PERFORMANCE REPORT

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FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-2

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2016 Fisheries Management Survey Report

Lake Murvaul

Prepared by:

Joseph D. Lechelt, Assistant District Management Supervisor
and
Timothy J. Bister, District Management Supervisor

Inland Fisheries Division
Marshall District
Marshall, Texas

Carter Smith
Executive Director

Craig Bonds
Director, Inland Fisheries

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lake Murvaul were surveyed in 2016 using electrofishing and trap netting and in 2017 using gill netting and tandem hoop netting. Anglers were surveyed from March 2017 through May 2017 with a spring-quarter creel survey. Historical data are presented with the 2016-2017 data for comparison. This report summarizes the results of the surveys and contains a management plan for the reservoir based on those findings.

- **Reservoir Description:** Lake Murvaul is a 3,507-acre impoundment constructed in 1958 on Murvaul Creek in the Sabine River Basin. Structural habitat is mainly inundated timber and natural shoreline features. Native aquatic plant abundance is limited. Invasive plant species have the potential of becoming problematic in Lake Murvaul. During the 2016 vegetation survey, water hyacinth was found on the western side of the FM 1971 bridge and giant salvinia was found in multiple nearshore areas around the lake.

- **Management History:** The trophy Largemouth Bass fishery at Lake Murvaul has been a focus of fisheries management efforts for many years. The fishery is currently managed with a 14- to 21-inch protective slot length limit with a 5-fish daily bag, of which only one fish can be greater than 21 inches. Florida Largemouth Bass were stocked in 2011, 2014, and 2016 to maintain trophy potential. Other important sport fish include Channel Catfish and crappies, which are managed with statewide harvest regulations.

- **Fish Community**
  - **Prey species:** Gizzard Shad and Threadfin Shad were collected in the latest survey. Over 80% of Gizzard Shad were small enough to be available as prey to most sport fish. Bluegill was the most abundant sunfish species in the reservoir.

  - **Channel Catfish:** Gill nets and hoop nets were used to sample Channel Catfish in 2017. The 2017 gill net catch rate was slightly lower than previous surveys. Baited hoop nets collected an adequate population sample. The majority of fish collected were above the minimum legal length (12 inches). A spring-quarter creel survey showed that 16% of the total angling effort was for anglers specifically targeting Channel Catfish.

  - **Largemouth Bass:** The electrofishing catch rate of Largemouth Bass in 2016 was similar to previous surveys, with a high number of fish collected within the 14- to 21-inch slot. Fish body condition was good, indicating adequate prey availability. The growth rate of Largemouth Bass was fast: average age of a 14-inch Largemouth Bass was 2.1 years. A spring-quarter creel showed that 31% of angling hours were specifically targeting Largemouth Bass. Angling catch rate of Largemouth Bass was 1.1 fish/h.

  - **Crappies:** Trap net catch rates for both White Crappie and Black Crappie were low. White Crappie catch rate decreased compared to the 2012 survey, while Black Crappie catch rate increased. Crappies were the most targeted fish during the 2017 spring-quarter creel; 45% of hours fished were specifically for crappies. Angling catch rate was 1.5 fish/h.

Management Strategies: Continue evaluation of the Largemouth Bass slot limit through population and fishery monitoring. Improve crappie fishing opportunities and success by adding artificial habitat structures and writing press releases for local papers. Monitor the spread of invasive plants, provide technical guidance to the controlling authority regarding invasive aquatic vegetation management, and consult with TPWD’s Aquatic Habitat Enhancement team on vegetation control as necessary. Stock Florida Largemouth Bass every other year to maintain the trophy fishery.

INTRODUCTION

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

Reservoir Description

Lake Murvaul is located on Murvaul Creek in the Sabine River Basin. It was constructed by the Panola County Fresh Water Supply District in 1958 for municipal and industrial water supply and public recreation. It has a drainage area of approximately 115 square miles. At conservation pool elevation, the reservoir covers 3,507 acres, shoreline length is 35 miles, and Shoreline Development Index is 6.7 (Table 1). Annual water level fluctuation is generally less than 2 feet; however, drought periods within the last 10 years have reduced the water level to approximately 5 feet below conservation pool elevation (Figure 1). Primary structural shoreline habitat consisted of natural shoreline. Almost 20% of shoreline has been modified with bulkhead. Lake Murvaul received national recognition during the 1960s for its trophy Largemouth Bass fishery. The introduction of Florida Largemouth Bass beginning in 1972 has further enhanced the trophy fishery. From 1987 to 1997, anglers caught six Largemouth Bass larger than 13 pounds that were entered into TPWD's ShareLunker Program. The current waterbody record for Largemouth Bass caught in 1993 is 14.87 lbs.

Angler Access

Lake Murvaul has four public boat ramps but shoreline access for anglers is limited. Additional boat ramp characteristics are in Table 2.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Bister and Wright 2013) included:

1. Conduct annual aquatic vegetation surveys to monitor invasive aquatic plants and provide technical guidance to controlling authority regarding invasive aquatic plant management.
   Action: Invasive vegetation has been monitored annually and herbicide treatments have been conducted periodically to control water hyacinth and giant salvinia.
2. Stock Florida Largemouth Bass every other year at a rate of 50 fish/acre to maintain the trophy aspect of the Largemouth Bass fishery.
   Action: Florida Largemouth Bass were stocked in 2014 at a rate of 50 fish/acre and 2016 at a rate of 1,000 fish/km of shoreline; stocking rates were modified in 2016 as directed by the updated stocking guidelines (TPWD, Inland Fisheries Division, unpublished manual revised 2015).
3. Conduct a roving angler creel survey during the spring-quarter every 8 years beginning 2017 to monitor angler utilization and fishing success for largemouth bass.
   Action: A spring-quarter roving creel survey was conducted from March through May in 2017.
4. Conduct electrofishing surveys in fall every 2 years beginning 2014 to monitor relative abundance, growth, and size structure of Largemouth Bass and prey species populations.
   Action: Electrofishing surveys were conducted in the fall of 2014 and 2016.
5. Solicit input from the controlling authority and Lake Murvaul Marina regarding the potential to implement a trophy Largemouth Bass volunteer angler reporting program at the reservoir to document angler catches of Largemouth Bass > 21 inches.
   Action: A Big Bass volunteer angler survey program was started in July 2017. The goal

of the program is to document catches of Largemouth Bass ≥ 8 pounds.

6. Inform anglers and stakeholders about fisheries management activities, fishing opportunities, and other issues at Lake Murvaul.
   Action: District staff provided fisheries information through written news releases and presented to the local bass club.

Harvest regulation history: Sport fishes in Lake Murvaul are currently managed with statewide regulations with the exception of Largemouth Bass. Largemouth Bass have been managed since 1999 with a 14- to 21-inch slot length limit and 5-fish daily bag of which only one fish can be over 21 inches. The previous regulation was a 14-inch minimum length limit. Current regulations are found in Table 3.

Stocking history: Lake Murvaul was stocked with advanced fingerling Channel Catfish between 1967 and 1979. These stockings were successful in establishing a self-sustaining population. Florida Largemouth Bass were initially stocked in Lake Murvaul in 1972, one of the first reservoirs in the State of Texas to receive such stockings. The complete stocking history is presented in Table 4.

Vegetation/habitat management history: Aquatic vegetation coverage has decreased substantially in Lake Murvaul during recent surveys. Historically, the reservoir had moderate densities of aquatic vegetation, with the maximum occurring in 1997 when hydrilla covered approximately 27% of the reservoir surface area (Ryan and Brice 1998). However, hydrilla coverage has been decreasing in recent years following drought conditions in 2006 and 2011 and less than an acre was found during the 2016 vegetation survey. Water hyacinth was initially discovered in 2000 (Ryan and Brice 2001) and was physically removed. Water hyacinth was discovered again in Lake Murvaul in 2014 and is currently present in the reservoir. Herbicide treatments have been conducted to control the spread of water hyacinth. Giant salvinia has been introduced on multiple occasion since 2009 and is currently found in the reservoir (Bister and Brice 2009). Efforts to control the spread of giant salvinia have included physical removal, preventing spread using booms, and treatment with herbicide.

Water transfer: Lake Murvaul was built for municipal and industrial water supply and public recreation and no interbasin water transfers are known to exist.

METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Lake Murvaul (TPWD Unpublished). Primary components of the OBS plan are listed in Table 5. All survey sites were randomly selected and all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Electrofishing – Largemouth Bass, Sunfishes, Gizzard Shad, and Threadfin Shad were collected by electrofishing (1 hour at 12, 5-min stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing. Ages for Largemouth Bass were determined using otoliths from 15 randomly-selected fish (range 13.0 to 14.6 inches) in 2014 and 19 randomly-selected fish (range 13.0 to 14.9 inches) in 2016.

Trap netting – Crappie were collected using trap nets (5 net nights at 5 stations). CPUE for trap netting was recorded as the number of fish caught per net night (fish/nn).

Gill netting – Channel Catfish and White Bass were collected by gill netting (5 net nights at 5 stations). CPUE for gill netting was recorded as the number of fish caught per net night (fish/nn).

Tandem hoop nets – Channel Catfish were collected using 10 tandem hoop-net series at 10 stations.

Nets were baited with soap and deployed for 2-night soak durations. CPUE for tandem hoop netting was recorded as the number of fish caught per tandem hoop net series (fish/series).

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 – A spring-quarter roving creel survey was conducted in 2017. The creel period was March through May. Angler interviews were conducted on 5 weekend days and 4 weekdays to assess angler use and fish catch/harvest statistics in accordance with the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Habitat – A structural habitat survey was conducted in 2012. No development had occurred at the reservoir, and there was no perceived change in structural habitat. Vegetation surveys were conducted in 2012-2016 to monitor invasive plants including alligator weed, giant salvinia, hydrilla, and water hyacinth. Native aquatic vegetation groups were surveyed and summarized in 2016. Habitat was assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Water level – Source for water level data was the United States Geological Survey (USGS 2017).

RESULTS AND DISCUSSION

Habitat: Bister and Wright (2013) reported littoral zone structural habitat consisted primarily of natural shoreline and standing timber (Table 6). Native vegetation covered roughly 7% of the reservoir's surface area and less than 1% was covered by non-native vegetation, which was similar to the 2012 survey (Table 7). Native floating-leaved vegetation coverage increased from 41 acres in 2012 to 64 acres in 2016 (Table 7). Alligator weed had been found in previous vegetation surveys, but was not found during the 2016 survey (Table 7). Water hyacinth coverage decreased from 1.9 acres in 2014 to less than 1 acre in 2016 (Table 7). Giant salvinia coverage increased slightly from 1.3 acres in 2014 to 1.6 acres in 2016 (Table 7). Hydrilla coverage/presence has been variable from year to year depending of water conditions and covered less than 1 acre in 2016 (Table 7).

Creel: Directed fishing effort by anglers was highest for crappies (45%), followed by anglers fishing for Largemouth Bass and Channel Catfish (Table 8). The percentage of directed fishing effort by anglers for Largemouth Bass increased from 23% in 2009 to 31% in 2017 and decreased for Channel Catfish from 36% in 2009 to 16% in 2017 (Table 8). Total fishing effort for all species (45,812 hours) and direct expenditures ($235,369) were significantly higher in 2017 than previous surveys (Table 9). The majority of anglers (80%) that were interviewed were from ZIP codes within 50 miles of Lake Murvaul (Appendix C).

Prey species: The 2016 electrofishing catch rate of Gizzard Shad (253.0/h) was similar to the 2014 survey (258.0/h) and higher than the 2012 survey (209.0/h) (Figure 2). The index of vulnerability (IOV) indicated that 85% of Gizzard Shad were available to existing predators (Figure 2). Bluegill was the most abundant prey species collected during the survey (CPUE = 956.0/h) (Figure 3). Threadfin Shad, Redbreast Sunfish, and Redear Sunfish serve as additional prey species. The CPUE for Threadfin Shad, Redbreast Sunfish, and Redear Sunfish was 121.0/h, 44.0/h, and 48.0/h, respectively (Figure 4, Figure 5; Appendix A). The presence of sunfish greater than 6 inches provided additional angling opportunities in this reservoir (Figure 4, Figure 5).

Channel Catfish: The gill net catch rate of Channel Catfish was 14.0/nn in 2017, which was lower than the 2013 survey (19.0/nn) and 2009 survey (24.0/nn) (Figure 6). The CPUE of fish greater than 12 inches also decreased from 17.8/nn in 2009 to 11.8/nn in 2017 (Figure 6). Body condition was adequate (relative weight ≥ 90 for most inch classes) and similar to previous surveys (Figure 6). Tandem hoop nets were also used to sample Channel Catfish in 2017 to compare the effectiveness of each gear and determine which gear should be used for future sampling. Tandem hoop nets caught more Channel Catfish than gill nets, but the size range of fish collected was similar. The tandem hoop net total CPUE and CPUE of fish greater than 12 inches were 16.4/series and 12.4/series (Figure 7). Total directed effort for Channel Catfish was 7,478 hours in spring 2017, which was lower than 2009 (11,544 hours) and similar to 2007 (7,830 hours) (Table 10). Angler catch per hour was 1.3 fish/h and an estimated 9,205 Channel Catfish were harvested from March to May 2017 (Figure 8; Table 10).

Largemouth Bass: The electrofishing catch rate of Largemouth Bass has increased in recent years. Total CPUE was 163.0/h in 2016, 157.0/h in 2014, and 123.0/h in 2012 (Figure 9). The CPUE of fish above 14 inches has also increased from 25.0/h in 2012 to 51.0/h in 2016 (Figure 9). Body condition in 2016 was good (relative weight ≥ 95) for nearly all size classes of fish (Figure 9). Growth rate has decreased in recent surveys, but remain well within an acceptable range; in 2016 average age at 14 inches (13.0 to 14.9 inches) was 2.1 years (N = 15; range = 1 – 4 years), in 2014 average age at 14 inches was 1.9 years (N =19; range = 1 – 2 years), and in 2012 average age at 14 inches was 1.7 years (N = 11; range = 1 – 3 years; Bister and Wright 2013). Total directed fishing effort was double the previous survey with 14,192 hours (Table 11). Of the Largemouth Bass released by anglers, an estimated 15% were over 4 pounds (Table 11). Nearly all (99.6%) Largemouth Bass were released by anglers (Table 11). Genetic analysis to determine the influence of Florida Largemouth Bass was not conducted in 2016. Previous genetic analyses (2006, 2010, 2012) can be found on Table 12.

Crappies: The 2016 trap net catch rates of both White Crappie and Black Crappie were low. White Crappie trap net catch rate was 0.6/nn in 2016, 10.4/nn in 2012, and 5.4/nn in 2008 (Figure 11). Interpretation and comparison of size structure and relative weight data to previous surveys could not be made due to the low sample size (N = 3) (Figure 11). Black Crappie trap net catch rate was 4.8/nn in 2016, which was higher than 2012 (1.2/nn) and lower than 2008 (9.2/nn) (Figure 12). Due to low catch rate we were unable to collect enough fish to calculate growth rates. Total directed effort by anglers was 20,439 hours and nearly double previous surveys (Table 13). The total estimated harvest from March to May 2017 was 16,268 crappie, which was higher than previous estimates of 5,760 in 2009 and 9,664 in 2007 (Figure 13; Table 13).

Fisheries management plan for Lake Murvaul, Texas

Prepared – July 2017.

ISSUE 1: Invasive aquatic plants, specifically water hyacinth and giant salvinia, have been introduced on multiple occasions and are currently present in Lake Murvaul. The water hyacinth infestation is located on the western side of the FM 1971 bridge. The giant salvinia infestation is more widespread and can be found in multiple coves around the lake. These invasive plants have a propensity to spread rapidly if left unchecked, which could decrease water quality and restrict boater and angler access. The 2016 vegetation survey suggests that the infestation covers a relatively small portion of the lake (giant salvinia = 1.6 acres, water hyacinth = 0.02 acres; Table 7), but should be monitored regularly and treated with herbicide when necessary to prevent future spread. Other invasive plants, such as alligator weed and hydrilla, should also be monitored as they have the potential to become problematic in the future.

MANAGEMENT STRATEGY

1. Provide technical guidance to the controlling authority regarding water hyacinth and giant salvinia management.
2. Conduct annual surveys to monitor trends and estimate coverage of water hyacinth, giant salvinia, and other invasive plants.
3. Coordinate with TPWD's Aquatic Habitat Enhancement team to treat nuisance aquatic vegetation with herbicide when necessary

ISSUE 2: Lake Murvaul has a high-quality Largemouth Bass fishery as a result of the 14- to 21-inch slot-length limit. Continued evaluation of the slot limit is necessary to monitor for large-scale changes in the Largemouth Bass population and fishery under the current regulation. Stocking of Florida Largemouth Bass is necessary to maintain or enhance the big-fish potential.

MANAGEMENT STRATEGY

1. Conduct a creel survey every 8 years, next survey will be conducted in 2024-2025, to monitor angling effort and catch rates for Largemouth Bass.
2. Conduct electrofishing surveys in fall every 2 years to monitor relative abundance, growth, and size structure of Largemouth Bass and prey species. The next survey will be in 2018.
3. Request stocking of Florida Largemouth Bass (1,000 fish/km of shoreline) every other year, to maintain the trophy aspect of the fishery.
4. Continue the Big Largemouth Bass Survey in Lake Murvaul that started in the summer of 2017. This is a volunteer angler reporting program to document angler catches of Largemouth Bass ≥ 8 pounds. As part of this program, if the angler chooses to provide their email, a monthly summary of all Big Bass caught in Lake Murvaul will be sent to each angler. Additionally, we will submit articles that summarize the Big Bass catches to the local paper to further highlight the program.

ISSUE 3: Lake Murvaul supports a popular crappie fishery. A habitat enhancement project using artificial fish attractors would bring further attention to this fishery and provide anglers additional opportunities to access the resource.

MANAGEMENT STRATEGY

1. Coordinate with the controlling authority to place artificial fish attractors in Lake Murvaul to

increase angler success.

2. Submit an article to the local paper at the beginning and end of the project to increase interest in the project and inform anglers.

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 (2017-2021)

Sport fish, forage fish, and other important fishes

Sport fishes in Lake Murvaul include Largemouth Bass, Channel Catfish, White Crappie, and Black Crappie. Known important forage fishes include Gizzard Shad, Threadfin Shad, and Bluegill. The proposed sampling schedule can be found on Table 14.

Low-Density Fisheries
No low-density fisheries exist in Lake Murvaul.

Survey objectives, fisheries metrics, and sampling objectives

Largemouth Bass: Largemouth Bass are a popular sport fish in Lake Murvaul. The most recent spring-quarter creel survey indicated Largemouth Bass angling comprised 31% of total angling effort. Largemouth Bass have been managed with a 14-21 inch slot regulation since 1999. Trend data on CPUE, size structure, and body condition have been collected biennially since 2004 with fall nighttime electrofishing. Continuation of biennial trend data in this reservoir with night electrofishing in the fall will allow for determination of any large-scale changes in the Largemouth Bass population under the slot-limit regulation that may spur further investigation. A minimum of 12 randomly selected 5-min electrofishing sites will be sampled in fall 2018 and 2020, but sampling will continue at random sites until 50 stock-size fish are collected and the RSE of CPUE-S is ≤ 25. Past sampling efforts have shown 12-random stations are usually sufficient to reach this level of precision; however, an additional 3 random stations will be determined in the event extra sampling is required. A maximum of 15 stations will be sampled. Sampling objectives for Largemouth Bass will include size structure (PSD and length frequency), growth (mean age at 14 inches using a sample size of 13 fish between 13.0 and 14.9 inches), relative abundance (CPUE-total and CPUE-stock), and condition (mean W_r using lengths and weights from 10 fish per inch group). A volunteer angler survey, which started in July 2017, will be used to collect supplemental information on bass ≥ 8 pounds.

Crappies: Crappies continue to be the most sought after species during the spring at Lake Murvaul, 45% of anglers were specifically targeting crappies during the creel. However, the catch of White Crappie and Black Crappie in fall trap netting surveys have been variable. Only one survey (2012) of the previous three has been sufficient in capturing enough White Crappie to meet our sampling goal of ≥ 50 stock-size fish and RSE of CPUE-S ≤ 25; the Black Crappie sampling goal has not been met in the previous three surveys. Therefore, our sampling objectives will be now be based on the combined catch of both crappie species (White Crappies and Black Crappies). A minimum of five single-cod trap nets set for one night at random locations will be used to collect crappies during fall 2020. If additional sampling is required to meet our objective, an additional five nets will be set for one night at random locations. A maximum of 10 net nights will be sampled. Our sampling goal is to collect ≥ 50 stock-size fish and achieve an RSE of CPUE-S ≤ 25. Data collected will include size structure (PSD and length frequency), growth (mean age at 10 inches using a sample size of 13 fish between 9.0 and 10.9 inches), relative abundance (CPUE-total and CPUE-stock), and condition (mean W_r using lengths and weights from 10 fish per inch group).

Channel Catfish: Trend data on relative abundance and size structure of Channel Catfish have been collected every 4 years using spring gill netting surveys in Lake Murvaul. In the spring of 2017, both gill nets and tandem hoop nets were used to sample Channel Catfish to compare the effectiveness of each gear and determine which gear should be used for future sampling. The sampling objective for each gear type was 100 stock-size fish for PSD and a RSE for CPUE-S ≤ 25. Five gill nets were set in random locations and a total of 61 stock-size fish were collected with a CPUE-S RSE of 3 (Figure 6). This achieved our goal of RSE for CPUE-S ≤ 25, but we were unable to capture the targeted 100 stock-size fish. In comparison, ten tandem hoop nets were set in random locations, which yielded 164 stock-size fish, but a CPUE-S RSE of 40 (Figure 7). The goal of RSE for CPUE-S ≤ 25 was not met for the tandem hoop nets, but it was sufficient at capturing enough stock-size fish. Given that both gears achieved only one of the sampling objectives, we will again sample Channel Catfish with both gears again in 2021. This will allow us to further investigate the recent downward trend in Channel Catfish gill net CPUE to determine if there are any large-scale changes to the population, add additional baseline data for tandem hoop net catch rates, and continue to evaluate the effectiveness of each gear.

Channel Catfish will be sampled using baited tandem hoop nets and gill nets in the spring of 2021. The estimated number of hoop net sets to achieve an RSE for CPUE-S ≤ 25 is 10 sets using the recommended 2-night soak duration. A target of 100 stock sized fish should provide an adequate PSD estimate per the tandem hoop net procedures (PSD within 10% with 80% confidence, 75-140 fish are recommended; Miranda 2007). Ten additional random stations will be selected in the event extra sampling is necessary. A maximum of 20 tandem hoop net sets will be sampled. The estimated number of gill nets to collect 100 stock length fish and achieve an RSE for CPUE-S ≤ 25 is five that will be soaked overnight. Five additional gill nets will be set if necessary. A maximum of 10 gill nets will be set. Sampling objectives for Channel Catfish for both gears will include size structure (PSD and length frequency), relative abundance (CPUE-total and CPUE-stock), and condition (mean W_r using lengths and weights from 10 fish per inch group).

Prey Species: Gizzard Shad, Threadfin Shad, and Bluegill are the important forage species at Lake Murvaul. Like Largemouth Bass, trend data on CPUE and size structure of these prey species has been collected biennially since 2004. Continuation of electrofishing sampling in 2018 and 2020, as per Largemouth Bass above, will allow for monitoring of large-scale changes in prey species relative abundance and size structure. Sampling effort based on achieving sampling objectives for Largemouth Bass has been sufficient in collecting the desired numbers of Bluegill for size structure estimation (PSD; 50 fish at a minimum of 12 stations with 80% confidence) and Gizzard Shad size structure (IOV; 50 fish)**.** Data from 2006-2016 has shown RSE ≤ 25 for CPUE-Total for Gizzard Shad and Bluegill using the traditional 12 randomly-selected stations. No additional effort will be expended to achieve an RSE ≤ 25 for CPUE of Gizzard Shad and Bluegill if not reached from designated Largemouth Bass sampling effort. Instead, Largemouth Bass body condition can provide information on forage abundance, vulnerability, or both relative to predator density. Relative weight of Largemouth Bass ≥ 8 inches total length will be determined from their length/weight data (maximum of 10 fish weighed and measured per inch class). Sampling effort based on sampling objectives for Largemouth Bass will also be sufficient to determine presence or absence of Threadfin Shad.

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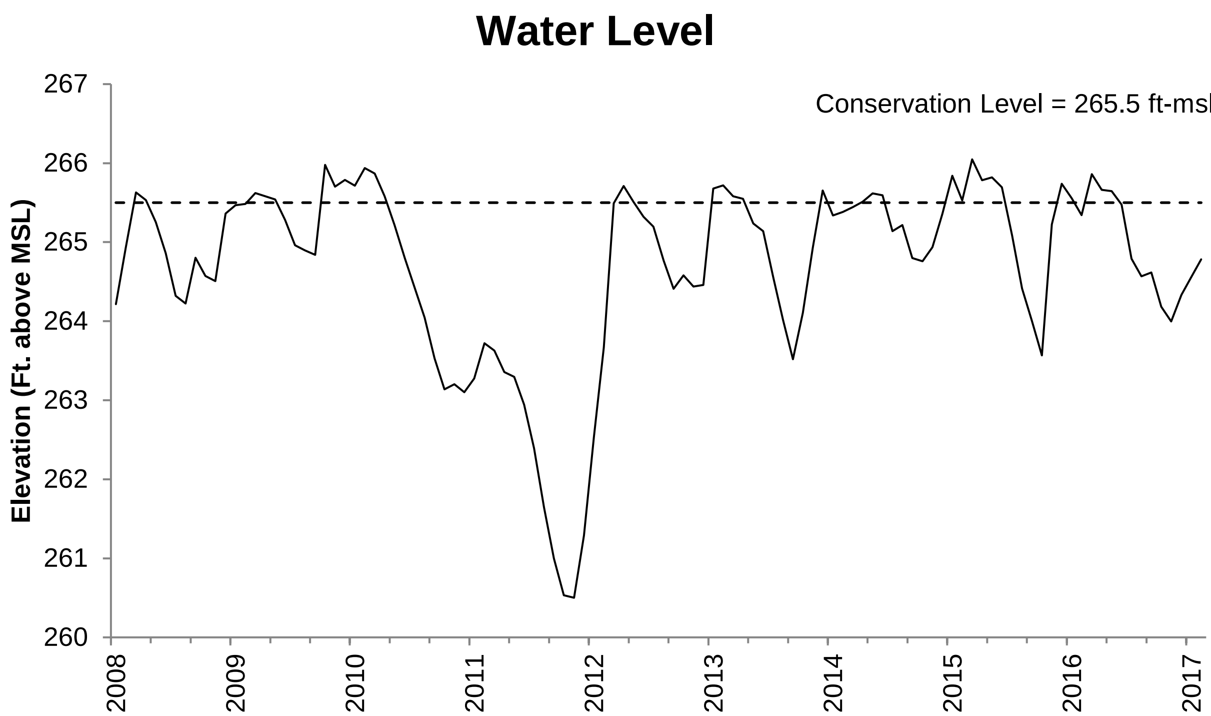


Figure 1. Monthly water level elevations in feet above mean sea level (MSL) recorded for Lake Murvaul, Texas. Horizontal dashed line denotes the conservation pool level (265.5 ft-msl).

Table 1. Characteristics of Lake Murvaul, Texas.

Characteristic	Description
Year constructed	1958
Controlling authority	Panola County Fresh Water District
County	Panola
Reservoir type	Tributary
Shoreline Development Index (SDI)	6.7
Conductivity	116 umhos/cm

Table 2. Boat ramp characteristics for Lake Murvaul, Texas.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Condition
Decker-Hill Park	32.04120 -94.42994	Y	30	Excellent, no access issues
FM 1971 Bridge (Dodson Landing)	32.03379 -94.48235	Y	10	Good, potholes near ramp pose potential hazard
Rosie Jones Park	32.04475 -94.47401	Y	10	Adequate, rough roads leading to boat ramp
Tinkle Park	32.02006 -94.43595	Y	10	Adequate, ramp is in good condition, but rough roads leading to boat ramp

Table 3. Harvest regulations for Lake Murvaul, Texas.

Species	Bag Limit	Length limit
Catfish, Channel	25	12-inch minimum
Catfish, Flathead	5	18-inch minimum
Bass, Largemouth	5 (only 1 > 21 inches)	14- to 21-inch slot
Crappie, White and Black Crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

Table 4. Stocking history Lake Murvaul, Texas. FGL = fingerling; AFGL = advanced fingerling; ADL = adults.

Species	Year	Number	Life Stage
Channel Catfish	1967	3,000	AFGL
	1968	6,000	AFGL
	1969	5,000	AFGL
	1973	3,000	AFGL
	1979	181,084	AFGL
	Total	198,084	
Florida Largemouth Bass	1972	200	AFGL
	1980	380	ADL
	1989	6	ADL
	1997	95,235	FGL
	1998	95,000	FGL
	1999	102,680	FGL
	2008	171,250	FGL
	2009	177,523	FGL
	2011	172,038	FGL
	2014	173,655	FGL
	2016	44,283	FGL
	Total	1,032,250	
Largemouth Bass	1972	10,000	UNK
	Total	10,000	

Table 5. Objective-based sampling plan components for Lake Murvaul, Texas 2016-2017.

Gear/target species	Survey objective	Metrics	Sampling objective
Electrofishing			
Largemouth Bass	Abundance	CPUE – stock	RSE-stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Age-and-growth	Age at 14 inches	N = 13, 13.0 – 14.9 inches
	Condition	W_r	10 fish/inch group (max)
Bluegill [a]	Abundance	CPUE – Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
Gizzard Shad [a]	Abundance	CPUE – Total	RSE ≤ 25
	Size structure	length frequency	N ≥ 50
	Prey availability	IOV	N ≥ 50
Threadfin Shad [a]			Presence/absence
Trap netting			
Crappie [b]	Abundance	CPUE - stock	RSE-stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
	Age-and-growth	Age at 10 inches	N = 13, 9.0 – 10.9 inches
	Condition	W_r	10 fish/inch group
Gill netting			
Channel Catfish	Abundance	CPUE - stock	RSE-stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 100 stock
Tandem hoop netting			
Channel Catfish	Abundance	CPUE– stock	RSE-stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 100 stock

[a] No additional effort will be expended to achieve an RSE ≤ 25 for CPUE of Bluegill and Gizzard Shad if not reached from designated Largemouth Bass sampling effort. Instead, Largemouth Bass body condition can provide information on forage abundance, vulnerability, or both relative to predator density.
[b] Sampling objectives are based off the catch of White Crappie. Due to past variability in CPUE, we will not increase sampling to achieve RSE of CPUE-S ≤ 25.

Table 6. Survey of structural habitat types Lake Murvaul, Texas, 2016. Shoreline habitat type units are in miles and standing timber is acres.

Habitat type	Estimate	% of total
Bulkhead with boat docks	6.2 miles	18.8
Natural shoreline	17.5 miles	52.6
Natural shoreline with boat docks	8.7 miles	26.3
Rocky	0.8 miles	2.3
Standing timber	1377.0 acres	36.0

Table 7. Survey of aquatic vegetation, Lake Murvaul, Texas, 2013-2016. Surface area (acres) is listed with percent of total reservoir surface area in parentheses. Native vegetation was only surveyed during 2016.

Vegetation	2013	2014	2015	2016
Native submersed				11.2 (0.3)
Native floating-leaved				64.4 (1.7)
Native emergent				177.4 (4.6)
Non-native				
Alligator Weed (Tier III)*	< 1	1.9 (0.05)	0	0
Hydrilla (Tier III)*	< 1	39.6 (1.0)	< 1	< 1
Giant Salvinia (Tier II)*	0	1.3 (0.03)	0	1.6 (0.04)
Water Hyacinth (Tier II)*	0	1.9 (0.05)	64 (1.8)	< 1

*Tier II is active management status; Tier III is Watch Status

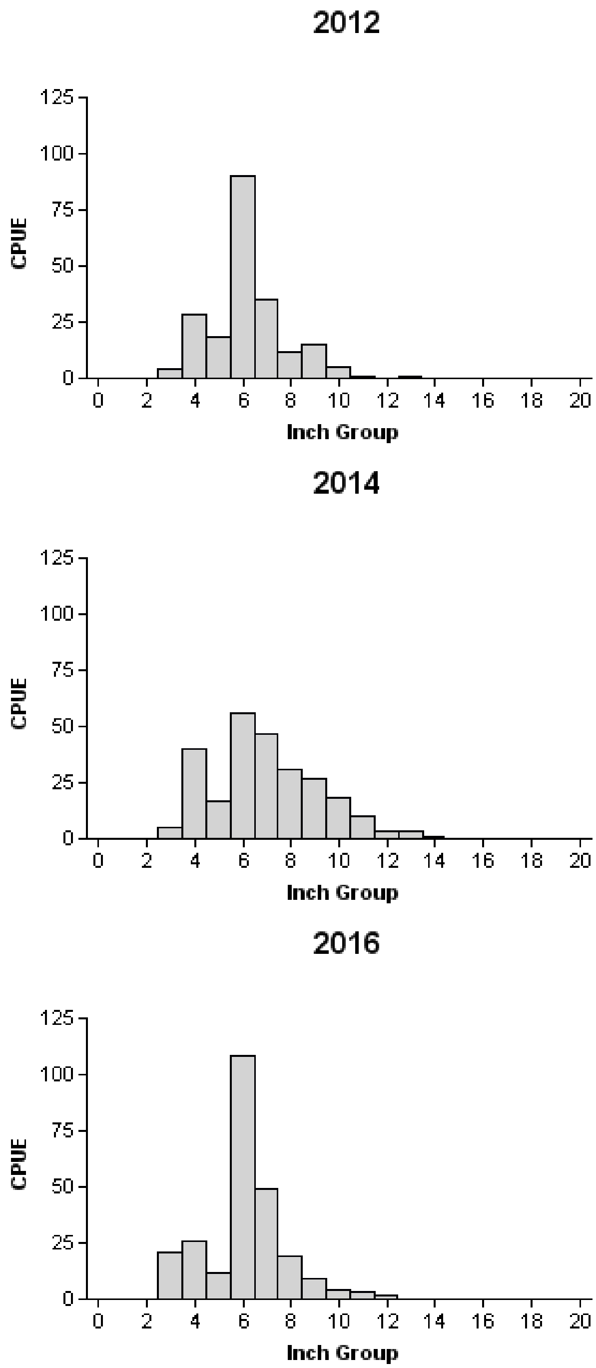
Table 8. Percent directed angler effort by species for Lake Murvaul, Texas, 2007-2017. Survey periods were spring-quarter only from 1 March through 31 May.

Species	2007	2009	2017
Channel Catfish	31.3	35.6	16.3
Largemouth Bass	11.7	23.0	31.0
Crappie	43.0	35.8	44.6
Sunfishes	2.9	4.4	2.3
Anything	11.2	1.2	5.8

Table 9. Total fishing effort (h) for all species and total directed expenditures at Lake Murvaul, Texas, 2007-2017. Survey periods were spring-quarter only from 1 March through 31 May. Relative standard error is in parentheses.

Creel statistic	2007	2009	2017
Total fishing effort	25,057 (11)	32,438 (14)	45,812 (35)
Total directed expenditures	$116,006 (38)	$139,885 (41)	$235,369 (53)

Gizzard Shad



2012

Effort = 1.0
Total CPUE = 209.0 (22; 209)
IOV = 84 (6)

2014

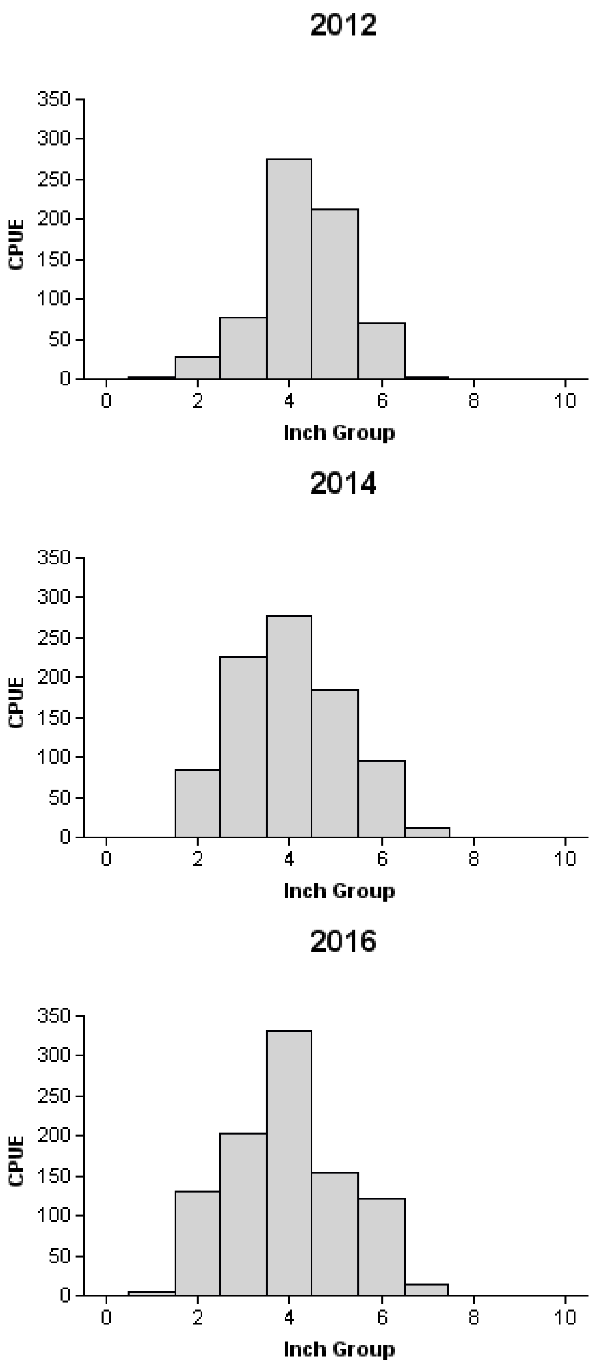
Effort = 1.0
Total CPUE = 258.0 (26; 258)
IOV = 64 (6)

2016

Effort = 1.0
Total CPUE = 253.0 (25; 253)
IOV = 85 (5)

Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Murvaul, Texas, 2012, 2014, and 2016.

Bluegill



2012

Effort = 1.0
Total CPUE = 667.0 (14; 667)
PSD = 11 (2)

2014

Effort = 1.0
Total CPUE = 881.0 (13; 881)
PSD = 13 (2)

2016

Effort = 1.0
Total CPUE = 956.0 (19; 956)
PSD = 16 (2)

Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Murvaul, Texas, 2012, 2014, and 2016.

Redbreast Sunfish

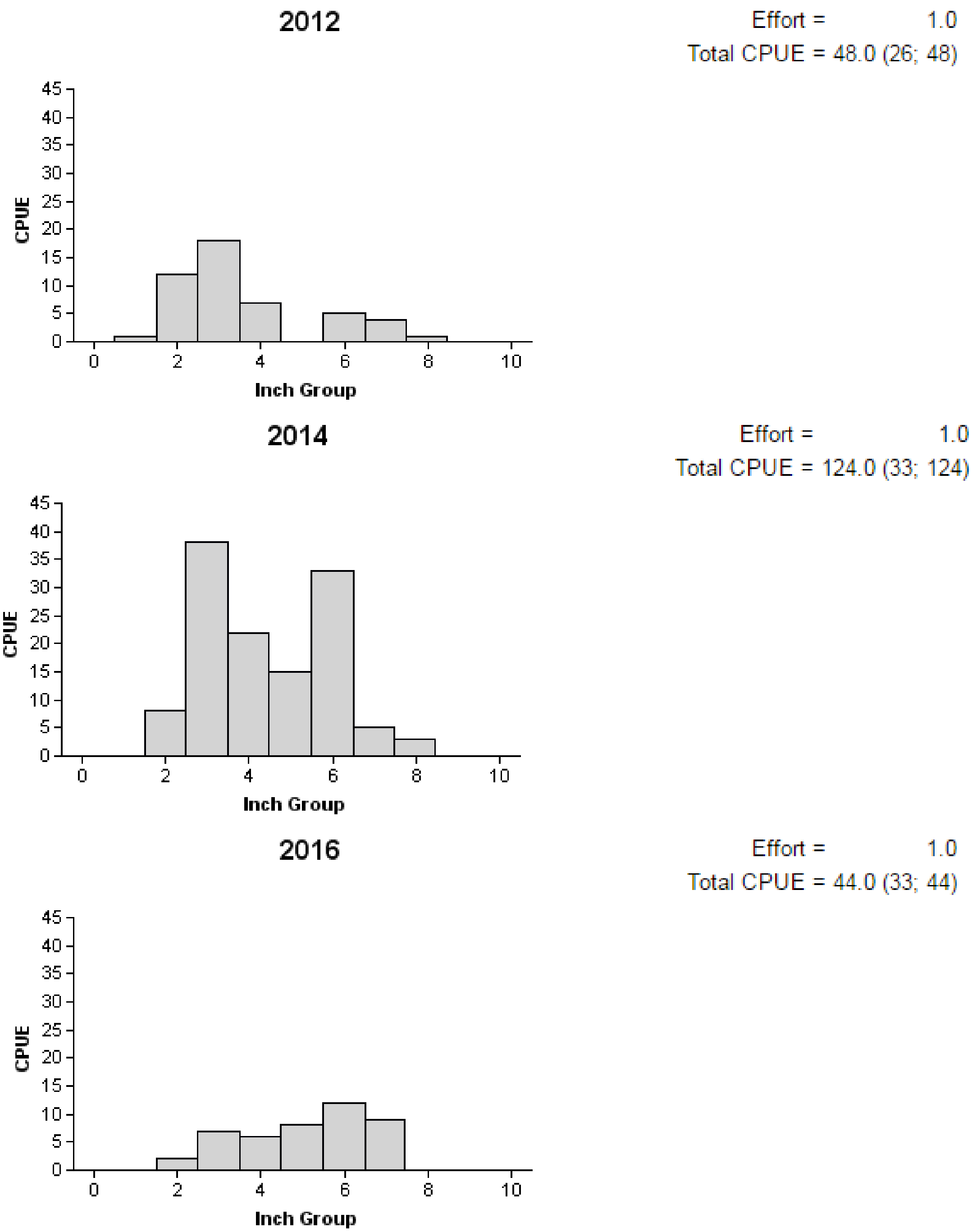


Figure 4. Number of Redbreast Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE) for fall electrofishing surveys, Lake Murvaul, Texas, 2012, 2014, and 2016.

Redear Sunfish

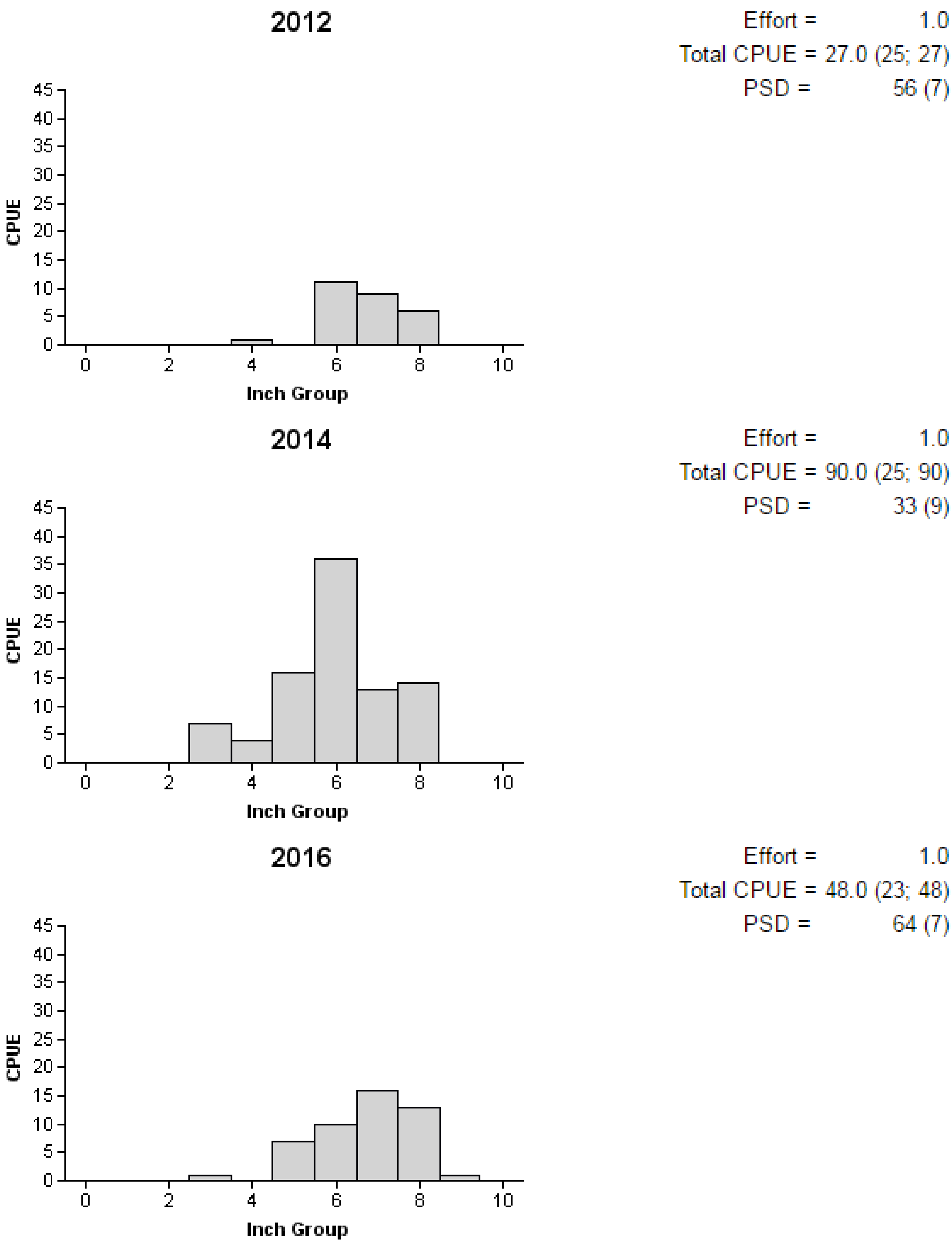


Figure 5. Number of Redear Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Murvaul, Texas, 2012, 2014, and 2016.

Channel Catfish (Gill Nets)

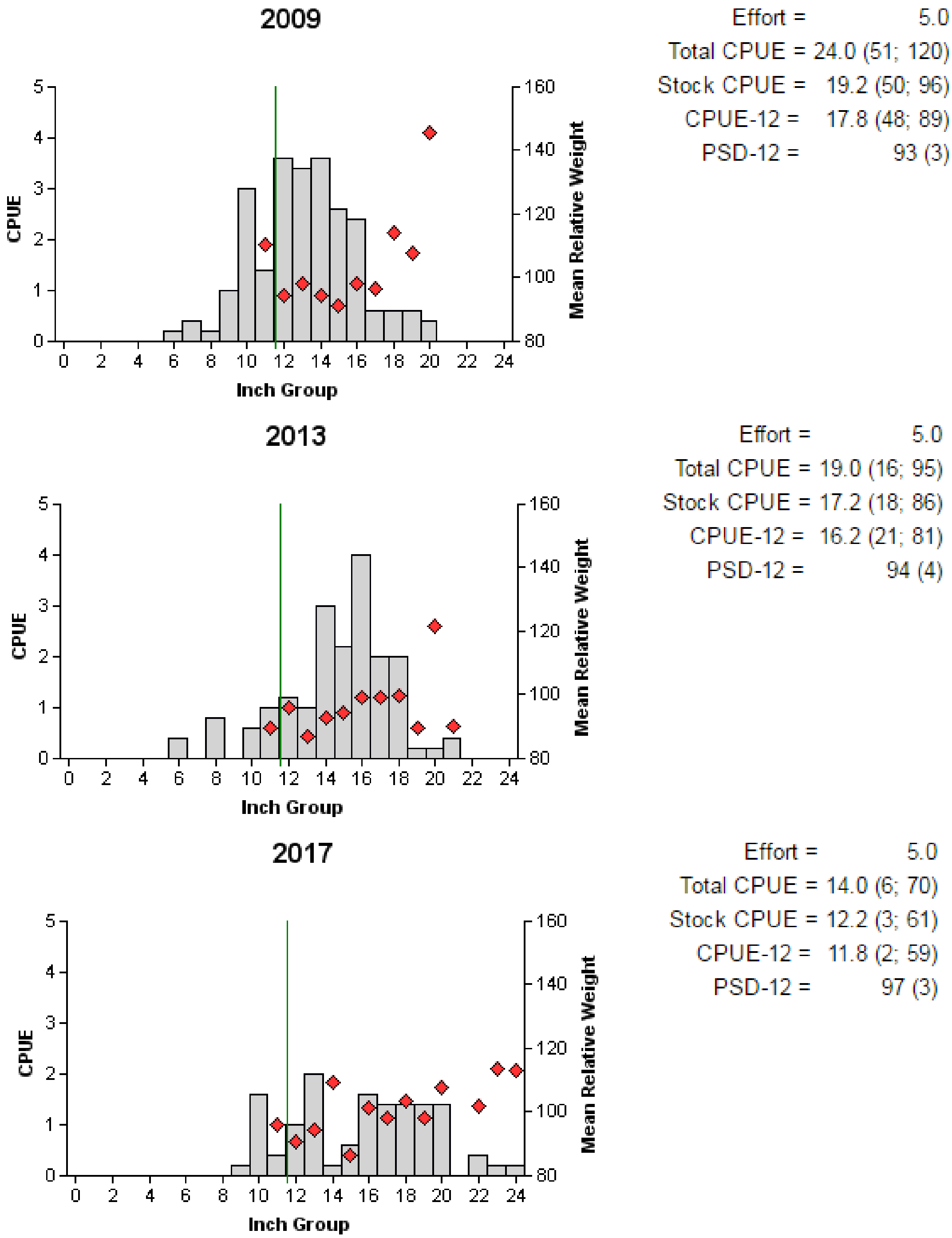
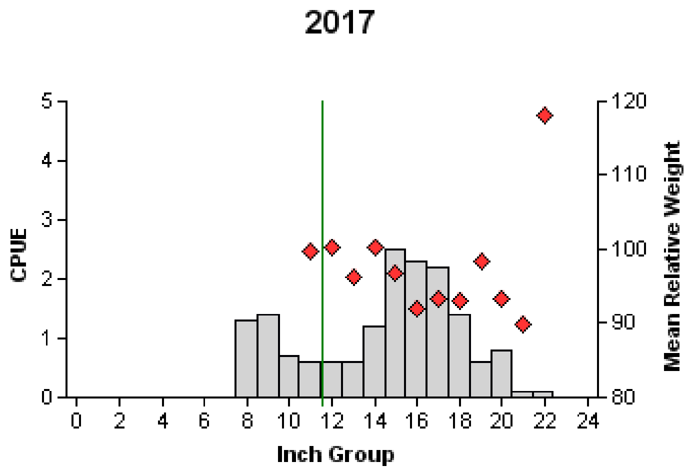


Figure 6. Number of Channel Catfish caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Murvaul, Texas, 2009, 2013, and 2017. Vertical lines indicate the minimum length limit.

Channel Catfish (Hoop Nets)



Effort =	10.0
Total CPUE =	16.4 (40; 164)
Stock CPUE =	13.0 (46; 130)
CPUE-12 =	12.4 (46; 124)
PSD-12 =	95 (1)

Figure 7. Number of Channel Catfish caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for the 2017 spring hoop net survey, Lake Murvaul, Texas. Vertical lines indicate the minimum length limit.

Channel Catfish

Table 10. Creel survey statistics for Channel Catfish at Lake Murvaul, Texas from March 2007 through May 2007, March 2009 through May 2009, and March 2017 through May 2017. Total catch per hour is for anglers targeting Channel Catfish and total harvest is the estimated number of Channel Catfish harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year		
	2007	2009	2017
Surface area (acres)	3,507	3,507	3,507
Directed effort (h)	7,830 (19)	11,544 (18)	7,478 (33)
Directed effort/acre	2.2 (19)	3.3 (18)	2.3 (33)
Total catch per hour	1.3 (40)	1.2 (32)	1.3 (38)
Total harvest	10,146 (22)	13,980 (35)	9,205 (49)
Harvest/acre	2.9 (22)	4.0 (35)	2.6 (49)
Percent legal released	3.0	6.5	3.6

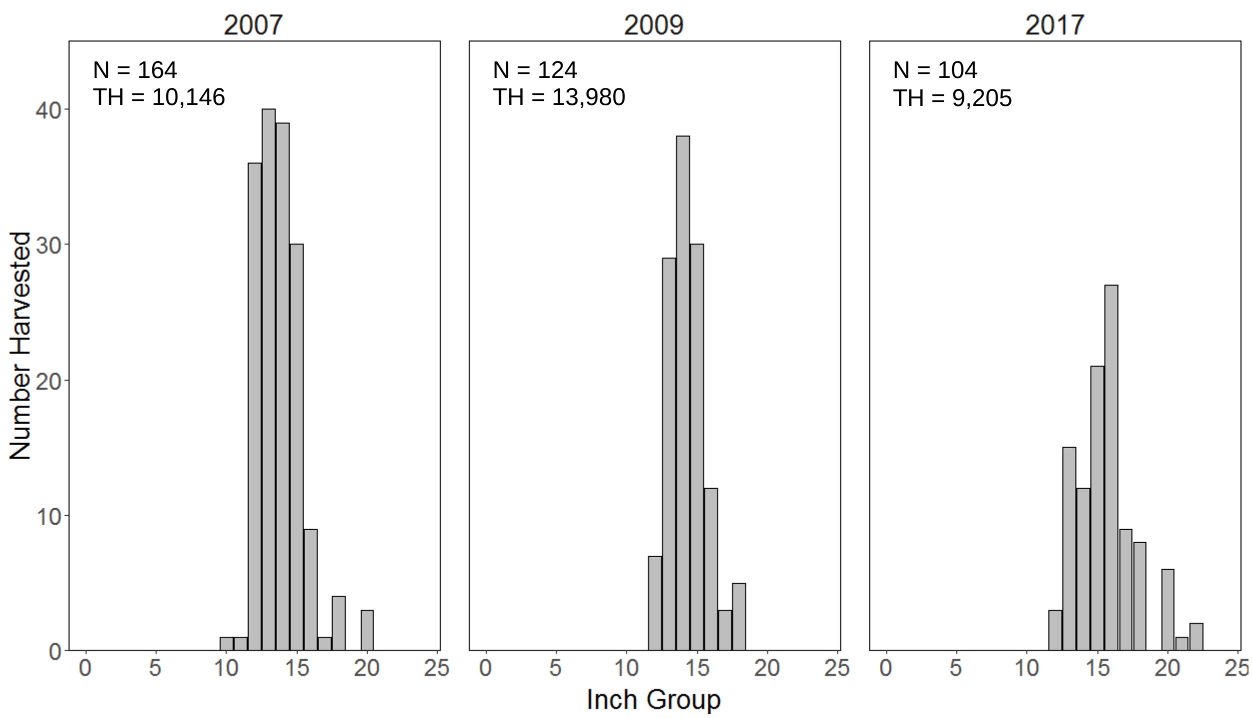


Figure 8. Length frequency of harvested Channel Catfish observed during spring-quarter (March-May) creel surveys at Lake Murvaul, Texas, 2007, 2009, and 2017, all anglers combined. N is the number of harvested Channel Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period.

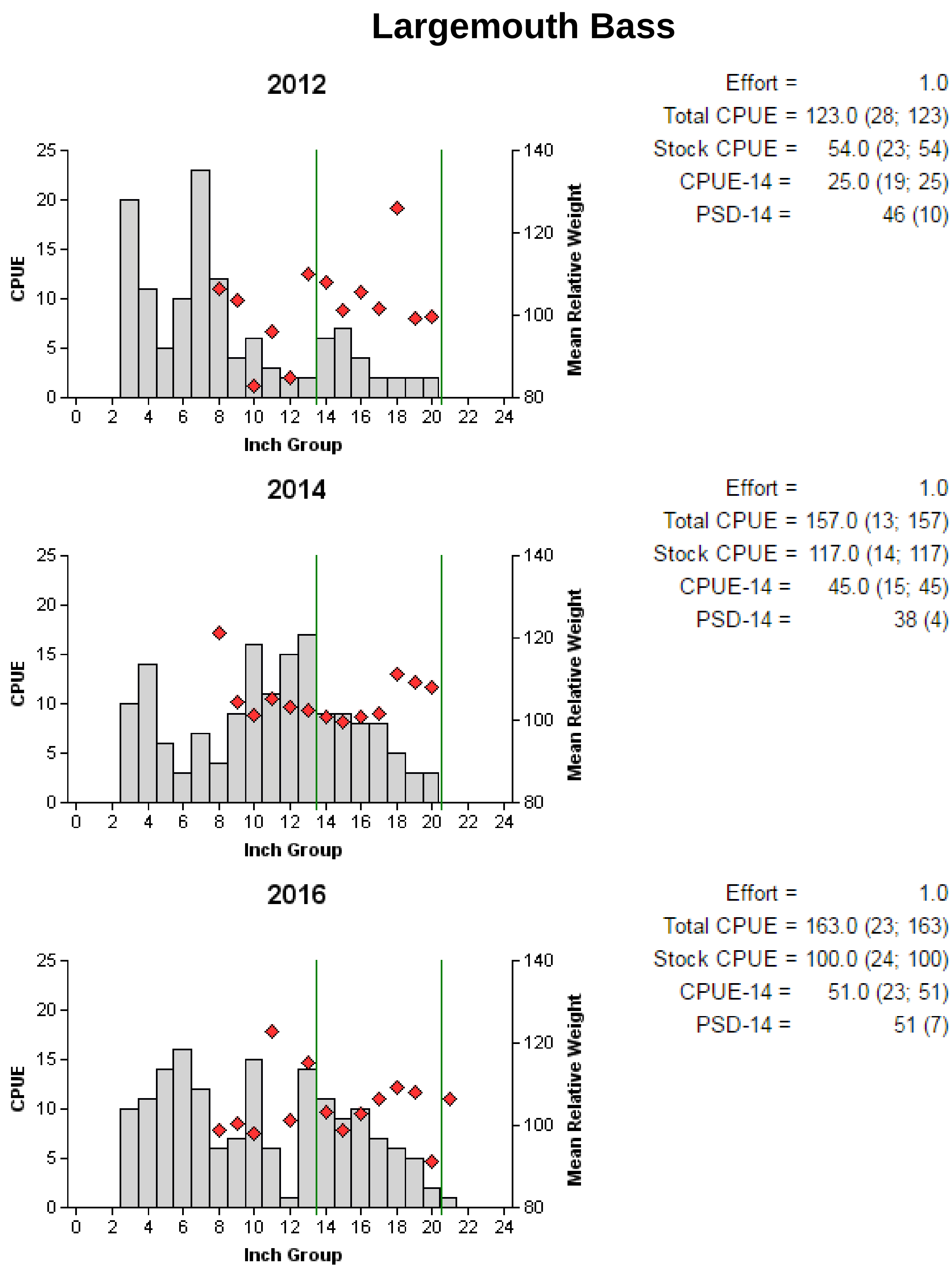


Figure 9. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Murvaul, Texas, 2012, 2014, and 2016. Vertical lines indicate the lower and upper end of the slot-length limit.

Largemouth Bass

Table 11. Creel survey statistics for Largemouth Bass at Lake Murvaul, Texas from March 2007 through May 2017, March 2009 through May 2009, and March 2017 through May 2017. Catch rate is for all anglers targeting Largemouth Bass. The estimated number of fish released by weight category is for anglers targeting Largemouth Bass. Relative standard errors (RSE) are in parentheses.

Creel Statistic	Year		
	2007	2009	2017
Surface area (acres)	3,507	3,507	3,507
Directed angling effort (h)			
Tournament	N/A	N/A	0[a]
Non-tournament	2,928 (28)	7,462 (24)	14,192 (31)
Angling effort/acre	0.8 (28)	2.1 (24)	4.0 (31)
Catch rate (number/h)	1.1 (47)	0.5 (26)	1.1 (22)
Harvest	0 (0)	712 (292)	52 (240)
Harvest/acre	0 (0)	0.2 (292)	1.4 (240)
Release by weight			
<4.0 lbs	NA	NA	12,079 (37)
4.0-6.9 lbs	NA	NA	2078 (43)
7.0-9.9 lbs	NA	NA	130 (102)
≥10.0 lbs	NA	NA	0 (0)
Percent legal released	100	72	100

[a] Bass tournaments are known to occur on Lake Murvaul, but no tournament anglers were surveyed during this creel.

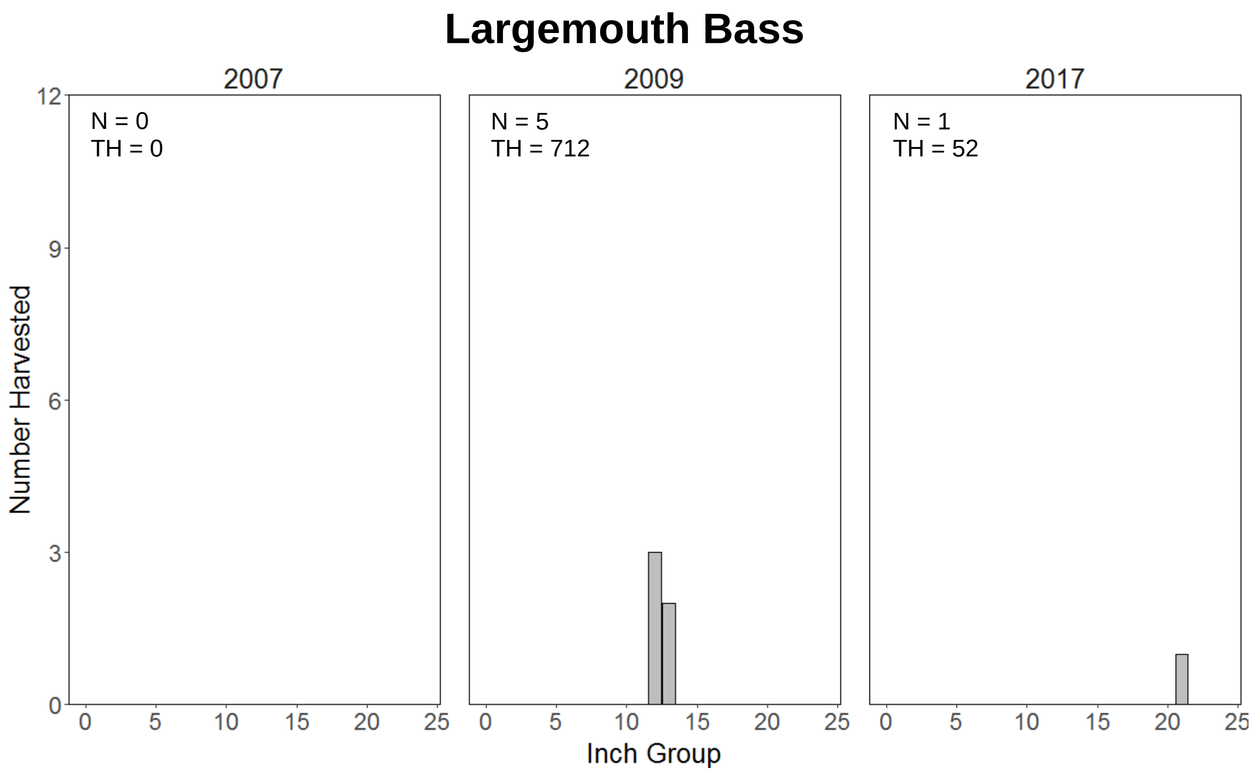


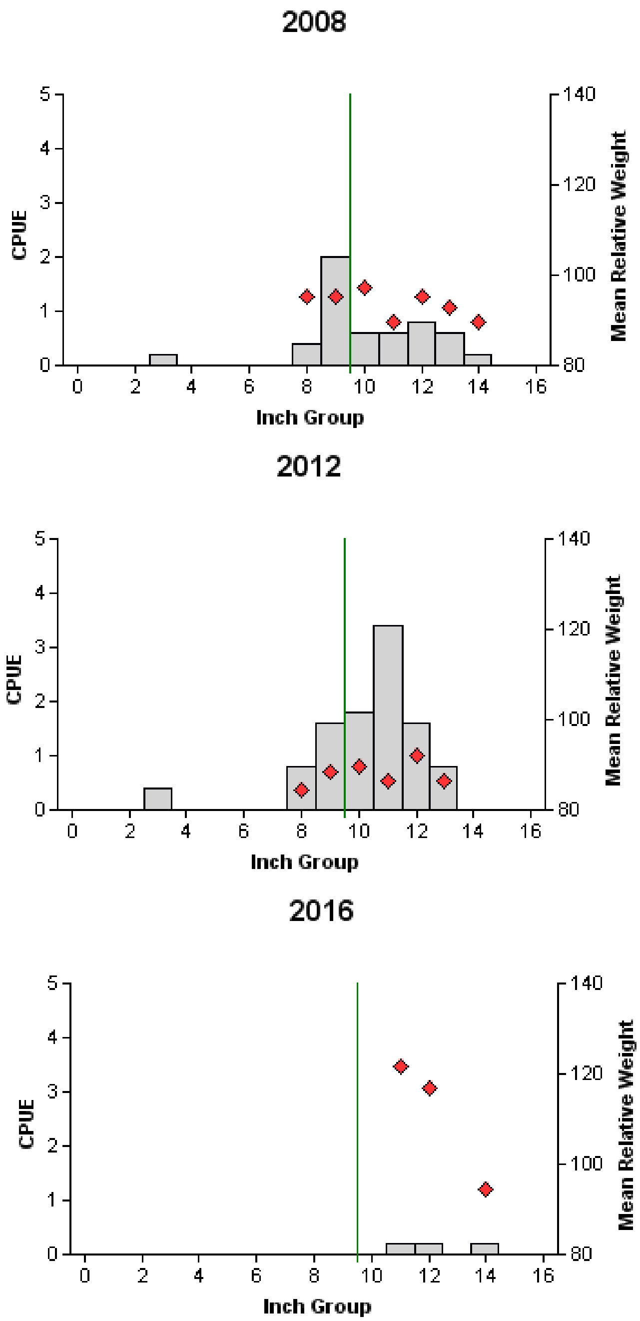
Figure 10. Length frequency of harvested Largemouth Bass observed during spring-quarter (March – May) creel surveys at Lake Murvaul, Texas, from 2007, 2009, and 2017, all anglers combined. N is the number of harvested Largemouth Bass observed during creel surveys, and TH is the estimated harvest for the creel period. Note: no Largemouth were reported harvested in 2007 creel.

Largemouth Bass

Table 12. Results of genetic analysis of Largemouth Bass collected by fall electrofishing at Lake Murvaul, Texas, 2006, 2010, and 2012. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between an FLMB and an NLMB. Genetic composition was determined by electrophoresis prior to 2005 and with micro-satellite DNA analysis since 2005. No genetic samples were collected in 2016.

		Number of fish				
Year	Sample size	FLMB	Intergrade	NLMB	% FLMB alleles	% FLMB
2006	30	0	29	1	33.0	0
2010	30	0	30	0	38.0	0
2012	30	1	28	1	41.0	3.3

White Crappie



2008

Effort = 5.0
Total CPUE = 5.4 (81; 27)
Stock CPUE = 5.2 (86; 26)
CPUE-10 = 2.8 (91; 14)
PSD-10 = 54 (5)

2012

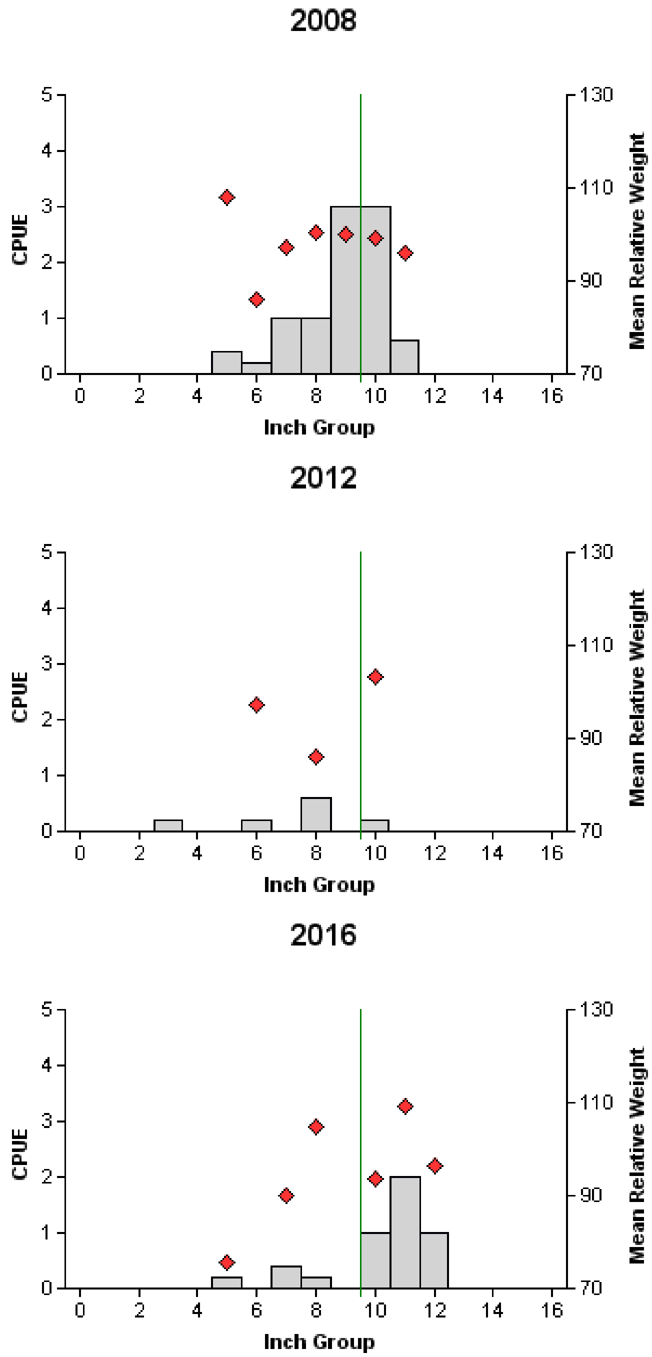
Effort = 5.0
Total CPUE = 10.4 (19; 52)
Stock CPUE = 10.0 (20; 50)
CPUE-10 = 7.6 (17; 38)
PSD-10 = 76 (4)

2016

Effort = 5.0
Total CPUE = 0.6 (67; 3)
Stock CPUE = 0.6 (67; 3)
CPUE-10 = 0.6 (67; 3)
PSD-10 = 100 (0)

Figure 11. Number of White Crappie 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 fall trap netting surveys, Lake Murvaul, Texas, 2010, 2012, and 2016. Vertical line indicates minimum length limit.

Black Crappie



2008

Effort = 5.0
Total CPUE = 9.2 (56; 46)
Stock CPUE = 9.2 (56; 46)
CPUE-10 = 3.6 (61; 18)
PSD-10 = 39 (3)

2012

Effort = 5.0
Total CPUE = 1.2 (61; 6)
Stock CPUE = 1.0 (55; 5)
CPUE-10 = 0.2 (100; 1)
PSD-10 = 20 (23)

2016

Effort = 5.0
Total CPUE = 4.8 (51; 24)
Stock CPUE = 4.8 (51; 24)
CPUE-10 = 4.0 (52; 20)
PSD-10 = 83 (9)

Figure 12. Number of Black Crappie 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 fall trap net surveys, Lake Murvaul, Texas, 2008, 2010, and 2016. Vertical line indicates the minimum length limit.

Crappie

Table 13. Creel survey statistics for Crappie (Black and White) at Lake Murvaul, Texas from March 2007 through May 2007, March 2009 through May 2009, and March 2017 through May 2017. Total catch per hour is for anglers targeting Crappie and total harvest is the estimated number of Crappie harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year		
	2007	2009	2017
Surface area (acres)	3,507	3,507	3,507
Directed effort (h)	10,767 (14)	11,620 (18)	20,439 (30)
Directed effort/acre	3.1 (14)	3.3 (18)	5.8 (30)
Total catch per hour	1.8 (21)	1.5 (35)	1.5 (45)
Total harvest	9,664 (33)	5,760 (88)	16,268 (70)
Harvest/acre	2.9 (33)	1.7 (88)	4.6 (70)
Percent legal released	4	0	0

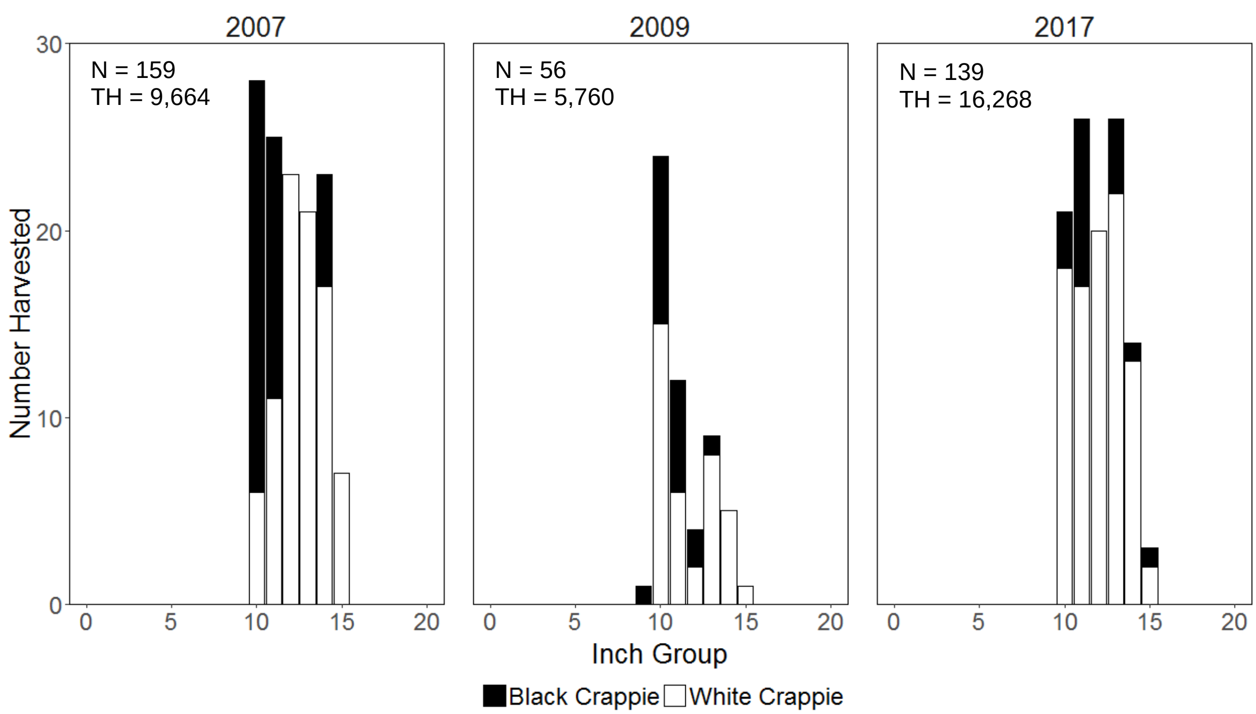


Figure 13. Length frequency of harvested Crappie observed during spring-quarter (March-May) creel surveys at Lake Murvaul, Texas, 2007, 2009, and 2017, all anglers combined. N is the number of harvested Crappie observed during creel surveys, and TH is the total estimated harvest for the creel period.

Table 14. Proposed sampling schedule for Lake Murvaul, Texas. Survey period is June through May. Hoop netting surveys are conducted in the spring, while electrofishing and trap netting surveys are conducted in the fall. Standard survey denoted by S and additional survey denoted by A.

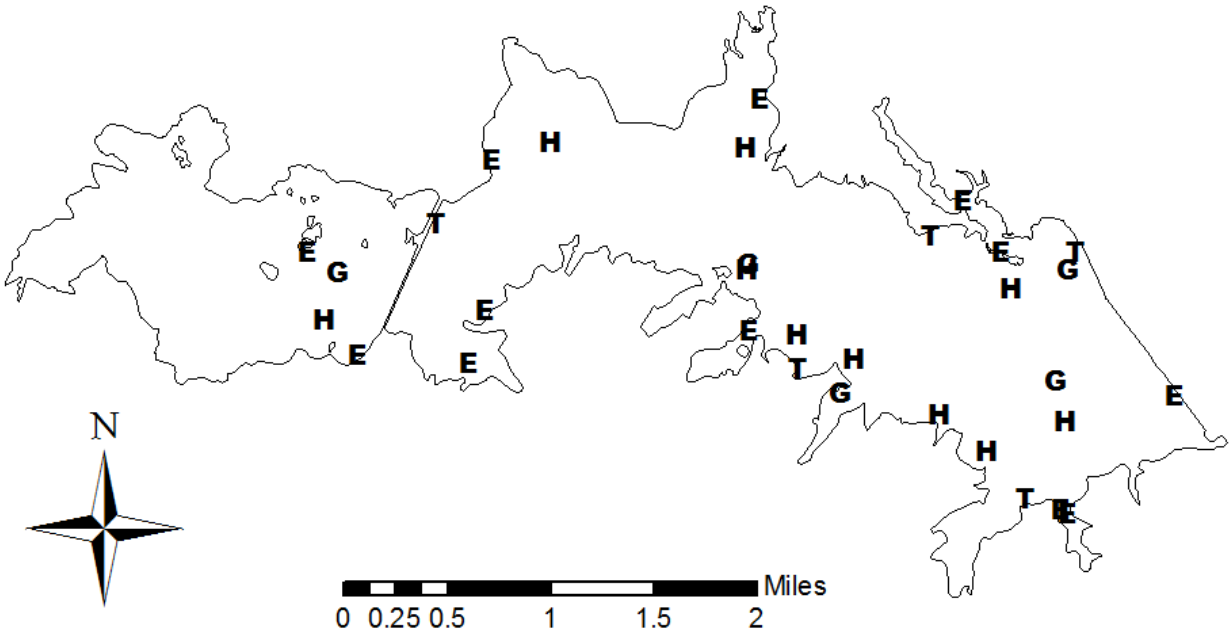
					Habitat			
Survey year	Electrofish Fall	Trap Net	Gill Net	Hoop Net	Structural	Vegetation	Access	Report
2017-2018						A		
2018-2019	A					A		
2019-2020						A		
2020-2021	S	S	S	S		S	S	S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Lake Murvaul, Texas, 2016-2017. Sampling effort was 5 net nights for gill netting, 10 net nights for hoop netting, 5 net nights for trap netting, and 1 hour for electrofishing.

Species	Gill Netting		Hoop Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad							253	253.0
Threadfin Shad							121	121.0
Channel Catfish	70	14.0	164	16.4				
White Bass	15	3.0						
Redbreast Sunfish							44	44.0
Warmouth							6	6.0
Orangespotted Sunfish							3	3.0
Redspotted Sunfish							1	1.0
Bluegill							956	956.0
Longear Sunfish							52	52.0
Redear Sunfish							48	48.0
Largemouth Bass							163	163.0
White Crappie					3	0.6		
Black Crappie					24	4.8		

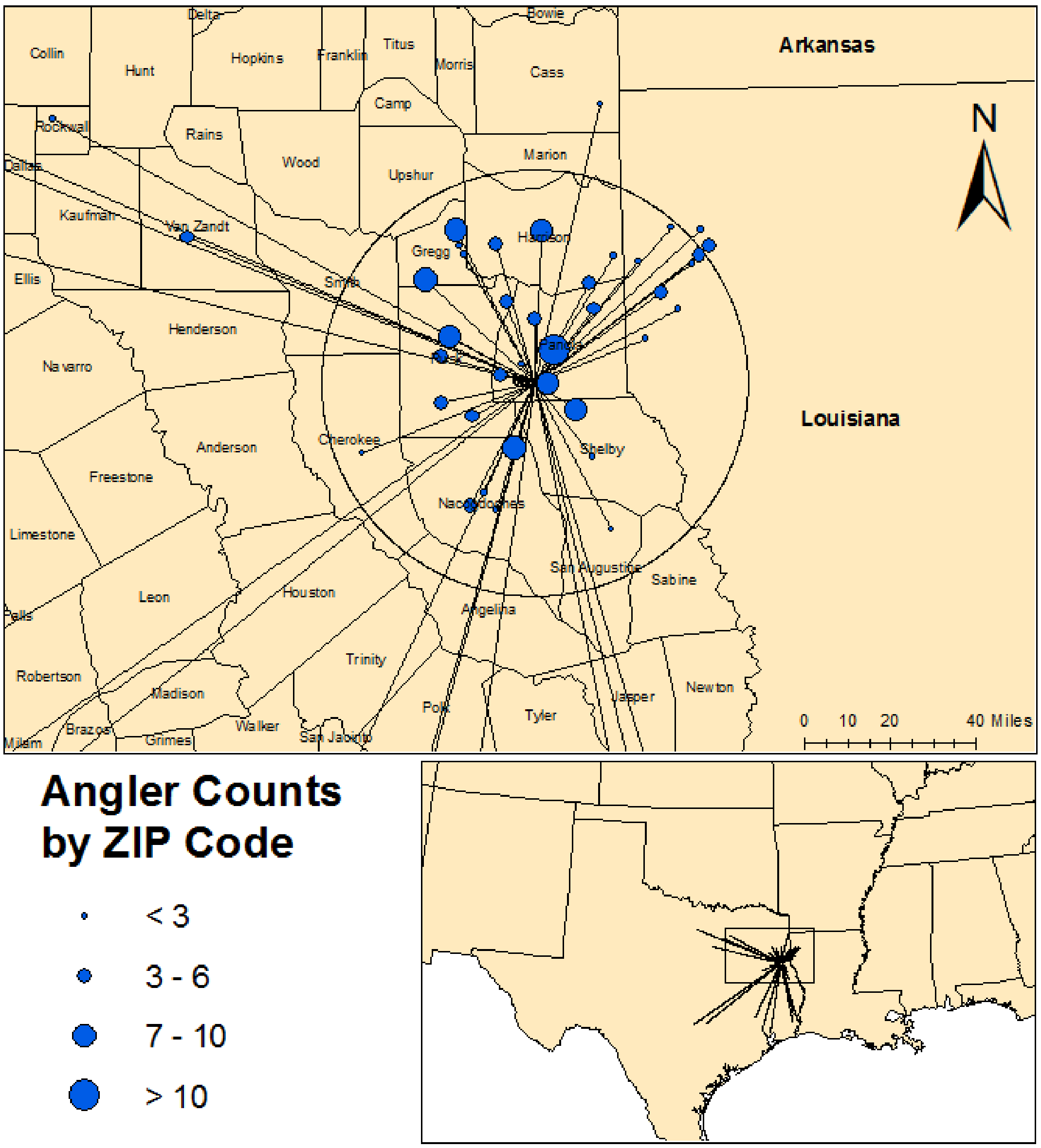
APPENDIX B



Location of sampling sites, Lake Murvaul, Texas, 2016-2017. Trap net, gill net, hoop net and electrofishing stations are indicated by T, G, H, and E, respectively. Water level was near full pool at time of sampling.

Appendix C

Lake Murvaul, March 2017 to May 2017



Location, by ZIP code, and frequency of anglers that were interviewed at Lake Murvaul, Texas during the March 2017 through May 2017 creel survey. Circle indicates 50-mile radius from Lake Murvaul.