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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2010 Survey Report

Lake Houston

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lake Houston were surveyed in 2010 using electrofishing and in 2011 using gill netting. Anglers were surveyed from June 2010 through May 2011 with a roving creel survey. This report summarizes the results of the surveys and contains a management plan for the reservoir based on those findings.

- **Reservoir description:** Lake Houston is a 12,240-acre reservoir constructed on the San Jacinto River by the City of Houston in 1954 to provide water for municipal and industrial purposes. Its location within the Houston metropolitan area results in heavy recreational use.

- **Management history:** All sport fisheries at Lake Houston are regulated under statewide length and bag limits. For a number of years palmetto bass were stocked annually, but stockings were discontinued in 1999. Poor quality shallow-water habitat has limited survival of many sport fish species, particularly largemouth bass. Silt loading from improper sand and gravel mining techniques in the West Fork San Jacinto River is the primary cause of the shallow-water habitat losses. Efforts to mitigate the sedimentation including solar water circulators, native vegetation restoration, and legislative action to better regulate sand and gravel mining are underway.

- **Fish community**

  - **Prey species:** Gizzard and threadfin shad, bluegill, and longear sunfish are the predominant prey species in Lake Houston. Other less numerous prey fishes include bullhead minnow, blacktail shiner, inland silverside, warmouth, and redear sunfish. Abundance of prey species is adequate to support predators.

  - **Catfishes:** Blue and channel catfish both occur in Lake Houston, but blue catfish are the dominant species. Catfish angling is an important segment of the Lake Houston fishery with 15% of all angling effort directed at catfish.

  - **White bass:** Gill net catches of white bass have declined in the past several years, but creel data indicate a significant level of white bass angler catch and harvest, despite a low level of directed angling pressure.

  - **Largemouth bass:** Electrofishing catch rates of largemouth bass have historically been low at Lake Houston. Degraded habitat due to silt loading and shoreline bulkheads limit the amount of available habitat for spawning and survival of juvenile bass. In spite of this, anglers seeking largemouth bass make up over 28% of all directed angling effort.

  - **Crappie:** Although both black crappie and white crappie occur in Lake Houston, white crappie far out-number black crappie. Crappie are the most sought after species in the fishery. Although catch rates from standard sampling are low, anglers continue to catch and harvest a substantial number of crappie.

- **Management strategies:** Statewide length and bag limits will continue to be used to regulate sport fish harvest. Cooperative efforts with the City of Houston will continue to address water quality and habitat issues. Exotic vegetation will continue to be monitored and treated as needed. Efforts to address the sand and gravel dredging operations in the West Fork San Jacinto River will also continue with help from the City of Houston and other private interests.

INTRODUCTION

This document is a summary of fisheries data collected from Lake Houston from June 2010 through May 2011. 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 with the 2010-2011 data for comparison.

Reservoir Description

Lake Houston is a 12,240-acre reservoir constructed on the San Jacinto River by the City of Houston in 1954 to provide water for municipal and industrial purposes. Its location within the Houston metropolitan area results in heavy recreational use. Lake Houston has a drainage area of approximately 2,600 square miles. Rainfall in the watershed averages 46.6 inches per year. Conservation pool elevation is 44.1 feet above mean sea level. Quarterly elevations are reported in Figure 1. The reservoir lies within the Piney Woods Vegetation Area. Other physical characteristics of Lake Houston are presented in Table 1.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Webb and Henson 2007) included:

1. Work with stakeholders to identify ways to reduce turbidity and littoral habitat degradation in Lake Houston.
   Action: TPWD is working with the City of Houston, the San Jacinto River Authority, private interests, and regulatory authorities to address sedimentation in the San Jacinto River and Lake Houston. Legislation (HB 571) was passed in 2011 to better regulate gravel dredging near the San Jacinto River. A contract with the U.S. Army Corps of Engineers Lewisville Aquatic Ecosystem Research Facility (LAERF) is underway to restore native vegetation in the upper part of Lake Houston. The City of Houston has installed water circulators to reduce biogenic turbidity. TPWD continues to distribute information concerning the sediment problems through local media outlets. Presentations have been given at state and national meetings regarding the San Jacinto River Watershed and the issues at Lake Houston. Lake Houston was named one of the top waters to watch by the National Fish Habitat Partnership in 2009.
2. Increase Florida largemouth bass genetic influence in Lake Houston
   Action: No Florida largemouth bass have been stocked since 1990 due to poor habitat conditions; however, the recent efforts at habitat improvement along with a greatly suppressed largemouth bass population, may justify Florida largemouth bass stocking in the future.
3. Floating exotic aquatic vegetation (primarily water hyacinth and water lettuce) continues to be a problem at Lake Houston.
   Action: TPWD continued to support SJRA and the City of Houston in their control of exotic vegetation.

Harvest regulation history: Crappie have been managed under a 10-inch minimum-length limit with a 25-fish daily bag since 1988. Channel and blue catfish were managed with a 9-inch minimum-length limit and 25-fish daily bag until 1995 when the length limit was increased to12 inches. All sport fisheries are regulated under statewide length and bag limits (Table 2).

Stocking history: Soon after impoundment, channel catfish were stocked in Lake Houston. Palmetto bass fingerlings were stocked 13 times between 1979 and 1999. However, no viable fishery was established and stockings were discontinued in 1999. Striped bass were substituted for Palmetto bass in 1989 and 1990. Florida largemouth bass were stocked in 1990. A complete stocking history is presented in Table 3.

Vegetation/habitat history: Lake Houston has limited littoral habitat. Heavy silt loading in the upper

reaches of the reservoir inhibits the growth of desirable aquatic vegetation. Real estate development and bulkhead construction along about 11% of the shoreline diminishes the quality of littoral fish habitat. Most of the Lake Houston shoreline is described as natural shoreline with standing timber and/or bulkhead and boat docks, rocky shoreline (Table 4). Water hyacinth and water lettuce are both nuisance species at Lake Houston. The City of Houston contracts with a private applicator to control these species.

Water Transfer: Lake Houston is used for municipal water supply and recreation. There is currently one water treatment facility on the reservoir that provides municipal water for the City of Houston. A project is under review to transfer water from the Trinity River below Lake Livingston to Lake Houston (San Jacinto River Drainage) by way of the Luce Bayou canal.

METHODS

Fishes were collected by electrofishing (2.0 hours at 24, 5-min stations), and gill netting (15 net nights at 15 stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing and for gill nets as the number of fish caught per net night (fish/nn). All survey sites were randomly selected and all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2009). Aquatic vegetation, littoral habitat, and angler access surveys were performed according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2009).

A roving creel survey was conducted from June 2010 through May 2011. A total of 36 days were surveyed during the creel year, with the entire lake treated as one section. The reservoir was surveyed for 6.5 hours chosen from two possible time periods.

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). 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 SE was calculated for structural indices and IOV. A sample of 30 largemouth bass were collected by electrofishing in spring 2011 and subjected to genetic analysis using DNA microsatellite analysis in accordance with Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2009). Source for water level data was the United States Geological Survey (USGS).

RESULTS AND DISCUSSION

Habitat: Native vegetation occupied approximately 30 acres in Lake Houston. Waterhyacinth, water lettuce, alligatorweed, and common salvinia covered approximately 45 acres in 2010 (Table 4).

Creel: Total angler effort declined from 61,003 angler-hours in 2005/2006 to 40,524 in 2010/2011. Anglers spent an estimated $354,371 in 2010/2011 compared to $175,844 in 2005/2006 (Table 6). The most sought after species in Lake Houston continued to be crappie. Anglers spent an estimated 16,033 hours seeking crappie (43% of total directed fishing effort). This estimate was similar to the 2005/2006 estimate of 15,900 hours (35.3% of total directed fishing effort). Angling for largemouth bass represented approximately 28% of total directed effort; whereas, catfish angling accounted for approximately 15% of total directed effort (Table 5).

Prey species: Gizzard shad, threadfin shad, bluegill, and longear sunfish make up the majority of the available forage in Lake Houston. IOV for gizzard shad was 92, indicating most gizzard shad are available as forage for adult largemouth bass. The total combined catch rate for gizzard shad and threadfin shad (Appendix A) was 516.5/h (289.5/h in 2006) (Webb and Henson 2007), for bluegill 40/h (117.5/h in 2006) (Figure 2), and for longear sunfish 67/h (179.5/h in 2006). Other available prey species present included bullhead minnow, inland silverside, brook silverside, and warmouth.

Catfish: Both blue catfish and channel catfish occur in Lake Houston with blue catfish the dominant species. The gill net CPUE of blue catfish in 2011 was 37.9/nn, up from 11.73/nn in 2007 (Figure 4). The

sample size distribution was good; PSD was 27 with fish up to 27 inches in length captured in gill nets. Gill net CPUE of channel catfish was 24.3/nn, up from 10.6/nn in 2007 (Figure 5). The sample length frequency distribution indicated an excellent size distribution for channel catfish with a PSD of 18 and a PSD-12 of 86. Body condition (W_r) of both blue and channel catfish was good.

Angler harvest of blue catfish was estimated to be 699 fish with an estimated harvest of 440 channel catfish (Table 7; Figure 6), down considerably from the 2005/2006 estimates of 1,695 and 4,536, respectively. Blue catfish and channel catfish to 22 inches were observed in angler creels from June 2010 through May 2011 (Figure 6). Angling effort was similar, but catch rate declined.

White bass: Gill net catch rates of white bass were low in 2011 (1.4/nn) but were similar to historic data (Figure 7). The total angling effort directed at white bass was low compared to other sport fish, but the angler catch rate was the highest of any species in 2010 at 1.49/h (Table 8). Anglers harvested an estimated 1,286 white bass during the 2010/2011 creel period with white bass up to 15 inches observed (Table 8; Figure 8).

Largemouth bass: Electrofishing catch rates of largemouth bass at Lake Houston have never been high due to habitat degradation. The electrofishing CPUE in 2010 was 9.5/h, a substantial decrease from 2006 (23.0/h) (Figure 9). Size structure is typical for populations under a 14-inch minimum length limit and PSD was within the target range. Fish up to 18 inches in length were captured in the fall sample. During the period from June 2010 through May 2011, anglers spent an estimated 11,342 hours seeking largemouth bass (Table 9), and anglers harvested an estimated 613 largemouth bass. Anglers released 75.5% of legal-sized fish caught. Largemouth bass up to 20 inches were observed during the creel survey in 2010-2011 (Figure 10). No Florida genotypes were detected in the 2011 sample and the Florida allele frequency was only 8.0% (Table 10).

Crappie: Both black crappie and white crappie are present in Lake Houston, though white crappie are far more numerous. Trap nets have traditionally proven inadequate at sampling crappies in Lake Houston. Gill net catches of crappie in 2011 were low with a catch rate of 1.7/nn for white crappie and 0.1/nn for black crappie (Figure 11; Figure 12). Anglers harvested an estimated 2,190 white crappie and 77 black crappie during the 2010-2011 creel period. Anglers released very few legal-sized fish (2.9% for white crappie, 0% for black crappie) indicating a highly harvest-oriented fishery (Table 11). Black crappie up to 11 inches and white crappie up to 14 inches were observed during the creel survey in 2010-2011 (Figure 13).

Fisheries management plan for Lake Houston, Texas

Prepared–July 2011

ISSUE 1: The primary issue facing Lake Houston continues to be sedimentation caused largely by gravel dredging in the San Jacinto River and its tributaries upstream of the reservoir. The suspended and dissolved solids prevent light penetration into the water column, decreasing rooted macrophytes and phytoplankton. The subsequent loss of productivity and habitat affects water quality and fish production.

MANAGEMENT STRATEGY

1. Continue to provide information to the City of Houston, other agencies, and the media concerning these issues.
2. Provide any support needed to the Texas Commission on Environmental Quality regarding the new permitting regulations for gravel dredging operations (HB 571).
3. Contract with the USCOE LAERF to begin establishment of native vegetation in the upper end of Lake Houston.

ISSUE 2: Florida largemouth bass influence has been low in Lake Houston. Genetics analysis indicated no FLMB genotypes and only 8.0% FLMB allele frequency.

MANAGEMENT STRATEGY

1. Request stocking of Florida largemouth bass for Lake Houston in 2012 and 2013 based on the need to rebuild the suppressed population of largemouth bass following attempts to improve aquatic habitat.
2. Continue to monitor largemouth bass population every four years with fall electrofishing survey.

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 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 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. Two invasive species, waterhyacinth and water lettuce, currently infest Lake Houston.

MANAGEMENT STRATEGIES

1. Provide logistical support to the City of Houston regarding exotic vegetation treatment.
2. Conduct annual vegetation surveys.
3. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir.
4. Contact and educate marina owners about invasive species, and provide them with posters, literature, etc. so that they can in turn educate their customers.
5. Educate the public about invasive species through the use of media and the internet.
6. Make a speaking point about invasive species when presenting to constituent and user groups.
7. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.
8. Deploy Portland Samplers in Lake Houston to help detect presence of zebra mussels.

SAMPLING SCHEDULE JUSTIFICATION:

Vegetation surveys are conducted annually at Lake Houston. Creel, electrofishing, gill netting, structural habitat, and access surveys are conducted once every four years to monitor trends.

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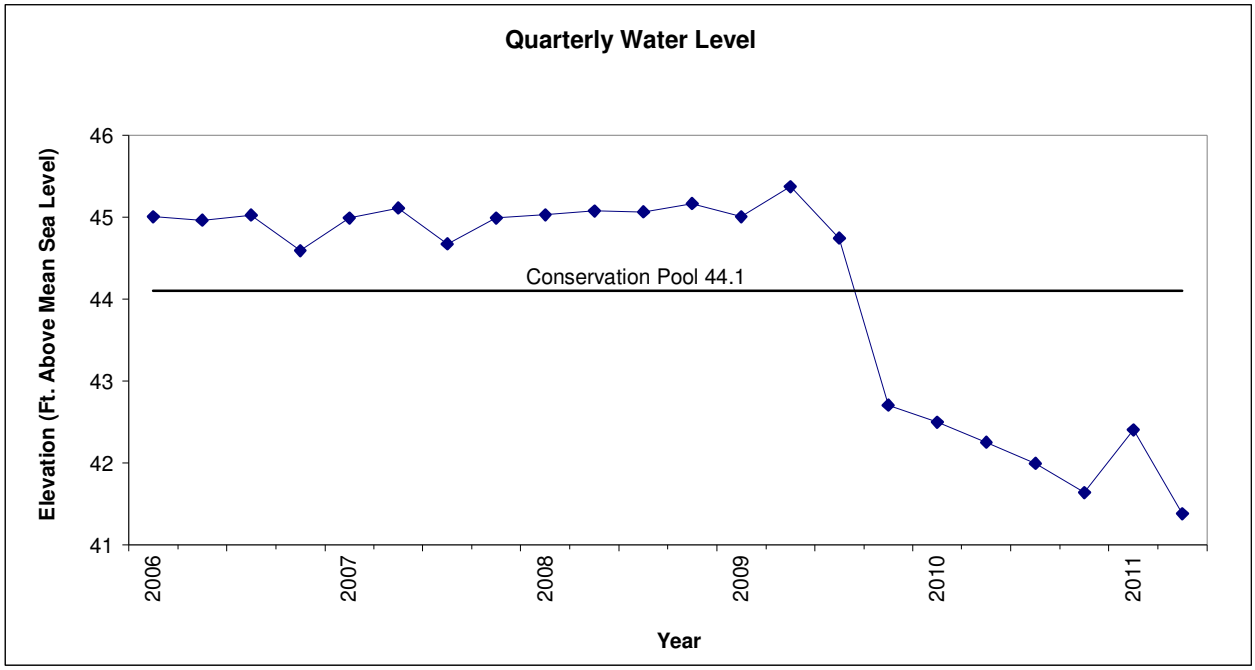


Figure 1. Quarterly water level elevations in feet above mean sea level (MSL) recorded for Lake Houston, Texas, 2006-2011.

Table 1. Characteristics of Lake Houston, Texas.

Characteristic	Description
Year constructed	1973
Controlling authority	City of Houston
County	Harris (location of dam)
Reservoir type	Main stream
Shoreline Development Index (SDI)	10.1
Conductivity	310 umhos/cm

Table 2. Harvest regulations for Lake Houston.

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

Table 3. Stocking history of Lake Houston, Texas. Size Category is FGL = 1-3 inches.

Species	Year	Number	Size
Channel catfish	1972	132,724	FGL
	1973	35,000	FGL
	Total	167,724	
Striped bass	1989	246,000	FGL
	1990	122,879	FGL
	Total	368,879	
Palmetto bass	1979	123,200	FGL
	1981	135,638	FGL
	1983	122,459	FGL
	1984	362,450	FGL
	1986	361,015	FGL
	1991	134,600	FGL
	1992	103,180	FGL
	1994	62,000	FGL
	1995	187,650	FGL
	1996	122,416	FGL
	1997	61,351	FGL
	1998	63,236	FGL
	Total	1,839,195	
Florida largemouth bass	1990	306,965	FGL
	Total	306,965	

Table 4. Survey of littoral zone and physical habitat types, Lake Houston, Texas, 2010. A linear shoreline distance (miles) was recorded for each habitat type found. Surface area (acres) and percent of reservoir surface area were 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
Natural shoreline/Standing timber	55.5	84.2		
Rocky shoreline/Piers and docks	0.2	<0.1		
Rocky shoreline/Open water	0.7	1.1		
Rocky shoreline/Standing timber	2.5	3.8		
Bulkhead/Piers and docks	0.9	1.4		
Bulkhead/Standing timber	6.1	9.3		
Floating waterhyacinth			10.9	<0.1
Waterlettuce			18.2	<0.1
Common salvinia			12.4	<0.1
Alligatorweed			1.2	<0.1
Native floating			<0.1	<0.1
Native submersed			0.1	<0.1
Native emergent			29.7	<0.1
Total			72.6	0.7

Table 5. Percent directed angler effort by species for Lake Houston, Texas, 2002-2003, 2005-2006, and 2010-2011.

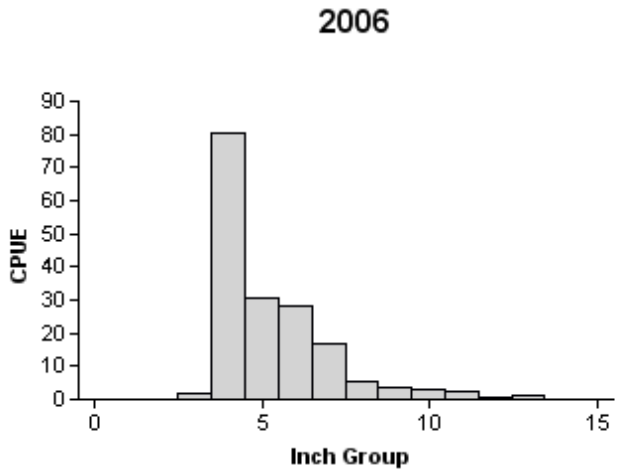
Species	Year		
	2002/2003	2005/2006	2010/2011
Catfishes	26.2	15.0	14.7
Temperate bass	1.8	4.2	0.81
Sunfishes	0.0	0.6	0.0
Largemouth bass	22.5	28.5	28.4
Crappies	44.4	35.3	43.1
Anything	0.0	16.3	12.9

Table 6. Total fishing effort (h) for all species and total directed expenditures at Lake Houston, Texas, 2002-2003, 2005-2006, and 2010-2011.

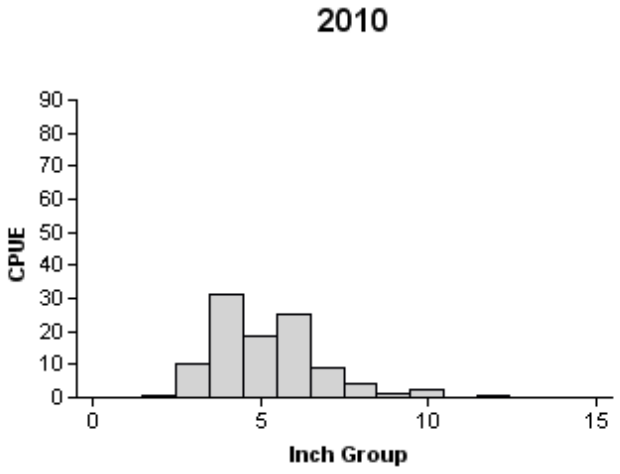
Creel Statistic	Year		
	2002/2003	2005/2006	2010/2011
Total fishing effort	120,655	61,003	40,524
Total directed expenditures	$247,884	$175,844	$354,371

Gizzard shad

Effort = 2.0
Total CPUE = 64.5 (20; 129)
IOV = 71 (7.4)



Effort = 2.0
Total CPUE = 174.5 (28; 349)
IOV = 91 (3.2)



Effort = 2.0
Total CPUE = 103.0 (19; 206)
IOV = 92 (2.2)

Figure 2. Number of gizzard shad caught per hour (CPUE), mean relative weight (Wr, diamonds), and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Houston, Texas, 2002, 2006, and 2010.

Bluegill

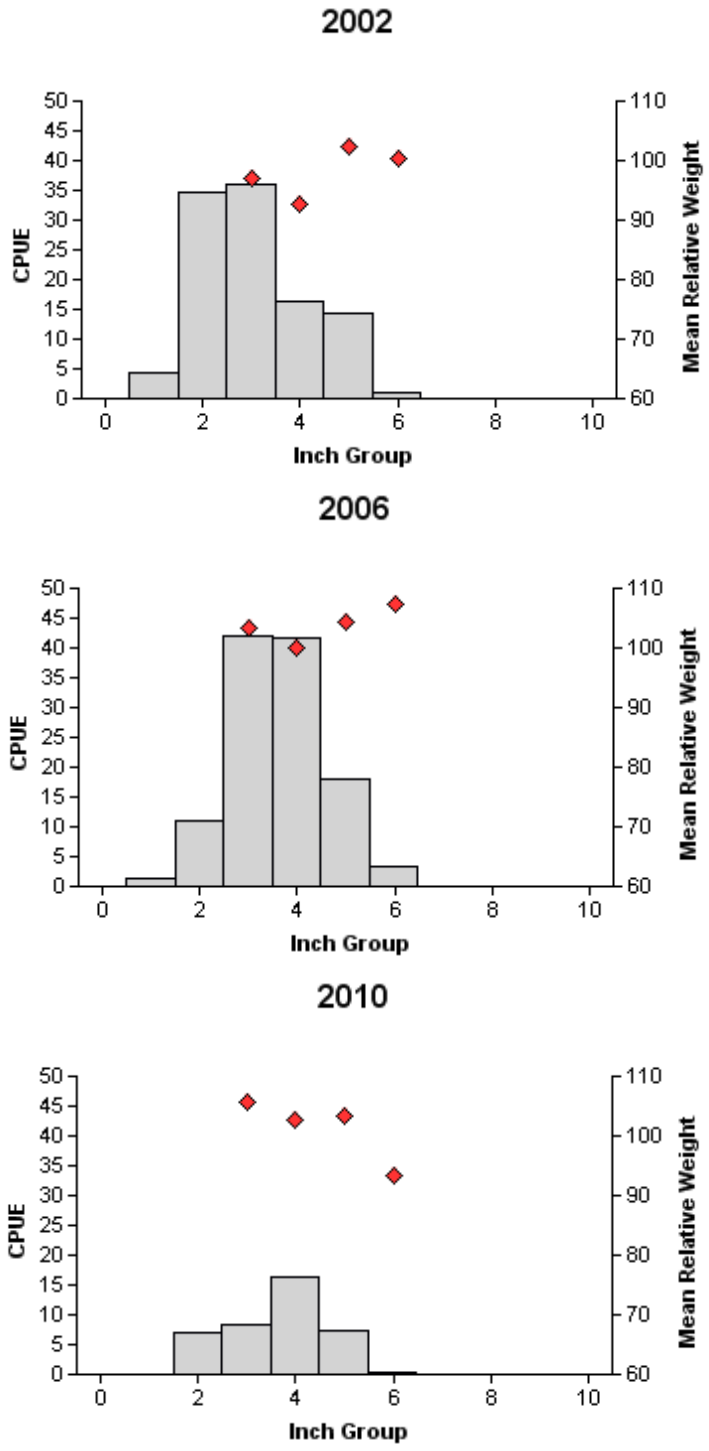


Figure 3. Number of bluegill caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE are in parentheses) for fall electrofishing surveys, Lake Houston, Texas, 2002, 2006, and 2010.

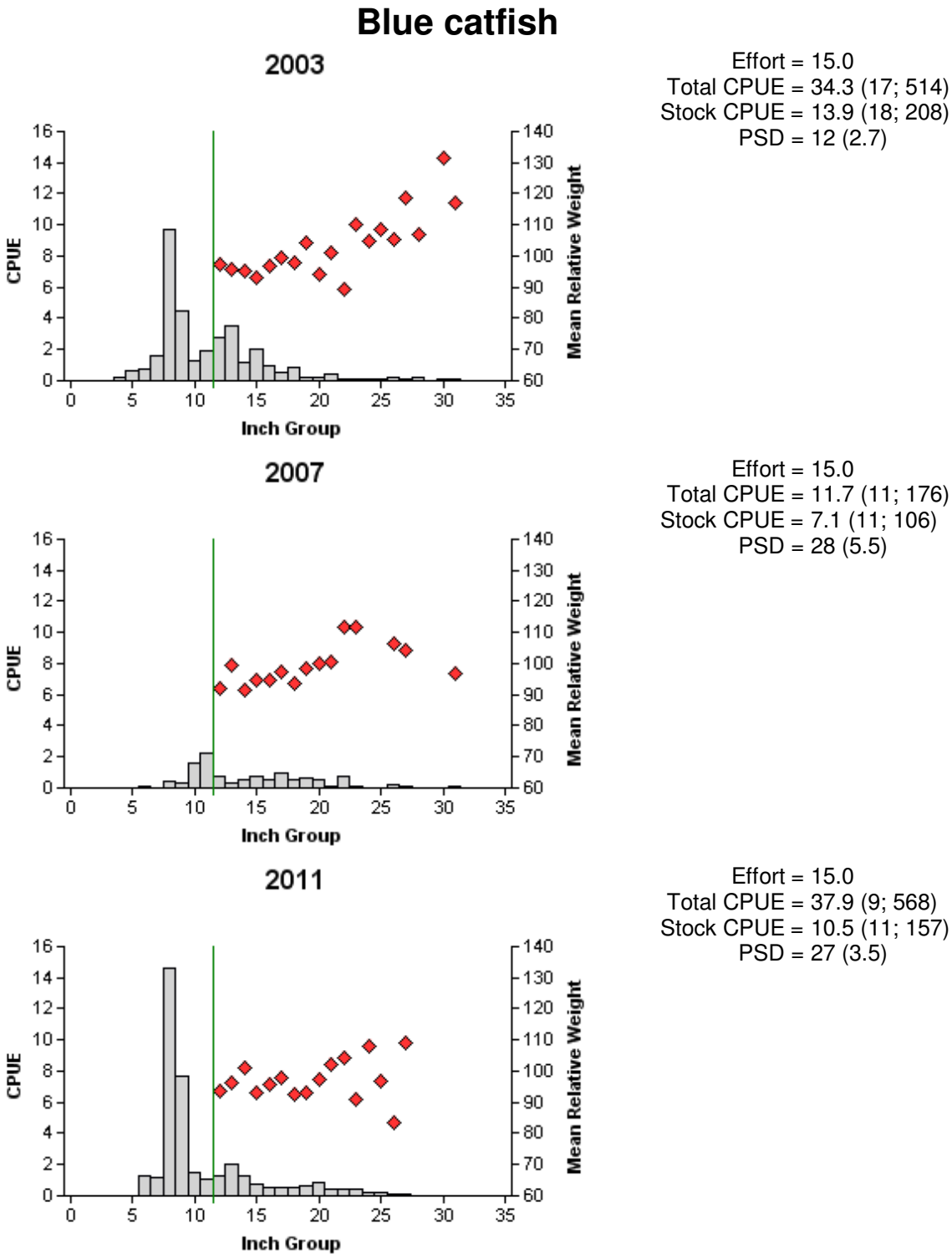
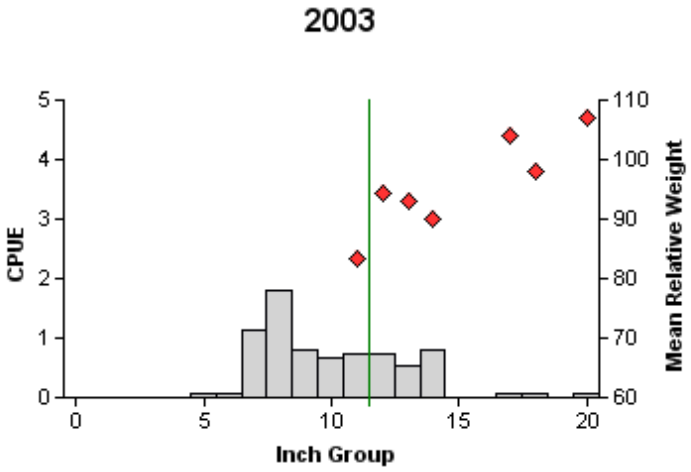
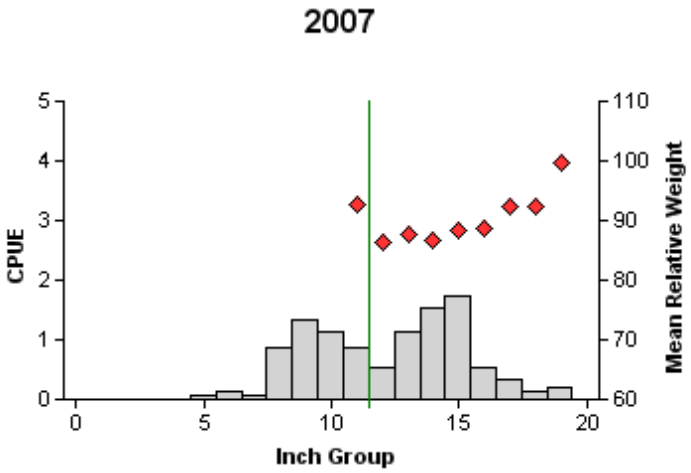


Figure 4. Number of blue catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill netting surveys, Lake Houston, Texas, 2003, 2007, and 2011. Vertical line is minimum length limit at time of survey.

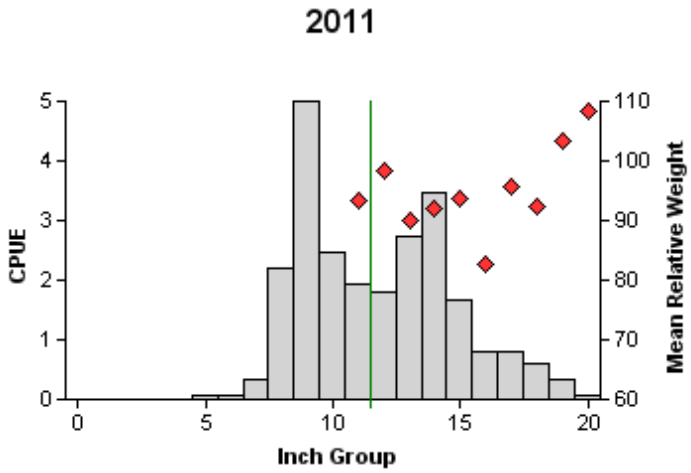
Channel catfish



Effort = 15.0
Total CPUE = 7.5 (23; 113)
Stock CPUE = 3.0 (25; 45)
PSD = 7 (3.8)



Effort = 15.0
Total CPUE = 10.6 (16; 159)
Stock CPUE = 7.0 (18; 105)
PSD = 17 (4.3)



Effort = 15.0
Total CPUE = 24.3 (11; 365)
Stock CPUE = 14.2 (17; 213)
PSD = 18 (2.3)

Figure 5. Number of channel catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill netting surveys, Lake Houston, Texas, 2003, 2007, and 2011. Vertical line is minimum length limit at time of survey

Table 7. Creel survey statistics for blue catfish and channel catfish at Lake Houston from June 2002 through May 2003, June 2005 through May 2006, and June 2010 through May 2011 where total catch per hour is for anglers targeting catfish (species combined) and total harvest is the estimated number of blue catfish and channel catfish harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year 2002/2003	2005/2006	2010/2011
Directed effort (h)	20,283 (15)	6,786 (26)	5,485 (21)
Directed effort/acre	1.66 (15)	0.55 (26)	0.45 (21)
Total catch per hour	0.58 (39)	0.82 (28)	0.43 (68)
Blue catfish total harvest	1,958 (132)	1,695 (58)	699 (67)
Blue catfish harvest/acre	0.16 (132)	0.14 (58)	0.06 (67)
Percent legal blue catfish released	0	3.0	0.0
Channel catfish total harvest	1,070 (321)	4,536 (68)	440 (90)
Channel catfish harvest/acre	0.09 (321)	0.37 (68)	0.04 (90)
Percent legal channel catfish released	47.3	4.2	7.8

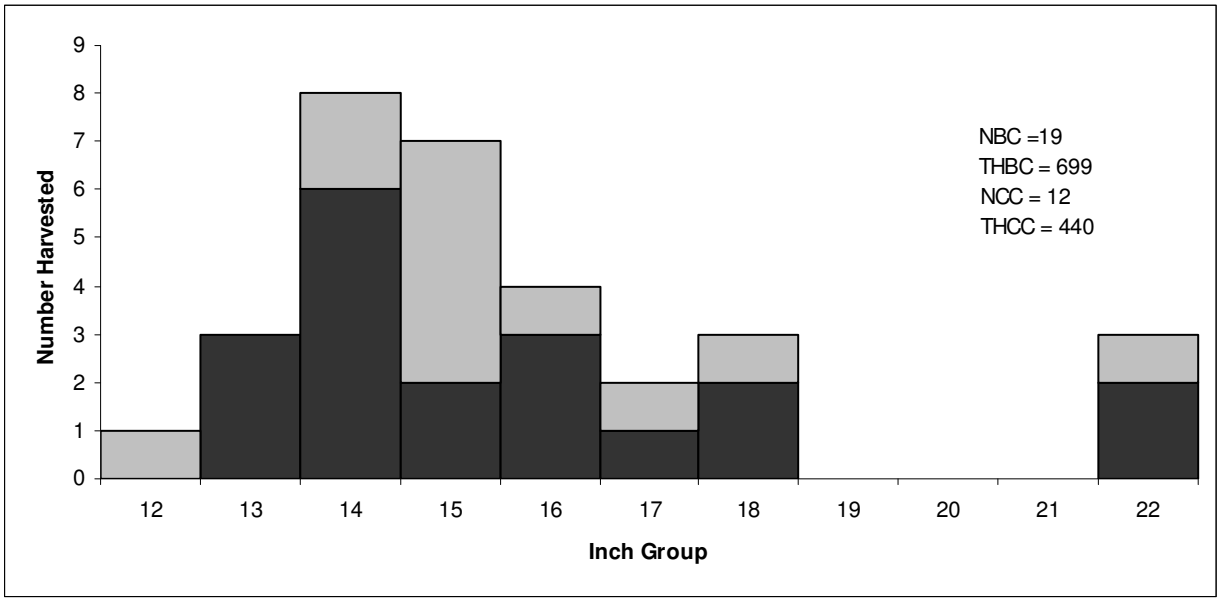


Figure 6. . Length frequency of harvested blue catfish (black) and channel catfish (grey) observed during creel surveys at Lake Houston, Texas, June 2010 through May 2011, all anglers combined. NBC and NCC are the numbers of harvested blue catfish and channel catfish, respectively, observed during creel surveys. THBC and THCC are the total estimated harvests of blue catfish and channel catfish, respectively, for the creel period.

White bass

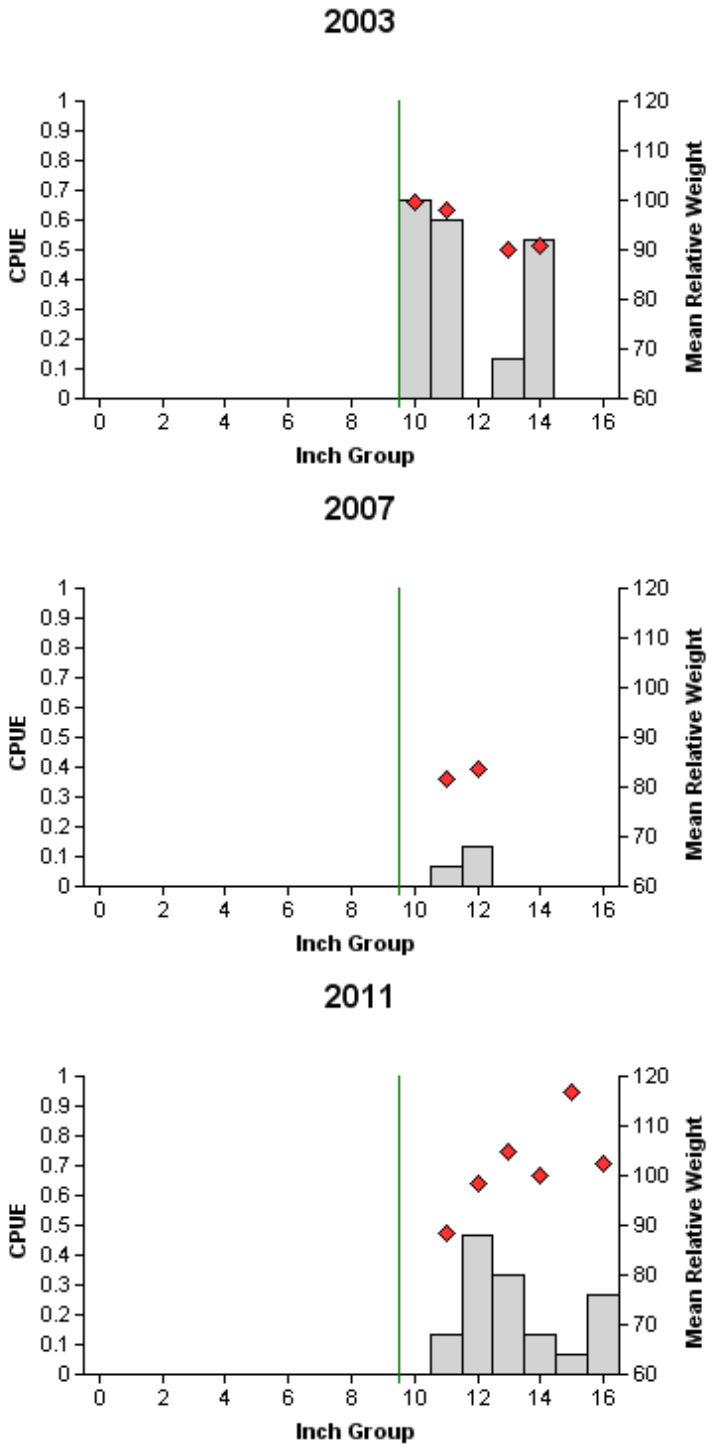


Figure 7. Number of white bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill netting surveys, Lake Houston, Texas, 2003, 2007, and 2011. Vertical line represents minimum length limit at time of survey.

White bass

Table 8. Creel survey statistics for white bass at Lake Houston from June 2002 through May 2003, June 2005 through May 2006, and June 2010 through May 2011 where total catch per hour is for anglers targeting white bass and total harvest is the estimated number of white bass harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year		
	2002/2003	2005/2006	2010/2011
Directed effort (h)	429 (117)	1,911 (46)	1,424 (66)
Directed effort/acre	0.03 (117)	0.16 (46)	0.12 (66)
Total catch per hour	5.71 (13)	7.94 (71)	1.49 (71)
Total harvest	4,948 (71)	10,384 (76)	1,286 (64)
Harvest/acre	0.40 (71)	0.85 (76)	0.11 (64)
Percent legal released	0	47.0	0.0

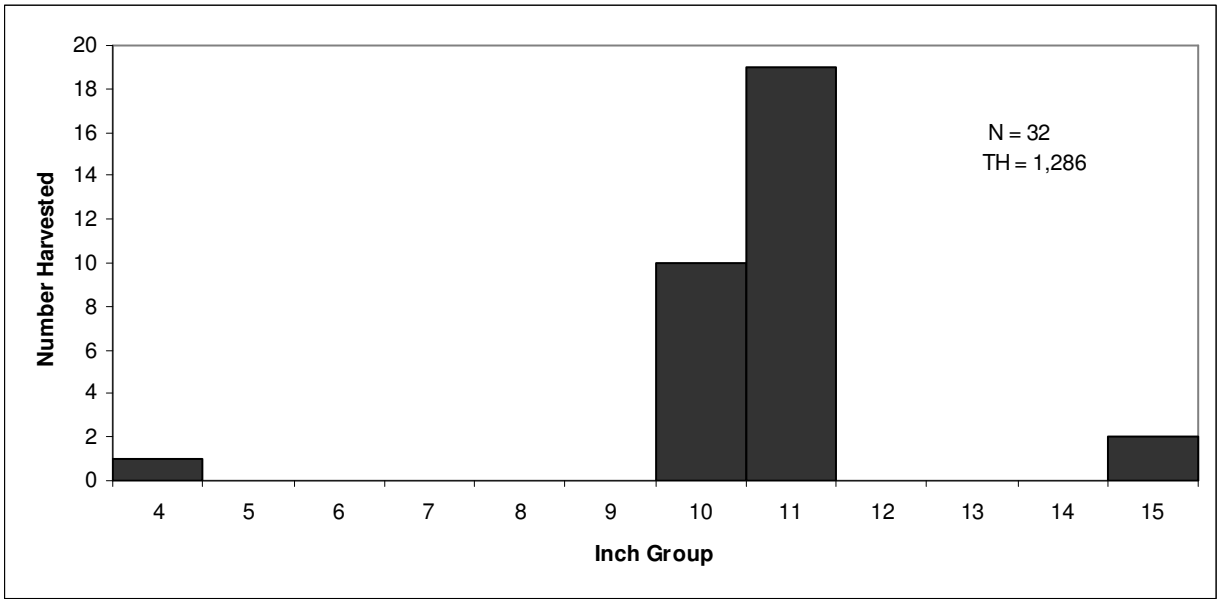
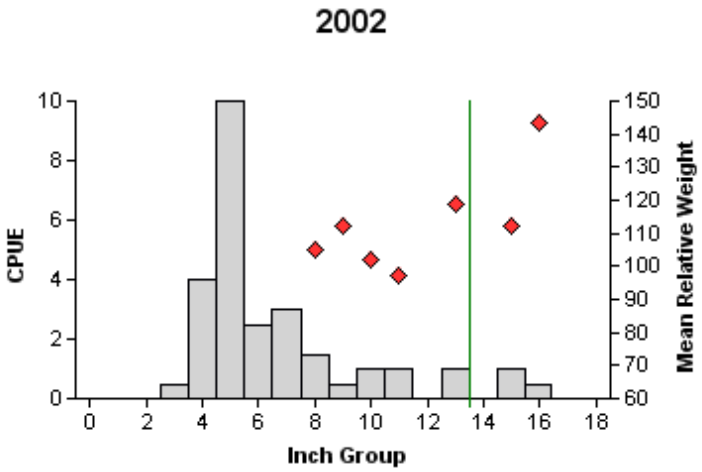
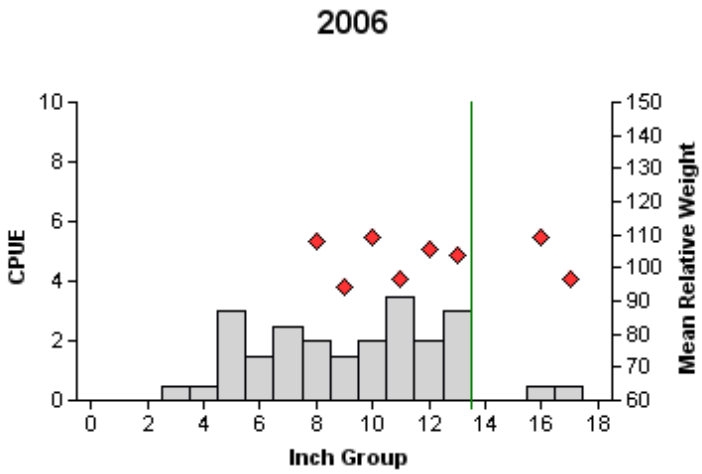


Figure 8. Length frequency of harvested white bass observed during creel surveys at Lake Houston, Texas, June 2010 through May 2011, all anglers combined. N is the number of harvested white bass observed during creel surveys, and TH is the total estimated harvest for the creel period.

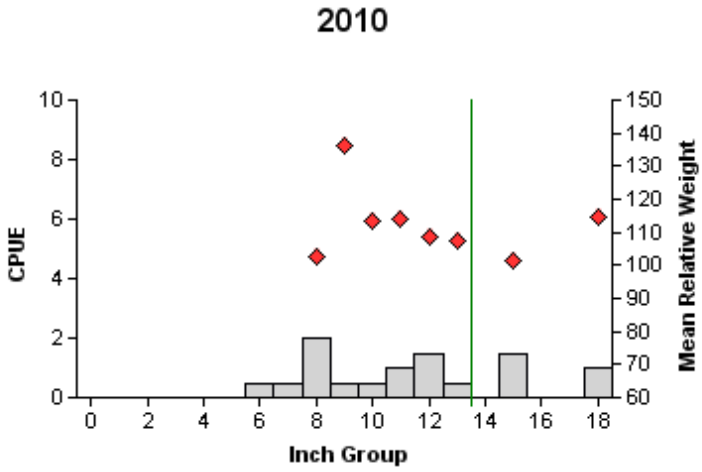
Largemouth bass



Effort = 2.0
Total CPUE = 26.5 (22; 53)
Stock CPUE = 6.5 (35; 13)
PSD = 38 (9)
PSD-14 = 23 (11.5)



Effort = 2.0
Total CPUE = 23.0 (24; 46)
Stock CPUE = 15.0 (26; 30)
PSD = 40 (9)
PSD-14 = 7 (4.1)



Effort = 2.0
Total CPUE = 9.5 (27; 19)
Stock CPUE = 8.5 (28; 17)
PSD = 53 (15)
PSD-14 = 29 (12)

Figure 9. Number of largemouth bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Houston, Texas, 2002, 2006, and 2010. Vertical line represents minimum length limit at time of survey.

Largemouth bass

Table 9. Creel survey statistics for largemouth bass at Lake Houston from June 2002 through May 2003, June 2005 through May 2006, and June 2010 through May 2011 where 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.

Creel Survey Statistic	Year		
	2002/2003	2005/2006	2010/2011
Directed effort (h)	17,715 (19)	12,877 (19)	11,342 (30)
Directed effort/acre	1.44 (19)	1.05 (19)	0.93 (30)
Total catch per hour	0.58 (25)	0.33 (29)	1.04 (37)
Total harvest	2,466 (78.3)	2,343 (67)	613 (48)
Harvest/acre	0.20 (78.3)	0.19 (67)	0.05 (48)
Percent legal released	34.0	18.7	75.5

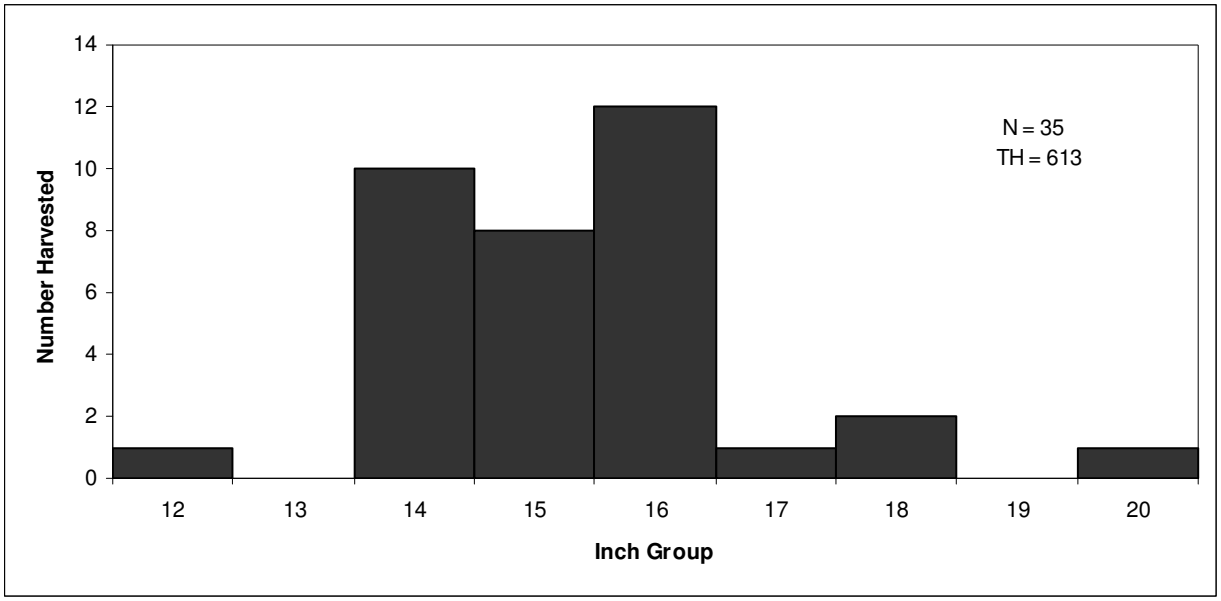


Figure 10. Length frequency of harvested largemouth bass observed during creel surveys at Lake Houston, Texas, June 2010 through May 2011, all anglers combined. N is the number of harvested largemouth bass observed during creel surveys, and TH is the total estimated harvest for the creel period.

Table 10. Results of genetic analysis of largemouth bass collected by fall electrofishing, Lake Houston,Texas, 1992, 1993, 1995, 1998, and 2002, and spring electrofishing in 2007. 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 an NLMB. Analysis prior to 2005 was conducted using Allozyme testing. Beginning in 2005 Microsatellite DNA testing was used.

		Genotype					
Year	Sample size	FLMB	F1	Fx	NLMB	% FLMB alleles	% pure FLMB
1992	9	0	0	0	9	0.0	0.0
1993	31	0	1	5	25	0.0	0.0
1995	28	0	0	6	22	0.0	0.0
1998	15	3	1	4	7	46.6	20.0
2002	39	5	4	16	14	35.8	12.8
2007	33	0			17	12.2	0.0
2011	30	0	1	18	11	8.0	0.0

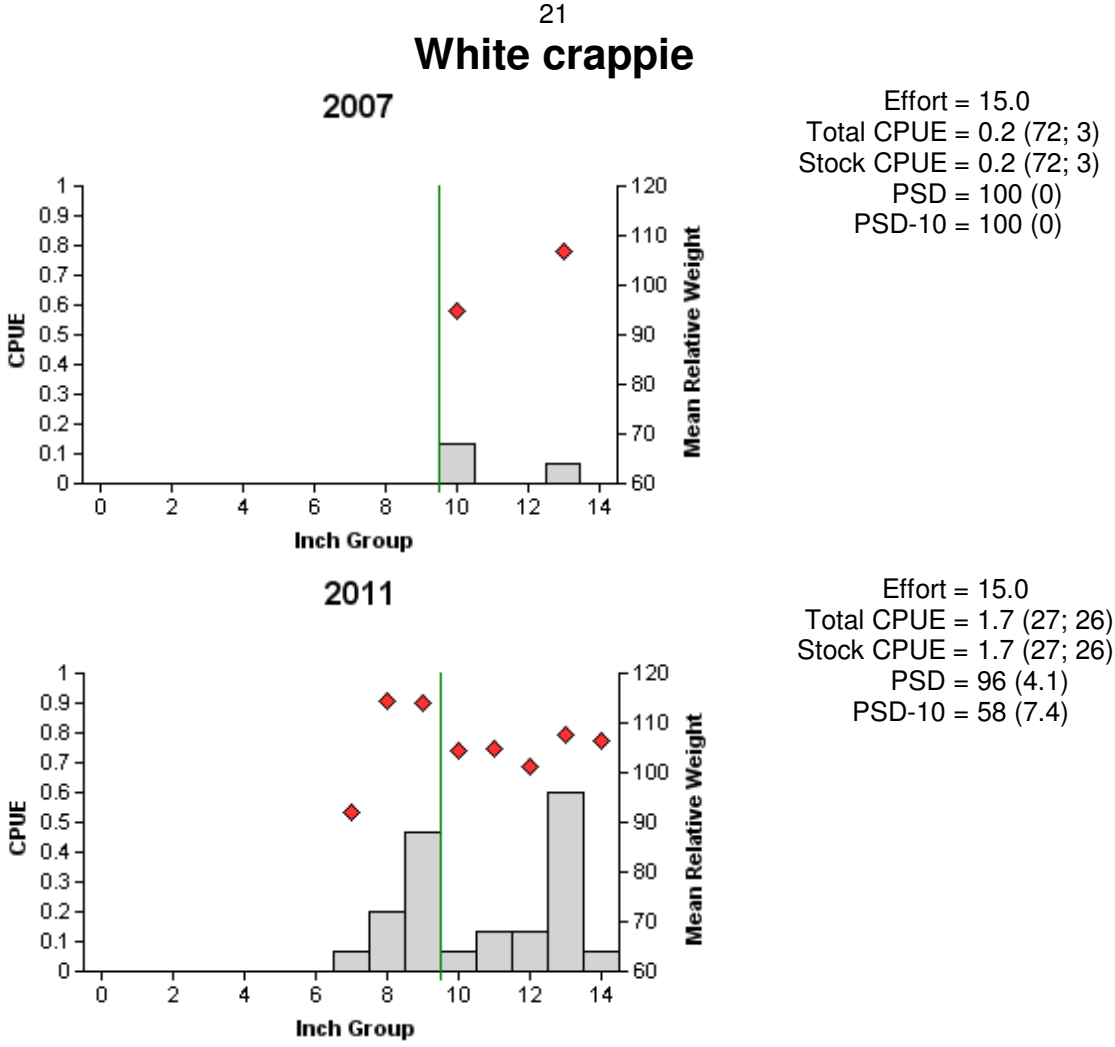


Figure 11. Number of white crappie caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill netting surveys, Lake Houston, Texas, 2007 and 2011. Vertical line represents minimum length limit at time of survey.

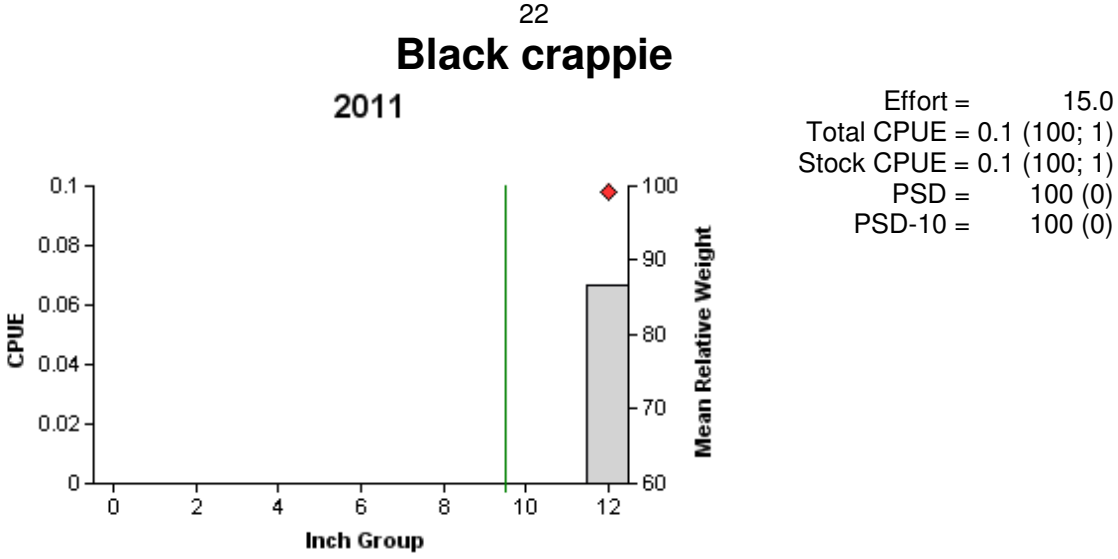


Figure 12. Number of black crappie caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill netting surveys, Lake Houston, Texas, 2011. Vertical line represents minimum length limit at time of survey.

Table 11. Creel survey statistics for crappie at Lake Houston from June 2002 through May 2003, June 2005 through May 2006 and June 2010 through May 2011 where total catch per hour is for anglers targeting crappie (species combined) and total harvest is the estimated number of black and white crappie harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year		
	2002/2003	2005/2006	2010/2011
Directed effort (h)	34,376 (14)	15,933 (20)	16,033 (29)
Directed effort/acre	2.81 (14)	1.30 (20)	1.31 (29)
Total catch per hour	1.22 (21)	1.71 (42)	0.42 (56)
Total white crappie harvested	3,489 (114)	33,615 (63)	2,190 (44)
White crappie harvest/acre	0.29 (114)	2.75 (63)	0.18 (44)
Percent legal white crappie released	3.8	3.5	2.9
Total black crappie harvested	0	4,320 (102)	77 (167)
Black crappie harvest/acre	0	0.35 (102)	0. 01 (167)
Percent legal black crappie released	0	0	0

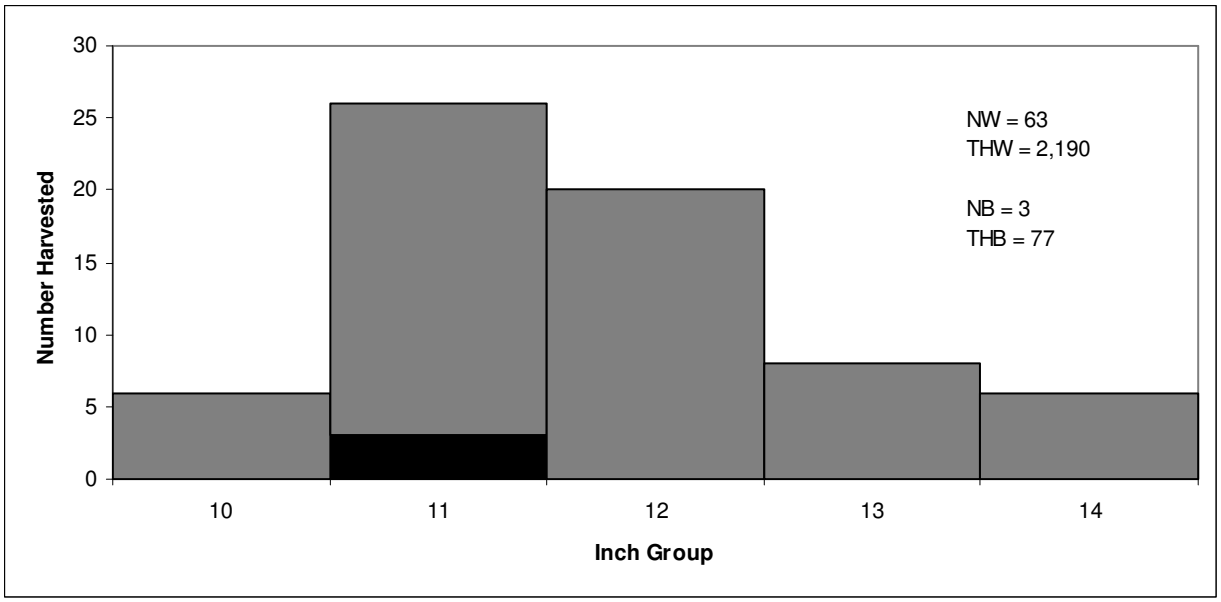


Figure 13. Length frequency of harvested black crappie (black) and white crappie (grey) observed during creel surveys at Lake Houston, Texas, June 2010 through May 2011, all anglers combined. NB and NW are the number of harvested black and white crappie, respectively, observed during creel surveys, and THB and THW are the total estimated harvest of black and white crappie, respectively, for the creel period.

Table 12. Proposed sampling schedule for Lake Houston, Texas. Gill netting surveys are conducted in the spring while electrofishing surveys are conducted in the fall. Standard survey denoted by S and additional survey denoted by A.

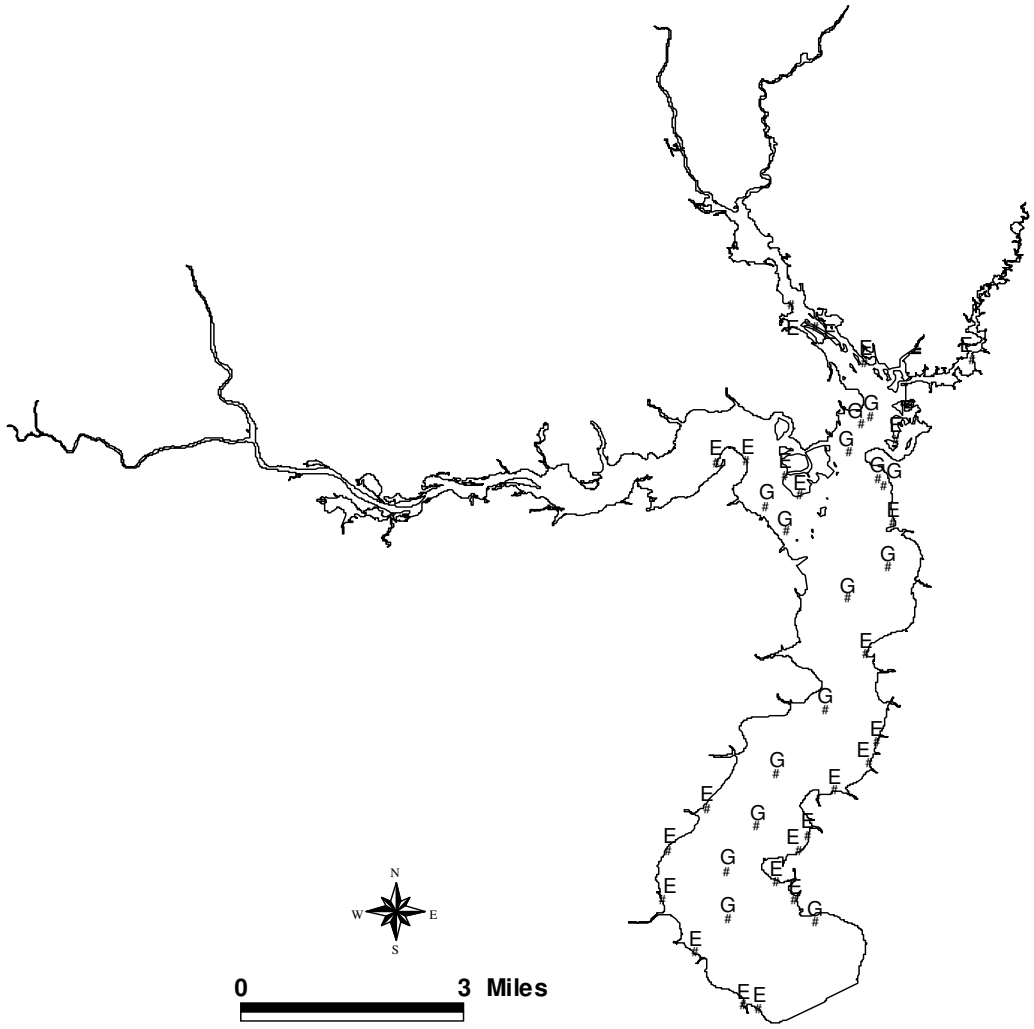
Survey Year	Electrofishing	Access	Gill Net	Creel Survey	Vegetation	Report
Fall 2011-Spring 2012					A	
Fall 2012-Spring 2013					A	
Fall 2013-Spring 2014					A	
Fall 2014-Spring 2015	S	S	S	A	S	S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Lake Houston, Texas, 2006-2007.

Species	Electrofishing		Gill Netting	
	N	CPUE	N	CPUE
Gizzard shad	206	103.0		
Threadfin shad	827	413.5.0		
Bullhead minnow	22	11.0		
Inland silverside	58	29.0		
Brook silverside	1	0.5		
Blue catfish			568	37.9
Channel catfish			365	24.3
White bass			21	1.4
Palmetto bass			4	0.3
Warmouth	2	1.0		
Bluegill	80	40.0		
Longear sunfish	134	67.0		
Largemouth bass	19	9.5		
White crappie			26	1.7
Black crappie	6	3.0	1	<0.1

Appendix B



Location of sampling sites, Lake Houston, Texas, 2010-2011. G and E indicate gill netting and electrofishing stations, respectively. No trap netting survey was conducted in 2010.