PERFORMANCE REPORT

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FEDERAL AID IN SPORT FISH RESTORATION ACT

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FEDERAL AID PROJECT F-221-M-2

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2011 Survey Report

Canyon Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Canyon Reservoir were surveyed in 2011 using electrofishing and in 2012 using gill nets. This report summarizes results of the surveys and contains a fisheries management plan for the reservoir based on those findings.

- **Reservoir Description:** Canyon Reservoir is an 8,308-acre impoundment of the Guadalupe River located in Comal County. It was constructed in 1964 by the U.S. Army Corp of Engineers (USACE) for purposes of flood control, water conservation and recreation. Canyon Reservoir has a drainage area of approximately 1,452 square miles and a shoreline length of 90.5 miles. The reservoir lies within the Edwards Plateau ecological area.

- **Management History:** Important sport fish include largemouth bass, striped bass, white bass and catfish species. Striped bass were introduced in 1973 and stocked until 1983, then restocked at a lower rate (5/acre) in 1989. White bass were managed under an experimental 12-inch minimum length limit. The regulation was rescinded in 2004 after analysis indicated environmental factors, not angler harvest, were probably more influential in determining white bass population density. Largemouth bass were present in the reservoir and have been managed under statewide regulations. Blue catfish were introduced in 1991 to provide enhanced catfish opportunities for anglers. The management plans from the 2007 survey report included maintaining fish attractor sites; continued annual stockings of striped bass; and increasing or enhancing pier fishing opportunities.

- **Fish Community**
  - **Prey species:** Sunfishes and gizzard shad were the dominant prey species available. Threadfin shad were present in low densities.

  - **Catfishes:** Channel and blue catfish were equally abundant in low densities. Low-frequency electrofishing helped capture many young individuals, not captured with gill nets. Flathead catfish were also present in low densities, with large individuals present.

  - **Temperate basses:** Striped bass and white bass were present in the reservoir. A fish consumption advisory was placed on striped bass in 2006, but limited consumption was allowed and the species still offered excellent catch-and-release opportunity. Striped bass showed reduced abundance with reduced stockings in the past two seasons. Legal-size (≥18 inches) striped bass were still present. White bass abundance declined, probably the result of the 2009 and 2011 droughts.

  - **Black basses:** Largemouth bass abundance was moderate, declining from previous surveys. Reduced abundance was possibly caused by extreme drought conditions in 2009 and 2011. Smallmouth bass were present in low densities.

- **Management Strategies:** Annual striped bass stockings should continue to be requested at the present stocking rate of 5/acre. Fish attractor sites should continue to be replenished with brush as needed.

INTRODUCTION

This document is a summary of fisheries data collected from Canyon Reservoir from 2011–2012. 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 for comparison.

Reservoir Description

Canyon Reservoir is an 8,308-acre impoundment of the Guadalupe River located in Comal County. It was constructed in 1964 by the U.S. Army Corp of Engineers for purposes of flood control, water conservation and recreation. Canyon Reservoir has a drainage area of approximately 1,452 square miles and a shoreline length of 90.5 miles. The reservoir lies within the Edwards Plateau ecological area. Boat angler access was excellent. Twenty-three boat ramps were available around the reservoir, of which fifteen offered bank angling opportunities. Shoreline access at many of the parks was excellent. One public fishing pier was available at Cranes Mill Park, on the upper end of the reservoir. White bass anglers could access the Guadalupe River above the reservoir using the Rebecca Creek boat ramp. The reservoir water levels are subject to frequent fluctuations (Figure 1), which may impact access during extreme conditions. Other descriptive characteristics for Canyon 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 2008) included:

1. Monitor striped bass population density with gill net surveys, and continue annual stocking requests at 5/acre.
   Action: Striped bass were stocked in 2009 and 2010 (5/acre), and surveyed with gill nets in 2010 and 2012.
2. Conduct a research study to evaluate the use of underwater light attractors for improving angler catch rates at the Canyon Lake Crane's Mill fishing pier and enhance pier fishing opportunities.
   Action: Partners were committed and a research study was proposed; however project was cancelled due to a change in commitment.
3. Continue to take advantage of the opportunities present to create fish attractor sites. When possible, coordinate efforts to create new sites or replenish existing sites.
   Action: Attractor installations and maintenance were conducted in 2009 to 2011.
4. Conduct an additional bass-only electrofishing survey to monitor the smallmouth bass population in spring 2010.
   Action: A smallmouth bass electrofishing survey was conducted in spring 2010.

Harvest regulation history: Sport fishes in Canyon Reservoir have been managed with statewide regulations (Table 2).

Stocking history: Florida largemouth bass were stocked in 2008 and 2010 to increase genetic influence and promote growth potential. Striped bass were an important species requested for annual stockings. Blue catfish were stocked in 1991-92. A complete stocking history is in Table 3.

Aquatic vegetation/habitat history: Canyon Reservoir has historically been known for lacking aquatic vegetation due to its rocky and steep shoreline. However an aquatic vegetation survey conducted in August 2011 revealed the presence of southern naiad *Najas guadalupensis* in a small area of the lake, about half an acre. It was possibly triggered by extreme drought conditions exposing deeper areas of substrate not normally exposed to sunlight. This species is known for late summer blooms in some hill country lakes, and many times their existence is limited to seasonal conditions. Shoreline composition was primarily vegetated bank, rock and rock bluff. Standing timber and marinas provided some cover for centrarchids. Artificial fish attractors have been installed and maintained around the reservoir (Appendix D and E) to provide concentrating habitat for cover-seeking species and to help improve angler success.

Water Transfer: There are no inter-basin water diversion structures at Canyon Reservoir.

METHODS

Fishes were collected by electrofishing (1.5 hours at 18 five-min stations) and gill netting (15 net nights at 15 stations). A smallmouth bass only daytime electrofishing survey (1.5 hours) was conducted in spring 2010. 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 nets as the number of fish per net night (fish/nn). All survey sites were randomly selected (except for smallmouth bass electrofishing survey) and all surveys were conducted according to the Fishery Assessment Procedures Manual (TPWD, Inland Fisheries Division, unpublished manual revised 2011).

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 (W_r)] 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 largemouth bass and striped bass using otoliths. Sample sizes were adequate to meet category 2 age-and-growth sampling design recommendations (TPWD, Inland Fisheries Division, unpublished manual revised 2011). Source for water level data was the USACE web site.

RESULTS AND DISCUSSION

Habitat: In 2004, littoral zone habitat consisted primarily of vegetated bank, rock and rock bluff. Standing timber and marinas provided cover for centrarchids (Table 4). Only 0.5 acre (<1% coverage) of southern naiad *Najas guadalupensis* was surveyed in the entire reservoir; hence not optimal for fish production (Durocher et al. 1984, Dibble et al. 1996). Fish in this reservoir relate mainly to topographical gradients or irregular contours found throughout the lake. A fish attractor project was initiated in 2005 to help concentrate cover seeking species and increase angler catch rates. Juniper trees (*Juniperus ashei*) and fabricated polyethylene fish attractors were installed at 19 sites in 2005, 13 sites in 2007 and five sites in 2008, 3 sites in 2009, 2010 and 1 site in 2011 for a total of 44 fish attractor sites throughout the lake (Appendix D). Global positioning system (GPS) coordinates were made available to the public (Appendix E), and direct observation through scuba diving revealed that largemouth bass and *Lepomis* sp. were attracted to these structures.

Prey species: Electrofishing catch rates of gizzard shad, redbreast sunfish and bluegill were 42.7/h, 210.0/h, and 70.0/h, respectively. Threadfin shad and other sunfish species were also available as forage. IOV for gizzard shad indicated that 42.7% of gizzard shad were available to existing predators. Total CPUE of gizzard shad was half of what it was in the 2007 survey (108.0/h; Figure 2). Redbreast sunfish was the dominant sunfish species in Canyon Reservoir with the majority of the sampled population dominated by small individuals (PSD = 29; Figure 3). Total CPUE of bluegill in 2011 was almost a third of the total CPUE from the survey in 2007 (198.0/h), and size structure continued to be dominated by small individuals (PSD = 14; Figure 4). A decline in forage abundance may be a result of reduced littoral habitat from recent significant drought events in 2009 and 2011.

Blue catfish: Blue catfish gill net catch rate (1.2/nn) in 2012 remained low and was similar to 2008, when it was 1.3/nn (Figure 5). While abundance was low, all individuals sampled were ≥12 inches, and large individuals ≥25 inches were present. Aging from otoliths in 2008 revealed that blue catfish were reproducing in Canyon Reservoir with individual ages ranging from 3 to 17 years (N = 13). Low frequency electrofishing in fall 2008 confirmed reproduction as most individuals captured were under the legal-size limit (≥12 inches); while total catch rates (34.7/h) may have revealed this survey method as a more efficient technique in this particular reservoir (Appendix C). Sub-optimal condition was observed for all stock-size inch groups sampled by gill nets as average relative weights remained below 100 (range: 64–96).

Channel catfish: The gill net catch rate for channel catfish was 1.6/nn in 2012, which increased since the 2008 and 2010 surveys (1.2/nn and 0.6/nn, respectively; Figure 6). Individuals ≥12 inches in length made up the entire gill net catch, and large channel catfish (≥20 inches) were present. Condition was good as average relative weights of stock-size fish remained above 85 (range: 86–115).

Flathead catfish: Flathead catfish were present in low density (1.3/nn), but more than doubled in abundance since the 2008 and 2010 surveys (0.6/nn and 0.5/nn, respectively; Figure 7). Discrepancies between surveys may be attributed to sampling inefficiency for this species. Large individuals (≥30 inches) were present. Sub-optimal condition was observed for most inch groups sampled by gill nets as relative weights generally remained below 100.

White bass: The gill net catch rate (1.4/nn in 2012 and 1.5/nn in 2010) for white bass declined from 4.1/nn in 2008 (Figure 8), which may have resulted from a strong year class as reported by De Jesus and Magnelia (2008). The current catch rates are closer to historical values, and this reservoir is well known for its strong spring spawning migrations, which provide great angling opportunities for this species in the upper portion of the reservoir. This population has served as a broodstock source for TPWD's palmetto bass production in recent years.

Striped bass: The gill net catch rate of striped bass was 0.5/nn in 2012, declining since the 2008 and

2010 surveys (1.8/nn and 2.9/nn, respectively; Figure 9). Eighty-eight percent of the adult striped bass sampled exceeded 18 inches, which was higher than 2008 (37%); however, sample size was considerably smaller, consisting only of eight individuals in 2012. Striped bass were not stocked in 2011 due to poor production at state hatcheries, affecting catch rates of one-year-old individuals, usually present in our surveys. Body condition (W_r) was sub-optimal for most inch groups (range 70-100), while values dropped as the fish got larger. This pattern was evident in other central Texas reservoirs, such as Lake Buchanan, and may be the result of stress from elevated water temperature and low dissolved oxygen conditions during the summer months (Magnelia and De Jesus 2008). In 2012 and 2010, striped bass reached the legal length limit (18 inches), on average between two and three years of age (Figure 10). In October 2006 the Texas Department of State Health and Human Services issued a fish consumption advisory for striped bass. Elevated mercury levels were detected and it was advised that consumption be limited to two 8-oz. portions for adults and two 4-oz. portions for children per month. Striped bass still provide a popular catch-and-release fishing opportunity at Canyon Reservoir (De Jesus and Magnelia 2008).

Smallmouth Bass: Electrofishing catch rate (8.0/h) in 2011 declined 37% since the 2007 survey, when it was 12.7/h (Figure 11). All individuals sampled in 2012 were below the legal size limit (14 inches). A spring bass-only electrofishing survey targeting smallmouth bass in 2010 yielded a catch rate of 4.5/h with a small sample size of 7 fish. Only two fish were of legal size. Smallmouth bass were initially stocked in the Guadalupe River Basin in 1974. Although TPWD ceased stockings of smallmouth bass in this reservoir since 1989, natural reproduction is still being documented in Canyon Reservoir and in the Guadalupe River Basin. Age analysis in 2007 confirmed natural reproduction, as multiple year classes were collected (De Jesus and Magnelia 2008). Relative weight (W_r) among most inch groups in 2011 was sub-optimal, with most inch groups averaging below 100.

Largemouth bass: Largemouth bass electrofishing total catch rates (51.3/h) dropped by over half in 2011 from 2007 (113.3/h; Figure 12). The reduced abundance in the 2011 survey may have reflected the impact of extreme drought conditions in 2009 and 2011, in which lake levels dropped, reducing important littoral habitat. This effect is opposite of a strong year class produced in 2007 as a result of high water levels (Magnelia and Bonds 2004). Steep rocky reservoirs in the hill country quickly lose optimal habitat when water levels decrease significantly. This habitat is essential for bass recruitment to adult size. The catch rate for legal-size fish (≥14 inches) also declined to 4.0/h (69%) since 2007, as quality-size bass proportions remained similar as PSD was 42% in 2012. However, low water levels (10 feet below conservation pool) at the time of sampling may have hindered efficiency of capture, which may have lead to misleading results. Steep-gradient shorelines may not hold many target species during electrofishing surveys, and several sampling stations were restricted to these types of areas at low lake levels. Condition (W_r) was sub-optimal in 2012, with most inch groups averaging below 100. Growth rates were slow, as individuals, on average reached 14 inches between age 3 and 4 (N = 13; Figure 13), which was considered below-average growth for the Edwards Plateau eco-region (Prentice 1987). This may also reflect effects of drought condition on prey availability, discussed above. Largemouth bass have historically been the most sought after sport fish species in Canyon Reservoir (Magnelia and Bonds 2004).

Crappies: While trap netting wasn't conducted in 2011, both white and black crappie species are present in the reservoir. Historical trap net surveys revealed low-density populations and historical creels detected low directed angler effort (Magnelia and Bonds 2004). White crappie catch rates were historically better in the upper end of the reservoir.

Fisheries management plan for Canyon Reservoir, Texas

Prepared – July 2012.

ISSUE 1: Striped bass are traditionally a harvest-oriented fishery for anglers. The striped bass fishery has been popular in Canyon Reservoir, but angler interest may decline due to the consumption advisory. Since the advisory doesn't constitute a ban, fish can still be harvested as table fare. Mercury levels may only be hazardous in older year classes of striped bass. Striped bass still provide catch-and-release opportunities for recreational anglers. Recent hatchery production setbacks have reduced striped bass stockings statewide, and Canyon Reservoir has not received a stocking since 2010. This fishery is contingent on supplemental stockings.

MANAGEMENT STRATEGIES

1. Continue to request annual striped bass stockings at a rate of 10/acre in 2013, then back to 5/acre thereafter.
2. Continue to monitor striped bass abundance with gill net surveys.

ISSUE 2: Largemouth bass are the reservoir's most sought after sport fish, but angler catch rates have traditionally been poor. The installation of fish attractors was successful at attracting largemouth bass and *Lepomis* sp. Anecdotal reports indicated this program was very popular with Canyon Reservoir anglers. Juniper trees are abundant along the reservoir's shoreline and are always available at no cost. Volunteers are readily available to provide labor for these types of projects.

MANAGEMENT STRATEGY

1. Continue to take advantage of the opportunities present to create fish attractor sites. When possible, coordinate efforts to create new sites or replenish existing sites.

ISSUE 3: Florida largemouth bass fingerlings and fry were stocked into Canyon Reservoir in 2008 and 2010, respectively in efforts to increase genetic influence for growth. The stockings were conducted during high water level years to take advantage of flooded shoreline habitat. Unfortunately lake levels receded significantly in subsequent years (2009 and 2011), reducing optimal habitat for growth and recruitment. Due to a poor electrofishing sample in 2011, caused by drought conditions, a genetic analysis was not conducted.

MANAGEMENT STRATEGY

1. Monitor genetic influence in largemouth bass collected during an additional standard fall electrofishing survey in 2013.

ISSUE 4: Many invasive species threaten aquatic habitats and organisms in Texas and can adversely affect the state ecologically, environmentally, and economically. For example, zebra mussels (*Dreissena polymorpha*) can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches and plugging engine cooling systems. Giant Salvinia (*Salvinia molesta*) and other invasive vegetation species can form dense mats, interfering with recreational activities like fishing, boating, skiing and swimming. The financial costs of controlling and/or eradicating these types of invasive species are significant. Additionally, the potential for

invasive species to spread to other river drainages and reservoirs via watercraft and other means is a serious threat to all public waters of the state.

MANAGEMENT STRATEGIES

1. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir.
2. Contact and educate marina owners about invasive species, and provide them with posters, literature, etc… so that they can in turn educate their customers.
3. Educate the public about invasive species through the use of media and the internet.
4. Make a speaking point about invasive species when presenting to constituent and user groups. 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 included mandatory monitoring in 2015/2016 (Table 5). An additional gill netting survey in 2014 will be used to monitor the striped bass population. Trap net sampling for white crappie will resume in 2015 pending new procedures that incorporate stratified random sampling. A habitat survey will be conducted in 2015. A largemouth bass genetic evaluation will be conducted in 2013.

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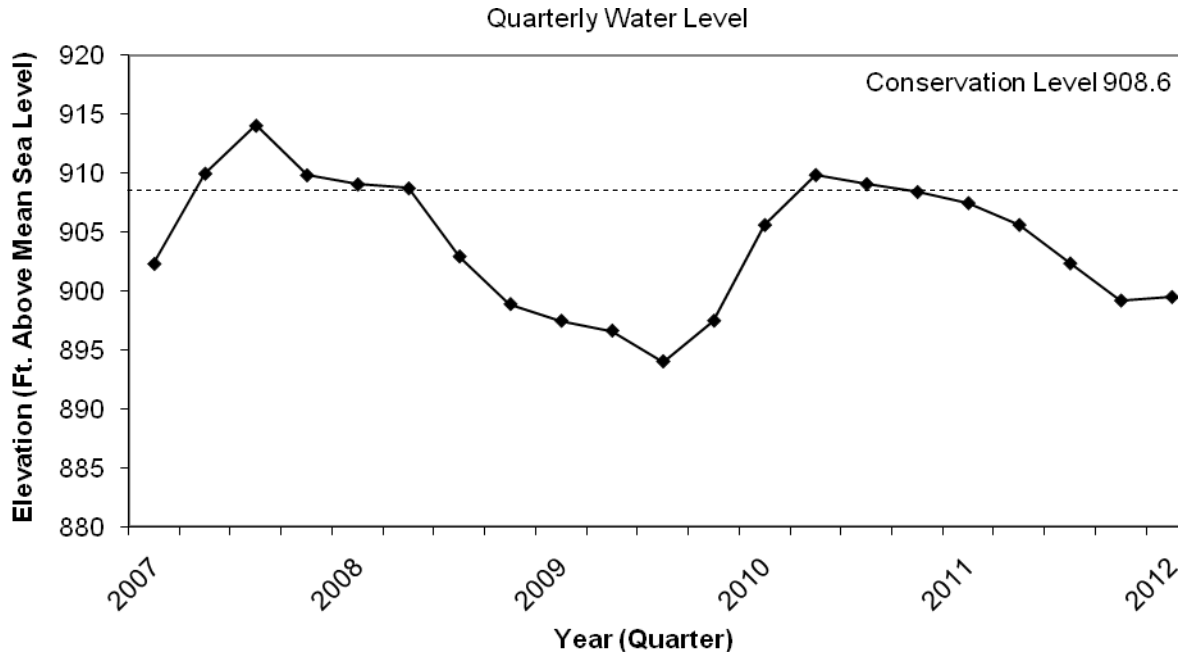


Figure 1. Mean quarterly water level elevations in feet above mean sea level (MSL) recorded from January 1, 2007 to March 31, 2012 for Canyon Reservoir, Texas. Dashed line represents conservation level (908.6 MSL).

Table 1. Characteristics of Canyon Reservoir, Texas.

Characteristic	Description
Year constructed	1964
Controlling authority	USACE
County	Comal
Reservoir type	Flood control, water conservation
Shoreline Development Index (SDI)	6.30
Conductivity	409 µmhos/cm

Table 2. Harvest regulations for Canyon Reservoir, Texas.

Species	Bag Limit	Length Limit (inches)
Catfish: channel catfish, blue catfish, hybrids and subspecies	25 (in any combination)	12 minimum
Catfish, flathead	5	18 minimum
Bass, white	25	10 minimum
Bass, striped	5	18 minimum
Black bass: largemouth, smallmouth, Guadalupe	5 (in any combination)	14 minimum*
Crappie: white and black crappie, their hybrids and subspecies	25 (in any combination)	10 minimum

*Guadalupe bass have no minimum length limit.

Table 3. Stocking history of Canyon Reservoir, Texas. Life stages are fry (FRY), fingerlings (FGL), advanced fingerlings (AFGL) 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)
Black crappie	1967	5,000		UNK
	1988	57,446		1.0
	Total	62,446		
Blue catfish	1991	79,991	FGL	2.5
	1992	179,804	FGL	2.4
	Total	259,795		
Channel catfish	1966	19,200	AFGL	7.9
	Total	19,200		
Florida largemouth bass	1987	34,320	FGL	2.0
	2008	407,962	FGL	1.6
	2010	294,856	FRY	0.3
	Total	737,138		
Largemouth bass	1987	30,380	FGL	2.0
	Total	30,380		
Smallmouth bass	1974	85,000	UNK	UNK
	1975	100,000	UNK	UNK
	1976	125,000	UNK	UNK
	1988	416,226	FRY	0.5
	1989	1,879	FGL	1.1
	1989	3,907	FRY	0.0
	Total	732,012		
Striped bass	1973	19,750	FGL	1.7
	1974	13,290	FGL	1.7
	1976	88,317	UNK	UNK
	1977	100,169	UNK	UNK
	1981	42,852	UNK	UNK
	1983	40,000	UNK	UNK
	1989	40,500	FRY	1.0
	1990	41,985	FGL	1.3
	1991	42,525	FGL	1.6
	1993	64,993	FGL	1.1
	1994	124,406	FGL	1.1
	1994	1,575,581	FRY	0.8
	1995	42,052	FGL	1.2
	1997	41,441	FGL	1.1

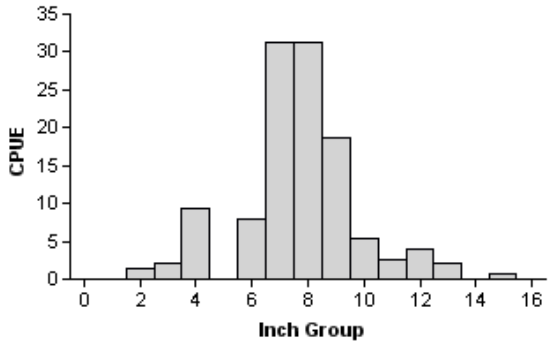
Species	Year	Number	Life Stage	Mean TL (in)
	1998	41,267	FGL	1.3
	1999	41,630	FGL	1.4
	2000	42,000	FGL	1.6
	2002	39,156	FGL	1.5
	2005	43,970	FGL	1.6
	2006	42,980	FGL	1.7
	2007	42,751	FGL	1.9
	2008	41,664	FGL	1.7
	2009	48,546	FGL	1.8
	2010	42,210	FGL	1.9
	Total	2,704,035		
Walleye	1965	500,000	FRY	0.2
	1973	1,068,920	FRY	0.2
	1974	371,080	FRY	0.2
	1981	4,370,000	FRY	0.2
	1984	3,925,000	FRY	0.2
	1985	48,910	FGL	2.0
	1985	17,203	FRY	0.6
	Total	10,301,113		
White crappie	1966	2,000	UNK	UNK
	1967	5,000	UNK	UNK
	Total	7,000		

Table 4. Survey of littoral and physical habitat types, Canyon Reservoir, Texas, 2004. A linear shoreline distance (miles) was recorded for each habitat type found.

Shoreline habitat type	Shoreline Distance		Surface Area	
	Miles	Percent of total	Acres	Percent of reservoir surface area
Vegetated bank	33.5	40		
Broken rock	25.5	31		
Rock bluff	17.5	21		
Standing timber	3	4		
Sandy bank	1.5	2		
Rip rap	1	1		
Marina	1	1		
Concrete	0.1	<1		
Southern naiad			0.5	<1

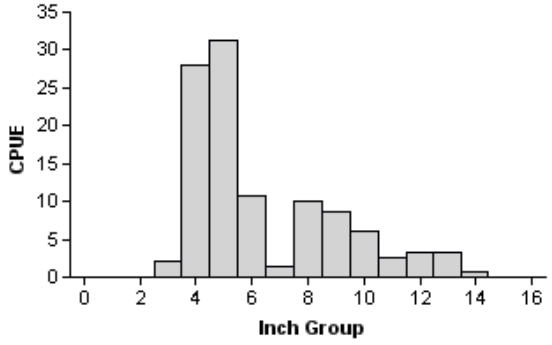
Gizzard Shad

2003



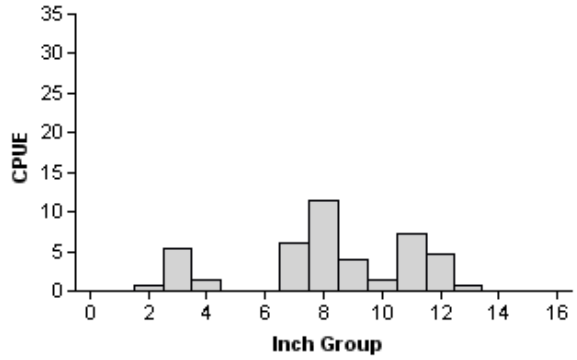
Effort = 1.5
Total CPUE = 116.7 (29; 175)
IOV = 44.57 (6.1)

2007



Effort = 1.5
Total CPUE = 108.0 (34; 162)
IOV = 67.9 (8.3)

2011

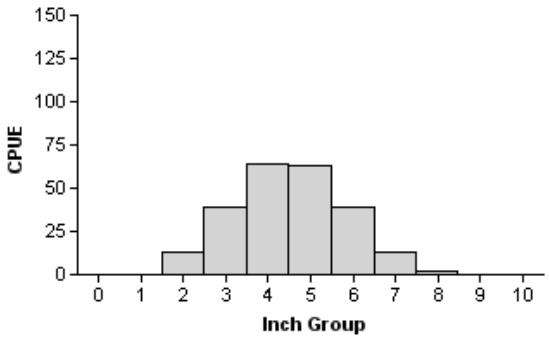


Effort = 1.5
Total CPUE = 42.7 (49; 64)
IOV = 31 (8.6)

Figure 2. Number of gizzard shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Canyon Reservoir, Texas, 2003, 2007 and 2011.

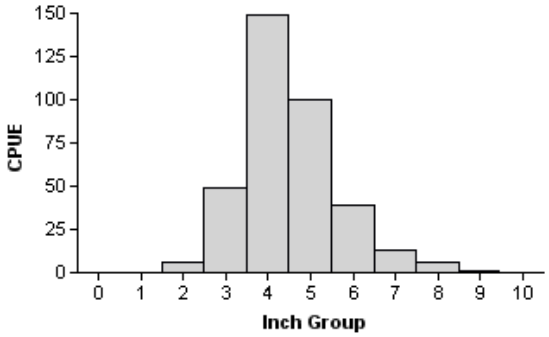
Redbreast Sunfish

2003



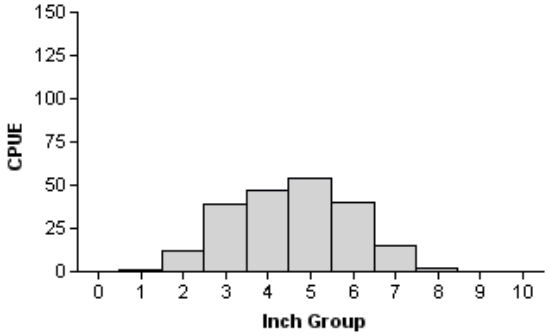
Effort =	1.5
Total CPUE =	234.0 (16; 351)
PSD =	25 (3.8)

2007



Effort =	1.5
Total CPUE =	362.7 (16; 544)
PSD =	17 (3.4)

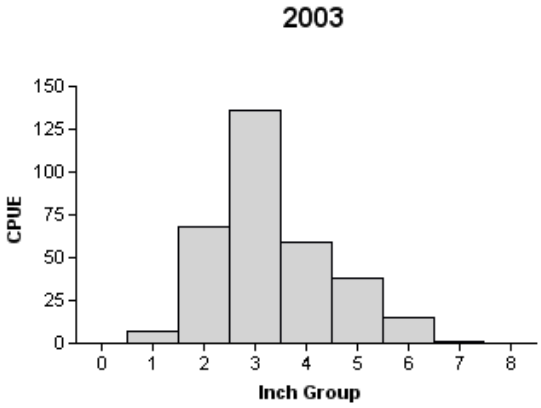
2011



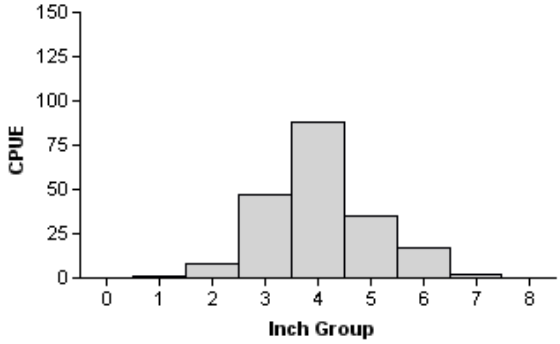
Effort =	1.5
Total CPUE =	210.0 (28; 315)
PSD =	29 (5)

Figure 3. Number of redbreast sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Canyon Reservoir, Texas, 2003, 2007 and 2011.

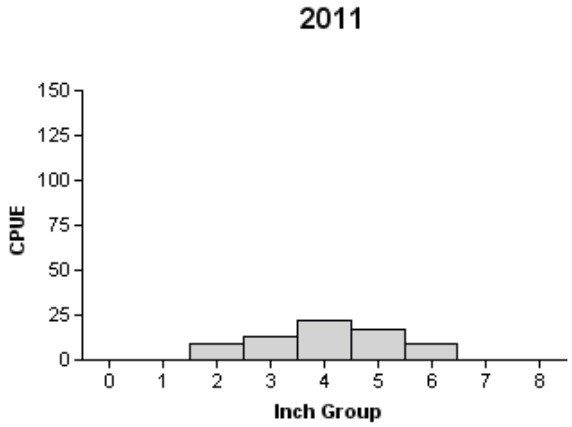
Bluegill



Effort = 1.5
Total CPUE = 324.0 (18; 486)
PSD = 6 (1.2)



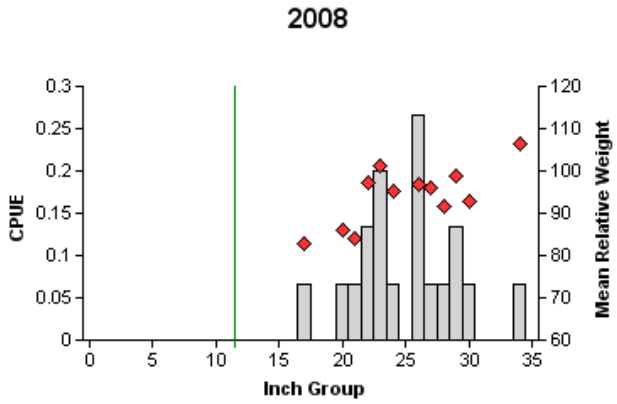
Effort = 1.5
Total CPUE = 198.0 (33; 297)
PSD = 10 (1.4)



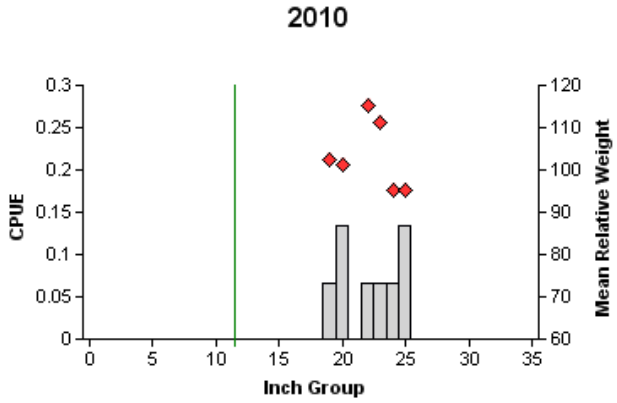
Effort = 1.5
Total CPUE = 70.0 (33; 105)
PSD = 14 (4.4)

Figure 4. Number of bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Canyon Reservoir, Texas, 2003, 2007 and 2011.

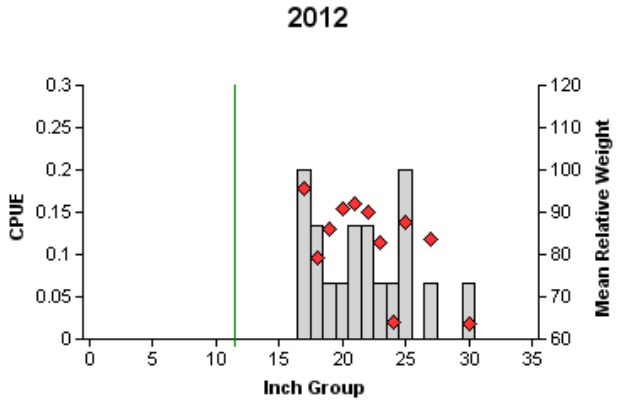
Blue Catfish



Effort =	15.0
Total CPUE =	1.3 (26; 19)
CPUE-12 =	1.3 (26; 19)
PSD-12 =	100 (0)



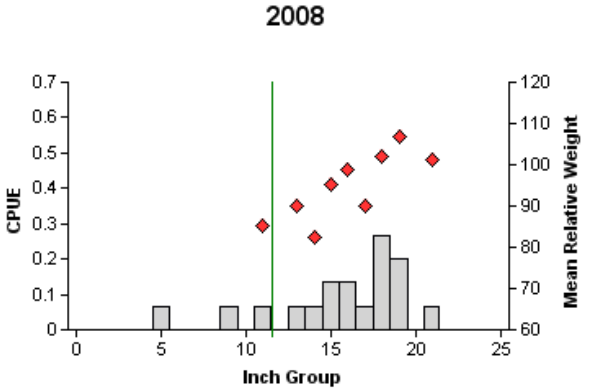
Effort =	15.0
Total CPUE =	0.5 (40; 8)
CPUE-12 =	0.5 (40; 8)
PSD-12 =	100 (0)



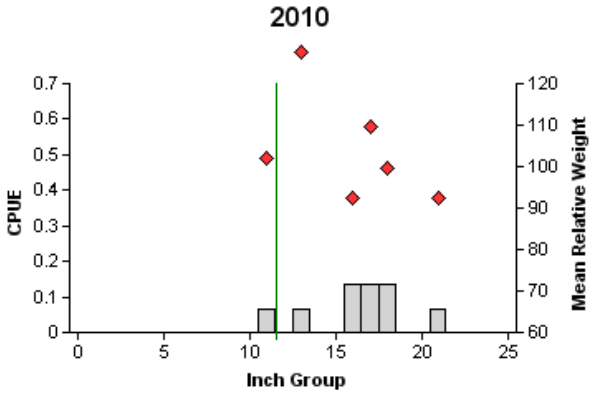
Effort =	15.0
Total CPUE =	1.2 (20; 18)
CPUE-12 =	1.2 (20; 18)
PSD-12 =	100 (0)

Figure 5. Number of blue catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Canyon Reservoir, Texas, 2008, 2010 and 2012. Vertical line represents minimum length limit at the time of the survey.

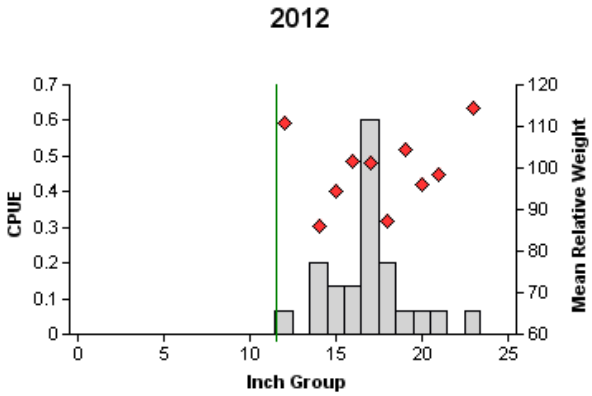
Channel Catfish



Effort = 15.0
Total CPUE = 1.2 (20; 18)
CPUE-12 = 1.0 (26; 15)
PSD-12 = 94 (6.4)



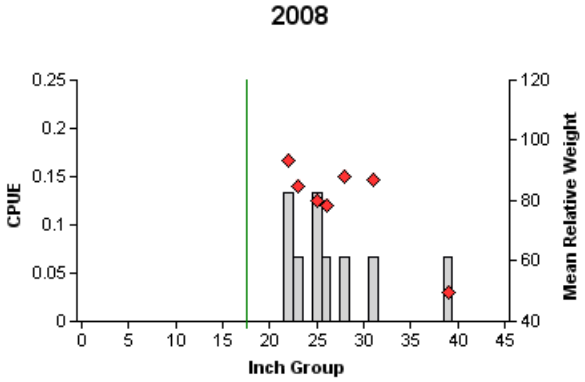
Effort = 15.0
Total CPUE = 0.6 (36; 9)
CPUE-12 = 0.5 (31; 8)
PSD-12 = 89 (8.3)



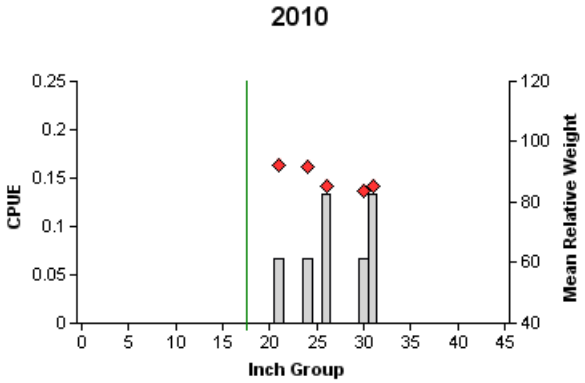
Effort = 15.0
Total CPUE = 1.6 (19; 24)
CPUE-12 = 1.6 (19; 24)
PSD-12 = 100 (0)

Figure 6. 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, Canyon Reservoir, Texas, 2008, 2010 and 2012. Vertical line represents minimum length limit at the time of the survey.

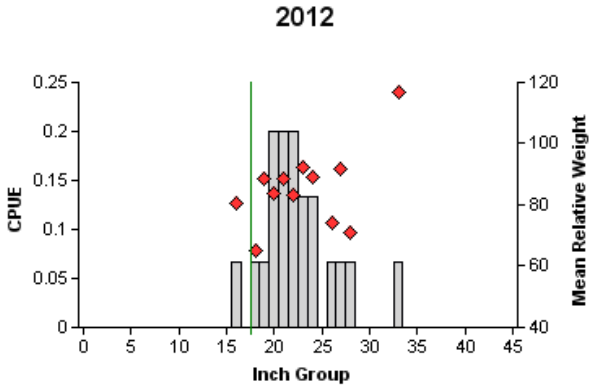
Flathead Catfish



Effort =	15.0
Total CPUE =	0.6 (39; 9)
CPUE-18 =	0.6 (39; 9)
PSD-18 =	100 (0)



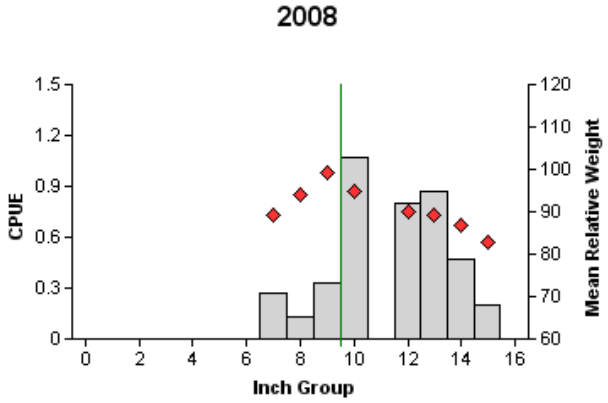
Effort =	15.0
Total CPUE =	0.5 (35; 7)
CPUE-18 =	0.5 (35; 7)
PSD-18 =	100 (0)



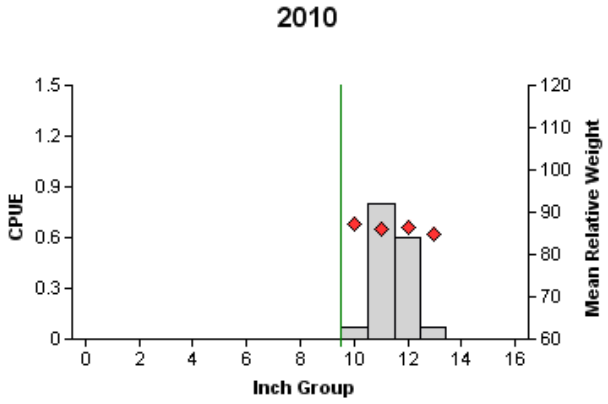
Effort =	15.0
Total CPUE =	1.3 (20; 20)
CPUE-18 =	1.3 (20; 19)
PSD-18 =	95 (4.6)

Figure 7. Number of flathead catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for spring gill net surveys, Canyon Reservoir, Texas, 2008, 2010 and 2012. Vertical line represents the minimum length limit at the time of the survey.

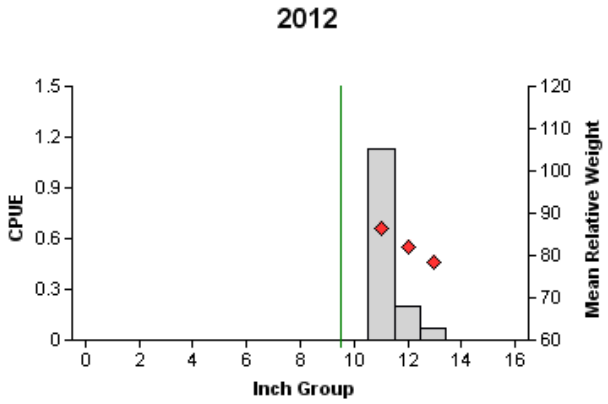
White Bass



Effort =	15.0
Total CPUE =	4.1 (30; 62)
CPUE-10 =	3.4 (29; 51)
PSD-10 =	82 (4.4)



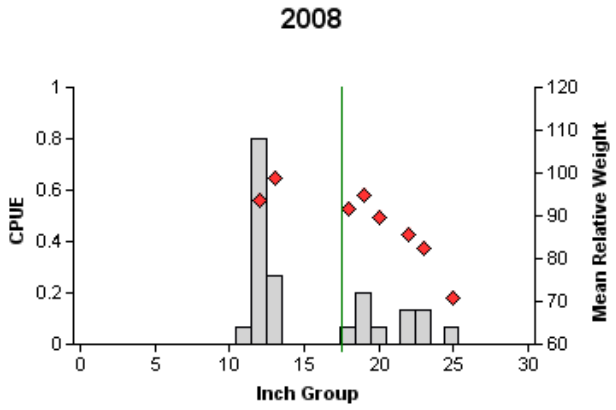
Effort =	15.0
Total CPUE =	1.5 (44; 23)
CPUE-10 =	1.5 (44; 23)
PSD-10 =	100 (0)



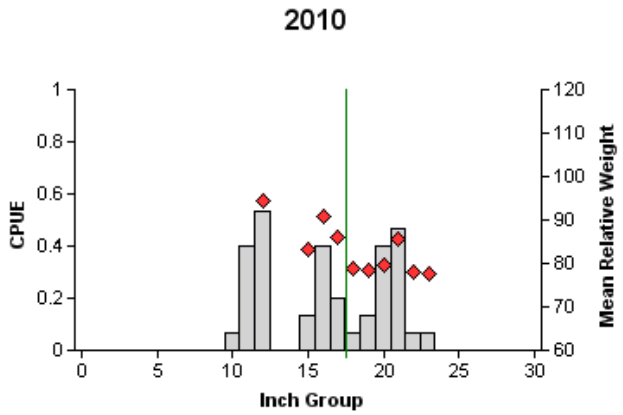
Effort =	15.0
Total CPUE =	1.4 (90; 21)
CPUE-10 =	1.4 (90; 21)
PSD-10 =	100 (0)

Figure 8. Number of white bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Canyon Reservoir, Texas, 2008, 2010 and 2012. Vertical line represents minimum length limit at the time of the survey.

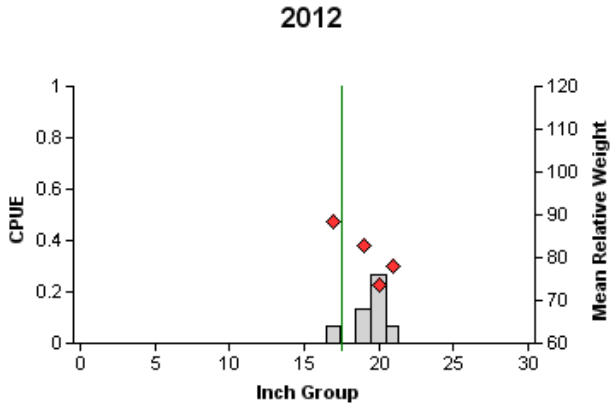
Striped Bass



Effort =	15.0
Total CPUE =	1.8 (26; 27)
CPUE-18 =	0.7 (28; 10)
PSD-18 =	38 (9.5)



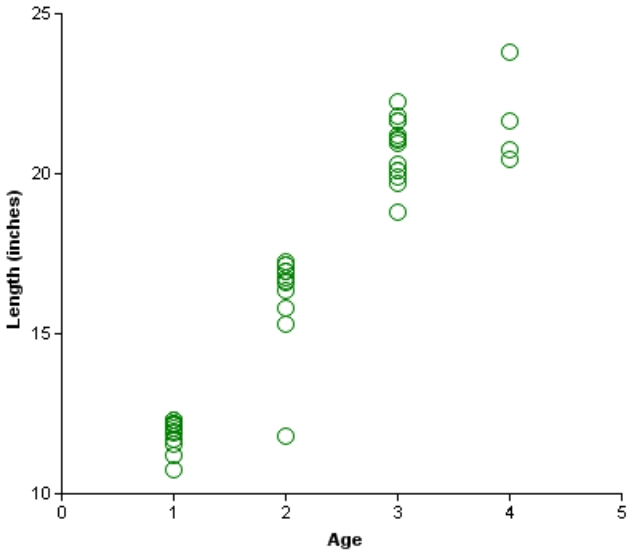
Effort =	15.0
Total CPUE =	2.9 (24; 44)
CPUE-18 =	1.2 (42; 18)
PSD-18 =	49 (14.6)



Effort =	15.0
Total CPUE =	0.5 (54; 8)
CPUE-18 =	0.5 (51; 7)
PSD-18 =	88 (7.7)

Figure 9. Number of striped bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Canyon Reservoir, Texas, 2008, 2010 and 2012. Vertical line represents minimum length limit at the time of the survey.

2010



2012

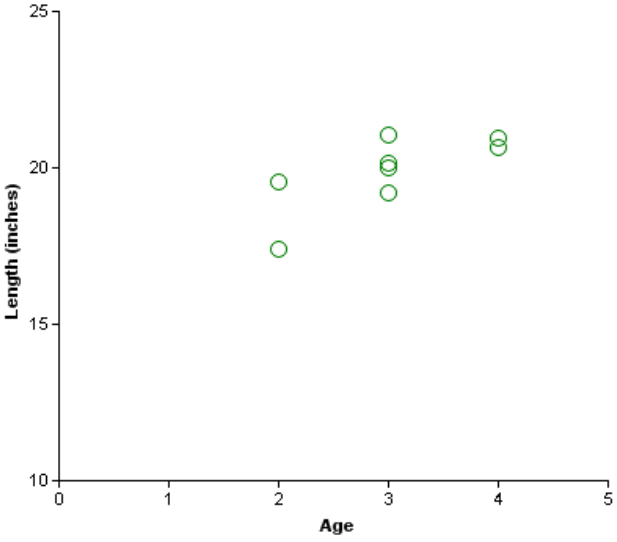
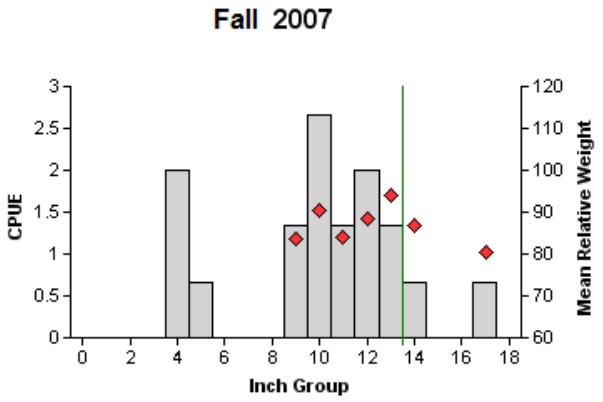
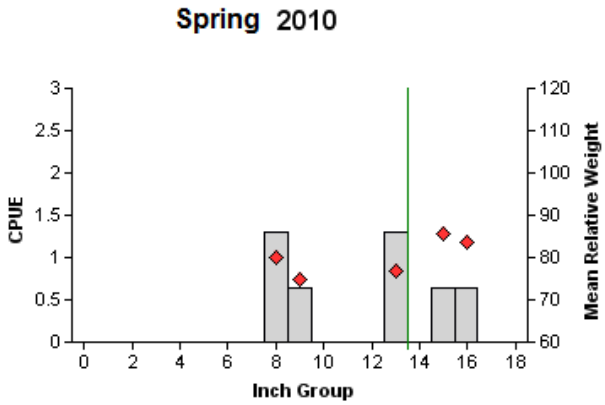


Figure 10. Length at age for striped bass collected during gill netting, Canyon Reservoir, Texas, February 2010 (N = 44) and April 2012 (N = 8).

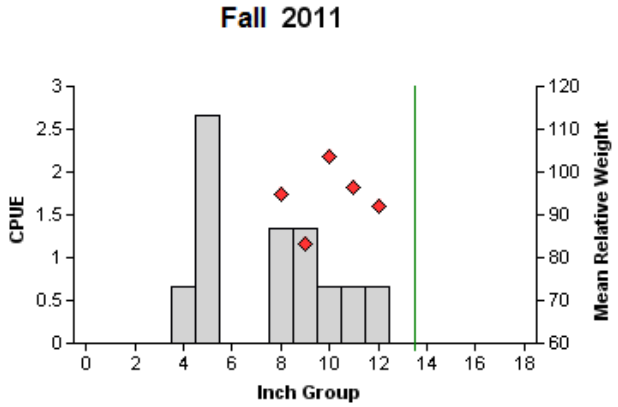
Smallmouth Bass



Effort =	1.5
Total CPUE =	12.7 (39; 19)
Stock CPUE =	10.0 (44; 15)
CPUE-14 =	1.3 (69; 2)
PSD =	60 (11.6)
PSD-14 =	13 (7.1)



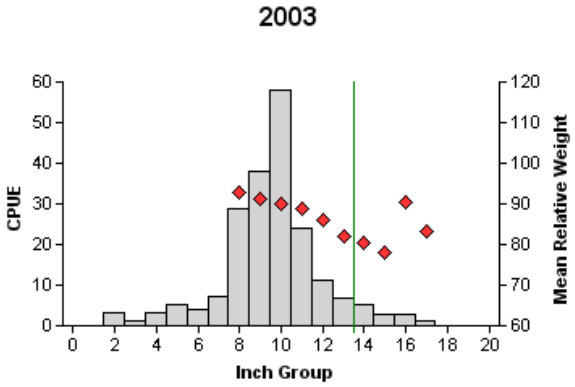
Effort =	1.5
Total CPUE =	4.5 (0; 7)
Stock CPUE =	4.5 (0; 7)
CPUE-14 =	1.3 (0; 2)
PSD =	57 (-1)
PSD-14 =	29 (-1)



Effort =	1.5
Total CPUE =	8.0 (42; 12)
Stock CPUE =	4.7 (52; 7)
CPUE-14 =	0.0 (0; 0)
PSD =	29 (18.1)
PSD-14 =	0 (0)

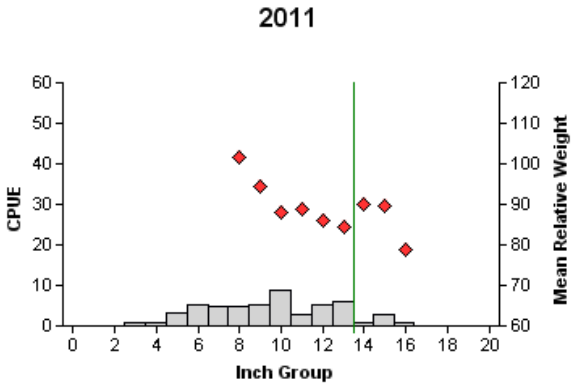
Figure 11. Number of smallmouth bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys 2007, 2011 and spring 2010, Canyon Reservoir, Texas. Vertical line represents minimum length limit at the time of survey.

Largemouth Bass



Effort =	1.5
Total CPUE =	203.3 (19; 305)
Stock CPUE =	178.7 (19; 268)
CPUE-14 =	12.0 (18; 18)
PSD =	17 (3.3)
PSD-14 =	7 (1.7)

Effort =	1.5
Total CPUE =	113.3 (15; 170)
Stock CPUE =	60.0 (18; 90)
CPUE-14 =	12.7 (26; 19)
PSD =	44 (6)
PSD-14 =	21 (3.7)



Effort =	1.5
Total CPUE =	51.3 (24; 77)
Stock CPUE =	36.7 (22; 55)
CPUE-14 =	4.0 (34; 6)
PSD =	42 (6.4)
PSD-14 =	11 (3.4)

Figure 12. 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, Canyon Reservoir, Texas, 2003, 2007 and 2011. Vertical line represents minimum length limit at time of survey.

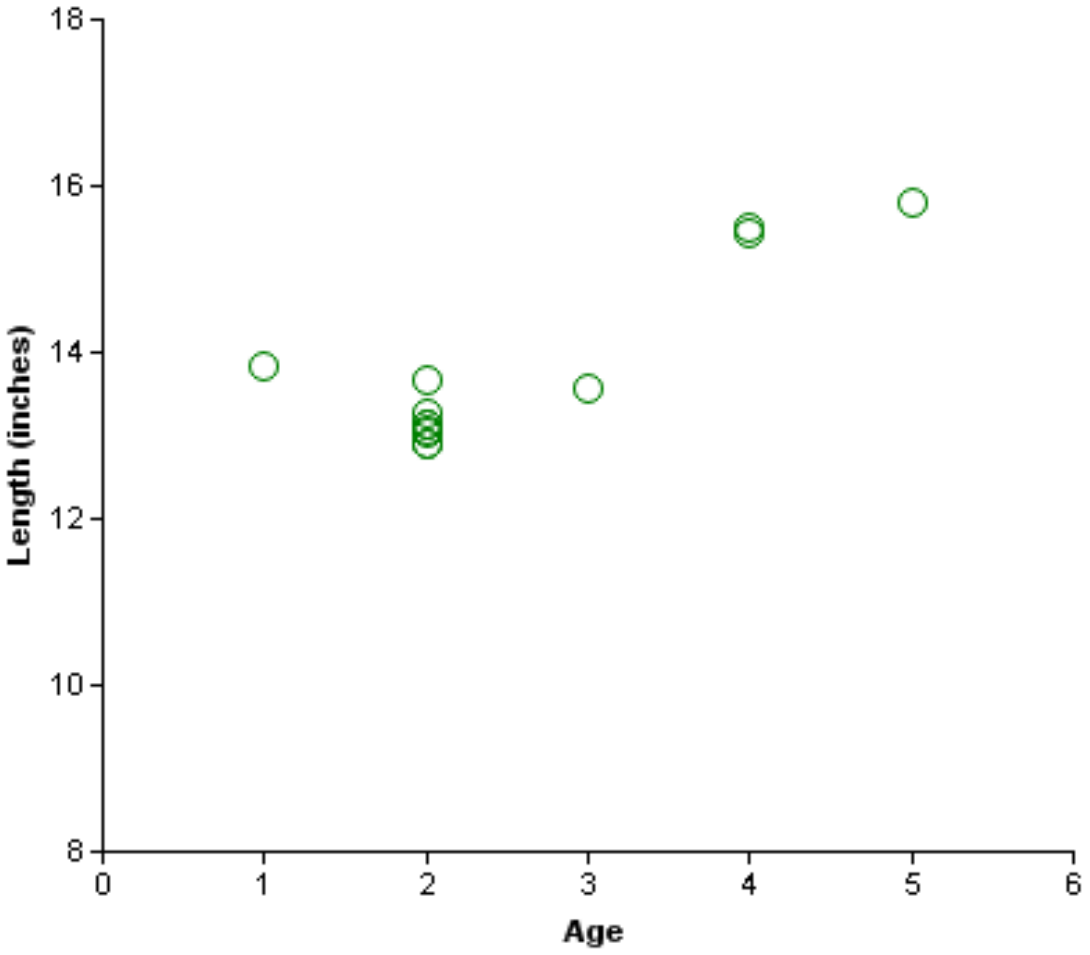


Figure 13. Length at age for largemouth bass collected electrofishing, Canyon Reservoir, Texas, October 2011 (N = 13).

Table 5. Proposed sampling schedule for Canyon 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 and additional survey denoted by A.

Survey Year	Electrofisher	Trap Net	Gill Net	Creel Survey	Habitat Survey	Vegetation Survey	Access Survey	Report
Fall 2012-Spring 2013								
Fall 2013-Spring 2014	A		A					
Fall 2014-Spring 2015								
Fall 2015-Spring 2016	S	S	S		S	S	S	S

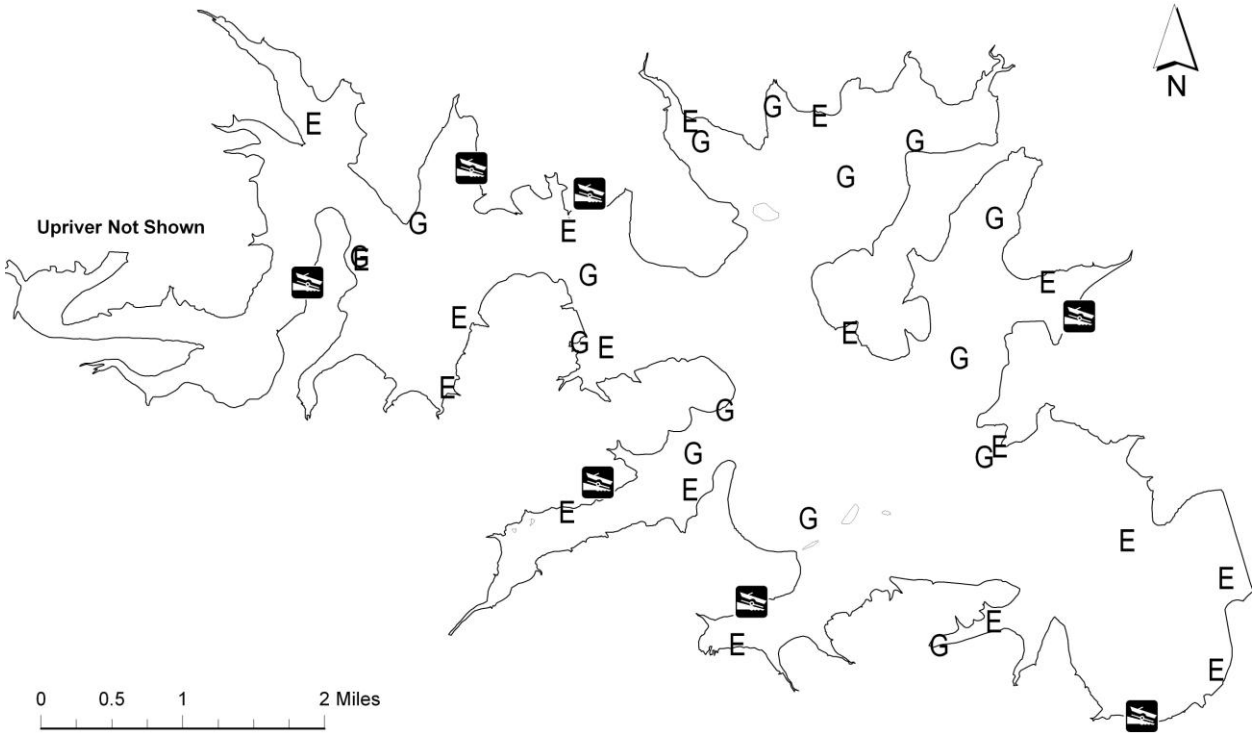
APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types used at Canyon Reservoir, Texas, 2011-2012.

Species	Gill Netting		Electrofishing	
	N	CPUE	N	CPUE
Gizzard shad			64	42.67
Threadfin shad			5	3.33
Blue catfish	18	1.20		
Channel catfish	24	1.60		
Flathead catfish	20	1.33		
White bass	21	1.40		
Striped bass	8	0.53		
Redbreast sunfish			315	210.00
Green sunfish			18	12.00
Warmouth			6	4.00
Bluegill			105	70.00
Redear sunfish			19	12.67
Smallmouth bass			12	8.00
Largemouth bass			77	51.33
Guadalupe bass			2	1.33
Rio Grande cichlid			9	6.0

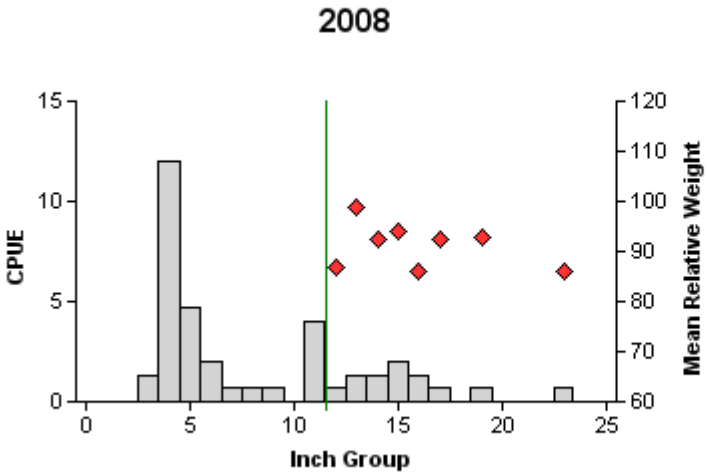
APPENDIX B

Location of sampling sites, Canyon Reservoir, Texas, 2011-2012. Gill net and electrofishing stations are indicated by G and E, respectively. Public boat ramps are marked with boat icon.



APPENDIX C

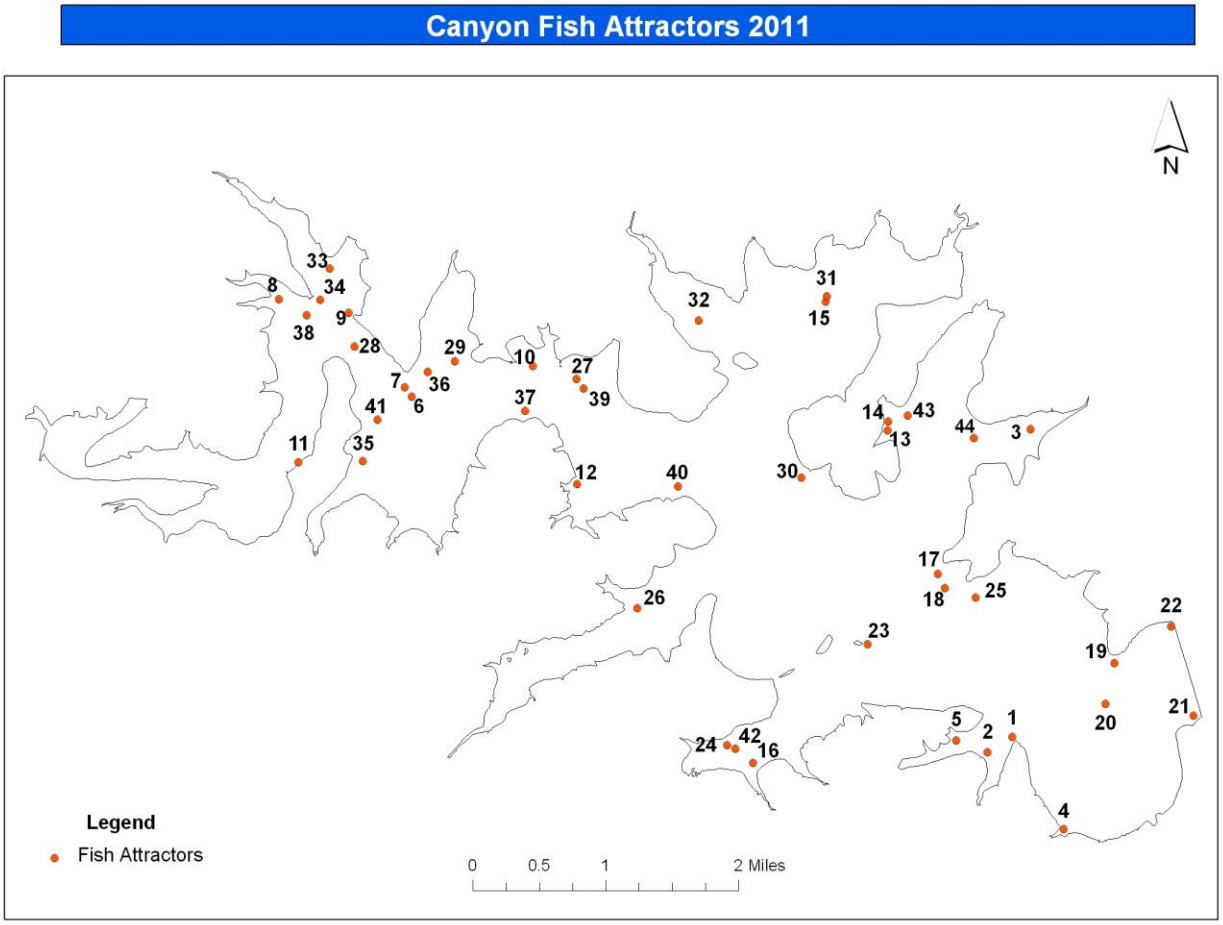
Number of blue catfish caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) from fish collected during a low-frequency electrofishing survey, Canyon Reservoir, Texas, 2008. Vertical line represents minimum length limit at the time of the survey.



Effort = 1.5
Total CPUE = 34.7 (56; 52)
CPUE-12 = 8.7 (70; 13)
PSD-12 = 100 (0)

APPENDIX D

Map of Canyon Reservoir with fish attractor locations (2011). Attractors (N = 44) have been installed and refurbished since January 2005. Juniper brush piles and plastic attractors were used at the sites.



APPENDIX E

GPS coordinates for Canyon Reservoir fish attractor locations. GPS coordinates are in degree decimal minutes. Attractors were installed or refurbished in January 2005 – 2011. Juniper brush piles, a.k.a. cedar trees (CT) and plastic artificial attractors (AFA) were used at the sites. Only sites 1 through 15 include artificial fish attractors**.**

Site #	Lat/Long	Attractor Description	Installed	Last Supplemented
1	N 29°51.697' W -98°13.027'	Mouth of Turkey Cove on east main lake point along river channel drop.	2005	2010
2	N 29°51.597' W -98°13.190'	In Turkey Cove on rocky bald Y-point splitting cove.	2005	2010
3	N 29°53.707' W -98°12.911'	Along Jacobs Creek channel drop off.	2005	2010
4	N 29°51.096' W -98°12.693'	Along creek channel drop in small cove uplake from dam.	2005	2010
5	N 29°51.676' W -98°13.394'	Bald secondary point on North side of Turkey Cove east of ramp.	2005	2010
6	N 29°53.918' W -98°16.949'	West side of long rocky point between Cranes Mill and Potters Creek along river channel drop.	2005	2011
7	N 29°53.979' W -98°16.994'	West side of long rocky point between Cranes Mill and Potters Creek along river channel drop.	2005	2011
8	N 29°54.554' W -98°17.814'	On main point splitting north side cove along deep ledge.	2005	2006
9	N 29°54.467' W -98°17.361'	Main lake point up-river from water pipeline along deep river channel drop.	2005	2008
10	N 29°54.118' W -98°16.157'	End of bald clay point at Potter's Creek Park near river channel drop.	2005	2011
11	N 29°53.492' W -98°17.690'	Cranes Mill fishing pier. Along North edge of pier and in middle pier hole.	2005	
12	N 29°53.343' W -98°15.866'	Ledge along steep bank near point.	2005	2011
13	N 29°53.698' W -98°13.840'	Ledge on rocky bank along east side of Canyon Park in ramp cove.	2005	2010
14	N 29°53.756' W -98°13.839'	Ledge on rocky bank along east side of Canyon Park in ramp cove.	2005	2010

APPENDIX E (Cont.)

GPS coordinates for Canyon Reservoir fish attractor locations. GPS coordinates are in degree decimal minutes. Attractors were installed or refurbished in January 2005 – 2011. Juniper brush piles, a.k.a. cedar trees (CT) and plastic artificial attractors (AFA) were used at the sites. Only sites 1 through 15 include plastic artificial fish attractors.

Site #	Lat/Long	Attractor Description	Installed	Last Supplemented
15	N 29°54.539' W -98°14.247'	End of extended point west of Canyon Park area near drop off.	2005	2011
16	N 29°51.530' W -98°14.722'	On southeast side of Comal Park cove along creek channel drop.	2005	2010
17	N 29°52.762' W -98°13.514'	End of west Jacobs Creek main lake point.	2005	2011
18	N 29°52.669' W -98°13.467'	End of east Jacobs Creek main lake point.	2005	2011
19	N 29°52.181' W -98°12.362'	East side of North Park main lake point.	2007	2011
20	N 29°51.913' W -98°12.422'	Along drop off on North Park extended main lake point.	2007	2010
21	N 29°51.835' W -98°11.844'	Southeast corner of dam.	2007	2011
22	N 29°52.419' W -98°11.994'	Northeast corner of dam.	2007	2011
23	N 29°52.301' W -98°13.973'	On the end of island/hump marked with buoy.	2007	2010
24	N 29°51.642' W -98°14.892'	Along creek channel near Comal Park.	2007	2011
25	N 29°52.608' W -98°13.269'	East side of Jacobs Creek main lake point.	2007	2010
26	N 29°52.538' W -98°15.475'	On the end of point northeast of Tom Creek boat ramp.	2007	2011
27	N 29°54.033' W -98°15.873'	Along ledge on east side of Potters Creek Park.	2007	2010
28	N 29°54.246' W -98°17.323'	Along ledge between Cranes Mill Park and water pipelines.	2007	2011

APPENDIX E (Cont.)

GPS coordinates for Canyon Reservoir fish attractor locations. GPS coordinates are in degree decimal minutes. Attractors were installed or refurbished in January 2005 – 2011. Juniper brush piles, a.k.a. cedar trees (CT) and plastic artificial attractors (AFA) were used at the sites.

Site #	Lat/Long	Attractor Description	Installed	Last Supplemented
29	N 29°54.150' W -98°16.668'	On point south of Potters Creek West boat ramp.	2007	2011
30	N 29°53.392' W -98°14.405'	On Canyon Park main lake point.	2007	2010
31	N 29°54.571' W -98°14.239'	End of extended point west of Canyon Park area near drop off.	2007	2011
32	N 29°54.416' W -98°15.077'	Along creek channel northwest of island across from Canyon Lake marina.	2007	2011
33	N 29°54.754' W -98°17.483'	On submerged Cranes Mill Road Bed, south of County Ramp 23.	2008	2011
34	N 29°54.549' W -98°17.547'	On Mystic Shores point near drop off.	2008	
35	N 29°53.496' W -98°17.268'	Near Cranes Mill Park, north of marina.	2008	
36	N 29°54.079' W -98°16.844'	Off east side of point, on opposite side of cove from Potters Creek ramp.	2008	
37	N 29°53.824' W -98°16.209'	On ledge off main lake point across lake from Potters Creek.	2008	
38	N 29°54.442' W -98°17.619'	Hump near river channel, south of Mystic Shores.	2009	2011
39	N 29°53.974' W -98°15.828'	River channel edge, east of Potters Creek.	2009	2011
40	N 29°53.334' W -98°15.211'	Flat point near river channel ledge.	2009	2011
41	N 29°53.768' W -98°17.171'	Hump North of Cranes Mill Marina.	2010	2011
42	N 29°51.619' W -98°14.837'	Creek channel bend near Comal Park.	2010	

APPENDIX E (Cont.)

GPS coordinates for Canyon Reservoir fish attractor locations. GPS coordinates are in degree decimal minutes. Attractors were installed or refurbished in January 2005 – 2011. Juniper brush piles, a.k.a. cedar trees (CT) and plastic artificial attractors (AFA) were used at the sites.

Site #	Lat/Long	Attractor Description	Installed	Last Supplemented
43	**N 29°53.794' W -98°13.711'**	**Hump on end of point near Canyon Park boat ramps.**	**2010**	
44	**N 29°53.648' W -98°13.278'**	**On big point in Jacobs Creek splitting arms**	**2011**	