PERFORMANCE REPORT

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FEDERAL AID PROJECT F-221-M-1

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2010 Survey Report

Possum Kingdom Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Possum Kingdom Reservoir were surveyed in 2010 using trap nets and electrofishing and in 2011 using gill nets. This report summarizes the survey results and contains a management plan based on the findings.

- **Reservoir Description:** Possum Kingdom Reservoir is a 15,588-acre impoundment located on the Brazos River approximately 76 miles west of Fort Worth. It has a primarily rocky shoreline with many boat docks. The reservoir was within 5 feet of conservation pool (1,000 ft. above mean sea level) from January of 2007 through May 2011.

- **Management history:** Important sport fish include catfish, white bass, striped bass, largemouth bass, and crappie. Possum Kingdom was managed under statewide regulations until September 1, 2002 when the largemouth bass minimum length limit was raised to 16 inches and the striped bass bag limit was lowered to two per day in response to a golden alga (*Prymnesium parvum*) fish kill that occurred in early 2001. Golden alga mortality events also reoccurred in 2003, 2007, and 2010

- **Fish Community**

  - **Prey species:** The 2010 gizzard shad catch rate was above the reservoir historical average and had an abundance of prey size fish. Additionally, threadfin shad were collected in relatively low numbers. The catch per unit effort (CPUE) for bluegill was below historical averages.

  - **Catfishes:** The 2011 CPUE for blue and channel catfish was slightly higher than the historical average, though not quite as high as the previous 2009 survey. Three flathead catfish were sampled in the gill net survey; the first time since 2001.

  - **Temperate bass:** White bass CPUE was down compared to the 2009 gill net survey. Striped bass CPUE in 2011 decreased greatly to the lowest CPUE in over 10 years. It appears the 2010 golden alga fish kill had a serious, adverse impact on this population. Three hybrid striped bass were also sampled, a species that is not stocked into the reservoir. They most likely entered the reservoir from the river above when Graham reservoir went over the spillway.

  - **Black bass:** The 2010 largemouth bass electrofishing sample was slightly higher than the previous survey in 2008. No spotted or smallmouth bass have been observed since the 2002 survey.

  - **Crappie:** The 2010 white crappie CPUE was the second highest catch rate documented at the reservoir. A good mix of sub-legal and legal length fish was sampled. Black crappie CPUE was the highest documented. White crappie were more abundant than black crappie.

- **Management Strategies:** Catfish, white bass, crappie and largemouth bass all provide good fishable populations and should be promoted to increase angler effort. The striped bass population and associated fishing effort has definitely declined since the initial golden alga fish kill in 2001. Annual stockings of striped bass will continue to be requested, although none were available from state hatcheries in 2011. Also propose a regulation change for striped bass from the more restrictive two fish bag to the statewide five fish bag. Florida largemouth bass fingerlings were stocked in 2011. Previous golden alga fish kills may have given anglers a more negative expectation than is warranted about certain fish populations. Continuing news release efforts will be needed.

INTRODUCTION

This document is a summary of fisheries data collected from Possum Kingdom Reservoir in 2010 and 2011. The purpose 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 important sport fish and prey species. Historical data is also presented for comparison.

Reservoir Description

Possum Kingdom Reservoir is a 15,588-acre impoundment constructed in 1941 on the Brazos River. It is located in Palo Pinto County approximately 76 miles west of Fort Worth and is operated and controlled by the Brazos River Authority (BRA). Primary uses include hydropower production, flood control and recreation. Mean depth is 37 feet, shoreline development index 14.4, and conductivity was 2,482 μmhos/cm (Table 1). Primary habitats at time of sampling consisted of rocky shorelines, boat docks, and aquatic vegetation (Table 4). The water level has generally been constant since 2007 except for 2009 when the reservoir was about five feet below conservation pool (Figure 1). Boat access consists of nine public boat ramps and 15 private ramps. Two of the public boat ramps (North D&D and Sandy Beach) charge a $3 per person entrance fee on weekends and holidays from mid-May to mid-September. Private ramp fees range from free to $35. On January 1, 2006 a mandatory Water Recreational User Permit program for boats was initiated by BRA. The fees are as follows: annual $50.00 ($35.00 if over 65 or active duty/retired military), one day $5.00, 3-day $12.00 and 5-day $20.00. The permit is available at local vendors, the BRA lake office or ticket dispensers at the major boat ramps. Bank fishing is available at the public access points including the boat ramps. Two fishing piers are also present on the reservoir. Other descriptive characteristics for Possum Kingdom are in Table 1.

Management History

Previous management issues and actions: Management issues and actions from the previous survey report (Howell and Mauk 2006) included:

1. Golden alga had impacted not only fish populations but angler attitudes resulting in a decline in fishing effort despite an improved fishery.

   Action: Issued news releases in 2008 in the local lake paper and the more regional Wichita Falls Times-Record News. A statewide news release was issued in 2011 that was picked up by various media sources. Annual articles were published in a special Possum Kingdom brochure distributed by the Times-Record News. The TPWD web site was maintained and updated with new lake information

2. The previously important striped bass fishery had been drastically reduced by golden alga induced impacts in terms of abundance, fishing effort, catch and harvest.

   Action: Continued annual stockings of striped bass fingerlings requesting the maximum rate of 15/acre.
   Action: Performed extra monitoring by completing 30 net nights of winter gill netting in 2009 and 2011.

Harvest regulation history: Sport fish species in Possum Kingdom Reservoir were historically managed using statewide regulations. However, on September 1, 2002, in response to the golden alga fish kill of 2001, the largemouth bass minimum length limit was raised from 14 to 16 inches and the striped bass daily bag limit was decreased from five to two 18 inches or greater to aid in recovery of the fishery.

Stocking history: Since the initial golden alga fish kill in 2001 an aggressive stocking program, involving multiple species, has continued in response to reoccurring golden alga kills in 2003, 2007, and 2010. Threadfin shad, blue catfish, channel catfish, striped bass, smallmouth bass, and largemouth bass (northern and Florida) have all been stocked since 2001. The complete stocking history is in Table 3.

Vegetation/habitat history: Possum Kingdom Reservoir has no significant vegetation/habitat management history. Noxious vegetation has not been a problem at the reservoir.

Water transfer: Possum Kingdom Reservoir is primarily used for hydropower production, flood control, municipal water and recreation. There are currently 29 entities permitted to remove water from Possum Kingdom Reservoir for differing uses. Four of these use water for municipal usage, seven are mining interests, eight have industrial usages and ten use the water for irrigation purposes.

METHODS

Fishes were collected by electrofishing (2.0 hours at 24 five-minute stations), gill netting (30 net nights at 30 stations), and trap netting (15 net nights at 15 stations). Catch per unit effort for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing and for gill and trap nets, as the number of fish caught per net night (fish/nn). All survey sites were randomly selected. Habitat, vegetation, and access surveys were completed in 2010. All surveys were conducted according to TPWD Inland Fisheries Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2009).

Sampling statistics (CPUE for various length categories), 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 calculated for gizzard shad (DiCenzo et al. 1996). Relative standard error (RSE = 100 X SE of the estimate/estimate) was calculated for all CPUE statistics and Standard Error (SE) was calculated for structural indices and IOV. Striped bass were aged in 2009 using otoliths from five fish per inch group. Largemouth bass ages were determined in 2008 using otoliths from bass between 15-17 inches in length to determine age when attaining the legal 16-inch minimum length limit. White crappie age and growth was determined in 2008 from the otoliths of five crappie per inch group. The source for water level data was the United States Geological Survey.

RESULTS AND DISCUSSION

Habitat: A physical habitat survey conducted August 2010 indicated the littoral zone habitat consisted primarily of nondescript or rocky shoreline (Table 4). The reservoir was 0.8 - 2.7 feet below conservation pool at time of survey. The previous physical habitat survey was conducted in 2006 (Howell and Mauk 2006). Few manmade changes to physical habitat occurred during the four year period. Observed aquatic vegetation had greatly decreased over the period though. Submergent vegetation went from an estimated 205 acres in 2006 to less than an acre in 2010. Emergent vegetation went from an estimated 461 acres to 11 acres during the same time interval.

Creel Survey: A creel survey was conducted from June – August 2010 and three creel trips were conducted March – April 2011. Originally, a year-long creel was planned but golden alga affected the reservoir in early 2010 and the resulting June - August fishing effort was quite low with no fish harvested. It was determined that continuing the creel survey that fall and winter would not be cost effective. The creel survey was resumed in March 2011 with the assumption that fishing effort would increase. After three creel days, very low effort was observed with only a few white bass being harvested. In April 2011, a wildfire affected the reservoir vicinity, causing bass clubs to move their tournaments; while several guides reported that clients were canceling trips. It was then decided to discontinue the spring 2011 creel survey.

Prey species: Electrofishing catch rates of gizzard shad, threadfin shad, and bluegill were 306.5/h, 2.0/h, and 37.0/h, respectively. The previous survey in 2008 had catch rates of 511.0/h for gizzard shad (Fig. 2), 7.5/h for threadfin shad, and 180.5/h for bluegill (Fig. 3). The index of vulnerability for gizzard shad was 82% and was nearly the same as the 2008 survey (84%) and higher than the 2006 survey (72%). While all of the catch rates have decreased since the last survey, the gizzard shad rate was still higher than the historical average of 287.9/h. Redear sunfish were sampled at the rate of 4.0/h including a specimen over seven inches.

Blue catfish: The 2011 blue catfish gill net CPUE (0.9/nn) was down slightly from the previous survey conducted in 2009 (1.2/nn; Figure 5) but nearly double the CPUE of 2007 (0.5/nn) and above the historical average (0.6/nn). Most of the fish sampled were greater than 12 inches and had Wr values near 100.

Channel catfish: The 2011 channel catfish gill net CPUE (3.0/nn; Fig. 6) was down from the previous two surveys but was still above the historical average (2.5/nn). Relative weight was around 90 except for channel catfish >20 inches which were well above 100.

White bass: The 2011 gill net catch rate for white bass was 5.5/nn, which was down from 10.8/nn in 2009, but higher than the 3.9/nn sampled in 2007 (Fig. 7). All 10-inch and greater inch groups had excellent Wr's with all being over 100.

Striped bass: Striped bass relative abundance showed a marked decrease (0.2/nn; Fig. 8) from the two previous gill net surveys of 2007 (2.5/nn) and 2009 (2.8/nn) being the lowest CPUE documented. This is probably the result of a 2010 golden alga fish kill that affected the reservoir. Of the six fish sampled, four were less than 12 inches in length. Historically, this is a species that is more negatively affected by the sporadic golden alga fish kills that have occurred since 2001 than most other species. The 2009 age and growth study found that growth was slower than some previous studies and well below the regional average (Table 5). It should be mentioned that three hybrid striped bass were captured during the 2011 gill net survey, likely when water from Graham reservoir went over the spillway and entered the Brazos River above Possum Kingdom.

Largemouth bass: The electrofishing CPUE of largemouth bass was 53.5/h in 2010, which is below the historical average (66.1/h) for the reservoir, but an increase over the previous 2008 survey (49.0/h). Largemouth bass body condition was considered excellent (relative weights above 100) (Figure 9). Florida largemouth bass genetic influence was measured at 53% from the 2010 year class sample (Table 6). Largemouth bass are showing much improved growth rates since the 2001 fish kill as evidenced by age and growth studies conducted since then. A type 2 age and growth study performed in 2008 showed that largemouth attained the legal minimum size of 16 inches at 2.2 years of age (Table 7).

Crappie: The trap net catch rate of white crappie was 5.7/nn in 2010, the second highest CPUE ever at this reservoir (Figure 10). Body condition (Wr) was excellent for all inch groups over 10 inches, with all being well over 100. A 2008 age and growth study found growth was above the regional average, but the crappie sampled were all one year old (Table 8).

The survey produced an improved catch rate for black crappie at 0.6/nn. This is a slight increase over the previous 2008 survey (0.5/nn) but a great improvement over 2006 (0.1/nn) when a single black crappie was captured. Black crappie have always been present but in lower abundance.

ISSUE 1: Golden alga has impacted not only fish populations, but angler attitudes. This has resulted in a decrease in fishing effort despite improving fish populations for most species.

MANAGEMENT STRATEGY

1. Issue news releases when appropriate and after reservoir surveys have been completed. Use TPWD media sources for distributing releases to the largest audience possible. Maintain and update TPWD website with new lake information as warranted.

ISSUE 2: The once thriving striped bass population appears to be greatly reduced by golden alga induced impacts. This had been an important species economically with several full time guides on the reservoir. The results of the 2006-07 and 2010-11 creel surveys show a great decline in both harvest and fishing effort compared to the 2000-01 survey.

MANAGEMENT STRATEGY

1. Continue annual striped bass fingerling stockings at the maximum rate of 15/acre if striped bass growth rates, relative weights and prey availability continue to support it.

ISSUE 3: Many invasive species threaten aquatic habitats and organisms in Texas and can adversely affect the state ecologically, environmentally, and economically. For example, zebra mussels (*Dreissena polymorpha*) can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches and plugging engine cooling systems. Giant Salvinia (*Salvinia molesta*) and other invasive vegetation species can form dense mats, interfering with recreational activities like fishing, boating, skiing and swimming. The financial costs of controlling and/or eradicating these types of invasive species are significant. Additionally, the potential for invasive species to spread to other river drainages and reservoirs via watercraft and other means is a serious threat to all public waters of the state.

MANAGEMENT STRATEGIES

1. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir.
2. Contact and educate marina owners about invasive species, and provide them with posters and literature so that they can in turn educate others.
3. Educate the public about invasive species through the use of media and the internet.
4. Make a speaking point about invasive species when presenting to constituent and user groups.
5. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.
6. Maintain zebra mussel samplers near highly utilized boat ramps.

ISSUE 4: After the first golden alga fish kill occurred in 2001, the striped bass bag limit was reduced from five fish to two. This was done to protect the remaining striped bass while still providing some opportunity for harvest. Subsequent fish kills have negatively impacted striped bass abundance and angling effort for the species. It is apparent that golden algae, not angler harvest, is the primary cause of mortality in Possum Kingdom; as a result the 2 fish bag limit is having no effect on the population .

MANAGEMENT STRATEGY

1. Change the striped bass regulation back to the statewide bag limit of five fish. This will ease confusion over the two fish bag limit that many anglers were not aware was in place. It will not affect the striped bass population and could possibly increase angling effort by removing the negative view of Possum Kingdom striped bass angling that some anglers have due to the more restrictive bag limit.

SAMPLING SCHEDULE JUSTIFICATION:

This important and dynamic fishery needs extra sampling using electrofishing and gill netting to more closely monitor golden alga impacts. We plan to go twice as frequently as required, by employing electrofishing and gill nets on an every other year basis. This would mean returning to electrofish during the fall of 2012 and gill net in early 2013. These gears would then be employed again in fall 2014 and early 2015, followed by a new management report in 2015 (Table 9).

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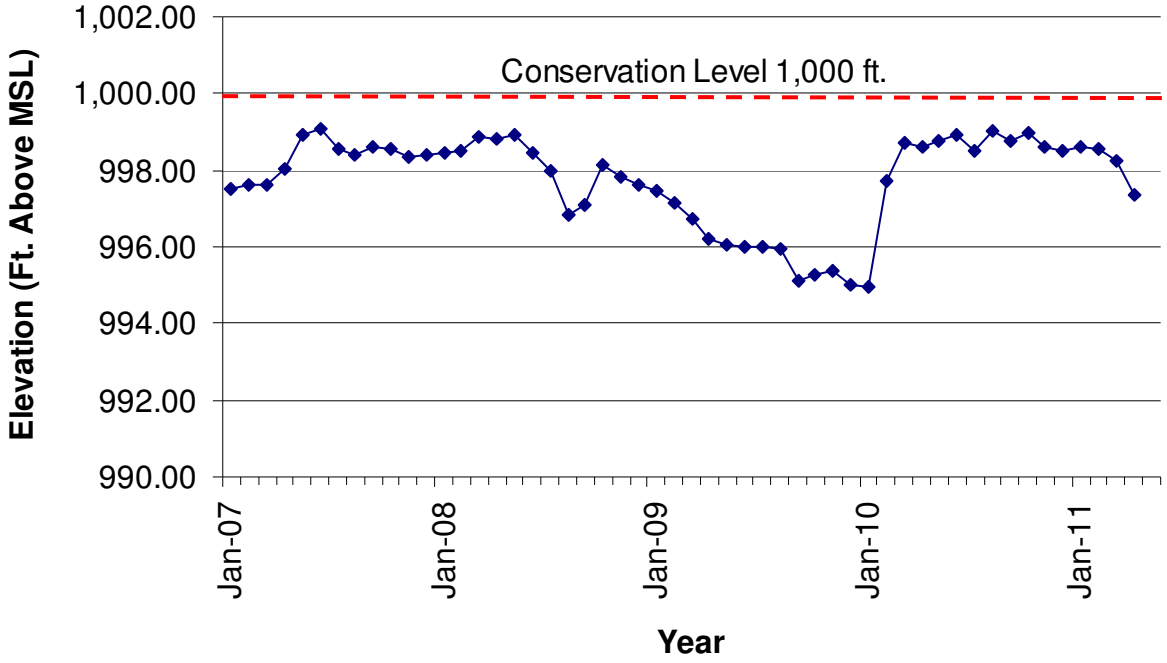


Figure 1. Monthly water level elevation averages in feet above mean sea level (MSL) recorded for Possum Kingdom Reservoir, Texas.

Table 1. Characteristics of Possum Kingdom Reservoir, Texas.

Characteristic	Description
Year constructed	1941
Controlling authority	Brazos River Authority
County	Palo Pinto
Reservoir type	Mainstem
Shoreline Development Index (SDI)	14.4
Conductivity	2,482 μmhos/cm

Table 2. Harvest regulations for Possum Kingdom Reservoir.

Species	Bag Limit	Length Limit (inches)
Catfish: Channel and Blue catfish, their hybrids and subspecies	25 (in any combination)	12 minimum
Catfish, Flathead	5	18 minimum
Bass, White	25	10 minimum
Bass, Striped	2[a]	18 minimum
Bass, Smallmouth	5	14 minimum
Bass, Spotted	(in any combination)	None
Bass, Largemouth		16 minimum[b]
Crappie, White and Black	25	10 minimum

a Striped bass bag limit changed from 5 to 2 on September 1, 2002
b Largemouth bass minimum length limit changed from to 16 inches on September 1, 2002

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

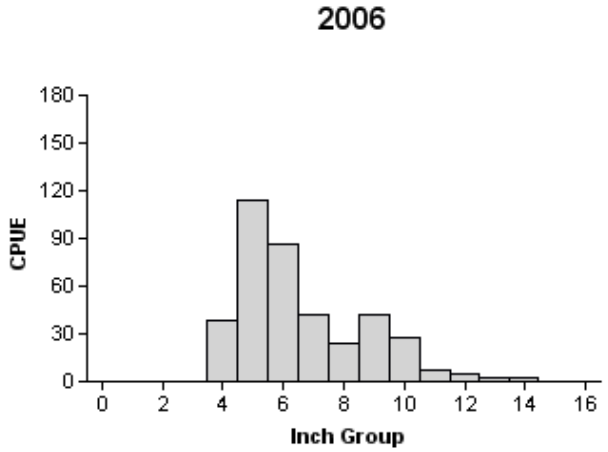
Species	Year	Number	Life Stage	Mean TL (in)
Blue catfish	2002	70,995	FGL	2.5
	Total	70,995		
Channel catfish	1972	2,800	AFGL	7.9
	2001	8,692	AFGL	9.8
	2001	426,256	FGL	2.8
	2010	89,973	FGL	3.5
	Total	527,721		
Florida Largemouth bass	1973	265,500	FRY	1.0
	1975	35,300	FRY	1.0
	1976	113,727	FGL	2.3
	1978	98,230	FGL	2.0
	1978	174,270	FRY	1.0
	2000	443,020	FGL	1.4
	2001	443,251	FGL	1.7
	2002	77	ADL	12.0
	2002	442,454	FGL	1.6
	2003	664,519	FGL	1.6
	2011	391,188	FGL	1.6
	Total	3,071,536		
Largemouth bass	1966	70,000	UNK	UNK
	1970	360,000	FRY	0.7
	1972	426,640	FRY	0.7
	1972	278,983	UNK	UNK
	2005	223,690	FGL	1.9
	Total	1,359,313		
Smallmouth bass	1978	162,000	UNK	UNK
	1979	108,000	UNK	UNK
	1980	75,090	UNK	UNK
	1984	131	ADL	10.7
	1987	30	ADL	10.7
	1988	51	ADL	10.7
	1998	71	ADL	10.7
	1998	259,100	FGL	1.1
	2001	20	ADL	10.7

	2002	500	AFGL	3.9
	2002	38,286	FGL	1.5
	2003	63,839	FGL	1.8
	Total	707,118		
Striped bass	1976	100,000	UNK	UNK
	1978	95,300	UNK	UNK
	1981	93,924	UNK	UNK
	1983	198,990	UNK	UNK
	1986	36,700	FGL	2.0
	1986	123,250	FRY	1.0
	1987	217,740	FGL	2.0
	1988	198,635	FRY	0.8
	1989	70,661	FGL	1.6
	1989	125,544	FRY	1.0
	1990	201,729	FGL	1.7
	1991	212,726	FGL	1.3
	1993	98,475	FGL	1.1
	1993	5,115,522	FRY	0.8
	1994	98,366	FGL	1.0
	1995	99,000	FGL	1.2
	1995	3,000,000	FRY	0.8
	1997	155,700	FGL	1.4
	1998	144,800	FGL	1.3
	1999	178,235	FGL	1.5
	2000	126,304	FGL	1.6
	2001	118,168	FGL	1.9
	2001	3,185,000	FRY	0.8
	2002	354,838	FGL	1.6
	2003	108,804	FGL	1.5
	2003	2,488,196	FRY	0.2
	2004	92,423	FGL	1.6
	2004	2,129,409	FRY	0.2
	2005	156,355	FGL	1.7
	2005	547,112	FRY	0.3
	2006	242,351	FGL	1.9
	2006	387,435	FRY	0.2
	2007	362,392	FGL	1.6
	2007	881,862	FRY	0.2
	2008	234,655	FGL	1.9
	2009	268,156	FGL	1.6
	2010	119,510	FGL	1.6
	Total	22,368,267		
Threadfin shad	1980	8,600	AFGL	2.9
	Total	8,600		

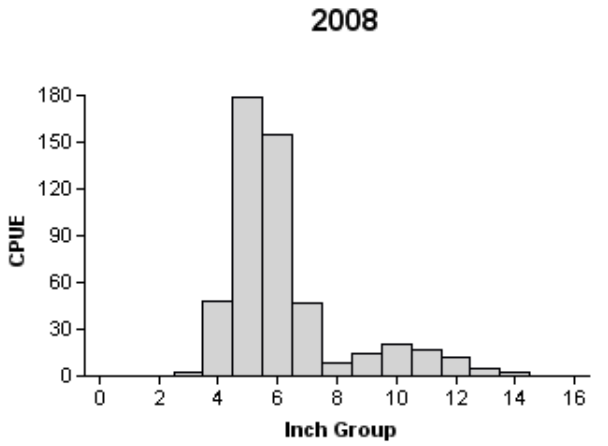
Table 4. Survey of littoral zone and physical habitat types, Possum Kingdom Reservoir, Texas, August 2010. A linear shoreline distance (miles) was recorded for each habitat type found. Surface area (acres) and percent of reservoir surface area was determined for each type of aquatic vegetation found.

Shoreline habitat type	Shoreline Distance		Surface Area	
	Miles	Percent of total	Acres	Percent of reservoir surface area
Bulkhead	1.7	1.1		
Featureless/nondescript	60.2	40.5		
Rocky bluff	13.4	9.0		
Rocky shore	73.4	49.4		
Total shoreline length	148.7			
Habitat adjacent to shoreline				
Standing timber			327	2.1
Boat docks			434	2.8
Native submerged vegetation			0.7	<0.1
Native emerged vegetation			10.9	<0.1

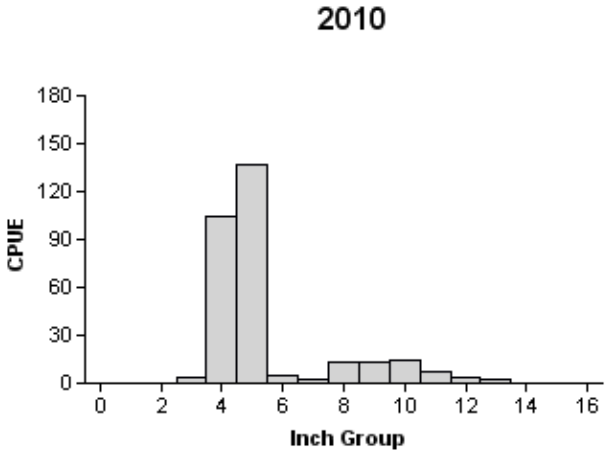
Gizzard Shad



Effort = 2.0
Total CPUE = 392.0 (22; 784)
Stock CPUE = 152.5 (18; 305)
PSD = 11 (2.8)
IOV = 72 (8.9)



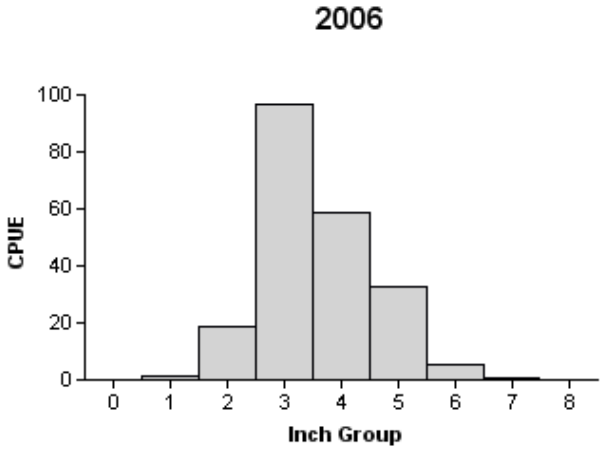
Effort = 2.0
Total CPUE = 511.0 (19; 1022)
Stock CPUE = 126.5 (21; 253)
PSD = 28 (4)
IOV = 84 (5.1)



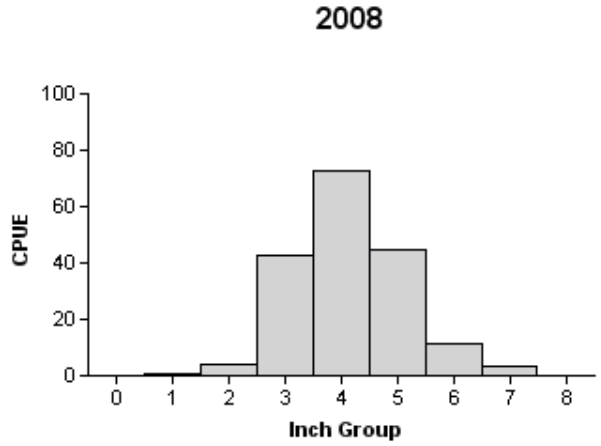
Effort = 2.0
Total CPUE = 306.5 (22; 613)
Stock CPUE = 56.5 (21; 113)
PSD = 25 (8.2)
IOV = 82 (6)

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, Possum Kingdom Reservoir, Texas, 2006, 2008, and 2010.

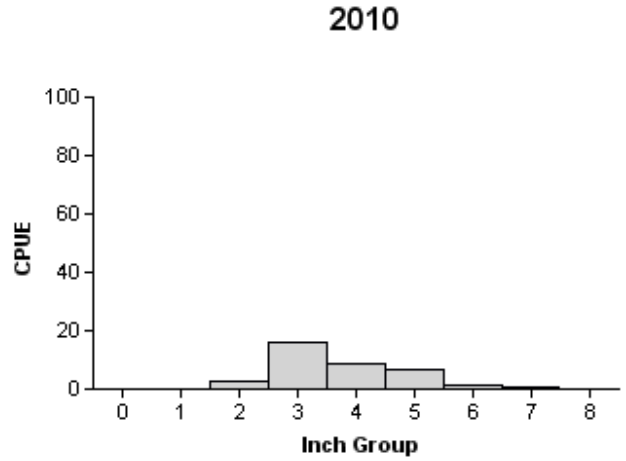
Bluegill



Effort = 2.0
Total CPUE = 214.5 (34; 429)
Stock CPUE = 194.5 (100; 389)
PSD = 3 (1.5)



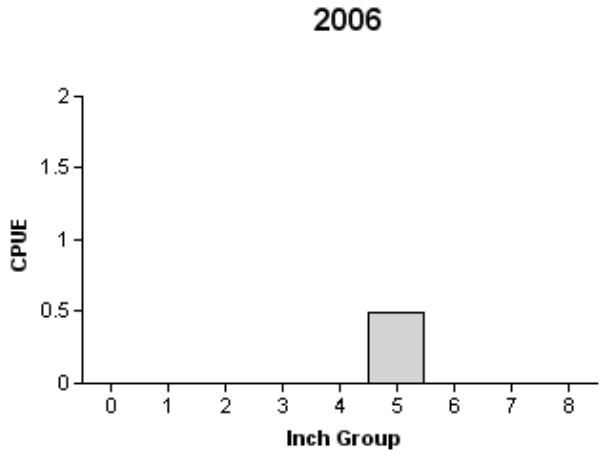
Effort = 2.0
Total CPUE = 180.5 (16; 361)
Stock CPUE = 175.5 (100; 351)
PSD = 9 (2.1)



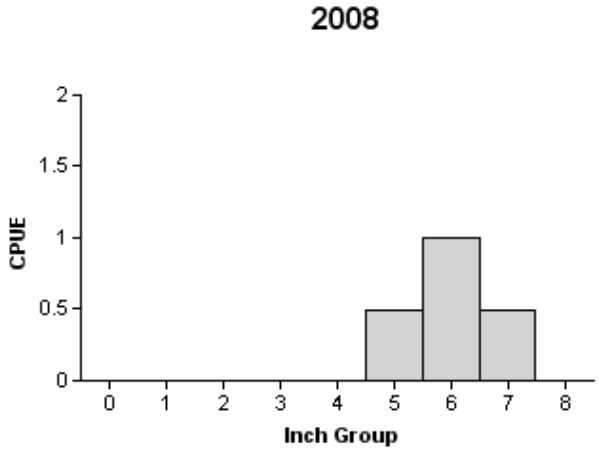
Effort = 2.0
Total CPUE = 37.0 (23; 74)
Stock CPUE = 34.5 (100; 69)
PSD = 7 (2.9)

Figure 3. 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, Possum Kingdom Reservoir, Texas, 2006, 2008, and 2010.

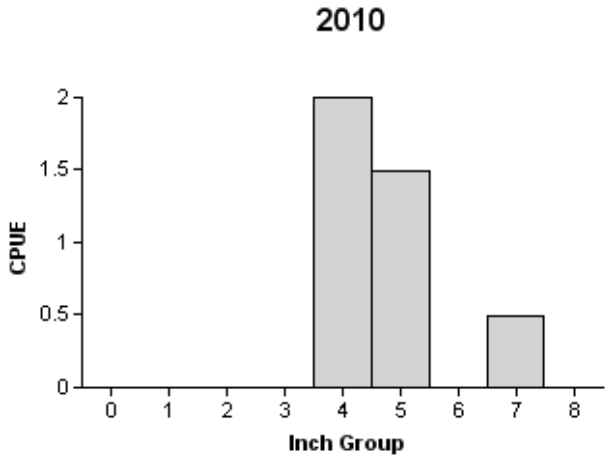
Redear Sunfish



Effort = 2.0
Total CPUE = 0.5 (100; 1)
Stock CPUE = 0.5 (100; 1)
PSD = 0 (102.2)
PSD-P = 0 (0)



Effort = 2.0
Total CPUE = 2.0 (47; 4)
Stock CPUE = 2.0 (47; 4)
PSD = 25 (22.1)
PSD-P = 0 (0)



Effort = 2.0
Total CPUE = 4.0 (76; 8)
Stock CPUE = 4.0 (76; 8)
PSD = 12 (14.6)
PSD-P = 0 (0)

Figure 4. Number of redear 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, Possum Kingdom Reservoir, Texas, 2006, 2008, and 2010.

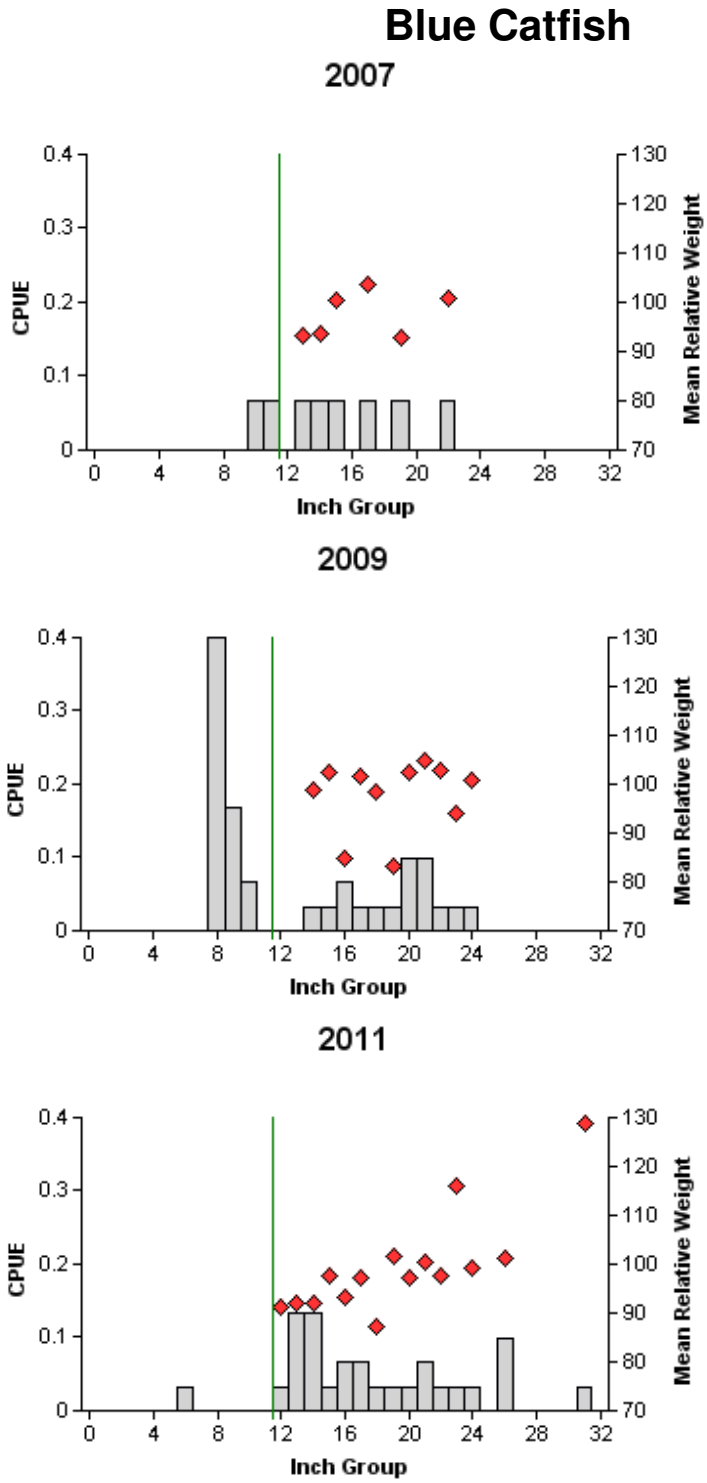
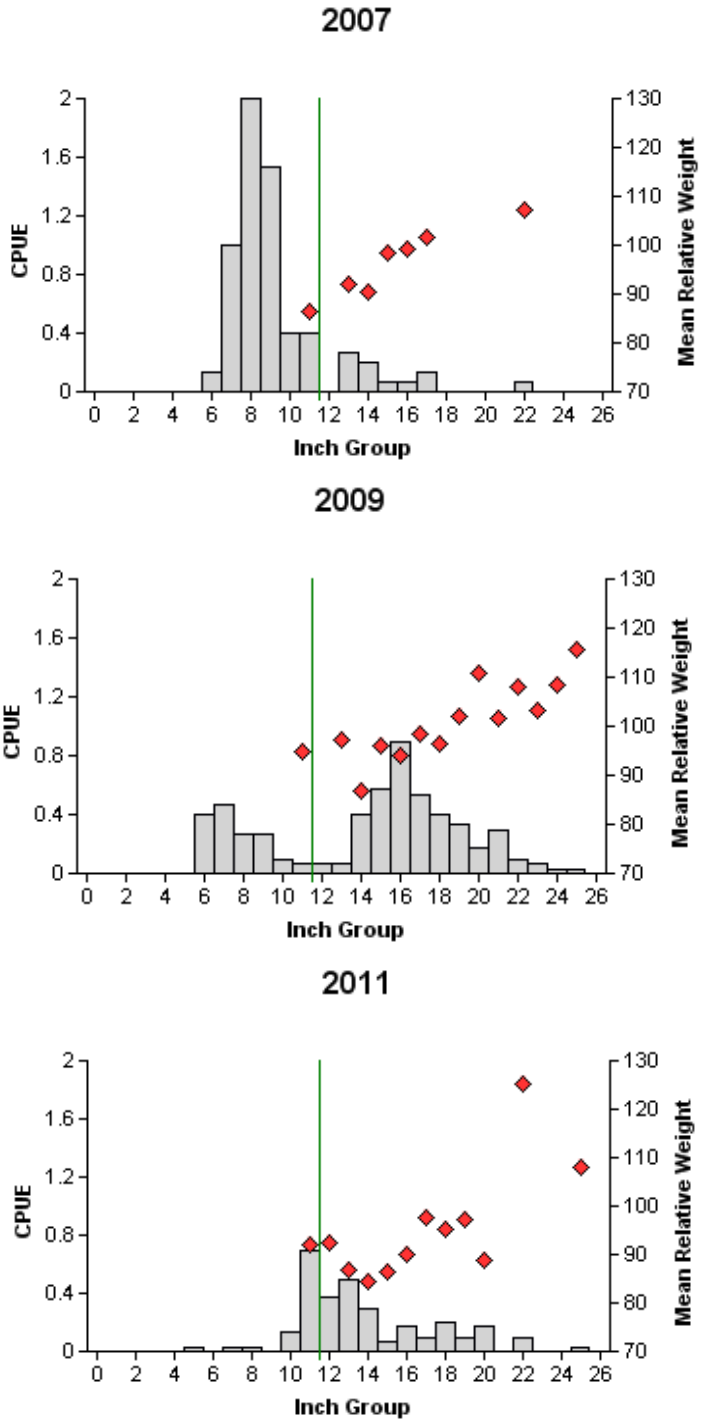


Figure 5. Number of blue catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for winter gill netting surveys, Possum Kingdom Reservoir, Texas, 2007, 2009, and 2011. Line indicates minimum length limit at time of sampling.

Channel Catfish



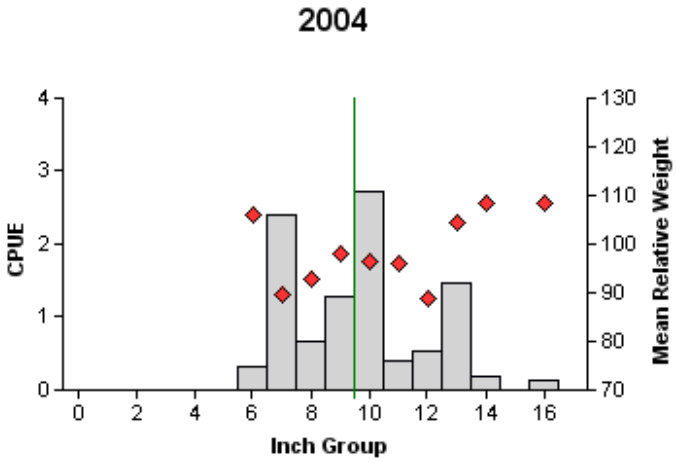
2007
Effort = 15.0
Total CPUE = 6.3 (65; 94)
Stock CPUE = 1.2 (62; 18)
PSD = 22 (5.3)
PSD-P = 0 (0)

2009
Effort = 30.0
Total CPUE = 5.5 (21; 166)
Stock CPUE = 4.0 (25; 121)
PSD = 71 (2.8)
PSD-P = 2 (0.8)

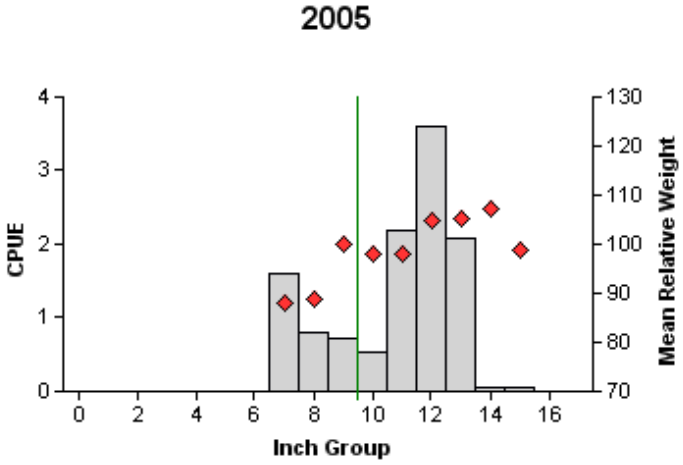
2011
Effort = 30.0
Total CPUE = 3.0 (24; 91)
Stock CPUE = 2.8 (24; 84)
PSD = 31 (9.4)
PSD-P = 1 (1.2)

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 winter gill netting surveys, Possum Kingdom Reservoir, Texas, 2007, 2009, and 2011. Line indicates minimum length limit at time of sampling.

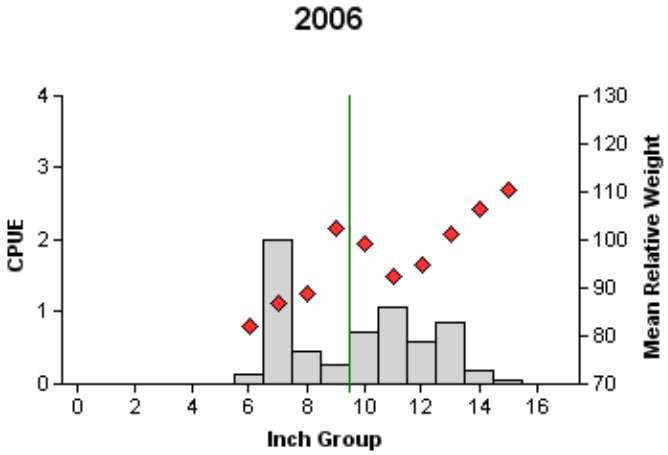
White Bass



Effort =	15.0
Total CPUE =	10.1 (36; 152)
Stock CPUE =	10.1 (73; 152)
PSD =	66 (5.3)
PSD-P =	23



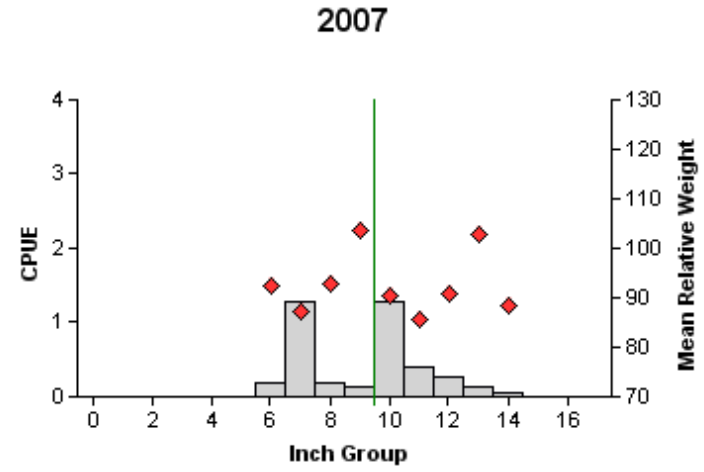
Effort =	15.0
Total CPUE =	11.7 (40; 175)
Stock CPUE =	11.7 (50; 175)
PSD =	79 (8.1)
PSD-P =	50



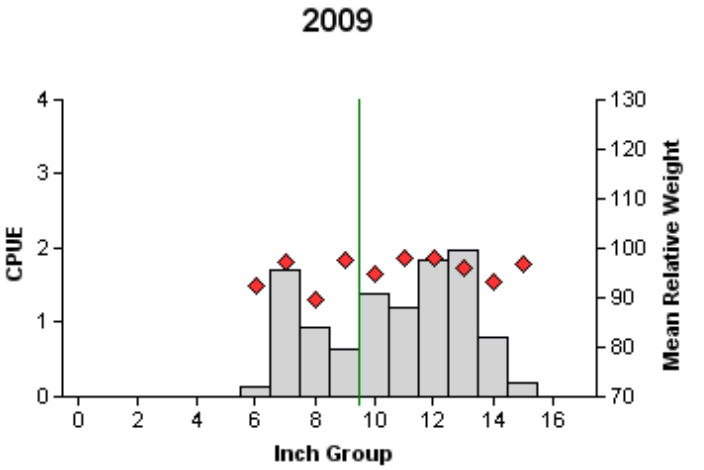
Effort =	15.0
Total CPUE =	6.4 (19; 96)
Stock CPUE =	6.4 (23; 96)
PSD =	59 (8.3)
PSD-P =	27

Figure 7. 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 winter gill netting surveys, Possum Kingdom Reservoir, Texas, 2004, 2005, and 2006. Line indicates minimum length limit at time of sampling.

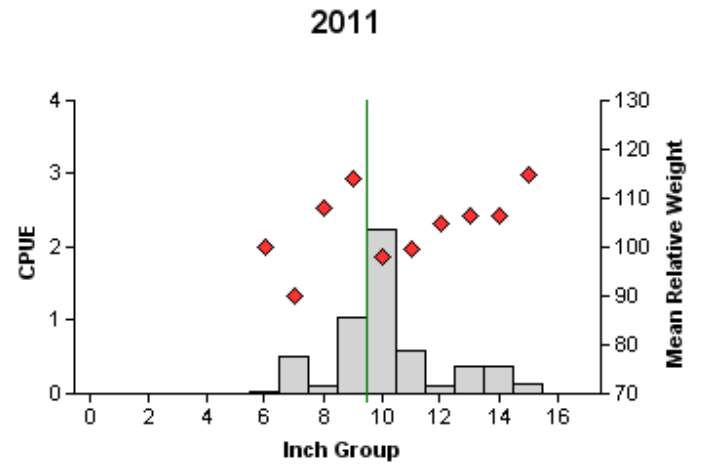
White Bass



Effort = 15.0
Total CPUE = 3.9 (58; 59)
Stock CPUE = 3.9 (46; 59)
PSD = 58 (14.3)
PSD-P = 12



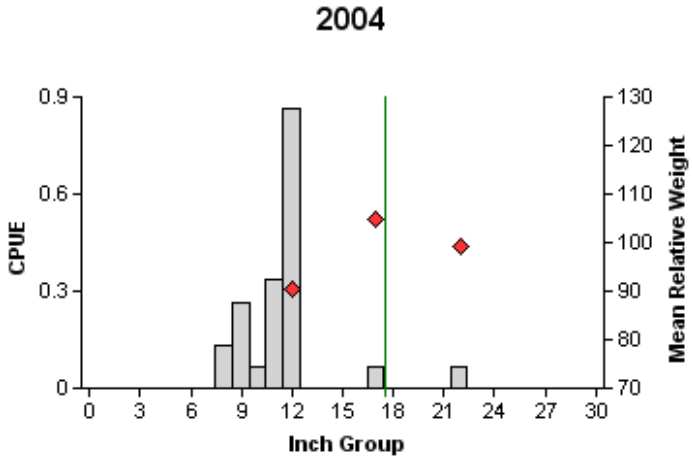
Effort = 30.0
Total CPUE = 10.8 (26; 324)
Stock CPUE = 10.8 (27; 324)
PSD = 74 (3.4)
PSD-P = 44



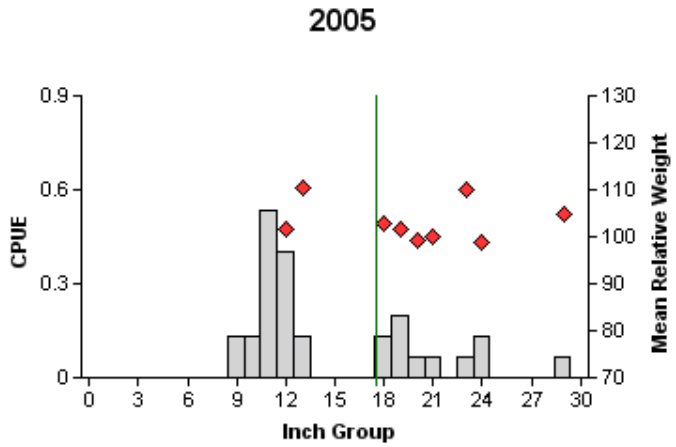
Effort = 30.0
Total CPUE = 5.5 (19; 164)
Stock CPUE = 5.5 (39; 164)
PSD = 88 (3)
PSD-P = 18

Figure 7 (continued). 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 winter gill netting surveys, Possum Kingdom Reservoir, Texas, 2007, 2009, and 2011. Line indicates minimum length limit at time of sampling.

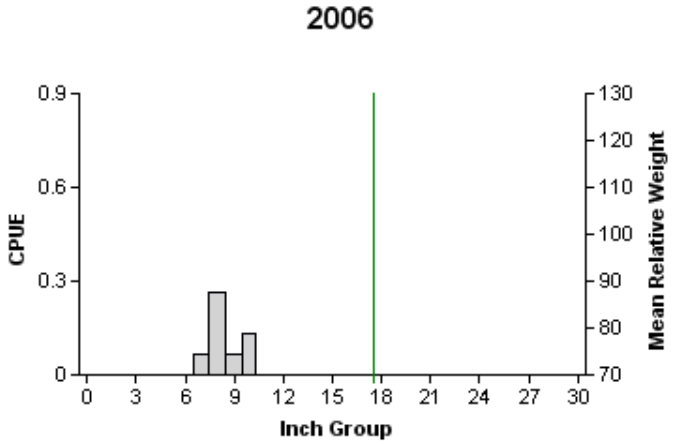
Striped Bass



Effort = 15.0
Total CPUE = 1.8 (56; 27)
Stock CPUE = 1.0 (55; 15)
PSD = 7 (3.6)
PSD-P = 0 (0)



Effort = 15.0
Total CPUE = 2.1 (35; 31)
Stock CPUE = 1.3 (45; 19)
PSD = 32 (16.4)
PSD-P = 0 (0)



Effort = 15.0
Total CPUE = 0.5 (54; 8)
Stock CPUE = 0.0 (0; 0)
PSD = 0 (-1)
PSD-P = 0 (0)

Figure 8. 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 winter gill netting surveys, Possum Kingdom Reservoir, Texas, 2004, 2005, and 2006.Line indicates minimum length limit at time of sampling.

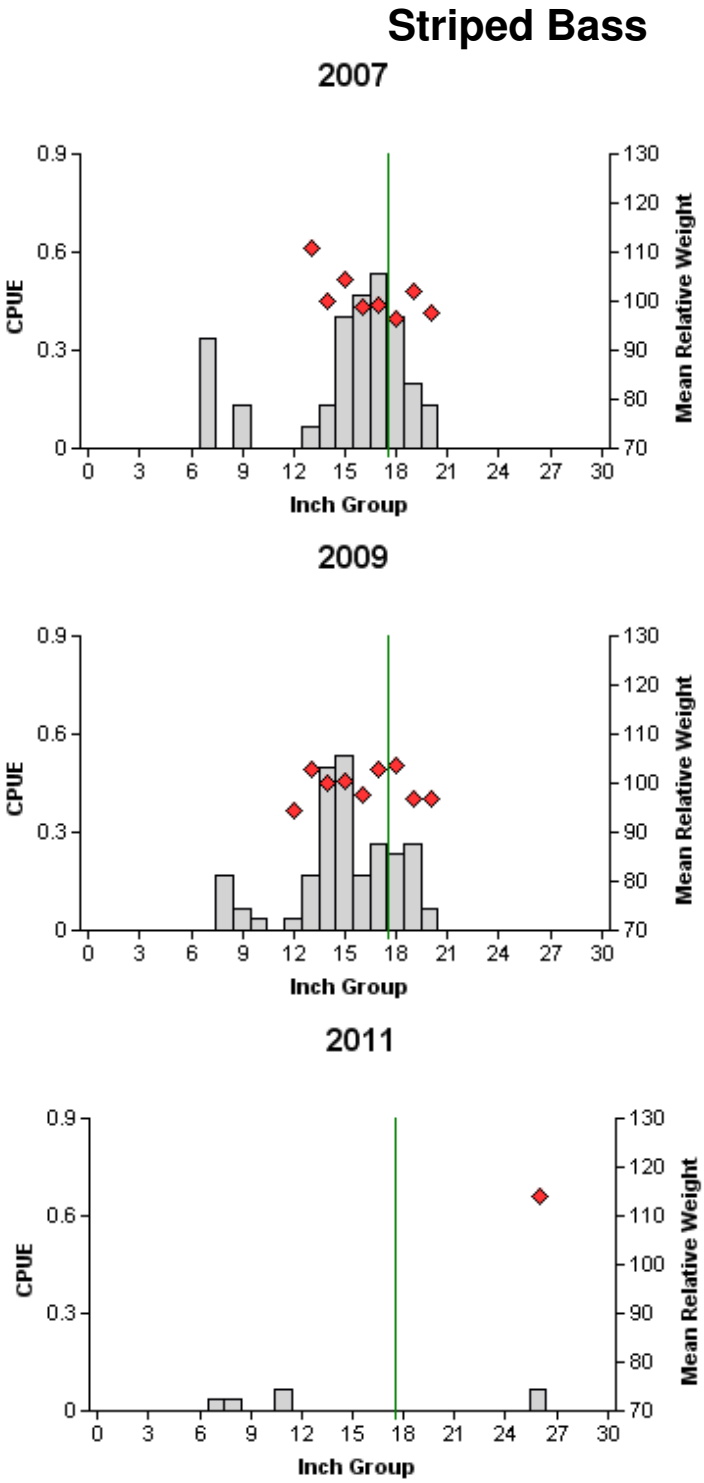


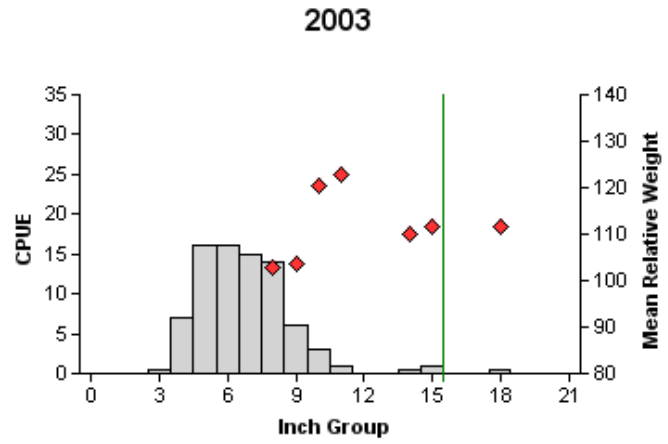
Figure 8 (continued). Number of striped bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for winter gill netting surveys, Possum Kingdom Reservoir, Texas, 2007, 2009, and 2011. Line indicates minimum length limit at time of sampling.

Table 5. Mean length at age of capture for striped bass (sexes combined) collected by gill nets, Possum Kingdom Reservoir, Texas, during winter surveys in 1999, 2001, 2002, 2003, 2005, 2007, and 2009. Sample sizes are in parentheses. Ages determined using otoliths.

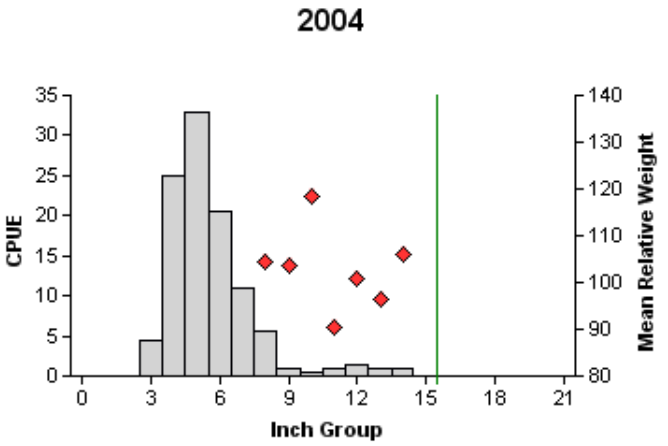
	Length (inches) at Age					
Year	1	2	3	4	5	6
1999		12.4(54)		22.0(9)	23.2(6)	27.6(1)
2001	9.6(10)	15.7(10)		18.4(19)		
2002		18.5(4)			22.8(11)	
2003	9.5(15)	14.1(16)				24.9(22)
2005	11.6(20)	19.6(6)	22.8(4)			
2007		17.7(20)				
2009	10.1(6)	16.1(33)				
Averages*	13.4	19.3	23.4	26.3	28.3	29.8

* Ecological region 5 averages from Prentice (1987); lengths derived for February 15.

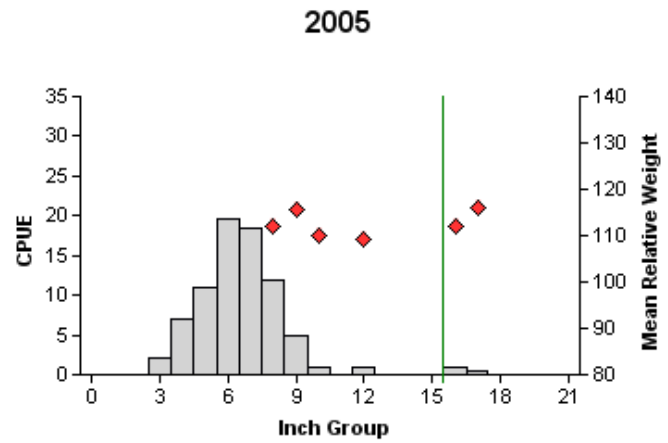
Largemouth Bass



Effort = 2.0
Total CPUE = 80.5 (20; 161)
Stock CPUE = 26.0 (32; 52)
PSD = 8 (4)
PSD-14 = 8 (4)



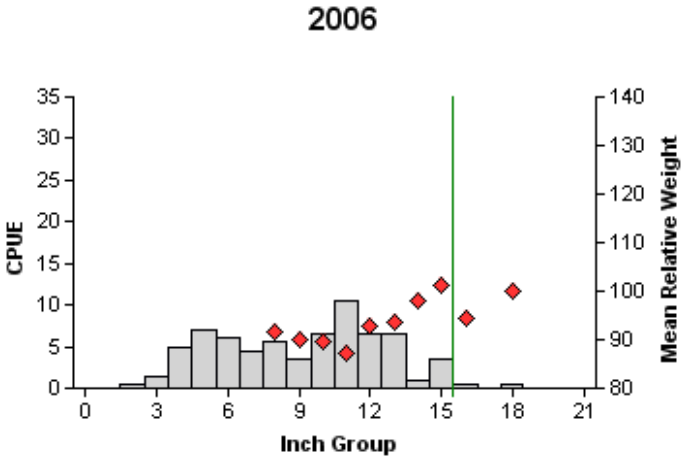
Effort = 2.0
Total CPUE = 105.5 (21; 211)
Stock CPUE = 11.5 (25; 23)
PSD = 30 (8.2)
PSD-14 = 9 (6.1)



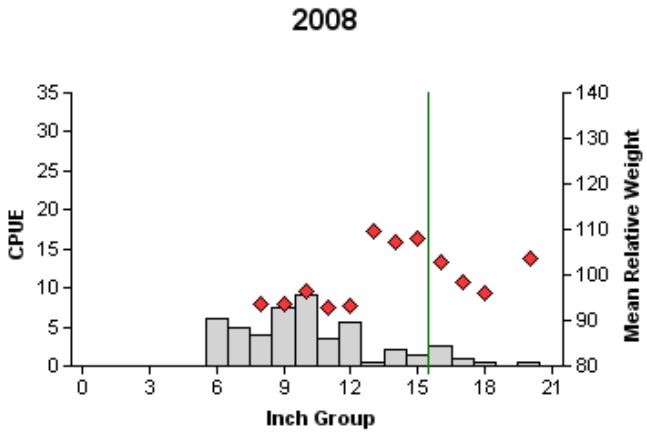
Effort = 2.0
Total CPUE = 78.5 (21; 157)
Stock CPUE = 20.5 (27; 41)
PSD = 12 (6.2)
PSD-14 = 7 (3.8)

Figure 9. Number of largemouth bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Possum Kingdom Reservoir, Texas, 2003, 2004, and 2005. Line indicates minimum length limit at time of sampling.

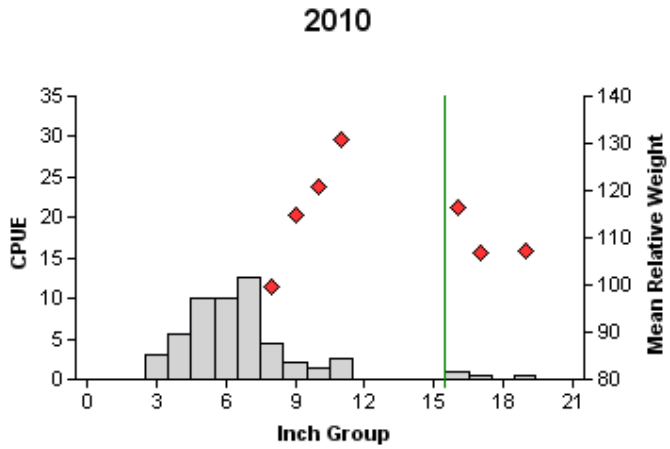
Largemouth Bass



Effort = 2.0
Total CPUE = 69.0 (23; 138)
Stock CPUE = 44.5 (25; 89)
PSD = 42 (7.3)
PSD-14 = 12 (3.6)



Effort = 2.0
Total CPUE = 49.0 (23; 98)
Stock CPUE = 38.0 (23; 76)
PSD = 37 (5.2)
PSD-14 = 21 (5.4)



Effort = 2.0
Total CPUE = 53.5 (14; 107)
Stock CPUE = 12.5 (28; 25)
PSD = 16 (13.8)
PSD-14 = 16 (13.8)

Figure 9 (continued). 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, Possum Kingdom Reservoir, Texas, 2006, 2008, and 2010. Line indicates minimum length limit at time of sampling.

Largemouth Bass

Table 6. Results of genetic analysis of largemouth bass collected by fall electrofishing, Possum Kingdom Reservoir, Texas, 1999, 2001, 2002, 2003, 2004, 2005, 2006 and 2010. FLMB = Florida largemouth bass, NLMB = Northern largemouth bass, F1 = first generation hybrid between a FLMB and a NLMB, Fx = second or higher generation hybrid between a FLMB and a NLMB. Genetic analysis was changed in 2005 from examining allozymes to microsatellite DNA genetics testing.

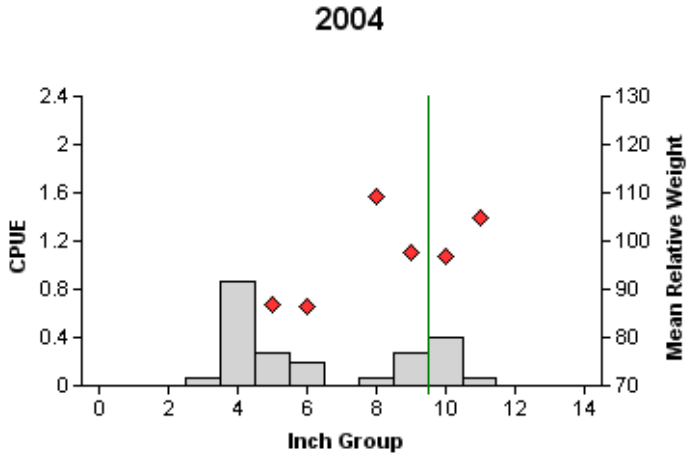
		Genotype				
Year	Sample size	FLMB	Fx	NLMB	% FLMB alleles	% pure FLMB
1999	28	4	21	3	50.0	14.3
2001	30	3	21	6	40.8	10
2002	30	7	15	8	50.8	23.3
2003	31	21	9	1	84.7	67.7
2004	49	12	34	3	62.6	24.5
2005	2	1	1	0	75	50
2006	30	2	28	0	60	7
2010	30	1	28	1	53	3

Table 7. Age and mean length at age for largemouth bass (sexes combined) collected by electrofishing, Possum Kingdom Reservoir, October 1999, 2000, 2002, 2003, 2005, 2006, and 2008. Sample sizes are in parentheses. Ages determined using otoliths.

	Length (inches) at Age			
Year	1	2	3	4
1999	10.8 (11)	13.6 (5)	14.8 (2)	16.1 (3)
2000	10.9 (17)	13.1 (3)	13.9 (2)	15.4 (1)
2002	12.0 (24)			
2003		15.1 (3)		
2005	12.6 (2)	16.9 (3)		
2006	10.7 (73)	14.8 (8)	18.2 (1)	
2008	15.4 (3)	16.3 (2)	16.7 (5)	
Averages*	10.2	13.0	15.2	16.9

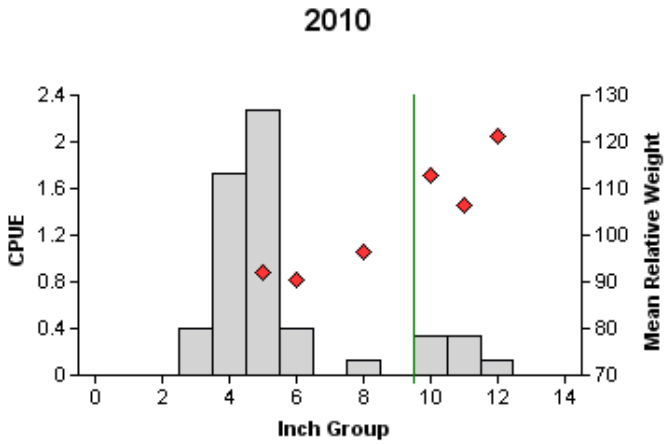
*Ecological region averages from Prentice (1987); lengths derived for November 1.

White Crappie



Effort = 15.0
Total CPUE = 2.2 (34; 33)
Stock CPUE = 1.3 (35; 19)
PSD = 63 (18.4)
PSD-P = 37 (12)

Effort = 15.0
Total CPUE = 1.8 (32; 27)
Stock CPUE = 1.7 (32; 26)
PSD = 46 (11.6)
PSD-P = 31 (14.4)



Effort = 15.0
Total CPUE = 5.7 (34; 86)
Stock CPUE = 3.6 (29; 54)
PSD = 26 (6.6)
PSD-P = 22 (7.5)

Figure 10. Number of white crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, Possum Kingdom Reservoir, Texas, 2004, 2006, and 2010. Line indicates minimum length limit at time of sampling.

White Crappie

Table 8. Age and mean length at age for white crappie (sexes combined) collected by trap nets, Possum Kingdom Reservoir, November 1993, 1996, 1999, 2001, 2002, and 2008. Sample sizes are in parentheses.

	Length (inches) at Age			
Year	1	2	3	4
1993	7.5 (20)	11.1 (14)	12.0 (3)	13.1 (4)
1996	8.0 (12)	10.8 (3)	12.9 (1)	14.4 (1)
1999	10.0 (2)	10.6 (1)	13.0 (1)	
2001	11.8 (2)			
2002	9.9 (12)			
2008	9.3 (19)			
Averages*	6.9	8.9	10.3	11.3

* Ecological region averages from Prentice (1987), lengths derived for November 15.

Table 9. Proposed sampling schedule for Possum Kingdom Reservoir, Texas. Gill netting surveys are conducted in the spring, while electrofishing and trap netting surveys are conducted in the fall. Standard surveys are denoted by S and additional surveys denoted by A.

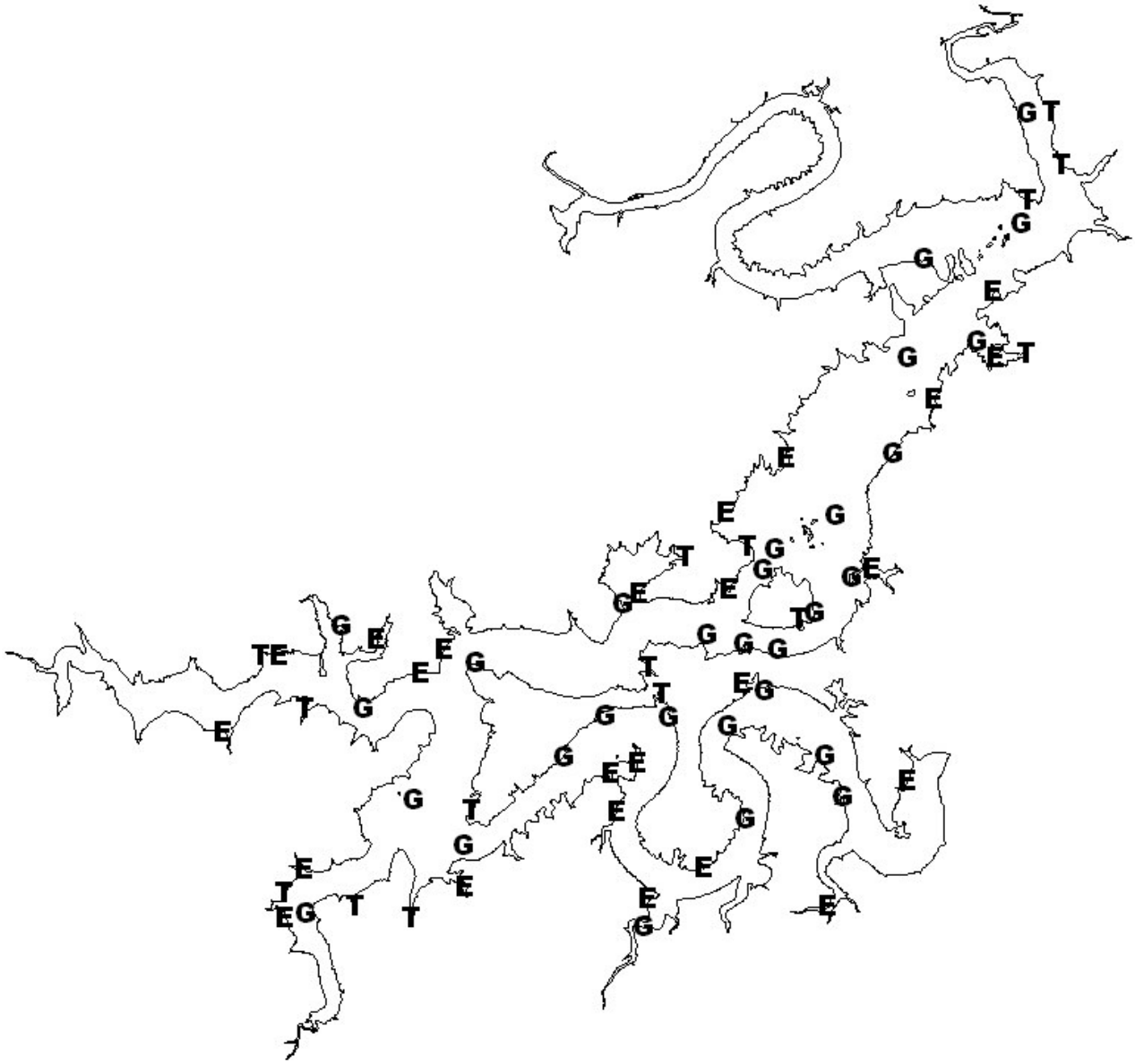
Survey Year	Electrofisher	Trap Net	Gill Net	Creel Survey	Vegetation Survey	Access Survey	Report
Fall 2011-Spring 2012							
Fall 2012-Spring 2013	A		A				
Fall 2013-Spring 2014							
Fall 2014-Spring 2015	S	S	S		S	S	S

APPENDIX A

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

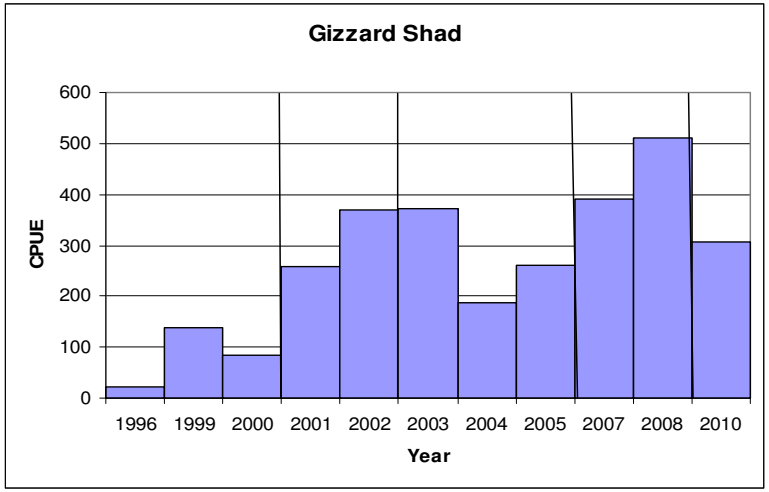
	Gill Nets		Trap Nets		Electrofishing	
Species	N	CPUE	N	CPUE	N	CPUE
Longnose gar	48	1.6				
Gizzard shad	137	4.6			613	306.5
Threadfin shad					4	2.0
Common carp	19	0.6				
River carpsucker	35	1.2				
Smallmouth buffalo	52	1.7				
Blue catfish	27	0.9	2	0.1		
Black bullhead			3	0.2		
Channel catfish	91	3.0	2	0.1		
Flathead catfish	3	0.1				
White bass	164	5.5	84	5.6		
Striped bass	6	0.2				
Palmetto bass	3	0.1				
Green sunfish			1	0.1	9	4.5
Warmouth			1	0.1	1	0.5
Bluegill	2	0.1	177	11.8	74	37.0
Longear sunfish			79	5.3	58	29.0
Redear sunfish			16	1.1	8	4.0
Largemouth bass	13	0.4			107	53.5
White crappie	5	0.2	86	5.7		
Black crappie			9	0.6		
Freshwater drum	22	0.7				

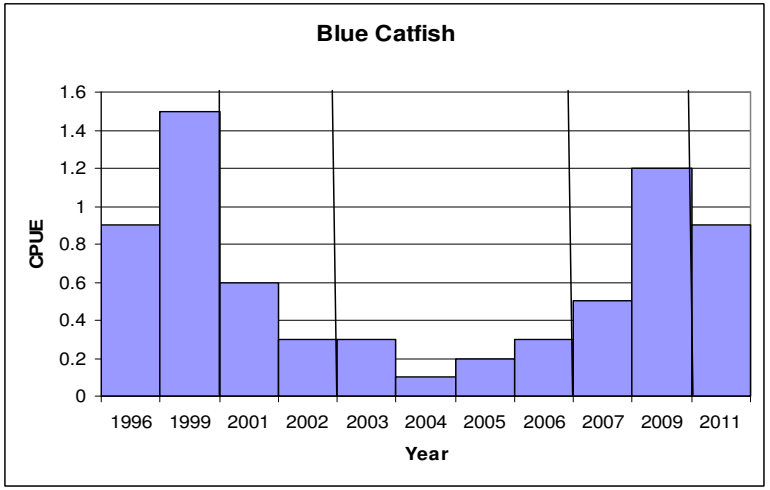
APPENDIX B

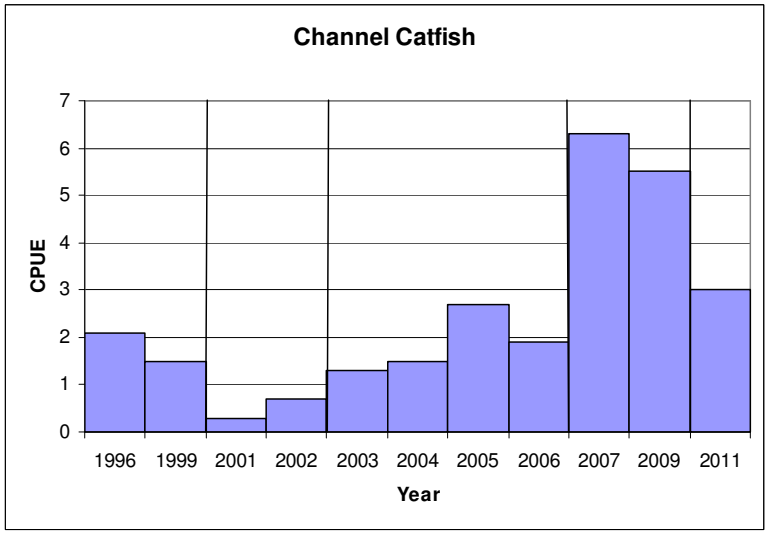


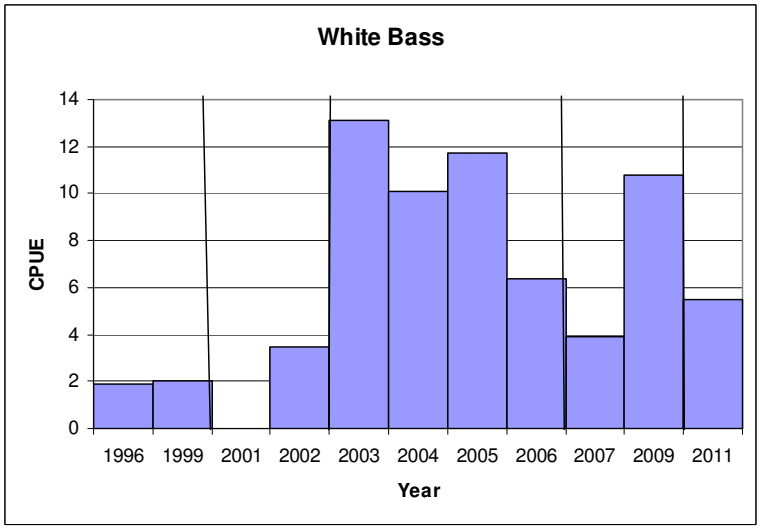
Location of sampling sites, Possum Kingdom Reservoir, Texas, 2010-2011. Trap net, gill net, and electrofishing stations are indicated by T, G, and E, respectively.

APPENDIX C

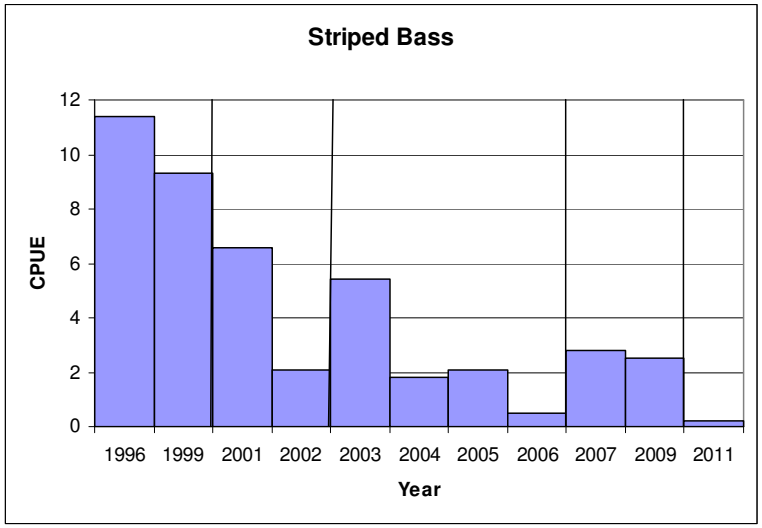


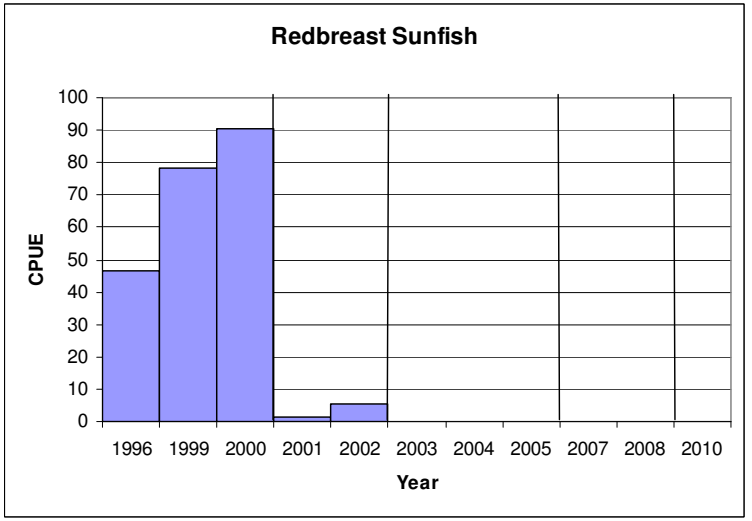


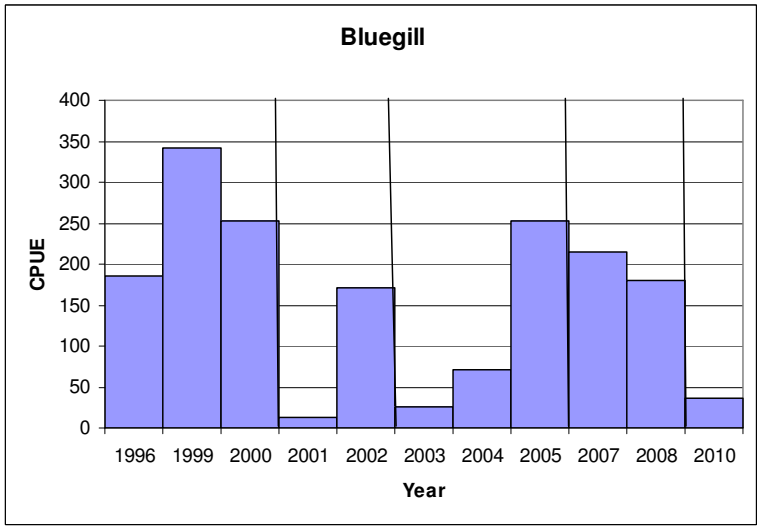


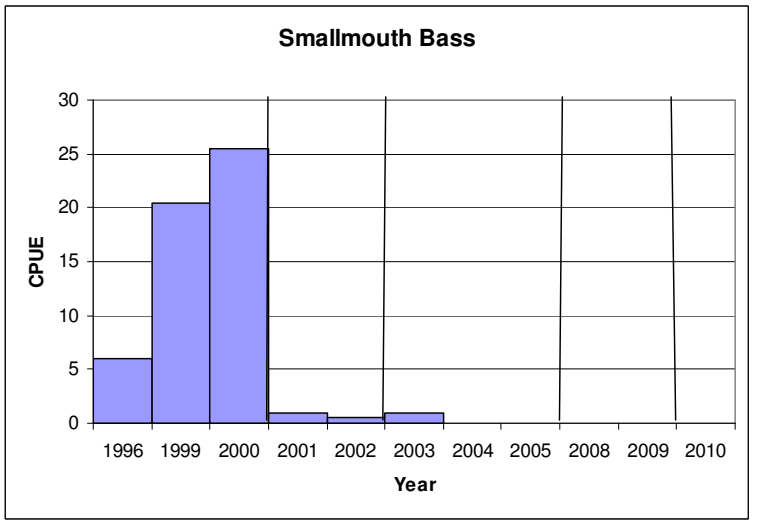


Historical catch rates for gizzard shad (electrofishing), blue catfish, channel catfish and white bass (gill netting). Vertical lines represent major golden alga fish kill events. Only the years sampled are shown.

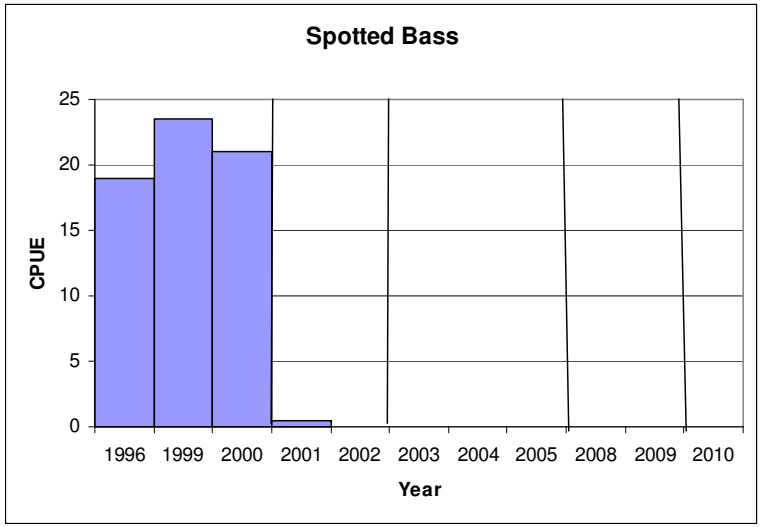


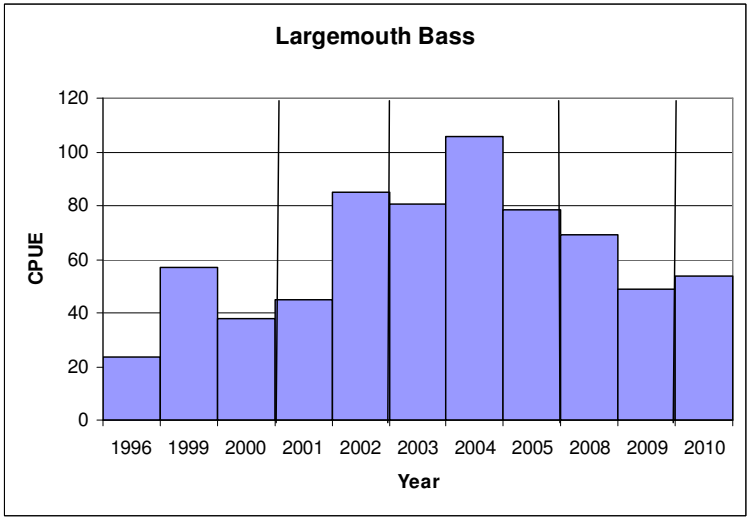


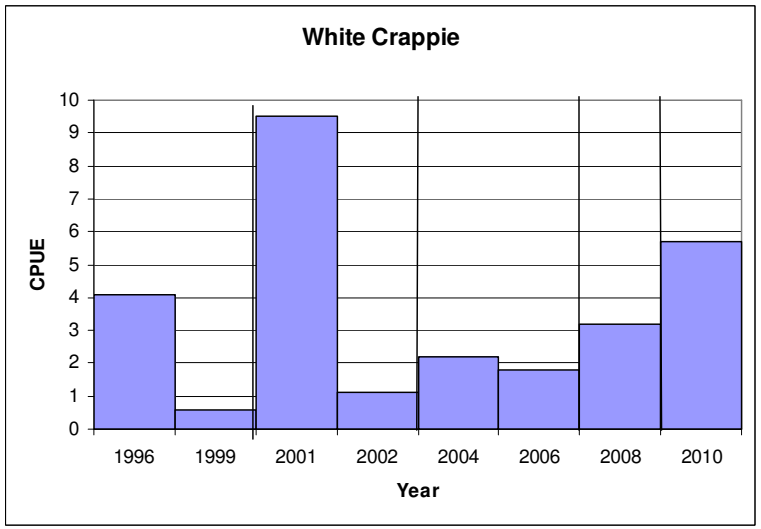


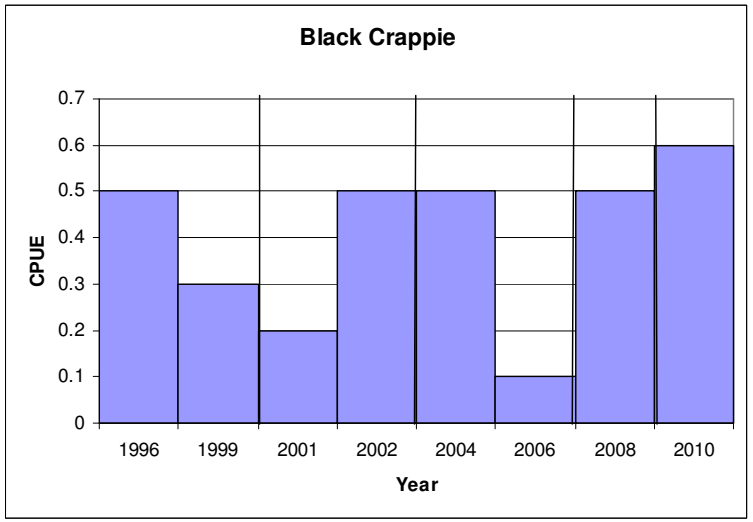


Historical catch rates for striped bass (gill nets), redbreast sunfish, bluegill, and smallmouth bass (electrofishing). Vertical lines represent major golden alga fish kill events. Only the years sampled are shown.









Historical catch rates for spotted bass, largemouth bass (electrofishing), white crappie, and black crappie (trap nets). Vertical lines represent major golden alga fish kill events. Only the years sampled are shown.