

PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2016 Fisheries Management Survey Report

**Colorado River
Hwy 183 bridge crossing, Austin to SH 71 bridge crossing, La Grange**

Prepared by:

Greg Cummings, Assistant District Management Supervisor
And
Marcos De Jesus, District Management Supervisor

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



Carter Smith
Executive Director

Craig Bonds
Director, Inland Fisheries

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in the Colorado River were surveyed in 2016 and 2017 using electrofishing. Anglers were surveyed from September through November 2016 and March through May 2017. Historical data are presented with the 2017 data for comparison. This report summarizes the results of the surveys and contains a management plan for the river based on those findings.

- **River Description:** The Colorado River in Texas originates south of Lubbock, on the Llano Estacado, near Lamesa. It is the 18th longest river in the United States at 862 miles in length. It flows generally southeast from Dawson County through the Texas Hill Country and several reservoirs including J.B. Thomas, E.V. Spence, O.H. Ivie, Buchanan, Inks, Lyndon B. Johnson, Marble Falls, Travis, Austin, and Ladybird. After passing through Austin, the Colorado River flows southeast emptying into Matagorda Bay in Matagorda County along the Texas Gulf Coast. This report covers the 115 miles of river between the Hwy 183 bridge crossing in Austin to the SH 71 bridge crossing in La Grange. Located within the counties of Travis, Bastrop and Fayette, the river flows through the city of Austin and the towns of Webberville, Utley, Bastrop, Smithville, and La Grange. The river in this section was wide, dominated by runs with intermittent pools, riffles, and rapids. Land use around this section of the river was predominantly agricultural or rangeland for grazing cattle. Most of the river shoreline was undeveloped, although some residential homes were located on the river. Signs of urbanization were apparent in the section of river near the 183 bridge crossing, but decreased downstream.
- **Management History:** Important sport fishes include Largemouth Bass, Guadalupe Bass, and Channel Catfish. The management plan in 2003 suggested improving angler access, sampling closer to Longhorn Dam, and promoting the underutilized fishery. 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. No Smallmouth Bass were collected in 2003 or 2017. Blue Catfish were stocked in 1980, 2000, and 2001 but were not collected in 2003 or 2017.
- **Fish Community**
 - **Prey Species:** Sunfishes and Gizzard Shad were the dominant prey species available. Red Shiner, Blacktail Shiner, and Mexican Tetra were present in low densities.
 - **Catfishes:** Channel Catfish abundance was high in the river. Flathead Catfish were present in low densities, with larger individuals available to anglers. Nearly 27% of anglers targeted catfishes.
 - **White Bass:** White Bass were present in low densities, with no directed angling effort.
 - **Black basses:** Largemouth Bass were present in low densities, with larger individuals available to anglers. Guadalupe Bass sampling indicated a low density population, with large individuals available to anglers. Most anglers (37%) targeted black basses.
 - **Freshwater Drum:** Freshwater Drum were present in moderate densities, with no directed angling effort. All drum caught were harvested, composing nearly 36% of all fish harvested.

Management Strategies:

Efforts to promote fishing opportunities and improve access on the Colorado River should continue. Many anglers are unaware of access points and paddling options. Consideration should be given to change the Guadalupe Bass regulation. Electrofishing should be conducted on a four-year rotation to monitor the sport fisheries, harvest species, and forage. An additional fall electrofishing survey will be done in 2017 to test the difference between fall and spring sampling. Inform the public about the negative impacts of aquatic invasive species. Continue to assist with aquatic invasive species management and monitoring.

INTRODUCTION

This document is a summary of fisheries data collected from the Colorado River in 2016-2017. The purpose of the document is to provide fisheries information and make management recommendations to protect and improve the sport fishery. While information on other fishes was collected, this report deals primarily with major sport fishes and important prey species. Historical data are presented with the 2016-2017 data for comparison.

River Description

The Colorado River is an 862-mile river, originating in Dawson County that empties into the Gulf of Mexico in Matagorda County. Primary water uses include municipal, industrial, and agricultural water supply, and recreation. The section covered by this report includes 115 miles of the lower Colorado River from Austin to La Grange. This portion of the river can be described as slow and meandering, but influenced by water releases from Longhorn Dam. Water in this portion of the river tends to be turbid due to high amounts of suspended solids. Nutrient loading from treated wastewater discharges promotes the growth of aquatic plants downstream of Austin (Texas Clean Rivers Program, TCRP, 2014). Near Austin, the flood plain is flat with earthen cut-banks, but towards La Grange the flood plain deepens, creating high sandstone bluffs and cliffs (TPWD 1974). The river substrate is composed of sand and gravel, with many sand or gravel bars and islands present. Invasive plant species such as hydrilla and water hyacinth have been problematic on this portion of the river.

The Colorado River provides water for farming, municipalities, and electrical power production. Water from the river is used to cool power plants at Lake Walter E. Long, Lake Bastrop, Fayette County Reservoir, and the South Texas Nuclear Project near Bay City. Flood control and use of the Colorado River is managed by three entities: the Colorado River Municipal Water District (CRMWD), the Upper Colorado River Authority (UCRA), and the Lower Colorado River Authority (LCRA).

Daily irrigation releases typically occur from mid-March to mid-October by the LCRA. These releases decrease water clarity and increase water depth downstream. Other releases are due to precipitation in the upper watershed or environmental flow requirements. Periodic flooding occurs along the river. In May and June of 2016 a major flooding event took place in Central and Southeastern Texas. Thirty-one counties were declared disaster areas, including Travis, Bastrop, and Fayette Counties located along the Colorado River. Flows exceeded 10,000 cubic feet per second (cfs) at Bastrop (Figure 1) and the river rose to more than 10-feet above flood stage in Smithville and La Grange. It was Bastrop County's third flood in 11 months. Other descriptive characteristics for the Colorado River are in Table 1.

Angler Access

River access involves more variables than reservoirs. 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 recreationists, legal entry and liability concerns, logistics for entry and exit points, and overnight camping (Baker 1998). Additionally, issues with safety and rapidly changing flow rates and water levels are concerns for those planning one or two-day floats. In a web-based survey conducted by Texas Tech University, river and stream anglers were asked "What is the most important thing that Texas Parks and Wildlife Department could do to get more people out fishing in 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 anglers utilized kayaks or canoes to access the Colorado River between Austin and La Grange. Propeller driven boats can be used in some sections, but jet drive outboards allow unlimited access during normal flows. This section of the river had seven public boat ramps and several private boat ramps. Most public boat ramps were short, allowing only small john boats or paddlecraft to launch. Extension may be feasible at several boat ramps. The boat ramp at Fisherman's Park in Bastrop was partially impeded by a large sand bar. The boat ramp at Little Webberville Park was partially impeded by

shallow boulders. The boat ramp at Webberville Park has been periodically covered in mud during high flow events. These issues can be addressed through the controlling authorities. Additional boat ramp characteristics are in Table 2. Limited shoreline fishing access was available at public parks and lease access sites. Shoreline fishing access existed at the Highway 183 public access site, but the site offered limited parking and may be shut down due to illegal dumping and bridge repairs (personal communication Texas Department of Transportation, TXDOT). The Lost Pines Recreational Trails were closed due to flood damage that occurred in 2016. This site was located downstream of Fisherman's Park in Bastrop and was the take out site for the El Camino Real paddling trail. Parking was allowed outside the gates but required a 50 yard portage from the river. In order for this site to be more accessible, repairs need to be made to Riverside Drive by Bastrop County. Other sites with good shoreline access were Fisherman's Park in Bastrop and Vernon L. Richards Riverbend Park in Smithville. Fishing piers were available at Fisherman's Park, Vernon L. Richards Park and Webberville Park in Elgin.

Additional public river access was provided by the TPWD River Access and Conservation Area (RACA) program. These sites were leased by TPWD from private landowners and outfitters for use by the public. Current RACA sites include the Texas River School River Camp in Austin, the WJF River Access near Smithville, and the Hidden Shores River Access near Smithville.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Magnolia et al. 2003) included:

1. Improve angler access on this section of the river.
Action: Three TPWD RACA sites were added to this section of the Colorado River. Surveys and game cameras were used to document usage. Fall and spring roving creel surveys documented put-in and take-out locations of fishermen on boats, kayaks, and canoes. The Highway 973 access site has been improved. News releases, website additions, and promotional material have been created to notify the public about access site amenities and locations.
2. Sample the river between Longhorn Dam and the low water dam upstream of the FM 973 bridge crossing.
Action: This section was electrofished in summer of 2003 to document sportfish. Guadalupe Bass, Largemouth Bass, Channel Catfish, and Flathead Catfish were documented. Forage species were present including sunfish, shad, and shiners. It was not sampled in 2017.
3. Promote the underutilized fishery on this section of the river.
Action: Promotion of the RACA sites has been ongoing, however, results of the roving creel surveys show many anglers still are not aware of them. Guides, forums, fishing reports, and the recent catch of the State Record Guadalupe Bass have increased angler awareness of the black bass fishery. Promotional material from TPWD, LCRA, city and county parks, and paddling/camping enthusiasts have been made available on the web and social media.

Harvest regulation history: All sport fish species are regulated under the statewide bag and length limits. On September 1, 2001 the Guadalupe Bass minimum length limit changed from 12 inches to no minimum (Magnolia et al. 2003). Commercial fishing for Channel Catfish was legal in Bastrop and Fayette counties, but between 2007 and 2015, only 4 trips were documented for commercial harvest (personal communication TPWD). Current regulations are found in Table 3.

Stocking history: Blue Catfish were stocked in 1980 and the early 2000s. Channel Catfish were stocked in the 1970s. Smallmouth Bass were stocked in the early 1980s. The complete stocking history is in Table 4.

Vegetation/habitat management history: In 2013, record low flows and nutrient-loading from wastewater effluent created favorable conditions for the establishment of hydrilla and water hyacinth in portions of the Colorado River below Austin (TCRP 2014). Some areas had large mats of vegetation and

impeded navigation and fishing. Scouring events in October and November 2013 and again in May 2015 removed most of the vegetation from the river. Small patches of hydrilla were left which could clog jet motors. In August and October of 2015 TPWD contractors conducted herbicide treatments on 30 acres of water hyacinth. District staff assisted with a post-treatment vegetation survey in September 2015 to assess herbicide effectiveness on water hyacinth. The RACA program provides habitat restoration at access sites including invasive species removal, seed planting, and streambank stabilization.

Water transfer: This section of the Colorado River is primarily used for municipal, industrial, and agricultural water supply. In Austin, two wastewater treatment plants discharged water into the river at Walnut Creek and South Austin Regional. Water is pumped from the Colorado River to supply three power plant reservoirs: Walter E. Long, Bastrop, and Fayette County. Downstream of La Grange, near Bay City, the Garwood Irrigation Company has secured the right to divert 35,000 acre-feet of water annually to the city of Corpus Christi. Proposed interbasin transfers into the Colorado River include pumping groundwater from the Guadalupe basin and coastal aquifers (LCRA 2016). Water rights that involve interbasin transfers with the lower Colorado River basin are included in Appendix A.

Instream flow: Instream flows in the lower Colorado River are determined by LCRA's state-approved 2015 Water Management Plan. The plan governs operation of the Highland Lakes, specifically Lakes Buchanan and Travis, to provide water to users in the lower Colorado River basin. The plan allows LCRA to adapt to changing water supply conditions by requiring the cutback of water to downstream agricultural users during drought, prioritizing municipal and industrial needs, and providing water to help meet environmental needs of the lower Colorado River and Matagorda Bay (LCRA 2015). Instream flow is vital to the flora and fauna of the lower Colorado River. Many aquatic species require certain flow regimes to facilitate spawning such as the Blue Sucker. Blue Sucker are a State Threatened species in Texas and studies are underway by TPWD and Texas Tech University relating instream flows to Blue Sucker spawning, movement, habitat use, and recruitment. Recommendations from the study will influence the LCRA Water Management Plan.

METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for the Colorado River (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, Guadalupe Bass, White Bass, catfishes, surfishes, Gizzard Shad, and Threadfin Shad were collected by spring electrofishing (high frequency, 4 hours at 24, 10-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 supplemental electrofishing survey for Guadalupe Bass was conducted in fall 2016 for age and growth analysis. Biologist-selected sites were sampled during six days (effort ~ 7 hours) from October to December. Ages for Guadalupe Bass were determined using otoliths for a category 2 age and growth analysis (79 fish ranging 8.0 to 15.9 inches).

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. Genetic analysis for Guadalupe Bass was conducted as a special project in 2014 (De Jesus and Lutz-Carrillo 2014).

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 (Wr)] 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 – A roving creel survey was conducted in fall of 2016 and spring of 2017. The creel periods were September through November and March through May. Angler interviews were conducted on 6 weekend days and 6 weekdays per quarter to assess angler use and fish catch/harvest statistics in accordance with the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015). Additional questions regarding access, black bass harvest and regulations, and satisfaction were included in the creel survey.

Habitat – A post-treatment vegetation survey was conducted in September 2015. The survey focused on water hyacinth and the effectiveness of herbicide treatment in August 2015. It was limited to several isolated areas on the river and noted presence/absence. No standard habitat surveys have been conducted on the Colorado River since 2002.

Hydrograph – Source for water discharge data was the United States Geological Survey (USGS) streamflow gauge 08159200 on the Colorado River at Bastrop.

RESULTS AND DISCUSSION

Creel: Total fishing effort for all species over the two quarters in 2016-2017 was 21,560 angler hours. Directed fishing effort by anglers was highest for catfishes (39%), followed by anglers fishing for black basses (30%, Table 6). The term “black basses” refers to anglers who were targeting both Largemouth Bass and Guadalupe Bass, with no significant preference for either. The term “catfishes” refers to anglers who were targeting both Channel Catfish and Flathead Catfish, with no significant preference for either. The term “anything” refers to anglers who did not have any preference for what species they caught. In both quarters, anglers targeted catfish the most. In fall 2016, 45% of effort was directed toward Channel Catfish or catfishes in general. In spring 2017, 54% of effort was directed toward catfish. Anglers targeted Largemouth Bass, Guadalupe Bass, and black basses in general a combined 39% in fall 2016, and 35% in spring 2017. Although creel season and duration differed, directed effort for catfishes and black basses appear to have increased since 2001, while effort for Freshwater Drum and “anything” decreased. Bank anglers comprised 26% of angling activity, while boat anglers represented the remaining 74%. Bank anglers primarily targeted catfish (58%) and “anything” (32%). Boat anglers targeted black bass (47%) and catfish (45%).

Channel Catfish and Freshwater Drum were the most harvested species on the Colorado River in 2016-2017. An estimated 551 Channel Catfish were harvested during the two quarters comprising 66% of total harvest. Freshwater Drum harvest was estimated at 188 fish for 23% of total harvest. No harvest was documented for black basses.

Direct expenditures for the Colorado River during the two quarters was estimated at \$102,975 (Table 7). Trip expenditures were \$63,577 in fall 2016 and \$39,398 in spring 2017. Respondents were asked how much more they would be willing to spend per day for their fishing experience. The responses varied, with the minimum at zero dollars, the maximum of \$200, and the median of \$25. Several of the responses near the maximum amount were related to the known cost of fishing guides and equipment rentals. Only 4.8 percent of fishing parties encountered were guided. Satisfaction of the fishing and recreational opportunities on the lower Colorado River was evaluated on a five-point scale. Most (49%) respondents answered 5 (highly satisfied). Over 83% of respondents answered 4 (satisfied) or 5 (highly satisfied). No respondents answered 1 (highly unsatisfied). Most anglers were local, coming from ZIP codes associated with the cities of Bastrop, Austin, and San Marcos (Appendix B). Six angling parties creelied were from out-of-state and another six were from the Houston or Dallas areas (outside of map area). The ZIP code with the highest number of anglers creelied was 78602 (Bastrop) with 38 fishing parties represented. According to ESRI’s Tapestry database, this ZIP code is composed of Southern Satellites (24%), Green Acres (23%), and Bright Young Professionals (15%). Each group differs in age and income, but they are largely composed of married couples in single family homes.

Several aspects of river access for anglers were addressed with the creel survey. Access usage was mainly through existing public access points (74.6%). Private access was used by 20.6% of fishing parties, while TPWD lease access sites were utilized by 4.8%. The Texas River School Camp was the only lease access site used by anglers creelied in 2016-2017. The close proximity to the creel area probably resulted in the bias towards this site. The WJF and Hidden Shores Access Sites were located near Smithville, while the creel survey extended to just downstream of Bastrop. Awareness of the RACA program was low (17.7%) for creelied fishing parties. The most popular put-in sites for paddlers were Fisherman’s Park (30.2%) and Little Webberville Park (23.8%). The most popular take-out sites were Big Webberville Park (14.3%) and Fisherman’s Park (12.7%).

Angler opinions and attitudes were assessed regarding black bass regulations. Anglers were asked if harvest of black bass was an important part of their fishing experience. Over 87% of respondents said “no”, reflective of the little to no harvest for black basses documented for the last three creel surveys on the river. Anglers were also asked if they would support more restrictive harvest regulations on black

bass species. Responses were supportive for more restrictive harvest regulations (86.7%), with 13.3% opposing.

Prey species: Gizzard Shad, Bluegill, and Longear Sunfish were the predominant prey species in the Colorado River. Electrofishing catch rate of Gizzard Shad was 40.9/h in 2017. Index of vulnerability (IOV) for Gizzard Shad was 24, indicating that 24% of the sample were vulnerable (≤ 7 inches) to existing predators (Figure 2). Longear Sunfish (Figure 3), Bluegill, Redbreast Sunfish, and Redspotted Sunfish catch rates were 12.6/h, 9.7/h, 0.5/h, and 0.3/h, respectively. Bluegill size structure was dominated by small individuals (PSD = 8), with only a few individuals of quality size (≥ 6 inches, Gabelhouse 1984, Figure 4). Other forage species collected included Red Shiner, Blacktail Shiner, and Mexican Tetra (Appendix C).

Channel Catfish: Channel Catfish were relatively abundant, with an electrofishing catch rate 19.3/h in 2017. Nearly all Channel Catfish sampled were over 12 inches (Figure 5), which suggested that ample numbers of larger fish were available to anglers for harvest. Several Channel Catfish were in the preferred size category (≥ 24 inches). Relative weight ranged from 91 to 117, indicating good body condition. Directed effort was only 10% specifically for Channel Catfish, but total angling effort for any catfish in general was 49%. Total catch for anglers during the 2016-2017 creel survey was 776 individuals with a harvest of 552 fish (Table 8). Channel Catfish anglers were harvest-oriented, with only 13.6% of legal sized fish released. During the 2016-2017 creel period, observed angler catches ranged from 14 to 27 inches (Figure 6).

Flathead Catfish: Flathead Catfish had low relative abundance with an electrofishing catch rate of 4.2/h. Most individuals were over 18 inches and available for harvest (Figure 7). A few individuals were in the preferred size category (≥ 24 inches, Quinn 1991). An estimated 337 Flathead Catfish were caught in the 2016-2017 creel survey. Of these fish, 74 were harvested and no legal sized individuals were released. No directed effort for Flathead Catfish was detected in the 1999 or 2001 creel surveys (Magnolia et al. 2003). No directed effort was noted in the 2016-2017 survey, but total effort for any catfish was 49%.

White Bass: White Bass were present in low relative abundance (CPUE = 3.0/h), with several large individuals over 15 inches (Figure 8). All White Bass sampled were over 10 inches, making them available for harvest. While their low relative abundance would make them hard to target for anglers, incidental catches can supplement other harvest species. Estimated catch for White Bass was 8 fish, with none of those released. No directed effort for White Bass was detected in the 1999, 2001, or 2016-2017 creel surveys. White Bass are not known to make large spawning runs in this section of the Colorado River as with other river systems.

Largemouth Bass: The electrofishing catch rate of Largemouth Bass was 6.2/h in 2017, similar to the mean catch rate from 1998 to 2002 (Magnolia et al. 2003). These catch rates indicate overall low relative abundance throughout the entire river section, but anecdotal information suggests anglers can catch substantial numbers targeting the right areas and habitat. One-fourth of the sample included bass over 14 inches and 2 individuals were over 18 inches (Figure 9). Relative weight was moderate, ranging from 82 to 102. There was not enough Largemouth Bass caught between 13 and 15 inches to perform a length-at-age analysis. The previous management report stated that Largemouth Bass reached 14 inches between ages 2 and 3 (Magnolia et al. 2003). Directed effort for Largemouth Bass was 820 hours in the 2016-2017 creel survey (Table 9). Directed effort per river mile has increased since 2001. No harvest has been detected in the 1999, 2001, or 2016-2017 creel surveys. Largemouth Bass had 45% Florida alleles in the lower Colorado River (Table 10). Just over 90% of Largemouth Bass collected for analysis were Fx hybrids.

Guadalupe Bass: The electrofishing catch rate of Guadalupe Bass was 7.7/h in 2017, indicating low relative abundance. The size range of Guadalupe Bass collected in 2017 was from 6 to 14 inches (Figure 10). This survey was random and exploratory, so habitats known for holding concentrations of Guadalupe Bass were not specifically targeted. Anecdotal information suggests anglers can catch

substantial numbers targeting the right areas and habitat. The time of year sampling occurs may influence catch rate. A supplemental fall survey will be conducted in 2017 to see if catch rate improves for black basses. A supplemental fall survey was conducted in 2016 for a category 4 age and growth analysis, which was not done due to low sample size. Instead, a category 2 age and growth analysis was completed, showing Guadalupe Bass reached 14 inches at age 3, and growth rates leveled off for older fish (Figure 11). Appendix E contains results from sampling surveys in 2014, 2015, and 2016 that targeted Guadalupe Bass with considerably more effort than the 2017 survey. The 2014 and 2015 data were collected by Texas Tech University, and the 2016 data were from the fall supplemental sampling. While not directly comparable to the 2017 survey for relative abundance, these histograms show a more defined size structure. Larger individuals are available, including some over 17 inches (432 mm). The current Texas State Record Guadalupe Bass was caught in this section of the Colorado River in 2014. It weighed 3.7 pounds and measured 17.3 inches in length. While these size fish are widely considered trophy size fish, there has been no established size categories for Guadalupe Bass. Guadalupe Bass length categories in the Fish Monitoring File (FMF) appear to be formulated using the Gabelhouse (1984) method but may be outdated. Further investigation into scientifically based size designations for this species is warranted for future management.

Directed effort for Guadalupe Bass was 700 hours in 2016-2017. Although the creel survey seasons and duration were different, this is higher than in 1999 and 2001 (Table 11). In 2016-2017, total catch for Guadalupe Bass was estimated at 1,946 fish. While some harvest was detected in the 1999 creel survey, no harvest was detected in 2001 or 2016-2017.

Guadalupe Bass have been listed as a species of special concern (Hubbs et al. 2008), mainly due to hybridization with Smallmouth Bass (Curtis et al. 2015). Guadalupe Bass X Smallmouth Bass hybrids, pure Smallmouth Bass, and Guadalupe Bass X Largemouth Bass hybrids have not been detected in the Colorado River subbasin (Bean et al. 2013). However, Guadalupe Bass X Spotted Bass hybrids have been detected. Genetic sequencing from 2012 to 2014, showed 28% sympatric introgression between Guadalupe and Spotted Bass (De Jesus and Lutz-Carrillo 2014). The study also showed that larger Guadalupe Bass tend to be pure, while the Guadalupe Bass X Spotted Bass hybrids tend to have smaller body size. This hybridization is considered natural and occurs at a background level (Bean 2017).

The economic value of river and stream fishing in Texas is high. In fiscal year 2012, a web-based survey documented fishing trips for river and stream anglers within the 24-county area of the Edwards Plateau ecoregion. Direct expenditures totaled \$74,182,080, providing 776 full-time jobs (Thomas et al. 2015). A significant portion of river and stream angling in Central Texas is directed toward Guadalupe Bass, the State Fish of Texas. Forty-two% of nonlocal anglers ($N = 190$) specifically targeted Guadalupe Bass with a total of \$68,400 in direct expenditures, while 43% of local anglers ($N = 373$) targeted Guadalupe Bass for \$200,304 (Thomas et al. 2015). Twenty-two% of all respondents fished the Colorado River, while 20% of Guadalupe Bass anglers fished the Colorado River most often (Thomas et al. 2015). The lower Colorado River is considered the state's premier trophy fishery for Guadalupe Bass, and serves as a sanctuary for pure Guadalupe Bass (Bean 2017).

Freshwater Drum: The electrofishing catch rate of Freshwater Drum was 6.0/h in 2017 (Figure 12). Several individuals were in the trophy size category (≥ 25 inches). Body condition was excellent, ranging from 95 to 155. This range is seen for Common Carp and ShareLunker Largemouth Bass during spawning season (personal communication TPWD). Electrofishing occurred at the time of spawning for Freshwater Drum in Texas (April and May), which may have explained some larger individuals. A new Colorado River waterbody record for Freshwater Drum was caught in March of 2017. It weighed 18.7 pounds and measured 29.8 inches in length. There was no directed effort for Freshwater Drum in 2016-2017, which has been declining since 1999 (Table 12). Estimated catch was 188 fish in 2016-2017. All Freshwater Drum caught were harvested in 1999, 2001, and 2016-2017. While creel respondents were not specifically targeting Freshwater Drum, they still retained them with other desirable fish. Observed harvest of Freshwater Drum in 2016-2017 ranged from 12 to 21 inches in length (Figure 13).

Fisheries management plan for the Colorado River, Texas

Prepared – July 2017

ISSUE 1: Access has been identified as the largest impediment to river and stream fishing for Texas anglers (Thomas et al. 2015). While some boat ramps, piers, and bank access are available, access is limited on the lower Colorado River. Some facilities need improvement and some river sections need additional access sites to reduce the distance required for paddling.

MANAGEMENT STRATEGIES

1. Notify controlling authorities about sites where access or facilities can be improved
2. Work with controlling authorities to utilize the TPWD boat ramp grant program to add more boat ramps to the river.
3. Coordinate with the River Access and Conservation Area program to find, develop, and promote access sites.
4. Encourage law enforcement to increase patrols at access sites to enforce game laws and increase safety.
5. Maintain communication with TXDOT concerning the Highway 183 access site. Bridge construction and illegal dumping may close the site (personal communication TXDOT).
6. Monitor the status of the Lost Pines Recreational Trails. Flood damage has temporarily closed the park and repairs to Riverside Drive are needed to make it accessible.

ISSUE 2: The Guadalupe Bass is a species of special concern statewide and provides a “trophy” fishery in the lower Colorado River. Currently, there is no size limit on Guadalupe Bass and anglers indicate support for more restrictive regulations. Since harvest is not currently documented, a regulation on the Colorado River would provide more promotional benefits than biological. A proactive regulation could prevent potential harvest of “trophy” Guadalupe Bass in the future.

MANAGEMENT STRATEGIES

1. Investigate if a more restrictive harvest regulation is suited for Guadalupe Bass in the Colorado River. If recommended, utilize creel survey results, sampling data, and input from Inland Fisheries Division to formulate a regulation proposal.
2. Work with TPWD Heart of the Hills Fisheries Research Center, Watershed program, and River Studies program to establish accepted length categories (stock, quality, preferred, memorable, trophy) for Guadalupe Bass.
3. Work with TPWD partners to fill data gaps stated in the Rangewide Guadalupe Bass Conservation Plan (Bean 2017).
4. Investigate whether fall or spring electrofishing is more effective at collecting black bass species in the Colorado River.

ISSUE 3: The lower Colorado River is still considered an underutilized fishery. There are multiple species that are attractive to anglers, but many people are still unaware of the fishing opportunities in the Colorado River.

MANAGEMENT STRATEGIES

1. Promote the Colorado River fishery via social media, TPWD television series, news releases, TPWD website, and during speaking engagements.
2. Continue promotion and education about the River Access and Conservation Area program and Texas Paddling Trails.
3. Work with local businesses and parks to establish official weigh-in sites for record fish from the Colorado River.

4. Promote and distribute the LCRA Lower Colorado River Guide located at <http://www.lcra.org/parks/Documents/2013-05-15-River-Users-Guide.pdf>. This is the most comprehensive and easy to understand layout of access sites, river miles, and planning considerations for the Colorado River available to recreationists. As access sites are added, it should be updated accordingly.

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 structure, restricting water flow in pipes, fouling swimming beaches, and plugging engine cooling systems. Hydrilla (*Hydrilla verticillata*) and water hyacinth (*Eichhornia crassipes*) can form dense mats, interfering with recreational activities like fishing, boating, kayaking, canoeing, and swimming. The potential for invasive species to spread to other river drainages and waterbodies is a serious threat to all public waters of the state.

MANAGEMENT STRATEGIES

1. Cooperate with the controlling authorities to post appropriate signage at access points.
2. Contact outfitters and parks about invasive species, and provide them with posters and literature to educate their customers.
3. Continue working with the Aquatic Invasive Species group to monitor and manage invasive species on the river.
4. Educate the public about invasive species through the use of media and the internet.
5. Keep track of existing and future inter-basin water transfers to facilitate potential invasive species responses.

Objective-Based Sampling Plan and Schedule

2017 - 2021

Sport fish, forage fish, and other important fishes

Sport fishes in the Colorado River include Guadalupe Bass, Largemouth Bass, Channel Catfish, Flathead Catfish, and White Bass. Some anglers harvest Freshwater Drum. Known important forage species include Gizzard Shad, Bluegill, and Longear Sunfish.

Low density fisheries

Flathead Catfish: Flathead Catfish had a catch per unit effort (CPUE) of 4.2/hour in 2017. No directed angling effort was noted for Flathead Catfish in the 2016-2017 creel survey. General monitoring trend data (without precision or sample size requirements) can be gathered for this species while sampling for black basses.

Freshwater Drum: Electrofishing catch rate for Freshwater Drum was 6.0/hour in 2017. No directed angling effort was noted for Freshwater Drum in the 2016-2017 creel survey. General monitoring trend data (without precision or sample size requirements) can be gathered for this species while sampling for black basses.

White Bass: White bass had a CPUE of 3.0/hour for boat electrofishing in 2017. No directed angling effort was noted for White Bass in the 2016-2017 creel survey. General monitoring trend data (without precision or sample size requirements) can be gathered for this species while sampling for black basses.

Survey objectives, fisheries metrics, and sampling objectives

Guadalupe Bass: Guadalupe Bass were collected at a rate of 7.7/hour during boat electrofishing in 2017. Guadalupe Bass had 3% directed angling effort in the 2016-2017 creel survey, while black bass species in general had 37% directed effort. Current regulations for Guadalupe Bass and their hybrids for the Colorado River include no length limit and a 5-fish daily bag limit for all black bass. A more restrictive harvest regulation for Guadalupe Bass is being considered.

An additional daytime boat electrofishing will occur in the fall of 2017 and routine electrofishing in fall or spring of 2020-2021 (Table 13). A minimum of 24 randomly selected 10-min stations will be sampled between the FM 973 Bridge in Austin to the SH 71 Bridge crossing in La Grange. Fall electrofishing in 2017 will determine whether fall or spring sampling are best to collect target species in the Colorado River. If the fall 2017 results are better than spring 2017, then electrofishing will be done in fall 2020. If spring 2017 results are better, then electrofishing will be conducted spring 2021. Fall electrofishing in 2017 will target sport fish and forage species. General monitoring trend data (without precision or sample size requirements) can be gathered for Guadalupe Bass.

Electrofishing conducted in fall 2020 or spring 2021 will be done with twenty-four, randomly-selected, ten-minute stations. Sampling objectives will include 30 stock-size fish and RSE of CPUE-S ≤ 25 . Past results have indicated 50 Guadalupe Bass may be difficult to obtain with random sampling. Exclusive of the original 24 stations, six additional random stations will be pre-determined in the event extra sampling is necessary.

Largemouth Bass: Largemouth Bass were collected at a rate of 6.2/hour during boat electrofishing in 2017. Directed angling effort for Largemouth Bass was 4% in the 2016-2017 creel survey, while black bass species in general had 37% directed effort. Daytime boat electrofishing will occur in fall 2017, and will follow the protocol for Guadalupe Bass. General monitoring trend data (without precision or sample size requirements) can be gathered for Largemouth Bass. Electrofishing objectives for fall 2020 or spring 2021 will include 30 stock-size fish and RSE of CPUE-S ≤ 25 . Past results have indicated it may be

difficult to obtain 50 Largemouth Bass with random sampling. Six additional random stations will be pre-determined in the event extra sampling is necessary.

Channel Catfish: Channel Catfish were stocked in the Colorado River in 1973 and 1978. Directed angling effort for Channel Catfish was 10% in the 2016-2017 creel survey, while catfish species in general had 49% directed effort. General monitoring trend data (without precision or sample size requirements) can be gathered for Channel Catfish in fall 2017 following the sampling protocol for Guadalupe Bass. Electrofishing conducted in fall 2020 or spring 2021 will continue until 50 stock-size fish are collected and the RSE of CPUE-S is ≤ 25 . Six additional random stations will be pre-determined in the event extra sampling is necessary.

Longear Sunfish, Bluegill, and Gizzard Shad: Longear Sunfish, Bluegill, and Gizzard Shad have been important forage species in the Colorado River. Collection during black bass sampling will allow for monitoring of large-scale changes in sunfish and Gizzard Shad relative abundance and size structure (PSD and IOV). No additional effort will be expended to achieve an RSE ≤ 25 for CPUE of Longear Sunfish, Bluegill, and Gizzard Shad. Body condition of Largemouth Bass can provide information on forage abundance, vulnerability, or both relative to predator density. Presence of other forage species will be noted.

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Hydrograph

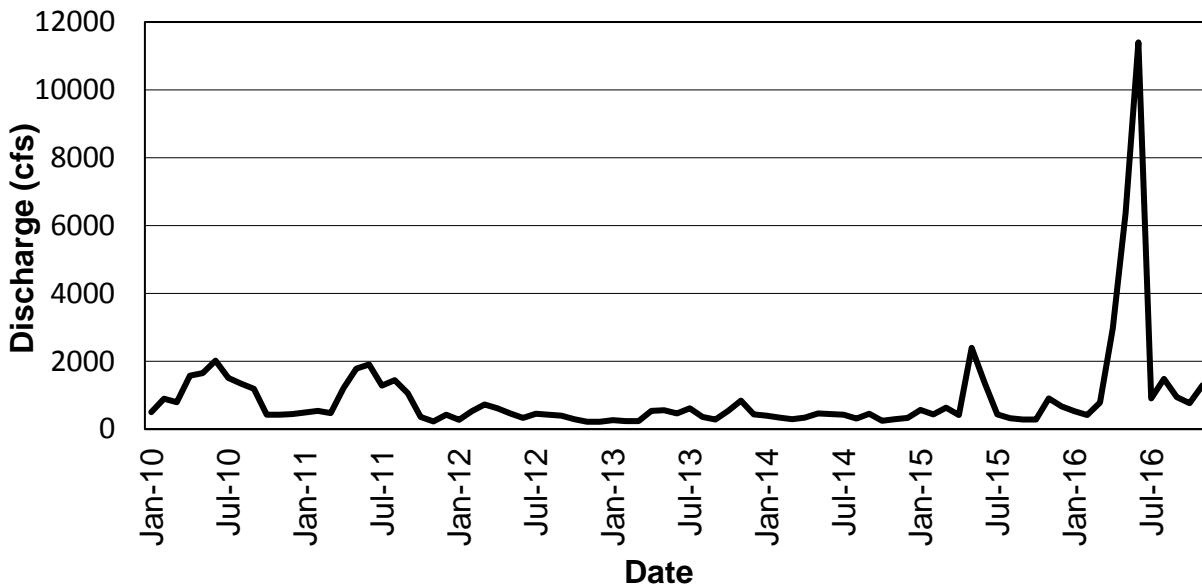


Figure 1. Median monthly discharge for the Colorado River recorded at gauge 08159200 in Bastrop, Texas, January 2010 – November 2016. Data were collected by the United States Geological Survey (USGS).

Table 1. Characteristics of the lower Colorado River, Texas.

Characteristic	Description
Controlling authority	Lower Colorado River Authority
Counties	Travis, Bastrop, Fayette
River type	Low gradient
Median of daily mean flow 1960-2017 (cfs)	1,835 ¹
Dissolved oxygen (mg/L)	4.0 to 12.0 ²
Seasonal temperature (°C)	May to October: 22 to 35, November to April: 2 to 27 ²
Alkalinity (pH)	6.5 to 9.0 ²
Specific conductance (µS/cm)	300 to 700 ²
Aquatic life use rating	Exceptional ³

¹ Calculated from USGS station 8159200 at Bastrop, Texas

² Range of annual average values reported for lower Colorado River (LCRA 2017)

³ Colorado River between Austin and La Grange (Texas Natural Resource Conservation Commission 1997)

Table 2. Boat ramp characteristics for the lower Colorado River, Texas, July 2017.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Fishing Pier	Condition
Little Webberville Park	30.229494 -97.518961	Y	12	N	Ramp partially obstructed by submerged boulders, extension feasible
Webberville Park	30.209038 -97.499385	Y	10	Y	Ramp periodically covered in mud after high flow events, extension feasible
969 bridge crossing	30.167744 -97.403235	Y	6	N	Steep ramp, repairs/extensions have been made
Bob Bryant Park	30.121953 -97.337544	Y	34	Y	Ramp for kayaks, canoes, and small rafts only
Fisherman's Park	30.111977 -97.325088	Y	18	Y	Good ramp, partially obstructed with sand bar
Loop 230 bridge crossing	30.013005 -97.161816	Y	15	N	No improvements necessary
Buffalo Trail Park	29.900325 -96.886656	Y	25	N	No improvements necessary

Table 3. Harvest regulations for the Colorado River, Texas.

Species	Bag limit	Length limit
Channel and Blue Catfish	25 (in any combination)	12-inch minimum
Flathead Catfish	5	18-inch minimum
White Bass	25	10-inch minimum
Spotted and Guadalupe Bass	5 (in any combination)	None
Largemouth Bass		14-inch minimum
White and Black Crappie	25 (in any combination)	10-inch minimum
Freshwater Drum	None	None

Table 4. Stocking history of the Colorado River, Texas. FGL = fingerling, UNK = unknown

Species	Year	Number	Size
Blue Catfish	1980	60,000	UNK
	2000	4,312	FGL
	2001	735	FGL
Species total		65,047	
Channel Catfish	1973	12,350	UNK
	1978	86,914	UNK
	Species total	99,264	
Smallmouth Bass	1980	152	UNK
	1982	270	UNK
	1984	45,400	FGL
Species total		45,822	

Table 5. Objective-based sampling plan components for the Colorado River, Texas 2016-2017.

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing</i>			
Guadalupe Bass	Abundance Size structure Age-and-growth	CPUE - stock PSD, length frequency Year-class strength	General monitoring trend data N = 400 (size classes)
Largemouth Bass	Abundance Size structure Age-and-growth Condition Genetics	CPUE - stock PSD, length frequency Age at 14 inches W_r % FLMB	General monitoring trend data
Bluegill	Abundance Size structure	CPUE - total PSD, length frequency	General monitoring trend data
Channel Catfish	Abundance Size structure Condition	CPUE - stock PSD, length frequency W_r	General monitoring trend data

Table 5. Objective-based sampling plan continued.

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Creel Survey</i>			
Guadalupe Bass	Trend information on angler utilization	Angler CPUE, total harvest, effort, expenditures, opinions on harvest regulations	
Largemouth Bass	Trend information on angler utilization	Angler CPUE, total harvest, effort, expenditures, opinions on harvest regulations	
Channel Catfish	Trend information on angler utilization	Angler CPUE, total harvest, effort, expenditures	

Table 6. Percent directed angler effort by species for the Colorado River, Texas, 1999, 2001 and 2016-2017. Survey periods for 1999 and 2001 were mid-July through mid-October. Survey periods for 2016-2017 were September 1 through November 30 and March 1 through May 31.

Species	1999	2001	2016-2017
Catfishes	0.0	0.0	38.7
Channel Catfish	59.5	12.6	10.2
Black Basses	0.0	13.1	30.1
Largemouth Bass	14.7	6.7	3.8
Guadalupe Bass	0.0	2.7	3.2
Freshwater Drum	15.5	7.2	0.0
Anything	10.1	57.6	14.0

Table 7. Total fishing effort (h) for all species and total directed expenditures at the Colorado River, Texas, 2016-2017. Survey periods were from September 1 through November 30 in 2016, and March 1 through May 31 for 2017. Relative standard error is in parentheses.

Creel statistic	1999	2001	2016/2017
Total fishing effort	4,859	7,576	21,560 (23)
Total directed expenditures			\$102,975 (91)

Gizzard Shad

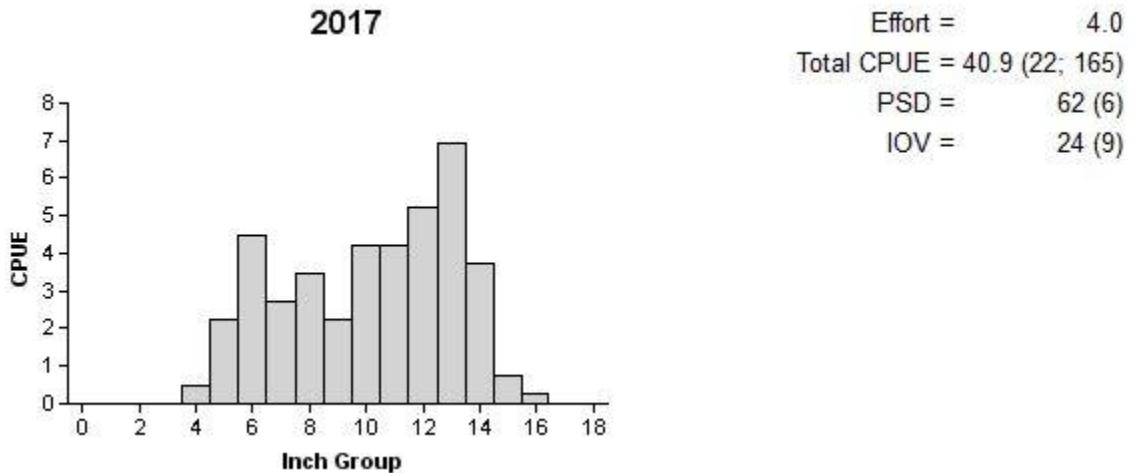


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV and size structure are in parentheses) for spring electrofishing surveys, Colorado River, Texas, 2017.

Longear Sunfish

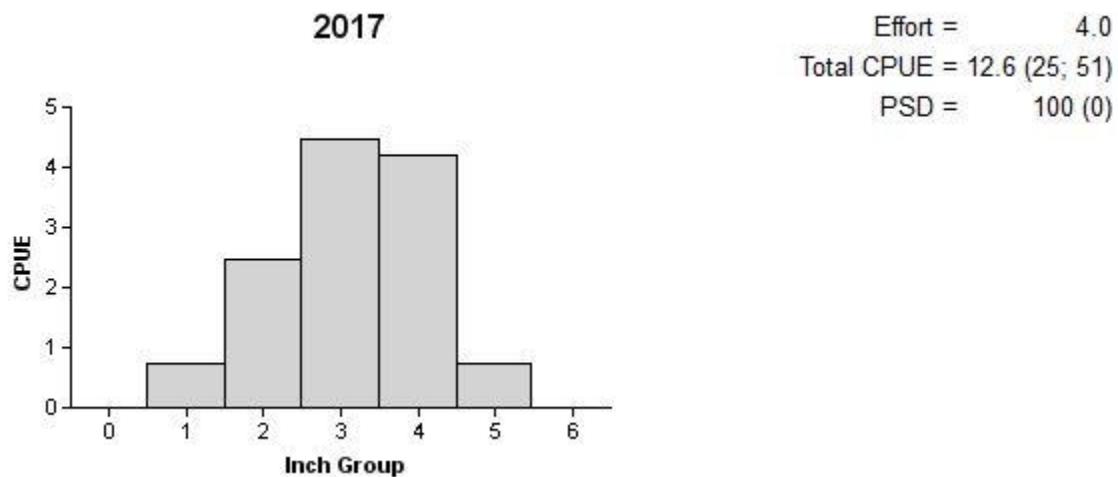


Figure 3. Number of Longear Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Colorado River, Texas, 2017.

Bluegill

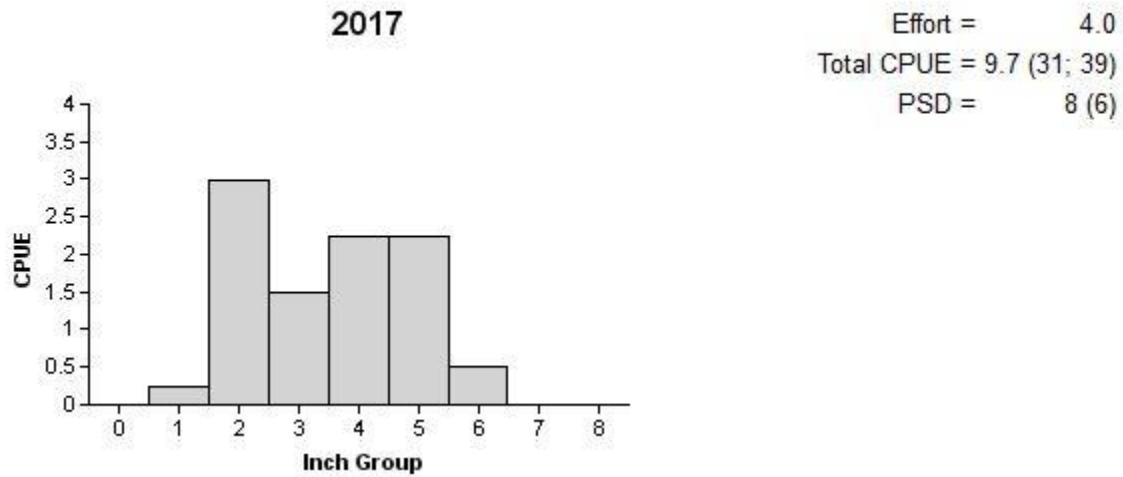


Figure 4. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Colorado River, Texas, 2017.

Channel Catfish

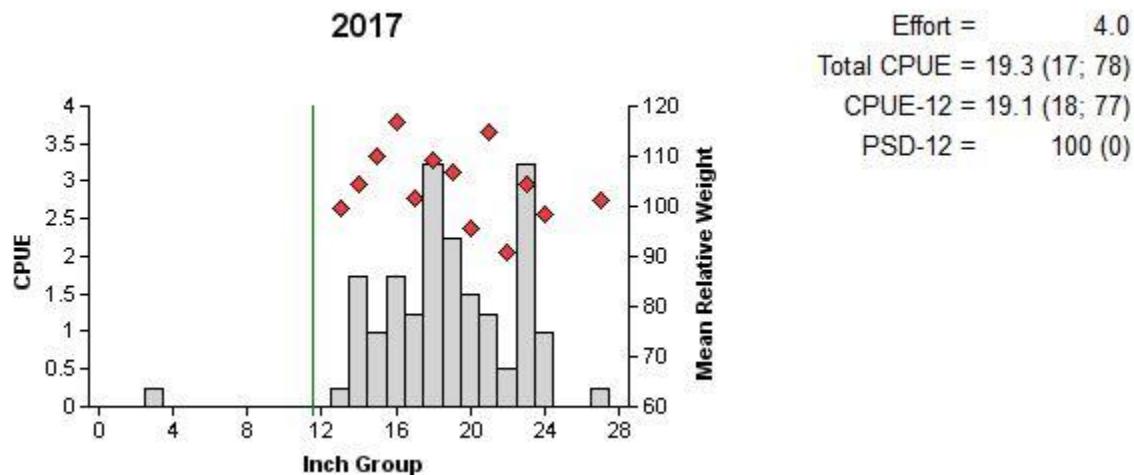
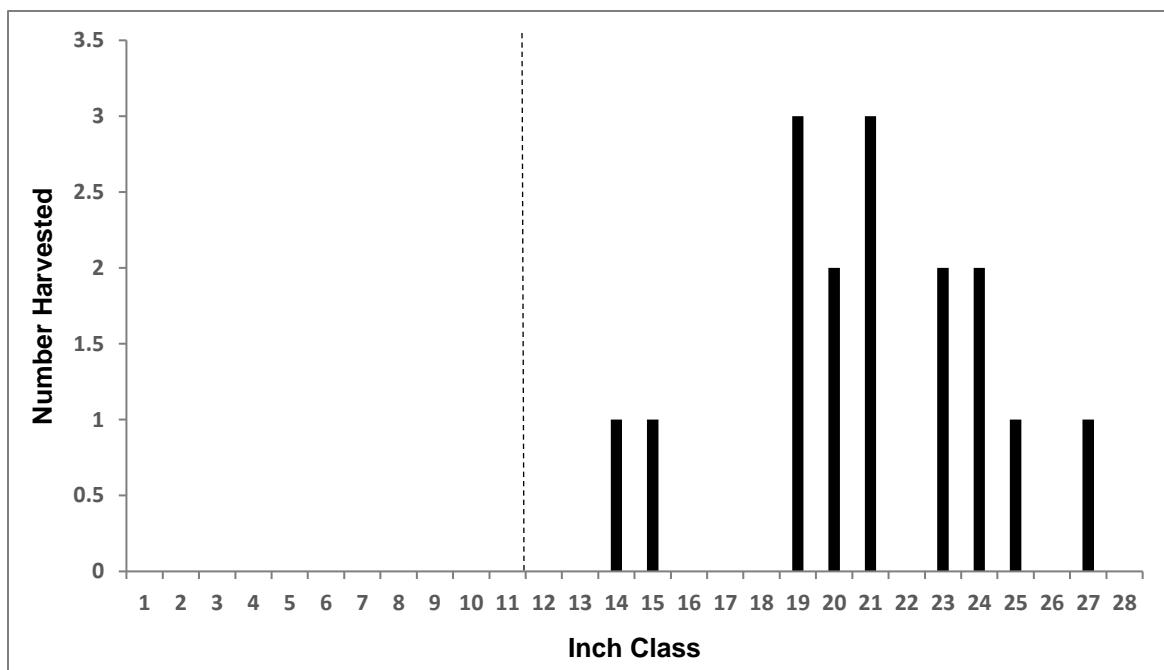


Figure 5. Number of Channel Catfish caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Colorado River, Texas, 2017. Vertical line represents minimum length limit at time of the survey.

Channel Catfish

Table 8. Creel survey statistics for Channel Catfish at the Colorado River, Texas from July through October 1999, July through October 2001, and September 2016 through May 2017. Total catch per river mile is for anglers targeting Channel Catfish and total harvest is the estimated number of Channel Catfish harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year		
	1999	2001	2016/2017
River miles	50	50	20
Directed effort (h)	2,895	954	2,195 (55)
Directed effort/river mile	57.9	19.1	109.8 (55)
Total catch	77.9 (76.1)	1,630.4 (70.1)	775.6 (51)
Mean angler catch rate	0.03 (76.1)	1.7 (70.1)	0.05 (67)
Total harvest	77.9 (76.1)	1,601 (71.2)	551.5 (49)
Total release	0	29.4 (268.3)	224.1 (130)
Percent legal released	0	1.80	13.6



N = 16; TH = 1,655

Figure 6. Length frequency of harvested Channel Catfish observed during creel surveys at the Colorado River, Texas, September 2016 through May 2017, all anglers combined. N is the number of harvested Channel Catfish observed during creel surveys, and TH is the total estimated harvest for the creel survey period. Dashed line indicates length limit at the time of the survey.

Flathead Catfish

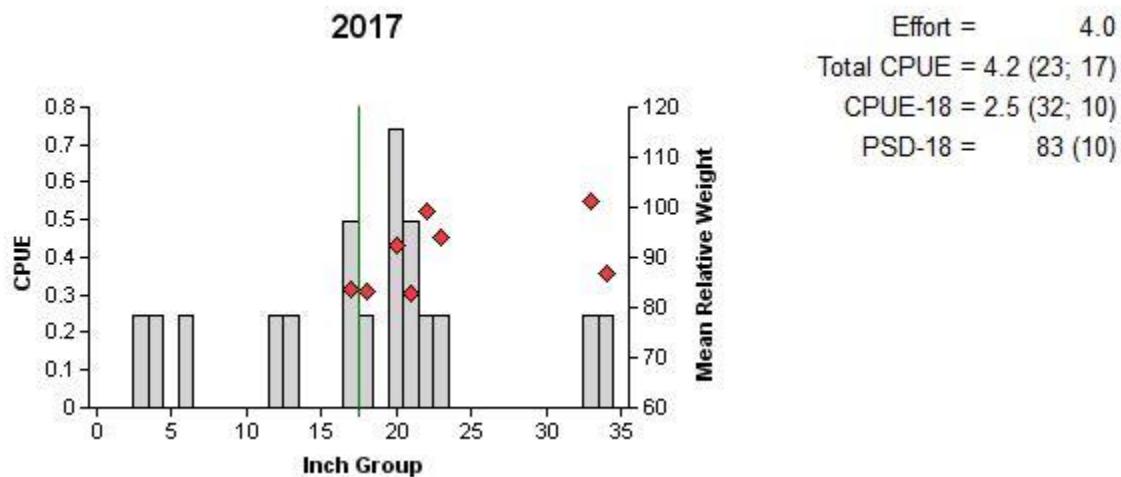


Figure 7. Number of Flathead Catfish caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Colorado River, Texas, 2017. Vertical line represents minimum length limit at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

White Bass

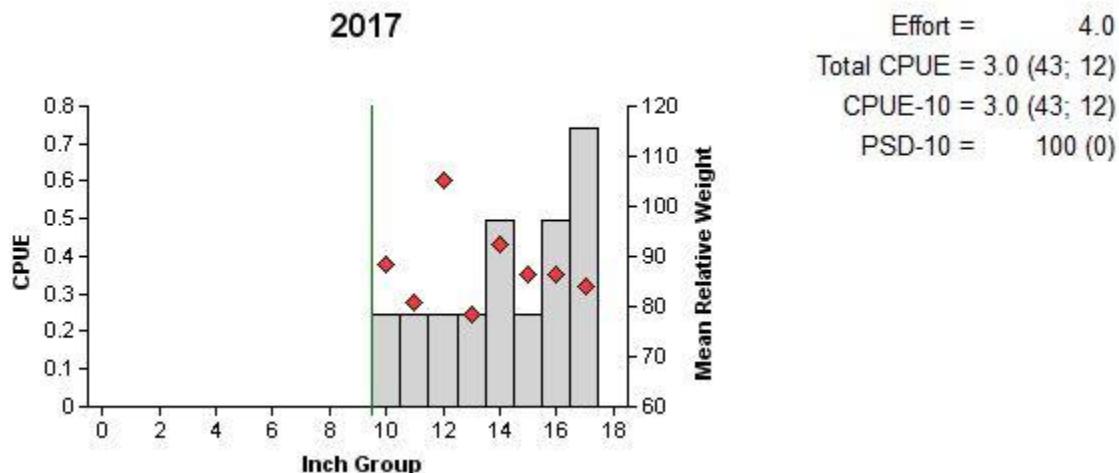


Figure 8. Number of White Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Colorado River, Texas, 2017. Vertical line represents minimum length limit at the time of the survey.

Largemouth Bass

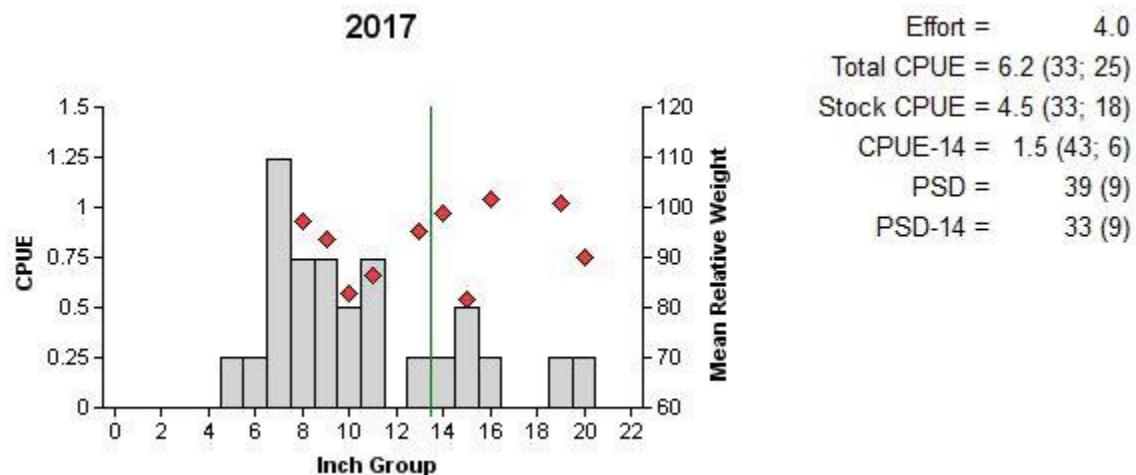


Figure 9. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Colorado River, Texas, 2017. Vertical line represents minimum length limit at the time of the survey.

Largemouth Bass

Table 9. Creel survey statistics for Largemouth Bass at the Colorado River, Texas, from July through October 1999, July through October 2001, and September 2016 through May 2017. Total catch per river mile is for anglers targeting Largemouth Bass and total harvest is the estimated number of Largemouth Bass harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year		
	1999	2001	2016/2017
River miles	50	50	20
Directed effort (h)	713	508	820 (76)
Directed effort/river mile	14.3	10.2	41 (76)
Total catch	769.6 (112.1)	381.7 (70.9)	4,227.6 (46)
Mean angler catch rate	1.1 (112.1)	0.8 (70.9)	0.3 (126)
Total harvest	0	0	0
Total release	769.6 (112.1)	381.7 (70.9)	4,227.6 (46)
Percent legal released	100	100	100

Table 10. Results of genetic analysis of Largemouth Bass collected by spring electrofishing, Colorado River, Texas. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, F1 = first generation hybrid between a FLMB and a NLMB, Fx = second or higher generation hybrid between a FLMB and a NLMB. Genetic composition was determined with micro-satellite DNA analysis.

Year	Sample size	Number of fish				% FLMB alleles	% pure FLMB
		FLMB	F1	Fx	NLMB		
2017	22	0	0	20	2	45.0	0

Guadalupe Bass

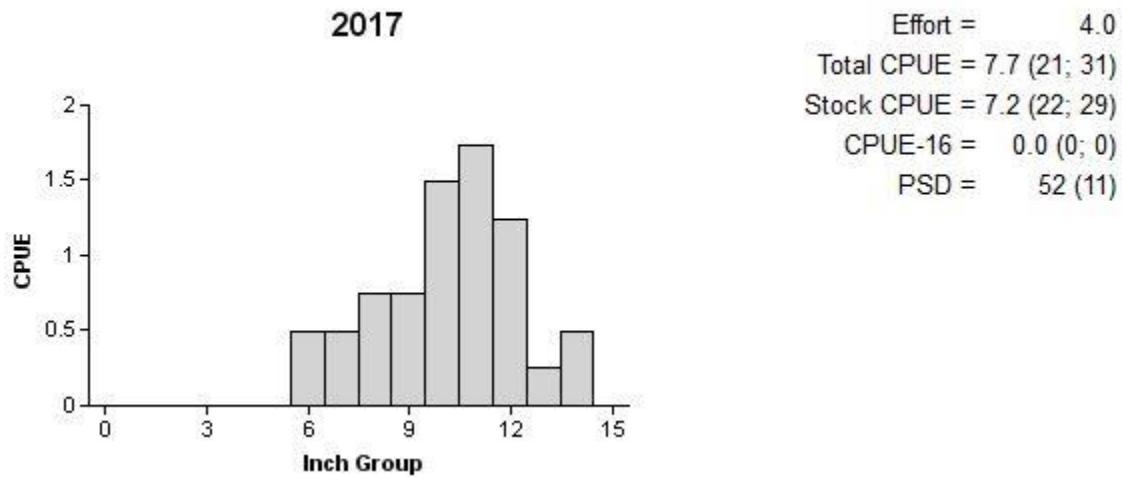


Figure 10. Number of Guadalupe Bass caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Colorado River, Texas, 2017. Guadalupe Bass had no minimum length limit at the time of the survey. No relative weight information currently exists for Guadalupe Bass.



Figure 11. Length at age for Guadalupe Bass collected during electrofishing, Colorado River, Texas, October to December 2016 (N = 79).

Guadalupe Bass

Table 11. Creel survey statistics for Guadalupe Bass at the Colorado River, Texas, from July through October 1999, July through October 2001, and September 2016 through May 2017. Total catch per river mile is for anglers targeting Guadalupe Bass and total harvest is the estimated number of Guadalupe Bass harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year		
	1999	2001	2016/2017
River miles	50	50	20
Directed effort (h)	0	202	700 (81)
Directed effort/river mile	0	4.0	35 (81)
Total catch	1,270.3 (78.9)	0	1,946.2 (63)
Mean angler catch rate	0	0	0.1
Total harvest	40.0 (100.0)	0	0
Total release	1231.4 (81.3)	0	1,946.2 (63)
Percent legal released	97	0	100

Freshwater Drum

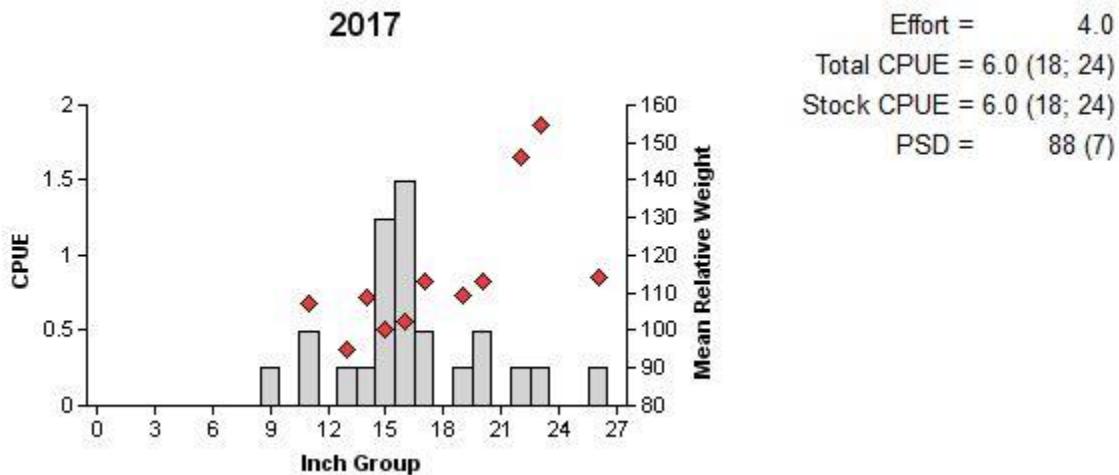
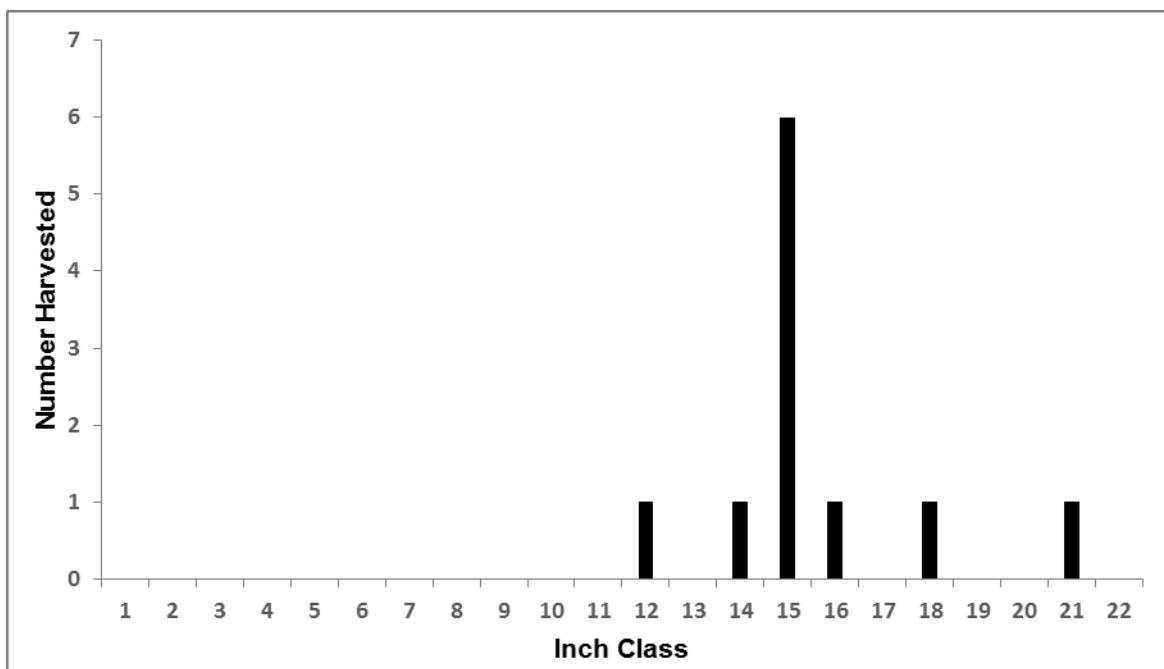


Figure 12. Number of Freshwater Drum caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Colorado River, Texas, 2017.

Freshwater Drum

Table 12. Creel survey statistics for Freshwater Drum at the Colorado River, Texas, from July through October 1999, July through October 2001, and September 2016 through May 2017. Total catch per river mile is for anglers targeting Freshwater Drum and total harvest is the estimated number of Freshwater Drum harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year		
	1999	2001	2016/2017
River miles	50	50	20
Directed effort (h)	754	545	0
Directed effort/river mile	15.1	10.9	0
Total catch	86.3 (92.1)	533 (147.7)	188.3 (84)
Mean angler catch rate	0.1 (92.1)	1.0 (147.7)	0
Total harvest	86.3 (92.1)	533 (147.7)	188.3 (84)
Total release	0	0	0
Percent legal released	0	0	0



N = 11; TH = 1,379

Figure 13. Length frequency of harvested Freshwater Drum observed during creel surveys at the Colorado River, Texas, September 2016 through May 2017, all anglers combined. N is the number of harvested Freshwater Drum observed during creel surveys, and TH is the total estimated harvest for the creel period.

Table 13. Proposed sampling schedule for the Colorado River, Texas. Survey period is June through May. An exploratory electrofishing survey will be conducted in fall 2018. Season for electrofishing survey in 2020/2021 will depend on results. Standard survey denoted by S and additional survey denoted by A.

Survey year	Electrofish Fall	Electrofish Spring	Access	Creel survey	Report
2017-2018	A				
2018-2019					
2019-2020					
2020-2021	?	?	S		S

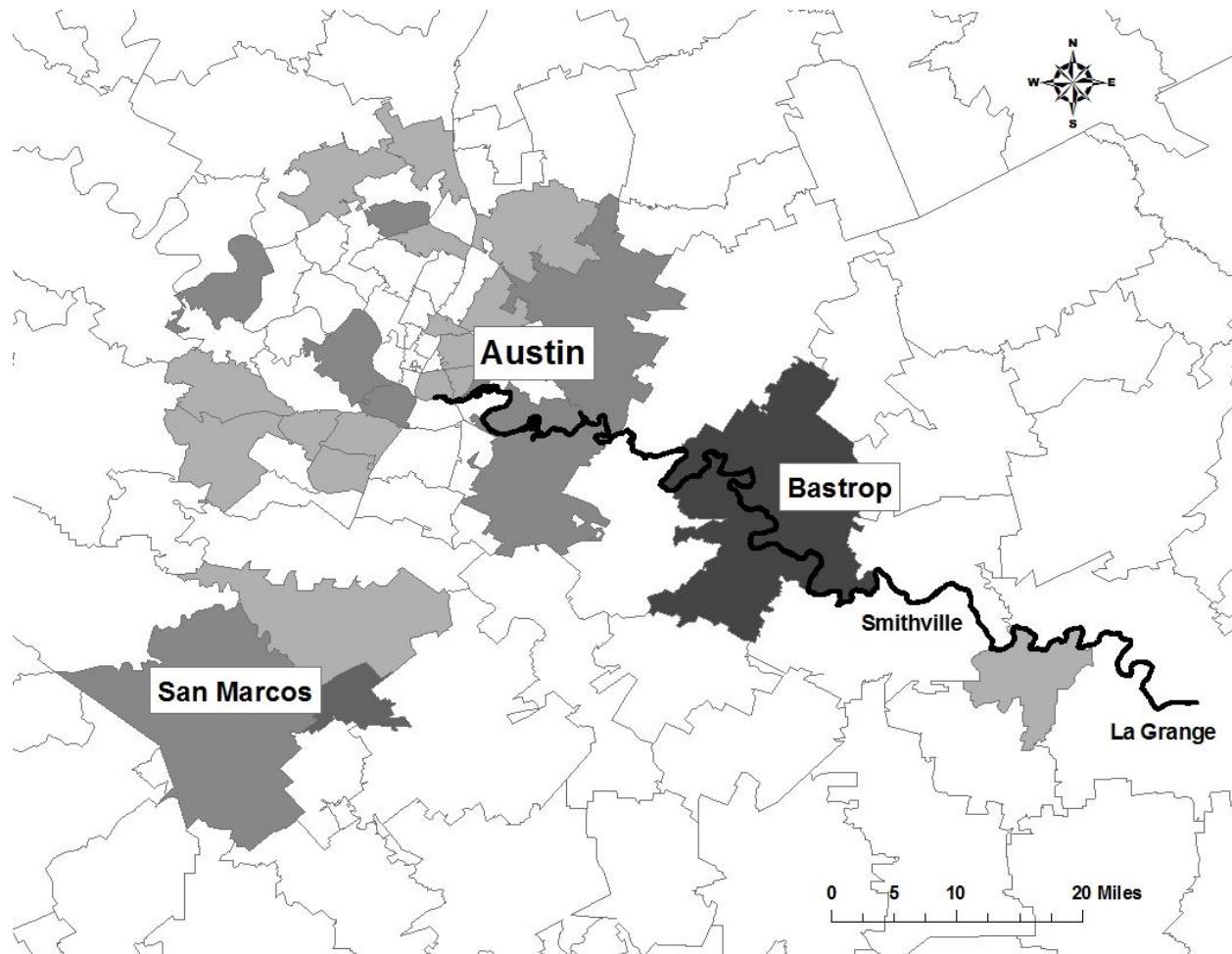
APPENDIX A

Water rights involving interbasin transfers into or from the Colorado River, Texas, 2009. This list identifies some of the major water rights, but is not necessarily comprehensive.

Water Right #	Owner	Basin From	Source	Basin To	Amount (acre-feet)
5434	LCRA	Colorado	Colorado River	Brazos-Colorado Colorado-Lavaca Lavaca	133,000
5434	City of Corpus Christi	Colorado	Colorado River	Colorado-Lavaca Lavaca San Antonio Nueces Lavaca-Guadalupe San Antonio-Nueces Nueces-Rio Grande	35,000
5437	LCRA and STPNOC	Colorado	Colorado River	Colorado-Lavaca	102,000
5476	LCRA	Colorado	Colorado River	Brazos-Colorado Colorado-Lavaca	262,500
5477	LCRA	Colorado	Colorado River	Brazos-Colorado Colorado-Lavaca	110,000
2074	GBRA	Guadalupe	Canyon Lake	Colorado Colorado-Lavaca Lavaca Lavaca-Guadalupe San Antonio San Antonio-Nueces	120,000
3600 5234	GBRA	Guadalupe	San Marcos River	San Antonio Colorado Lavaca	1,622
5173 5174 5175 5176 5177 5178	GBRA	Guadalupe	Guadalupe River	Lavaca-Guadalupe San Antonio San Antonio-Nueces Colorado Colorado-Lavaca Lavaca	172,501

APPENDIX B

Map of ZIP codes for angling parties encountered during the 2016-2017 creel survey, Colorado River, Texas. ZIP code areas are shaded on a gray scale, indicating how many angling parties resided there. Darker areas indicate more anglers encountered in the creel survey. The lower Colorado River is represented by a thick black line.



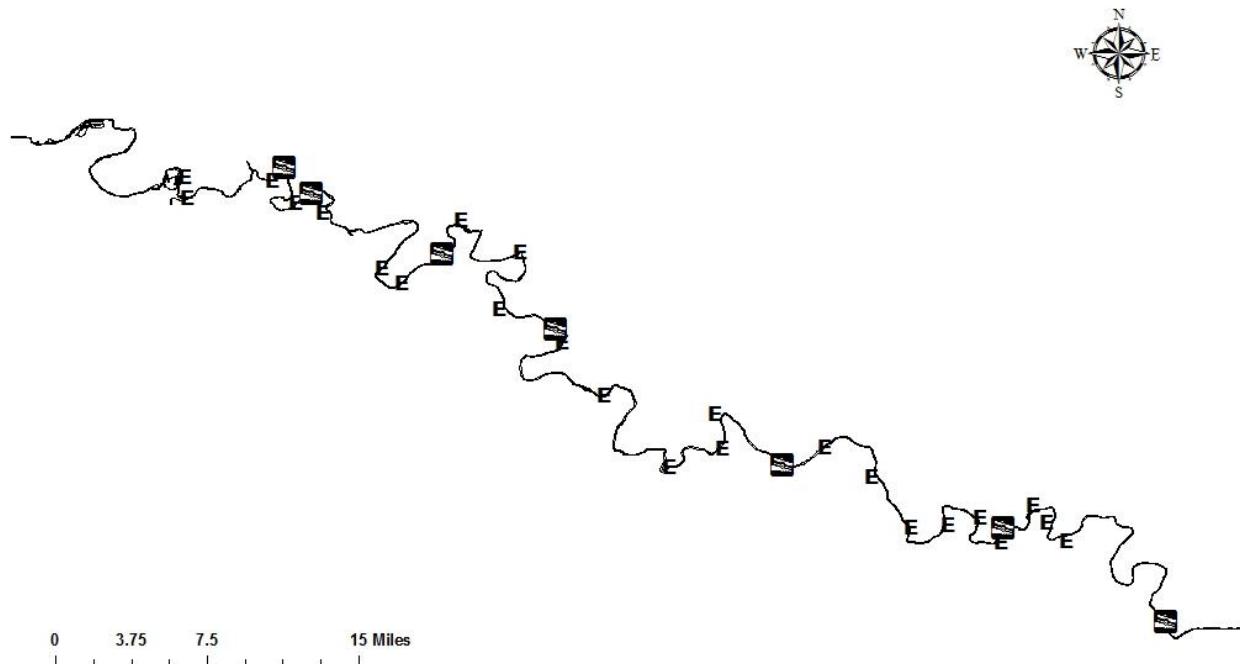
APPENDIX C

Number (N) and catch rate (CPUE) of all target species collected by electrofishing in April 2017 from the Colorado River, Texas. Sampling effort was 4 hours electrofishing.

Species	Electrofishing	
	N	CPUE (fish/hr)
Gizzard Shad	165	40.9
Red Shiner	9	2.2
Blacktail Shiner	6	1.5
Yellow Bullhead	1	0.3
Channel Catfish	78	19.3
Flathead Catfish	17	4.2
Mexican Tetra	5	1.2
White Bass	12	3.0
Redbreast Sunfish	2	0.5
Warmouth	1	0.3
Bluegill	39	9.7
Longear Sunfish	51	12.6
Redspotted Sunfish	1	0.3
Largemouth Bass	25	6.2
Guadalupe Bass	31	7.7
White Crappie	1	0.3
Freshwater Drum	24	6.0

APPENDIX D

Location of sampling sites, Colorado River, Texas, 2017. Electrofishing sites are indicated by an E.
Access points are indicated by 



APPENDIX E

Supplemental Guadalupe Bass length-frequency information, Colorado River, Texas, 2014 – 2016. The 2014 and 2015 graphs were derived from data collected by Texas Tech University. The 2016 data were obtained through a supplemental fall survey targeting Guadalupe Bass for age and growth analysis.

