

PERFORMANCE REPORT

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FEDERAL AID IN SPORT FISH RESTORATION ACT

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FEDERAL AID PROJECT F-30-R-33

STATEWIDE FRESHWATER FISHERIES MONITORING AND MANAGEMENT PROGRAM

2007 Survey Report

Lake Livingston

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lake Livingston were surveyed in 2007 using electrofishing, and in 2008 using trap netting and gill netting. Anglers were surveyed from June 2007 to May 2008 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 Livingston is an 83,277-acre impoundment on the Trinity River in Trinity, Polk, San Jacinto, and Walker Counties, Texas. Lake Livingston was constructed in 1969 by the Trinity River Authority (TRA) and the City of Houston to provide water for municipal, agricultural, and industrial purposes. There is considerable private and commercial real estate development, as well as Lake Livingston State Park and several TRA public parks, around the lower two-thirds of the reservoir.

- **Management history:** All sport fisheries at Lake Livingston are regulated under statewide length and bag limits, with the exception of the bag limit (50/angler/day) for channel and blue catfish. Striped bass fingerlings are stocked annually, and the tailrace provides TPWD hatcheries brood-stock for striped bass and palmetto bass production. The primary management challenges are heavy silt loading and infestations of the noxious exotic plants water hyacinth and water lettuce. Florida largemouth bass were stocked periodically.
- **Fish community**
 - **Prey species:** Gizzard and threadfin shad, bluegill, and longear sunfish are the predominant prey species in Lake Livingston. Other less numerous prey fishes include bullhead minnow, inland silverside, green sunfish, warmouth, redear sunfish, and spotted sunfish.
 - **Catfishes:** Blue, channel, and flathead catfishes occur in Lake Livingston, but blue catfish is the dominant species. Commercial trotlines are still allowed on Lake Livingston for blue and channel catfish. Blue and channel catfish are the most sought-after species by anglers at Lake Livingston.
 - **White bass:** Gill net catch rates and intended angler effort for white bass have increased in the past several years. Angler catch and harvest declined, but both remained high.
 - **Largemouth bass:** Electrofishing catch rates of largemouth bass have historically been low at Lake Livingston. Degraded habitat due to heavy silt loading and shoreline bulkheads limit the amount of available habitat for spawning and survival of juvenile bass. Intended angler effort, catch, and harvest for largemouth bass dramatically declined since 2004.
 - **Crappie:** Though both black and white crappie occur in Lake Livingston, white crappie far outnumber black crappie. Recent trap net catches of white crappie have been high, yet the creel data indicate intended effort, angler catch, and harvest for crappie was very low at Lake Livingston.
- **Management strategies:** Statewide length and bag limits will continue to be used to regulate sport fish harvest. Cooperative efforts with the Trinity River Authority will continue to address exotic noxious vegetation issues. A research project directed by Heart of the Hills Research Station is investigating stocking survival of stocked striped bass.

INTRODUCTION

This document is a summary of fisheries data collected from Lake Livingston from June 2007 through May 2008. 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 2007 and 2008 data for comparison.

Reservoir Description

Lake Livingston is located on the Trinity River in Trinity, Polk, San Jacinto, and Walker Counties, Texas lying within the Piney Woods Vegetational Area. Soil types are Kaufman-Trinity, Lufkin-Tabor, Bowie-Kirvin, and Susquehanna Associations. Lake Livingston was constructed in 1969 by the Trinity River Authority (TRA) and the City of Houston to provide water for municipal, agricultural, and industrial purposes. Lake Livingston has a surface area of 83,277 acres, a drainage area of approximately 15,700 square miles, and a shoreline length of approximately 350 miles. Rainfall in the watershed averages 48.0 inches per year. There is considerable private and commercial real estate development, as well as Lake Livingston State Park and several TRA public parks, around the lower two-thirds of the reservoir. Monthly water level elevations are reported in Figure 1. Other physical characteristics of Lake Livingston are presented in Table 1.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Webb and Henson 2004) included:

1. Littoral habitat degradation and siltation have contributed to a decline in sport fish populations at Lake Livingston.
Action: Continued cooperative effort with the U.S. Army Corps of Engineers, the Trinity River Authority, and Texas Black Bass Unlimited to establish native aquatic plants in Lake Livingston. To date, success is limited to small areas of emergent vegetation.
2. Lake Livingston has a popular largemouth bass fishery with over 42% of intended angling effort directed at this species.
Action: Stocked Florida largemouth bass fingerlings in 2006 (201,694) and 2007 (200,586).
3. Many striped bass stocked in Lake Livingston make their way into the tailrace below the dam and help provide brood fish for the hatchery program. There is a marginal fishery for striped bass in the reservoir itself and a popular fishery for them below the dam.
Action: Continued procurement of adult striped bass from the Livingston tailrace for hatchery production of palmetto bass and striped bass fingerlings. Continued to stock striped bass fingerlings each year from 2004 through 2007. Total number stocked in that time period was 2,908,336.
4. Although many access points are available on Lake Livingston, few of them offer handicapped access.
Action: To date, no recommendations for improvements have been made either to individuals holding private access points or to TRA concerning their public access points.
5. Lake Livingston is infested with water hyacinth and water lettuce at levels that impede access.
Action: Continued to offer assistance to Trinity River Authority as needed in monitoring and treating. Conducted vegetation survey in the summer of 2007.

Harvest regulation history: All sport fisheries are regulated under statewide length and bag limits with the exception that the bag limit for channel and blue catfish is 50 in combination (Table 2).

Stocking history: The first stockings into Lake Livingston were channel and blue catfish and largemouth bass in 1969 and 1970. Striped bass were first introduced in 1977 and, with the exception of four years, have been stocked annually since. Florida largemouth bass were first stocked into Lake Livingston in 1975 and were stocked four years consecutively. Florida largemouth bass were not stocked again until 1996. Florida bass fingerlings have been stocked since then in 2000, 2001, 2006, and 2007. A complete stocking history is presented in Table 3.

Vegetation/habitat history: Habitat management at Lake Livingston has two major components; exotic vegetation control and littoral habitat enhancement. The Trinity River Authority currently treats water hyacinth and water lettuce throughout the growing season to keep these species under control. In past years, TPWD has worked with Texas Black Bass Unlimited to plant native aquatic vegetation with some success; however, far more effort is needed to mitigate the results of siltation and turbidity. Future efforts toward habitat enhancement should be concentrated in creeks and backwater areas where these efforts have the best chance for success.

Boat docks, bulkheads, and eroded bank are the predominant physical shoreline habitat types. An area of about 5,700 acres of standing timber covers the middle portion of the reservoir.

METHODS

Fishes were collected by electrofishing (2 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 trap nets and gill nets as the number of fish 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 2005).

A roving creel survey was conducted from June 2007 through May 2008. A total of 36 days were surveyed during the creel year, with the lake divided into three sections with one section surveyed during each 3-hour creel period.

Sampling statistics (CPUE for various length categories), structural indices [Proportional Stock Density (PSD), Relative Stock Density (RSD)], and condition indices [relative weight (Wr)] 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 = $100 \times \text{SE of the estimate/estimate}$) was calculated for all CPUE statistics and for creel statistics and SE was calculated for structural indices and IOV. Source for water level data was the United States Geological Survey (USGS).

A sub-sample of eleven striped bass in the 18-inch group (458-482mm) were aged using otoliths. The otoliths were sectioned and polished to distinguish annuli. Mean age at 18 inches (legal length) was calculated.

RESULTS AND DISCUSSION

Habitat: A shoreline habitat and vegetation survey was conducted in September 2007. No changes to shoreline physical habitat were noted since the survey in 2003. Water hyacinth and water lettuce increased in abundance since 2003, and native emergent vegetation remained unchanged (Table 4).

Creel: Overall, anglers spent less time fishing on Lake Livingston from June 2007 through May 2008 compared to similar months in 2003 and 2004. Total fishing effort in 2007 to 2008 dropped from

101,132 hours in 2003 to 2004 to 82,760 hours. Total expenditures also declined from \$233,555 to \$212,890 (Table 6).

Catfishes (blue and channel) were the most sought after species in 2007 to 2008 followed by white bass, while largemouth bass and sunfishes were the least sought after (Table 5). Angler catch and harvest were high for blue catfish (Table 7) and white bass (Table 8). Striped bass were not highly targeted by anglers and intended effort, catch and harvest were low for striped bass (Table 9). Crappies were not highly targeted by anglers (Table 12), despite good catch rates in trap nets (Figures 14 and 15).

Prey species: Clupeids (threadfin and gizzard shad) continue to dominate the forage base in Lake Livingston. The electrofishing catch rate of both species combined in 2007 was 603.5 fish/h, similar to 2003 (614.0 fish/h). Most gizzard shad in the sample were available as prey (IOV = 97.0) (Figure 2).

Sunfishes are the second most abundant prey fish in Lake Livingston with bluegill being the most abundant in the 2007 sample (79.5/h) (Figure 3). Longear sunfish were the most abundant sunfish in the 2003 sample (117.5 fish/h), but the catch rate in 2007 dropped to 45.0/h. Most individuals captured were less than 6 inches and were available as prey. Other prey species present in the 2007 sample were inland silverside (6.0/h), warmouth (0.5/h), and redear sunfish (5.0/h) (Figure 4).

Catfishes: Blue catfish continue to be the dominant catfish species in Lake Livingston. The 2008 gill net catch rate was 22.8/nn (Figure 5), similar to the 2004 catch rate (23.9/nn). Length frequency data indicate good size distribution with fish as large as 30 inches in the sample. The Proportional Stock Density (PSD) of the sample was 14 in 2008 and has not changed since 2004. The condition (Wr) of the blue catfish was good across all size classes.

Channel catfish are far less abundant than blue catfish in Lake Livingston. Only 45 individuals were captured in the 2008 sample (Figure 6).

Flathead catfish occur in Lake Livingston, but are rarely encountered in gill net surveys. Only 2 were captured in the 2008 sample (Figure 8).

Anglers spent 28,761 hours seeking catfishes (blue and channel combined), (Table 7) similar to the results observed in the 2003 to 2004 creel (29,392 hours). Anglers harvested over 49,000 catfish (blue and channel) during the creel period from June 2007 to May 2008 (Figure 7).

Temperate basses: The gill net catch rate of white bass in 2008 was 10.5/nn (Figure 9), similar to 2004 (11.3/nn). Half of the stock-sized fish in the sample were of legal size. Angler Intended effort for white bass was low in 2003 to 2004 (5,589 hours) but has increased to 13,488 hours (Table 8) in the past four years. The angler catch rate remained high in 2007 to 2008 (4.6 fish/angler hour), and anglers released fewer legal-sized white bass (0.1%) than they did four years ago (14.1%). Anglers harvested an estimated 28,499 white bass with fish to 16 inches actually observed in the creel. Observed harvested fish measured 10 to 17 inches (Figure 10).

Although striped bass have been stocked in Lake Livingston almost every year since 1977, fisheries monitoring surveys have not documented the presence of a significant population or fishery. In 2004, the catch rate was 2.4 fish/nn, the highest ever observed, and was slightly lower in 2008 (1.5/nn) (Figure 11). Striped bass stocked in the reservoir are thought to support a significant striped bass fishery in the tailrace below the dam. This area is used by TPWD to obtain striped bass brood fish necessary to support statewide hatchery production of striped bass and Palmetto bass. It is also possible that some of the large striped bass in the tailrace are actually anadromous fish that, during spring, migrate into the area from the Gulf of Mexico. An in-house research project is currently being conducted to investigate whether this is occurring. Reservoir striped bass were in excellent condition and grew to 18 inches by

age 2. Creel surveys indicate that few anglers in Lake Livingston target striped bass. The intended effort was estimated at 295 hours during the creel period (Table 9) with just over 1,000 striped bass caught by all anglers combined.

Largemouth bass: Electrofishing catch rates of largemouth bass have always been low at Lake Livingston, usually 20 to 40/h in any given sample. Since 2001, electrofishing catch rates of bass have further declined. In 2007, the electrofishing catch rate was 18.5/h with only one legal-size fish in the sample (Figure 13). Poor bass recruitment is likely due to the scarcity of rooted aquatic plants and associated juvenile habitat. Lake Livingston also collects a very high volume of silt that, over time, has contributed to the overall decline in habitat quality.

From June 2003 through May 2004, over 43% (>34,000 hours) of the total intended angling effort at Lake Livingston targeted largemouth bass, making it the most sought after species in the reservoir at that time. From June 2007 through May 2008, intended effort declined to 1,252 hours; only 2.2% of total fishing effort (Table 10). This apparent decline in popularity among bass anglers may be the result of an actual decline in the numbers of legal-sized bass in the population. In the 2003 to 2004 creel, we observed very high harvest rates for a largemouth bass fishery, so it is not unreasonable to conclude that over-exploitation of the largemouth bass population may have occurred. No bass were observed harvested in the creel, and it was estimated that anglers caught and released only 1,790 bass, compared to 16,000 bass harvested and over 28,000 caught in 2003 to 2004 (Tables 5 and 10).

Florida largemouth bass fingerlings were stocked in 2000 and 2001 (over 1 million fish) and again in 2006 and 2007 (Table 3) in an attempt to increase the Florida genetic influence in the population. To date, there has been little change in allele frequencies, and in 2007, no pure Florida or northern strain largemouth bass were collected (Table 11).

Crappie: The trap net catch rate of white crappie in 2008 was 5.3/nn, similar to the 2004 sample (6.0 fish/nn) (Figure 14). Length frequency data suggest that recruitment over the past five years has been consistent. All size classes of white crappie had relative weights over 100. Black crappie occur very infrequently in trap net samples; only 10 were captured in 2003 and 26 in 2008 (Figure 15)

Creel data indicated a minimal fishery for crappie at Lake Livingston. Less than 6% of effort was directed toward crappie. Though intended effort has increased since 2003 to 2004, no crappie were observed in the creel (Table 12).

Fisheries management plan for Lake Livingston, Texas

Prepared—July 2008.

ISSUE 1: Littoral habitat degradation and siltation have possibly contributed to a decline in the largemouth bass population at Lake Livingston. The 2003 to 2004 creel data indicated that largemouth bass were the most sought after species at Lake Livingston; however, currently they are one of the least sought after (2.2%). The fall 2007 electrofishing length frequency data indicates few legal-size fish remaining in the population and could account for the precipitous decline in interest by anglers. No bass harvest was observed in the creel, and it was estimated that anglers only caught 1,790 bass, compared to 16,000 bass harvested and over 28,000 caught in 2003 to 2004.

MANAGEMENT STRATEGY

1. Seek funding to increase native littoral vegetation in backwaters and creeks where conditions are the most likely to allow success.

ISSUE 2: Striped bass in the Lake Livingston tailrace provide both a popular fishery and the source for TPWD brood fish; however, there is only a marginal fishery for striped bass in the reservoir itself even though nearly a million striped bass are stocked into Lake Livingston each year.

MANAGEMENT STRATEGIES

1. Support an in-house research project currently underway to investigate if striped bass stocked into the reservoir move through Lake Livingston Dam and into the tailrace.
2. Continue to research the best methods for anglers to utilize the striped bass fishery in the reservoir and provide that information to the public.

ISSUE 3: Lake Livingston is infested with the exotic plants water hyacinth and water lettuce at levels that impede access.

MANAGEMENT STRATEGIES

1. Support the Trinity River Authority's efforts to control water hyacinth and water lettuce with funding and labor including securing an aerial application contract in summer 2008 using boating access funds.

ISSUE 4. Lake Livingston has an excellent blue catfish population and a high quality fishery. The lake's increased turbidity which has resulted from natural reservoir ageing processes limits the success of centrarchid populations. This resource should be promoted.

MANAGEMENT STRATEGIES

1. Conduct routine gill netting surveys to monitor population trends of blue catfish
2. Promote this fishery through news releases and interviews

SAMPLING SCHEDULE JUSTIFICATION: Electrofishing, trap netting, and gill netting surveys will be conducted every four years to monitor trends in sport fish populations. A creel survey will be conducted every four years to monitor angler activity. A complete habitat survey will be conducted every four years with exotic vegetation surveys conducted annually to monitor problem infestations. Other sampling will be conducted in support of research efforts as the need arises.

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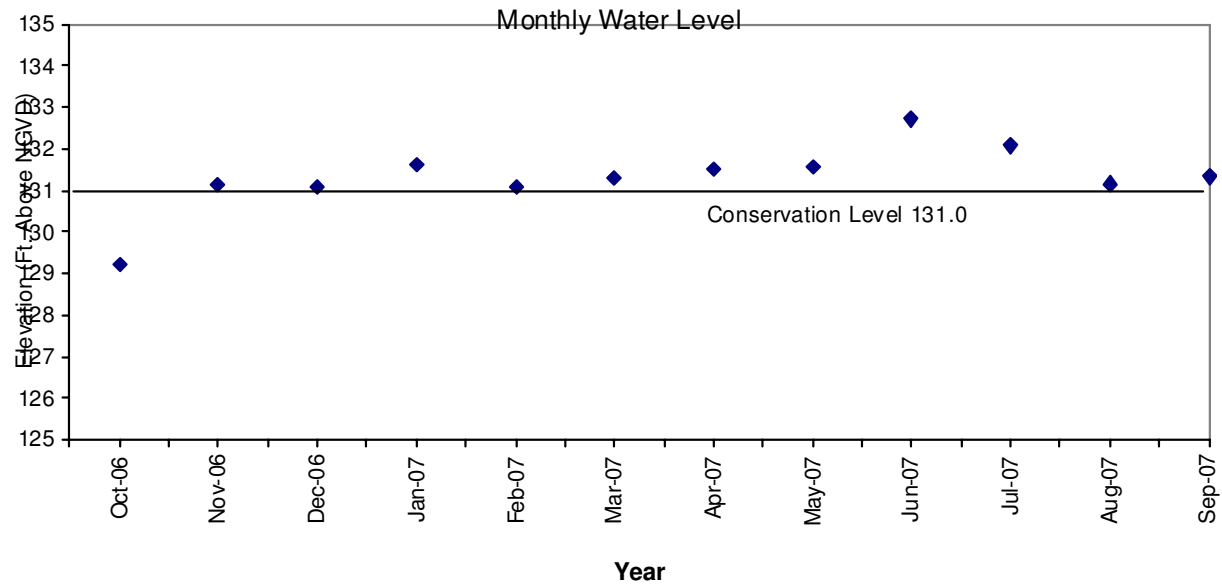


Figure 1. Quarterly water level elevations in feet above mean sea level (MSL) recorded for Lake Livingston, Texas, October 2006 – September 2007.

Table 1. Characteristics of Lake Livingston, Texas.

Characteristic	Description
Year constructed	1969
Controlling authority	Trinity River Authority
County	Polk (location of dam), Trinity, San Jacinto, and Walker
Reservoir type	Main stream (Trinity River)
Shoreline Development Index (SDI)	10.7
Conductivity	200-450 umhos/cm

Table 2. Harvest regulations for Lake Livingston.

Species	Bag Limit	Minimum-Maximum Length (inches)
Catfish: channel and blue catfish, their hybrids and subspecies	50 ^a (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

^a Walker, Trinity, San Jacinto, and Polk Counties only

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

Species	Year	Number	Size
Blue catfish	1969	159,800	FGL
Channel catfish	1969	634,905	FGL
	1970	254,000	FGL
	Total	888,905	
Striped bass	1977	884,726	FGL
	1978	117,091	FGL
	1979	224,000	FGL
	1980	283,584	FGL
	1982	341,357	FGL
	1983	189,265	FGL
	1984	1,424,455	FGL
	1985	896,996	FGL
	1986	448,485	FGL
	1987	898,585	FGL
	1988	899,615	FGL
	1989	905,687	FGL
	1992	351,750	FGL
	1993	405,370	FGL
	1994	1,788,670	FGL
	1995	900,833	FGL
	1996	441,079	FGL
	1997	985,431	FGL
	1998	689,849	FGL
	1999	913,952	FGL
	2000	900,264	FGL
	2002	1,392,893	FGL
	2003	1,032,104	FGL
	2004	437,308	FGL
	2005	526,148	FGL
	2006	746,278	FGL
	2007	796,122	FGL
	2008	206,090	FGL
	Total	20,027,987	
Largemouth bass	1969	1,018,400	FGL
Florida largemouth bass	1975	26,000	FGL
	1976	22,000	FGL
	1977	250,330	FGL
	1978	753,286	FGL
	1996	889,304	FGL
	2000	501,639	FGL
	2001	500,018	FGL
	2006	201,694	FGL
	2007	200,586	FGL
	Total	3,344,857	

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

Paddlefish	1990	63,232	FGL
	1991	34,132	FGL
	1992	5,136	FGL
	1993	28,003	FGL
	Total	<hr/> 130,503	

Table 4. Survey of littoral zone and physical habitat types, Lake Livingston, Texas, 2007. 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
Bulkhead	14.2	4.6	5,778	6.4
Concrete	5.9	1.9		
Dead trees	7.3	2.4		
Eroded bank	12.0	3.9		
Featureless	7.9	2.6		
Flooded terrestrial	24.4	8.0		
Native emergent	0.4	0.1		
Overhanging brush	3.4	1.1		
Rip rap	5.5	1.8		
Bulkhead/boat dock	106.2	35.1		
Bulkhead/overhanging brush	0.8	0.2		
Bulkhead/rip rap	0.1	<0.1		
Concrete/dead trees	0.6	0.1		
Eroded bank/dead trees	6.1	2.0		
Eroded bank/rock shoreline	0.5	0.1		
Featureless/boat dock	0.5	0.1		
Featureless/dead trees	1.2	0.4		
Flooded terrestrial/dead trees	9.0	2.9		
Flooded terrestrial/native floating	1.1	0.3		
Flooded terrestrial/overhanging brush	2.9	0.9		
Flooded terrestrial/water hyacinth	26.5	8.7		
Native emergent/water hyacinth	41.8	13.7		
Rip rap/boat dock	0.4	0.1		
Boat dock/flooded terr/water hyacinth	1.2	0.3		
Bulkhead/boat dock/dead trees	1.2	0.3		
Bulkhead/boat dock/rip rap	0.3	<0.1		
Bulkhead/boat dock/water hyacinth	1.8	0.5		
Eroded bank/dead trees/water hyacinth	0.8	0.2		
Eroded bank/rocky shoreline/dead trees	2.3	0.7		
Eroded bank/native emergent/water hyacinth	11.8	3.9		
Flooded terr/dead trees/eroded bank	0.7	0.2		
Flooded terr/dead trees/overhanging brush	3.2	1.0		
Flooded terr/dead trees/rip rap	0.3	<0.1		
Flooded terr/dead trees/water hyacinth	0.3	<0.1		
Flooded terr/overhanging brush/eroded bank	0.3	<0.1		
Water hyacinth			1,000	0.01
Water lettuce			1,000	0.01
Native emergent			100	0.001

Table 5. Percent intended angler effort by species for Lake Livingston, Texas, 2003-2004 and 2007-2008.

Species	Year	
	2003-2004	2007-2008
Catfishes	36.6	49.7
White bass	6.9	23.7
Sunfishes	0.1	1.9
Largemouth bass	43.6	2.2
Crappies	1.5	5.6
Anything	10.1	7.5

Table 6. Total fishing effort (h) for all species and total directed expenditures at Lake Livingston, Texas, 2003-2004 and 2007-2008.

Creel Statistic	Year	
	2003-2004	2007-2008
Total fishing effort	101,132	82,670
Total directed expenditures	\$233,555	\$212,890

Gizzard Shad

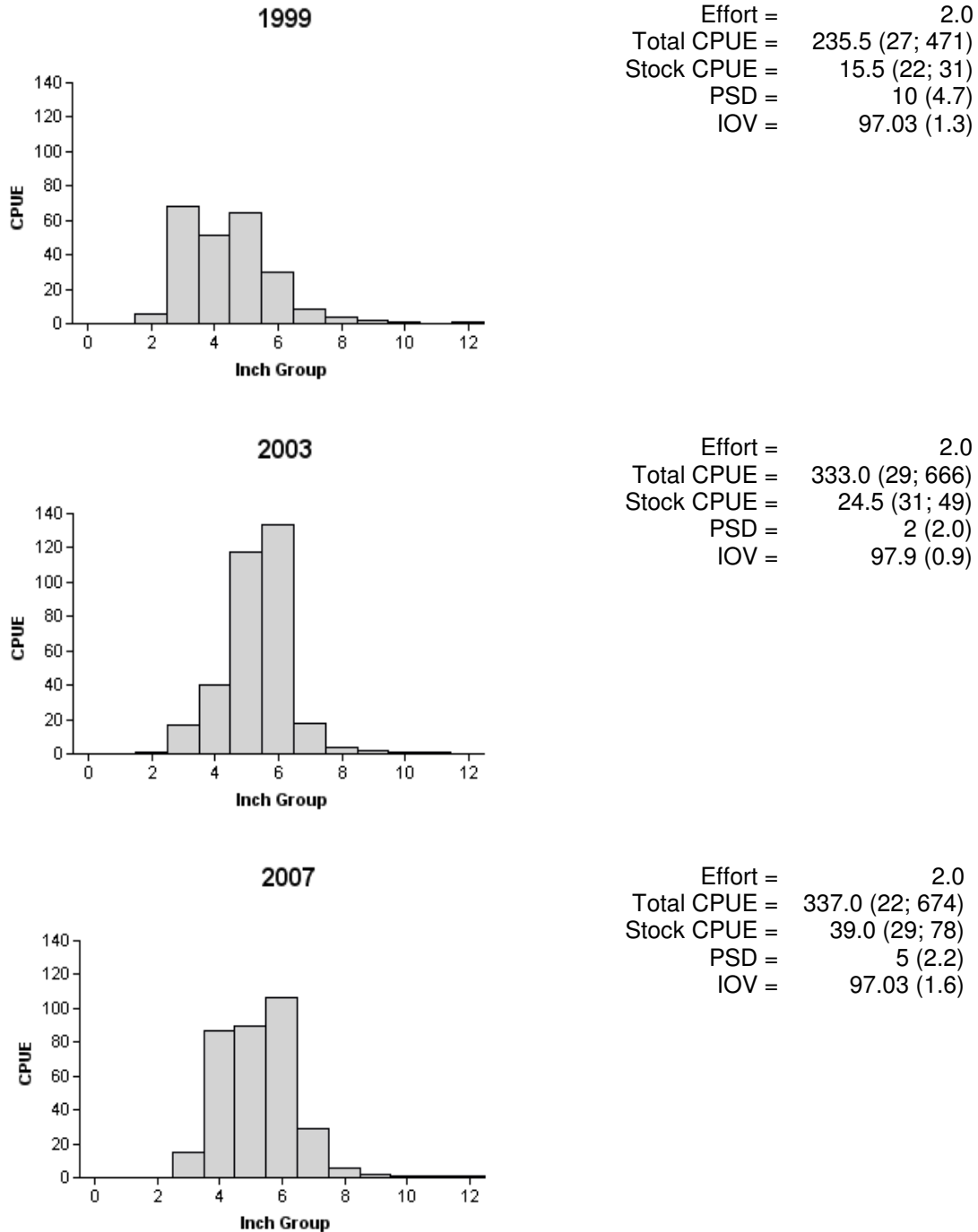


Figure 2. Number of gizzard shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure and IOV are in parentheses) for fall electrofishing surveys, Lake Livingston, Texas, 1999, 2003, and 2007.

Bluegill

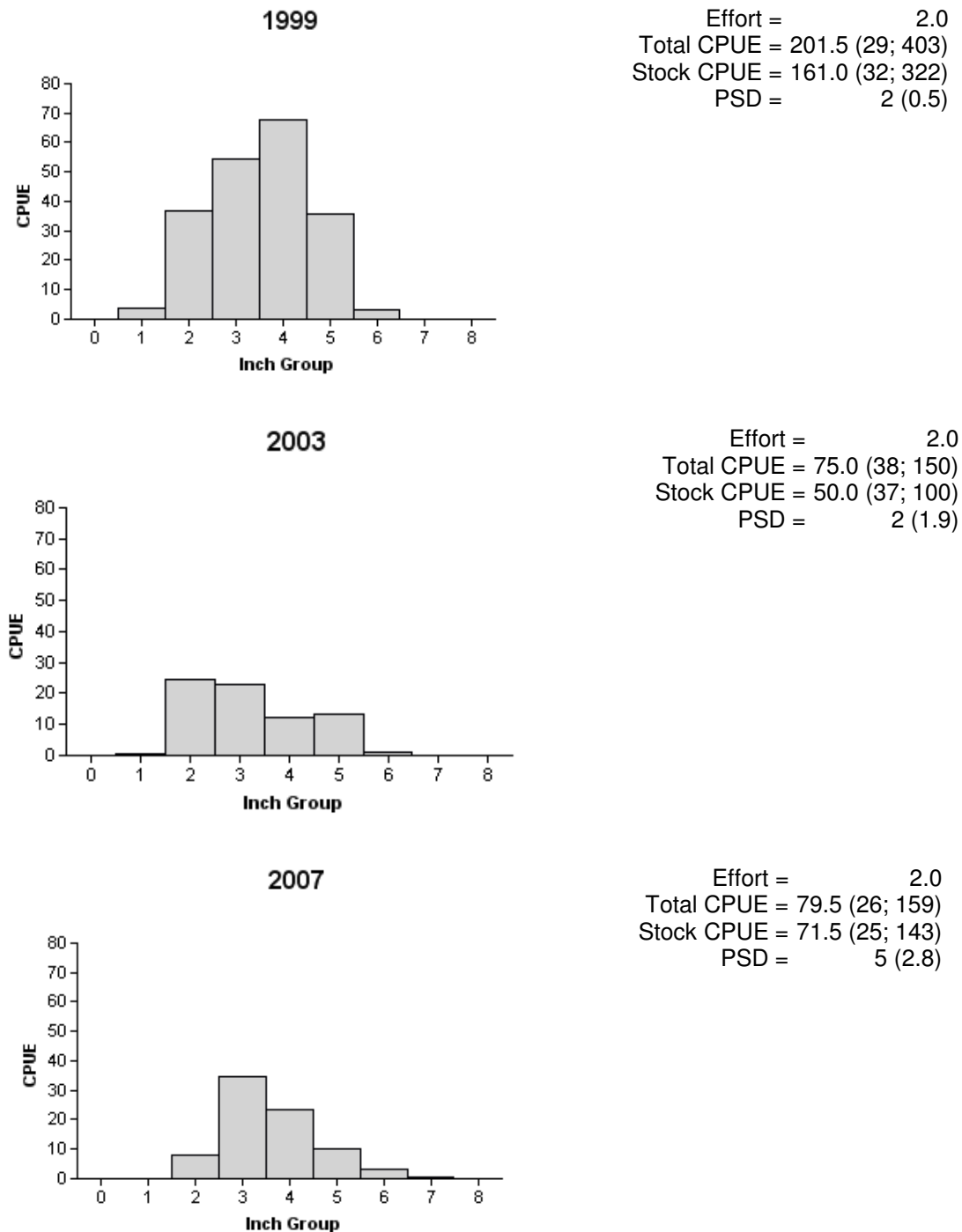
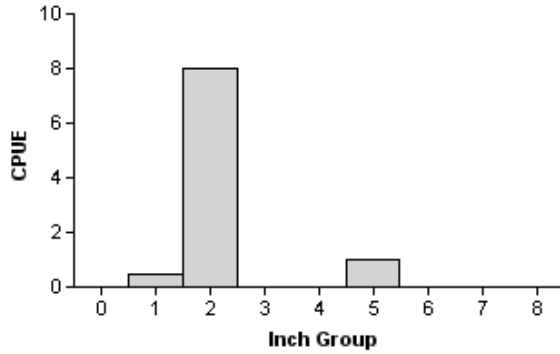


Figure 3. Number of bluegill caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Livingston, Texas, 1999, 2003, and 2007.

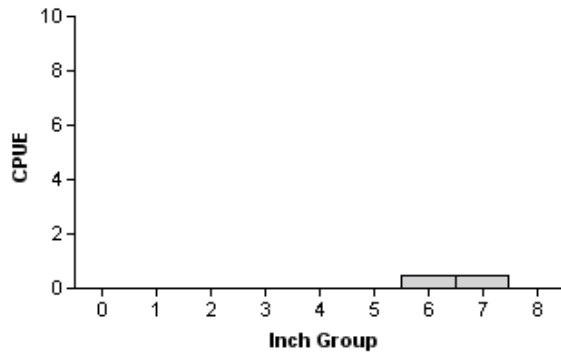
Redear sunfish

1999



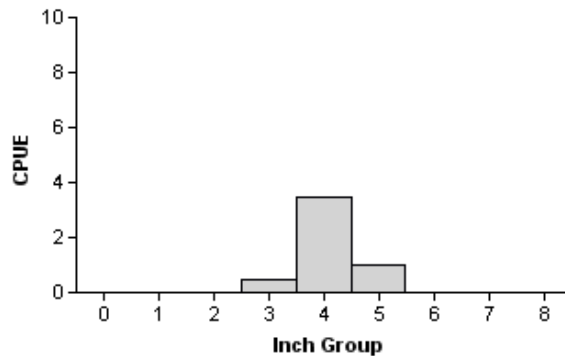
Effort = 2.0
 Total CPUE = 9.5 (47; 19)
 Stock CPUE = 1.0 (69; 2)
 PSD = 0 (487.2)

2003



Effort = 2.0
 Total CPUE = 1.0 (69; 2)
 Stock CPUE = 1.0 (69; 2)
 PSD = 50 (36.1)

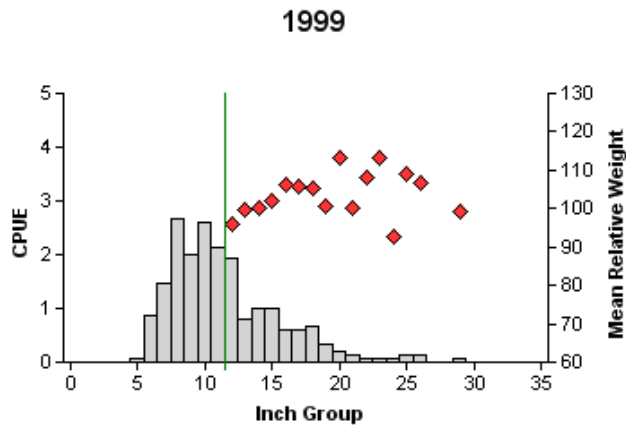
2007



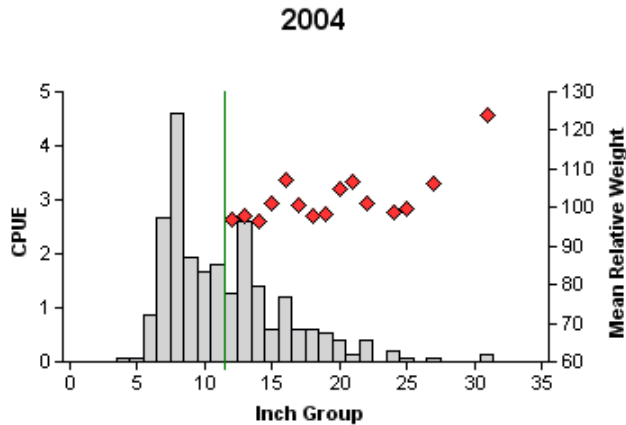
Effort = 2.0
 Total CPUE = 5.0 (48; 10)
 Stock CPUE = 4.5 (50; 9)
 PSD = 0 (57.9)

Figure 4. Number of redear sunfish caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Livingston, Texas, 1999, 2003, and 2007.

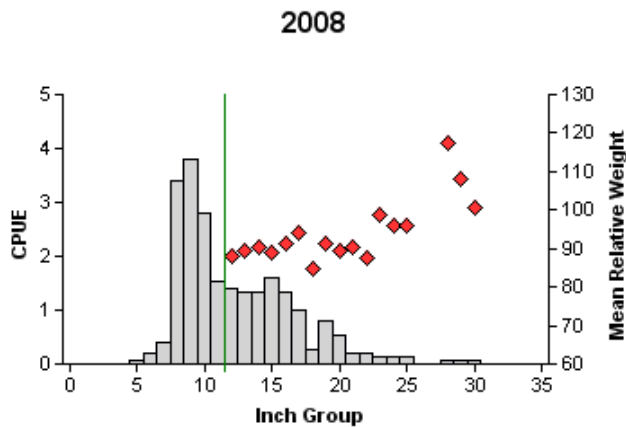
Blue Catfish



Effort = 15.0
 Total CPUE = 19.6 (30; 294)
 Stock CPUE = 7.8 (26; 117)
 PSD = 11 (3.9)
 RSD-12 = 100 (0)



Effort = 15.0
 Total CPUE = 23.9 (18; 358)
 Stock CPUE = 10.2 (16; 153)
 PSD = 14 (3.6)
 RSD-12 = 100 (0)



Effort = 15.0
 Total CPUE = 22.8 (20; 342)
 Stock CPUE = 10.6 (16; 159)
 PSD = 14 (2.5)
 RSD-12 = 100 (0)

Figure 5. Number of blue catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Livingston, Texas, 1999, 2004, and 2008. Vertical line is minimum length limit at time of survey.

Channel Catfish

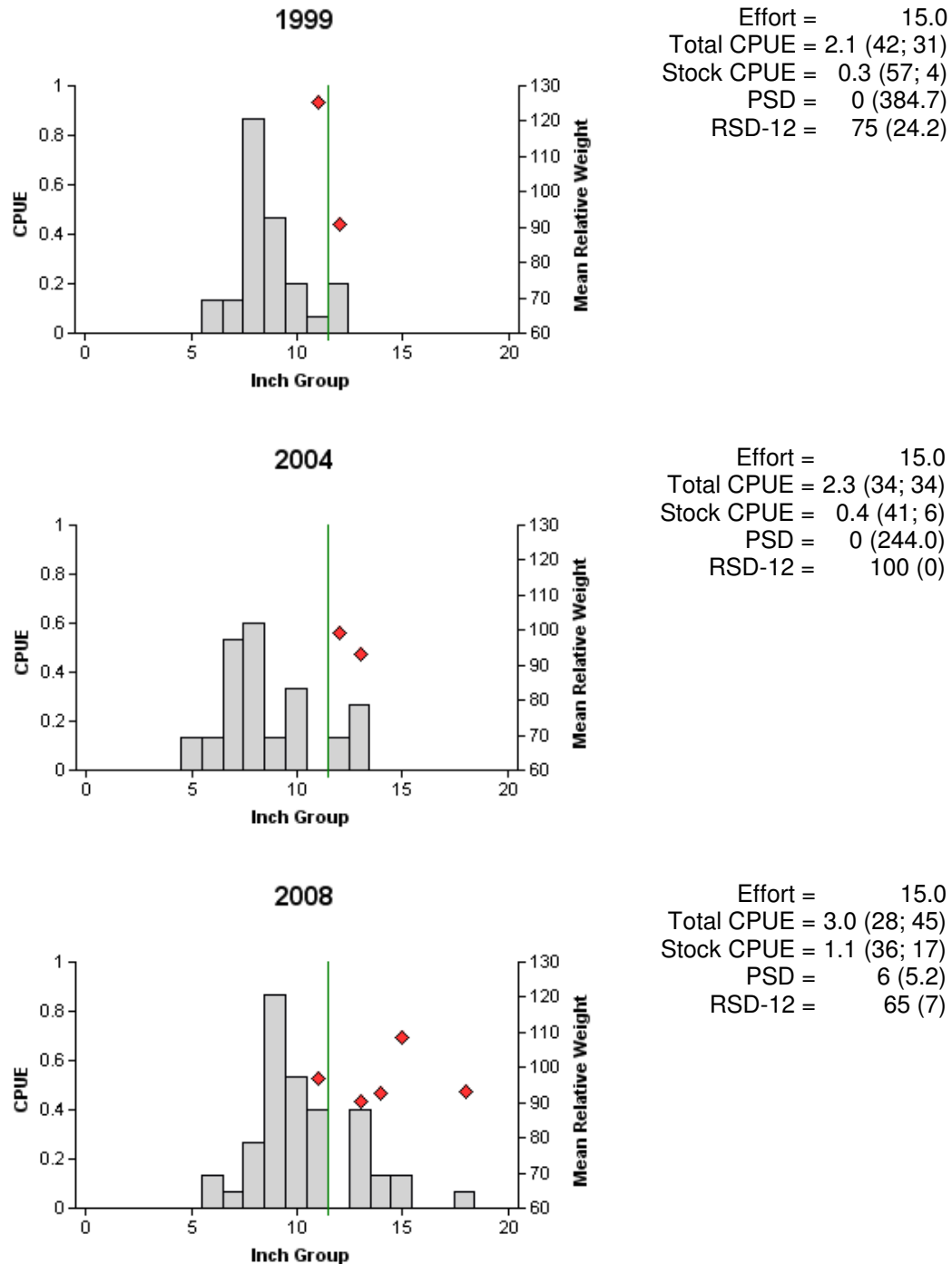


Figure 6. Number of channel catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Livingston, Texas, 1999, 2004, and 2008. Vertical line is minimum length limit at time of survey.

Catfishes

Table 7. Creel survey statistics for channel catfish at Lake Livingston from June 2003 through May 2004 and June 2007 through May 2008 where intended effort and total catch per hour is for anglers targeting catfish (species combined) and total harvest is the estimated number of channel catfish harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year	
	2003-2004	2007-2008
Intended effort (h)	29,329.9 (28.9)	28,761.6 (25.3)
Intended effort/acre	0.32 (28.9)	0.32 (25.3)
Total catch per hour	1.48 (72.9)	2.38 (36.2)
Total harvest		
Blue catfish	52,988 (39.0)	44,143 (35.3)
Channel catfish	1,577 (221.7)	5,404 (90.8)
Harvest/acre		
Blue catfish	0.58 (39.0)	0.49 (35.3)
Channel catfish	0.01 (221.7)	0.06 (90.8)
Percent legal released		
Blue catfish	14.1	2.1
Channel catfish	0.0	7.8

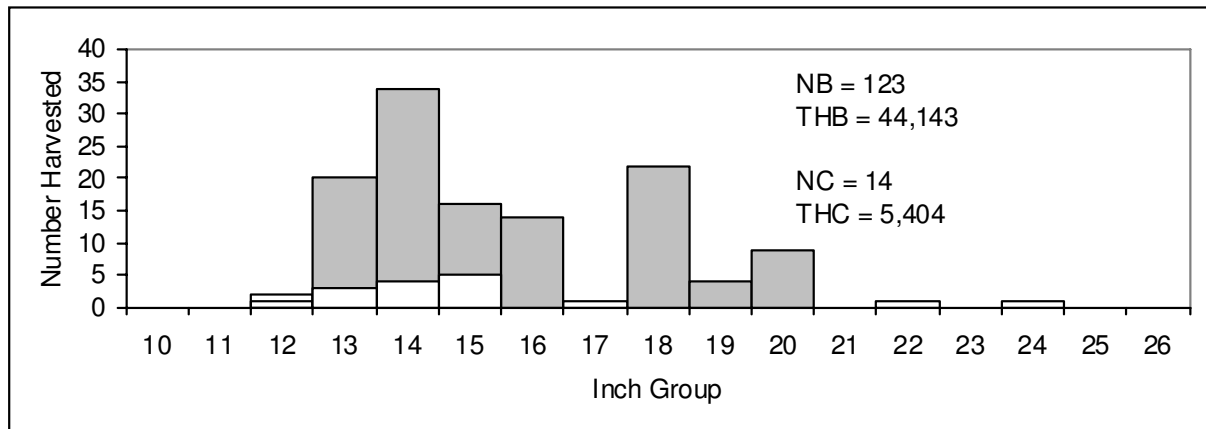


Figure 7. Length frequency of harvested blue (gray bars) and channel (white bars) catfish observed during creel surveys at Lake Livingston, Texas, June 2007 through May 2008, all anglers combined. NB and NC are the total the number of harvested blue and channel catfish, respectively, observed during creel surveys, and THB and THC are the total estimated harvest of blue and channel catfish, respectively, for the creel period.

Flathead Catfish

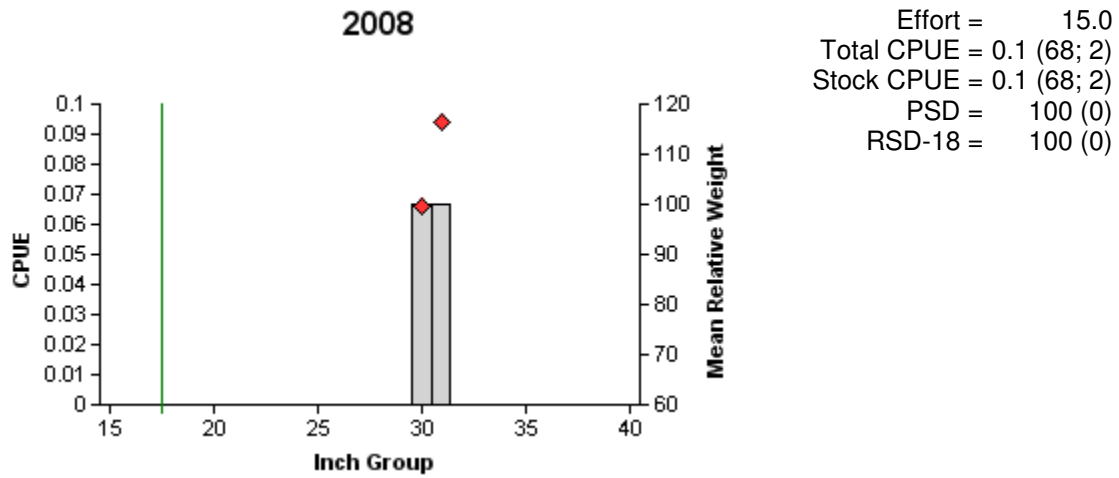


Figure 8. Number of flathead catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for the spring gill net survey, Lake Livingston, Texas, 2008. No flathead catfish were captured in the 1999 or 2004 surveys.

White Bass

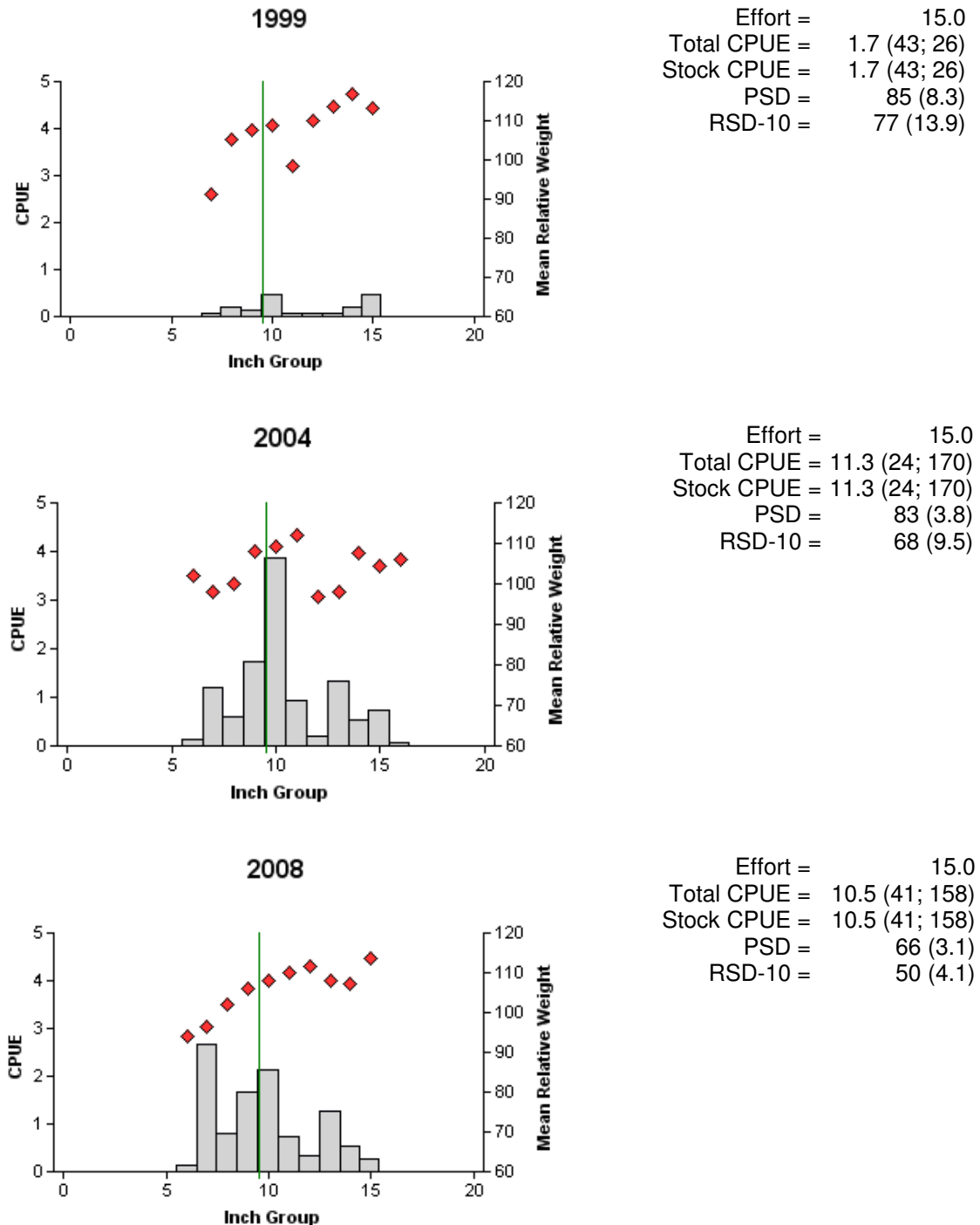


Figure 9. Number of white bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Livingston, Texas, 1999, 2004, and 2008. Vertical line represents minimum length limit at time of survey.

White Bass

Table 8. Creel survey statistics for white bass at Lake Livingston from June 2003 through May 2004 and June 2007 through May 2008 where intended effort and 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	
	2003-2004	2007-2008
Intended effort (h)	5,589.3 (38.7)	13,488.3 (28.2)
Intended effort/acre	0.06 (38.7)	0.15 (28.2)
Total catch per hour	4.99 (62.9)	4.56 (50.0)
Total harvest	41,445 (35.0)	28,499 (45.2)
Harvest/acre	0.46 (35.0)	0.32 (45.2)
Percent legal released	14.4	0.1

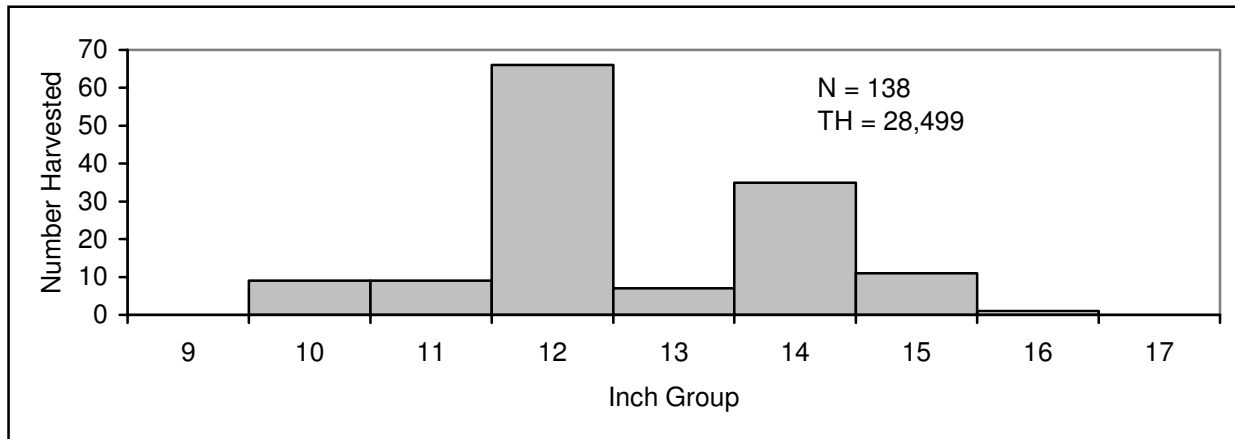


Figure 10. Length frequency of harvested white bass observed during creel surveys at Lake Livingston, Texas, June 2007 through May 2008, all anglers combined. N is the number of harvested white bass observed during creel surveys, and TH is the total estimated harvest for the creel period.

Striped Bass

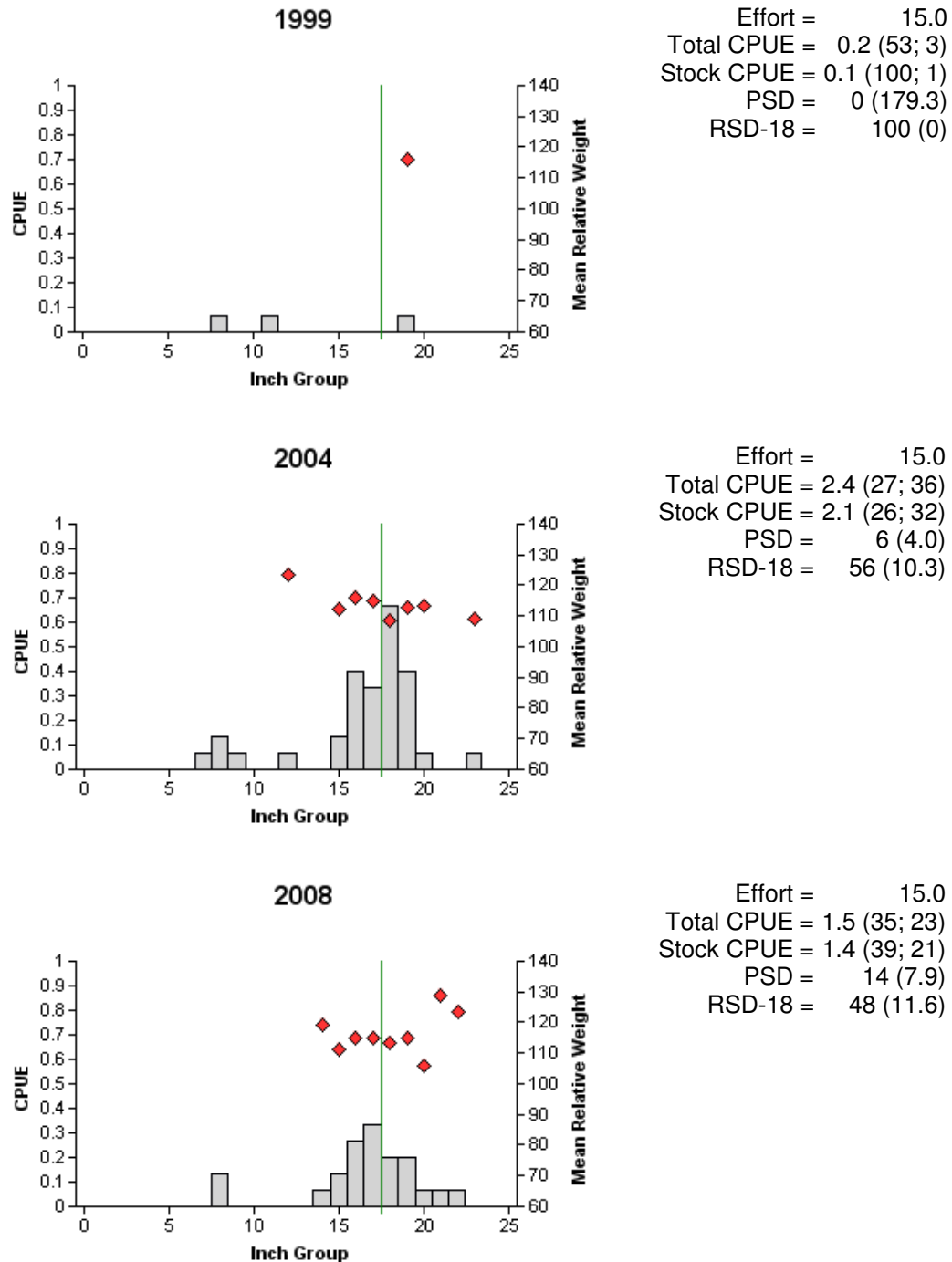


Figure 11. Number of striped bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Livingston, Texas, 1999, 2004, and 2008. Vertical line represents minimum length limit at time of survey.

Striped Bass

Table 9. Creel survey statistics for striped bass at Lake Livingston from June 2003 through May 2004 and June 2007 through May 2008 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	
	2003-2004	2007-2008
Intended effort (h)	228.5 (147.9)	295.0 (169.1)
Intended effort/acre	0.003 (147.9)	0.003 (169.1)
Total catch per hour	0.0	0.0
Total harvest	586 (314.5)	149.0 (671.1)
Harvest/acre	0.007 (314.5)	0.001 (671.1)
Percent legal released	0.0	0.0

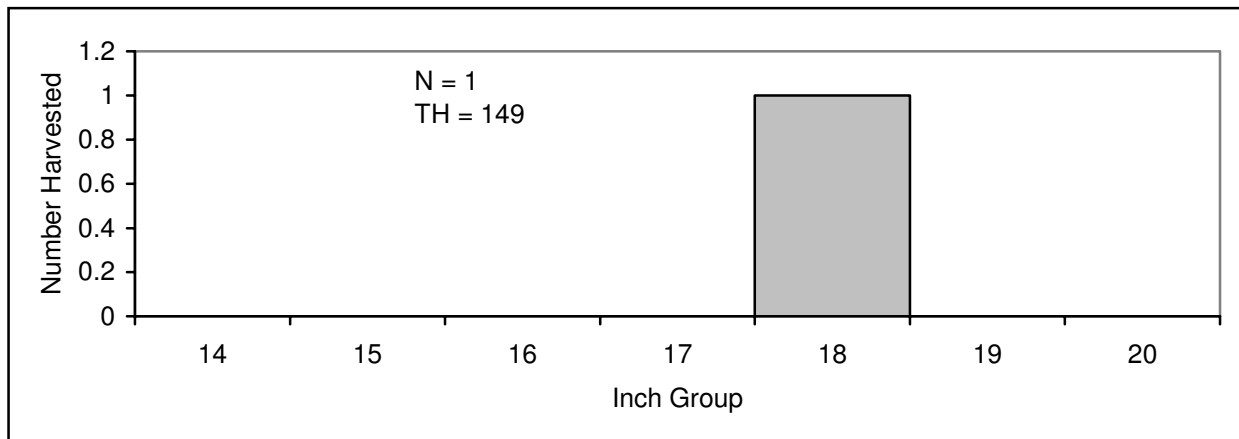
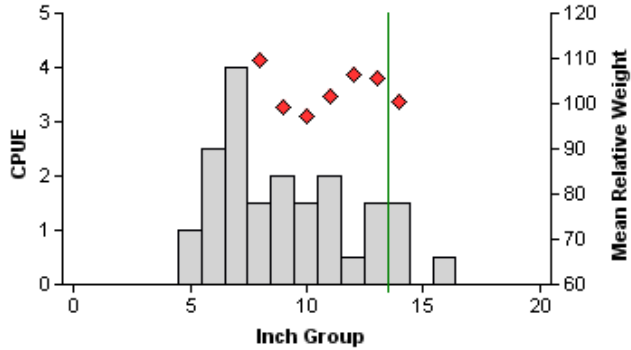


Figure 12. Length frequency of harvested striped bass observed during creel surveys at Lake Livingston, Texas, June 2007 through May 2008, all anglers combined. N is the number of harvested white bass observed during creel surveys, and TH is the total estimated harvest for the creel period.

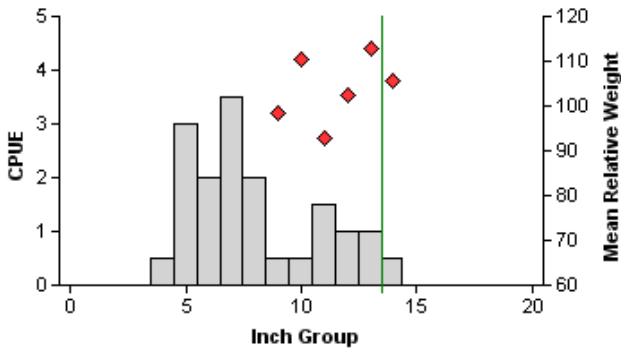
Largemouth Bass

2001



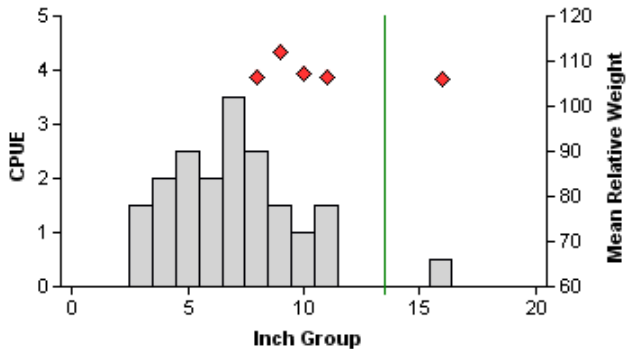
Effort = 2.0
 Total CPUE = 18.5 (30; 37)
 Stock CPUE = 11.0 (34; 22)
 PSD = 36 (9.6)
 RSD-14 = 18 (6.1)

2003



Effort = 2.0
 Total CPUE = 16.0 (54; 32)
 Stock CPUE = 7.0 (47; 14)
 PSD = 36 (12.3)
 RSD-14 = 7 (6.6)

2007



Effort = 2.0
 Total CPUE = 18.5 (32; 37)
 Stock CPUE = 7.0 (34; 14)
 PSD = 7 (6.2)
 RSD-14 = 7 (6.2)

Figure 13. 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 Livingston, Texas, 2001, 2003, and 2007. Vertical line represents minimum length limit at time of survey.

Largemouth Bass

Table 10. Creel survey statistics for largemouth bass at Lake Livingston from June 2003 through May 2004 and June 2007 through May 2008 where intended effort and 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	
	2003-2004	2007-2008
Intended effort (h)	34,965.4 (28.9)	1,253.8 (82.9)
Intended effort/acre	0.39 (28.9)	0.02 (82.9)
Total catch per hour	0.49 (22.4)	<0.01
Total harvest	15,952 (70.9)	0.0
Harvest/acre	0.18 (70.9)	0.0
Percent legal released	14.8	48

Table 11. Results of genetic analysis of largemouth bass collected by fall electrofishing, Lake Livingston, Texas, 1999, 2001, 2003, and 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.

Year	Sample size	Genotype				% FLMB alleles	% pure FLMB
		FLMB	F1	Fx	NLMB		
1999	33	1	1	3	19	18.2	3.0
2001	17	0	1	12	4	30.8	0.0
2003	21	0	2	9	10	22.6	0.0
2007	30	0			0	30.8	0.0

White Crappie

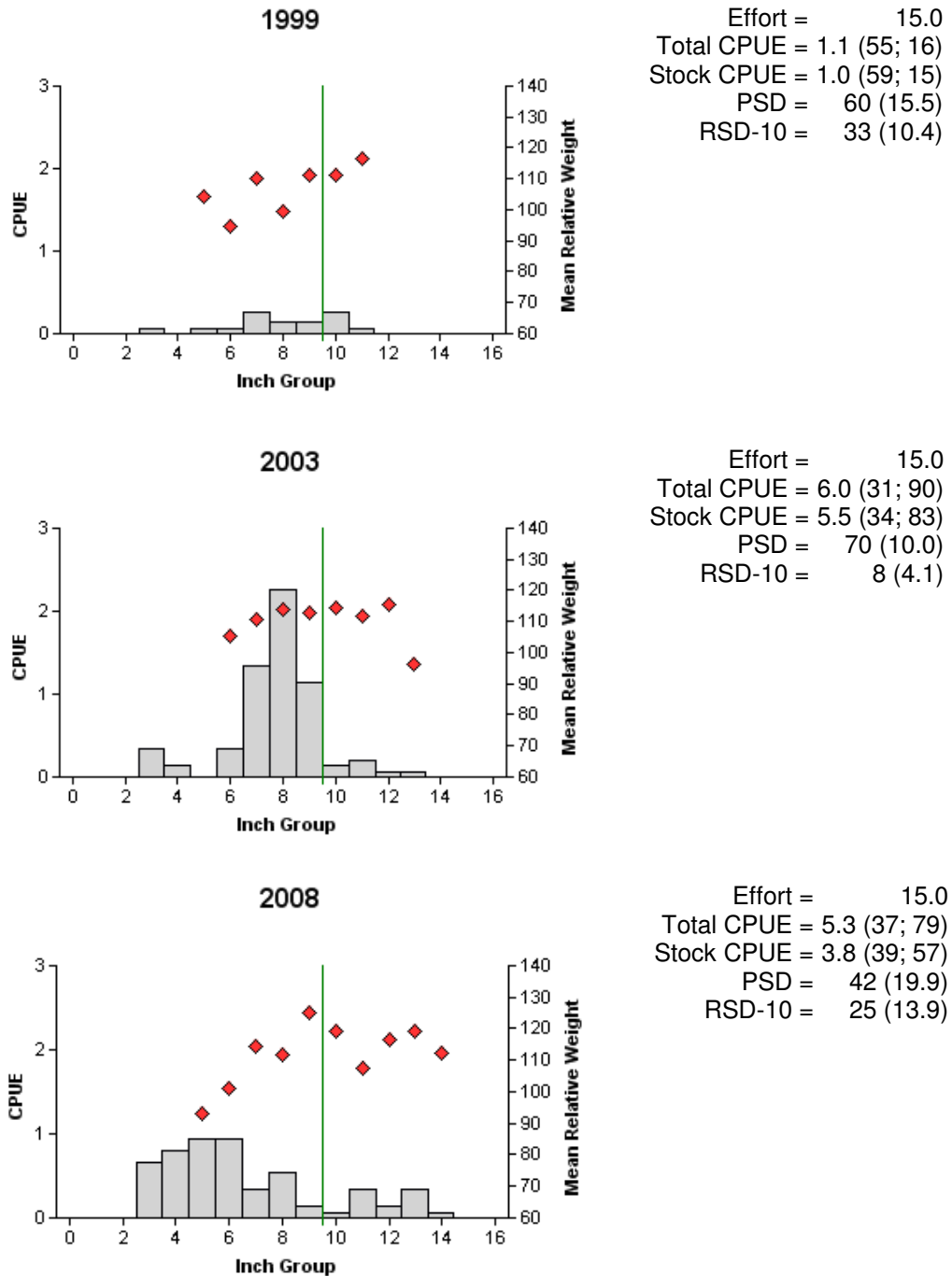


Figure 14. Number of white crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for trap net surveys, Lake Livingston, Texas, fall 1999 and 2003, and winter 2008. Vertical line represents minimum length limit at time of survey.

Black Crappie

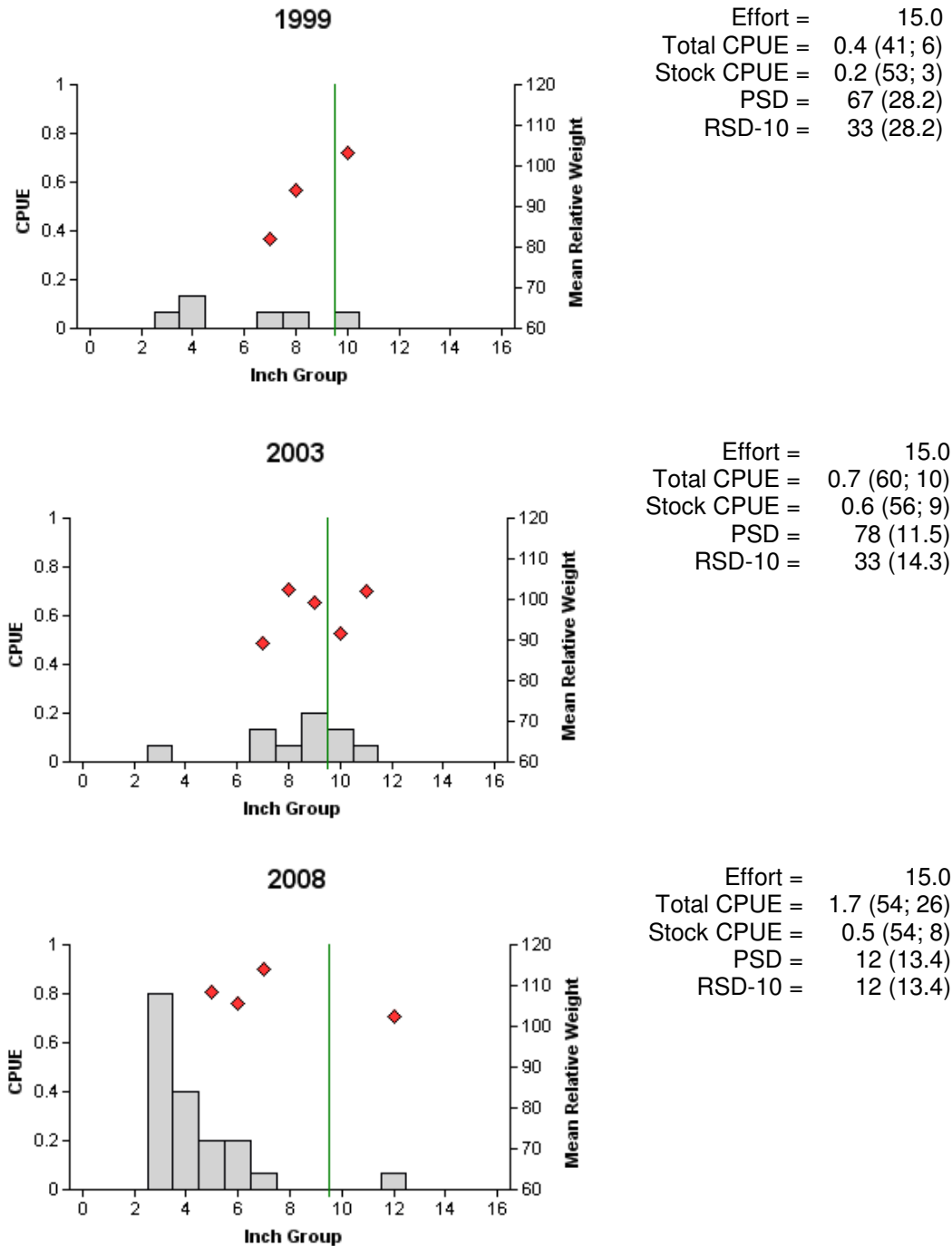


Figure 15. Number of black crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for trap net surveys, Lake Livingston, Texas, fall 1999 and 2003, and winter 2008. Vertical line represents minimum length limit at time of survey.

Crappie

Table 12. Creel survey statistics for crappie at Lake Livingston from June 2003 through May 2004 and June 2007 through May 2007 where intended effort and total catch per hour is for anglers targeting crappie (species combined) and total harvest is the estimated number of black and white crappie (species combined) harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel Survey Statistic	Year	
	2003-2004	2007-2008
Intended effort (h)	1,180 (75.5)	3,176 (69.9)
Intended effort/acre	0.01(14)	0.04 (69.9)
Total catch per hour	0 (0)	0.0
Total crappie harvested	2,931 (169.5)	0
Crappie harvest/acre	0.0 (0)	0.0
Percent legal crappie released	0.0	n/a

Table 13. Proposed sampling schedule for Lake Livingston, Texas. Gill netting surveys are conducted in the spring while electrofishing and trap netting surveys are conducted in the fall. Standard survey denoted by S and additional survey denoted by A.

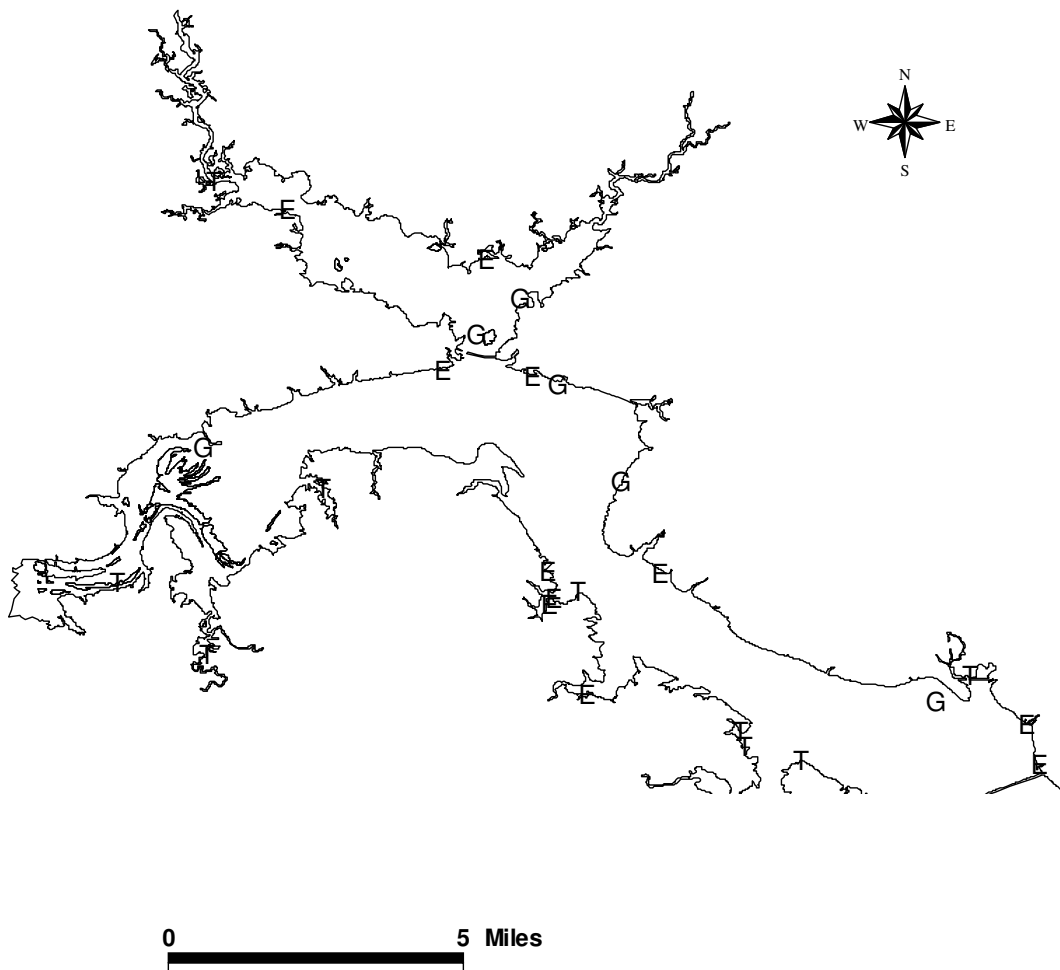
Survey Year	Electrofisher	Trap Net	Gill Net	Creel Survey	Vegetation/Habitat	Report
Summer 2008-Spring 2009					A	
Summer 2009-Spring 2010					A	
Summer 2010-Spring 2011					A	
Summer 2011-Spring 2012	S	A	S	A	S	S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Lake Livingston, Texas, 2007-2008.

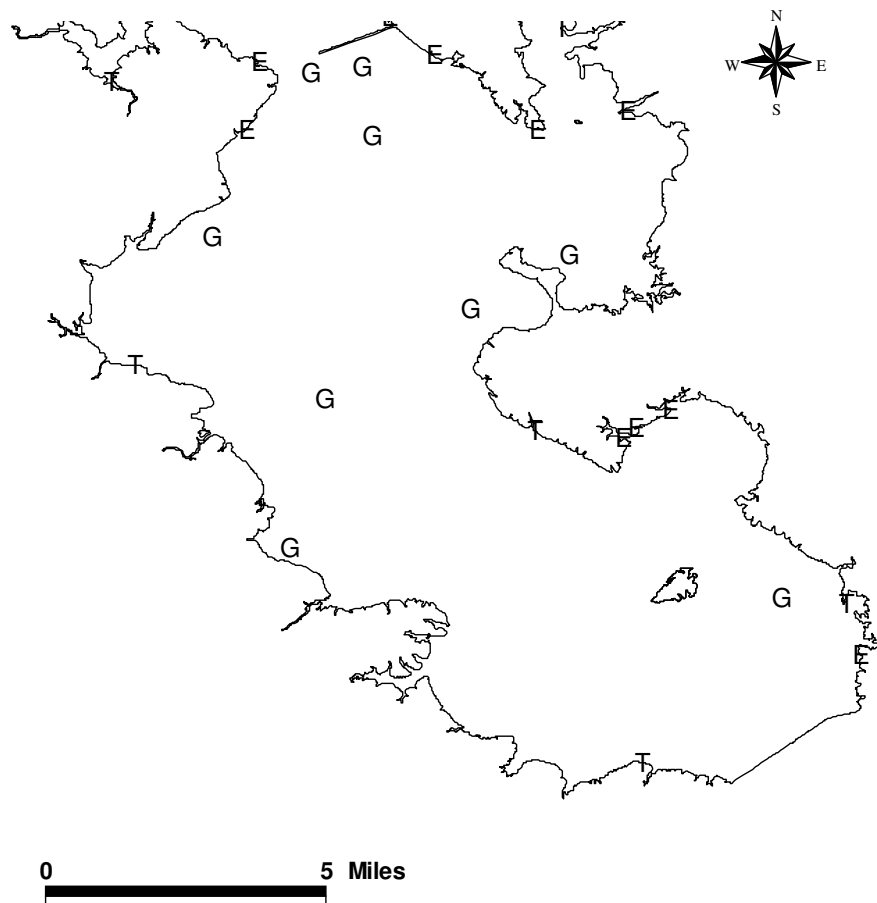
Species	Electrofishing		Gill Netting		Trap Netting	
	N	CPUE	N	CPUE	N	CPUE
Gizzard shad	674	337.0				
Threadfin shad	533	266.5				
Inland silverside	12	6.0				
Blue catfish			342	22.8		
Channel catfish			45	3.0		
Flathead catfish			2	0.1		
White bass			158	10.5		
Yellow bass			18	1.2		
Striped bass			23	1.5		
Palmetto bass			4	0.3		
Warmouth	1	0.5				
Bluegill	159	79.5				
Longear sunfish	90	45.0				
Redear sunfish	10	5.0				
Largemouth bass	37	18.5				
White crappie					79	5.3
Black crappie					26	1.7

APPENDIX B



Location of sampling sites, Lake Livingston, Texas, 2007-2008. E, T, and G indicate electrofishing, trap net, and gill net stations, respectively.

APPENDIX B Continued



Location of sampling sites, Lake Livingston, Texas 2007-2008. E, T, and G represent electrofishing, trap net, and gill net stations, respectively.