

Amistad Reservoir

2018 Fisheries Management Survey Report

PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-3

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

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Contents

Survey and Management Summary	1
Introduction	2
Reservoir Description	2
Reservoir Characteristics.....	2
Angler Access	2
Management History	2
Stocking History	3
Methods	3
Results and Discussion.....	5
Fisheries Management Plan for Amistad Reservoir, Texas	7
Objective-Based Sampling Plan and Schedule (2019-2023)	8
Literature Cited	10
Tables and Figures	11
Water Level	11
Reservoir Characteristics.....	12
Boat Ramp Characteristics.....	12
Harvest Regulations	13
Stocking History	14
Objective-Based Sampling Plan for 2016-2019	15
Aquatic Vegetation Survey	Error! Bookmark not defined.
Percent Directed Angler Effort per Species	16
Total Fishing Effort and Fishing Expenditures.....	16
Gizzard Shad.....	17
Bluegill.....	18
Redbreast Sunfish.....	19
Redear Sunfish.....	20
Channel Catfish.....	21
Catfishes	22
White Bass	24
Striped Bass	26
Largemouth Bass	28
Appendix A – Map of Sampling Locations	34
Appendix B – Catch Rates for All Species and Gear Types	35

Survey and Management Summary

Fish populations in Amistad Reservoir were surveyed in 2018-2019 using electrofishing and gill netting since the last report (2017). Anglers were surveyed from January through June in 2018 using a creel survey. 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: Amistad Reservoir (63,680 acres when full) borders Mexico and was constructed in 1969 on the Rio Grande River. It is managed by the International Boundary and Water Commission to provide water for irrigation and hydro-electric power generation. Boat and angler access are excellent; the National Park Service (NPS) maintains 9 public boat ramps. Water level declined from full pool in 2011 to 61 feet low in 2013. Water level subsequently increased and remained 26-37 feet low since 2015 with water level fluctuating 12.9 feet annually on average. Aquatic vegetation occurrence decreased and hydrilla occurrence increased slightly in 2018 compared to in 2016. Three water samples from the reservoir tested positive for Zebra Mussel DNA in December 2018, further water tests have tested negative and monthly shoreline surveys have not found any adult mussels.

Management History: Important sport fishes include Largemouth Bass, Smallmouth Bass, catfishes, Striped Bass, and White Bass. Striped Bass were stocked in most years since 1974. Florida Largemouth Bass (FLMB) were stocked periodically from 1975 to 2006 and annually since 2010 to improve FLMB introgression and trophy Largemouth Bass potential. Angler harvest of all sport fishes has been regulated according to statewide size and bag limits. Since 2004, the NPS has regulated Largemouth Bass tournaments via a tournament permitting program.

Fish Community

- **Prey species:** Relative abundance of Gizzard Shad was lower than the previous survey in 2016, but their Index of Vulnerability (IOV) was comparatively higher in 2018. Bluegill, Redbreast Sunfish, and Redear Sunfish were other important forage species present in the reservoir. Overall, prey species relative abundance and size was sufficient to support existing predator species populations.
- **Catfishes:** Channel Catfish was the predominant catfish species present in the reservoir. Directed angling effort was lower than the previous survey in 2015, however angling success and harvest were higher in 2018 than in previous years. Fishing for catfishes accounted for 5.7% of the total angling effort occurring on the reservoir in 2018.
- **Temperate Basses:** White Bass and Striped Bass relative abundance has been consistently low since 2011. Fishing for temperate basses accounted for 3.7% of total angling effort occurring on the reservoir in 2018.
- **Black Basses:** Relative abundance of Largemouth Bass has stayed constant in recent years. The population was mostly comprised of quality-sized fish (≥ 12 inches) in 2018-2019. Directed angling effort was similar in 2018 compared to 2015; however, harvest was higher. Anglers caught and released an estimated 162,421 fish from January to June 2018. Catch of Smallmouth Bass has been constant since 2012, after increasing considerably since 2007.

Management Strategies: Continue to provide a Striped Bass fishery supported by annual stockings. Continue stocking FLMB annually to maintain high FLMB introgression and trophy potential. Work cooperatively with Amistad Reservoir stakeholders to address issues that arise. Conduct electrofishing, gill netting, vegetation surveys every other year, and a creel survey every four years.

Introduction

This document is a summary of fisheries dependent and independent data collected from Amistad Reservoir in 2018-2019. 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 2018-2019 data for comparison.

Reservoir Description

Amistad Reservoir is a Texas-Mexico border impoundment constructed on the Rio Grande River. The reservoir encompasses 63,680 acres at conservation pool elevation (CP), with 34,312 acres located within Texas' jurisdiction. The reservoir was completed in 1969 and was built for flood control, domestic and agricultural water supply, and hydro-electric power generation. Ownership of water is shared between Mexico (46%) and the U.S. (54%). Commercial netting (gill and hoop) is legal on the Mexico side of the reservoir, however this activity has been rarely observed. The reservoir is the centerpiece of the Amistad National Recreation Area which had a visitation of nearly 1.2 million visitors in 2016 (Thomas and Koontz 2017). Most of the Texas shoreline is federally owned and managed by the NPS as a National Recreation Area. The reservoir experiences dramatic water level fluctuations due to variable rainfall and water releases for downstream use (Figure 1). Average annual water fluctuation is 12.9 feet per year since 1990. Three water samples from the reservoir tested positive for Zebra Mussel DNA in December 2018, further water tests have tested negative and monthly shoreline surveys have not found any adult mussels. The reservoir is a popular site for black bass tournaments. Average annual number of tournament events and Black Bass weighed-in were 153 and 31,472, respectively, from 2004 to 2008 (unpublished data, NPS). The total economic value of the fishery was estimated to be \$22.7 million in 2007 (Schuett et al. 2012). Other descriptive characteristics for the reservoir are in Table 1.

Angler Access

The NPS maintains 9 public boat ramps at the reservoir, four of which are only functional when water level is at or near conservation pool elevation. The NPS also provides two fish cleaning stations and operates a tournament permitting and scheduling program to avoid over-crowding at boat ramps and to obtain tournament catch statistics. Shoreline angling access is limited, and fishing is not allowed at boat ramp locations per NPS rule. Boat ramp characteristics are in Table 2.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Myers and Dennis 2017) included:

1. Stock Striped Bass annually at 3-5 fish/acre and conduct gill net survey and creel survey to assess the Striped Bass population.

Action: A total of 200,617 Striped Bass fingerlings were stocked in 2018. Striped Bass fingerlings were requested for stocking in 2019, but these have not been stocked to date. A gill net survey was conducted in the spring of 2019 and a creel survey was conducted in 2018 from January through June.

2. Stock Florida Largemouth Bass (FLMB) fingerlings annually at the rate of 1,000/km of shoreline to maintain a high-level of FLMB introgression and maximize production of trophy fish. Assess the population by using spring and fall electrofishing and a creel survey.

Action: A total of 601,882 and 569,935 FLMB were stocked in 2018 and 2019, respectively. An electrofishing survey was conducted in the fall of 2018 and the spring of 2019. A creel survey was conducted in 2018 from January through June.

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 2018, and no invasive aquatic plants were found. “Clean, Drain, and Dry” signs were posted at public boat ramps. Zebra Mussel eDNA was positively identified in water samples in 2018. Further surveys are ongoing by NPS.

4. Work cooperatively with other management agencies.

Action: Provided assistance to the NPS in renovation and testing of renovated fish release tube at the Diablo East boat ramp. Attended and presented at a public cooperative management meeting with members of the National Park Service, Texas Department of Environmental Quality, International Boundary and Water Commission, and Texas Parks and Wildlife to inform and answer questions from stakeholders regarding management of the reservoir. The annual NPS fishing event is still ongoing, but they have not requested fish since 2017.

Harvest regulation history: Harvest of all sport fishes has been managed according to statewide regulations since reservoir impoundment (Table 3).

Stocking history: Florida and Northern strain Largemouth Bass, Blue and Channel Catfishes, Smallmouth Bass, White Crappie, Striped Bass, Palmetto Bass, Walleye, Northern Pike, and Muskellunge have been stocked. FLMB and Striped Bass are the only fish still stocked, all other species stockings have been discontinued. Annual stocking of FLMB have been conducted since 2010 to maintain high FLMB introgression and trophy potential. Striped Bass were stocked in most years since 1974 to support a fishery. The complete stocking history is in Table 4.

Vegetation/habitat management history: Aquatic vegetation has been routinely monitored and quantified. In 2012, a few dozen left over Christmas trees donated by Home Depot in Del Rio were secured to large cement blocks and deployed to serve as a fish attractor.

Water transfer: Amistad Reservoir is used to store, conserve, and distribute water for downstream water supply needs in both Mexico and the United States. Rio Grande River water is allocated per terms of a treaty formed in 1944 between the two countries. Each country has separate operational control of the dam and release water in response to downstream water needs. No inter-basin transfer of water is known to exist.

Methods

Surveys were conducted to achieve survey and sampling objectives in accordance with the 2017-2021 objective-based sampling (OBS) plan for Amistad Reservoir (Myers and Dennis 2017). Primary components of the OBS plan are listed in Table 5. All survey sites were randomly selected, except when otherwise specified, and all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Electrofishing – Largemouth Bass, sunfishes, Gizzard and Threadfin Shad were collected by day-time electrofishing (24, 5-min stations) during fall 2018. Largemouth Bass were collected by day-time electrofishing (24, 5-min stations) during spring 2019. Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing. Ages for Largemouth Bass (N=17) were determined using otoliths from fish between 13.0 and 14.9 inches total length (TL).

Gill netting – Catfishes, Striped Bass and White Bass were collected by gill netting (16 net nights at 16

stations) in spring of 2017 and 2019, using biologist selected stations. Catch-per-unit-effort for gill netting was recorded as the number of fish caught per net night (fish/nn). Striped Bass (N=13) and White Bass (N=3) ages were determined using otoliths from fish between 9.0-10.9 inches for White Bass and 17.0-18.9 inches for Striped Bass.

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.

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

Habitat - A vegetation survey was conducted using the random point sampling method during September 2018 (TPWD Inland Fisheries Division, unpublished manual, revised 2015).

Creel survey – An access creel survey was conducted from January to June 2018 at five of the public boat ramps. Non-uniform spatial sampling probabilities were used and these were derived from NPS vehicle counts at boat ramps. The five selected boat ramps account for >90% boats accessing the reservoir. The sampling occurred on 10 random weekend days and 8 random weekdays per quarter, which is double the minimum required sampling effort. The additional effort was done to increase sample size and data precision. Each sample day was split into equal duration time periods, with random time period selection and one time period sampled per creel survey day. Percent legal release was calculated as:

$$\text{Percent legal release} = \frac{\sum \text{Legal-sized Fish Released}}{(\sum \text{Harvested Fish} + \sum \text{Legal-sized Fish Released})} \times 100$$

Estimated weights of caught and released Largemouth Bass ≥ 14 inches were obtained from interviewed anglers to estimate number of fish released by weight category.

Water level - Source for water level data was the International Boundary Water Commission (IBWC 2019).

Results and Discussion

Habitat: The reservoir experiences substantial water level fluctuations (Figure 1). During the 2017-2019 study period water level fluctuated approximately 10 feet on two occasions and remained between 26 and 37 feet below CP. Percent occurrence of aquatic vegetation in 2018 (26%) was lower than in 2016 (36%) and greater than in 2011 (19%) and 2014 (17%; Table 6). Hydrilla was the predominant aquatic plant species present in the reservoir in 2018 (19%).

Creel: Fishing for Largemouth Bass continued to comprise the majority of the total fishing effort expended on the reservoir (86.3%; Table 7). Other species targeted by anglers in 2018 included catfishes (5.7%), and temperate basses (5.7%). Total angling effort expended on the reservoir in 2018 (238,786 h) was similar to that in 2015 (237,397 h), and lower than in 2012 (295,314 h; Table 8). The recreational fishery at the reservoir continues to have a high economic value; however, direct expenditures were lower in 2018 (\$2.4 million) than in 2015 (\$3.3 million; Table 8).

Prey species: Electrofishing CPUE of Gizzard Shad in 2018 (38.0/h) was lower than in 2016 (49.5/h) and greater than in 2011 (16.5 fish/h; Figure 2). Although Gizzard Shad CPUE was lower than in recent years, IOV in 2018 (29) was greater than IOV reported in any survey since 1986. Threadfin Shad CPUE in fall 2018 (64.5 fish/h) was the highest it has been in the reservoir since 1986. Sunfishes accounted for the majority of the prey base, and the most abundant species was Redbreast Sunfish (171.0 fish/h), many of which were ≥ 6 inches, followed by Bluegill (54.0 fish/h). Electrofishing CPUE of combined Sunfishes in 2018 (236.0/h) was higher than in 2016 (93.5 fish/h) and 2011 (123.0 fish/h; Figures 3-5). A very limited sunfish fishery exists at the reservoir. Angling effort directed for sunfishes was not documented in 2018. Growth rates of sport fishes and mean relative weights exceeding 80 for most size classes of Largemouth Bass in 2018 and 2019 suggest prey availability was sufficient.

Catfishes: Channel, Blue, and Flathead Catfishes were present in the reservoir, and Channel Catfish were the predominant species. Gill net CPUE of Channel Catfish has been similar since 2011 (ranging from 0.9-1.7 fish/nn; Figure 6). Most fish collected in 2019 were available for angler harvest with individuals up to 19 inches collected. Blue and Flathead Catfishes occurred in low relative abundance (CPUE < 1.0 fish/nn). Directed angling effort for catfish was slightly lower in 2018 (13,656 h) than in 2015 (18,512 h), but much higher than 2012 (3,191 h; Table 9). Angler catch rate increased in 2018 (0.68/h) compared to 2015 (0.24/h). Likewise, angler harvest was higher in 2018 (16,095 fish) compared to 2015 (2,963 fish). Harvested Channel Catfish ranged in size from 12-20 inches in 2018 (Figure 7).

White Bass: Use of the sampling protocol set forth in the 2016-2019 OBS plan (16 nn at biologist-selected stations) yielded a catch of 39 stock-size fish in 2019 (Figure 8) which achieved the sampling objective (≥ 25 stock fish). Precision of the PSD and CPUE-stock estimates (SE = 9 and RSE = 32, respectively) was adequate given the survey objective of monitoring for large-scale changes in population size and relative abundance. Relative abundance in 2019 (2.0 fish/nn) was similar to that in 2017 (1.6 fish/nn). Quality fish (≥ 9 inches) continue to account for most of the fish sampled, with PSD ranging from 66-96 across years. Two age classes were represented in the sample that was collected using gill nets in 2019. White Bass attained legal-harvestable size between age 1 and 2. White Bass angler effort has decreased since 2015, while harvest has increased. Effort and harvest in 2018 was 3,059 h and 9,581 fish, respectively; whereas, in 2015 angler effort and harvest were 11,504 h and 6,512 fish, respectively (Table 10). Lengths of harvested fish ranged from 11 to 15 inches (Figure 9). Five percent of legal White Bass (≥ 10 inches) caught were released.

Striped Bass: Striped Bass gill net CPUE has increased from 0.9 fish/h in 2015 to 2.9 fish/h in 2017 and 2019 (Figure 10). At least two stocked year classes were discernable in the 2019 gill net sample, suggesting that recent stockings (2017 and 2018) were successful. All 13 of the Striped Bass aged in the 2019 gill net sample were from the 2017-year class. Mean length of 2017 year class fish at time of collection was 17.6 inches. The 2018 creel survey showed decreased effort, but increased harvest (412 h, 1,360 fish) compared to the previous creel survey conducted in 2015 (895 h, 0 fish; Table 11). Lengths of harvested fish ranged from 18 to 24 inches (Figure 11). Twenty-five percent of legal Striped Bass (≥ 18 inches) caught were released.

Largemouth Bass: Electrofishing CPUE of Largemouth Bass was similar in fall 2018, 2016, and 2011 ranging from 45.5 to 64.0 fish/h (Figure 12). Electrofishing during spring indicated Largemouth Bass relative abundance was greater in 2017 (84.0 fish/h) compared to 2015 (56.0 fish/h) and 2019 (65.5 fish/h; Figure 13). Since the record low water levels in 2013 and extreme water level fluctuations that followed, relative abundance has been low compared to historical averages (Figure 14). Despite the low relative abundance, stock-sized fish continued to represent a substantial portion ($>50\%$) of Largemouth Bass collected. The PSD estimates have been similar across time, ranging from 50-66 since 2016, and all have been greater than 50 since 2007. Mean relative weight values were acceptable with most size categories exceeding 80 in fall 2018 and spring 2019. Largemouth Bass exhibited moderate growth, obtaining harvestable length in two growing seasons. Fish ranging from 13 to 14.9 inches total length (TL) collected in spring 2019 (N=17) were all either 2016 or 2017-year class fish. Genetic introgression of FLMB into the population has been high at the reservoir, ranging from 71 to 83% FLMB alleles since 2006 (Table 12). Percent FLMB alleles was 71% in 2018 and has lowered since 2016 (83%). Percent pure FLMB in the population was 0% in 2018 and has reduced since 2016 (17%). Annual stocking of FLMB fingerlings since 2010 have maintained high FLMB introgression; however, proportionally purer FLMB has not resulted. Angling effort targeting Largemouth Bass was similar in 2018 (206,104 h) and 2015 (198,559 h), which was less than in 2012 (281,150 h; Table 13). Tournament angling accounted for 13% of total Largemouth Bass angling. Angling success was good in 2018, with anglers catching an average of 0.91 fish/h which was higher than 2012 (0.73 fish/h) and 2015 (0.47 fish/h). Non-tournament anglers harvested 11,343 fish in 2018 and was substantially greater than in 2015 (1,574 fish), but fewer than in 2012 (23,342 fish). Percent legal release of legal-length fish was lower in 2018 (83%) than in 2015 (90%) and similar to 2012 (82%). The majority of caught and released fish (98%) were <4.0 lbs. The length distribution of harvested fish in 2018 was similar to previous years, with fish ranging in size from 14-16 inches most frequently harvested (Figure 15).

Fisheries Management Plan for Amistad Reservoir, Texas

Prepared - July 31, 2019

ISSUE 1: Striped Bass are an important sport fish at Amistad Reservoir. Annual stocking is required to maintain the population because the species does not successfully reproduce in the reservoir.

MANAGEMENT STRATEGY

1. Stock Striped Bass annually at 3-5 fish/acre.

ISSUE 2: Amistad Reservoir is well known for its high-quality Largemouth Bass fishery and for catches of trophy-size fish. The reservoir has been ranked in the top 10 bass fishing destinations by ESPN-Bassmaster. 260 Largemouth Bass weighing between 7 to 10 lbs. were reported caught during the 2018 creel survey. However, no bass weighing over 10 lbs. have been reportedly caught during our creels since 2012. This is potentially an effect of the record low water levels in 2013.

MANAGEMENT STRATEGY

1. Annually stock FLMB fingerlings at the rate of 1,000/km of shoreline to maintain a high-level Florida bass introgression and maximize production of trophy fish.

ISSUE 3: 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. Check for presence of Zebra Mussels and other aquatic invasive species at reservoir boat ramps during all visits to the reservoir.
2. Coordinate control activities (if needed) with the controlling authority (IBWC), National Park Service and the Val Verde County government.
3. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir.
4. Contact and educate marina owners about invasive species, and provide them with posters, literature, etc., so that they can in turn educate their customers.
5. Educate the public about invasive species through the use of media and the internet.
6. Make a speaking point about invasive species when presenting to constituent and user groups.
7. 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 (2019-2023)

Sport fish, forage fish, and other important fishes

Important sport fishes in Amistad Reservoir include Largemouth Bass, Channel Catfish, White Bass, Striped Bass, and Smallmouth Bass. Known important forage species include Bluegill, Redbreast Sunfish, and Gizzard Shad. Sampling schedule is in Table 14.

Low-density fisheries

Amistad Reservoir include Blue Catfish, Flathead Catfish, and White Crappie. The presence or absence of these species will be determined from incidental gill net catches.

Survey objectives, fisheries metrics, and sampling objectives

Largemouth Bass: Largemouth Bass are the most highly sought-after sport fish in the reservoir. This fishery is a popular destination for anglers from across the nation having been ranked in the top 10 (including #1) of the 100 top bass fishing lakes in the nation, by ESPN-Bassmaster's. This reservoir experiences extreme water level fluctuations and changes in habitat which leads to fluctuations in Largemouth Bass relative abundance, size structure, and fishing quality. Since 2001, the Largemouth Bass population has been sampled on a biennial basis to track trends in relative abundance, size structure, growth, and Florida Bass gene introgression. As one of the premier Largemouth Bass fisheries in the nation, continued biennial sampling will be needed to track changes in the relative abundance and size structure, and trigger further investigations into issues and conditions as they arise. Fall night time electrofishing will occur every other fall (2020 and 2022) and spring day-time bass-only electrofishing will occur every other spring (2021 and 2023). The fall surveys will consist of 18 randomly selected 5-minute stations. Based on our evaluation of existing electrofishing data, $RSE \leq 20$ for CPUE-(S), the collection of 50+ stock-sized and larger bass for size structure determination, 30 fish for genetic analysis, and 13 fish between 13.0 and 14.9 inches for age and growth analysis with approximately 12 stations. However, we chose to set the total effort at 18 stations because of the distance from the office to the reservoir requiring an overnight stay. Spring surveys will consist of 24 randomly selected stations to collect 50+ fish for size structure determination and should allow for an $RSE \leq 25$ for CPUE-(S). No further sampling effort will be expended in the spring. Fishing quality (as determined by directed effort and angler catch rates) will be measured with a 6-month creel survey conducted January through June, 2021. Sixteen creel survey days per quarter will be sampled. Effort will be split approximately 50:50 between weekend and weekday creels. Sample sites (boat ramps) will be stratified among the five most used boat ramps using vehicle counts supplied by the National Park Service.

Smallmouth Bass: Electrofishing surveys do not sample Smallmouth Bass effectively in Amistad Reservoir; however, anglers do report catches of these fish. Large-scale changes in angler use will be monitored by determining angler catch, harvest, and directed effort of Smallmouth Bass during the 2021 creel survey described in the Largemouth Bass section.

Channel Catfish: Our survey objective is to monitor for large-scale changes in angler use. The sampling objective is to determine angler catch, harvest, effort, and harvest size-structure from the creel survey in 2021 (described in the Largemouth Bass section).

White Bass: The objective for White Bass is to determine large-scale changes in relative abundance and size structure. From personal observations during previous creel surveys, most anglers targeting White Bass at Amistad Reservoir fish for them in the Castle Canyon and Devil's River areas of the reservoir from January through March. Sampling, therefore, will be accomplished using gill nets at biologist-selected stations in each of those areas. A minimum of eight nets will be set for one night in each area. This sampling protocol was used in 2019, and the sampling objective at that time was achieved with the

collection of 25 stock-size White Bass yielding a CPUE of 2.0 fish/nn with an RSE of 39. The next sampling event will occur in 2021, and no fish sample size and estimate precision targets are set.

Striped Bass: The objective for Striped Bass is to determine large-scale changes in relative abundance and size structure. From personal observations during previous creel surveys, most anglers targeting this species fish for them in the Castle Canyon and Devil's River areas of the reservoir from January through March. Sampling, therefore, will be accomplished using gill nets at biologist-selected stations in each of those areas. A minimum of eight nets will be set for one night in each area. This sampling protocol was used in 2019, and the sampling objective at that time was achieved with the collection of 38 stock-size Striped Bass yielding a CPUE of 2.9 fish/nn with an RSE of 20. The next sampling event will occur in 2021, and no fish sample size and estimate precision targets are set.

Bluegill Redbreast Sunfish, and Gizzard Shad: Bluegill, Redbreast Sunfish, Threadfin Shad, and Gizzard Shad are the primary forage fishes at Amistad Reservoir. Major changes in the relative abundance of Bluegill and Redbreast can be indicated in CPUE trend data for these sunfishes. Sampling of the sunfishes concurrently with the Largemouth Bass in the fall should provide adequate precision ($RSE \leq 20$) for CPUE to detect major changes in relative abundance. Gizzard Shad CPUEs were so variable that trends in relative abundance cannot be detected with a reasonable amount of sampling effort (see table below). They will be collected concurrently with the Largemouth Bass sampling, but due to the variability, the data will be of minimal use. No additional sampling effort will be expended to increase the precision of Bluegill, Redbreast Sunfish, and Gizzard Shad.

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Tables and Figures

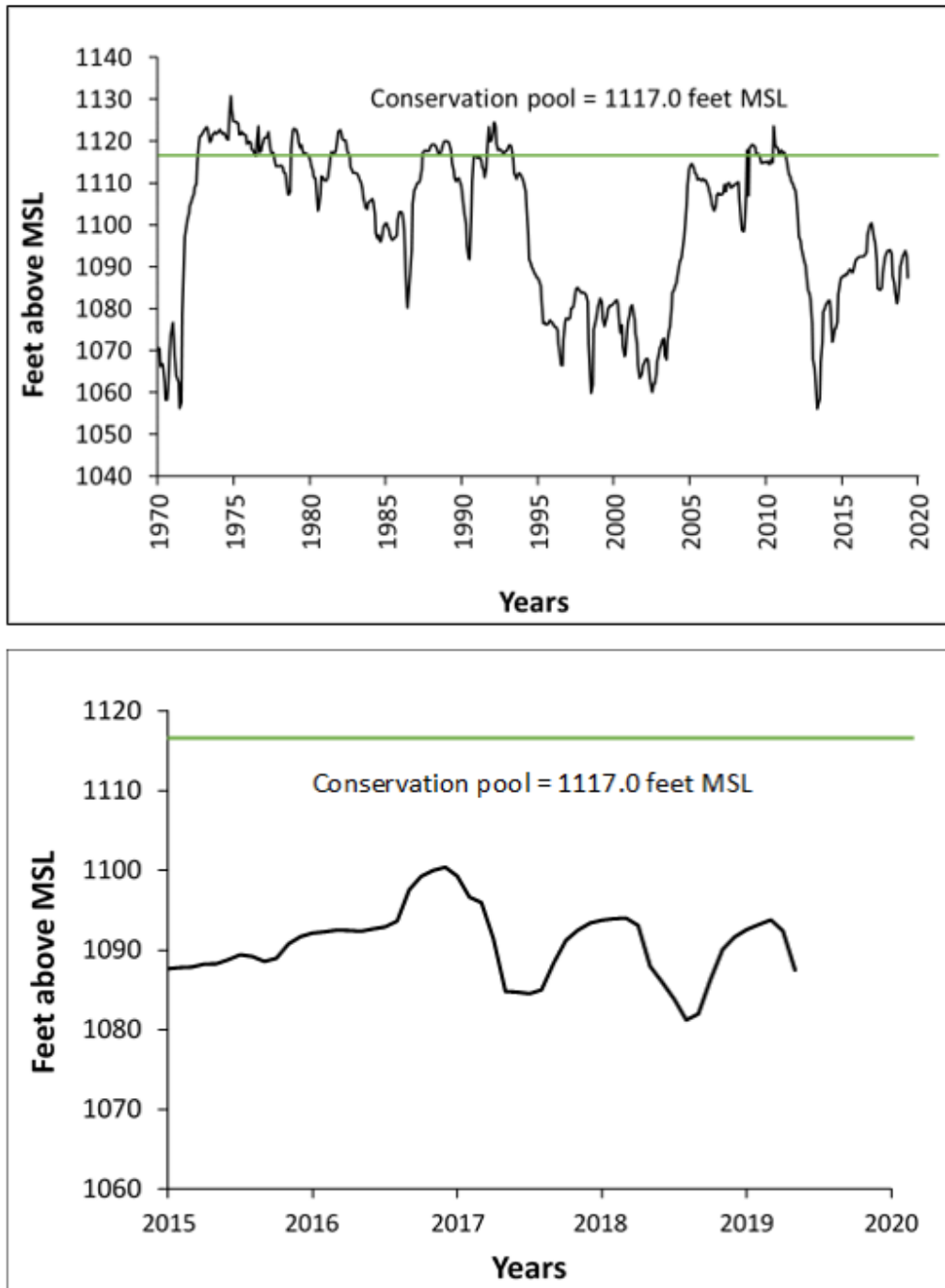


Figure 1. Average water level elevation in feet above mean sea level (MSL) by month since 1970 (top panel) and by month since 2015 (bottom panel) for Amistad Reservoir, Texas. Conservation pool elevation is 1,177 feet above MSL and is represented by the horizontal green line.

Table 1. Characteristics of Amistad Reservoir, Texas.

Characteristic	Description
Year constructed	1969
Controlling authority	International Boundary and Water Commission
Counties	Val Verde
Reservoir type	Mainstream
Shoreline Development Index (SDI)	23.47
Conductivity	871 umhos/cm

Table 2. Boat ramp characteristics for Amistad Reservoir, Texas, August 2018. Reservoir elevation at time of survey was 1,085 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Condition
Diablo East	29.477313 -101.016495	Y	250	Excellent
Black Brush	29.474045 -100.986480	Y	50	Excellent
Air Force	29.473237 -101.037822	Y	50	Excellent
Rough Canyon	29.576928 -100.978195	Y	50	Excellent
Box Canyon	29.524826 -101.173759	Y	50	Excellent
Spur 454	29.465880 -100.956986	Y	10	Fair
277 South	29.494889 -100.907736	Y	10	Fair
277 North	29.509789 -100.906474	Y	10	Fair
Spur 406	29.551029 -101.020351	Y	10	Fair

Table 3. Harvest regulations for Amistad Reservoir, Texas.

Species	Bag Limit	Minimum length limit (inches)
Gar, Alligator	1	None
Catfish: Channel and Blue, their hybrids and subspecies	25*	12
Catfish, Flathead	5	18
Bass, White	25	10
Bass, Striped	5	18
Bass, Largemouth and Smallmouth	5	14
Crappie: White and Black, their hybrids and subspecies	25*	10

*In any combination

Table 4. Stocking history of Amistad, Texas. Size categories are FRY = <1-inch, FGL = 1-3 inches, AFGL = 4-8 inches, and UNK = Unknown.

Species	Year(s) Stocked	Number of Years	Number Stocked	Size
Blue Catfish	1971	1	5,445	UNK
Channel Catfish	1967-1973	7	486,020	UNK
Florida Largemouth Bass	1975-1980	6	1,694,120	FGL
	1977-1978	2	552,800	FRY
	1992	1	507,075	FGL
	1996-1997	2	631,711	FGL
	2004	1	552,648	FGL
	2008	1	501,874	FGL
	2010-2017	8	3,230,972	FGL
	2018	1	601,882	FGL
	2019	1	569,935	FGL
ShareLunker Largemouth Bass	2006-2010	3	9,214	FGL
Largemouth Bass	1967-1973	6	3,240,685	UNK
	2004-2005	2	331,743	FGL
Walleye	1954-1978	5	17,393,000	UNK
Striped Bass	1974	1	82,616	FGL
	1976-1982	6	1,099,490	UNK
	1984-1999	11	3,296,938	FGL
	1988-1993	3	1,332,843	FRY
	2000-2017	13	2,426,243	FGL
	2018	1	200,617	FGL
Smallmouth Bass	1975-1983	4	665,250	UNK
White Crappie	1968	1	100	UNK
	1989	1	144,391	FRY
Palmetto Bass	1975-1982	3	1,614,962	UNK
Muskellunge	1976	1	700	UNK
Northern Pike	1976	1	1,030,305	UNK

Table 5. Objective-based sampling plan (OBS) components for Amistad Reservoir, Texas. 2017-2019 (Myers and Dennis 2017).

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing^a</i>			
Largemouth Bass	Relative abundance	CPUE-stock	RSE-Stock ≤ 20
	Size structure	PSD, length frequency	$N \geq 50$ stock
	Age-and-growth	Age at 14 inches	$N = 13, 13.0 - 14.9$ inches
	Genetics	% FLMB	$N = 30$, any age
Bluegill	Relative abundance	CPUE-total	RSE ≤ 20
Redbreast Sunfish	Relative Abundance	CPUE-total	RSE ≤ 20
Gizzard Shad	Relative abundance	CPUE-total	None
	Size structure	PSD, length frequency	None
	Prey availability	IOV	None
<i>Gill netting</i>			
White Bass	Relative abundance	CPUE-stock	$N \geq 25$ stock
	Size structure	Length frequency	$N \geq 25$ stock
Striped Bass	Relative abundance	CPUE-stock	None
	Size structure	Length frequency	None

Table 6. Results of random point sampling vegetation surveys conducted at Amistad Reservoir (Texas-side only) in August of 2011, 2014, 2016, and 2018. Percent occurrence is shown for predominate habitat types along with lower and upper 95% confidence interval (in parentheses). N/A describes instances where the habitat type was not recorded or observed. Reservoir elevation (in feet) relative to conservation pool elevation (1,117.0 feet above mean sea level) and number of random points sampled are provided for reference.

Habitat type/survey metric	2011	2014	2016	2018
Open water	81 (78-85)	73 (67-79)	64 (58-70)	70 (64-76)
Flooded terrestrial vegetation	N/A	11 (6-15)	12 (8-16)	8 (5-11)
Combined aquatic vegetation	19 (15-23)	17 (12-22)	36 (30-42)	26 (20-32)
Hydrilla	5 (3-8)	9 (5-13)	15 (11-20)	19 (14-24)
Pondweed spp.	12 (9-16)	3 (0-5)	16 (12-21)	10 (6-14)
Chara	10 (7-13)	2 (0-3)	6 (3-10)	3 (1-5)
Relative reservoir elevation (ft. above MSL)	-6	-42	-23	-35
Number of random points	421	195	246	236

Table 7. Percent directed angler effort by species for Amistad Reservoir, Texas, from January to June in 2012, 2015, and 2018.

Species	2012	2015	2018
Catfishes	1.1	7.3	5.7
Temperate Basses	0	1.3	2.2
White Bass	1.3	4.8	1.3
Striped Bass	0.2	0.4	0.2
Sunfishes	0	<0.1	0.0
Largemouth Bass	95.2	83.6	86.3
Crappie spp.	0.0	0.0	0.3
Other	2.2	2.0	3.8

Table 8. Total fishing effort (h) for all species and total directed expenditures (\$ in millions) for Amistad Reservoir, Texas, from January to June in 2012, 2015, and 2018. Relative standard error is in parentheses.

Creel Statistics	2012	2015	2018
Total fishing effort	295,314	237,397 (27)	238,786 (31)
Total directed expenditures	4.3	3.3	2.4 (42)

Gizzard Shad

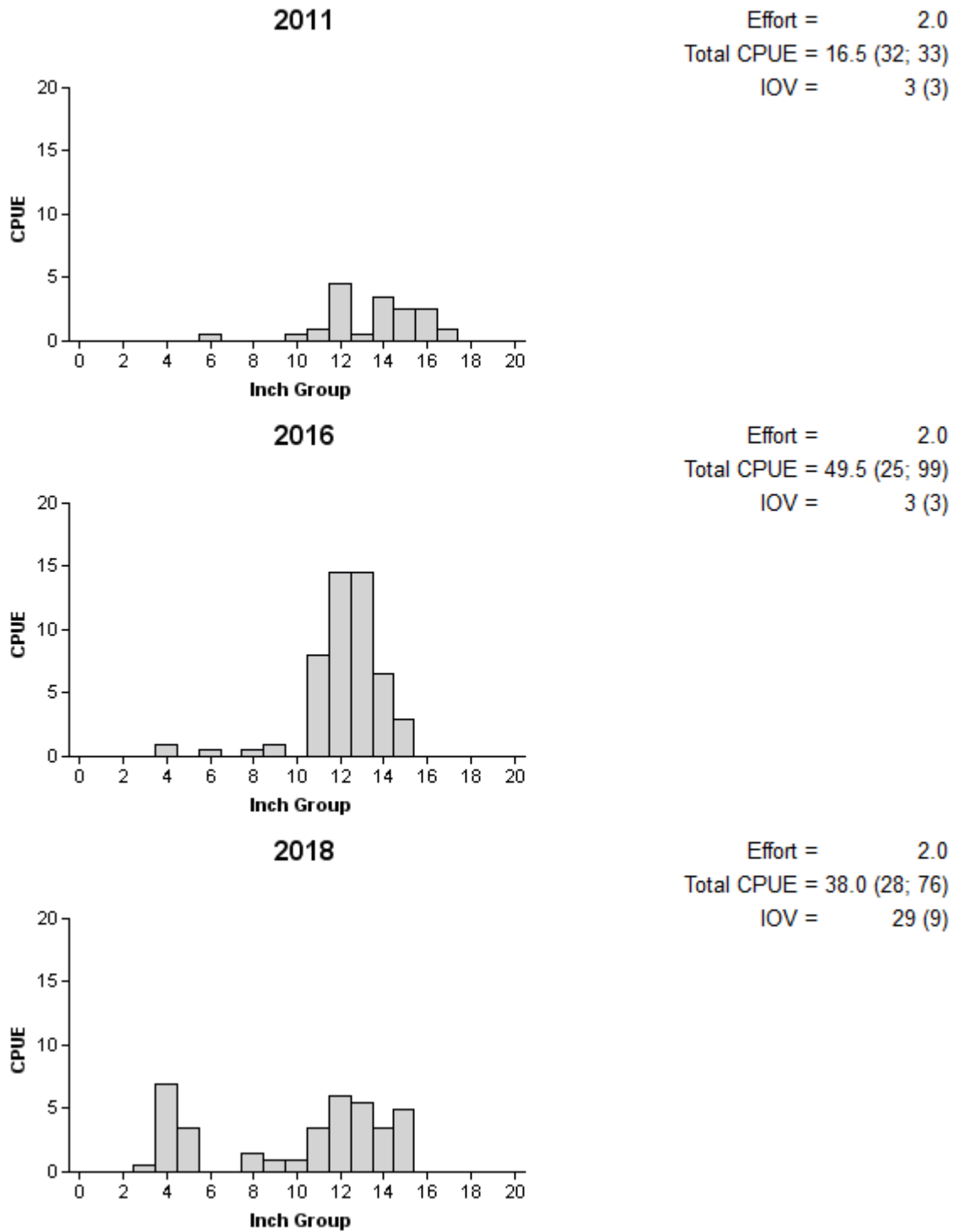
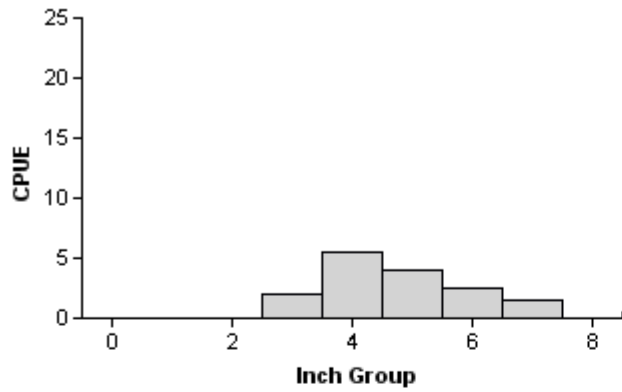


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for all fall electrofishing surveys, Amistad Reservoir, Texas, 2011, 2016, and 2018.

Bluegill

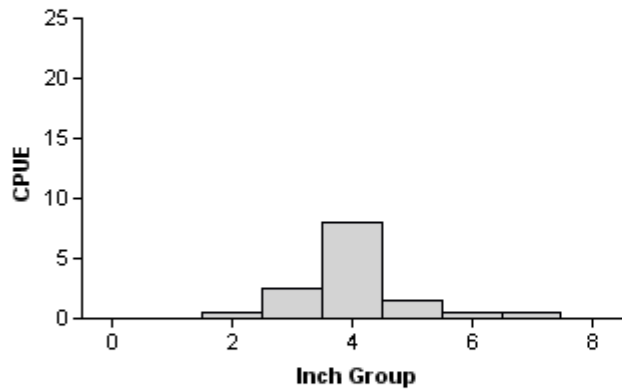
2011

Effort = 2.0
 Total CPUE = 16.0 (25; 32)



2016

Effort = 2.0
 Total CPUE = 13.5 (37; 27)



2018

Effort = 2.0
 Total CPUE = 54.0 (23; 108)

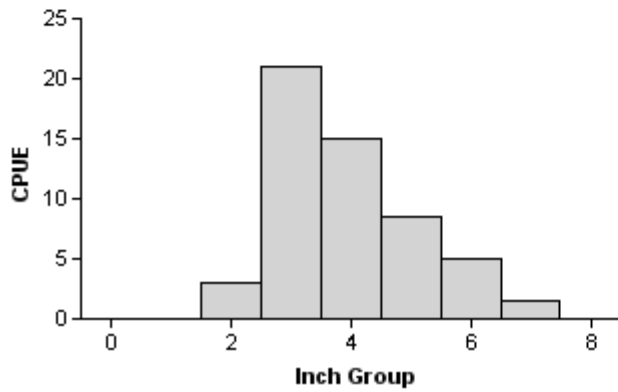


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE are in parentheses) for all fall electrofishing surveys, Amistad Reservoir, Texas, 2011, 2016, and 2018.

Redbreast Sunfish

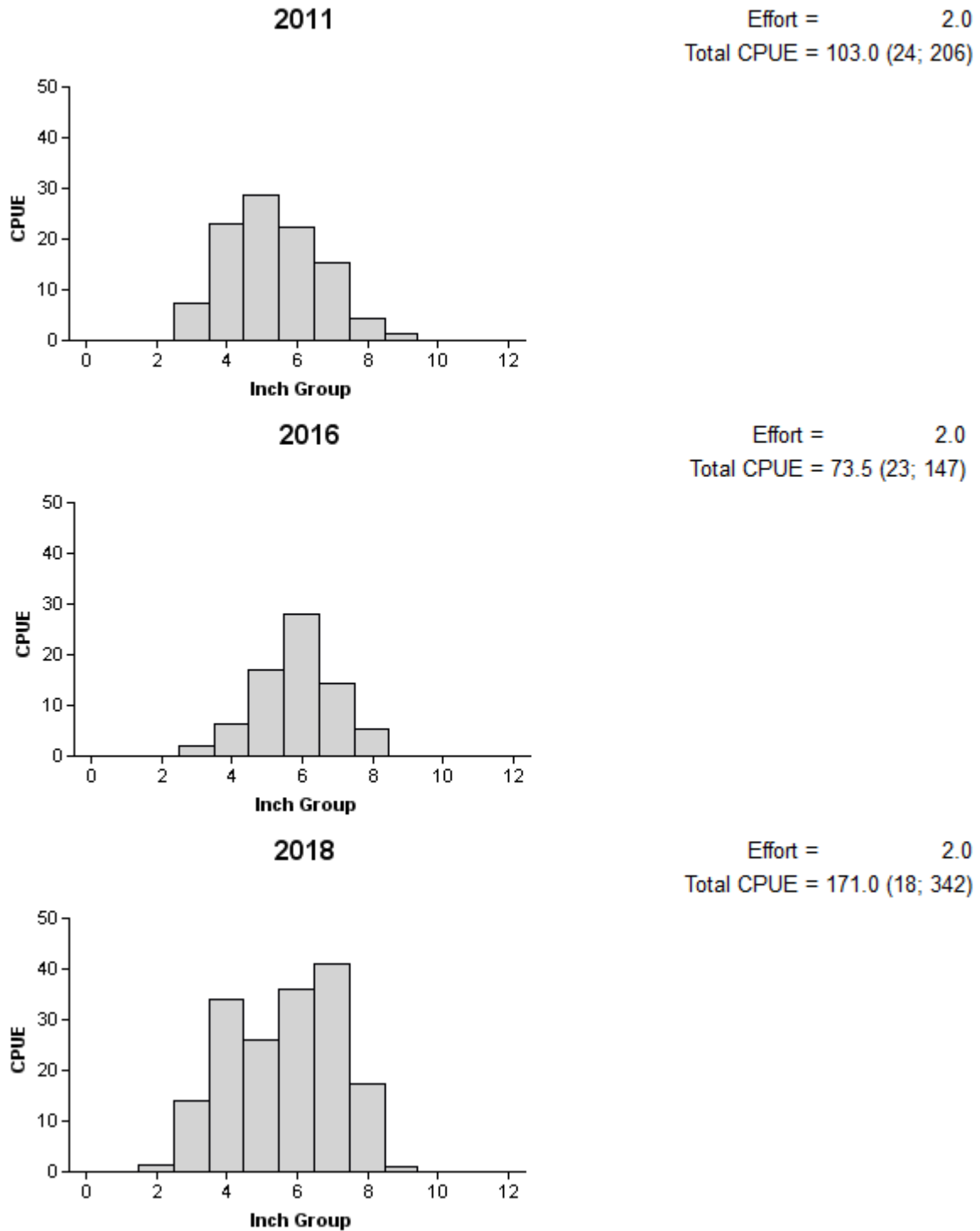


Figure 4. Number of Redbreast Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE are in parentheses) for all fall electrofishing surveys, Amistad Reservoir, Texas, 2011, 2016, and 2018.

Redear Sunfish

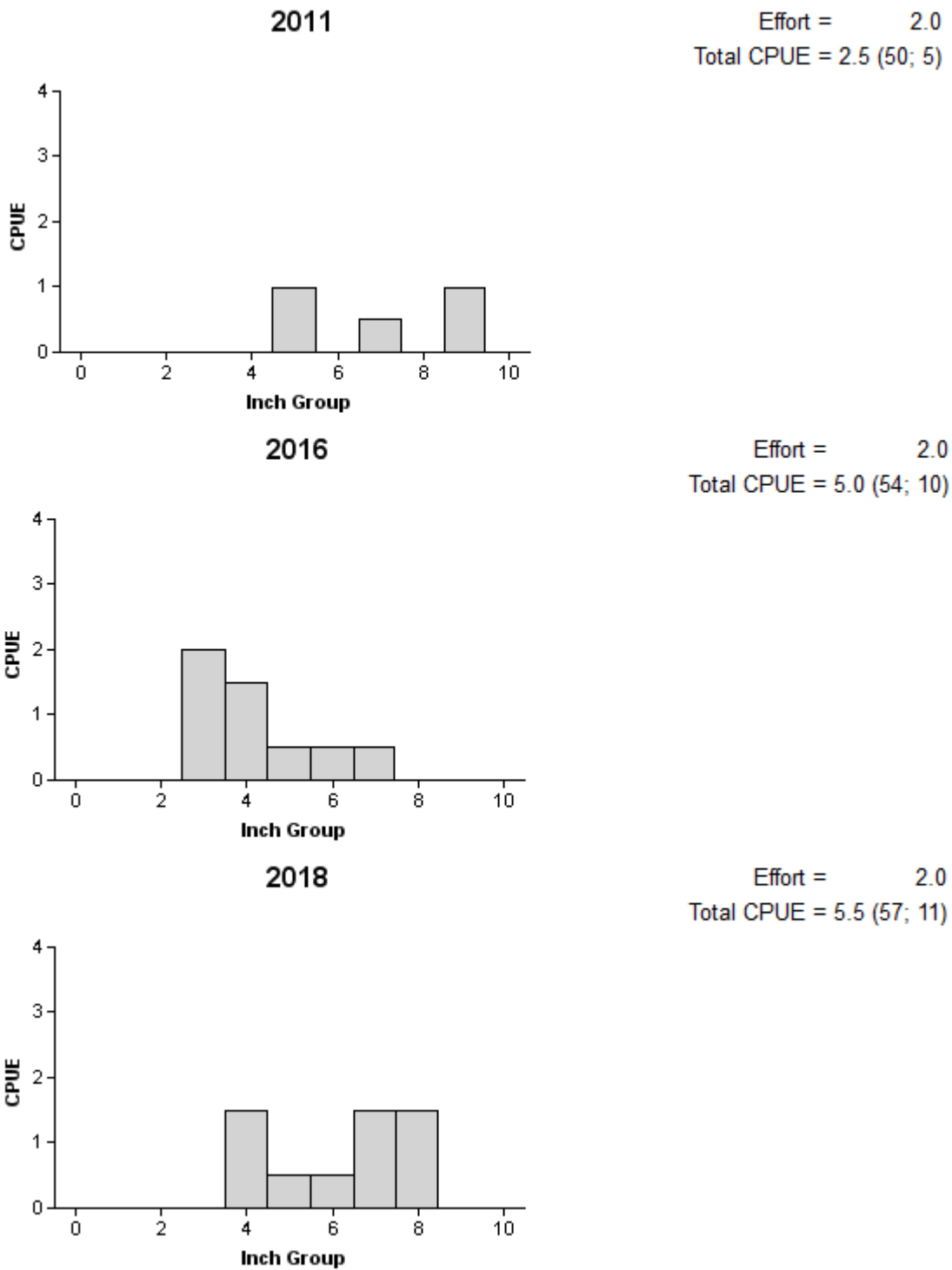


Figure 5. Number of Redear Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE are in parentheses) for all fall electrofishing surveys, Amistad Reservoir, Texas, 2011, 2016, and 2018.

Channel Catfish

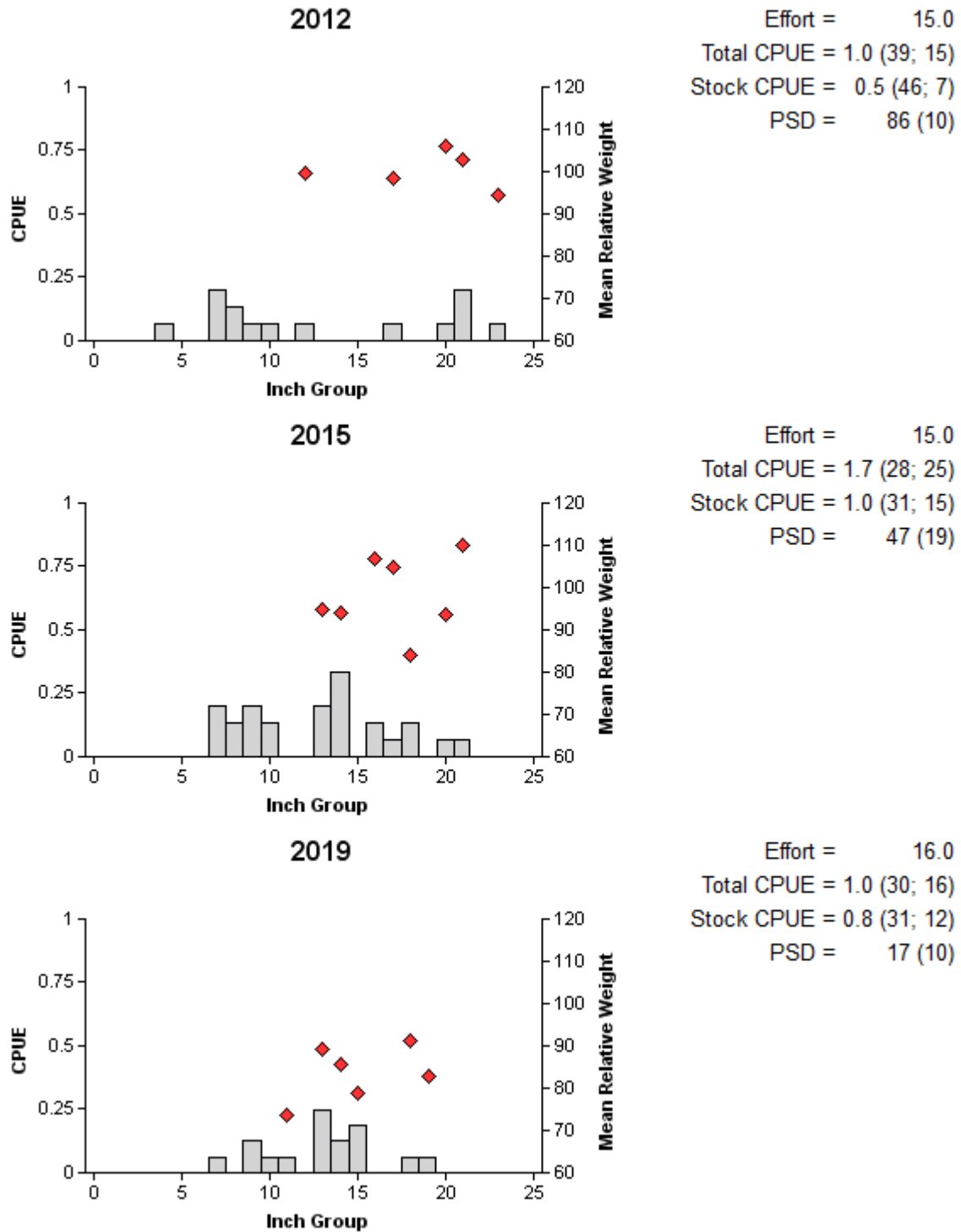


Figure 6. Number of Channel Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Amistad Reservoir, Texas, 2012, 2015, and 2019.

Catfishes

Table 9. Creel survey statistics for catfishes at Amistad Reservoir, Texas, from January to June in 2012, 2015, and 2018. Estimates are for Blue, Channel, and Flathead catfishes combined unless otherwise indicated. Relative standard errors are shown in parentheses.

Creel Survey Statistic	2012	2015	2018
Surface area (acres)	49,724	41,940	44,581
Directed effort total (h)	3,191 (60)	18,512 (38)	13,656 (44)
Directed effort/acre (h/acre)	0.06 (60)	0.44 (38)	0.31 (43)
Average catch/hour	0.73 (73)	0.24 (49)	0.68 (34)
Total harvest (fish)			
Blue Catfish	469 (>100)	101 (>100)	0
Channel Catfish	2,696 (>100)	2,666 (50)	15,907 (62)
Flathead Catfish	0	196 (>100)	188 (>100)
Harvest/acre			
Blue Catfish	0.01 (>100)	<0.01 (>100)	0
Channel Catfish	0.05 (>100)	0.06 (50)	0.36 (62)
Flathead Catfish	0	<0.01 (>100)	<0.01 (>100)
Percent legal release rate (%)	0	9	<1

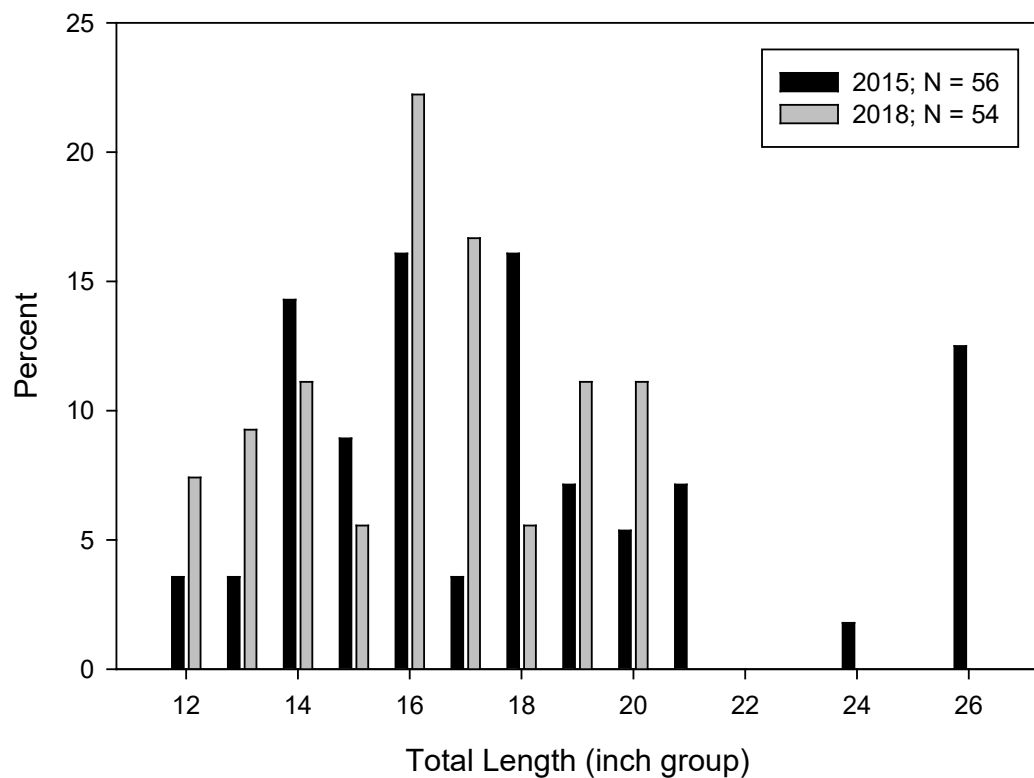


Figure 7. Length Frequency of angler-harvested Channel Catfish observed during creel surveys at Amistad Reservoir, Texas, January to June, 2015 and 2018. N is the number of harvest Channel Catfish observed during creel surveys. Insufficient number of Blue Catfish and Flathead Catfish in all years were observed harvested to plot length frequency.

White Bass

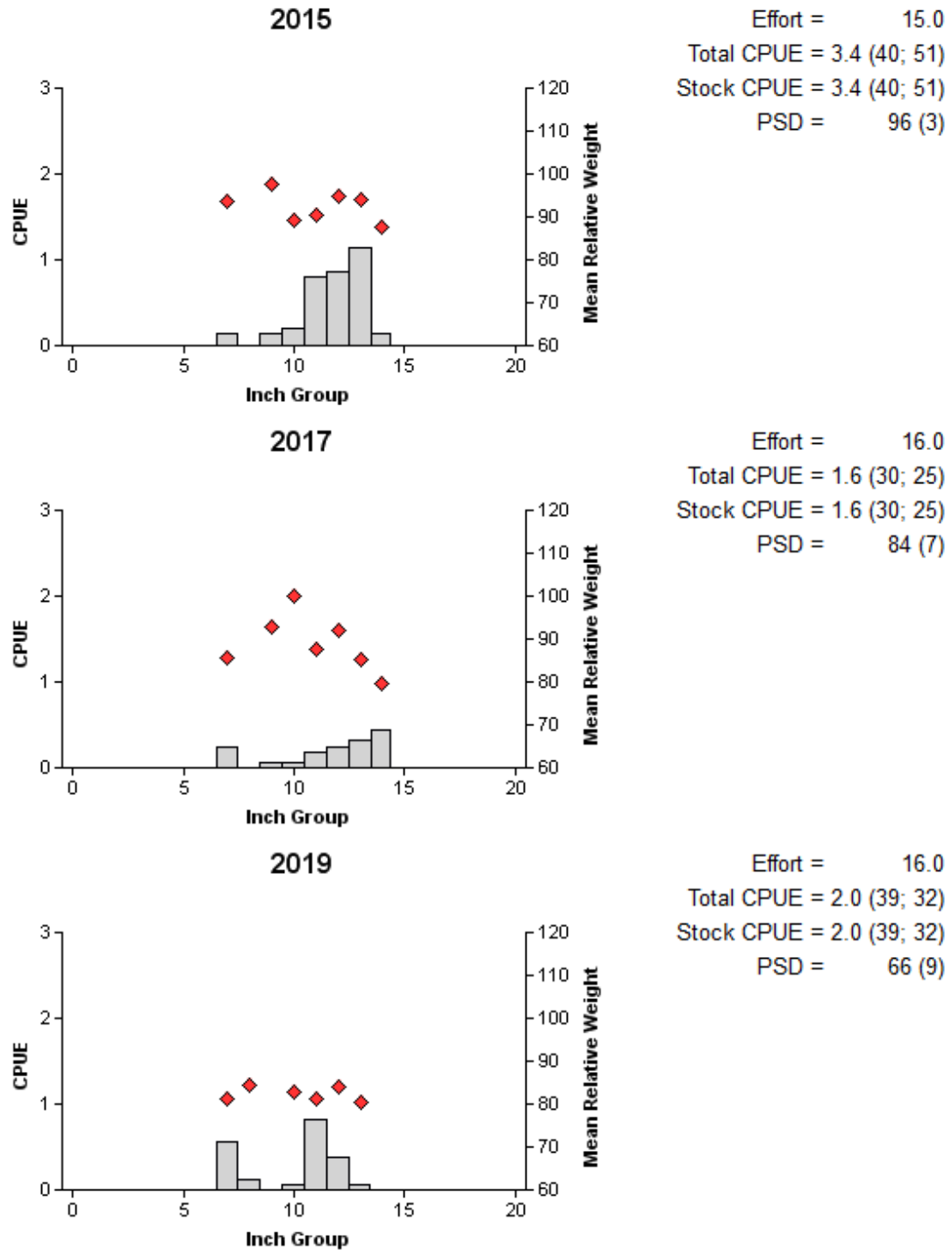


Figure 8. Number of White Bass caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Amistad Reservoir, Texas, 2015, 2017, and 2019.

Table 10. Creel survey statistics for White Bass at Amistad Reservoir, Texas, from January to June in 2012, 2015, and 2018. Relative standard errors are shown in parentheses.

Creel survey statistic	2012	2015	2018
Surface area (acres)	49,724	41,940	44,581
Directed effort total (h)	3,852 (56)	11,504 (48)	3,059 (58)
Directed effort/acre (h/acre)	0.08 (56)	0.27 (48)	0.07 (58)
Average catch per hour	1.10 (67)	0.84 (34)	1.64 (27)
Total harvest	5,544 (98)	6,512 (49)	9,581 (60)
Harvest/acre	0.11 (98)	0.16 (49)	0.21 (60)
Percent legal release rate (%)	14	45	5

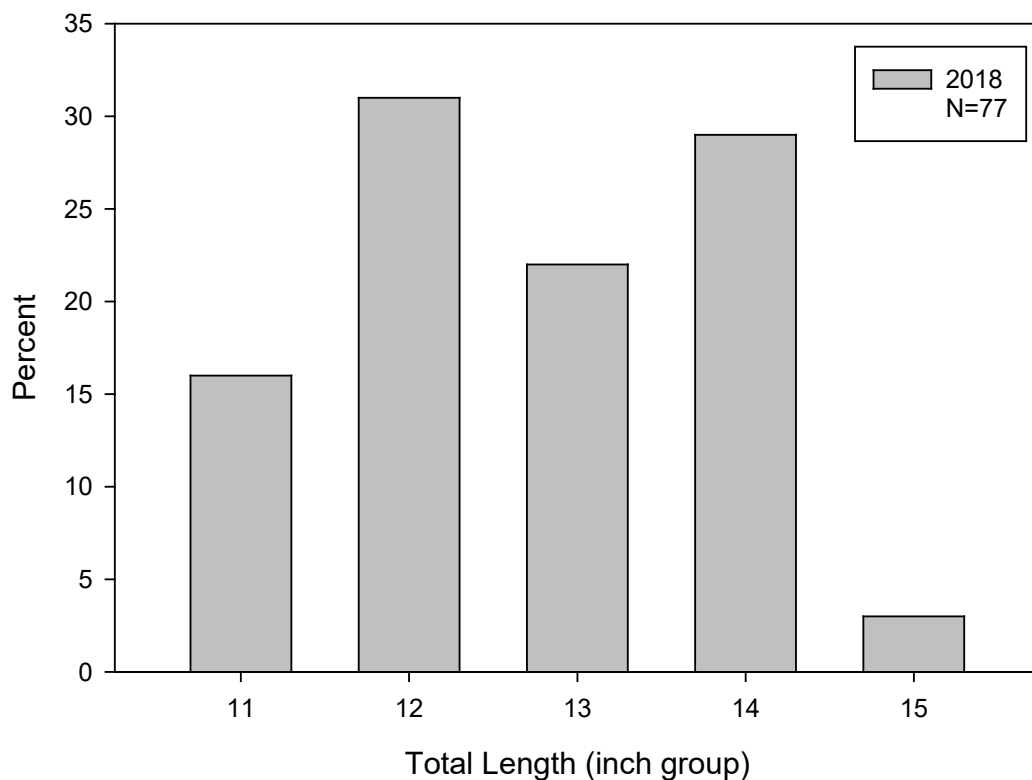


Figure 9. Length frequency of angler-harvested White Bass measured during creel survey sampling at Amistad Reservoir, Texas, January through June 2018.

Striped Bass

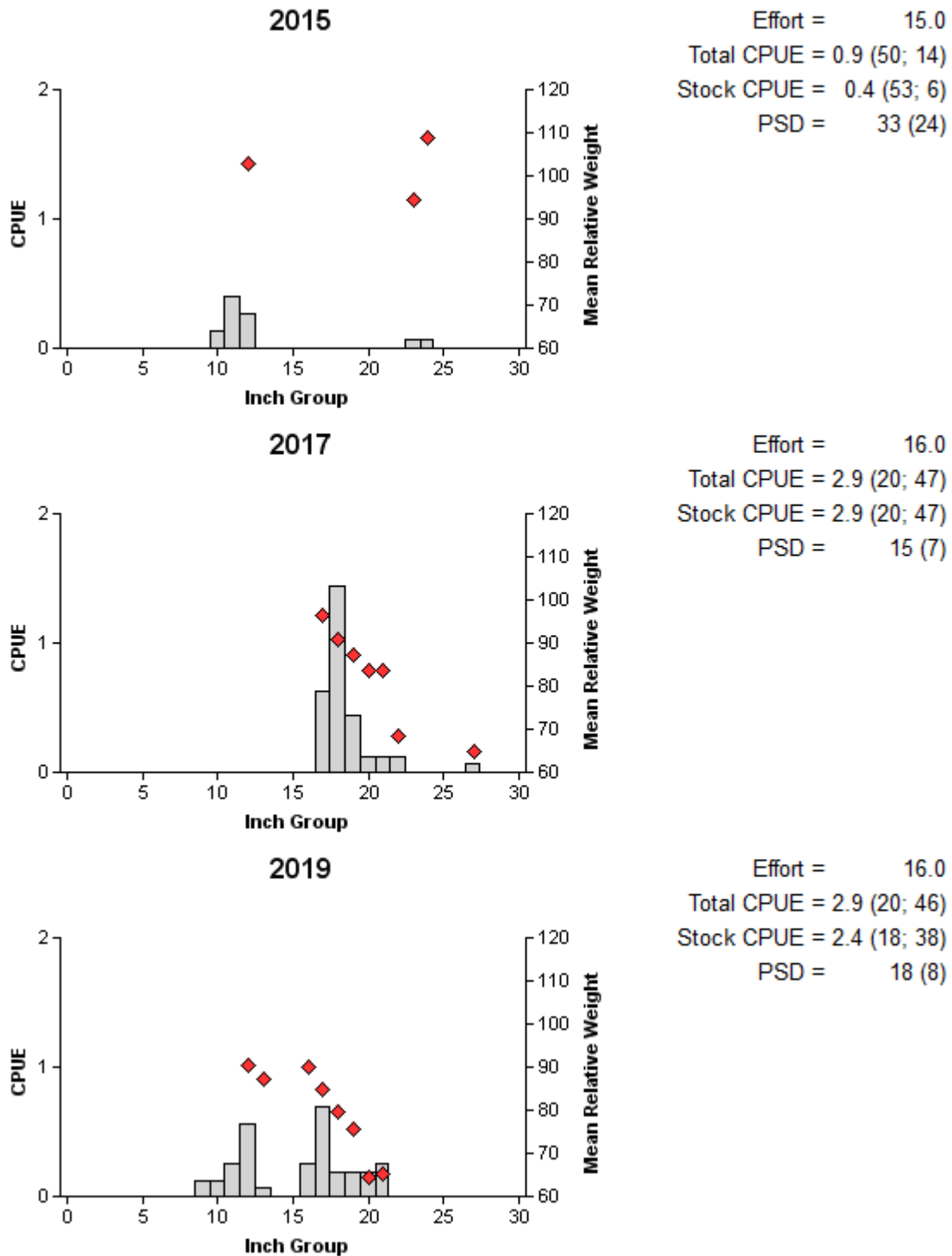


Figure 10. Number of Striped Bass caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Amistad Reservoir, Texas, 2015, 2017, and 2019.

Table 11. Creel survey statistics for Striped Bass at Amistad Reservoir, Texas, from January to June in 2012, 2015, and 2018. Relative standard errors are shown in parentheses.

Creel survey statistic	2012	2015	2018
Surface area (acres)	49,724	41,940	44,581
Directed effort total (h)	480 (>100)	895 (>100)	412 (>100)
Directed effort/acre (h/acre)	0.01 (>100)	0.02 (>100)	0.01 (>100)
Average catch per hour	0.10 ^a	0	0
Total harvest	0	0	1,360 (>100)
Harvest/acre	0	0	0.03
Percent legal release rate (%)	100	100	25

^a RSE not available due to insufficient sample size

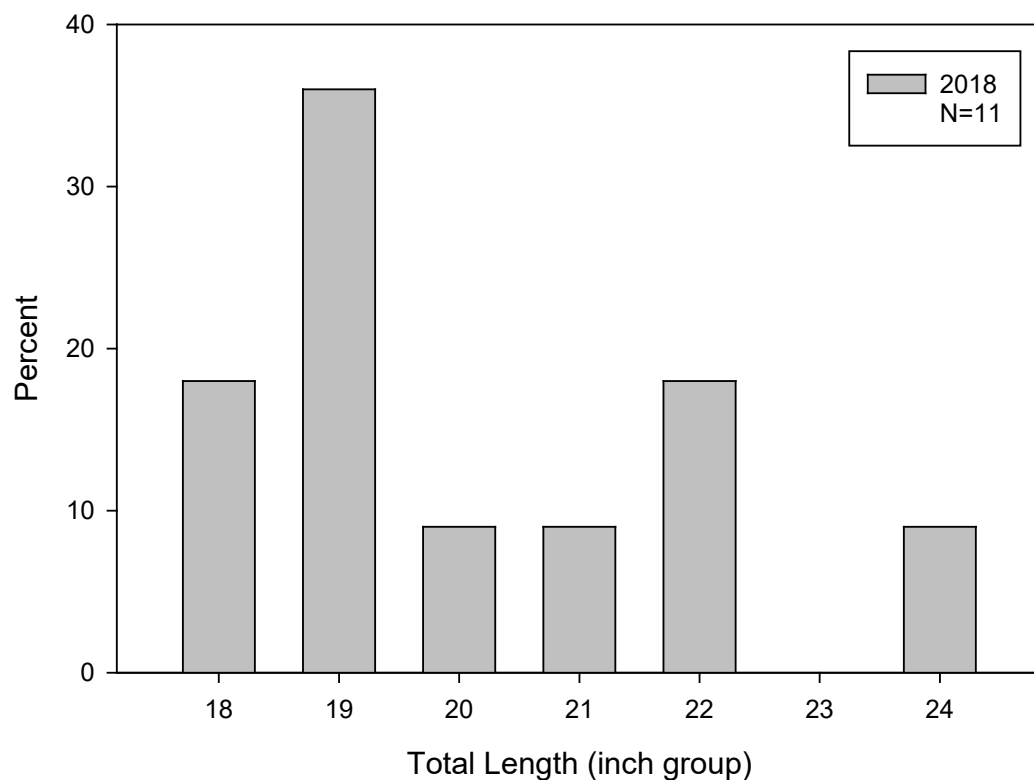


Figure 11. Length frequency of angler-harvested Striped Bass measured during creel survey sampling at Amistad Reservoir, Texas, January 2018 through June 2018.

Largemouth Bass

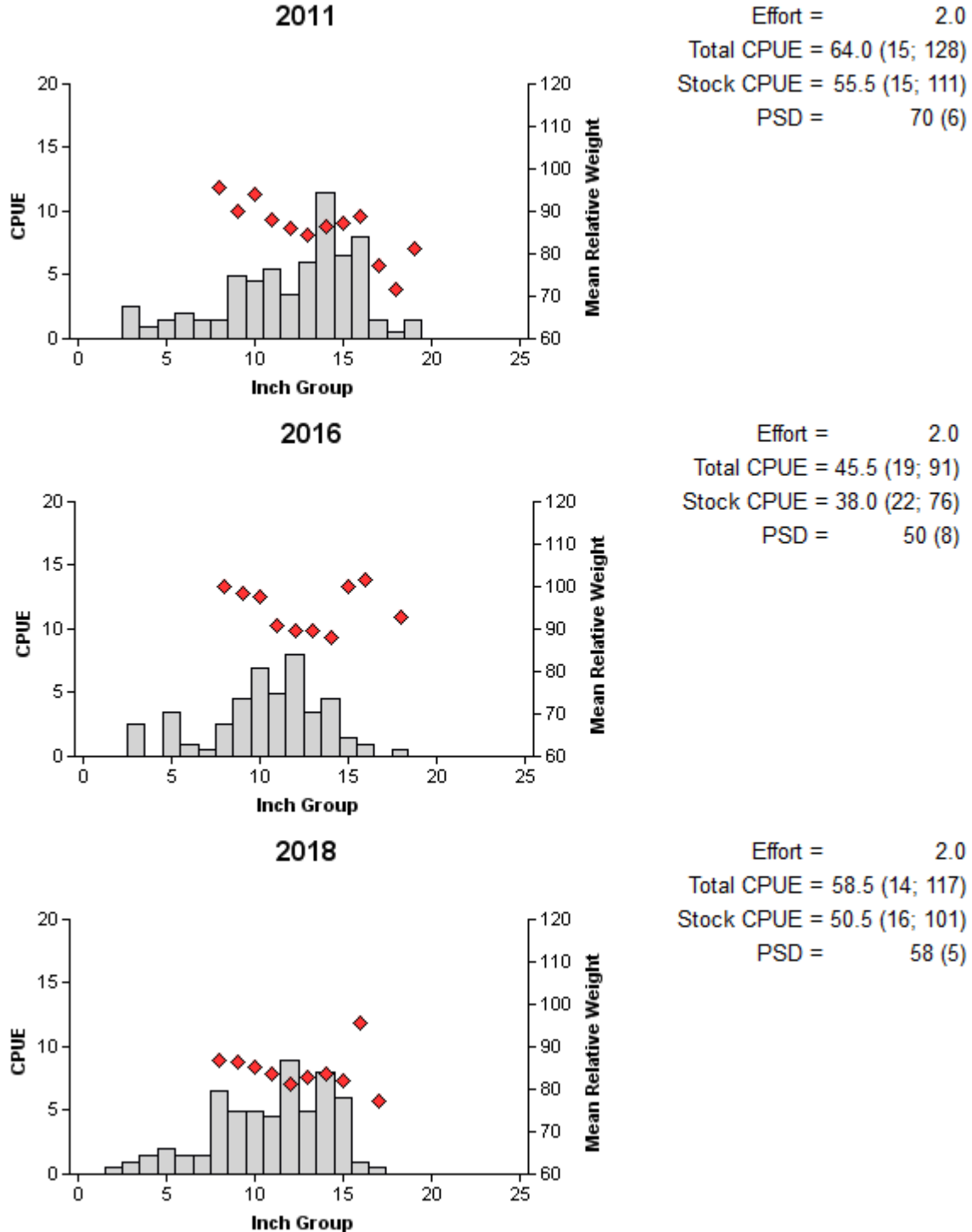


Figure 12. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Amistad Reservoir, Texas, 2011, 2016, and 2018.

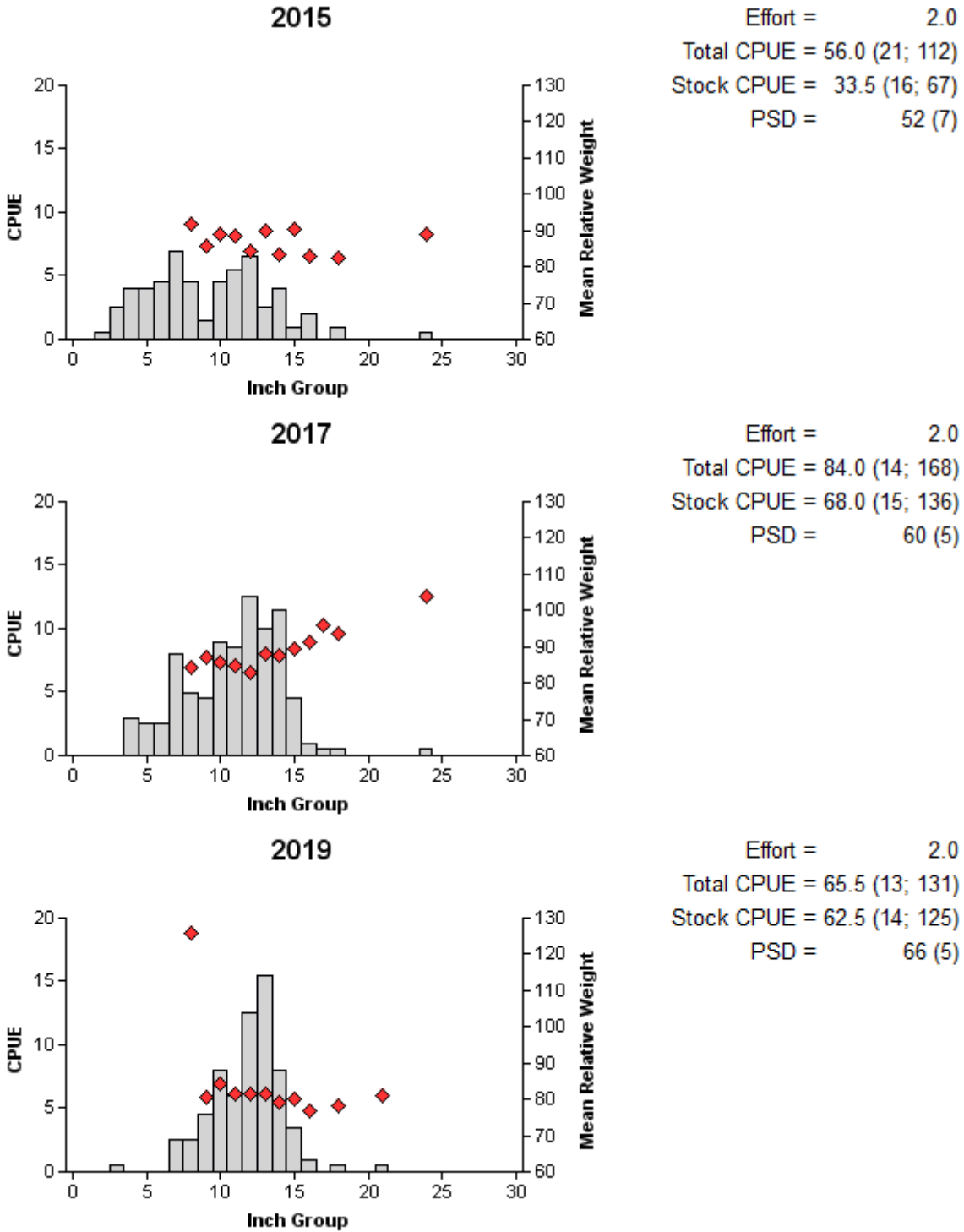


Figure 13. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Amistad Reservoir, Texas, 2015, 2017, and 2019.

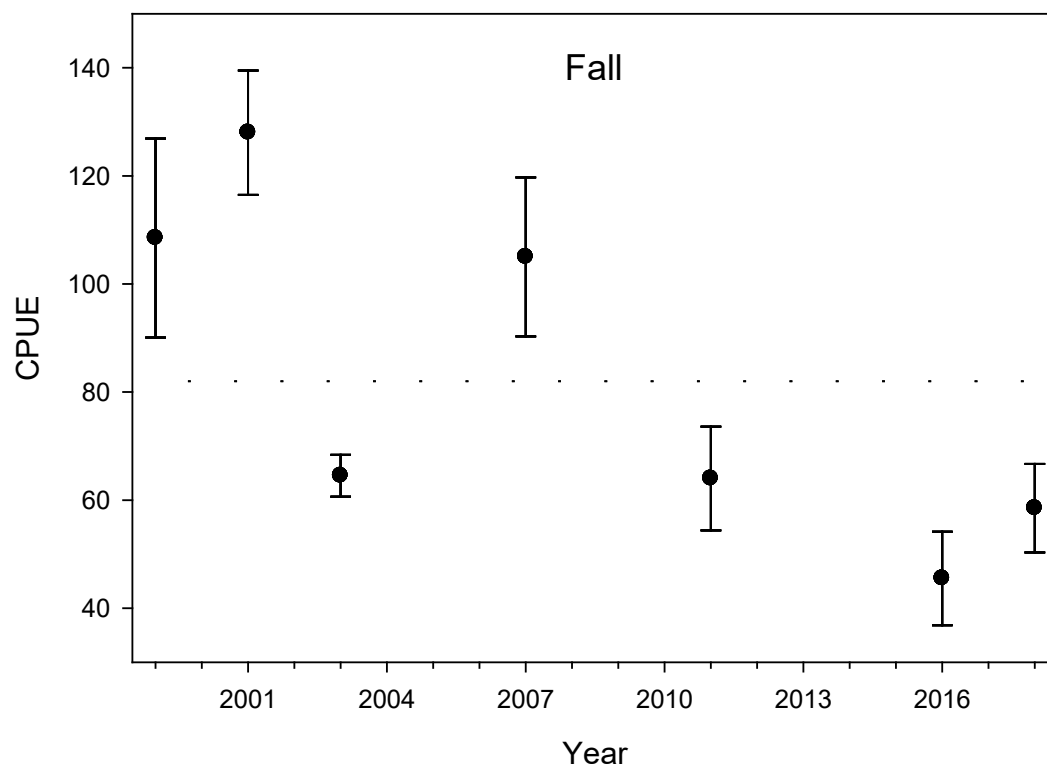


Figure 14. Average number of Largemouth Bass collected per 1 h of electrofishing effort (CPUE) at Amistad Reservoir, Texas, 1999-2018 for fall surveys. Error bars represent ± 1 standard error. Dashed line represents average CPUE. Insufficient number of years to create similar plot for spring surveys.

Table 12. Genetic analysis results for Largemouth Bass collected from Amistad Reservoir, Texas. Fish were collected using electrofishing. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB. Genetic composition was determined with micro-satellite DNA analysis.

Year	Sample size	Number of fish			% FLMB alleles	% FLMB
		FLMB	Intergrade	NLMB		
2006	413	55	357	1	76.0	13.3
2009	30	7	23	0	82.0	23.3
2011	30	2	28	0	73.0	6.6
2016	30	5	25	0	83.0	16.6
2018	30	0	30	0	71.0	0.0

Table 13. Creel survey statistics for Largemouth Bass at Amistad Reservoir, Texas. Surveys were conducted from January to June in 2012, 2015, and 2018. Relative standard errors are shown in parentheses.

Creel survey statistic	2012	2015	2018
Surface area (acres)	49,724	41,940	44,345
Directed angling effort (h)			
Tournament	92,543 (27)	72,234 (29)	26,568 (33)
Non-tournament	188,607 (21)	126,325 (28)	179,536 (33)
Combined	281,150 (22)	198,559 (27)	206,104 (31)
Angling effort/acre	5.6 (22)	4.7 (27)	4.6 (31)
Average catch per hour	0.73 (7)	0.47 (12)	0.91 (11)
Harvest			
Non-tournament anglers	23,342 (30)	1,574 (40)	11,343 (56)
Average harvest/acre	0.47 (30)	0.04 (40)	0.26 (56)
Tournament weigh-in and release	35,954 (60)	3,249 (48)	6,276 (56)
Number released by weight			
Fish <4 lbs.	241,730 (55)	75,386 (45)	159,852 (47)
Fish ≥4 to <7 lbs.	13,404 (57)	1,700 (72)	2,493 (76)
Fish >7 to 10 lbs.	693 (>100)	66 (>100)	75 (>100)
Fish ≥10 lbs.	197 (>100)	0	0
Percent legal release rate (%)			
Non-tournament anglers	82	90	83

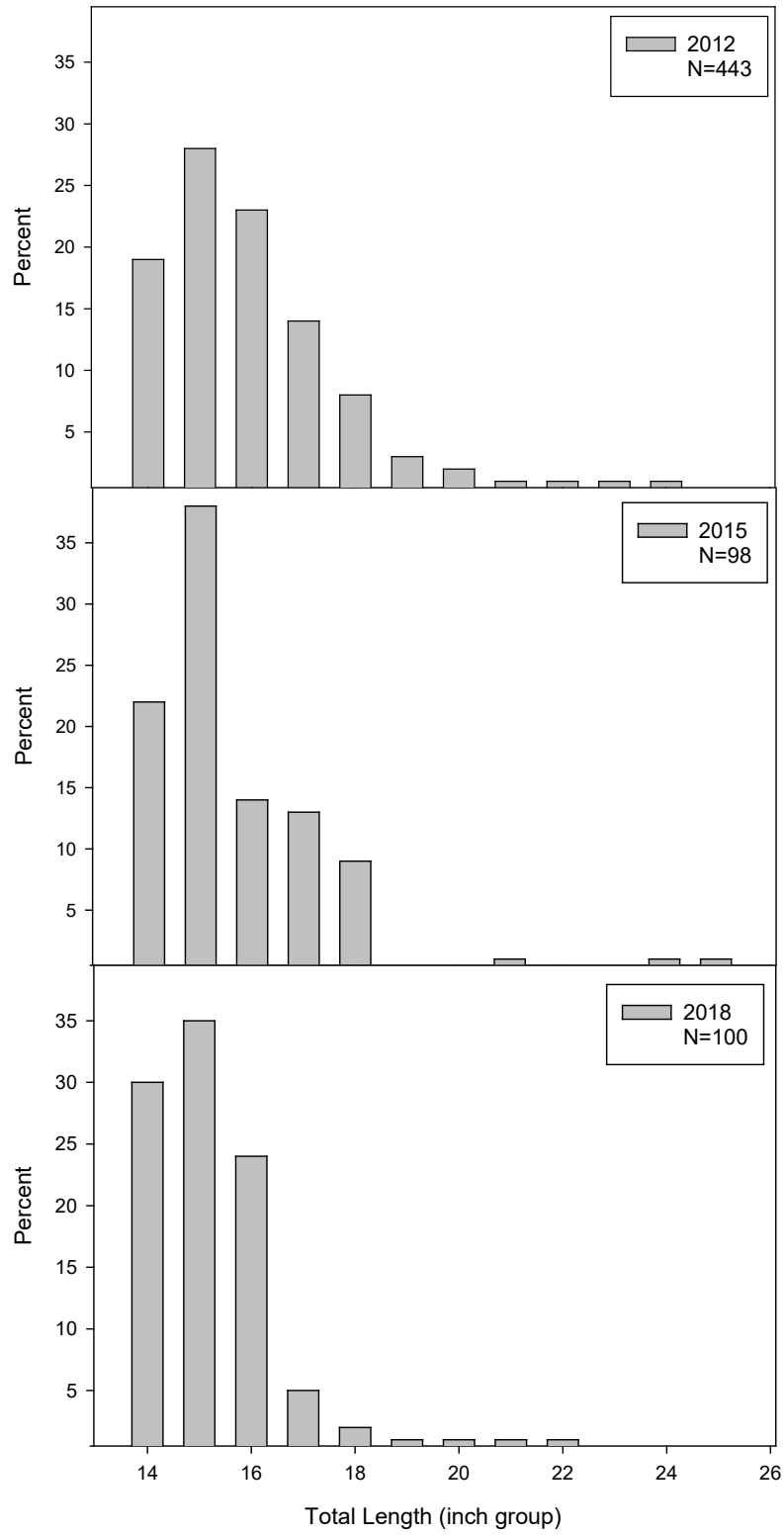
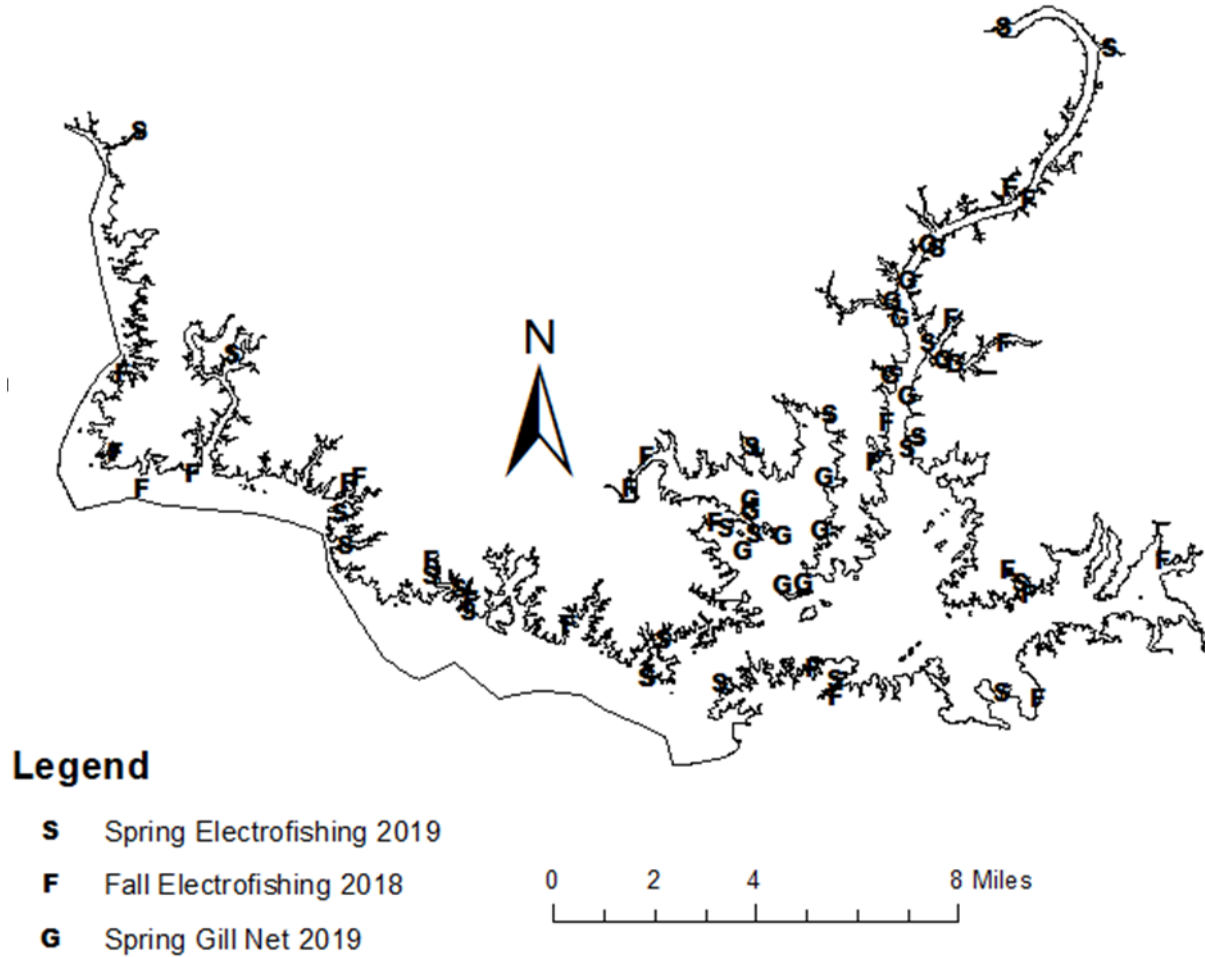


Figure 15. Length frequency of angler-harvested and tournament caught Largemouth Bass measured during creel survey sampling at Amistad Reservoir, Texas, January to June in 2012, 2015, and 2018.

Table 14. Proposed sampling schedule for Amistad Reservoir, Texas. Survey period is June through May. The creel surveys denoted for 2020-2021 will be conducted January-June 2021. Standard survey denoted by S and additional survey denoted by A.

	Survey year			
	2019-2020	2020-2021	2021-2022	2022-2023
Angler Access		A		S
Structural Habitat				
Vegetation		A		S
Electrofishing – Fall		A		S
Electrofishing – Spring		A		S
Electrofishing – Low frequency				
Trap netting				
Gill netting		A		S
Baited tandem hoop netting				
Creel survey		A		
Report		A		S

Appendix A – Map of Sampling Locations



Location of electrofishing and gill net sampling sites, Amistad Reservoir, Texas, 2018 – 2019. Fall and spring electrofishing sampling sites are indicated by “F” and “S” respectively. Water level was 1089.0 feet above mean sea level (MSL) in fall 2018, 1094.0 feet above MSL in spring 2019 for the electrofishing surveys and 1093.2 feet above MSL for the spring gill netting survey.

Appendix B – Catch Rates for All Species and Gear Types

Number (N) and catch rate (CPUE) of all target species collected during electrofishing in fall 2018 and gill netting spring 2019. Sampling effort was two hours of electrofishing and 16 mn of gill netting.

Species	Fall Electrofishing		Spring Gill net	
	N	CPUE	N	CPUE
Gizzard Shad	76	38.0 (28)	157	9.8 (24)
Threadfin Shad	129	64.5 (56)		
Redbreast Sunfish	342	171.0 (18)	2	0.1 (68)
Green Sunfish	7	3.5 (44)		
Warmouth	3	1.5 (55)		
Bluegill	108	54.0 (23)		
Longear Sunfish	1	0.5 (100)		
Redear Sunfish	11	5.5 (57)	1	0.1 (100)
Smallmouth Bass	9	4.5 (35)	1	0.1 (100)
Largemouth Bass	117	58.5 (14)	12	0.8 (29)
Spotted Gar			6	0.4 (100)
Longnose Gar			2	0.1 (68)
Common Carp			10	0.6 (38)
Gray Redhorse			3	0.2 (54)
Blue Catfish			4	0.3 (58)
Channel Catfish			16	1.0 (30)
Flathead Catfish			13	0.8 (41)
White Bass			32	2.0 (39)
Striped Bass			46	2.9 (20)
White Crappie			6	0.4 (41)
Freshwater Drum			14	0.9 (33)



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