factors, not angler harvest, were probably more influential in determining White Bass population density. Largemouth Bass were present in the reservoir and have been managed under statewide regulations. Florida Largemouth Bass were stocked in 2008, 2010, 2014, and 2015 to influence genetics. Blue Catfish were introduced in 1991 to provide enhanced catfish opportunities for anglers.

- **Fish Community**
  - **Prey species:** Sunfishes and Gizzard Shad were the dominant prey species available. Threadfin Shad and Inland Silversides were present in low densities.

  - **Catfishes:** Channel and Blue Catfish were present in low densities. Large Flathead Catfish were also present in low densities.

  - **Temperate basses:** Striped Bass and White Bass were present in the reservoir. A fish consumption advisory was placed on Striped Bass in 2006, but limited consumption was allowed and the species still offered excellent catch-and-release opportunity. Striped Bass showed reduced abundance. Legal-size (≥18 inches) Striped Bass were still present. White Bass abundance declined in 2010 and has remained low.

  - **Black basses:** Largemouth Bass abundance was moderate, rebounding slightly from previous surveys. Smallmouth Bass were present in low densities and have declined since 2007.

- **Management Strategies:** Annual Striped Bass stockings should continue to be requested at the present stocking rate of 5/acre. Fish attractor sites should continue to be replenished with brush as needed. Inform the public about the negative impacts of aquatic invasive species. Conduct general monitoring surveys with electrofishing (2019) and gill nets (2018, 2020). Access and habitat surveys will be conducted in 2019/2020.

INTRODUCTION

This document is a summary of fisheries data collected from Canyon Reservoir from 2015–2016. The purpose of the document is to provide fisheries information and make management recommendations to protect and improve the sport fishery. While information on other fishes was collected, this report deals primarily with major sport fishes and important prey species. Historical data are presented with the 2015-2016 data for comparison.

Reservoir Description

Canyon Reservoir is an 8,308-acre impoundment of the Guadalupe River located in Comal County. It was constructed in 1964 by the U.S. Army Corps of Engineers for purposes of flood control, water conservation and recreation. Canyon Reservoir has a drainage area of approximately 1,452 square miles and a shoreline length of 90.5 miles. The reservoir lies within the Edwards Plateau ecological area. Other descriptive characteristics for Canyon Reservoir are in Table 1.

Angler Access

Canyon Reservoir has twenty-two public boat ramps, of which fifteen offered bank angling opportunities. Shoreline access at many of the parks was excellent. One public fishing pier was available at Cranes Mill Park, on the upper end of the reservoir. White Bass anglers could access the Guadalupe River above the reservoir using the Rebecca Creek boat ramp. Reservoir water levels are subject to frequent fluctuations (Figure 1), which may impact access during extreme conditions. Additional boat ramp characteristics are in Table 2.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (De Jesus and Farooqi 2011) included:

1. Monitor Striped Bass population density with gill net surveys, and continue annual stocking requests at 10/acre in 2013 and 5/acre thereafter.
   Action: Striped Bass were stocked in 2013 (10/acre) and 2014-2015 (5/acre). Striped Bass were surveyed with gill nets in 2014 and 2016.
2. Continue to maintain fish attractor sites. When possible, create new sites.
   Action: Attractor sites were refurbished from 2013 to 2016. One new site was created in 2014.
3. Monitor genetic influence in Largemouth Bass.
   Action: Largemouth Bass genetic influence was evaluated in the 2015 electrofishing survey.
4. Inform the public about invasive species threats to Canyon Reservoir.
   Action: Zebra mussel signage has been added to the two main marinas on the reservoir and at all public boat ramps. Partnership with Water-Oriented Recreation District (WORD) has provided $5,000 annually since 2014 for TPWD invasive species awareness campaign, including a billboard in San Marcos. Summer zebra mussel surveys were conducted in 2015. Several at risk vessels have been inspected for zebra mussels by District staff before being cleared to launch in the reservoir.

Harvest regulation history: Sport fishes in Canyon Reservoir are currently managed with statewide regulations (Table 3).

Stocking history: Florida Largemouth Bass were stocked in 2014 and 2015 to increase genetic influence and promote growth potential. Striped Bass were an important species requested for annual stockings. Blue Catfish were stocked in 1991-92. A complete stocking history is in Table 4.

Vegetation/habitat management history: Canyon Reservoir has historically lacked aquatic vegetation due to its rocky and steep shoreline. A vegetation survey in August 2015 found no significant stands of vegetation. Littoral zone structural habitat was primarily rocky shoreline, natural shoreline, and rock bluff. Standing timber and marinas provided some cover for centrarchids. Artificial fish attractors have been installed and maintained around the reservoir (Appendix D through F) to provide habitat for cover-seeking species and to help improve angler success.

Water Transfer: There are no inter-basin water diversion structures at Canyon Reservoir.

METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Canyon 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 electrofishing (1.5 hours at 18, 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. A category-2 age and growth evaluation (using otoliths from 13 randomly-selected fish ranging 13.0 to 14.9 inches) was completed for Largemouth Bass (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Gill netting – Channel Catfish, Blue Catfish, Flathead Catfish, Striped Bass, 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). In 2016, a stratified random sampling strategy was employed for gill nets targeting Striped Bass as part of the 2016-2020 objective-based sampling plan. Stratified sampling was one option to reach target relative standard error (RSE) while minimizing effort. Additional surveys will allow further evaluation of this method. Canyon Reservoir was divided into three sections (upper, middle, lower) with approximately equal area. Historic gill net catch rates (2004-2014) were used to determine how much each section contributed to total catch of Striped Bass (Appendix C). Proportions of total catch for each section were: upper = 25%, middle = 30%, lower = 45%. The closest arrangement of gill nets to these proportions was: upper = 4 nets, middle = 5 nets, lower = 6 nets. Gill nets were randomly distributed in each section. White Bass and catfish species were collected under this sampling regime. All Striped Bass captured were aged.

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 2015.

Statistics – Sampling statistics (CPUE for various length categories), and 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 statistics.

Habitat – A structural habitat and vegetation survey was conducted in 2015. Habitat was assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Water level - Source for water level data was the United States Geological Survey (USGS 2016).

RESULTS AND DISCUSSION

Habitat: In 2015, littoral zone habitat consisted primarily of rocky shoreline, natural shoreline, and rock bluff. Standing timber and marinas provided cover for centrarchids (Table 6). No aquatic vegetation was found, which is not optimal for fish production (Durocher et al. 1984, Dibble et al. 1996). Fish in this reservoir relate mainly to irregular topographical features and available cover. A fish attractor project was initiated in 2005 to help concentrate cover-seeking species and increase angler catch rates. Juniper trees (*Juniperus ashei*) and fabricated polyethylene fish attractors were installed at 19 sites in 2005 (Appendix D). Since 2005, 24 sites have been added for a total of 43 fish attractor sites throughout the reservoir (Appendix E). Attractor sites are refurbished annually with assistance from partner organizations and volunteers. Global positioning system (GPS) coordinates were made available to the public (Appendix F), and direct observation through scuba diving revealed that cover-seeking species were attracted to these structures.

Prey species: Electrofishing catch rates of Gizzard Shad, Redbreast Sunfish and Bluegill were 142.7/h, 199.3/h, and 154.0/h, respectively. Threadfin Shad and other sunfish species were also available as forage. Index of Vulnerability (IOV) for Gizzard Shad was good, indicating that 79% of Gizzard Shad were available to existing predators. Total CPUE of Gizzard Shad increased from 42.7/h (2011) to 142.7/h (2015), likely due to rising water level. Most of the increase in Gizzard Shad abundance was from fish 4 to 7 inches in length (Figure 2). Redbreast Sunfish was the dominant sunfish species in Canyon Reservoir with the majority of the sampled population dominated by small individuals (PSD = 19; Figure 3). Total CPUE of Bluegill in 2015 (154.0/h) was more than double the survey in 2011 (70.0/h), and size structure continued to be dominated by small individuals (PSD = 6; Figure 4). An increase in forage abundance may be a result of increased flooded littoral habitat due to the reservoir returning to conservation pool level in 2015-16 after a prolonged drought event.

Blue Catfish: Blue Catfish gill net catch rate (2.5/nn) in 2014 remained low but was double that of 2012, when it was 1.2/nn (Figure 5). All individuals sampled were ≥12 inches, and large individuals ≥25 inches were present. Aging from otoliths in 2008 revealed that Blue Catfish were reproducing in Canyon Reservoir with individual ages ranging from 3 to 17 years (N = 13). Body condition has improved since 2012 as average relative weights (Wr) have increased for several inch groups (range: 82–102). In 2016, stratified random gillnets resulted in a catch rate of 1.1/nn (Figure 6). Average relative weights for 2016 ranged from 85 to 109.

Channel Catfish: The gill net catch rate for Channel Catfish was 0.6/nn in 2014, which was a decrease since the 2012 survey (1.6/nn; Figure 7). Individuals <12 inches in length indicated reproduction was occurring. Large Channel Catfish (≥20 inches) were not present in this survey. Condition was good as average relative weights (Wr) of stock-size fish remained above 85 (range: 91–101). In 2016, stratified random sampling resulted in a catch rate of 1.1/nn (Figure 8). Average relative weights for 2016 ranged from 75 to 128.

Flathead Catfish: Flathead Catfish were present in low density (0.7/nn) in 2014, with decreased abundance since the 2012 survey (1.3/nn; Figure 9). All individuals were over 18 inches, and large individuals (≥30 inches) were present. Body condition (Wr) ranged from 80 to 100. In 2016, stratified random sampling resulted in a catch rate of 0.7/nn (Figure 10). Average relative weights for 2016 ranged from 40 to 103.

White Bass: The gill net catch rates for White Bass were consistent for the 2010 (1.5/nn), 2012 (1.4/nn), and 2014 (1.6/nn) surveys (Figure 11) and were lower than the historical values average 3.9/nn. Stratified random sampling resulted in a gill net catch rate of 3.0/nn for 2016 (Figure 12). This rate can serve as a new baseline for future stratified sampling. Drought conditions may have impacted White Bass abundance in recent years, but consistent catch rates and capture of smaller individuals in 2014 may be evidence that this species has maintained a viable population for anglers. Canyon Reservoir is well

known for its White Bass spring spawning migrations, which provide great angling opportunities for this species in the upper portion of the reservoir. This population has served as a broodstock source for TPWD's Palmetto Bass production in the past.

Striped Bass: The gill net catch rate of Striped Bass was 1.0/nn in 2014, an increase from 2012 (0.5/nn), but less than 2010 (2.9/nn; Figure 13). Missing year classes of two- and three-year-old individuals in the 2014 survey were due to missed stockings in 2011 and 2012. Body condition (W_r) was below average for most inch groups (range 71-95) and may be the result of stress from elevated water temperature and low dissolved oxygen conditions during the summer months (Magnelia and De Jesus 2008). From 2012 to 2016, Striped Bass reached the legal length limit (18 inches), on average between two and three years of age (Figure 15). In 2016, a stratified random sampling strategy was employed for gill nets targeting Striped Bass. The resulting catch was 3.4/nn (Figure 14), which was the highest CPUE for this species since 1986 (where online records began). High CPUE can be attributed to high catch rates of 2- and 3-year-old Striped Bass, which likely correlates to a double stocking rate in 2013, followed by a normal stocking event in 2014. This was reflected by 39 Striped Bass (2.6/nn) that were over 18 inches in the 2016 survey (also the highest since 1986). Body condition (Wr) decreased as fish length increased, likely due to summer stress. Future stratified random sampling will be compared to the 2016 survey. In October 2006, the Texas Department of State Health and Human Services issued a fish consumption advisory for Striped Bass. Elevated mercury levels were detected and it was advised that consumption be limited to two 8-oz. portions for adults and two 4-oz. portions for children per month. Striped Bass still provide a popular catch-and-release fishing opportunity at Canyon Reservoir (De Jesus and Magnelia 2008). Guides, angler reports, and tournament results attest to the availability of quality- to trophy-sized fish.

Smallmouth Bass: Electrofishing catch rates have declined over the last three surveys. In 2007, Smallmouth Bass total catch was 19 fish (12.7/h), in 2011 it was 12 fish (8.0/h), and in 2015 it was 2 fish (1.3/h; Figure 16). All individuals sampled in 2011 and 2015 were below the legal size limit (14 inches). Relative weights (W_r) of the two fish sampled in 2015 were average. A spring bass-only electrofishing survey targeting Smallmouth Bass in 2010 yielded a catch rate of 4.5/h with a small sample size of 7 fish. Only two fish were of legal size. Smallmouth Bass were initially stocked in the Guadalupe River Basin in 1974. Due to introgression with Guadalupe Bass, TPWD ceased stockings of Smallmouth Bass in this reservoir in 1989. Natural reproduction has been documented in Canyon Reservoir and in the Guadalupe River Basin.

Largemouth Bass: Largemouth Bass electrofishing total catch rates increased in 2015 (80.0/h) from 2011 (51.3/h; Figure 17). This was likely due to high water levels that began in May 2015, providing optimal littoral habitat. The 2015 catch rate was less than 2007 (113.3/h) when another high water event produced a strong year class (De Jesus and Magnelia 2008). The catch rate for legal-size fish (≥14 inches) increased to 9.3/h (29% of stock CPUE) since 2011, which was 4.0/h (11% of stock CPUE). Body condition (W_r) was average in 2015, with most inch groups averaging below 100. Largemouth Bass reached 14 inches between ages 2 and 3, but growth rates leveled off for older fish (N = 13; Figure 18). This is similar to the findings of previous surveys (De Jesus and Magnelia 2008, De Jesus and Farooqi 2012). Florida Largemouth Bass (FLMB) genetic influence in the population increased to 70% in 2015 from 59% in 2007 (Table 7). One pure FLMB was sampled in 2015, with no pure Northern Largemouth Bass sampled. Largemouth Bass have historically been the most sought after sport fish species in Canyon Reservoir (Magnelia and Bonds 2004).

Fisheries management plan for Canyon Reservoir, Texas

Prepared – July 2016.

ISSUE 1: Striped Bass provide quality catch-and-release opportunities for recreational anglers at Canyon Reservoir, with limited harvest due to the current consumption advisory. Low stocking rates combined with low harvest allow for some fish to live long and grow well, providing trophy opportunities. Since 2013, hatchery production has allowed stockings to resume on an annual basis. This fishery is contingent on supplemental stockings.

MANAGEMENT STRATEGIES

1. Continue to request annual Striped Bass stockings at a rate of 5/acre.
2. Continue to monitor Striped Bass abundance with randomly-stratified gill net surveys.

ISSUE 2: Largemouth Bass are the reservoir's most sought after sport fish, but angler catch rates have traditionally been poor. The installation of fish attractors was successful at attracting Largemouth Bass and other cover-seeking species. Anecdotal reports indicated this program was very popular with Canyon Reservoir anglers, however the longevity of Juniper tree fish attractors is four years. Trees are locally available in several public parks on the reservoir at no cost and volunteers are readily available to provide labor.

MANAGEMENT STRATEGY

1. Continue to take advantage of the opportunities present to maintain fish attractor sites. When possible, coordinate efforts to create new sites or replenish existing sites.

ISSUE 3: Florida Largemouth Bass were stocked into Canyon Reservoir in 2008, 2010, 2014, and 2015 to increase genetic influence for growth. Recent stockings were conducted during high water level to take advantage of flooded shoreline habitat.

MANAGEMENT STRATEGY

1. Monitor genetic influence in Largemouth Bass collected during standard fall electrofishing survey in 2019.

ISSUE 4: Many invasive species threaten aquatic habitats and organisms in Texas and can adversely affect the state ecologically, environmentally, and economically. For example, zebra mussels (*Dreissena polymorpha*) can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches and plugging engine cooling systems. Giant Salvinia (*Salvinia molesta*) and other invasive vegetation species can form dense mats, interfering with recreational activities like fishing, boating, skiing and swimming. The financial costs of controlling and/or eradicating these types of invasive species are significant. Additionally, the potential for invasive species to spread to other river drainages and reservoirs via watercraft and other means is a serious threat to all public waters of the state.

MANAGEMENT STRATEGIES

1. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir.
2. Contact and educate marina owners about invasive species, and provide them with posters, literature, etc… so that they can in turn educate their customers.

3. Educate the public about invasive species through the use of media and the internet.
4. Make a speaking point about invasive species when presenting to constituent and user groups. 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

FY 2017- FY 2020

Sport fish, forage fish, and other important fishes

Sport fishes in Canyon Reservoir include Largemouth Bass, Smallmouth Bass, Guadalupe Bass, Blue Catfish, Channel Catfish, Flathead Catfish, White and Black Crappie, Striped Bass, and White Bass. Known important forage species include Redbreast Sunfish, Bluegill, and Gizzard Shad. A summary of objective-based sampling components is in Table 5.

Negligible/low density fisheries

Channel catfish: Channel Catfish were stocked in 1966 and are present in Canyon Reservoir, but population abundance is low. Water clarity is high and predation on juvenile catfish is likely high. Catch per unit effort (CPUE) from gill netting surveys in 2004, 2006, 2008, 2010, and 2012 were 1.7, 1.1, 1.2, 0.6, and 1.6/nn respectively. Channel Catfish accounted for 5.9% of the directed fishing effort in the last creel survey conducted on the reservoir (1999). General monitoring trend data (without precision or sample size requirements) can be gathered for this species while sampling for Striped Bass and White Bass with gill nets as outlined below.

Blue Catfish: Blue Catfish were stocked in Canyon Reservoir in 1991 and 1992. Catch per unit effort (CPUE) from gill netting surveys in 2004, 2006, 2008, 2010, and 2012 were 0.9, 0.6, 1.3, 0.5, and 1.2/nn respectively. Blue Catfish accounted for 0.5% of the directed fishing effort in the last creel survey conducted on the reservoir (1999). General monitoring trend data (without precision or sample size requirements) can be gathered for this species while sampling for Striped Bass and White Bass with gill nets as outlined below.

Flathead Catfish: Flathead Catfish are present in low abundance based on gill netting surveys. Catch per unit effort (CPUE) from gill netting surveys in 2004, 2006, 2008, 2010, and 2012 were 0.0, 0.4, 0.6, 0.5, and 1.3/nn respectively. General monitoring trend data (without precision or sample size requirements) can be gathered for this species while sampling for Striped Bass and White Bass with gill nets as outlined below.

Crappie: No trap netting has been conducted for crappie since 2003 (0.5/nn) because of historically low catch rates. During a 1999 creel survey, White Crappie angling activity accounted for only 3.6% of the total directed fishing effort, or 0.5 h/acre. Crappie will not be sampled in the 2017-2020 period.

Smallmouth Bass: Smallmouth Bass were initially stocked in the Guadalupe River Basin in 1974. The last stocking was in 1989. Catch per unit effort from electrofishing surveys in Canyon Reservoir in 2007, and 2011 were 12.7, and 8.0/h respectively. In addition, CPUE from a spring 2010 bass-only electrofishing survey targeting Smallmouth Bass was 4.5/h. This species does not provide a significant fishery. We will still monitor presence/absence with practical effort estimates from electrofishing surveys.

Guadalupe Bass: Catch per unit effort from electrofishing surveys in 2003, 2007, and 2011 were 5.3, 4.0, and 1.3/h respectively. This species does not provide a significant fishery. We will still monitor

presence/absence with practical effort estimates from electrofishing surveys.

Survey objectives, fisheries metrics, and sampling objectives

Largemouth Bass: In a 1999 creel survey, Largemouth Bass was the most sought-after sport fish with 46% of the total fishing effort directed toward this species. Canyon Reservoir is relatively clear, and lacks vegetation and woody cover. A fish attractor project was initiated in 2005 to help concentrate cover seeking species and increase angler catch rates. Anecdotal reports indicated this program was very popular with Canyon Reservoir anglers. Largemouth Bass are managed with a 14-inch minimum length regulation. Catch per unit effort from electrofishing surveys in 2003, 2007, and 2011 were 203.3, 113.3, and 51.3/h respectively. The reduced abundance in the 2011 survey may have reflected the impact of extreme drought conditions in 2009 and 2011. Trend data on CPUE, size structure, and body condition have been collected every four years since 1999 with fall nighttime electrofishing. Continuation of quadrennial trend data in this clear reservoir with night electrofishing in the fall will be sufficient to allow for determination of any large-scale changes in the Largemouth Bass population that may spur further investigation. A minimum of 18 randomly selected 5-min electrofishing sites will be sampled in 2019 (Table 8), but sampling will continue at random sites until 50 stock-size fish are collected and the RSE of CPUE-S is ≤ 25. Exclusive of the original 18 random stations, six additional random stations will be pre-determined in the event extra sampling is necessary. If failure to achieve either objective has occurred after one night of sampling and objectives can be attained with up to six additional random stations, another night of effort will be expended.

Striped Bass: Canyon Reservoir supports a low-density Striped Bass fishery. In 1999, Striped Bass were the third most sought-after species comprising 8.3% of the total directed fishing effort. Trend data on CPUE, size structure, and body condition have been collected biennially since 2000 with spring gill netting. Catch per unit effort from gill netting surveys in 2008, 2010, and 2012 were 1.8, 2.9, and 0.5/nn respectively. Due to production issues, Canyon Reservoir was not stocked in 2011 and 2012, but has since been stocked in 2013, 2014, and 2015. Variation in RSE values can be attributed to random sampling and weak or missing year classes when Striped Bass are not produced at hatcheries. It is believed that RSE values of 25 can be achieved with consistent sampling with stratified random or fixed sampling sites selected from historical catch data. Collecting a minimum of 50 stock-length Striped Bass during spring 2018 and 2020 gill netting (Table 8) will allow us to calculate proportions (i.e., size structure indices) with a 70% confidence interval. In other area lakes, catch rates from previous sample years indicate that this is an achievable goal if the standard sampling effort is doubled (30 net nights). However, a minimum of 15 stratified random gill net sites may help achieve this goal in this smaller reservoir. Fifteen stratified random gill net stations will be sampled in spring 2018 to determine if the goal is achievable. In addition to the original 15 stratified random stations, 5 additional stratified random stations will be pre-determined in the event extra sampling is necessary. If this approach does not achieve the goal; then we will consider transitioning to 15 strategically selected fixed gill netting sites in FY 2020. In addition to the original 15 fixed stations, 5 additional fixed stations will be pre-determined in the event extra sampling is necessary.

White Bass: In 1999, White Bass were the second most sought-after species comprising 24.8% of the total directed fishing effort. Catch per unit effort from gill netting surveys in 2008, 2010, and 2012 were 4.1, 1.5, and 1.4/nn respectively. Collecting a minimum of 50 stock-length White Bass during spring 2018 and 2020 gill netting (Table 8) will allow us to calculate proportions (i.e., size structure indices) with a 70% confidence interval. A minimum of 15 stratified random or strategically-selected fixed gill net sites may help achieve this goal. Fifteen stratified random gill net stations will be sampled in spring 2018 to determine if the goal is achievable. In addition to the original 15 stratified random stations, 5 additional stratified random stations will be pre-determined in the event extra sampling is necessary. If this approach does not achieve the goal; then we will consider transitioning to 15 strategically-selected fixed gill netting sites in FY 2020. In addition to the original 15 fixed stations, 5 additional fixed stations will be pre-determined in the event extra sampling is necessary.

Redbreast Sunfish, Bluegill, and Gizzard Shad: Redbreast Sunfish, Bluegill, and Gizzard Shad are the primary forage at Canyon Reservoir. Trend data on CPUE and size structure of Redbreast Sunfish, Bluegill, and Gizzard Shad have been collected quadrennially since 1999. Continuation of sampling for 2019, as per Largemouth Bass above, will allow for monitoring of large-scale changes in Redbreast Sunfish, Bluegill, and Gizzard Shad relative abundance and size structure. Sampling effort based on achieving sampling objectives for Largemouth Bass will result in sufficient numbers of Redbreast Sunfish, Bluegill, and Gizzard Shad for size structure estimation (PSD and IOV; 50 fish minimum at 5-12 stations with 80% confidence), but not for relative abundance estimates (RSE $\leq$ 25 of CPUE-Total; anticipated effort is 25-30 stations). At the sampling effort needed to achieve sampling objectives for Largemouth Bass, the expected RSE for CPUE-T is 30 for Redbreast Sunfish and Bluegill, and 35 for Gizzard Shad. No additional effort will be expended to achieve an RSE ≤ 25 for CPUE of Redbreast Sunfish, Bluegill, and Gizzard Shad. Instead, Largemouth Bass body condition can provide information on forage abundance, vulnerability, or both relative to predator density. Relative weight of Largemouth Bass $\geq$ 8" TL will be determined from their length/weight data (maximum of 10 fish weighed and measured per inch class).

LITERATURE CITED

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

DiCenzo, V. J., M. J. Maceina, and M. R. Stimert. 1996. Relations between reservoir trophic state and gizzard shad population characteristics in Alabama reservoirs. North American Journal of Fisheries Management 16:888-895.

Dibble, E. D., K. J. Killgore, and S. H. Harrel. 1996. Assessment of fish-plant interactions. American Fisheries Society Symposium 16:357-372

Durocher, P. P., W. C. Provine, and J. E. Kraai. 1984. Relationship between abundance of largemouth bass and submerged vegetation in Texas reservoirs. North American Journal of Fisheries Management 4:84-88.

De Jesus, M. J., and S. J. Magnelia. 2008. Statewide freshwater fisheries monitoring and management program survey report for Canyon Reservoir, 2007. Texas Parks and Wildlife Department, Federal Aid Report F-30-R-33, Austin, TX. 33 pp.

De Jesus, M. J., and M. Farooqi. 2012. Inland Fisheries Division monitoring and management program survey report for Canyon Reservoir, 2011. Texas Parks and Wildlife Department, Federal Aid Report F-221-M-2, Austin, TX. 36 pp.

Guy, C. S., R. M. Neumann, D. W. Willis, and R. O. Anderson. 2007. Proportional Size Distribution (PSD): A Further Refinement of Population Size Structure Index Terminology. Fisheries 32(7):348.

Magnelia, S. J., and C. C. Bonds. 2004. Statewide freshwater fisheries monitoring and management program survey report for Canyon Reservoir, 2004. Texas Parks and Wildlife Department, Federal Aid Report F-30-R-29, Austin, TX. 29 pp.

United States Geological Society (USGS). 2016. National water information system: Web interface. Available: http://waterdata.usgs.gov/tx/nwis (June 2016).

.

Water Level

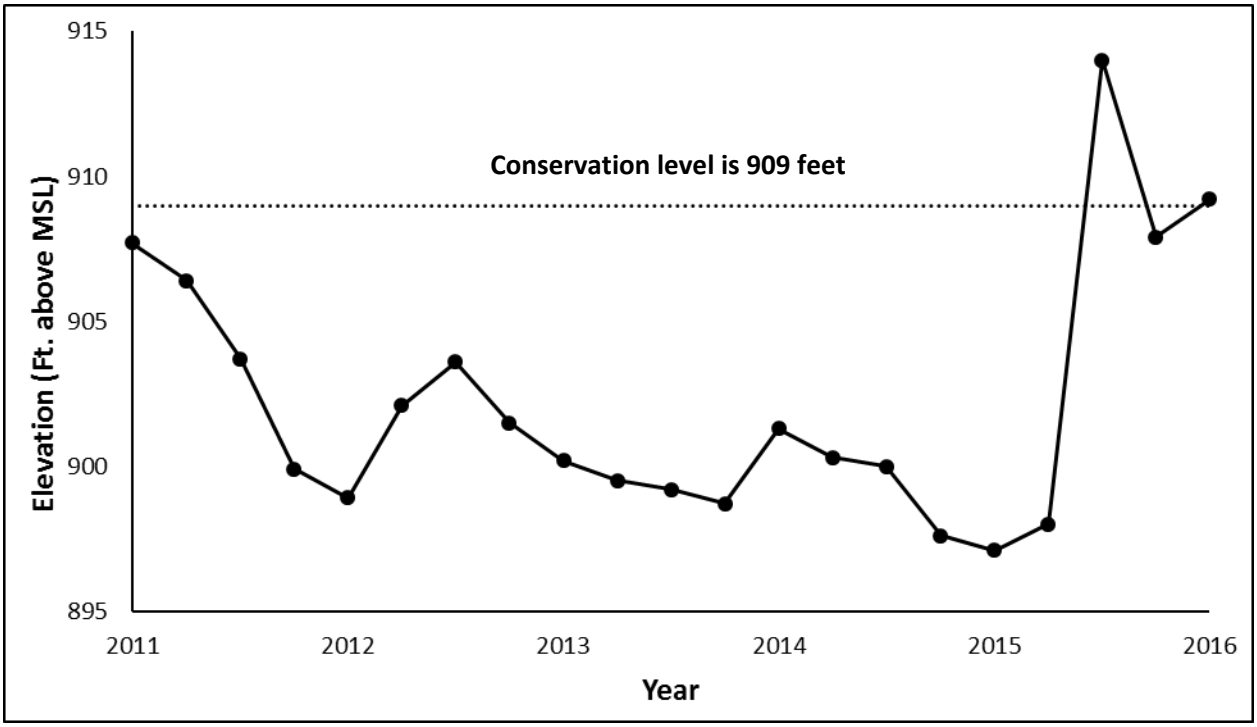


Figure 1. Quarterly mean water level elevations in feet above mean sea level (MSL) recorded for Canyon Reservoir, Texas.

Table 1. Characteristics of Canyon Reservoir, Texas.

Characteristic	Description
Year constructed	1964
Controlling authority	USACE
County	Comal
Reservoir type	Mainstem
Shoreline Development Index (SDI)	6.30
Conductivity	320 µS/cm

Table 2. Boat ramp characteristics for Canyon Reservoir, Texas, August, 2015. Reservoir elevation at time of survey was 908.61 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking Capacity (N)	Closure Elevation (ft.)	Condition
Skyline Park	29.85029 -98.20791	Y	17	897.60	Good
Turkey Cove	29.86019 -98.22567	Y	25	898.50	Good
Comal Park ramp #1	29.86093 -98.25168	Y	16	898.00	Good
Comal Park ramp #2	29.86289 -98.24555	Y	54	902.50	Good
Tom Creek #1	29.86994 -98.25478	Y	16	905.80	Good
Tom Creek #2	29.87279 -98.26378	Y	13	890.00	Good
Canyon Lake Hills 1 East	29.87292 -98.26385	Y	40	890.00	Good
Canyon Lake Hills 2 West	29.89537 -98.26787	Y	11	904.76	Good
Canyon Springs Resort	29.88326 -98.28489	Y	10	899.86	Good
Cranes Mill Marina	29.88870 -98.29066	Y	30	899.00	Good
Cranes Mill Park	29.89537 -98.29247	Y	45	903.00	Good
Cypress Cove (Rebecca Creek)	29.91364 -98.33871	Y	8	901.60	Good
Sunny Side (Joint Base S.A. East)	29.88230 -98.21728	Y	20	Unknown	Good
Hancock Cove (Joint Base S.A. West)	29.89081 -98.21742	Y	10	Unknown	Good
Jacobs Creek #1	29.88241 -98.22359	Y	22	878.00	Good
Jacobs Creek #2	29.88307 -98.22304	Y	22	893.00	Good
Jacobs Creek North	29.89372 -98.21424	Y	55	889.00	Good

Table 2 Continued.

Boat ramp	Latitude Longitude (dd)	Public	Parking Capacity (N)	Closure Elevation (ft.)	Condition
Canyon Park	29.89391 -98.23027	Y	100	883.00	Good
Potters Creek Park	29.90534 -98.26747	Y	30	895.00	Good
Potter Creek Park West	29.90638 -98.27645	Y	30	893.00	Good
North Cranes Mill Road	29.91455 -98.29238	Y	40	905.15	Good
Canyon Lake Marina	29.90030 -98.23381	Y	75	884.00	Good

Table 3. Harvest regulations for Canyon Reservoir, Texas.

Species	Bag Limit	Length Limit (inches)
Catfish: Channel Catfish, Blue Catfish, hybrids and subspecies	25 (in any combination)	12 minimum
Catfish, Flathead	5	18 minimum
Bass, White	25	10 minimum
Bass, Striped	5	18 minimum
Black bass: Largemouth, Smallmouth, Guadalupe	5 (in any combination)	14 minimum*
Crappie: White and Black crappie, their hybrids and subspecies	25 (in any combination)	10 minimum

*Guadalupe Bass have no minimum length limit.

Table 4. Stocking history of Canyon Reservoir, Texas. Life stages are fry (FRY), fingerlings (FGL), advanced fingerlings (AFGL), adults (ADL) 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)
Black Crappie	1967	5,000	UNK	UNK
	1988	57,446	FGL	1.0
	Total	62,446		
Blue Catfish	1991	79,991	FGL	2.5
	1992	179,804	FGL	2.4
	Total	259,795		
Channel Catfish	1966	19,200	AFGL	7.9
	Total	19,200		
Florida Largemouth Bass	1987	34,320	FGL	2.0
	2008	407,962	FGL	1.6
	2010	294,856	FRY	0.3
	2014	240,199	FGL	1.5
	2015	84,009	FGL	1.7
	2016	110.000	FGL	
	Total	1,171,346		
Largemouth Bass	1987	30,380	FGL	2.0
	Total	30,380		
Rainbow Trout	2016	200	ADL	12.0
	Total	200		
Smallmouth Bass	1974	85,000	UNK	UNK
	1975	100,000	UNK	UNK
	1976	125,000	UNK	UNK
	1988	416,226	FRY	0.5
	1989	1,879	FGL	1.1
	1989	3,907	FRY	0.0
	Total	732,012		
Striped Bass	1973	19,750	FGL	1.7
	1974	13,290	FGL	1.7
	1976	88,317	UNK	UNK
	1977	100,169	UNK	UNK
	1981	42,852	UNK	UNK
	1983	40,000	UNK	UNK
	1989	40,500	FRY	1.0
	1990	41,985	FGL	1.3
	1991	42,525	FGL	1.6
	1993	64,993	FGL	1.1
	1994	124,406	FGL	1.1
	1994	1,575,581	FRY	0.8

Species	Year	Number	Life Stage	Mean TL (in)
Striped Bass	1995	42,052	FGL	1.2
	1997	41,441	FGL	1.1
	1998	41,267	FGL	1.3
	1999	41,630	FGL	1.4
	2000	42,000	FGL	1.6
	2002	39,156	FGL	1.5
	2005	43,970	FGL	1.6
	2006	42,980	FGL	1.7
	2007	42,751	FGL	1.9
	2008	41,664	FGL	1.7
	2009	48,546	FGL	1.8
	2010	42,210	FGL	1.9
	2013	75,810	FGL	1.9
	2013	495,000	FRY	0.2
	2014	36,439	FGL	1.6
	2015	39,212	FGL	1.6
	Total	3,350,496		
Walleye	1965	500,000	FRY	0.2
	1973	1,068,920	FRY	0.2
	1974	371,080	FRY	0.2
	1981	4,370,000	FRY	0.2
	1984	3,925,000	FRY	0.2
	1985	48,910	FGL	2.0
	1985	17,203	FRY	0.6
	Total	10,301,113		
White Crappie	1966	2,000	UNK	UNK
	1967	5,000	UNK	UNK
	Total	7,000		

Table 5. Objective-based sampling plan components for Canyon Reservoir, Texas 2015-2016.

Gear/target species	Survey objective	Metrics	Sampling objective
Electrofishing			
Largemouth Bass	Abundance	CPUE – stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Age-and-growth	Age at 14 inches	N = 13, 13.0 – 14.9 inches
	Condition	W_r	10 fish/inch group (max)
	Genetics	% FLMB	N = 30, any age
Redbreast Sunfish	Abundance	CPUE – Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
Bluegill	Abundance	CPUE – Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
Gizzard Shad	Abundance	CPUE – Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
	Prey availability	IOV	N ≥ 50
Gill netting			
Striped Bass	Abundance	CPUE– stock	RSE-Stock ≤ 30
	Size structure	Length frequency	N ≥ 50 stock
	Age-and-growth	Length-at-age	N ≥ 50 stock
	Condition	W_r	10 fish/inch group (max)
White Bass	Abundance	CPUE – stock	RSE-Stock ≤ 30
	Size structure	Length frequency	N ≥ 50 stock
	Condition	W_r	10 fish/inch group (max)

Table 6. Survey of structural habitat types, Canyon Reservoir, Texas, 2015. Shoreline habitat type units are in miles and standing timber is acres.

Habitat Type	Estimate	% of total
Rocky	39.3 miles	49.2
Natural	32.1 miles	40.1
Rock bluff	7.1 miles	8.9
Gravel	0.8 miles	1.0
Rocky with boat docks	0.4 miles	0.5
Rock bluff with boat docks	0.3 miles	0.4
Standing timber	549 acres	6.6

Gizzard Shad

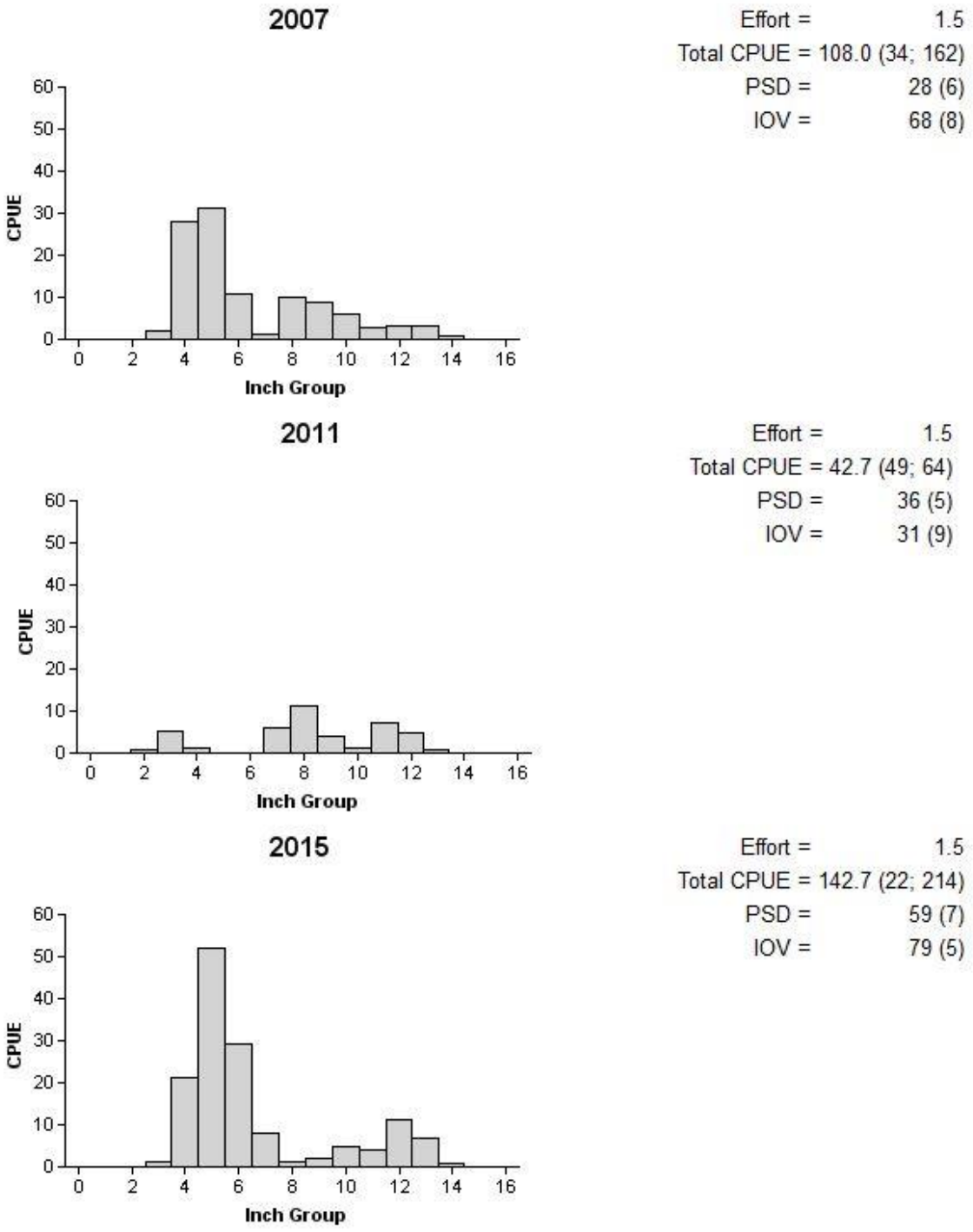


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV and size structure are in parentheses) for fall electrofishing surveys, Canyon Reservoir, Texas, 2007, 2011, and 2015.

Redbreast Sunfish

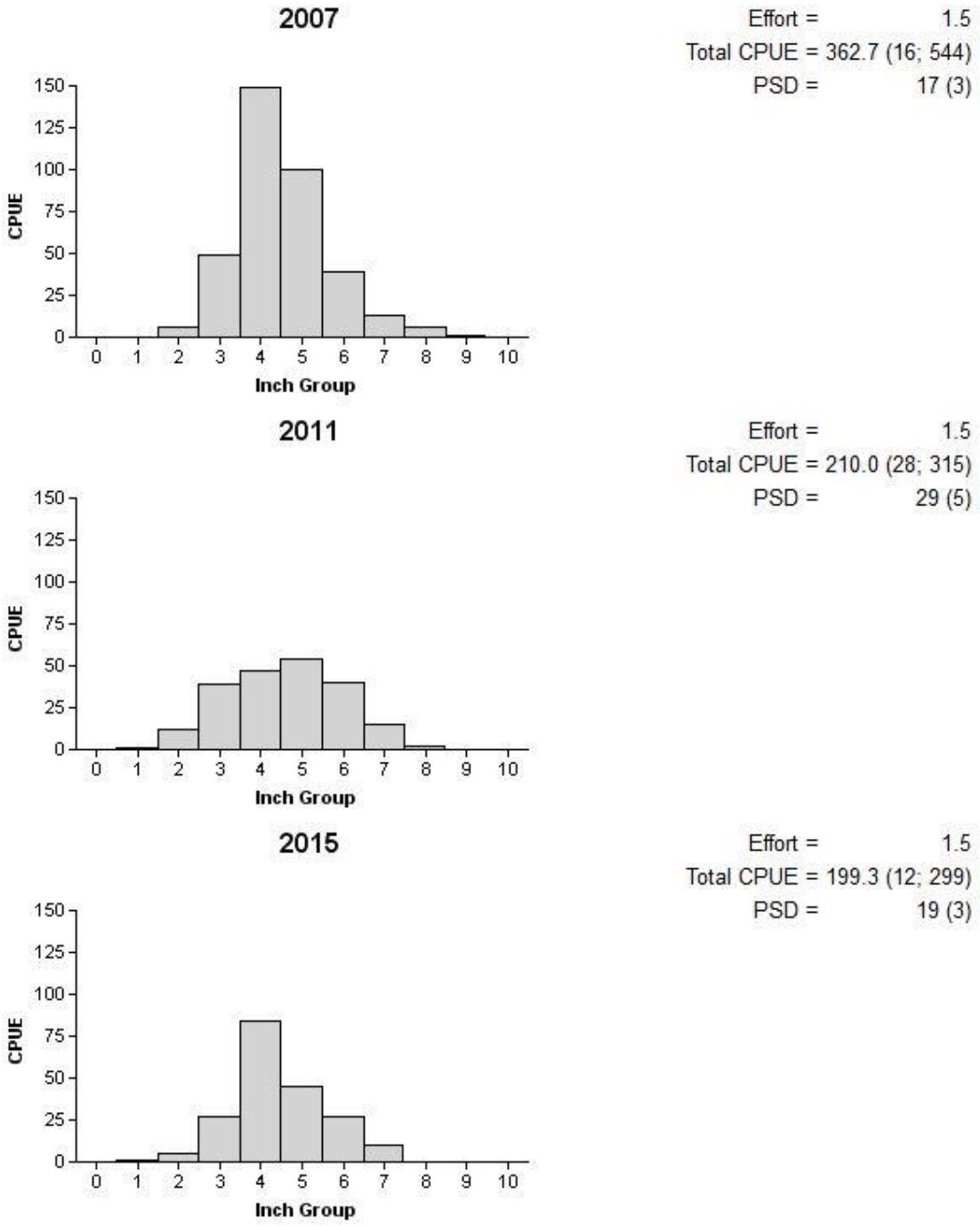


Figure 3. Number of Redbreast Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Canyon Reservoir, Texas, 2007, 2011 and 2015.

Bluegill

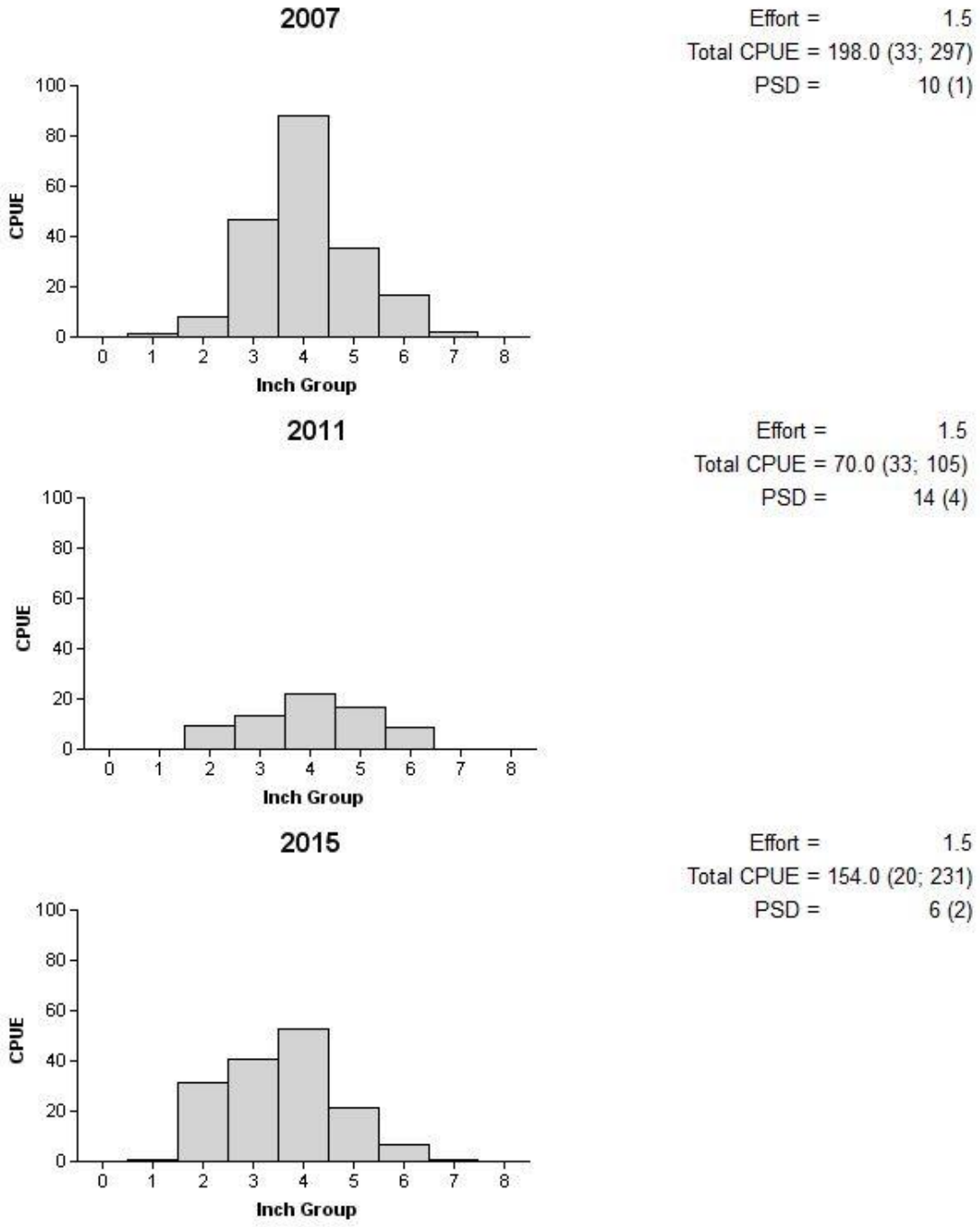


Figure 4. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Canyon Reservoir, Texas, 2007, 2011 and 2015.

Blue Catfish

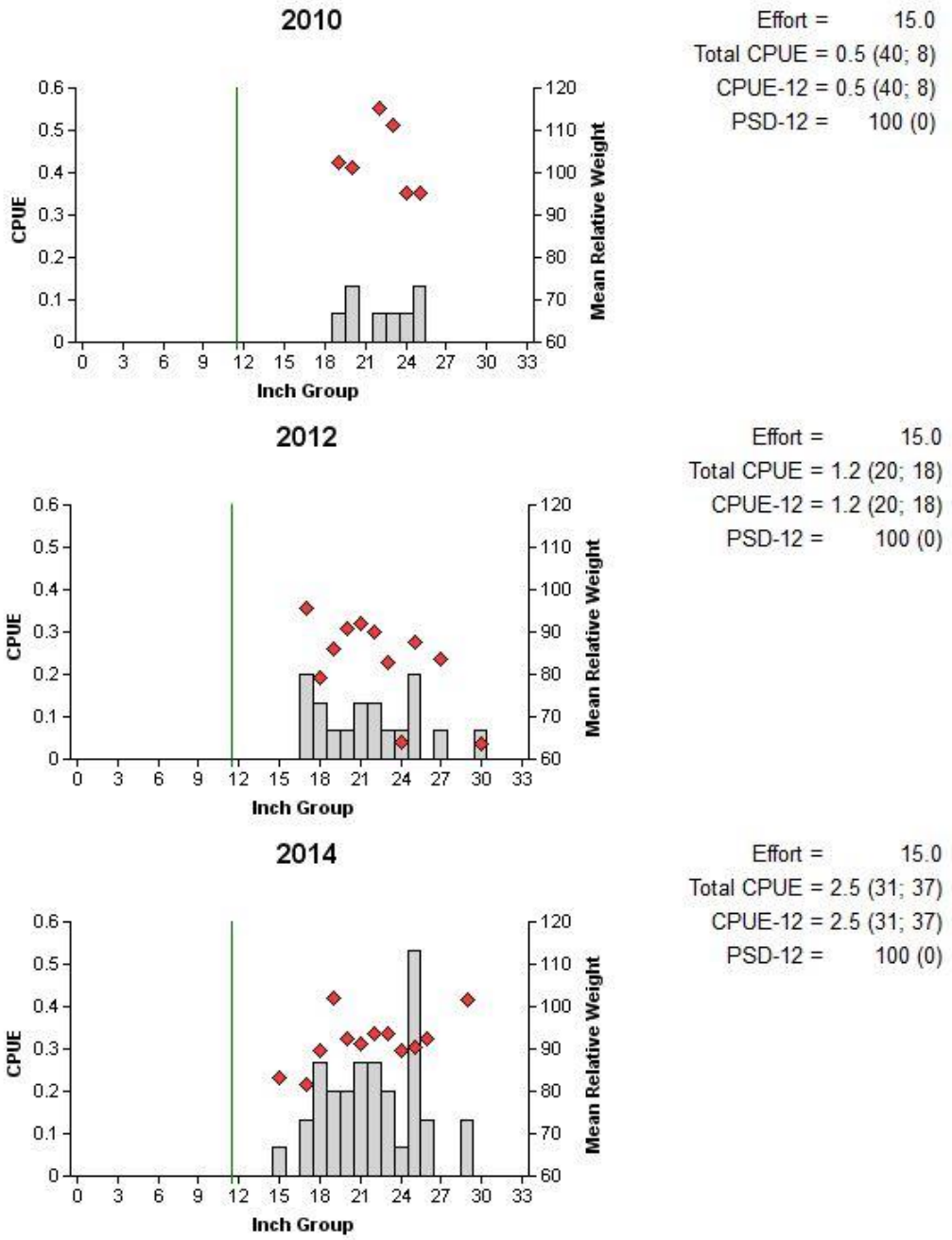


Figure 5. Number of Blue Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Canyon Reservoir, Texas, 2010, 2012 and 2014. Vertical line represents minimum length limit at the time of the survey.

Blue Catfish

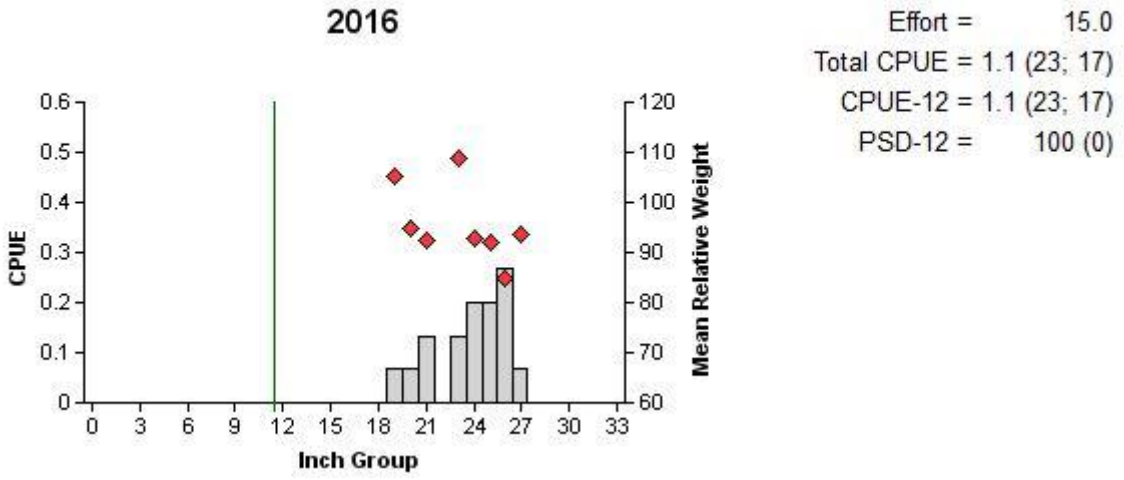


Figure 6. Number of Blue Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for stratified random spring gill net survey, Canyon Reservoir, Texas, 2016. Vertical line represents minimum length limit at the time of the survey.

Channel Catfish

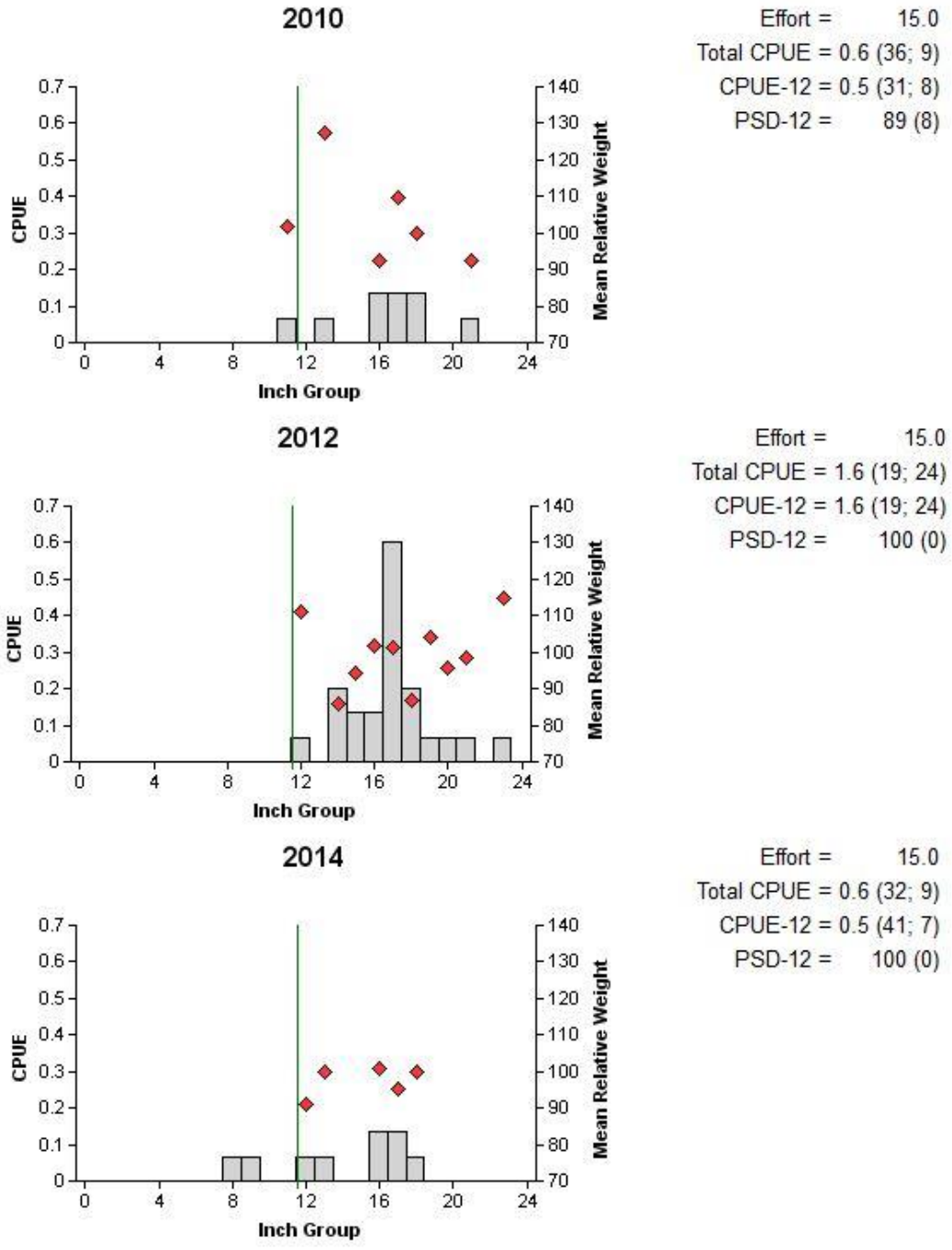


Figure 7. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Canyon Reservoir, Texas, 2010, 2012 and 2014. Vertical line represents minimum length limit at the time of the survey.

Channel Catfish

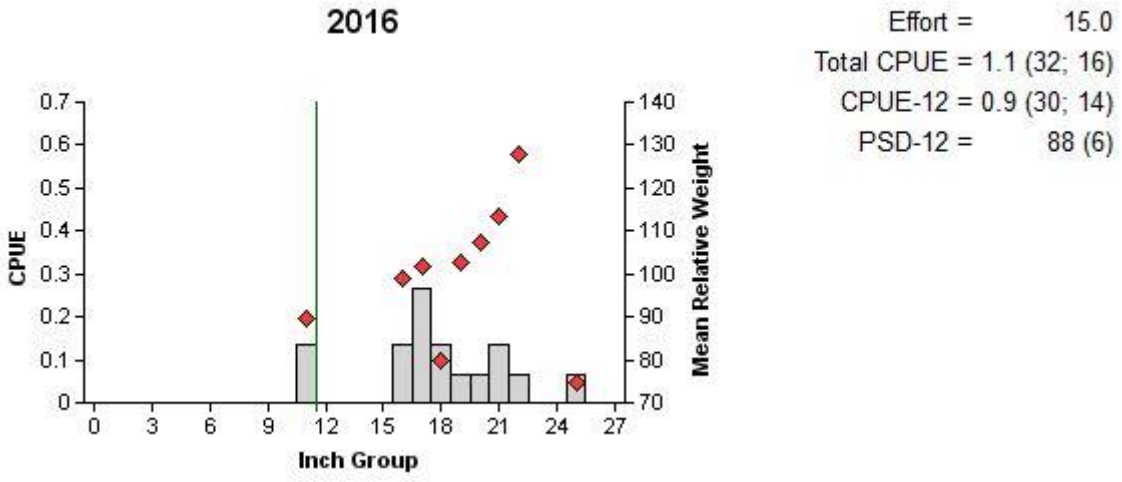


Figure 8. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for stratified random spring gill net survey, Canyon Reservoir, Texas, 2016. Vertical line represents minimum length limit at the time of the survey.

Flathead Catfish

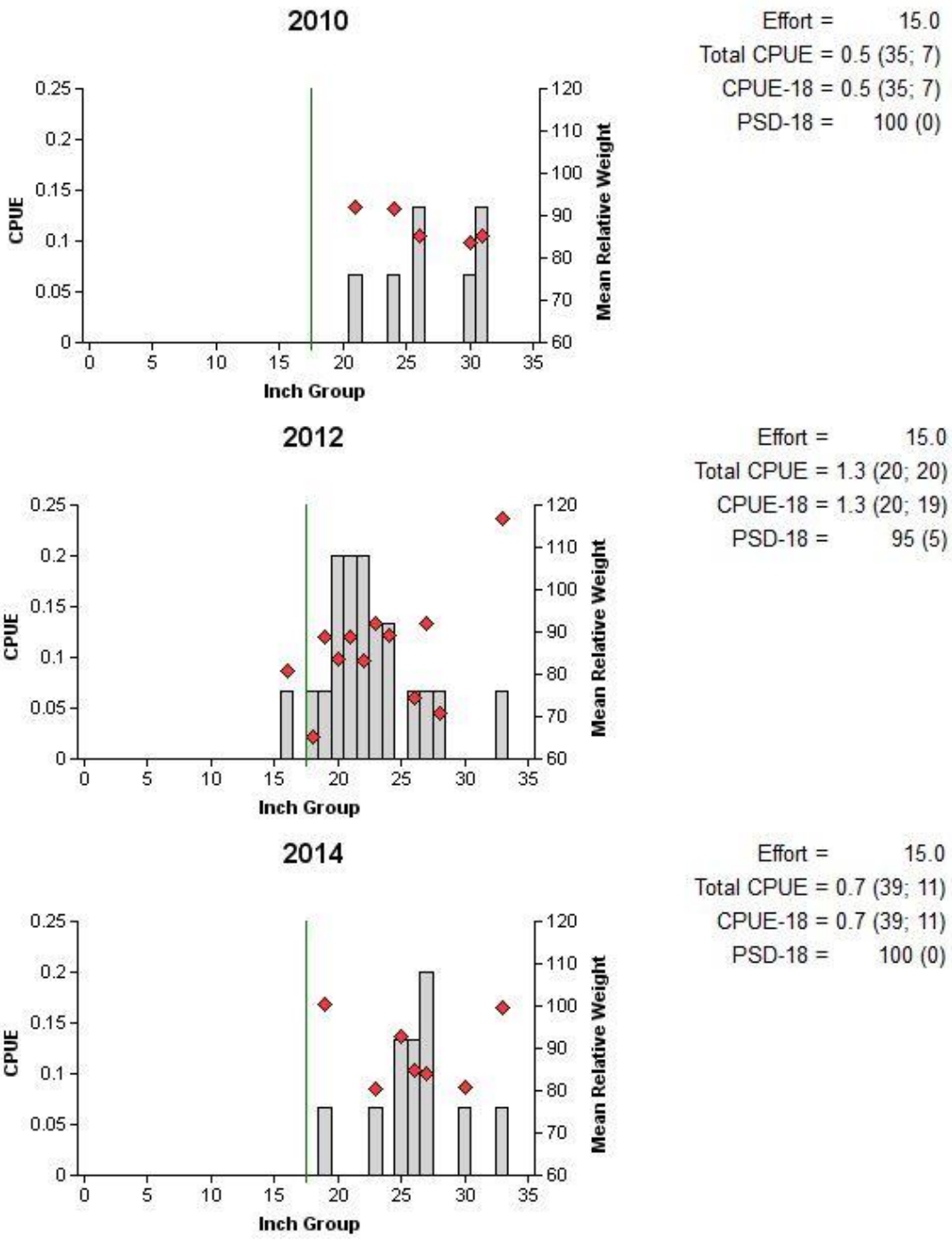


Figure 9. Number of Flathead Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for spring gill net surveys, Canyon Reservoir, Texas, 2010, 2012 and 2014. Vertical line represents the minimum length limit at the time of the survey.

Flathead Catfish

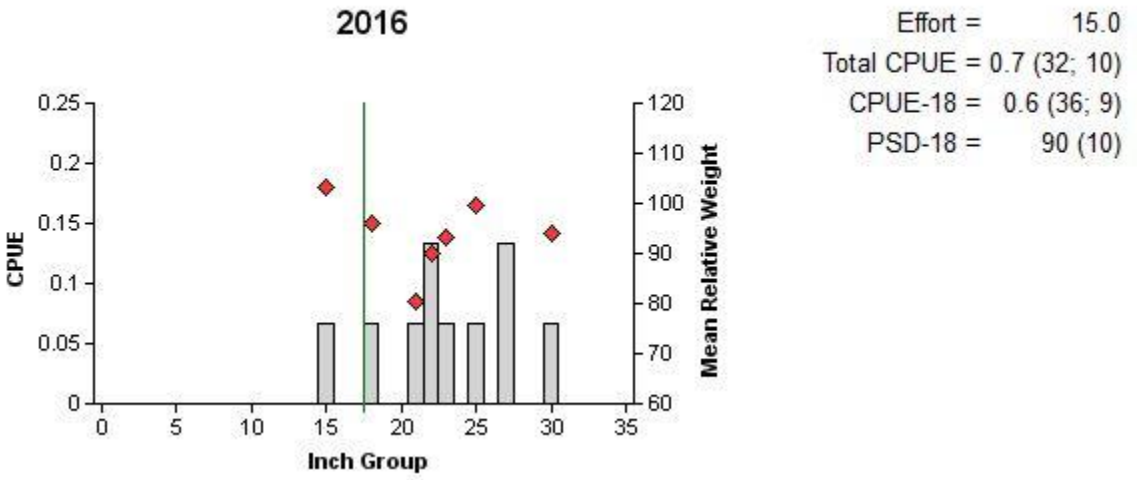


Figure 10. Number of Flathead Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for stratified random spring gill net survey, Canyon Reservoir, Texas, 2016. Vertical line represents the minimum length limit at the time of the survey.

White Bass

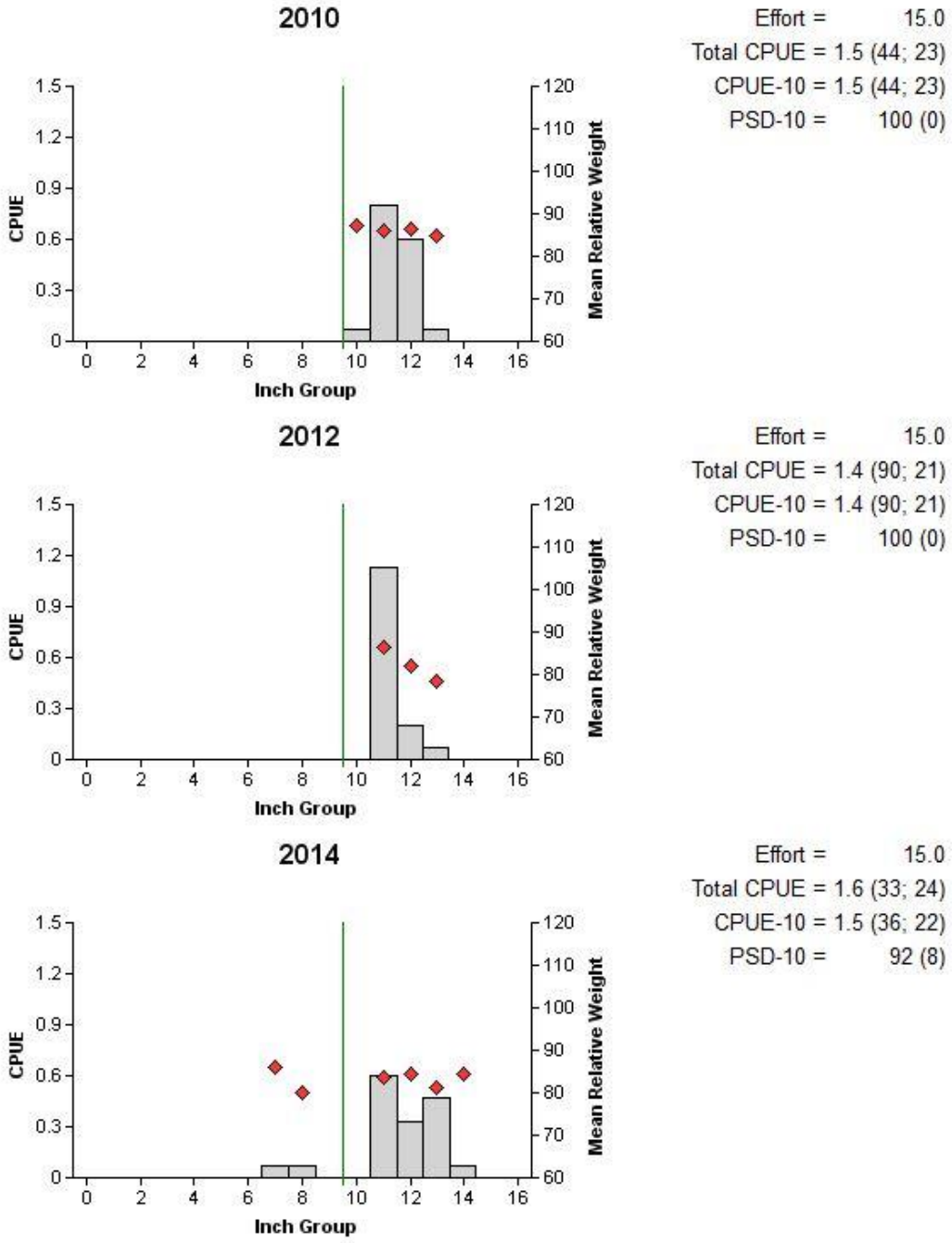


Figure 11. Number of White Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Canyon Reservoir, Texas, 2010, 2012 and 2014. Vertical line represents minimum length limit at the time of the survey.

White Bass

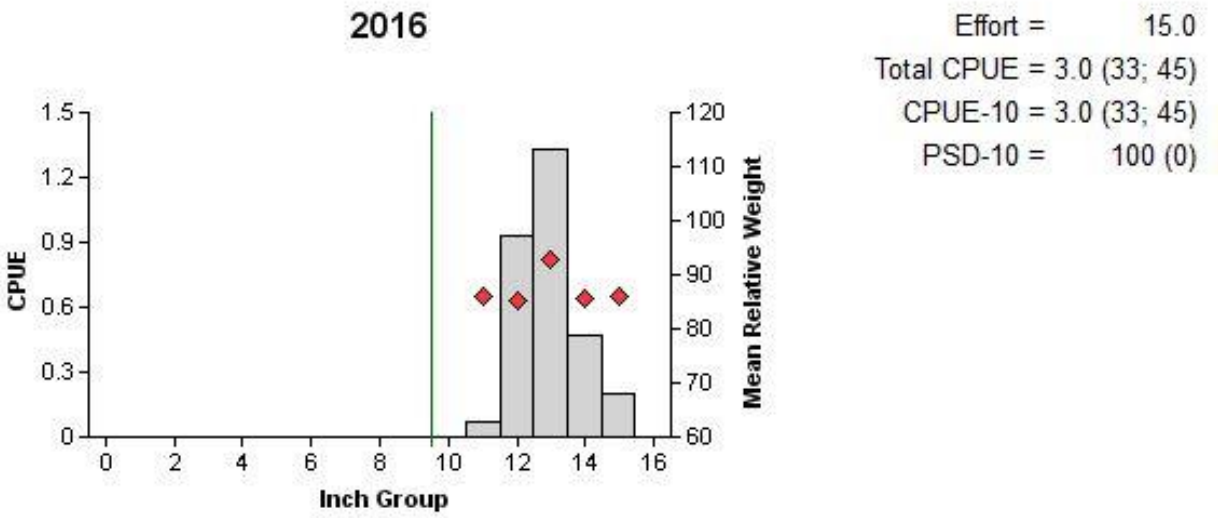


Figure 12. Number of White Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for stratified random spring gill net survey, Canyon Reservoir, Texas, 2016. Vertical line represents minimum length limit at the time of the survey.

Striped Bass

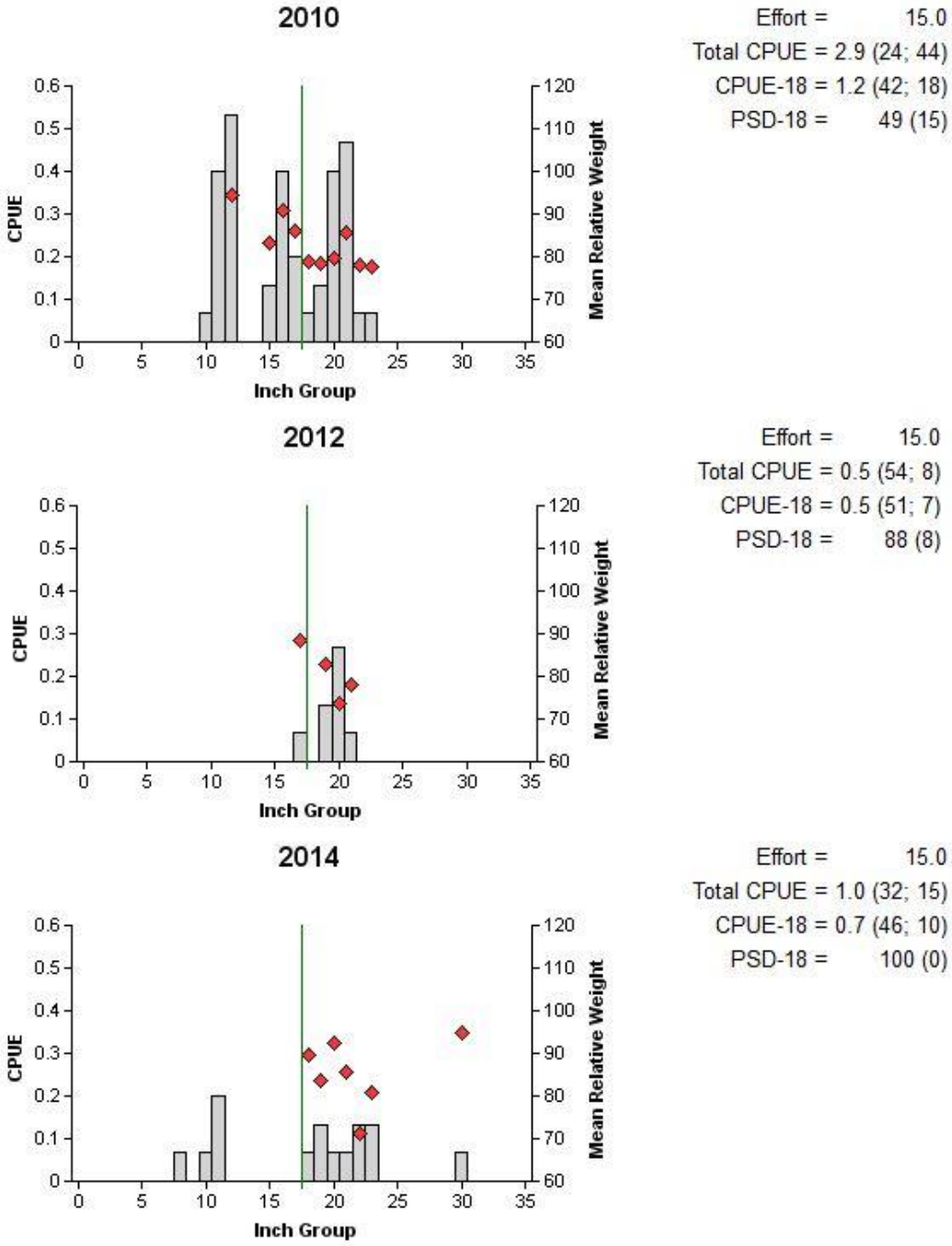


Figure 13. Number of Striped Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Canyon Reservoir, Texas, 2010, 2012 and 2014. Vertical line represents minimum length limit at the time of the survey.

Striped Bass

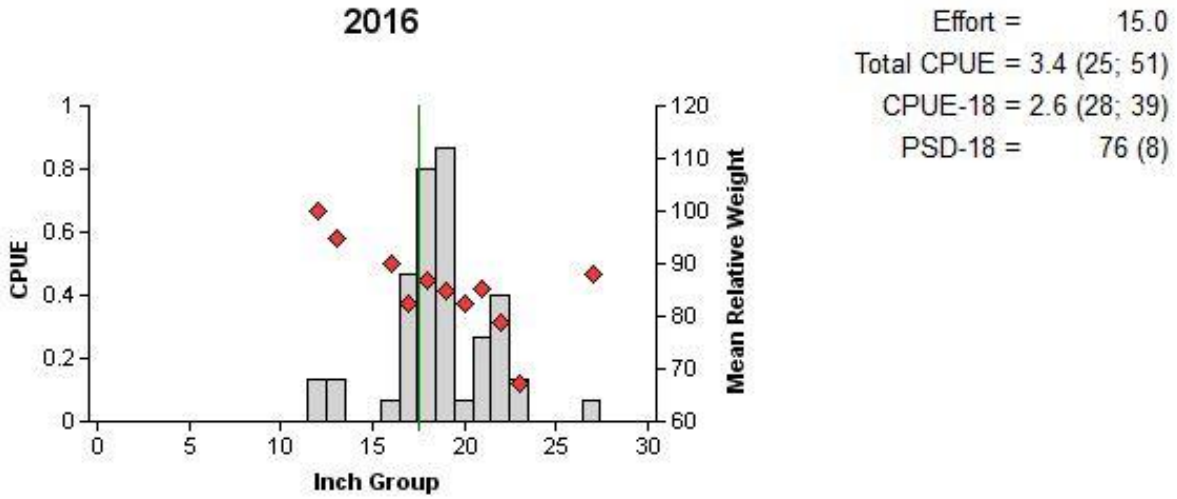


Figure 14. Number of Striped Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for stratified random spring gill net survey, Canyon Reservoir, Texas, 2016. Vertical line represents minimum length limit at the time of the survey.

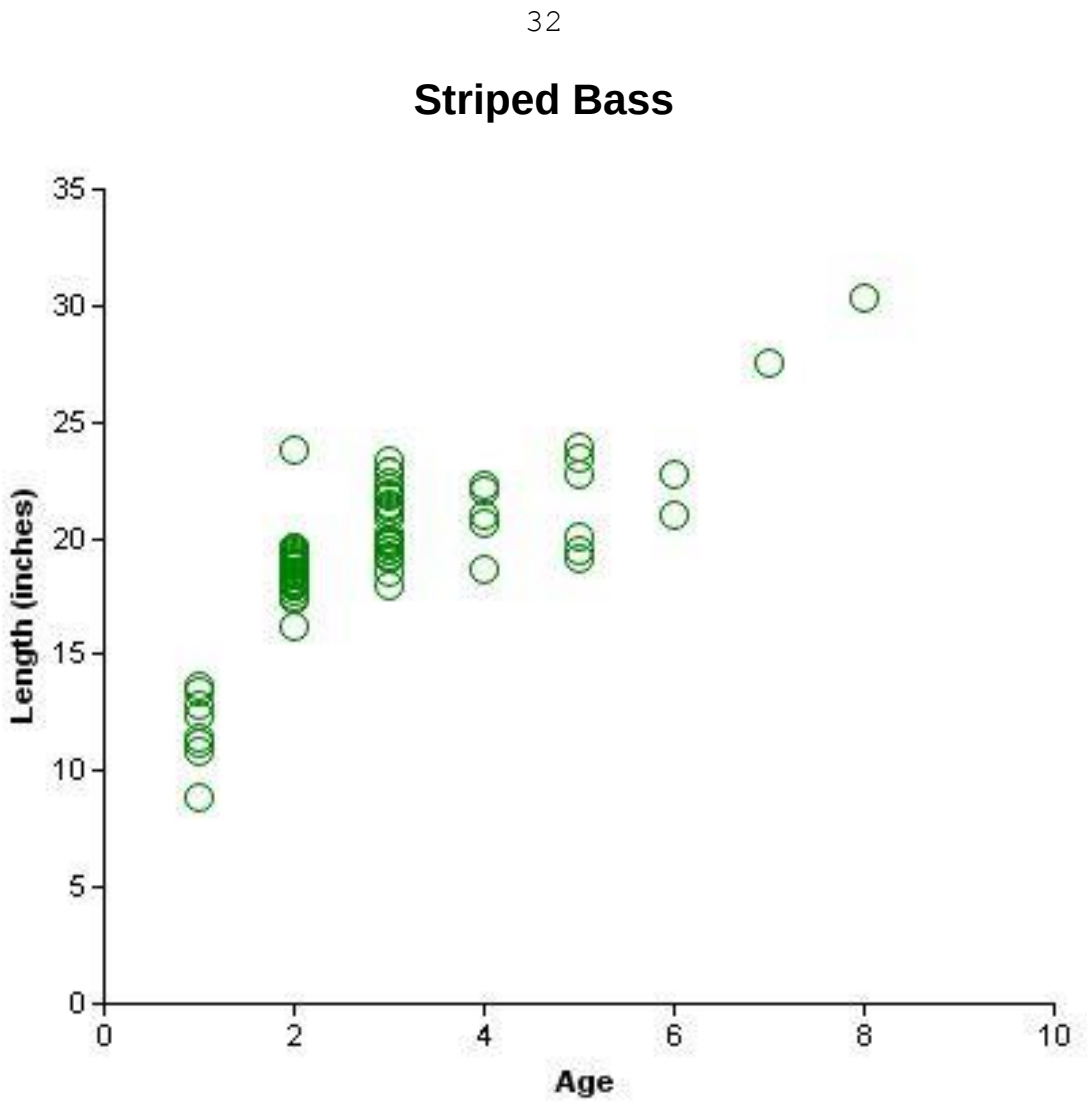


Figure 15. Length at age for Striped Bass collected during gill netting, Canyon Reservoir, Texas, April 2012 (N = 8), March 2014 (N = 15) and March 2016 (N = 51).

Smallmouth Bass

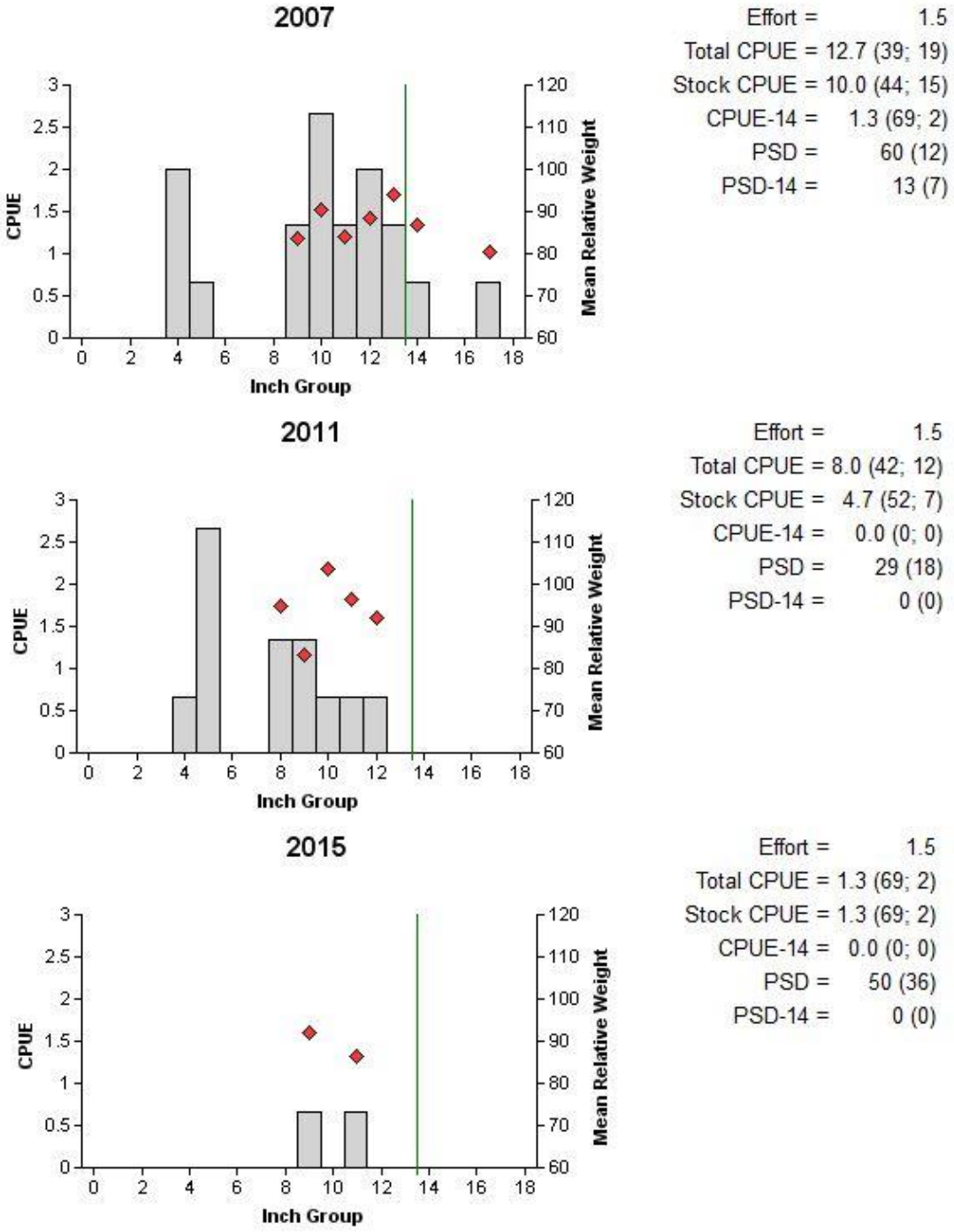


Figure 16. Number of Smallmouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys 2007, 2011 and 2015, Canyon Reservoir, Texas. Vertical line represents minimum length limit at the time of survey.

Largemouth Bass

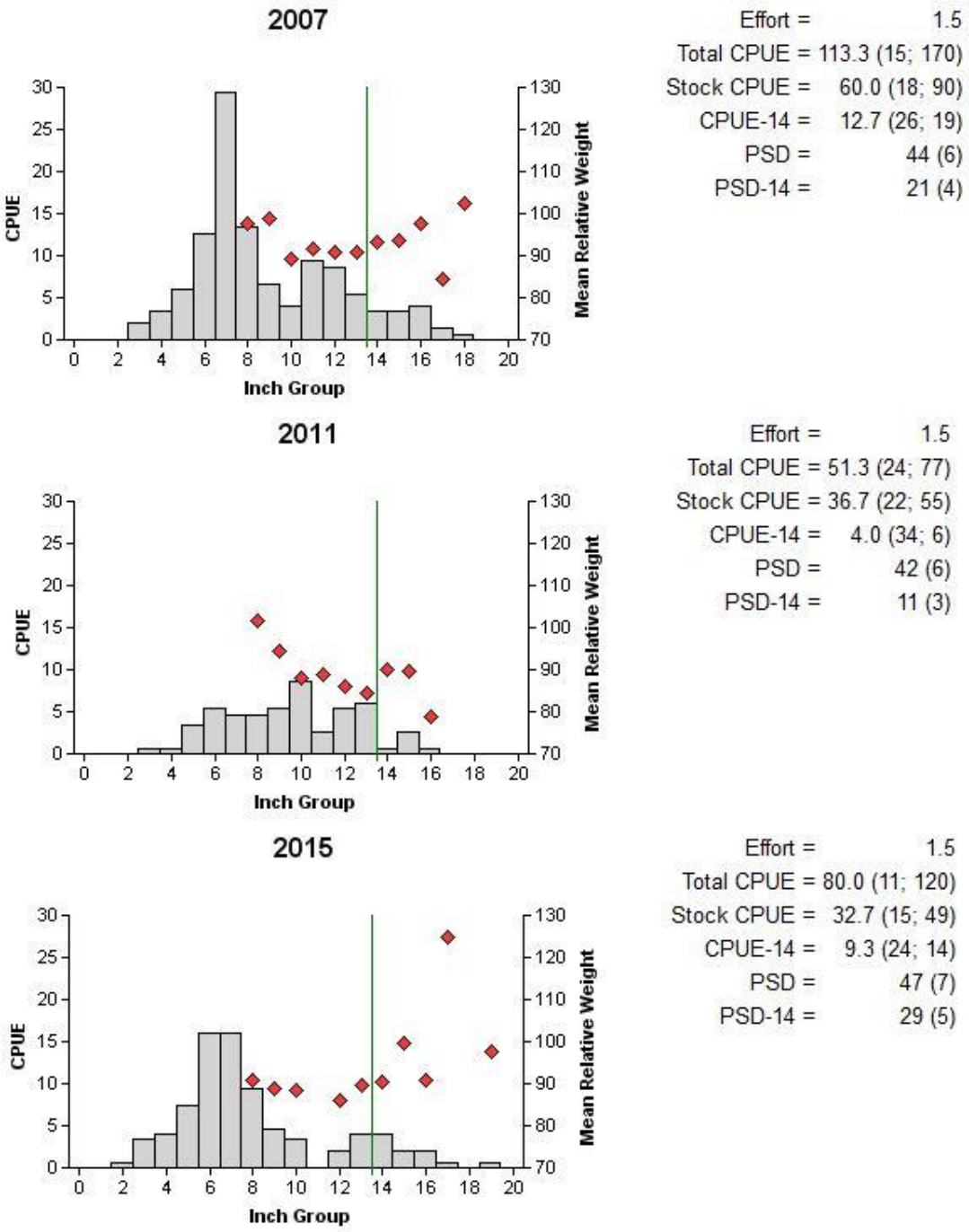


Figure 17. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Canyon Reservoir, Texas, 2007, 2011 and 2015. Vertical line represents minimum length limit at time of survey.

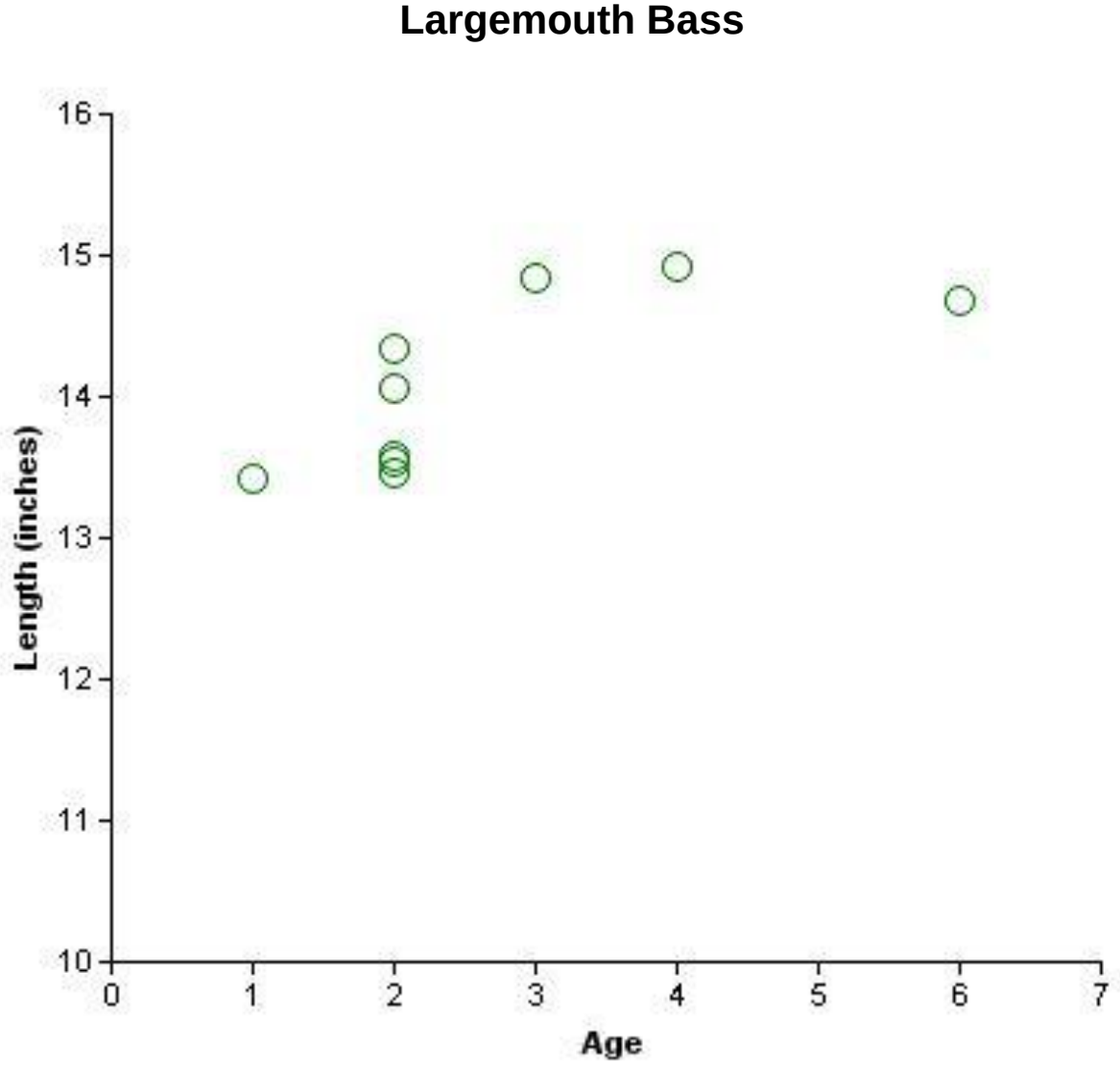


Figure 18. Length at age for Largemouth Bass collected electrofishing, Canyon Reservoir, Texas, November 2015 (N = 9).

Largemouth Bass

Table 7. Results of genetic analysis of Largemouth Bass collected by electrofishing, Canyon Reservoir, Texas, 2003, 2007, and 2015. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB. Genetic composition was determined by electrophoresis prior to 2005 and with micro-satellite DNA analysis since 2005.

Year	Sample size	Number of fish			% FLMB alleles	% FLMB
		FLMB	Intergrade	NLMB		
2003	30	8	22	0	72.0	27.0
2007	30	0	30	0	59.0	0.0
2015	30	1	29	0	70.0	3.0

Table 8. Proposed sampling schedule for Canyon 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.

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

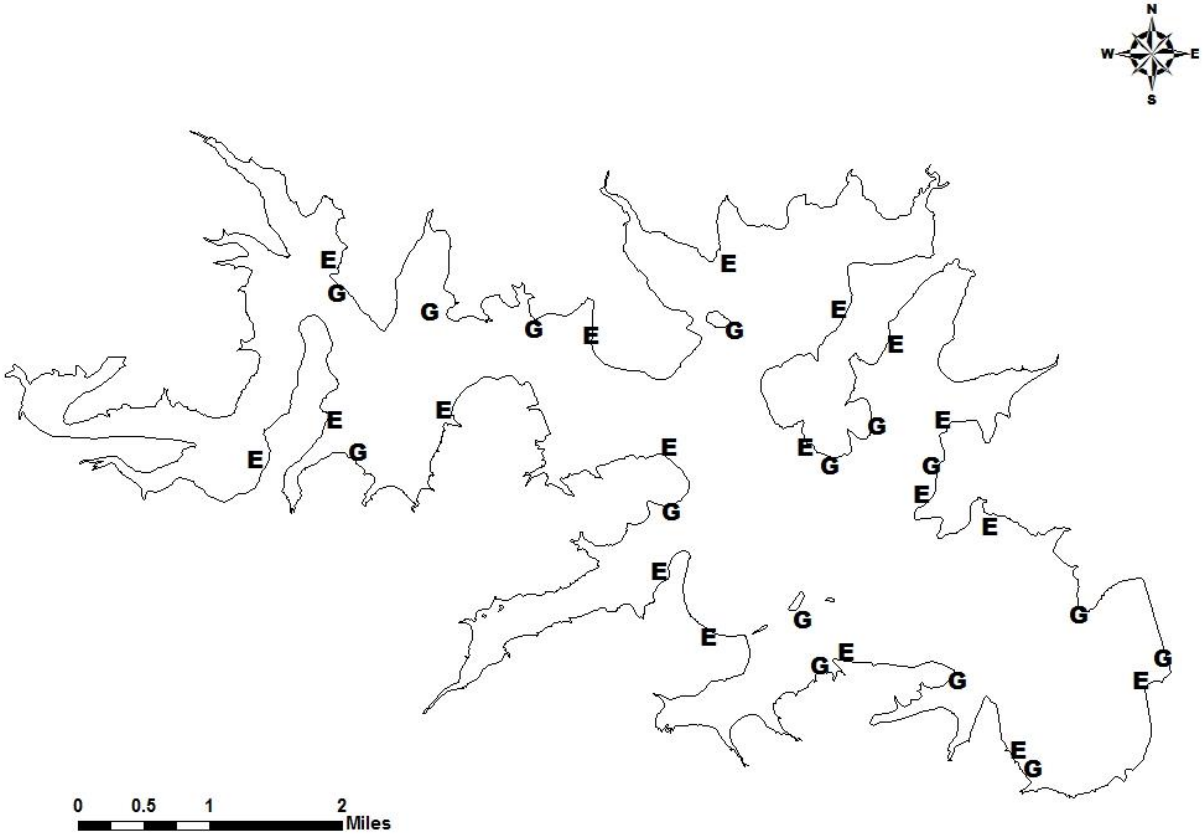
APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Canyon Reservoir, Texas, 2015-2016. Sampling effort was 15 net nights for gill netting and 1.5 hours for electrofishing.

Species	Gill Netting		Electrofishing	
	N	CPUE	N	CPUE
Gizzard Shad			214	142.7
Threadfin Shad			28	18.7
Blue Catfish	17	1.1		
Channel Catfish	17	1.1		
Flathead Catfish	10	0.7		
White Bass	45	3.0		
Striped Bass	51	3.4		
Redbreast Sunfish			299	199.3
Green Sunfish			35	23.3
Warmouth			1	0.7
Bluegill			231	154.0
Longear Sunfish			17	11.3
Redear Sunfish			10	6.7
Smallmouth Bass			2	1.3
Largemouth Bass			120	80.0
Guadalupe Bass			11	7.3
Rio Grande Cichlid			3	2.0

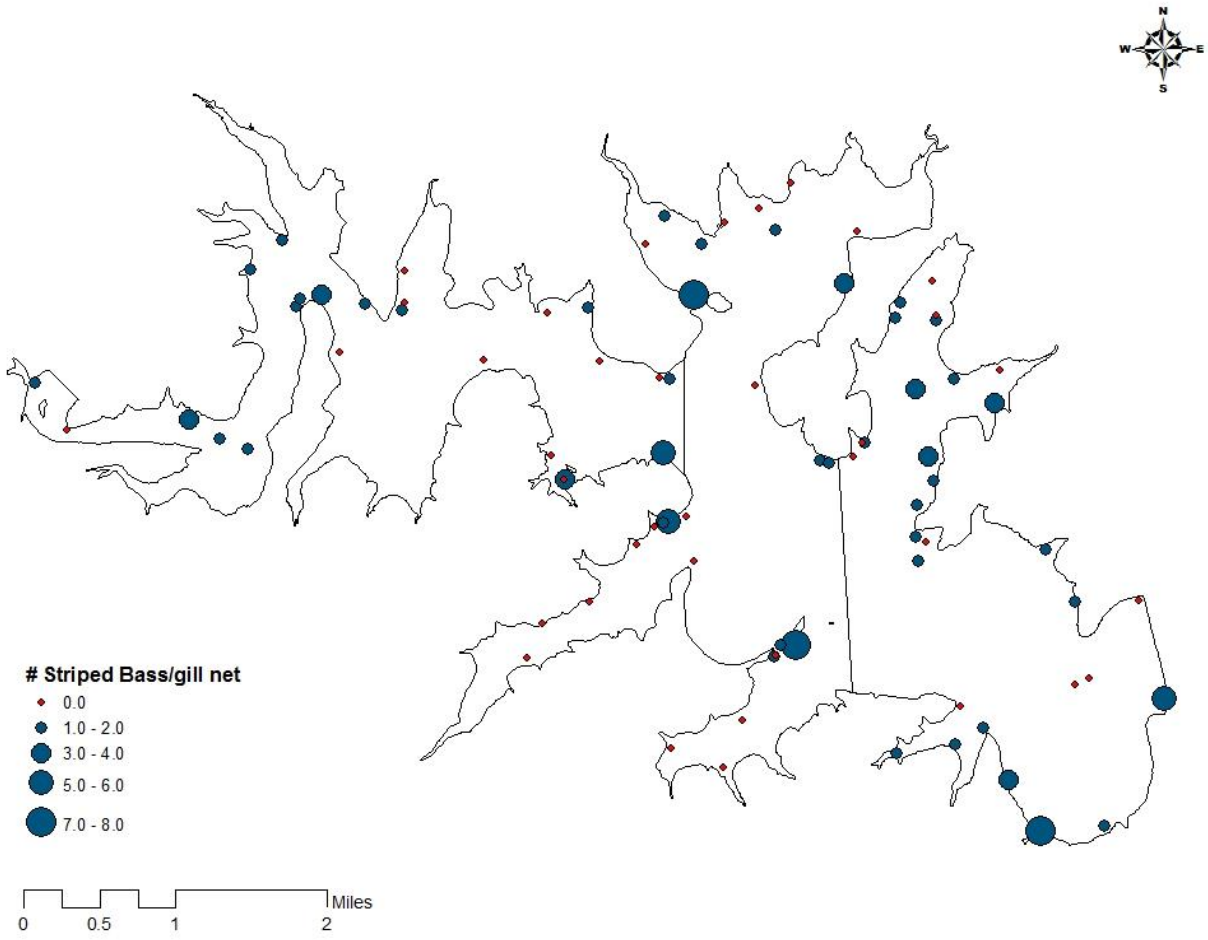
APPENDIX B

Location of sampling sites, Canyon Reservoir, Texas, 2015-2016. Gill net and electrofishing stations are indicated by G and E, respectively. Water level was near full pool at time of sampling



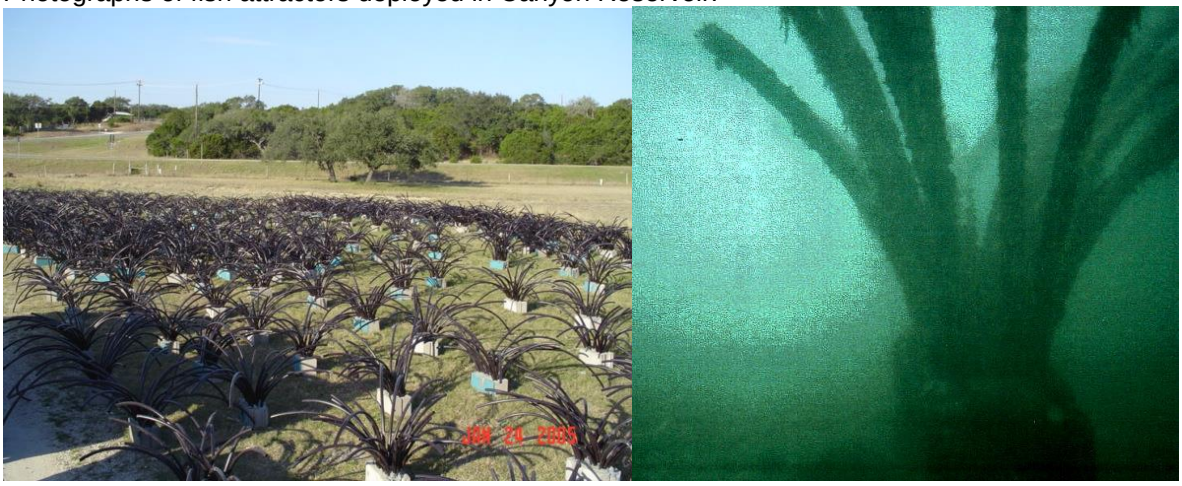
APPENDIX C

Location and gill net CPUE of Striped Bass sampled in 2004, 2006, 2008, 2010, 2012, and 2014 for Canyon Reservoir, Texas. Catch rates of zero denoted by red point, catch rates of one to eight denoted by blue circles of varying size according to Striped Bass catch per net night. Lake divided into sections (upper, middle, lower) with equal area.



APPENDIX D

Photographs of fish attractors deployed in Canyon Reservoir.



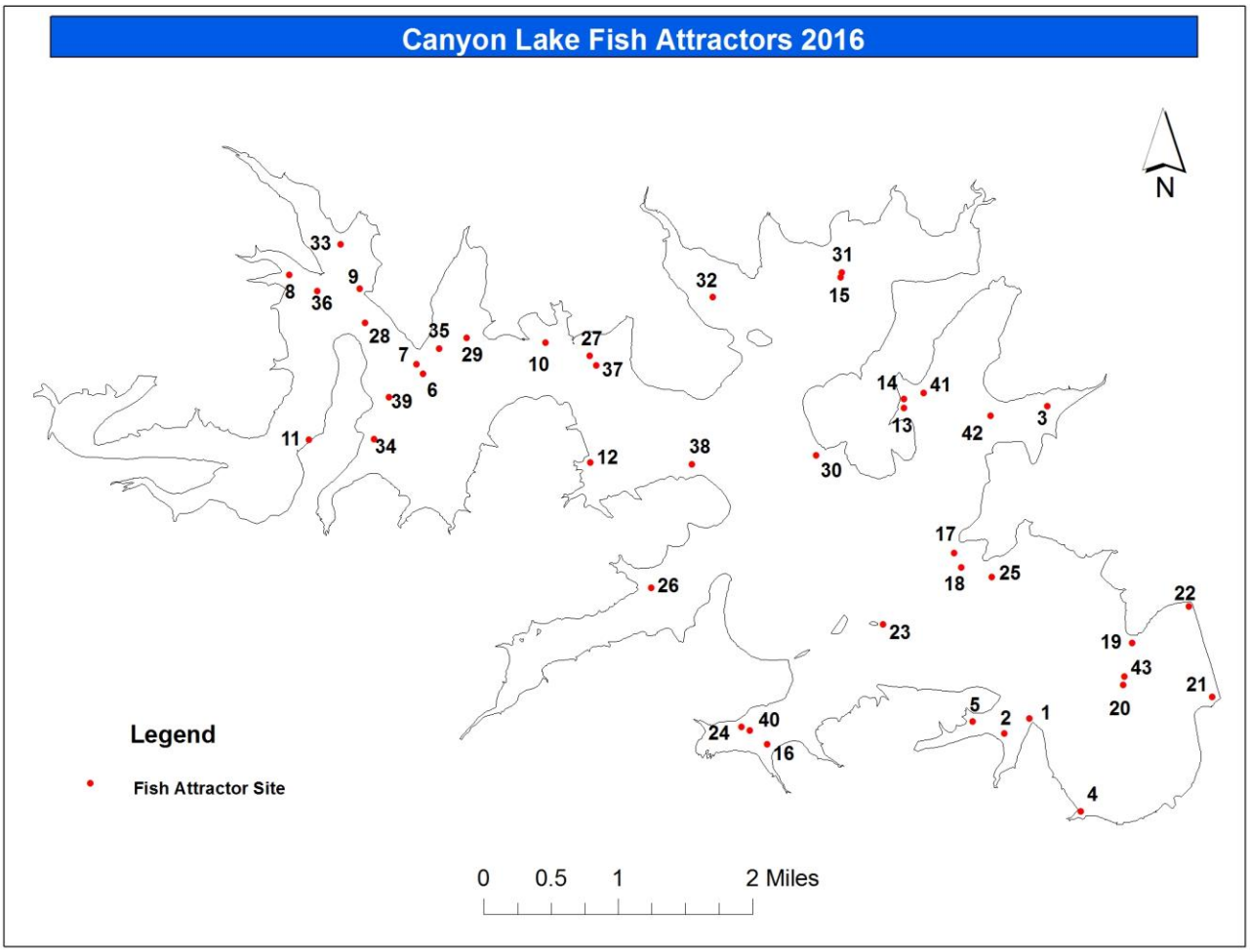
Polyethylene Fish Attractors

Ashe Juniper Fish Attractors

Bundling and Deployment

APPENDIX E

Map of Canyon Reservoir with fish attractor locations (2016). Attractors (N = 43) have been installed and refurbished since January 2005. Ashe juniper brush piles and plastic attractors were used at the sites.



APPENDIX F

GPS coordinates for Canyon Reservoir fish attractor locations. GPS coordinates are in degree decimal minutes. Attractors were installed or refurbished in January 2005 – 2016. Juniper brush piles (cedar trees) were used at all sites. Sites 1 through 15 include artificial fish attractors**.**

Site #	Lat/Long	Attractor Description	Installed	Last Supplemented
1	N 29º51.697' W -98º13.027'	Mouth of Turkey Cove on east main lake point along river channel drop.	2005	2014
2	N 29º51.597' W -98º13.190'	In Turkey Cove on rocky bald Y-point splitting cove.	2005	2014
3	N 29º53.707' W -98º12.911'	Along Jacobs Creek channel drop off.	2005	2016
4	N 29º51.096' W -98º12.693'	Along creek channel drop in small cove uplake from dam.	2005	2014
5	N 29º51.676' W -98º13.394'	Bald secondary point on North side of Turkey Cove east of ramp.	2005	2013
6	N 29º53.918' W -98º16.949'	West side of long rocky point between Cranes Mill and Potters Creek along river channel drop.	2005	2015
7	N 29º53.979' W -98º16.994'	West side of long rocky point between Cranes Mill and Potters Creek along river channel drop.	2005	2016
8	N 29º54.554' W -98º17.814'	On main point splitting north side cove along deep ledge.	2005	2013
9	N 29º54.467' W -98º17.361'	Main lake point up-river from water pipeline along deep river channel drop.	2005	2013
10	N 29º54.118' W -98º16.157'	End of bald clay point at Potter's Creek Park near river channel drop.	2005	2015
11	N 29º53.492' W -98º17.690'	Cranes Mill fishing pier. Along North edge of pier and in middle pier hole.	2005	2013
12	N 29º53.343' W -98º15.866'	Ledge along steep bank near point.	2005	2015
13	N 29º53.698' W -98º13.840'	Ledge on rocky bank along east side of Canyon Park in ramp cove.	2005	2014
14	N 29º53.756' W -98º13.839'	Ledge on rocky bank along east side of Canyon Park in ramp cove.	2005	2014
15	N 29º54.539' W -98º14.247'	End of extended point west of Canyon Park area near drop off.	2005	2015
16	N 29º51.530' W -98º14.722'	On southeast side of Comal Park cove along creek channel drop.	2005	2014
17	N 29º52.762' W -98º13.514'	End of west Jacobs Creek main lake point.	2005	2015

APPENDIX F (Cont.)

Site #	Lat/Long	Attractor Description	Installed	Last Supplemented
18	N 29º52.669' W -98º13.467'	End of east Jacobs Creek main lake point.	2005	2015
19	N 29º52.181' W -98º12.362'	East side of North Park main lake point.	2007	2015
20	N 29º51.913' W -98º12.422'	Along drop off on North Park extended main lake point.	2007	2013
21	N 29º51.835' W -98º11.844'	Southeast corner of dam.	2007	2015
22	N 29º52.419' W -98º11.994'	Northeast corner of dam.	2007	2015
23	N 29º52.301' W -98º13.973'	On the end of island/hump marked with buoy.	2007	2014
24	N 29º51.642' W -98º14.892'	Along creek channel near Comal Park.	2007	2015
25	N 29º52.608' W -98º13.269'	East side of Jacobs Creek main lake point.	2007	2013
26	N 29º52.538' W -98º15.475'	On the end of point northeast of Tom Creek boat ramp.	2007	2016
27	N 29º54.033' W -98º15.873'	Along ledge on east side of Potters Creek Park.	2007	2014
28	N 29º54.246' W -98º17.323'	Along ledge between Cranes Mill Park and water pipelines.	2007	2016
29	N 29º54.150' W -98º16.668'	On point south of Potters Creek West boat ramp.	2007	2016
30	N 29º53.392' W -98º14.405'	On Canyon Park main lake point.	2007	2013
31	N 29º54.571' W -98º14.239'	End of extended point west of Canyon Park area near drop off.	2007	2016
32	N 29º54.416' W -98º15.077'	Along creek channel northwest of island across from Canyon Lake marina.	2007	2016
33	N 29º54.754' W -98º17.483'	On submerged Cranes Mill Road Bed, south of County Ramp 23.	2008	2016
34	N 29º53.496' W -98º17.268'	Near Cranes Mill Park, north of marina.	2008	2013

.

APPENDIX F (Cont.)

Site #	Lat/Long	Attractor Description	Installed	Last Supplemented
35	N 29º54.079' W -98º16.844'	Off east side of point, on opposite side of cove from Potters Creek ramp.	2008	2013
36	N 29º54.442' W -98º17.619'	Hump near river channel, south of Mystic Shores.	2009	2016
37	N 29º53.974' W -98º15.828'	River channel edge, east of Potters Creek.	2009	2016
38	N 29º53.334' W -98º15.211'	Flat point near river channel ledge.	2009	2016
39	N 29º53.768' W -98º17.171'	Hump North of Cranes Mill Marina.	2010	2016
40	N 29º51.619' W -98º14.837'	Creek channel bend near Comal Park.	2010	2014
41	N 29º53.794' W -98º13.711'	Hump on end of point near Canyon Park boat ramps.	2010	2013
42	N 29º53.648' W -98º13.278'	On big point in Jacobs Creek splitting arms	2011	2014
43	N 29º51.968' W -98º12.413'	Near drop off on extended main lake point near North Park.	2014	