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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2012 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 2012 using electrofishing and trap netting and in 2013 using gill netting. Historical data are presented with the 2012-2013 data for comparison. This report summarizes results of the surveys 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. LBJ Reservoir has a drainage area of approximately 36,290 square miles and a shoreline length of about 154 miles. Residential and commercial properties border most of the shoreline area.

    - **Management History:** Important sport fish include Largemouth Bass, White Bass, and catfish species. Fisheries management plans for 2009 were to make the controlling authority and homeowners aware of the importance of shoreline habitat to the Largemouth Bass fishery (since shoreline habitat continues to be negatively affected by bulkheading), and to monitor aquatic vegetation due to potential expansion of exotic invasive species. In addition, the plans called for evaluating the progress of planted beneficial aquatic vegetation. The lake is managed under statewide regulations.

    - **Fish Community**
        - **Prey species:** Bluegill, Redbreast Sunfish, and Gizzard Shad were the predominant prey species available. Threadfin Shad were also available in low density

        - **Catfishes:** Channel Catfish was the predominant catfish species, although catch rate had decreased since the previous survey. Blue Catfish and Flathead Catfish were present in low densities, but tended to be large.

        - **White Bass:** White Bass were present in low density; fish up to 14 inches in length were present.

        - **Black basses:** Largemouth Bass were relatively abundant and the population size structure was good. Body condition was sub-optimal. On average, bass reached 14 inches by 2.6 years. Guadalupe Bass were also present.

        - **White Crappie:** White Crappie were present in the lake and have been reported as providing fishing opportunities by anglers; however trap net catch rates have persistently been low.

Management Strategies: The reservoir's fish population should continue to be managed with existing harvest regulations. Aquatic vegetation surveys should continue to be conducted annually to monitor coverage of non-native water hyacinth and Eurasian watermilfoil, and the potential for reintroduction of hydrilla. Mandatory gill netting, tap netting, and electrofishing surveys should be conducted in 2016 – 2017, and an additional electrofishing survey in 2014 to monitor Largemouth Bass.

INTRODUCTION

This document is a summary of fisheries data collected from Lyndon B. Johnson (LBJ) Reservoir from 2012–2013. 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 species of fishes was collected, this report deals primarily with major sport fishes and important prey species. Historical data are presented with the 2012–2013 data for comparison.

Reservoir Description

LBJ 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. LBJ Reservoir was eutrophic with a mean TSI chl-*a* of 52.68 (Texas Commission on Environmental Quality 2011). LBJ has a drainage area of approximately 36,290 square miles and a shoreline length of about 154 miles. This is a stable-level reservoir (825 ft. above mean sea level), and lies within the Edwards Plateau ecological area. 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 Lake LBJ are in Table 1.

Angler Access

Angler access at LBJ Reservoir was good for boat anglers, but poor for bank anglers. Eighteen concrete boat ramps were available for anglers. Of the 18 ramps, two are considered the primary public ramps on the reservoir (Wirtz Dam, Cottonwood (lower reservoir) and the Kingsland Lions Park (upper reservoir)), and are open to the general public. Cottonwood requires a fee. The remaining ramps are part of home owner association amenities, 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 (De Jesus and Magnelia 2009) included:

1. Educate shoreline homeowners on the importance of littoral shoreline habitat when the opportunity arises.
   Action: When encountered, homeowners were informed about the benefits of littoral shoreline habitat.
2. Contact organized constituent groups and try to involve them in partnerships to restore shoreline areas and coves with small-scale planting projects using spatterdock and water willow.
   Action: Four species of native aquatic vegetation, reared at the Athens plant nursery, were planted in cages at 3 sites in the upper reaches of LBJ Reservoir. Partners from LCRA and local bass clubs joined TPWD staff in these efforts.
3. Stay aware of funding opportunities to conduct large-scale habitat improvement projects applicable to LBJ Reservoir. If opportunities become available, submit proposals to acquire funding for such projects.
   Action: Reservoir areas were scoped to find potential sites for large-scale restoration projects. Some areas were deemed potentially suitable.
4. Conduct annual vegetation surveys to monitor coverage of non-native water hyacinth and Eurasian watermilfoil, and the potential for reintroduction of hydrilla.
   Action: Annual aquatic vegetation surveys were conducted from 2009 to 2012.

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

Stocking history: Florida Largemouth Bass were stocked in 2011, 2012, and 2013 to improve the growth potential for Largemouth Bass. In 2010, a 13.7-pound bass from LBJ 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. Channel Catfish were stocked in 2012. The complete stocking history is in Table 4.

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

Fishes were collected by electrofishing (1.5 hour at 18, 5-min stations) and gill netting (10 net nights at 10 stations), and trap netting (15 net nights at 15 stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing and for gill and trap nets as the number of fish per net night (fish/nn). All survey sites were randomly selected and all surveys were conducted according to the Fishery Assessment Procedures Manual (TPWD, Inland Fisheries Division, unpublished manual revised 2011). Aquatic vegetation surveys were conducted during peak growing season around the entire reservoir. Aquatic vegetation coverage was estimated by the use of Trimble® GPS unit in conjunction with sonar depth finder. Species identification was confirmed on samples collected with a modified aquatic rake. The reservoir maintains a stable water level, with little change in elevation, so a water level figure was omitted from this report.

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. Ages were determined using otoliths for Largemouth Bass (n=13) and White Bass (n=13) (TPWD, Inland Fisheries Division, unpublished manual revised 2011).

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 through 2012 and by electrophoresis for previous years.

RESULTS AND DISCUSSION

Habitat: The last structural habitat survey (Table 5) was conducted in 2008 (De Jesus and Magnelia 2009). At that time, shoreline habitat was comprised mostly (88%) of bulkhead with docks and natural vegetated shoreline.

Total coverage estimate of all plant species in 2012 was 2.6% (171 acres) compared to 0.5% (34 acres) in 2008 and 1% (67 acres) in 2006. This relatively small increase in percentage vegetative cover was largely due to the expansion of Eurasian watermilfoil (*Myriophyllum spicatum*) from 18 acres in 2010 to 144 acres in 2012 (Appendix C). Water willow (*Justicia americana*) coverage has remained consistently low at <1% (18 acres in 2006 and 21 acres in 2008 and 2012).

Currently nine planted native aquatic vegetation sites exist (Appendix D). Six sites have produced minor expansion, but remain established; one site has flourished and expanded; two sites were planted in 2011 and will need more time to show expansion. In most cases plantings survive within the wire cages (used to exclude herbivores), but have not expanded beyond the cages. Three species of aquatic plants have expanded beyond the cages, water willow, spike rush and spatterdock. These species were already present in the reservoir prior to the native plant project in 2001. They were transplanted to the cages and have expanded beyond the confines of the cage. Large scale transplanting of these species throughout the reservoir might be successful in improving habitat for cover seeking species which has been consistently below optimal coverage for fish production (Durocher et al. 1984, Dibble et al. 1996).

Prey species: Electrofishing catch rates of Gizzard Shad, Redbreast Sunfish and Bluegill were 106.7/h, 186.0/h and 307.3/h, respectively in 2012 (Figure 1). Blacktail Shiner, Inland Silverside, Threadfin Shad, and Redear Sunfish were the most abundant other species also available as forage (Appendix A). Index of vulnerability for Gizzard Shad was 4; indicating 4% of Gizzard Shad available to existing predators were of vulnerable size (≤ 8 inches). The IOV was slightly lower than in previous surveys; although, this reservoir has historically had low IOV values. Total CPUE of Gizzard Shad (106.7/h) was similar to previous surveys in 2010 (121.3/h) and 2008 (110.0/h). Total CPUE of Redbreast Sunfish in 2012 (186.0/h) was higher than that recorded in 2010 (92.0/h) and 2008 (132.7/h), with inch classes dominated by individuals in the 4- to 6-inch range (Figure 2). Total CPUE of Bluegill in 2012 (307.3/h) had increased since the 2010 (141.3/h) and 2008 (236.7) surveys. Size structure was dominated by individuals in the 4- to 5-inch range (Figure 3). Larger Bluegill individuals (≥6 inches) were present in good numbers, providing fishing opportunities for panfish anglers.

Catfishes: Blue Catfish were present in low numbers, probably from upstream emigration, as none have been stocked in the reservoir. The total gill net catch rate of Blue Catfish was 0.3/nn in 2013 compared to 0.2/nn in 2009 and 0.1/nn in 2005. The Blue Catfish population continued to show low relative abundance, with the few individuals sampled being large – up to 31 inches in 2013 (Figure 4). Body condition for the three specimens collected in 2013 was good (W_r above 90). While Channel Catfish was the predominant catfish species in the reservoir, the total gill net catch rate of Channel Catfish was 1.8/nn in 2013, decreasing from 2.3/nn in 2009 and 3.5/nn in 2005. The Channel Catfish population continued to have low relative abundance (Figure 5). In 2013, most of the fish were above harvestable-size (≥ 12 inches) and the largest fish was up to 21 inches in length. Body condition of harvestable size fish had improved since 2009 with most having relative weights ≥ 90. The total gill net catch rate of Flathead Catfish was 1.2/nn in 2013, remaining consistent with previous surveys in 2009 (1.5/nn) and 2005 (1.6/nn). The Flathead Catfish population continued to show low relative abundance, with a population structure dominated by large individuals (Figure 6). The biggest fish was 32 inches in length. Body condition in 2009 was sub-optimal (relative weights under 100) for most size classes of fish (Figure 7).

White Bass: This reservoir supported a low density White Bass population. The total gill net catch rate of White Bass was 1.5/nn in 2013. This was slightly lower than that recorded in 2009 (2.0/nn) and similar to that obtained in 2005 (1.6/nn) (Figure 7). The catch rate in 2013 (1.5/nn) was close to the average (1.8/nn) calculated from the previous six surveys. Furthermore, most individuals sampled were of legal size with the largest fish 14 inches long. Body condition in 2013 was sub-optimal (relative weights under

100) for all size classes of fish. On average, White Bass reached harvestable size (10 inches) by age 1 (n=15) (Figure 8).

Largemouth Bass: Total CPUE in 2012 (82.7/h) had improved since 2010 (50.0/h) and 2008 (61.3/h) and matched the historical (1986-2008) average total CPUE of 82.7/h (+/- 19.8/h) reported by De Jesus and Magnelia (2009). The electrofishing catch rate of stock-length Largemouth Bass was 62.7/h in 2012 which is higher than in 2010 (42.0/h) and 2008 (40.0/h) (Figure 9). Catch rates of harvestable bass (CPUE-14) increased to 18.7/h in 2012 from 8.7/h in 2010, and was similar to the 20.7/h obtained in 2008. In 2012, 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 was good; population indices (PSD= 51, PSD-P=16, PSD-M=2) 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). Body condition in 2012 was sub-optimal (relative weights under 100) for most size classes of fish (Figure 9). Age and growth analysis from 2012 indicated individuals on average reached 14 inches by 2.6 years (N = 13, Figure 10), which is normal for central Texas reservoirs. The improvement in the abundance and size structure of the Largemouth Bass population may be reflected by an increase in Largemouth Bass fishing tournament activity in 2012.

Genetic influence from the Florida Largemouth Bass sub-species has remained similar; Florida alleles constituted 66% in 2012 and 58% in 2008, compared to 61% in 2006. One pure Florida Largemouth Bass was sampled in 2012 and one in 2006 (Table 7).

White Crappie: The total trap net catch rate for White Crappie decreased to 0.2/nn in 2012 from 3.5/nn in 2008, and was similar to the catch rate of 0.8/nn in 2004 (Figure 11). The 2012 total CPUE was below the historical average of 2.3/nn and fell below the range (0.8/nn – 4.5/nn) (De Jesus and Magnelia 2009). The CPUE-10 was 0.1/nn, 0.3/nn and 0.2/nn in 2012, 2008 and 2004, respectively.

Fisheries management plan for LBJ Reservoir, Texas

Prepared – July 2013.

ISSUE 1: Aquatic vegetation coverage in Lyndon B. Johnson Reservoir has been consistently below optimal levels for fish production. Previously, native aquatic vegetation plantings were most successful with water willow, spike rush and spatterdock. Large scale transplanting of these species throughout the reservoir might be successful in improving habitat for cover seeking species.

MANAGEMENT STRATEGY

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, water willow and spike rush.
2. Stay aware of funding opportunities to conduct large-scale habitat improvement projects applicable to LBJ Reservoir. If opportunities become available, submit proposals to acquire funding for such projects.

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. Improved vegetative habitat might be behind these patterns. Recent Florida Largemouth Bass stockings along with improving habitat may redirect this bass fishery towards the quality it historically provided before shoreline development and bulkheading.

MANAGEMENT STRATEGY

1. Continue to monitor the Largemouth Bass tournament scene to capture large fish data.
2. Request a Florida Largemouth Bass fingerling stocking (5/acre) if aquatic vegetation coverage remains favorable in spring 2014. Surplus Florida Largemouth Bass would be recommended for stocking in subsequent years if available and the habitat persists or expands.

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 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:

The proposed sampling schedule includes additional electrofishing in 2014 and mandatory monitoring in 2016/2017 (Table 8). Additional electrofishing survey in 2014 is necessary to monitor the Largemouth Bass population. Gill net and trap net surveys are only necessary every four years at this point to ensure presence or absence of Channel Catfish, Flathead Catfish, White Bass, and crappie. Annual Aquatic vegetation surveys are necessary to monitor coverage of non-native water hyacinth and Eurasian watermilfoil, and the potential for reintroduction of hydrilla.

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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 (SDI)	13.3
Conductivity	454 µS/cm

Table 2. Boat ramp characteristics for LBJ Reservoir, Texas, August, 2012. Reservoir elevation at time of survey was 825 feet above mean sea level. This is a stable-level reservoir.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft.)	Condition
Wirtz Dam, Cottonwood	30.55060 -98.33717	Y	50	NA	Good
Kingsland Lions Park	30.65322 -98.43600	Y	30	NA	Good

Table 3. Harvest regulations for LBJ Reservoir, Texas.

Species	Bag limit	Length limit
Catfish: channel and Blue Catfish, their hybrids and subspecies	25 (in any combination)	12-inch minimum
Catfish, flathead	5	18-inch minimum
Bass, white	25	10-inch minimum
Bass, largemouth	5[a]	14-inch minimum
Bass, Guadalupe	5[a]	None
Crappie: white and black crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

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

Table 4. Stocking history of 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
	Total	559,163		
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	250,659	FRY	0.3
	Total	1,638,841		
Green Sunfish x Redear Sunfish	1972	15,000		UNK
	Total	15,000		
Largemouth Bass	1971	308,126	FRY	0.7
	Total	308,126		
Palmetto Bass (Striped X White Bass hybrid)	1977	71,000	UNK	UNK
	1980	64,000	UNK	UNK
	Total	135,000		
ShareLunker Largemouth Bass	2010	2,220	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	747	AFGL	4.0
	Total	144,647		

Species	Year	Number	Life Stage	Mean TL (in)
Striped Bass	1983	59,881	UNK	UNK
	Total	59,881		
Walleye	1973	5,600,000	FRY	0.2
	1974	1,600,000	FRY	0.2
	Total	7,200,000		

Table 5. Survey of structural habitat types, LBJ Reservoir, Texas, 2012. Shoreline habitat type units are in miles.

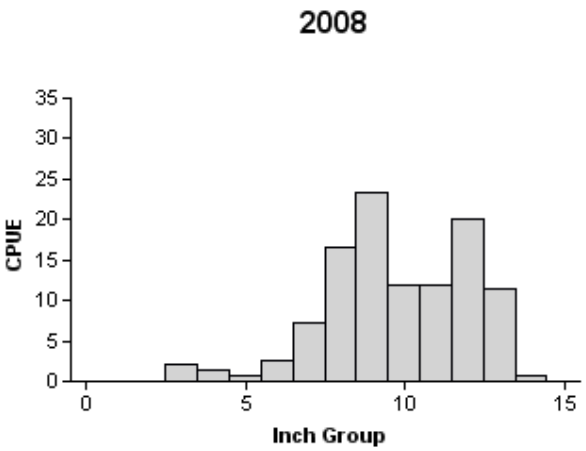
Habitat type	Estimate	% of total
Bulkhead	11 miles	7.0
Bulkhead with piers & boat docks	68 miles	44.0
Native emergent aquatic veg.	11 miles	7.0
Piers and boat docks	<1 mile	<1.0
Rip rap	1 mile	<1.0
Rock bluff	<1 mile	<1.0
Rocky shoreline	5 miles	3.0
Sand	<1 mile	<1.0
Vegetated bank	57 miles	37.0
Standing timber	1 mile	<1.0

Table 6. Survey of aquatic vegetation, LBJ Reservoir, Texas, 2009 – 2012. Surface area (acres) is listed with percent of total reservoir surface area in parentheses. Non-native species were the focus of the 2010 survey.

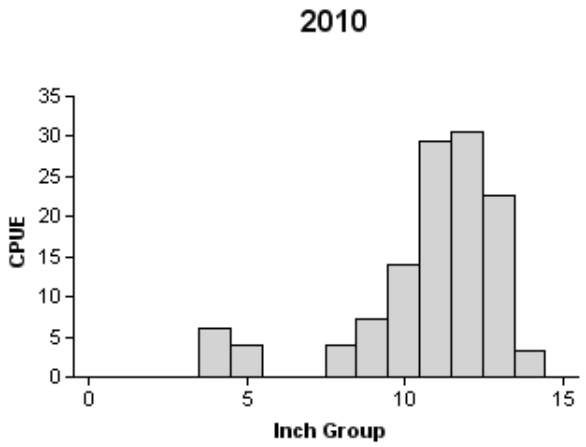
Vegetation	2006	2008	2010	2012
Native submersed				
Bushy pondweed				<1 (<1)
Chara	26 (<1)			<1 (<1)
Coontail		1 (<1)		
Eel grass	<1 (<1)	<1 (<1)		<1 (<1)
Pondweed	<1 (<1)			
Pondweed mix				<1 (<1)
Eel grass/coontail/chara mix		<1 (<1)		<1 (<1)
Native emergent				
Arrowhead	<1 (<1)	<1 (<1)		
Bulrush	15 (<1)	9 (<1)		
Cattail		<1 (<1)		
Fragrant water lily	<1 (<1)			
Pickerel weed	<1 (<1)			
Smartweed	<1 (<1)			
Spatterdock	7 (<1)	2 (<1)		3 (<1)
Spike rush	<1 (<1)	<1 (<1)		<1 (<1)
Water Willow	18 (<1)	21 (<1)		21 (<1)
Spike rush/water willow mix				<1 (<1)
Non-native				
Curly-leafed pondweed/water willow mix				<1 (<1)
Eurasian milfoil	<1 (<1)		18 (<1)	144 (2)
Eurasian milfoil/bushy pondweed mix			<1 (<1)	<1 (<1)

Vegetation	2006	2008	2010	2012
Eurasian milfoil/marine naiad mix			4 (<1)	<1 (<1)
Hydrilla	<1 (<1)			
Water hyacinth	<1 (<1)	1 (<1)	2 (<1)	3 (<1)

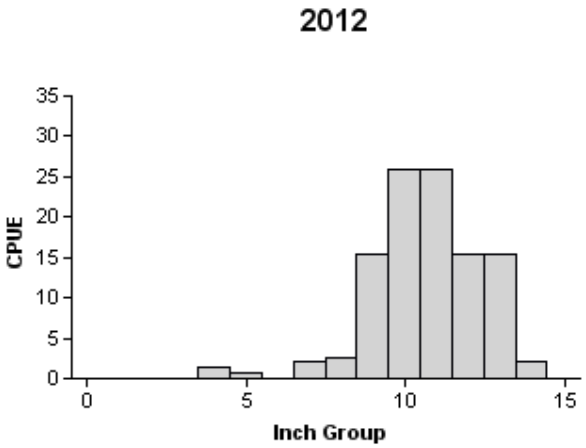
Gizzard Shad



Effort = 1.5
Total CPUE = 110.0 (20; 165)
IOV = 13 (4.1)



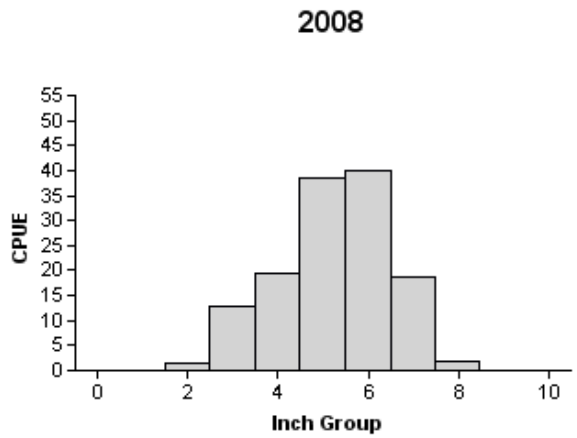
Effort = 1.5
Total CPUE = 121.3 (23; 182)
IOV = 8 (4.5)



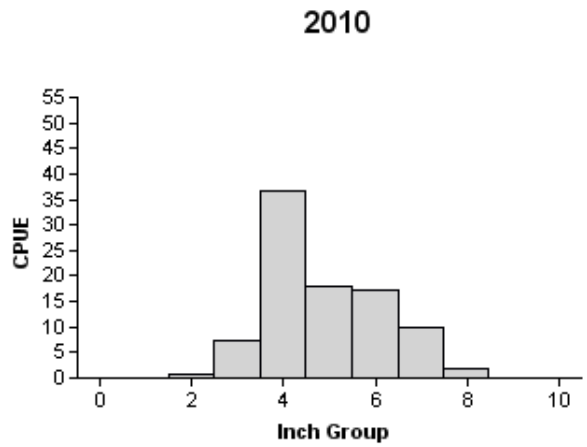
Effort = 1.5
Total CPUE = 106.7 (17; 160)
IOV = 4 (1.8)

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, 2008, 2010 and 2012.

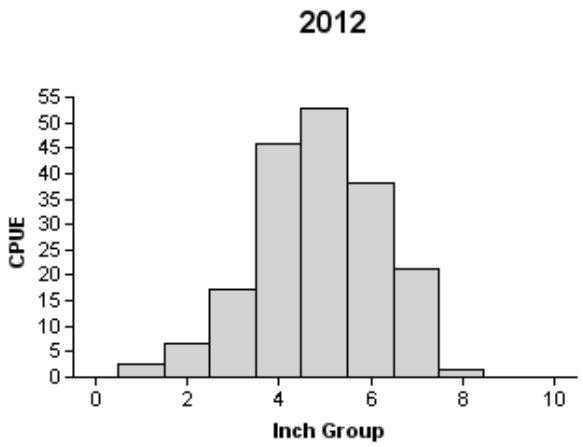
Redbreast Sunfish



Effort = 1.5
Total CPUE = 132.7 (23; 199)
PSD = 46 (6.6)



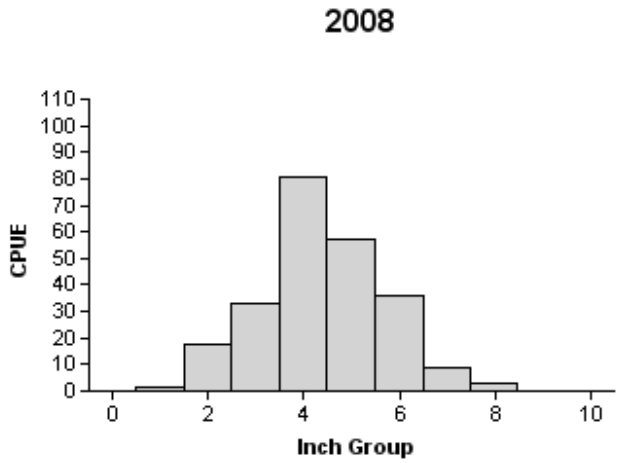
Effort = 1.5
Total CPUE = 92.0 (24; 138)
PSD = 32 (7.6)



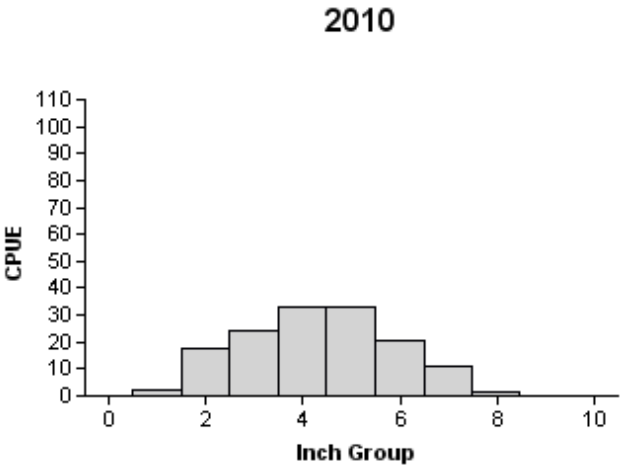
Effort = 1.5
Total CPUE = 186.0 (19; 279)
PSD = 34 (5.7)

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, 2008, 2010 and 2012.

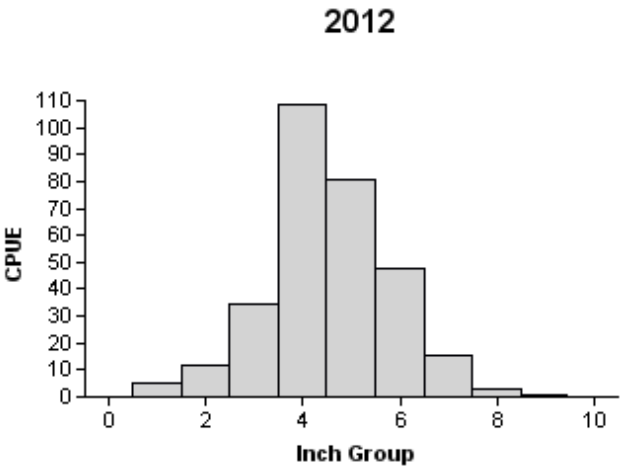
Bluegill



Effort = 1.5
Total CPUE = 236.7 (20; 355)
PSD = 22 (2.6)
PSD-P = 1 (0.8)



Effort = 1.5
Total CPUE = 141.3 (21; 212)
PSD = 27 (6.4)
PSD-P = 1 (0.8)



Effort = 1.5
Total CPUE = 307.3 (18; 461)
PSD = 23 (3.2)
PSD-P = 1 (0.5)

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, 2008, 2010 and 2012.

Blue Catfish

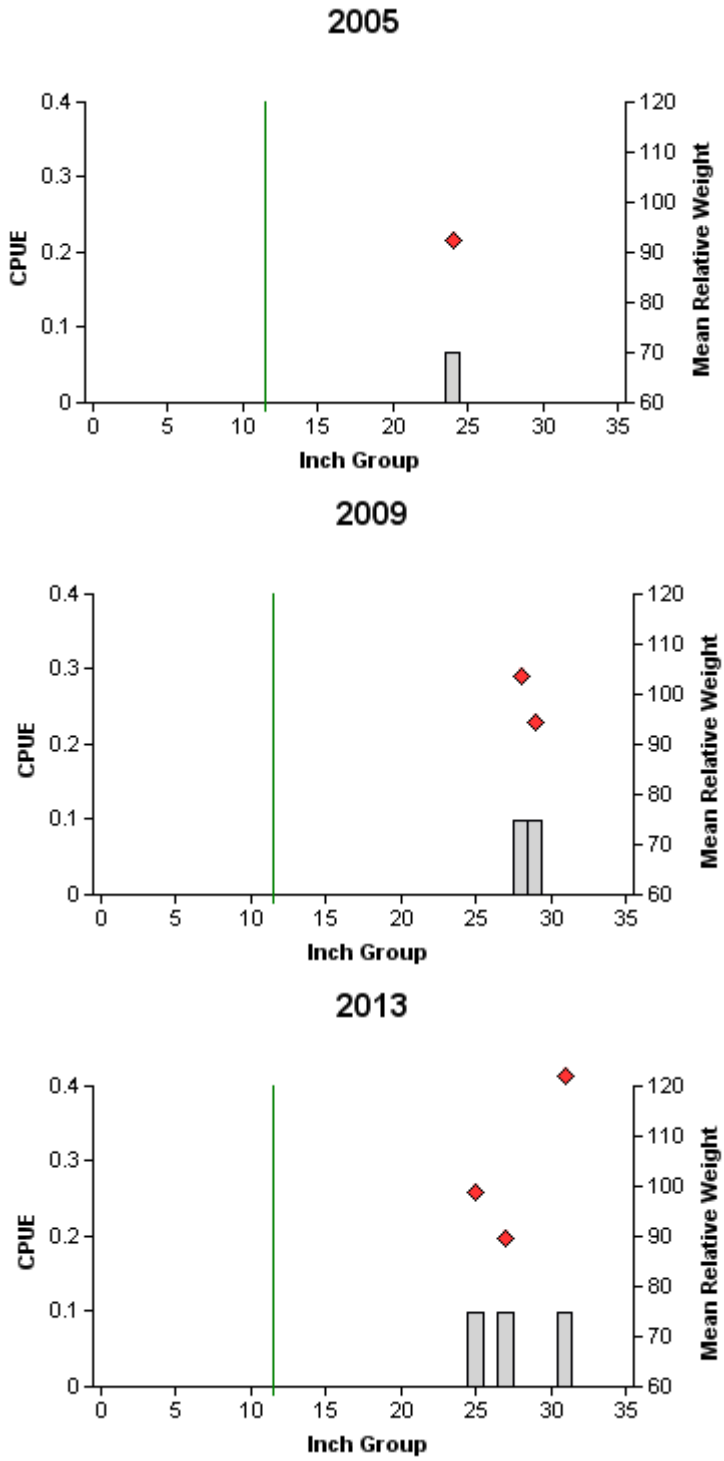


Figure 4. Number of Blue Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, LBJ Reservoir, Texas, 2005, 2009 and 2013. Vertical line represents minimum length limit at the time of sampling.

Channel Catfish

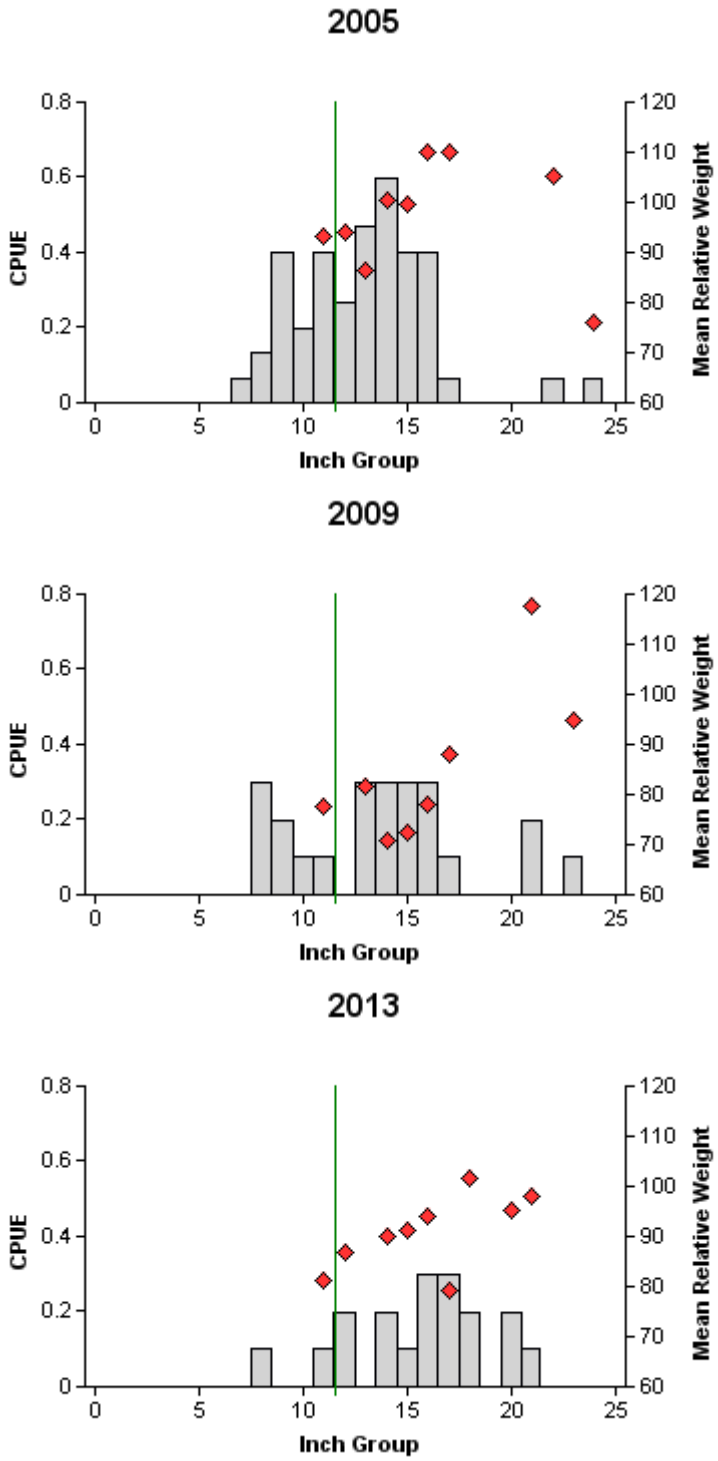
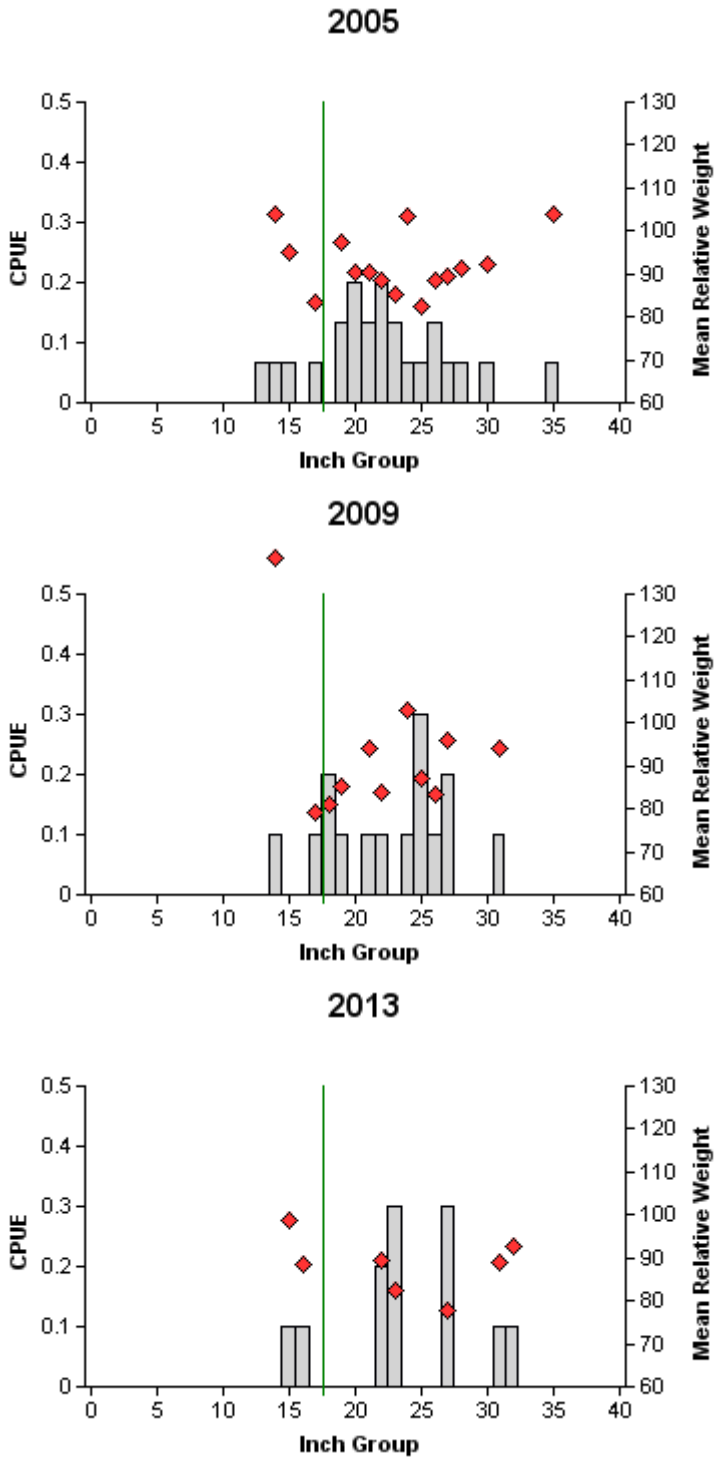


Figure 5. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, LBJ Reservoir, Texas, 2005, 2009 and 2013. Vertical line represents minimum length limit at the time of sampling.

Flathead Catfish



Effort = 15.0
Total CPUE = 1.6 (27; 24)
CPUE-18 = 1.3 (31; 20)
PSD = 78 (8.1)
PSD-P = 13 (7.7)
PSD-M = 4 (4.4)

Effort = 10.0
Total CPUE = 1.5 (18; 15)
CPUE-18 = 1.3 (20; 13)
PSD = 67 (15.6)
PSD-P = 7 (6.5)
PSD-M = 0 (0)

Effort = 10.0
Total CPUE = 1.2 (30; 12)
CPUE-18 = 1.0 (26; 10)
PSD = 83 (7.4)
PSD-P = 17 (12.6)
PSD-M = 0 (0)

Figure 6. Number of Flathead 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, 2005, 2009 and 2013. No Flathead Catfish were caught in 2004. Vertical line represents minimum length limit at the time of sampling.

White Bass

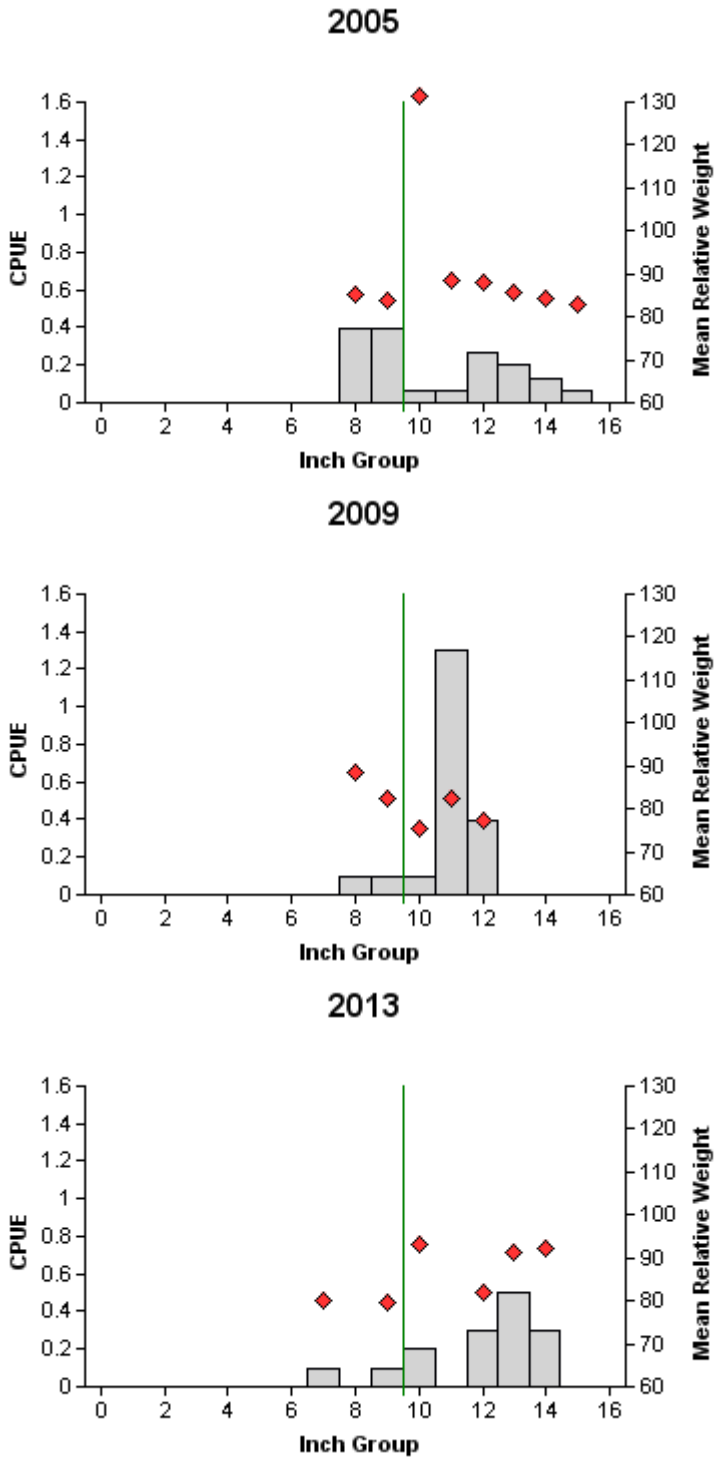


Figure 7. Number of White Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, LBJ Reservoir, Texas, 2005, 2009 and 2013. Vertical lines represent minimum length limit at the time of sampling.

White Bass

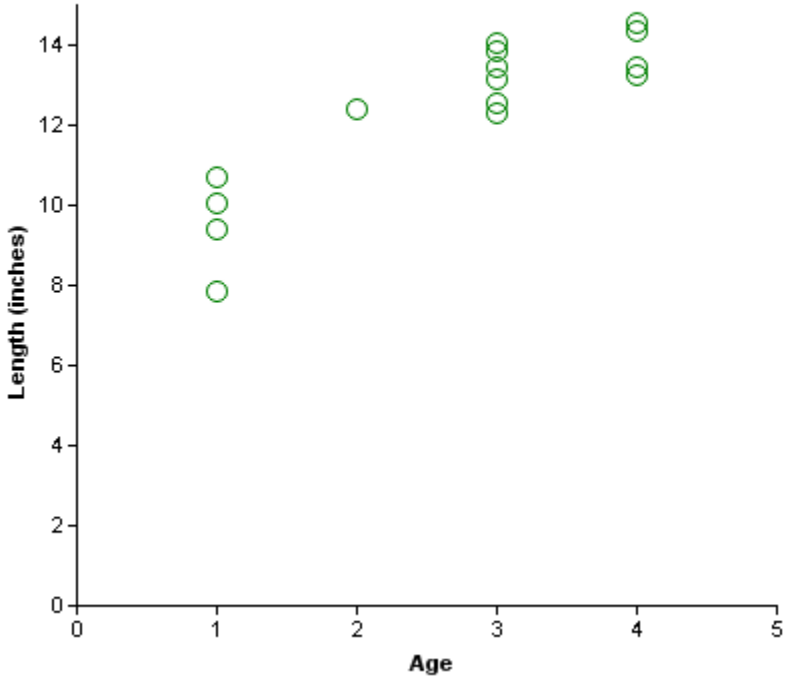
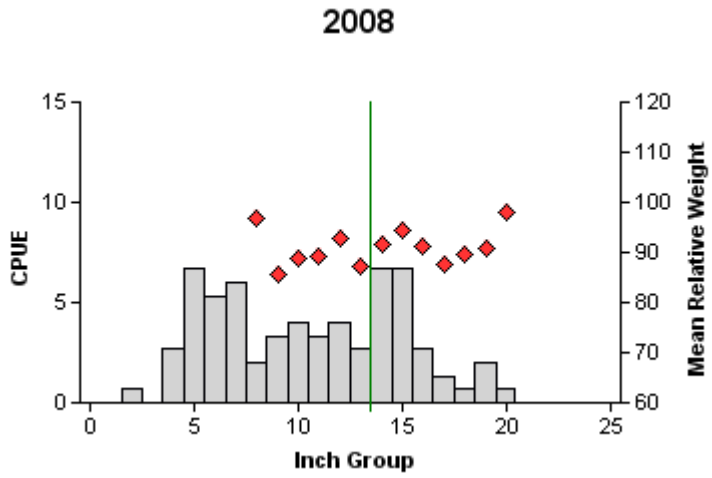
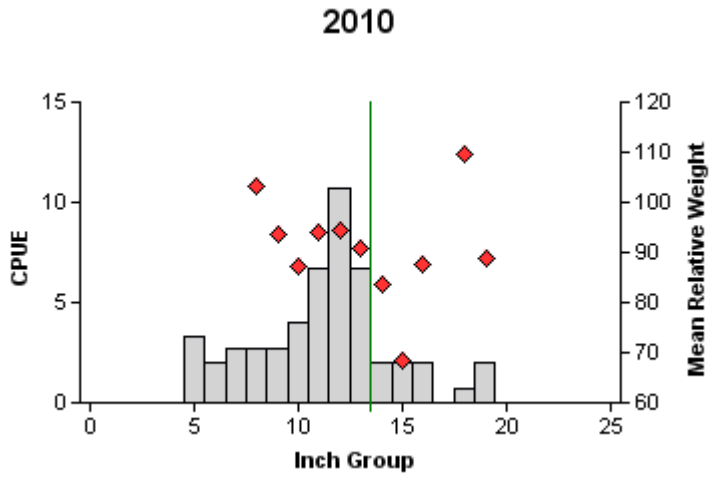


Figure 8. Length at age for White Bass collected by gill netting at LBJ Reservoir, Texas, April 2013.

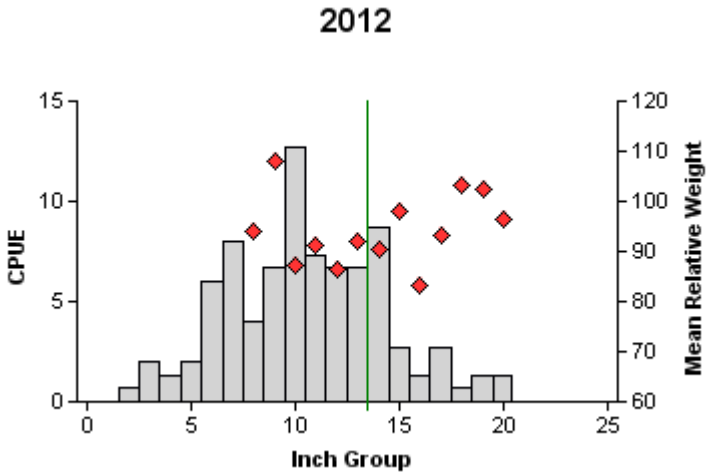
Largemouth Bass



Effort = 1.5
Total CPUE = 61.3 (15; 92)
Stock CPUE = 40.0 (23; 60)
CPUE-14 = 20.7 (31; 31)
PSD = 68 (7.5)
PSD-P = 35 (6.5)
PSD-M = 2 (1.7)



Effort = 1.5
Total CPUE = 50.0 (18; 75)
Stock CPUE = 42.0 (19; 63)
CPUE-14 = 8.7 (29; 13)
PSD = 62 (6.4)
PSD-P = 16 (4.6)
PSD-M = 0 (0)



Effort = 1.5
Total CPUE = 82.7 (18; 124)
Stock CPUE = 62.7 (17; 94)
CPUE-14 = 18.7 (20; 28)
PSD = 51 (5.9)
PSD-P = 16 (4.1)
PSD-M = 2 (1.2)

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, 2008, 2010 and 2012. Vertical lines represent minimum length limit at the time of sampling.

Largemouth Bass

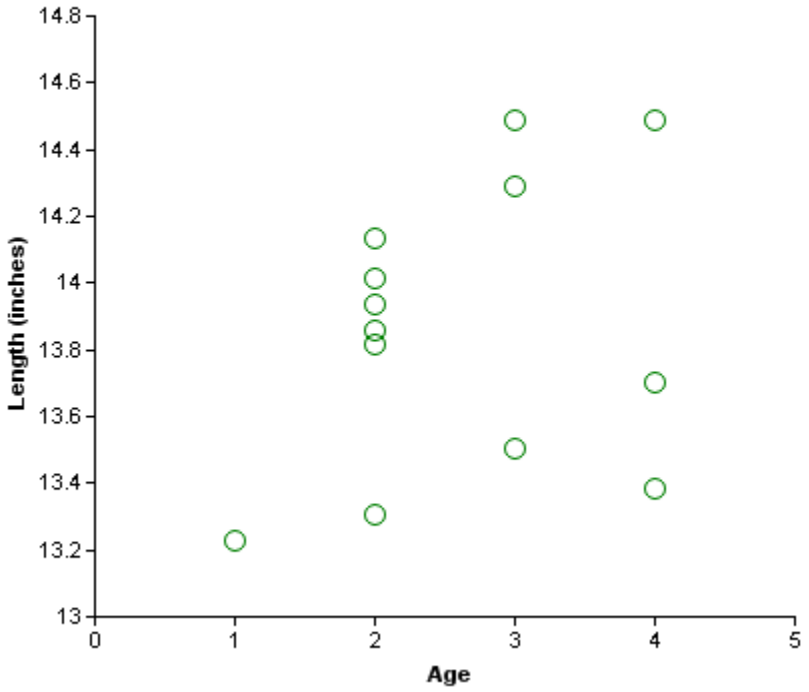
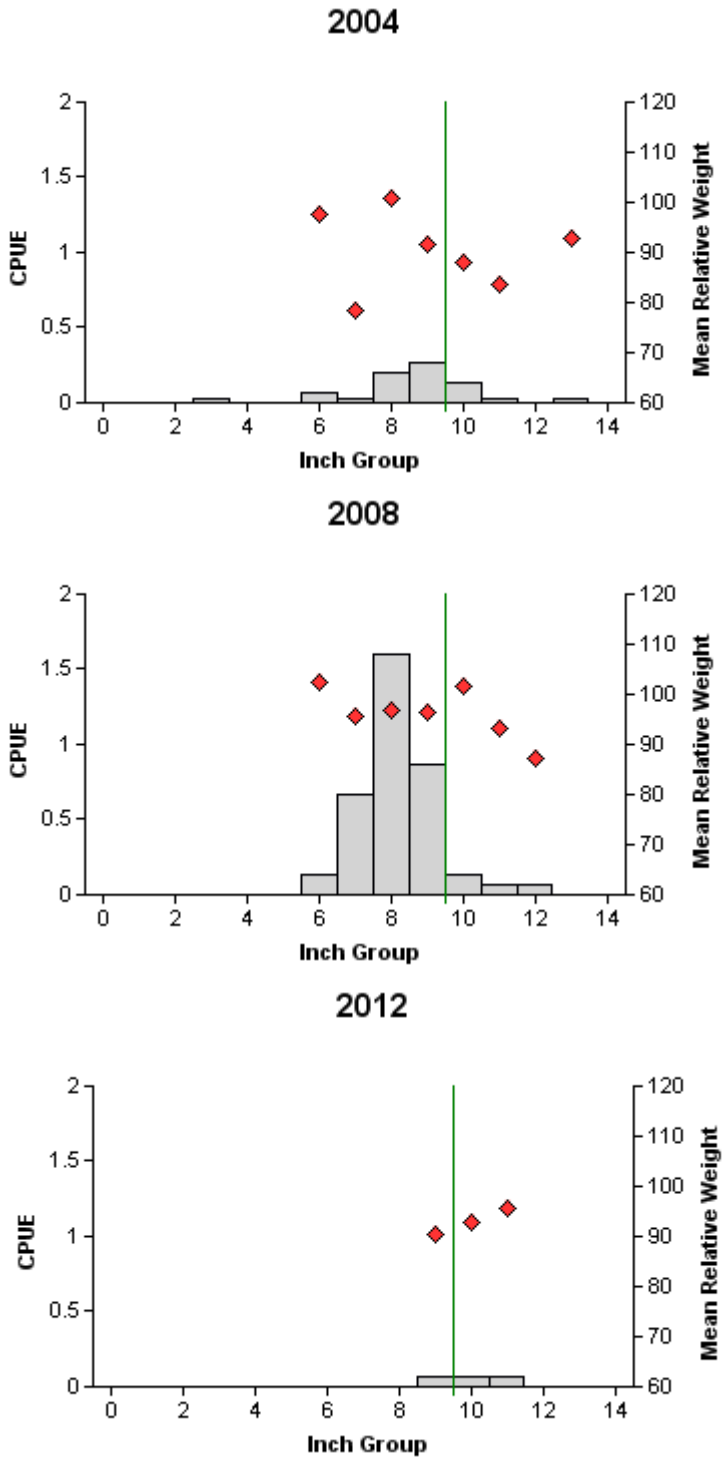


Figure 10. Length at age for Largemouth Bass collected by electrofishing at LBJ Reservoir, Texas, November 2013.

Table 7. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, LBJ Reservoir, Texas, 2006, 2008, and 2012. 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.

		Number of fish				
Year	Sample size	FLMB	Intergrade	NLMB	% FLMB alleles	% FLMB
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

White Crappie



2004
Effort = 30.0
Total CPUE = 0.8 (28; 24)
CPUE-10 = 0.2 (37; 6)
PSD = 87 (5.8)
PSD-P = 26 (10.4)
PSD-M = 4 (4.5)

2008
Effort = 15.0
Total CPUE = 3.5 (43; 53)
CPUE-10 = 0.3 (57; 4)
PSD = 77 (5.5)
PSD-P = 8 (3.8)
PSD-M = 2 (1.6)

2012
Effort = 15.0
Total CPUE = 0.2 (53; 3)
CPUE-10 = 0.1 (68; 2)
PSD = 100 (0)
PSD-P = 67 (28.2)
PSD-M = 0 (0)

Figure 11. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, LBJ Reservoir, Texas, 2004, 2008 and 2012. Vertical line represents minimum length limit at the time of sampling.

Table 8. Proposed sampling schedule for LBJ 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 (except where noted). Standard survey denoted by S and additional survey denoted by A.

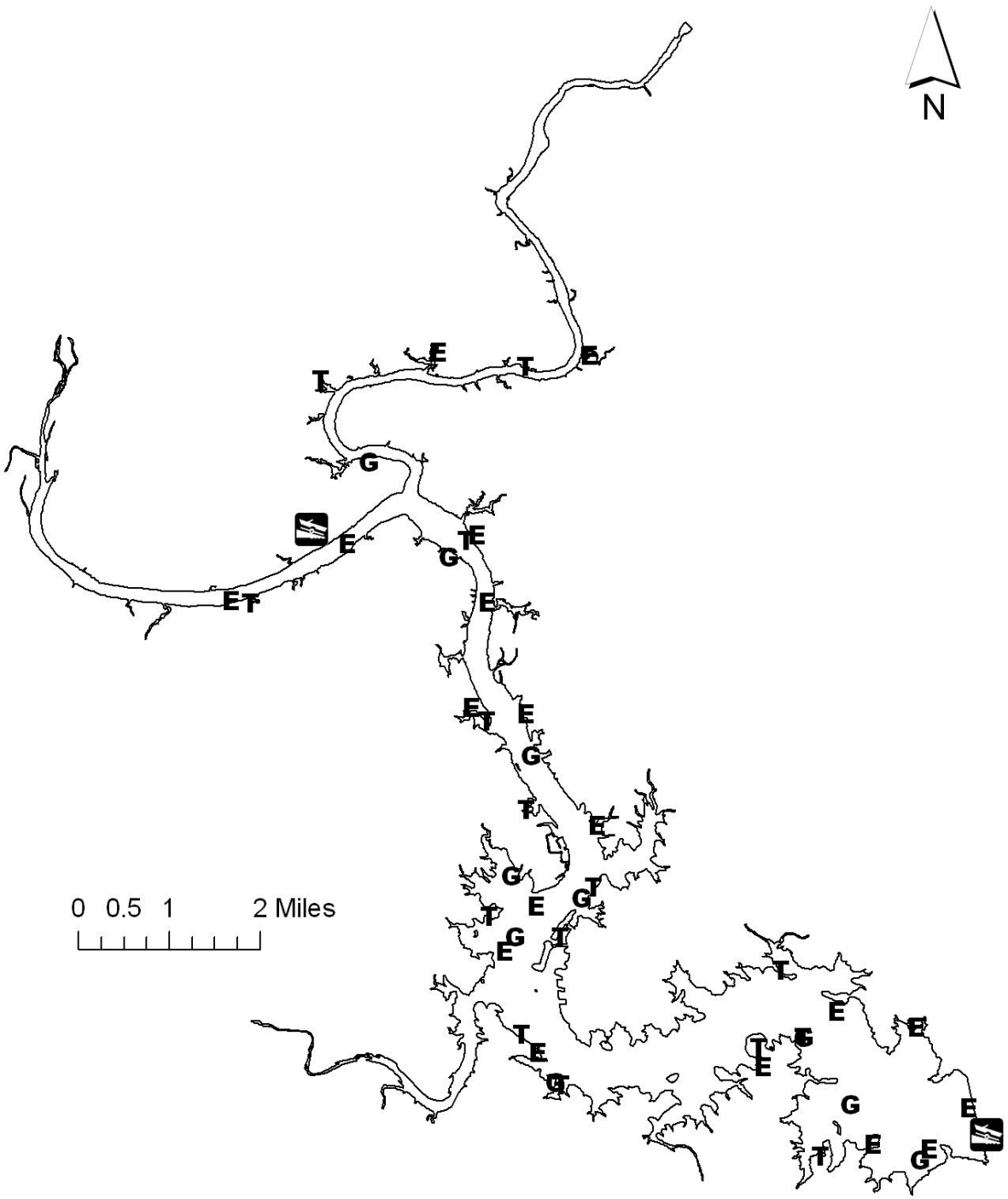
Survey year	Electrofish Fall(Spring)	Trap net	Gill net	Habitat		Access	Creel survey	Report
				Structural	Vegetation			
2013-2014					A			
2014-2015	A				A			
2015-2016					A			
2016-2017	S	S	S		S	S		S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from LBJ Reservoir, Texas, 2012-2013. Sampling effort was 10 net nights for gill netting, 15 net nights for trap netting, and 1.5 hour for electrofishing.

Species	Gill Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					160	106.7
Threadfin Shad					12	8.0
Inland Silverside					63	42.0
Other minnows					2	1.3
Blacktail Shiner					95	63.3
Blue Catfish	3	0.3				
Channel Catfish	18	1.8				
Flathead Catfish	12	1.2				
White Bass	15	1.5				
Redbreast Sunfish					279	186.0
Green sunfish					3	2.0
Warmouth					14	9.3
Bluegill					461	307.3
Longear Sunfish					29	19.3
Redear Sunfish					52	34.7
Largemouth Bass					124	82.7
Guadalupe Bass					6	4.0
Logperch					3	2.0
White Crappie			3	0.2		

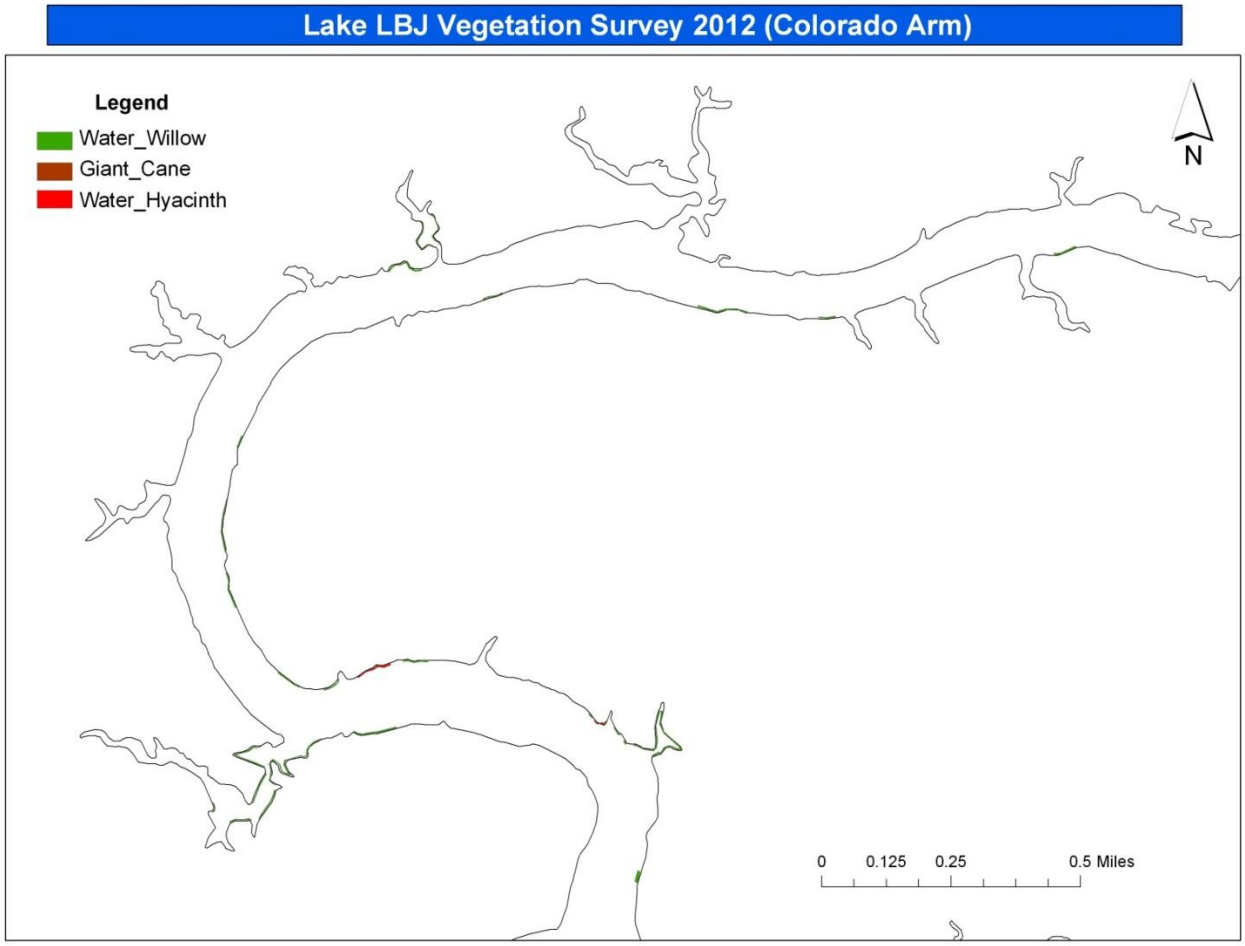
APPENDIX B



Location of sampling sites, Granger Reservoir, Texas, 2012-2013. Trap net, gill net, and electrofishing stations are indicated by T, G, and E respectively. Boat ramps are indicated by the boat ramp symbol (). Water level was near full pool at the time of sampling.

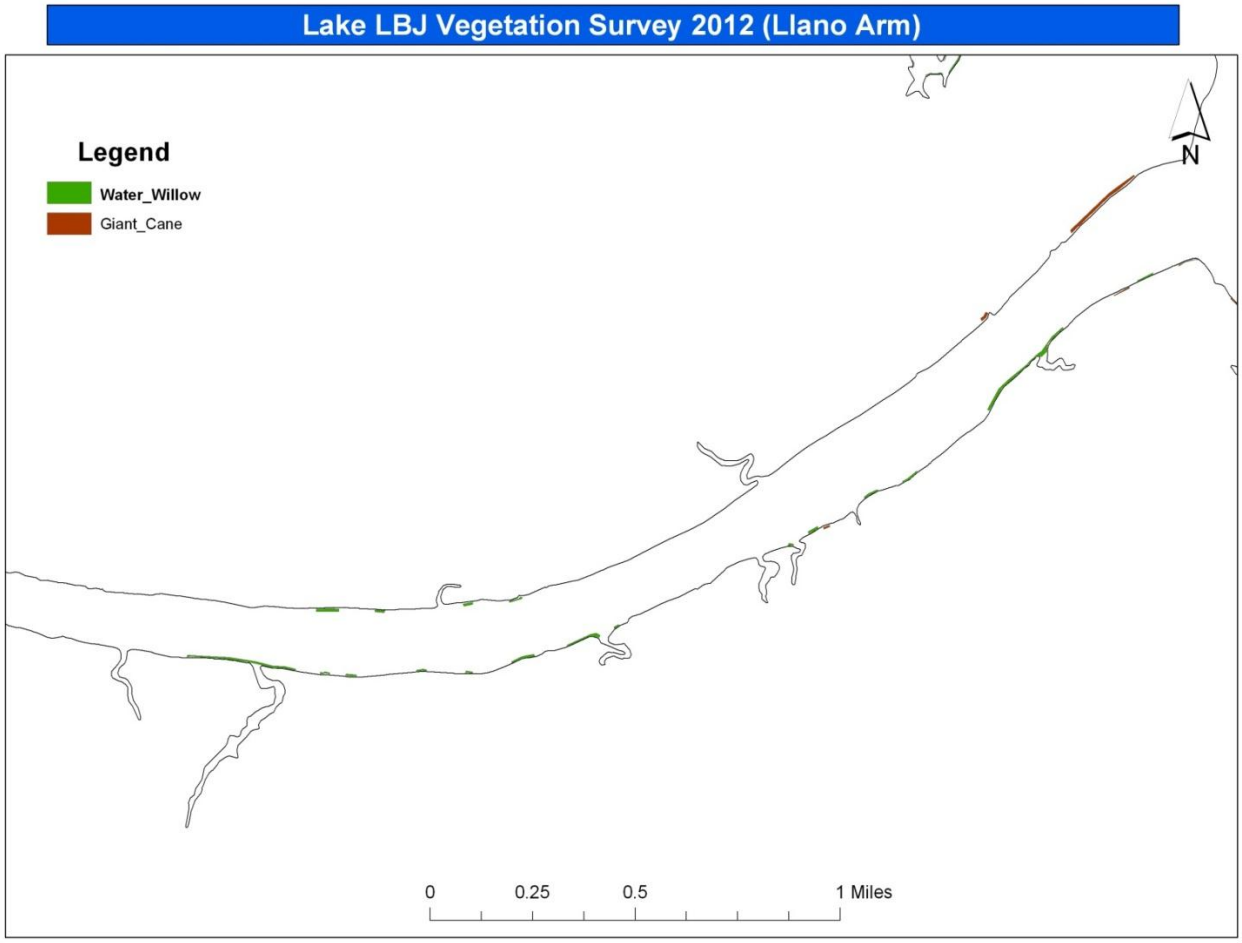
APPENDIX C

Aquatic vegetation survey coverage map for LBJ Reservoir (Colorado River arm), Texas, August 2012.



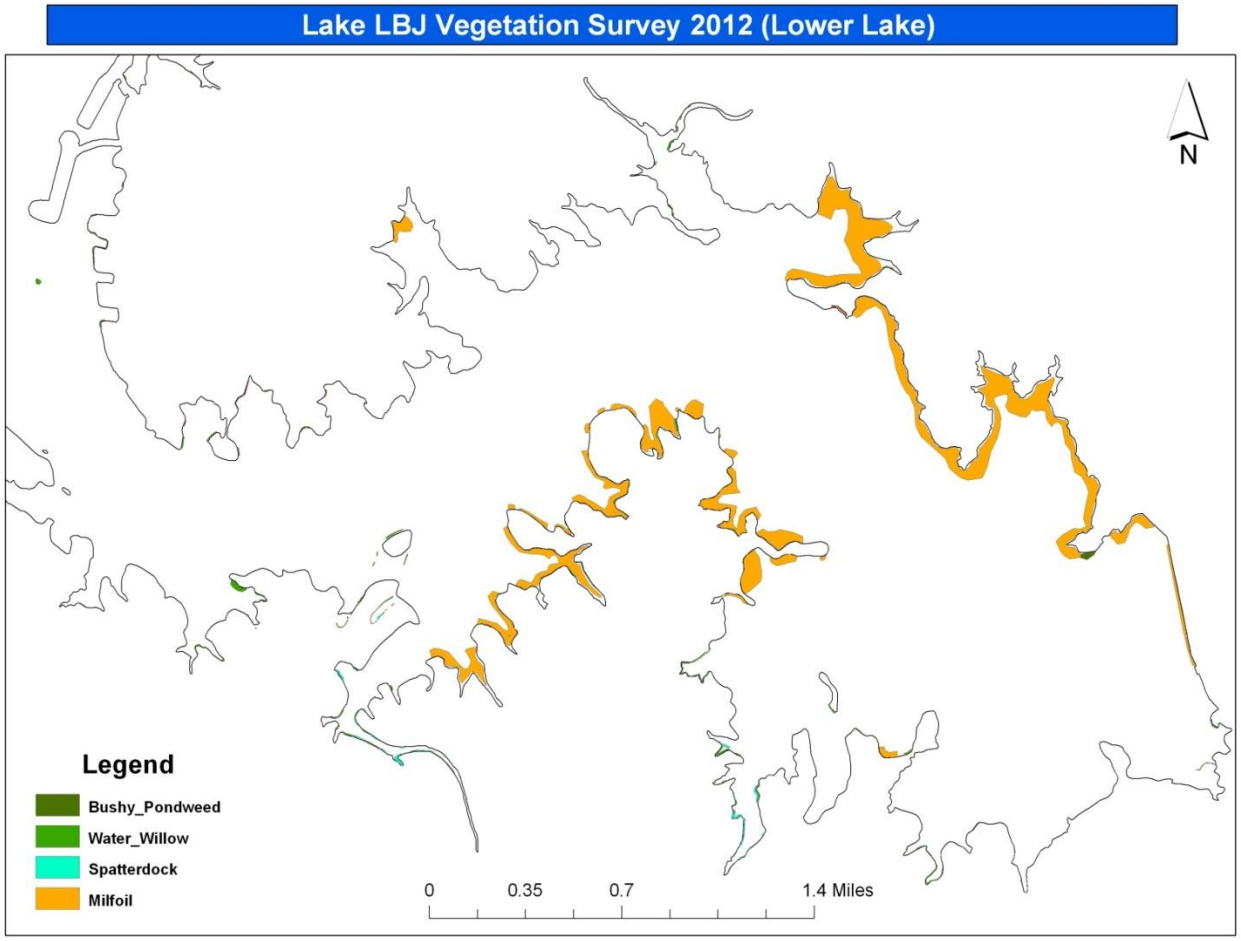
APPENDIX C (cont.)

Aquatic vegetation survey coverage map for LBJ Reservoir (Llano River arm), Texas, August 2012.



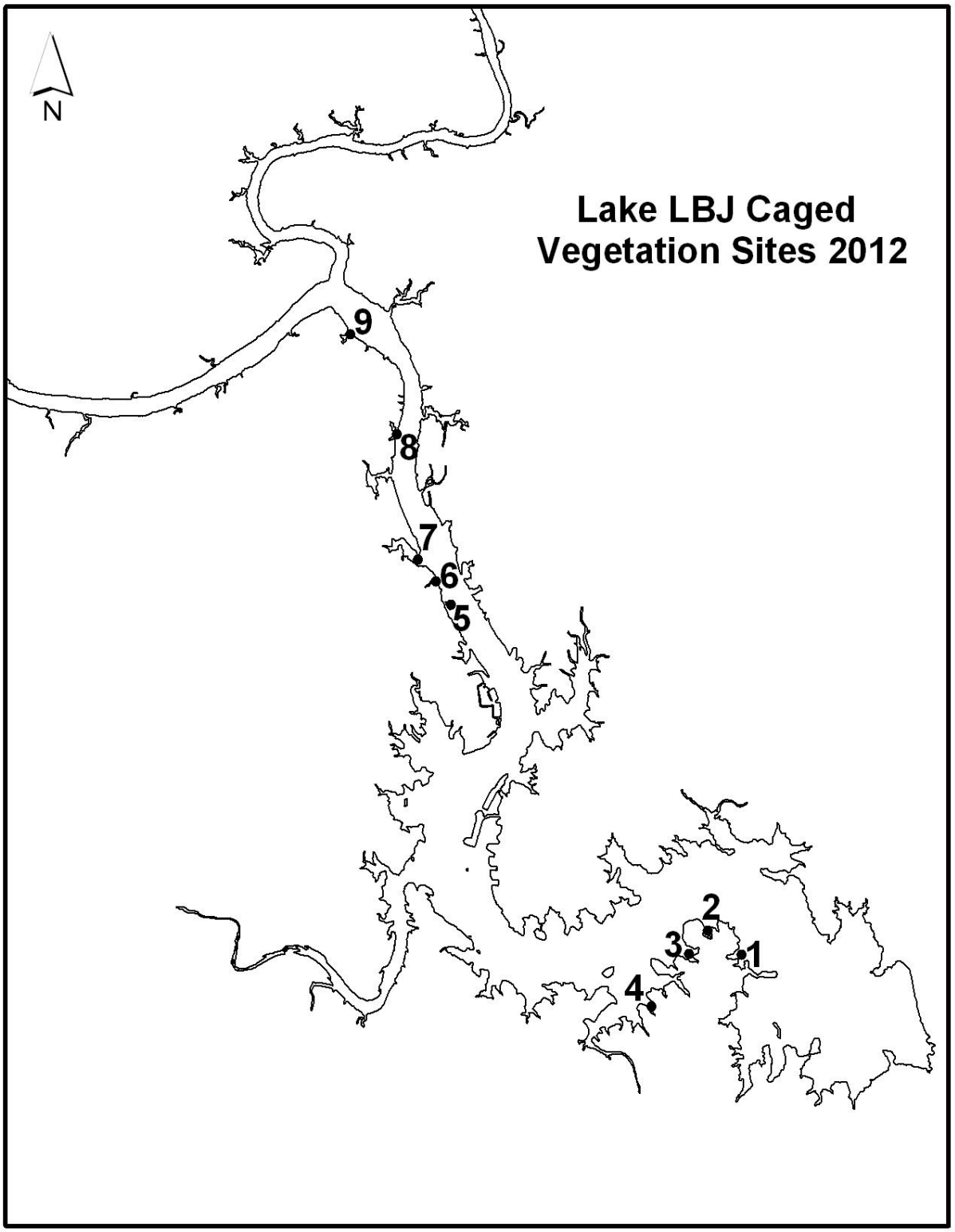
APPENDIX C (cont.)

Aquatic vegetation survey coverage map for LBJ Reservoir (lower lake), Texas, August 2012.



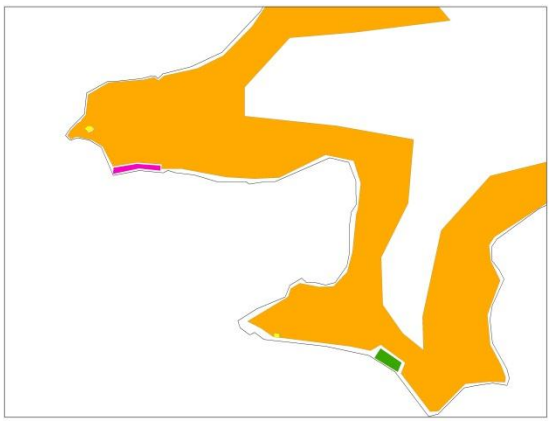
APPENDIX D

Aquatic native vegetation planting sites and adjacent vegetation coverage, LBJ Reservoir, 2012.



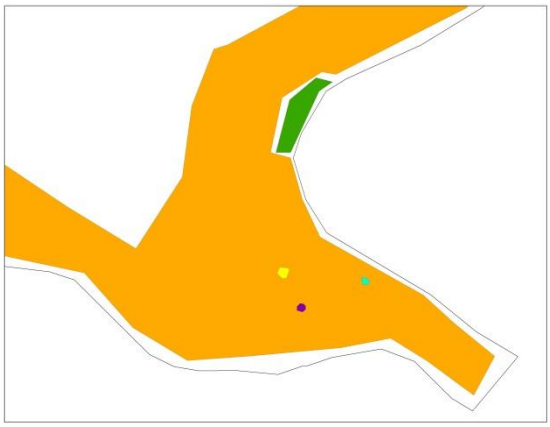
APPENDIX D (cont.)

Aquatic native vegetation planting sites and adjacent vegetation coverage, LBJ Reservoir, 2012.



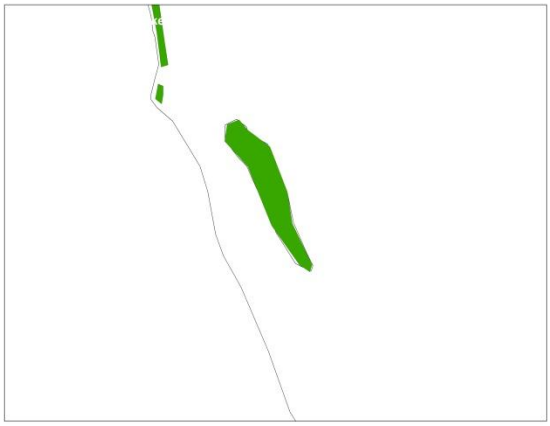
Site 1

Site 2

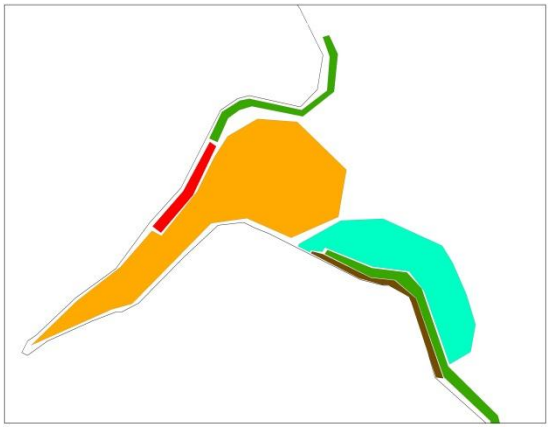


Site 3

Site 4



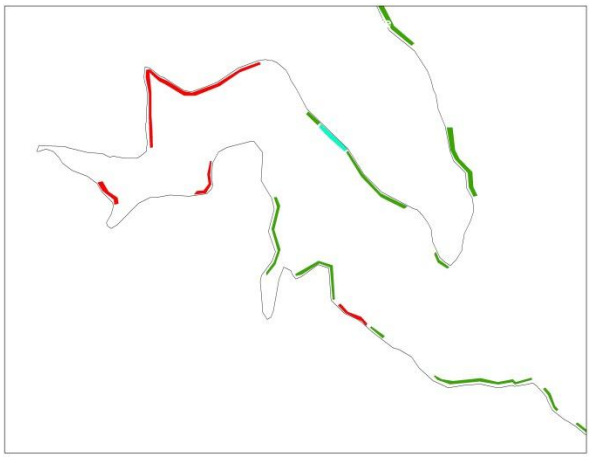
Site 5



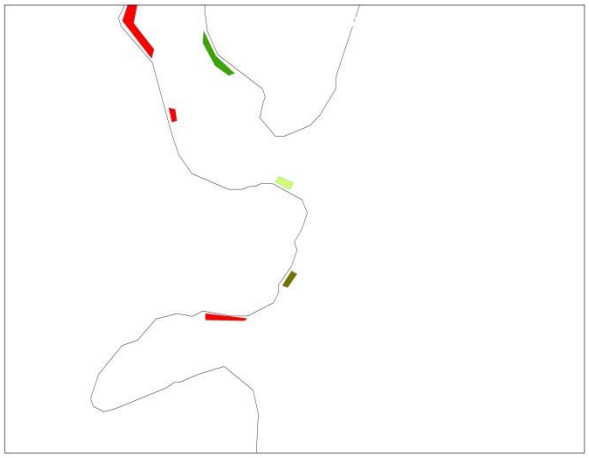
Site 6

APPENDIX D (cont.)

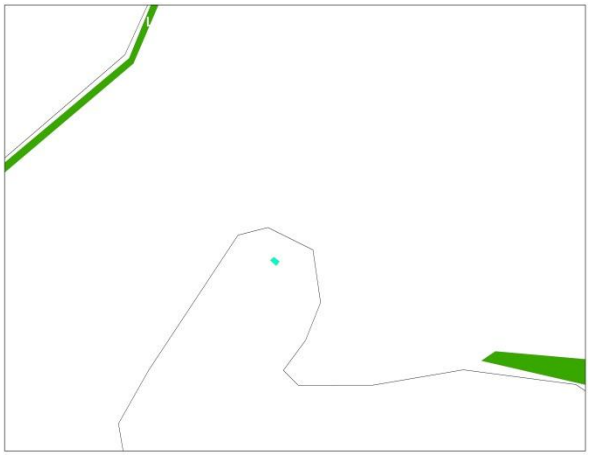
Aquatic native vegetation planting sites and adjacent vegetation coverage, LBJ Reservoir, 2012.



Site 7



Site 8



Site 9