PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-30-R-35

STATEWIDE FRESHWATER FISHERIES MONITORING AND MANAGEMENT PROGRAM

2009 Survey Report

Kirby Reservoir

Prepared by:

Ben Neely and Spencer Dumont
Inland Fisheries Division
District 1-B, Abilene, Texas

Carter Smith
Executive Director

Gary Saul
Director, Inland Fisheries

July 31, 2010

TABLE OF CONTENTS

SURVEY AND MANAGEMENT SUMMARY

Fish populations in Kirby Reservoir were surveyed in 2006-2010 using creels, hoop nets, electrofishing, trap nets, jug lines, gill nets, and low-frequency electrofishing. This report summarizes the results of the surveys and contains a management plan for the reservoir based on those findings.

- **Reservoir Description:** Kirby Reservoir is a 740-acre impoundment at conservation level and is located in the city limits of Abilene on Cedar Creek in the Brazos River Basin. The reservoir was completely dry in early fall 2000, but filled in July 2002 and has remained within five feet of conservation pool. Treated effluent water has been pumped into the reservoir since September 2001 and has helped maintain water level. Habitat primarily consisted of mud flats, rocks, brush, and bulrush. Two boat ramps and one handicap-accessible fishing pier were available for anglers. Bank fishing access was excellent.

- **Management History:** Kirby Reservoir went completely dry in 2000. Forage and sport fish were re-introduced as the reservoir filled. District staff have maintained contact with city officials and encouraged them to retain a high and stable water level in the reservoir with treated effluent water. Saugeye have been stocked annually since 2001 (excluding 2003 and 2007) to provide additional sport fishing opportunities. Abiotic fish habitat structures were placed in the reservoir in 2006 and 2008 to increase fish habitat diversity.

- **Fish Community**
  - **Prey species:** Predominant prey species were threadfin shad, gizzard shad, inland silversides, and bluegill. Prey fish were abundant in Kirby Reservoir and were capable of supporting quality sport fish populations.

  - **Catfishes:** A quality blue catfish population has been established and reproduction has occurred since the reservoir filled in 2002. Channel catfish were abundant although the population was mainly comprised of sub-legal fish. Approximately 60% of angling effort in March – August 2009 was directed toward catfishes.

  - **Largemouth bass:** Electrofishing catch rates of largemouth bass were similar in 2007 and 2009. However, catch rate of legal-size bass (≥ 14 in) in 2009 increased from 2005 and 2007 surveys. Only 3% of angler effort in March – August 2009 was directed toward largemouth bass. Most largemouth bass reached legal size by age 2 or 3.

  - **White crappie:** Trap net catch rate of white crappie was very high in 2004. However, catch rate has generally decreased since then. Nearly all white crappie sampled in 2008 and 2009 surveys were legal length (≥ 10 in). Most crappie reached legal size at age 1 or 2.

  - **Saugeye:** Large stockings in 2008 and 2009 have resulted in many sub-legal saugeye in Kirby reservoir. However, there are legal-size saugeye (≥ 18 in) in the reservoir as well. A habitat use survey revealed that adult saugeye preferred open water and mid-water ledge habitats year round and increasingly inhabited the east bank in winter and spring.

- **Management Strategies:** Request saugeye stockings annually and continue to inform anglers about saugeye fishing opportunities. Conduct creel survey from March – August 2012 and determine if angling effort for saugeye increases. Additionally, examine saugeye gut contents in summer to determine if saugeye are foraging on age-0 crappie. Consider discontinuing saugeye stockings if angler effort does not increase or white crappie constitute a large portion of saugeye gut contents. Continue with evaluation of jug lines, gill nets, and low-frequency electrofishing surveys to sample blue catfish. Propose a regulation to remove the minimum length limit for blue and channel catfish and only allow harvest of two fish ≥ 24 inches daily. Conduct additional electrofishing and trap net surveys in 2011 and jug line, gill net, hoop net, and low-frequency electrofishing surveys in 2012.

INTRODUCTION

This document is a summary of fisheries data collected from Kirby Reservoir in 2006-2010. 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

Kirby Reservoir is a 740-acre impoundment at conservation level and was constructed on Cedar Creek in 1928. It is located in Taylor County within the city limits of Abilene. It is operated and controlled by the city of Abilene. Primary uses included non-potable municipal water supply, water storage, and recreation. Watershed use was primarily residential and ranching. Habitat at time of sampling mainly consisted of rocks, bulrush, and submerged woody vegetation. In fall 2000, Kirby Reservoir went completely dry. Rain events in late 2000 and early 2001 added some water to the reservoir (Figure 1). A treated effluent water discharge permit was approved in 2001 and the city of Abilene began pumping reuse water into Kirby Reservoir in September 2001. The reservoir filled with a rain event in July 2002. Largely because of reuse water, the reservoir remained within five feet of conservation pool since it filled in 2002 (Figure 2). Kirby Reservoir reached conservation level after a rain event in January 2010. Figure 1 describes quarterly water levels in Kirby Reservoir from 1990 – 2010.

Two public boat ramps were available. Bank-fishing access covered nearly the entire shoreline. One handicap-accessible fishing dock was available. Other descriptive characters of Kirby Reservoir are in Table 1.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Dumont and Farooqi 2006) included:

1. Evaluate poor white crappie recruitment with increased trap net effort.

   Action: Trap nets were used in 2006, 2008, and 2009 to monitor the white crappie population. Samples were dominated by white crappie ≥ 10 in but relative abundance decreased.

2. Continue stocking saugeye and promote angling opportunities.

   Action: Approximately 12,000 saugeye fingerlings were stocked in 2006, 58,000 in 2008, and 109,000 in 2009. A telemetry survey was conducted from December 2007 to November 2008 to assess habitat use of adult saugeye. Habitat use patterns were identified and relayed to anglers via monthly publications in local newspapers and map handouts. Approximately 900 angling hours (2.38% of directed effort) were expended in March – August 2009 targeting saugeye.

3. Increase fish habitat with abiotic structures.

   Action: Eighty medusa structures (20 one- to four-foot sections of plastic irrigation tubing cemented in a cinder block) were placed around the fishing pier and in open water as a reef-type habitat in 2006. A FishAmerica grant ($7,500) was secured in 2008 and 100 Berkley Fish Habs (four foot cubes made from recycled fishing line; Berkley, Spirit Lake, IA) were purchased. Berkley Fish Habs were placed in the mouth of every cove, along the midwater ledge, in the northeast corner of the reservoir, and near the fishing pier in August 2008.

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

Stocking history: Kirby Reservoir was extensively stocked with various forage and sport fishes from 2000 to 2004 to re-establish fish populations that were extirpated when the reservoir went dry in October 2000. Stockings of saugeye were requested annually from 2001-2009. The stocking history since 2000 is in Table 3.

Vegetation/habitat management history: Numerous abiotic habitat structures were placed in Kirby Reservoir in 2006 and 2008. Eighty medusa structures and 100 Berkley Fish Habs were placed in cove mouths and other strategic areas of the reservoir to increase fish habitat.

METHODS

Fishes were collected by hoop netting (22 hoop net series at 22 stations), electrofishing (1.0 hour at 12, 5-min stations), trap netting (10 net nights at 10 stations), jug lining (160 jugs [each with two hooks] at 80 stations), gill netting (5 net nights at 5 stations), and low-frequency electrofishing (1.0 hour at 20, 3-min stations). The effect of hoop net soak duration on precision of channel catfish catch was evaluated in Kirby Reservoir in summer 2009. Hoop net catch was measured as the number of channel catfish caught per hoop net series, regardless of soak duration. Electrofishing CPUE and low-frequency electrofishing CPUE were recorded as the number of fish caught per hour (fish/h) of actual electrofishing. Trap net and gill net CPUE were calculated as the number of fish per net night (fish/nn). Jug line CPUE was recorded as the number of fish per hook-night (fish/hn).

Electrofishing, trap netting, and gill netting surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual, revised 2009). Survey sites were randomly generated for all gear deployments. A habitat survey was conducted in summer 2008 by assessing substrate and cover at 618 points arranged in transects. Depth profiles were measured in summer 2005 using a boat-mounted Garmin GPSmap 398 and depth contours were digitized using ArcGIS 3.3.

A hoop net series consisted of three hoop nets tied in tandem (Sullivan and Gale 1999). Each net was baited with approximately 2 lbs of cheese log (Boatcycle, Henderson, TX) suspended above the terminal throat in a mesh bag. Hoop netting was conducted in summer 2009 when water temperature was approximately 70 - 80^{o}F. All hoop net series were deployed at randomly selected locations. Jug lines were deployed with a foam block as the float and anchored with an approximate 8-lb lead weight. Two circle hooks with 12-in leaders were tied to the line between the float and the weight. One leader was tied 2 ft above the terminal weight and another leader was tied 4 ft above the terminal weight. One hook size (5/0 or 7/0) was used on each jug and equal numbers of jugs with each hook size were used to sample the blue catfish population. All jug lines were deployed in randomly selected locations. Low-frequency electrofishing (DC, 1000 V, 15 pulses/sec, 4.0 ± 0.5 A) was conducted in April 2010 when surface water temperature was 61 - 65^{o}F. Each low-frequency electrofishing station was randomly selected.

A roving creel was used to collect angler information. Boat angler data were collected by placing a survey card under the windshield wiper of each vehicle with a boat trailer that was present in the parking lot at the beginning of each creel survey. Instructions were printed on the survey card distributed to boat anglers to place the completed survey in a locked box near the boat ramp. A total of 31 roving creels were completed in March – May 2009, and 29 were completed in June – August 2009. Boat surveys were no longer distributed or collected after June 7, 2009 because the survey deposit box was vandalized. However, boat anglers were counted for the duration of the creel period. Standard creel statistics were calculated according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual, revised 2009). Proportional angling success (PAS) scores were calculated, by taxa, as the proportion of anglers catching 0.5 target fish / hour (PAS_{50}) and 1.0 target fish / hour (PAS_{100}) (Bailey 2007). Chi-square tests, with Bonferroni-corrected alpha = 0.017, were used to test for differences in PAS_{50} and PAS_{100} for selected target taxa between 2005, 2006, and 2009.

Seasonal home ranges and habitat selection of 17 saugeye were measured using ultrasonic telemetry from December 2007 – November 2008 on 118 randomly selected dates. Start times were randomly selected during daytime to collect information that would benefit anglers. Telemetry data were grouped by season (i.e., spawn, spring, summer, fall, and winter) for proportional home range and habitat selection analyses. Proportional home ranges (PHRs) were calculated for each fish, by season, by dividing the areal extent of its 100% minimum convex polygon range by the total surface area of the reservoir. A one-way ANOVA was used to determine seasonal differences in PHRs. Least-square means were used for post hoc pairwise comparisons with Bonferroni corrections to preserve experimentwise type-I error. Compositional analysis was used to test for randomness of habitat use within the telemetered population (Aebischer et al. 1993). If habitat use was determined to be non-random, then selection occurred and post hoc *t*-tests were used to rank habitats in order of selection.

Sampling statistics (CPUE for various length categories), structural indices (Proportional Size Distribution [PSD]), and condition indices (relative weight [W_r]) were calculated for target fishes according to Anderson and Neumann (1996). Size structure index terminology was modified according to Guy et al. (2007). Index of vulnerability (IOV) was calculated for gizzard shad (DiCenzo et al. 1996). Total forage was measured by summing gizzard shad < 8 in CPUE, threadfin shad CPUE, and bluegill CPUE.

Standard error (SE) was calculated for IOV and PSD estimates and relative standard error (RSE) was calculated for all CPUE statistics. Ages of 13 largemouth bass (13 – 15”) and 41 white crappie (9 – 13”) were determined by counting annular growth rings on otoliths. Microsatellite DNA analysis was used to determine genetic makeup of 30 age-0 largemouth bass in 2007. Relation of prey community relative abundance to effluent water input was examined with linear regression. Differences in blue catfish size structure, as estimated by jug lines, gill nets, and low-frequency electrofishing, were measured with a Kolmogorov-Smirnov test. Mean largemouth bass W_r values, by size class, were compared pre- and post-effluent water input with *t*-tests. Statistical significance was determined at alpha = 0.05 for all tests unless otherwise noted. Water level was determined by visual inspection of a gauge located at the dam.

RESULTS AND DISCUSSION

Habitat: Habitat in Kirby Reservoir consisted of shallow water flats (SW; < 9 ft deep with silt and clay bottom), open water (OW; > 9 ft deep with silt and clay bottom), emergent vegetation (EV; primarily bulrush and dead brush), rock and gravel (RG; sloping shoreline with rock and gravel substrate), midwater ledge (ML; area with rapid bottom contour change relative to adjacent areas), and riprap (RR; submerged, revetted dam face) (Figure 3; Table 4). Depth contours are represented in Figure 4.

Creel: Total angling effort in 2009 was 36,892 hours. Angling effort in 2009 was increased from 2005 (24,428 hours) and 2006 (17,076 hours) estimates. Bank anglers remained prominent at Kirby Reservoir in 2009 and accounted for approximately 88% of angling effort from March - August. Directed effort was spread among seven species and three general taxa (i.e., catfishes, sunfishes, and anything). Catfish anglers and anglers not targeting any specific taxa or species accounted for approximately 84% of all angling effort in 2009 (Table 5). Overall, mean angler catch was 0.94 fish/h in 2009. Directed catch rates ranged from 0.00 fish/h (saugeye) to 3.81 fish/h (bluegill) in 2009 (Table 6). Chi-square analyses of PAS scores indicated that success of anglers targeting blue catfish, largemouth bass, white crappie, anything, and catfishes did not differ between 2005, 2006, and 2009 (Figure 5). Temporal comparisons between other targeted species were not made because of small sample sizes.

Prey species: Electrofishing CPUE was 648.0/h for gizzard shad, 83.0/h for threadfin shad, and 865.0/h for bluegill. Gizzard shad IOV was 91 in 2009; similar to measurements in 2007 (94) and 2005 (85). Gizzard shad CPUE in 2009 increased from 2007 (250/h) and 2005 (251/h) surveys (Figure 6). Bluegill CPUE was similar in 2009 (865/h) and 2007 (864/h) but increased from 2005 (277/h) (Figure 7). Directed angling effort for bluegill in March – August 2009 was approximately 715 hours and an estimated 4,694 were harvested during that time period (Table 7; Figure 8). Total forage in 2009 was 1,538/h. Relative abundance of total forage was positively related to annual effluent water input based on the five most

recent pre-effluent water electrofishing samples (1994, 1995, 1997, 1998, and 1999) and the five most recent post-effluent water electrofishing samples (2002, 2004, 2005, 2007, and 2009) ($P = 0.023$, $r^2 = 0.49$; Figure 9).

Blue catfish: In 2010, 52 blue catfish were sampled with gill nets and ranged from 8 to 29 in. Catch rate of blue catfish in gill nets was 10.4/nn in 2010, similar to 9.4/nn in 2006 (Figure 10). Sixty-one blue catfish were sampled with jug lines in 2009 and ranged from 17 to 35 in. Catch rate of blue catfish with jug lines was 0.19/hn and catch rate of quality-length blue catfish was 0.17/hn. In 2010, 176 blue catfish were sampled with low-frequency electrofishing and ranged from 7 – 28 in. Length frequency analysis revealed that jug line sampled fish were generally larger than gill net sampled fish (D = 0.669; $P < 0.001$; Figure 11) and low-frequency electrofishing sampled fish (D = 0.904; $P < 0.001$; Figure 11). Additionally, gill nets generally sampled larger blue catfish than low-frequency electrofishing (D = 0.577; $P < 0.001$; Figure 11). Estimated effort for blue catfish angling was 2,433 hours (Table 8) and an estimated 1,667 blue catfish (2.3/acre) were harvested in March – August 2009 (Figure 12). Mean PAS_{50} from 2005, 2006, and 2010 creel surveys was 36 (SE = 7) indicating that 36% of angling groups targeting blue catfish caught at least 0.5 blue catfish/hour. Mean PAS_{100} from 2005, 2006, and 2010 creel surveys was 29 (SE = 11) indicating that 29% of angling groups targeting blue catfish caught at least 1.0 blue catfish/hour.

Channel catfish: Gill net CPUE was 4.8/nn in 2010 and similar to CPUE in 2006 (4.0/nn). However, size distribution in 2010 (PSD = 29) was shifted toward smaller fish compared to 2006 (PSD = 88) (Figure 13). A total of 2,003 channel catfish ranging from 3-19 in were collected from hoop nets in 2009. Approximately 89% of sampled fish were less than 12 in (Figure 14). Hoop nets with three-night soak durations more precisely sampled channel catfish than hoop nets with one- or two-night soak durations in Kirby Reservoir (Table 9). Channel catfish anglers expended 729 hours of effort (Table 10) and an estimated 3,948 channel catfish were harvested in March – August 2009 (Figure 15).

Largemouth bass: The electrofishing catch rate of stock-length largemouth bass was 87.0/h in 2009 and increased compared to 2007 (51.2/h) and 2005 (22.4/h) (Figure 16). The PSD value in 2009 (84) increased from 2007 (52) and 2005 (71). Body condition of fish sampled in 2009 revealed that W_r generally increased with fish length (Table 11). Relative weights of largemouth bass < 20 in were greater in post-effluent water input years (2004, 2005, 2007, and 2009) than pre-effluent water years (1997, 1998, and 1999) (Figure 17). Mean age at 14 in (13.5 to 14.5 in) was 2.1 years (N = 8; range = 2 – 3 years). Genetic composition of largemouth bass in 2007 indicated the population was dominated by Florida-strain alleles (70%). Additionally, Florida-strain genotypes (40%) were more prevalent than northern-strain genotypes (10%) (Table 12). Angling effort for largemouth bass in March – August 2009 (1,140 h) was less than effort in 2006 (2,013 h) and similar to effort in 2005 (1,284 h). Mean angler-catch/hour in March – August was similar in 2009 (0.33/h) and 2006 (0.25/h) but decreased compared to 2005 catch (0.59/h) (Table 13). Largemouth bass harvest remained low in 2009 (Figure 18). Mean PAS_{50} from 2005, 2006, and 2010 creel surveys was 21 (SE = 2) indicating that 21% of angling groups targeting largemouth bass caught at least 0.5 largemouth bass/hour. Mean PAS_{100} from 2005, 2006, and 2010 creel surveys was 14 (SE = 5) indicating that 14% of angling groups targeting largemouth bass caught at least 1.0 largemouth bass/hour.

White crappie: Trap net catch rate of white crappie was 4.1/nn in 2009. Catch rate decreased from 2008 (6.9/nn) and 2006 (11.5/nn) samples (Figure 19). The PSD for white crappie in 2009 was 100 and has remained high since 2006 (PSD > 80). The lack of white crappie < 9 in suggests that reproduction and/or recruitment are limited in Kirby Reservoir. Mean length of age-2 fish was 11.3 in (N = 38; range = 9.3 to 12.3 in). Mean age at 10 in (9.5 to 10.5 in) was 1.6 years (N = 5; range = 1 to 2 years). Angling effort for white crappie increased in March – August 2009 (1,524 h) compared to 2006 (783 h) but was substantially lower than the estimated effort in 2005 (6,706 h) (Table 14). An estimated 205 white crappie were harvested in March – August 2009 (Figure 20). Mean PAS_{50} from 2005, 2006, and 2010 creel surveys was 17 (SE = 4) indicating that 17% of angling groups targeting white crappie caught at least 0.5 white crappie/hour. Mean PAS_{100} from 2005, 2006, and 2010 creel surveys was 15 (SE = 5) indicating that 15% of angling groups targeting white crappie caught at least 1.0 white crappie/hour.

Saugeye: Fifty-one saugeye were sampled by electrofishing in 2009 and 65 were sampled with gill nets in 2010. Saugeye sampled with electrofishing ranged from 6 – 24 in with 73% of the total catch being 7 – 8 in (Figure 21). Gill net sampled saugeye ranged from 8 – 25 in with 91% of the total catch measuring 9-11 in. Gill net CPUE of saugeye in 2010 was 13.0/nn and similar to CPUE in 2006 (16.4/nn). However, size structure shifted toward smaller fish in 2010 and evident year classes weren't sampled as in 2006 (Figure 22).

Telemetry data revealed that saugeye generally exhibited seasonal variation in habitat selection patterns. However, saugeye frequently selected open water and mid-water ledge habitats throughout the year (Figure 23). Saugeye in Kirby Reservoir exhibited non-random habitat selection during all seasons (winter: $\Lambda = 0.013$, df = 5, $P < 0.001$; spawn: $\Lambda = 0.085$, df = 5, $P < 0.001$; spring: $\Lambda = 0.118$, df = 4, $P < 0.001$; summer: $\Lambda = 0.120$, df = 4, $P < 0.001$; fall: $\Lambda = 0.347$, df = 4, $P = 0.005$). All habitats were used by at least one fish in all seasons excluding RR in spring, summer and fall. Therefore, RR was removed from habitat selection analysis in spring, summer and fall. In winter, habitat selection was ranked in descending order as OW, ML, RG, SW, EV, RR. During spawn, habitats were ranked in descending order of selection as ML, OW, RG, SW, EV, RR. In spring, habitats were ranked in descending order of selection as ML, OW, SW, EV, RG. During summer, habitats were ranked in descending order of selection as OW, ML, SW, EV, RG. In fall, habitats were ranked in descending order of selection as OW, ML, SW, RG, EV. All seasonal pairwise comparisons are listed in Table 15.

Mean PHR estimates of saugeye in Kirby Reservoir differed among seasons ($F = 3.55$, $P = 0.010$). Seasonal mean PHR estimates were greatest during spawn followed by spring, summer, fall, and winter (Table 16). Post hoc pairwise comparisons revealed the only seasonal difference in mean PHR size was between spawn and winter ($t = 3.66$, $P = 0.005$).

Monthly angler guides were published in several area newspapers from February – September 2009 highlighting saugeye habitat use by month in an attempt to increase angling effort for saugeye. However, angling effort for saugeye in March – August 2009 (877 h) did not increase from 2006 (810 h). An estimated 23 saugeye were caught and released in Kirby Reservoir in 2009.

Fisheries management plan for Kirby Reservoir, Texas

Prepared – July 2010.

ISSUE 1: Few white crappie < 10 in were sampled in 2008 and 2009 trap net samples suggesting limited reproduction or recruitment.

MANAGEMENT STRATEGY

1. Monitor white crappie population biennially with trap nets to assess size structure.
2. Examine gut contents of saugeye in summer for age-0 white crappie.
3. Consider discontinuing saugeye stockings if white crappie are predominant forage for saugeye in Kirby Reservoir.

ISSUE 2: Angling effort for saugeye was unchanged in 2009 from 2006 despite consistent stockings to supplement the population and intensive promotional efforts.

MANAGEMENT STRATEGY

1. Continue to request saugeye fingerlings annually at 50 fish/acre to sustain existing population.
2. Continue to distribute maps of saugeye habitat use patterns in an effort to increase saugeye angling effort and angler catch rates.
3. Obtain and distribute information on angling techniques to improve saugeye catch rates.
4. Conduct creel survey in spring and summer 2012 to estimate saugeye angling effort and harvest.
5. Consider discontinuing saugeye stockings if directed effort does not increase.

ISSUE 3: A small-scale evaluation of three sampling gears (jug lines, gill nets, and low-frequency electrofishing) suggests that each gear samples different size groups of blue catfish from Kirby Reservoir.

MANAGEMENT STRATEGY

1. Further evaluate effectiveness of jug lines, gill nets, and low-frequency electrofishing gears to sample blue catfish.
2. If discrepancies remain, consider a multi-reservoir evaluation.

ISSUE 4: Numerous blue catfish > 10 lbs were observed in Kirby Reservoir in 2009-2010. Creel surveys and anecdotal evidence suggest that blue catfish exploitation may become problematic if current harvest tendencies continue. Additionally, channel catfish < 12 in are abundant in Kirby Reservoir.

MANAGEMENT STRATEGY

1. A mail-out survey was sent to 1,000 randomly selected fishing license holders in a five-county area around Abilene to gauge angler opinion on local blue catfish management. Survey respondents who indicated they fished for blue catfish in Kirby Reservoir (N = 32) generally supported harvest restrictions for big blue catfish (56%) and generally opposed reduction of the daily bag limit (65%). Approximately 81% of these respondents indicated that they preferred to eat blue catfish < 24 in.
2. Remove the minimum length limit for blue and channel catfish and only allow two fish ≥ 24 in to be harvested daily. Retain the current 25-fish daily bag limit.
3. Evaluate blue catfish and channel catfish populations with jug lines, gill nets, low-frequency electrofishing, and hoop nets biennially to assess population size structure.
4. Conduct creel survey in spring/summer 2012 to estimate blue catfish and channel catfish angling effort and harvest.

SAMPLING SCHEDULE JUSTIFICATION:

The proposed sampling schedule includes additional monitoring in 2011/2012 and standard monitoring in 2013/2014 (Table 17). Electrofishing will be used for both additional and standard sampling and will allow assessment of the largemouth bass population, prey-fish community, and saugeye population. Gill nets will be deployed during both additional and standard sampling periods to allow further assessment of the channel catfish, blue catfish, and saugeye populations. Trap nets will be deployed biennially to assess the white crappie population. Hoop nets and low-frequency electrofishing will be conducted during both additional and standard sampling periods to assess channel catfish and blue catfish populations.

LITERATURE CITED

Aebischer N. J., P. A. Robertson, and R. E. Kenward. 1993. Compositional analysis of habitat use from animal radio-tracking data. Ecology 74: 1313-1325.

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Bailey, P. E. 2007. Proportional angling success: an alternative approach to representing angler success. Fisheries 32:129-135.

DiCenzo, V. J., M. J. Maceina, and M. R. Stimert. 1996. Relations between reservoir trophic state and gizzard shad population characteristics in Alabama reservoirs. North American Journal of Fisheries Management 16:888-895.

Dumont S., and M. Farooqi. 2006. Statewide freshwater fisheries monitoring and management program survey report for Kirby Reservoir, 2005. Texas Parks and Wildlife Department, Federal Aid Report F-30-R, Austin.

Guy, C. S., R. M. Neumann, D. W. Willis, and R. O. Anderson. 2007. Proportional size distribution (PSD): a further refinement of population size structure index terminology. Fisheries 32:348.

Sullivan K. P., and C. M. Gale. 1999. A comparison of channel catfish catch rates, size distributions, and mortalities using three different gears in a Missouri impoundment. Pages 293-300 *in* E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr., and T. Coon, editors. Catfish 2000: proceedings of the international symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

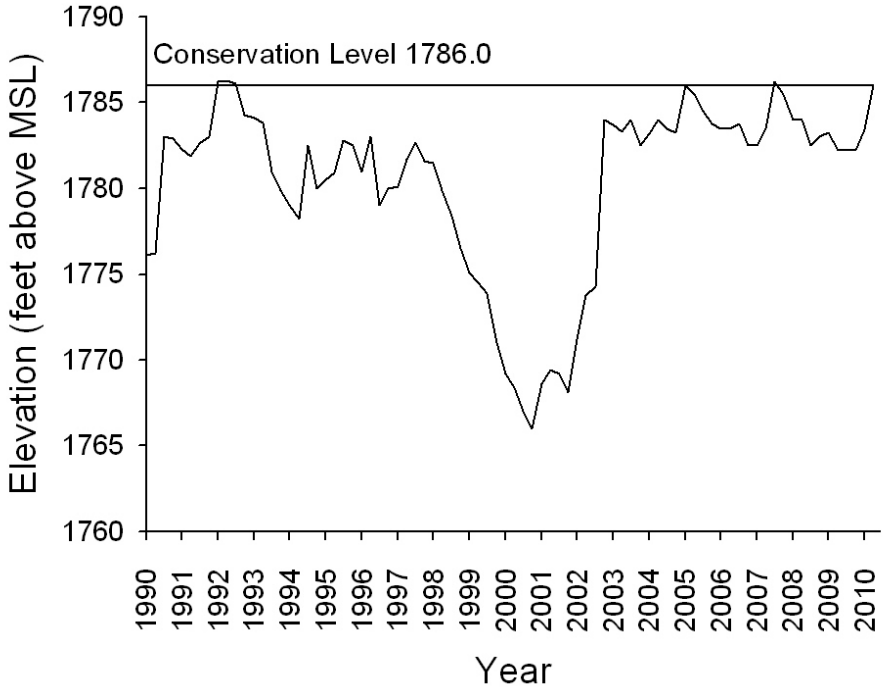


Figure 1. Quarterly water level elevations in feet above mean sea level (MSL) recorded for Kirby Reservoir, Texas, 1990-2010.

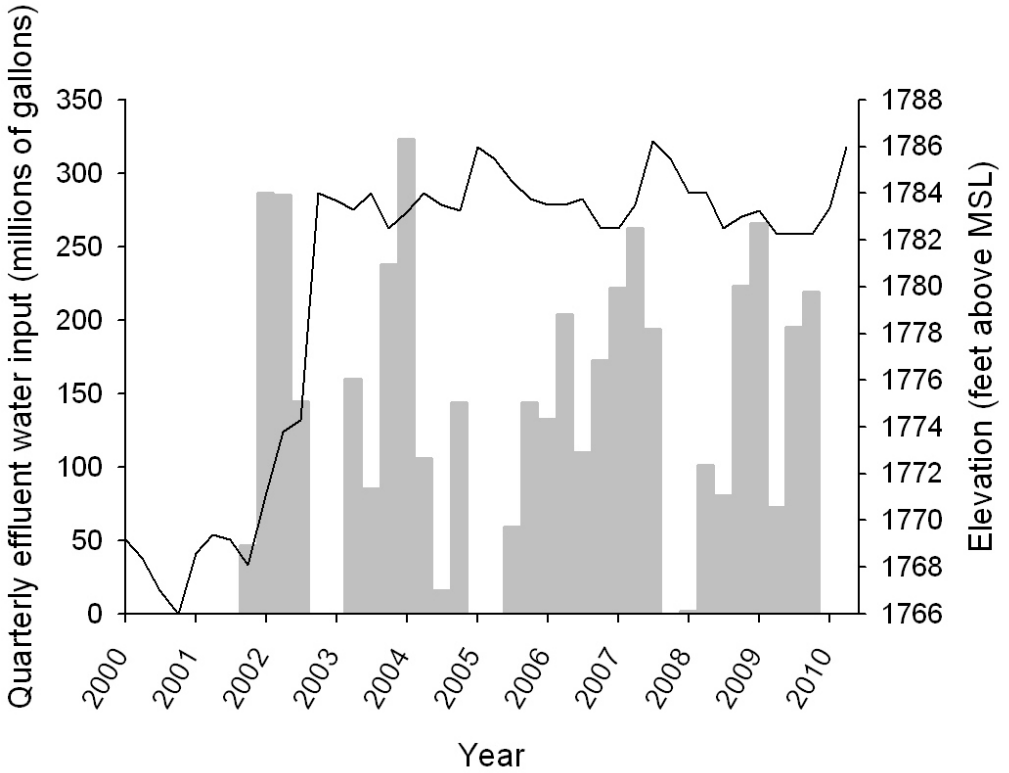


Figure 2. Quarterly effluent water input into Kirby Reservoir, Texas, 2001-2010, in millions of gallons (shaded bars). Quarterly water level elevations are presented on the secondary y-axis (line).

Table 1. Characteristics of Kirby Reservoir, Texas.

Characteristic	Description
Year constructed	1928
Controlling authority	City of Abilene, TX
Water uses	Municipal supply; recreation; flood control
Impoundment size	740 acres at conservation level
County	Taylor
Geographical coordinates	32° 23' N; 99° 44' W
Watershed basin	Cedar Creek in the Brazos River Basin
Mean depth	6.5 ft
Maximum depth	18.0 ft
Secchi disc range	1-3 ft
Shoreline Development Index	2.18
Conductivity	1000 µmhos/cm
Boat access	2 ramps
Handicap access	1 fishing pier
Bank access	Abundant

Table 2. Harvest regulations for Kirby Reservoir, Texas.

Species	Bag Limit	Minimum – Maximum Length (in)
Catfish: channel and blue catfish, their hybrids and subspecies	25 (in any combination)	12 – No Limit
Catfish, flathead	5	18 – No Limit
Bass, largemouth	5	14 – No Limit
Crappie: white and black crappie, their hybrids and subspecies	25 (in any combination)	10 – No Limit
Saugeye	3	18 – No Limit

Table 3. Stocking history in Kirby Reservoir, Texas from 2000 – 2008. Size categories are: FRY < 1 in; FGL = 1-3 in; ADL = adults.

Species	Year	Number	Size
Threadfin shad	2002	300	ADL
	Total	300	
Golden shiner	2000	100	ADL
	Total	100	
Fathead minnow	2000	500	ADL
	Total	500	
Inland silverside	2001	200	ADL
	Total	200	
Blue catfish	2001	74,000	FGL
	Total	74,000	
Channel catfish	2001	73,794	FGL
	2004	1,621	FGL
	Total	75,415	
Flathead catfish	2003	44	ADL
	Total	44	
Bluegill	2001	370,196	FGL
	2001	475	ADL
	Total	370,671	
Largemouth bass	2003	8,775	FGL
	2004	76,290	FGL
	Total	85,065	
Florida Largemouth Bass	2002	51,315	FGL
	Total	51,315	
Saugeye	2001	704,701	FRY
	2002	143,101	FRY
	2002	8,410	FGL
	2004	37,425	FGL
	2005	15,806	FGL
	2006	12,134	FGL
	2008	58,500	FGL
	2009	108,815	FGL
	Total	1,088,892	

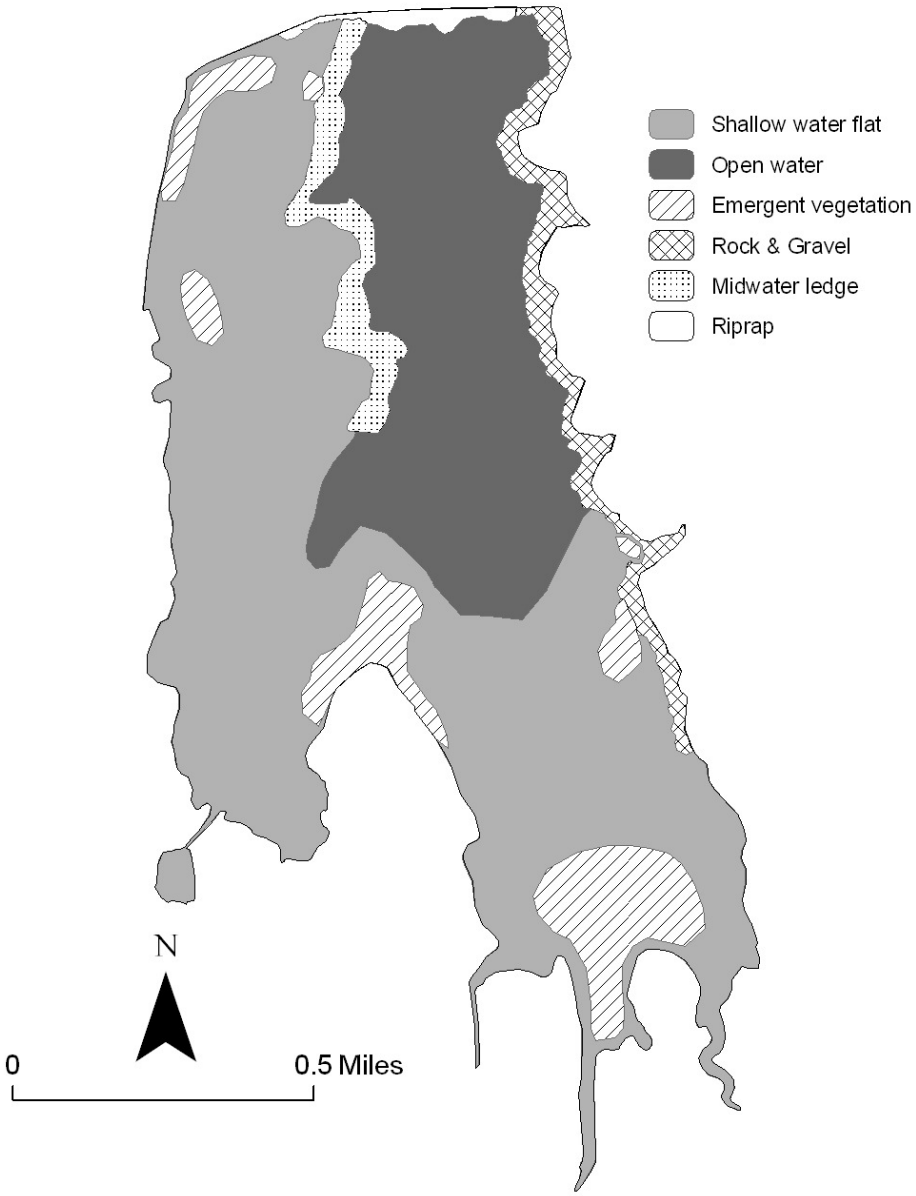


Figure 3. Habitat map of Kirby Reservoir, Texas, 2008.

Table 4. Areal coverage and proportion of habitats in Kirby Reservoir, Texas, 2008. The reservoir was approximately 2 ft below conservation level at time of habitat sampling.

Habitat type	Area (Acres)	Proportion
Shallow water flat	377	55.0%
Open water	188	27.4%
Emergent vegetation	63	9.2%
Rock & Gravel	29	4.2%
Midwater ledge	23	3.4%
Riprap	5	0.8%
Total	685	

Figure 4. Depth contour map (with 2 ft contour lines) of Kirby Reservoir, Texas, 2005.

Table 5. Angler hours and percent directed effort, by species or general taxa, in Kirby Reservoir, Texas, 2005, 2006, and 2009. Creel surveys were conducted March – August each year. Asterisks indicate no observed effort.

	2005		2006		2009	
Species	Hours (RSE)	Percent	Hours (RSE)	Percent	Hours (RSE)	Percent
Common carp	65 (148)	0.26	24 (212)	0.14	511 (41)	1.39
Blue catfish	554 (48)	2.27	99 (80)	0.58	2,433 (21)	6.60
Channel catfish	550 (51)	2.25	66 (98)	0.39	729 (35)	1.97
Flathead catfish	***	***	94 (82)	0.55	***	***
Catfishes	7,732 (17)	31.65	7,340 (19)	42.99	19,229 (13)	52.11
Bluegill	***	***	554 (49)	3.25	715 (37)	1.94
Sunfishes	***	***	***	***	1,070 (31)	2.90
Largemouth bass	1,284 (31)	5.26	2,013 (29)	11.79	1,140 (29)	3.09
White Crappie	6,706 (19)	27.45	783 (37)	4.58	1,524 (25)	4.13
Saugeye	***	***	810 (46)	4.74	877 (79)	2.38
Anything	7,538 (17)	30.86	5,293 (19)	30.99	8,665 (14)	23.49

Table 6. Mean angler catch/hour (CPUE) and relative standard error (RSE), by species or general taxa, in Kirby Reservoir, Texas, 2005, 2006, and 2009. Creel surveys were conducted March – August each year. Asterisks indicate no RSE was calculated.

Species	2005 CPUE (RSE)	2006 CPUE (RSE)	2009 CPUE (RSE)
Common carp	1.00 (***)	0.00 (***)	1.69 (45)
Blue catfish	0.43 (100)	1.00 (100)	0.35 (41)
Channel catfish	1.77 (112)	0.33 (***)	1.14 (149)
Catfishes	0.64 (37)	0.57 (50)	0.73 (18)
Bluegill	0.00 (***)	0.33 (***)	3.81 (29)
Sunfishes	0.00 (***)	0.00 (***)	0.67 (47)
Largemouth bass	0.59 (103)	0.25 (77)	0.33 (108)
White Crappie	0.35 (34)	0.06 (52)	0.31 (52)
Saugeye	0.00 (***)	0.16 (103)	0.00 (***)
Anything	0.93 (45)	0.61 (44)	0.59 (23)

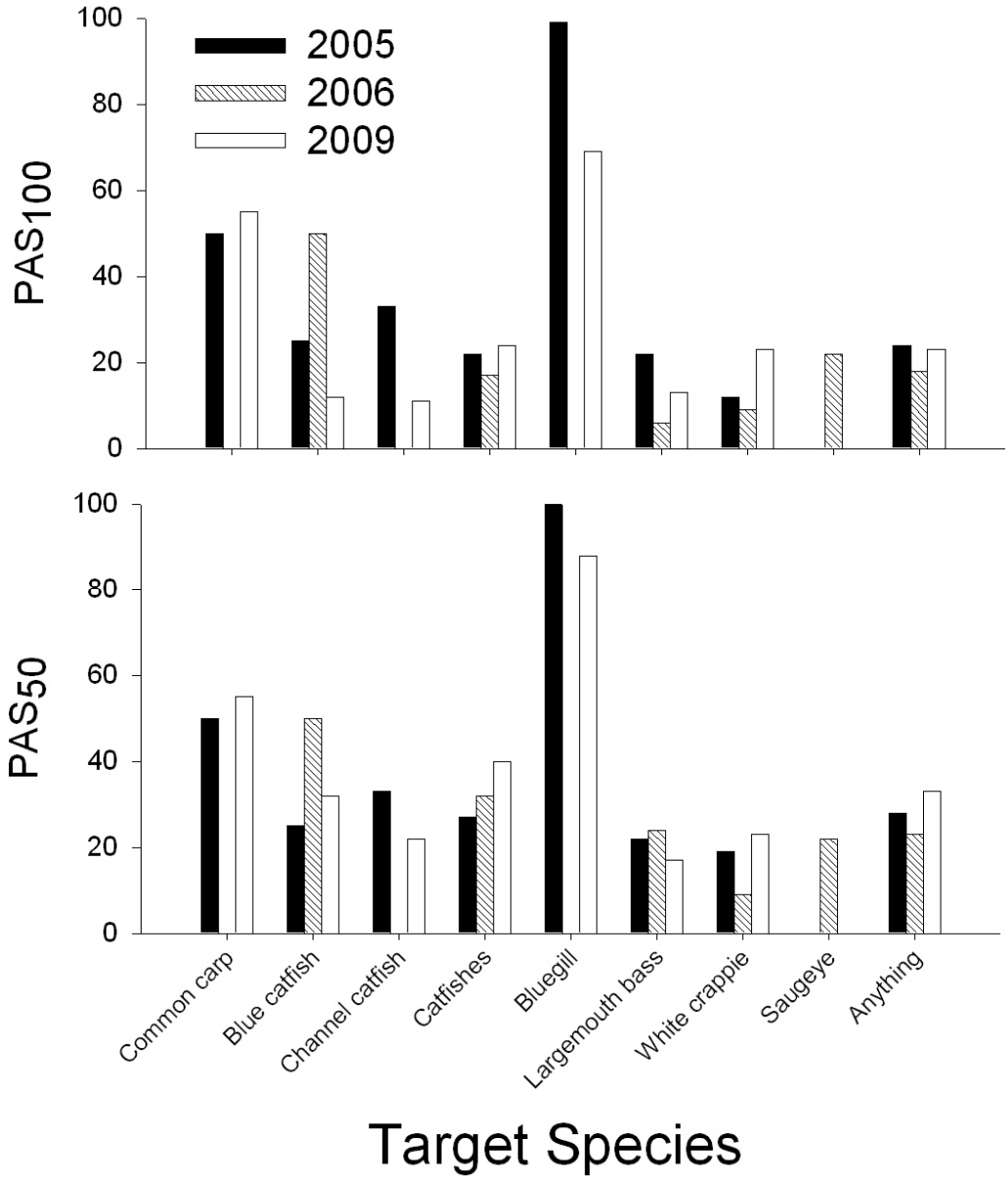
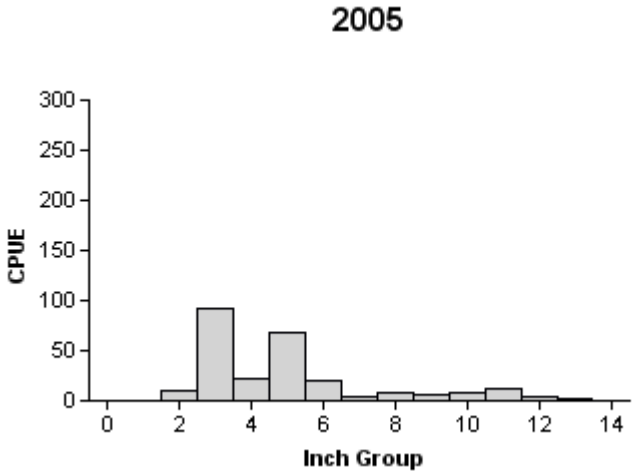
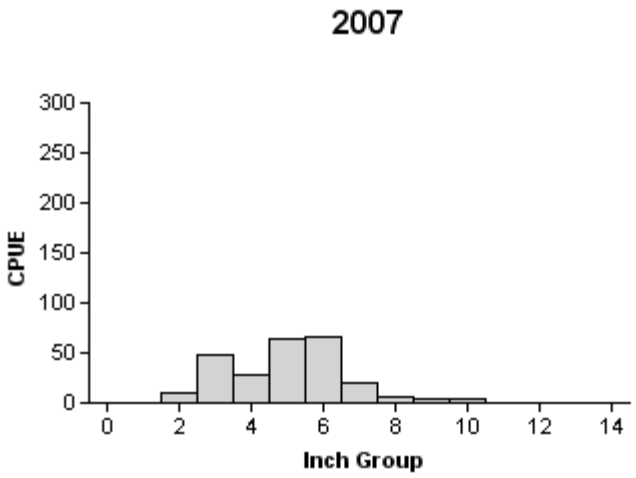


Figure 5. Proportion of anglers who caught ≥ 1.0 target fish / hour (PAS_{100}) and ≥ 0.5 target fish / hour (PAS_{50}) in Kirby Reservoir, 2005, 2006, and 2009. Creel survey data were collected from March – August each year.

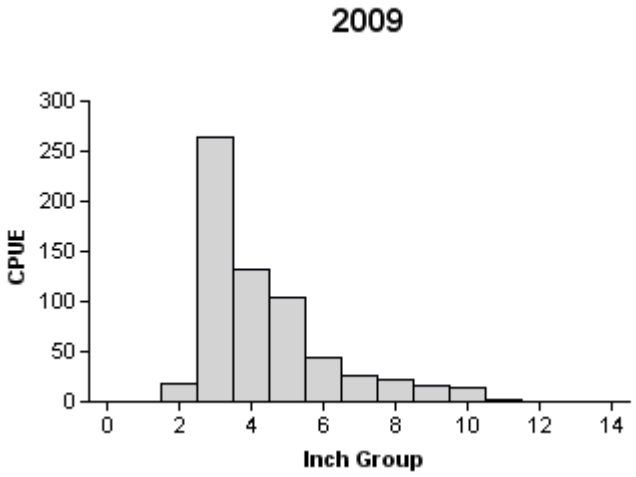
Gizzard Shad



Effort = 1.3
Total CPUE = 251.2 (41; 314)
IOV = 85 (8)



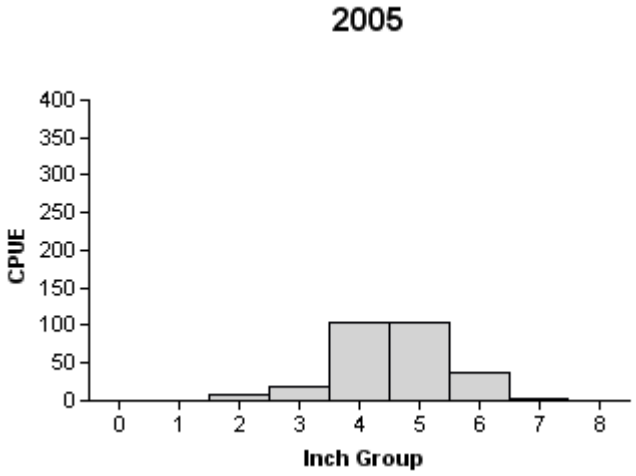
Effort = 1.3
Total CPUE = 250.4 (24; 313)
IOV = 94 (2)



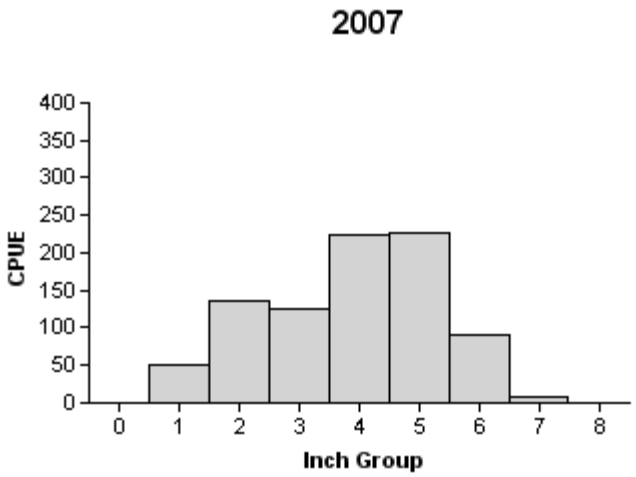
Effort = 1.0
Total CPUE = 648.0 (59; 648)
IOV = 91 (7)

Figure 6. Number of gizzard shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Kirby Reservoir, Texas, 2005, 2007, and 2009.

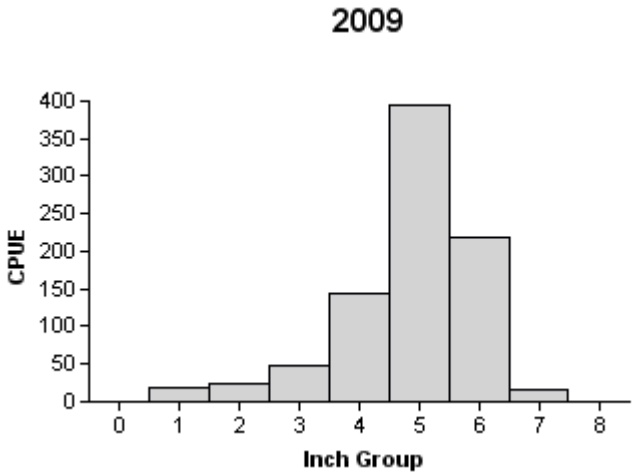
Bluegill



Effort = 1.3
Total CPUE = 276.8 (26; 346)
CPUE-6 = 39.2 (43; 49)
PSD = 15 (5)



Effort = 1.3
Total CPUE = 864.0 (25; 1080)
CPUE-6 = 100.0 (36; 125)
PSD = 15 (2)



Effort = 1.0
Total CPUE = 865.0 (20; 865)
CPUE-6 = 236.0 (26; 236)
PSD = 29 (4)

Figure 7. 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, Kirby Reservoir, Texas, 2005, 2007, and 2009.

Bluegill

Table 7. Creel survey statistics for bluegill at Kirby Reservoir from March – August, 2005, 2006, and 2009. Total catch per hour is for anglers targeting bluegill and total harvest is the estimated number of bluegill harvested by all anglers. Relative standard errors (RSE) are in parentheses. Asterisks indicate no statistic was calculated.

Creel Survey Statistic	Year		
	2005	2006	2009
Directed effort (h)	***	554 (49)	715 (37)
Directed effort/acre	***	0.75 (49)	0.97 (37)
Total catch per hour	***	0.33 (***)	3.81 (29)
Total harvest	2,192 (80)	1,997 (60)	4,694 (28)
Harvest/acre	2.96 (80)	2.70 (60)	6.34 (28)
Percent legal released	44	43	31

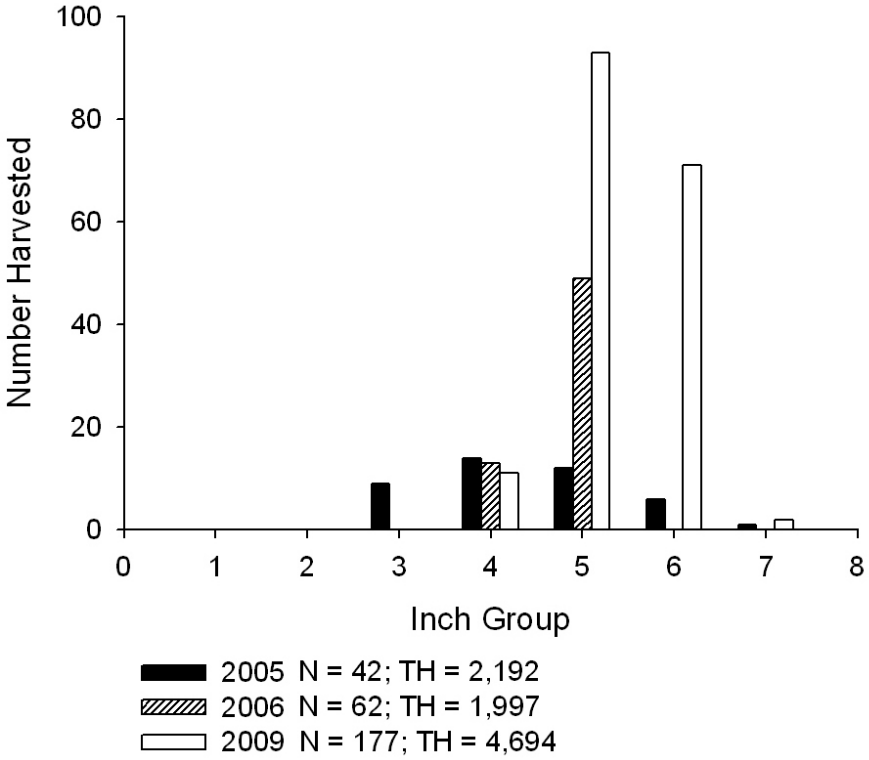


Figure 8. Length frequency of harvested bluegill observed during creel surveys at Kirby Reservoir, Texas, March – August, 2005, 2006, and 2009. The number of observed harvested bluegill during each creel survey is notated by N, and TH is the total estimated harvest for each creel period.

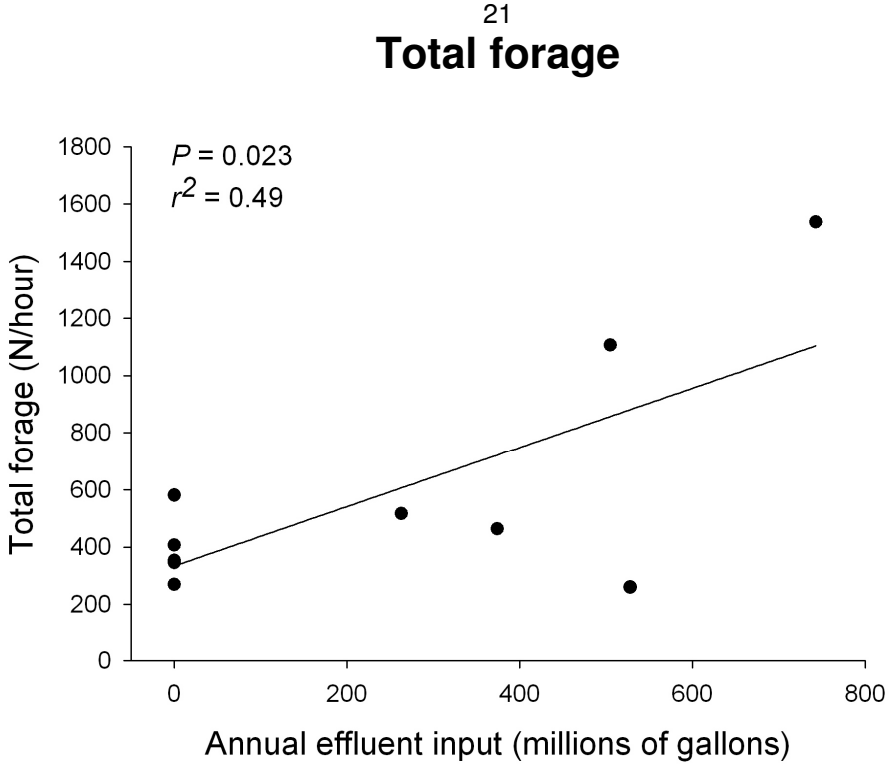
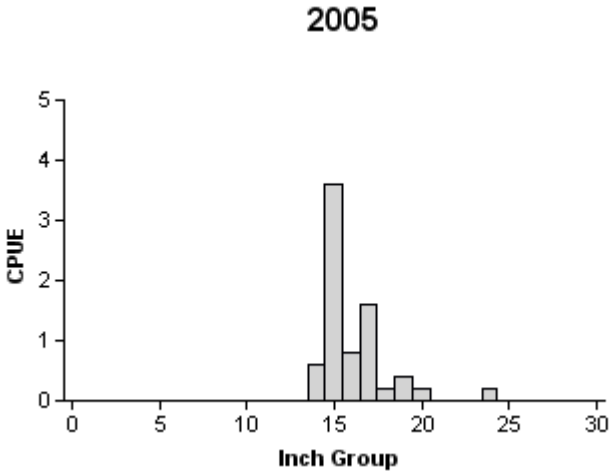
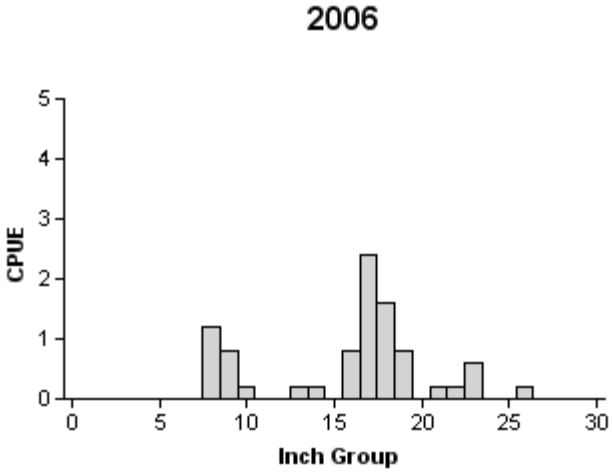


Figure 9. Positive relation between annual effluent water input and total forage (calculated as sum of gizzard shad < 8 in CPUE, threadfin shad CPUE, and bluegill CPUE) in Kirby Reservoir based on the five most recent pre-effluent water electrofishing samples (1994, 1995, 1997, 1998, and 1999) and the five most recent post-effluent water electrofishing samples (2002, 2004, 2005, 2007, and 2009).

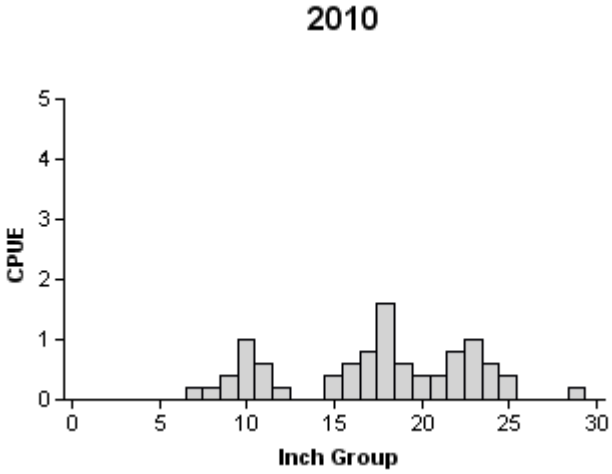
Blue catfish



Effort =	5.0
Total CPUE =	7.6 (27; 38)
CPUE-12 =	7.6 (27; 38)
CPUE-20 =	0.4 (61; 2)
PSD =	5 (3)



Effort =	5.0
Total CPUE =	9.4 (30; 47)
CPUE-12 =	7.2 (31; 36)
CPUE-20 =	1.2 (61; 6)
PSD =	17 (11)



Effort =	5.0
Total CPUE =	10.4 (10; 52)
CPUE-12 =	8.0 (13; 40)
CPUE-20 =	3.8 (34; 19)
PSD =	48 (11)

Figure 10. Number of blue catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Kirby Reservoir, Texas, 2005, 2006, and 2010.

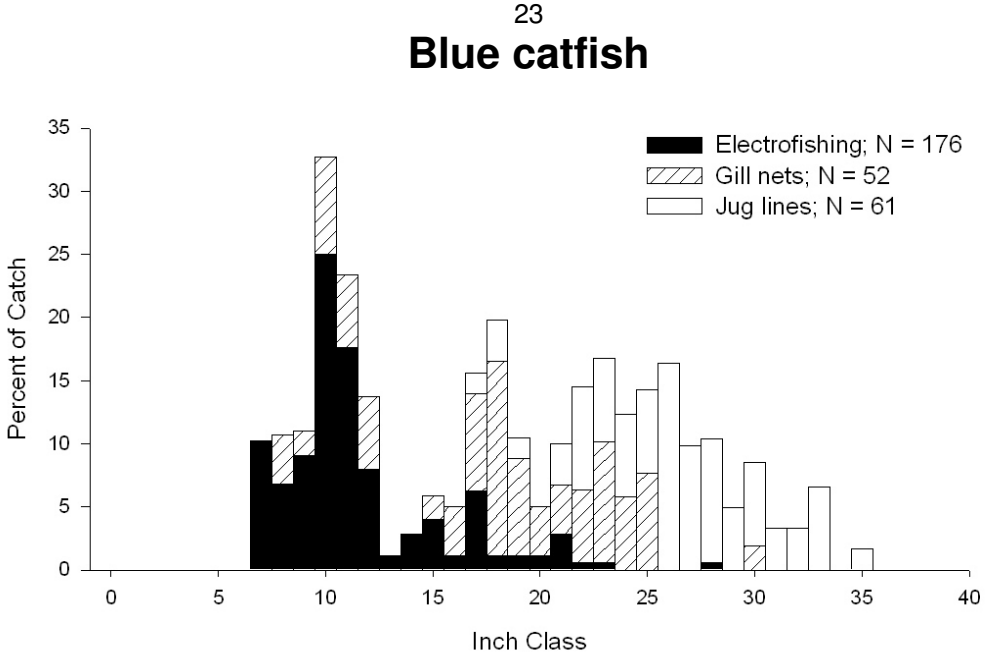


Figure 11. Length frequency distributions of blue catfish sampled with low-frequency electrofishing, gill nets, and jug lines in Kirby Reservoir, Texas, 2009-2010. The number of blue catfish sampled with each gear is notated by N.

Blue catfish

Table 8. Creel survey statistics for blue catfish at Kirby Reservoir from March – August, 2005, 2006, and 2009. Total catch per hour is for anglers targeting blue catfish and total harvest is the estimated number of blue catfish harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year		
	2005	2006	2009
Directed effort (h)	554 (48)	99 (80)	2,433 (21)
Directed effort/acre	0.75 (48)	0.13 (80)	3.29 (21)
Total catch per hour	0.43 (399)	1.00 (100)	0.35 (41)
Total harvest	587 (59)	213 (75)	1,667 (34)
Harvest/acre	0.79 (59)	0.29 (75)	2.25 (34)
Percent legal released	51	63	12

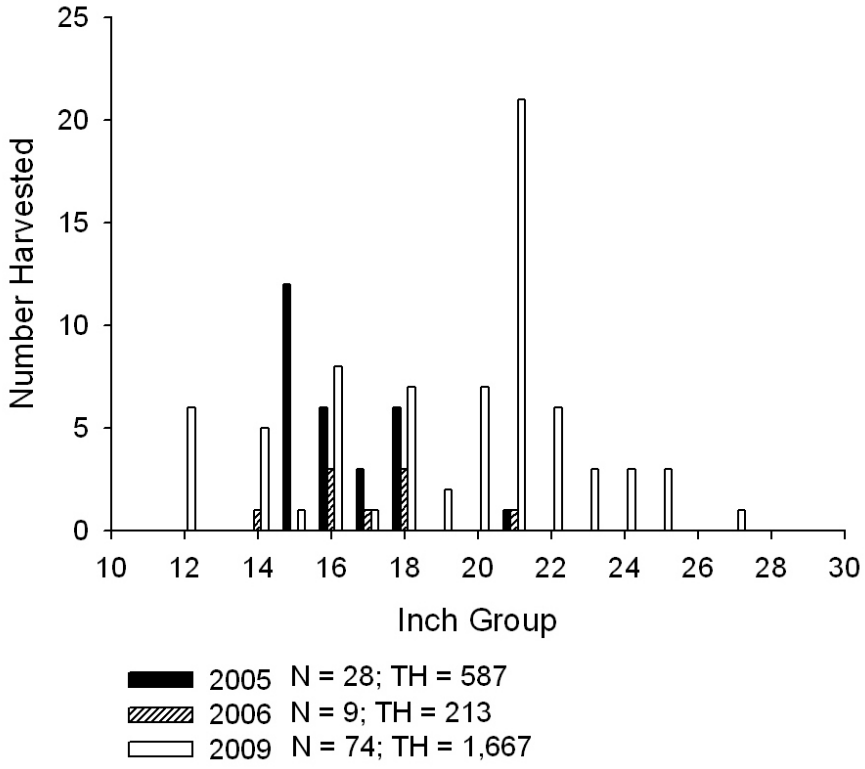
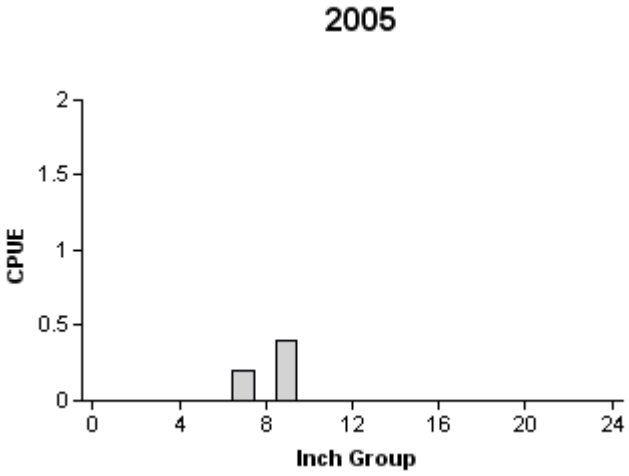
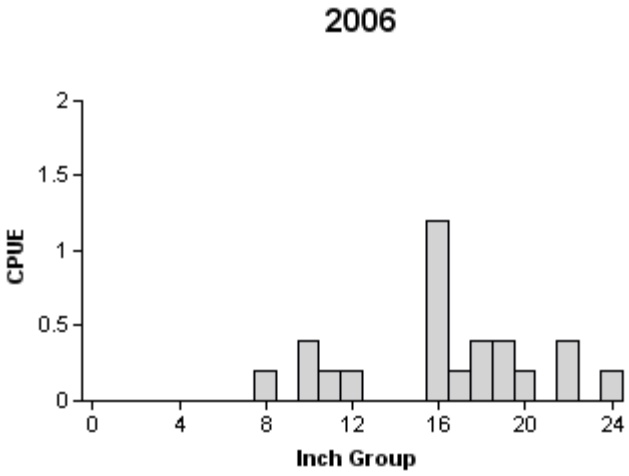


Figure 12. Length frequency of harvested blue catfish observed during creel surveys at Kirby Reservoir, Texas, from March – August, 2005, 2006, and 2009. The number of observed harvested blue catfish during each creel survey is notated by N, and TH is the total estimated harvest for each creel period.

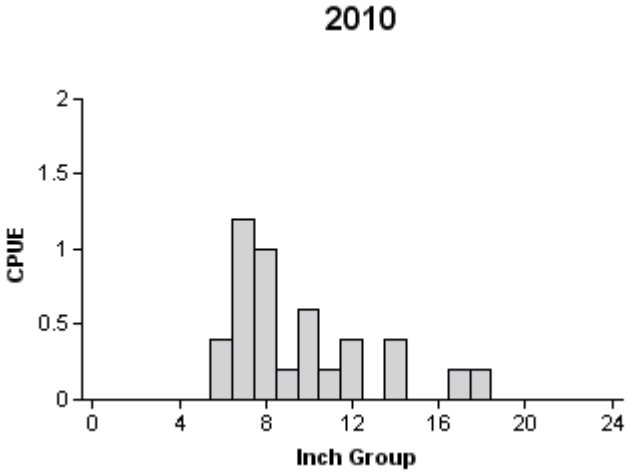
Channel catfish



Effort =	5.0
Total CPUE =	0.6 (41; 3)
CPUE-12 =	0.0 (0; 0)
PSD =	75 (26)



Effort =	5.0
Total CPUE =	4.0 (29; 20)
CPUE-12 =	3.2 (36; 16)
PSD =	88 (13)



Effort =	5.0
Total CPUE =	4.8 (14; 24)
CPUE-12 =	1.2 (49; 6)
PSD =	29 (21)

Figure 13. Number of channel catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Kirby Reservoir, Texas, 2005, 2006, and 2010.

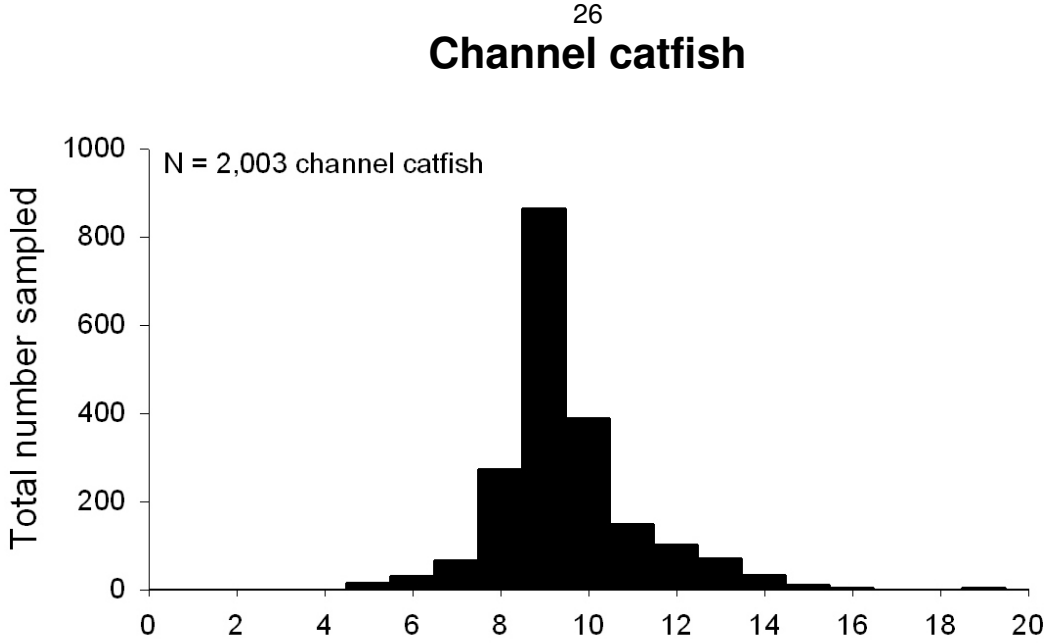


Figure 14. Length frequency distribution of hoop net sampled channel catfish from Kirby Reservoir, Texas, 2009.

Table 9. The number of baited, tandem hoop net deployments needed to attain relative standard errors of 25% (RSE_{25}) and 15% (RSE_{15}) with 80% confidence of the catch estimate for one-, two-, and three-night soak durations in Kirby Reservoir, Texas, 2009.

Soak duration	RSE_{25}	RSE_{15}
1 night	13	29
2 nights	9	20
3 nights	4	10

Table 10. Creel survey statistics for channel catfish at Kirby Reservoir from March – August, 2005, 2006, and 2009. Total catch per hour is for anglers targeting channel catfish and total harvest is the estimated number of channel catfish harvested by all anglers. Relative standard errors (RSE) are in parentheses. Asterisks indicate no statistic was calculated.

Creel Survey Statistic	Year		
	2005	2006	2009
Directed effort (h)	550 (51)	66 (98)	729 (35)
Directed effort/acre	0.74 (51)	0.09 (98)	0.99 (35)
Total catch per hour	1.77 (112)	0.33 (***)	1.14 (149)
Total harvest	383 (68)	785 (46)	3,948 (23)
Harvest/acre	0.52 (68)	1.06 (46)	5.34 (23)
Percent legal released	29	50	16

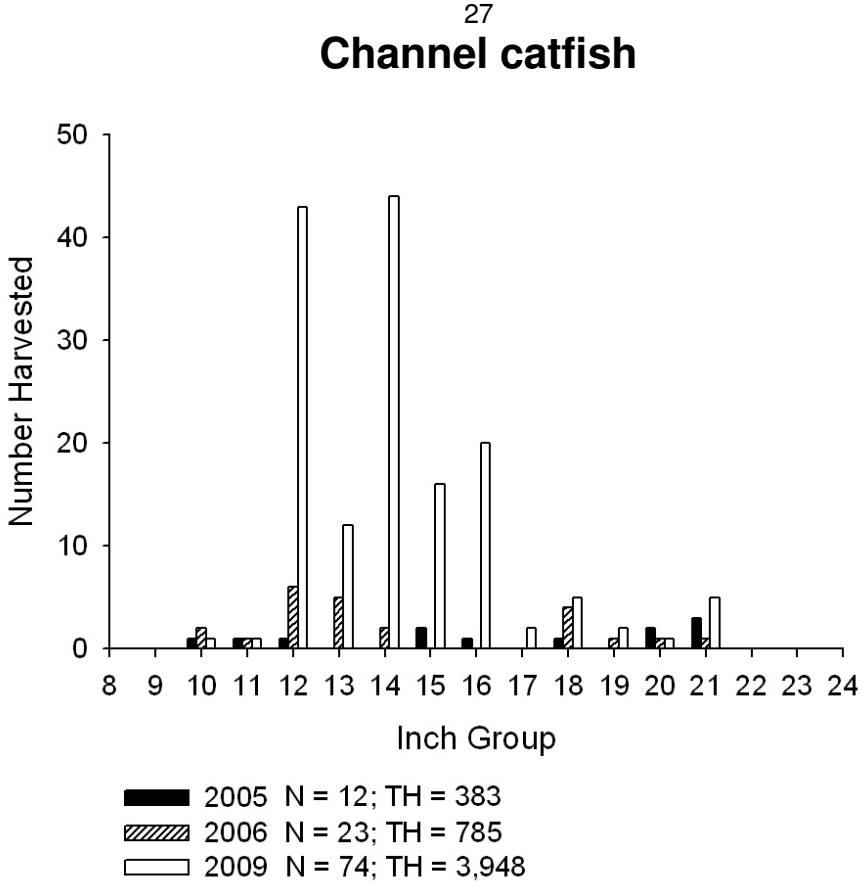
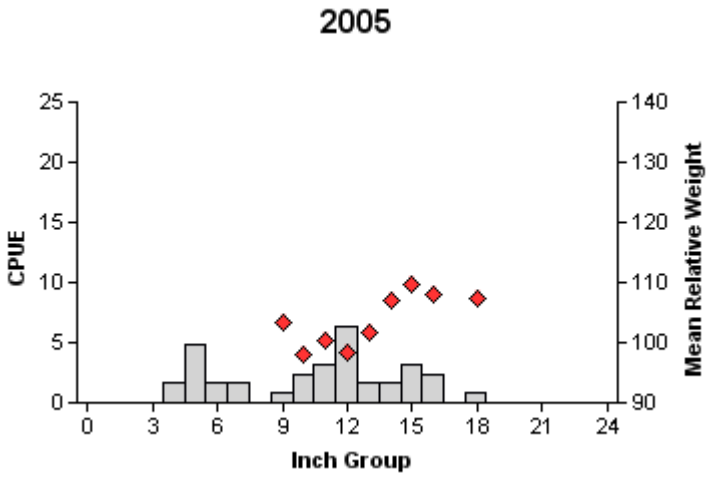
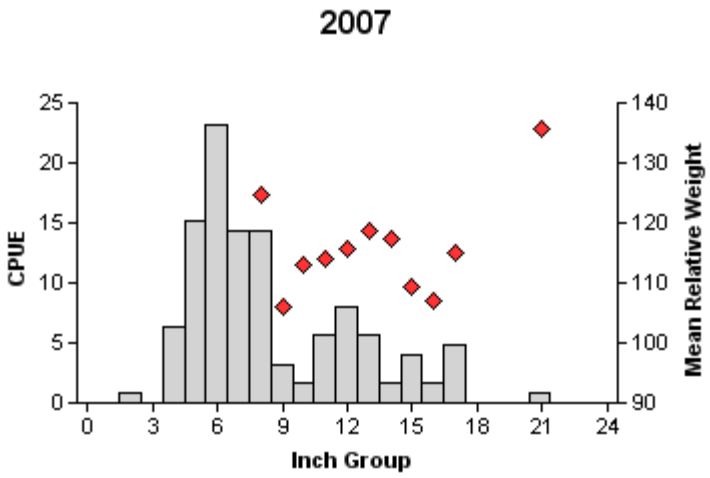


Figure 15. Length frequency of harvested channel catfish observed during creel surveys at Kirby Reservoir, Texas, March – August, 2005, 2006, and 2009. The number of observed harvested channel catfish during each creel survey is notated by N, and TH is the total estimated harvest for each creel period.

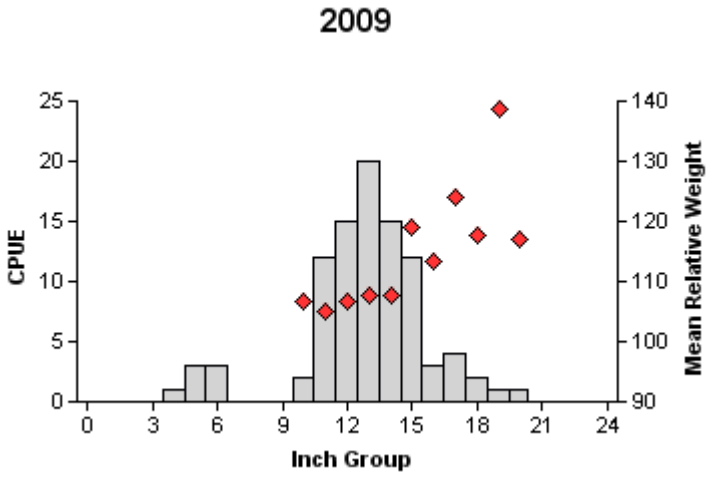
Largemouth Bass



Effort =	1.3
Total CPUE =	32.0 (24; 40)
Stock CPUE =	22.4 (23; 28)
CPUE-14 =	8.0 (38; 10)
PSD =	71 (10)
PSD-P =	29 (8)



Effort =	1.3
Total CPUE =	111.2 (25; 139)
Stock CPUE =	51.2 (27; 64)
CPUE-14 =	12.8 (31; 16)
PSD =	52 (8)
PSD-P =	6 (2)



Effort =	1.0
Total CPUE =	94.0 (21; 94)
Stock CPUE =	87.0 (23; 87)
CPUE-14 =	38.0 (23; 38)
PSD =	84 (5)
PSD-P =	26 (4)

Figure 16. 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, Kirby Reservoir, Texas, 2005, 2007, and 2009.

Largemouth bass

Table 11. Mean, minimum, and maximum relative weight (W_r), with 95% confidence intervals (CI), of largemouth bass by length group in Kirby Reservoir, Texas 2009. Length groups are defined as stock to quality (S - Q; ≥ 8 in and < 12 in), quality to preferred (Q - P; ≥ 12 in and < 15 in), and preferred to memorable (P - M; ≥ 15 in and < 20 in).

Length group	N	Mean W_r	Minimum W_r	Maximum W_r	Lower 95% CI	Upper 95% CI
S - Q	9	100	91	110	95	106
Q - P	54	106	88	124	104	109
P - M	22	121	106	147	116	125

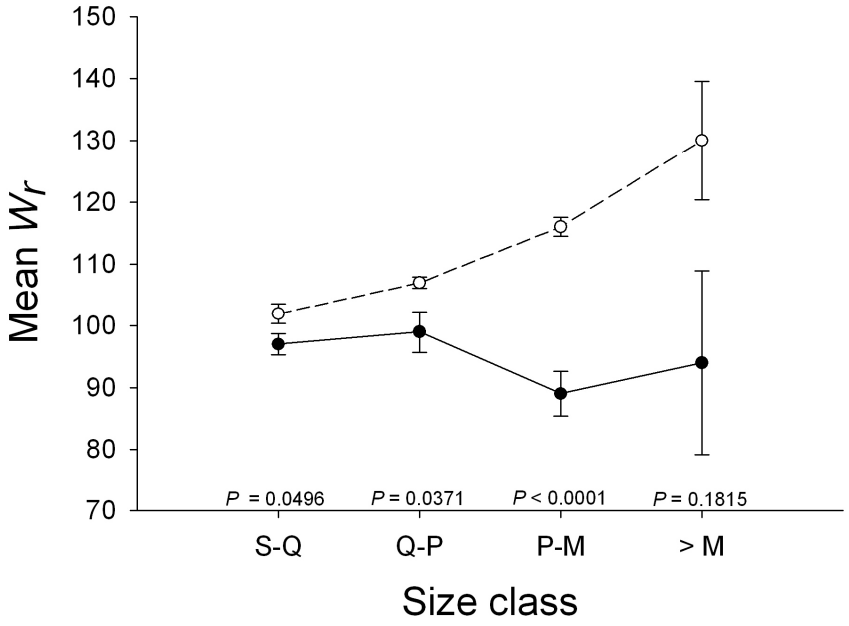


Figure 17. Mean relative weight (W_r) of largemouth bass from Kirby Reservoir pre-effluent water input (1997, 1998, and 1999; solid circles and solid line) and post-effluent water input (2004, 2005, 2007, and 2009; empty circles and dashed line). *P*-values derived from *t*-tests comparing pre-effluent water and post-effluent water W_rs are notated above each size class.

Table 12. Genetic composition of the largemouth bass population in Kirby Reservoir, Texas in 2007 with 95% confidence intervals (CI). Genetic composition was analyzed by evaluating microsatellite DNA from 30 age-0 largemouth bass. Asterisks indicate confidence intervals were not calculated.

Genetic measurement	Proportion	Lower 95% CI	Upper 95% CI
Northern-strain alleles	0.30	0.15	0.44
Florida-strain alleles	0.70	0.56	0.85
Northern-strain genotypes	0.10	***	***
Florida-strain genotypes	0.40	***	***

Largemouth bass

Table 13. Creel survey statistics for largemouth bass at Kirby Reservoir from March – August, 2005, 2006, and 2009. Total catch per hour is for anglers targeting largemouth bass and total harvest is the estimated number of largemouth bass harvested by all anglers. Relative standard errors (RSE) are in parentheses. Asterisks indicate no statistic was calculated.

Creel Survey Statistic	Year		
	2005	2006	2009
Directed effort (h)	1,284 (31)	2,013 (29)	1,140 (29)
Directed effort/acre	1.74 (31)	2.72 (29)	1.54 (29)
Total catch per hour	0.59 (107)	0.25 (77)	0.33 (108)
Total harvest	0 (***)	389 (58)	26 (443)
Harvest/acre	0 (***)	0.53 (58)	0.04 (443)
Percent legal released	100	13	67

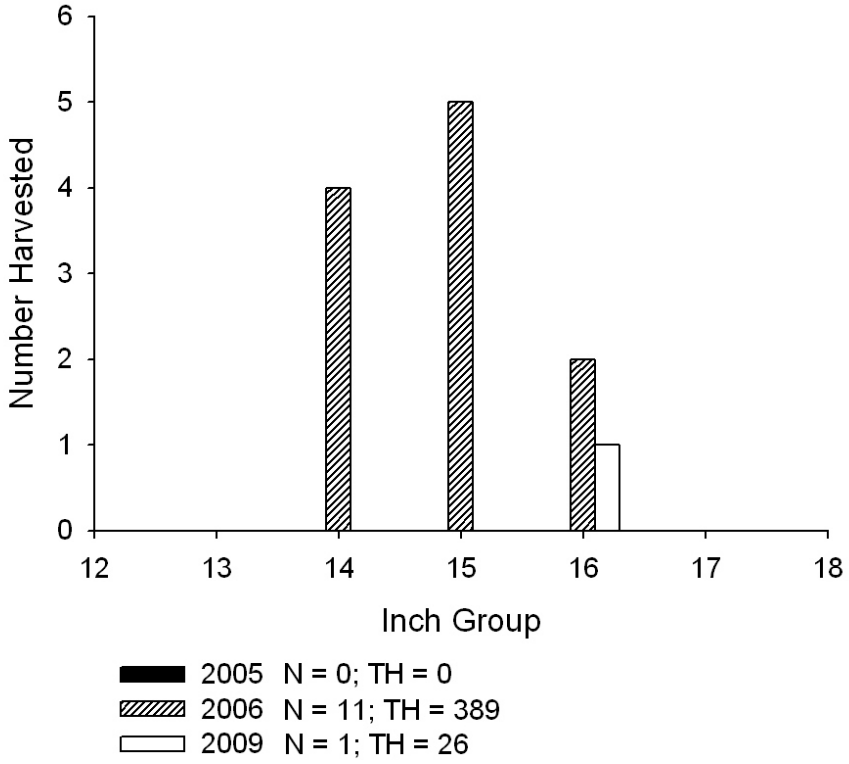
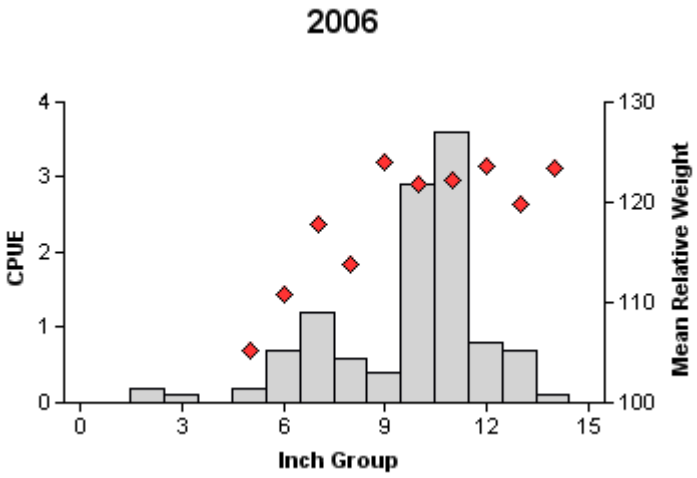
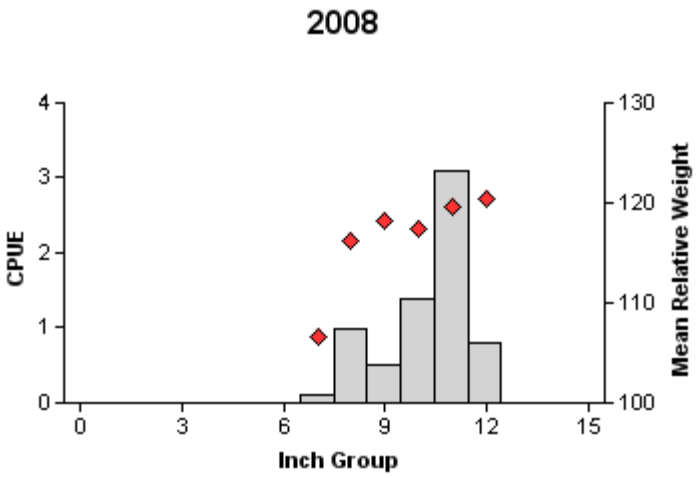


Figure 18. Length frequency of harvested largemouth bass observed during creel surveys at Kirby Reservoir, Texas, March – August, 2005, 2006, and 2009. The number of observed harvested largemouth bass during each creel survey is notated by N, and TH is the total estimated harvest for each creel period.

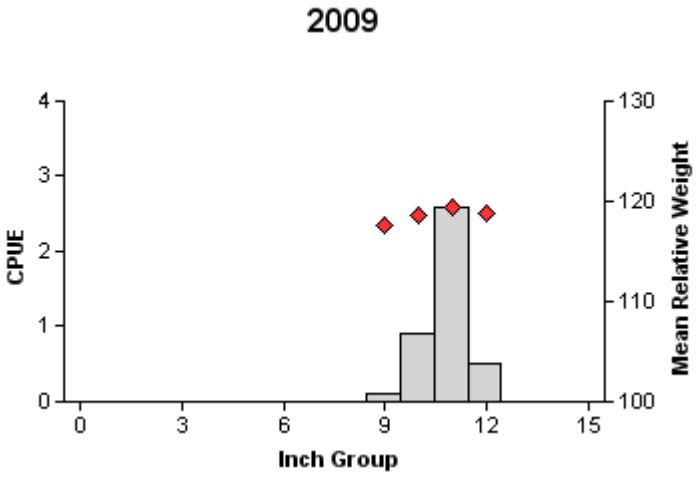
White crappie



Effort =	10.0
Total CPUE =	11.5 (19; 115)
CPUE-10 =	8.1 (21; 81)
PSD =	81 (6)
PSD-P =	72 (5)



Effort =	10.0
Total CPUE =	6.9 (33; 69)
CPUE-10 =	5.3 (41; 53)
PSD =	99 (2)
PSD-P =	77 (8)



Effort =	10.0
Total CPUE =	4.1 (38; 41)
CPUE-10 =	4.0 (39; 40)
PSD =	100 (0)
PSD-P =	98 (3)

Figure 19. Number of white crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Kirby Reservoir, Texas, 2006, 2008, and 2009.

White crappie

Table 14. Creel survey statistics for white crappie at Kirby Reservoir from March – August, 2005, 2006, and 2009. Total catch per hour is for anglers targeting white crappie and total harvest is the estimated number of white crappie harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year		
	2005	2006	2009
Directed effort (h)	6,706 (19)	783 (37)	1,524 (25)
Directed effort/acre	9.06 (19)	1.06 (37)	2.06 (25)
Total catch per hour	0.35 (34)	0.06 (52)	0.31 (52)
Total harvest	2,022 (43)	31 (121)	205 (96)
Harvest/acre	2.73 (43)	0.04 (121)	0.28 (96)
Percent legal released	0	67	27

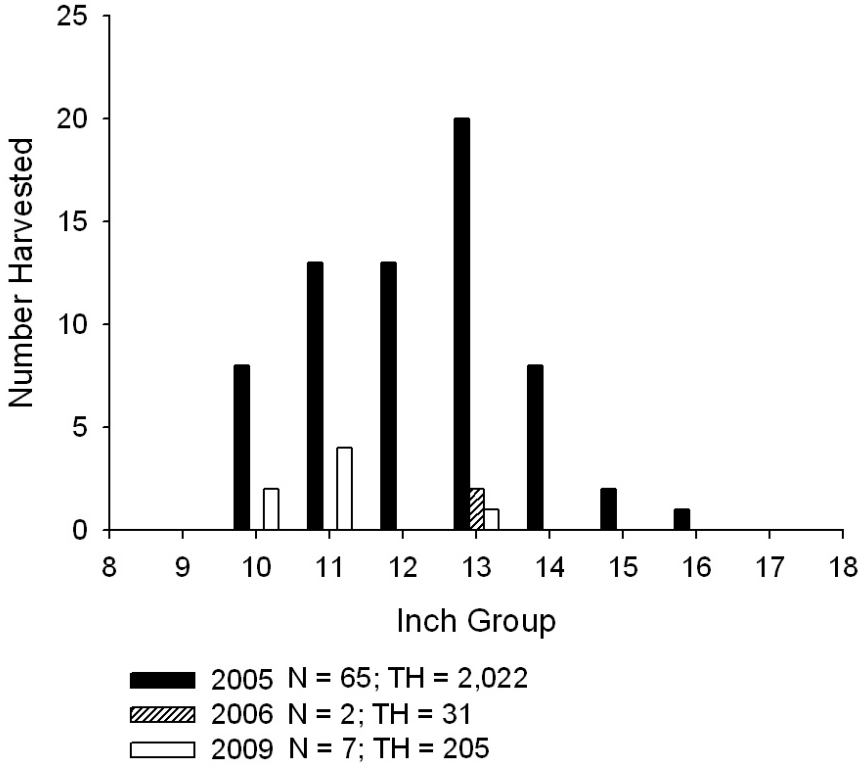
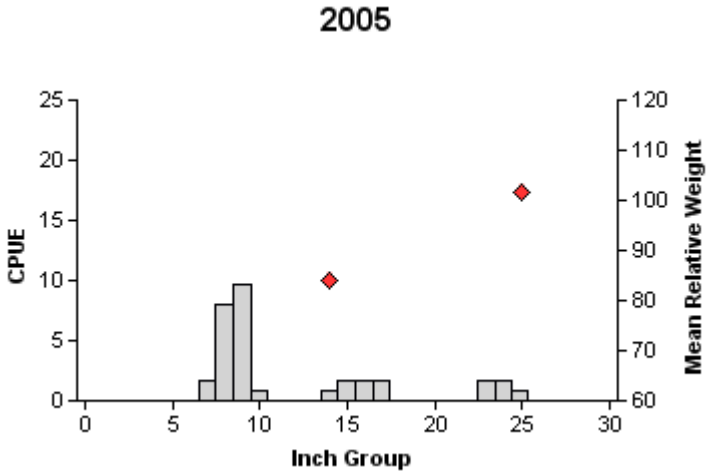
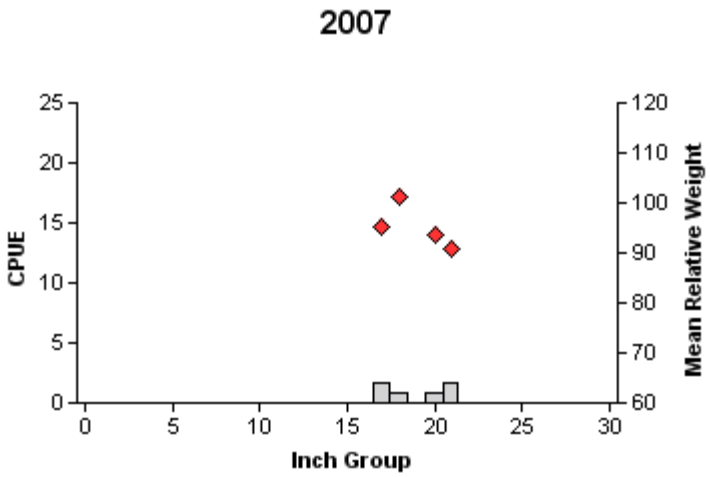


Figure 20. Length frequency of harvested white crappie observed during creel surveys at Kirby Reservoir, Texas, March – August, 2005, 2006, and 2009. The number of observed harvested white crappie during each creel survey is notated by N, and TH is the total estimated harvest for each creel period.

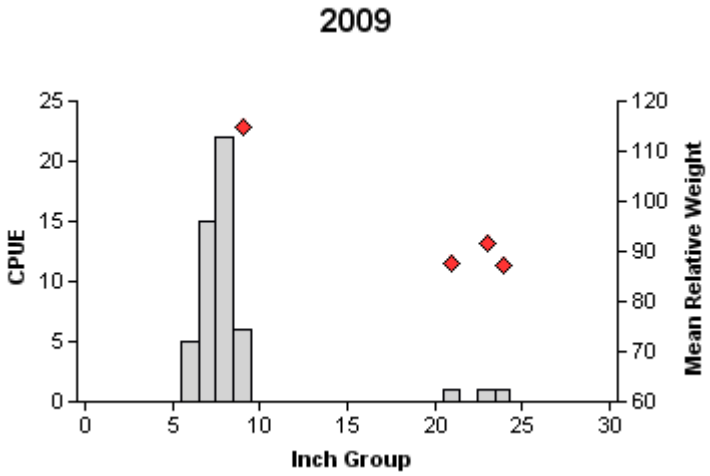
Saugeye



Effort =	1.3
Total CPUE =	29.6 (27; 37)
CPUE-18 =	4.0 (63; 5)
PSD =	48 (11)



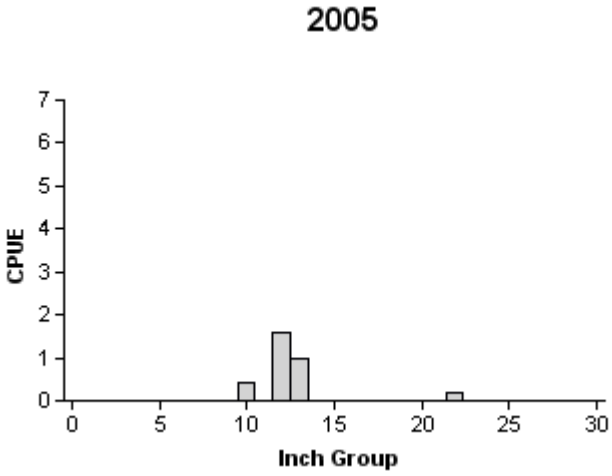
Effort =	1.3
Total CPUE =	4.8 (41; 6)
CPUE-18 =	3.2 (44; 4)
PSD =	100 (0)



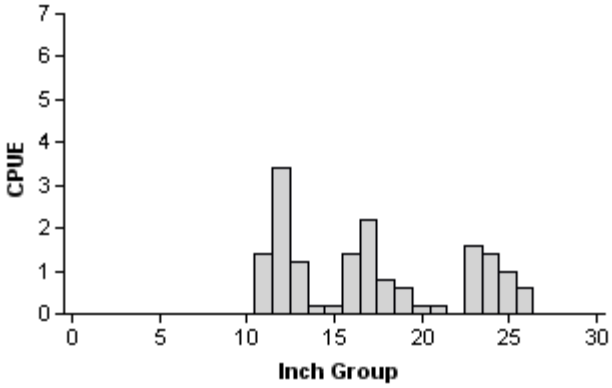
Effort =	1.0
Total CPUE =	51.0 (35; 51)
CPUE-18 =	3.0 (52; 3)
PSD =	33 (17)

Figure 21. Number of saugeye 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, Kirby Reservoir, Texas, 2005, 2007, and 2009.

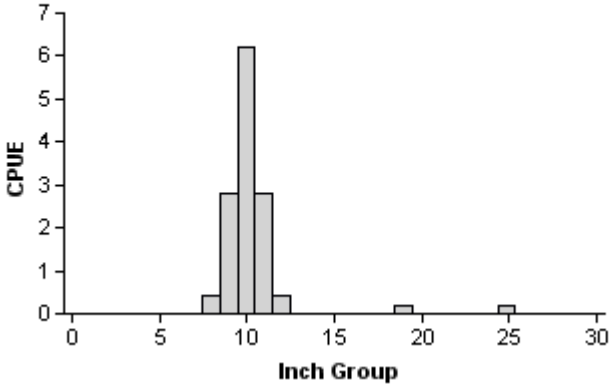
Saugeye



Effort =	5.0
Total CPUE =	3.2 (57; 16)
CPUE-18 =	0.2 (100; 1)
PSD =	6 (6)



Effort =	5.0
Total CPUE =	16.4 (16; 82)
CPUE-18 =	6.4 (25; 32)
PSD =	63 (8)



Effort =	5.0
Total CPUE =	13.0 (26; 65)
CPUE-18 =	0.4 (61; 2)
PSD =	3 (2)

Figure 22. Number of saugeye caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Kirby Reservoir, Texas, 2005, 2006, and 2010.

Saugeye

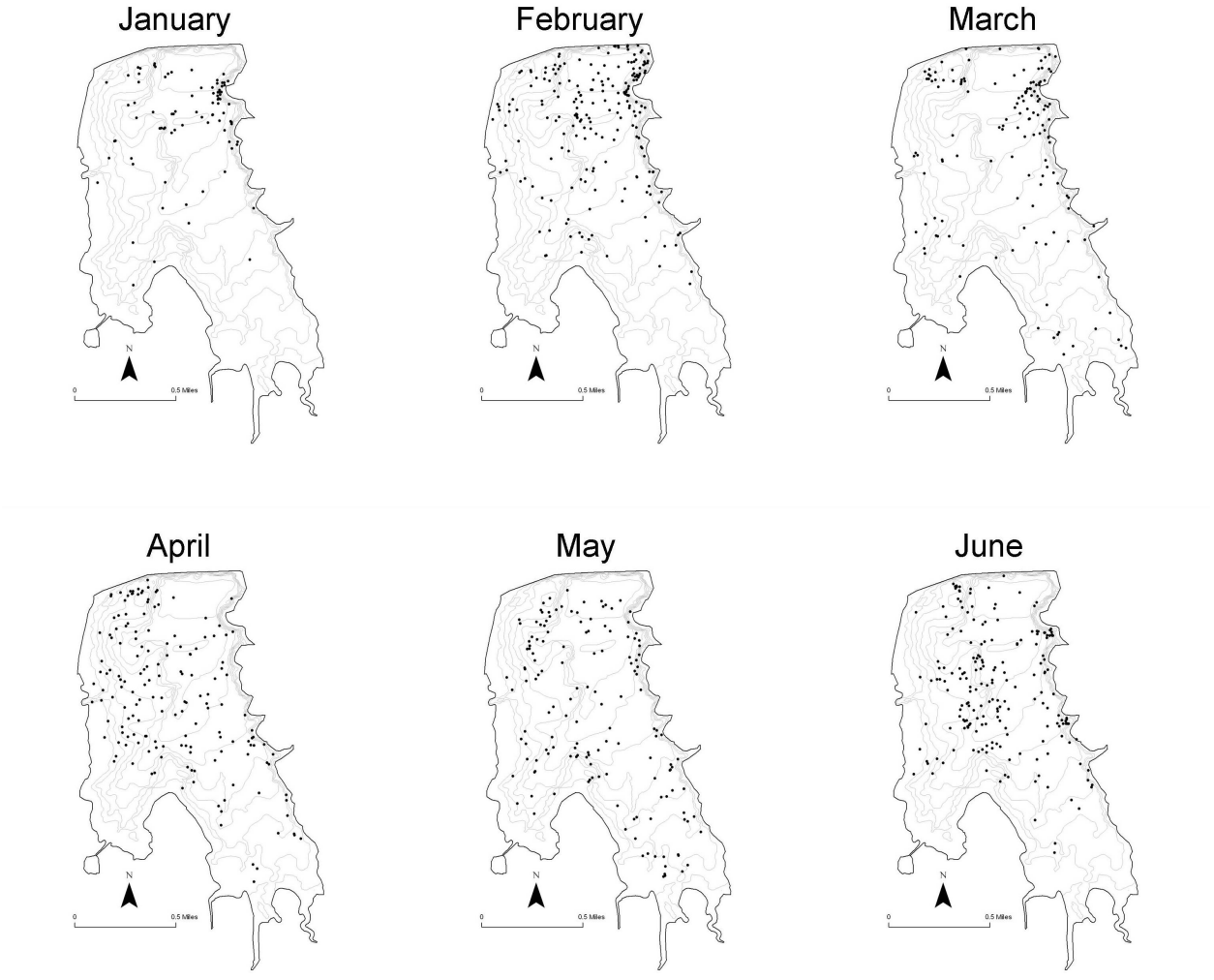


Figure 23. Maps of Kirby Reservoir with saugeye telemetry detections, by month, for December 2007 and January – November 2008.

Saugeye

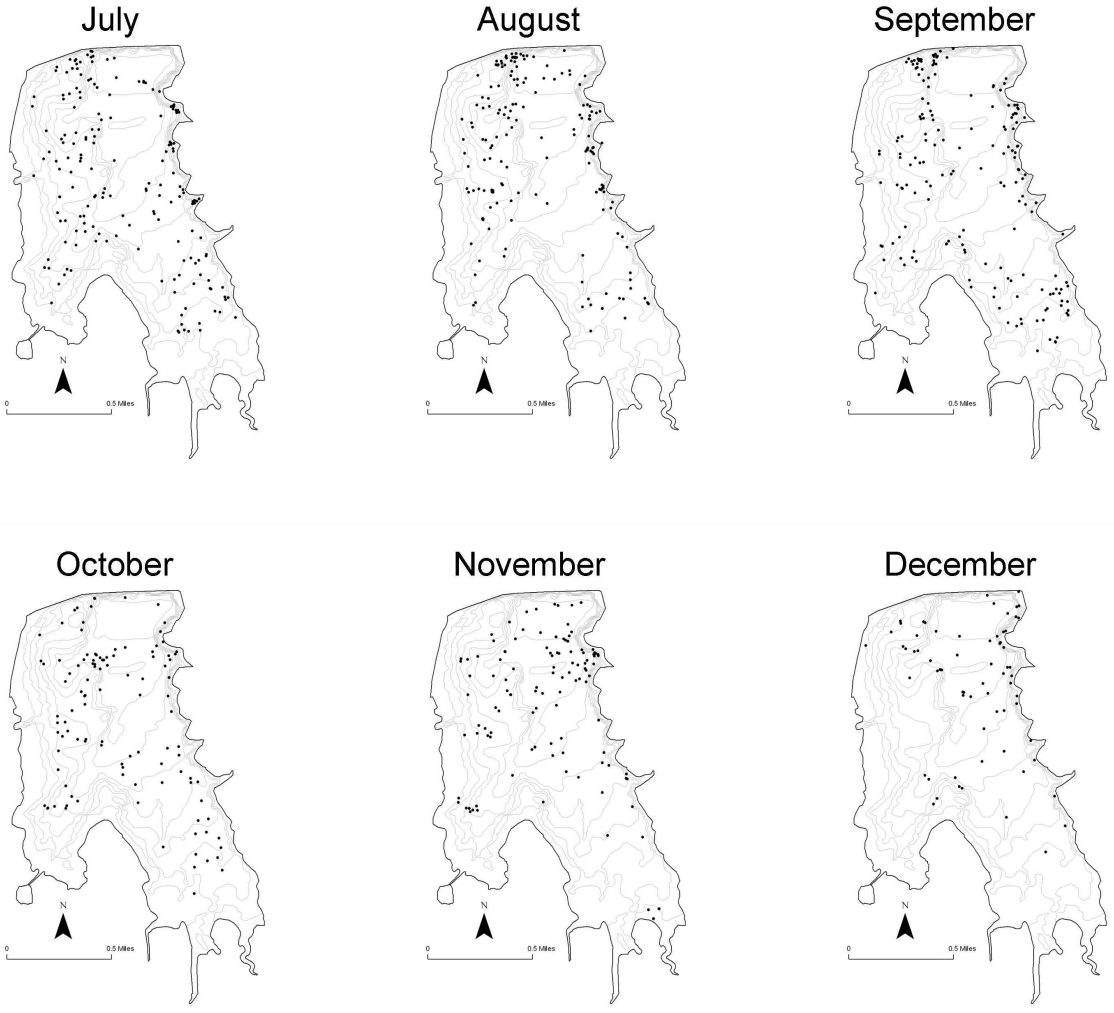


Figure 23 cont. Maps of Kirby Reservoir with saugeye telemetry detections, by month, for December 2007 and January – November 2008.

Saugeye

Table 15. All habitat selection pairwise comparisons for saugeye in Kirby Reservoir, Texas, 2007-2008, between emergent vegetation (EV), mid-water ledge (ML), open water (OW), rock/gravel shoreline (RG), shallow-water flats (SW), and rip-rap (RR) for each season. Bold, italicized *P*-values represent a significant difference at alpha = 0.05 where the first habitat listed in the comparison was selected if the *t*-value is positive and the second habitat listed in the comparison was selected if the *t*-value is negative. Asterisks indicate too few detections were made to conduct comparison.

Comparison	Winter		Spawn		Spring		Summer		Fall	
	t-value	P-value	*t*-value	P-value	*t*-value	P-value	*t*-value	P-value	*t*-value	P-value
EV vs. ML	-8.25	***< 0.001***	-6.90	***< 0.001***	-6.61	***< 0.001***	-3.51	***0.003***	-2.49	***0.027***
EV vs. OW	-7.63	***< 0.001***	-6.90	***< 0.001***	-7.03	***< 0.001***	-5.27	***< 0.001***	-3.65	***0.003***
EV vs. RG	-4.75	***< 0.001***	-5.51	***< 0.001***	0.14	0.890	0.15	0.883	-0.62	0.546
EV vs. RR	0.55	0.592	2.12	0.050	***	***	***	***	***	***
EV vs. SW	-6.26	***< 0.001***	-4.72	***< 0.001***	-5.88	***< 0.001***	-4.76	***< 0.001***	-2.20	***0.046***
ML vs. OW	-0.51	0.619	1.60	0.129	0.65	0.525	-0.83	0.420	-0.28	0.784
ML vs. RG	2.61	***0.022***	7.19	***< 0.001***	4.80	***< 0.001***	2.84	***0.012***	2.01	0.066
ML vs. RR	23.80	***< 0.001***	6.41	***< 0.001***	***	***	***	***	***	***
ML vs. SW	8.70	***< 0.001***	7.70	***< 0.001***	6.70	***< 0.001***	1.73	0.104	0.92	0.374
OW vs. RG	3.18	***0.007***	7.76	***< 0.001***	5.13	***< 0.001***	4.52	***< 0.001***	3.03	***0.010***
OW vs. RR	24.71	***< 0.001***	6.31	***< 0.001***	***	***	***	***	***	***
OW vs. SW	5.64	***< 0.001***	7.04	***< 0.001***	6.45	***< 0.001***	3.57	***0.003***	1.02	0.326
RG vs. RR	7.47	***< 0.001***	5.34	***< 0.001***	***	***	***	***	***	***
RG vs. SW	0.48	0.639	3.60	***0.002***	-2.67	***0.017***	-2.17	***0.046***	-0.89	0.390
RR vs. SW	-11.58	***< 0.001***	-4.61	***< 0.001***	***	***	***	***	***	***

Table 16. Mean proportional home range (PHR) estimates for saugeye in Kirby Reservoir, Texas 2007-2008 where N is the number of fish observed in each season. Proportional home range for each fish was calculated as that fish's home range divided by the total area of the reservoir. Standard deviation of PHR is notated by SD, minimum is the lowest observed PHR, and maximum is the greatest observed PHR.

Season	N	PHR	SD	Minimum	Maximum
Winter	14	21.9%	8.3%	11.3%	40.2%
Spawn	17	38.7%	13.1%	18.4%	61.6%
Spring	17	33.9%	9.7%	20.0%	58.3%
Summer	16	31.5%	14.0%	5.2%	55.4%
Fall	14	29.9%	17.1%	3.1%	56.0%

Table 17. Proposed sampling schedule for Kirby Reservoir, Texas. Hoop net surveys are conducted in summer, electrofishing and trap net surveys are conducted in fall, and gill net and low-frequency electrofishing surveys are conducted in spring. Creel surveys occur in spring and summer. Standard surveys are denoted by S and additional surveys are denoted with A.

Survey year	Hoop net	Electrofish	Trap net	Gill net	Low-frequency electrofish	Creel	Report
Summer 2010 – Spring 2011							
Summer 2011 – Spring 2012	A	A	A	A	A	A	
Summer 2012 – Spring 2013						A	
Summer 2013 – Spring 2014	A	S	S	S	A		S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Kirby Reservoir, Texas, 2009-2010. Asterisks indicate CPUE was not calculated.

Species	Hoop nets		Electrofisher		Trap nets		Jug lines		Gill nets		Low-frequency electrofisher	
	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE
Gizzard shad			648	648.0								
Threadfin shad			83	83.0								
Blue catfish							61	0.19	52	10.4	176	176.0
Channel catfish	2,003	***							24	4.8		
Flathead catfish									1	0.2		
Green sunfish			66	66.0								
Bluegill			865	865.0								
Longear sunfish			29	29.0								
Largemouth bass			94	94.0								
White crappie					41	4.1						
Saugeye			51	51.0					65	13.0		

APPENDIX B

Location of standard sampling sites, Kirby Reservoir, Texas, 2009-2010. Locations of electrofishing sites (E), trap netting sites (T), and gill netting sites (G) are indicated on the map. Water level was within three feet of conservation elevation at time of sampling.

APPENDIX C

Location of additional sampling sites, Kirby Reservoir, Texas, 2009-2010. Locations of hoop netting sites (H), jug lining sites (J), and low-frequency electrofishing sites (L) are indicated on the map. Water level was within three feet of conservation elevation at time of sampling.