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STATEWIDE FRESHWATER FISHERIES MONITORING AND MANAGEMENT PROGRAM

2008 Survey Report

# Lake Lyndon B. Johnson Reservoir

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## SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lake Lyndon B. Johnson (LBJ) were surveyed in 2008 using electrofishing and trap nets, and in 2009 using gill nets. This report summarizes the results of the surveys and contains a fisheries management plan for the reservoir based on those findings.

- **Reservoir Description:** Lake LBJ is a 6,502-acre impoundment of the Colorado and Llano Rivers in Burnet and Llano counties. 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. Lake LBJ 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 white bass, largemouth bass, and catfish species. Fisheries management plans for 2005 were to; monitor largemouth bass and prey populations in regard to their response to vegetation expansion within the reservoir; monitor aquatic vegetation due to potential expansion of exotic invasive species, and to evaluate the progress of planted beneficial aquatic vegetation. Prior management activities included fingerling Florida largemouth bass stockings in 2001 and 2002 to improve the potential for trophy largemouth bass. The lake has always been managed under statewide regulations.

- **Fish Community**
  - **Prey species:** Gizzard shad, bluegill, and redbreast sunfish were the predominant sources of forage. Threadfin shad were also available in low density.

  - **Catfishes:** Channel catfish was the predominant catfish species, but present in low densities. Flathead and blue catfish were also present in low densities.

  - **Temperate basses:** White bass were present in low density.

  - **Black basses:** Largemouth bass were relatively abundant. Size structure was good, with 52% of the adult bass exceeding 14 inches in 2008. Largemouth bass growth was moderate. On average individuals exhibited sub-optimal body condition. Guadalupe bass were also present.

- **Shoreline Habitat:** The majority (88%) of the shoreline was comprised of bulkhead (51%) and vegetated bank (37%). Bulkheading has decreased the quality of shoreline fish habitat.

**Management Strategies**

The reservoir should continue to be managed with existing fishing regulations. Shoreline habitat continues to be negatively affected by bulkheading, and the controlling authority and homeowners should be made aware of the importance of shoreline habitat to the largemouth bass fishery. A vegetation and shoreline habitat survey should be conducted in 2011. Routine gill netting, trap netting and electrofishing surveys should be conducted in 2012–2013.

# INTRODUCTION

This document is a summary of fisheries data collected from Lake LBJ in 2008 and 2009. The purpose of the document is to provide fisheries information and make fisheries 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 species and important prey species. Fisheries management strategies are included to address existing problems or opportunities. Historical data are presented with the 2008 and 2009 data for comparison.

*Reservoir Description*

Lake LBJ is a 6,502-acre impoundment of the Colorado and Llano Rivers in Burnet and Llano counties. 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 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. This is a stable level reservoir (Figure 1), and lies within the Edwards Plateau ecological area. Land use in the watershed is predominantly ranching. Residential properties border much of the shoreline. Shoreline habitat at the time of sampling consisted mostly of bulkhead with docks and vegetated shoreline. Aquatic vegetation is present throughout the reservoir, but is below optimal levels for fish production (Durocher 1984 and Dibble 1996). Angler access was good for boat anglers, but poor for bank anglers. Seventeen concrete public boat ramps were available for anglers, of which two required launch fees. Of the seventeen ramps, two are considered the primary public ramps on the reservoir (Cottonwood (lower reservoir) and the Kingsland Lions Club ramp (upper reservoir)). Other descriptive characteristics for Lake LBJ are in Table 1.

*Management History*

**Previous management strategies and actions:** Management strategies and actions from the previous survey report (Bonds and Magnelia 2005) included:

1. Conduct electrofishing surveys in 2006 and 2008 to monitor population characteristics of the largemouth bass, sunfishes, and shad species.

   **Actions:** Electrofishing surveys were conducted in 2006 and 2008. Data were compared to previous surveys to evaluate CPUE trends over recent survey history; additional largemouth bass age and growth data were collected to evaluate growth and year-class strength.

2. Conduct annual aquatic vegetation surveys to document the expansion of exotic aquatic plants.

   **Actions:** Aquatic vegetation surveys were conducted annually from 2005 to 2008. The 2007 survey was partial to vegetation project sites and to evaluate water hyacinth expansion. A hydrilla treatment plan for a 2.15 acre area proposed by the LCRA was approved in 2007 to prevent expansion.

**Harvest Regulation History:** Sport fishes in Lake LBJ are currently managed with statewide regulations (Table 2).

**Stocking History:** Florida largemouth bass were stocked in 2001 and 2002 to increase Florida largemouth bass genetic influence and increase the potential for trophy bass catches. A complete stocking history is in Table 3.

**Aquatic Vegetation and Shoreline Habitat:** Lake LBJ had sub-optimal (Durocher 1984 and Dibble

1996) aquatic vegetation coverage for fish production. In efforts to increase native aquatic vegetation coverage, eight sites were planted in 2000 and evaluated in 2006. Little expansion was documented (Bonds and Magnelia 2005). These sites were again evaluated in 2008 and little expansion was noted. Most of the shoreline habitat was comprised of bulkhead and natural vegetated shoreline (Table 4).

## METHODS

Fishes were collected by electrofishing (1.5 hours 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 netting as the number of fish caught in one net set overnight (fish/nn). All survey sites were randomly selected and all surveys were conducted according to the Texas Parks and Wildlife Department Inland Fisheries Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual, revised 2008).

Sampling statistics (CPUE for various length categories) and structural indices [Proportional Stock Density (PSD), Relative Stock Density (RSD)], and condition indices [relative weights (Wr)] were calculated for target fishes according to Anderson and Neumann (1996). The Index of Vulnerability (IOV) was used to determine the percentage of gizzard shad vulnerable to predation (DiCenzo et al. 1996). Relative standard error (RSE = 100 x SE of the estimate/estimate) was calculated for all CPUE statistics and SE was calculated for structural indices and IOV. Ages were determined for LMB using otoliths from 521 individuals off all sizes (category 4 age analysis with >400 exceeding 150mm in length; TPWD Procedures Manual, revised 2005). Age and growth data were supplied by the TPWD Heart of the Hills Science Center collected during a research project conducted in 2007. Largemouth bass electrophoresis samples were collected according to the Texas Parks and Wildlife Department Inland Fisheries Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2008). The source for water level data was the Lower Colorado River Authority.

## RESULTS AND DISCUSSION

**Habitat:** Shoreline habitat was comprised mostly (88%) of bulkhead with docks and natural vegetated shoreline (Table 4), similar to the 2004 survey (Bonds and Magnelia 2005). Submerged, floating and emergent aquatic vegetation was present and provided habitat for phytophilic fish species. Aquatic vegetation coverage in October 2008 was below optimal (34 acres; 0.5% coverage) for fish production (Durocher et al. 1984, Dibble et al. 1996) and was lower than in previous years. This reduction is the result of natural variation in aquatic vegetation abundance and not from aquatic vegetation herbicide treatments. Waterwillow (*Justicia americana*), Bulrush (*Scirpus* sp) and Eurasian water milfoil (*Myriophyllum spicatum*) were the predominant species in the reservoir. Complete results of the last three aquatic vegetation surveys are presented in Tables 5a-c. Shoreline development, primarily bulkheading, has degraded shoreline habitat and has accounted for over half (51%) of the shoreline. Native aquatic vegetation plantings at eight sites have produced minor expansion. A list of species (submergent and emergent) that were planted can be found in Bonds and Magnelia 2001. In most cases plantings survive within the wire cages (used to exclude herbivores), but have not expanded beyond the cages. Herbivory is probably responsible for the lack of expansion. Two species of aquatic plants have expanded beyond the cages, water willow 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. However, in areas with developed shorelines homeowners often perceive aquatic vegetation as unsightly and a nuisance. Because of this perception there may be resistance to any future proposed large scale aquatic vegetation plantings. Eurasian watermilfoil abundance has fluctuated, making it an unreliable source of aquatic habitat. 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.

**Prey species:** Total electrofishing catch rates of gizzard shad**,** redbreast sunfish, and bluegill were 110.0/hour, 132.7/hour, and 236.7/hour, respectively. Index of Vulnerability (IOV) for gizzard shad decreased to 12.7 in 2008 from 34.6 in 2004, indicating that only 12.7% of gizzard shad were vulnerable to existing predators (Figure 2); although, this reservoir has historically had low IOV values. Total CPUE of gizzard shad also declined in 2008 from 2004 (Figure 2). Threadfin shad were present in lower densities. Total CPUE of redbreast sunfish in 2008 was almost identical to total CPUE from the 2004 survey, with inch classes dominated by individuals in the 5- to 6-inch range (Figure 3). Total CPUE of bluegill in 2008 slightly increased since the 2004 survey, and size structure continued to be dominated by small individuals < 5 inches (Figure 4). 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 0.2/nn in 2009. The blue catfish population continued to show low relative abundance, with the few individuals sampled being large (Figure 5). LBJ does not share the characteristics (steep and deep) of other successful hill country blue catfish reservoirs like Buchanan, Travis, or Canyon. Body condition for the two specimens collected in 2009 was good (relative weights above 90) and were larger fish as reported in previous surveys (Figure 5).

While channel catfish was the predominant catfish species in the reservoir, the total gill net catch rate of channel catfish was 2.3/nn in 2009, decreasing from 3.5/nn in 2005. The channel catfish population continued to show low relative abundance, with most individuals within the 13- to 16-inch length range (Figure 6). Body condition in 2009 was poor (relative weights below 90) for nearly all size classes and remained similar to previous surveys (Figure 6).

The total gill net catch rate of flathead catfish was 1.5/nn in 2009, remaining consistent with previous surveys. The flathead catfish population continued to show low relative abundance, with a population structure dominated by large individuals (Figure 7). 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 2.0/nn in 2009. Catch rates improved from the 2005 survey (Figure 8), but remained lower than the average (2.6/nn) calculated from historical surveys (Bonds and Magnelia 2005). Furthermore, most individuals sampled were of legal size (90.0%). Bonds and Magnelia (2005) revealed that most white bass reached harvestable size (10 inches) by age 1 (age 1 = 10.08 inches average; N = 35). Body condition in 2009 was sub-optimal (relative weights under 100) for all size classes of fish (Figure 8).

**Largemouth bass:** The electrofishing catch rate of stock-length largemouth bass was 40.0/h in 2008, much lower than the 71.3/h in 2006 and 67.5/h in 2004. Size structure slightly shifted from previous surveys, with individuals between 14 and 15 inches more abundant in the population (Figure 9). Catch rates of harvestable bass (CPUE-14) increased to 20.7/h in 2008 from 10.0/h in 2006 and 17.5/h in 2004; in spite of the overall decline in CPUE. The increased catch rate of legal fish (≥14 inches) may be a reflection of an abundant 2005 year class (Figure 9 and Appendix C). Anglers have complained of poor largemouth bass catch rates on this reservoir since the 1970's (Butler 1983). However, electrofishing surveys since 1986 confirm that the lake has a stable and moderate level largemouth bass population, averaging 82.7/h (+/- 19.8/h) for total CPUE (Appendix A). Average CPUE-14 since 1986 was 10.4/h (+/- 4.7/h), with the two highest electrofishing catch rates for bass greater than 14 inches coming on the last three surveys (Appendix B). These numbers may not represent the quality bass fishery for which the lake was recognized in the 1960's during its prime (Butler 1983), but the fishery for this species is still a good

one, when compared to other Central Texas reservoirs. The decrease in the quality of the largemouth bass fishery is possibly the result of long term declines in shoreline habitat due to bulkheading and sub-optimal aquatic vegetation coverage. In the 1960's aquatic vegetation (*Myriophyllum spicatum*) on this reservoir was abundant and was often considered noxious (Butler 1983). Vegetation coverage receded in the 1970's as a result of a drawdown (Butler 1983) and has never recovered to pre-drawdown levels. Shoreline development has been reported to be detrimental to littoral fish species (Radomski and Goeman 2001; Trial et al. 2001; Wagner et al. 2006).

Growth of largemouth bass in Lake LBJ remained moderate; average age at 14 inches of length was 2.5 years (N = 521; range = 0 – 9 years; Figures 10a – b). Size overlap is evident at most age groups. Body condition in 2008 was sub-optimal (relative weights under 100) for nearly all size classes of fish, and was consistent with previous surveys (Figure 9). Genetic influence from the Florida largemouth bass sub-species has remained similar since the last stocking in 2001, as Florida alleles constituted 58% in 2008 and 61% in 2006, compared to 50% in 2004. One pure Florida largemouth bass was sampled in 2006 (Table 6). We were not able to detect any genetic shift toward the Florida largemouth bass sub-species from the supplemental stockings in 2000 and 2001.

**White crappie:** The total trap net catch rate for white crappie increased to 3.5/nn in 2008 from 0.8/nn in 2004 (Figure 11). The 2008 total CPUE superseded the 2.3/nn average (1989 – 2004; n = 6 surveys) and fell within the range (0.8/nn – 4.5/nn) during that same period. While high PSD values may indicate good size structure, poor catch rates of harvestable-size fish (CPUE-10) indicate otherwise. CPUE-10 was 0.3/nn, 0.2/nn and 1.3nn in 2008, 2004 and 2000, respectively. Average body condition (Wr) was good, as they fell between 90 and 100 for most size groups.

**Fisheries management plan for Lake LBJ, Texas**

Prepared - July 2009.

**ISSUE 1:** Long term bulkheading on Lake LBJ has contributed to the loss of littoral aquatic habitat. Reduction of future bulkheading may improve the fishery for cover seeking species.

MANAGEMENT STRATEGY

1. Educate shoreline homeowners on the importance of littoral shoreline habitat when the opportunity arises.

**ISSUE 2:** Approximately $15,000 was spent developing a small-scale aquatic vegetation restoration project in 2000. Results indicated that while several species of introduced vegetation survived in this reservoir, it appeared most were lost to herbivory once they expanded beyond the protective cages. Transplanted water willow and spatterdock expanded beyond cages and could provide improved habitat for largemouth bass if transplanted on a large scale throughout the reservoir.

MANAGEMENT STRATEGIES

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 and waterwillow.

2. Stay aware of funding opportunities to conduct large-scale habitat improvement projects applicable to Lake LBJ. If opportunities become available, submit proposals to acquire funding for such projects.

**ISSUE 3:** Non-native vegetation (water hyacinth and Eurasian watermilfoil) were present in the reservoir. There was potential for expansion of these species. Hydrilla was found in this reservoir in 2007 and could become established again.

MANAGEMENT STRATEGY

1. Conduct annual vegetation surveys to monitor coverage of these as well as native species.

**SAMPLING SCHEDULE JUSTIFICATION:**

The proposed sampling schedule will constitute standard sampling in 2012/2013; with an additional electrofishing survey in fall 2010 to assess the abundance and condition of largemouth bass (Table 7).

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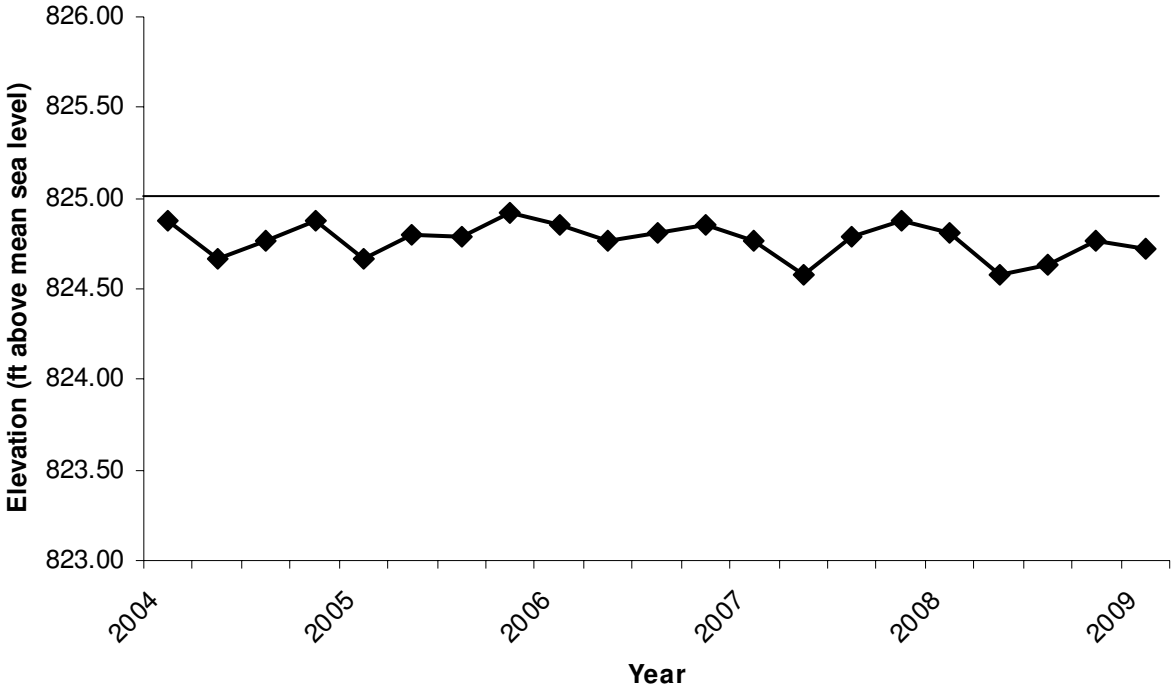



Figure 1. Mean quarterly water level elevations in feet above mean sea level (MSL) recorded for Lake LBJ, Texas. Conservation Pool = 825.00 ft above msl.

Table 1. Characteristics of Lake LBJ, Texas

| Characteristic | Description |
|---|---|
| Year constructed | 1951 |
| Controlling authority | LCRA |
| Counties | Burnet and Llano |
| Reservoir type | Mainstream river system: Colorado |
| Shoreline development index (SDI) | 13.3 |
| Conductivity | 454 umhos/cm |

Table 2. Harvest regulations for Lake LBJ.

| Species | Bag limit | Length limit (inches) |
|---|---|---|
| Bass: largemouth | 5* | 14 minimum |
| Bass: Guadalupe | 5* | No minimum limit |
| White bass | 25 | 10 minimum |
| Flathead catfish | 5 | 18 minimum |
| Catfish: channel and blue catfish | 25 (in any combination) | 12 minimum |
| Crappie: white and black crappie and their hybrids and sub species | 25 (in any combination) | 10 minimum |

*Five largemouth and Guadalupe bass in any combination.

Table 3. Stocking history of Lyndon B. Johnson, 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 |
| | Total | 433,290 | | |
| 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 |
| | Total | 713,690 | | |
| 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 | | |
| 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 | | |
| 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 4. Survey of shoreline habitat types, Lake LBJ, Texas, 2008. A linear shoreline distance (miles) was recorded for each habitat type found. Shoreline estimated at 154 total miles at conservation pool.

| Shoreline habitat type | Shoreline distance | |
|---|---|---|
| | Miles | Percent of total |
| Bulkhead | 11 | 7 |
| Bulkhead with piers and boat docks | 68 | 44 |
| Native emergent aquatic vegetation | 11 | 7 |
| Piers and boat docks | <1 | <1 |
| Rip rap | 1 | <1 |
| Rock bluff | <1 | <1 |
| Rocky shoreline | 5 | 3 |
| Sand | <1 | <1 |
| Standing timber | 1 | <1 |
| Vegetated bank | 57 | 37 |

Table 5a. Aquatic plants observed during aquatic vegetation surveys in Lake LBJ, Texas, October 2008. Surface area (acres) and percent reservoir coverage were determined for each plant species.

| Common Name | Scientific name | Acres | % coverage |
|---|---|---|---|
| Arrowhead* | *Sagittaria latifolia* | <1 | <1 |
| Bulrush | *Scirpus* sp | 9 | <1 |
| Cattail | *Typha* sp | <1 | <1 |
| Coontail | *Ceratophyllum demersum* | 1 | <1 |
| Eelgrass* | *Vallisneria americana* | <1 | <1 |
| Spatterdock | *Nuphar luteum* | 2 | <1 |
| Spike rush* | *Eleocharis* sp | <1 | <1 |
| Water hyacinth | *Eichhornia crassipes* | 1 | <1 |
| Water willow | *Justicia americana* | 21 | <1 |
| Mix 1 | *V. americana, C. demersum* *Chara* sp | <1 | <1 |
| | Total | 34 | <1 |

*Indicates species introduced to the lake from the 2000 vegetation project.

Table 5b. Aquatic plants observed during aquatic vegetation surveys in Lake LBJ, Texas, September 2006. Surface area (acres) and percent reservoir coverage were determined for each plant species.

| Common Name | Scientific name | Acres | % coverage |
|---|---|---|---|
| Arrowhead | *Sagittaria latifolia* | <1 | <1 |
| Bulrush | *Scirpus* sp | 15 | <1 |
| Eelgrass* | *Vallisneria americana* | <1 | <1 |
| Hydrilla | *Hydrilla verticillata* | <1 | <1 |
| Milfoil | *Myriophyllum spicatum* | <1 | <1 |
| Muskgrass | *Chara* sp | 26 | <1 |
| Pickerelweed* | *Pontederia cordata* | <1 | <1 |
| Pondweed* | *Potomogeton* sp | <1 | <1 |
| Smartweed | *Polygonum hydropiperoides* | <1 | <1 |
| Spatterdock | *Nuphar luteum* | 7 | <1 |
| Spike rush* | *Eleocharis* sp | <1 | <1 |
| Water hyacinth | *Eichhornia crassipes* | <1 | <1 |
| Fragrant water lily* | *Nymphaea odorata* | <1 | <1 |
| Water willow | *Justicia americana* | 18 | <1 |
| Mixed 1 | *V. americana, M. spicatum, Potomogeton* sp*, Chara* sp | <1 | <1 |
| Mixed 2 | *M. spicatum, Chara* sp | <1 | <1 |
| Mixed 3 | *M. spicatum, V. americana* | <1 | <1 |
| Mixed 4 | *M. spicatum, J. americana* | <1 | <1 |
| Mixed 5 | *M. spicatum, N. luteum* | <1 | <1 |
| | Total | 67 | 1 |

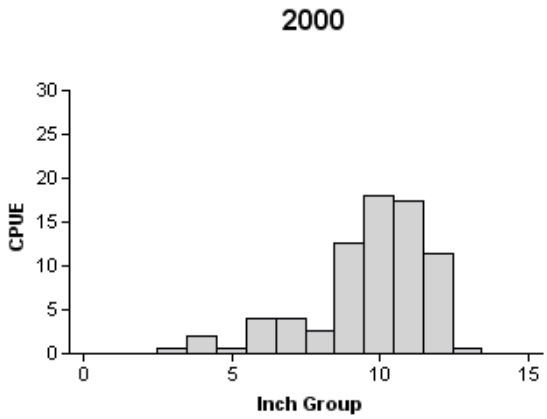
*Indicates species introduced to the lake from the 2000 vegetation project.

Table 5c. Aquatic plants observed during aquatic vegetation surveys in Lake LBJ, Texas, September 2005. Surface area (acres) and percent reservoir coverage were determined for each plant species.

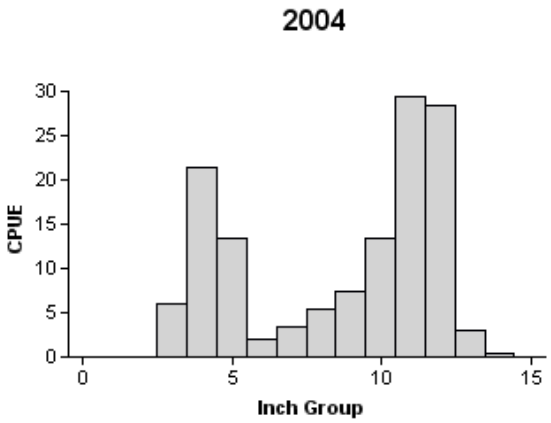
| Common Name | Scientific name | Acres | % coverage |
|---|---|---|---|
| Bulrush | *Scirpus* sp | 15 | <1 |
| Milfoil | *Myriophyllum spicatum* | <1 | <1 |
| Pickerelweed* | *Pontederia cordata* | <1 | <1 |
| Pondweed* | *Potomogeton* sp | 7 | <1 |
| Spatterdock | *Nuphar luteum* | <1 | <1 |
| Water hyacinth | *Eichhornia crassipes* | <1 | <1 |
| Fragrant water lily* | *Nymphaea odorata* | <1 | <1 |
| Water willow | *Justicia americana* | 18 | <1 |
| | Total | 41 | <1 |

*Indicates species introduced to the lake from the 2000 vegetation project.

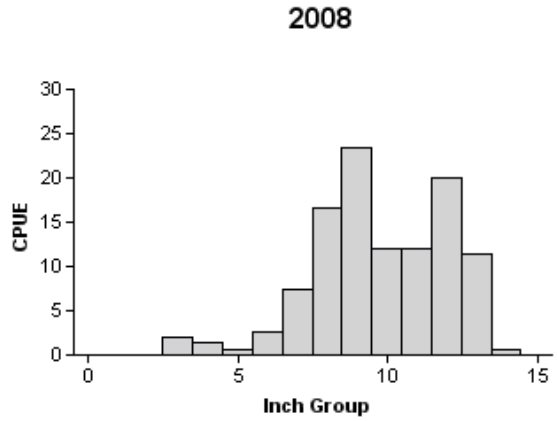
# Gizzard Shad




Effort = 1.5
Total CPUE = 74.0 (20; 111)
IOV = 15.32 (5.9)



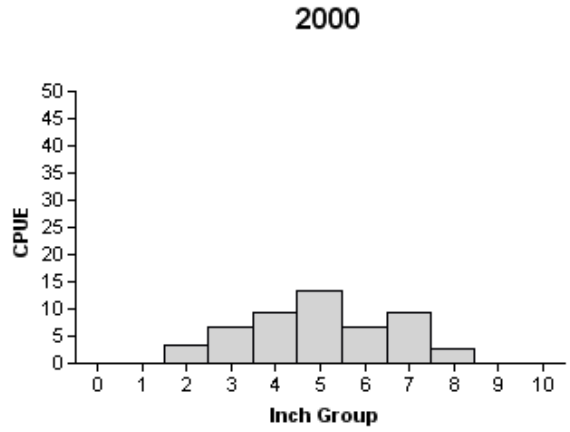

Effort = 2.0
Total CPUE = 134.5 (21; 269)
IOV = 34.57 (8.7)



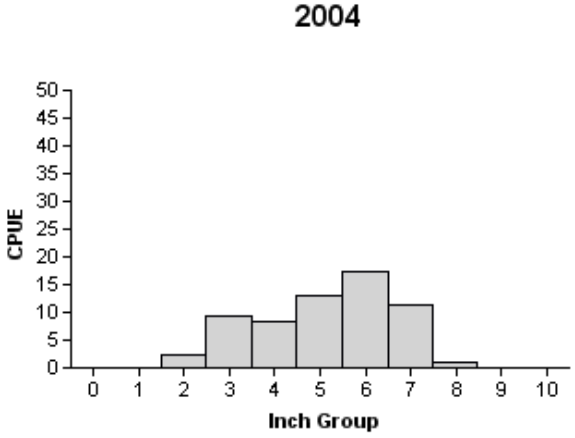

Effort = 1.5
Total CPUE = 110.0 (20; 165)
IOV = 12.73 (4.1)

Figure 2. 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, Lake LBJ, Texas, 2000, 2004 and 2008.

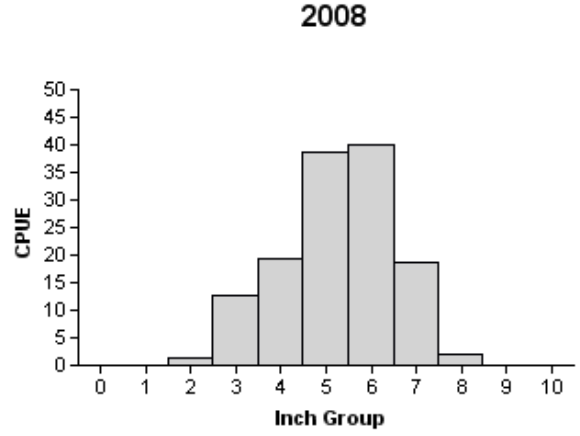
# Redbreast Sunfish




| | |
|---|---|
| Effort = | 1.5 |
| Total CPUE = | 51.3 (28; 77) |
| PSD = | 39 (8.2) |



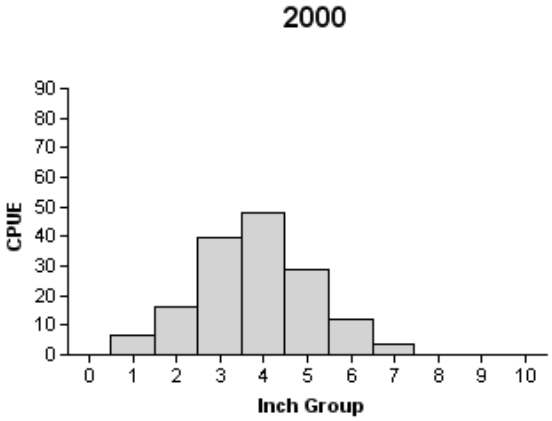

| | |
|---|---|
| Effort = | 2.0 |
| Total CPUE = | 63.5 (21; 127) |
| PSD = | 49 (7.7) |



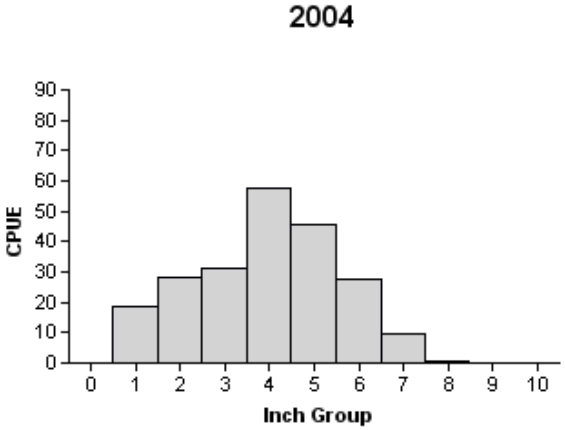

| | |
|---|---|
| Effort = | 1.5 |
| Total CPUE = | 132.7 (23; 199) |
| PSD = | 46 (6.6) |

Figure 3. 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, Lake LBJ, Texas, 2000, 2004 and 2008.

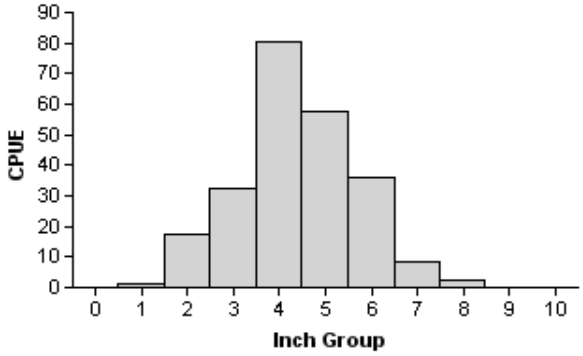
# Bluegill




Effort = 1.5
Total CPUE = 154.0 (14; 231)
PSD = 12 (3.5)



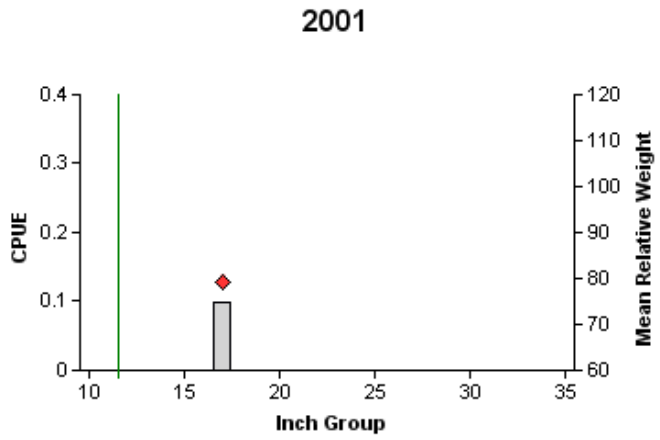

Effort = 2.0
Total CPUE = 218.5 (16; 437)
PSD = 22 (2.4)



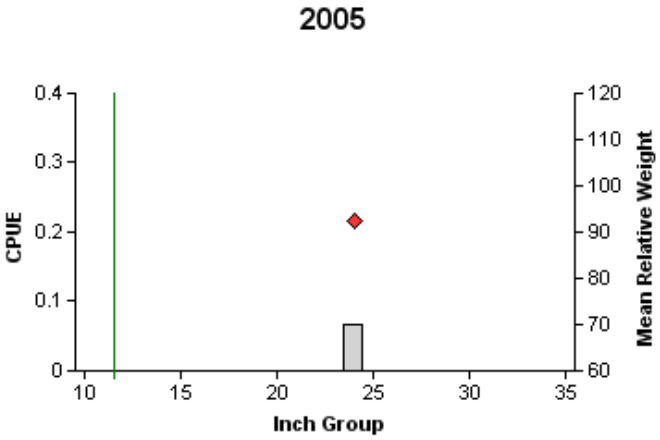

Effort = 1.5
Total CPUE 236.7 (20; 355)
PSD = 22 (2.6)

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, Lake LBJ, Texas, 2000, 2004 and 2008.

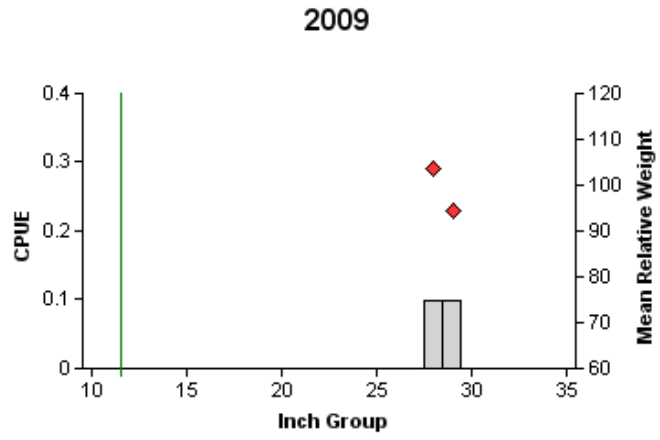
# Blue Catfish




| | |
|---|---|
| Effort = | 10.0 |
| Total CPUE = | 0.1 (100; 1) |
| CPUE-12 = | 0.1 (100; 1) |
| PSD = | 0 (105.4) |



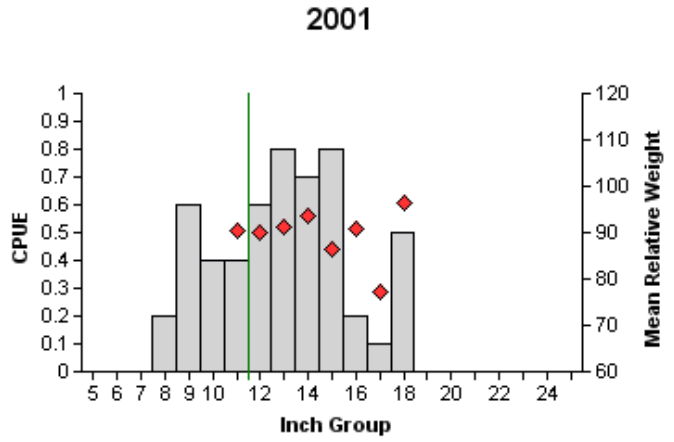

| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 0.1 (100; 1) |
| CPUE-12 = | 0.1 (100; 1) |
| PSD = | 100 (0.0) |



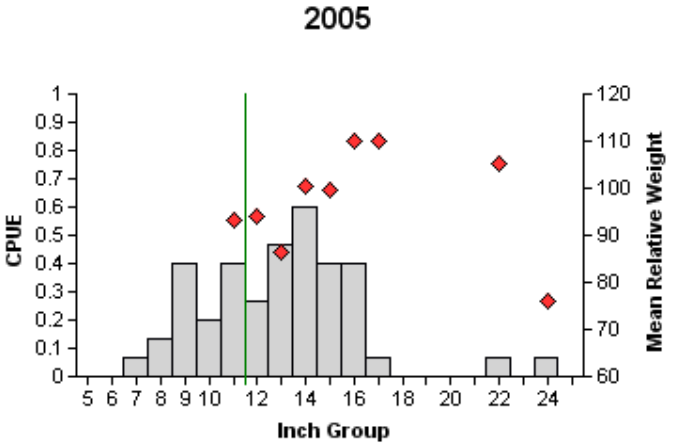

| | |
|---|---|
| Effort = | 10.0 |
| Total CPUE = | 0.2 (67; 2) |
| CPUE-12 = | 0.2 (67; 2) |
| PSD = | 100 (0) |

Figure 5. Number of blue catfish caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake LBJ, Texas, 2001, 2005 and 2009. Minimum length limit indicated by vertical line.

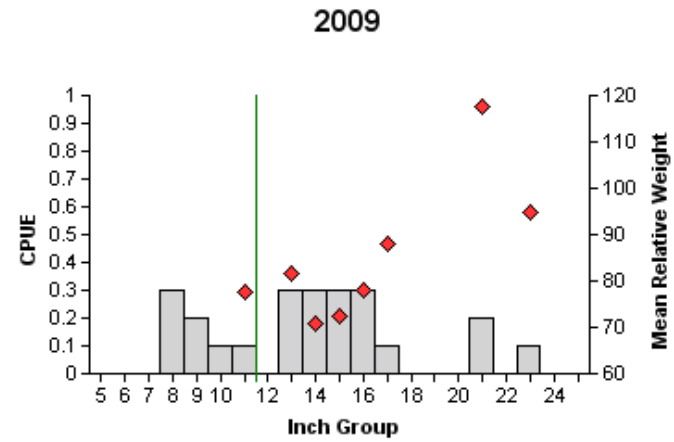
# Channel Catfish




| | |
|---|---|
| Effort = | 10.0 |
| Total CPUE = | 5.3 (18; 53) |
| CPUE-12 = | 3.7 (21; 37) |
| PSD = | 20 (6.2) |



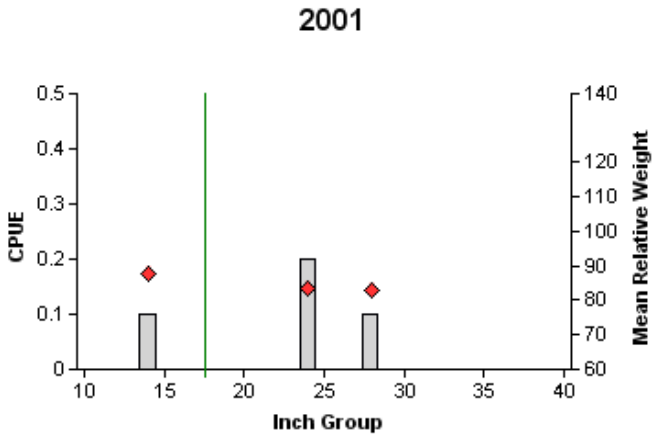

| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 3.5 (22; 53) |
| CPUE-12 = | 2.3 (26; 35) |
| PSD = | 22 (8.8) |



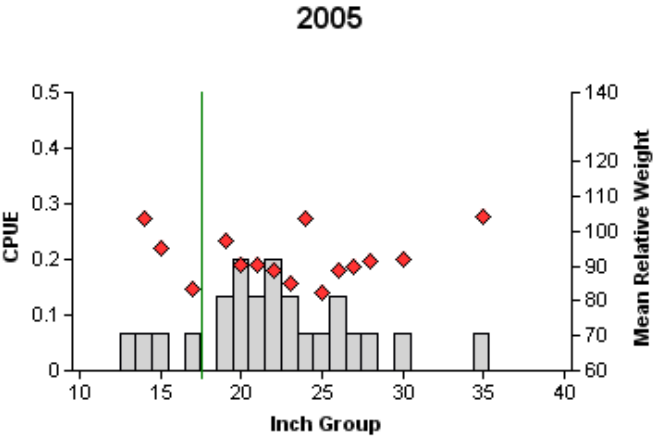

| | |
|---|---|
| Effort = | 10.0 |
| Total CPUE = | 2.3 (28; 23) |
| CPUE-12 = | 1.6 (36; 16) |
| PSD = | 41 (12.5) |

Figure 6. Number of channel catfish caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake LBJ, Texas, 2001, 2005 and 2009. Minimum length limit indicated by vertical line.

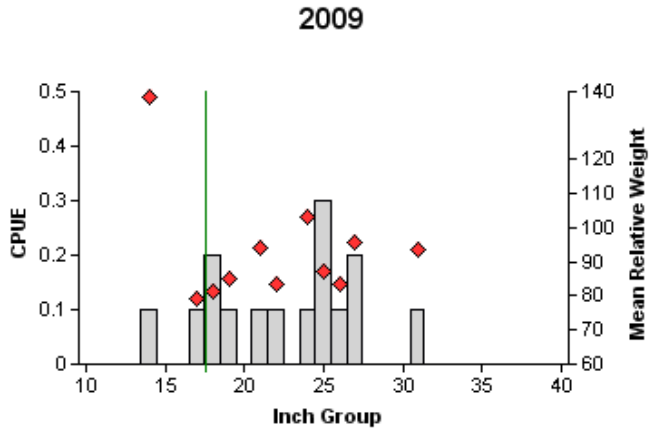
# Flathead Catfish




| | |
|---|---|
| Effort = | 10.0 |
| Total CPUE = | 0.4 (41; 4) |
| CPUE-18 = | 0.3 (51; 3) |
| PSD = | 75 (22.8) |



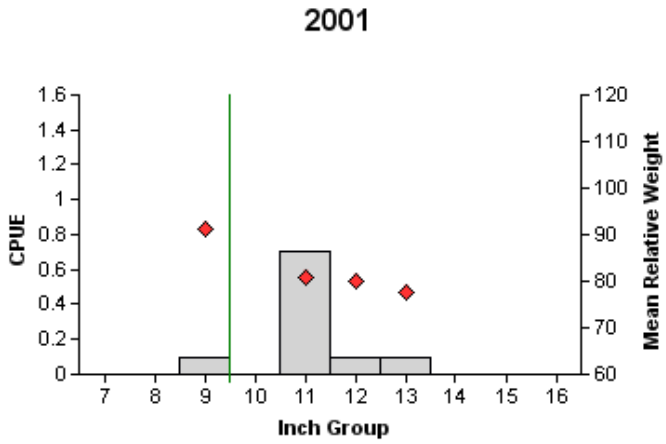

| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 1.6 (27; 24) |
| CPUE-18 = | 1.3 (31; 20) |
| PSD = | 78 (8.1) |



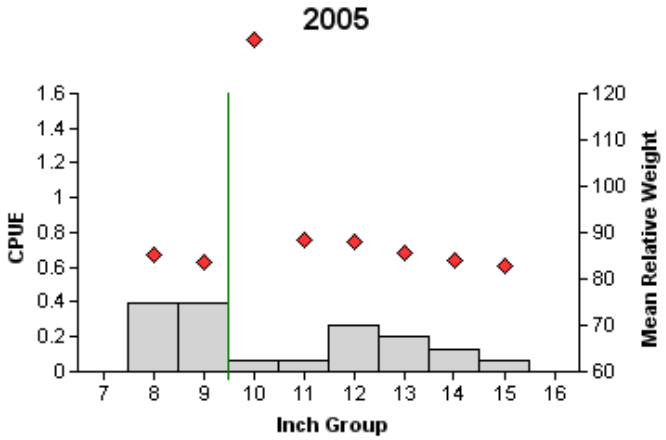

| | |
|---|---|
| Effort = | 10.0 |
| Total CPUE = | 1.5 (18; 15) |
| CPUE-18 = | 1.3 (20; 13) |
| PSD = | 67 (15.6) |

Figure 7. Number of flathead catfish caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake LBJ, Texas, 2001, 2005 and 2009. Minimum length limit indicated by vertical line.

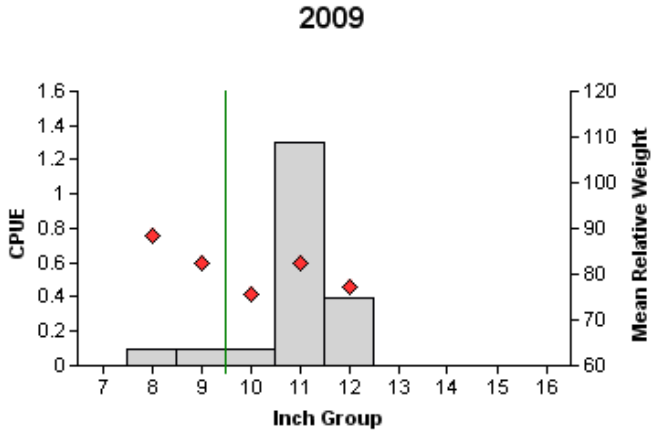
# White Bass




Effort = 10.0
Total CPUE = 1.0 (42; 10)
CPUE-10 = 0.9 (39; 9)
PSD = 100 (0)



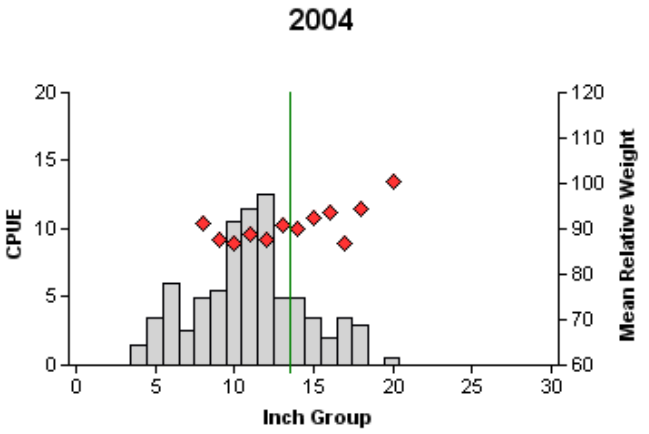

Effort = 15.0
Total CPUE = 1.6 (41; 24)
CPUE-10 = 0.8 (55; 12)
PSD = 75 (9.6)



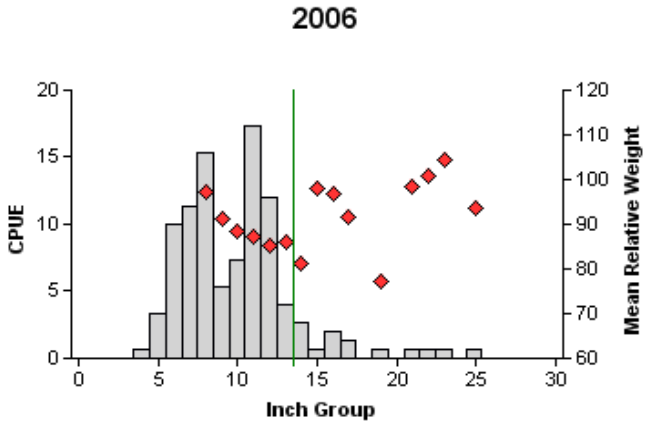

Effort = 10.0
Total CPUE = 2.0 (50; 20)
CPUE-10 = 1.8 (54; 18)
PSD = 95 (5.1)

Figure 8. Number of white bass caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake LBJ, Texas, 2001, 2005 and 2009. Minimum length limit indicated by vertical line.

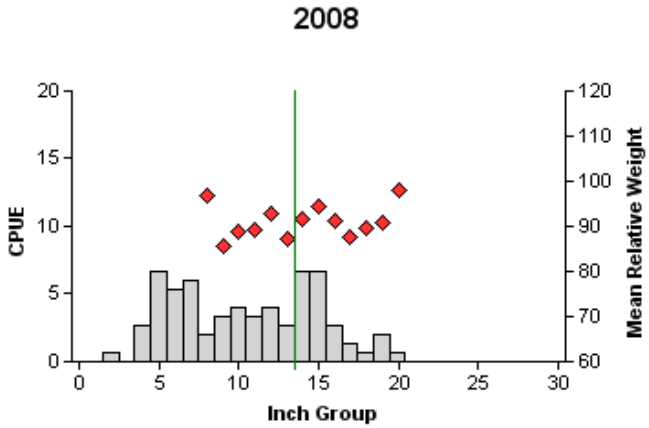
# Largemouth Bass




| | |
|---|---|
| Effort = | 2.0 |
| Total CPUE = | 81.0 (17; 162) |
| Stock CPUE = | 67.5 (18; 135) |
| CPUE-14 = | 17.5 (20; 35) |
| PSD = | 52 (4.4) |
| RSD-14 = | 26 (3.1) |




| | |
|---|---|
| Effort = | 1.5 |
| Total CPUE = | 96.7 (17; 145) |
| Stock CPUE = | 71.3 (17; 107) |
| CPUE-14 = | 10.0 (24; 15) |
| PSD = | 36 (4.9) |
| RSD-14 = | 14 (2.9) |




| | |
|---|---|
| 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) |
| RSD-14 = | 52 (7.9) |

Figure 9. Number of largemouth bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake LBJ, Texas, 2004, 2006 and 2008. Minimum length limit indicated by vertical line.

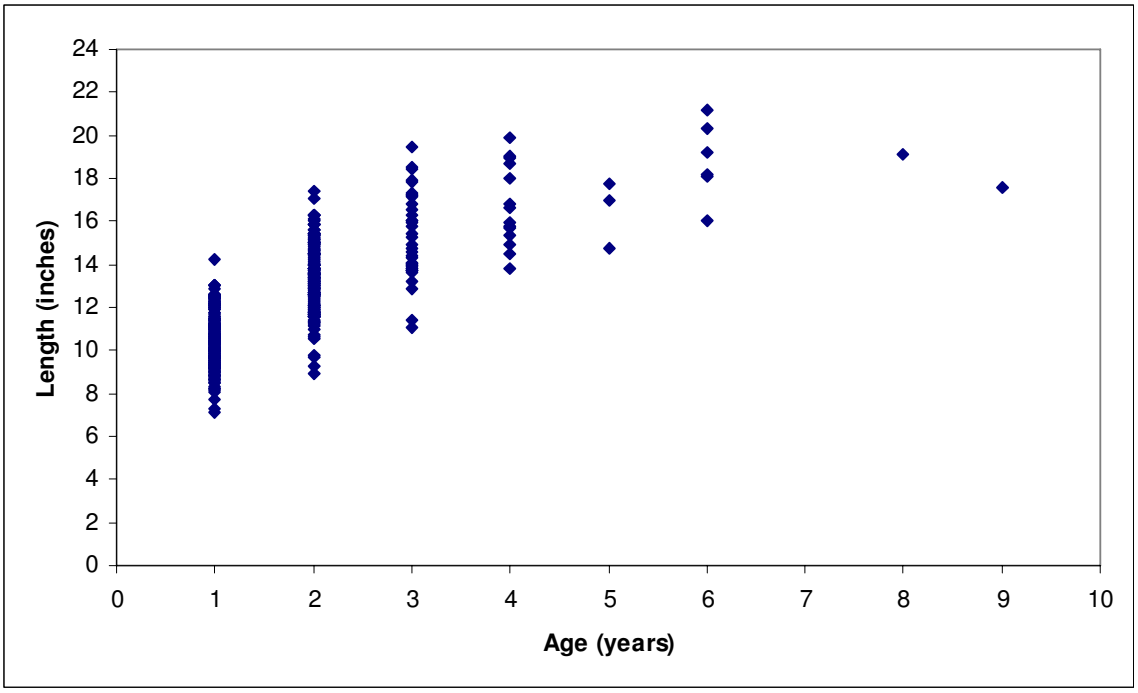



Figure 10a. Length at age for largemouth bass collected by electrofishing at Lake LBJ, Texas, November 2007 (N = 521; range 0-9 years).

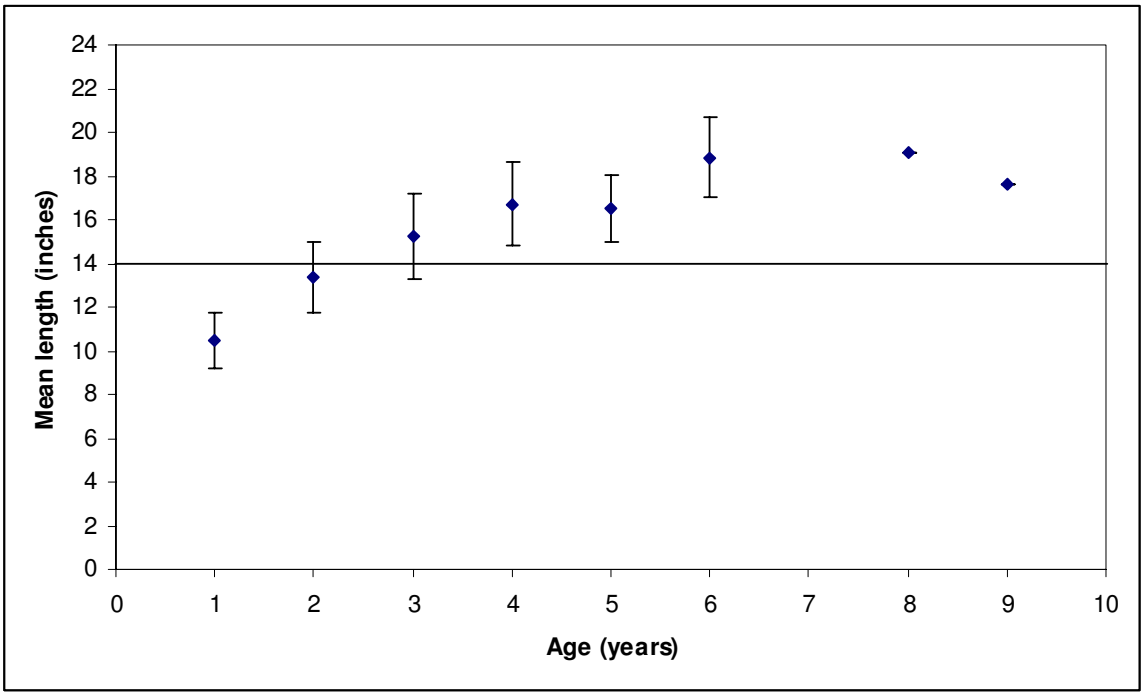
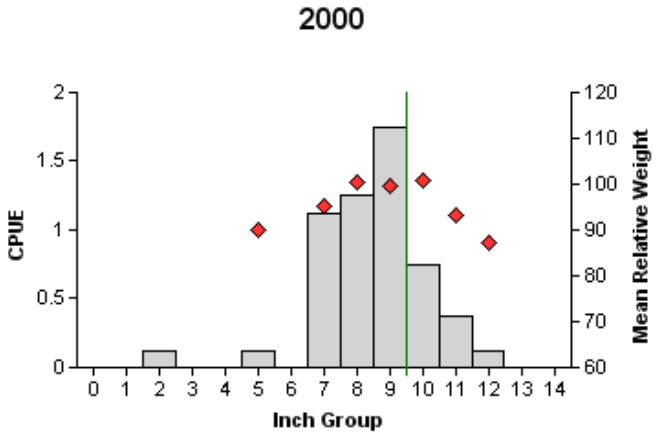



Figure 10b. Mean length at age with standard deviations for largemouth bass collected by electrofishing at Lake LBJ, Texas, November 2007 (N = 521; range 0-9 years). The 14-inch minimum length limit is indicated by line. Standard deviations were not calculated for 8 and 9 year old individuals due to low sample size.

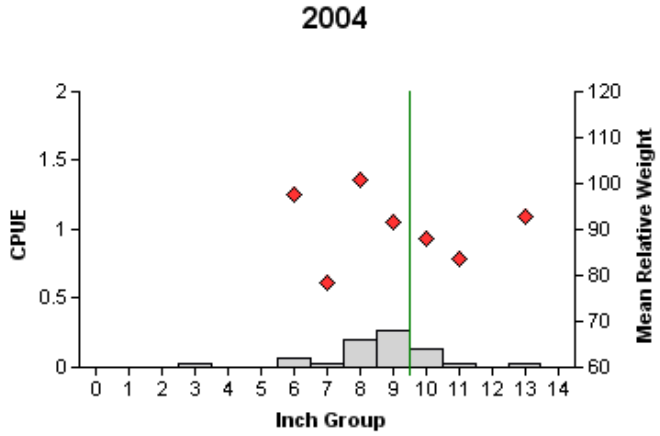
Table 6. Results of genetic analysis of largemouth bass collected by electrofishing, Lake LBJ, Texas, 2004, 2006 and 2008. FLMB = Florida largemouth bass, NLMB = northern largemouth bass, Fx = any generation hybrid between FLMB and NLMB.

| Year | Sample size | Genotype | | | % FLMB alleles | % pure FLMB |
|---|---|---|---|---|---|---|
| | | FLMB | Fx | NLMB | | |
| 2004 | 39 | 7 | 25 | 7 | 50 | 19 |
| 2006 | 30 | 1 | 29 | 0 | 61 | 3 |
| 2008 | 30 | 0 | 30 | 0 | 58 | 0 |

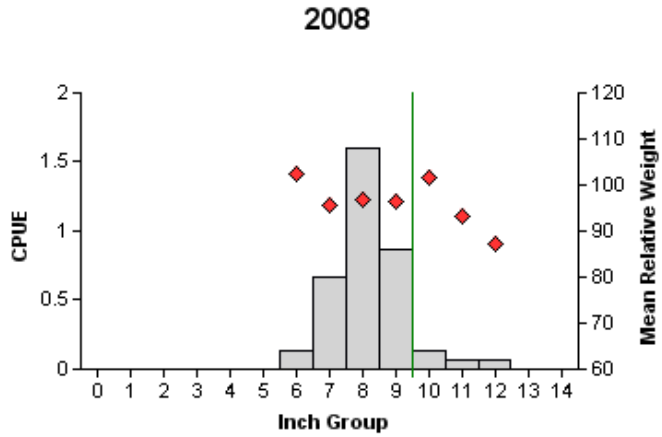
# White Crappie




| | |
|---|---|
| Effort = | 10.0 |
| Total CPUE = | 4.5 (18; 45) |
| CPUE-10 = | 1.0 (33; 10) |
| PSD = | 77 (8.3) |




| | |
|---|---|
| Effort = | 30.0 |
| Total CPUE = | 0.8 (28; 24) |
| CPUE-10 = | 0.2 (37; 6) |
| PSD = | 87 (5.8) |




| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 3.5 (43; 53) |
| CPUE-10 = | 0.3 (57; 4) |
| PSD = | 77 (5.5) |

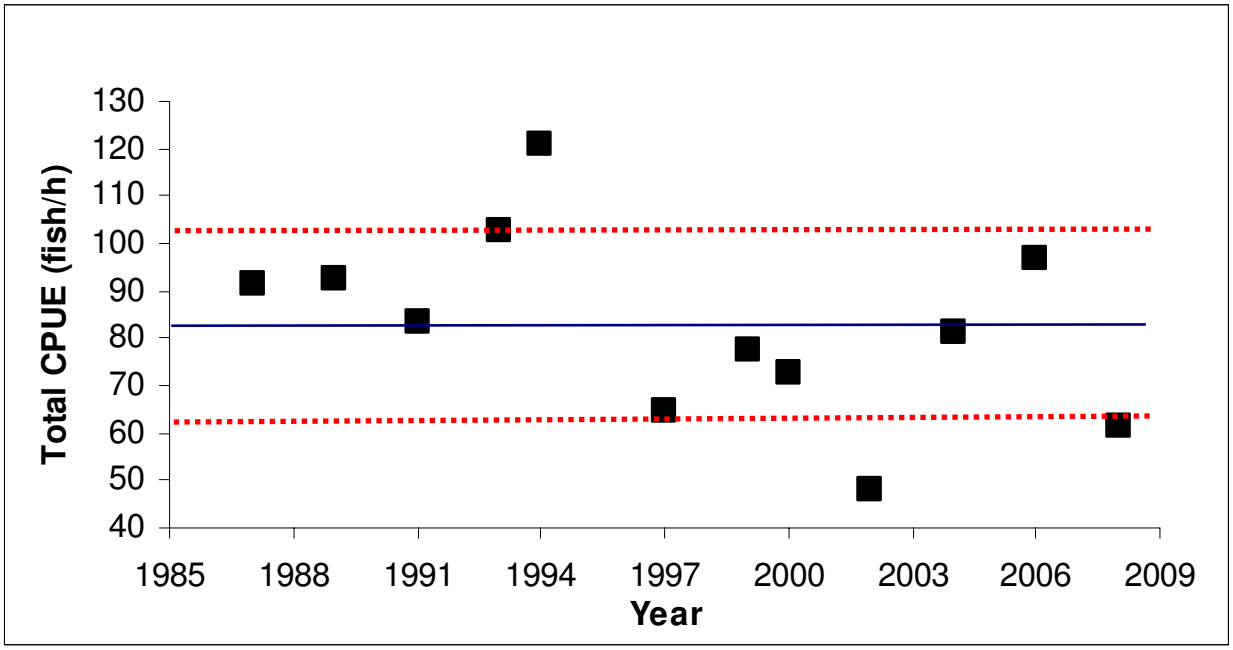
Figure 11. Number of white crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, Lake LBJ, Texas, 2000, 2004 and 2008. Minimum length limit indicated by vertical line.

Table 7. Proposed sampling schedule for Lake LBJ, Texas. 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 surveys denoted by A.

| Survey Year | Electrofisher | Gill Net | Trap Net | Creel Survey | Report |
|---|---|---|---|---|---|
| Fall 2009-Spring 2010 | | | | | |
| Fall 2010-Spring 2011 | A | | | | |
| Fall 2011-Spring 2012 | | | | | |
| Fall 2012-Spring 2013 | S | S | S | | S |

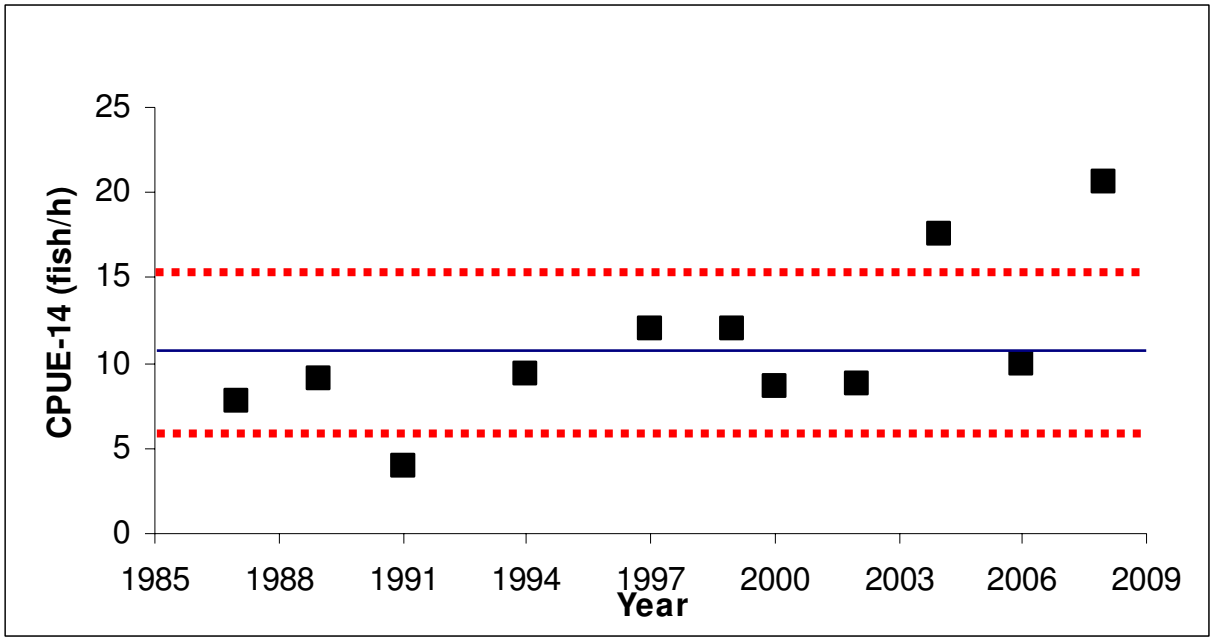
**Appendix A**

Historical trend of largemouth bass total CPUE (squares) from electrofishing surveys conducted on LBJ Reservoir from 1986 to 2008. Solid line represents average catch rate (82.70/h) and dotted lines represent one standard deviation (+/-19.84/h).



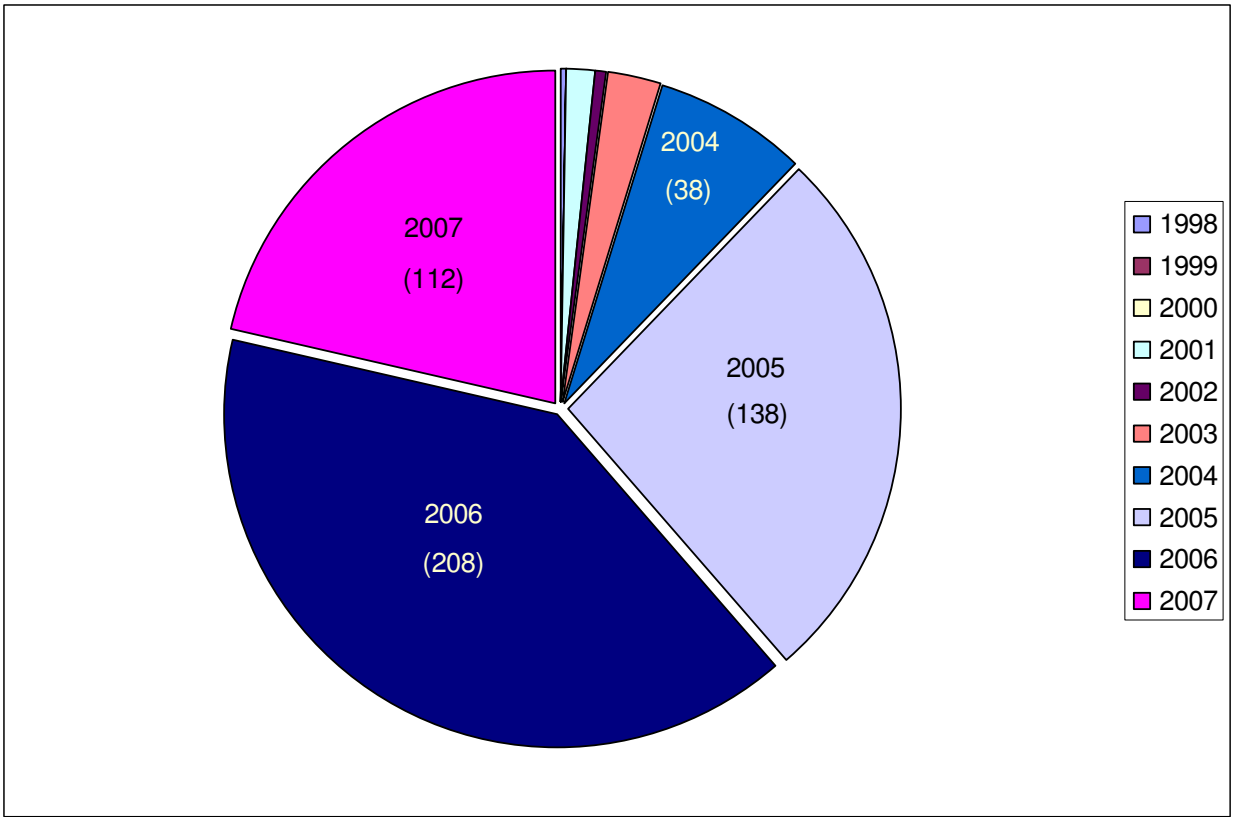
**Appendix B**

Historical trend of harvestable length largemouth bass (CPUE-14; squares) from electrofishing surveys conducted on LBJ Reservoir from 1986 to 2008. Solid line represents average catch rate (10.41/h) and dotted lines represent one standard deviation (+/-4.71/h).



**Appendix C**

Year class frequency for largemouth bass collected for age and growth evaluation in November, 2007, Lake LBJ, Texas (N size = 521 fish; range = 0 – 9 years). Frequency of year class for most abundant year classes in sample presented in parentheses.

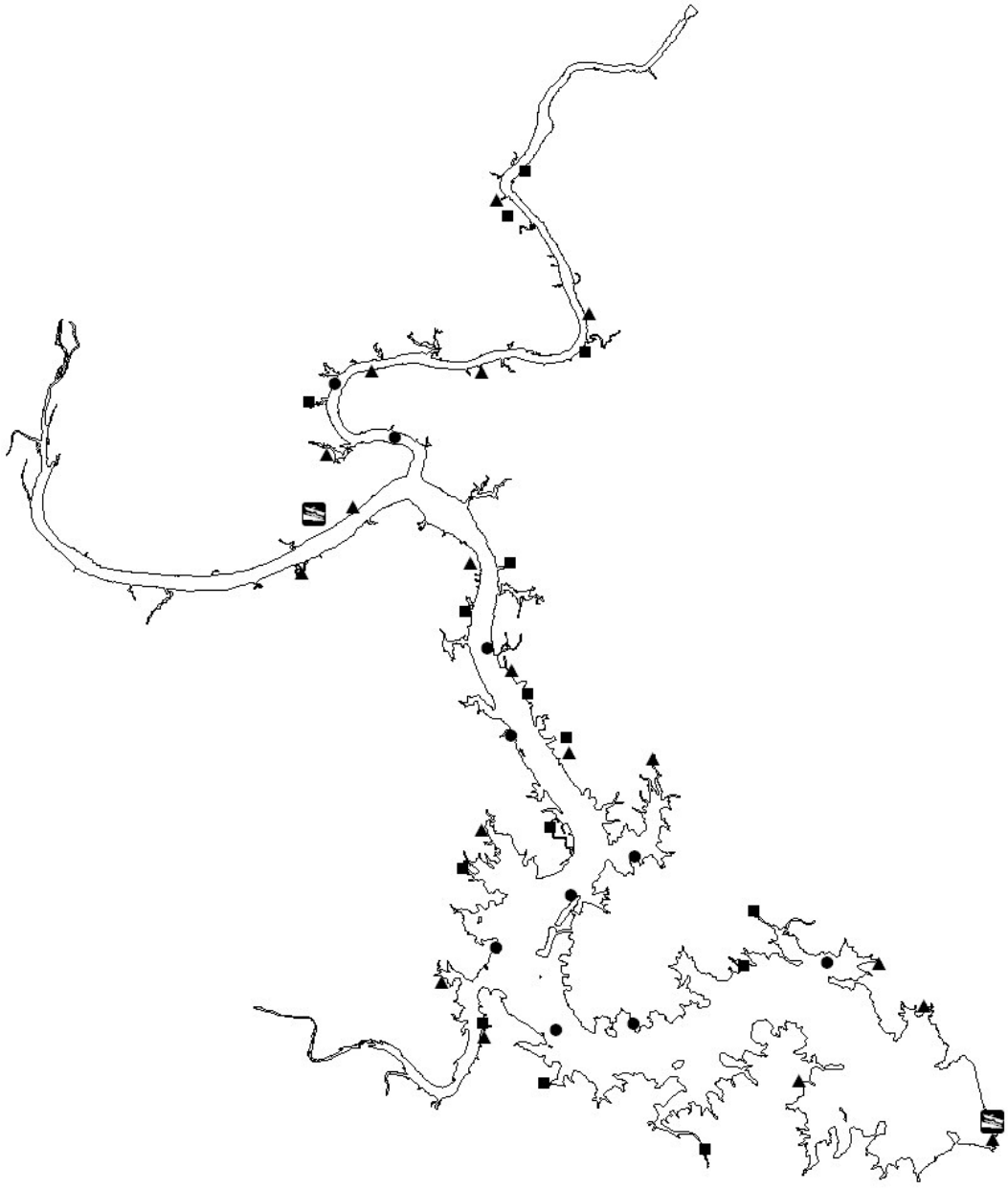


## Appendix D

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Lake LBJ, Texas, 2008 and 2009.

| Species | Gill Netting | | Trap Netting | | Electrofishing | |
|---|---|---|---|---|---|---|
| | N | CPUE | N | CPUE | N | CPUE |
| Gizzard shad | | | | | 165 | 110.0 |
| Threadfin shad | | | | | 16 | 10.7 |
| Bullhead minnow | | | | | 6 | 4.0 |
| Inland silverside | | | | | 45 | 30.0 |
| Blacktail shiner | | | | | 3 | 2.0 |
| Blue catfish | 2 | 0.2 | | | | |
| Channel catfish | 23 | 2.3 | | | | |
| Flathead catfish | 15 | 1.5 | | | | |
| White bass | 20 | 2.0 | | | | |
| Redbreast sunfish | | | | | 199 | 132.7 |
| Green sunfish | | | | | 30 | 20.0 |
| Warmouth | | | | | 7 | 4.7 |
| Bluegill | | | | | 355 | 236.7 |
| Longear sunfish | | | | | 45 | 30.0 |
| Redear sunfish | | | | | 39 | 26.0 |
| Largemouth bass | | | | | 92 | 61.3 |
| Guadalupe bass | | | | | 14 | 9.3 |
| White crappie | | | 53 | 3.5 | | |
| Logperch | | | | | 5 | 3.3 |
| Rio Grande cichlid | | | | | 1 | 0.7 |

**Appendix E**



Location of sampling sites, Lake LBJ, Texas, 2008-2009. Gill netting sites are indicated by circles, trap netting sites by squares, and electrofishing sites by triangles. The two primary public boat ramps are indicated by boat ramp symbol (⛾).