

Canyon Reservoir Tailrace

2017 Fisheries Management Survey Report

PERFORMANCE REPORT

As Required by

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

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Survey and Management Summary

The fish population in the Canyon Reservoir Tailrace was surveyed in 2017 using boat electrofishing. Creel surveys were conducted in 2013, 2016, and 2017. Previous angler utilization surveys were conducted in 1968, 1969, 1993, 1994, 2000, 2004, 2005, and 2006 (White 1968, White 1969, Magnelia 2005, Magnelia and De Jesus 2018). Angler count surveys were conducted from 1992 through 1999 (Bradle et al. 2006). This report summarizes the results of the surveys and contains a management plan for the tailrace based on those findings.

Description: The Canyon Reservoir Tailrace is a 13.8-mile hypolimnetic-release tailrace located below Canyon Reservoir, on the Guadalupe River in Comal County, northeast of the city of San Antonio. Releases from the reservoir are controlled by United States Army Corps of Engineers (USACE) (above conservation pool) and Guadalupe-Blanco River Authority (GBRA) (below conservation pool). GBRA also has authority to manage the sale of water from the river. The river itself is state owned property, including the river bottom. This Canyon Reservoir Tailrace reach of the Guadalupe River is in the Edwards Plateau ecoregion, carving an incised channel through the limestone escarpment. Flow in the tailrace is regulated by Canyon Dam. The hypolimnetic discharge produces cold and clear water (Groeger and Bass 2005, Fuchs and Whitenberg 1979). The riparian area is moderately developed with private homes and businesses. Free public access is limited to the Canyon Reservoir Dam, at a USACE park. Paid access is available through private outfitters along the stretch of river, and free leased access is available at specific sites during the winter season.

Management History: The Canyon Reservoir Tailrace supports both coldwater and warmwater sportfish species. Important coldwater fishes include stocked Rainbow and Brown Trout which are mainly sought during the winter months (December-February). Important warmwater species include Largemouth Bass, Smallmouth Bass, Guadalupe Bass, Channel Catfish, Flathead Catfish, and various small bodied sunfishes. Smallmouth Bass were stocked by Texas Parks and Wildlife Department (TPWD) in the early 1980s, but stockings were discontinued due to hybridization with Guadalupe Bass (Garret et al. 2015). Rainbow Trout have been stocked in the tailrace since 1966. Brown Trout were stocked from 1978 through 1981, 1990 through 2000, and stockings resumed in 2016. Primary management efforts for the Canyon Reservoir Tailrace have focused on increasing angler access and continued stocking of trout.

Fish Community

- **Prey species:** Sunfishes and Gizzard Shad were the dominant prey species sampled. Multiple minnow species (*Cyprinidae*) are known to be present in the river (Hendrickson and Cohen 2015, Terre and Magnelia 1996). While trout sometimes target small fish, they rely mainly on invertebrates, detritus, and other items found in the river (Quinonez 1995, Halloran and Arsuffi 2000, Sullivan et al. 2011)
- **Catfishes:** Channel and Flathead Catfish are present. Previous creel surveys documented minimal directed angling effort towards these species.
- **Temperate basses:** Striped Bass are stocked in Canyon Reservoir and emigrate into the tailrace during flood releases. Some individuals in the tailrace reach trophy size (>45 inches in length). White Bass are present, however none were collected during the fall 2017 electrofishing survey.
- **Black basses:** Largemouth Bass were present in low abundance, with larger (>18 inches) individuals present. Guadalupe Bass were found in low abundance. However, Smallmouth Bass abundance was higher, with most below the harvestable length limit. Creel surveys indicated minimal directed effort these species.
- **Rainbow Trout:** The Rainbow Trout population is maintained by annual stockings (annual average from 2010-2017 is approximately 31,000 Rainbow Trout). Over-summer survival of trout in this stretch is highly variable, which dictates size structure and abundance on a year-to-year basis.

- **Brown Trout:** Brown Trout are stocked in lower numbers than Rainbow Trout (annual average from 2016 and 2017 is approximately 870 Brown Trout). Like Rainbow Trout, over-summer survival will dictate their abundance and size structure on a year-to-year basis.

Management Strategies: Fishing opportunities and public access improvements should continue. Fall (November) electrofishing surveys to assess over-summer survival of trout in the upper segment of the tailrace will be scheduled for the next 3 years. A feasibility study regarding the addition of cover such as large woody debris or boulder clusters in the upper 4.0 miles of the tailrace should be initiated. Rainbow and Brown Trout should continue to be stocked annually. An additional management strategy will be to evaluate the effectiveness of the new flow agreement for keeping water temperatures below 21.1 C.

Introduction

This document is a summary of fisheries data collected from Canyon Reservoir Tailrace in 2013, 2016 and 2017. The purpose of the document is to provide fisheries information and make management recommendations to protect and improve the sport fishery. While information on other fishes was collected, this report deals primarily with major sport fishes and important prey fish species. Historical data are presented for comparison to the data collected for this report. Information on invertebrates, an important diet component of Rainbow Trout (Halloran and Arsuffi 2000, Sullivan et al. 2011) was not collected for this report. Sullivan et al. 2011, suggested macroinvertebrate food availability may not be a factor limiting this fishery.

River Description

Canyon Reservoir Tailrace is a 13.8-mile hypolimnetic-release tailrace located below Canyon Reservoir on the Guadalupe River in Comal County, northeast of the city of San Antonio. Its clear water is attributed to Canyon Reservoir, which is classified as oligotrophic, with a mean Chlorophyll A trophic state index of 38.1 (TCEQ 2018). Discharge into the tailrace is controlled by the GBRA and USACE. Because of the hypolimnetic release summer (May-September) water temperatures are sometimes suitable for sustaining a year-around cold-water fishery. The tailrace is also popular for recreational tubing and paddling, which creates substantial economic output for Comal County (DataSource 2012). The tailrace is susceptible to large water fluctuations due to releases from Canyon Reservoir (Figure 1). High water events associated with periods of heavy rainfall occurred in 2015 and 2016. These pulse flood events can prevent anglers from safely accessing and fishing the river. In addition, prolonged flood releases can ultimately affect the tailrace water temperature, which is a limiting factor for sustaining the cold-water fishery through the summer (Cummings 2015). A TPWD habitat survey from the Canyon Reservoir Dam outflow to 10.6 miles downstream in 2006, using the basin wide visual estimation technique (BVET), (Roghair and Nuchols 2005) found 75% pools and 13% riffles (author's unpublished data). Mean thalweg depth was 102 cm and mean river width was approximately 40 m. Dominant substrates were bedrock (61%), boulder (14%), large gravel (11%), and cobble (7%). Additional characteristics for the tailrace are found in Table 1.

Angler Access

Public access to Texas rivers can be complicated by many factors including: variability of access conditions, poorly defined access areas, remote locations, extent of privately owned land, conflict between landowners and recreational users, legal entry and liability concerns, logistics for entry and exit points, and overnight camping (Baker 1998). In a web-based survey conducted by Texas Tech University, river and stream anglers were asked "What is the most important thing that TPWD could do to get more people out fishing rivers and streams?" Respondents recommended increasing secure parking areas, increasing safe access, providing more public access in general, and providing more information about available access (Thomas et al. 2015).

Most of the land bordering the Canyon Reservoir Tailrace is under private ownership. Guadalupe Park, located directly below the Canyon Reservoir Dam, has historically provided the only "no fee" public access. Typically, angler access has been limited to businesses that offered access along the river for a fee (Table 2). Additional private lease access is available to Guadalupe River Trout Unlimited (GRTU) members that enroll in their lease program. In 2000, TPWD started leasing access sites during the peak trout fishing months (December through February) to increase fishing opportunity (Magnelia and De Jesus 2018). In 2011-2012, TPWD developed the River Access and Conservation Area Program (RACA) to address the need for increased access to the state's rivers and streams. The program is funded through the Texas Parks and Wildlife Foundation and the United States Department of Agriculture's Voluntary Public Access and Habitat Incentive Program. The RACA Program focuses on expanding recreational access to rivers surrounded by private lands. In 2017-2018, there were four RACA lease sites on the Canyon Reservoir Tailrace. The leased locations include Rio Guadalupe Resort, Whitewater Sports, Mountain Breeze Resort, and Camp Huaco Springs. Most anglers access the fishery by wading and walking the shoreline within the access sites.

Management History

Previous management strategies and actions: Management strategies and actions for the Canyon Reservoir Tailrace from related reports (Terre and Magnelia 1996, Magnelia and De Jesus 2018, and Bradle et al. 2006) included:

1. Maintain native and non-native fisheries.

Action: Annual Rainbow Trout stockings have been conducted since 1966 (stocking records through TPWD begin in 1974) and Brown trout stockings resumed in 2016. Conducted angler creel surveys in 2013, 2016, and 2017 (previous angler utilization surveys were conducted in 1968, 1969, 1993, 1994, 2004, 2005, and 2006) to assess angler usage and economic impact. Further, management actions to improve the trout fishery included extensive temperature monitoring, the establishment of a flow agreement, two special regulation zones, habitat studies, diet studies, invertebrate abundance studies, stocking (Brown and Redband Trout and fingerling Rainbow Trout) evaluations, and evaluation of over-summer survival.

2. Continue to annually fund lease access points during the winter months (December-February).

Action: Public lease areas provided by RACA were funded and promoted.

3. Improve instream fish habitat in the upper segment (first four miles) of the tailrace.

Action: A flow agreement between GRTU and GBRA was extended in 2016 to help maintain adequate temperatures for trout survival during hot summer months. Discussions on adding additional cover in the form of large woody debris and/or boulder clusters, or constructing fish habitat improvements in the upper 4 miles were initiated by TPWD and GRTU. Further, water temperature monitoring conducted by TPWD from July 1997 to August 2011 assessed the relationship between outflow from Canyon Reservoir and downstream water temperature, providing recommended reservoir releases for protecting trout from high summer water temperatures, and documenting water temperature related mortality.

4. Increase public awareness of fisheries management activities and available fisheries.

Action: Installed angler information signs in the trout regulation zones. The public have been kept informed of on-going management activities through presentations and press releases.

Harvest regulation history: With the exception of trout species, all sportfish species are managed under statewide harvest regulations. In the mid-1990's interest developed in using restrictive length and bag limits to develop a portion of the tailrace into a put-grow-and-take area. Rainbow and Brown trout are currently managed with three harvest regulations, including two "special" regulations with restrictive length and bag limits.

For the first 0.45 mile (800 yards) from the reservoir outflow statewide length and bag limit regulations are in place; no minimum length and 5 trout daily bag limits. The area directly below the dam has historically been a popular area for harvest-oriented anglers. From this point to the easternmost bridge crossing on HWY 306 (approximately 3.7 miles) there is a 12 to 18-inch slot length limit and a 5 trout (Rainbow and Brown Trout, their hybrids and subspecies, in any combination) daily bag limit. Only one trout 18 inches in length or greater may be retained each day (initiated September 1, 2014) These regulations were implemented to take advantage of the optimal summer water temperatures (< 21.1 C) that can occur in approximately the first 6 km of the fishery and the resulting potential of this area for oversummer survival. From the easternmost bridge crossing on HWY 306 to the second bridge crossing on River Road (approximately 16 km), trout are regulated under 457 mm minimum length and one trout daily bag limits.

This regulation was implemented as a result of documented oversummer survival and water temperature monitoring which occurred in the early 1990's. The area upstream of this was not considered at that time for a special regulation (now regulation zone 1) because of public concern with maintaining put-and-take fishing at a popular campground (Whitewater Sports; although the business remains open the campground portion of the property closed about 2005) located just above the easternmost 306 bridge crossing. For both Trout Zones harvest (the two areas beyond the first 0.45 mile from the reservoir tailrace) is by artificial lures only, although live or prepared bait may be used for other sportfish species. Below the second bridge crossing on River Road statewide length and bag limits for trout apply. This area includes Camp Huaco Springs, a popular put-and-take RACA site.

Current regulations are summarized in Table 3.

Stocking history: Canyon Reservoir Tailrace has been stocked annually with Rainbow Trout since 1966. Brown Trout were stocked from 1978 through 1981, 1990 through 2000, and stockings resumed in 2016. Brook Trout and Redband Trout have also been intermittently stocked in various years. The complete stocking history is in Table 4.

Vegetation/habitat management history: In most years instream aquatic vegetation within the tailrace appears to be minimal. Most of the stream is dominated by pools and riffles with bedrock substrate. Instream cover is lacking and large woody debris is routinely removed after flood events to minimize hazards to recreational tubers.

Minimum flow: Flow is predominantly controlled by the discharge through the Canyon Reservoir Dam. In the summer months, the distance downstream from the discharge where the water remains cold enough to support a year-round trout fishery (≤ 21.1 C) is directly correlated with releases from the reservoir (Magnelia 2004). A hydropower plant located below the reservoir operates under a Federal Energy Regulatory Commission (FERC) hydropower permit which requires a minimum discharge into the tailrace during non-drought periods of 88.8 cfs. Under drought conditions discharge is reduced to reservoir inflow. In addition to the FERC permit requirements, an agreement between the GBRA and GRTU established a minimum flow agreement in 2001 and modified the agreement in 2016 to specifically protect the tailrace trout fishery from high summer water temperatures. An additional management strategy is to evaluate the effectiveness of the new flow agreement for keeping water temperatures below 21.1 C.

Methods

Fishery surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Canyon Reservoir Tailrace (TPWD unpublished).

Electrofishing – Largemouth Bass, Guadalupe Bass, Smallmouth Bass, Striped Bass, catfishes, sunfishes, and Gizzard Shad were collected by fall boat electrofishing (low voltage, 8-10 amps and 60 pulses per second, 3.3 h at 16, stations ranging from 0.12 to 0.36h). Catch-per-unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing. No trout were collected during the electrofishing survey.

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

Creel survey – Roving creel surveys were performed during the summers (June through August) of 2013, 2016, and 2017 to assess summertime fishery characteristics and angler opinions within the first 3.9 miles of the fishery, which is regulated with a 12- to 18-inch slot length limit for Rainbow and Brown Trout. These creel surveys were intended to address pre- and post-angler attitudes regarding the regulation change that went into effect September 1, 2014. The 2016 survey occurred during abnormally high flows (mean daily flow from June 2016 to August 2016 – 1,738 cfs) which likely reduced the number of anglers utilizing the tailrace. Nine survey days were conducted during each summer quarter (June - August), according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Habitat: A habitat survey was last conducted by TPWD in summer 2006 using methodology detailed by Rosgen and Nuchols 2005. The purpose of the survey was to quantify mesohabitat types and large woody debris in the first 10 miles of the tailrace. Further, efforts including physical habitat modeling coupled with hydraulic modeling to assess habitat quality and quantity at various flow rates were completed as part of a master's thesis in 2015 (Cummings 2015).

Hydrograph – The source for water discharge data was the United States Geological Survey (USGS) streamflow gauge 08167800 on the Guadalupe River at Sattler, Texas.

Results and Discussion

Habitat: Mesohabitat documented in the 2006 habitat survey was 47% pools, 36% riffles, and 16% runs, and substrate was bedrock (61%), boulders (14%), large gravel (11%), and cobble (7%; Magnelia, TPWD, unpublished data). In 2002, Canyon Reservoir topped the emergency spillway forming a deep gorge from the reservoir to the tailrace. This event dislodged and deposited a large quantity of 3-foot sized boulders, excavated 23 feet of limestone and transformed a soil-mantled valley into a bedrock canyon in approximately 3 days (Lamb and Fonstad 2010). The event also removed riparian trees and overhead cover (Cummings 2015). This event, along with landowners clearing riparian zones, shoreline grazing, erosion, bulkheading, and removal of woody debris from river likely result in aquatic habitat degradation. The Cummings (2015) trout habitat evaluation provided potential habitat improvement approaches as they relate to influencing water temperature, depth, instream cover, and instream flow, particularly in areas of the tailrace where optimal temperatures for trout are consistent. Habitat improvements such as increasing riparian vegetation and increasing instream cover (woody debris) coupled with sufficient flow rates, could enhance habitat quantity and quality for trout. A comprehensive analysis of the entirety of the TPWD water temperature data-set has not been undertaken. Analysis is needed to further refine recommendations/considerations for protective summer releases, as well as identifying specific areas under the 2016 GRTU/GBRA flow agreement where water temperature induced stress/mortality might be reduced through restoration actions aimed at providing cool-water refuges, or reducing overall stream temperatures (e.g. - increased riparian shading, undercut banks, instream structures to increase velocities in shallow pools).

Creel: Total fishing effort for all species during the summer season surveys in 2013, 2016, and 2017 were 765 angler hours, 1,819 angler hours, and 3,337 angler hours, respectively (Table 5). Thus, an increasing trend in angler usage from 2013 through 2017 was observed. This increase in angler hours corresponds with an increase in direct expenditures during the same time. Direct expenditures were estimated at \$2,186 for 2013, \$5,060 for 2016, and \$71,991 for 2017 (Table 6). Angling effort directed at trout has historically been in the winter months. However, the effort to protect quality-size trout through implementation of the slot length limit in the upper portion of the fishery where the potential for oversummer survival is the highest may increase angling in this upper stretch of the tailrace during the summer.

In 2013, only three anglers were intercepted during surveys; each targeting Rainbow Trout. No trout anglers were encountered during the creel surveys of 2016. Rather, 100% of anglers in 2016 were targeting warmwater fish species (e.g. black basses). The lack of trout anglers encountered in 2016 may be a consequence of high flows deterring wading trout anglers. In 2017, however, 59% of angler directed effort was toward trout. The angler directed effort toward any species of trout in 2017 may be an indication of increasing angler awareness of the Brown Trout Stockings in the Canyon Reservoir Tailrace which commenced in 2016 following a 17-year stocking hiatus. However, given the low number of anglers intercepted during the surveys, caution should be used when interpreting the creel data.

In 2016 and 2017, 59% and 22% of angler directed effort was toward “anything”, respectively. In 2016 40% of direct angler effort was toward the “black basses”, which for Canyon Reservoir Tailrace would include Largemouth Bass, Guadalupe Bass, Smallmouth Bass, and situations in which the angler is targeting any of the species of black bass. In 2017, 19% of directed angler effort was toward the black basses (Table 5). Overall and across all species, the creel surveys recorded no harvest. Catch rates for all species combined in 2013, 2016, and 2017 were 0.07/h, 2.30/h, and 0.94/h, respectively.

Angler opinions were collected regarding pre- and post-implementation of a trout slot length limit regulation in 2014. Anglers were asked if they supported the regulation. In 2013, 67% (n=3) supported the regulation. In 2016 and 2017 (combined), 96.7% supported the regulation (n=29). Based on the low number of angler interviews during the three summers, it is likely that fishing pressure is extremely low during the summer months.

Prey species: Gizzard Shad, Redbreast Sunfish, Bluegill, and Longear Sunfish were the predominant prey species sampled in the Canyon Reservoir Tailrace. Macroinvertebrates were not sampled for this survey. Though not collected during the 2017 electrofishing survey, multiple minnow species (Cyprinidae) are known to be present in the river (Terre and Magnelia 1996). Common species such as Texas Shiner, Central Stoneroller, Blacktail Shiner and Red Shiner have been collected in the system during other surveys (Terre and Magnelia 1996). Electrofishing catch rate of Gizzard Shad was 6.4/h in 2017. IOV for Gizzard Shad was 0, which indicated that 0% of the sample were vulnerable (≤ 7 inches) to existing predators (Figure 2). Redbreast Sunfish (Figure 3), Bluegill and Longear Sunfish total catch rates were 95.0/h, 5.5/h, and 3.4/h, respectively. Bluegill size structure was dominated by small individuals (PSD = 29), with only a few individuals of quality size (≥ 6 inches; Figure 4). Redbreast Sunfish was the most abundant sunfish, with quality-size individuals available for anglers (Figure 5).

Channel Catfish: Channel Catfish were moderately abundant, with an electrofishing catch rate of 15.9/h. Most Channel Catfish sampled were over 12 inches (Figure 6), which suggested that harvestable-size catfish were available to anglers. Relative weight ranged from 85 to 110 indicating good body condition. Creel survey data from 2013, 2016, and 2017 indicated that there was no direct effort toward Channel Catfish.

Flathead Catfish: Flathead Catfish had low relative abundance with an electrofishing catch rate of 1.5/h in 2017. Most individuals were under 18 inches and not legal for harvest (Figure 7). No individuals were in the preferred size category (≥ 24 inches, Quinn 1991). Creel survey data from 2013, 2016, and 2017 indicated that there was no directed effort toward Flathead Catfish.

Striped Bass: Striped Bass were present in low to moderate abundance (CPUE = 9.2/h), with most individuals exceeding the minimum length limit of 18 inches (Figure 8). Striped Bass from Canyon Reservoir Tailrace, where there is an active stocking program (Cummings, and De Jesus 2015) likely emigrated to the tailrace during flood releases. Creel survey data from 2013, 2016, and 2017 reported no direct effort toward Striped Bass. Large Striped Bass have been routinely collected during electrofishing surveys targeting trout (Magnelia 2007), and the state record for this species was angled from the tailrace on two occasions. Electrofishing catch rates for Striped Bass have historically been low (< 2.0/h) (TPWD, unpublished data), and a mark-recapture study indicated population numbers were likely low (Magnelia 2007).

Smallmouth Bass: The electrofishing catch rate of Smallmouth Bass was 16.9/h (Figure 9). Relative weight was low, ranging from 65 to 80. Less than 10% (n=4) of the sample were fish above 14 inches.

Largemouth Bass: The electrofishing catch rate of Largemouth Bass was 11.0/h (Figure 9). Relative weight was moderate, ranging from 80 to 100. More than half of the included bass (n=19) were over 14 inches with several fish over 18 inches.

Rainbow and Brown Trout: No trout were collected during the electrofishing survey in 2017. Explanations may be attributable to the time of year (November) with poor over summer survivorship within the electrofishing stations. Creel surveys in 2013 and 2017 indicated that anglers were targeting these species during the summer months. However, the creel data from 2013 and 2017 showed that no trout were caught.

Fisheries Management Plan for Canyon Reservoir Tailrace, Texas

Prepared – July 2018

ISSUE 1: Access has been identified as the largest impediment to river and stream fishing for Texas anglers (Thomas et al. 2015). While access to the Canyon Reservoir Tailrace has greatly improved through the seasonally opened lease sites (with current funding provided by RACA), maintaining and exploring additional sites should be continued.

MANAGEMENT STRATEGIES

1. Continue to lease the existing RACA sites as well as explore additional access sites to facilitate angler access to the Canyon Reservoir Tailrace during the peak trout fishing months (December-February).

ISSUE 2: Promoting the fishery to people who may be unaware of the fishing opportunities in the Canyon Reservoir Tailrace and the RACA Program should also continue.

MANAGEMENT STRATEGY

1. Bradle et. al (2006) noted that most anglers used the TPWD Inland Fisheries web page to gain information on stockings, most were unaware of free leased site availability. An effort should be made to link web page stocking information with information on leased site availability to increase angler awareness of leased areas.
2. Promote the Canyon Reservoir Tailrace fishery and RACA Program via social media, news releases, TPWD website, and during speaking engagements.
3. Worthy sportfish fisheries in the tailrace (trout, Striped Bass, Channel Catfish) should be promoted via social media, news releases, and new fishing segment in TPWD magazine. Species, locations, best time of year, and tactics should be included.

ISSUE 3: Previous reports related to the Canyon Reservoir Tailrace have indicated that a paucity in instream habitat, particularly large woody debris and boulders, has a negative effect on trout abundance and survival. Habitat modifications may concentrate trout, increase oversummer survival and increase angler success.

MANAGEMENT STRATEGIES

1. Continue to explore the feasibility of adding additional cover such as large woody debris or boulder clusters in the upper 3 miles of the tailrace, where summer water temperatures are often optimal for trout survival and where tubing is minimal. If additional cover can be added, evaluate the effectiveness of this cover for increasing relative abundance of trout.
2. Continue to work with GRTU and other potential partners to initiate a comprehensive plan for a habitat improvement project.

ISSUE 4: Oversummer survival of trout appears to be highly variable as a result of flows that increase summer water temperature above lethal levels. Annual winter trout stockings are required to maintain the fishery. Stockings have been funded by TPWD, GRTU, and Water Oriented Recreation District of Comal County (WORD). Recent efforts to collect trout by boat electrofishing to evaluate summer survival have yielded poor results.

MANAGEMENT STRATEGIES

1. Continue to work with partners to fund Rainbow Trout and Brown Trout stockings.

2. Utilize temperature monitoring data to assess habitat conditions, particularly in the upper tailrace segment (where over-summer trout survival could occur) following the 2016 GRTU/GBRA flow agreement.

Objective-Based Sampling Plan

Sport fish, forage fish, and other important fishes

Sport fishes in the Canyon Tailrace include Rainbow Trout, Brown Trout, Striped Bass, White Bass, Largemouth Bass, Smallmouth Bass, Guadalupe Bass, Channel Catfish, and Flathead Catfish. Known forage species include Gizzard Shad, Bluegill, Redbreast Sunfish, other sunfishes, and minnows.

Low-density or underutilized fisheries

Striped Bass: Striped Bass are stocked in Canyon Reservoir and emigrate to the tailrace during flood releases. Striped Bass electrofishing total catch rate was 9.2/h in 2017. Brood collection and previous surveys have indicated that some individuals in the tailrace reach memorable and trophy size. A 2005 creel survey revealed less than 1% directed effort for Striped Bass during the winter trout stocking season (Bradle et al. 2006). General monitoring trend data (without precision or sample size requirements) can be gathered for this species through electrofishing.

White Bass: White Bass are present in Canyon tailrace and emigrate to the tailrace during flood releases. No White Bass were collected during the 2017 electrofishing sampling. Winter creel surveys performed in 2000, 2002, and 2005 along with the summer creels performed in 2013, 2016, and 2017 have shown minimal directed effort for this species. General monitoring trend data (without precision or sample size requirements) can be gathered for this species through electrofishing.

Largemouth Bass: The electrofishing catch rate of Largemouth Bass was 11.0/h in 2017. Winter creel surveys performed in 2000, 2002, and 2005 along with the summer creels performed in 2013, 2016, and 2017 have shown minimal directed effort for this species. General monitoring trend data (without precision or sample size requirements) can be gathered for this species through electrofishing.

Smallmouth Bass: Smallmouth Bass are present throughout the tailrace. The electrofishing catch rate of Smallmouth Bass was 16.9/h in 2017. Winter creel surveys performed in 2000, 2002, and 2005 along with the summer creels performed in 2013, 2016, and 2017 have shown minimal directed effort for this species. General monitoring trend data (without precision or sample size requirements) can be gathered for this species through electrofishing.

Guadalupe Bass Hybrids: Guadalupe Bass Hybrids are present in the Canyon Reservoir Tailrace. Winter and summer creel surveys have shown minimal directed effort for this species. Very few Guadalupe Bass Hybrids were collected in the 2017 electrofishing samples. General monitoring trend data (without precision or sample size requirements) can be gathered for this species through electrofishing.

Channel Catfish: Channel Catfish are present in the tailrace. Channel Catfish had an electrofishing catch rate of 15.9/h in 2017. Winter and summer creel surveys have shown minimal directed effort for this species. General monitoring trend data (without precision or sample size requirements) can be gathered for this species through electrofishing.

Flathead Catfish: Flathead Catfish had an electrofishing catch rate of 1.5/h in 2017. Winter and summer creel surveys have shown minimal directed effort for this species. General monitoring trend data (without precision or sample size requirements) can be gathered for this species through electrofishing.

Survey objectives, fisheries metrics, and sampling objectives

Rainbow Trout: The Rainbow Trout fishery on the Canyon Reservoir Tailrace evolved from a put-and-take fishery. Management strategies sometimes allow for a put-grow-and-take fishery to exist in portions of the tailrace under favorable summer conditions. Regardless of over-summer survival, the fishery depends on annual stockings of adult trout. Rainbow Trout are stocked extensively each year by TPWD, GRTU, and WORD. Over 230,000 Rainbow Trout were stocked in 2016/2017. A creel survey from December 1993 through February 1994 estimated total fishing pressure for trout at 35,570 angler hours (Magnelia 2004). Surveys from 2004 to February 2005 estimated the economic value of the tailrace at \$164,537 (Bradle et al. 2006). Management actions to improve the trout fishery have included extensive temperature monitoring, the establishment of a flow agreement, two special regulation zones, habitat studies, diet studies, invertebrate abundance studies, stocking (Brown and Redband trout and fingerling Rainbow Trout) evaluations, and evaluation of over-summer survival. No Rainbow Trout were collected during electrofishing in the fall of 2016 and 2017. However, multiple large trout were observed swimming in shallow pools during the 2017 summer creel survey. With irregular annual survival, sampling for this species under general objectives is unnecessary. Existing instream temperature data will be analyzed to document areas that could allow for oversummer trout survival. Additional water temperature monitoring may be undertaken in 2019 and 2020 to assess the new flow agreement.

Brown Trout: Brown Trout have been stocked sporadically with Rainbow Trout by GRTU. Starting in 2016 Brown Trout were stocked in the first 4 miles of the tailrace to assess their persistence through summer compared to Rainbow Trout. No Brown Trout were collected during the fall 2017 electrofishing sampling. General monitoring trend data (without precision or sample size requirements) can be gathered for Brown Trout through electrofishing. Sampling parameters will follow those for Rainbow Trout.

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Table 2. Public access points and descriptions for the Canyon Reservoir Tailrace, Texas, 2017.

Access Point	Latitude Longitude (dd)	Public	Parking capacity (N)	Condition
Guadalupe Park	29.8702, -98.1941	Y	<10	Access for canoe or kayaks only. Bank and wade fishing is available.
Hwy 306 Bridge A	29.8645, -98.1634	Y	0	Access for canoe or kayaks only. Possible fee for usage at Whitewater Sports. Bank and wade fishing is available.
Whitewater Sports - Hwy 306 Bridge B	29.8614, -98.1582	Y	0	Access for canoe or kayaks only. Fee location. Bank and wade fishing is available.
Rio Guadalupe Resort	29.8430, -98.1682	Y	<10	Access for canoe or kayaks only. Fee location. Bank and wade fishing is available.
Rocky Beach	29.8031, -98.1731	Y	<10	Access for canoe or kayaks only. Fee location. Bank and wade fishing is available.
Action Angler	29.8033, -98.1634	Y	unknown	Access for canoe or kayaks only. Fee location. Bank and wade fishing is available.
Mountain Breeze	29.8066, -98.1539	Y	<10	Provides approximately 1,000 feet of bank access along a deep pool. There are no free public downstream take-outs for float trips below this site. Bank and wade fishing is available.
Camp Huaco Springs	29.7622, -98.1396	Y	<10	Access for canoe or kayaks only. Fee location. Bank and wade fishing is available.

Table 3. Current harvest regulations for the Canyon Reservoir Tailrace, Texas.

Species	Bag limit	Length limit
Catfish: Channel and Blue Catfish, their hybrids and subspecies	25 (in any combination)	12-inch minimum
Catfish, Flathead	5	18-inch minimum
Bass, White	25	10-inch minimum
Bass: Largemouth and Smallmouth	5 ^a	14-inch minimum
Bass: Spotted and Guadalupe	5 ^a	None
	5 ^b	None
Trout (Brown and Rainbow)	5 ^c	12- to 18-inch slot
	1 ^d	18-inch minimum

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

^b Outside special trout zones: For Rainbow and Brown Trout, their hybrids and subspecies, there is no minimum length and daily bag limit = 5 trout in any combination.

^c 800 yards downstream from Canyon Dam release downstream to easternmost bridge on Hwy 306: For Rainbow and Brown Trout, length limit is a 12-18 inch slot. Trout 12 inches and less or 18 inches or greater in length may be retained. Daily bag = 5 trout and only one trout 18 inches or longer may be retained.

^d From easternmost Hwy 306 bridge crossing downstream to 2nd crossing on River Road: For Rainbow and Brown Trout, minimum length is 18 inches and daily bag limit is one fish.

Table 4. Stocking history for Canyon Tailrace, Texas. Life stages are 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. Stockings occurred before 1974 but this data is not available electronically.

Species	Year	Number	Life Stage	Mean TL (in)
Brook Trout	1981	6,977		0.0
	1993	7		5.1
	1994	6		5.1
	Total	6,990		
Brown Trout	1978	6,500		0.0
	1979	12,992		0.0
	1980	8,800		0.0
	1981	16,314		0.0
	1990	37,530		3.4
	1991	26,974		2.8
	1992	300		11.0
	1993	3,600		10.0
	1994	1,018		20.3
	1995	2,934		10.0
	1996	4,005		8.0
	1997	3,832		11.6
	1998	3,250		9.8
	1999	360		11.0
	2000	200		11.0
	2016	700		15.2
2017	1,040		13.0	
Total	130,349			
Rainbow Trout	1974	3,573	UNK	0.0
	1975	14,186	UNK	0.0
	1976	66,257	UNK	0.0
	1977	130,766	UNK	0.0
	1978	61,394	UNK	0.0
	1979	25,886	UNK	0.0
	1980	48,061	UNK	0.0
	1981	33,135	UNK	0.0
	1982	76,231	UNK	0.0
	1983	53,772	UNK	0.0
	1984	68,048	ADL	9.3
	1985	58,763	ADL	9.3
	1986	77,668	ADL	9.3

Species	Year	Number	Life Stage	Mean TL (in)
	1987	80,030	ADL	9.3
	1988	38,303	ADL	9.3
	1989	31,797	ADL	9.3
	1990	21,363	ADL	9.3
	1991	30,685	ADL	9.3
	1992	20,609	ADL	9.3
	1993	35,971	ADL	9.4
	1994	29,116	ADL	9.3
	1995	26,028	ADL	9.3
	1995	2,883	AFGL	5.1
	1996	22,035	ADL	9.3
	1996	5,183	AFGL	5.1
	1996	65,823	FGL	3.3
	1997	29,563	ADL	9.3
	1997	16,161	AFGL	5.0
	1997	129,048	FGL	3.1
	1998	33,122	ADL	9.3
	1998	237,374	FGL	2.9
	1999	32,204	ADL	9.3
	1999	26,758	AFGL	4.4
	2000	25,776	ADL	9.3
	2000	105,518	FGL	3.5
	2001	31,730	ADL	9.3
	2001	2,982	AFGL	5.1
	2002	21,348	ADL	9.3
	2002	21,061	AFGL	4.8
	2002	24,154	FGL	2.7
	2003	21,657	ADL	9.3
	2004	19,243	ADL	9.3
	2005	20,952	ADL	9.4
	2005	2,960	AFGL	8.7
	2005	66,451	FGL	2.5
	2006	20,939	ADL	10.3
	2006	12,310	AFGL	8.7
	2007	27,138	ADL	9.9
	2007	5,708	AFGL	8.8
	2008	17,728	ADL	9.4
	2008	4,255	AFGL	8.6
	2009	22,499	ADL	10.6
	2009	8,637	AFGL	8.9
	2010	28,025	ADL	10.0
	2010	1,617	AFGL	8.8
	2010	50	FGL	2.5
	2011	29,539	ADL	10.4
	2011	2,000	AFGL	8.9

Species	Year	Number	Life Stage	Mean TL (in)
	2012	8,001	ADL	11.3
	2012	18,407	AFGL	8.8
	2012	5,012	FGL	2.1
	2013	21,018	ADL	10.4
	2013	7,195	AFGL	8.9
	2013	2,683	FGL	2.5
	2014	17,907	ADL	10.8
	2014	12,664	AFGL	8.8
	2015	9,642		0.0
	2015	23,796	ADL	9.5
	2015	2,017	AFGL	8.9
	2015	325	FGL	2.6
	2016	21,364	ADL	11.1
	2016	10,760	AFGL	8.8
	2016	765	FGL	1.9
	2017	1,537		0.0
	2017	17,525	ADL	10.1
	2017	5,862	AFGL	8.8
	2018	13,899	ADL	10.3
	2018	1,903	AFGL	8.9
	Total	2,378,355		
Redband Trout	1983	70		0.0
	1986	8,372		7.0
	Total	8,442		

Table 5. Percent directed angler effort by species for the Canyon Reservoir Tailrace, 2013, 2016 and 2017. Survey Periods for all three surveys were June 1 through August 31.

Species	2013	2016	2017
Rainbow Trout	100	0.0	5.4
Any Trout Species	0.0	0.0	46.0
Black Basses	0.0	11.2	15.0
Largemouth Bass	0.0	20.1	8.1
Guadalupe Bass	0.0	0.0	6.3
Smallmouth Bass	0.0	9.4	0.0
Panfishes	0.0	0.0	0.5
Anything	0.0	59.4	18.8

Table 6. Total fishing effort (h) for all species and total directed expenditures at the Canyon Reservoir Tailrace, Texas, 2013, 2016, 2017. Survey Periods for all three surveys were June 1 through August 31. Relative stand error is in parentheses.

Creel statistic	2013	2016	2017
Total fishing effort	765 (32)	1,819 (34)	3,337 (27)
Total directed expenditures	\$2,186 (124)	\$5,060 (97)	\$71,991 (124)

Table 7. Objective-based sampling plan components for Canyon Reservoir Tailrace, Texas 2017-2018.

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing</i>			
Rainbow and Brown Trout	Abundance	CPUE–Total	General Trend Monitoring Data / Assess Trout Survival
	Size structure	PSD, length frequency	
Largemouth Bass	Abundance	CPUE–Stock	General Trend Monitoring Data
	Size structure	PSD, length frequency	
	Age-and-growth	Age at 14 inches	
	Condition	W_r	
	Genetics	% FLMB	
Guadalupe Bass	Abundance	CPUE–Stock	General Trend Monitoring Data
	Size structure	PSD, length frequency	
	Age-and-growth	Year-class strength	
Smallmouth Bass	Abundance	CPUE–Stock	General Trend Monitoring Data
	Size structure	PSD, length frequency	
	Age-and-growth	Year-class strength	
Bluegill	Abundance	CPUE–Total	General Trend Monitoring Data
	Size structure	PSD, length frequency	
Striped Bass	Abundance	CPUE–Total	General Trend Monitoring Data
	Size structure	PSD, length frequency	
White Bass	Abundance	CPUE–Total	General Trend Monitoring Data
	Size structure	PSD, length frequency	
Flathead Catfish	Abundance	CPUE–Stock	General Trend Monitoring Data
	Size structure	PSD, length frequency	
	Condition	W_r	
Channel Catfish	Abundance	CPUE–Stock	General Trend Monitoring Data
	Size structure	PSD, length frequency	
	Condition	W_r	

Gizzard Shad

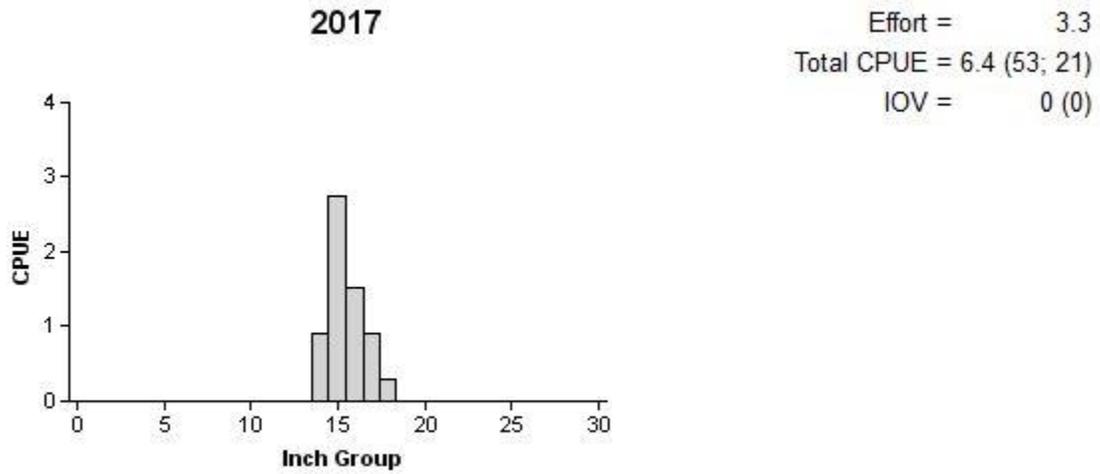


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall boat electrofishing surveys, Canyon Reservoir Tailrace, Texas, 2017.

Redbreast Sunfish

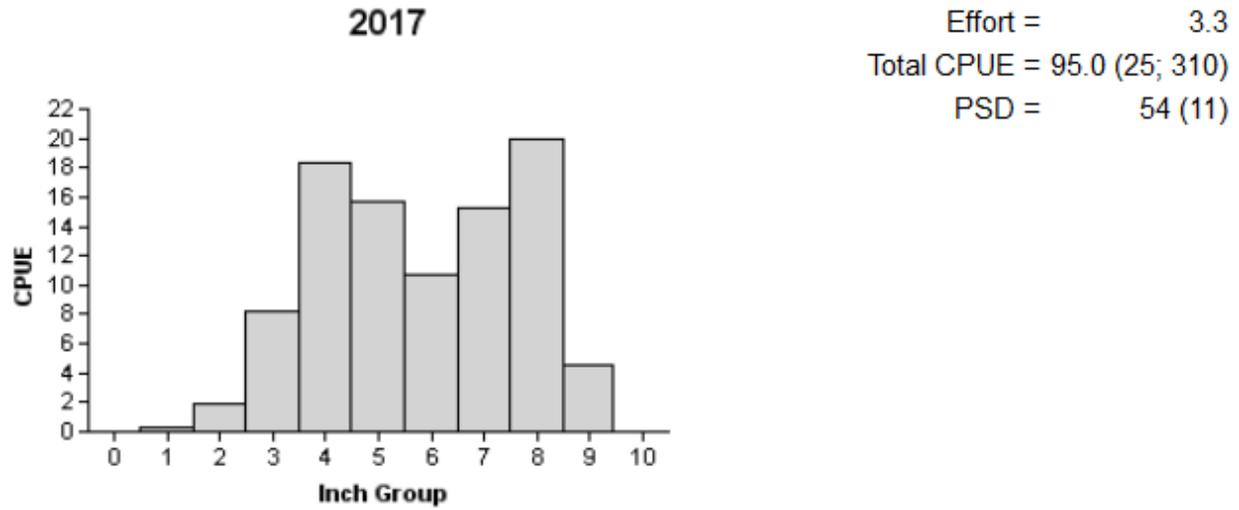


Figure 3. Number of Redbreast Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall boat electrofishing surveys, Canyon Reservoir Tailrace, Texas, 2017.

Bluegill

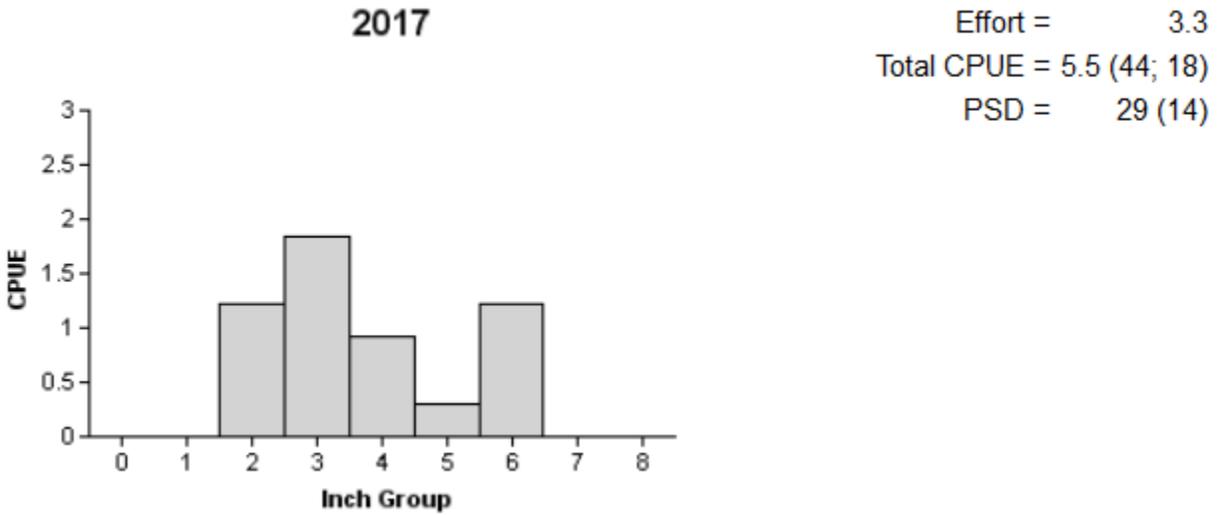


Figure 4. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall boat electrofishing surveys, Canyon Reservoir Tailrace, Texas, 2017.

Longear Sunfish

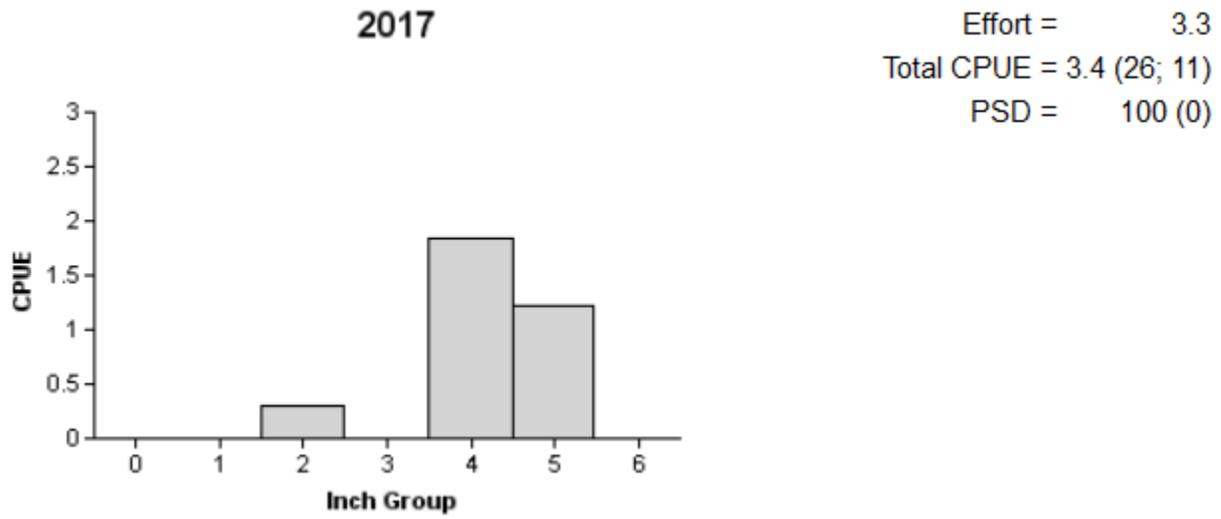


Figure 5. Number of Longear Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall boat electrofishing surveys, Canyon Reservoir Tailrace, Texas, 2017.

Channel Catfish

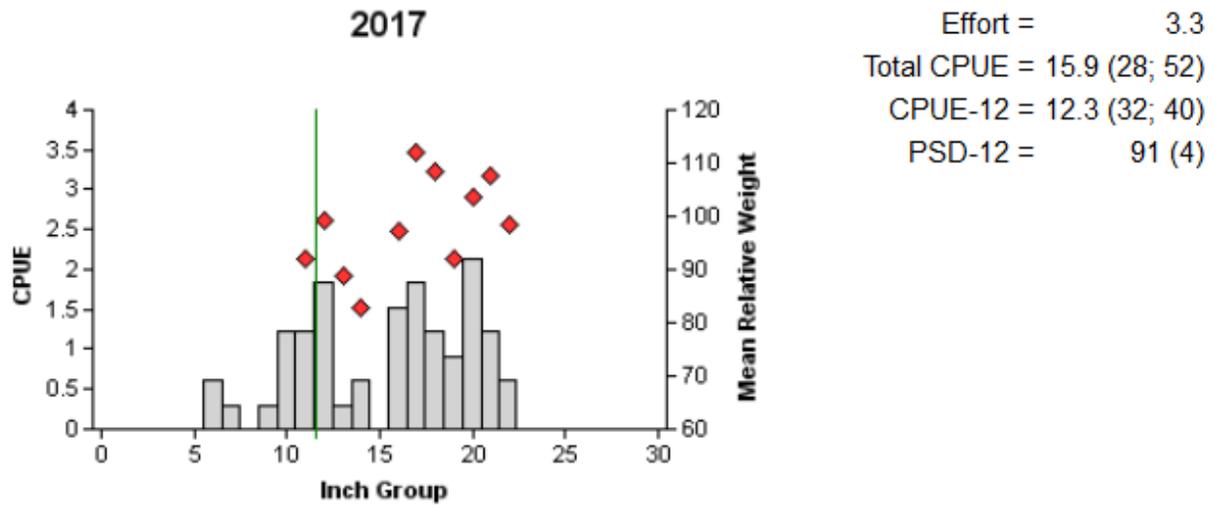


Figure 6. Number of Channel Catfish caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall boat electrofishing survey, Canyon Reservoir Tailrace, Texas, 2017. Vertical line represents minimum length limit at the time of the survey.

Flathead Catfish

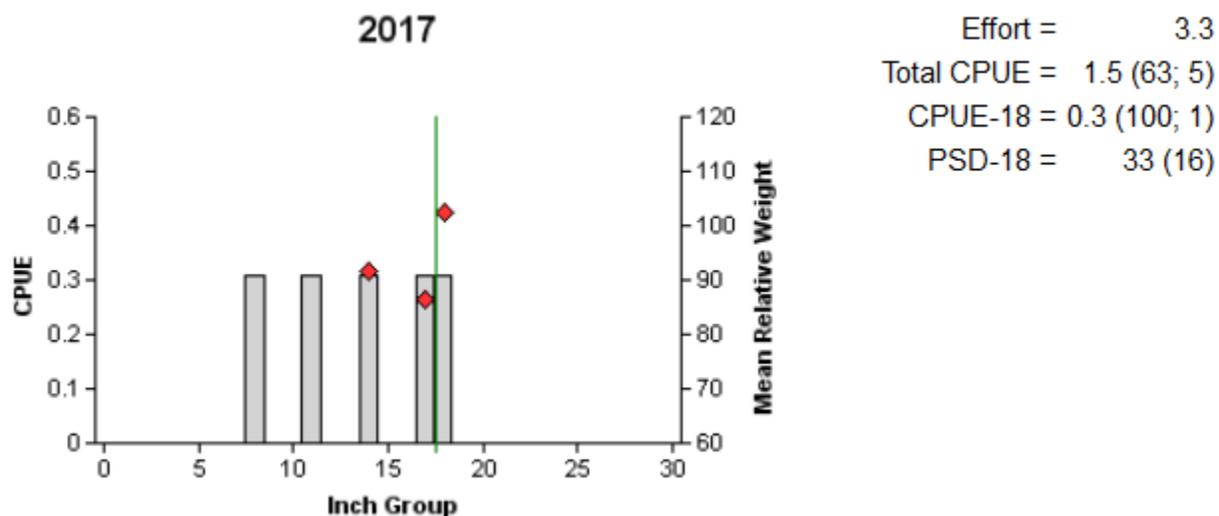


Figure 7. Number of Flathead Catfish caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall boat electrofishing survey, Canyon Reservoir Tailrace, Texas, 2017. Vertical line represents minimum length limit at the time of the survey.

Striped Bass

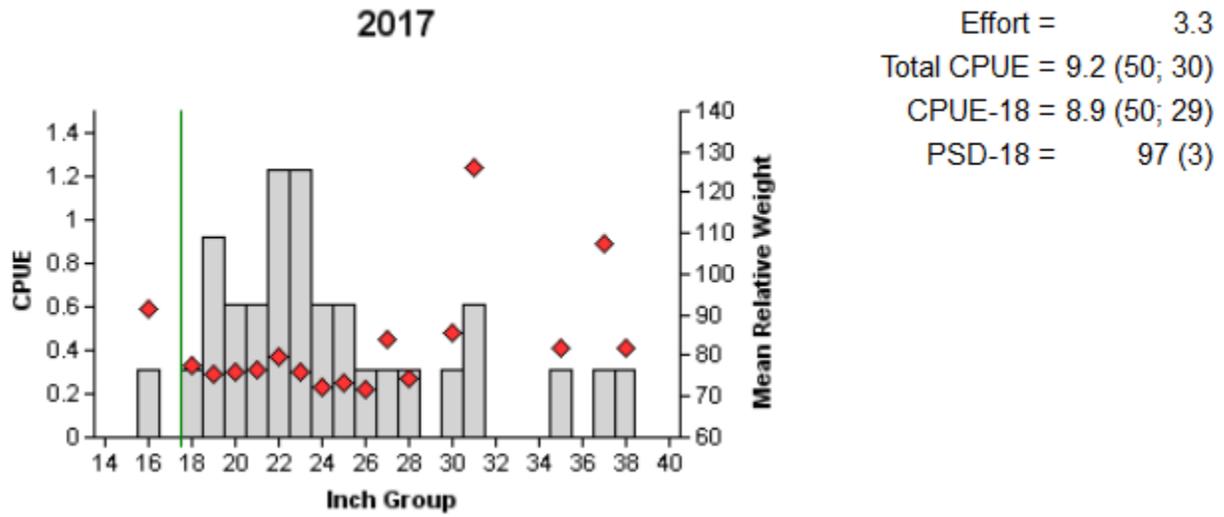


Figure 8. Number of Striped Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall boat electrofishing survey, Canyon Reservoir Tailrace, Texas, 2017. Vertical line represents minimum length limit at the time of the survey.

Smallmouth Bass

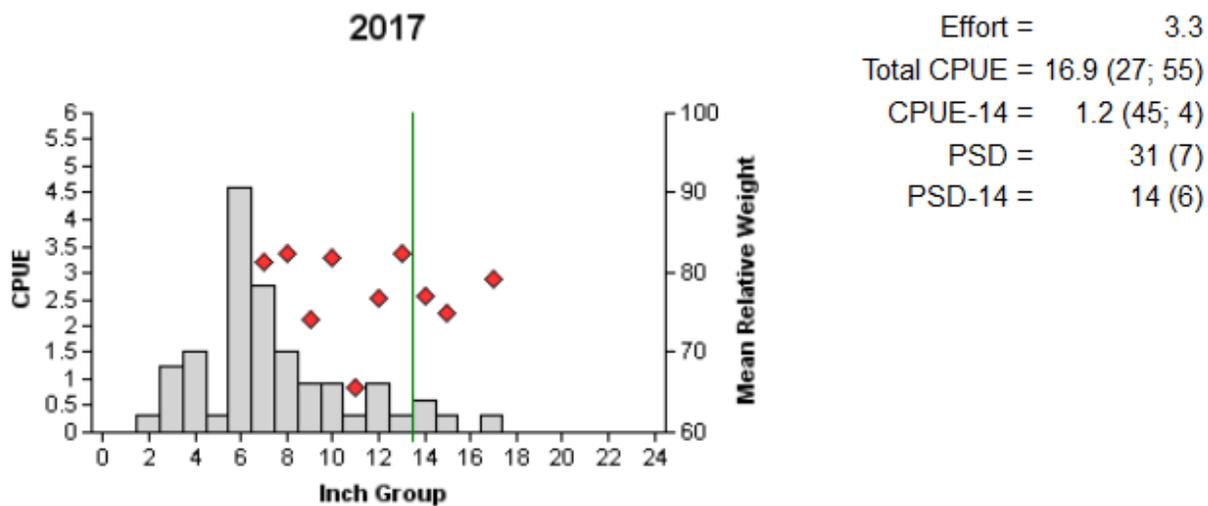


Figure 9. Number of Smallmouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall boat electrofishing survey, Canyon Reservoir Tailrace, Texas, 2017. Vertical line represents minimum length limit at the time of the survey.

Largemouth Bass

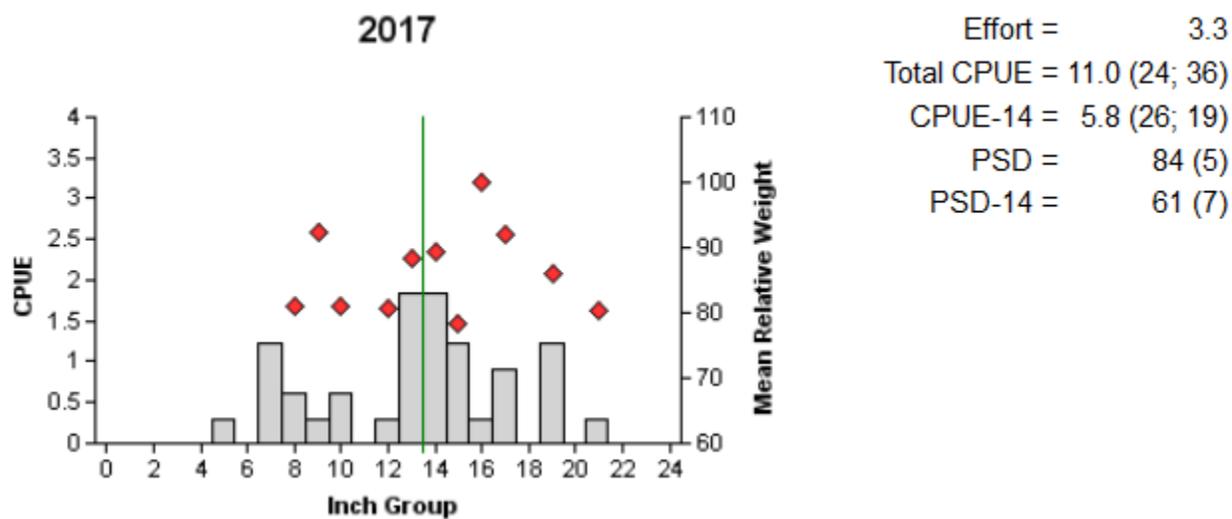


Figure 10. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing survey, Canyon Reservoir Tailrace, Texas, 2017. Vertical line represents minimum length limit at the time of the survey.

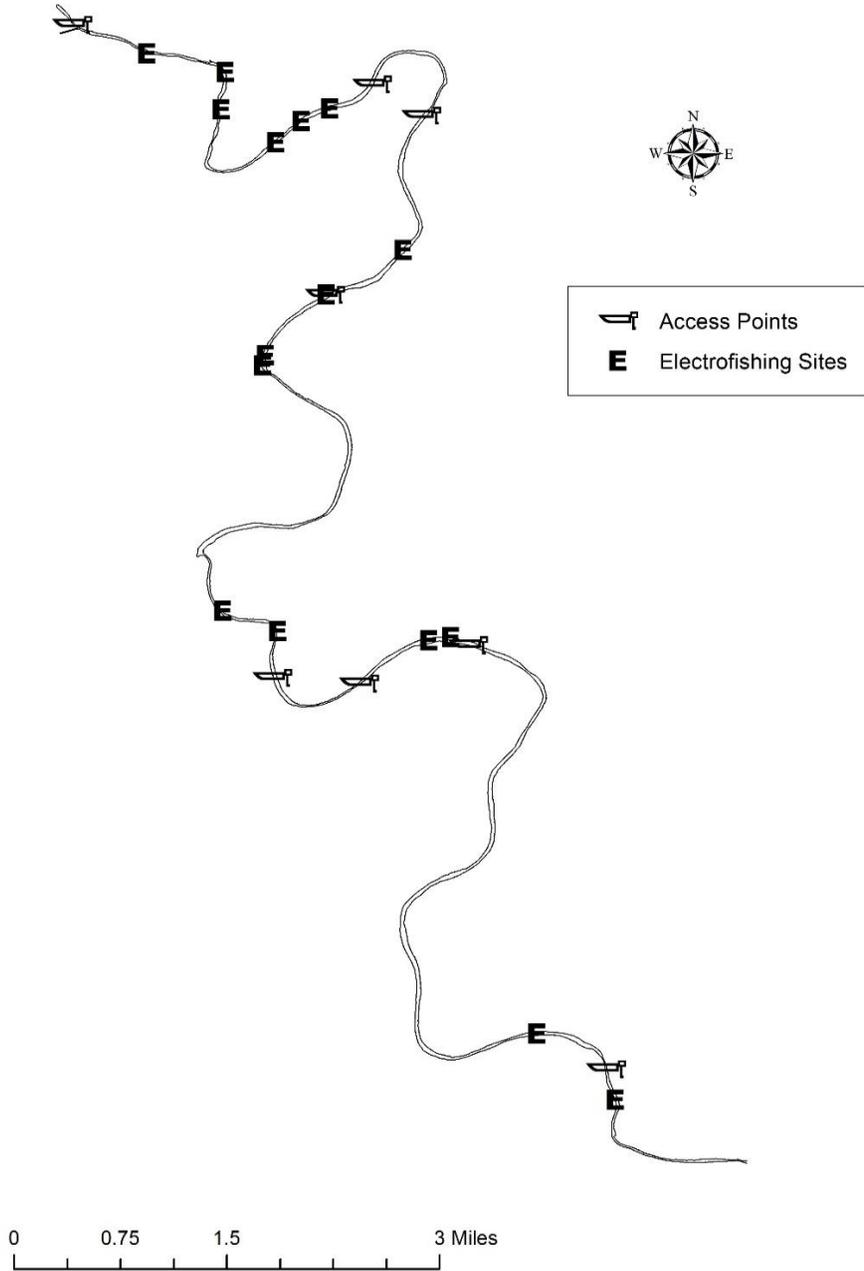
APPENDIX A – Catch rates for all species from all gear types

Number (N) and catch rate (CPUE) and relative standard error (RSE) of all target species collected from all gear types from Canyon Reservoir Tailrace, Texas, in fall 2017. Sampling effort was 3.3 hours of electrofishing.

Species	Electrofishing		
	N	CPUE (fish/h)	RSE
Gizzard Shad	21	6.4	53
Channel Catfish	52	15.9	28
Flathead Catfish	5	1.5	63
Redbreast Sunfish	310	95	25
Warmouth	5	1.5	38
Green Sunfish	7	2.2	36
Bluegill	18	5.5	44
Longear Sunfish	11	3.4	26
Redspotted Sunfish	1	0.31	100
Rock Bass	3	0.9	73
Hybrid Sunfish	1	0.3	100
Striped Bass	30	9.2	50
Smallmouth Bass	55	16.9	27
Largemouth Bass	36	11	24
Guadalupe Bass x Smallmouth Bass Hybrid	4	1.2	100
Logperch	1	0.3	100

APPENDIX B – Map of sampling locations

Location of sampling sites, Canyon Reservoir Tailrace, 2017.





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