PERFORMANCE REPORT

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FEDERAL AID PROJECT F-221-M-4

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2013 Fisheries Management Survey Report

Falcon Reservoir

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July 31, 2014

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Falcon Reservoir were surveyed using electrofishing in 2009, 2011, 2013-2014, gill nets in 2010, 2012, 2014, and trap nets in 2009-2010 and 2012-2013. Historical data are presented with the 2013-2014 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:** Falcon Reservoir (83,654 acres when full) borders Mexico and was constructed in 1954 on the Rio Grande River. The reservoir experiences extreme water level fluctuations due to variable rainfall and water releases for downstream agricultural irrigation. During the survey period (6/2009-5/2014),water level ranged from 41 feet below (5/2013) to 4 feet above (10/2010) conservation pool elevation. Flooded terrestrial vegetation is the predominant structural habitat for fish.

- **Management History:** Fish harvest is regulated by Texas Parks and Wildlife Department according to the standard statewide restrictions and is unregulated by Mexico. A substantial commercial gill net fishery exists on the Mexico-side of the reservoir targeting primarily Blue Tilapia, Catfishes, and rough fish species. Striped Bass were stocked prior to 2003 to provide an additional angling opportunity, but were discontinued because of low water level and minimal angler utilization. White Bass and White Crappie stockings were conducted in the 2000s in an attempt to restore these two populations. Florida Largemouth Bass (FLMB) fingerlings have been stocked annually in recent years to increase FLMB genetic introgression and in turn, Largemouth Bass trophy potential.

- **Fish Community**
  - **Prey species:** Gizzard Shad, Threadfin Shad, Bluegill, and Blue Tilapia are the primary forage species, and were present in sufficient quantity and size to support predator species.

  - **Alligator Gar:** Abundance has reportedly increased in recent years. Catches of state and world record size fish were reported in 2013, but these were unconfirmed.

  - **Catfishes:** Blue Catfish abundance increased during the study period, but the population was comprised of a larger proportion of small fish than in the past. Channel Catfish abundance declined during the study period and the population was dominated by small fish. Catfishes accounted for a decreased proportion of the total fishing effort.

  - **White Bass:** White Bass were first collected in gill nets in 2014 after not having been collected since 1995 due to the effects of an extended low water period coinciding with intense Mexican commercial netting.

  - **Largemouth Bass:** Largemouth Bass relative abundance peaked in 2009-2011, then declined by about 60%. Fishing effort increased by 135%, catch by 79%, and harvest by 95% in 2011 over 2006.

  - **Black Crappie:** Black Crappie have been reestablished in the reservoir since 2009, however relative abundance remains low.

- **Management Strategies:** Stock FLMB annually, increase frequency of surveys to monitor Largemouth Bass and White Bass populations, and conduct an intensive study of Alligator Gar.

INTRODUCTION

This document is a summary of fisheries data collected from Falcon Reservoir in 2009-2014. 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 2013-2014 data for comparison.

Reservoir Description

Falcon Reservoir is a Texas-Mexico border impoundment constructed on the Rio Grande River. At conservation pool elevation, the reservoir encompasses 83,654 acres, with 38,360 acres located within Texas jurisdiction. The reservoir was completed in 1954 and was built for water conservation, flood control, hydroelectric energy, and recreation. Ownership of water is shared between Mexico (41%) and the U.S. (59%) and flows are managed by the International Boundary and Water Commission (IBWC) and Texas Commission on Environmental Quality according to the 1944 Water Treaty established between the two countries.

The reservoir experiences dramatic water level fluctuations due to variable rainfall and downstream agricultural irrigation needs (Figure 1). Water level declined to a record low of 54 feet below conservation pool elevation (CP) in 2002 due largely to a drought that began in 1992. Dense terrestrial vegetation became established on the exposed reservoir bottom during this extended low water period. Beginning in 2002, heavy rainfalls caused the water level to rise to within 10 feet of CP in 2005. As a result, more than 10,000 acres of terrestrial vegetation were inundated creating ideal fisheries habitat for a period of three years. From 2005-2008, water level remained between 10 and 30 feet below CP. A similar magnitude and duration water level increase occurred beginning in fall 2008 and lasted through 2010 with water level exceeding full pool on two occasions. This water level increase resulted in inundation of an additional large area of terrestrial vegetation yielding additional improvement in fish habitat. Water level declined rapidly starting in 2011 and remained at about 40 feet below CP from early 2012 to mid-2013. Water level increased by about 15 feet during latter 2013 and receded to be about 25 feet low in spring 2014.

Flooded terrestrial vegetation is the predominant structural fisheries habitat. Species include mesquite, retama, huisache, acacia, salt cedar, and various grasses. Other descriptive characteristics for the reservoir are in Table 1.

Angler Access

There are two public boat ramps (Zapata County Park and Falcon Lake State Park) and several private boat launches associated with motels and RV parks adjacent to the reservoir (Table 2). Shoreline angling access is limited to areas around the boat ramps. Zapata County completed construction of a county park adjacent to their boat ramp, renovated the boat ramp, and expanded boat trailer parking. In spring 2012, low water level caused the old highway 83 bridge which crosses the Veleno arm of the reservoir to become a boating hazard. At the request of Texas Parks and Wildlife Department (TPWD), Inland Fisheries, the IBWC marked the structure with buoys thereby minimizing the hazard. For a 3-4 month period in 2013, the primary boat ramp at Falcon State Park became unusable due to low water level, however anglers were able to launch boats from shore at location designated for such.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Dennis and Myers 2010) included:

1. Conduct additional trap net sampling in 2011-2012 to monitor the recovery of the Black Crappie population.

   Action: Additional trap netting was conducted in 2012 and results are presented in this report.

2. Conduct a creel survey from January through June in 2011 to determine Black Crappie catch.

   Action: The creel survey was conducted and results are presented in this report.

3. Conduct additional gill net sampling to monitor the white bass populations in 2011-2012.

   Action: Additional gill netting was conducted in 2012 and results are presented in this report.

Harvest regulation history: All sport fishes are currently managed, and have historically been managed, with statewide regulations (Table 3). Fish harvest is unregulated in Mexico

Stocking history: Walleye (1975-1977), Palmetto Bass (1984 and 1987), Striped Bass (1976-2002), Smallmouth Bass (1984), White Crappie (2003), White Bass (2003-2009), Bluegill (2003), Blue Catfish (2003) and Largemouth Bass (1975-2013) have been stocked into the reservoir. Stockings of walleye, Smallmouth Bass, Palmetto Bass, and Striped Bass were conducted to provide additional angling opportunities, but these were discontinued either because they were ineffective or had low angler utilization. White Bass and White Crappie stockings were conducted in an attempt to restore these two populations which historically supported popular fisheries, but were decimated during the 1990s due an extended period of low water level combined with commercial netting impacts. Bluegill, Blue Catfish, and Largemouth Bass stockings in 2003-2005 occurred coincident with the dramatic water level increase to improve populations depressed as a result of the previous extended period of low water. Since 2010, FLMB have been stocked annually to increase FLMB genetic introgression and in turn, Largemouth Bass trophy potential. The complete stocking history is in Table 4.

Vegetation/habitat management history: No habitat or vegetation management activities have been conducted on this reservoir.

Water transfer: No interbasin transfers are known to exist.

METHODS

Fishes were collected by electrofishing (2 h at 24, 5-minute randomly-selected stations) during fall 2009 and 2013. Bass-only electrofishing was conducted in fall 2009 (2 h at 24, 5-minute randomly-selected stations) and during 2011 (variable duration biologist-selected stations) and in spring 2009, 2011, and 2013-2014 (2 h at 24, 5-minute randomly-selected stations). Additional bass-only electrofishing was conducted in 2009, 2011, and 2014 (variable duration biologist-selected stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing.

Fishes were collected by gill-netting (15 net nights at 15 randomly selected stations) in spring 2010 and 2014. Additional gillnetting was conducted in 2012 (6 biologist selected stations) specifically targeting White Bass. Catch per unit effort (CPUE) for gill netting was recorded as the number of fish caught per net night (fish/nn).

Fishes were collected by trap-netting in 2010, 2012, 2013 (8-16 net nights/year). Sample stations were biologists-selected to maximize catch. Catch per unit effort (CPUE) for trap-netting was recorded as the number of fish caught per net night (fish/nn).

Sampling locations for 2013 -2014 sampling year, by gear type, are shown in Appendix A.

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.

Alligator Gar were collected using nylon-twine gillnets ranging in size from 3.5-5.0 inch bar mesh in fall 2013 across a 2-day time period. Sampling stations were biologist selected within one general location of the reservoir (Goose Bay). Nets were fished both during day and night.

Creel survey sampling was conducted from 1/1/2011 to 6/30/2011 (6 months). Sampling was conducted according to TPWD Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2011). Creel sampling was conducted on a total of 6 random weekend days and 4 random weekdays. Each sample day was split into equal duration time periods, with random time period selection and 1 time period sampled per creel day. Voluntary release rates were computed as number of legally harvestable size fish released divided by the sum of number of harvested fish and legally-harvestable size fish released *100 (Myers et al. 2008). Additionally, estimated weights of caught and released largemouth bass $\geq$14 inches were obtained from interviewed anglers to estimate number of fish released by weight category.

Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2011). Micro-satellite DNA analysis was used to determine genetic composition of individual fish from 2005 to present and by electrophoresis prior to 2005. Fish utilized for genetic analysis prior to 2011 were collected by electrofishing in fall. Fish, utilized in genetic analysis after 2011 and described as controls were collected at bass tournament weigh-ins in fall and weighed <10 lbs. Those described as trophy were $\geq$10 lbs with fin clips voluntarily provided by anglers.

Largemouth bass collected in March 2013 were aged using otoliths in accordance to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2011). Five largemouth bass per 1-inch length group was the targeted sample size. Alligator Gar were aged according to Buckmeier et al. (2012).

A shoreline structural habitat survey was conducted in 2009 and vegetation surveys were conducted in 2009 and 2013. These surveys were conducted according to the TPWD Fishery Assessment Procedures in effect at time of the surveys.

Source for water level data was the International Boundary Water Commission (IBWC 2014).

RESULTS AND DISCUSSION

Habitat: Flooded terrestrial vegetation (huisache, mesquite, acacia, and salt cedar) is the primary fisheries habitat in the reservoir, and its quantity varies with water level. On the Texas side of the reservoir, percent occurrence of terrestrial vegetation decreased from 68% in 2009 when water level was 11 feet below CP to 22% in 2013 when water level was 39 feet below CP (Table 5). Flooded terrestrial vegetation occupied 98% of the Texas shoreline according to the 2009 structural habitat survey (Table 6). Aquatic vegetation was not found in the reservoir during the study period (2009-2014).

Creel: Fishing for Largemouth Bass comprised 91.9% of the total fishing effort expended on the reservoir in 2011 (Table 7), which represented an increase compared to 2006 (83.3%). Fishing for catfishes comprised 4.8% of the total fishing effort on the reservoir in 2011 which represented a decrease compared to 2006 (16.3%). Total fishing effort on the reservoir was 113% greater in January-June 2011 than in the same period in 2006 (Table 8). Likewise, total direct fishing expenditures increased by 185% in January-June 2011 than in the same period in 2006.

Prey species: Electrofishing CPUE of Gizzard Shad was low and similar among years ranging from 5.5 fish/h in 2005 to 25.0 fish/h in 2009 (Figure 2). Gizzard Shad IOV ranged from a low of zero in 2009 to a high of 83 in 2013. Electrofishing CPUE of Threadfin Shad was 4.0 fish/h in 2013 (Appendix B) and of Bluegill was zero in 2013. Bluegill were present in the reservoir, but relative abundance values have been historically low (Figure 3). Fluctuating water level and associated changes in electrofishing catch efficiency along with predatory effects were likely responsible for the low Gizzard Shad relative abundance and size structure values. Blue Tilapia and crayfish are also important prey species in the reservoir. However, relative abundance of Blue Tilapia could not be determined because of low susceptibility of this species to electrofishing. Rapid growth of predator species (see below) and average relative weights exceeding 90 for all but one size class of Largemouth Bass (see below) suggest prey availability is sufficient for predator fish populations.

Alligator Gar: A total of 28 Alligator Gar were captured ranging in length from 45 to 70 inches and in weight from 28 to 98 lbs (Figure 4). Collected fish ranged in age from 3 to 6 years old. Ages of fish generally coincided with years during which water level increased. Stomach contents included Common Carp (N = 5 fish), Blue Tilapia (N = 2 fish), Gizzard Shad (N = 1 fish), and Largemouth Bass (N = 1 fish). In late summer 2013, catches of very large Alligator Gar were reported, the biggest of which reportedly was 8 feet 9 inches in length and bottomed-out a 300 lb weighing scale. Photos of the fish were received, but attempts to get to get the fish weighed on certified scales were unsuccessful.

Catfishes: Gillnet CPUE of Blue Catfish (Figure 5) in 2014 (8.1 fish/nn) was similar to in 2010 (8.7 fish/nn) which represents about a 50% increase compared to in 2006 (4.6 fish/nn). However, gill net CPUE of stock size fish was substantially less in 2014 (1.6 fish/nn) than in 2010 (6.2 fish/nn indicating the

population was dominated by young, sub-legal size individuals. Blue Catfish PSD values were similar across years ranging from 11-17. High winds during sampling prevented collection of weight data in 2014. Average relative weights exceeded 85 for most size classes in 2006 and 2010.

Gillnet CPUE of Channel Catfish was low (1.5-3.0 fish/nn) in 2006, 2010, and 2014 (Figure 6). Population size structure remained poor with length frequency distribution modal peaks decreasing from 13 inches in 2006 to 10 inches in 2010, and to 8 inches in 2014. Channel Catfish PSD ranged from 0-6 across years. Insufficient weight data were collected in 2006 and 2010, and high winds during sampling prevented computation of legitimate relative weight values in 2014.

While fishing effort directed for catfishes was less in 2011 (5,216 h) than in 2006 (8,308 h), catch and harvest of both Blue and Channel catfishes increased (Table 9). Catch nearly doubled from 12,714 fish in 2006 to 22,380 fish in 2011. As such, angling success increased with average catch per hour of 2.3 in 2011. Blue and Channel catfish harvest was 150% and 23% greater, respectively, in 2011 than 2006. The most frequent size of Blue and Channel catfish harvested was 16 inches (Figure 7).

White Bass: White Bass were first collected in gill nets in 2014 after not having been collected since 1995 due to the effects of an extended low water period coincident with intense Mexican commercial netting. Gillnet CPUE was 0.5 fish/nn in 2014 (Figure 8). Collected fish ranged from 10-12 inches in length and were born in late 2012 early 2013. White Bass spawning historically occurred as early as November-December upstream of Falcon in the Rio Grande River. No directed effort or catch were documented occurring in 2011 creel survey sampling.

Largemouth Bass: Relative abundance of Largemouth Bass increased during the study, peaking in 2009-2011, then declined substantially similar to that recorded in the early 2000s when water level was near the historic low (Figures 9-10, Table 10). Electrofishing CPUE was 65% less in fall 2013 (17.0 fish/h) than in fall 2009 (48.0 fish/h). Spring surveys confirmed the decline in relative abundance. Average CPUE in 2013-2014 represented a 69% decrease compared to 2011 (65.5 fish/h).

Relative abundance of stock-size and ≥14 inch Largemouth Bass exhibited the same trend. Based on spring surveys, electrofishing CPUE of stock-size and ≥14 inch fish declined 65% and 53%, respectively from 2011 to 2013-2014. Fall surveys likewise yielded 53% and 40% decreases in electrofishing CPUE of stock-size and ≥14 inch fish, respectively from 2009 to 2013.

Overall, average relative weight of Largemouth Bass was good during the study period exceeding 90 for most fish size classes, with exception of fish collected in spring 2013. The lower average relative weights in spring 2013, however, were short-lived as values were above 90 for most size classes in spring 2014.

Population size structure was consistent during the study period. Proportional size distribution remained above 70 based on both fall and spring surveys. Proportional size distribution of ≥18 inch fish ranged from 18-21 during the study period according to fall surveys and from 14-31 based on spring surveys.

Fish continued to exhibit rapid growth obtaining legal-harvestable size in two growing seasons (Table 11). Most fish born in 2012 exceeded 14 inches in length during March 2014. Relatively strong year classes were produced in 2010 and 2006, representing 51% and 8%, respectively, of all sampled fish. Total annual mortality could not be estimated using a catch curve analysis as there was no significant relationship between age and number-at-age ($P = 0.30$).

Genetic introgression of Florida Largemouth Bass (FLMB) into the population was greater in 2011 than in 2005 and 2009 (Table 12). Percent FLMB alleles was 74 in 2011, whereas it was 68 and 52 in 2005 and 2009, respectively. Annual stockings of FLMB since 2010 were likely responsible for the increase in average introgression. Introgression in trophy fish (≥10 lbs) was 76% FLMB alleles, which was similar to

the ≤10 lb fish population average (74%). Surprisingly, a higher proportion of the <10 lb population (15%) were FLMB genotype than trophy fish (7%). This suggests that an increase in percent FLMB genotypes and in average FLMB introgression level in Falcon Largemouth Bass may not yield a higher trophy potential. However, a more detailed analysis (Figure 11) shows that minimum FLMB introgression increases with fish size. This confirms that trophy potential is influenced by FLMB introgression level and suggests that an increase in minimum introgression *values* through additional stockings may yield greater overall trophy potential.

Directed-fishing effort, catch, and harvest of Largemouth Bass were considerably greater in 2011 than in 2006 (Table 13). Effort increased by 135%, catch by 79%, and harvest by 95%. Fishing success as measured by average catch/h was very good (non-tournament anglers; 1.2 fish/h) and similar in 2006 and 2011. The reservoir provided high quality catches. Of the fish caught and released, 22% were ≥4 lbs and 4% were ≥7 lbs. Although catch of tournament fish was much lower in 2011 (13,707 fish) than in 2006 (40,420 fish), the number of fish brought to weigh-in was similar between the two years. This and a substantial increase in voluntary release rate (from 54 to 78% for non-tournament anglers) suggest fishing mortality was lower in 2011 than 2006. Anglers most frequently harvested 16-inch fish in both 2006 and 2011 (Figure 12). Comparing the 2011 length frequency distribution of angler-harvested fish to the spring 2011 population size structure (Figure 10) suggests that anglers were not selective in size of fish harvested as these distributions were similar.

Black Crappie: Trapnet CPUE of Black Crappie ranged from a low of 0.6 fish/nn in 2010 to a high of 4.3 fish/nn in 2012, and was 1.3 fish/nn in 2013 (Figure 13). Although Black Crappie have reestablished in the reservoir since 2009, relative abundance remains low. The population was mostly comprised of adults with PSD ranging from 82-100 during the study period. No directed effort occurred in 2006 and only 477 h were expended fishing for the species in January-June 2011 (Table 14). Despite the low fishing effort, fishing success was very good with anglers catching an average of 6.8fish/h. Anglers harvested nearly all of their Black Crappie catch, with the most frequently harvested length being 13-14 inches (Figure 14).

Fisheries Management Plan for Falcon Reservoir, Texas

Prepared – July 2014.

ISSUE 1: Falcon Lake was ranked #1 in *Bassmaster Magazine's* top 100 bass lakes in the U.S. in 2012, #7 in 2013, and #12 in 2014. Despite the high ranking, Largemouth Bass relative abundance has declined substantially (about 65%) since 2011.

MANAGEMENT STRATEGIES

1. Conduct additional electrofishing surveys to better monitor Largemouth Bass population parameters.
2. Stock 500,000 FLMB fingerlings annually to increase trophy Largemouth Bass potential.
3. Conduct 6-month (January-June) creel survey in 2016 and use these data along with existing creel data to determine via simulation modeling the effects of a reduced daily bag limit and other possible harvest regulation changes on the population and fishery.
4. Coincident with the 2016 creel survey, determine angler's opinions and preferences regarding harvest regulation changes.

ISSUE 2: White Bass were first collected in gill nets in 2014 after not having been collected since 1995 due to the effects of an extended low water period coincident with intense commercial netting.

MANAGEMENT STRATEGIES

1. Conduct an additional gillnetting survey to document and monitor the recovering white bass population.

ISSUE 3: Management of Alligator Gar has become controversial at the reservoir due to anecdotal reports of a large increase in abundance and negative impact on Largemouth Bass.

MANAGEMENT STRATEGIES

1. Conduct an intensive study determining Alligator Gar relative abundance (baseline measures), population size and age-structure, diet, age-at-maturity, spawning time, and fecundity.
2. Conduct a survey to determine angler's opinions concerning management of this species.

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.

SAMPLING SCHEDULE JUSTIFICATION:

Additional electrofishing (bass-only) surveys in both spring and fall are needed to monitor trends in the Largemouth Bass population parameters (Table 14). An additional gillnetting survey is needed to monitor the recovering White Bass population.

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.

Buckmeier, D. L., N. G. Smith, and K. S. Reeves. 2012. Utility of alligator gar age estimates from otoliths, pectoral fin rays, and scales. Transactions of the American Fisheries Society, 141:6, 1510-1519.

Dennis, J. A., and R. Myers. 2010. Statewide freshwater fisheries monitoring and management program survey report for Falcon Reservoir, 2009. Texas Parks and Wildlife Department, Federal Aid Report F-30-R, Austin.

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.

International Boundary and Water Commission (IBWC). 2014. Web interface. http://www.ibwc.gov/home.html (2014).

Myers, R. A., J. Taylor, M. Allen, and T. Bonvechio. 2008. Temporal trends in voluntary release of largemouth bass. North American Journal of Fisheries Management 28:428–433.

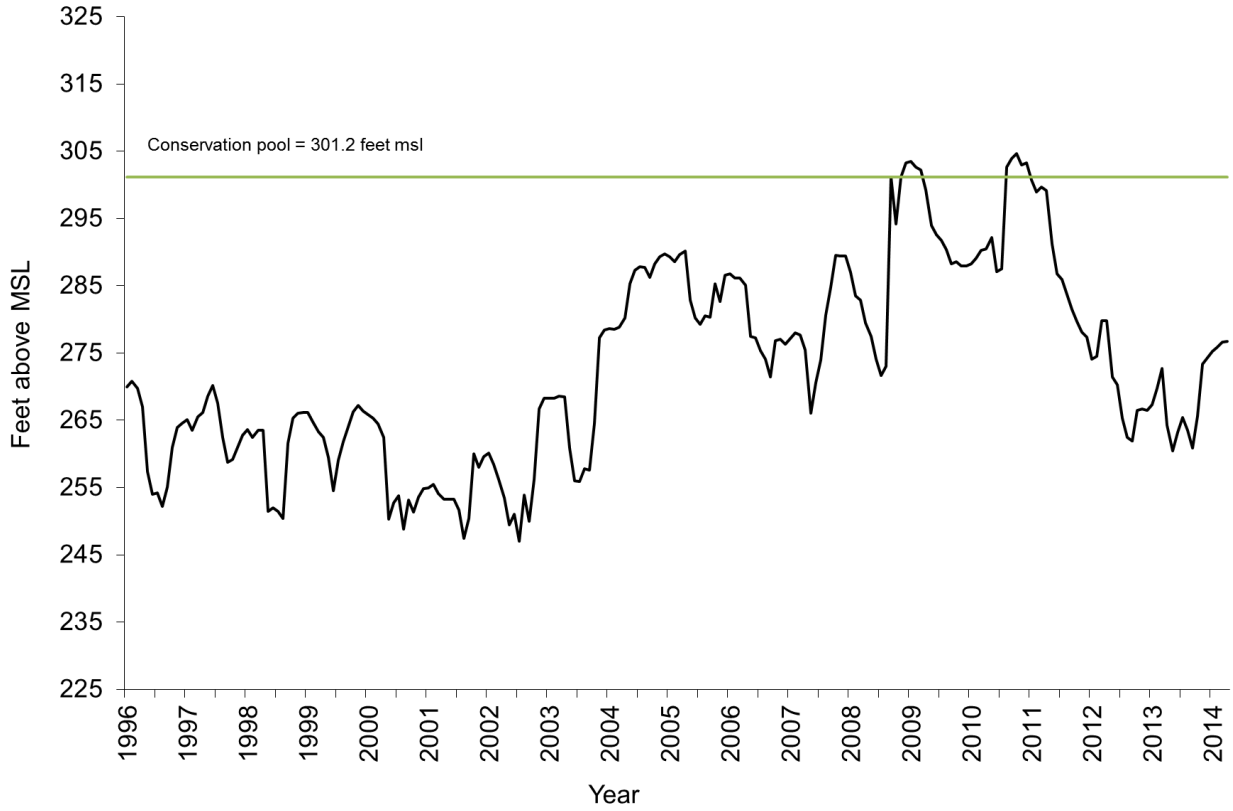


Figure 1. Monthly water level elevations in feet above mean sea level (MSL) recorded for Falcon Reservoir, Texas. Conservation pool is 301.2 ft MSL.

Table 1. Characteristics of Falcon Reservoir, Texas.

Characteristic	Description
Year constructed	1954
Controlling authority	International Boundary and Water Commission
Counties	Zapata and Starr
Reservoir type	Mainstream
Shoreline Development Index (SDI)	10.64
Conductivity	712 umhos/cm

Table 2. Boat ramp characteristics for Falcon Reservoir, Texas, August, 2013.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Zapata County Ramp	26.86156 –99.2622	Y	50-100*	unknown	Adequate
Falcon State Park	26.58721 −99.15250	Y	61	unknown	Adequate

*varies with water level

Table 3. Harvest regulations for Falcon Reservoir, Texas.

Species	Bag limit	Length limit
Gar, Alligator	1	none
Catfish: Channel and Blue catfish, their hybrids and subspecies	25 (in any combination)	12 - No Limit
Catfish, Flathead	5	18 - No Limit
Bass, White	25	10 - No Limit
Bass, Striped	5	18 - No Limit
Bass, Largemouth	5	14 – No Limit
Crappie: White and Black crappie, their hybrids and subspecies	25 (in any combination)	10 - No Limit

Table 4. Stocking history in Falcon Reservoir, Texas from 1967 – 2013.

Species	Year	Number Stocked	Size
Bass, Florida Largemouth	2013	514,858	Fingerling
Bass, Florida Largemouth	2012	250,276	Fingerling
Bass, Florida Largemouth	2011	270,159	Fingerling
Bass, Florida Largemouth	2010	238,244	Fingerling
Bass, Florida Largemouth	2005	11,995	Fingerling
Bass, Florida Largemouth	2004	664,165	Fingerling
Bass, Florida Largemouth	2004	185	Adult
Bass, Florida Largemouth	2003	313,739	Fingerling
Bass, Florida Largemouth	2001	131,021	Fingerling
Bass, Florida Largemouth	1997	501,783	Fingerling
Bass, Florida Largemouth	1989	117	Adult
Bass, Florida Largemouth	1985	102,000	Fingerling
Bass, Florida Largemouth	1984	18,375	Fingerling
Bass, Florida Largemouth	1981	67,000	Fingerling
Bass, Florida Largemouth	1979	131,455	Fingerling
Bass, Florida Largemouth	1978	451,049	Fingerling
Bass, Florida Largemouth	1976	2,250	Fingerling
Bass, Florida Largemouth	1975	750,000	Fingerling
Bass, Largemouth	2004	174,241	Fingerling
Bass, Largemouth	1984	6,000	Adult
Bass, Mixed Largemouth	1989	219,316	
Bass, Palmetto	1987	665,000	Fry
Bass, Palmetto	1984	222,174	Fingerling
Bass, ShareLunker Largemouth	2013	4,315	Fingerling
Bass, ShareLunker Largemouth	2012	25,067	Fingerling
Bass, ShareLunker Largemouth	2011	30,488	Fingerling
Bass, ShareLunker Largemouth	2010	2,091	Fingerling
Bass, ShareLunker Largemouth	2008	2,842	Fingerling
Bass, Smallmouth	1984	20,265	Fingerling
Bass, Striped	2002	108,027	Fingerling
Bass, Striped	2000	769,406	Fingerling
Bass, Striped	1999	390,919	Fingerling
Bass, Striped	1998	78,645	Fingerling
Bass, Striped	1997	78,837	Fingerling
Bass, Striped	1995	782,685	Fingerling
Bass, Striped	1994	685,542	Fingerling
Bass, Striped	1989	4,786,960	Fry
Bass, Striped	1988	617,902	Fingerling
Bass, Striped	1983	386,503	
Bass, Striped	1979	174,638	
Bass, Striped	1978	186,287	
Bass, Striped	1977	725,692	
Bass, Striped	1976	149,804	

Table 4. (Continued).

Species	Year	Number Stocked	Size
Bass, White	2009	1,162,094	Fry
Bass, White	2008	125,187	Fry
Bass, White	2007	9,048	Fry
Bass, White	2004	110	Adult
Bass, White	2003	29	Adult
Bluegill	2003	215,718	Fingerling
Catfish, Blue	2003	28,043	Fingerling
Catfish, Channel	2013	256	Fingerling
Catfish, Channel	2012	290	Fingerling
Catfish, Channel	2011	250	Fingerling
Catfish, Channel	2010	230	Fingerling
Catfish, Channel	2007	321	Fingerling
Catfish, Channel	2006	334	Fingerling
Crappie, White	2003	1,500	Adult
Trout, Rainbow	1999	1,255	Adult
Trout, Rainbow	1997	1,335	Adult
Trout, Rainbow	1996	1,743	Adult
Trout, Rainbow	1994	2,012	Adult
Walleye	1977	1,706,600	
Walleye	1976	4,830,000	
Walleye	1975	447,184	

Table 5. Results of random point sampling habitat surveys conducted during August in 2009 (N = 382 points) and 2013 (N = 123 points). Percent occurrence with lower and upper 95% confidence limits (CL) is shown for major habitat types. Water level at time of survey in 2009 was 11 feet below conservation pool elevation (CP) and in 2013 was 39 feet below CP.

Vegetation	Percent occurrence		Lower 95% CL		Upper 95% CL	
	2009	2013	2009	2013	2009	2013
Open water	29	78	23	70	35	85
Flooded terrestrial vegetation	68	22	62	15	74	29
Standing timber/stumps	2	0	1	0	5	0

Table 6. Results of a structural habitat survey conducted at Falcon Reservoir, Texas, in August, 2009. Linear distance (miles) was estimated for each habitat type for the Texas side of the reservoir from the dam to the Beacon Lodge cove using 382 randomly selected sample points.

Habitat type	Linear distance	Percent	Lower 95% CL	Upper 95% CL
Natural shoreline	147	75	71	80
Rocky shoreline	22	11	8	15
Flooded terrestrial vegetation	193	98	97	99
Gravel	27	14	11	18

Table 7. Percent directed angler effort by species for Falcon Reservoir, Texas, from January to June in 2006 and 2011.

Species	2006	2011
Catfishes	16.3	4.8
White Bass	0.0	0.0
Sunfishes	0.3	0.0
Largemouth Bass	83.3	91.9
Black Crappie	0	0.4
Anything	0	2.8

Table 8. Total fishing effort (h) for all species and total directed expenditures for Falcon Reservoir, Texas, from January to June in 2006 and 2011. Relative standard error is in parentheses.

Creel statistic	2006	2011
Total fishing effort	50,939 (17)	108,427 (24)
Total directed expenditures	453,115 (39)	1,289,545 (54)

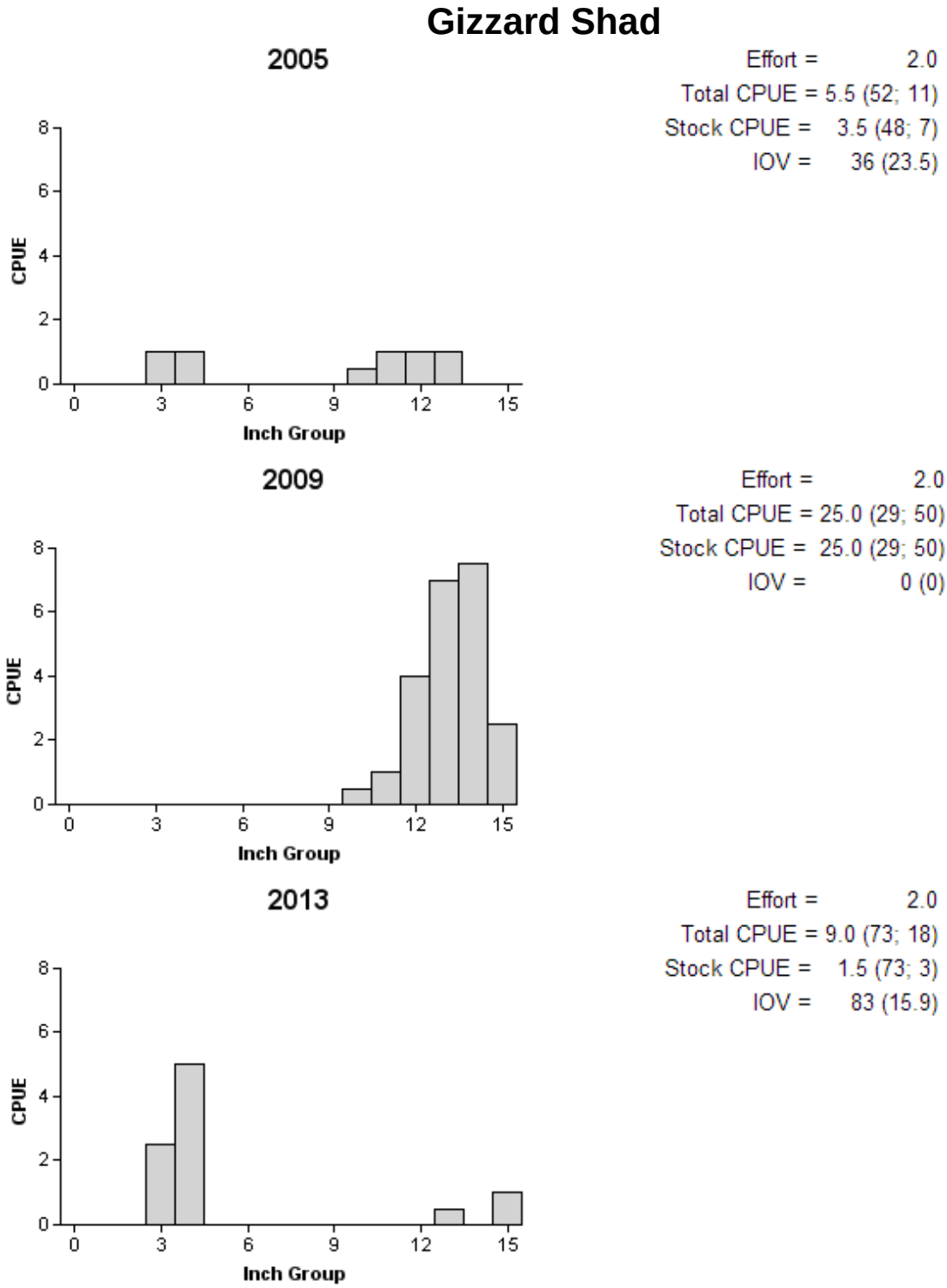


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Falcon Reservoir, Texas, 2005, 2009, and 2013.

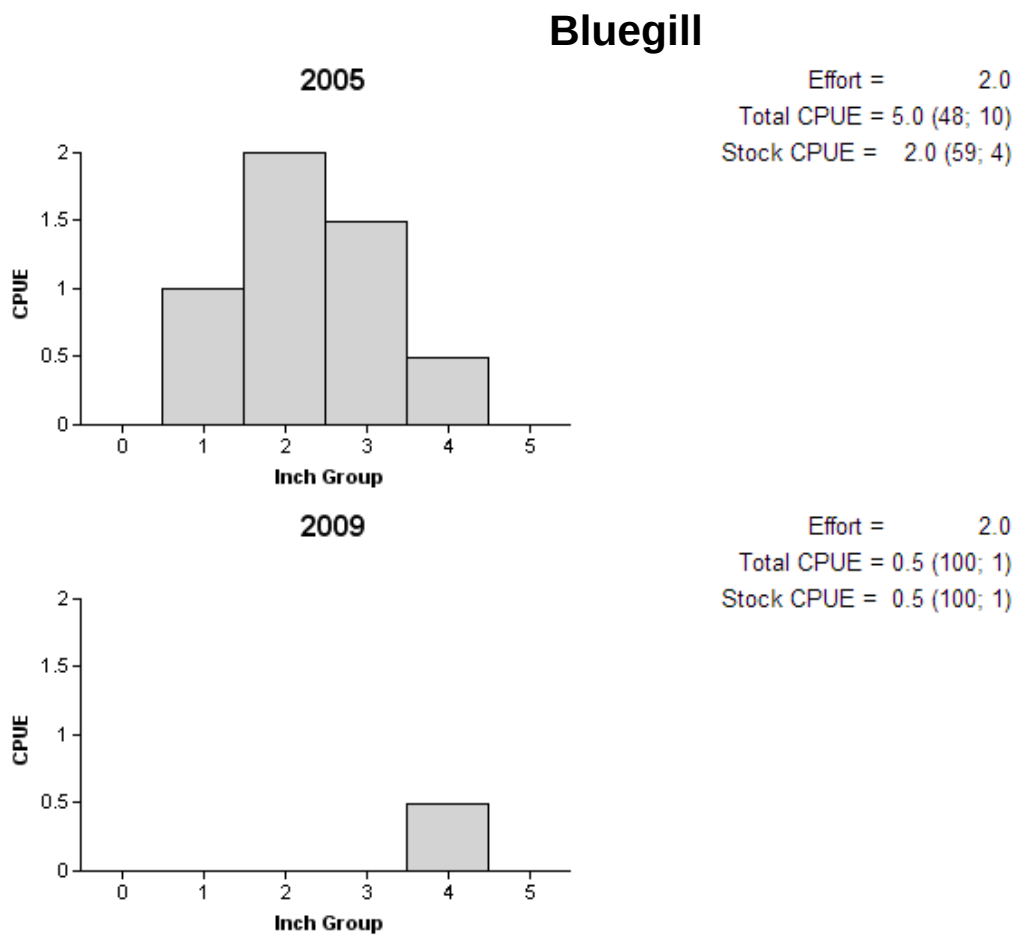


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Falcon Reservoir, Texas, 2005 and 2009. No Bluegill were collected in 2013.

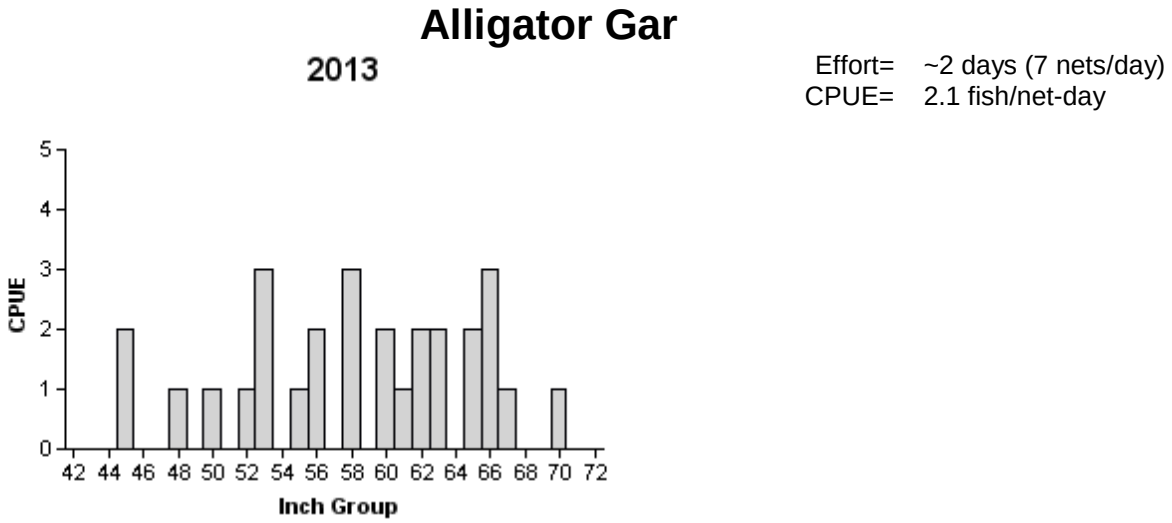


Figure 4. Number of Alligator Gar caught per day (24 h period, CPUE), during a fall gill net survey Falcon Reservoir, Texas, 2013.

Blue Catfish

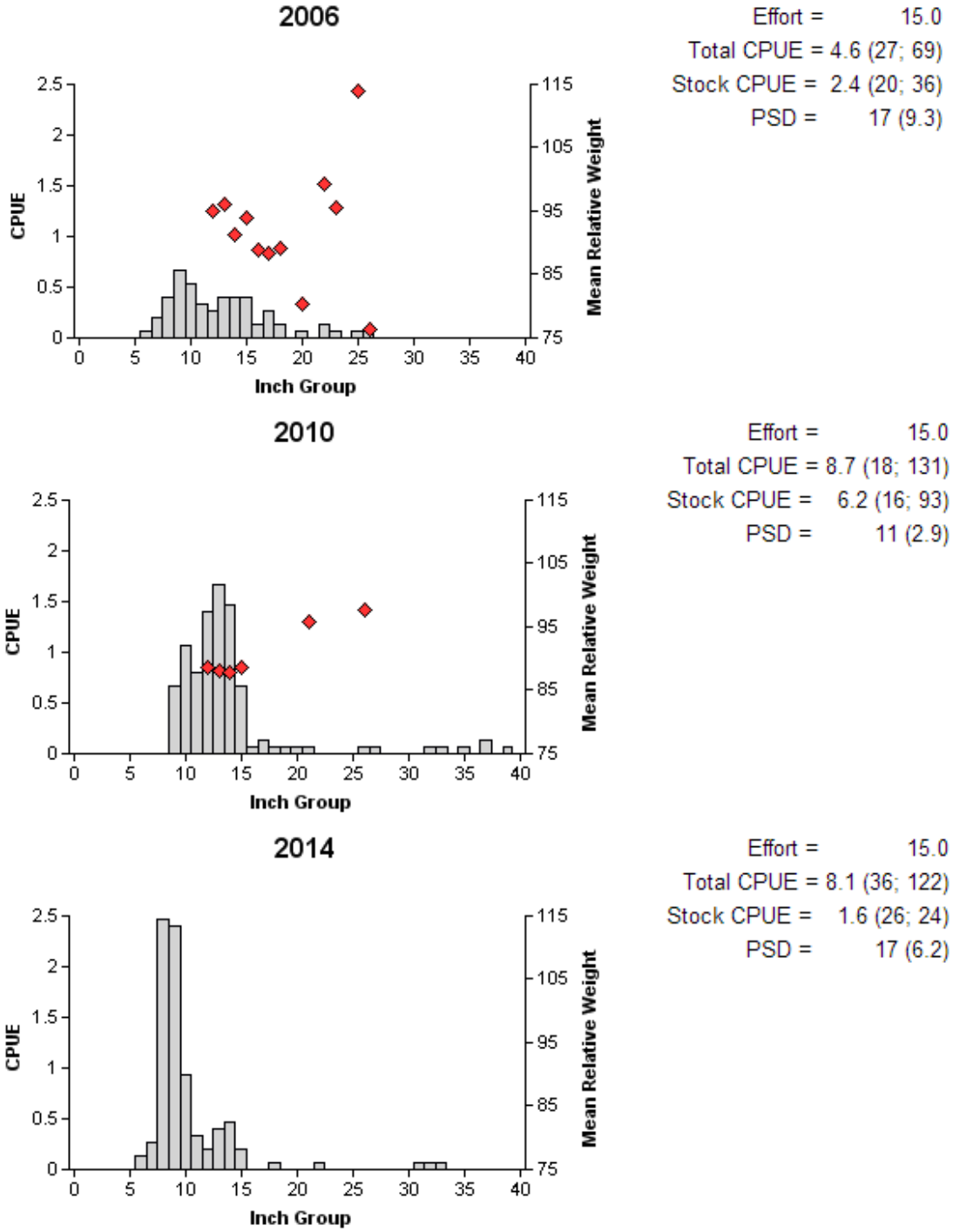


Figure 5. Number of Blue Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Falcon Reservoir, Texas, 2006, 2010 and 2014.

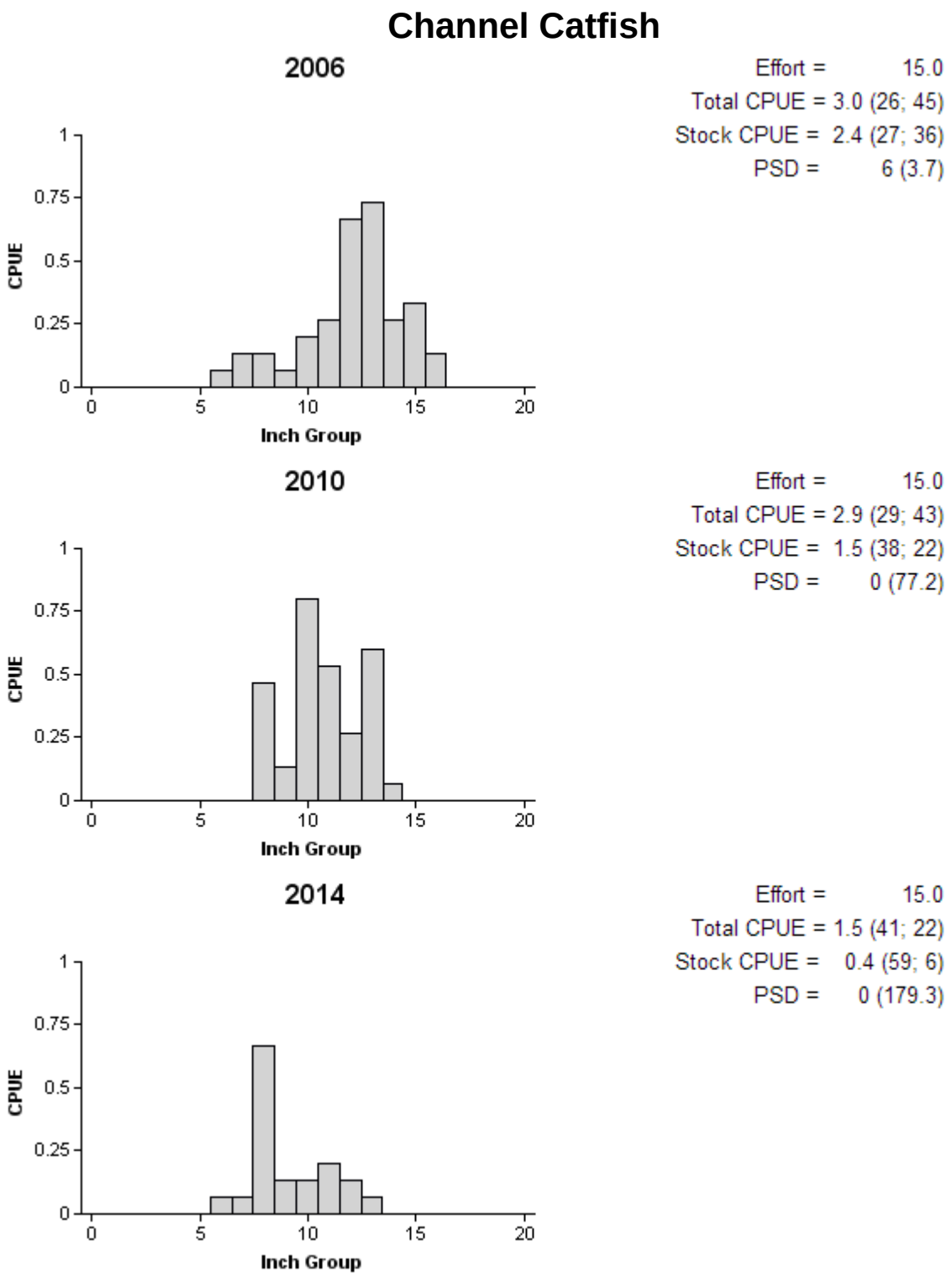


Figure 6. Number of Channel Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Falcon Reservoir, Texas, 2006, 2010, and 2014.

Table 9. Creel survey results for catfishes at Falcon Reservoir, Texas, from January to June in 2006 and 2011. Estimates are for Blue and Channel Catfishes combined unless otherwise indicated. Relative standard errors, when available, are shown in parentheses.

Creel survey statistic	Year	
	2006	2011
Directed effort total (h)	8,308 (25)	5,213 (36)
Directed effort/acre (h)	0.10	0.06
Catch total	12,714	22,380
Average catch per hour	1.2 (25)	2.3 (36)
Release total	173	2,831
Harvest total	12,541	19,550
Blue Catfish	3,232 (57)	8,087 (77)
Channel Catfish	9,309 (43)	11,463 (63)
Average harvest/h	0.99 (28)	2.1 (37)
Harvest/acre	0.15	0.23
Voluntary release rate (%)	0	4

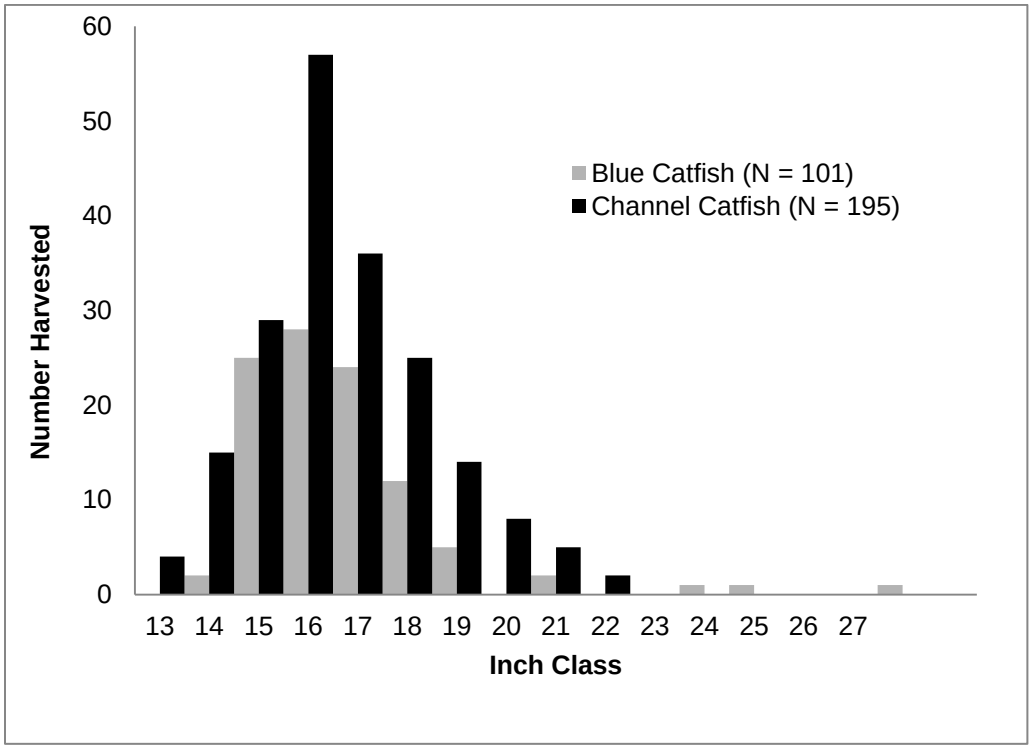


Figure 7. Length frequency distribution of angler-harvested Blue and Channel Catfishes from Falcon Reservoir, Texas, from January to June in 2006 and 2011. Data were pooled among years.

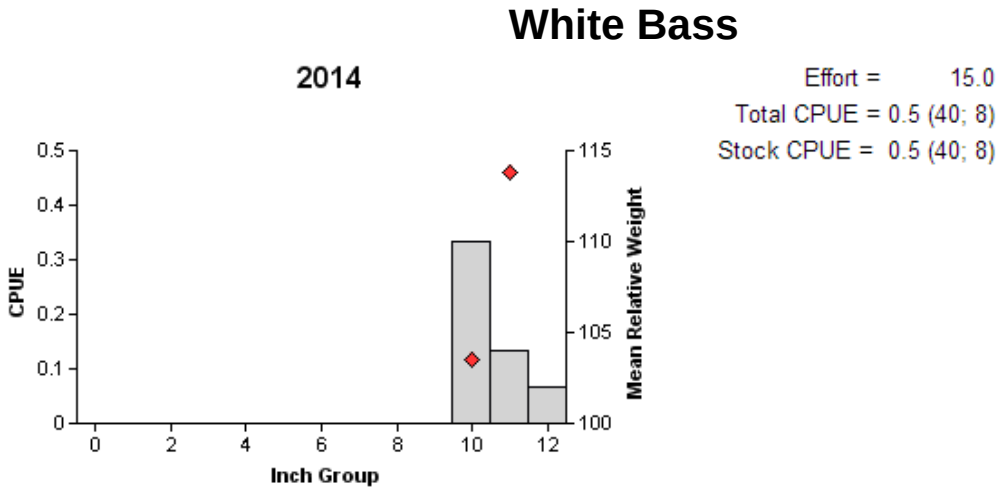


Figure 8. Number of White Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Falcon Reservoir, Texas, 2014.

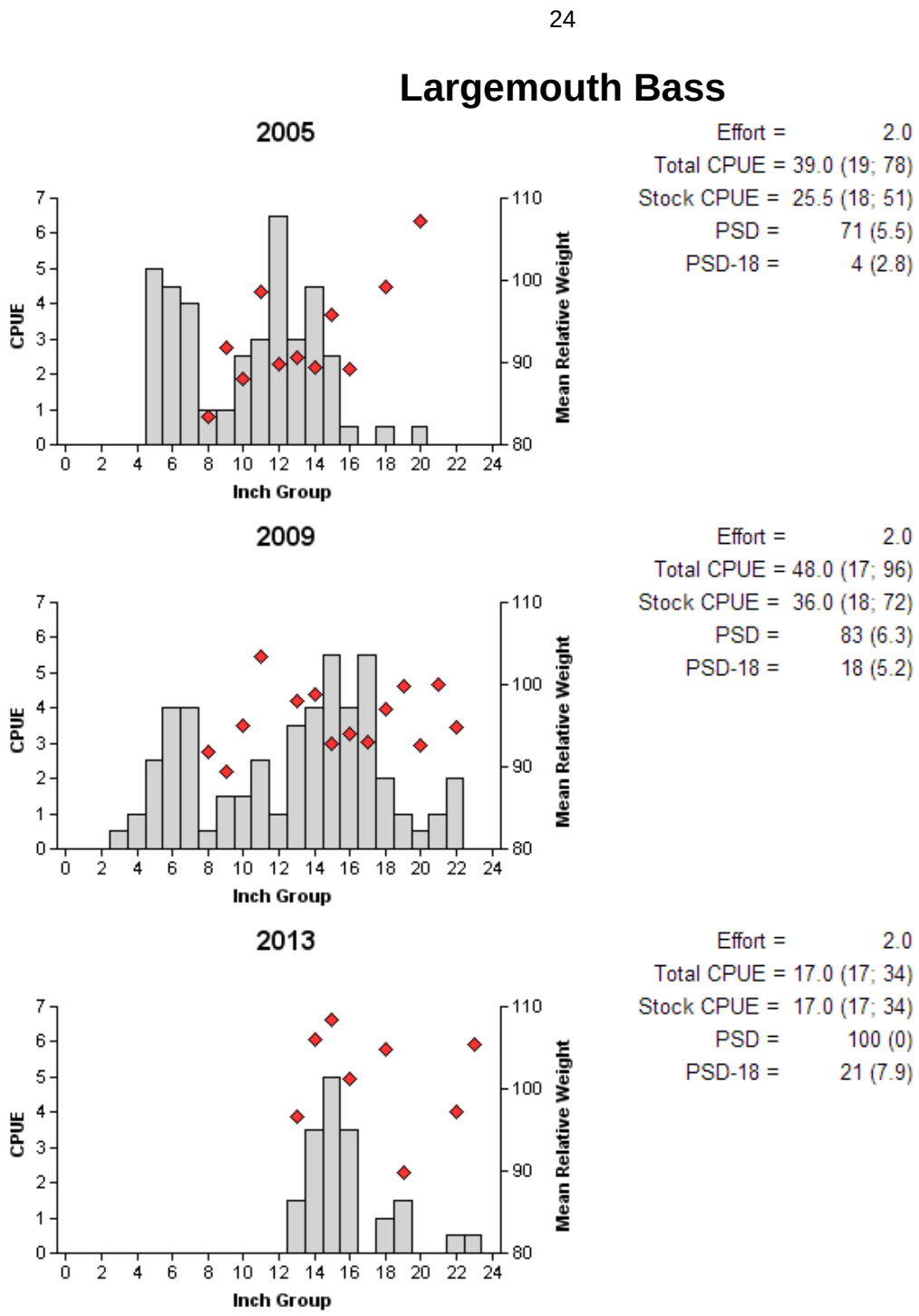


Figure 9. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Falcon Reservoir, Texas, 2005, 2009, and 2013.

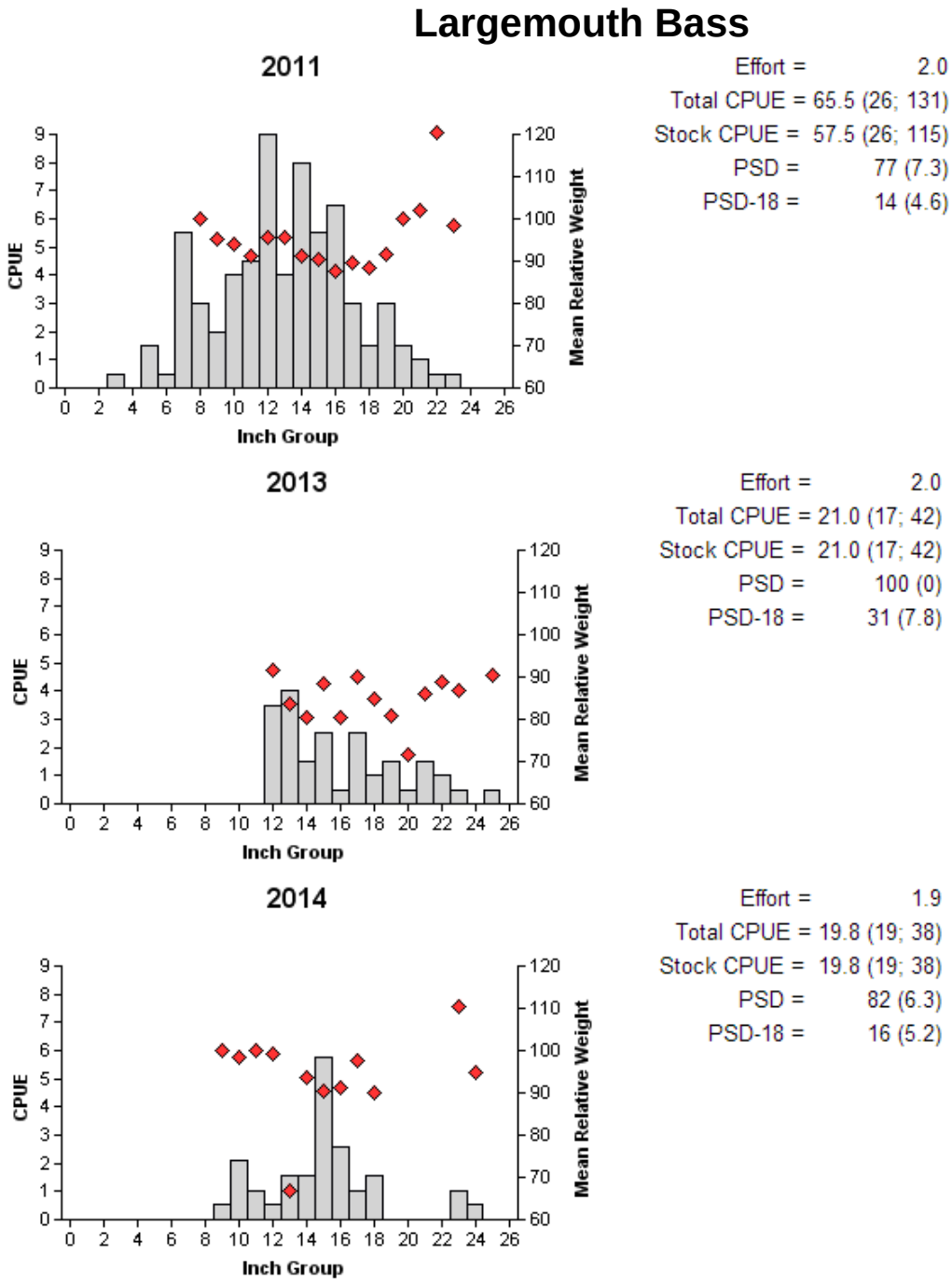


Figure 10. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Falcon Reservoir, Texas, 2011, 2013, and 2014.

Table 10. Annual mean electrofishing catch rate (number of fish/h) of Largemouth Bass, by season (spring and fall), electrofishing method (all fish and bass only), sample site selection method (R = random and B =biologist selected), and fish size category (total fish and fish ≥14 inches). Relative standard errors are shown in parentheses.

	Spring			
	Bass only-R		Bass only-B	
Year	Total fish	Fish ≥14	Total fish	Fish ≥14
2005	66.5 (15)	6.9 (29)		
2006				
2007	71.5 (19)	46.5 (16)		
2008				
2009	33.5 (19)	25.9 (19)	90.0 (7)	60.0 (20)
2010				
2011	65.5 (26)	31.0 (17)	58.0 (14)	30.0 (18)
2012				
2013	21.0 (17)	13.5 (20)		
2014	19.8 (19)	14.1 (21)	31.1 (16)	25.2 (15)

	Fall					
	All fish-R		Bass only-R		Bass only-B	
Year	Total fish	Fish ≥14	Total fish	Fish ≥14	Total fish	Fish ≥14
2000	35.0 (23)	13.0 (24)				
2001	19.5 (45)	2.0 (47)				
2002	14.5 (23)	12.0 (25)				
2003	20.0 (24)	0.0 (0)				
2004						
2005	35.0(19)	8.5 (25)				
2006						
2007						
2008						
2009	48.0 (17)	25.5 (20)			49.5 (28)	28.0 (34)
2010						
2011			34.5 (20)	14.0 (22)		
2012						
2013	17.0 (17)	15.5 (18)				

Table 11. Largemouth Bass age and growth results for Falcon Reservoir, Texas. Fish were collected in March 2013. Total number was derived using an age-length key to assign ages to all un-aged sampled fish.

Age	Year class	Number aged	Total number	Percentage (total number)	Mean-length-at-age (inches)	Standard error
1	2013	15	18	18	11.1	0.2
2	2012	4	9	9	14.6	0.4
3	2011	1	5	5	15.3	0.2
4	2010	18	51	51	15.8	0.2
5	2009	2	2	2	19.5	1.2
6	2008	2	4	4	17.2	0.2
7	2007	3	3	3	19.7	1.7
8	2006	5	8	8	19.9	1.3

Table 12. Genetic analysis results for Largemouth Bass collected from Falcon Reservoir, Texas. In 2000 and prior fish were collected by electrofishing and fish collected in 2011 and later were angler-caught. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB. Genetic composition was determined by electrophoresis prior to 2005 and with micro-satellite DNA analysis since 2005. Fish classified as "trophy" weighed ≥10 lbs and fish classified as "control" were random tournament-weighed fish weighing ≤10 lbs.

Year/ classification	Sample size	Number of fish			% FLMB alleles	% FLMB
		FLMB	Intergrade	NLMB		
2000	34	14	20	0	81	41
2001	32	13	19	0	84	42
2005	33	4	29	0	68	12
2009	30	0	30	0	52	0
2011						
Trophy	56	4	52	0	76	7
Control	165	25	140	0	74	15

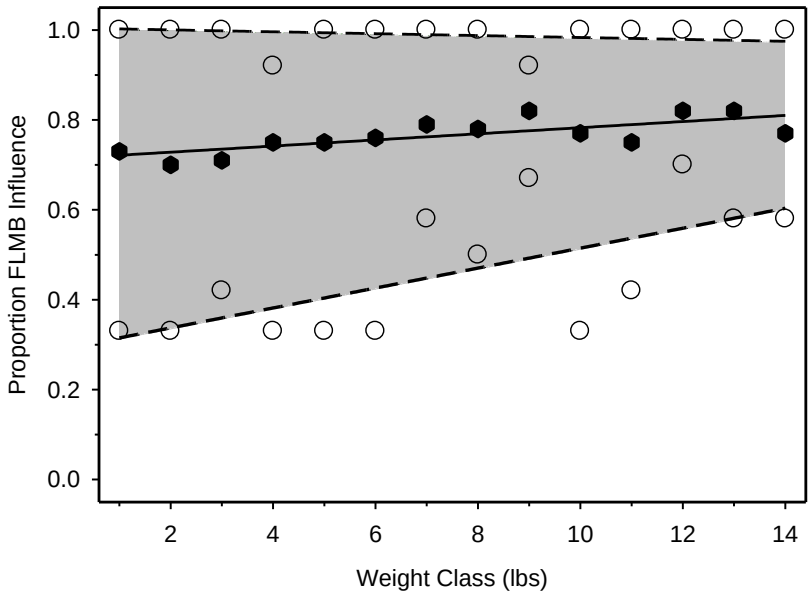


Figure 11. Proportion Florida Largemouth Bass (FLMB) influence of angler-caught Largemouth Bass by weight class at Falcon Reservoir. Open circles and dashed lines represent minimum and maximums values and black symbols and solid line represent averages. Sample size for each weight class is in table below. Data, when available, for fish ≥13 lbs (N = 14 Sharelunkers) were included for comparison.

Table 13. Largemouth Bass creel survey results for Falcon Reservoir, Texas, from January to June in 2006 and 2011. Relative standard errors, when available, are shown in parentheses.

Creel survey statistic	Year	
	2006	2011
Directed effort total (h)	42,472 (18)	99,653 (25)
Tournament	10,778 (24)	9,336 (40)
Non-tournament	31,694 (19)	90,318 (24)
Directed effort/acre (h)	0.51	1.2
Catch total	80,542 (32)	144,177 (23)
Tournament	40,427 (37)	13,707 (71)
Average catch/h	2.1 (18)	1.1 (23)
Non-tournament	40,115 (29)	130,470 (23)
Average catch/h	1.2 (21)	1.2 (9)
Release total	64,054 (38)	117,241 (26)
Fish <4 lbs	-	91,273
Fish ≥4 to <7 lbs	-	21,640
Fish >7 to 10 lbs	-	4,102
Fish ≥10 lbs	-	226
Tournament released fish	33,778 (43)	5,968 (128)
Voluntary release rate (%)	16	34
Non-tournament released fish	30,276 (36)	111,274 (26)
Voluntary release rate (%)	54	78
Harvest total (non-tournament)	9,839 (41)	19,196 (42)
Average harvest/h	0.19 (25)	0.12 (19)
Harvest/acre	0.19	0.23
Weighed-in total (tournament)	6,649 (47)	7,739 (79)

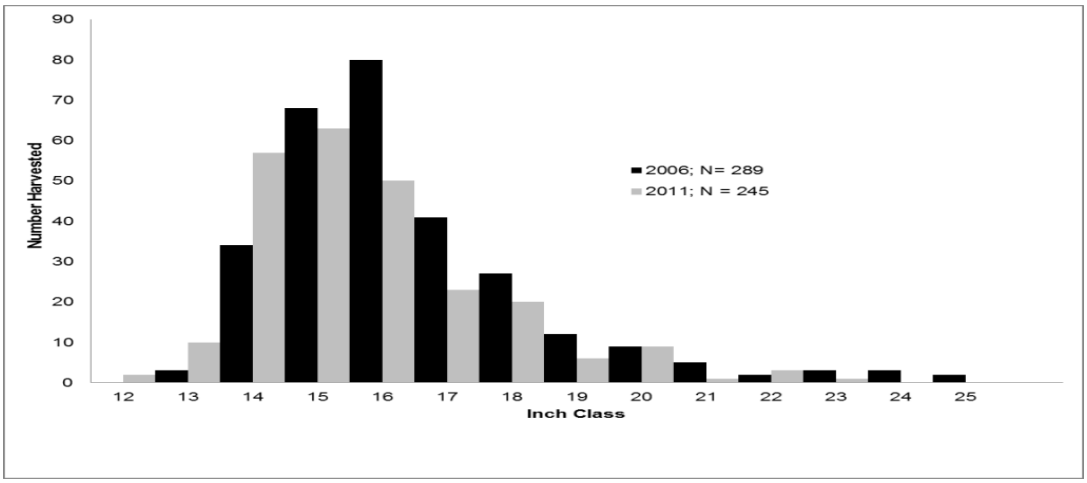


Figure 12. Length frequency distribution of Largemouth Bass harvested by non-tournament anglers from Falcon Reservoir, Texas, from January to June in 2006 and 2011.

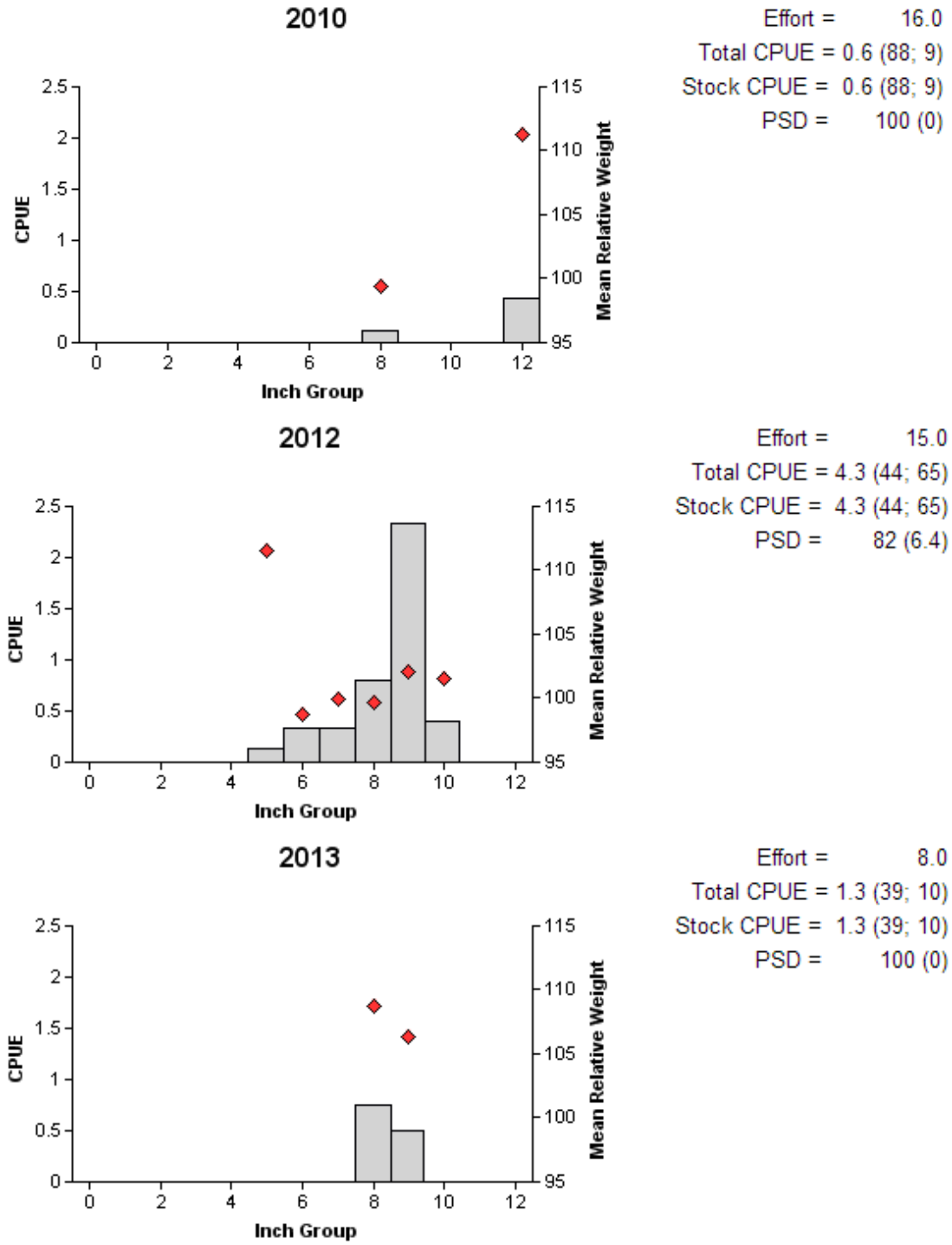


Figure 13. Number of Black Crappie caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Falcon Reservoir, Texas, 2010, 2012, and 2013.

Table 14. Black Crappie creel survey results for Falcon Reservoir, Texas, from January to June in 2006 and 2011. Relative standard errors, when available, are shown in parentheses.

Creel survey statistic	Year	
	2006	2011
Directed effort total (h)	0	477 (101)
Directed effort/acre (h)	0	<0.01
Catch total	0	3,243 (220)
Average catch per hour	0	6.8(56)
Release total	0	593 (546)
Harvest total	0	2,651(164)
Average harvest/h	0	5.6 (78)
Harvest/acre	0	0.03
Voluntary release rate (%)	0	2

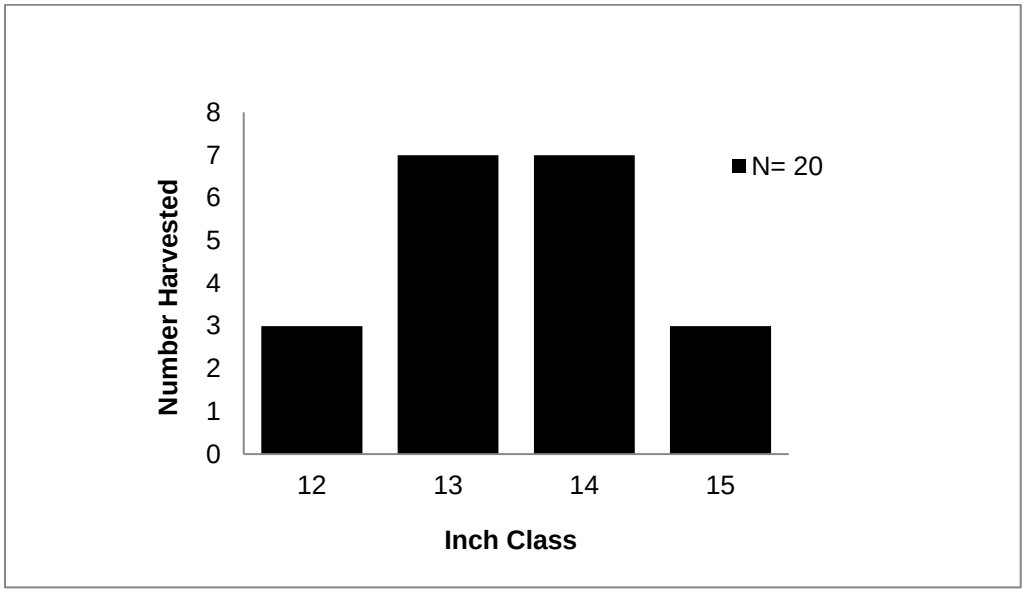


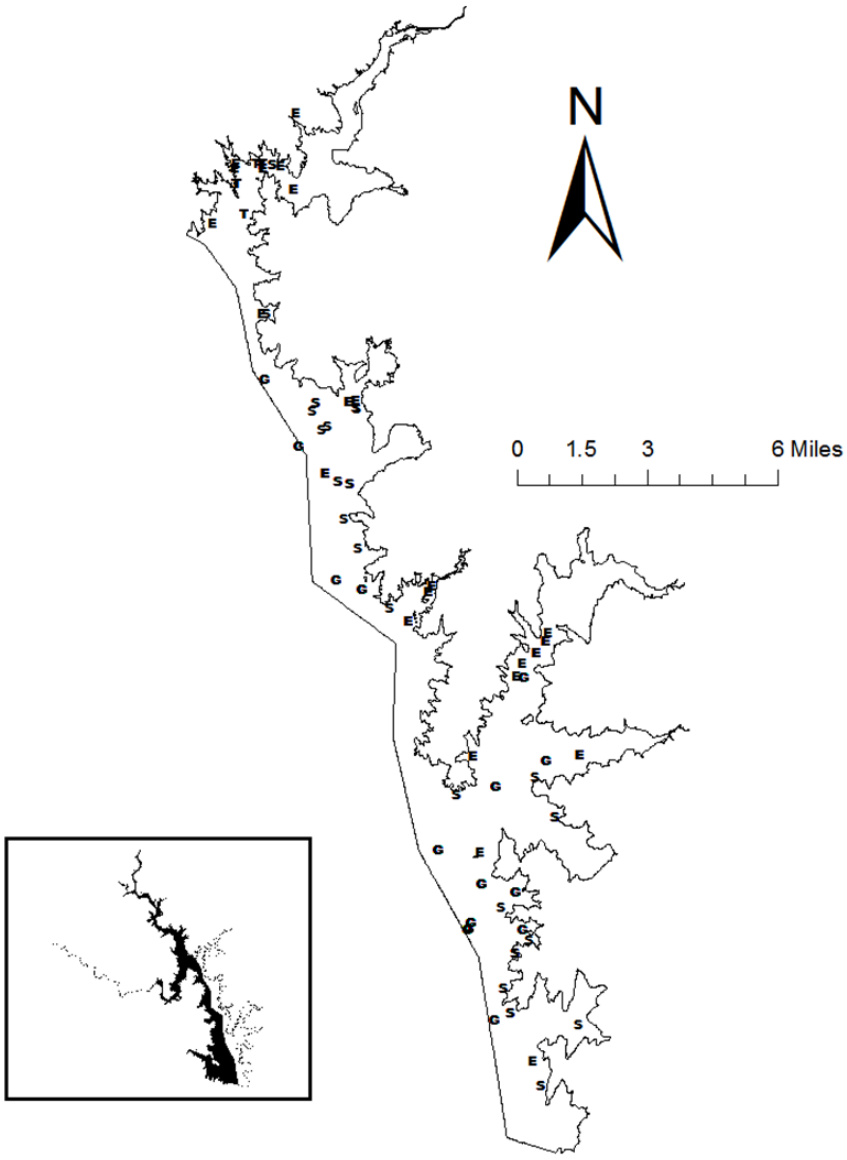
Figure 14. Length frequency distribution of angler-harvested Black Crappie from Falcon Reservoir, Texas, from January to June 2011.

Table 15. Proposed sampling schedule for Falcon 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. Standard survey denoted by S and additional survey denoted by A.

Survey year	Electrofish Fall(Spring)	Trap net	Gill net	Habitat		Access	Creel survey	Report
				Structural	Vegetation			
2014-2015	A*(A)*							
2015-2016	A(A)		A				S	A
2016-2017	A*(A)*							
2017-2018	S(A)	S	S		S	S		S

*Bass-only in spring.

APPENDIX A.



Location of random sampling sites, Falcon Reservoir, Texas, 2013-2014. Gill net = G, fall electrofishing =E, spring electrofishing = S, and trap netting = T.

APPENDIX B

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Falcon Reservoir, Texas, 2013-2014. Sampling effort was 2 hours for fall electrofishing, 8 net nights trap netting, 15 net nights for gill netting, and 1.93 hours spring electrofishing.

Species	Fall electrofishing		Trap netting		Gill netting		Spring electrofishing	
	N	CPUE	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad	18	9.00						
Threadfin Shad	8	4.00						
Blue Catfish					122	8.13		
Channel Catfish					22	1.47		
White Bass					8	0.53		
Largemouth Bass	34	17.00					38	19.83
Black Crappie			10	1.25				