PERFORMANCE REPORT

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FEDERAL AID PROJECT F-221-M-5

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2014 Fisheries Management Survey Report

Lake Houston

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July 31, 2015

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lake Houston were surveyed in 2014 using electrofishing and trap netting and in 2015 using gill netting. Anglers were surveyed from June 2013 through May 2014 with a roving creel survey. Historical data are presented with the 2013-2015 data for comparison. 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 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 upstream of the reservoir 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, Inland Silverside, and Longear Sunfish are the predominant prey species in Lake Houston. Abundance of prey species is adequate to support predators.

  - **Catfishes:** Blue and Channel Catfish are both present in Lake Houston, and both provide outstanding fisheries. Catfish angling is an important segment of the Lake Houston fishery with 30% of all angling effort directed at catfish.

  - **White Bass:** Gill net catches of White Bass have declined in the past several years likely due to poor spring inflows needed for spawning. In past creel surveys there has been pressure directed toward true bass species, but no pressure was documented in 2013–2014.

  - **Largemouth Bass:** The Largemouth Bass population appears to be improving at Lake Houston in conjunction with improvements in available habitat for spawning and survival of juvenile bass. Anglers seeking Largemouth Bass make up 36% of all directed angling effort.

  - **Crappie:** Although both Black Crappie and White Crappie occur in Lake Houston, White Crappie are more abundant. The percentage of anglers seeking crappie decreased in the last 4 years, but overall crappie harvest increased.

- **Management strategies:** Statewide length and bag limits will continue to be used to regulate sport fish harvest. Cooperative efforts with the City of Houston and the Lake Houston Sports and Recreation Foundation (LHSRF) will continue to address water quality and habitat issues. Exotic vegetation will continue to be monitored, and TPWD will assist the City of Houston with their control efforts whenever possible.

INTRODUCTION

This document is a summary of fisheries data collected from Lake Houston from June 2013 through May 2015. 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 2013-2015 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.

Angler Access

Lake Houston has four public boat ramps. Access was limited during a few months in 2011 but with the exception of that short period of time all four ramps have been available to boaters. Because of a low bridge on Luce's Bayou, only small boats can access Ponderosa Marina from the main lake. Additional boat ramp characteristics are listed in Table 2. Shoreline access is limited to the public boat ramp areas and the shoreline at Deussen Park.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Webb and Gore 2011) included:

1. Continue to provide information to the City of Houston, other agencies, and the media concerning sedimentation and other water quality issues.
   Action: TPWD has worked cooperatively with the City of Houston and other agencies on watershed management and habitat improvement plans.
2. Provide any support needed to the Texas Commission on Environmental Quality regarding the new permitting regulations for gravel dredging operations (HB 571).
   Action: TPWD continues to assist TCEQ in any way needed.
3. Contract with the USCOE LAERF to begin establishment of native vegetation in the upper end of Lake Houston.
   Action: In a cooperative effort between TPWD, the LHSRF, the City of Houston, and the USCOE LAERF, native aquatic vegetation founder colonies have been established at Lake Houston. Also, the LHSRF has constructed a native aquatic plant nursery and are producing native plants for future planting.
4. Request stocking of Florida Largemouth Bass for Lake Houston in 2012 and 2013. Justify stocking based on the need to rebuild the suppressed population of Largemouth Bass following attempts to improve aquatic habitat.
   Action: The LHSRF purchased 10,000 advanced Florida Largemouth Bass fingerlings in 2012 that were stocked into Lake Houston. In 2013, 2014, and 2015 TPWD stocked a total of 269,833 Florida Largemouth Bass fingerlings into the reservoir.
5. Continue to monitor Largemouth Bass population every four years with fall electrofishing.
   Action: TPWD conducted fall electrofishing in 2014.
6. Provide logistical support to the City of Houston regarding exotic vegetation treatment.
   Action: TPWD provided $60,000 to the Coastal Water Authority (CWA) in 2014-2015 for exotic vegetation control.
7. Conduct annual vegetation surveys.

Action: TPWD conducted exotic aquatic vegetation surveys in 2011, 2012, and 2013 with a complete habitat survey conducted in 2014.

8. Cooperate with the controlling authority to post appropriate signage at access points.
   Action: TPWD has provided giant salvinia and zebra mussel awareness signs for posting at all major access points.
9. Contact and educate marina owners about invasive species, and provide them with posters, literature, etc. so that they can in turn educate their customers.
   Action: TPWD has provided giant salvinia and zebra mussel awareness information to area marinas.
10. Educate the public about invasive species through the use of media and the internet.
    Action: TPWD has written numerous magazine articles as well as news releases and Facebook posts regarding giant salvinia and zebra mussel awareness.
11. Make a speaking point about invasive species when presenting to constituent and user groups.
    Action: TPWD has given several presentations in the Lake Houston area including information on giant salvinia and zebra mussel awareness.
12. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.
    Action: TPWD continues to stay informed regarding inter-basin water transfers.
13. Deploy Portland Samplers in Lake Houston to help detect presence of zebra mussels.
    Action: TPWD deployed Portland samplers on the reservoir and continues to monitor boat ramp and access areas for zebra mussel presence. TPWD exotic species specialists are monitoring Lake Houston for zebra mussel larvae and DNA.

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. Current regulations are found in Table 3.

Stocking history: Soon after impoundment, Channel Catfish were stocked in Lake Houston. Palmetto Bass 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 and in 2013, 2014, and 2015 by TPWD and in 2012 by the Lake Houston Sports and Recreation Foundation. A complete stocking history is presented in Table 4.

Vegetation/habitat management history: Lake Houston has historically had limited littoral habitat. Heavy silt loading in the upper reaches of the reservoir has inhibited the growth of desirable aquatic vegetation; however, with regulation of gravel mining upstream from Lake Houston and native aquatic vegetation restoration projects in the reservoir, the conditions are improving. Lake Houston is infested with the nuisance aquatic plants common salvinia, water hyacinth, and water lettuce. The City of Houston has contracted with a private applicator to control these species. TPWD provided $60,000 to the Coastal Water Authority (CWA) in 2014-2015 for exotic vegetation control.

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 by gill netting and trap 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 and trap nets as the number of

fish caught per net night (fish/nn). All survey sites for gill netting and trap netting were randomly selected. Twelve electrofishing stations were chosen at random and sampled at night. Twelve electrofishing stations were biologist selected under an approved Objective Based Sampling Plan (Appendix D). The biologist selected stations were in areas containing native vegetation in an attempt to collect a minimum of 50 stock size Largemouth Bass for population structure analysis, condition analysis, age and growth analysis, and genetic analysis. All surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2014) with the exception of the daytime electrofishing at the biologist chosen stations.

Aquatic vegetation, structural habitat, and angler access surveys were performed according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2014) and were assessed using the digital shape file method (TPWD, Inland Fisheries Division, unpublished manual revised 2014). The entire shoreline was assessed. A structural habitat survey was conducted in 2014. Vegetation surveys were conducted in 2012–2014 to monitor exotic aquatic plants.

A roving creel survey was conducted from June 2013 through May 2014. 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), 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.

Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2014). Micro-satellite DNA analysis was used to determine genetic composition of individual fish from 2014.

Source for water level data was the United States Geological Survey (USGS).

RESULTS AND DISCUSSION

Habitat: Real estate development and bulkhead construction covers about 30% of the shoreline (Table 5). Native vegetation occupied approximately 519 acres in Lake Houston in 2014 (Table 6). This is up substantially from 30 acres in the 2010 survey. Non-native (invasive) species included water hyacinth, water lettuce, alligatorweed, and common salvinia. These species covered approximately 642 acres in 2014. This is also a substantial increase from 45 acres in 2010.

Creel: The most sought after species on Lake Houston was Largemouth Bass. Anglers spent an estimated 19,444 hours seeking Largemouth Bass (36% of total directed fishing effort) (Tables 7 and 10). Angling for catfish represented approximately 30% of total directed effort (an increase from 15% in 2010/2011; whereas, crappie angling decreased from 43 % of total directed effort to 13% in 2013/2014 (Table 7). Total angler effort increased from 40,524 hours in 2010/2011 to 54,587 hours in 2013/2014. Anglers spent an estimated $334,893 in 2013/2014 compared to $354,371 in 2010/2011 (Table 8).

Prey species: Gizzard Shad, Threadfin Shad, Bluegill, Longear Sunfish, and Inland Silversides make up the majority of the available forage in Lake Houston. IOV for Gizzard Shad was 90, indicating most Gizzard Shad are available to existing predators (Figure 3). The catch rate from random electrofishing was 257/h for Gizzard Shad and Threadfin Shad combined, 30/h for Bluegill, 17/h for Longear Sunfish, and 99/h for Inland Silversides (Appendix A). In the 2010 survey the catch rate from electrofishing was 517/h for Gizzard Shad and Threadfin Shad combined, 40/h for Bluegill, 67/h for Longear Sunfish, and 29/h for Inland Silversides.

Catfish: Both Blue Catfish and Channel Catfish occur in Lake Houston, and both provide excellent fisheries. The gill net CPUE of Blue Catfish in 2015 was 14.8/nn, down from 37.9/nn in 2011 (Figure 5). Size distribution was good (PSD = 26; PSD-20 = 26) with fish up to 32 inches in length captured in gill nets. Gill net CPUE of Channel Catfish was 18.9/nn, down from 24.3/nn in 2011 (Figure 6). The length frequency distribution indicated an excellent size distribution for Channel Catfish (PSD = 11). Body condition (W_r) of both Blue and Channel Catfish was good.

Angler harvest of Blue Catfish was estimated to be 876 fish with an estimated harvest of 2,194 Channel Catfish (Table 9; Figures 7 and 8). Blue Catfish and Channel Catfish to 21 and 22 inches respectively were observed in angler creels during the 2013-2014 creel period (Figures 7 and 8). Angling effort and harvest increased from the 2010/2011 creel (Table 9)

White Bass: Gill net catch rates of White Bass were low in 2014 (0.3/nn) (Figure 9). No anglers targeted White Bass during the 2013/2014 creel period, and no White Bass were observed in the creel.

Largemouth Bass: Electrofishing catch rates of Largemouth Bass at Lake Houston have never been high due to habitat degradation. The electrofishing CPUE in 2014 from random stations was 16.0/h. Size structure is typical for populations under a 14-inch minimum length limit with a PSD of 64 and a PSD-14 of 25 with fish up to 18 inches in length captured in the fall sample that included biologist chosen daytime electrofishing stations (Figure11). Largemouth Bass reached legal size between age 2 and 3.

During the period from June 2013 through May 2014, anglers spent an estimated 19,444 hours seeking Largemouth Bass (Table 10), and anglers harvested an estimated 2,015 Largemouth Bass. Anglers released 88.3% of legal-sized fish caught. Largemouth Bass up to 21 inches were observed during the creel survey in 2013-2014 (Figure 12). One pure Florida Largemouth Bass was detected in the 2014 sample and the Florida allele frequency was 88.0%. This is substantially different from the 2011 sample when the Florida allele frequency was only 8% (Table 11) and indicates that the annual stockings from 2012-2014 were successful.

Crappie: Both White Crappie and Black Crappie are present in Lake Houston although White Crappie are more numerous. Trap net sampling in 2014 captured 16.3 White Crappie and 4.3 Black Crappie per net night (Figure 13 and Figure 14). White Crappie and Black Crappie reach legal size between age 1 and 2. Anglers harvested an estimated 4,387 White Crappie and 301 Black Crappie during the 2013-2014 creel period. Catch rate for both species combined was 1.6 fish per hour. All legal fish caught by anglers were harvested (Table 12). White Crappie and Black Crappie up to 15 inches were observed during the creel survey in 2013-2014 (Figures 15 and 16).

Fisheries management plan for Lake Houston, Texas

Prepared – July 2015

ISSUE 1: The primary issue facing Lake Houston continues to be the need for habitat and water quality improvement.

MANAGEMENT STRATEGY

1. Continue working with the City of Houston, other agencies, and the Lake Houston Sports and Recreation Foundation on habitat improvement projects including native vegetation restoration.
2. Continue to assist the Houston Galveston Area Council with watershed management plans.
3. Continue to highlight habitat improvement projects and needs in media releases and public presentations.

ISSUE 2: Florida Largemouth Bass influence has been improving since Florida Largemouth Bass fingerlings were stocked in 2012, 2013, 2014, and 2015.

MANAGEMENT STRATEGY

1. Request stocking of Florida Largemouth Bass for Lake Houston annually to continue improving trophy potential of the Largemouth Bass population.
2. Continue to monitor Largemouth Bass population every four years with fall electrofishing surveys and genetic analysis.

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. Four invasive species, common salvinia, water hyacinth, water lettuce, and alligator weed, currently infest Lake Houston.

MANAGEMENT STRATEGIES

1. Provide logistical support to the City of Houston regarding exotic vegetation treatment.
2. Conduct annual exotic 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.

Objective-Based Sampling Plan and Schedule

Sport fish, forage fish, and other important fishes

Sport fishes in Lake Houston include Blue Catfish, Channel Catfish, White Bass, Largemouth Bass, Black Crappie, and White Crappie. Important forage species include Gizzard Shad, Threadfin Shad, and Bluegill.

Negligible fisheries

All sport species at Lake Houston contribute to the overall fishery and justify sampling effort.

Survey objectives, fisheries metrics, and sampling objectives

A complete sampling schedule is listed in Table 13.

Crappie: During the June 2013 through May 2014 creel survey crappie anglers represented 13% of the directed angler effort at Lake Houston. Although both White and Black Crappies were harvested, White Crappie were the most abundant in angler creels. Based on bootstrap analysis of historical data, it would take 15 trap nets to attain acceptable precision and catch of stock-length fish (RSE < 25, N > 50) at least 80% of the time for White Crappie. Our **survey objective** is to monitor White Crappie trend data (CPUE, PSD, Wr) during the fall of 2018 in order to detect any larger scale population fluctuations. Our **sampling objective** is to set 15, randomly selected single-cod shoreline trap net sites to achieve an RSE < 25 of CPUE-total and collect at least 50 stock size individuals. Black Crappie data will be used to show presence/absence since this is a very minor part of the crappie fishery. 15 trap net nights will be the maximum effort expended even if objectives are not met.

White Bass: White Bass are present within the reservoir but no directed angling effort was documented in the June 2013 through May 2014 creel survey. Bootstrap analysis of historic data suggests over 15 randomly-selected gill net nights would be required to obtain reliable CPUE values (i.e. RSE < 25 for CPUE-total) and to collect 50 stock sized fish for size structure, age and growth, or body condition analysis. Since White Bass are targeted by such a small percentage of anglers our **survey objective** is to determine presence/absence of White Bass in spring 2019 gill net sampling. Our **sampling objective** is to confirm presence/absence of White Bass in conjunction with the catfish sampling efforts using 15 random gill net sites. No additional sampling will occur above that conducted based on catfish sampling objectives, to determine White Bass presence/absence.

Blue Catfish: Blue and Channel Catfishes combined accounted for 30% of directed angler effort during the June 2013 through May 2014 creel survey. Based on bootstrap analysis of historical data 15 gill nets should obtain Blue Catfish data with an acceptable precision and catch (CPUE-total, RSE < 25, N > 50) at least 80% of the time. Our **survey objective** is to monitor Blue Catfish trend data (CPUE, PSD, Wr) during the spring of 2019 with gill nets in order to detect any larger scale population fluctuations. Our **sampling objective** is to sample 15 randomly selected gill net sites to achieve a CPUE-total RSE < 25 and collect at least 50 stock sized individuals. Fifteen gill net nights will be the maximum effort expended even if objectives are not met.

Channel Catfish: Blue and Channel catfishes combined accounted for 30% of directed angler effort during the June 2013 through May 2014 creel survey. Based on bootstrap analysis of historical data 15 gill nets should obtain Channel Catfish data with an acceptable precision and catch (CPUE-total RSE < 25, N > 50) at least 80% of the time. Our **survey objective** is to monitor Channel Catfish trend data (CPUE, PSD, Wr) during the spring of 2019 with gill nets in order to detect any larger scale population fluctuations. Our **sampling objective** is to sample 15 randomly selected gill net sites to achieve a CPUE Total RSE < 25 and collect at least 50 stock sized individuals. Fifteen gill net nights will be the maximum effort expended even if objectives are not met.

Largemouth bass: Largemouth Bass abundance is limited by turbidity and commensurate lack of submersed aquatic vegetation; however, the Largemouth Bass fishery at Lake Houston is popular,

accounting for 36% of the total directed angling effort during the June 2013 through May 2014 creel survey. Bootstrap analysis of historic data suggests reliable population metrics (CPUE S; RSE<25, PSD and Wr; N>50 stock sized individuals) would require well over 24 randomly selected 5-minute electrofishing stations. Our **survey objective** is to monitor largemouth bass population trend data in the fall of 2018 including size structure and body condition only. Our **sampling objective** is to collect at least 50 stock sized Largemouth Bass by sampling 24 stratified random chosen electrofishing sites (daytime sampling). Stratification will be spatially based, however specific strata will be determined at a later date. If stated effort is inadequate to achieve the sampling objective, additional subjectively chosen electrofishing sites (daytime electrofishing) will be sampled until sampling objective is met.

Gizzard Shad, Threadfin Shad, and Bluegill: Gizzard Shad, Threadfin Shad, and Bluegill are the primary forage species at Lake Houston. Based on sampling history, fall electrofishing generally provides adequate data to evaluate the overall forage base at Lake Houston; therefore, our **survey objective** is to monitor long term trends in size structure and relative abundance of these important forage species. Relative abundance and availability of these forage species will be monitored through analysis of predator body condition. For size structure, our **sampling objective** is to collect 50 individuals for PSD and IOV of Gizzard Shad and PSD of Bluegill with sampling effort used to meet Largemouth Bass sampling objectives. No additional sampling will occur beyond what is done to meet Largemouth Bass sampling objectives.

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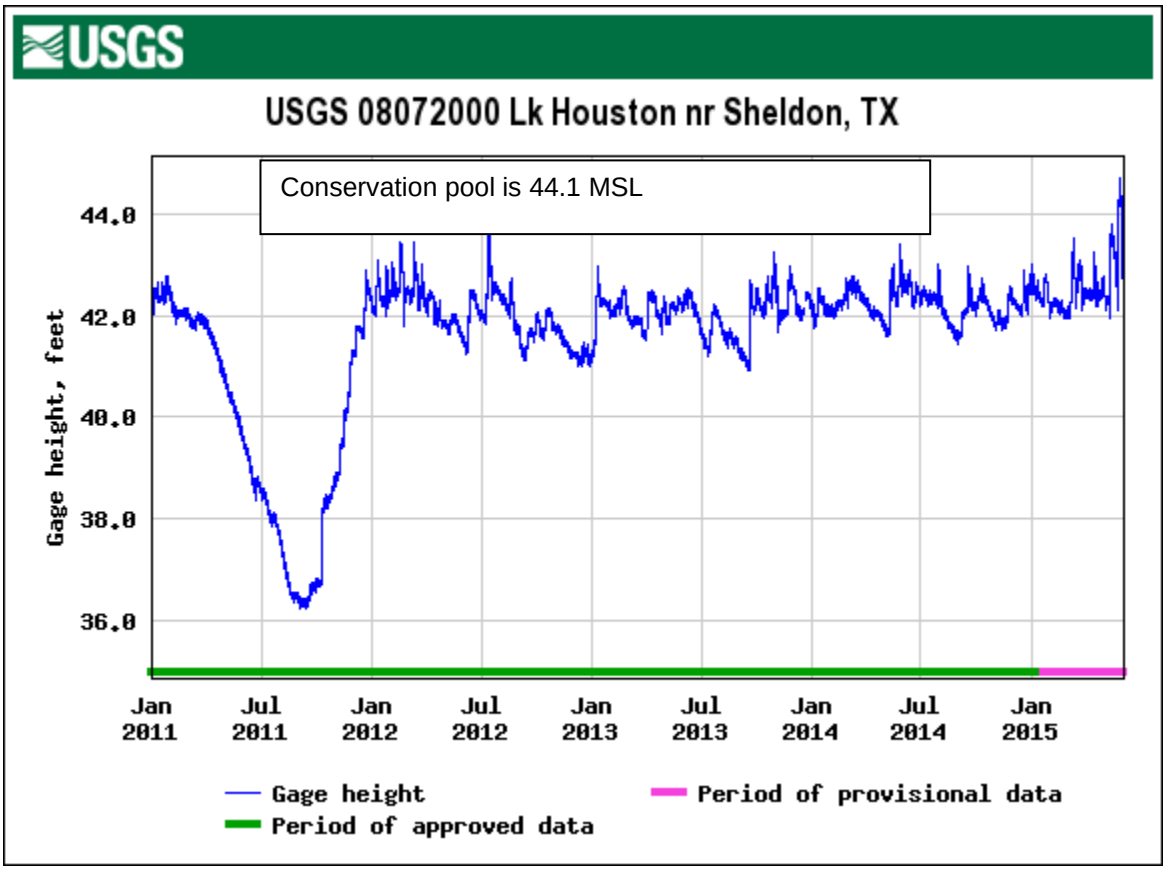


Figure 1. Quarterly water level elevations in feet above mean sea level (MSL) recorded for Lake Houston, Texas, 2011- spring 2015.

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. Boat ramp characteristics for Lake Houston, Texas, August 2014. Reservoir elevation at time of survey was approximately 43 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Alexander Deussen Park	29.91687 -95.14800	Y	260	39	2 boat ramps with 8 lanes plus a 1 lane small boat ramp. Excellent condition.
Lake Houston Marina	30.01868 -95.11914	Y	45	40	1 boat ramp with 2 lanes. Excellent condition.
Ponderosa Marina	30.05640 -95.14800	Y	30	41	1 boat ramp with 2 lanes. Good condition but a low bridge on Luces' Bayou prevents access to main reservoir by tall boats.
BJ's Marina	29.916875 95.148003	Y	30	41	1 boat ramp with 2 lanes. Good condition.

Table 3. Harvest regulations for Lake Houston,Texas.

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 4. 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
	2012	10,000	FGL
	2013	100,370	FGL
	2014	99,463	FGL
	2015	70,000	FGL
	Total	586,798	

Table 5. Survey of structural habitat types, Lake Houston, Texas, 2014. A linear shoreline distance (miles) was recorded for each habitat type found.

Habitat type	Estimate	% of Total
Bulkhead/ Open water	4.3	4.1
Bulkhead/ Piers and docks	24.7	23.4
Bullkhead/Dead timber	1.9	1.8
Concrete/Open water	3.7	3.5
Eroded bank/Concrete	0.4	0.4
Eroded bank/Dead timber	7.1	6.7
Eroded bank/Piers and docks	0.9	0.9
Eroded bank/Standing timber	0.9	0.9
Overhanging brush/Dead timber	36.5	34.6
Overhanging brush/Standing timber	24	22.7
Rip rap/Dead timber	0.5	0.5
Rip rap/Open water	0.5	0.5
Rocky shoreline/Piers and docks	0.1	0.1

Table 6. Survey of aquatic vegetation Lake Houston, Texas, 2012–2014. Surface area (acres) is listed with percent of total reservoir surface area in parenthesis.

Vegetation	2012	2013	2014
Native submersed			122 (1)
Native floating-leaved			397 (3)
Native emergent			<1 (<0.1)
Non-native			
Common salvinia (Tier II)*	9 (<0.1)	150 (1)	295 (2)
Water hyacinth (Tier II)*	188 (2)	250 (2)	208 (2)
Water lettuce (Tier II)*	270 (2)	200 (2)	133 (1)
Alligatorweed			7 (<0.1)
Elephant ear			13 (<0.1)

*Tier II is Maintenance Status

Table 7. Percent directed angler effort by species for Lake Houston, Texas, 2005-2006, 2010-2011, and 2013-2014. Survey periods were 1 June through 31 May.

Species	Year		
	2005/2006	2010/2011	2013/2014
Catfishes	15	15	30
Temperate Bass	4	1	0
Sunfishes	1	0	0
Largemouth Bass	29	28	36
Crappies	35	43	13
Anything	16	13	21

Table 8. Total fishing effort (h) for all species and total directed expenditures at Lake Houston, Texas, 2005-2006, 2010-2011, and 2013-2014. Survey periods were from 1 June through 31 May. Relative standard error is in parentheses.

Creel Statistic	Year		
	2005/2006	2010/2011	2013/2014
Total fishing effort	61,003	40,524	54,587 (12.2)
Total directed expenditures	$175,844	$354,371	$334,893 (28.2)

Gizzard Shad

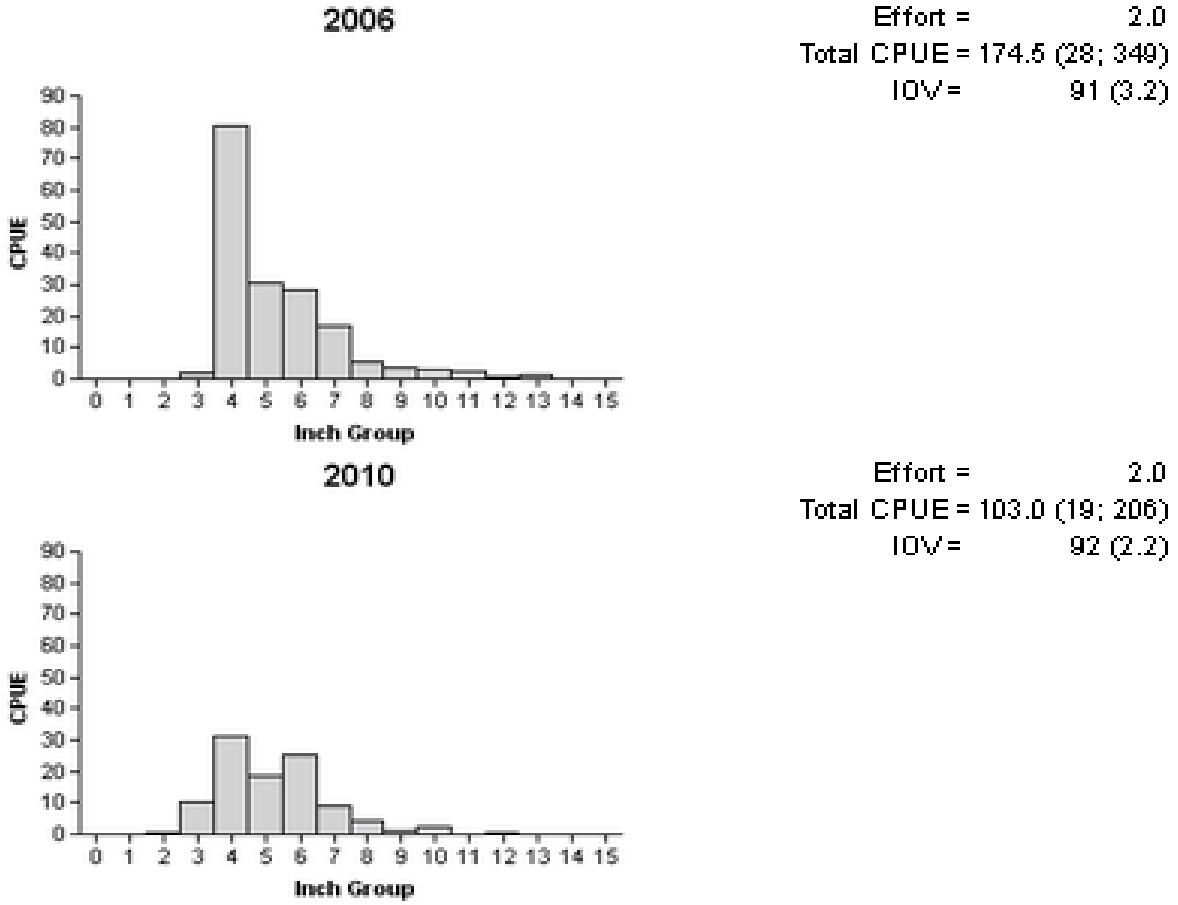


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Houston, Texas, 2006, and 2010.

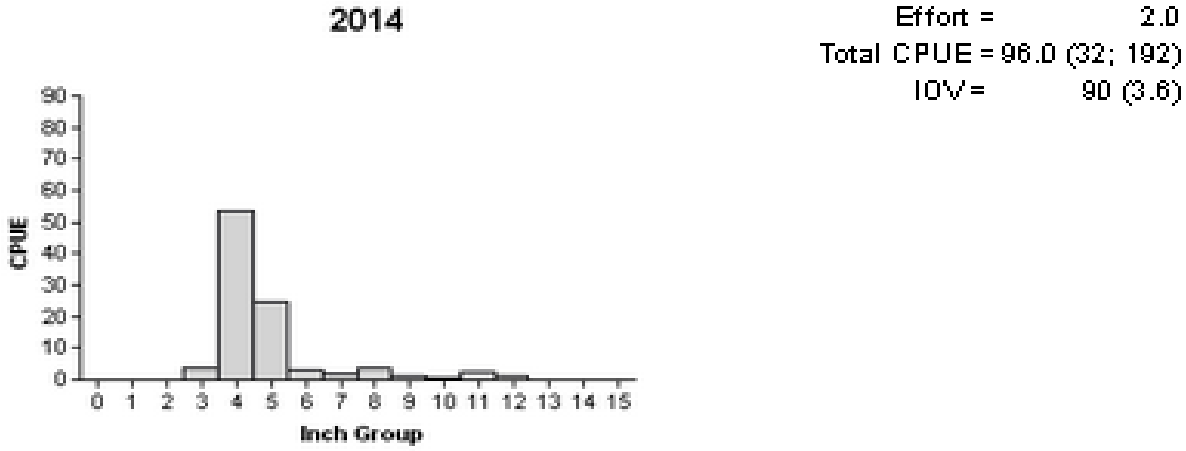


Figure 3. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Houston, Texas, 2014. Electrofishing was conducted following the Objective Based Sampling Plan and schedule outlined in this report using 12 randomly chosen nighttime electrofishing stations and 12 biologist chosen daytime electrofishing stations.

Bluegill

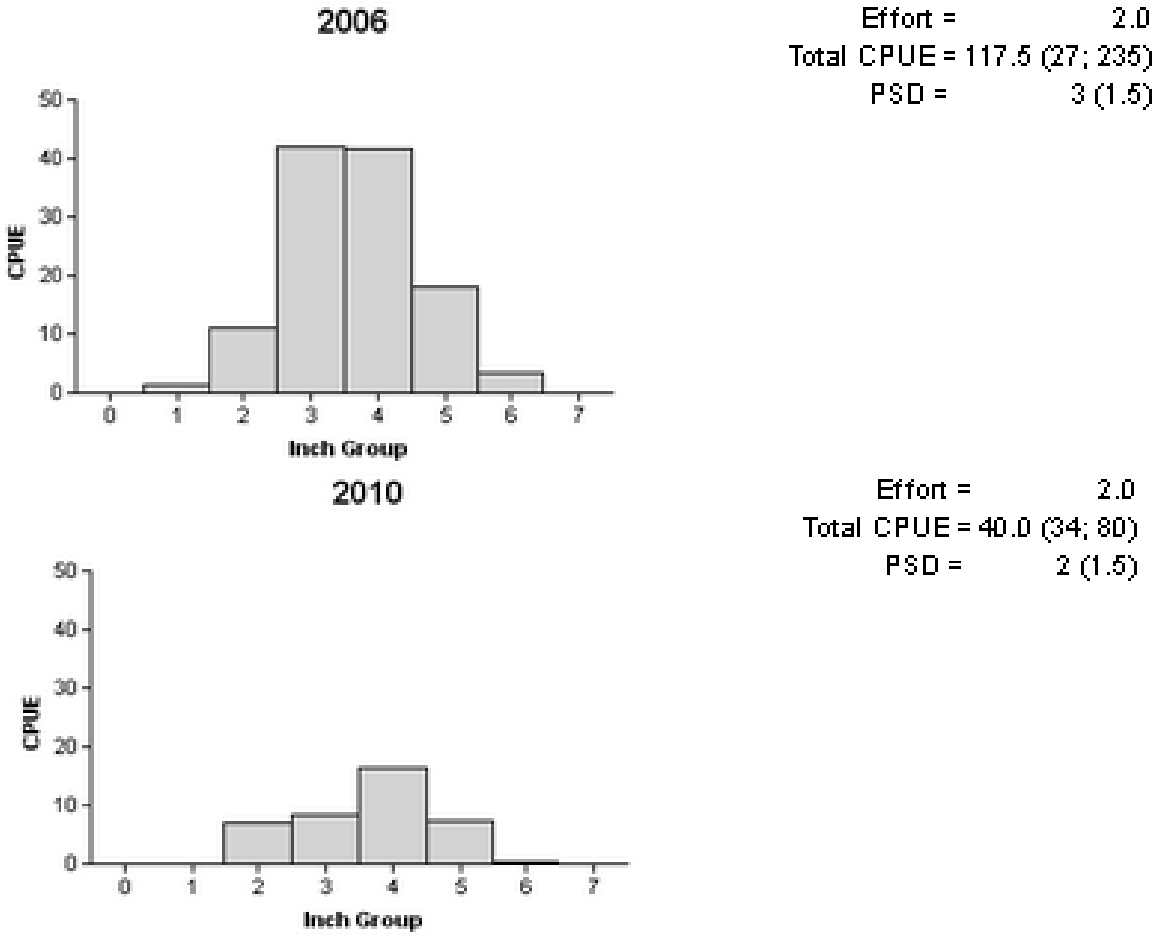


Figure 4. Number of Bluegill caught per hour (CPUE, bars) and population indices (RSE and N for CPUE are in parentheses) for fall electrofishing surveys, Lake Houston, Texas, 2006 and 2010.

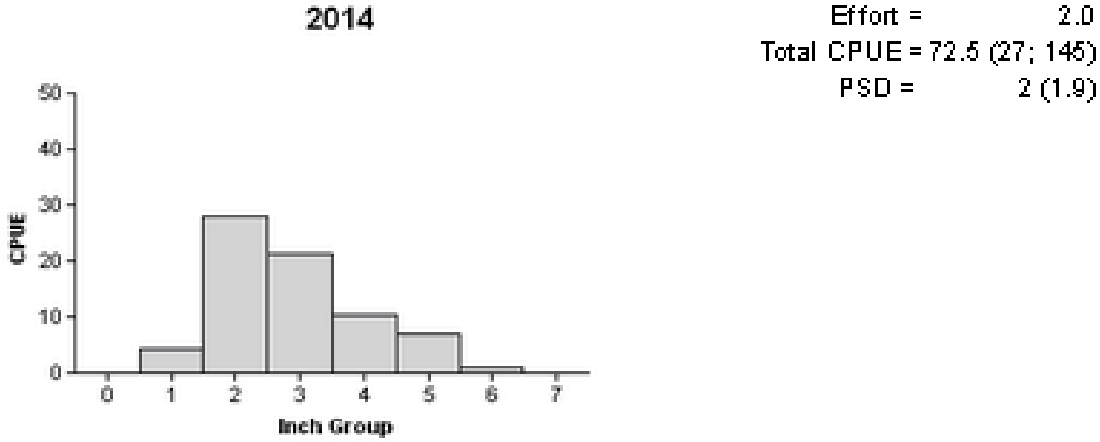


Figure 5. Number of Bluegill caught per hour (CPUE, bars) and population indices (RSE and N for CPUE are in parentheses) for fall electrofishing surveys, Lake Houston, Texas, 2014. Electrofishing in 2014 was conducted following the Objective Based Sampling Plan and schedule outlined in this report using 12 randomly chosen nighttime electrofishing stations and 12 biologist chosen daytime electrofishing stations.

Blue Catfish

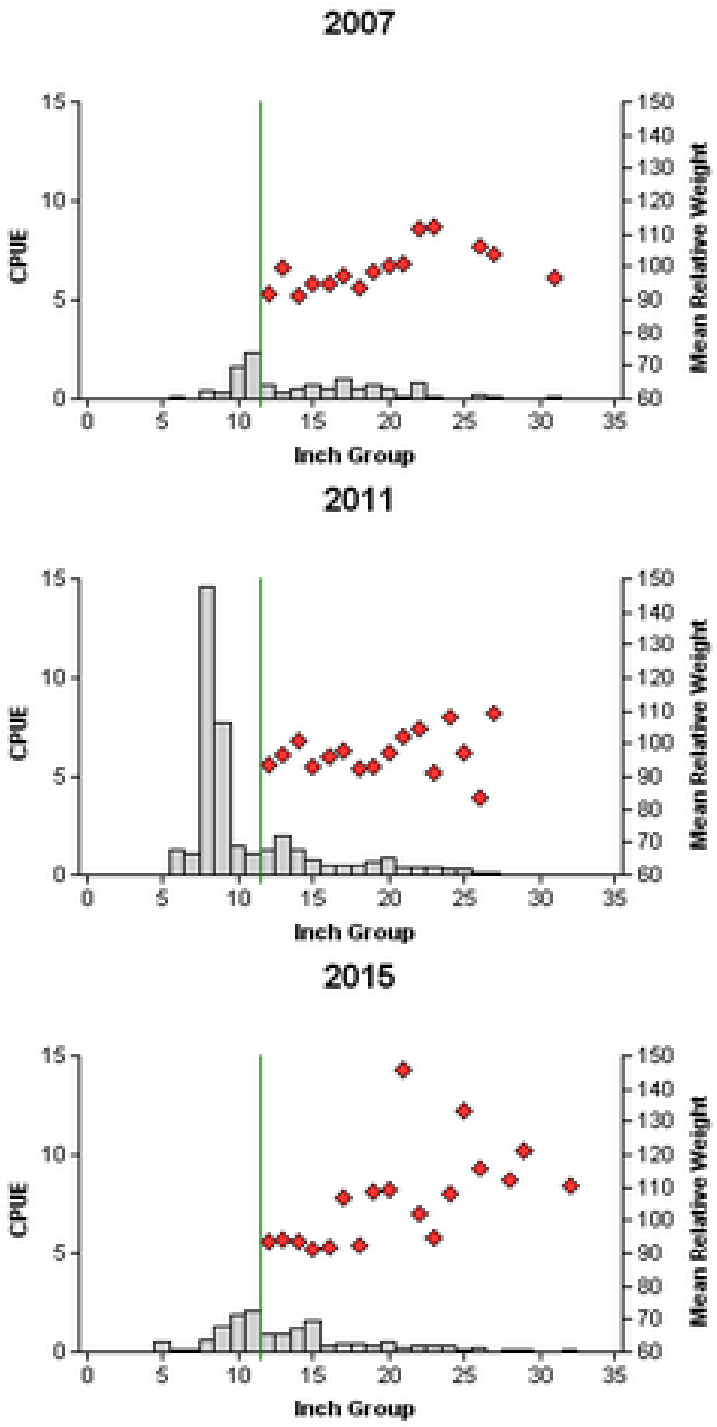


Figure 6. Number of Blue Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill netting surveys, Lake Houston, Texas, 2007, 2011, and 2015. Vertical line is minimum length limit at time of survey.

Channel Catfish

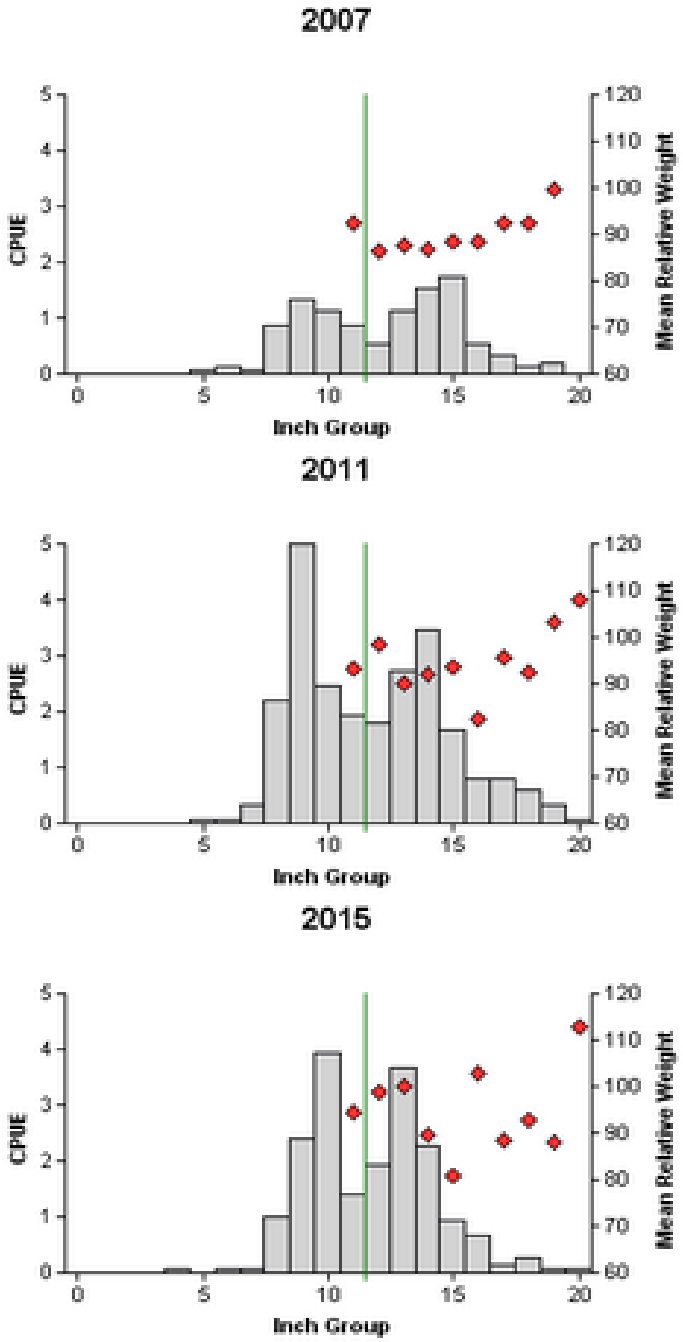


Figure 7. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill netting surveys, Lake Houston, Texas, 2007, 2011, and 2015. Vertical line is minimum length limit at time of survey.

Catfishes

Table 9. Creel survey statistics for Blue Catfish and Channel Catfish at Lake Houston from June 2005 through May 2006, June 2010 through May 2011, and June 2013 through May 2014 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 Statistic	Year		
	2005/2006	2010/2011	2013/2014
Surface area (acres)			
Directed effort (h)	6,786 (26)	5,458 (21)	16,547 (21)
Directed effort/acre	0.6 (26)	0.4 (21)	1.4 (21)
Total catch per hour	0.8	0.4	
Blue Catfish			0.1 (25)
Channel Catfish			0.3 (24)
Total harvest			
Blue Catfish	1,695 (58)	699 (67)	876 (101)
Channel Catfish	4,536 (68)	440 (90)	2,194 (57)
Harvest/acre			
Blue Catfish	0.1	<0.1	0.1 (101)
Channel Catfish	0.4	<0.1	0.2 (57)
Percent legal released			
Blue Catfish	3	0	73 (105)
Channel Catfish	4.2	7.8	19 (83)

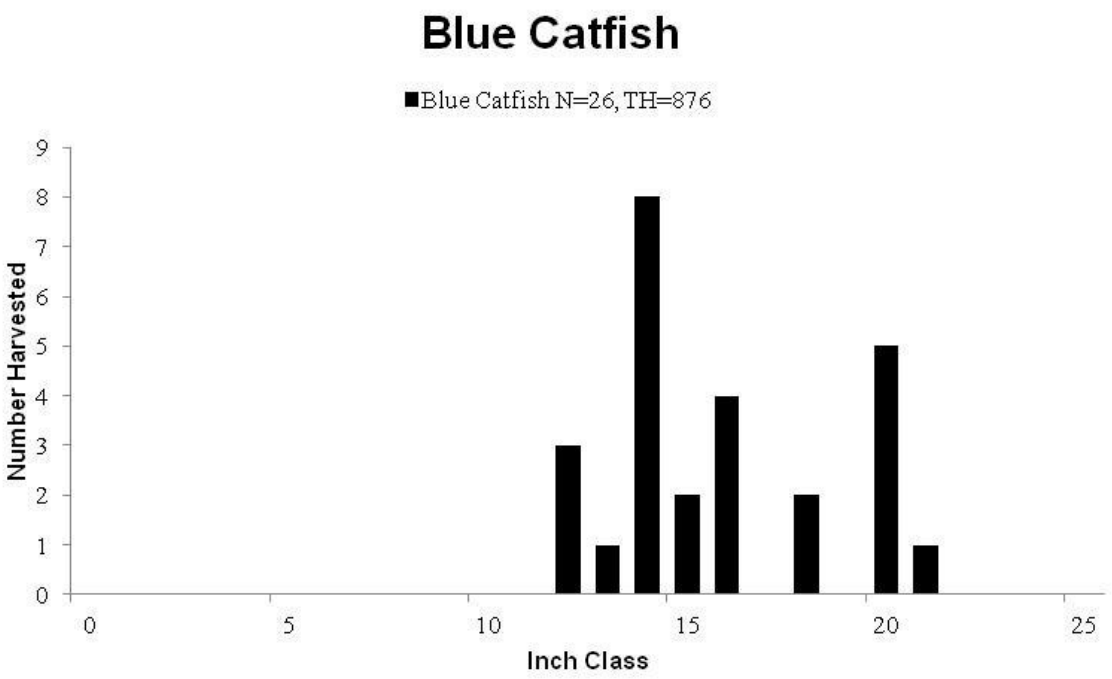


Figure 8. Length frequency of harvested Blue Catfish observed during creel surveys at Lake Houston, Texas, June 2013 through May 2014, all anglers combined. N is the number of harvested Blue Catfish observed during creel surveys. TH is the total estimated harvest of Blue Catfish for the creel period.

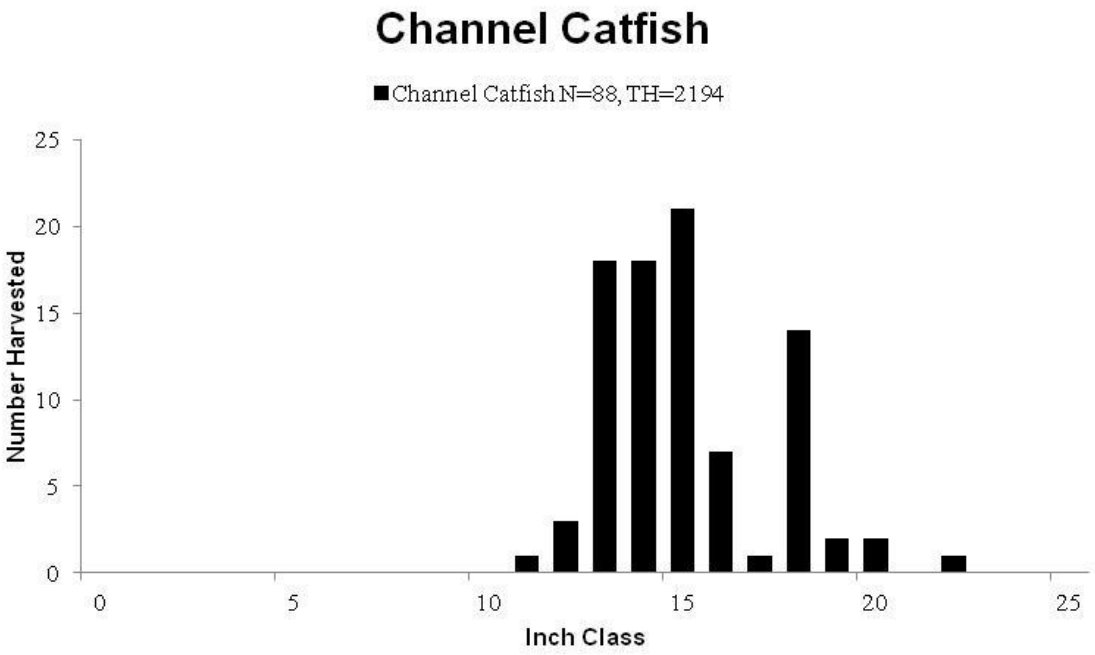


Figure 9. Length frequency of harvested Channel Catfish observed during creel surveys at Lake Houston, Texas, June 2013 through May 2014, all anglers combined. N is the number of harvested Channel Catfish observed during creel surveys. TH is the total estimated harvest of Channel Catfish for the creel period.

White Bass

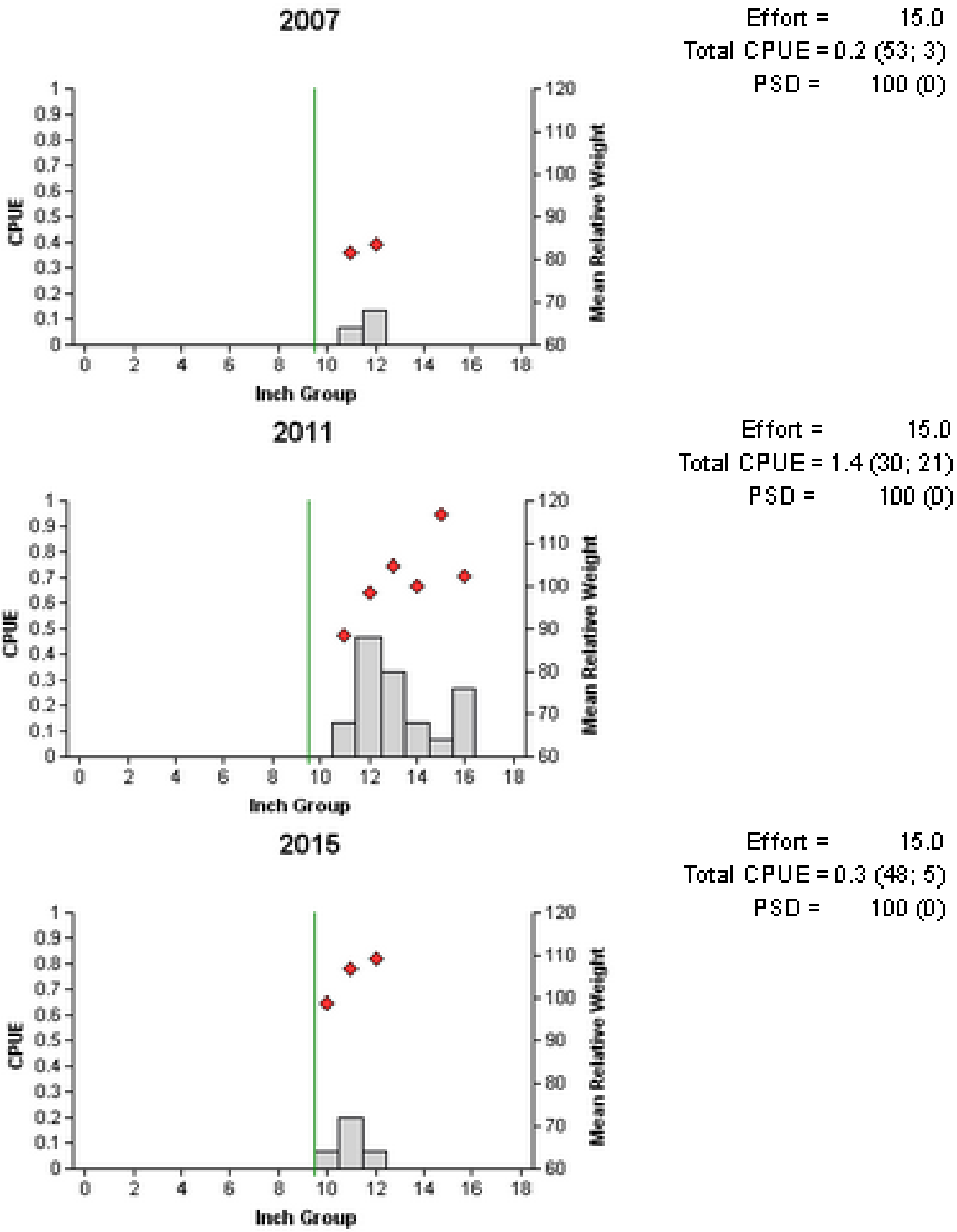


Figure 10. Number of White Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill netting surveys, Lake Houston, Texas, 2007, 2011, and 2015. Vertical line represents minimum length limit at time of survey.

Largemouth Bass

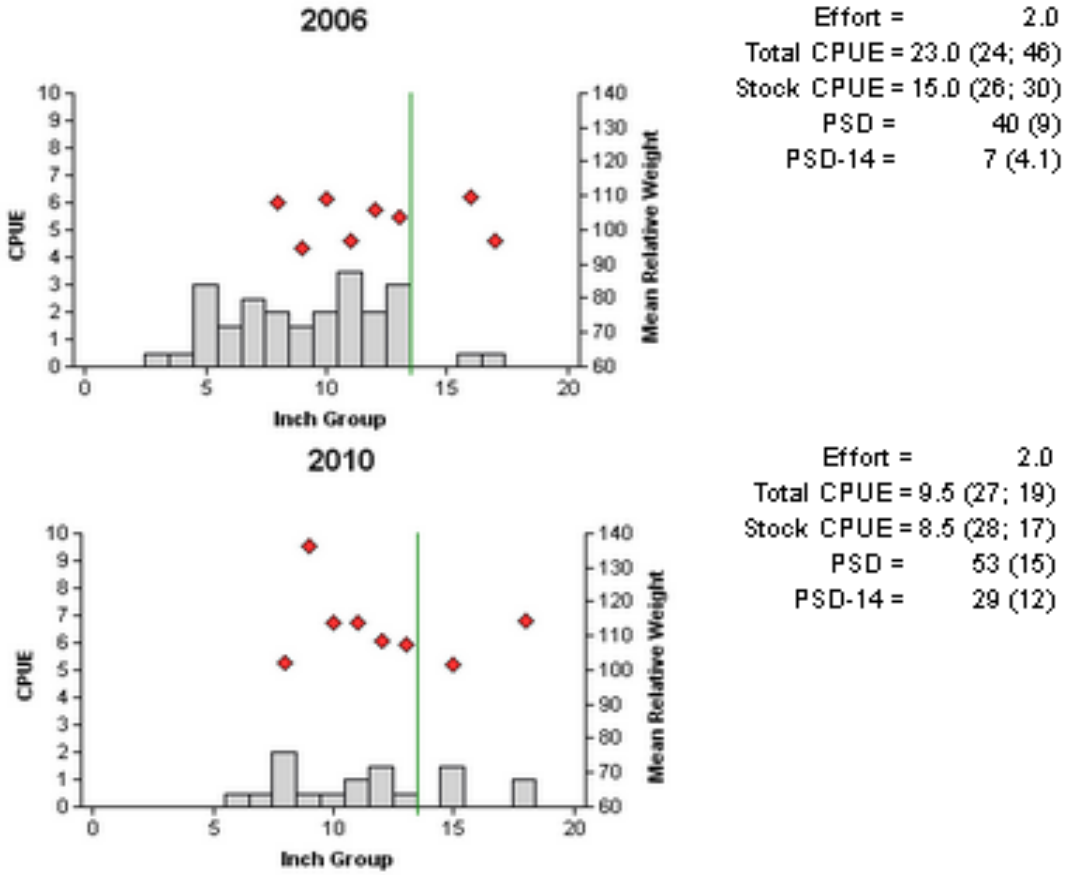


Figure 11. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Houston, Texas, 2006 and 2010. Vertical line represents minimum length limit at time of survey.

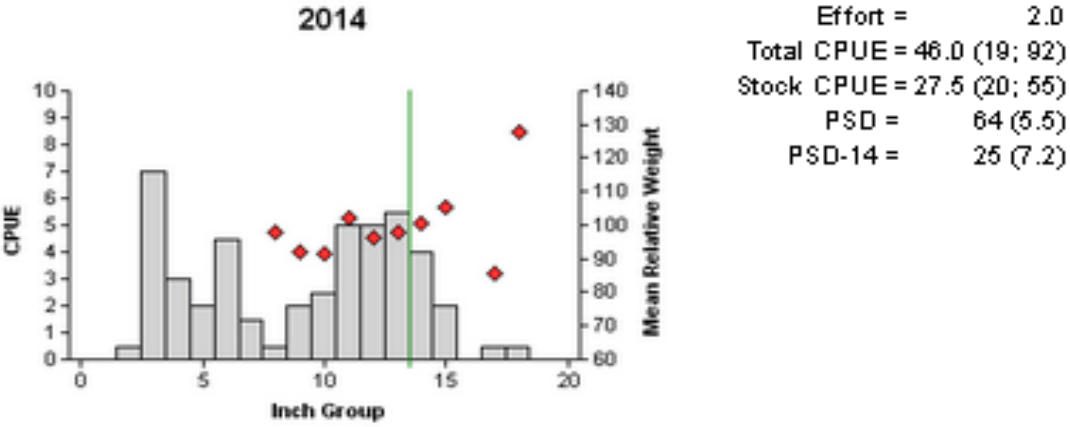


Figure 12. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Houston, Texas, 2014. Vertical line represents minimum length limit at time of survey. Electrofishing in 2014 was conducted following the Objective Based Sampling Plan and schedule outlined in this report using 12 randomly chosen nighttime electrofishing stations and 12 biologist chosen daytime electrofishing stations.

Largemouth Bass

Table 10. Creel survey statistics for Largemouth Bass at Lake Houston from June 2005 through May 2006, June 2010 through May 2011, and June 2013 through May 2014 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 Statistic	Year		
	2005/2006	2010/2011	2013/2014
Directed effort (h)	12877(19)	11342(30)	19443.5(24.2)
Directed effort/acre	1.05	0.93	1.6
Total catch per hour	0.33(29)	1.04(37)	0.7
Total harvest	2343(67)	613(48)	2015.2(50.1)
Harvest/acre	0.19	0.05	0.2
Released by Weight			
<4.0 lbs	NA	NA	11230(23.8)
4.0-6.9 lbs	NA	NA	15(115.2
7.0-9.9 lbs	NA	NA	0
≥10.0 lbs	NA	NA	0
Percent legal released (non-tournament)	18.7	75.5	88.3(52.4)

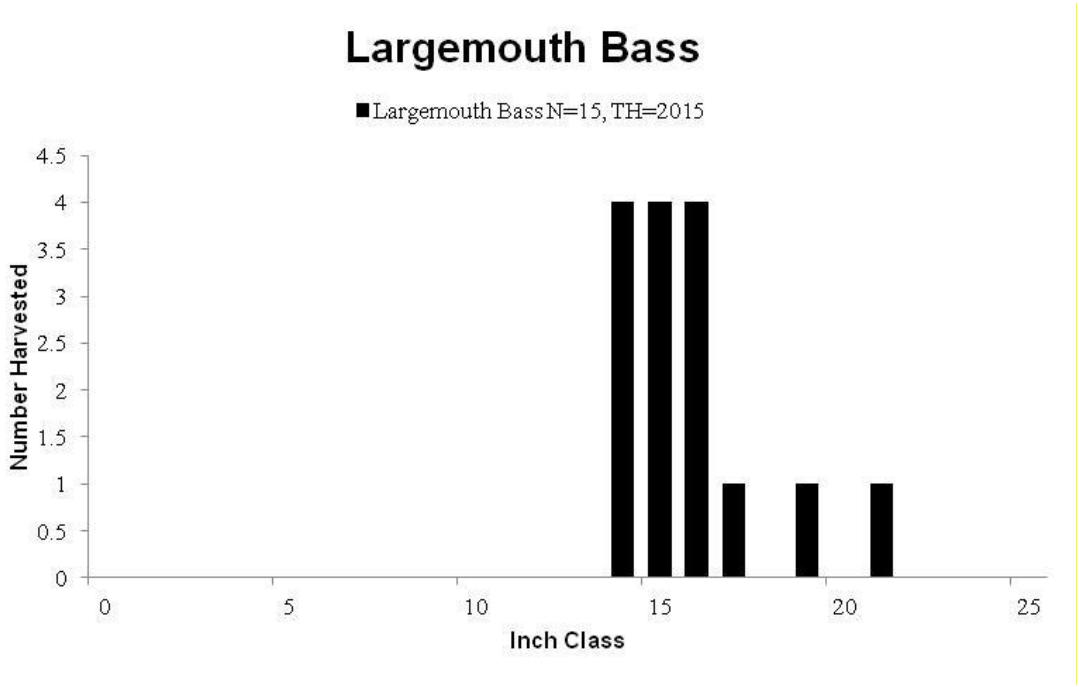


Figure 13. Length frequency of harvested Largemouth Bass observed during creel surveys at Lake Houston, Texas, June 2013 through May 2014, all anglers combined. N is the number of harvested Largemouth Bass observed during creel surveys, and TH is the total estimated harvest for the creel period.

Table 11. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Lake Houston, Texas, 2011 and 2014. FLMB = Florida Largemouth Bass and NLMB = Northern Largemouth Bass, Intergrade = hybrid between FLMB and NLMB. Genetic comp[osition was determined with micro-satellite DNA analysis.

		Number of Fish				
Year	Sample Size	FLMB	Intergrade	NLMB	% FLMB alleles	% pure FLMB
2011	30	0	19	11	8	0
2014	30	1	29	0	88	3

White Crappie

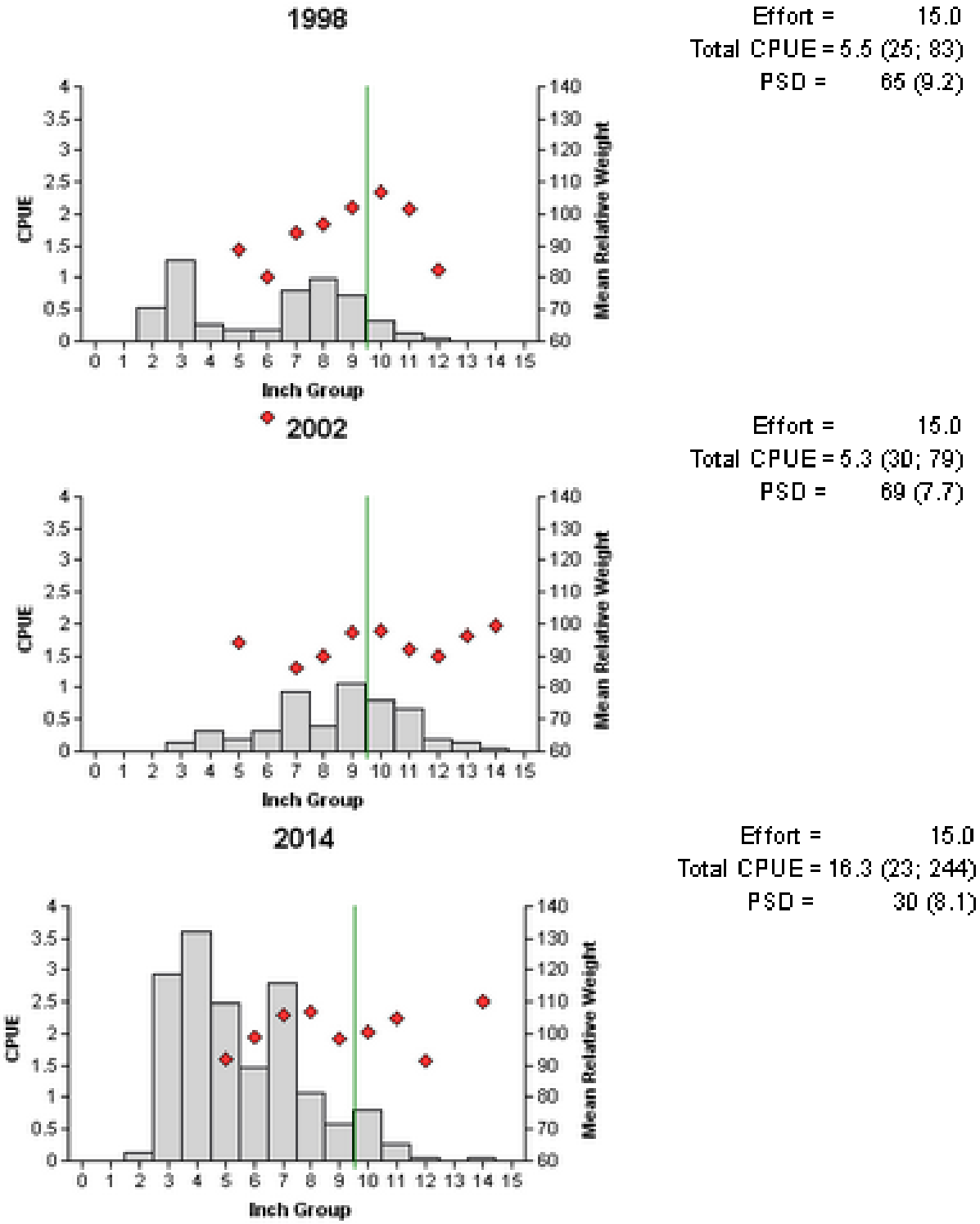


Figure 14. Number of White Crappie caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, Lake Houston, Texas, 1998, 2002,and 2014. Vertical line represents minimum length limit at time of survey.

Black Crappie

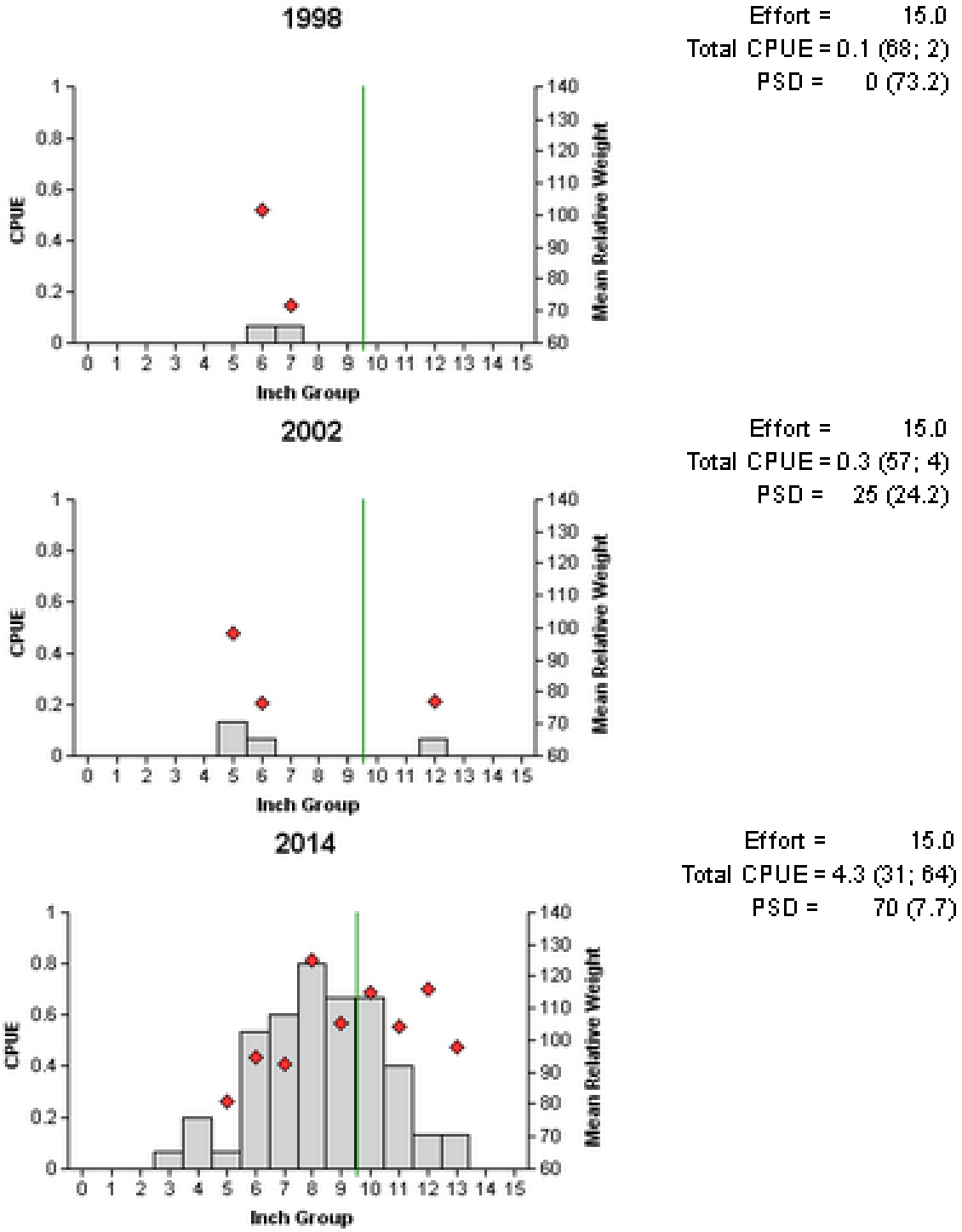


Figure 15. Number of Black Crappie caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, Lake Houston, Texas, 1998, 2002, and 2014. Vertical line represents minimum length limit at time of survey.

Crappie

Table 12. Creel survey statistics for crappie at Lake Houston from June 2005 through May 2006, June 2010 through May 2011 and June 2013 through May 2014 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		
	2005/2006	2010/2011	2013/2014
Surface area (acres)			
Directed effort (h)	15,933(20)	16,033(29)	7,274.3 (32)
Directed effort/acre	1.30	1.31	0.6
Total catch per hour	1.7(42)	0.042(56)	1.6 (40)
Total harvest			
White Crappie	33,615(36)	2,190(44)	4,387 (37)
Black Crappie	4,320(102)	77(167)	301 (73)
Harvest/acre			
White Crappie	2.78	0.2	0.4
Black Crappie	0.4	<0.1	>0.1
Percent legal released			
White Crappie	3.5	2.9	0
Black Crappie	0	0	0

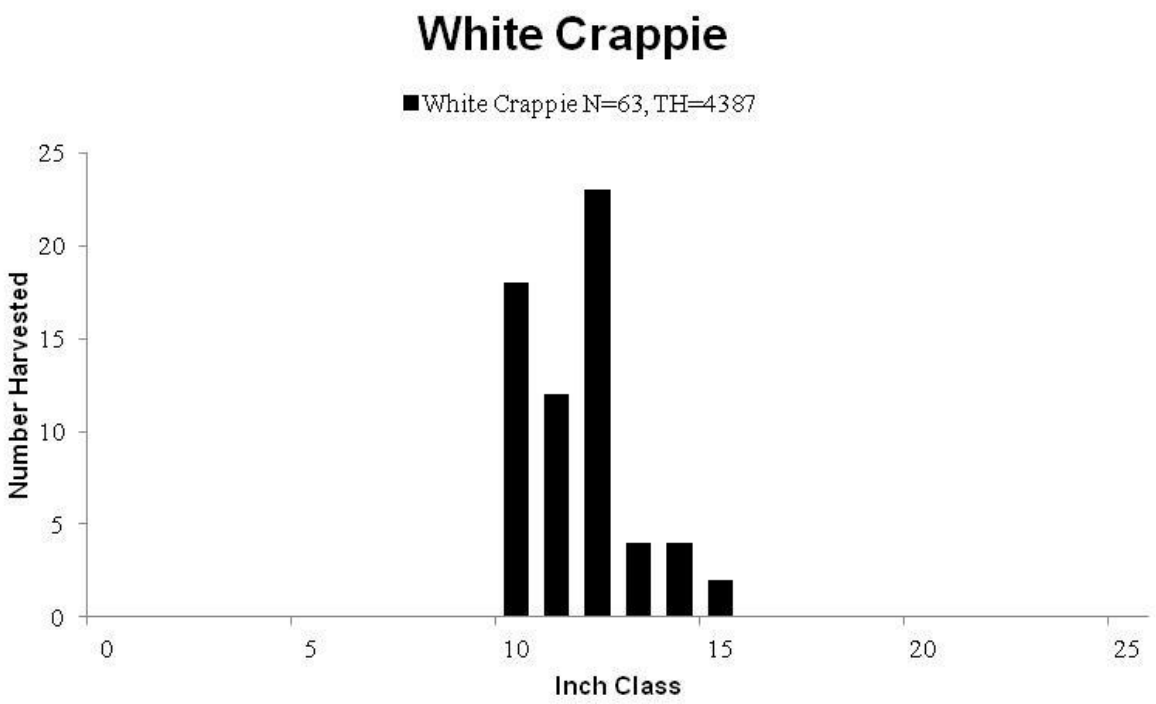


Figure 16. Length frequency of harvested White Crappie observed during creel surveys at Lake Houston, Texas, June 2013 through May 2014, all anglers combined. N is the number of harvested White Crappie, and TH is the total estimated harvest of White Crappie for the creel period.

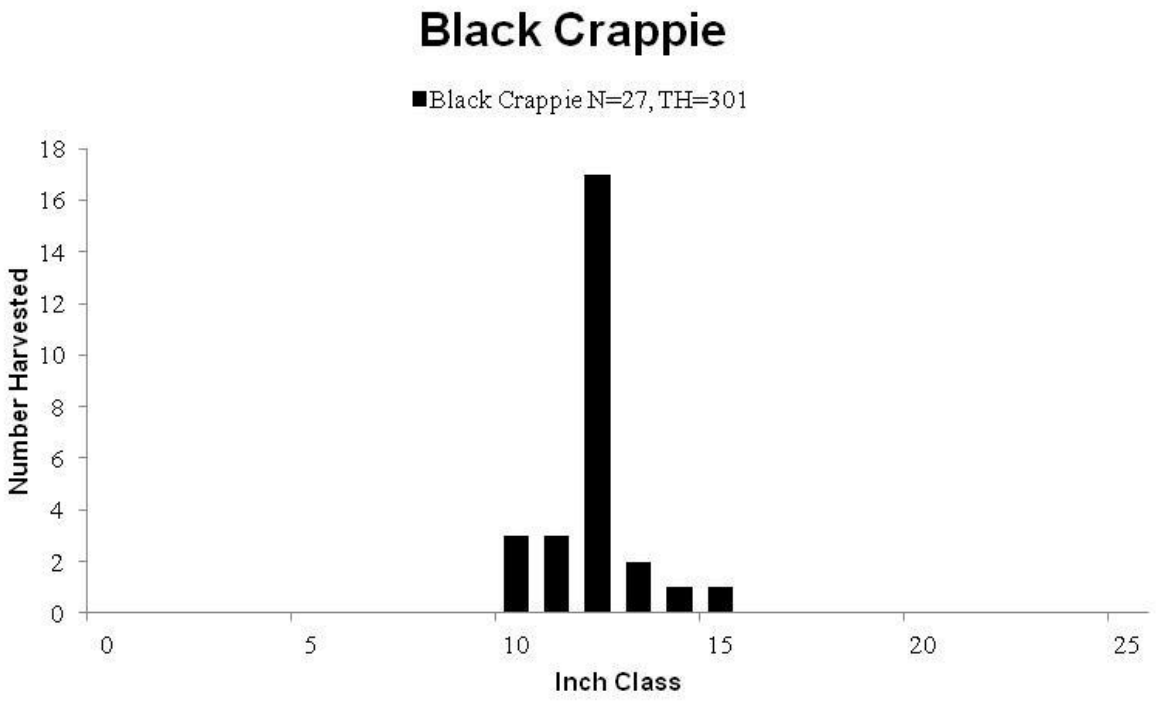


Figure 17. Length frequency of harvested Black Crappie observed during creel surveys at Lake Houston, Texas, June 2013 through May 2014, all anglers combined. N is the number of harvested Black Crappie, and TH is the total estimated harvest of Black Crappie for the creel period.

Table 13. 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.

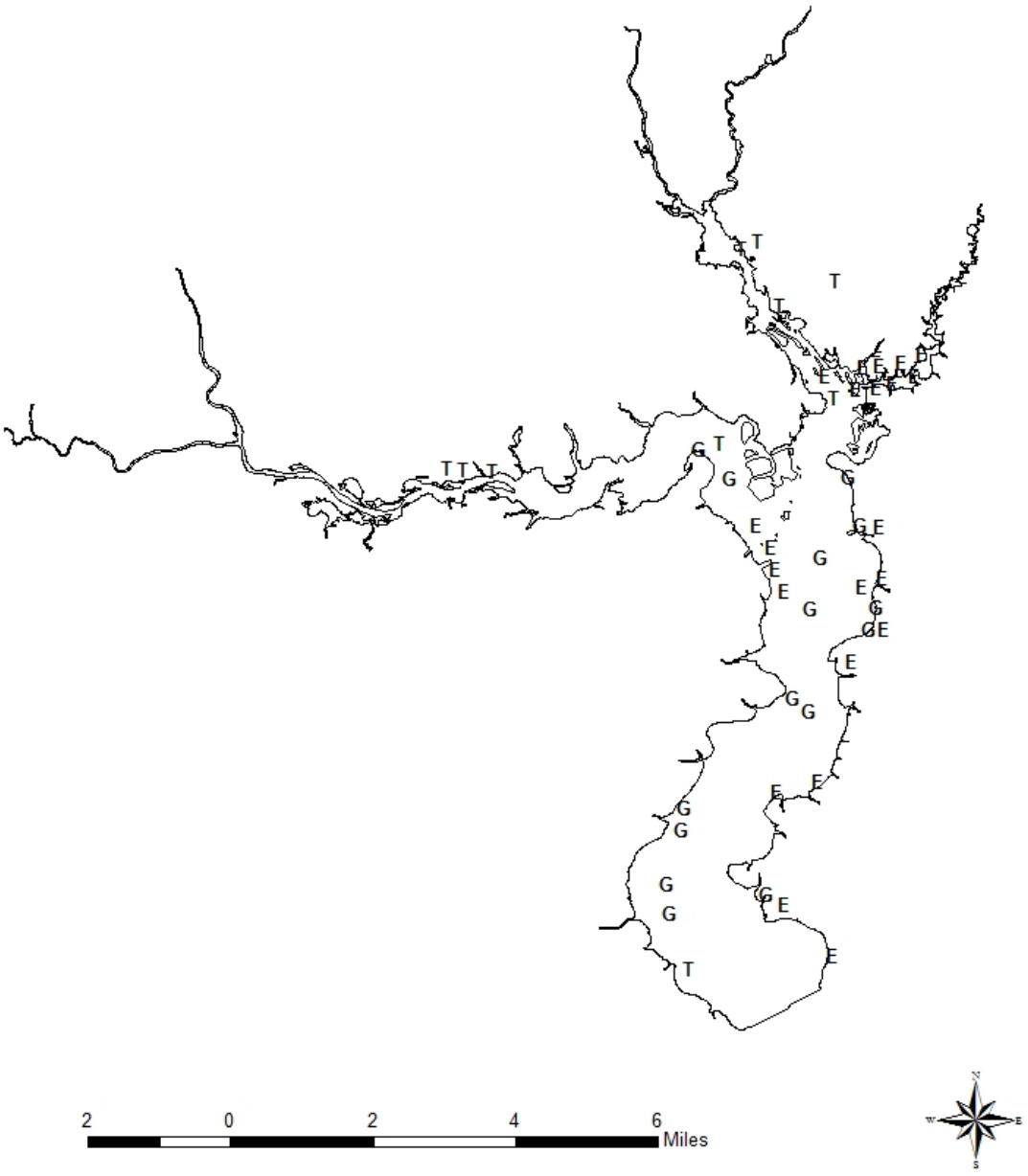
				Habitat				
Survey year	Electrofish Fall(Spring)	Trap net	Gill net	Structural	Vegetation	Access	Creel survey	Report
2015-2016					A			
2016-2017					A			
2017-2018					A		A	
2018-2019	S	S	S		S	S		S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Lake Houston, Texas, 2014-2015. Sampling effort was 15 net nights for gill netting and trap netting, 1 hour for nighttime random electrofishing, and 1 hour for daytime biologist selected electrofishing.

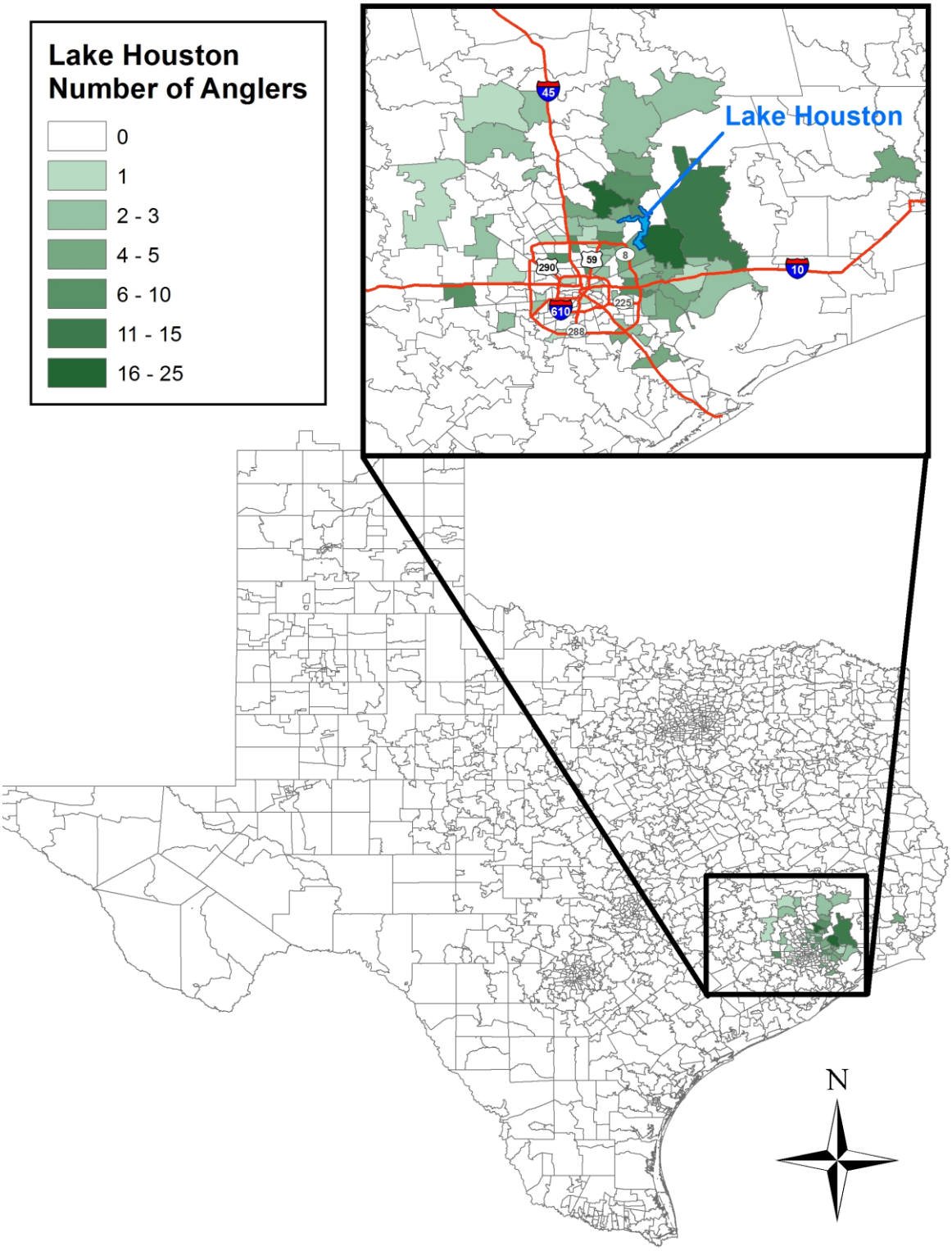
Species	Gill Netting		Trap Netting		Electrofishing (Night Random Stations)		Electrofishing (Day, Biologist-Selected Stations)	
	N	CPUE	N	CPUE	N	CPUE	N	CPUE
Spotted Gar	9	0.6						
Gizzard Shad	177	11.8			171	171.0	23	21.2
Threadfin Shad					86	86.0	3	2.8
Common Carp	4	0.3						
Bullhead Minnow					8	8.0	7	6.5
Inland Silverside					99	99.0	98	90.5
Brook Silverside					2	2.0	9	8.3
River Carpsucker							14	12.9
Blue Catfish	222	14.8						
Channel Catfish	284	18.9						
Flathead Catfish	1	0.1						
White Bass	5	0.3			1	1.0		
Yellow Bass	10	0.7			294	294.0	24	22.2
Bluegill	4	0.3			30	30.0	116	107.1
Longear Sunfish					17	17.0	59	54.5
Redear Sunfish	2	0.1			3	3.0	29	26.8
Spotted Bass							2	1.9
Largemouth Bass			1	0.1	16	16.0	76	70.2
White Crappie	12	0.8	244	16.27	6	6.0	1	0.9
Black Crappie	3	0.2	64	4.27	2	2.0		
Logperch							2	1.9
Freshwater Drum	60	4.0						
Blue Tilapia							2	1.9

APPENDIX B



Location of sampling sites, Lake Houston, Texas, 2014-2015. Trap netting, gill netting, and electrofishing stations are indicated by T, G, and E, respectively. Water level at time of sampling was approximately 43 feet above MSL.

APPENDIX C



Location by ZIP Code and frequency of anglers that were interviewed at Lake Houston, Texas, during the June 2013 through May 2014 creel survey.

APPENDIX D

Objective-based sampling plan for Lake Houston, Texas
2014-2015

Sport fish, forage fish, and other important fishes

Sport fishes in Lake Houston include Blue Catfish, Channel Catfish, White Bass, Largemouth Bass, Black Crappie, and White Crappie. Important forage species include Gizzard Shad, Threadfin Shad, and Bluegill.

Negligible fisheries

All sport species at Lake Houston contribute to the overall fishery and justify sampling effort.

Survey objectives, fisheries metrics, and sampling objectives

Crappie: During the June 2010 through May 2011 creel survey crappie represented 43% of the directed angler effort at Lake Houston and was the most popular fishery. Although both White and Black Crappies were harvested, White Crappie were the most abundant in angler creels. Based on bootstrap analysis of historical data, it would take 15 trap nets to attain acceptable precision (RSE < 25, N > 50) at least 80% of the time. Our **survey objective** is to monitor White Crappie trend data (CPUE, PSD, Wr) during the fall of 2014 in order to detect any larger scale population fluctuations. Our **sampling objective** is to set a minimum of 15, randomly selected single-cod shoreline trap net sites to achieve an RSE < 25 and collect at least 50 stock size individuals. We believe that the level of sampling proposed will provide sufficient catch to meet our **secondary sampling objective** of 13 specimens between 9.0 and 10.9 inches for aging. Black Crappie data will be used to show presence/absence since this is a very minor part of the crappie fishery.

White Bass: White Bass are present within the reservoir, and directed angling effort was documented in June 2010 through May 2011 creel survey, but less than 1% of anglers targeted any true bass species. Bootstrap analysis of historic data suggests at least 18 randomly-selected gill net nights would be required to obtain reliable CPUE values (i.e. RSE < 25), but over 24 net nights would be required to collect 50 stock size fish for size structure, age and growth, or body condition analysis. Since White Bass are targeted by such a small percentage of anglers, our **survey objective** is to determine presence/absence of White Bass in spring 2015 gill net sampling. Our **sampling objective** is to confirm presence/absence of White Bass in conjunction with the catfish sampling efforts using 15 random gill net sites.

Blue Catfish: Blue and Channel Catfishes combined accounted for 14.7% of directed angler effort during the June 2010 through May 2011 creel survey. Based on bootstrap analysis of historical data 15 gill nets should obtain Blue Catfish data with an acceptable precision (RSE < 25, N > 50) at least 80% of the time. Our **survey objective** is to monitor Blue Catfish trend data (CPUE, PSD, Wr) during the spring of 2015 with gill nets in order to detect any larger scale population fluctuations. Our **sampling objective** is to sample 15 randomly selected gill net sites to achieve an RSE < 25 and collect at least 50 stock sized individuals.

Channel Catfish: Blue and Channel Catfishes combined accounted for 14.7% of directed angler effort during the June 2010 through May 2011 creel survey. Based on bootstrap analysis of historical data 15 gill nets should obtain Channel Catfish data with an acceptable precision (RSE < 25, N > 50) at least 80% of the time. Our **survey objective** is to monitor Channel Catfish trend data (CPUE, PSD, Wr) during the spring of 2015 with gill nets in order to detect any larger scale population fluctuations. Our **sampling objective** is to sample 15 randomly selected gill net sites to achieve an RSE < 25 and collect at least 50 stock sized individuals.

Largemouth Bass: Largemouth Bass abundance is limited by turbidity and commensurate lack of submersed aquatic vegetation; however, the Largemouth Bass fishery at Lake Houston is popular, accounting for 28.4% of the total directed angling effort during the June 2010 through May 2011 creel

survey. Bootstrap analysis of historic data suggests reliable population metrics (CPUE; RSE<25, PSD and Wr; N>50 stock sized individuals) would require well over 24 randomly selected 5-minute electrofishing stations. Our **survey objective** is to monitor Largemouth Bass population trend data in the fall of 2014 including size structure, age and growth, and body condition only. Our **sampling objective** is to collect at least 50 stock sized Largemouth Bass by sampling at 12 randomly selected electrofishing sites (night time sampling) and 12 subjectively chosen electrofishing sites (daytime sampling). We believe that this proposed level of sampling will also provide sufficient catch to allow us to meet our **secondary sampling objective** of obtaining 13 specimens between 13.0 and 14.9 inches for aging.

Gizzard Shad, Threadfin Shad, and Bluegill: Gizzard Shad, Threadfin Shad, and Bluegill are the primary forage species at Lake Houston. Based on sampling history fall electrofishing generally provides adequate data to evaluate the overall forage base at Lake Houston; therefore, our **survey objective** is to monitor Gizzard Shad CPUE, size structure, and IOV; Threadfin Shad CPUE; and Bluegill CPUE and size structure in the fall of 2014 using electrofishing in conjunction with Largemouth Bass sampling. Our **sampling objective** is to sample at 12 randomly selected electrofishing sites (night time sampling) and 12 subjectively chosen electrofishing sites (daytime sampling) to collect at least 50 individuals of each target forage species.