Calaveras Reservoir

2019 Fisheries Management Survey Report

PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-4

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

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July 31, 2020

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Survey and Management Summary

Fish populations in Calaveras Reservoir were surveyed in 2019 using electrofishing and in 2018 and 2020 using gill netting. Historical data are presented for comparison. This report summarizes the results of the surveys and contains a management plan for the reservoir based on those findings.

Reservoir Description: Calaveras is a 3,110-acre reservoir located on the southeast side of San Antonio in Bexar County, Texas. It was built in 1969 by City Public Service Energy (CPSE) for power plant cooling, and later opened for recreation. Recreation access is controlled by Thousand Trails Management Services, Inc., and paid entry is required. Water level is maintained at or near conservation pool by pumping from the San Antonio River. Aquatic plant coverage in the reservoir is minimal and primarily bulrush.

Management History: Important sport fishes include Red Drum, Hybrid Striped Bass, Blue Catfish, and Channel Catfish. Stockings of Red Drum and Hybrid Striped Bass have occurred most years since the mid-1970s and are required to maintain their populations. Advanced-size Sunshine Bass (4-6 inches), purchased by CPSE, were stocked in 2014-2017. Numerous other species were stocked historically, including marine fishes, to provide additional, unique angling opportunities. All sport fish are currently managed with statewide regulations, except Red Drum which have a 20-inch minimum length limit and no maximum length limit. Various Largemouth Bass harvest regulations have been used, and the current minimum length limit of 14 inches was implemented in 2015.

Fish Community

- **Prey species:** Gizzard Shad and Bluegill were the primary prey species in the reservoir. Threadfin Shad, Blue Tilapia, and Redear Sunfish are also important prey species. Combined relative abundance of prey species in the reservoir was slightly greater in the most recent survey compared to the previous survey and remains sufficient to support existing predator species populations.
- **Channel and Blue Catfishes:** Relative abundance slightly increased during the study period for Channel Catfish and while higher than the previous study period, was lower than the historical average. Relative abundance has continued to decline for Blue Catfish and was lower than the historical average. In 2017, catfish angling comprised 20% of total angling effort, and catfish catch success (mean catch/h) was substantially lower in 2017 than in previous years.
- **Hybrid Striped Bass:** Relative abundance during the study period was very low and well below the historic average. In 2017, Hybrid Striped Bass angling comprised 2% of total angling effort with similar catch success as the previous survey conducted in 2010.
- **Largemouth Bass:** Relative abundance remained low and only a negligible fishery exists.
- **Red Drum:** Red Drum were the most sought-after sport fish in the reservoir. Their relative abundance during the study period was increased and was higher than the historical average. In 2017, Red Drum angling comprised 60% of total angling effort and Red Drum catch success was substantially higher than in previous surveys.

Management Strategies: Continue the moratorium on stocking Hybrid Striped Bass until Shad spp. abundance increase to historic average level. Stock Channel Catfish and Blue Catfish fingerlings annually from 2020-2022. Continue annual stockings of Red Drum fingerlings at 200/acre. Conduct biennial gill net surveys to monitor populations of Red Drum, Channel Catfish, Blue Catfish, and Hybrid Striped Bass and creel survey sampling in either 2021 or 2022 to quantify the sport fishery and evaluate stocking effectiveness. Inform the public about the negative impacts of aquatic invasive species and conduct a vegetation survey in 2023.

Introduction

This document is a summary of fisheries data collected from Calaveras Reservoir in 2016-2020. 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 2016-2020 data for comparison.

Reservoir Description

Calaveras Reservoir is a 3,110-acre power plant cooling reservoir located on Chupaderas and Calaveras creeks in the San Antonio River Basin in Bexar County inside Loop 1604 southeast of San Antonio. It was constructed in 1969 and is owned and operated by City Public Service Energy (CPSE) and a near-constant water level was maintained by pumping from the San Antonio River. Angler access and recreational facilities are managed and maintained by Thousand Trails Management Services. Aquatic plant coverage is minimal in the reservoir. Exotic Blue Tilapia and armored catfish populations have become established in the reservoir. Other descriptive characteristics for Calaveras Reservoir are in Table 1.

Angler Access

Calaveras Reservoir has two public boat ramps, an accessible fishing pier, and a designated small kayak launching area. Two multilane ramps were renovated in 2007 using Texas Parks and Wildlife Department (TPWD) Boating Access Grant funds. Shoreline angler access is also excellent and includes a barrier free fishing pier (Table 2).

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Dennis and Myers 2016) included:

1. Annually stock Red Drum at 200 fingerlings/acre. Assess growth and survival of stocked fish to aid in developing appropriate management strategies.

   Action: Red Drum fingerlings were stocked annually from 2016 to 2019 at stocking rates ranging from 196 to 235/acre. Otoliths were collected from fish collected in 2020, but ages have not yet been assigned. Red drum ageing requires specialized equipment and is done by the TPWD-Coastal Fisheries Division. Existing age and growth data were used in an age-structured model to evaluate alternative minimum length limits.

2. Annually stock 13,000 Sunshine Bass provided by CPSE. Monitor population trends with biennial gill netting to determine if stockings should continue.

   Action: In fall 2016 and 2017, 13,000 4-6 inch Sunshine Bass fingerlings were stocked. Annual stockings were ceased in 2018 because of poor success of past stockings and low forage abundance. In lieu of Sunshine Bass, CPS began stocking Channel Catfish in 2019**.** Gill net surveys were conducted in 2018 and 2020.

3. Monitor for the presence of aquatic invasive species and cooperate with the controlling authority to inform users about such and measures to take to reduce risk of introductions.

   Action: A habitat/vegetation survey was conducted in 2019 and no invasive aquatic plants were found. “Clean, Drain, and Dry” signs were offered to the controlling authority for placement at boat ramps and the park entry. The controlling authority constructed their own similar signs and placed at appropriate locations.

Harvest regulation history: Since impoundment, harvest of all sport fishes except Largemouth Bass and Red Drum were managed according to statewide regulations (Table 3). Largemouth Bass were managed

with a 14-18-inch slot limit with a 3-fish daily bag limit from 1981-1987. In 1988, the slot limit was changed to 14-21 inches. The slot limit was replaced in 1990 with an 18-inch minimum length limit. The bag limit was raised to 5 fish in 1995. In 2015, the minimum length limit was changed to the statewide 14-inch MLL. Freshwater populations of Red Drum, including in Calaveras Reservoir, are managed with a 20-inch MLL and 3 fish daily bag limit; The maximum size limit utilized for saltwater populations is not used in freshwater populations.

Stocking history: Various species, including non-native fishes, have been stocked into the reservoir. Hybrid Black x White Crappie and sub-adult White Crappie were stocked to re-introduce crappie to the reservoir. Orangemouth Corvina and Orangemouth Corvina-Speckled Trout hybrids were introduced into the reservoir to provide an additional sport fish. Northern Largemouth Bass (NLMB) were stocked to increase genetic diversity; however stocking success was short-lived. The Orangemouth Corvina and their hybrids stockings were discontinued because of their ability to hybridize with Speckled Trout and the proximity of Calaveras Reservoir to the Texas Coast. White Crappie stockings were discontinued because of low stocking success. During the last two decades Red Drum and Palmetto Bass were the primary species stocked. From 2014 to 2017, 4-6 inch Sunshine Bass purchased by CPS Energy were stocked. These annual stockings of Sunshine Bass were discontinued in 2018 due to poor stocking success and low forage abundance. The complete stocking history is summarized in Table 4.

Vegetation/habitat management history: In 1999 and 2003, various native aquatic species were planted in the reservoir. Only bulrush remains from those plantings.

Water transfer: Water from the San Antonio River is pumped into the reservoir, and no inter-basin transfers are known to exist.

Methods

An objective-based sampling plan (OBS) was implemented for Calaveras Reservoir in 2016. Sampling activities were conducted to achieve survey and sampling objectives specified in the plan. Primary components of the updated OBS plan are listed in Table 5. Sampling activities conducted prior to OBS implementation were conducted according to Dennis and Myers (2016) and TPWD Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual, revised 2015), except when otherwise indicated. All survey sites were randomly selected.

Electrofishing – Largemouth Bass, sunfishes, and Shad spp. were collected during day-time electrofishing (12, 5-min stations) during fall 2019. Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing.

Gill netting – Channel Catfish, Blue Catfish, Hybrid Striped Bass, and Red Drum were collected by gill netting (5 total net-nights across 5 stations) in spring 2018 and 2020. CPUE for gill-netting was recorded as the number of fish caught per net night (fish/nn). The additional 5 nn of gill net sampling effort as prescribed in the OBS plan to collect 50 Hybrid Striped Bass was not done because of very low population abundance and/or sampling efficiency. Based on initial survey CPUE, completing this level of extra sampling effort would have resulted in a total catch of 0 fish in 2018 and 4 fish in 2020, which was substantially short of the 50 fish target.

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

Creel survey – Access creel survey sampling was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual, revision in use at time of survey).

Although shoreline-based angling was significant at the reservoir, creel survey sampling was conducted only for boat anglers because of concerns for staff safety. Survey periods were from December 1, 2001 to May 31, 2002, June 1, 2009 to May 31, 2010, and from March 1, 2017 to August 31, 2017.

Age-structured model – For Red Drum, the impact of two minimum length limits (12 and 16 inches) were simulated relative to the existing 20-inch minimum length limit on yield-per-recruit and proportion of trophy-length fish (>30 inches). Growth and weight-length parameters used in the model were derived from existing Red Drum data for Calaveras and Braunig Reservoirs (Dennis and Myers 2014; Dennis and Myers 2016), and natural mortality was estimated according to Jensen (1996). Simulations were conducted using Excel 2019 according to Allen et al. (2008).

Habitat – The random point method was used to survey vegetation in August 2019 in accordance with the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015). A shoreline structural survey was not conducted as no significant shoreline modifications took place since the last survey done in 2011.

Results and Discussion

Habitat: A shoreline structural habitat survey was last conducted in 2011 (Dennis and Myers 2012). Shoreline structural habitat has remained rocky or natural since reservoir impoundment. Native emergent aquatic vegetation (bulrush) occupied 1% of the reservoir in 2019, which was similar to in previous years (Table 6). Cattails were also observed along the shoreline, but this species was sparse and did not occur at any of the random survey sites. Herbicide treatments have never been conducted.

Creel: Angler utilization has declined since the last survey in 2010 (Table 7). Angling expenditures were consistent in 2017, when expanded to an annual estimate, compared to previous surveys. The distribution of fishing effort by species at Calaveras Reservoir has changed over time (Table 8). Fishing for catfish species and Hybrid Striped Bass has decreased, while fishing for Red Drum has increased. In 2017, Red Drum accounted for 60% of the total angling effort on the reservoir.

Prey species: Gizzard Shad relative abundance in 2019 (40.0/h) was higher than in the previous sampling period (12.0/h; Figure 1). Gizzard Shad population size structure in 2019 differed from previous years. Modal peak of the 2019 distribution was at 4 inches, whereas modal peak was at 7 inches in 2015. A larger fraction of the population was suitably sized as prey in 2019 (IOV = 88) than in previous years (IOV = 75). Threadfin Shad relative abundance was higher in 2019 (17.0/h) than in 2015 (0.0/h; Appendix B). Electrofishing CPUE of Bluegill in 2019 (7.0/h) was lower than in 2015 (26.0/h; Figure 2). Bluegill population size structure in 2019 (PSD = 0) differed from 2015 (PSD=12). Redear Sunfish electrofishing CPUE was 19.0/h in 2019, which was similar in 2015 (13.0/h; Appendix B). Although not enumerated because of low susceptibility to gear, Blue Tilapia were present in the reservoir in high abundance. A commercial cast-netting fishery exists for this species at the reservoir. The overall prey species abundance in the reservoir was sufficient to support existing predator species populations.

Channel and Blue Catfish: For Blue Catfish, relative abundance continued to decline (Figure 3) and was substantially lower than the historic average (Figure 4). Gill net CPUE in 2020 was 1.6/nn compared to 4.2/nn in 2018, and 6.0/nn in 2016. Similar to the decline in relative abundance, the stock-size CPUE has declined from 6.0/nn in 2016, to 3.8/nn in 2018, and 1.6/nn in 2020. All captured fish in 2020 were ≥25 inches, with a maximum size of 33 inches. For Channel Catfish, relative abundance had begun to increase (Figure 5), but was still lower than the historic average (Figure 6). Gill net CPUE in 2020 was 5.4/nn compared to 3.8/nn in 2018 and 3.6/nn in 2016. In all years from 1999 to 2011, except 2002, gill net CPUE exceeded 10.0/nn (Figure 6). The population has been dominated by quality-size fish (PSD ≥69 since 2016) with PSD of 100 in 2018 and 2020. Mean relative weight values remained high exceeding 120 for most size classes. The catfish fishery has diminished since 2012. In 2017, directed angling effort (10,776 h), angler catch rate (0.19/h), and harvest (3,602 fish) were considerably lower than in previous years (Table 9). Size structure of Blue Catfish has shown a slight improvement (Figure 7). We

were unable to make meaningful comparisons for size structure of Channel Catfish due to low sample size (Figure 8).

Hybrid Striped Bass: Relative abundance has declined following the change in stocking protocol (Figure 9). Palmetto Bass fingerlings produced by TPWD were stocked prior to 2014, and from 2014 to 2017, 4-6 inch Palmetto Bass and Sunshine Bass produced by a private producer in Arkansas were stocked. Gill net CPUE of Hybrid Striped Bass in 2018 (0.0/nn) and 2020 (0.4/nn) was substantially lower than the historic average (Figure 10). Mean relative weights are no longer able to be calculated as we have a mixture of both Palmetto Bass and Sunshine Bass, each with different relative weight formulas. The Hybrid Striped Bass fishery has continued to decline since 2010. In 2017, directed effort (827 h), angler catch rate (0.13/h), and harvest (551 fish) were similar to or lower than previous years (Table 10). Size structure appears to have remained similar, although legitimate comparisons cannot be made due to low sample size (Figure 11). The additional 5 nn of gill net sampling effort as prescribed in the OBS plan to collect 50 for Hybrid Striped Bass was not done because of very low population abundance and/or sampling efficiency. Based on initial survey CPUE, completing this level of extra sampling effort would have resulted in a total catch of 0 fish in 2018 and 4 fish in 2020, which is substantially short of the 50 fish target.

Red Drum: Gill net CPUE had increased since the last survey period (Figure 12). Gill net CPUE in 2016 was 2.7/nn compared to 3.6/nn in 2018 and 9.8/nn in 2020. Gill net CPUE in 2020 was the highest ever recorded for Calaveras Reservoir (Figure 13). All captured Red Drum in 2018 and 2020 were greater than stock-length. During the March-August 2017 creel survey, anglers expended 30,719 h targeting Red Drum and harvested 9,160 fish (Table 11). Angling effort in 2017 was consistent with angling effort occurring during the one-year period from June 2009 to May 2010 (55,312 h). However, harvest during the 2017 six-month creel survey was greater than harvest during the one-year 2009-2010 survey (6,713 fish). Anglers experienced higher catch success in 2017 (0.32 fish/h) than in 2009-2010 (0.19). Percent legal release was 29% in 2017 which was higher than in 2009-2010 (22%). Red Drum <25 inches accounted for 82% of harvest in 2017 and 71% of the harvest in 2009-2010 (Figure 14). Trophy-length fish (>30 inches) comprised similar fractions of harvest in 2017 (6.5%) and 2009-2010 (8%). Red Drum attain legal-harvestable size (>20 inches) at age-3. (Dennis and Myers 2014). This extremely rapid growth manifests high yield and trophy potential. Age-structured simulation modelling revealed MLLs exceeding the current 20-inch MLL would have little impact on Red Drum yield and trophy potential. Thus, lowering the MLL was evaluated as a possible strategy. At exploitation of 0.25, 24, 16 and 12-inch MLLs had negligible effects on Red Drum yield; however, larger effects were predicted on trophy potential (Figure 15). A 16-inch MLL would reduce the number of fish >30 inches by 16% and a 12-inch MLL would reduce number of fish >30 inches by 31%. Trophy potential could increase by 22% under a 24-inch MLL The Calaveras Reservoir Red Drum fishery is reputed for providing trophy catches and with trophy-length fish accounting for <10% of harvest, we recommend no changes to the MLL at this time so to maintain trophy potential at the current level.

Fisheries Management Plan for Calaveras Reservoir, Texas

Prepared - July 2020

ISSUE 1: Channel Catfish and Blue Catfish once provided a popular fishery for anglers to utilize, however substantial population declines occurred for both species, potential due to years of high harvest. Recent sampling indicated the relative abundance of Channel Catfish has begun to increase, although their numbers were still well below the historical average. Blue Catfish also provide a popular fishery, but their numbers have continued to decline.

MANAGEMENT STARTEGIES

1. Annually stock Channel Catfish and Blue Catfish fingerlings, some of which may be provided by CPSE.
2. Evaluate stocking success using biennial gill net sampling (2022 and 2024) and a creel survey in 2021 or 2022.

ISSUE 2: Red Drum is a popular sport fish among anglers and stocking is required to sustain their population because they do not reproduce in the reservoir.

MANAGEMENT STARTEGIES

1. Continue to stock 200 Red Drum fingerlings/acre annually.
2. Evaluate stocking success using biennial gill net sampling (2022 and 2024) and a creel survey in 2021 or 2022.

ISSUE 3: Hybrid Striped Bass populations have declined drastically coincident with a decline in Shad spp. abundance and increase in Red Drum abundance. Stocking Hybrid Striped Bass has been cancelled until prey populations recover to a more sustainable level.

MANAGEMENT STARTEGY

1. Evaluate Gizzard Shad populations using electrofishing in 2023 to assess the feasibility of resuming stocking of Hybrid Striped Bass.

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

MANAGEMENT STRATEGIES

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

Objective-Based Sampling Plan and Schedule (2020-2024)

Sport fish, forage fish, and other important fishes

Sport fishes in Calaveras Reservoir include Red Drum, Hybrid Striped Bass, Channel Catfish, and Blue Catfish. Known important forage species include Bluegill, Gizzard Shad, and Blue Tilapia.

Low-density fisheries

Largemouth Bass: Based on historic electrofishing and angler surveys, Largemouth Bass are not abundant in the reservoir, and very little effort is expended by anglers targeting this species. Their presence/absence will be documented during electrofishing surveys for Gizzard Shad and Bluegill and their importance as a sportfish at the reservoir will be monitored through our creel survey. Any significant changes observed in those surveys will be addressed by additional sampling, as needed.

Hybrid Striped Bass: Both Palmetto Bass and Sunshine Bass have been stocked in this reservoir. At least one of these species has been stocked on a near annual basis until stockings were ended in 2017. Our objectives are to monitor for population for presence/absence of Hybrid Striped Bass populations as stocking has been cancelled. Gill net surveys will be conducted in spring 2022 and 2024 (5 net-nights of sampling effort/survey) to assess presence of this species. A six-month creel survey will be conducted in either 2021 or 2022 to assess angler utilization and angling success for the remaining population of Hybrid Striped Bass. Stocking will be re-evaluated following 2023-2024 electrofishing survey based on the presence of a sufficient prey base.

Survey objectives, fisheries metrics, and sampling objectives

Gizzard Shad and Bluegill: Gizzard Shad and Bluegill are the primary forage fishes at Calaveras Reservoir. While CPUE of both species is variable, major changes in their relative abundances can be inferenced from CPUE trend data. Sampling of these species will be done through day-time random electrofishing at 12 5-minute stations. This should provide adequate CPUE precision (RSE<25) of Gizzard Shad and Bluegill to detect major changes in relative abundance. No additional effort will be expended to increase the number of Bluegill or Gizzard Shad collected or reduce RSEs. Sampling will occur once every four years and the next sample will be fall 2023 (Table 12).

Blue and Channel Catfishes: Channel Catfish abundance had begun to increase in the last survey period, while Blue Catfish abundance continues to decline. Our objective is to continue to monitor for large-scale population and fishery changes. Gill net surveys will be conducted in spring 2022 and 2024 (5 net-nights of sampling effort/survey) to assess relative abundance and population size structure. Our target is collect $\geq$30 stock-size Channel Catfish. Data from previous years predicted that 5 net-nights of sampling effort would achieve a RSE <25 (95% confidence) for CPUE-Stock. A six-month creel survey will be conducted in either 2021 or 2022 to assess angler utilization and angling success (Table 12).

Red Drum: Red Drum are one of the most sought-after game fish at the reservoir. Historically, gill net sampling has been ineffective for sampling this species. However, in recent years this gear yielded more consistent catches (18-49 fish/nn) and reasonable estimate precision (RSE = 41-76). Our objectives are to monitor for population changes and determine general stocking success. Gill net surveys will be conducted in spring 2022 and 2024 (5 net-nights of sampling effort/survey) to assess relative abundance and population size structure. Our target is to biennially collect $\geq$30 Red Drum. If that target is not reached, an additional five nets will be set at randomly selected stations to achieve or get closer to achieving the 30 fish target. Sampling will cease after 10 net-nights. A six-month creel survey will be conducted in either 2021 or 2022 to assess angler utilization and angling success (Table 12).

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Tables and Figures

Table 1. Characteristics of Calaveras Reservoir, Texas.

Characteristic	Description
Year constructed	1969
Controlling authority	City Public Service Energy and Thousand Trails
Counties	Bexar
Reservoir type	Tributary
Shoreline Development Index (SDI)	5.96
Conductivity	1,561 µmhos/cm

Table 2. Boat ramp characteristics for Calaveras Reservoir, Texas, September 2019.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
North Ramp	29.29180 -98.29946	Y	48	Unknown	Excellent
South Ramp	29.28977 -98.29897	Y	41	Unknown	Excellent
Kayak Launch	29.28256 -98.29687	Y	20	Not Applicable	Excellent
Fishing Pier	29.29485 -98.29603	Y	34	Not Applicable	Excellent

Table 3. Harvest Regulation for Calaveras Reservoir, Texas.

Species	Bag Limit	Minimum Length Limit (inches)
Catfish: Channel and Blue Catfish, their hybrids and subspecies	25 (in any combination)	12
Catfish, Flathead	5	18
Bass, Hybrid Striped	5	18
Bass, Largemouth	5	14
Drum, Red	3	20

Table 4. Stocking history of Calaveras Reservoir, Texas. Size categories are FRY =<1 inch, FGL = 1-3 inches, AFGL = 8 inches, ADL = 12 inches and UNK = unknown.

Species	Year(s) Stocked	Number of Years	Number Stocked	Size
Black Crappie	1969	1	10,000	UNK
Black Crappie x White Crappie	1993-1997	4	598,641	FGL/FRY
Blue Catfish	1969-1973	3	44,446	UNK
Channel Catfish	1969-1972	3	162,192	UNK
	2007-2019	13	8,041	ADL
	2019	1	157,567	FGL
	2020	1	93,495	FGL
Fathead Minnow	1985	1	10,590	UNK
Florida Largemouth Bass	1974-1999	9	973,656	FGL
	1989-1990	2	35,500	FRY
Green Sunfish x Redear Sunfish	1969-1972	4	152,575	UNK
Largemouth Bass	1969-1973	2	43,900	UNK
	1987-2005	3	77,862	FGL
Orangemouth Corvina	1986	1	766,844	UNK
	1986-1987	2	19	ADL
Palmetto Bass	1975-1982	6	270,637	UNK
	1984-2014	25	1,283,075	FGL
	2005-2010	2	1,919,284	FRY
Red Drum	1984-2016	24	11,893,432	FGL
	1984-2006	2	5,092	ADL
	1989-2006	5	1,046,459	FRY
	2017	1	610,282	FGL
	2018	1	732,026	FGL
	2019	1	693,371	FGL
Spotted Seatrout x Corvina	1984-1986	3	73,124	UNK
	1984	1	2,518	ADL
Sunshine Bass	2014-2017	4	52,000	FGL
White Crappie	1985-2001	3	196,894	FGL
	1987-2004	2	10,096	ADL

Table 5. Objective-based sampling plan components for Calaveras Reservoir, Texas, 2016-2020.

Gear/target species	Survey objective	Metrics	Sampling objective
Electrofishing			
Gizzard Shad[a]	Abundance	CPUE-total	RSE ≤25
	Prey availability	IOV	Practical effort
Bluegill[a]	Abundance	CPUE-total	RSE ≤25
	Size structure	Length frequency	Practical effort
Largemouth Bass	Presence	N/A	Practical effort
Creel			
Red Drum	Angler utilization and success	Fishery metrics	Practical effort
	Age and growth	Length at age	Practical effort
Gill nets			
Blue Catfish	Abundance	CPUE-stock	RSE ≤25
	Size structure	Length frequency	Practical effort
Channel Catfish	Abundance	CPUE-stock	RSE ≤25
	Size structure	Length frequency	Practical effort
Hybrid Striped Bass[b]	Abundance	CPUE-total	≥50 fish (>8-inches)
	Size structure	PSD, length frequency	≥50 fish (>8-inches)
	Age and growth	Length at age	≥50 fish (>8-inches)

[a] No additional effort will be expended to achieve an RSE ≤ 25 for CPUE of Bluegill and Gizzard Shad if not reached using 1 h of electrofishing sampling effort.
[b] Five additional net-nights of sampling effort will be used to achieve sampling objective target of ≥50 Hybrid Striped Bass.

Table 6. Results of random point sampling habitat surveys conducted at Calaveras Reservoir in August-September of 2015 and 2019. Percent occurrence is shown for predominate habitat types along with lower and upper 95% confidence interval (in parentheses).

Habitat type/survey metric	2015	2019
Open Water	96 (91-100)	99 (90-100)
Native Emergent	2 (0-7)	1 (0-7)
Native Submersed	0	0
Flooded Terrestrial	2 (0-4)	0
Number of random points	69	72

Table 7. Total fishing effort (h) for all species and total directed expenditures ($) for Calaveras Reservoir, Texas, from 2002, 2010, and 2017. Survey periods were from December 1, 2001 to May 31, 2002, June 1, 2009 to May 31, 2010 and from March 1, 2017 to August 31, 2017. Relative standard error is in parentheses. Bank anglers and boat anglers were survey separately in 2002 but are shown combined here. In 2010 and 2017 bank anglers were not surveyed.

Creel Statistics	2002	2010	2017
Total fishing effort	28,902	150,566 (18)	51,326 (29)
Total directed expenditures	87,603	756,654 (36)	436,439 (45)

Table 8. Percent directed angler effort for boat anglers by species for Calaveras Reservoir, Texas, 2002, 2010, and 2017. Survey periods were from December 1, 2001 to May 31, 2002, June 1, 2009 to May 31, 2010 and from March 1, 2017 to August 31, 2017. Relative standard error is in parentheses. Bank anglers and boat anglers were survey separately in 2002 but are shown with a combined average here. In 2010 and 2017 bank anglers were not surveyed.

Species	2002	2010	2017
Catfishes	32	38 (16)	20 (44)
Hybrid Striped Bass	18	2 (35)	2 (82)
Largemouth Bass	2	4 (29)	1 (104)
Red Drum	11	36 (17)	60 (28)
Anything	37	19 (19)	16 (37)

Gizzard Shad

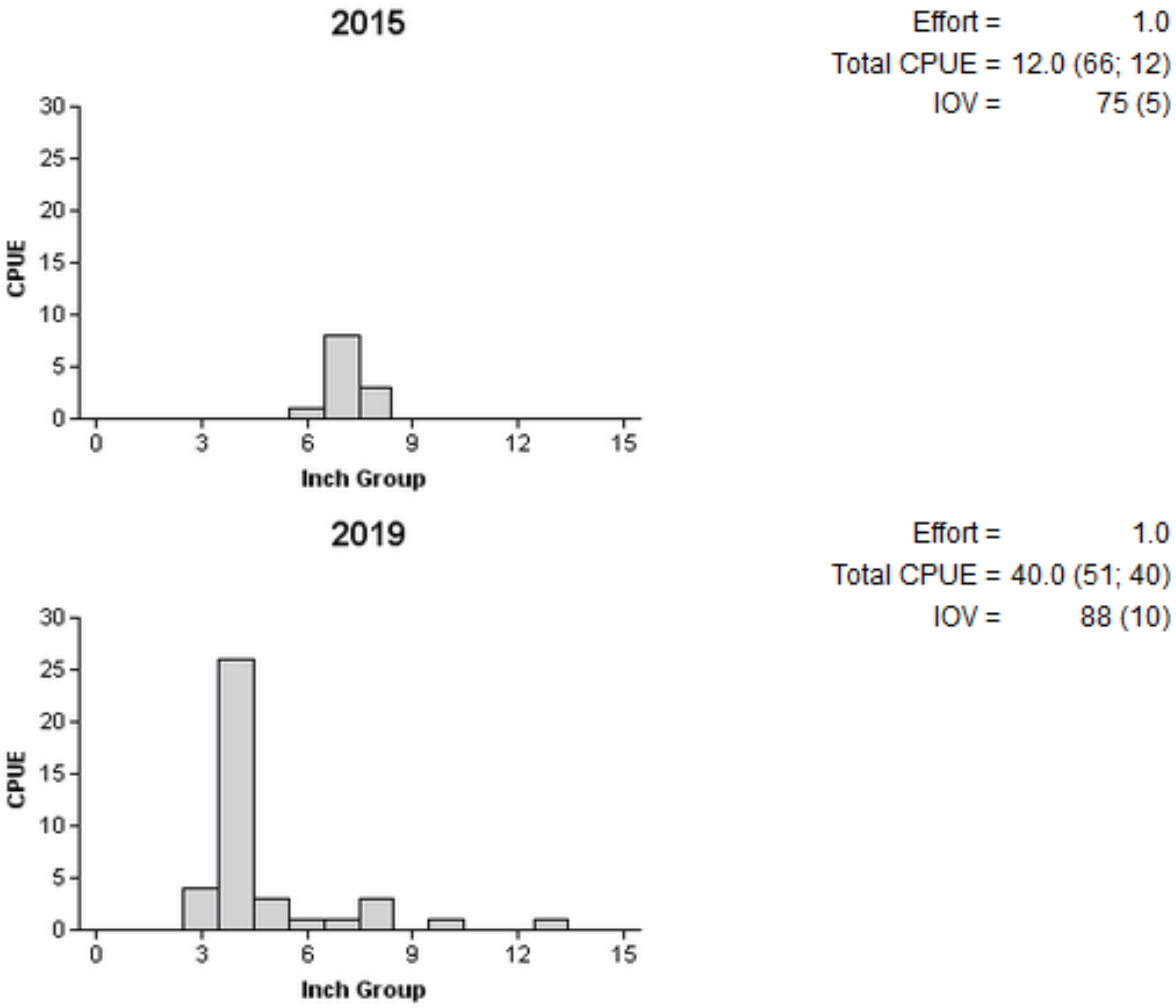


Figure 1. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for all fall daytime electrofishing surveys, Calaveras Reservoir, Texas, 2015 and 2019.

Bluegill

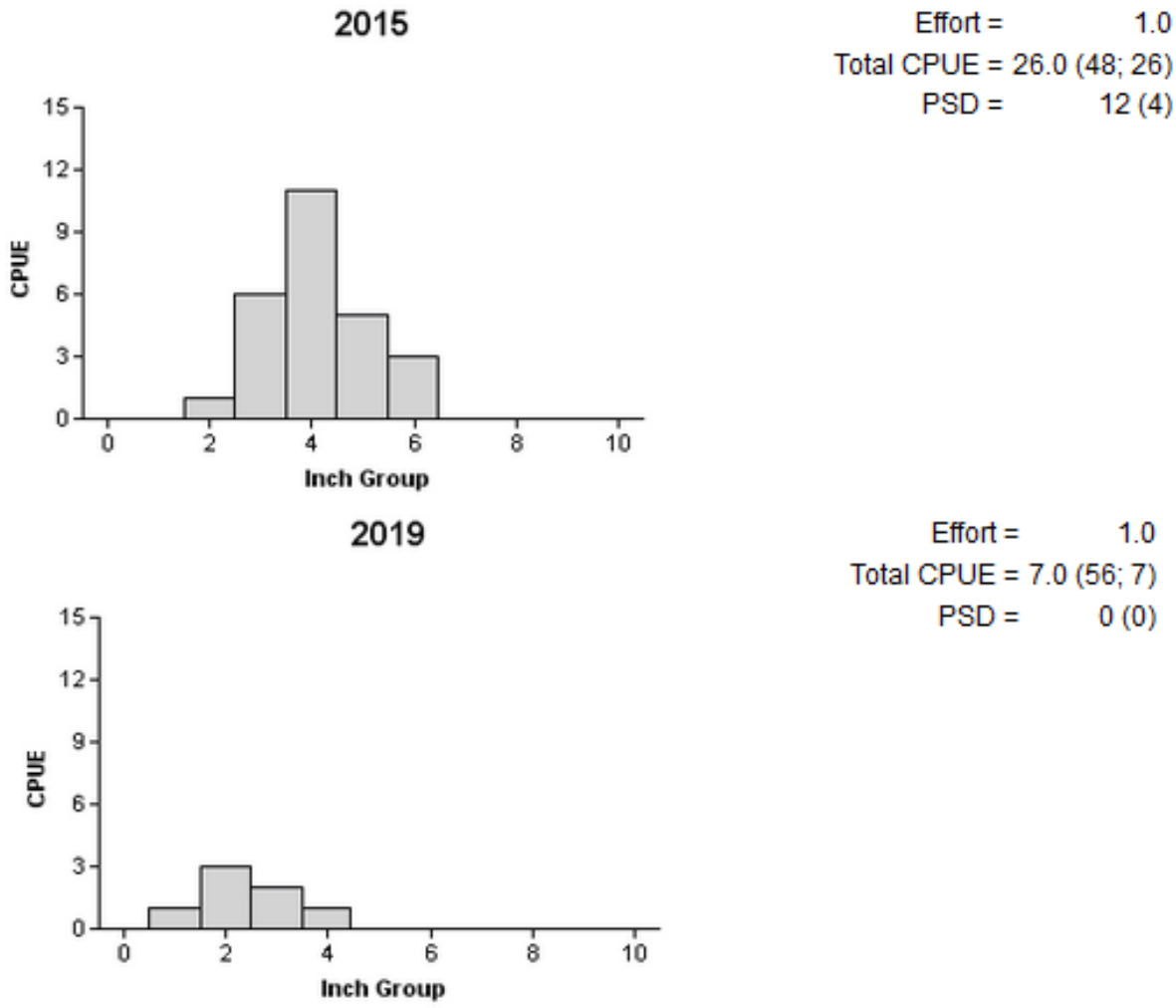


Figure 2. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for all fall daytime electrofishing surveys, Calaveras Reservoir, Texas, 2015 and 2019.

Blue Catfish

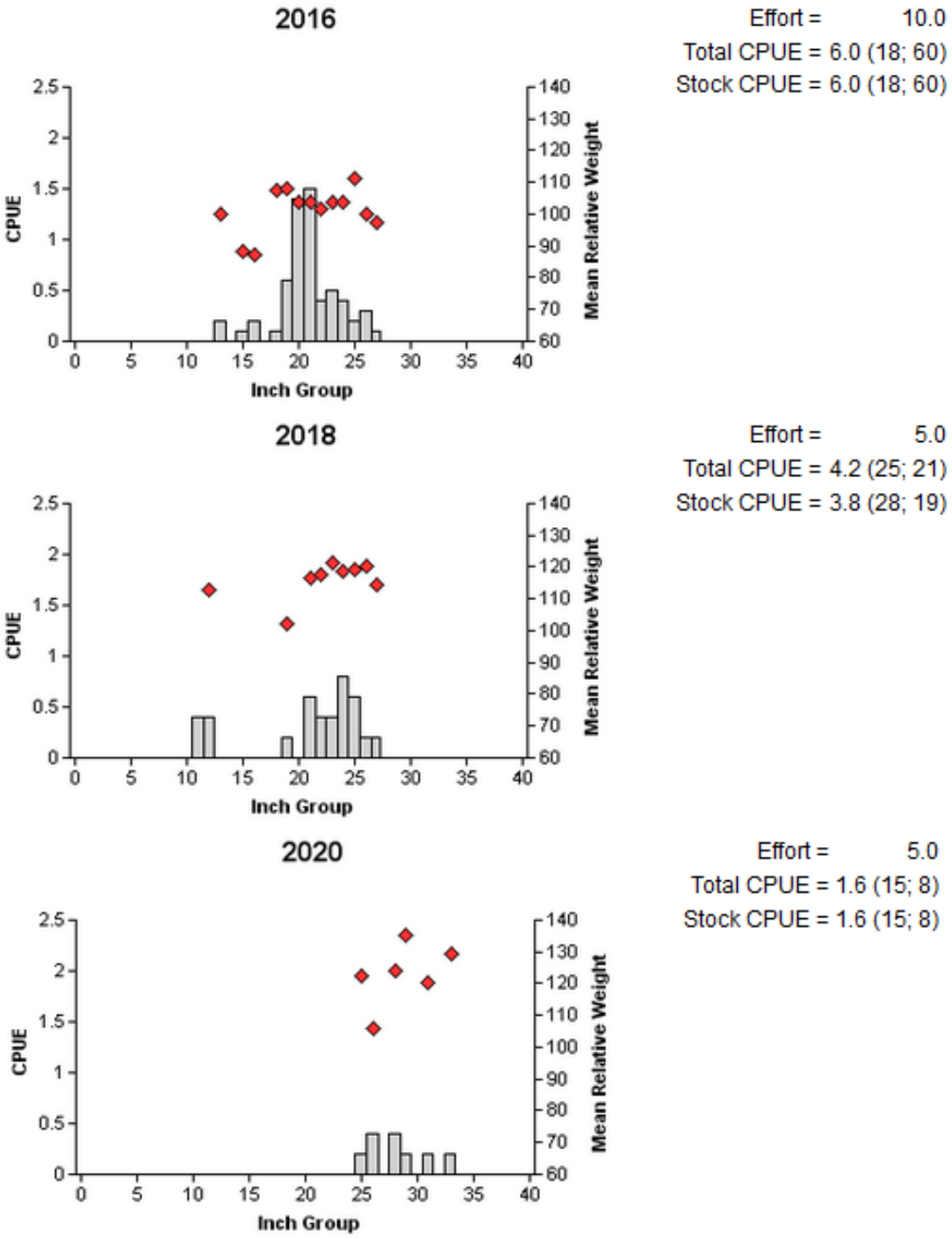


Figure 3. Number of Blue Catfish caught per net-night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Calaveras Reservoir, Texas, 2016, 2018, and 2020.

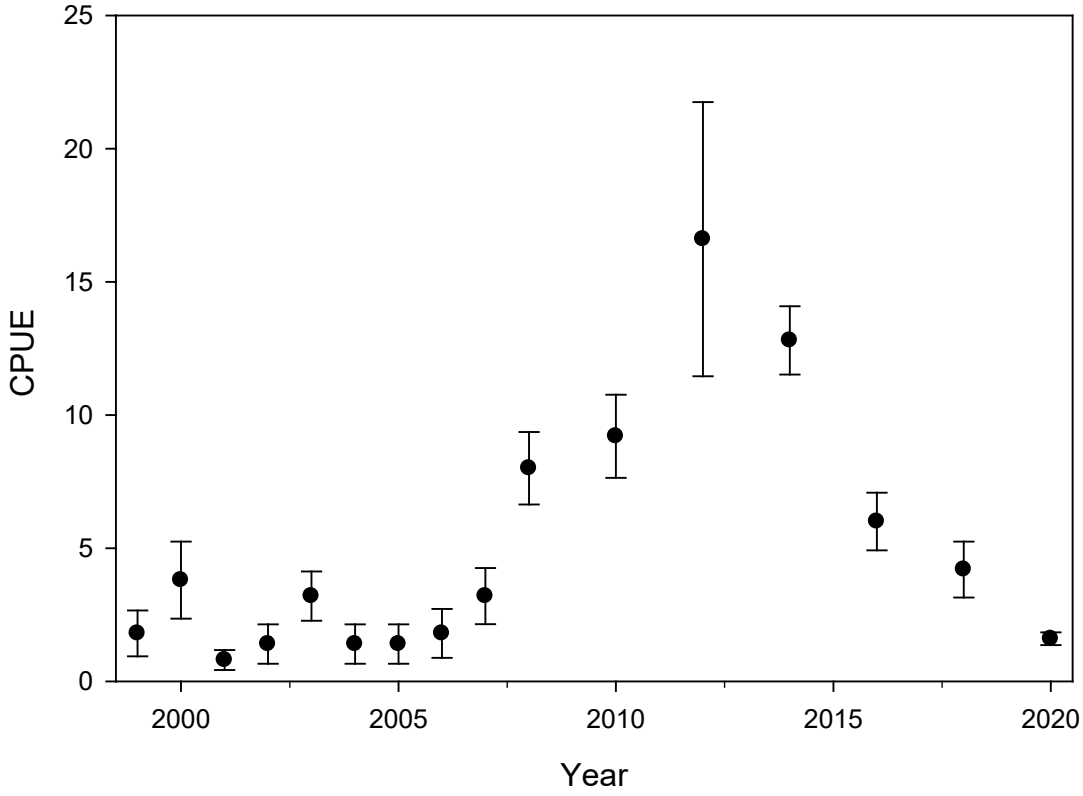


Figure 4. Average number of Blue Catfish collected per net-night (CPUE) at Calaveras Reservoir, Texas, 1999-2020 for spring gill net surveys. Error bars represent ±1 standard error.

Channel Catfish

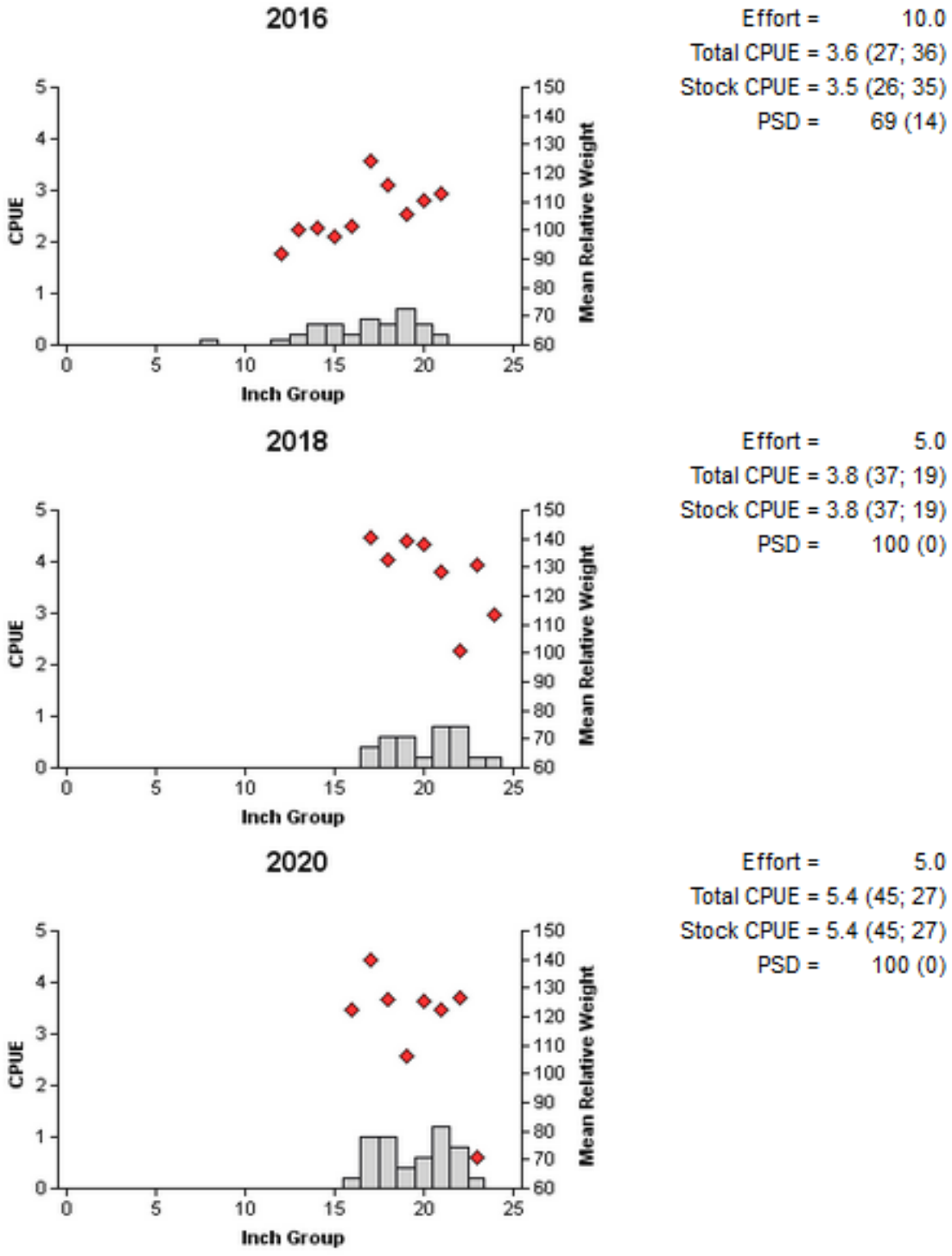


Figure 5. Number of Channel Catfish caught per net-night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Calaveras Reservoir, Texas, 2016, 2018, and 2020.

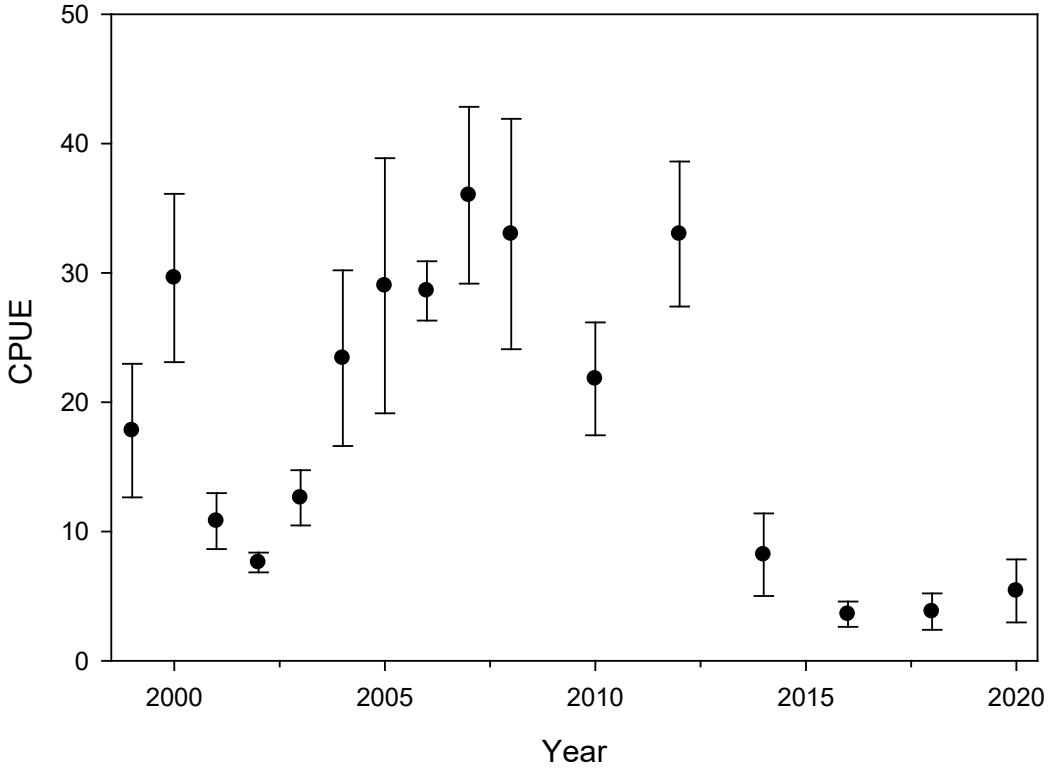


Figure 6. Average number of Channel Catfish collected per net-night (CPUE) at Calaveras Reservoir, Texas, 1999-2020 for spring gill net surveys. Error bars represent ±1 standard error.

Table 9. Creel survey statistics for catfish anglers at Calaveras Reservoir, Texas, for 2001-2002, 2010, and 2017. Survey periods were from December 1, 2001 to May 31, 2002, June 1, 2009 to May 31, 2010 and from March 1, 2017 to August 31, 2017. Average angler catch rate is for anglers targeting catfishes and total harvest is the estimated number of combined Blue and Channel Catfishes harvested by all anglers. Relative standard error (RSE) is in parentheses.

Creel Survey Statistic	2002	2010	2017
Directed effort total (h)	7,182 (31)	56,704 (16)	10,776 (44)
Directed effort/acre (h)	2.31 (31)	18.23 (16)	3.5 (44)
Average angler catch rate (fish/h)	0.57 (21)	0.85 (22)	0.19 (87)
Total harvest (fish)	4,281 (47)	53,624 (33)	3,602 (91)
Harvest/acre	1.4 (47)	17.2 (33)	1.2 (91)
Percent legal release	14	13	10

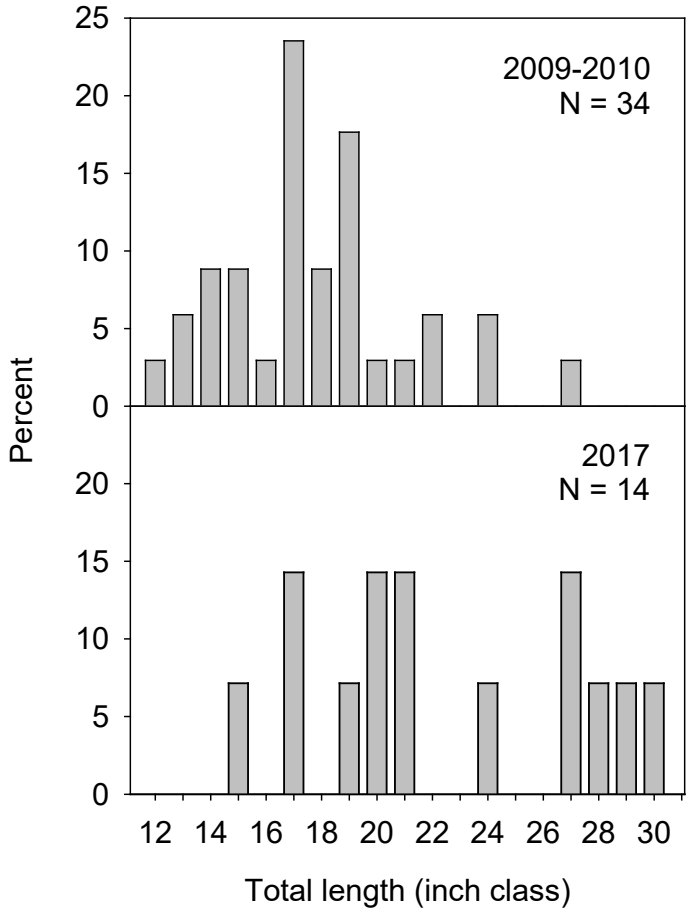


Figure 7. Length frequency of harvested Blue Catfish observed during creel surveys at Calaveras Reservoir, Texas, June 2009-May 2010 and March 2017-August 2017, all anglers combined. N is the number of harvested Blue Catfish measured during creel surveys.

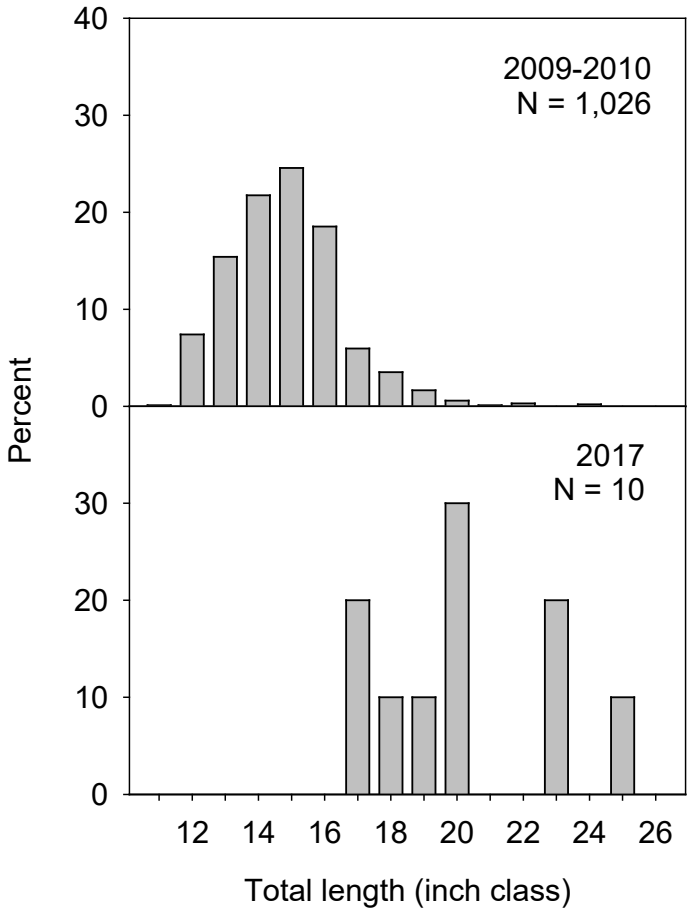


Figure 8. Length frequency of harvested Channel Catfish observed during creel surveys at Calaveras Reservoir, Texas, June 2009-May 2010 and March 2017-August 2017, all anglers combined. N is the number of harvested Channel Catfish measured during creel surveys.

Hybrid Striped Bass

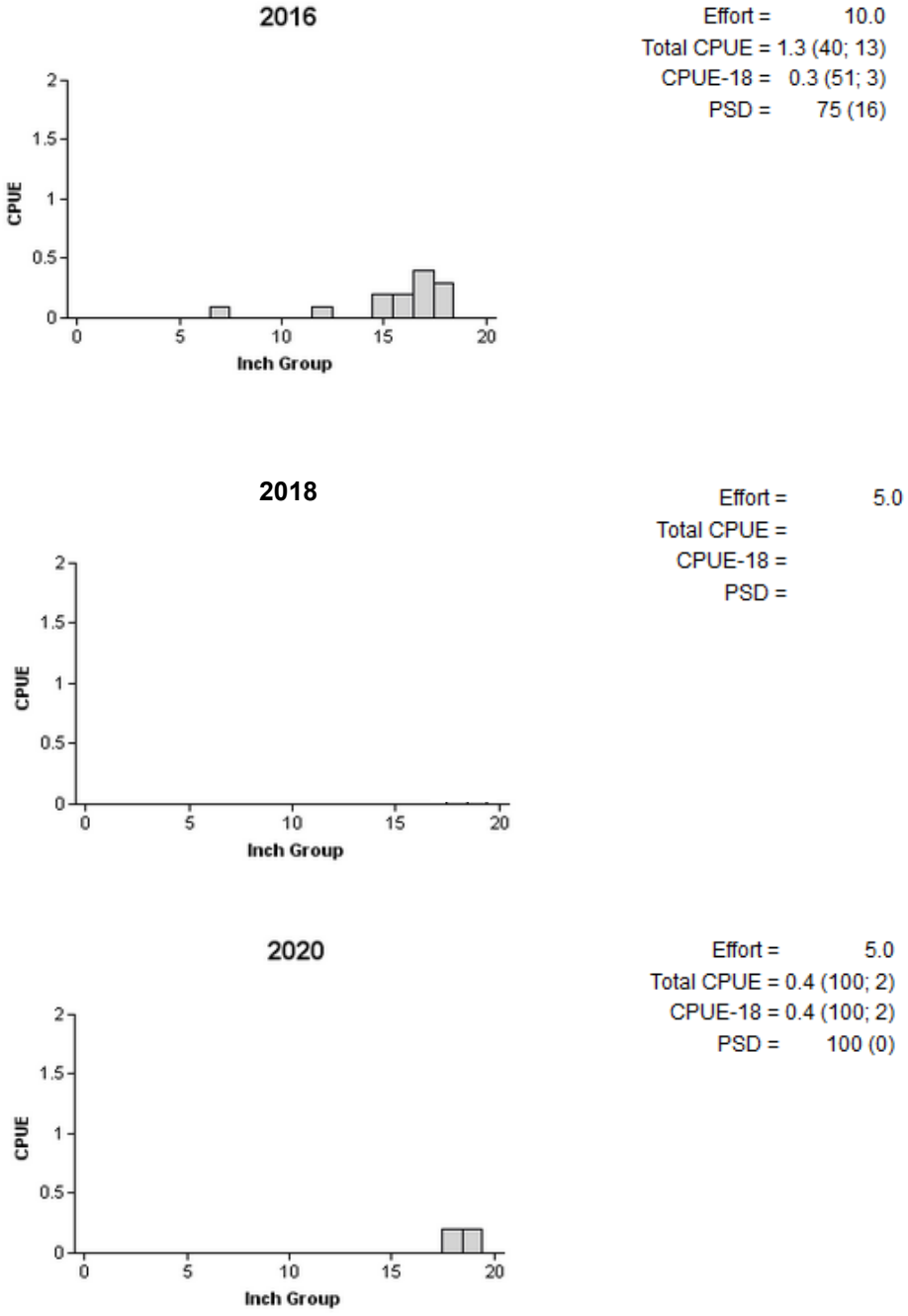


Figure 9. Number of Hybrid Striped Bass caught per net night (CPUE, bars) and population indices (RSE and N are in parentheses) for spring gill net surveys, Calaveras Reservoir, Texas, 2016, 2018, and 2020. RSE is used for CPUE values and SE is used for PSD values. Beginning in 2014 both Palmetto Bass and Sunshine Bass have been stocked. No relative weight data are presented in 2016 and 2020 as there is no relative weight equation for both Palmetto and Sunshine Basses. In 2018 no Hybrid Striped Bass were caught.

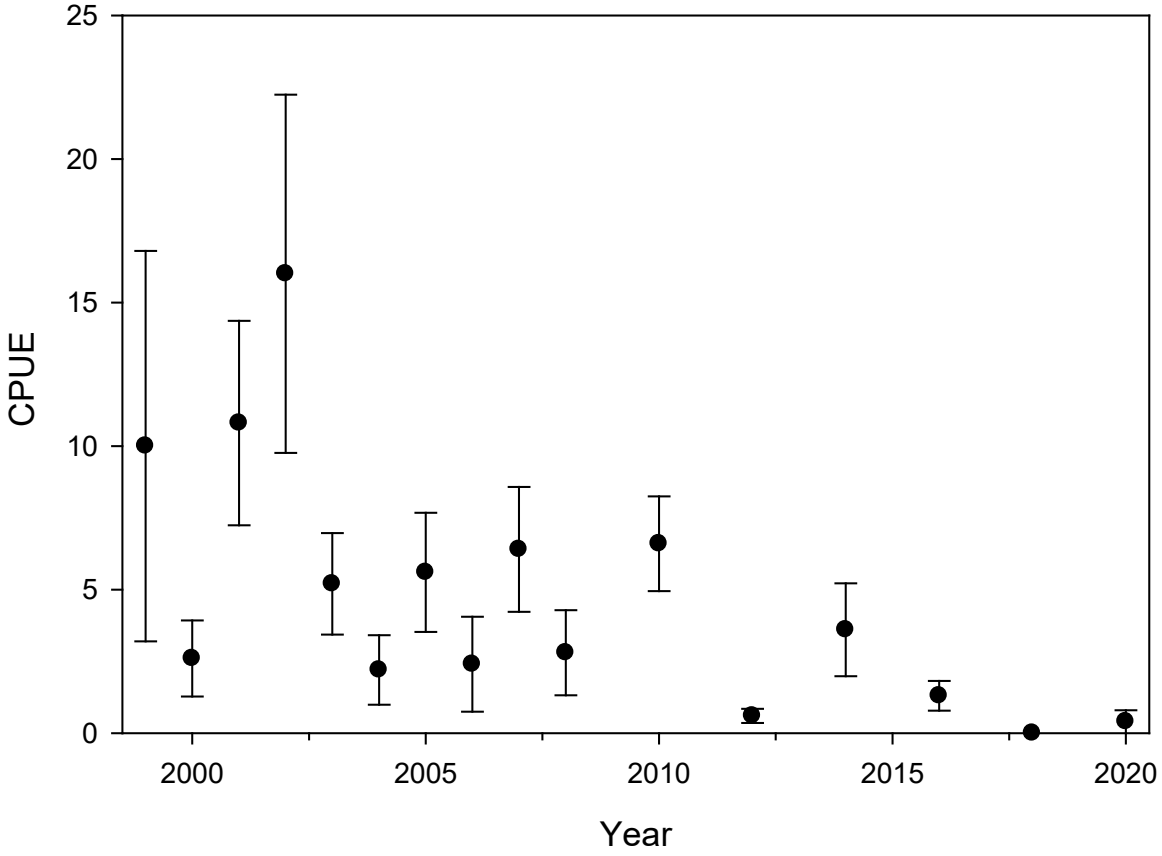


Figure 10. Average number of Hybrid Striped Bass collected per net-night (CPUE) at Calaveras Reservoir, Texas, 1999-2020 for spring gill net surveys. Error bars represent ±1 standard error.

Table 10. Creel survey statistics for Hybrid Striped Bass boat anglers at Calaveras Reservoir, Texas, for 2001-2002, 2010, and 2017. Survey periods were from December 1, 2001 to May 31, 2002, June 1, 2009 to May 31, 2010 and from March 1, 2017 to August 31, 2017. Average angler catch rate is for anglers targeting Hybrid Striped and total harvest is the estimated number of Hybrid Striped harvested by all anglers. Relative standard error (RSE) is in parentheses.

Creel survey statistic	2002	2010	2017
Directed effort total (h)	1,813 (38)	3,662 (36)	827 (82)
Directed effort/acre (h)	0.58 (38)	1.18 (36)	0.27 (82)
Average angler catch rate (fish/h)	0.43 (63)	0.09 (149)	0.13 (N/A)
Total harvest (fish)	897 (70)	669 (174)	551 (106)
Harvest/acre	0.29 (70)	0.22 (174)	0.1 (106)
Percent legal release	0	17	19

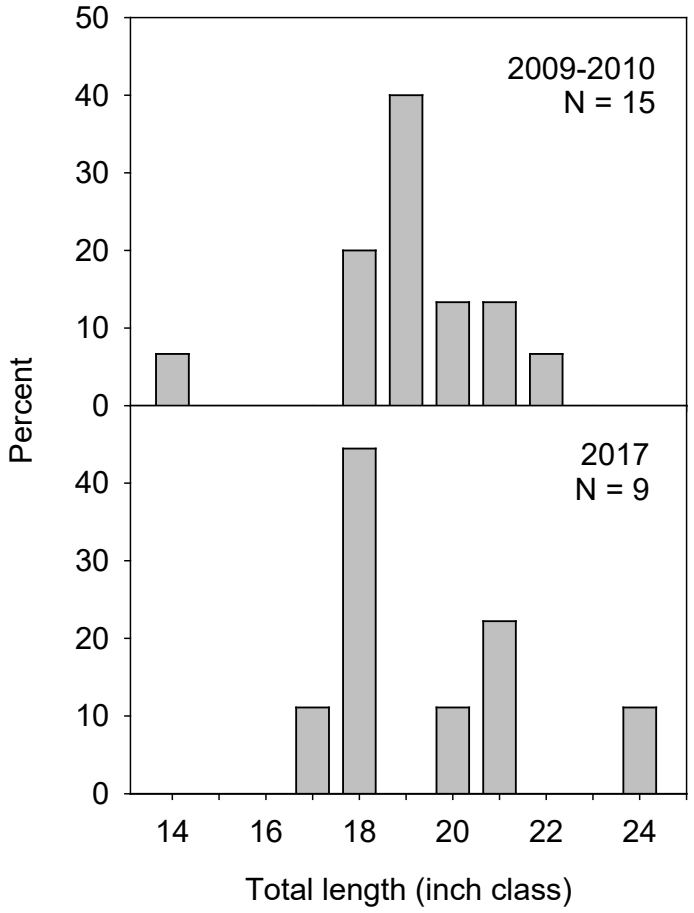


Figure 11. Length frequency of harvested Hybrid Striped Bass observed during creel surveys at Calaveras Reservoir, Texas, June 2009-May 2010 and March 2017-August 2017, all anglers combined. N is the number of harvested Hybrid Striped Bass measured during creel surveys.

Red Drum

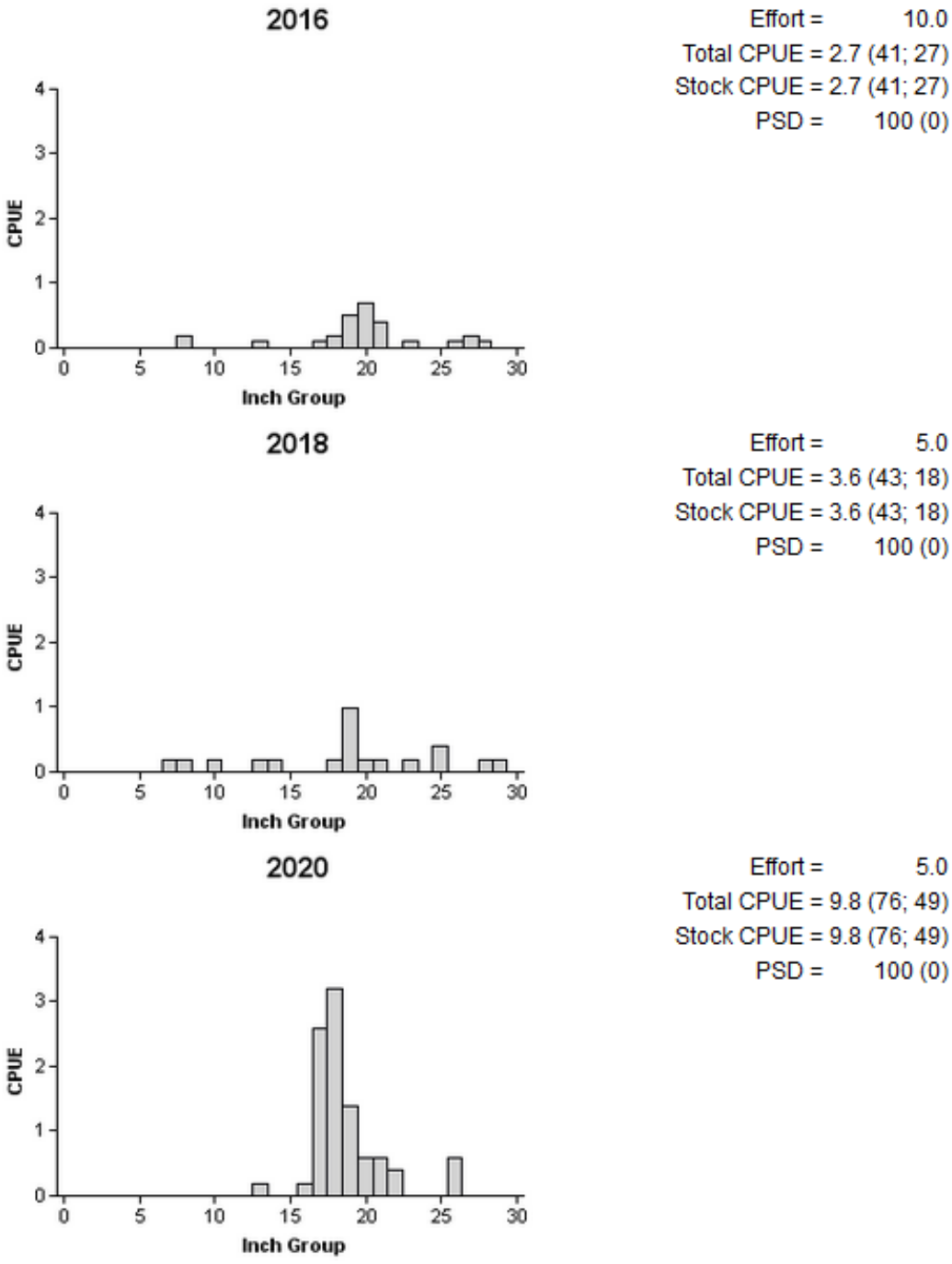


Figure 12. Number of Red Drum caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Calaveras Reservoir, Texas, 2016, 2018, and 2020.

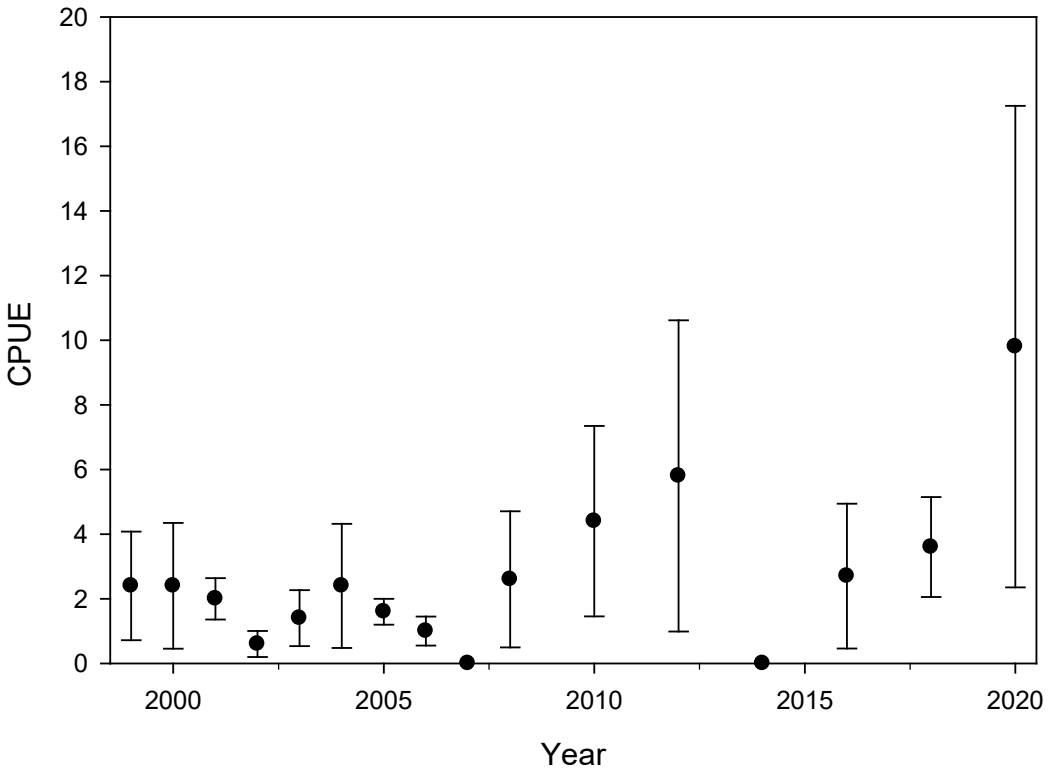


Figure 13. Average number of Red Drum collected per net-night (CPUE) at Calaveras Reservoir, Texas, 1999-2020 for spring gill net surveys. Error bars represent ±1 standard error.

Table 11. Creel survey statistics for Red Drum boat anglers at Calaveras Reservoir, Texas, for 2001-2002, 2010, and 2017. Survey periods were from December 1, 2001 to May 31, 2002, June 1, 2009 to May 31, 2010 and from March 1, 2017 to August 31, 2017. Average angler catch rate is for anglers Red Drum and total harvest is the estimated number of Red Drum harvested by all anglers. Relative standard error (RSE) is in parentheses.

Creel survey statistic	2002	2010	2017
Directed effort total (h)	4,367 (33)	55,312 (17)	30,719 (27)
Directed effort/acre (h)	1.4 (33)	17.8 (17)	9.9 (27)
Average angler catch rate (fish/h)	0.15 (40)	0.19 (27)	0.32 (26)
Total harvest (fish)	436 (79)	6,713 (32)	9,160 (34)
Harvest/acre	0.14 (79)	2.16 (32)	2.94 (34)
Percent legal release	0	22	29

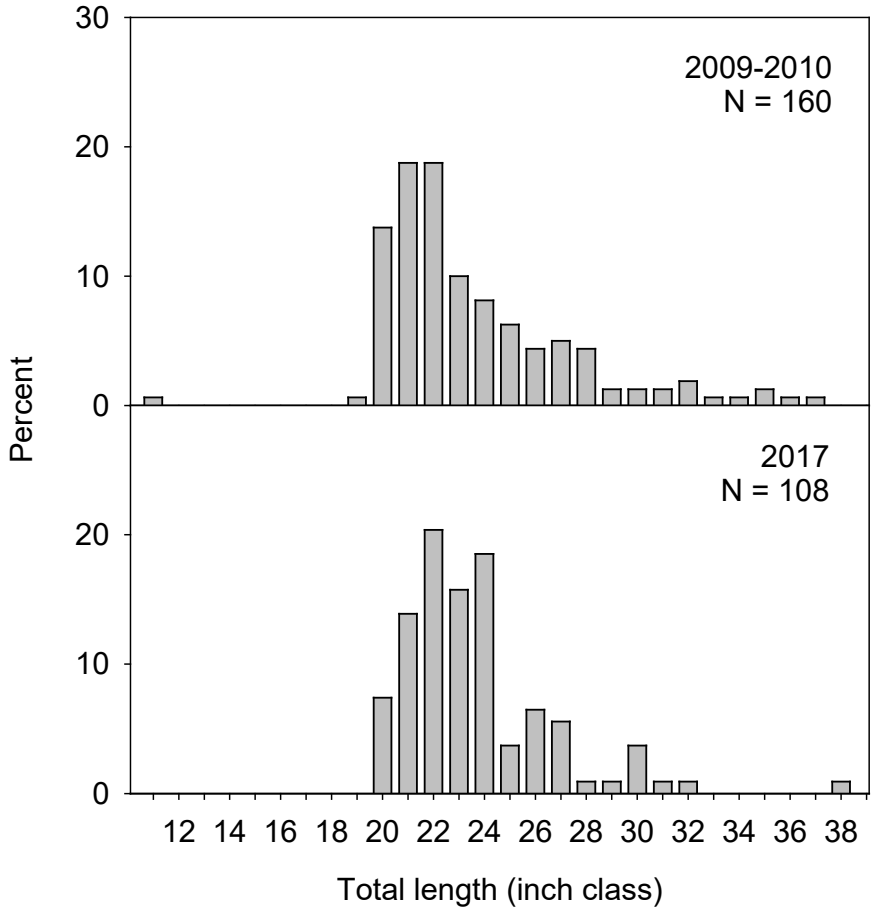
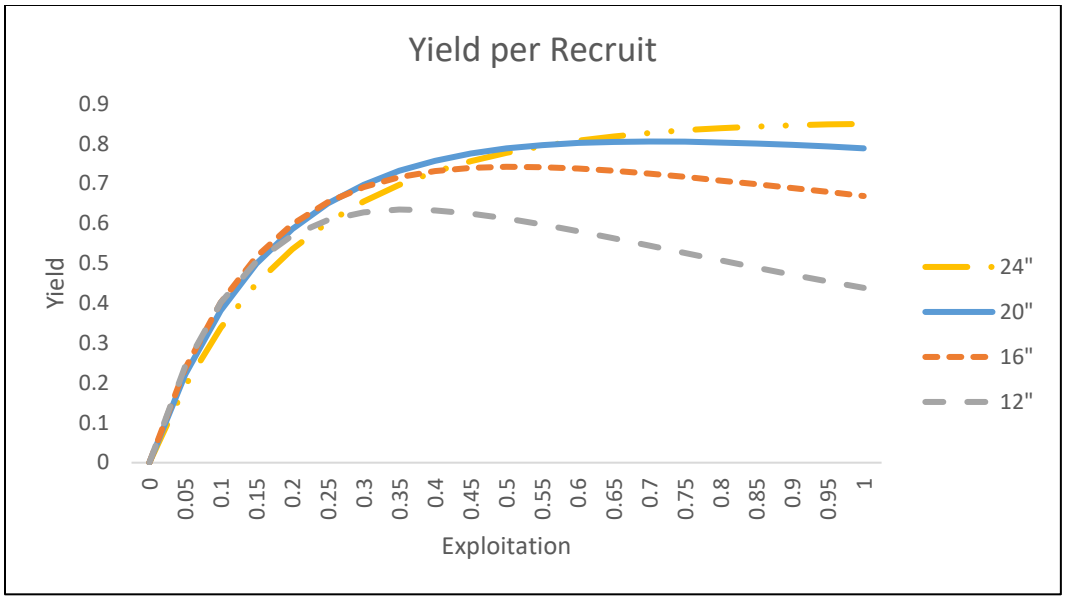


Figure 14. Length frequency of harvested Red Drum observed during creel surveys at Calaveras Reservoir, Texas, June 2009-May 2010 and March 2017-August 2017, all anglers combined. N is the number of harvested Red Drum measured during creel surveys.



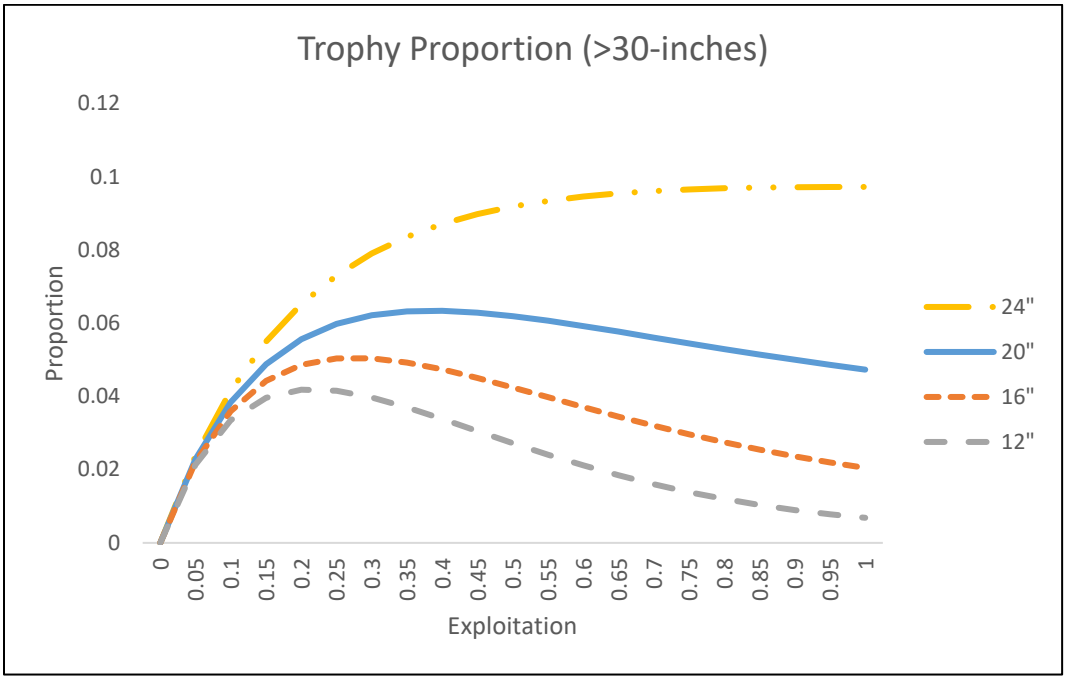


Figure 15. Comparison of the effect of 12 16 and 24-inch minimum length limits relative to the existing 20-inch minimum length limit on yield-per-recruit (top) and trophy potential (bottom) for Red Drum at Calaveras Reservoir. Model parameters can be found in Appendix C.

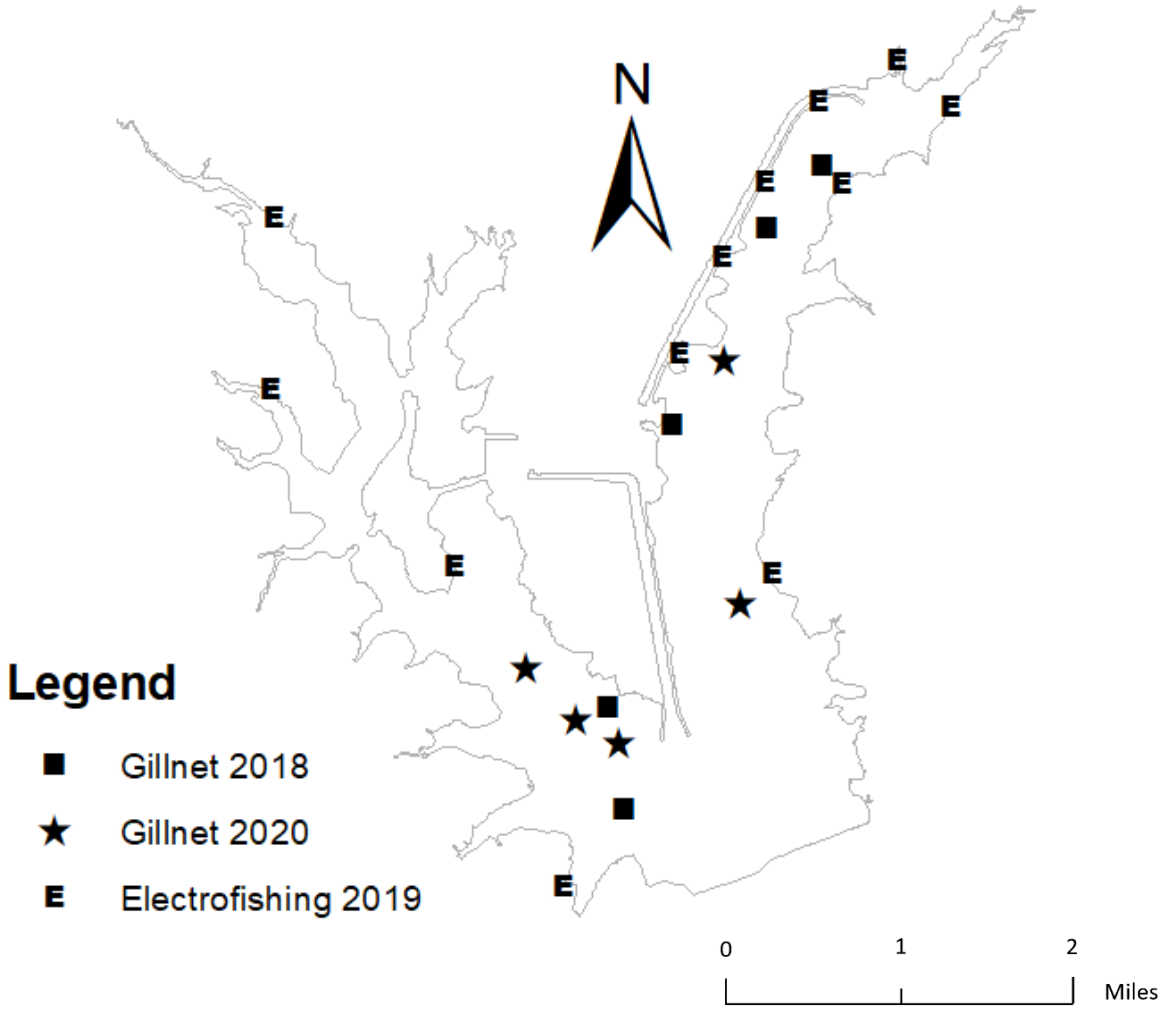
Proposed Sampling Schedule

Table 12. Proposed sampling schedule for Calaveras Reservoir, Texas. Survey period is June through May. Only one of the below denoted creel survey sampling events will occur and selection of such is yet to be determined. Standard survey denoted by S and additional survey denoted by A.

	Survey year			
	2020-2021	2021-2022	2022-2023	2023-2024
Angler Access				S
Vegetation				S
Electrofishing – Fall				S
Electrofishing – Spring				S
Gill netting		A		S
Creel survey		S[1]	S[1]	
Report				S

[1]Creel survey sampling will occur during only one of the indicated survey years and that has yet to be determined.

APPENDIX A – Map of Sampling Locations



Location of gill netting and electrofishing sample sites, Calaveras Reservoir, Texas 2016-2020. Gill netting sites are denoted by a “square” and “star”, while electrofishing sites are denoted by an “E”.

APPENDIX B – Catch Rates for All Species and Gear Types

Number (N), and catch rate (CPUE, RSE in parentheses) for all species collected from all gear types from Calaveras Reservoir, Texas, 2016-2020. Sampling effort was 1 h for electrofishing and 5 net-nights for each gill netting survey.

Species	Gill Netting 2017		Gill Netting 2020		Electrofishing 2019	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad	435	87.0 (28)	348	69.6 (43)	40	40.0 (51)
Threadfin Shad					17	17.0 (65)
Blue Catfish	21	4.2 (25)	8	1.6 (15)		
Channel Catfish	19	3.8 (37)	27	5.4 (45)		
Hybrid Striped Bass			2	0.4 (100)		
Bluegill	4	0.8 (47)			7	7.0 (56)
Redear Sunfish					19	19.0 (56)
Blue Tilapia	2	0.4 (61)				
Red Drum	18	3.6 (43)	49	9.8 (76)		

APPENDIX C – Age Structured Model Parameters

Calculated using aggregate growth data from Braunig and Calaveras Reservoirs in a von Bertalanffy growth formula.

Growth Parameters	
L inf	951.2
K	0.3195
tnot	0.5908

Calculated using the weight length relationship formula: W=aL^b

Weight Parameters	
a_wl	951.2
b_wl	0.3195

M was calculated according to Jensen (1996) using the formula M=1.5*K. So is annual natural survival using the formula e^-M. U is annual harvest (exploitation).

Mortality Parameters	
M	0.3592
So	0.69823
U	0.25

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