

PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2016 Fisheries Management Survey Report

Lyndon B. Johnson Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lyndon B. Johnson (LBJ) Reservoir were surveyed in 2016 using electrofishing and in 2017 using gill netting. Historical data are presented with the 2016-2017 data for comparison. This report summarizes results of the survey and contains a fisheries management plan for the reservoir based on those findings.

- **Reservoir Description:** LBJ Reservoir is a stable-level 6,502-acre impoundment of the Colorado and Llano Rivers in Burnet and Llano counties, Texas. It was constructed in 1951 by the Lower Colorado River Authority (LCRA) for purposes of hydro-electric and steam-electric power, flood control, and water conservation. The reservoir has a drainage area of approximately 36,290 square miles and a shoreline length of about 270 miles. Residential and commercial properties border most of the shoreline area.
- **Management History:** Important sport fish include Largemouth Bass, Channel Catfish and White Bass. Fisheries management plans for 2013 were to contact organized constituent groups and try to involve them in partnerships to restore shoreline areas and coves with small-scale planting projects and to stay aware of funding opportunities to conduct large-scale habitat improvement projects applicable to LBJ Reservoir. Management activities included Florida Largemouth Bass stockings from 2011 to 2016 to improve the potential for trophy Largemouth Bass, and conducting annual aquatic vegetation surveys to monitor exotic invasive species. The reservoir is managed under statewide regulations. Prior to 2012, low vegetative coverage has been descriptive of LBJ Reservoir.
- **Fish Community**
 - **Prey species:** Threadfin Shad, Bluegill, Gizzard Shad, and Redbreast Sunfish were the predominant prey species. Catch rates for Bluegill, Gizzard Shad, and Redbreast Sunfish decreased since the previous survey.
 - **Catfishes:** Channel Catfish was the predominant catfish species. Total catch rate was slightly higher than in the previous survey. Blue Catfish and Flathead Catfish were present in low densities and most were over harvestable-size.
 - **White Bass:** White Bass were present in low density, fish up to 16 inches in length were present.
 - **Largemouth Bass:** Largemouth Bass abundance was moderate; population size structure was good, and overall body condition for most fish was close to optimal.
- **Management Strategies:** Based on current information, the reservoir should continue to be managed with existing regulations. Aquatic vegetation surveys should continue to be conducted annually to monitor coverage of non-native water hyacinth, Eurasian watermilfoil, and hydrilla. Standard gill netting and electrofishing surveys will be conducted in 2020 – 2021, and an additional electrofishing survey in fall 2018 to monitor Largemouth Bass population dynamics.

INTRODUCTION

This document is a summary of fisheries data collected from Lyndon B. Johnson (LBJ) Reservoir from 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

Lyndon B. Johnson Reservoir is a 6,502-acre impoundment of the Colorado and Llano rivers in Burnet and Llano counties, Texas. It was constructed in 1951 by the Lower Colorado River Authority (LCRA) for purposes of hydro-electric and steam-electric power production, flood control, and water conservation. The reservoir was eutrophic with a mean TSI chl-a of 52.7 (Texas Commission on Environmental Quality 2011). Lyndon B. Johnson Reservoir has a drainage area of approximately 36,290 square miles and a shoreline length of about 270 miles. This is a stable-level reservoir (825 ft. above mean sea level), and lies within the Edwards Plateau ecological area and Colorado River Basin. Land use in the watershed is predominantly ranching. Residential and commercial properties border most of the shoreline. Shoreline habitat at the time of sampling consisted mostly of bulkhead with docks, and vegetated natural shoreline. Aquatic vegetation is present throughout the reservoir, but is below optimal levels for fish production (Durocher 1984; Dibble et al. 1996). Other descriptive characteristics for LBJ Reservoir are in Table 1.

Angler Access

Angler access at LBJ Reservoir was good for boat anglers, but poor for bank anglers. Nineteen concrete boat ramps were available for anglers. Of the 19 ramps, two are considered the primary public ramps on the reservoir (Cottonwood Shores (lower reservoir) and the Kingsland Lions Club (upper reservoir)), and are open to the general public. Cottonwood Shores requires a fee. The remaining ramps are controlled by various home owner associations, but provide access to lake area residents. Additional boat ramp characteristics are in Table 2.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Farooqi and De Jesus 2013) included:

1. Contact organized constituent groups and try to involve them in partnerships to restore shoreline areas and coves with small-scale planting projects using spatterdock, waterwillow, and spike rush.
Action: Significant increases in submerged aquatic vegetation (primarily Eurasian watermilfoil) provided a substantial increase in fish habitat, lowering the priority for the initiation of small-scale planting projects. This work has been postponed until such time as deemed appropriate.
2. If opportunities become available, submit proposals to acquire funding for large-scale habitat improvement projects.
Action: No suitable large-scale habitat improvement opportunities arose during this reporting period.
3. Continue to monitor the Largemouth Bass tournament scene to capture large fish data.
Action: Texas Tournament Zone held annual tournaments on LBJ Reservoir from 2014 to 2017 with winning five-fish bags ranging from 21.5 lbs to 33.1 lbs. In 2017, there was a record high of 254 teams competing and the winning weight was 32.2 lbs; big fish weighed 10.7 lbs. Bass Champs Tournament Trail held 11 tournaments on LBJ from 2014 to 2017; winning five-fish bags ranged from 22.2 lbs to 27.4 lbs. In 2017, the winning weight was 26.8 lbs and the heaviest fish weighed 11.5 lbs.

4. Request a Florida Largemouth Bass fingerling stocking (5/acre) if aquatic vegetation coverage remains favorable in spring 2014. Request surplus Florida Largemouth Bass for stocking in subsequent years if habitat persists or expands.
Action: Florida Largemouth Bass were stocked from 2013 to 2016.
5. Continue to engage partners and the general public about the negative impacts of aquatic invasive species through the use of print media, social media, and public engagements.
Action: Outreach efforts regarding invasive species included social media, print media, public presentations, and one-on-one interactions with constituents.

Harvest regulation history: Sport fish in LBJ Reservoir have been, and are currently managed with statewide regulations (Table 3).

Stocking history: Florida Largemouth Bass were first stocked in LBJ Reservoir in 1976. Recent stockings from 2011 to 2016 have been conducted to improve the growth potential for Largemouth Bass. In 2010, a 13.7-pound bass from LBJ Reservoir was submitted to the ShareLunker selective breeding program and a portion of the offspring (2,220 ShareLunker Largemouth Bass fingerlings) were stocked in LBJ Reservoir. The most recent Channel Catfish stockings were in 2012, 2013, and 2016. The complete stocking history is in Table 4.

Vegetation/habitat management history: The reservoir had sub-optimal aquatic vegetation coverage for fish production. In efforts to increase native aquatic vegetation coverage, nine sites have been planted with aquatic vegetation since 2000 and have been evaluated since 2005. Little expansion was documented at most sites (Bonds and Magnelia 2005); however one site had flourished (DeJesus and Magnelia 2009).

While aquatic vegetative coverage has been low from a fishery perspective, reservoir-based businesses and waterfront homeowners have been impacted by localized nuisance vegetation issues. With the cooperation and participation of LCRA, municipal authorities that surround the reservoir, and Texas Parks & Wildlife Department (TPWD), a nuisance aquatic vegetation management plan was developed in 2015 to help manage localized nuisance vegetation issues.

Water hyacinth was first documented in 2003 in one cove of the reservoir and has spread. This species is still only present in small quantities. Herbicide treatments have successfully been used by the LCRA to control large scale infestations of this species. Eurasian watermilfoil has been the dominant non-native species since 2011.

Most of the shoreline habitat was comprised of bulkhead, and natural vegetated shoreline.

Water Transfer: No inter-basin water transfers are known to exist at LBJ Reservoir.

METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for LBJ Reservoir (TPWD unpublished). Primary components of the OBS plan are listed in Table 5. All survey sites (Appendix A) 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, and Gizzard Shad were collected by electrofishing (1.5 hours at 18, 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 by a Category 2 evaluation using otoliths from 13 randomly-selected fish (range 13.0 to 14.9 inches; TPWD,

Inland Fisheries Division, unpublished manual revised 2015).

Gill netting – Channel Catfish and White Bass were collected by gill netting (15 net nights at 15 stations). Catch per unit effort (CPUE) was recorded as the number of fish per net night (fish/nn). Ages for White Bass were determined by a Category 2 evaluation using otoliths from 11 fish (range 9.0 to 10.9 inches; TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Genetics – Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015). Micro-satellite DNA analysis was used to determine genetic composition of individual fish.

Statistics – Sampling statistics (CPUE for various length categories), structural indices [Proportional Size Distribution (PSD), terminology modified by Guy et al. 2007], and condition indices [relative weight (W_t)] 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 and vegetation survey was conducted in 2016. Habitat was assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

RESULTS AND DISCUSSION

Habitat: In 2016, littoral zone structural habitat consisted primarily of bulkhead with piers and docks (51.2 %), and natural shoreline (38.5%; Table 6; Appendix B).

Total coverage estimate of all plant species in 2016 was 5.0% (325.3 acres). By comparison, total coverage ranged from 4.8% (310.0 acres) to 11.6% (753.4 acres) during the period 2013 to 2015 (Table 7; Appendix C and D). These totals are still below that considered optimum for productive fisheries (Dibble et al. 1996, Durocher et al. 1984). The dynamics of vegetative coverage has been driven largely by Eurasian watermilfoil. Eurasian watermilfoil was not present in the reservoir in 2008, but it had become established by 2010 (18 acres, 0.3% of reservoir surface area; Farooqi and De Jesus 2013) reaching a peak coverage of 638.9 acres (9.9%) in 2014. Drought conditions that prevailed from 2011 to 2014 most likely created an environment in which Eurasian watermilfoil could flourish. As the drought ended, Eurasian watermilfoil coverage was reduced to 0.0% by 2016, likely aided by heavy grazing from coots.

Hydrilla was not present in 2013, but became established by 2014 (22.3 acres) and reached 112.9 acres (1.8% of reservoir surface area) by 2016. Water hyacinth coverage has remained steady from 2013 to 2016 (6.0-7.0 acres, < 1.0%). Hydrilla can become an operational issue for LCRA, and water hyacinth can rapidly overtake a lake and significantly impact recreational usage. To address these issues, LCRA has been treating hydrilla with herbicide, and TPWD has been using herbicide for water hyacinth.

Prey species: Threadfin Shad, Bluegill, Gizzard Shad, and Redbreast Sunfish were the predominant prey species in 2016. Redear Sunfish and Longear Sunfish were also available as forage (Appendix F).

Threadfin Shad were the most abundant prey species; CPUE was 305.3/h in 2016 compared to 8.0/h in 2012 and 34.0/h in 2010. Total CPUE of Gizzard Shad (88.7/h) was lower than in previous surveys conducted in 2012 (106.7/h) and 2010 (121.3/h; Figure 1).

Index of vulnerability for Gizzard Shad was 47; indicating 47% of Gizzard Shad were of vulnerable size (< 8 inches) and were available to existing predators. The IOV was significantly higher than in the 2012 (IOV=4) and 2010 (IOV=8) surveys. Historically, this reservoir has had low IOV values (De Jesus and Magnelia 2009).

Total CPUE of Redbreast Sunfish in 2016 (75.3/h) was lower than in 2012 (186.0/h) and 2010 (92.0/h). Larger fish (up to 8 inches in length) were still present, providing some good opportunities for panfish anglers (Figure 2). A new water body record (rod and reel) for Redbreast Sunfish (0.8 pounds, 10.0 inches) was established in 2017.

Total CPUE of Bluegill (94.7/h) significantly decreased since 2012 (307.3/h) and was also lower than in 2010 (141.3). Although less abundant, fish in the 6-to-8-inch size range were still present (Figure 3).

Low catch rates of Redear Sunfish (24.7/h) and Longear Sunfish (21.3/h) were obtained in 2016. However, larger fish were available to anglers.

Catfishes: Blue Catfish continued to have low relative abundance (0.5/nn in 2017); the few individuals that were sampled being large – up to 33 inches in length (Figure 4). Blue Catfish have never been stocked in the reservoir by TPWD. The current water body record (rod and reel) for Blue Catfish was established in 2016 (71.4 pounds, 51.8 inches).

Channel Catfish was the predominant catfish species in the reservoir. The most recent stockings of Channel Catfish in LBJ Reservoir were in 2012, 2013, and 2016. In 2017, the total gill net catch rate of Channel Catfish was 2.7/nn, which was a small increase from catch rates of 1.8/nn in 2013 and 2.3/nn in 2009 (Figure 5). By comparison, catch rates have been higher in previous surveys (5.3/nn in 2001 and 5.2/nn in 2000). In 2016, all of the fish sampled were above harvestable-size (≥ 12 inches) and the largest fish was 25 inches in length. Body condition of harvestable-size fish has improved since the 2013 and 2009 surveys with most Channel Catfish having relative weights ≥ 90 and some fish at or above optimum (≥ 100).

Flathead Catfish relative abundance is typically low in this reservoir. Total CPUE of Flathead Catfish was 0.5/nn in 2017 compared to 1.2/nn in 2013 and 1.5/nn in 2009 (Figure 6). The majority of fish were over harvestable-size (≥ 18 inches) and the largest fish measured 26" in length.

White Bass: This reservoir continued to support a low-abundance White Bass population. The total CPUE of White Bass was 1.6/nn in 2017. This is similar to that recorded in 2013 (1.5/nn) and 2009 (2.0/nn; Figure 7). The total catch rate in 2017 (1.6/nn) was close to the average (1.8/nn) calculated from the previous seven surveys going back to 1997. Furthermore, most individuals sampled were of minimum legal size and above (≥ 10 inches) with the largest fish measuring 16 inches long.

White Bass reached minimum harvestable-size (10 inches) by age 1 ($n=11$; Figure 8) which is typical for this reservoir (Farooqi and De Jesus 2013, De Jesus and Magnelia 2009).

Largemouth Bass: In 2016, the reservoir contained a moderate density Largemouth Bass population relative to bass populations in other central Texas reservoirs. The total CPUE of Largemouth Bass was 60.7/h in 2016 compared to catch rates of 70.0/h in 2014, and 82.7/h in 2012 (Figure 9) and was slightly lower than the 22-year average total CPUE of 82.7/h (+/- 19.8/h) reported by De Jesus and Magnelia (2009). The CPUE of larger size classes of Largemouth Bass were more consistent with the previous two surveys. The electrofishing catch rate of stock-length Largemouth Bass was 54.0/h in 2016 compared to 54.0/h in 2014 and 62.7/h in 2012. Catch rates of harvestable bass (CPUE-14) increased slightly to 21.3/h in 2016 from 16.7/h in 2014 and 18.7/h in 2012. In all three surveys, CPUE-14 was above the historical average of 10.4/h (+/- 4.7/h) for LBJ Reservoir (De Jesus and Magnelia 2009).

Population size structure in the last three surveys was good; population indices (Figure 9) were within the expected range (PSD 40 to 70, PSD-P 10 to 40, PSD-M 0 to 10) for a balanced population (Gabelhouse 1984).

Overall, body condition was close to optimal ($W_r=100$) in 2016, with fish in most length groups having relative weights of between 90 and 110.

Age and growth analysis from 2016 was not conclusive, but indicated individuals likely reached

harvestable-size (14 inches) between ages one and two (N = 13, Figure 10), which is about average compared to values for the Edwards Plateau ecological area (Prentice 1987).

Florida Largemouth Bass influence in 2016 was 58.0%; nearly all the fish were intergrades. Florida Largemouth Bass influence has remained relatively constant during the last four evaluations since 2006 (Table 8) even though the reservoir has been stocked with Florida Largemouth Bass annually from 2011 to 2016.

The characteristics of the Largemouth Bass population in LBJ Reservoir have made it a popular venue for tournaments. The Texas Tournament Zone held annual tournaments on the reservoir from 2014 to 2017. In 2017, there was a record-high of 254 teams competing and the winning weight (five-fish bag) was 32.2 lbs; big fish weighed 10.7 lbs. Also, Bass Champs Tournament Trail held 11 tournaments on the reservoir from 2014 to 2017. In 2017, the winning weight was 26.8 lbs (five-fish bag) and the heaviest fish weighed 11.5 lbs.

Fisheries management plan for LBJ Reservoir, Texas

Prepared – July 2017.

ISSUE 1: Previous expansion of vegetation in LBJ Reservoir has augmented Largemouth Bass fishing opportunities, helping to make this reservoir one of the most popular bass fishing destinations in central Texas. Drought conditions likely drove the expansion of vegetation. However, since 2015 there have been changes to this plant community that may influence Largemouth Bass population dynamics.

MANAGEMENT STRATEGIES

1. Continue annual aquatic vegetation surveys.
2. Conduct an additional electrofishing survey in 2018 to monitor the Largemouth Bass population in response to vegetation dynamics.

ISSUE 2: The Largemouth Bass population structure at LBJ Reservoir has shown improvement over the past few years. Large individuals are reported caught by tournament anglers from an increasing tournament scene at LBJ Reservoir. A first-ever ShareLunker entry was reported in 2010, showing the potential for this lake to produce trophy-size fish.

MANAGEMENT STRATEGY

1. Continue to monitor the Largemouth Bass tournament scene to capture large fish data.

ISSUE 3: Many invasive species threaten aquatic habitats and organisms in Texas and can adversely affect the state ecologically, environmentally, and economically. For example, zebra mussels (*Dreissena polymorpha*) can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches and plugging engine cooling systems. Giant salvinia (*Salvinia molesta*) and other invasive vegetation species can form dense mats, interfering with recreational activities like fishing, boating, skiing, and swimming. The financial costs of controlling and/or eradicating these types of invasive species are significant. Additionally, the potential for invasive species to spread to other river drainages and reservoirs via watercraft and other means is a serious threat to all public waters of the state.

MANAGEMENT STRATEGIES

1. Cooperate with LCRA to post appropriate signage at access points around the reservoir.
2. If applicable, 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 for Lyndon B. Johnson Reservoir

2017-2021

Sport fish, forage fish, and other important fishes

Important sport fish in Lyndon B. Johnson (LBJ) Reservoir include Largemouth Bass, White Bass, and catfish species. Known important forage species include Bluegill, Redbreast Sunfish, Gizzard Shad, and Threadfin Shad.

Low density fisheries

White Crappie: White Crappie total CPUE in 2012, 2008, 2004, and 2000 were 0.2, 3.5, 0.8, 4.5/nn respectively. The historical average total CPUE is 2.3/nn (range 0.8/nn – 4.5/nn). The CPUE-10 was 0.1/nn, 0.3/nn and 0.2/nn in 2012, 2008, and 2004, respectively. Sampling this population is not a priority for 2017-2021.

Blue Catfish: Blue Catfish have not been stocked in LBJ Reservoir. Some Blue Catfish have been recorded in surveys and their presence is most likely as a result of upstream emigration from stocked reservoirs. Blue Catfish total CPUE in 2013, 2009, 2005, and 2001 were 0.3, 0.2, 0.1, 0.1/nn, respectively. Sampling this population is not a priority for 2017-2021. However, we will monitor presence/absence of Blue Catfish while conducting gill netting surveys for Channel Catfish.

Flathead Catfish: Flathead catfish are present in low abundance based on gill netting surveys. Flathead Catfish total CPUE in 2013, 2009, 2005, and 2001 were 0.2, 1.5, 1.6, 0.4/nn respectively. Sampling this population is not a priority for 2017-2021. However, we will monitor presence/absence while conducting gill netting surveys for Channel Catfish.

Survey objectives, fisheries metrics, and sampling objectives

Largemouth Bass: Largemouth Bass are the most popular sport fish in LBJ Reservoir. Recent improvements in abundance and size structure of the population is reflected by an increase in Largemouth Bass fishing tournament activity since 2012. Texas Tournament Zone held annual tournaments on LBJ Reservoir from 2014 to 2017 with winning five-fish weights ranging from 21.5 lbs to 33.1 lbs. In 2017, there was a record high of 254 teams competing and the winning weight was 32.2 lbs; big fish weighed 10.7 lbs. Bass Champs Tournament Trail held 11 tournaments on LBJ from 2014 to 2017; winning five-fish weights ranged from 22.2 lbs to 27.4 lbs. in 2017, the winning weight was 26.8 lbs

and the heaviest fish weighed 11.5 lbs. Largemouth Bass total CPUE in 2016, 2014, 2012, 2010, 2008, 2006, 2004, 2002, and 2000 were 60.7, 70.0, 82.7, 50.0, 61.3, 96.7, 81.0, 48.0, and 72.7/h, respectively. A ShareLunker weighing 13.7 lbs. was caught from LBJ Reservoir in 2010. The popularity and growing reputation for quality Largemouth Bass fishing at this reservoir warrants sampling time and effort.

Trend data on CPUE, size structure, and body condition have been collected biennially since 2000 with fall nighttime electrofishing. Continuation of biennial trend data with night-electrofishing in the fall will allow for determination of any large-scale changes in the Largemouth Bass population. A minimum of 18 randomly selected 5-min electrofishing sites will be sampled, but sampling will continue at random sites until 50 stock-size fish are collected and the RSE of CPUE-S is ≤ 25 (the anticipated effort to meet both sampling objectives is 18 stations with 80% confidence). Exclusive of the original 18 random stations, three additional random stations will be pre-determined in the event some extra sampling is necessary. If failure to achieve either objective has occurred after one night of sampling and objectives can be attained with 6-12 additional random stations, another night of effort will be expended.

Relative weight of Largemouth Bass ≥ 8 " will be determined from their length/weight data (maximum of 10 fish weighed and measured per inch class). Ages for Largemouth Bass will be determined by a Category 2 evaluation using otoliths from 13 randomly-selected fish (range 12.9 to 14.9 inches) to determine at what age fish reach harvestable size. Fin samples will be taken from 30 randomly selected Largemouth Bass for genetic analysis.

Channel Catfish: Channel Catfish were last stocked in LBJ Reservoir in 2016. Channel Catfish total CPUE in 2017, 2013, 2009, 2005, 2001, and 2000 were 2.7, 1.8, 2.3, 3.5, 5.3, and 5.2/nn respectively. Target sample sizes to evaluate size structure and CPUE will be 50 stock-length fish, and an RSE of CPUE-S ≤ 30 . Based on the number of gill nets set in previous surveys, a minimum of 15 randomly selected gill net stations will be sampled, but sampling will continue at random stations until a minimum of 50 stock size Channel Catfish have been collected. In addition to the original 15 random stations, five additional random stations will be pre-determined in the event extra sampling is necessary.

White Bass: White Bass CPUE in 2017, 2013, 2009, and 2005 were 1.6, 1.5, 2.0, and 1.6/nn /nn respectively. White Bass will be collected when sampling for Channel Catfish with gill nets. Sampling will be limited to general monitoring trend data (without precision or sample size requirements). An age and growth sample with a minimum of 13 fish between 9.0 and 11.9 inches in length will be collected from gill netting to assess the time required for White Bass to grow to the minimum length limit for harvest (Category 2 evaluation; TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Bluegill, Redbreast Sunfish and Gizzard Shad: Bluegill, Redbreast Sunfish, Gizzard Shad and Threadfin Shad are the predominant prey species available in LBJ Reservoir. Sampling effort based on achieving sampling objectives for Largemouth Bass will result in sufficient numbers of Bluegill, Redbreast Sunfish and Gizzard Shad for size structure estimation (PSD for sunfish and IOV for Gizzard Shad; 50 stock-size fish minimum at 18 stations with 80% confidence), but not for relative abundance estimates (RSE ≤ 25 of CPUE-Total (CPUE-T); anticipated effort is 25-30 stations). At the sampling effort needed to achieve sampling objectives for Largemouth Bass, the expected RSE for CPUE-T is 30 for Bluegill and Redbreast Sunfish, and 35 for Gizzard Shad. No additional effort will be expended to achieve an RSE ≤ 25 for CPUE of Bluegill, Redbreast Sunfish, and Gizzard Shad. Instead, Largemouth Bass body condition can provide information on forage abundance, vulnerability, or both relative to predator density.

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Table 1. Characteristics of LBJ Reservoir, Texas.

Characteristic	Description
Year constructed	1951
Controlling authority	Lower Colorado River Authority
Counties	Burnet and Llano
Reservoir type	Mainstream: Colorado River
Shoreline Development Index	13.3
Conductivity	338 μ S/cm

Table 2. Boat ramp characteristics for LBJ Reservoir, Texas, September 2016. Reservoir elevation at time of survey was 824 ft. above MSL (conservation level is 825 ft. above MSL).

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft.)	Condition
Cottonwood Shores	30.550603 -98.337208	Y	50	NA	Good
Sherwood Forest Park	30.584761 -98.370508	Y	10	NA	Good
Clear Cove City Park	30.579892 -98.369933	Y	10	NA	Good
Timberhill Park	30.580825 -98.376675	Y	10	NA	Good
Belaire Park	30.576706 -98.385850	Y	10	NA	Good
Bluebriar City Park	30.593392 -98.395156	Y	10	NA	Good
Castleshoals Park	30.594089 -98.389842	Y	10	NA	Needs improvement
Dove Point Park	30.603619 -98.392897	Y	10	NA	Good
Boat Ramp #9	30.603883 -98.394597	N	10	NA	Needs improvement
Granite Shoals Park	30.604406 -98.406822	Y	10	NA	Needs improvement
Boat ramp #11	30.628600 -98.415583	N	10	NA	Good
Riverside View	30.647325 -98.418103	N	10	NA	Good
Boat Ramp #13	30.649772 -98.419142	N	10	NA	Good
Gas Station Boat Ramp	30.657461 -98.427850	N	15	NA	Good
Clearwater Marina	30.672928 -98.420567	Y	10	NA	Good
Boat Ramp #16	30.704183 -98.412719	N	10	NA	Good
RV and Boat Storage	30.491119 -98.429969	N	10	NA	Good
Kingsland Lions Club	30.653214 -98.436011	Y	15	NA	Needs improvement
Sidney Rowe Mem. Park	30.643678 -98.450256	Y	10	NA	Good

Table 3. Harvest regulations for LBJ Reservoir, Texas.

Species	Bag limit	Length limit (inches)
Channel and Blue Catfish	25 (in any combination)	12 (minimum)
Flathead Catfish	5	18 (minimum)
White Bass	25	10 (minimum)
Largemouth Bass	5 ^a	14 (minimum)
Guadalupe Bass	5 ^a	None
White and Black Crappie	25 (in any combination)	10 (minimum)

^a Daily bag for Largemouth Bass and Guadalupe Bass = five fish in any combination.

Table 4. Stocking history for Lyndon B. Johnson 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)
Channel Catfish	1969	112,457	AFGL	7.9
	1971	263,925	AFGL	7.9
	1972	32,400	AFGL	7.9
	1984	7,682	AFGL	11.0
	1989	5,346	ADL	12.0
	1991	10,900	AFGL	5.9
	1994	580	AFGL	7.4
	2009	400	ADL	14.5
	2012	22,923	AFGL	4.3
	2012	40,179	FGL	1.1
	2012	62,371	FRY	0.9
	2013	17,995	AFGL	4.3
	2016	64,903	FGL	1.6
	Total	642,061		
Flathead Catfish	1971	52		UNK
	Total	52		
Florida Largemouth Bass	1976	64,600	FRY	1.0
	2001	228,300	FGL	1.4
	2002	420,790	FGL	1.6
	2011	338,740	FGL	1.5
	2012	335,752	FGL	1.5
	2013	472,365	FRY	0.3
	2014	330,103	FGL	1.6
	2015	240,671	FGL	1.7
	2016	156,140	FGL	1.8
	Total	2,587,461		
Green Sunfish x Redear Sunfish	1972	15,000		UNK
	Total	15,000		
Largemouth Bass	1971	308,126	FRY	0.7
	Total	308,126		

Table 4. Stocking history for Lyndon B. Johnson 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)
Palmetto Bass Striped X White Bass hybrid)	1977	71,000	UNK	UNK
	1980	<u>64,000</u>	UNK	UNK
	Total	135,000		
ShareLunker Largemouth Bass	2010	<u>2,220</u>	FGL	2.5
	Total	2,220		
Smallmouth Bass	1976	25,000	UNK	UNK
	1984	59,400	FGL	2.0
	1985	59,500	FGL	2.0
	1986	<u>747</u>	AFGL	4.0
	Total	144,647		
Striped Bass	1983	<u>59,881</u>	UNK	UNK
	Total	59,881		
Walleye	1973	5,600,000	FRY	0.2
	1974	<u>1,600,000</u>	FRY	0.2
	Total	7,200,000		

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

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing</i>			
Largemouth Bass	Abundance	CPUE – stock	RSE-stock ≤ 25
	Size structure	PSD, length frequency	$N \geq 50$ stock
	Age-and-growth	Age at 14 inches	$N = 13, 13.0 - 14.9$ inches
	Condition	W_r	10 fish/inch group (max)
	Genetics	% FLMB	$N = 30$, any age
Redbreast Sunfish ^a	Abundance	CPUE – total	RSE ≤ 25
	Size structure	PSD, length frequency	$N \geq 50$ stock
Bluegill ^a	Abundance	CPUE – total	RSE ≤ 25
	Size structure	PSD, length frequency	$N \geq 50$
Gizzard Shad ^a	Abundance	CPUE – total	RSE ≤ 25
	Size structure	Length frequency	$N \geq 50$
	Prey availability	IOV	$N \geq 50$
<i>Gill netting</i>			
White Bass	Abundance	CPUE – total	Presence/absence
	Size structure	Length frequency	Presence/absence
	Age-and-growth	Age at 10 inches	$N = 13, 9.0 - 10.9$ inches
Channel Catfish	Abundance	CPUE – stock	RSE-stock ≤ 30
	Size structure	Length frequency	$N \geq 50$ stock
	Condition	W_r	10 fish/inch group (max)

^a No additional effort will be expended to achieve an RSE ≤ 25 for CPUE and $N \geq 50$ for Redbreast Sunfish, 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.

Table 6. Survey of structural habitat types, LBJ Reservoir, Texas, 2016.

Habitat type	Shoreline coverage (miles)	% of total
Bulkhead with Piers and Docks	138.3	51.2
Natural Shoreline	103.9	38.5
Natural Shoreline/Piers/Docks	21.0	7.8
Rocky Shoreline	4.4	1.6
Rocky Bluff	2.4	0.9

Table 7. Survey of aquatic vegetation, LBJ Reservoir, Texas, 2013 – 2016. Surface area (acres) is listed with percent of total reservoir surface area in parentheses. Surveys were conducted in the fall.

Vegetation	2013	2014	2015	2016*
Native submersed	1.0 (<1.0)	3.2 (<1.0)	11.0 (<1.0)	39.2 (<1.0)
Native floating-leaved	7.0 (<1.0)	9.6 (<1.0)	9.9 (<1.0)	25.5 (<1.0)
Native emergent	28.0 (<1.0)	73.4 (1.1)	49.3 (<1.0)	140.7 (2.2)
<i>Non-native</i>				
Hydrilla (Tier I)**	0.0 (0.0)	22.3 (<1.0)	17.0 (<1.0)	112.9 (1.8)
Eurasian watermilfoil (Tier III)**	268.0 (4.0)	638.9 (9.9)	364.0 (5.6)	0.0 (0.0)
Water Hyacinth (Tier I)	6.0 (<1.0)	6.0 (<1.0)	7.0 (<1.0)	7.0 (<1.0)

* 2016 survey included Colorado River and Llano River arms of the lake (Comprehensive lake survey)

**Tier I is immediate Response, Tier III is Watch Status.

Gizzard Shad

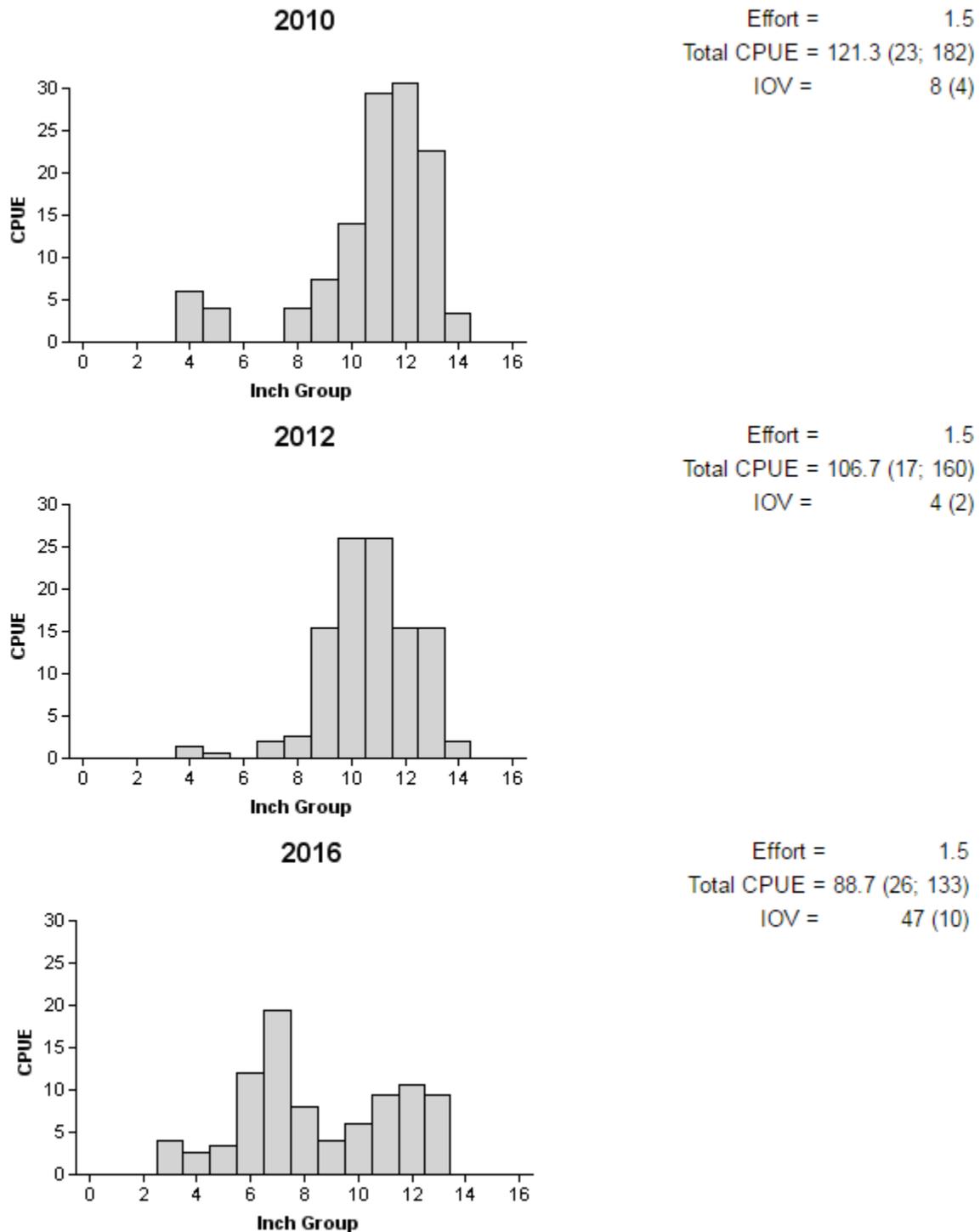


Figure 1. Number of Gizzard Shad caught per hour (CPUE) population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, LBJ Reservoir, Texas, 2010, 2012, and 2016.

Redbreast Sunfish

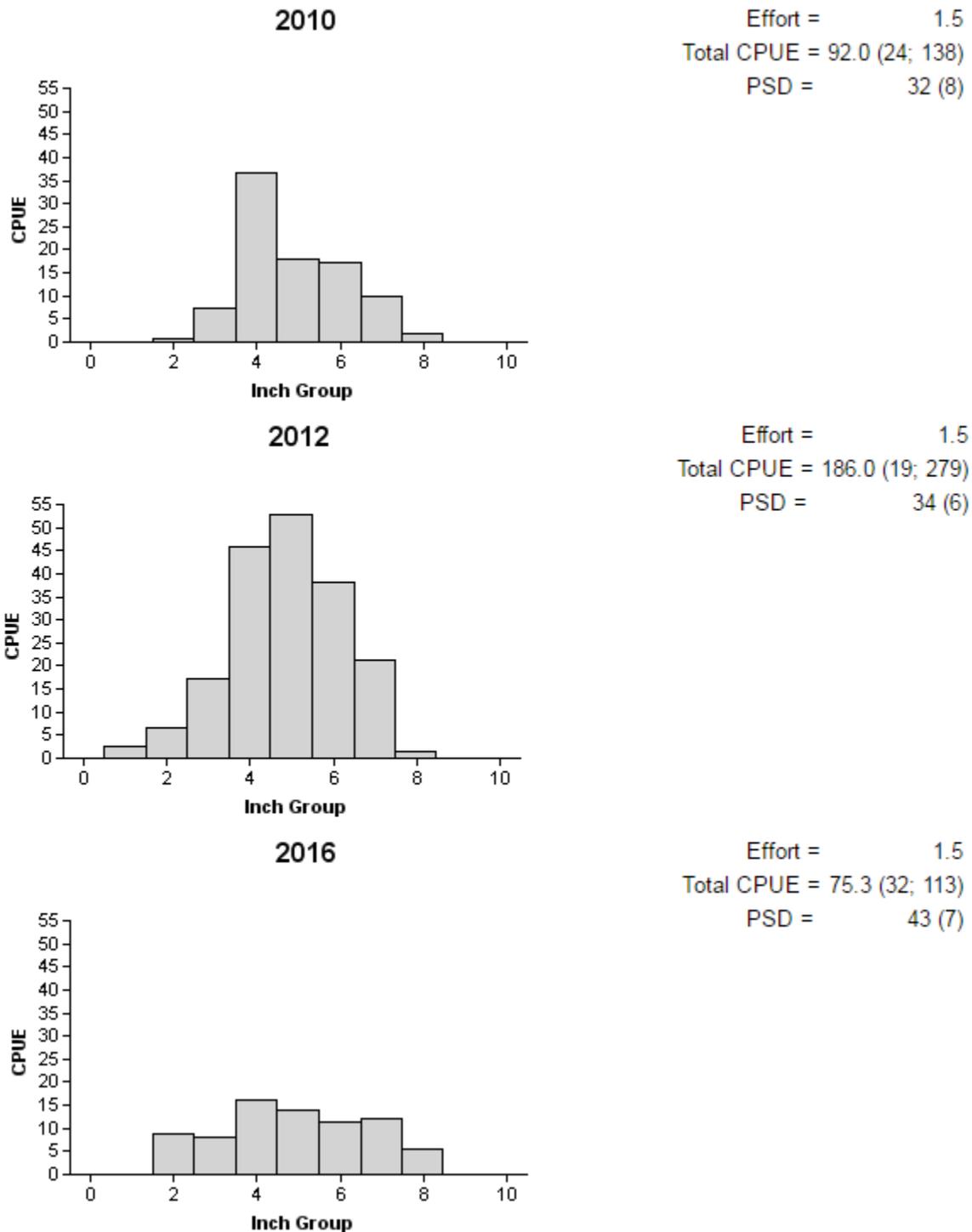


Figure 2. Number of Redbreast Sunfish caught per hour (CPUE) population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, LBJ Reservoir, Texas, 2010, 2012, and 2016.

Bluegill

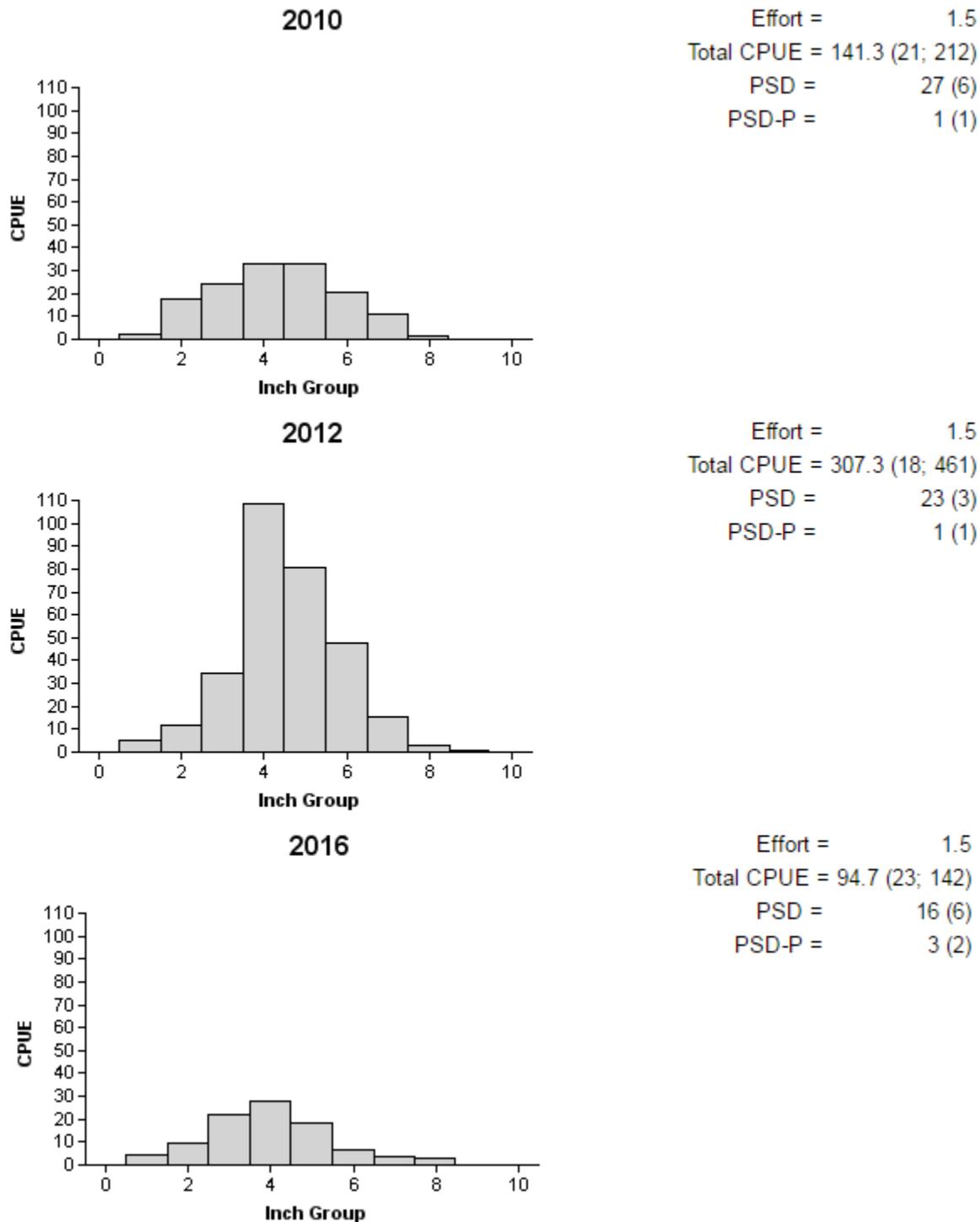


Figure 3. Number of Bluegill caught per hour (CPUE) population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, LBJ Reservoir, Texas, 2010, 2012, and 2016.

Blue Catfish

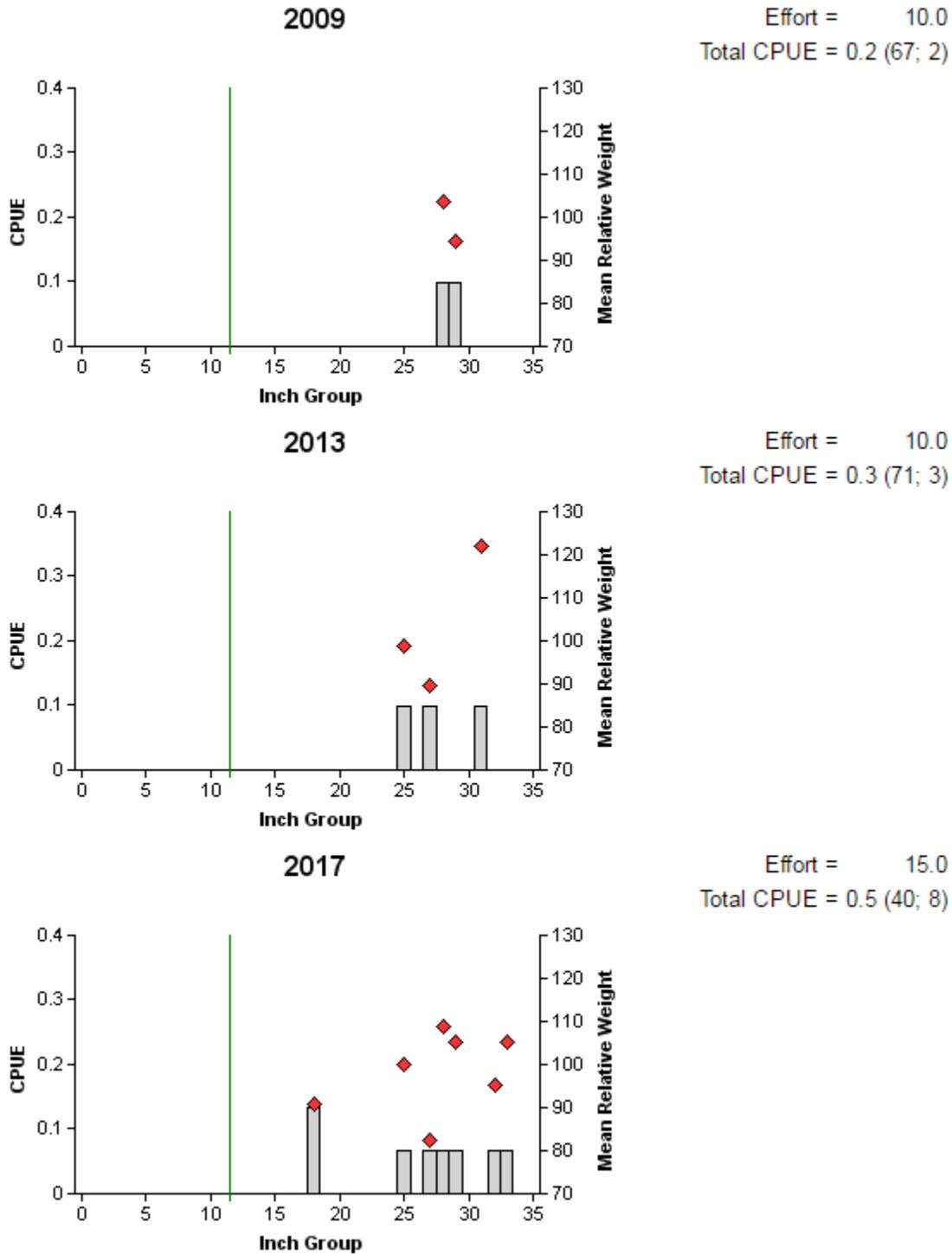


Figure 4. Number of Blue Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE are in parentheses) for spring gill net surveys, LBJ Reservoir, Texas, 2009, 2013, and 2017. Vertical line represents minimum length limit at the time of sampling.

Channel Catfish

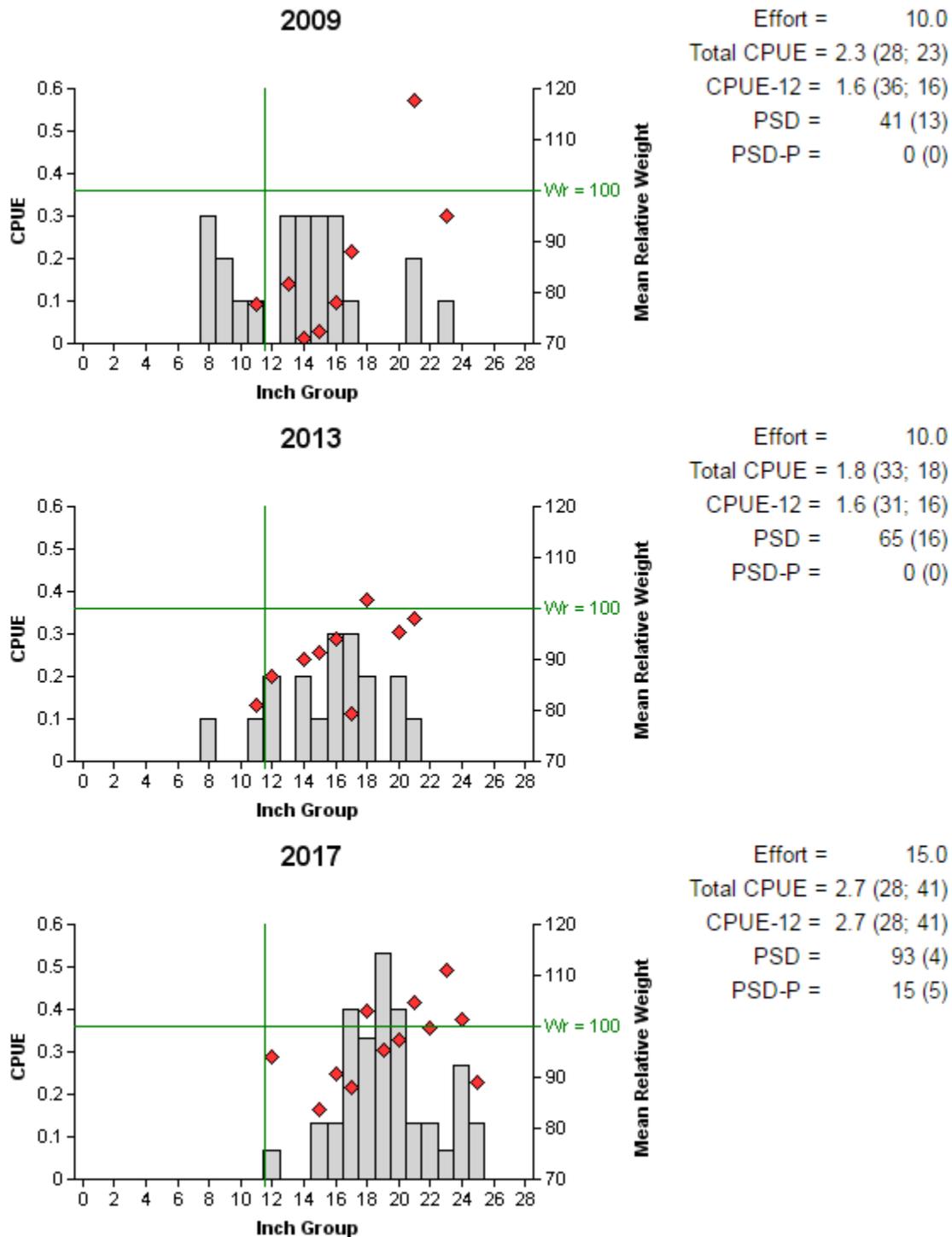


Figure 5. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, LBJ Reservoir, Texas, 2009, 2013, and 2017. Vertical line represents minimum length limit at the time of sampling.

Flathead Catfish

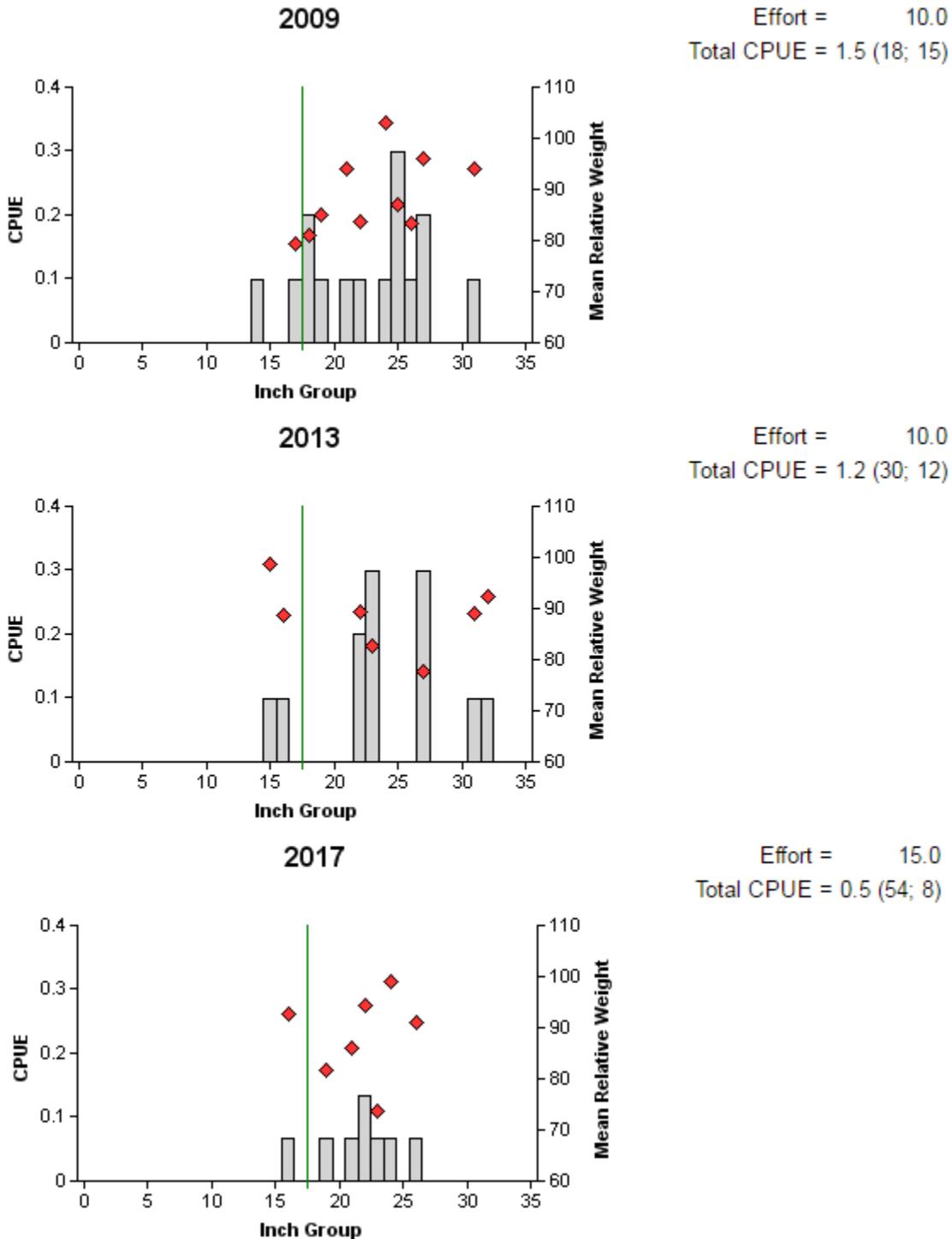


Figure 6. Number of Flathead Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE are in parentheses) for spring gill net surveys, LBJ Reservoir, Texas, 2009, 2013, and 2017. Vertical line represents minimum length limit at the time of sampling.

White Bass

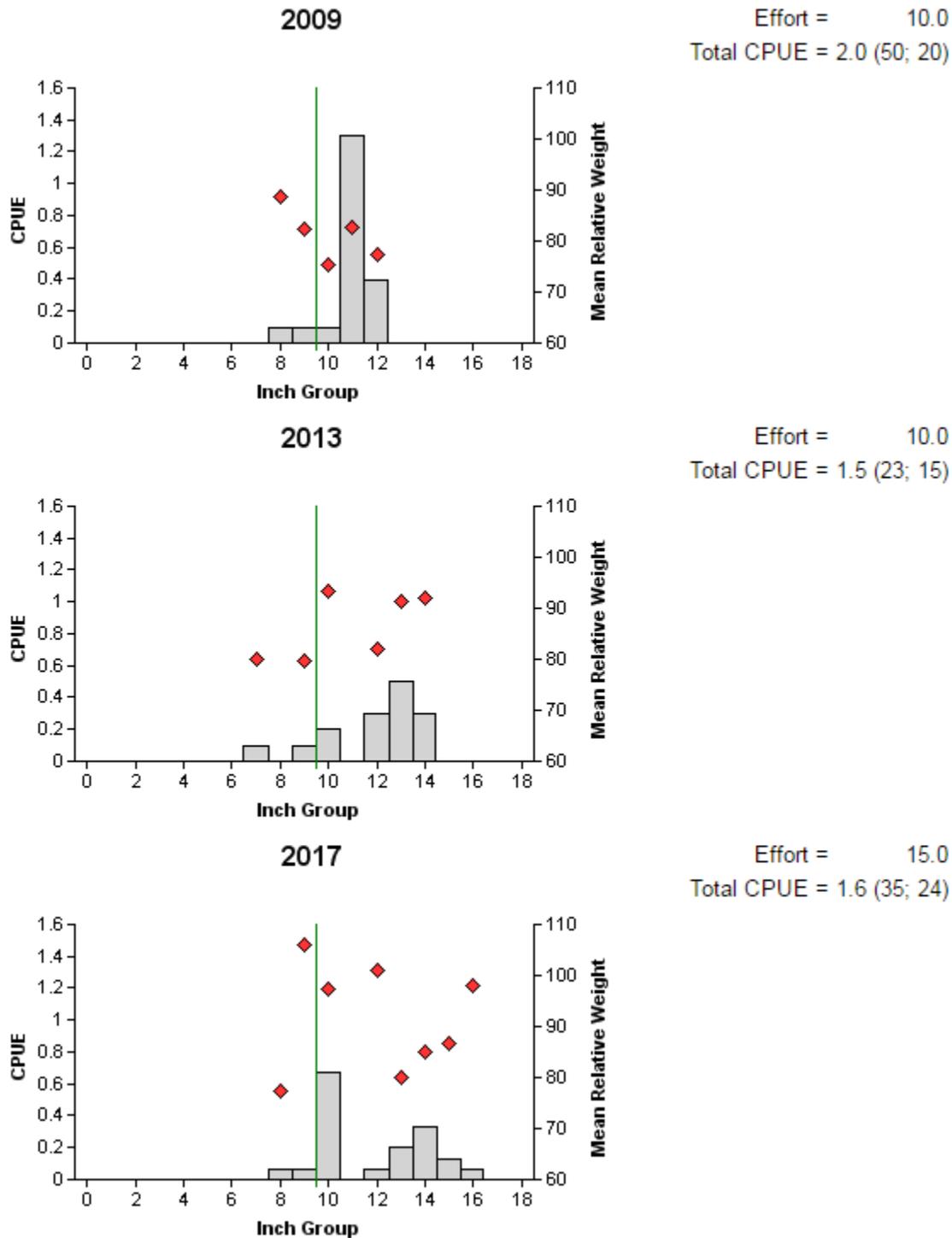


Figure 7. Number of White Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE are in parentheses) for spring gill net surveys, LBJ Reservoir, Texas, 2009, 2013, and 2017. Vertical line represent minimum length limit at the time of sampling.

White Bass

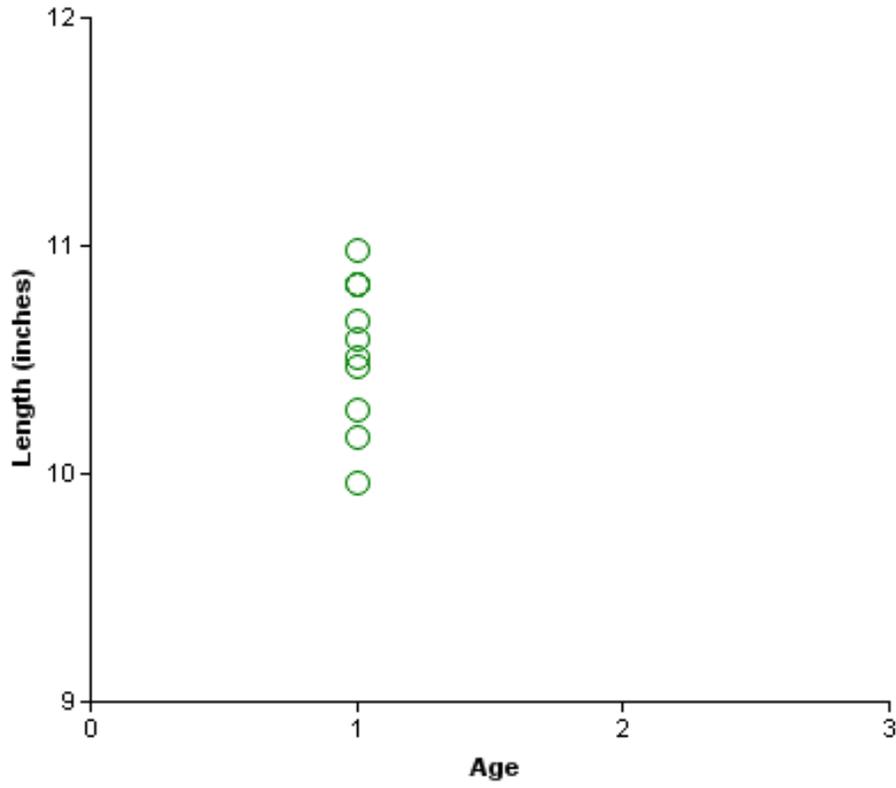


Figure 8. Length at age for White Bass (n=11) collected by gill netting at LBJ Reservoir, Texas, March 2017.

Largemouth Bass

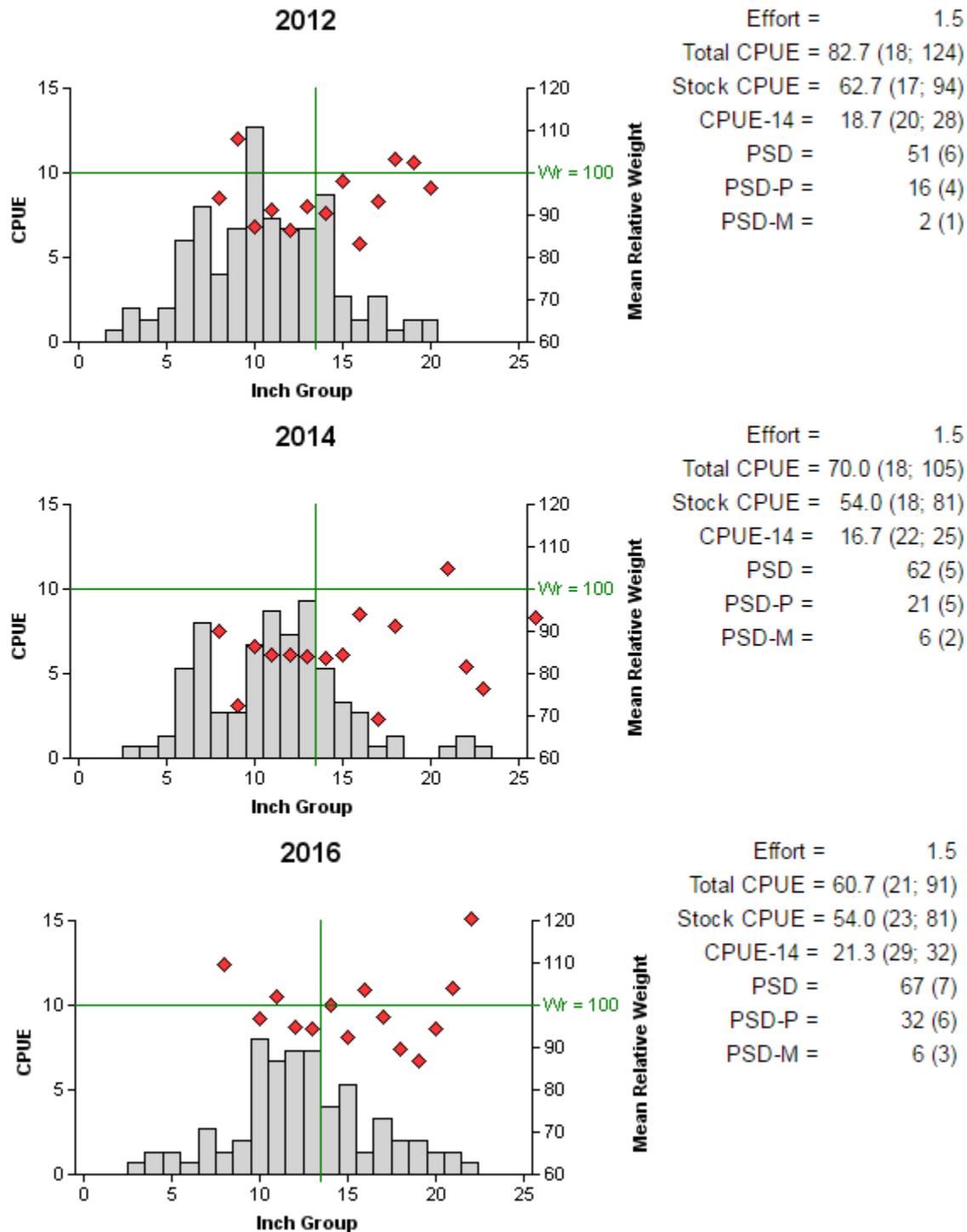


Figure 9. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, LBJ Reservoir, Texas, 2012, 2014, and 2016. Vertical line represents the minimum length limit at the time of sampling.

Largemouth Bass

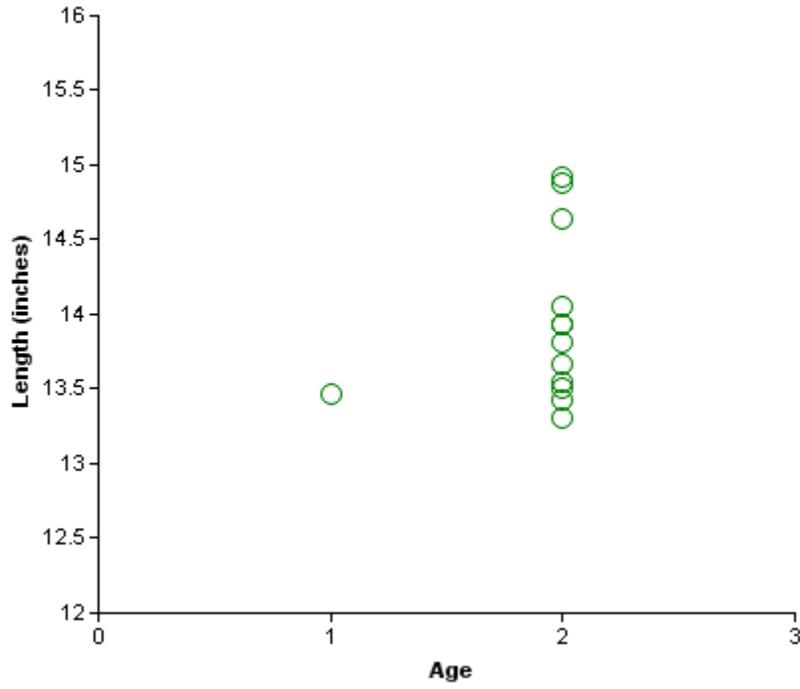


Figure 10. Length at age for Largemouth Bass (n=13) collected by electrofishing at LBJ Reservoir, Texas, November 2016.

Table 8. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, LBJ Reservoir, Texas, 2006, 2008, 2012, and 2016. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB. Genetic composition was determined by micro-satellite DNA analysis.

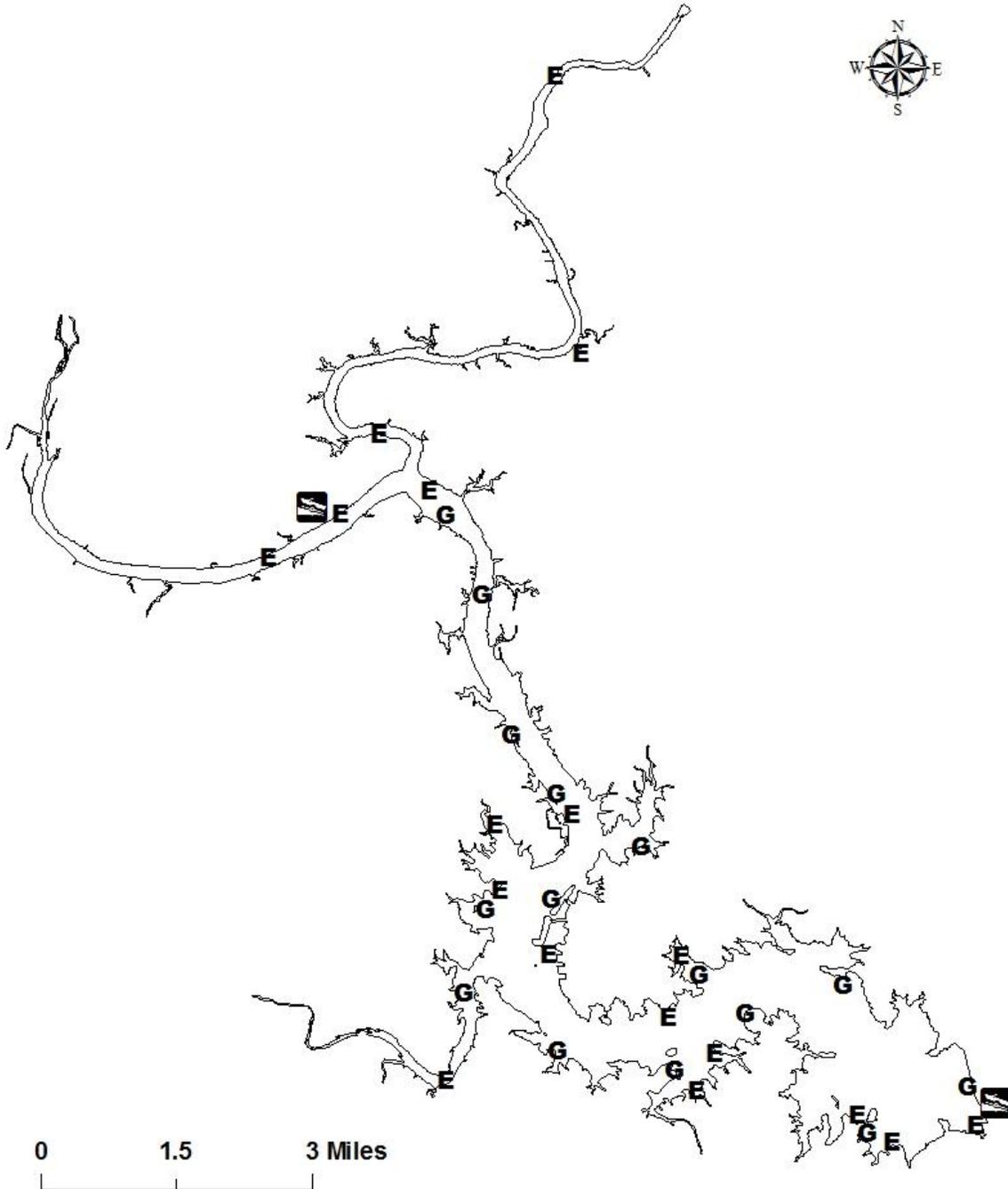
Year	Sample size	Number of fish			% FLMB alleles	% FLMB
		FLMB	Intergrade	NLMB		
2006	30	1	29	0	61.0	3.3
2008	30	0	30	0	58.0	0.0
2012	29	1	28	0	66.0	3.4
2016	30	1	29	0	58.0	3.3

Table 9. Proposed sampling schedule for LBJ Reservoir, Texas. Survey period is June through May. Electrofishing surveys are conducted in the fall (except where noted). Standard survey denoted by S and additional survey denoted by A.

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

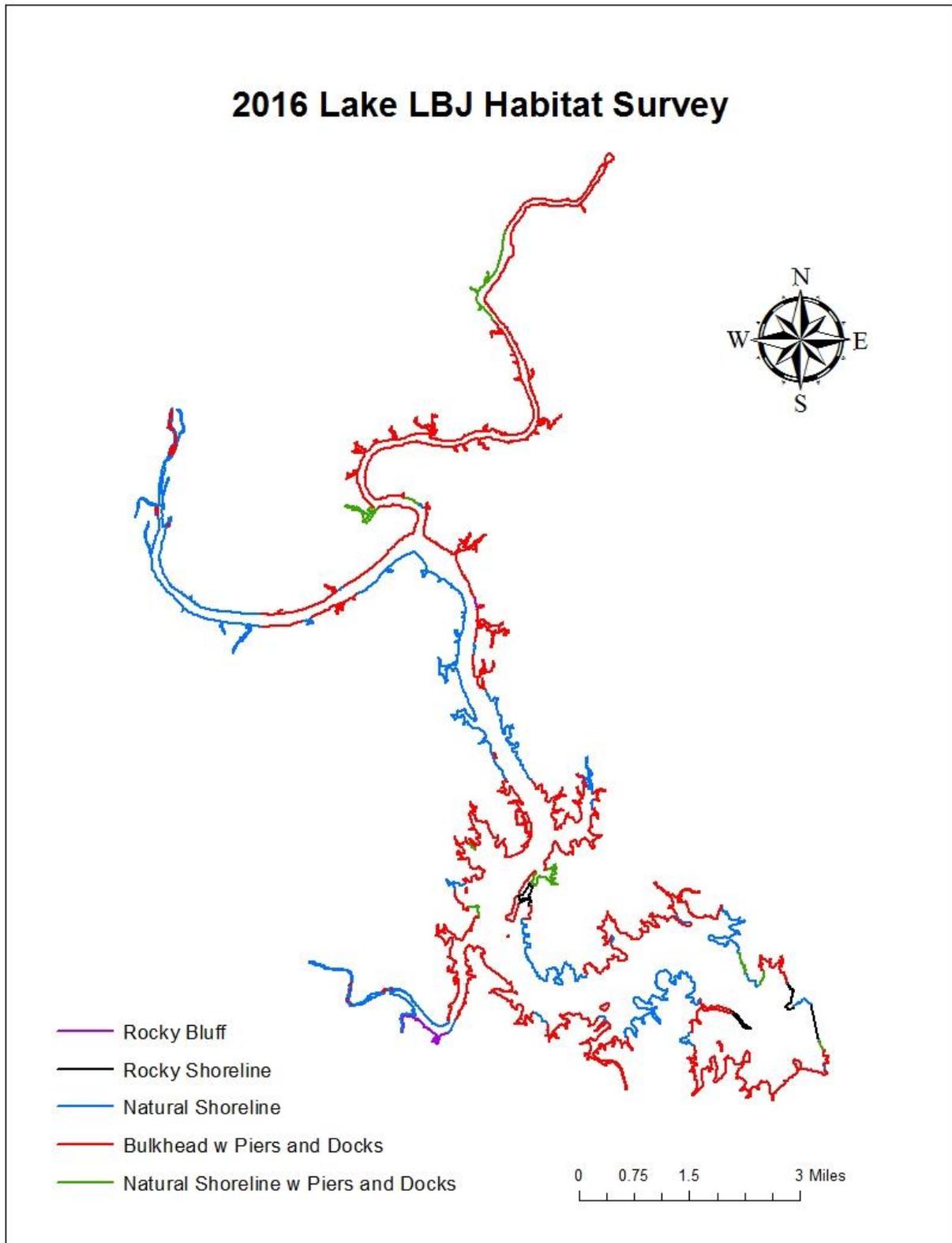
APPENDIX A

Location of sampling sites, LBJ Reservoir, Texas, 2016-2017. Gill net and electrofishing stations are indicated by G and E respectively. Major boat ramps are indicated by the symbol "▣". This is a stable-level reservoir (conservation pool is 825 ft. above mean sea level).



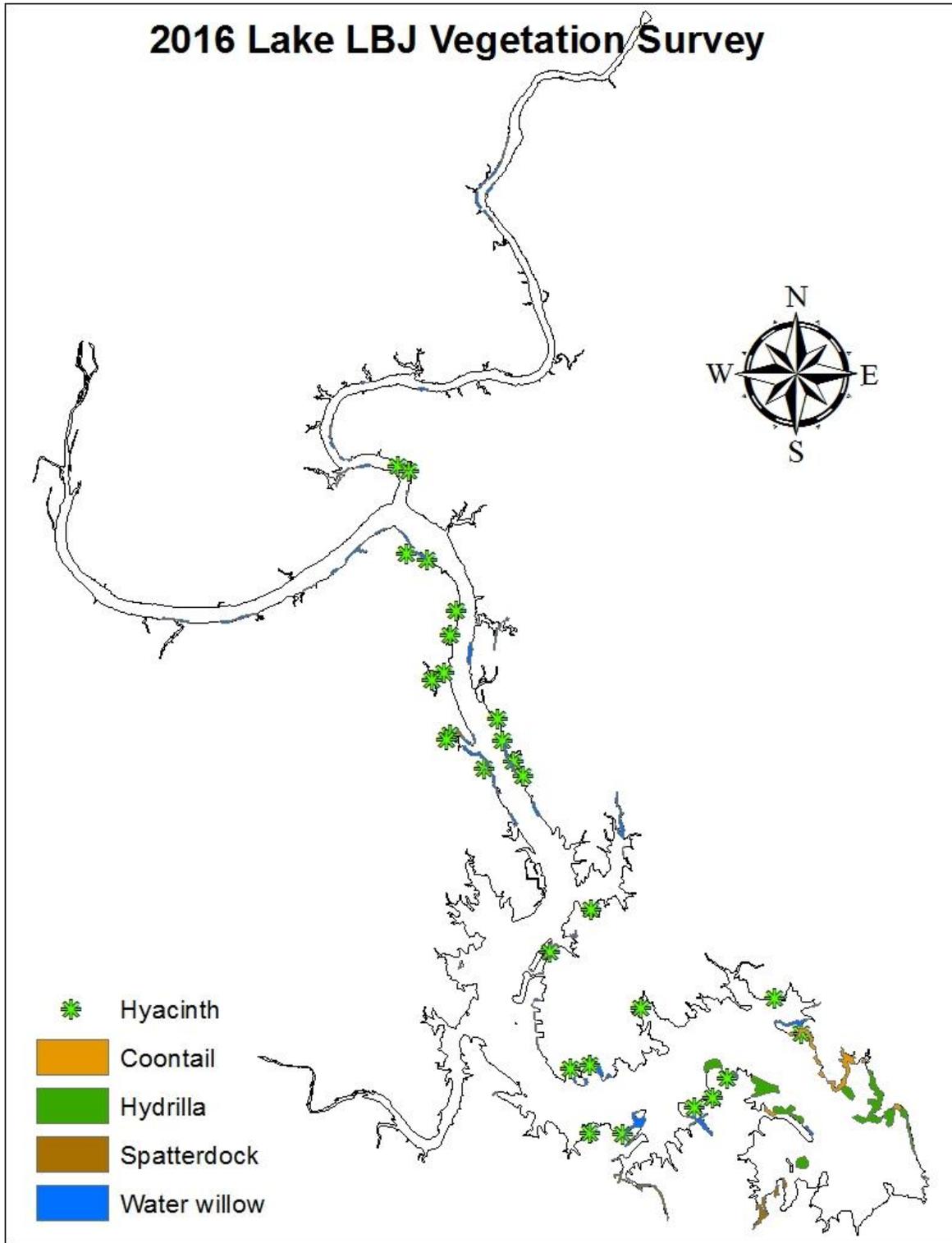
APPENDIX B

Structural habitat survey map for LBJ Reservoir, Texas, September 2016.



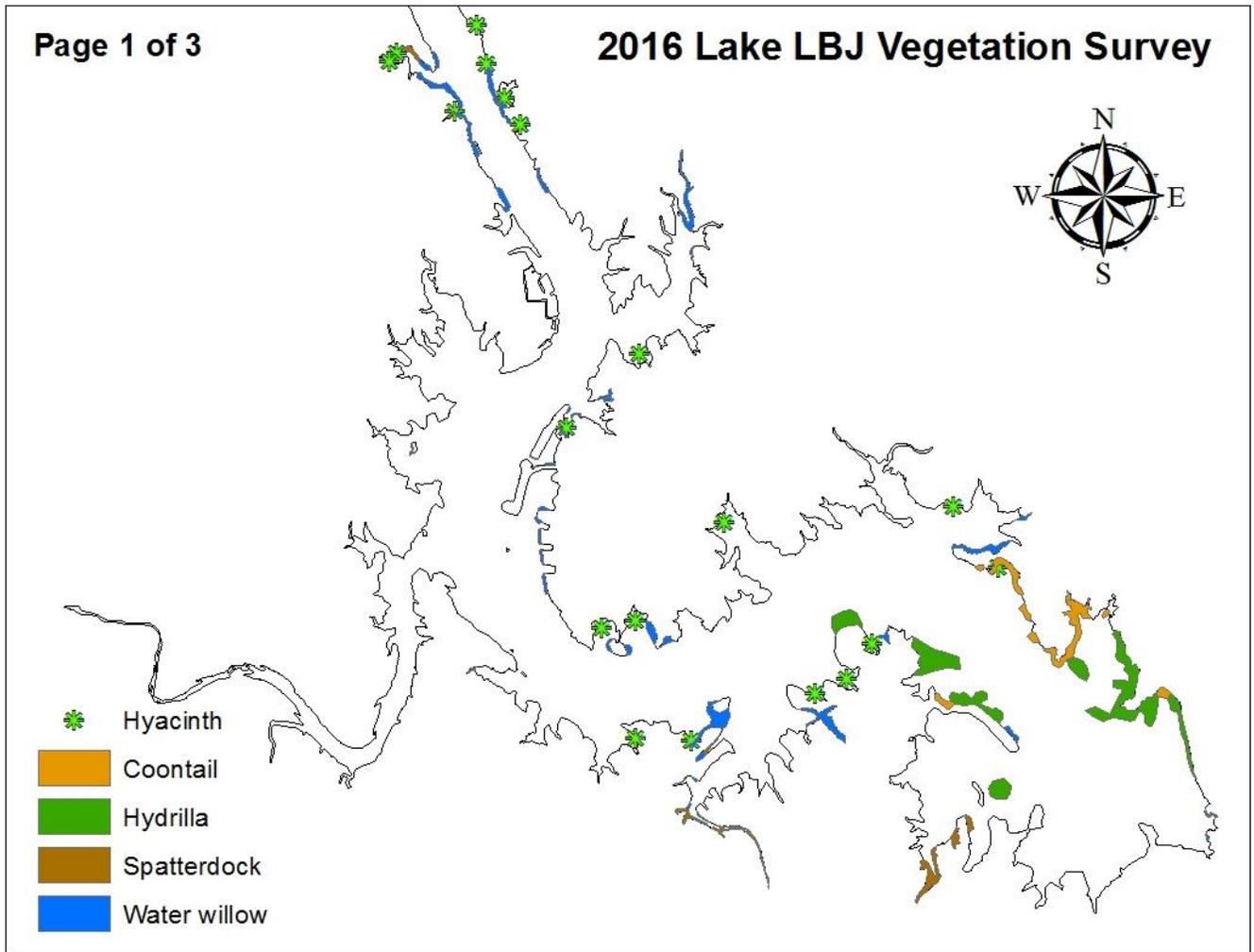
APPENDIX C

Aquatic vegetation survey coverage map for LBJ Reservoir, Texas, September 2016.



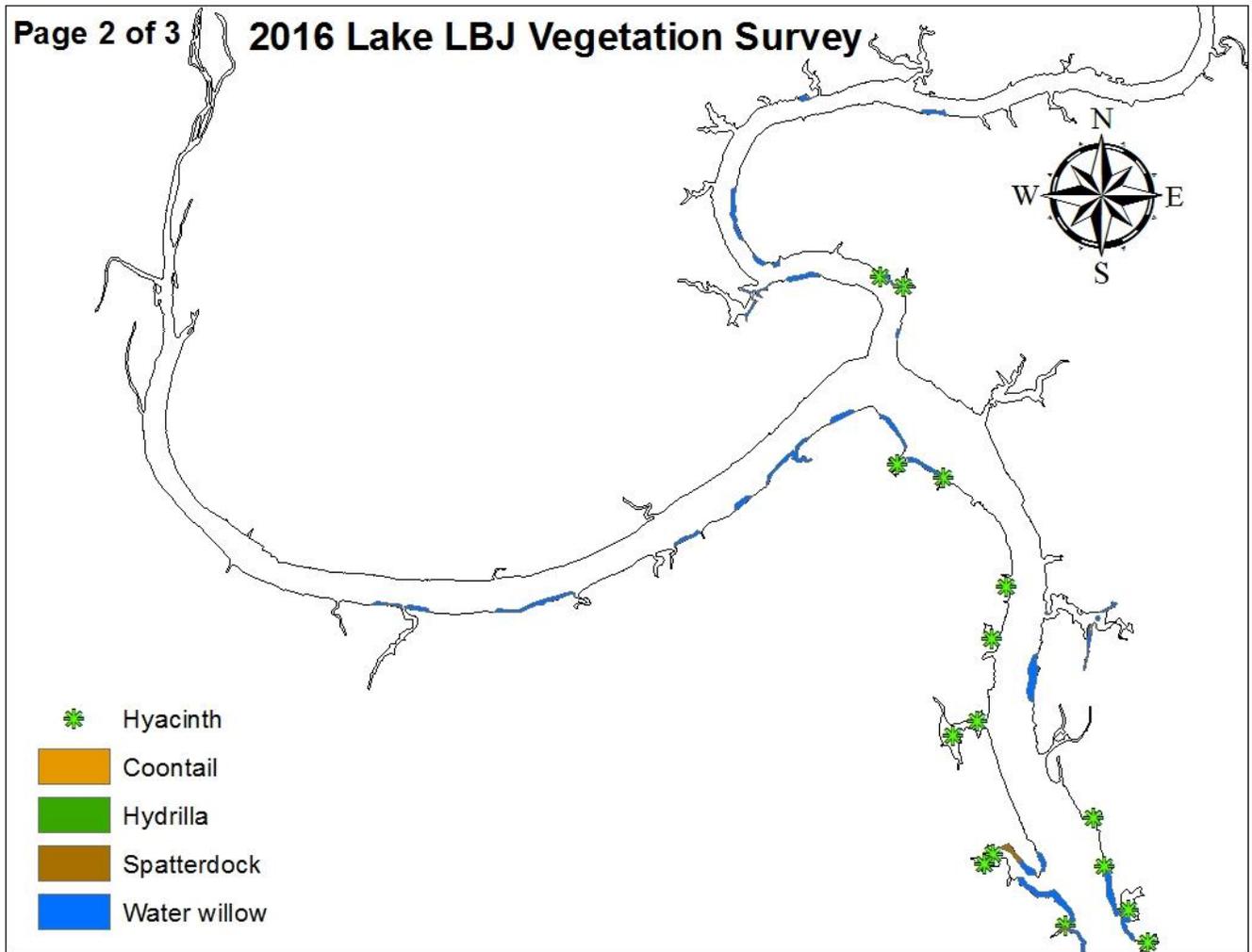
APPENDIX D

Aquatic vegetation survey coverage map for LBJ Reservoir (lower reservoir), Texas, September 2016.



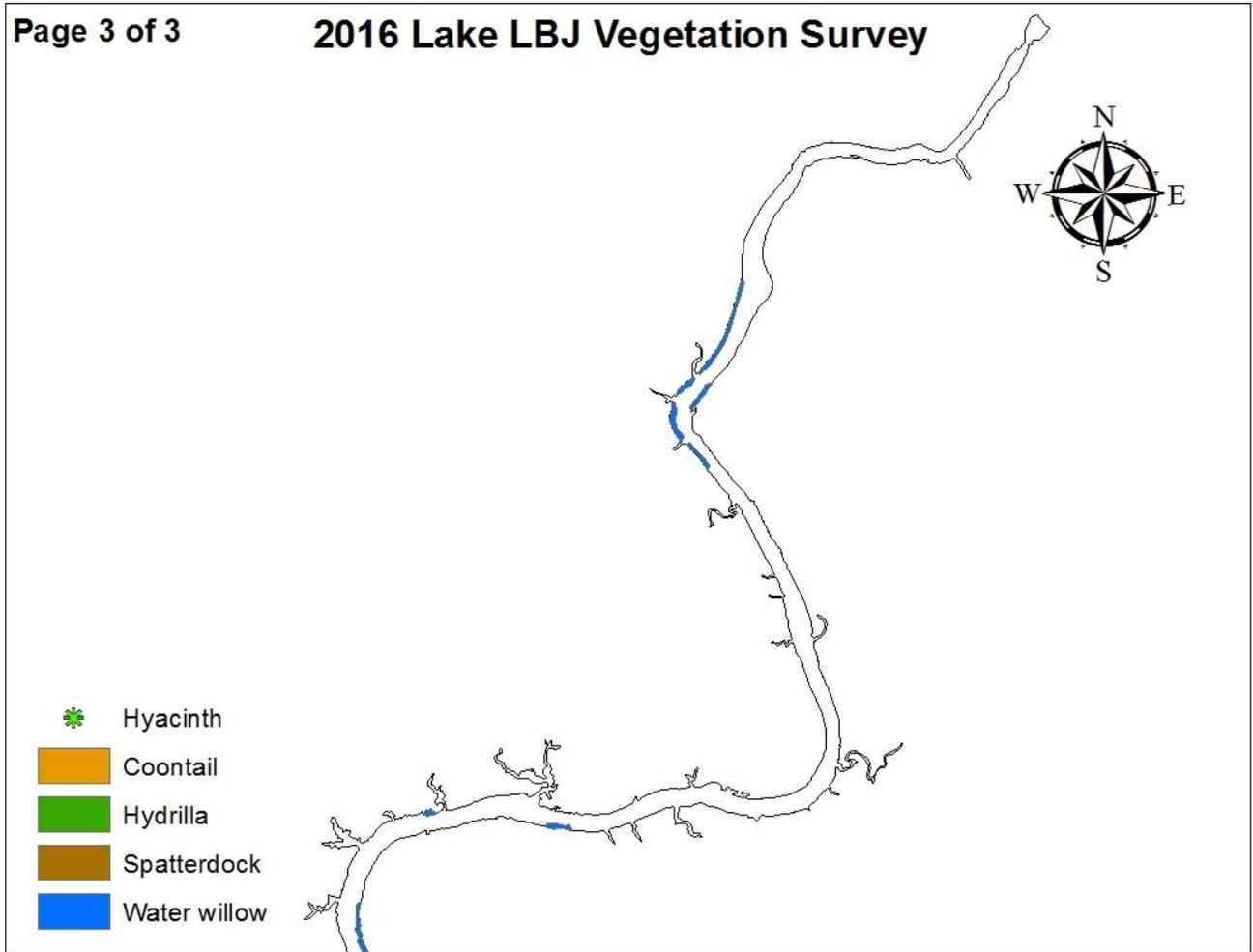
APPENDIX D (Cont.)

Aquatic vegetation survey coverage map for LBJ Reservoir (middle reservoir), Texas, September 2016.



APPENDIX D (Cont.)

Aquatic vegetation survey coverage map for LBJ Reservoir (upper reservoir), Texas, September 2016.



APPENDIX E

Number (N) and catch rate (CPUE) of all target species collected from all gear types from LBJ Reservoir, Texas, 2016-2017. Sampling effort was 15 net nights for gill netting and 1.5 hour for electrofishing.

Species	Gill Netting		Electrofishing	
	N	CPUE	N	CPUE
Gizzard Shad			133	88.7
Threadfin Shad			458	305.3
Inland Silverside			5	3.3
Blacktail Shiner			1	0.7
Blue Catfish	8	0.5		
Channel Catfish	41	2.7		
Flathead Catfish	8	0.5		
White Bass	24	1.6		
Redbreast Sunfish			113	75.3
Bluegill			142	94.7
Longear Sunfish			32	21.3
Redear Sunfish			37	24.7
Largemouth Bass			91	60.7
Guadalupe Bass			4	2.7
Sunshine Bass	7	0.5		