PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2010 Survey Report

# Travis Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Travis Reservoir were surveyed in 2010 using electrofishing and in 2011 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:** Travis Reservoir is an 18,622-acre impoundment of the Colorado River located in Travis and Burnet Counties, approximately 12 miles northwest of Austin, TX. It was constructed in 1942 by the Lower Colorado River Authority (LCRA) for purposes of flood control, municipal and industrial water supplies, irrigation, and hydroelectric power. Travis Reservoir has a shoreline development index of 18.3. The basin is steep-sided with relatively few shallow coves and shoal areas. This reservoir experiences extreme water level fluctuations and lies within the Edwards Plateau ecological area. Land use is predominantly ranching in the upper reservoir, with residential properties common in the lower reservoir. Significant stands of aquatic vegetation have never been documented in the reservoir.

- **Management History:** Important sport fish include white bass, striped bass, largemouth bass, and catfish species. The management plans from 2007 were to continue stocking striped bass; and to stock Florida largemouth bass in spring 2008 if the reservoir water level elevation was above 670 msl. The Florida subspecies of largemouth bass was originally stocked in the reservoir in the late 1980's to increase Florida largemouth bass genetic influence in the population. Blue and channel catfish were stocked in the 1970's to help establish a sustainable population. White bass were managed under an experimental 12-inch minimum length limit from 1995 to 2003. The regulation was rescinded after analysis indicated environmental factors, not angler harvest, were probably more influential in determining white bass population density.

- **Fish Community**
  - **Prey species:** Gizzard shad, bluegill and redbreast sunfish were the predominant forage species. Threadfin shad were also present.

  - **Catfishes:** Blue catfish was the dominant species present. Large blue catfish are available for anglers. Channel and flathead catfish were also present in lower densities. A previous fall creel survey indicated directed effort towards catfish species was low.

  - **Temperate basses:** White bass abundance improved in 2011. This may be the result of a strong year class produced in 2010 when the reservoir re-filled after extremely low water levels in 2008 and 2009. Only one striped bass was caught in the 2011 gill net survey. Previous surveys in 2007 and 2008 indicated higher abundance.

  - **Black basses:** Largemouth bass were abundant, although total electrofishing catch rate and catch rate of individuals over 14 inches was lower than previous surveys. Low lake levels in 2008 and 2009 may have decreased recruitment of this species. Largemouth bass growth in 2011 was similar to previous surveys**.** Guadalupe bass were present.

**Management Strategies**

The reservoir should continue to be managed with existing fishing regulations. Routine gill netting and electrofishing surveys should be conducted in 2014–2015. An additional gill net survey should be conducted in spring 2013 to monitor striped bass abundance. Striped bass should continue to be stocked in efforts to maintain the fishery. A creel survey should be conducted in 2014 to evaluate angler utilization/exploitation of the striped bass fishery. The survey should include angler attitude and opinion questions regarding angler utilization of the striped bass fishery, as this species may be primarily caught by anglers targeting other species. Results of that

survey should be used to justify future stockings. Florida largemouth bass should be stocked when water levels are favorable for stocking. Largemouth bass fishing tournament results indicate average "big bass" weights exceed 8 pounds and justify additional stockings of this species to maintain or improve maximum size.

## INTRODUCTION

This document is a summary of fisheries data collected from Travis Reservoir in 2010 and 2011. 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 is presented with the 2010 and 2011 data for comparison.

### *Reservoir Description*

Travis Reservoir is an 18,622-acre impoundment of the Colorado River located in Travis and Burnet Counties, approximately 12 miles northwest of Austin. It was constructed in 1942 by the Lower Colorado River Authority (LCRA) for purposes of flood control, municipal and industrial water supplies, irrigation, and hydroelectric power. Travis Reservoir has a shoreline development index of 18.3. The basin is steep-sided with relatively few shallow coves and shoal areas. This reservoir experiences extreme water level fluctuations (Figure 1), and lies within the Edwards Plateau ecological area. Land use is predominantly ranching in the upper reservoir, with residential properties common in the lower reservoir. Shoreline habitat at the time of sampling consisted mostly of rocky shoreline, rock bluff, and sand. No aquatic vegetation was present. Availability of boat access on Travis Reservoir is highly sensitive to water level variation (Daugherty et. al. 2011). At water levels above 667 msl angler access was excellent for boat anglers. Eleven concrete public boat ramps were available when water level exceeded this level. As water level falls due to releases from the reservoir the number of usable boat ramps available declined. Under low water conditions (<650 msl) boat access was poor and only two public boat ramps were available, although anglers frequently launch boats from the shoreline using four-wheel drive vehicles. Increased municipal water demand and effects of climate change (i.e. less rainfall) may make future recreational boating access to Travis Reservoir difficult in the future (Daugherty et. al. 2011). The population of the Austin – Round Rock Metropolitan Statistical Area (MSA) was over 1.45 million people in 2006; having grown almost 16% from 1.25 million in 2000. Much of the development associated with that population growth is moving toward Travis Reservoir and the Hill Country. Population data indicate that census tracts immediately north and south of Travis Reservoir fell into the two highest growth categories between 1990 and 2000 and that they grew at a greater rate than a vast majority of census tracts in the MSA (City of Austin, 2007). Bank fishing was available at 18 public parks. Handicapped access was poor with no specific handicap accessible fishing sites available. Other descriptive characteristics for Travis Reservoir are in Table 1.

### *Management History*

**Previous management strategies and actions:** Management strategies and actions from the previous survey report (De Jesus and Magnelia 2007) included:

1. Request striped bass fingerlings be stocked once per year at a rate of 5/acre. A gill net survey should be conducted in spring 2009 to monitor striped bass abundance and condition.

   **Action:** Striped bass were stocked annually since 2007. An additional gill net survey was conducted in 2008 to monitor the population.

2. Stock Florida largemouth bass in spring 2008 if reservoir water level is above 670 msl.

**Action:** Florida largemouth bass were stocked in 2008 and again in 2011.

**Harvest Regulation History:** Sport fish in Travis reservoir are currently managed with statewide regulations (Table 2). The white bass minimum length limit was reduced to 10 inches in September 2003 as analyses suggested that population densities were probably determined by environmental factors (inflow and water level) rather than angler harvest.

**Stocking History:** Annual striped bass stockings at a rate of 5/acre have been requested since 2002 to re-establish a popular fishery. Florida largemouth bass were introduced in 1988, 2008 and 2011 to increase Florida largemouth bass genetic influence. Blue catfish were stocked in 1979 and a self sustaining population is now present. A complete stocking history is in Table 3.

**Aquatic Vegetation/habitat history:** Travis Reservoir had no aquatic vegetation coverage. Most of the shoreline habitat was comprised of rocky shoreline, bluff, and sand (Table 4). Water levels at Travis Reservoir fluctuated widely, but shoreline habitat in the middle and lower portions of the reservoir change very little because the shorelines were generally steep sided.

## METHODS

Fishes were collected by electrofishing (2.0 hours at 24 stations) and gill 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 2009). Trap netting for crappie was not performed due to historically low catch rates and high cost associated with collecting these data. A habitat survey has not been conducted since 1998. No large scale structural habitat changes have occurred in the interim.

Sampling statistics (CPUE for various length categories) and structural indices [Proportional Size Distribution (PSD); as defined by Guy et al. (2007)], 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 for white bass and were obtained using otoliths from individuals collected between 229 and 279 mm in length. Because only one striped bass was collected in 2011 a length at age figure is not included in this report. Ages were determined for LMB using otoliths from 13 individuals between 13 and 15 inches (category 2 age analysis for 14-inch LMB; TPWD Procedures Manual, revised 2009). Supplemental age-and-growth information for channel catfish, largemouth bass and white/black crappie (combined sample) was provided by the Texas Parks and Wildlife Department Heart of the Hills Fisheries Science Center and is included in the appendices. 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 2009). The source for water level data was the Lower Colorado River Authority.

## RESULTS AND DISCUSSION

**Habitat:** Shoreline habitat was comprised mostly of rocky shoreline, bluff, and sand bank (Table 4).

**Prey species:** Electrofishing catch rates of gizzard shad**,** bluegill, and redbreast sunfish were 83.5/hour, 204.5/hour, and 112.5/hour, respectively. Forty-nine percent of gizzard shad were vulnerable to existing predators (Figure 2). Threadfin shad were present in lower densities. Bluegill and redbreast sunfish populations were dominated by small individuals (Figures 3 and 4), but some individuals greater than seven inches in length were available to anglers.

**Catfishes:** Blue catfish was the predominant species of catfish surveyed. The gill net catch rate of blue catfish was 2.9/nn in 2011, which was similar to the catch rate in 2007. Population structure was dominated by fish between 10 and 20 inches which was similar to previous years (Figure 5). Body condition for most length groups exceeded 90. The number of large (>25 inches) individuals sampled was higher than in the two previous surveys (Figure 5). The gill net catch rate of channel catfish was 0.8/nn in 2011, which was lower than the previous two surveys. Body condition in 2011 was good (relative weights above 90) for nearly all length classes and remained similar to previous surveys (Figure 6). Most channel catfish exceeded the minimum length limit of 12 inches by age-3 (mean length = 13.3 inches) (Appendix C). The gill net catch rate of flathead catfish in 2011 was 0.9/nn, which was similar to previous surveys. The population structure was dominated by large individuals (Figure 7). The last creel survey conducted on the reservoir in fall 2001 indicated that few anglers on this reservoir specifically targeted catfish species (only 5.3% of the pole and line directed effort) (Magnelia and Bonds 2003), although directed effort may be higher at other times of the year.

**White bass:** White bass are a popular species on this reservoir with spring spawning runs in the Pedernales and Colorado River arms of the reservoir. The gill net catch rate of white bass was 4.0/nn in 2011. Catch rates greatly improved from surveys conducted in 2003 and 2007 (Figure 8), which can possibly be explained by a strong year class produced in spring 2010 after the reservoir re-filled in fall 2009 after two years of severe drought conditions (Figure 1). Most individuals sampled exceeded the minimum length limit of 10 inches. As with previous surveys many white bass reach 10 inches by age 1 (Figure 9) (mean length at age 1 = 10.09 inches; N = 10).

**Striped bass:** Only one striped bass was collected in the 2011 gill net survey. An optional survey using subjective sample site selection in spring 2008 collected what appeared to be several year classes of striped bass from previous stockings (Figure 10). The inability to collect more than one striped bass in 2011 was puzzling, given annual stocking (Table 3) and the relatively high gill net catch rate in 2008. Sampling variability may explain the low catch rate, but there was also a substantial kill of large (mean length = 24 inches, TPWD unpublished data) striped bass near the dam in summer 2010. This was attributed to a deep (between 80 and 140 feet) oxygenated water layer which was eventually depleted (Appendix D). Adult striped bass will seek water temperature less than 25 C and dissolved oxygen levels greater than 3-4 mg/L (Coutant 1985), but they can tolerate higher temperatures for brief periods if dissolved oxygen concentrations remain above 2 mg/l (Farquhar and Gutreuter 1989: Zale et al. 1990). Adult striped bass seek out lower temperatures as they age, and are often “squeezed” between their thermal and dissolved oxygen preferences (Coutant 1985). Adults often seek cooler water that becomes low in dissolved oxygen (Coutant 1985). Remaining in this environment causes stress, and in some cases kills of striped bass occur. Stress related to temperature/dissolved oxygen squeeze, observed as seasonally poor body condition, was documented in striped bass from Buchanan Reservoir, a Colorado River reservoir upstream of Travis Reservoir, (Smith, 2011), however no kills were observed. The effect of the kill on the overall population of striped bass in Travis Reservoir was unknown, although reports indicated the kill was localized to the area near the dam (Stephen Twidwell, TPWD Kills and Spills team, personal communication). Previous age and growth data revealed that striped bass reached harvest size (18 inches) during their second growing season (age 1 = 13.25 inches average, age 2 = 19.85 inches average; N = 13) (De Jesus and Magnelia 2007).

**Largemouth bass:** Largemouth bass are an extremely important sport fish in Travis Reservoir. The reservoir hosts many (estimated ≥40) fishing tournaments for this species each year. A fall 2001 creel survey indicated 91% of the directed fishing effort was directed toward this species (Bonds and Magnelia 2003). The total- and stock-length largemouth bass electrofishing catch rates in 2010 were lower than the previous two samples (Figure 12). Size structure remained similar to previous surveys (Figure 12). The reduction in catch rate may be a reflection of below average year classes produced under falling and/or low water conditions in 2008 and 2009. In addition, a fish kill which included adult largemouth bass, was reported in the upper end of the reservoir (from the confluence of Cow Creek up-reservoir) in late-October 2009 when the reservoir started to re-fill. This was attributed to the combination of a high biological oxygen demand and low water level (Stephen Twidwell, TPWD Kills and Spills team, personal communication). Maximum water depth in much of this portion (above the confluence of the Pedernales River) of the reservoir in October 2010 (at reservoir level of 631 msl) rarely exceeded 10 feet (personal observation). This kill may have decreased the number of adult bass in this portion of the reservoir. Anglers reported poor fishing for largemouth bass in this portion of the reservoir in 2010, when compared to previous years.

Strong year classes of largemouth bass are often positively correlated with reservoir water levels and inflow (Smith 2009). However, on Travis Reservoir a positive correlation in year-class strength for largemouth bass and spring or summer water level was not found (Smith 2009), although the author indicated range of variability in the Travis Reservoir water level during the study period may have been a factor which decreased variability in year-class strength (Nathan Smith, Heart of the Hills Fisheries Science Center, personal communication). On other reservoirs on the Colorado River system included in this study (e.g. O.H. Ivie) a positive correlation between largemouth bass year class strength and water level was detected. A continuation of this study with increased sample size and variability range in water level for Travis Reservoir (e.g. 2008, 2009) was being completed. Chronically low water levels may be the norm on Travis Reservoir in the future. This may ultimately decrease overall abundance of largemouth bass and other species dependent on littoral zone habitat (Daugherty 2009).

An analysis of 2010 electrofishing catch rates comparing the upper portion of the reservoir (effected by the October 2009 fish kill) and the middle-to-lower portion of the reservoir was conducted to look for indications the fish kill had an effect on the adult largemouth bass population in this portion of the reservoir. Total electrofishing catch rate in the upper end of the reservoir (119.0/hr) was almost three times higher than catch rates from the middle (40.0/hr) and lower portions of the reservoir (59.1/hr), although almost all (94%) individuals were of sub-legal length. Catch rates in the middle and lower sections of the reservoir, although lower, had a much higher percentage (34%) of legal length bass. Catch rates of harvestable length bass (CPUE-14) were lower than the 2006 survey but higher than the survey from 2002. An overall increasing trend in CPUE14 was recorded from 1988 to 2006 (De Jesus and Magnelia 2007). The authors surmised this trend reflected the effect of catch-and-release practiced by anglers, or an increase in growth rates over time as the reservoir become more fertile (LCRA, unpublished data), or a combination of both. The decrease in CPUE14 in 2010 while lower than the historically high value of 18/hr in 2006 still reflected this increasing trend (Appendix E). Largemouth bass in Travis Reservoir reached 14 inches by age 2 (average length at age 2 = 14.2 inches, range = 12.0 - 16.7 inches, N = 151) (Appendix F), although some individuals had not surpassed 14 inches by age 3 (Appendix F, Figure 13). Florida largemouth bass influence (Florida bass alleles) increased from the previous survey and may reflect the influence of a Florida largemouth bass stocking in 2008. The average big bass from eight major largemouth bass tournaments on Travis Reservoir from 2006 to 2010 was 8.01 pounds (range 6.76 to 9.34 pounds) which indicates reservoir conditions are adequate for this species to growth to a large size. Body condition in 2010 was close to optimal (100) with most length groups between 90 and 100, which was an improvement from 2006 (Figure 12).

**Water Transfer:** Travis Reservoir is primarily used for flood control, municipal and agricultural water supply, and recreation. There are currently three inter-basin water transfers from the reservoir which transfer water to other locations. The spread of aquatic organisms from these transfers is possible.

**Fisheries management plan for Travis Reservoir, Texas**

Prepared - July 2011.

**ISSUE 1:** Striped bass stockings have been made almost annually in Travis Reservoir since 2002. Index of vulnerability and catch rate for gizzard shad and body condition of striped bass remained adequate. The length distribution of striped bass from the 2008 gill netting survey indicating a fishable population was established. In 2011 the gill netting survey produced only one striped bass. This survey followed a kill of this species in summer 2010 attributed to dissolved oxygen/temperature squeeze. Future fish kills may occur as older individuals become more susceptible to temperature/oxygen squeeze conditions. The popularity of this species with anglers and effort directed toward this species is unknown. Additional information to justify future stockings is needed.

MANAGEMENT STRATEGY

1. Continue to request striped bass fingerlings be stocked once per year at a rate of 5/acre.

2. An additional gill netting survey should be conducted spring 2013 to monitor striped bass abundance and condition.

3. A year-long creel survey should be conducted in 2014. The survey should measure directed effort for this species and angler attitude and opinions regarding the fishery and future stockings.

**ISSUE 2:** Large largemouth bass are not effectively sampled with electrofishing. Largemouth bass tournament results from Travis Reservoir indicate largemouth bass over 8 pounds are commonly caught. Additional stocking of this species increases the potential for additional catches of largemouth bass over 8 pounds.

MANAGEMENT STRATEGY

1. Stock Florida bass fingerlings at a rate of 25/acre every two-four years if the reservoir is above 660 msl in May of the year when stocking is planned.

2. Use largemouth bass fishing tournament results and Florida bass genetic analysis to track the effectiveness of these stockings.

**ISSUE 3:** Many invasive species threaten aquatic habitats and organisms in Texas and can adversely affect the state ecologically, environmentally, and economically. Zebra mussels (*Dreissena polymorpha*) can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches, plugging engine cooling systems and decreasing primary productivity. Boats from all areas of the United States are commonly transferred to Travis Reservoir, often from areas where the incidence of zebra mussels is high. The potential for introduction of this species, in conjunction with the predominantly hard substrate make the risk for establishment of this species in Travis Reservoir is high. The financial costs of controlling and/or eradicating this species are significant. Additionally, the potential for invasive species to spread to other river drainages and reservoirs via watercraft or interbasin transfer is a serious threat to all public waters of the state. Decreases in primary productivity due to zebra mussel introduction could significantly decrease recruitment of sport fishes in Travis Reservoir.

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 zebra mussels and other 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.

**ISSUE 4:** Water level on Travis Reservoir fluctuates widely. Because of increased population growth and municipal water demands future average reservoir water level at Travis Reservoir will probably decrease. Boater access decreases when water level falls into the 650's msl. Water level at or below this level may be common in the future, decreasing angler access to the reservoir. Decreased access decreases economic impact from fishing and boating to surrounding businesses and communities.

MANAGEMENT STRATEGIES

1. Recommend to all controlling authorities (LCRA, Travis County Parks, City of Jonestown, City of Lago Vista, City of Lakeway etc.) that current concrete boat ramps be extended during periods of low water to maintain future access under lower reservoir water levels.
2. Recommend that all controlling authorities construct unimproved (i.e. – rock gabion) boat ramps specifically designed and designated for low water use by 2-wheel drive vehicles.

**SAMPLING SCHEDULE JUSTIFICATION:**

The proposed sampling schedule will constitute mandatory sampling in 2014/2015; with an additional gill netting survey in spring 2013 to assess the abundance and condition of striped bass. A year-long creel survey should be conducted in 2014 to assess directed effort and angler attitude and opinions regarding this species (Table 6).

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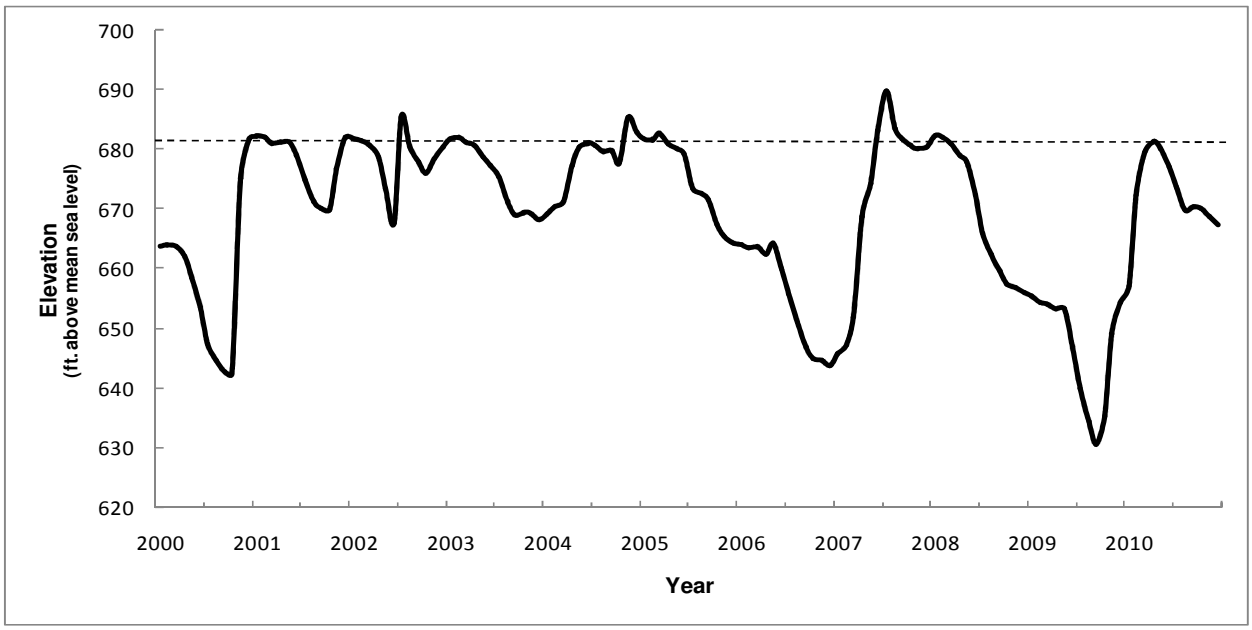



Figure 1. Mean monthly water level elevations in feet above mean sea level (msl) recorded for Travis Reservoir, Texas, January 2000 to December 2010. Horizontal dashed line is conservation pool elevation. Reservoir elevation reached 629.84 msl in September 2009 (51 feet below conservation pool elevation).

Table 1. Characteristics of Travis Reservoir, Texas

| Characteristic | Description |
|---|---|
| Year constructed | 1941 |
| Controlling authority | LCRA |
| Counties | Burnet and Travis |
| Reservoir type | Mainstream river system: Colorado |
| Shoreline development index (SDI) | 18.3 |
| Conductivity | 900 umhos/cm |

Table 2. Harvest regulations for Travis Reservoir.

| Species | Bag limit | Length limit (inches) |
|---|---|---|
| Bass: largemouth | 5* | 14 minimum |
| Bass: Guadalupe | 5* | No minimum limit |
| Striped bass | 5 | 18 minimum |
| White bass | 25 | 10 minimum |
| Flathead catfish | 5 | 18 minimum |
| Catfish: channel and blue catfish | 25 (in any combination) | 12 minimum |

*Five largemouth and Guadalupe bass in any combination.

Table 3. Stocking history of Travis Reservoir, Texas. Life stages are fry (FRY), fingerlings (FGL), advanced fingerlings (AFGL), adults (ADL) and unknown (UNK). Life stages for each species are defined as having a mean length that falls within the given length range. For each year and life stage the species mean total length (Mean TL; in) is given. For years where there were multiple stocking events for a particular species and life stage the mean TL is an average for all stocking events combined.

| Species | Year | Number | Life Stage | Mean TL (in) |
|---|---|---|---|---|
| Blue catfish | 1979 | 101,313 | UNK | UNK |
| | Total | 101,313 | | |
| Channel catfish | 1971 | 13,000 | AFGL | 7.9 |
| | 1972 | 87,000 | AFGL | 7.9 |
| | 2005 | 457 | ADL | 15.4 |
| | 2008 | 400 | ADL | 13.0 |
| | Total | 100,857 | | |
| Florida Largemouth bass | 1988 | 474,535 | FRY | 1.0 |
| | 2008 | 464,568 | FGL | 1.7 |
| | 2011 | 175,034 | FGL | 1.8 |
| | Total | 1,114,137 | | |
| Largemouth bass | 1967 | 238,000 | UNK | UNK |
| | Total | 238,000 | | |
| Smallmouth bass | 1977 | 211,400 | UNK | UNK |
| | 1978 | 196,050 | UNK | UNK |
| | 1979 | 343,940 | UNK | UNK |
| | Total | 751,390 | | |
| Striped bass | 1973 | 206,285 | FGL | 1.7 |
| | 1974 | 163,611 | FGL | 1.7 |
| | 1976 | 175,854 | UNK | UNK |
| | 1978 | 90,250 | UNK | UNK |
| | 1981 | 180,000 | UNK | UNK |
| | 1983 | 183,699 | UNK | UNK |
| | 1991 | 94,600 | FGL | 1.4 |
| | 2002 | 110,490 | FGL | 1.5 |
| | 2005 | 96,000 | FGL | 1.6 |
| | 2006 | 98,842 | FGL | 1.9 |
| | 2007 | 103,569 | FGL | 1.8 |
| | 2008 | 94,734 | FGL | 1.7 |
| | 2009 | 101,813 | FGL | 1.6 |
| | 2010 | 99,097 | FGL | 1.8 |
| | Total | 1,798,844 | | |
| Walleye | 1976 | 190,000 | FRY | 0.2 |

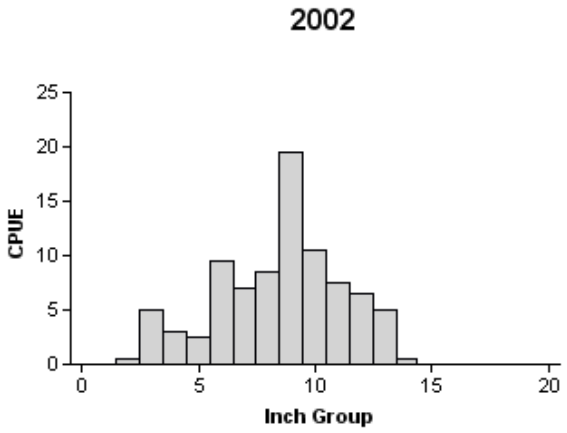
| | | | |
|---|---|---|---|
| 1977 | 3,666,925 | FRY | 0.2 |
| 1978 | 4,391,640 | FRY | 0.2 |
| 1979 | 4,503,500 | FRY | 0.2 |
| Total | 12,752,065 | | |

Table 4. Survey of shoreline habitat types, Travis Reservoir, Texas, 1998. A linear shoreline distance (miles) was recorded for each habitat type found.

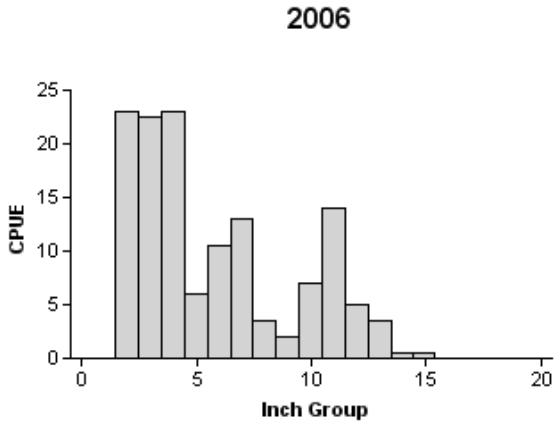
| Shoreline habitat type | Shoreline distance | |
|---|---|---|
| | Miles* | Percent of total |
| Rocky shoreline | 103.1 | 67 |
| Bluff | 30.2 | 19 |
| Sand | 22.4 | 14 |
| Riprap | 0.3 | <1 |
| Concrete | 0.4 | <1 |

*Reservoir was 16 feet below conservation pool at time of survey. Survey was terminated at mile marker 57 due to low water conditions (156.4 total shoreline miles surveyed).

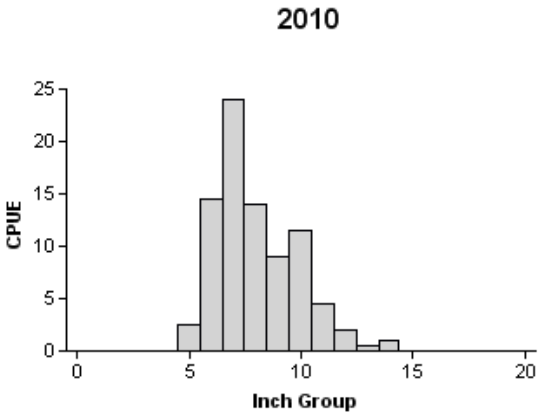
# Gizzard Shad




Effort = 2.0
Total CPUE = 85.5 (28; 171)
IOV = 32.16 (7.7)



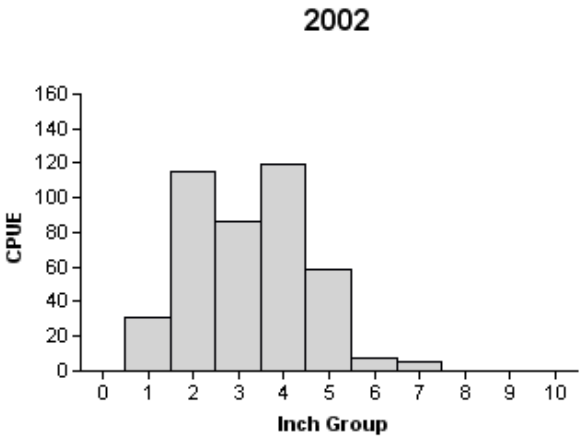

Effort = 2.0
Total CPUE = 134.0 (35; 268)
IOV = 73.13 (9.4)



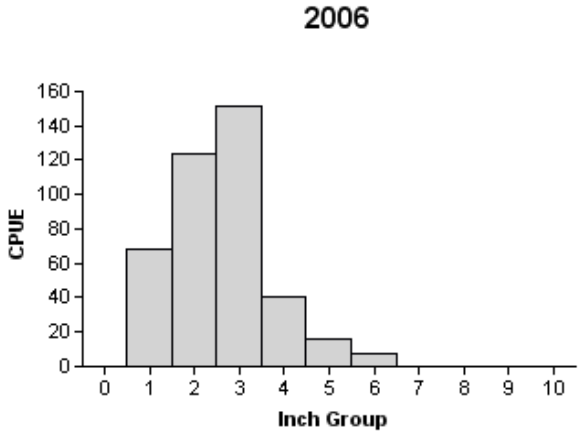

Effort = 2.0
Total CPUE = 83.5 (47; 167)
IOV = 49 (13.1)

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, Travis Reservoir, Texas, 2002, 2006 and 2010.

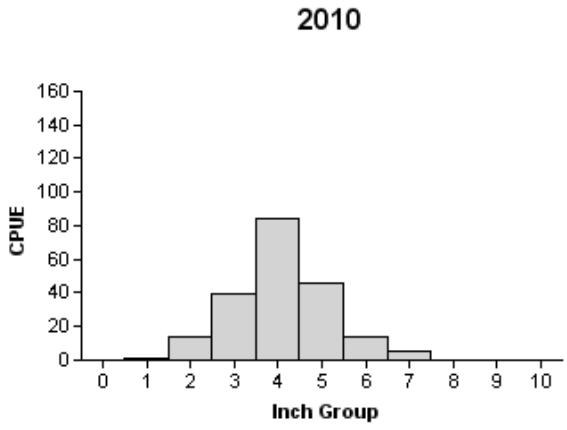
# Bluegill




Effort = 2.0
Total CPUE = 422.5 (16; 845)
PSD = 5 (1.4)



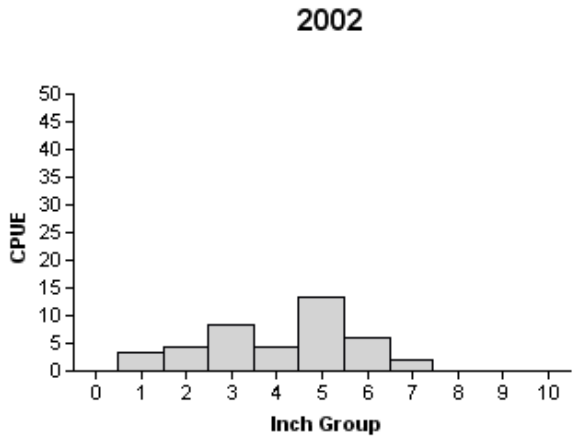

Effort = 2.0
Total CPUE = 410.5 (25; 821)
PSD = 4 (1.2)



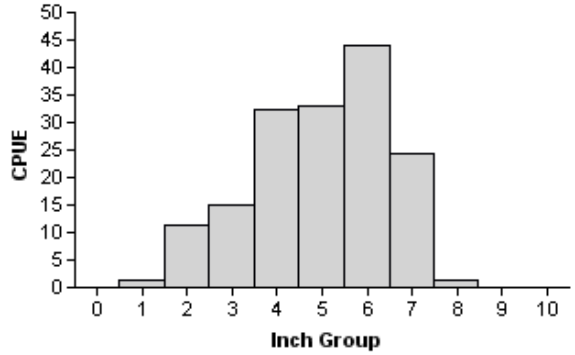

Effort = 2.0
Total CPUE = 204.5 (25; 409)
PSD = 10 (2.4)

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, Travis Reservoir, Texas, 2002, 2006 and 2010.

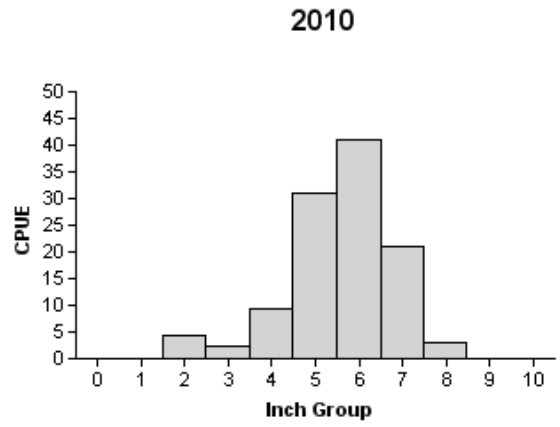
# Redbreast Sunfish




| | |
|---|---|
| Effort = | 2.0 |
| Total CPUE = | 42.5 (19; 85) |
| PSD = | 23 (3.5) |



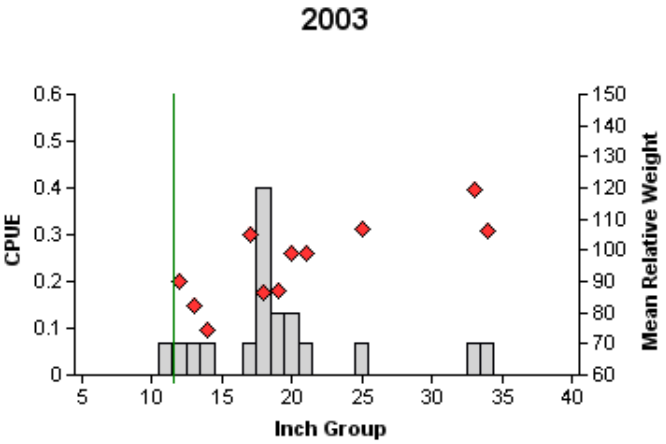

| | |
|---|---|
| Effort = | 2.0 |
| Total CPUE = | 163.5 (17; 327) |
| PSD = | 47 (5.2) |



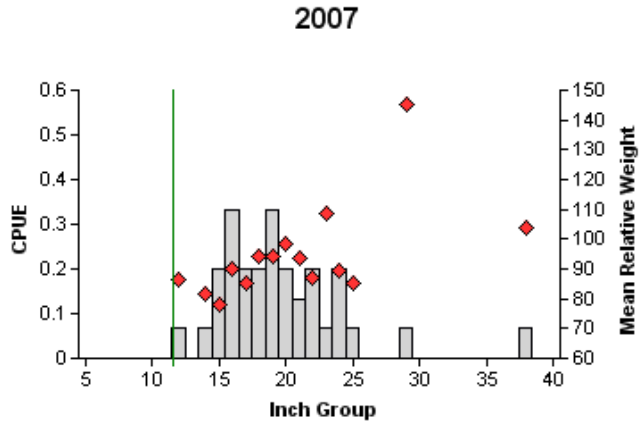

| | |
|---|---|
| Effort = | 2.0 |
| Total CPUE = | 112.5 (20; 225) |
| PSD = | 60 (4.9) |

Figure 4. 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, Travis Reservoir, Texas, 2002, 2006 and 2010.

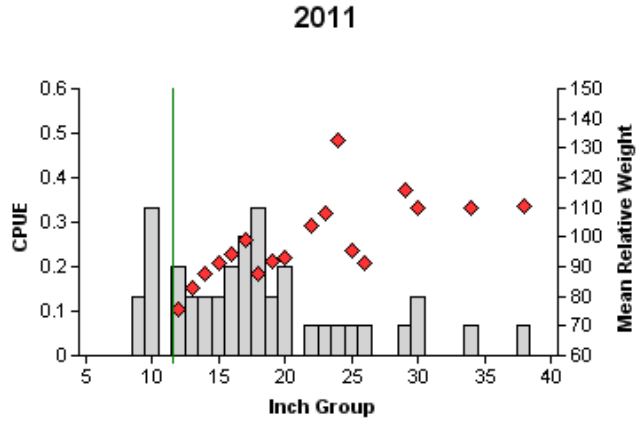
# Blue Catfish




| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 1.3 (24; 19) |
| CPUE-12 = | 1.2 (26; 18) |
| PSD = | 33 (12.4) |




| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 2.4 (30; 36) |
| CPUE-12 = | 2.4 (30; 36) |
| PSD = | 42 (11.3) |

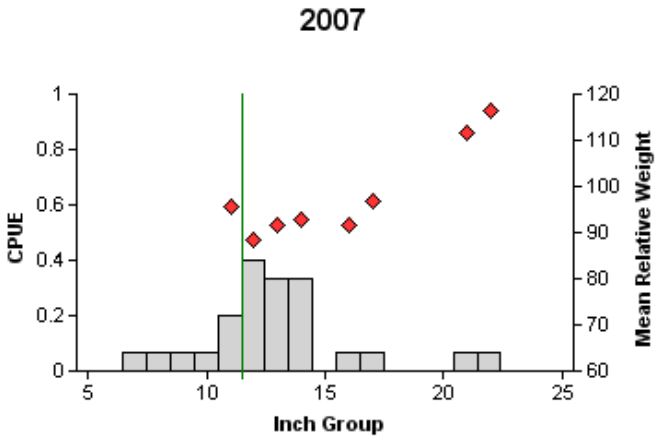



| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 2.9 (12; 43) |
| CPUE-12 = | 2.4 (15; 36) |
| PSD = | 36 (8) |

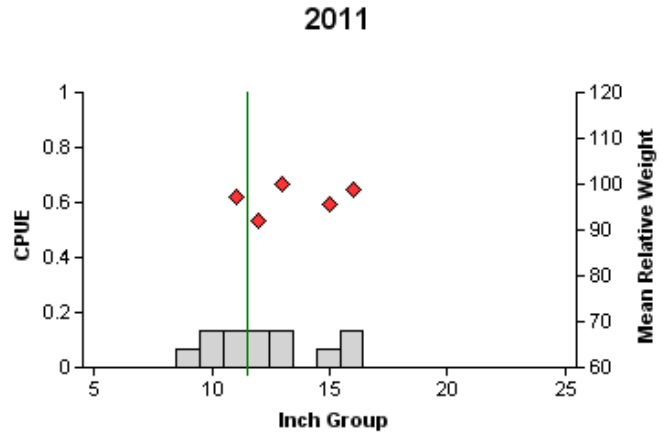
Figure 5. Number of blue catfish caught per hour (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Travis Reservoir, Texas, 2003, 2007 and 2011. Minimum length limit indicated by vertical line.

# Channel Catfish


| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 1.7 (25; 26) |
| CPUE-12 = | 1.4 (33; 21) |
| PSD = | 59 (10.7) |



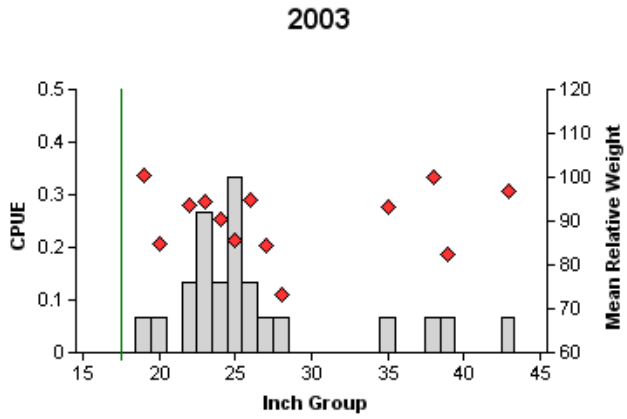

| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 1.8 (18; 27) |
| CPUE-12 = | 1.3 (17; 20) |
| PSD = | 17 (9.9) |



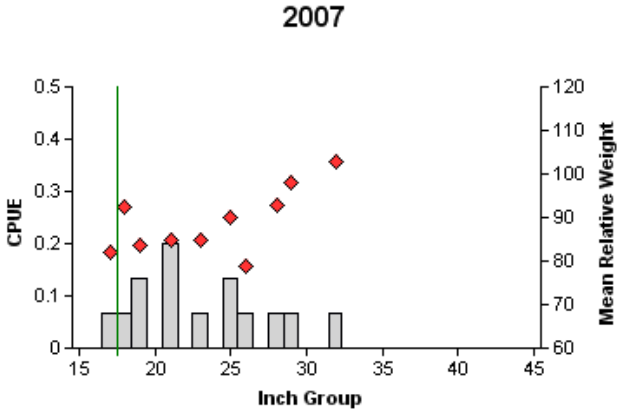

| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 0.8 (35; 12) |
| CPUE-12 = | 0.5 (46; 7) |
| PSD = | 22 (16.8) |

Figure 6. Number of channel catfish caught per hour (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Travis Reservoir, Texas, 2003, 2007 and 2011. Minimum length limit indicated by vertical line.

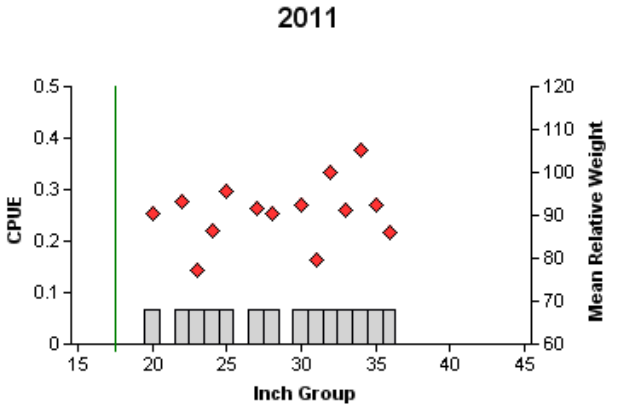
# Flathead Catfish




| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 1.5 (18; 23) |
| CPUE-18 = | 1.5 (18; 23) |
| PSD = | 96 (4.5) |



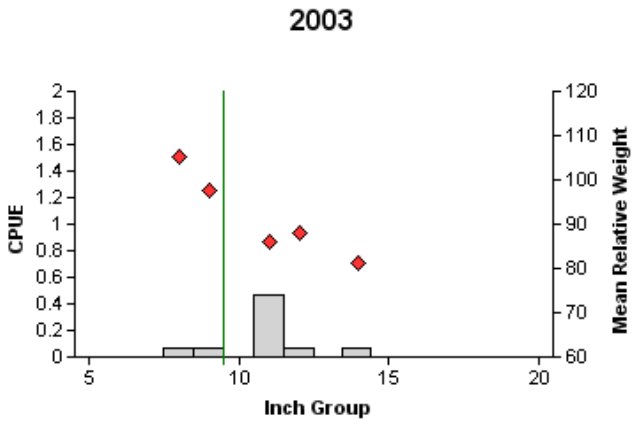

| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 0.9 (38; 14) |
| CPUE-18 = | 0.9 (40; 13) |
| PSD = | 71 (15.1) |



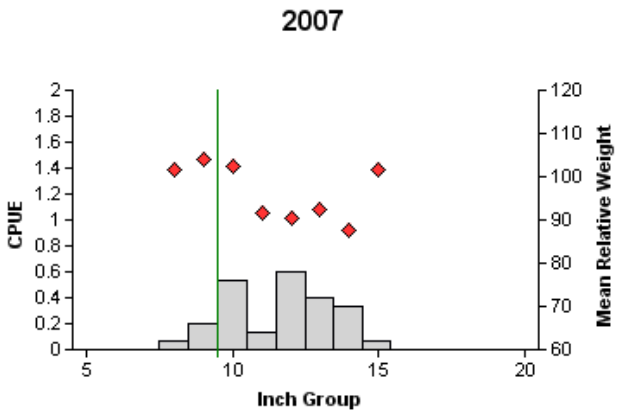

| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 0.9 (35; 14) |
| CPUE-18 = | 0.9 (35; 14) |
| PSD = | 100 (0) |

Figure 7. Number of flathead catfish caught per hour (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Travis Reservoir, Texas, 2003, 2007 and 2011. Minimum length limit indicated by vertical line.

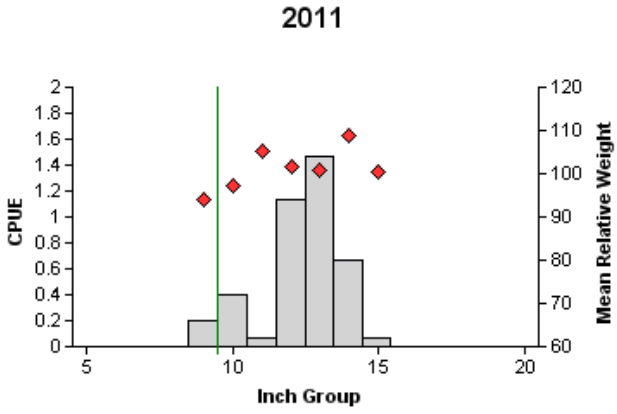
# White Bass




| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 0.7 (39; 11) |
| CPUE-10 = | 0.6 (45; 9) |
| PSD = | 91 (8.6) |




| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 2.3 (37; 35) |
| CPUE-10 = | 2.1 (37; 31) |
| PSD = | 97 (2.4) |




| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 4.0 (51; 60) |
| CPUE-10 = | 3.8 (50; 57) |
| PSD = | 100 (0) |

Figure 8. Number of white bass caught per hour (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Travis Reservoir, Texas, 2003, 2007 and 2011. Minimum length limit indicated by vertical line.

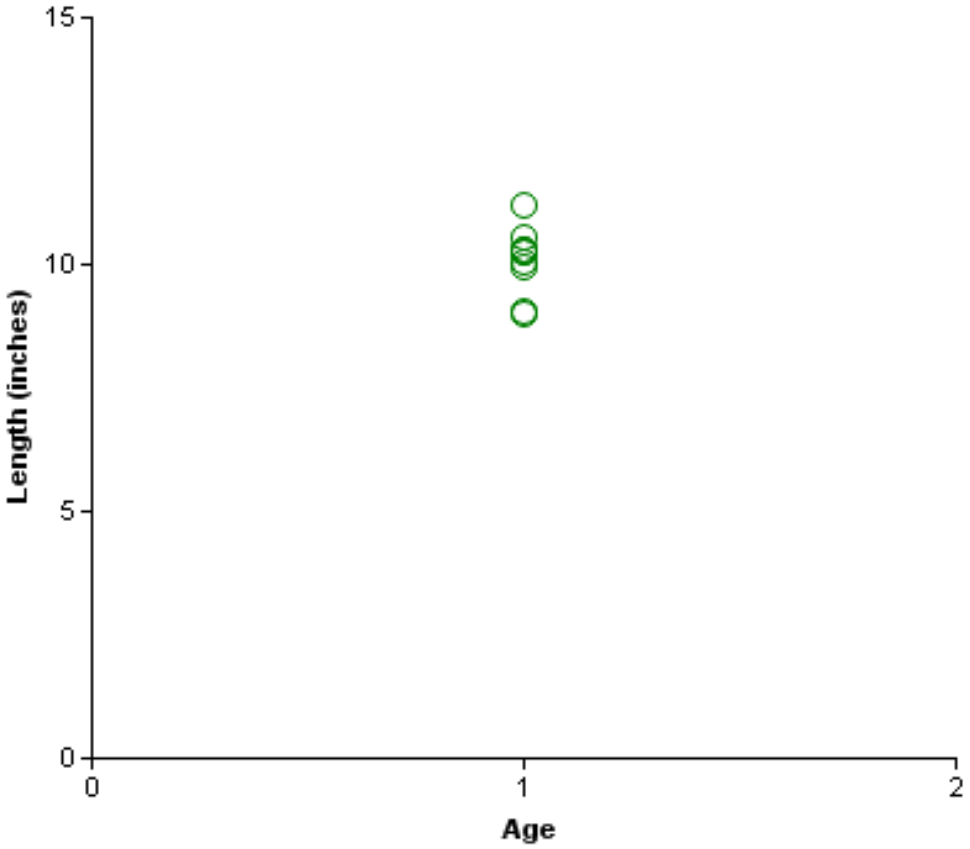
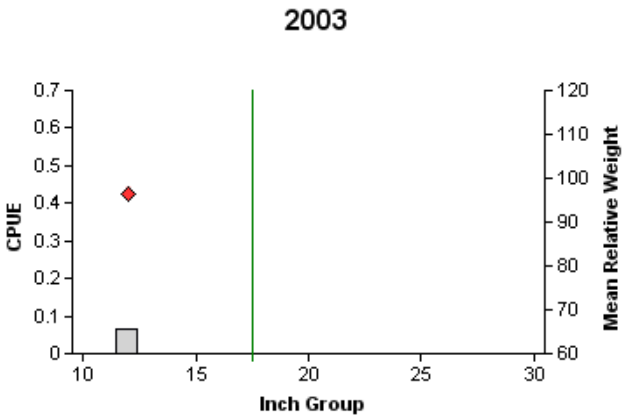


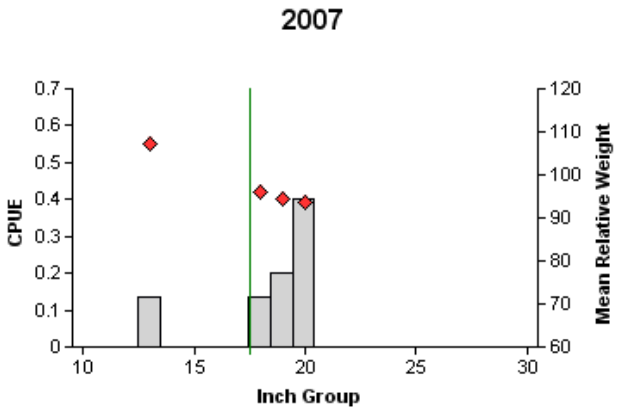

Figure 9. Length at age for white bass collected by gill nets at Travis Reservoir, Texas, February 2011 (N = 10).

# Striped Bass


| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 0.1 (100; 1) |
| CPUE-18 = | 0.1 (100; 1) |
| PSD = | 100 (0) |



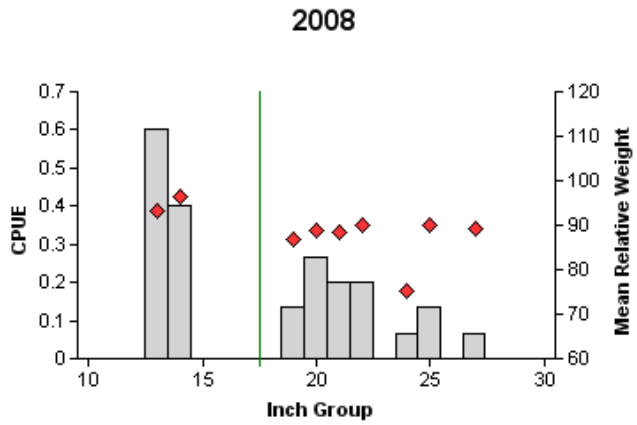

| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 0.1 (100; 1) |
| CPUE-18 = | 0.0 (0; 0) |
| PSD = | 0 (103.5) |



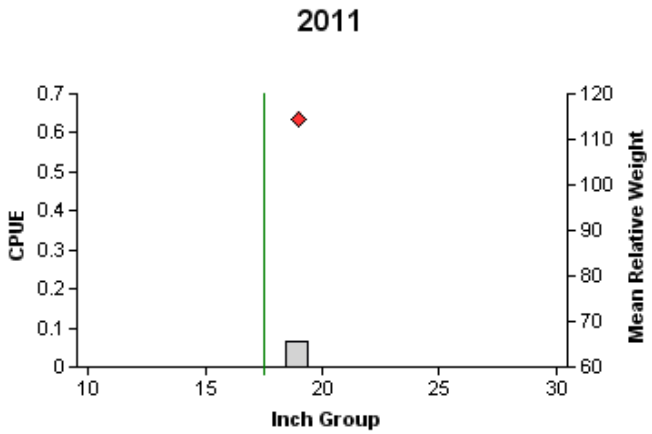

| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 0.9 (32; 13) |
| CPUE-18 = | 0.7 (34; 11) |
| PSD = | 46 (10.5) |

Figure 10. Number of striped bass caught per hour (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Travis Reservoir, Texas, 1999, 2003 and 2007. Minimum length limit indicated by vertical line.

# Striped Bass



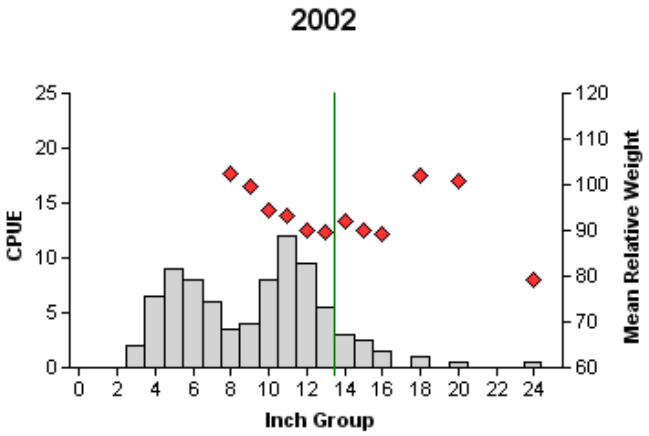

| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 2.1 (22; 31) |
| CPUE-18 = | 1.1 (34; 16) |
| PSD = | 45 (10.7) |



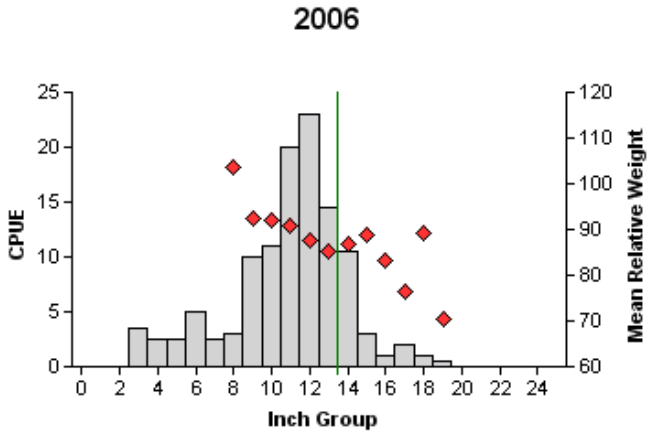

| | |
|---|---|
| Effort = | 15.0 |
| Total CPUE = | 0.1 (100; 1) |
| CPUE-18 = | 0.1 (100; 1) |
| PSD = | 0 (103.5) |

Figure 10 (continued). Number of striped bass caught per hour (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Travis Reservoir, Texas, 2008 and 2011. Minimum length limit indicated by vertical line. Sampling stations in 2008 were picked subjectively to maximize catch for fish tissue contaminants analysis.

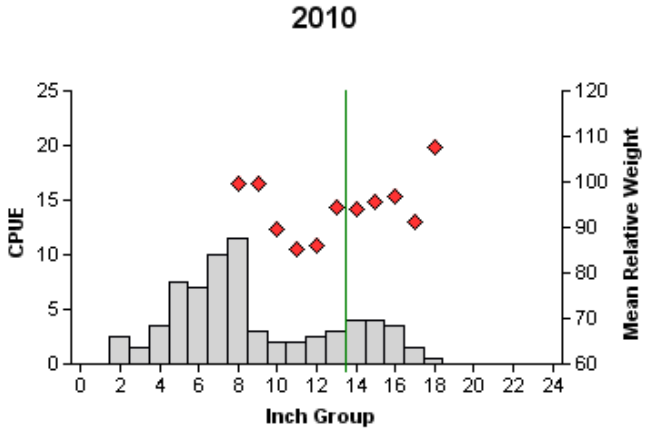
# Largemouth Bass




| | |
|---|---|
| Effort = | 2.0 |
| Total CPUE = | 83.0 (15; 166) |
| Stock CPUE = | 51.5 (15; 103) |
| CPUE-14 = | 9.0 (23; 18) |
| PSD = | 47 (5.6) |
| RSD-14 = | 17 (3.8) |




| | |
|---|---|
| Effort = | 2.0 |
| Total CPUE = | 115.5 (17; 231) |
| Stock CPUE = | 99.5 (17; 199) |
| CPUE-14 = | 18.0 (16; 36) |
| PSD = | 56 (4.6) |
| RSD-14 = | 18 (2.8) |




| | |
|---|---|
| Effort = | 2.0 |
| Total CPUE = | 69.5 (26; 139) |
| Stock CPUE = | 37.5 (22; 75) |
| CPUE-14 = | 13.5 (30; 27) |
| PSD = | 51 (10.1) |
| RSD-14 = | 36 (8) |

Figure 11. 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, Travis Reservoir, Texas, 2002, 2006 and 2010. Minimum length limit indicated by vertical line.

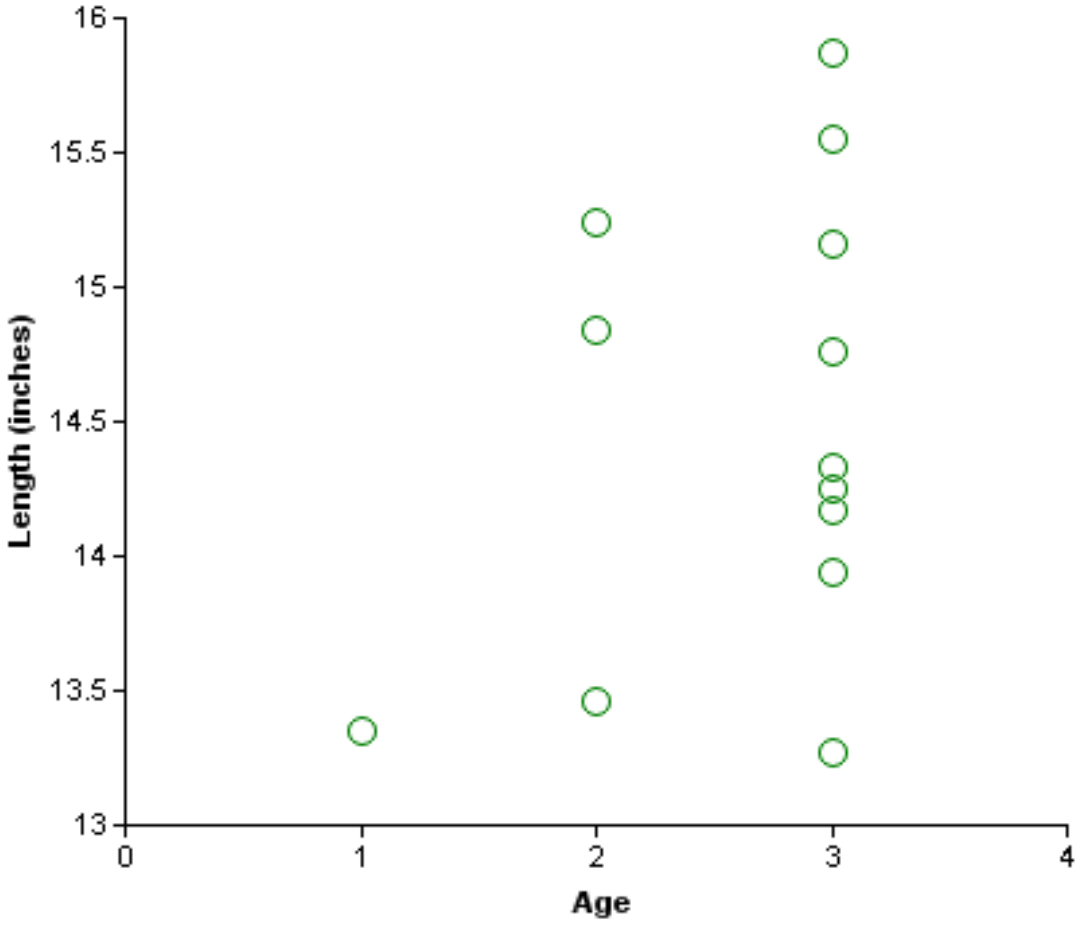



Figure 12. Length at age for largemouth bass collected by electrofishing at Travis Reservoir, Texas, November 2010 (N = 13; range 1-3 years).

Table 5. Results of genetic analysis of largemouth bass collected by electrofishing, Travis Reservoir, Texas, 1998, 2002, 2006 and 2011. FLMB = Florida largemouth bass, NLMB = northern largemouth bass, F1 = first generation hybrid between a FLMB and NLMB, Fx = second or higher generation hybrid between FLMB and NLMB.

| Year | Sample size | Genotype | | | | % FLMB alleles | % pure FLMB |
|---|---|---|---|---|---|---|---|
| | | FLMB | F1 | Fx | NLMB | | |
| 1998 | 30 | 0 | 6 | 22 | 2 | 45 | 0 |
| 2002 | 29 | 3 | 9 | 14 | 3 | 50 | 10.3 |
| 2006 | 30 | 0 | N/A* | N/A* | 1 | 40 | 0 |
| 2010 | 30 | 1 | 1 | 27 | 1 | 61 | 5 |

*Not available (29 hybrids total).

Table 6. Proposed sampling schedule for Travis Reservoir, 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.

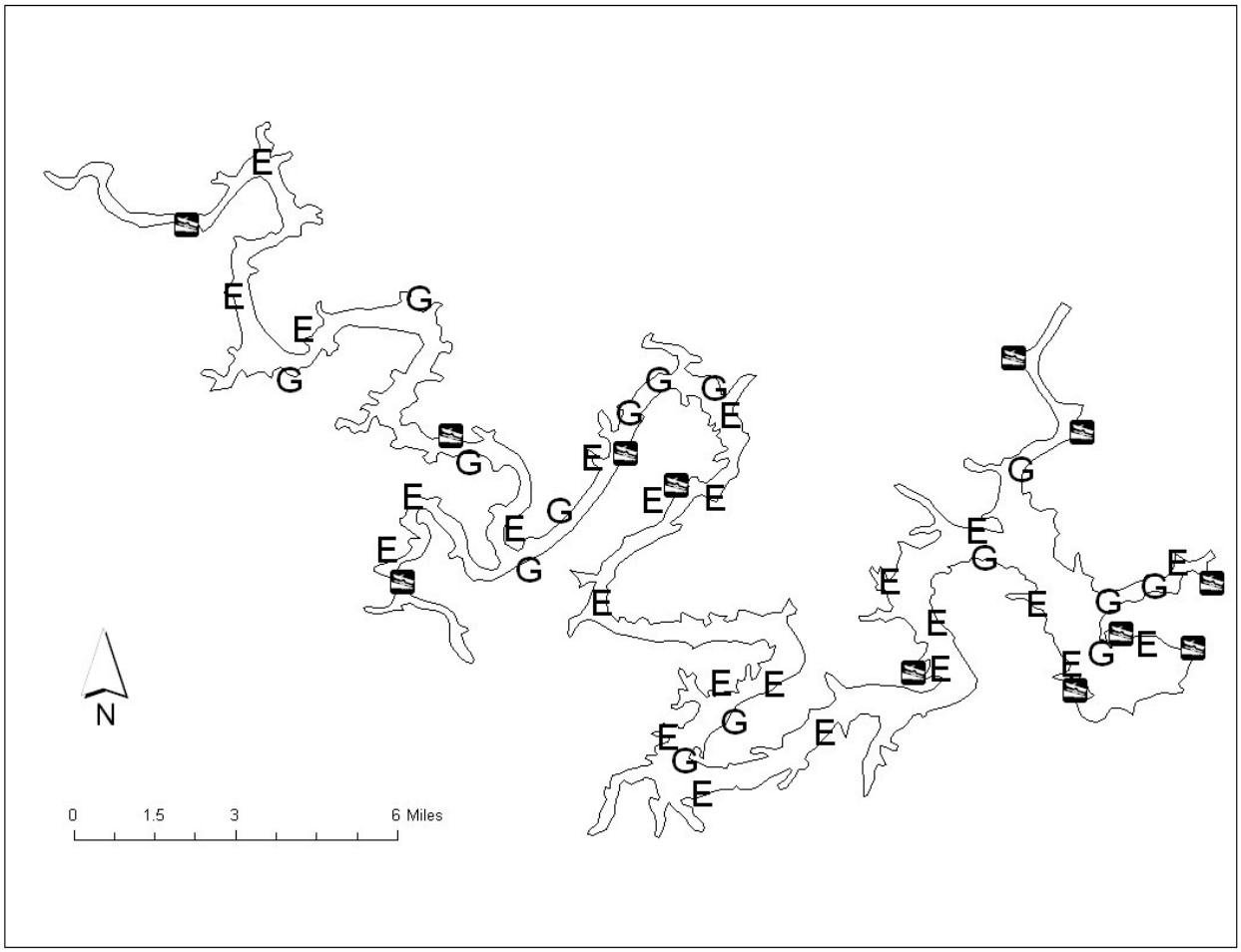
| Survey Year | Electrofisher | Trap Net | Gill Net | Creel Survey | Vegetation Survey | Access Survey | Report |
|---|---|---|---|---|---|---|---|
| Fall 2011-Spring 2012 | | | | | | | |
| Fall 2012-Spring 2013 | | | A | | | | |
| Fall 2013-Spring 2014 | | | | A | | | |
| Fall 2014-Spring 2015 | S | | S | | S | S | S |

**Appendix A**

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Travis Reservoir, Texas, 2010 and 2011.

| | Gill Netting | | Electrofishing | |
|---|---|---|---|---|
| Species | N | CPUE | N | CPUE |
| Gizzard shad | | | 167 | 83.5 |
| Threadfin shad | | | 41 | 20.5 |
| Inland silverside | | | 7 | 3.5 |
| Blue catfish | 30 | 2.9 | | |
| Channel catfish | 12 | 0.8 | | |
| Flathead catfish | 13 | 0.9 | | |
| White bass | 60 | 4.0 | | |
| Striped bass | 1 | 0.1 | | |
| Redbreast sunfish | | | 225 | 112.5 |
| Green Sunfish | | | 28 | 14.0 |
| Warmouth | | | 4 | 2.0 |
| Bluegill | | | 409 | 204.5 |
| Longear sunfish | | | 12 | 6.0 |
| Redear sunfish | | | 8 | 4.0 |
| Largemouth bass | | | 139 | 69.5 |
| Guadalupe bass | | | 37 | 18.5 |
| Logperch | | | 3 | 1.5 |
| Rio Grande cichlid | | | 3 | 1.5 |
| Blue tilapia | | | 3 | 1.5 |

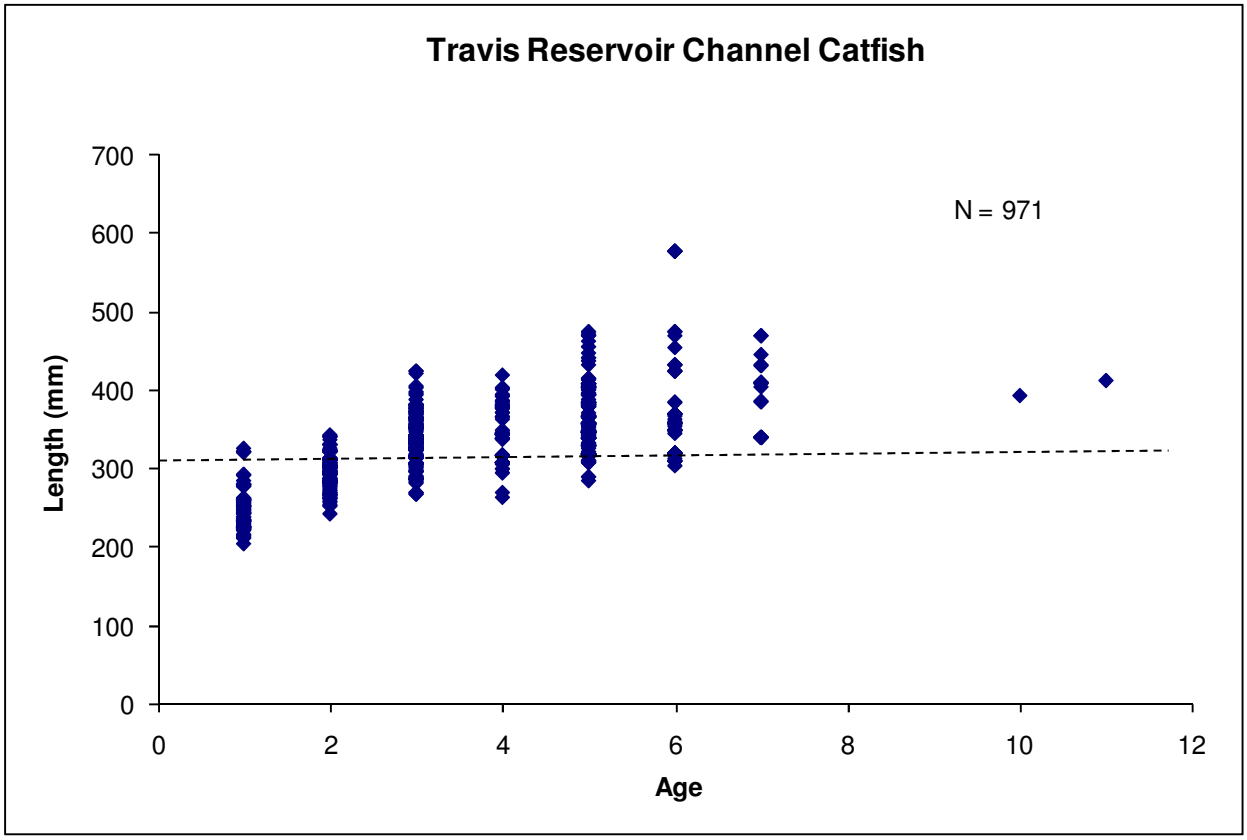
**Appendix B**




Location of sampling sites, Travis Reservoir, Texas, 2010-2011. Gill netting and electrofishing stations indicated by G and E, respectively. Boat ramps are indicated by boat ramp symbols. Reservoir level at the time of sampling was 669 feet above mean sea level (msl) for electrofishing and 667 msl for gill netting.

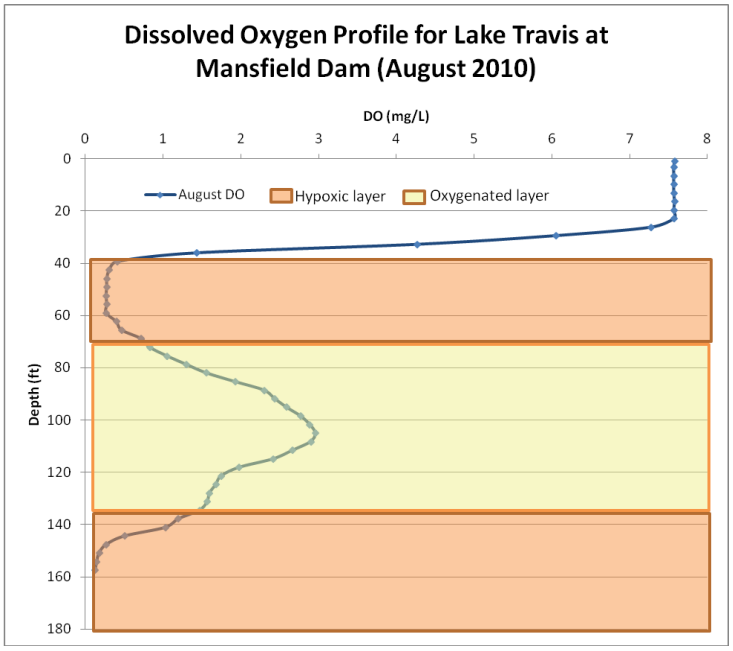
**Appendix C**

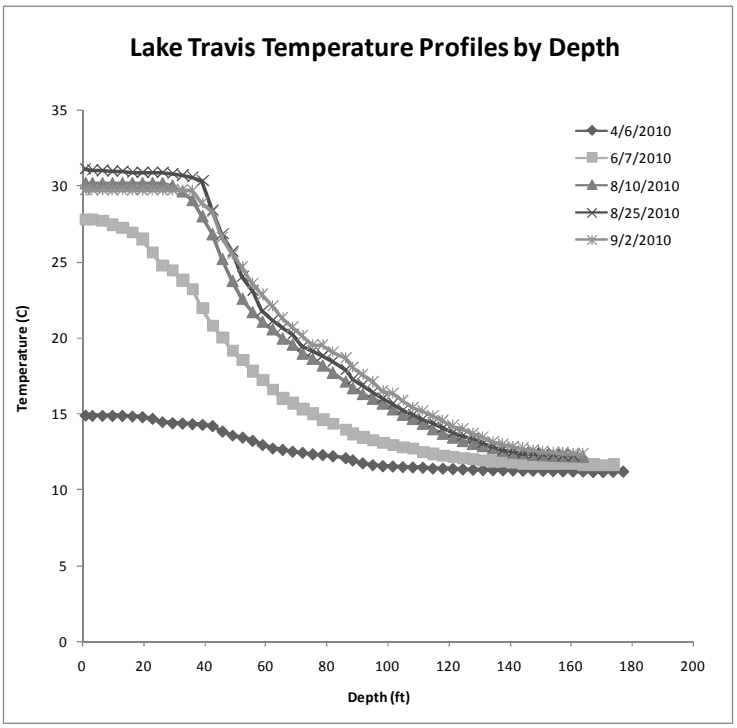
Length at age for channel catfish from Travis Reservoir, Texas, November, 2007 (N = 971; range 1-11 years). Horizontal line indicates minimum length limit (305 mm (12 inches)). Data collected by Heart of the Hills Fisheries Science Center.



## Appendix D

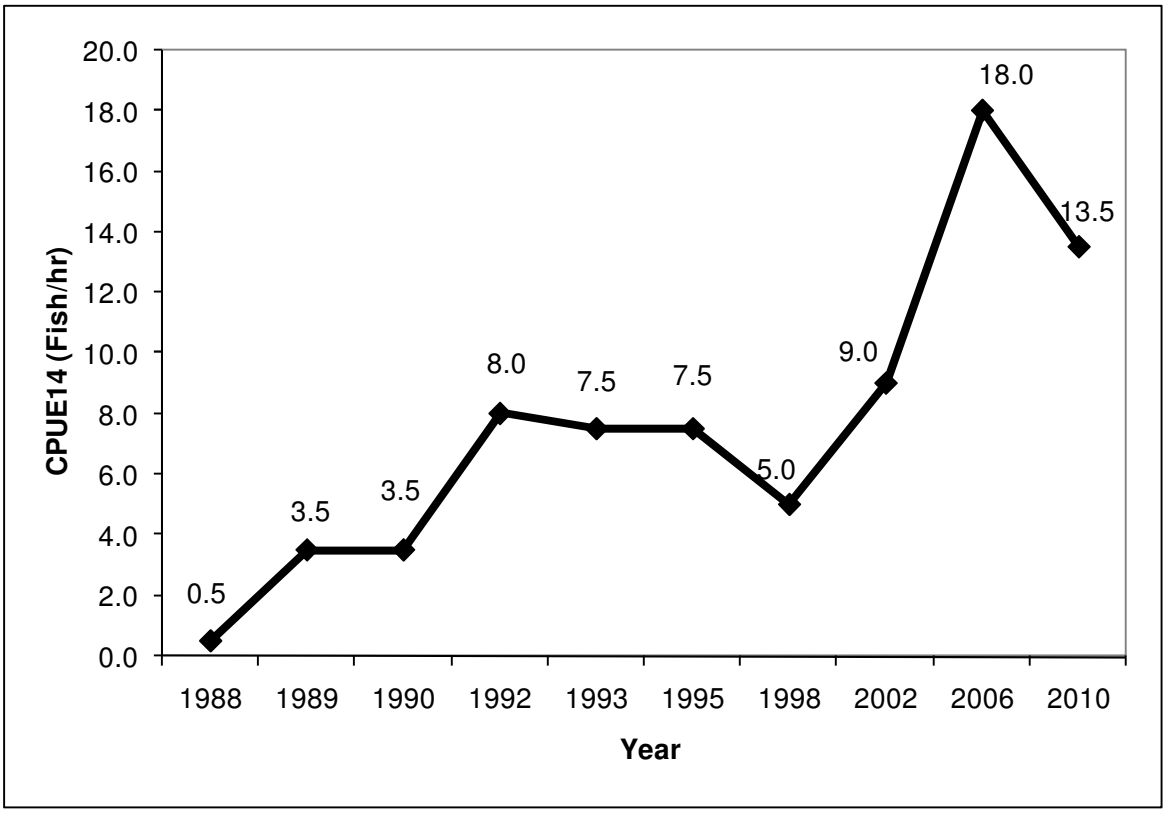
Dissolved oxygen profile (August 2010), and water temperature profiles by date for Travis Reservoir, TX. All data was collected near Mansfield Dam by the Lower Colorado River Authority.



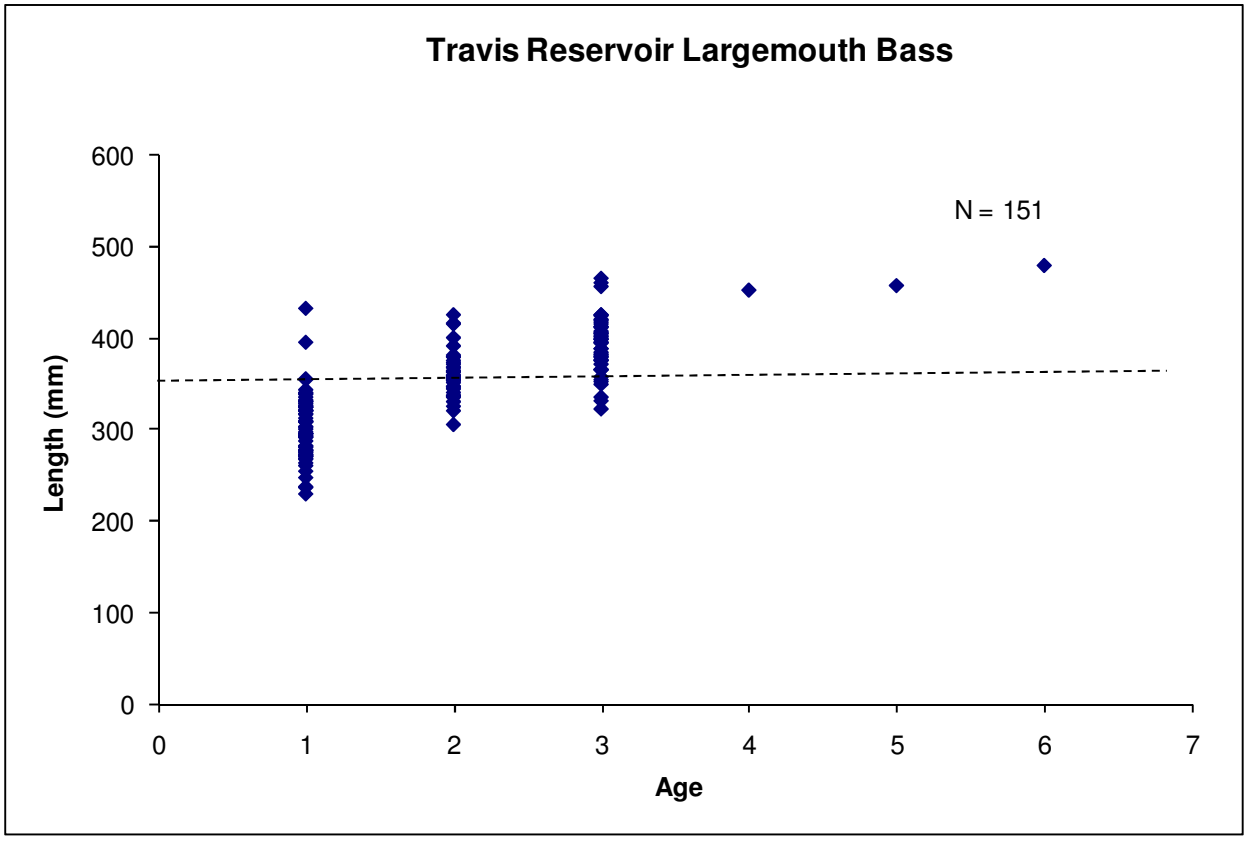
**Appendix E**

Historical trend of largemouth bass CPUE14 (diamonds) from electrofishing surveys conducted on Travis Reservoir, TX 1988-2010.



**Appendix F**

Length at age for largemouth bass, Travis Reservoir, Texas, October, 2007 (N = 151; range 1-6 years). Horizontal line indicates minimum length limit (354 mm, (14 inches)). Data collected by Heart of the Hills Fisheries Science Center.



**Appendix G**

Length at age for white and black crappie (combined sample), Travis Reservoir, Texas, October, 2007 (N = 161; range 1-6 years). Horizontal line indicates minimum length limit (254 mm, (10 inches)). Data collected by Heart of the Hills Fisheries Science Center.