PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2016 Fisheries Management Survey Report

Lake Brazos Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lake Brazos Reservoir were surveyed in 2016 using electrofishing and trap nets and in 2017 using gill nets. 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 Brazos Reservoir is a 523-acre impoundment of the Brazos River located in downtown Waco, McLennan County, Texas. There is no water gaging station on Lake Brazos Reservoir, therefore water elevation data are not available. Bank and boat access on the reservoir are good, and include handicap-friendly facilities such as walkways, picnic shelters, and fishing piers. Habitat features consisted mainly of natural shoreline, limited bulkheading, piers and bridge pilings and emergent aquatic vegetation.

- **Management History:** Important sport fish include Largemouth Bass, catfishes, White Bass and White Crappie. Sport fish have always been managed with statewide regulations. The management plan from 2008 recommended annual monitoring of Giant reed, and working with the City of Waco on control efforts if necessary. Giant reed was monitored annually through 2014, at which time it was established that it was not increasing in coverage and there was little probability that it would require treatment. Management plans from 2008 and 2012 included addition of new fish habitat, and to date, over 50 bamboo crappie condos have been placed into the reservoir. Since 2013, management efforts have focused on cooperating with the City of Waco to post appropriate invasive species signage at access points to try and prevent the spread of zebra mussels into the reservoir, and supporting the statewide PR campaign “Clean, Drain, and Dry”. Recent management efforts include full aquatic vegetation and boater access surveys conducted during summer 2016.

- **Fish Community**
  - **Prey species:** Threadfin and Gizzard Shad were present in the reservoir in record numbers, and most Gizzard Shad were available as prey to sport fish. Other forage species included Bluegill, Longear Sunfish and Redear Sunfish.

  - **Catfishes:** Blue Catfish and Channel Catfish were important sport fish in the reservoir, yet their catch rates were below historical averages. Condition was generally good for both species.

  - **Black basses:** Largemouth Bass were collected in the reservoir below the historical average. Recent recruitment appeared to be excellent. Body condition was generally good.

  - **White Crappie:** White Crappie were present in the reservoir in low numbers and body condition was poor. Black Crappie were not observed in 2016.

- **Management Strategies:** The sport fishes of Lake Brazos Reservoir will continue to be managed with statewide regulations. We will continue to maintain invasive species signage and inform the public on the negative impacts of invasive species. Access and vegetation surveys will be conducted in summer 2020, and electrofishing, trap netting and gill net surveys will be conducted in 2020 and 2021.

INTRODUCTION

This document is a summary of fisheries data collected from Lake Brazos Reservoir 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 Brazos is a 523-acre impoundment of the Brazos River located in downtown Waco, McLennan County, Texas. The reservoir was constructed by the City of Waco in 1965 to serve as a municipal water source and to stimulate economic development in the downtown area. Other water uses include recreation. The reservoir is eutrophic with an average reservoir depth of 12.3 feet, and water transparencies typically ranging from 1 to 3 feet. Habitat at time of sampling consisted mainly of natural shoreline, limited bulkheading, piers and bridge pilings and emergent aquatic vegetation (e.g., water willow *Justicia Americana*, bulrush *Scirpus sp*., and cattail *Typha sp*.). There are currently no sources for water level data for Lake Brazos. Other descriptive characteristics for Lake Brazos Reservoir are in Table 1.

Angler Access

Bank and boat access on Lake Brazos Reservoir is excellent. Boat access consists of two two-lane ramps (Brazos Park East I and II) and a kayak launch (Brazos Park East III), and a single lane ramp at the McLennan Community College (MCC) campus. All four boat ramps were useable during the recent 2016/2017 surveys, and there are currently no access issues. Shoreline access is excellent throughout the lower two-thirds of the reservoir. Additional boat ramp characteristics are in Table 2.

Management History

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

1. Monitor the reservoir for giant reed annually through 2016 and work with the City of Waco to control giant reed with appropriate means.
   Action: Giant reed was monitored annually with summer surveys from 2009 to 2013. The collected data show no significant changes in coverage. Actually, large stands of giant reed were permanently *removed* during the construction of McLane Stadium, completed in 2014. Because giant reed does not impede access on Lake Brazos Reservoir, and there is little chance that it will require treatment in the foreseeable future, its status on Lake Brazos Reservoir was changed to tier III in 2013, requiring monitoring every four years only.
2. Utilize side scan sonar to monitor artificial fish habitat structure condition, work with the City of Waco to organize placement of new fish habitat structures and update the habitat structure maps on the TPWD website.
   Action: Side scan sonar was used to monitor previous crappie condo sites in 2014; only remnant structures were observed. This was not surprising due to the riverine condition of Lake Brazos Reservoir. However, these structures may still be in the reservoir attracting fish; anglers just need to find them. Additional condos were placed in 2014 near several major fishing piers along the mid to lower reservoir, and the structures' coordinates were made available to interested anglers and constituents on the TPWD website, under the Lake Brazos Reservoir link.
3. Explore new concepts for fish attractors and implement as feasible.
   Action: A literature search was conducted in 2013 on the use of underwater lights to concentrate sportfish, as is commonly done along the coast and in private waters throughout the state. The idea was that the lights could be installed near McLane

Stadium, and serve a two-fold purpose: 1) concentrate sportfish to provide opportunity for anglers and 2) add to the evening/nighttime aesthetics of the McLane Stadium/Baylor area. Infrastructure has since been built in the McLane Stadium area, but the logistics of operating underwater lighting in a riverine environment during flooding, and their maintenance, and safety concerns, still require much needed input from potential partners (i.e., City of Waco and Baylor University).

4. Cooperate with City of Waco to post invasive species signage at access points, provide technical support/informational materials for the "Clean, Drain and Dry" campaign, and educate business owners about invasive species so that they can in turn educate their customers.

   Action: Invasive species signage was posted at Lake Brazos Reservoir access points during summer 2013. District biologists have made a speaking point about invasive species, how to prevent their spread, and potential effects on Lake Brazos Reservoir while speaking to business owners and constituent groups such as the Central Texas Flyrodders, Legacy Outfitters and Brazos River Sportsman's Club over the past several years.

Harvest regulation history: Sport fishes in Lake Brazos Reservoir have always been managed with statewide regulations. The current harvest regulations are listed in Table 3.

Stocking history: Lake Brazos Reservoir was stocked with 47,491 Blue Catfish in 2009 and 47,025 Florida Largemouth Bass in 2010. The complete stocking history is in Table 4.

Vegetation/habitat management history: Vegetation/habitat management actions have been limited to the addition of fish habitat (crappie condos) near fishing piers, and past, annual monitoring of giant reed shoreline coverage.

Water transfer: There are no interbasin transfers within Lake Brazos Reservoir.

METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Lake Brazos Reservoir (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 daytime electrofishing (1 hour at 12, 5-min stations). The 2016 survey is the first daytime electrofishing survey completed on Lake Brazos Reservoir. Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing.

Trap netting – White Crappie were collected by trap netting (5 net nights at 5 stations). Catch per unit effort for trap netting was recorded as the number of fish caught per net night (fish/nn).

Gill netting – Channel Catfish and Blue Catfish were collected by gill netting (5 net nights at 5 stations). Gill nets in 2017 were set parallel to the shoreline to avoid fouling from debris flowing through the reservoir. Catch per unit effort for gill netting was recorded as the number of fish caught per net night (fish/nn).

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 from 2005 to present, and by electrophoresis for previous years.

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 statistics.

Habitat – A structural habitat survey was conducted in 2009 (Tibbs and Baird 2009). Vegetation surveys were conducted using an adaptation of the point method during 2016 (TPWD, Inland Fisheries Division, unpublished manual revised 2015). Points were randomly generated on the shoreline and averaged a minimum of one point per shoreline mile. Aquatic vegetation has always been found close to the shore in Lake Brazos Reservoir, so stratifying the random points to exclude deep-water areas increased precision and resulted in better data.

Water level – There is currently no source for water level data for Lake Brazos Reservoir however water levels are relatively stable.

RESULTS AND DISCUSSION

Habitat: Lake Brazos Reservoir is a mildly turbid reservoir with a secchi range from one to two feet. The most recent habitat survey results can be found in Table 6. A full vegetation survey conducted during summer 2016 found dominant shoreline vegetation to be American water-willow (*Justicia Americana*), Giant reed (*Arundo donax*) and cattail (*Typha spp.*; Table 7).

Creel: No angler creel surveys have been conducted on Lake Brazos Reservoir to date. A spring 2017 quarter creel was included in the 2016 Lake Brazos OBS Plan to determine angler preferences and success for all sport fish species in the reservoir. However sustained spring flooding and unsafe conditions prevented the creel from being initiated. A year-long creel survey will be conducted between June 1, 2018 and May 30, 2019 to answer these basic questions about the fishery.

Prey species: Threadfin Shad and Gizzard Shad were collected by electrofishing at 116.0/h and 343.0/h respectively in 2016 (Figure 1; Appendices A and B). These are the highest catch rates ever recorded for both species since sampling began in 2008. The IOV for Gizzard Shad was good as 72% of the population was available to existing predators as forage. Other important forage species collected were Bluegill (54.0/h; Figure 2), Longear Sunfish (35.0/h; Figure 3), and Redear Sunfish (14.0/h; Figure 4) (Appendices A and B). Redear Sunfish are the only sunfish species in our sample that reached preferred sizes.

Catfishes: Blue Catfish were collected with gill nets at 4.0/nn in 2017, which is well below average for the species (Figure 5; Appendices A and B). Few individuals approached or exceeded the preferred size category of 30 inches, and body condition was generally good.

Channel Catfish were collected with gill nets at 1.6/nn in 2017, also well below average for the species (Figure 6; Appendices A and B). Few Channel Catfish approached the preferred size category of 24 inches. Body condition was fair-to-good, and improved with increasing length.

Flathead Catfish were not targeted during the 2017 gill net survey, but are still included in Appendix B.

Black basses: The total Largemouth Bass electrofishing catch rate was 40.0/h in 2016, which is below average for this reservoir (Figure 7; Appendices A and B). The OBS goal for this species (obtaining a CPUE-stock RSE of 25 or less) was reached. Body condition was fair to good, and generally increased

with increasing length. Largemouth Bass genetics analyzed in 2016 showed slightly improved Florida Largemouth Bass influence from the 2008 survey (39% vs. 33%; Table 8).

Spotted and Smallmouth Bass were not targeted during the 2016 electrofishing survey, but are still included in Appendix B.

White Crappie: White Crappie were collected from trap nets at 5.6/nn in 2016, above average for the species (Figure 8; Appendices A and B). Few sampled fish were of legal size and no fish larger than 12 inches were observed. Body condition was generally poor.

Black Crappie were not targeted during the 2016 trap net survey, but are still included in Appendix B.

Fisheries management plan for Lake Brazos Reservoir, Texas

Prepared – July 2017

ISSUE 1: High water from rains and releases from both the Waco and Whitney dams fouled gill nets in early March, requiring a second effort in late April during a small window of opportunity with relatively clear water. Most of these nets were set pelagic and parallel to the bank to minimize fouling. It is likely that this negatively affected catch rates of catfish and temperate bass species.

MANAGEMENT STRATEGIES

1. Gill net in mid- to late January 2019 and 2021 to minimize impacts of debris, obtain better information on catfish spp. and target temperate bass prior to them migrating upstream for spawning.
2. Increase gill netting effort to 10 nets for the 2019 and 2021 surveys to improve sampling precision, particularly for the potentially under-sampled hybrid striped bass and Striped Bass populations.

ISSUE 2: Creel information is needed for this developing urban fishery. The proposed spring quarter, 2017 creel was cancelled due to poor conditions during the first half of the quarter that negatively affected angler usage.

MANAGEMENT STRATEGY

1. Creel Lake Brazos Reservoir from June 1, 2019 through May 30, 2020. A year-long creel will minimize impacts to our data collection from flood events. Urban anglers may also be less seasonally oriented than traditional reservoir anglers and this approach will help us determine if that is true. This will also give us needed information on the quality of the temperate bass fishery. Lastly, Lake Brazos Reservoir includes a tailrace fishery where anglers can fish directly below the gates of Waco Reservoir from an elevated platform. Several temperate bass and crappie records have been caught from this area, but we don't have any direct measurement of angling metrics.

ISSUE 3: Lake Brazos Reservoir has a lot of potential as an urban fishery and further development is needed. Several fishing piers have been built by the City of Waco to accommodate bank anglers and other user groups. Texas Parks and Wildlife, City of Waco, Cameron Park Zoo staff, and other volunteers have placed almost 50 artificial fish habitat structures called Crappie condos. Additional fish attractors are needed to accommodate a growing contingent of urban anglers.

MANAGEMENT STRATEGIES

1. Continue working with partners to organize placement of new fish habitat structures.
2. Utilize side scan sonar to monitor artificial fish habitat structure condition.
3. Update artificial fish habitat structure maps for angler/constituent use upon request.
4. Investigate the possibility of partnering with the City to install fishing lights on piers.
5. Explore new concepts for fish attractors and implement as feasible.

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 City of Waco to post appropriate signage at access points around the reservoir.
2. Provide technical support and informational materials for the City of Waco's "Clean, Drain, Dry" initiative. Interns will conduct inspections at ramps on Lake Brazos and Lake Waco during summer, 2017.

Objective Based Sampling Plan and Schedule 2017 - 2021

Sport fish, forage fish and other important fishes

Survey data suggest important sport fishes in Lake Brazos Reservoir include Largemouth Bass, Channel and Blue Catfish and White Crappie. Anecdotal information and information from our Fish Records Program also suggests three additional species are important, particularly within the Waco Reservoir tailrace area: White bass, Striped Bass and hybrid striped bass (Palmetto and Sunshine Bass). Important forage fishes include Gizzard Shad, Threadfin Shad, Bluegill, Longear Sunfish and Redear Sunfish. The proposed sampling schedule (Table 9) lists surveys planned for the next four years.

Low-density fisheries

Spotted Bass, Smallmouth Bass, Flathead Catfish and Black Crappie occur in low abundance in Lake Brazos Reservoir and are generally caught incidentally to targeted species. We will continue collecting and reporting data for these species, and upgrade their status if appropriate.

Survey objectives, fisheries metrics, and sampling objectives

Fall Electrofishing: This survey will be used to evaluate Largemouth Bass, and primary forage species (Gizzard Shad, Threadfin Shad, Bluegill Sunfish, Longear Sunfish and Redear Sunfish). District daytime versus nighttime electrofishing surveys on other reservoirs have shown to be effective at obtaining data needed to manage the fishery. The 2016 electrofishing survey marked the first standard daytime survey for Lake Brazos Reservoir. All future surveys will also be daytime surveys. The goal of the 2020 Largemouth Bass survey will be general monitoring to characterize the Largemouth Bass population (CPUE, size structure, Wr, genetics) and compare to historical and future data. The number of sampling sites will be determined based on achieving a CPUE-stock RSE of 25 or less as well as collecting a total of 50 stock-length fish. A minimum of 12 randomly selected stations will be sampled. If the goals are not attained, and catch rates indicate that achieving the desired precision and collecting the proposed number of fish is reasonable, sampling will continue at pre-determined random stations until the target is reached.

The goals of the forage species survey will be general monitoring to characterize forage species populations (CPUE, size structure) and compare to historical and future data. No minimum level of precision is assigned to this effort and sampling will only continue for 12 randomly selected stations.

Winter trap netting: Creel data are needed to determine the extent that White Crappie are sought and harvested in Lake Brazos Reservoir. Pending results of the creel survey, the goal of the 2020 survey would be to conduct a general monitoring survey with no minimum level of precision required. A minimum of five randomly selected trap netting stations will be sampled overnight during winter 2020.

Spring Gill Netting: The goals of the 2019 and 2021 spring gill net surveys will be general monitoring to characterize the catfish and temperate bass populations and compare to historical and future data. The number of sampling sites will be determined based on achieving a CPUE-stock RSE of 25 or less and collecting a total of 50 stock-length fish for Channel Catfish, Blue Catfish, Striped Bass, hybrid striped bass, and White Bass. A minimum of ten randomly selected gill net stations will be sampled in spring 2019 and 2021. If the goals for all species aren't attained, and catch rates indicate that achieving the desired precision and collecting the proposed number of fish is reasonable, sampling will continue at pre-determined random stations until the target is reached. This increased effort is needed to obtain additional baseline information for this developing urban fishery.

Creel Survey: Creel data are needed to determine the extent that all game fishes are sought and harvested in Lake Brazos Reservoir. Survey anglers 9 days/quarter from June 1, 2019 through May 30, 2020. This effort will include the main lake as well as the tailrace fishery below Waco Reservoir, which is an impounded portion of Lake Brazos Reservoir.

LITERATURE CITED

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

DiCenzo, V. J., M. J. Maceina, and M. R. Stimert. 1996. Relations between reservoir trophic state and Gizzard Shad population characteristics in Alabama reservoirs. North American Journal of Fisheries Management 16:888-895.

Guy, C. S., R. M. Neuman, D. W. Willis, and R. O. Anderson. 2007. Proportional size distribution (PSD): a further refinement of population size structure index terminology. Fisheries 32(7): 348.

Tibbs, J., and M. S. Baird. 2009. Statewide freshwater fisheries monitoring and management program survey report for Lake Brazos, 2008. Texas Parks and Wildlife Department, Federal Aid Report F-30-R-33, Austin.

Tibbs, J., and M. S. Baird. 2013. Statewide freshwater fisheries monitoring and management program survey report for Lake Brazos, 2012. Texas Parks and Wildlife Department, Federal Aid Report F-221-M-3, Austin.

Table 1. Characteristics of Lake Brazos Reservoir, Texas 2016 - 2017.

Characteristic	Description
Year Constructed	1965
Controlling authority	City of Waco
County	McLennan
Reservoir type	Main stem Brazos River
Shoreline Development Index (SDI)	N/A
Conductivity	811 umhos/cm

Table 2. Boat ramp characteristics for Lake Brazos Reservoir, Texas, 2016 - 2017. There is currently no source for water level data for Lake Brazos Reservoir; elevations at the ends of boat ramps are unavailable.

Boat ramp	Latitude Longitude (dd)	Trailer Parking capacity (N)	Elevation at end of boat ramp	Condition
Brazos Park East I	31.5897/-97.1543	53	N/A	Good
Brazos Park East II	31.5829/-97.1511	15	N/A	Poor
Brazos Park East III	31.5886/-97.1546	7	N/A	Good
MCC	31.594/-97.1701	5	N/A	Good

Table 3. Harvest regulations for Lake Brazos Reservoir, 2016 - 2017.

Species	Bag Limit	Length limit (inches)
Catfish: Channel, Blue, their hybrids and subspecies	25 (in any combination)	12-inch minimum
Catfish, Flathead	5	18-inch minimum
Bass, White	25	10-inch minimum
Bass, Striped and Hybrid Striped Bass	5 (in any combination)	18-inch minimum
Bass, Largemouth, Smallmouth, their hybrids and subspecies	5 [a] (in any combination)	14-inch minimum
Bass, Spotted	5 [a]	None
Crappie: White, Black, their hybrids and subspecies	25 (in any combination)	10-inch minimum

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

Table 4. Stocking history for Lake Brazos Reservoir, Texas. Life stages are fry (FRY), fingerlings (FGL), advanced fingerlings (AFGL), adults (ADL) and unknown (UNK). Life stages for each species are defined as having a mean length that falls within the given length range. For each year and life stage the species mean total length (Mean TL; in) is given. For years where there were multiple stocking events for a particular species and life stage the mean TL is an average for all stocking events combined.

Species	Year	Number	Life Stage	Mean TL (in)
Blue Catfish	2008	47,400	FGL	2.0
	2009	47,491	FGL	2.0
	Total	94,891		
Bluegill	2007	10,203	AFGL	2.0
	2008	47,890	AFGL	2.1
	Total	58,093		
Channel Catfish	1989	2,700	FGL	3.9
	1990	5,456	FGL	2.4
	2006	19,609	AFGL	8.5
	2007	99,090	FGL	2.4
	Total	126,855		
Florida Largemouth Bass	2007	35,640	FRY	0.3
	2008	49,860	FGL	1.7
	2010	47,025	FGL	1.8
	Total	132,525		
Largemouth Bass	2007	12,712	FGL	1.1
	Total	12,712		

Table 5. Objective-based sampling plan components for Lake Brazos Reservoir, Texas 2016 – 2017.

Gear/target species	Survey objective	Metrics	Sampling objective
Electrofishing			
Largemouth Bass	General monitoring	CPUE, size structure, Wr	RSE – Stock ≤ 25
	Genetics	% FLMB	N = 30, any age
Bluegill	General monitoring	CPUE, size structure	None
Longear Sunfish	General monitoring	CPUE, size structure	None
Gizzard Shad	General monitoring	CPUE, size structure	None
Threadfin Shad	General monitoring	CPUE	None
Gill Netting			
Blue Catfish	General monitoring	CPUE, size structure, Wr	None
Channel Catfish	General monitoring	CPUE, size structure, Wr	None
White Bass	General monitoring	CPUE, size structure, Wr	None
Striped Bass	General monitoring	CPUE, size structure, Wr	None
Palmetto Bass	General monitoring	CPUE, size structure, Wr	None
Trap Netting			
Crappie spp.	General monitoring	CPUE, size structure, Wr	None
Creel Survey			
All sport fish species	Angler preference and success for all sportfish species	Angler CPUE, total harvest, effort, size composition of harvest and total expenditures	9 days/spring quarter

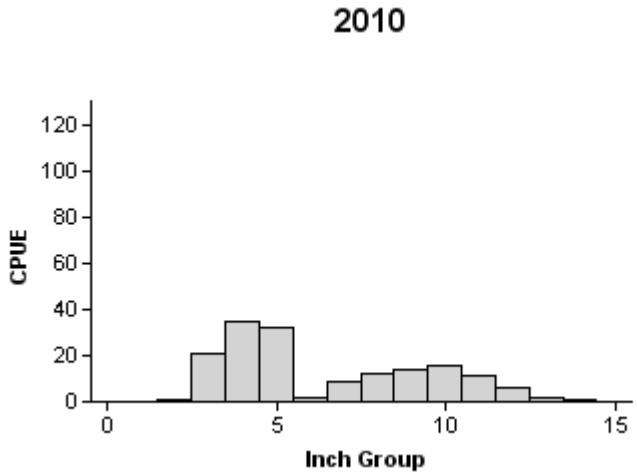
Table 6. Survey of structural habitat types, Lake Brazos Reservoir, Texas, 2009. Survey was conducted using 2010 NAIP, 1-meter resolution satellite imagery. Shoreline habitat type units are in miles.

Habitat type	Estimate	% of total
Bulkhead	4.06	11.45
Gravel shoreline	0.10	0.30
Boulder/Rip-rap shoreline	3.52	9.91
Rock bluff	0.95	2.68
Natural	26.67	75.20
Giant Reed	0.88	2.48
Boat docks and ramps	0.52	1.47

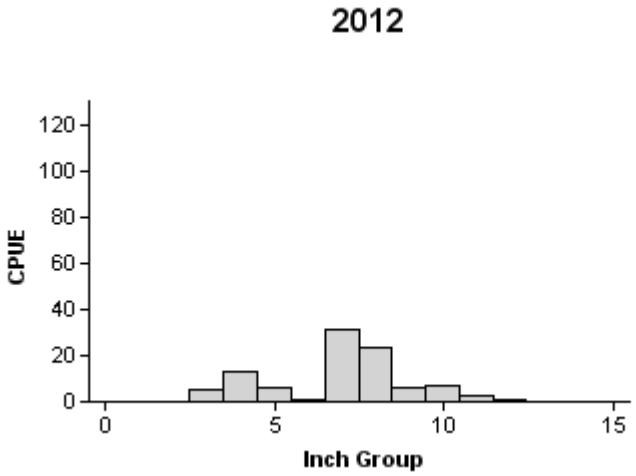
Table 7. Survey of aquatic vegetation, Lake Brazos Reservoir, Texas, 2009, 2010, 2011, 2012, 2013 and 2016. Percent of total reservoir area is listed for 2009 through 2013, while percent of randomly-selected points where species occurred is listed for 2016. Although no gauging station exists near Lake Brazos, water level was near full pool during the surveys. Tier III is watch status.

Vegetation	2009	2010	2011	2012	2013	2016
Native emergent						
Cattail (*Typha spp.*)						8.3% (3 of 36)
Common buttonbush (*Cephalanthus occidentalis*)						2.8% (1 of 36)
American water-willow (*Justicia americana*)						31.0% (11 of 36)
Non-native						
Giant reed (*Arundo donax)* (Tier III)	3.6 (0.7)	6.6 (1.3)	6.2 (1.2)	7.5 (1.4)	7.5 (1.4)	19.4% (7 of 36)

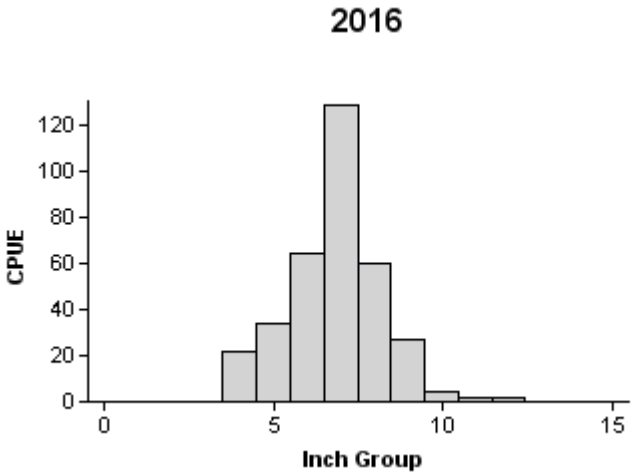
Gizzard Shad



Effort = 1.0
Total CPUE = 162.0(26;162)
Stock CPUE= 71.0 (32; 71)
IOV = 62 (6)



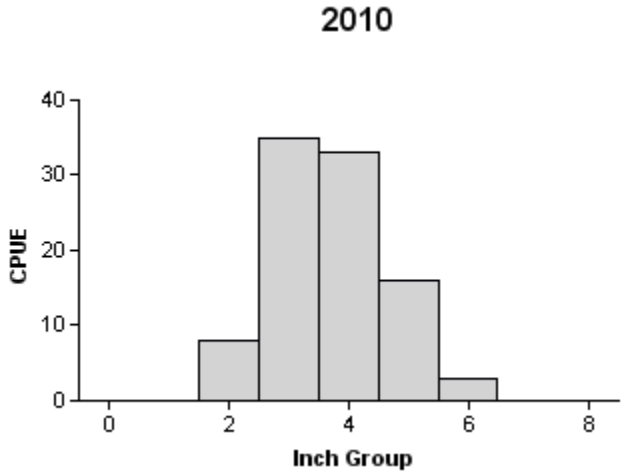
Effort = 1.0
Total CPUE = 96.0 (41; 96)
Stock CPUE = 71.0 (48; 71)
IOV = 58 (11)



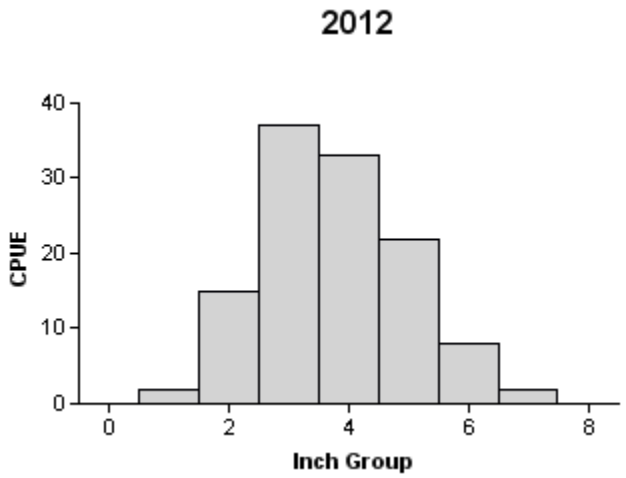
Effort = 1.0
Total CPUE = 343.0(21;343)
Stock CPUE= 223.0(20;223)
IOV = 72 (5)

Figure 1. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Brazos Reservoir, Texas, 2010, 2012 and 2016 (daytime).

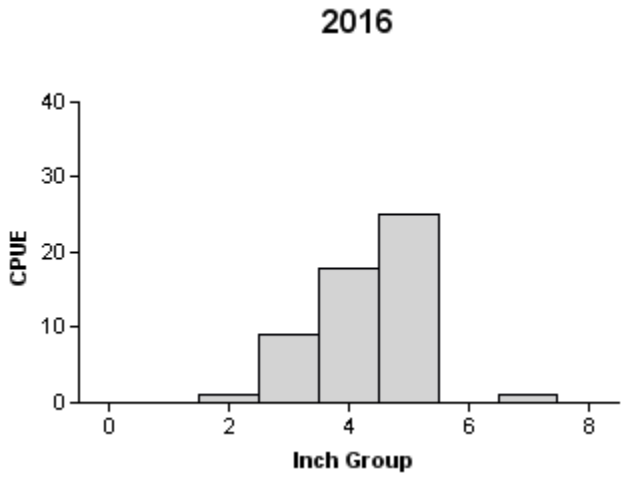
Bluegill



Effort = 1.0
Total CPUE = 95.0 (23; 95)
Stock CPUE = 87.0 (21; 87)
PSD = 3 (2)



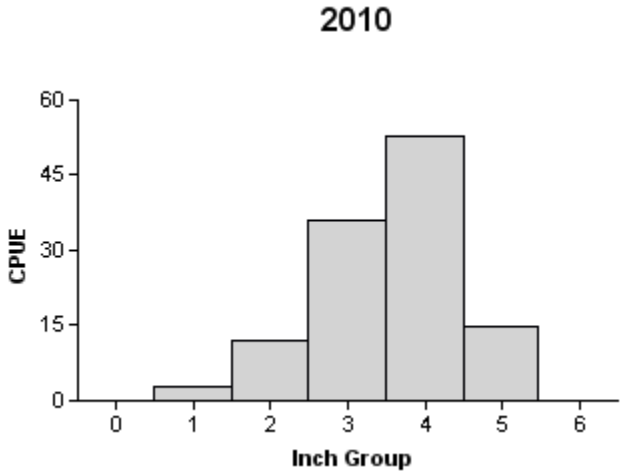
Effort = 1.0
Total CPUE = 119.0(27;119)
Stock CPUE= 102.0(28;102)
PSD = 10 (3)



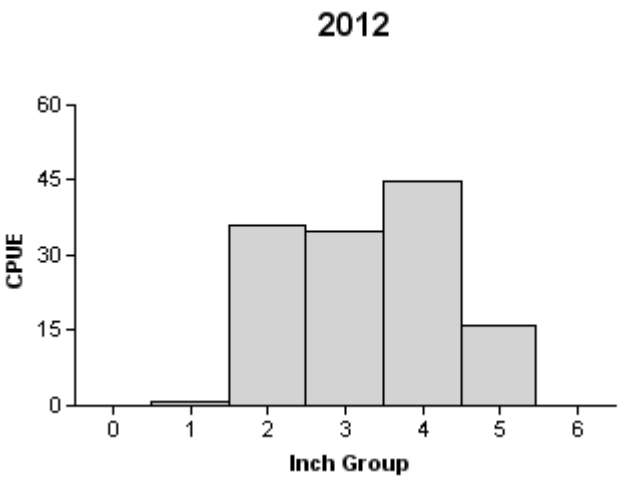
Effort = 1.0
Total CPUE = 54.0 (24; 54)
Stock CPUE = 53.0 (25; 53)
PSD = 2 (2)

Figure 2. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parenthesis) for fall electrofishing surveys, Lake Brazos Reservoir, Texas, 2010, 2012 and 2016 (daytime).

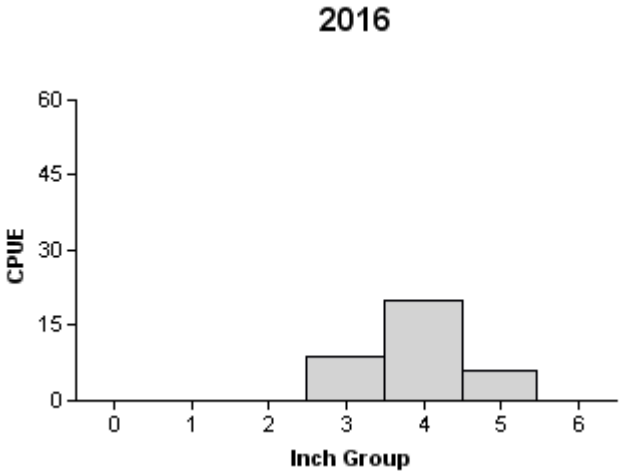
Longear Sunfish



Effort = 1.0
Total CPUE = 119.0 (21;119)
Stock CPUE = 119.0 (21;119)
PSD = 100 (0)



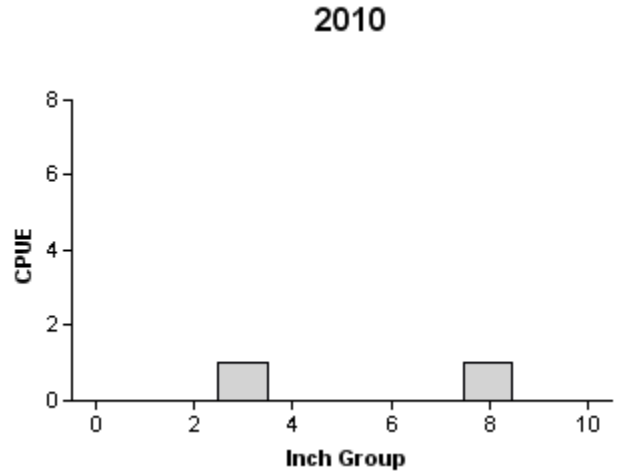
Effort = 1.0
Total CPUE = 133.0 (39; 133)
Stock CPUE = 133.0 (39; 133)
PSD = 100 (0)



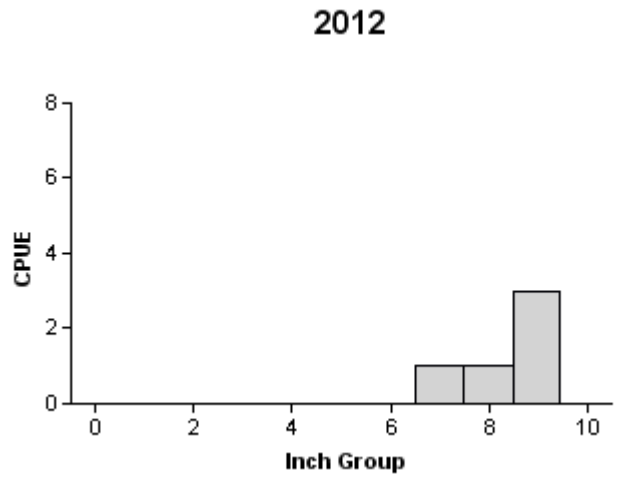
Effort = 1.0
Total CPUE = 35.0 (23; 35)
Stock CPUE = 35.0 (23; 35)
PSD = 100 (0)

Figure 3. Number of Longear Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parenthesis) for fall electrofishing surveys, Lake Brazos Reservoir, Texas, 2010, 2012 and 2016 (daytime).

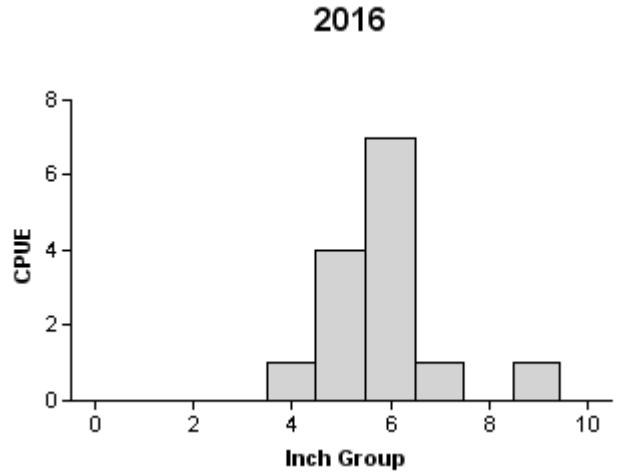
Redear Sunfish



Effort = 1.0
Total CPUE = 2.0 (67; 2)
Stock CPUE = 1.0 (100; 1)
PSD = 100 (0)



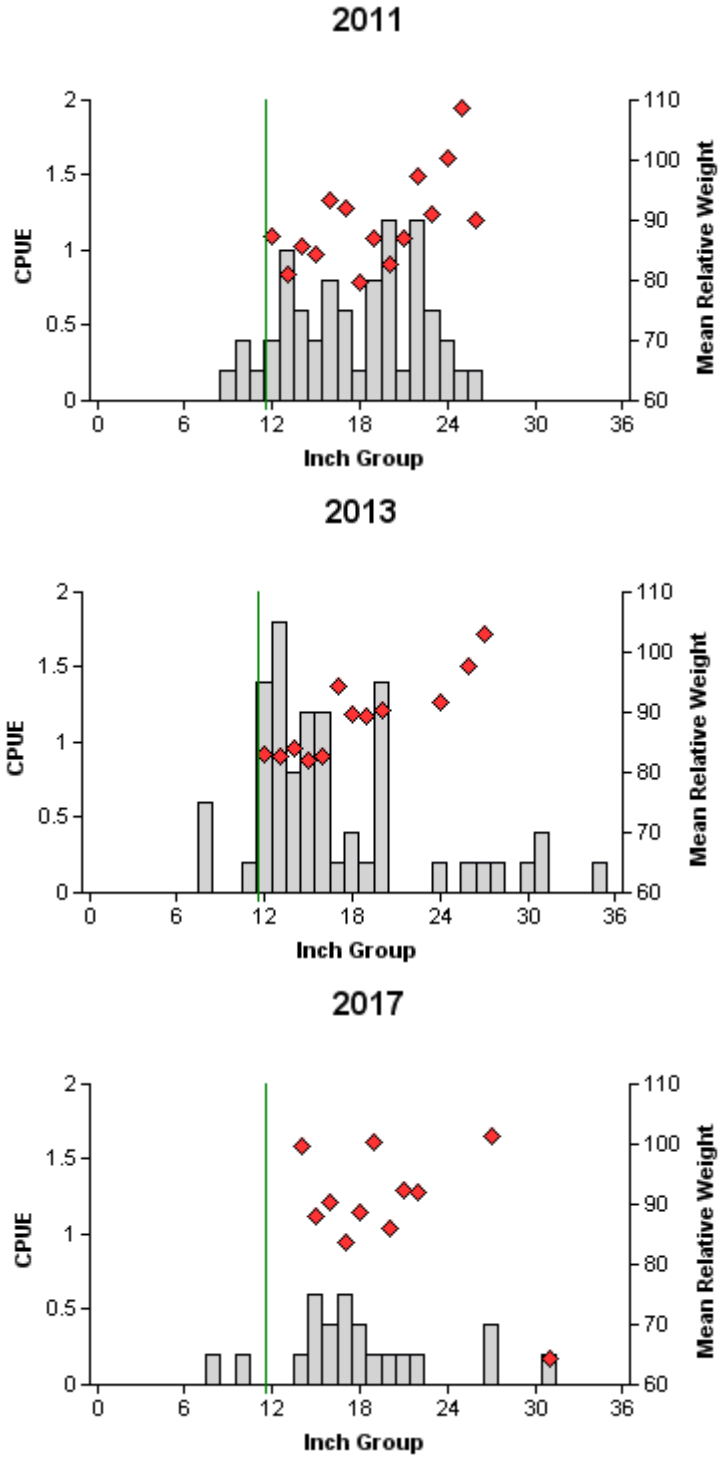
Effort = 1.0
Total CPUE = 5.0 (46; 5)
Stock CPUE = 5.0 (46; 5)
PSD = 100 (0)



Effort = 1.0
Total CPUE = 14.0 (35; 14)
Stock CPUE = 14.0 (35; 14)
PSD = 14 (7)

Figure 4. Number of Redear Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parenthesis) for fall electrofishing surveys, Lake Brazos Reservoir, Texas, 2010, 2012 and 2016 (daytime).

Blue Catfish



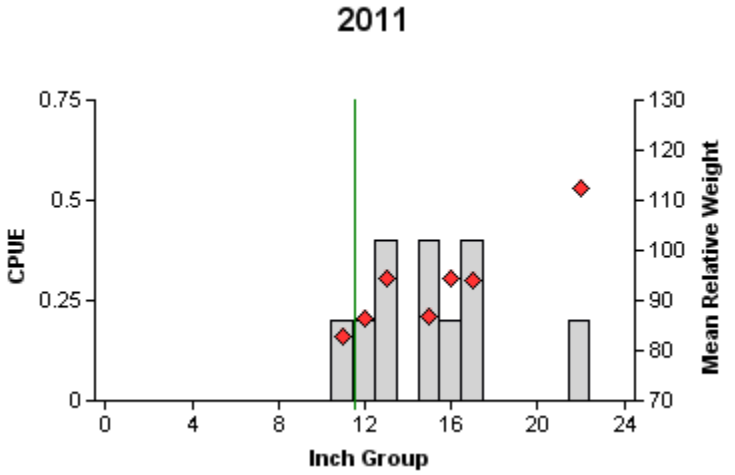
2011
Effort = 5.0
Total CPUE = 9.6 (10; 48)
Stock CPUE = 8.8 (10; 44)
PSD = 45 (11)
PSD-12 = 100 (0)

2013
Effort = 5.0
Total CPUE = 11.0 (29; 55)
Stock CPUE = 10.2 (28; 51)
PSD = 29 (9)
PSD-12 = 100 (0)

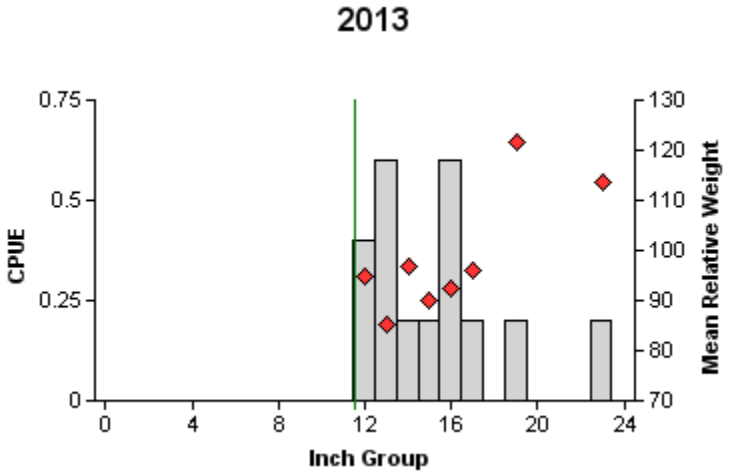
2017
Effort = 5.0
Total CPUE = 4.0 (40; 20)
Stock CPUE = 3.6 (41; 18)
PSD = 33 (10)
PSD-12 = 100 (0)

Figure 5. Number of Blue 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 Brazos Reservoir, Texas, 2011, 2013 and 2017 (nets set parallel to shoreline). Minimum length limit represented by vertical line.

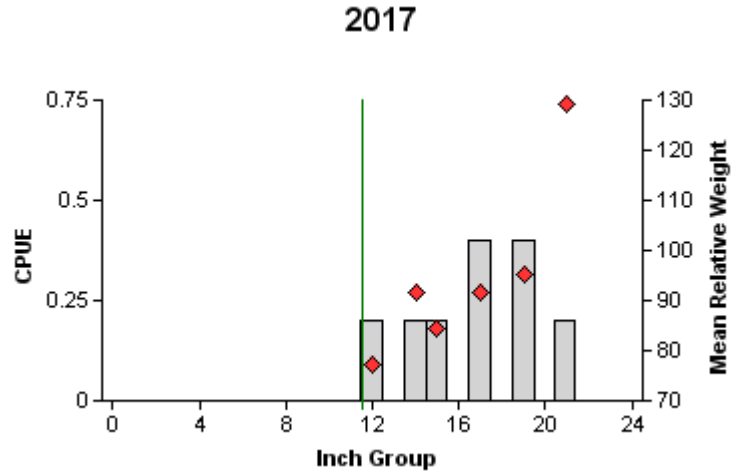
Channel Catfish



Effort = 5.0
Total CPUE = 2.0 (27; 10)
Stock CPUE = 2.0 (27; 10)
PSD = 40 (13)
PSD-12 = 90 (10)



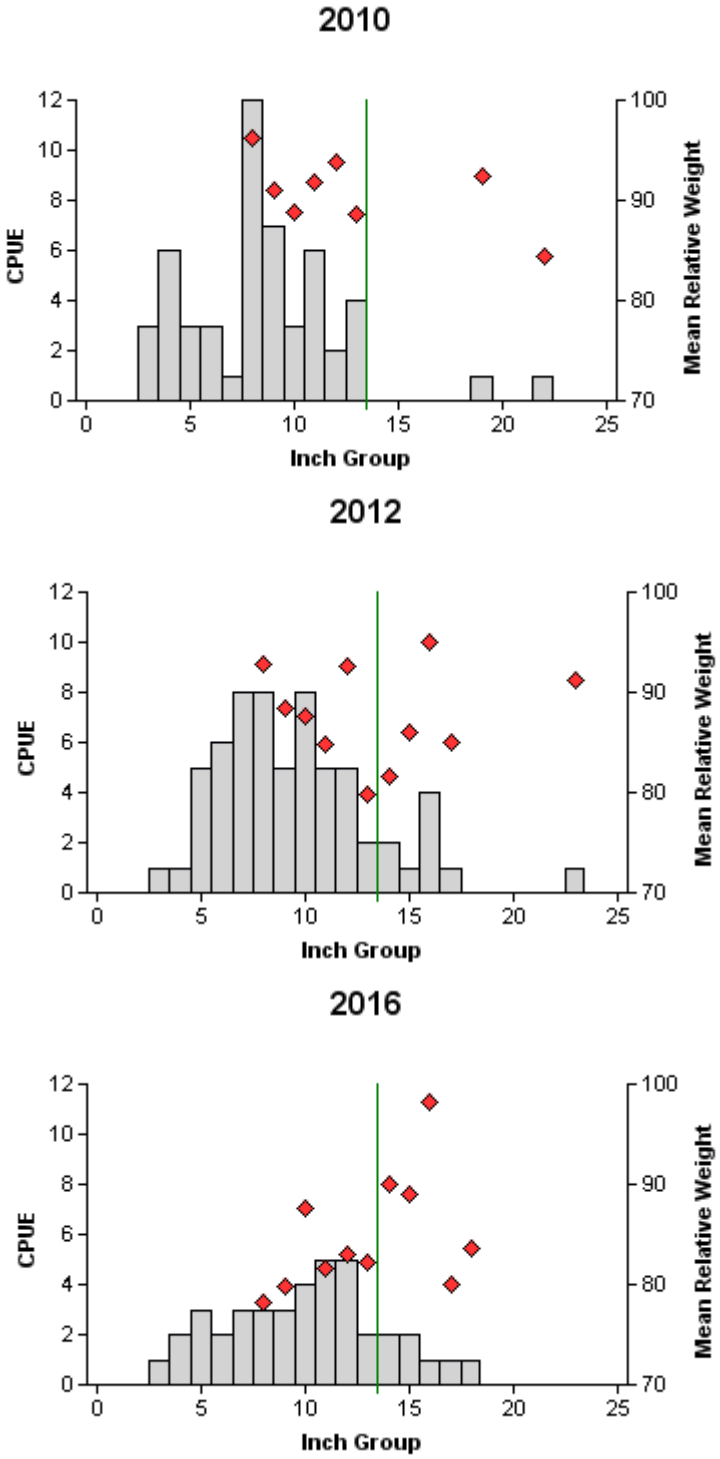
Effort = 5.0
Total CPUE = 2.6 (20; 13)
Stock CPUE = 2.6 (20; 13)
PSD = 46 (20)
PSD-12 = 100 (0)



Effort = 5.0
Total CPUE = 1.6 (47; 8)
Stock CPUE = 1.6 (47; 8)
PSD = 62 (9)
PSD-12 = 100 (0)

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 Brazos Reservoir, Texas, 2011, 2013 and 2017 (nets set parallel to shoreline). Minimum length limit represented by vertical line.

Largemouth Bass



Effort =	1.0
Total CPUE =	52.0 (24; 52)
Stock CPUE =	36.0 (25; 36)
PSD =	22 (5)
PSD-14 =	6 (4)

Effort =	1.0
Total CPUE =	63.0 (29; 63)
Stock CPUE =	42.0 (29; 42)
PSD =	38 (5)
PSD-14 =	21 (6)

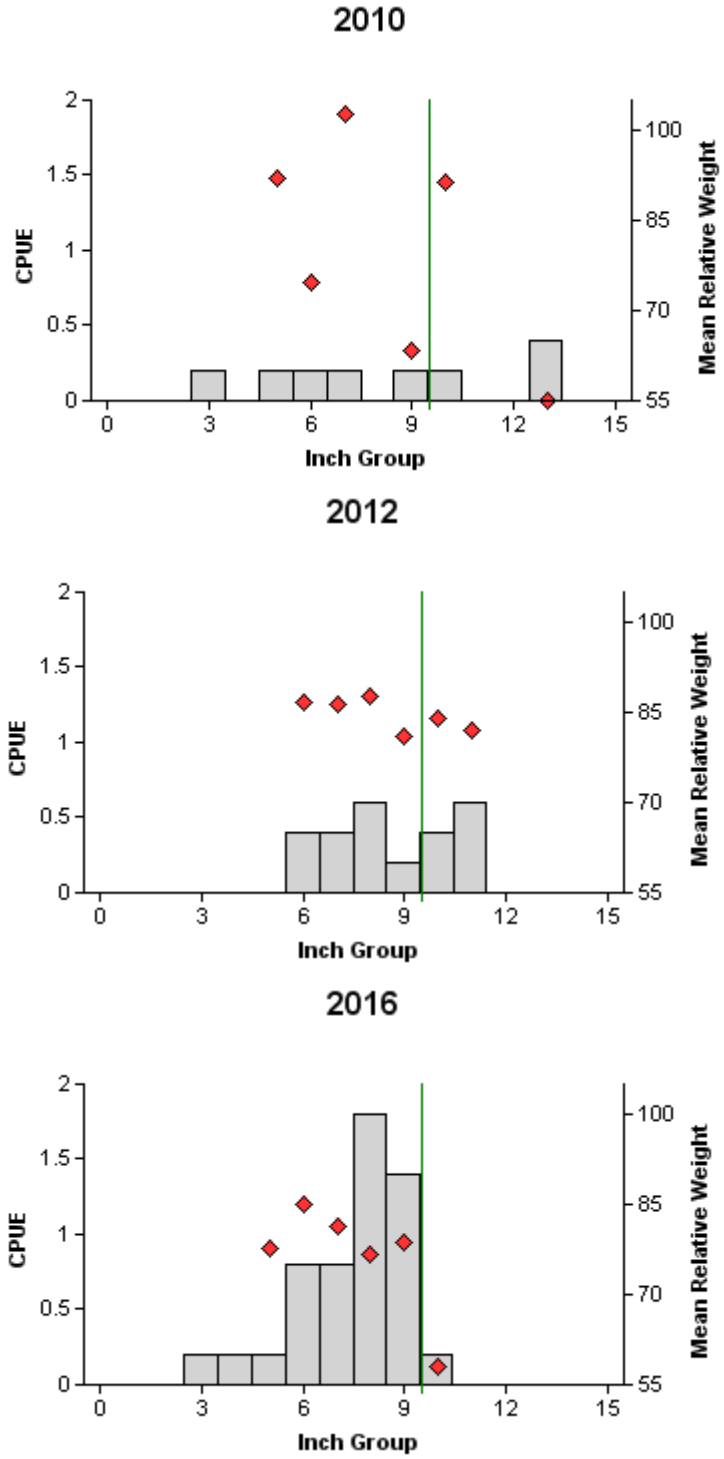
Effort =	1.0
Total CPUE =	40.0 (16; 40)
Stock CPUE =	29.0 (20; 29)
PSD =	48 (12)
PSD-14 =	24 (8)

Figure 7. Number of Largemouth Bass caught per hour (CPUE), 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 Brazos Reservoir, Texas, 2010, 2012 and 2016 (daytime). Minimum length limit represented by vertical line.

Table 8. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Lake Brazos Reservoir, Texas, 2008 and 2016. 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.

		Number of fish				
Year	Sample size	FLMB	Hybrid	NLMB	% FLMB alleles	% FLMB
2008	15	0	13	2	33	0
2016	30	0	29	1	39	0

White Crappie



Effort = 5.0
Total CPUE = 1.6 (51; 8)
Stock CPUE = 1.4 (53; 7)
PSD = 57 (15)
PSD-10 = 43 (26)

Effort = 5.0
Total CPUE = 2.6 (73; 13)
Stock CPUE = 2.6 (73; 13)
PSD = 24 (14)
PSD-10 = 38 (9)

Effort = 5.0
Total CPUE = 5.6 (58; 28)
Stock CPUE = 5.2 (58; 26)
PSD = 65 (6)
PSD-10 = 4 (3)

Figure 8. Number of White Crappie 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 fall trap net surveys, Lake Brazos Reservoir, Texas, 2010, 2012 and 2016. Minimum length limit represented by vertical line.

Table 9. Proposed sampling schedule for Lake Brazos Reservoir, Texas. Survey period is June through May. Gill netting surveys are conducted in the spring, while electrofishing and trap netting surveys are conducted in the fall and winter. Standard survey denoted by S and additional survey denoted by A.

Survey year	Electrofish Fall	Trap net	Gill net	Habitat		Access	Creel survey	Report
				Structural	Vegetation			
2017-2018								
2018-2019			A					
2019-2020							S	
2020-2021	S	S	S		S	S		S

APPENDIX A

Number (N), relative standard error (RSE) and catch rate (CPUE) of all target species collected from all gear types from Lake Brazos Reservoir, Texas, 2016-2017.

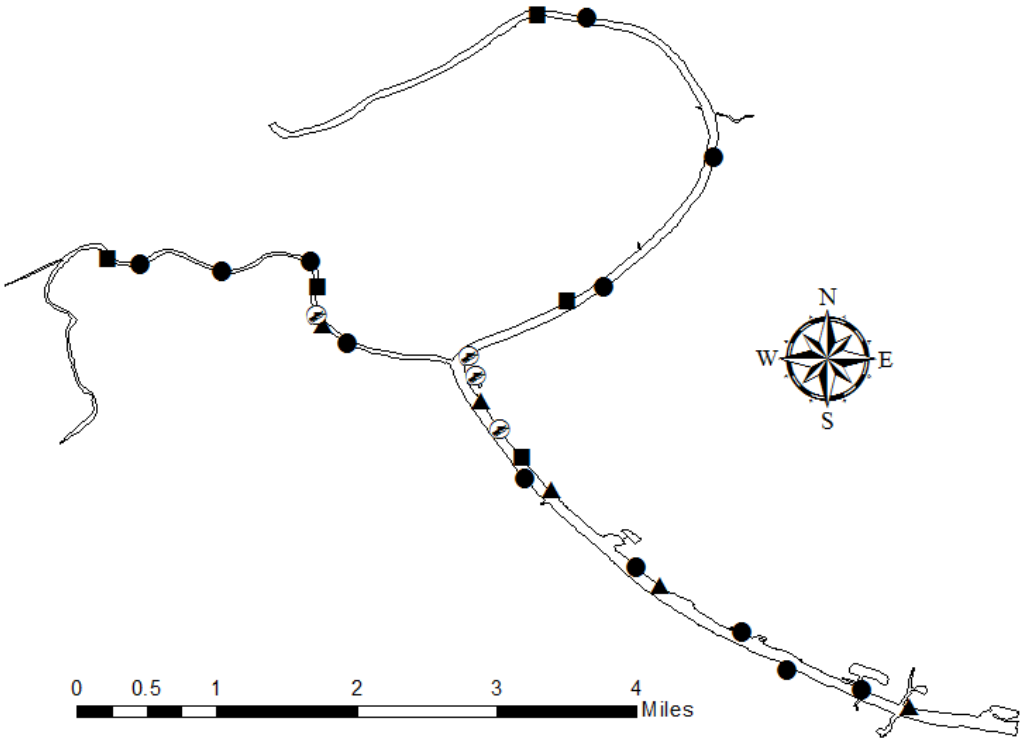
Species	Gill Netting		Trap Netting		Electrofishing	
	N/RSE	CPUE	N/RSE	CPUE	N/RSE	CPUE
Gizzard Shad					343/21	343.0
Threadfin Shad					116/66	116.0
Blue Catfish	20/40	4.00				
Channel Catfish	8/47	1.60				
Green Sunfish					1/100	1.0
Bluegill					54/24	54.0
Longear Sunfish					35/23	35.0
Redear Sunfish					14/35	14.0
Largemouth Bass					40/16	40.0
White Crappie			28/58	5.60		

APPENDIX B

Catch rates (CPUE) of targeted species by gear type for standard surveys on Lake Brazos Reservoir, Texas, 2008 to present. Electrofishing stations were shocked with a 5.0 Smith-Root GPP (Gas Powered Pulsator) until 2010, then a 7.5 Smith-Root GPP was used. Objective based sampling began in 2015. Species averages are in bold.

Gear	Species	2008	2009	2010	2011	2012	2013	2016	2017	**Avg.**
Electrofisher										
	Largemouth Bass	20.0		52.0		63.0		40.0		**43.8**
	Smallmouth Bass	0		0		2.0		0		**0.5**
	Spotted Bass	13.0		7.0		13.0		0		**8.3**
	Gizzard Shad	155.0		162.0		96.0		343.0		**189.0**
	Threadfin Shad	21.0		12.0		17.0		116.0		**41.5**
	Bluegill Sunfish	50.0		95.0		119.0		54.0		**79.5**
	Redear Sunfish	12.0		2.0		5.0		14.0		**8.3**
	Longear Sunfish	41.0		119.0		133.0		35.0		**82.0**
	Green Sunfish	5.0		2.0		0		1		**2.0**
	Warmouth	0		4.0		2.0		0		**1.5**
Gill nets										
	Blue Catfish		5.2		9.60		11.0		4.00	**7.5**
	Channel Catfish		7.4		2.00		2.60		1.60	**3.4**
	White Bass		1.4		0.20		1.80		0	**0.9**
	Palmetto Bass		0		0		0.40		0	**0.1**
	Striped Bass		0.6		1.60		0.60		0	**0.7**
	Flathead Catfish		0		0.40		0		0	**0.1**
Trap nets										
	White Crappie	4.2		1.60		2.60		5.60		**3.5**
	Black Crappie	0		0.20		0		0		**0.05**

APPENDIX C



Location of electrofishing (circles), trap netting (squares), and gill netting (triangles) sites, Lake Brazos Reservoir, Texas, 2016 and 2017. Boat ramps are also marked.