PERFORMANCE REPORT

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FEDERAL AID PROJECT F-221-M-2

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2016 Fisheries Management Survey Report

Lake Livingston

Prepared by:

Todd Driscoll, District Management Supervisor
and
Dan Ashe, Assistant District Management Supervisor

Inland Fisheries Division
Jasper District
Brookeland, Texas

Carter Smith
Executive Director

Craig Bonds
Director, Inland Fisheries

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lake Livingston were surveyed in 2016-2017 using electrofishing and gill netting. Anglers were surveyed from June through August 2016 with a creel survey. Historical data are presented with the 2016-2017 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 Livingston is an 83,277-acre mainstream impoundment on the Trinity River in Trinity, Polk, San Jacinto, and Walker counties. The reservoir was constructed in 1969 by the Trinity River Authority (TRA) and the City of Houston for municipal, agricultural, and industrial purposes. Private and commercial real estate development, Lake Livingston State Park, and several TRA public parks are present in the lower half of the reservoir. Primary fish habitat is standing timber and woody debris.

- **Management History:** Important sport fish include catfishes, White Bass, Largemouth Bass, and crappies. All recreational fisheries are regulated with statewide length and bag limits, with the exception of the bag limit for Blue and Channel Catfish (50 fish/day; commercial harvest is allowed). The management plan from the 2011 survey report suggested exploring funding opportunities and volunteer efforts to increase littoral vegetation. Since 2013, Lake Livingston Friends of Reservoirs (LLFOR), with support from 6 independent school districts and numerous other local partners, propagated and introduced over 10,000 water willow plants. Striped Bass are stocked annually to provide TPWD hatcheries a source of broodfish for temperate bass production. Primary management challenges include siltation and habitat loss, and control of invasive species, primarily giant salvinia and water hyacinth.

- **Fish Community**
  - **Prey species:** Gizzard Shad and Threadfin Shad were abundant and provided ample forage for sport fish**.** Bluegill were the most abundant sunfish. Although catch rate increased in 2016, abundance was low (116.3/h) and no fish > 6 inches were collected.

  - **Catfishes:** Blue Catfish abundance was relatively high and stable over the last three survey years, and high numbers of fish 12 to 20 inches were available to anglers. Channel Catfish numbers were also similar over the same period, but abundance was considerably lower. Catfishes were the most popular sportfish during most creel survey years.

  - **Temperate basses:** White Bass abundance has varied over the last three survey years, but numbers were high in 2017. Size structure and fish condition were desirable. The White Bass fishery was the most popular during the summer of 2016, and the angler catch rate was 2.4/h. Striped Bass abundance was relatively low and stable. No directed angling effort for Striped Bass was observed during the last two creel surveys.

  - **Largemouth Bass:** Historically, Largemouth Bass abundance has been relatively low. Electrofishing catch rates did increase in 2016, but few legal-size fish were available to anglers. Largemouth Bass had adequate growth rates (age at 14 inches was 2.3 years).

  - **Crappies:** Trap net catch rates of crappies have been historically low, and trap net surveys were discontinued in 2016. Few anglers target crappies.

Management Strategies: Continue to support habitat enhancement efforts by LLFOR and Texas Black Bass Unlimited. Stock Striped Bass annually to maintain hatchery broodfish for temperate bass production. Support TRA as needed with control of invasive aquatic vegetation. Conduct standard fall electrofishing and gill netting in 2020-2021 and a summer quarter creel survey in 2020.

INTRODUCTION

This document is a summary of fisheries data collected from Lake Livingston in 2016-2017. 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 fishes was collected, this report deals primarily with major sport fishes and important prey species. Historical data are presented with the 2016-2017 data for comparison.

Reservoir Description

Lake Livingston is located on the Trinity River in Trinity, Polk, San Jacinto, and Walker counties, approximately 60 miles northeast of Houston. The 83,277-acre reservoir was constructed in 1969 by the Trinity River Authority (TRA) and the City of Houston to provide water for municipal, agricultural, and industrial purposes. In cooperation with the TRA and the City of Houston, East Texas Electric Cooperative is constructing a hydroelectric facility at the dam (completion scheduled for 2018). Lake Livingston was hypereutrophic with a mean TSI chl-*a* of 57.54 (Texas Commission on Environmental Quality 2011). Lake Livingston has a drainage area of approximately 15,700 square miles and a shoreline length of approximately 350 miles. Aquatic habitat consisted of standing timber, woody debris, and boat docks. In 2015, the Texas Department of State Health Services (TDSHS) issued a fish consumption advisory for seven fish species (including Blue Catfish and White Bass) (Appendix D). There is considerable private and commercial real estate development, as well as Lake Livingston State Park and several TRA public parks, around the lower half of the reservoir. Other physical characteristics of Lake Livingston are in Table 1.

Angler Access

Lake Livingston has 31 public boat ramps and two private boat ramps. Two of these boat ramps were not usable in 2017 due to siltation and lack of water depth. Additional boat ramp characteristics are in Table 2. Shoreline access is limited to public boat ramp areas. Fishing piers are present at Wolf Creek, Tigerville Park, and Lake Livingston State Park.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Homer and Webb 2012) included:

1. Seek funding to underwrite efforts to increase native littoral vegetation in backwaters and creeks to improve habitat for sport fish.
   Action: In 2013, Lake Livingston Friends of Reservoirs (LLFOR) was established. With primary funding from the Reservoir Fisheries Habitat Partnership and support from 6 independent school districts and numerous other local partners, LLFOR has propagated and introduced over 10,000 water willow plants at 17 sites throughout the reservoir.
2. Continue to support TRAs efforts to control giant salvinia, water hyacinth, and water lettuce with funding and labor.
   Action: Annual vegetation surveys have been conducted in cooperation with TRA. Herbicides have been provided when surplus was available.

Harvest regulation history: Sport fishes in Lake Livingston are currently managed with statewide regulations, with the exception of the bag limit for Blue and Channel Catfish. Current regulations are found in Table 3.

Stocking history: Since 1977, Striped Bass have been stocked annually, with the exception of four years. Florida Largemouth Bass have been stocked periodically; over 100,000 fish were stocked in 2017. A complete stocking history is presented in Table 4.

Vegetation/habitat management history: Historically, water hyacinth and water lettuce have been problematic at Lake Livingston. During 2000 – 2010, abundance varied from 100 – 1,000 acres (approximately 90% of coverage was water hyacinth). Low water in 2011 reduced coverages significantly. Since then, plants have been scattered reservoir-wide, but total coverage has been < 50 acres. Giant salvinia was first discovered in 2011. The TRA has been annually treating giant salvinia, water hyacinth, and water lettuce with herbicide to minimize plant coverage. In 2016, adult zebra mussels were found in Lake Livingston, but current reproductive status within the reservoir is unknown.

Historically, TPWD and Texas Black Bass Unlimited (TBBU) have planted native aquatic vegetation with little success. Since 2013, LLFOR has introduced over 10,000 water willow plants at 17 sites throughout the reservoir. However, initial surveys in 2017 reflect low survival of introduced plants. Natural bank, bulkheads, and boat docks are the predominant physical shoreline habitat types. An area of approximately 5,800 acres of standing timber occupies the middle portion of the reservoir.

Water transfer: Lake Livingston was built by the TRA for municipal water supply. The TRA functions as a water wholesaler to the Houston/Galveston metropolitan complex and surrounding areas. Municipal water from Lake Livingston is also provided to Huntsville, Trinity County, and Livingston. The Luce Bayou Interbasin Project, which will transfer 500 million gallons of raw water per day from the Trinity River below Lake Livingston to Lake Houston, is scheduled for completion in 2020. This project will supplement the existing Trinity River Pump Station near Liberty, which provides up to 700 million gallons of water per day, either directly to industrial users or to water treatment plants in the Houston area.

METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Lake Livingston (TPWD unpublished). Primary components of the OBS plan are listed in Table 5. In 2016, fall electrofishing sites were randomly selected within 10 creeks and embayments that provided more desirable centrarchid habitat and were sampled during daytime. Otherwise, all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Electrofishing – Largemouth Bass, Sunfishes, Gizzard Shad, and Threadfin Shad were collected by fall electrofishing in 2007 and 2011 (2.0 hours at 24, 5-min stations) and 2016 (2.2 hours at 26, 5-min stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing. Ages for Largemouth Bass were determined using otoliths from 8 randomly-selected fish (range 13.5 to 14.5 inches).

Gill netting – Blue Catfish, Channel Catfish, White Bass, and Striped Bass were collected by gill netting (15 net nights at 15 stations) in 2008, 2012, and 2017. CPUE for gill netting was recorded as the number of fish caught per net night (fish/nn).

Statistics – Sampling statistics (CPUE for various length categories), structural indices [Proportional Size Distribution (PSD), terminology modified by Guy et al. 2007], and condition indices [relative weight (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). Standard error (SE) was calculated for structural indices and IOV. Relative standard error (RSE = 100 X SE of the estimate/estimate) was calculated for all CPUE and creel statistics.

Creel survey – An annual roving creel survey was conducted from June 2007 through May 2008 and June 2011 through May 2012. A summer quarter roving creel survey was conducted from June through August 2016. Angler interviews were conducted on 5 weekend days and 4 weekdays per quarter to assess angler use and fish catch/harvest statistics in accordance with the Fishery Assessment

Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015). Total angler catch of Largemouth Bass $\geq$ 4, 7, and 10 pounds was also estimated in 2011/2012 and 2016. Anglers were asked if released fish were within weight categories.

Habitat – A structural habitat survey was conducted in 2016. Aquatic vegetation surveys were conducted from 2013 - 2016 to monitor giant salvinia and water hyacinth, and coverages were assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Water level – Source for water level data was the United States Geological Survey (USGS 2017).

RESULTS AND DISCUSSION

Habitat: Littoral zone structural habitat consisted primarily of natural shoreline, bulkhead, and boat docks (Table 6). Aquatic vegetation was limited to detrimental plants (e.g., giant salvinia, water hyacinth, and water lettuce), but coverages were limited. Water hyacinth and water lettuce were scattered throughout the reservoir and comprised approximately 15 acres. Giant salvinia is confined to the White Rock Creek arm of the reservoir. Current coverage is < 10 acres.

Creel: The catfish (35 – 63% of directed effort) and White Bass fisheries (6 – 39% of directed effort) were the most popular (Table 7). Directed angling effort was relatively low and consistent during 2007/2008 and 2011/2012 (88,151 and 82,954 hours, respectively) (Table 8). During June through August 2016, directed effort was 30,950 hours. Total angler expenditures were $313,913 during June through August 2016 (Table 8).

Prey species: In 2016, Gizzard Shad and Threadfin Shad abundance was high, with electrofishing catch rates of 688.6 and 3,021.2/h, respectively (Figure 2 and Appendix A). Most Gizzard Shad were available as prey (IOV = 99). Other prey species included sunfishes [Bluegill (Figure 3), Longear Sunfish, Redear Sunfish, and Warmouth], but abundance was low (combined catch rate of 143.1/h) (Appendix A).

Catfishes: Blue Catfish gill net catch rates were relatively high and stable (range = 22.8 to 34.8/nn) during the last three sampling years (Figure 4). However, few fish > 20 inches were caught, and PSDs ranged from 14 to 18. Fish condition was moderate as W_r for most fish ranged from 80 to 120, indicating adequate prey availability.

Historically, Channel Catfish abundance has been low. Gill net catch rates form the last three surveys ranged from 2.2 to 4.1/nn, and few fish were > 12 inches (Figure 5).

Catfish anglers (rod and reel only) accounted for 34.7% of the total angling effort during the summer of 2016 (Table 7), and catch rate was 0.8/h (Table 9). Total estimated harvest was 3,465 fish; 3,355 were Blue Catfish (97%; Figure 6) and 110 were Channel Catfish (3%; Figure 7).

Temperate basses: Gill net surveys indicate variable abundance and recruitment of White Bass, as catch rates ranged from 3.1 to 11.3/nn during the last three sampling years (Figure 8). Fish were in adequate condition, as Wr for most inch groups exceeded 90. The White Bass fishery was the most popular during the summer of 2016, accounting for 39.2% of the total angling effort (Table 7). Angler catch rates were high (2.4/h), and 25,162 fish were harvested (Table 10 and Figure 9).

Striped Bass have been stocked annually to maintain a broodfish source for hatchery production of Striped Bass, Palmetto Bass, and Sunshine Bass. Population abundance in the reservoir has been low. Gill net catch rates from the last three surveys ranged from 0.9 to 1.5 fish/nn (Figure 10). Few anglers target Striped Bass, and no directed effort was observed during the last two creel surveys (Table 7).

Largemouth Bass: Limited littoral habitat has inhibited Largemouth Bass recruitment and abundance.

Historically, fall electrofishing catch rates of Largemouth Bass have been low (< 20/h) (Figure 11). In 2016, catch rates were higher (39.2/h), but few fish > 14 inches were observed (Figure 12). Increased catch was likely a result of randomly sampling within 10 creeks and embayments with more desirable habitat. Prior to 2016, fall electrofishing sites were randomly sampled from the entire reservoir. Growth of Largemouth Bass was desirable; average age at 14 inches (13.5 to 14.5 inches) was 2.3 years (N = 8; range = 1 – 4 years). Body condition from the past three surveys was adequate (relative weight above 80) for all size classes of fish.

Popularity of the Largemouth Bass fishery has varied, accounting for 2.1 to 16.5% of the total angling effort from the last three creel surveys (Table 7). Angler catch rate during the summer of 2016 was 0.5/h, and 4,040 fish were caught (Table 11). All of the catch was comprised of fish < four pounds. Although some tournaments are conducted on the reservoir each year, none were observed during the last three creel surveys.

Crappies: White and Black Crappie were present, but population abundance has been low. Trap netting for crappies was discontinued in 2016 due to historically poor catch rates (typically < 2.0/nn). Few anglers target crappies (< 6% of the total angling effort).

Fisheries management plan for Lake Livingston, Texas

Prepared – July 2017.

ISSUE 1: Littoral habitat degradation and siltation limit centrarchid recruitment and abundance. Since 2013, LLFOR, in cooperation with 6 independent school districts and numerous other local partners, has propagated and introduced over 10,000 water willow plants throughout the reservoir. The LLFOR has also partnered with TBBU to introduce plastic fish attractors.

MANAGEMENT STRATEGIES

1. Continue to support habitat enhancement efforts by LLFOR and TBBU.
2. Monitor water willow planting sites to document progress. When appropriate, recommend changes that may improve project efficiency and success.

ISSUE 2: Although Blue Catfish and White Bass populations are abundant and provide the most popular fisheries, the TDSHS issued a fish consumption advisory in 2015.

MANAGEMENT STRATEGY

1. Promote these fisheries when appropriate, but ensure anglers are aware of the consumption advisory.

ISSUE 3: Striped Bass broodfish are collected from the Lake Livingston tailrace for hatchery production of Striped Bass, Palmetto Bass, and Sunshine Bass.

MANAGEMENT STRATEGY

1. Stock Striped Bass annually to maintain the population.

ISSUE 4: Historically, water hyacinth and water lettuce coverages have impeded access. Giant salvinia was discovered in 2011. Although coverages of these invasive plants have been minimal in recent years, the potential exists for these plants to expand.

MANAGEMENT STRATEGIES

1. Monitor invasive aquatic plants annually.
2. Continue to support annual treatment and control efforts by TRA.

ISSUE 5: 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.

MANAGEMENT STRATEGIES

1. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir.
2. Contact and educate marina owners about invasive species, and provide them with educational

information.

3. Educate the public about invasive species through the use of media and the internet.
4. Discuss invasive species when presenting to constituent and user groups.
5. Document existing and future inter-basin water transfers to facilitate potential invasive species responses.

Objective-Based Sampling Plan and Schedule, 2017 - 2021

Sport fish, forage fish, and other important fishes

Sport fishes in Lake Livingston include Blue Catfish, Channel Catfish, Flathead Catfish, White Bass, Striped Bass, Largemouth Bass, and crappies. Important forage species include Bluegill, Gizzard Shad, and Threadfin Shad.

Low density fisheries

Although Striped Bass are stocked annually to maintain a broodfish population for hatchery production of Striped Bass, Palmetto Bass, and Sunshine Bass, no directed angling effort for Striped Bass has been observed during the last two creel surveys (2011-2012 and 2016). Catch rates from the last three gill net surveys (2008, 2012, and 2016) have also been low (< 2.0/nn). Although no future directed sampling is planned, Striped Bass catch will be recorded from gill net surveys directed at catfishes and White Bass (see below).

Fishery status and population sampling objectives

Catfishes: Historically, the catfish fishery is the most popular at Lake Livingston, accounting for 35-60% of the annual angling effort. Blue Catfish is the most abundant species, accounting for over 85% of the annual harvest. Channel Catfish comprise the remaining catfish harvest. Flathead Catfish are present in the reservoir but are rarely sampled, and no fish have been observed during creel surveys.

Gill netting surveys conducted every four years have indicated relatively stable Blue and Channel Catfish recruitment and abundance and should provide adequate population-level insight relative to large-scale changes that would dictate further investigation. A minimum of 15 randomly selected gill netting sites will be sampled in 2021 (and every four years thereafter), but sampling will continue at random sites until 50 stock-sized Blue Catfish are collected and the RSE of CPUE-S is ≤ 25 (the anticipated effort to meet both sampling objectives is 6-12 stations with 80% confidence). A maximum of 10 additional gill nets will be deployed if objectives are not attained. At the effort needed to achieve sampling objectives for Blue Catfish, the expected RSE for CPUE-S is 45-55 for Channel Catfish. No additional effort will be expended to achieve an RSE25.

White Bass: Popularity of the White Bass fishery has been variable, accounting for 6-39% of the annual angling effort. Gill net catch rates have also been variable, ranging from 3.1 to 11.3/nn over the last three survey years. Gill net surveys every four years, per catfish sampling above, should provide sufficient population-level insight. At 15 nn of effort, the expected RSE for CPUE-S is 28-45. A maximum of 10 additional gill nets will be deployed in an attempt to achieve an RSE25 and collect 50 stock-size fish.

Largemouth Bass: During the last three creel surveys, the proportion of angling effort directed at Largemouth Bass has varied from 2-17%. Historically, random, fall nighttime electrofishing reservoir-wide has resulted in catch rates of < 20 fish/h. Due to poor habitat conditions throughout a majority of the reservoir, the Largemouth Bass population is primarily confined to embayments and creek arms. Daytime, fall electrofishing (reservoir is shallow and turbid) in 2020 (and every four years thereafter), randomized only within areas of better habitat off the main body of the reservoir, should increase sampling efficiency and catch rates, and allow for determination of any large-scale changes in the Largemouth Bass population. A minimum of 24, 5-min electrofishing sites will be sampled, but sampling will continue until 50 stock-sized fish are collected and the RSE of CPUE-S is ≤ 25. If failure to achieve either objective has occurred after one day of sampling and objectives can be attained with up to 12 additional random stations, another day of effort will be expended.

In addition, average age of Largemouth Bass between 13.0 and 14.9 inches (Category 2; N = 13) will be estimated in 2020 and every four years thereafter.

Crappies: The crappie fishery accounts for < 10% of the annual angling effort. Historically, trap netting has resulted in low catch rates (typically < 2 fish/nn). Trap netting was discontinued in 2016. Creel surveys (as described below) will be used to monitor the crappie fishery and make inferences about the population.

Prey species: Bluegill, Gizzard Shad, and Threadfin Shad are the primary forage at Lake Livingston. Daytime, fall electrofishing, as per Largemouth Bass above, will allow for monitoring of large-scale changes in Bluegill and Gizzard Shad relative abundance and size structure. Effort based on achieving sampling objectives for Largemouth Bass should result in sufficient numbers of Bluegill (PSD; 50 fish minimum) and Gizzard Shad size structure (IOV; 50 fish minimum). No additional effort will be expended to achieve an RSE25 for forage species, but Largemouth Bass body condition (fish $\geq$ 8" TL) will be used to provide additional information on forage abundance and vulnerability.

Creel survey frequency and objectives

The overall fishery at Lake Livingston (i.e., directed angling effort, catch rates, and harvest) will be monitored with a summer quarter, roving creel survey in 2020 (5 weekend and 4 week days/quarter), and every four years thereafter.

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Water Level

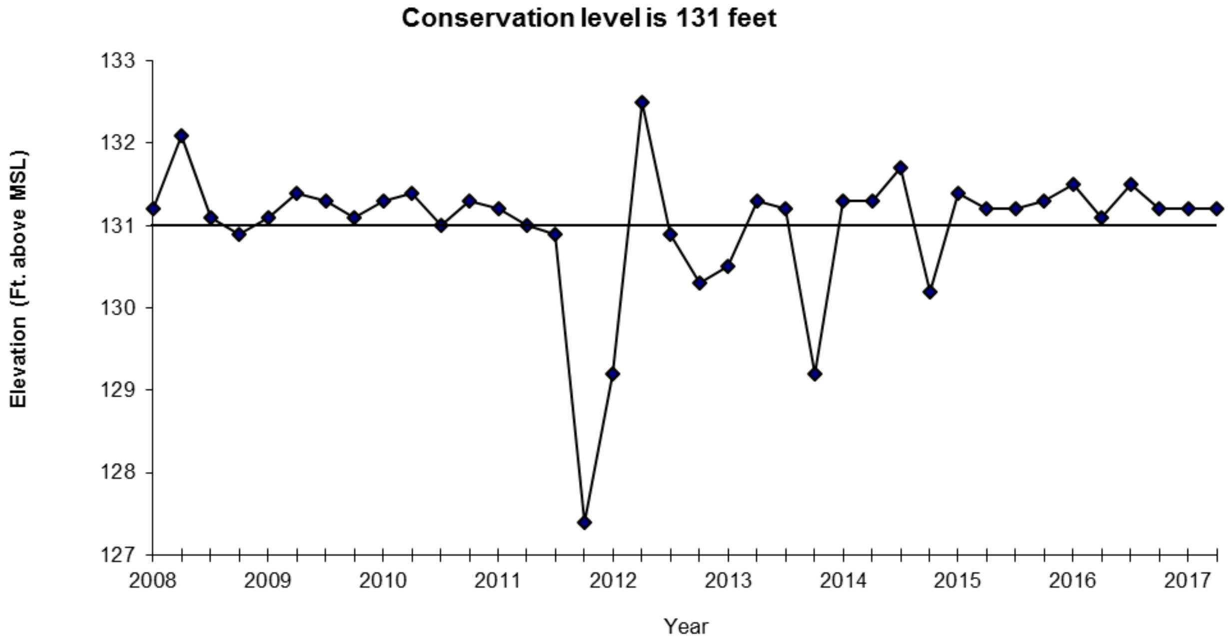


Figure 1. Quarterly water level elevations in feet above mean sea level (MSL) recorded for Lake Livingston, Texas.

Table 1. Characteristics of Lake Livingston, Texas.

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

Table 2. Boat ramp characteristics for Lake Livingston, Texas, November 2016. Reservoir elevation at time of survey was 131 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
3278 Marina	30.61514; -95.04683	Y	10	124	Adequate
Indian Creek	30.64172; -95.13651	Y			Severe siltation, not usable
Wolf Creek	30.66198; -95.14763	Y	20	125	Excellent
Point Blank	30.74622; -95.20692	Y	10	127	Adequate
Patrick's Ferry	30.79775; -95.15983	Y	15	128	Adequate
Waterwood	30.82968; -95.24328	Y	45	126	Excellent
Cove Marina	30.85554; -95.34311	Y	5	128	Adequate
Bethy Creek Resort	30.84801; -95.38249	Y	5	126	Adequate
Highway 19	30.85829;-95.39874	Y	20	123	Adequate
White Rock City	30.95933; -95.33519	Y	10	123	Adequate
Cauthan	30.96803; -95.33293	Y	12	126	Adequate
Parr's Marina	30.97732; -95.33322	N			
Outback Marina	30.90502; -95.30331	Y	15	125	Adequate
Gallaway's	30.91249; -95.27454	Y	5	125	Adequate
Gilmore's Marina	30.91220; -95.26294	Y	20	127	Severe erosion in front of boat ramp
Harbor's Point	30.92358; -95.25762	N			
Nick's Pit Stop	30.83309; -95.15414	Y	8	127	Access road and parking area rough and eroded
Lakeside Resort	30.81121; -95.12912	Y	20	123	Excellent
Fair Four Seasons	30.79606; -95.10657	Y	15	126	Adequate
Vince's RV Park	30.81037; -95.09626	Y			Severe siltation, not usable
Hilton K	30.81145; -95.09682	Y	15	127	Adequate

Playcation Station	30.81300; -95.09441	Y	4	125	Adequate
Broken Arrow Marina	30.83992; -95.08195	Y	20	127	Adequate
Walker's Waterpoint	30.83271; -95.08348	Y	20	127	Access road and parking area rough and eroded
Kickapoo Marina	30.81272; -95.08143	Y	10	124	Adequate
Sandy Creek Marina	30.80994; -95.07560	Y	3	128	Adequate
Penwaugh Marina	30.74011; -95.05815	Y	10	124	Adequate
Blanchard	30.73642; -95.08828	Y	32	124	Excellent
Tigerville Park	30.71518; -95.05353	Y	12	123	Adequate
Beacon Bay Marina	30.68744; -95.03510	Y	15	122	Adequate
State Park #1	30.66050; -95.00699	Y	14	124	Adequate
State Park #2	30.65898; -95.00649	Y	26	124	Excellent
State Park #3	30.65219; -95.00570	Y			Under renovation

Table 3. Harvest regulations for Lake Livingston, Texas.

Species	Bag limit	Length limit
Catfish: Channel and Blue Catfish, their hybrids and subspecies	50 (in any combination)	12-inch minimum
Catfish, Flathead	5	18-inch minimum
Bass, White	25	10-inch minimum
Bass, Striped	5	18-inch minimum
Bass, Largemouth	5	14-inch minimum
Crappie: White and Black Crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

Table 4. Stocking history of Lake Livingston, Texas. FGL = fingerling; AFGL = advanced fingerling; ADL = adults; UNK = unknown.

Species	Year	Number	Size
Blue Catfish	1969	159,800	UNK
	2012	21	ADL
	Total	159,821	
Channel Catfish	1969	634,905	AFGL
	1970	254,000	AFGL
	Total	888,905	
Florida Largemouth Bass	1975	26,000	FRY
	1976	22,000	FRY
	1977	250,330	FRY
	1978	301,350	FGL
	1978	451,936	FRY
	1996	814,762	FGL
	1996	84,252	FRY
	2000	501,639	FGL
	2001	500,018	FGL
	2006	201,694	FGL
	2007	200,586	FGL
	2017	108,695	FGL
	Total	3,463,262	
Largemouth Bass	1969	1,018,400	FRY
	Total	1,018,400	
Paddlefish	1990	63,232	
	1991	34,132	
	1992	20,370	
	Total	117,734	
ShareLunker Largemouth Bass	2010	2,069	FGL
	Total	2,069	
Striped Bass	1977	884,726	UNK
	1978	117,091	UNK
	1979	224,000	UNK
	1980	283,584	UNK
	1982	341,357	UNK
	1983	189,265	UNK
	1984	1,424,455	FGL
	1985	896,996	FGL
	1986	108,780	FGL
	1986	339,705	FRY
	1987	97,416	FGL

1987	801,169	FRY
1988	59,800	FGL
1988	839,815	FRY
1989	766,205	FGL
1989	139,482	FRY
1992	351,750	FGL
1993	405,370	FGL
1994	1,114,221	FGL
1994	674,449	FRY
1995	900,833	FGL
1996	207,158	FGL
1996	233,921	FRY
1997	740,024	FGL
1997	245,407	FRY
1998	689,849	FGL
1999	913,952	FGL
2000	900,264	FGL
2002	1,392,893	FGL
2003	1,032,104	FGL
2004	437,508	FGL
2005	526,148	FGL
2006	746,278	FGL
2007	796,122	FGL
2008	206,090	FGL
2009	814,606	FGL
2010	767,253	FGL
2010	1,938,340	FRY
2011	50,687	FGL
2012	252,640	FGL
2013	1,029,903	FGL
2014	795,073	FGL
2015	1,067,557	FGL
2016	497,249	FGL
2017	814,698	FGL
Total	28,056,193	

Table 5. Objective-based sampling plan components for Lake Livingston, Texas, 2016 – 2017.

Gear/target species	Survey objective	Metrics	Sampling objective
	For all target species monitor for large-scale changes in:		
Electrofishing			
Largemouth Bass	Abundance	CPUE – stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Age-and-growth	Age at 14 inches	N = 13, 13.0 – 14.9 inches
	Condition	W_r	10 fish/inch group (max)
Bluegill [a]	Abundance	CPUE – Total	
	Size structure	PSD, length frequency	
Threadfin Shad [a]	Abundance	CPUE – Total	
Gizzard Shad [a]	Abundance	CPUE – Total	
	Size structure	Length frequency	
	Prey availability	IOV	
Gill netting			
Blue Catfish	Abundance	CPUE– stock	RSE-stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Condition	W_r	10 fish/inch group (max)
Channel Catfish[a]	Abundance	CPUE– stock	
	Size structure	PSD, length frequency	
	Condition	W_r	
White Bass	Abundance	CPUE– stock	RSE-stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Condition	W_r	10 fish/inch group (max)
Creel survey [b]			
Black basses, crappies, and catfishes	Trend information on angler utilization	Angler effort, CPUE, total harvest and size composition	

[a] No additional effort will be expended to achieve an RSE ≤ 25 for CPUE of Bluegill, Threadfin Shad, Gizzard Shad, or Channel Catfish if not reached from designated Largemouth Bass or Blue Catfish sampling effort.
[b] Angler utilization data and associated statistics will be calculated for all sport fish.

Table 6. Survey of structural habitat types, Lake Livingston, Texas, 2016.

Habitat type	Estimate	% of total
Bulkhead	32.2 miles	9.6
Bulkhead with boat docks	126.0 miles	37.7
Natural	163.5 miles	49.0
Natural with boat docks	3.4 miles	0.1
Rocky	7.6 miles	2.3
Rocky with boat docks	0.1 miles	<0.1
Rock bluff	1.3 miles	<0.1
Standing timber	5,778 acres	6.9

Table 7. Percent directed angler effort by species for Lake Livingston, Texas, 2007, 2011, and 2016. Survey periods were from 1 June through 31 May (2007/2008 and 2011/2012) and 1 June through 31 August (2016).

Species	2007/2008	2011/2012	2016
Catfishes	50.6	63.1	34.7
White Bass	32.0	5.9	39.2
Striped Bass	0.5	0.0	0.0
Sunfishes	1.8	0.2	0.0
Largemouth Bass	2.1	16.5	13.7
Crappies	5.4	0.9	2.4
Anything	7.6	13.3	10.0

Table 8. Total fishing effort (h) for all species and total directed expenditures at Lake Livingston, Texas, 2007, 2011, and 2016. Survey periods were from 1 June through 31 May (2007/2008 and 2011/2012) and 1 June through 31 August (2016). Relative standard error is in parentheses.

Statistic	2007/2008	2011/2012	2016
Total fishing effort	88,151 (23)	82,954 (31)	30,950 (40)
Total directed expenditures	$226,236 (57)	$382,470 (58)	$313,913 (93)

Gizzard Shad

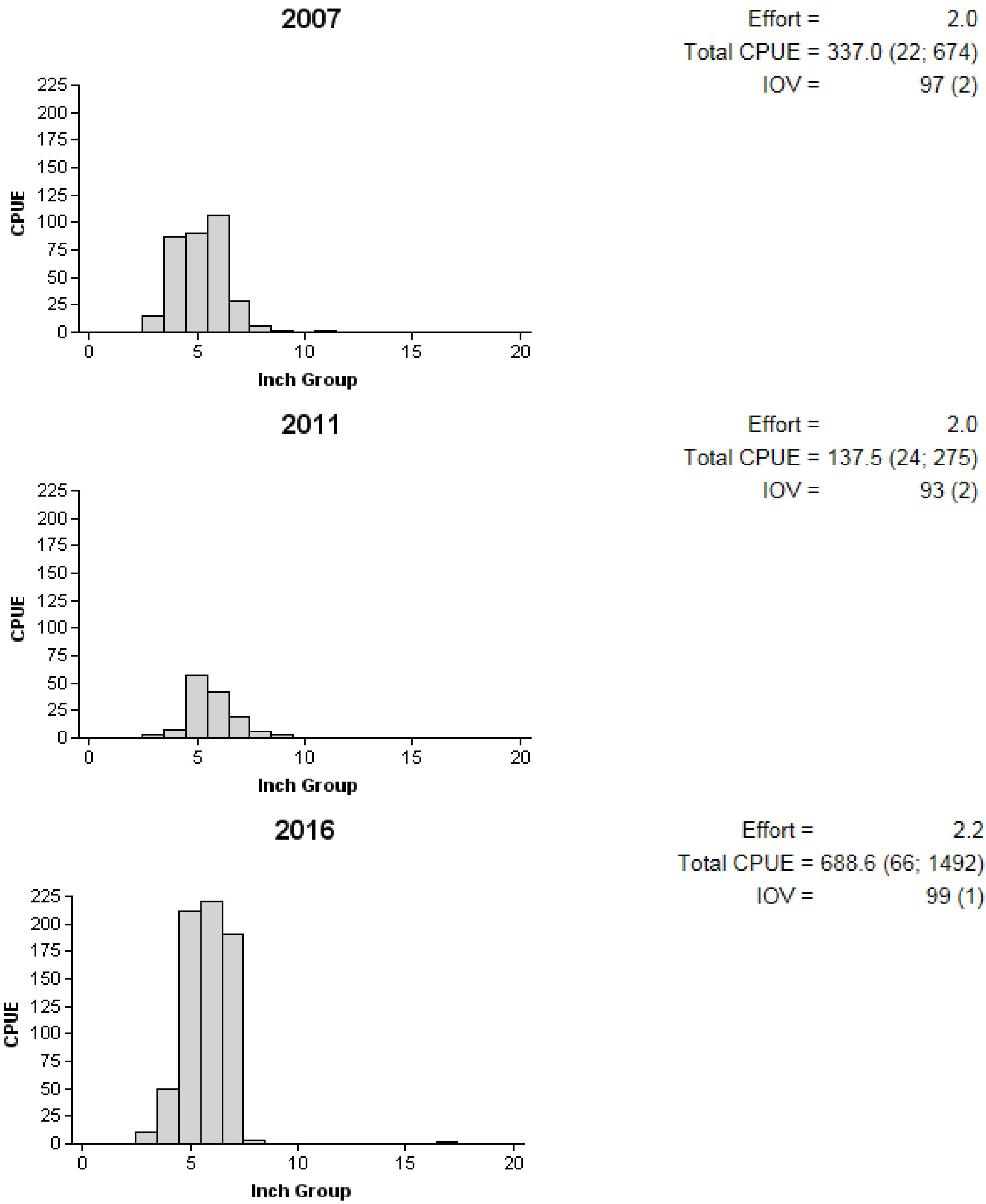
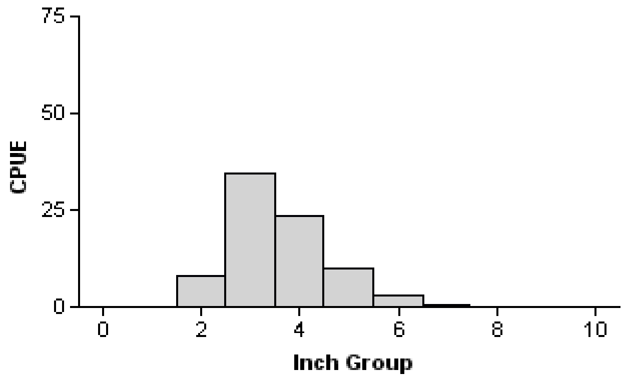


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Livingston, Texas, 2007, 2011, and 2016.

Bluegill

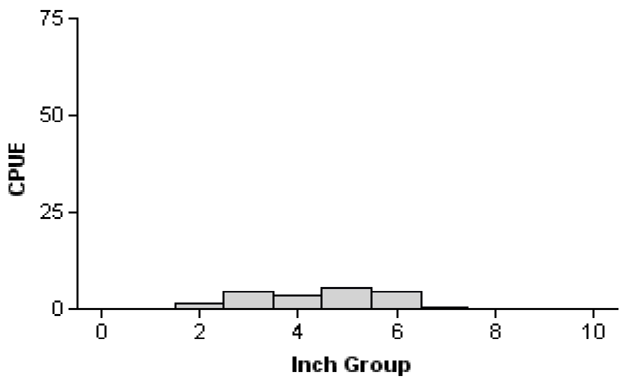
2007

Effort = 2.0
Total CPUE = 79.5 (26; 159)
PSD = 5 (3)



2011

Effort = 2.0
Total CPUE = 20.0 (32; 40)
PSD = 27 (8)



2016

Effort = 2.2
Total CPUE = 116.3 (29; 252)
PSD = 0 (0)

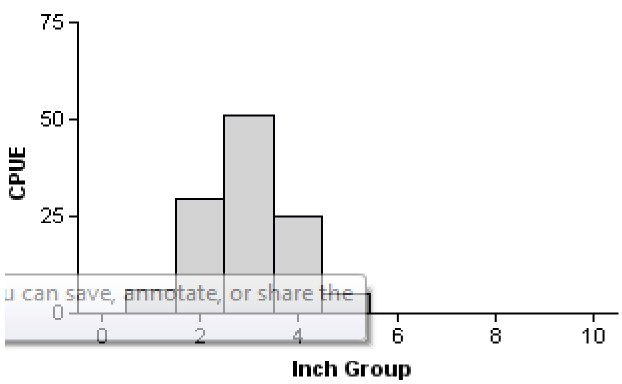
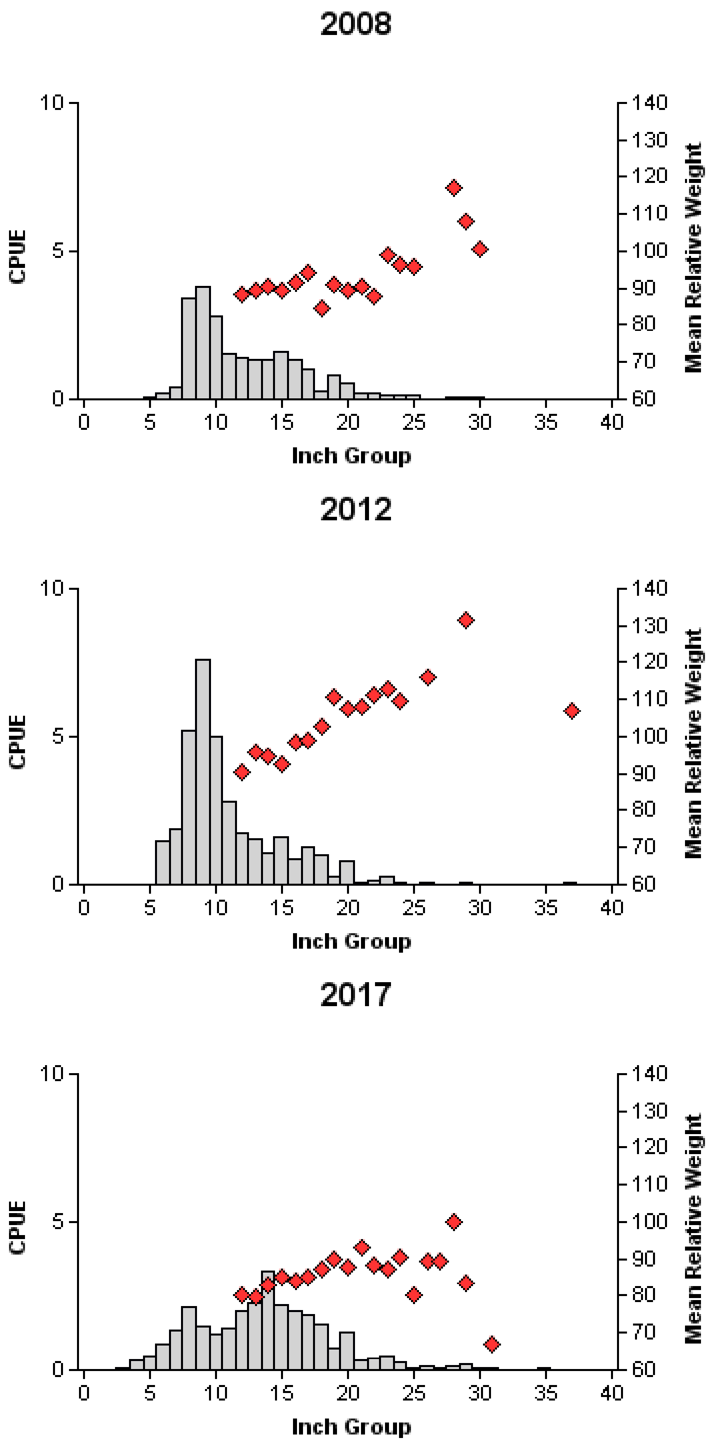


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Livingston, Texas, 2007, 2011, and 2016.

Blue Catfish



Effort = 15.0
Total CPUE = 22.8 (20; 342)
PSD = 14 (2)

Effort = 15.0
Total CPUE = 34.8 (13; 522)
PSD = 14 (4)

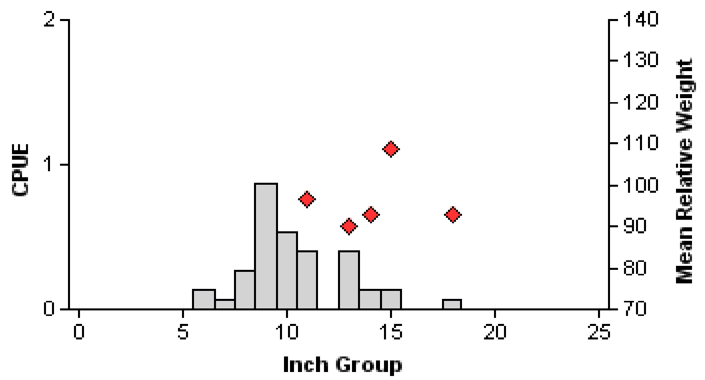
Effort = 15.0
Total CPUE = 28.7 (16; 431)
PSD = 18 (3)

Figure 4. Number of Blue Catfish caught per net night (CPUE), 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, 2008, 2012, and 2017.

Channel Catfish

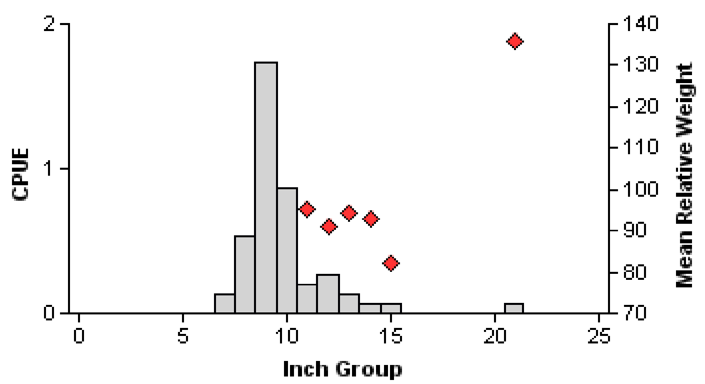
2008

Effort = 15.0
Total CPUE = 3.0 (28; 45)
PSD = 6 (5)



2012

Effort = 15.0
Total CPUE = 4.1 (27; 61)
PSD = 8 (7)



2017

Effort = 15.0
Total CPUE = 2.2 (34; 33)
PSD = 0 (0)

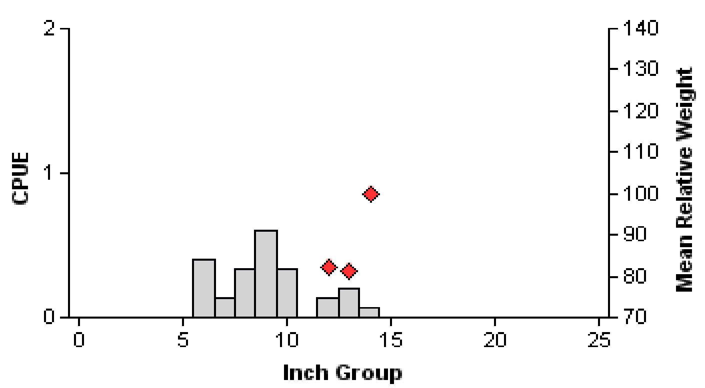


Figure 5. Number of Channel Catfish caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Livingston, Texas, 2008, 2012, and 2017.

Catfishes

Table 9. Creel survey statistics for catfishes at Lake Livingston, Texas, from June 2007 through May 2008, June 2011 through May 2012, and June through August 2016. Total catch per hour is for anglers targeting catfishes, and total harvest is the estimated number of catfishes harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year		
	2007/2008	2011/2012	2016
Surface area (acres)	83,277	73,887	83,277
Directed effort (h)	31,004.74 (26)	52,325.43 (36)	10,749.49 (37)
Directed effort/acre	0.37 (26)	0.71 (36)	0.13 (37)
Total catch per hour	2.38 (36)	1.88 (27)	0.84 (53)
Total harvest	53,494.00 (38)	38,827.00 (51)	3,465.00 (103)
Harvest/acre	0.64 (38)	0.53 (51)	0.04 (103)
Percent legal released	2.9	15.1	0.0

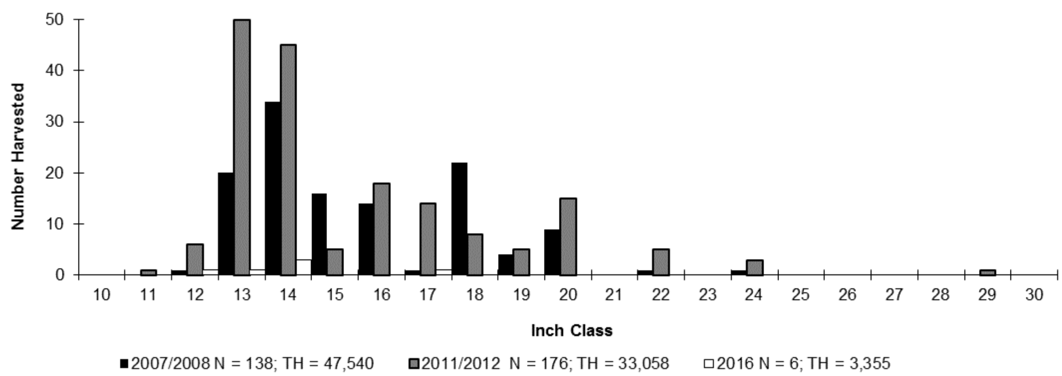


Figure 6. Length frequency of harvested Blue Catfish observed during creel surveys at Lake Livingston, Texas, June 2007 through May 2016, all anglers combined. N is the number of harvested Blue Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period.

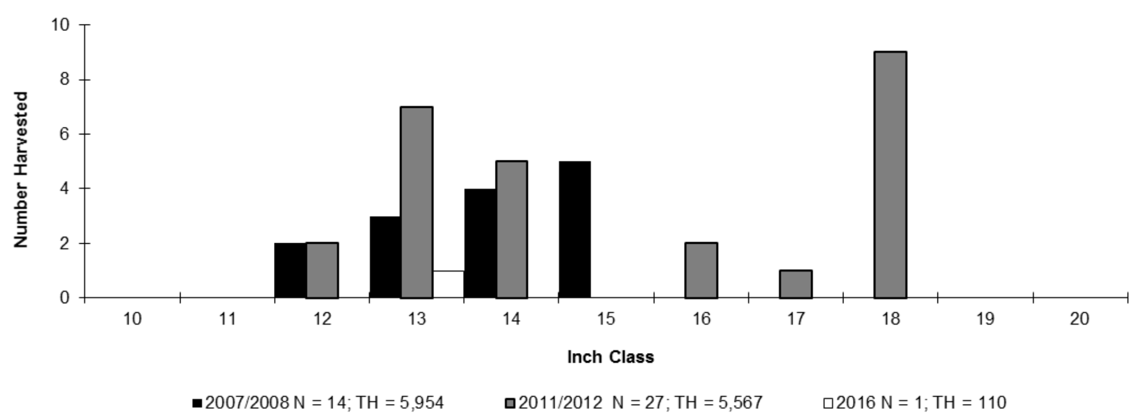


Figure 7. Length frequency of harvested Channel Catfish observed during creel surveys at Lake Livingston, Texas, June 2007 through May 2016, all anglers combined. N is the number of harvested Channel Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period.

White Bass

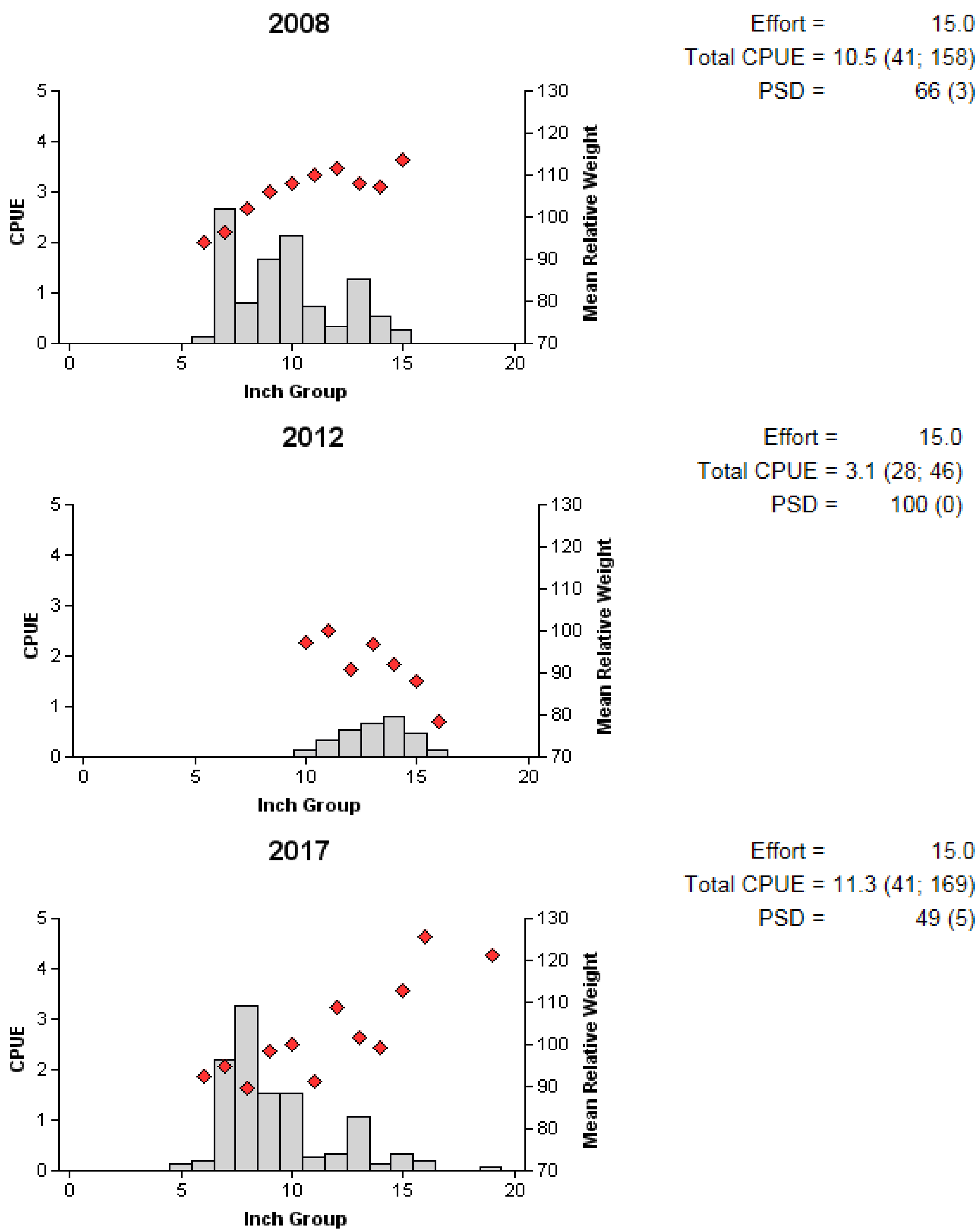


Figure 8. Number of White Bass caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Livingston, Texas, 2008, 2012, and 2017.

White Bass

Table 10. Creel survey statistics for White Bass at Lake Livingston, Texas, from June 2007 through May 2008, June 2011 through May 2012, and June through August 2016. 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		
	2007/2008	2011/2012	2016
Surface area (acres)	83,277	73,887	83,277
Directed effort (h)	19,607.86 (31)	4,925.00 (49)	11,792.20 (50)
Directed effort/acre	0.24 (31)	0.07 (49)	0.14 (50)
Total catch per hour	4.58 (50)	4.32 (64)	2.41 (62)
Total harvest	30,387.00 (45)	18,483.00 (55)	25,162.00 (82)
Harvest/acre	0.36 (45)	0.25 (55)	0.30 (82)
Percent legal released	<0.1	1.4	0.0

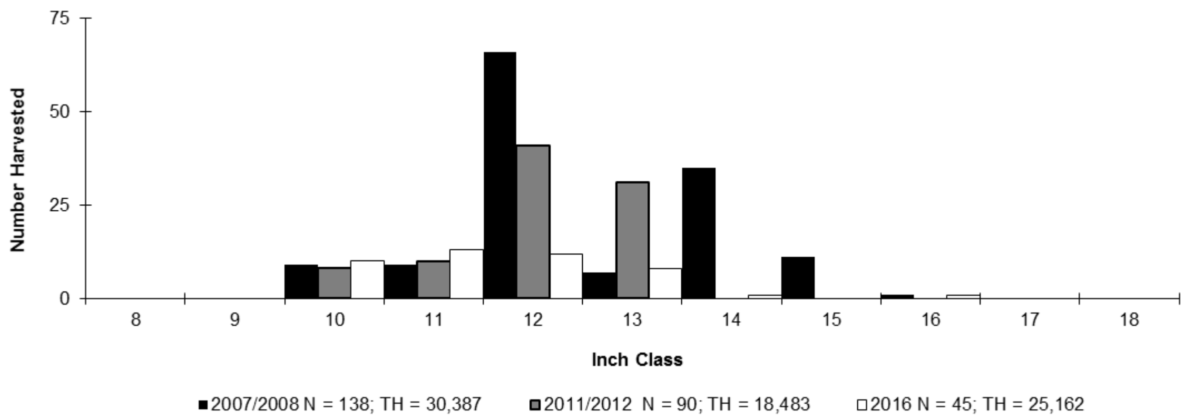
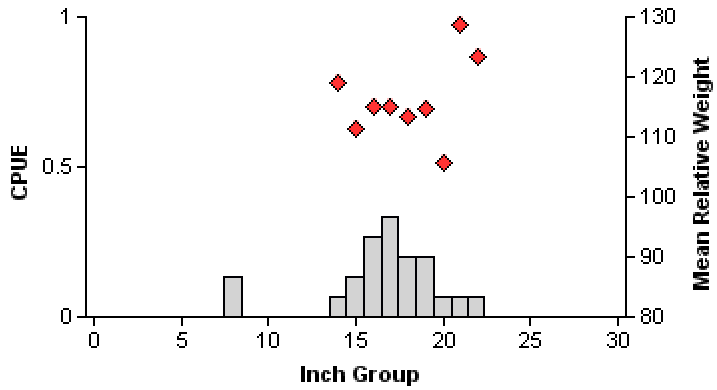


Figure 9. Length frequency of harvested White Bass observed during creel surveys at Lake Livingston, Texas, June 2007 through May 2016, all anglers combined. N is the number of harvested White Bass observed during creel surveys, and TH is the total estimated harvest for the creel period.

Striped Bass

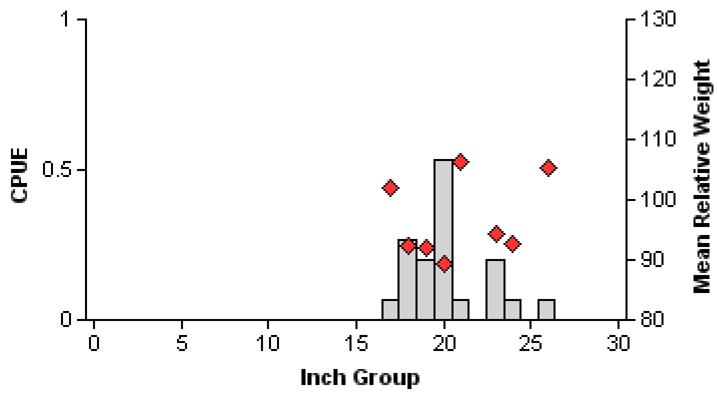
2008

Effort = 15.0
Total CPUE = 1.5 (35; 23)
PSD = 14 (8)



2012

Effort = 15.0
Total CPUE = 1.5 (39; 22)
PSD = 64 (8)



2017

Effort = 15.0
Total CPUE = 0.9 (80; 14)
PSD = 0 (0)

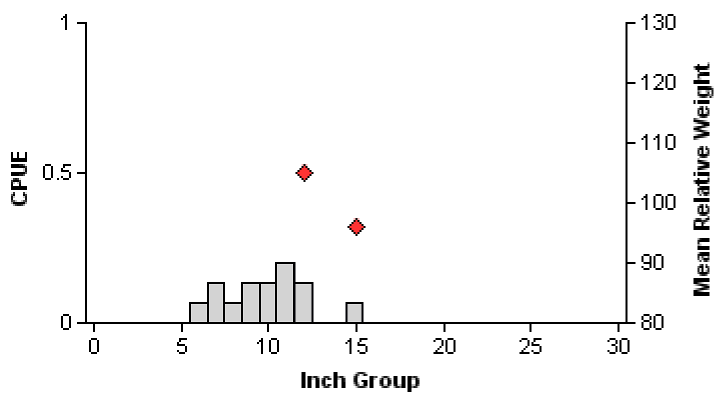
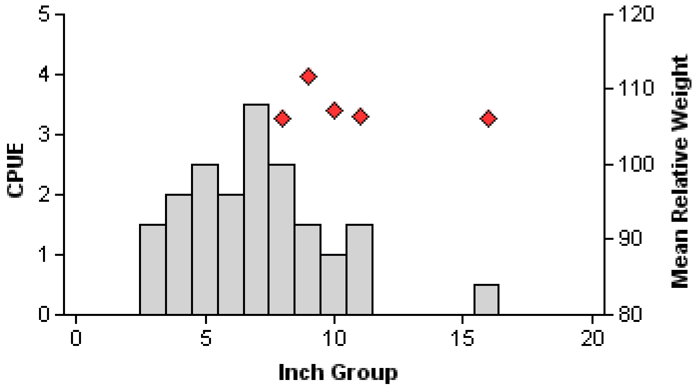


Figure 10. Number of Striped Bass caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Livingston, Texas, 2008, 2012, and 2017.

Largemouth Bass

2007

Effort = 2.0
Total CPUE = 18.5 (32; 37)
PSD = 7 (6)



2011

Effort = 2.0
Total CPUE = 7.5 (30; 15)
PSD = 93 (6)

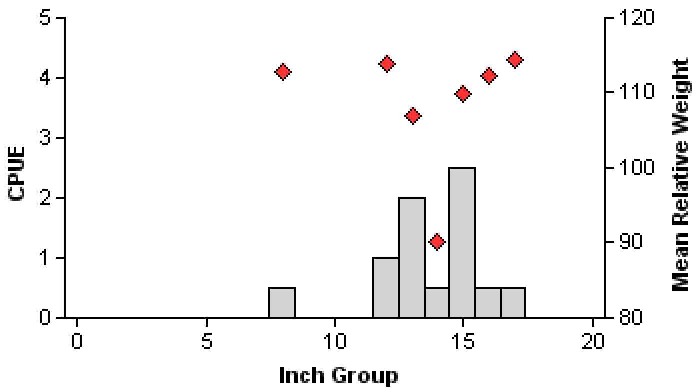
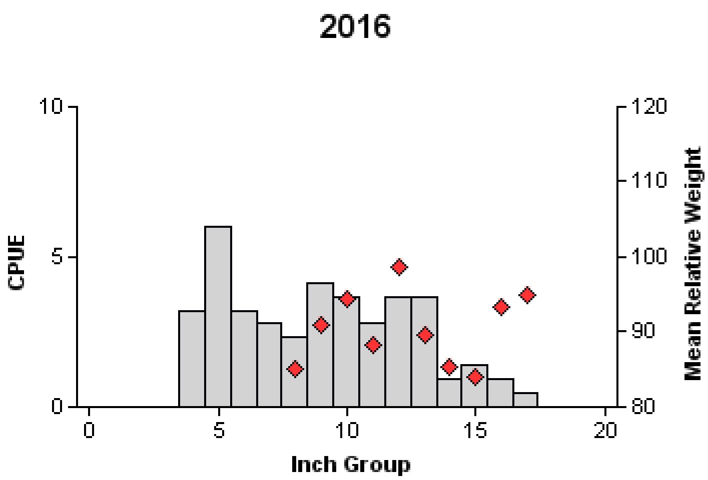


Figure 11. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Livingston, Texas, 2007 and 2011.

Largemouth Bass



Effort = 2.2
Total CPUE = 39.2 (20; 85)
PSD = 46 (6)

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 the 2016 fall electrofishing survey, Lake Livingston, Texas. This survey was conducted during the day, and survey sites were randomly selected within 10 creeks and embayments with more desirable habitat.

Largemouth Bass

Table 11. Creel survey statistics for Largemouth Bass at Lake Livingston, Texas from June 2007 through May 2008, June 2011 through May 2012, and June through August 2016. Catch rate is only for anglers targeting Largemouth Bass, and total catch and harvest is the estimated number from all anglers. Relative standard errors (RSE) are in parentheses.

Statistic	2007/2008	2011/2012	2016
Surface area (acres)	83,277	73,887	83,277
Directed angling effort (h)			
Tournament	0.00	0.00	0.00
Non-tournament	1,295.75 (83)	13,724.28 (34)	4,226.08 (55)
All black bass anglers combined	1,295.75 (83)	13,724.28 (34)	4,226.08 (55)
Angling effort/acre	0.02 (83)	0.19 (34)	0.05 (55)
Catch rate (number/h)	0.00	0.95 (33)	0.48 (36)
Total catch	1,909.00 (442)	10,070.00 (83)	4,040.00 (155)
< 4.0 lbs		10,070 – 100%	4,040 – 100%
≥ 4-6.9 lbs		0	0
≥ 7-9.9 lbs		0	0
≥ 10 lbs		0	0
Harvest			
Non-tournament harvest	0.00	1,533.00 (93)	1,677.00 (171)
Harvest/acre	0.00	0.02 (93)	0.02 (171)
Tournament weigh-in and release	0.00	0.00	0.00
Percent legal released (non-tournament)	100.0	59.2	0.0

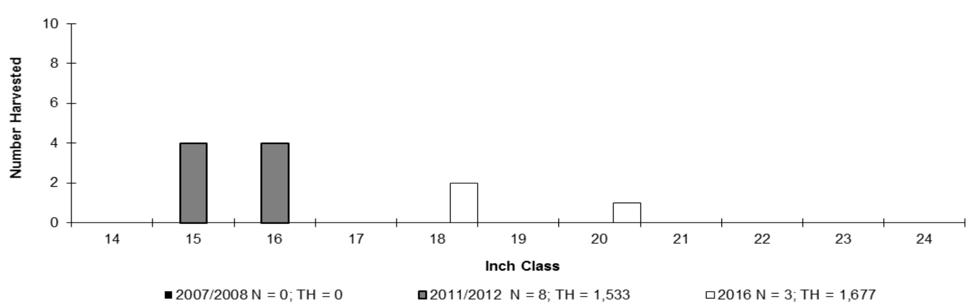


Figure 13. Length frequency of harvested Largemouth Bass observed during creel surveys at Lake Livingston, Texas, June 2007 through May 2016, all anglers combined. N is the number of harvested Largemouth Bass observed during creel surveys, and TH is the total estimated harvest for the creel period.

Crappies

Table 12. Creel survey statistics for crappies at Lake Livingston, Texas, from June 2007 through May 2008, June 2011 through May 2012, and June through August 2016. Total catch per hour is for anglers targeting crappies, and total harvest is the estimated number of crappies harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Statistic	2007/2008	2011/2012	2016
Surface area (acres)	83,277	73,887	83,277
Directed effort (h)	3,298.32 (62)	786.70 (125)	735.17 (122)
Directed effort/acre	0.04 (62)	0.01 (125)	0.01 (122)
Total catch per hour	0.00	4.50	0.00
Total harvest	0.00	1,014.00 (505)	0.00
Harvest/acre	0.00	0.01 (505)	0.00
Percent legal released		15.0	

Table 13. Proposed sampling schedule for Lake Livingston, Texas. Survey period is June through May. Standard electrofishing surveys are conducted in the fall. Standard survey denoted by S and additional survey denoted by A.

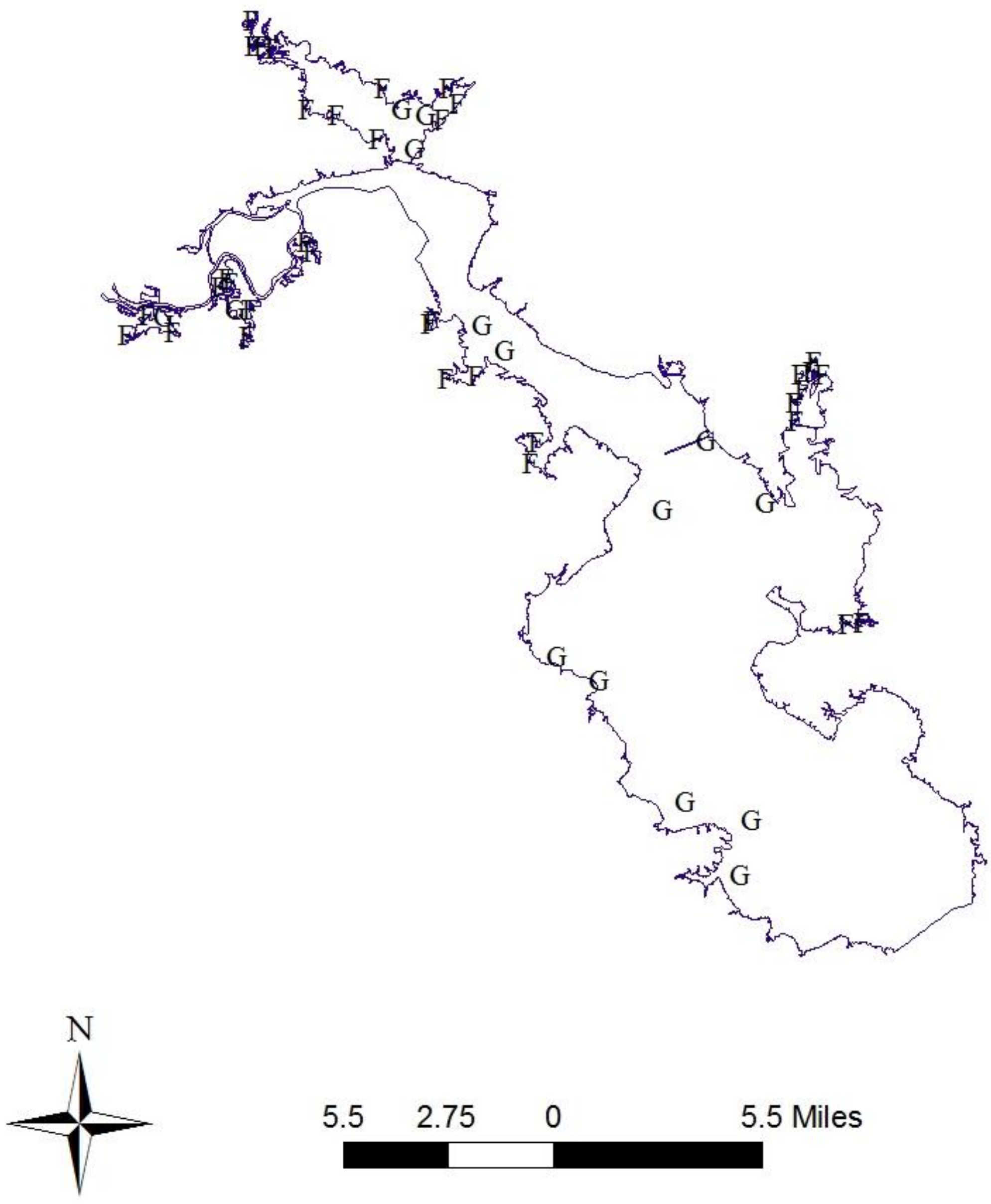
			Habitat				
Survey year	Electrofish Fall(Spring)	Gill net	Structural	Vegetation	Access	Creel survey	Report
2017-2018				S			
2018-2019				S			
2019-2020				S			
2020-2021	S	S	S	S	S	A	S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Lake Livingston, Texas, 2016-2017. Sampling effort was 2.2 hours for electrofishing and 15 net nights for gill netting.

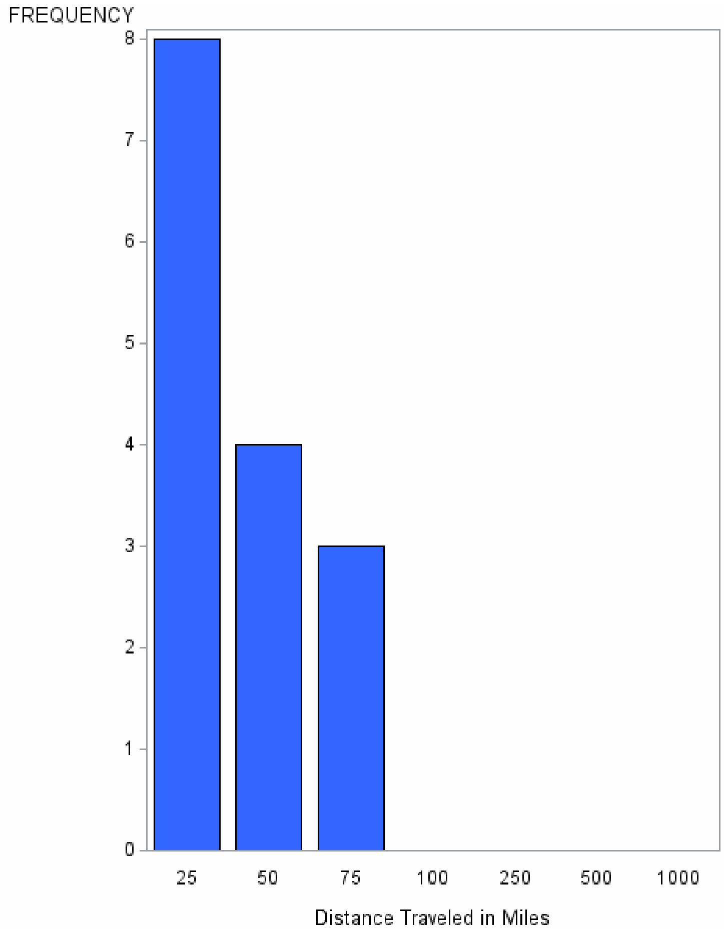
Species	Fall Electrofishing		Gill Netting	
	N	CPUE	N	CPUE
Spotted Gar			13	0.9
Alligator Gar			7	0.5
Gizzard Shad	1,492	688.6	168	11.2
Threadfin Shad	6,546	3,021.2		
Common Carp			5	0.3
Smallmouth Buffalo			74	4.9
Blue Catfish			431	28.7
Channel Catfish			33	2.2
White Bass			169	11.3
Yellow Bass			33	2.2
Striped Bass			14	0.9
Warmouth	2	0.9		
Bluegill	252	116.3		
Longear Sunfish	53	24.5		
Redear Sunfish	3	1.4		
Largemouth Bass	85	39.2		

APPENDIX B



Location of sampling sites, Lake Livingston, Texas, 2016-2017. Gill net and fall electrofishing stations are indicated by G and F, respectively. Water level was near full pool at time of sampling.

APPENDIX C



Frequency of anglers that traveled various distances (miles) to Lake Livingston, Texas, as determined from the June through August 2016 creel survey.

APPENDIX D

Fish consumption advisory issued by the Texas Department of State Health Services for Lake Livingston and portions of the Trinity River (U.S. 287 downstream to U.S. 90.) due to elevated levels of dioxins and polychlorinated biphenyls (PCBs), December 2015.

Species	Women of childbearing age & children under 12	Women past childbearing age and males 12 and older
Blue Catfish	DO NOT EAT	1 meal per month
Flathead Catfish	DO NOT EAT	1 meal per month
Freshwater Drum	DO NOT EAT	2 meals per month
Gar (all species)	DO NOT EAT	DO NOT EAT
Smallmouth Buffalo	DO NOT EAT	1 meal per month
Striped Bass	1 meal per month	3 meals per month
White Bass	1 meal per month	3 meals per month