

# Lake Nacogdoches

## 2020 Fisheries Management Survey Report

PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-4

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

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## Survey and Management Summary

Fish populations in Lake Nacogdoches were surveyed in 2020 using fall electrofishing and in 2019 and 2021 using spring electrofishing. Anglers were surveyed from March through May 2021 with a creel survey. Historical data are presented with the 2017-2021 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 Nacogdoches is located on Loco Bayou, a tributary of the Angelina River in the Neches River basin. The City of Nacogdoches is the controlling authority. Primary uses are municipal water supply and recreation. At conservation pool elevation, Lake Nacogdoches is 2,212 surface acres and has a mean depth of 15 feet. Water level fluctuations average 3 feet annually. Habitat in the lake consists of submerged and emergent aquatic vegetation (mainly hydrilla, American lotus, and torpedograce) and standing timber. Most of the land around the reservoir is utilized for timber production, agriculture, and residential use.

**Management History:** Important sport fish include Largemouth Bass, White Crappie, and Black Crappie. The 14- to 21-inch slot-length limit for Largemouth Bass (implemented in 1988) was changed to a 16-inch maximum length limit in 2008. Florida Largemouth Bass fingerlings were stocked annually from 2008–2020 (except for 2012-2014) and ShareLunker Largemouth Bass were stocked in 2008 and 2020 to maximize trophy bass potential. Giant salvinia was first discovered in 2018. Since 2019, herbicide treatments and the introduction of giant salvinia weevils have maintained abundance to less than 5 surface acres.

### Fish Community

- **Prey species:** Primary prey species include Threadfin Shad and Bluegill. Both populations were abundant and provided ample forage for sport fish. The majority of Bluegill were less than 5 inches in length and available as prey. Few anglers targeted sunfish; estimated total harvest was 509 Bluegill during the 2021 spring creel survey. Gizzard Shad were also present but catch rates were relatively low.
- **Channel Catfish:** Historically, abundance of Channel Catfish has been relatively low. Gill net surveys were discontinued in 2016. Few anglers target catfish at Lake Nacogdoches (< 1% of total fishing effort in 2021).
- **Black basses:** Historically, Spotted Bass have been present, but population abundance has been low. No fish were caught from electrofishing in 2020 or 2021. Largemouth Bass were abundant and numbers of fish greater than 16 inches in length increased. Growth rates were adequate, and fish were in moderate condition. A high-quality Largemouth Bass fishery exists and accounts for most of the angling effort (88%). Directed angler effort increased considerably in 2021, and angler catch rates remained relatively high and stable (range = 1.0 – 1.3/h).
- **Crappies:** Crappies were an important component of the overall fishery in 2021 (9% total directed effort). Angler catch rate was high (2.3/h) and 8,215 fish were harvested in 2021.

**Management Strategies:** Continue to manage Largemouth Bass with a 16-inch maximum length limit. Request annual stockings of Florida Largemouth Bass to maximize trophy fish abundance. Promote the ShareLunker Program to increase reporting rates of trophy Largemouth Bass catch and justify Florida Largemouth Bass stockings. Continue to monitor trends of hydrilla and giant salvinia coverage through annual aquatic vegetation surveys.

## Introduction

This document is a summary of fisheries data collected from Lake Nacogdoches from 2020-2021. 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 2020-2021 data for comparison.

## Reservoir Description

Lake Nacogdoches is a 2,212-acre impoundment constructed in 1976 on Loco Bayou. It is located in Nacogdoches County approximately 10 miles west of Nacogdoches and is operated and controlled by the City of Nacogdoches. Primary water uses include municipal water supply and recreation. At conservation pool, Lake Nacogdoches has a shoreline length of 27 miles and a mean depth of 15 feet. Secchi disc readings average 2-4 feet. Water fluctuations average 3 feet annually (Figure 1). Habitat at time of sampling consisted of aquatic vegetation (primarily hydrilla, American lotus, and torpedograss) and standing timber. The reservoir was mesotrophic with a mean Trophic State Index chl-a of 48.1 (Texas Commission of Environmental Quality 2020). The majority of the land surrounding the reservoir is used for agriculture, timber production, and residential development. Other descriptive characteristics for Lake Nacogdoches are in Table 1.

## Angler Access

Lake Nacogdoches has two public access areas, East Park and West Park. Both parks have boat ramps in excellent condition. Additional boat ramp characteristics are in Table 2. Shoreline access is limited to the public boat ramp areas and the fishing pier located at West Park.

## Management History

**Previous management strategies and actions:** Management strategies and actions from the previous survey report (Ashe and Driscoll 2017) included:

1. Conduct annual vegetation surveys to monitor hydrilla coverage. If abundance increased to levels that initiated public complaints, consult with the City of Nacogdoches to develop a management plan for hydrilla control.
 

**Action:** Aquatic vegetation surveys were conducted annually from 2017 to 2020. Currently, no problems concerning hydrilla have been reported by the City of Nacogdoches or the angling public.
2. Conduct creel surveys to monitor catch, harvest, and directed effort for Largemouth Bass and crappies.
 

**Action:** A spring quarter (March-May) creel survey was conducted in 2021.
3. Continue to monitor Largemouth Bass population size structure and growth to assess the success of the 16-inch maximum length limit by fall and spring electrofishing.
 

**Action:** Spring electrofishing surveys were conducted in 2019 and 2021. A fall electrofishing survey was conducted in 2020.
4. Continue annual stockings of Florida Largemouth Bass (FLMB) to maximize trophy fish abundance.
 

**Action:** FLMB were stocked annually from 2017-2020.

**Harvest regulation history:** Sport fishes in Lake Nacogdoches are currently managed with statewide regulations except for Largemouth Bass (Table 3). From 1988 to 2008, Largemouth Bass were managed with a 14- to 21-inch slot length limit. A 16-inch maximum length limit was implemented in 2008 to increase the abundance of large fish.

**Stocking history:** Channel Catfish were stocked in 1976 and 1977 (Table 4). Florida Largemouth Bass were stocked in 2000, 2002, and 2008-2011 at a rate of 50 fish/acre, and from 2015 through 2020 at a rate of 1,000 fish/km of shoreline. ShareLunker Largemouth Bass were stocked in 2008 (19,991 advanced fingerlings) and in 2020 (5,006 fingerlings).

**Vegetation/habitat management history:** Historically, hydrilla has not negatively impacted angler access, and no treatments have been conducted. Torpedograss and hydrilla has been problematic in designated swimming areas and targeted herbicide treatments have been used to alleviate those issues. Giant salvinia was first discovered in 2018 and coverage reached 24 surface acres. Since 2018, numerous herbicide treatments each growing season, along with the introduction of giant salvinia weevils, have reduced abundance to less than 5 surface acres.

**Water transfer:** Lake Nacogdoches is primarily used for municipal water supply and recreation. There are no interbasin transfers of water.

## Methods

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Lake Nacogdoches (Ashe and Driscoll 2017). Primary components of the OBS plan are listed in Table 5. All survey sites were randomly selected, and all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

**Electrofishing** – Largemouth Bass, sunfishes, Gizzard Shad, and Threadfin Shad were collected by electrofishing (1 hour at 12, 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 12 randomly selected fish (range 13.5 to 14.5 inches).

**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** – A spring quarter access-point creel survey was conducted from March through May 2021. 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 2017).

**Habitat** – A structural habitat survey was conducted in 2008 (Ashe and Driscoll 2008). Vegetation surveys were conducted in 2017–2020 to monitor hydrilla and giant salvinia coverage. Habitat was assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2017).

**Water level** – Source for water level data was the United States Geological Survey (USGS 2021).

## Results and Discussion

**Habitat:** Aquatic vegetation provides the primary habitat at Lake Nacogdoches and includes hydrilla, American lotus, torpedograss, and pondweed. Hydrilla coverage has historically been as high as 40% of the reservoir surface area. In 2017, hydrilla reached 38% coverage, which was a significant increase from the 3% coverage observed in 2016 (Table 6). Since 2017, hydrilla coverage has declined and was 323 surface acres (15% coverage) in 2020. American lotus has been relatively abundant, with coverages ranging from 3% (2019) to 26% (2016 and 2017). In 2020, coverage was 15%. A structural habitat survey was last conducted in 2008 with 59% of the shoreline characterized with overhanging brush and 28% of the shoreline described as rocky primarily along the dam (Ashe and Driscoll 2008).

**Creel:** Total angling effort for black basses increased from 2017 (78.0%) to 2021 with 87.9% of directed effort (Table 7). Crappies were the second most sought species for directed angler effort although effort has declined substantially from 2013 when 17.6% of directed effort were for crappies to 2021 with 9.4% of the directed angler effort. Directed angler effort for catfishes were similar between 2013 (2.0%) and 2017 (2.8%), then declined in 2021 with 0.5% directed effort observed for catfishes. Overall angling effort has steadily increased from 2013 (13,939 h), 2017 (29,452 h) and 2021 (42,820 h) (Table 8). In conjunction with increasing angling effort an increase in total directed expenditures were also observed with \$75,853 for 2013, \$141,470 (2017) and \$186,576 (2021). The increases in both angling effort and expenditures observed in 2021 followed a similar pattern statewide likely due to an increase in fishing participation in response to COVID-19 quarantines.

**Prey species:** Primary prey species include Threadfin Shad and Bluegill. Both populations were abundant and provided ample forage for sport fish. Electrofishing catch rate of Threadfin Shad was high

in 2020 (925.0/h) (Appendix A). In 2020, the catch rate of Bluegill (213.0/h) was lower than it was in 2012 (538.0/h) and 2016 (265.0/h) (Figure 3). The majority of catch was  $\leq 5$  inches in length for all three survey years. Few anglers target sunfish: estimated total harvest was 509 Bluegill during the 2021 spring creel survey (Table 9 and Figure 4). Gizzard Shad were present in low abundance. Catch rates declined considerably from 2012 (82.0/h) to 2016 (5.0/h) but increased to 43.0/h in 2020 (Figure 2). Index of Vulnerability (IOV) ranged from 16 to 40 over the last three survey years indicating minimal contribution to the overall prey base. Overall, it is believed that the prey base is adequate to maintain the goal of maintaining a trophy / quality Largemouth Bass population as evidenced by size structure, body condition, and growth rates.

**Channel Catfish:** Historically, Channel Catfish abundance has been low with little directed angling effort; sampling efforts were discontinued in 2016. Few anglers targeted catfish (0.5% of directed effort) (Table 7) but catch rates were high (1.6 fish/h) (Table 10). Estimated total harvest was 582 fish (Figure 5).

**Black basses:** Electrofishing catch rates of Spotted Bass have been historically low with catch rates of 47.0/h and 15.0/h during fall electrofishing surveys in 2012 and 2016, respectively (Figure 6). No spotted bass were collected during the 2020 fall or 2021 spring electrofishing surveys. No fish were observed as harvested during the spring 2021 creel survey.

Since 2012, fall electrofishing catch rates of Largemouth Bass have been high and ranged from 137.0 to 166.0/h (Figure 7). Since 2016, catch rates of larger bass have increased as reflected by higher PSD values (range = 63-72). Relative weights exceeded 80 for most inch-groups, indicating fish were in adequate condition. Growth of Largemouth Bass was excellent; average age at 14 inches (13.5-14.5 inches) was 1.2 years (N = 12; range = 1-2 years). Spring electrofishing catch rates have been typically greater than those observed in the fall, and catch rates were relatively high in 2017 (225.0/h) and 2021 (238.0/h) (Figure 8). The low catch rate in 2019 (128.0/h) can be attributed to turbid water conditions that decreased electrofishing efficiency. Similar to fall electrofishing, population size structure was desirable (PSD range = 80-87; PSD-16 range = 24-33).

Similar to previous years, the black bass fishery accounted for most of the annual fishing effort (88%) during the 2021 spring creel survey (Table 7). Directed effort for black basses was high in 2021 (17.0 h/acre) and increased considerably from 2013 (4.9 h/acre) and 2017 (11.7 h/acre) (Table 11). Total angler catch rates were high and stable during the last three survey periods (range = 1.0-1.3/h). Anglers released an estimated 93% of legal fish caught. Total estimated harvest was lower in 2021 (2,108 fish) than 2017 (3,261 fish) but greater than 2013 (627 fish). Catch of fish greater than four pounds was higher in 2021 compared to previous surveys and included 207 fish greater than 7 pounds.

Anglers indicate that they are satisfied with the 16-inch maximum length limit, with only a few minor complaints that it may hinder weigh-in style tournaments. Tournament anglers have been surveyed before in 2017 and they incorporated a paper style format.

**Crappies:** Crappies were an important component of the overall fishery and ranked as the second-most sought species group by anglers. A total of 9.4% of angler effort was directed towards crappies in 2021 (Table 7). Angler catch rate in 2021 (2.3/h) was high and greater than catch rates in 2013 (1.8/h) and 2017 (1.5/h) (Table 12). In 2021, directed effort (4,011 h) and total harvest (8,215 fish) increased from the previous two survey years. Overall, angler catch and harvest reflected an abundant crappie population.

# Fisheries Management Plan for Lake Nacogdoches, Texas

Prepared – July 2021

**ISSUE 1:** Creel surveys indicate most angling effort at Lake Nacogdoches is for Largemouth Bass. Directed angling effort has increased over the last three spring creel surveys and was 17.0 h/acre in 2021. Data indicate the 16-inch maximum length limit is producing desirable results. Abundance of fish > 16 inches is relatively high and appears to be increasing.

## MANAGEMENT STRATEGIES

1. Continue to manage Largemouth Bass harvest with a 16-inch maximum length limit to increase trophy bass abundance.
2. Continue annual stockings of FLMB to maximize trophy fish abundance.

**ISSUE 2:** From 2009-2014, data collected from a voluntary angler reporting program indicated that catch of trophy bass was high. Adjusting for non-reporting, an estimated total of 1,181 Largemouth Bass > 8 pounds were caught by anglers (N = 426 > 10 pounds). Anecdotal information from anglers indicate that catch of trophy bass has increased since 2014. The 2021 spring quarter creel survey estimated that 207 fish  $\geq$  7 pounds were caught by anglers. However, since implementing a revised ShareLunker Program in 2018, overall angler participation has been low, and only 25 fish  $\geq$  8 pounds have been entered.

## MANAGEMENT STRATEGIES

1. Promote the ShareLunker Program via news releases, presentations, and creel surveys to increase reporting rates of trophy Largemouth Bass catch and justify FLMB stockings.
2. Maintain ShareLunker signage posted at both boat ramps.

**ISSUE 3:** In 2018, giant salvinia was discovered in Lake Nacogdoches and coverage reached 24 surface acres. Since 2018, herbicide treatments and the introduction of giant salvinia weevils have reduced abundance to less than 5 surface acres.

## MANAGEMENT STRATEGY

1. Continue to coordinate with Aquatic Habitat Enhancement regarding ongoing herbicide treatments.

**ISSUE 4:** Historically, hydrilla coverage in Lake Nacogdoches has exceeded 40%. In 2016, hydrilla coverage declined to 3% of the reservoir surface area but then rebounded to 38% coverage in 2018. In 2020 hydrilla coverage was 15%.

## MANAGEMENT STRATEGIES

1. Continue to monitor aquatic vegetation annually (2021-2024). If hydrilla coverage expands and prompts public complaint, meet with city officials and angling public to develop an integrated aquatic vegetation management plan.

2. Permit lakeside homeowners to conduct herbicide treatments (at homeowner expense) adjacent to their property.

## Objective-Based Sampling Plan and Schedule (2021–2025)

### Sport fish, forage fish, and other important fishes

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

### Low density fisheries

Historically, few anglers target Channel Catfish (< 3% of annual angling effort) and population abundance has been low. Traditional channel catfish sampling with gill nets was discontinued in 2016 and the fishery will be monitored via spring quarter creel surveys in 2025.

### Survey objectives, fisheries metrics, and sampling objectives

**Largemouth Bass:** Largemouth Bass are the most popular sport fish in Lake Nacogdoches, accounting for approximately 85% of the annual angling effort. From 1988 to 2008, Largemouth Bass were managed with a 14- to 21-inch slot length limit. A 16-inch maximum length limit was implemented in 2008 to increase the number of trophy fish. Since 2002, trend data on CPUE, size structure, and body condition have been collected every four years with fall electrofishing, and biennially with spring electrofishing. The population is abundant, recruitment rates have been high and steady, and size structure has been desirable and stable. Continuation of trend data with nighttime electrofishing in the fall (2024) and spring (biennially, 2023 and 2025) will allow for determination of any large-scale changes in the Largemouth Bass population that may spur further investigation. The minimum of 12 randomly selected 5-min electrofishing sites will be sampled, but the anticipated effort to meet sampling objectives (N = 50 stock-size fish; RSE-S  $\leq$  25) is 5-8 stations with 80% confidence. The Largemouth Bass fishery (i.e., angling effort, catch rates, size distribution of catch and harvest) will be monitored with a spring quarter access point creel survey in 2025 (5 weekend days and 4 weekdays). Average age of Largemouth Bass between 13.5 and 14.5 inches (Category 2; N = 13) will be estimated in 2024.

**Crappies:** The crappie fishery is the second most popular at Lake Nacogdoches, accounting for approximately 10% of the annual angling effort. Historically, trap netting resulted in low catch rates, and sampling was discontinued in 2004. Since then, spring quarter creel surveys have been used to monitor the crappie fishery and make inferences about the population.

**Prey species:** Bluegill, Threadfin Shad, and Gizzard Shad are the primary forage at Lake Nacogdoches. Fall electrofishing in 2024, sampling the minimum of 12 random sites, should result in sufficient numbers of Bluegill (N = 50 stock-size fish). Gizzard Shad abundance will be monitored via fall electrofishing, but no additional effort will be expended if less than 50 stock-size fish are collected. Largemouth Bass body condition (fish  $\geq$  8" TL) will be used to provide additional information on forage abundance and vulnerability.

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## Tables and Figures

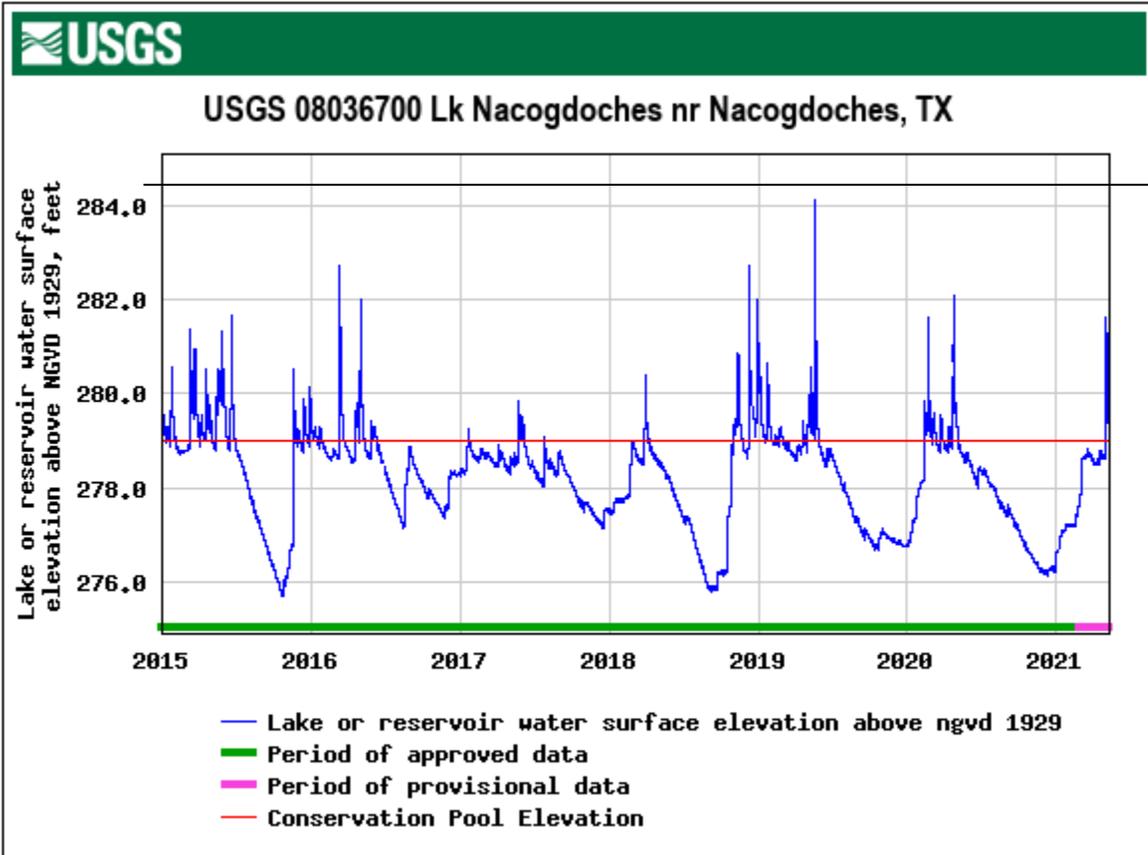


Figure 1. Daily water level elevations in feet above mean sea level recorded for Lake Nacogdoches, Texas.

Table 1. Characteristics of Lake Nacogdoches, Texas.

Characteristic	Description
Year constructed	1976
Controlling authority	City of Nacogdoches
County	Nacogdoches
Reservoir type	Tributary
Shoreline Development Index (SDI)	2.3
Conductivity	120 $\mu\text{S}/\text{cm}$

Table 2. Boat ramp characteristics for Lake Nacogdoches, Texas, April 2021. Reservoir elevation at time of survey was 278 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
East Park	31.58849 -94.82183	Y	30	276	Excellent
West Park	31.59314 -94.83738	Y	20	275	Excellent

Table 3. Harvest regulations for Lake Nacogdoches, Texas.

Species	Bag limit	Length limit
Catfish: Channel and Blue Catfish, their hybrids and subspecies	25 (in any combination)	12-inch minimum
Catfish, Flathead	5	18-inch minimum
Bass, Largemouth	5 <sup>a,b</sup>	16-inch maximum
Bass, Spotted	5 <sup>a</sup>	None
Crappie: White and Black Crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

<sup>a</sup>Daily bag for Largemouth Bass and Spotted Bass = 5 fish in any combination.

<sup>b</sup>Largemouth Bass 24 inches or greater in length may be temporarily retained in a live well or other aerated holding device and immediately weighed using personal scales. Fish weighing 13 pounds or more may be donated to the ShareLunker program; otherwise, the fish must be immediately released in Lake Nacogdoches.

Table 4. Stocking history of Lake Nacogdoches, Texas. FGL = fingerling, AFGL = advanced fingerling and FRY = fry.

Species	Year	Number	Size
Channel Catfish	1976	110,000	AFGL
	1977	100,300	AFGL
	Total	210,300	
Florida Largemouth Bass	1977	221,400	FRY
	1999	500	FGL
	2000	110,743	FGL
	2002	110,152	FGL
	2008	110,762	FGL
	2009	110,661	FGL
	2010	112,475	FGL
	2011	124,619	FGL
	2015	48,734	FGL
	2016	47,847	FGL
	2017	26,681	FGL
	2018	26,112	FGL
	2019	31,072	FGL
2020	27,398	FGL	
Total	1,109,156		
ShareLunker Largemouth Bass	2008	19,991	AFGL
	2020	5,006	FGL
	Total	24,997	

Table 5. Objective-based sampling plan components for Lake Nacogdoches, Texas 2020–2021.

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing</i>			
Largemouth Bass	Abundance	CPUE – stock	RSE-Stock $\leq$ 25
	Size structure	PSD, length frequency	N $\geq$ 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 <sup>a</sup>	Abundance	CPUE – Total	
	Size structure	PSD, length frequency	N $\geq$ 50
Gizzard Shad <sup>a</sup>	Abundance	CPUE – Total	
	Prey availability	IOV	
Threadfin Shad <sup>a</sup>	Abundance	CPUE – Total	
<i>Creel survey</i>			
All sport fish	Trend information on angler utilization	Angler effort, CPUE, total harvest and size composition	

<sup>a</sup> No additional effort will be expended to achieve an RSE  $\leq$  25 for CPUE of Bluegill, Gizzard Shad, and Threadfin Shad if not reached from designated Largemouth Bass sampling effort.

Table 6. Survey of aquatic vegetation, Lake Nacogdoches, Texas, 2016–2020. Surface area (acres) is listed with percent of total reservoir surface area in parentheses.

Species	2016	2017	2018	2019	2020
Torpedograss	46 (2)	45 (2)	9 (<1)	36 (2)	65 (3)
Giant cutgrass	0	0	3 (<1)	3 (<1)	2 (<1)
Watershield	Trace	0	0	5 (<1)	3 (<1)
Pondweed	44 (2)	59 (3)	21 (<1)	0	7 (<1)
American lotus	565 (26)	568 (26)	227 (10)	76 (3)	338 (15)
Hydrilla (Tier III)*	58 (3)	836 (38)	395 (18)	182 (8)	323 (15)
Giant salvinia (Tier II)*	0	0	24 (1)	0	3 (<1)

\*Tier II is Maintenance Response, Tier III is Watch Status

Table 7. Percent directed angler effort by species for Lake Nacogdoches, Texas, 2013, 2017, and 2021. Survey periods were from 1 March through 31 May.

Species	2013	2017	2021
Catfishes	2.0	2.8	0.5
Sunfishes	0.0	0.7	0.7
Black basses	78.0	87.7	87.9
Crappies	17.6	8.2	9.4
Anything	2.4	0.6	1.5

Table 8. Total fishing effort (h) for all species and total directed expenditures at Lake Nacogdoches, Texas, 2013, 2017, and 2021. Survey periods were from 1 March through 31 May. Relative standard error is in parentheses.

Creel statistic	2013	2017	2021
Total fishing effort	13,939 (28)	29,452 (23)	42,820 (30)
Total directed expenditures	\$75,853 (40)	\$141,470 (42)	\$186,576 (30)

## Gizzard Shad

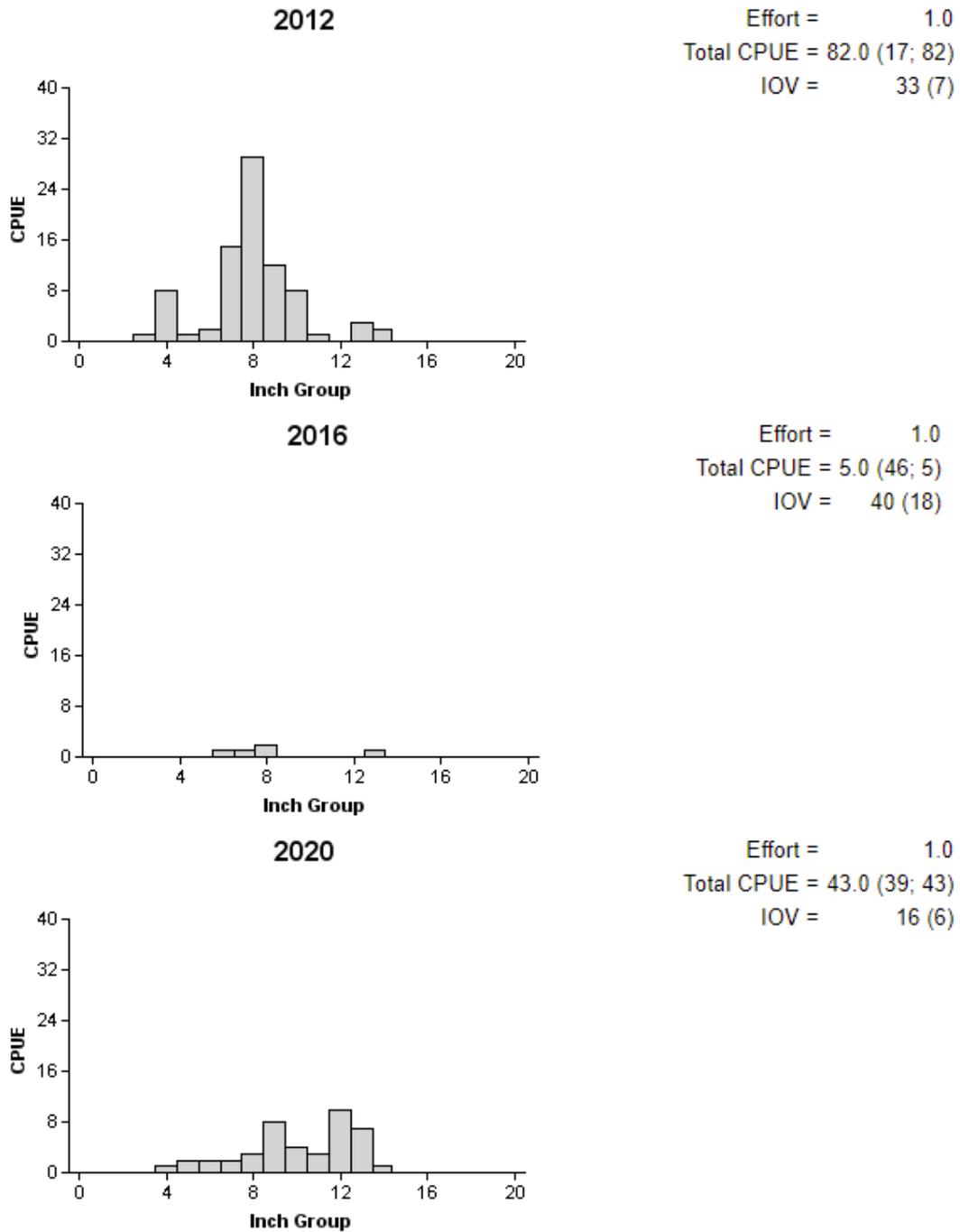


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Nacogdoches, Texas, 2012, 2016, and 2020.

# Bluegill

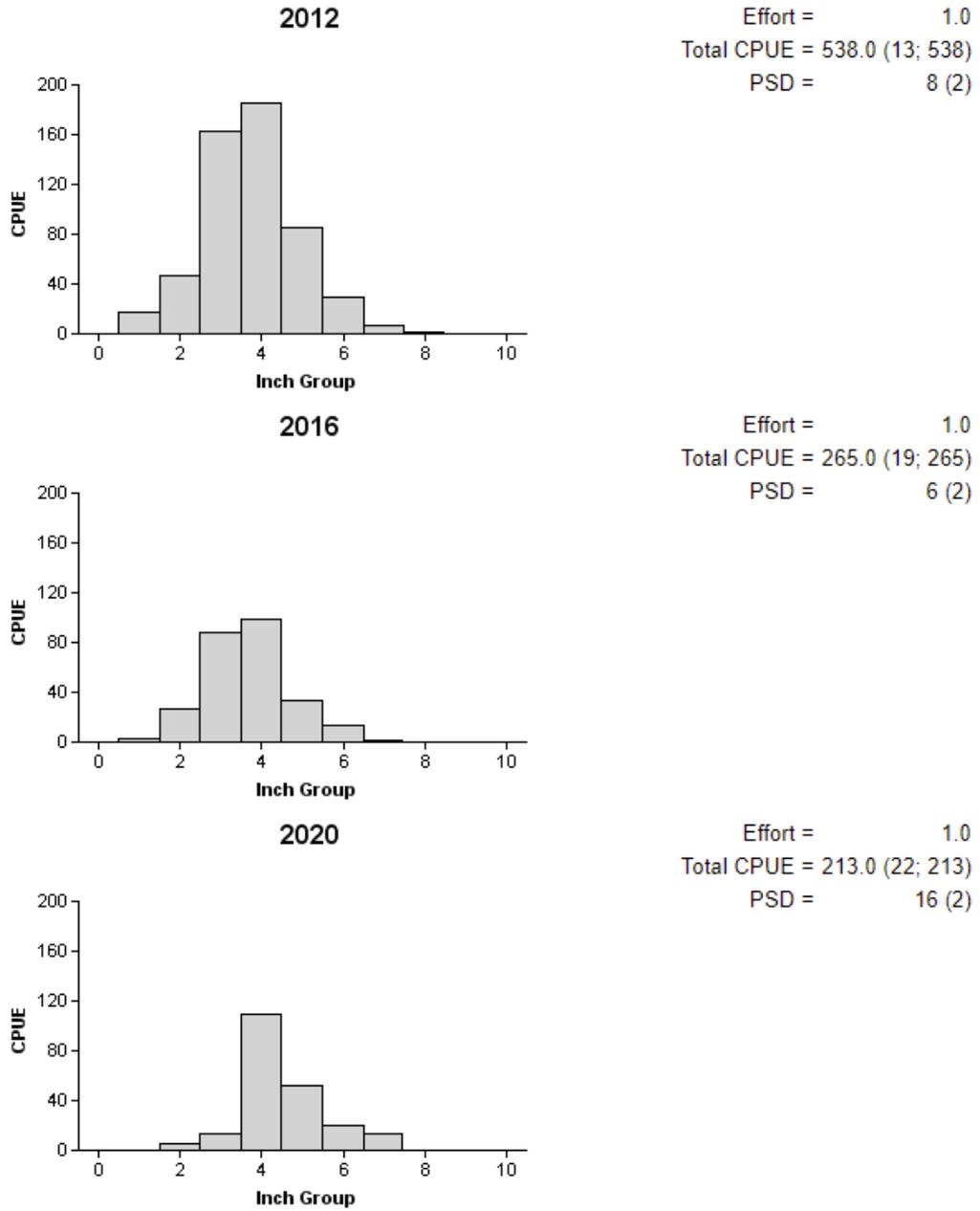


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Nacogdoches, Texas, 2012, 2016, and 2020.

## Sunfishes

Table 9. Creel survey statistics for sunfishes at Lake Nacogdoches, Texas from March through May 2013, 2017, and 2021. Total catch per hour is for anglers targeting sunfishes and total harvest is the estimated number of sunfishes harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year		
	2013	2017	2021
Surface area (acres)	2,212	2,212	2,212
Directed effort (h)		214 (100)	298 (97)
Directed effort/acre		0.1 (100)	0.1 (97)
Total catch per hour		1.5 (.)	0.6 (.)
Total harvest	52 (316)	265 (342)	509 (224)
Harvest/acre	< 0.1 (316)	0.1 (342)	0.2 (224)
Percent legal released	93	0	44

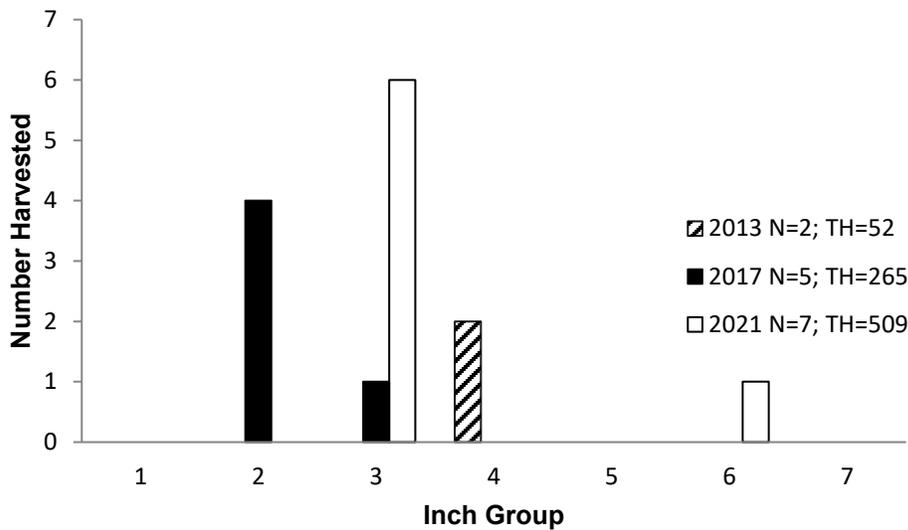


Figure 4. Length frequency of harvested Bluegill observed during creel surveys at Lake Nacogdoches, Texas, March through May 2013, 2017, and 2021, all anglers combined. N is the number of harvested Bluegill observed during creel surveys, and TH is the total estimated harvest for the creel period.

## Channel Catfish

Table 10. Creel survey statistics for catfishes at Lake Nacogdoches, Texas from March through May 2013, 2017, and 2021. 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		
	2013	2017	2021
Surface area (acres)	2,212	2,212	2,212
Directed effort (h)	280 (84)	811 (54)	230 (111)
Directed effort/acre	0.1 (84)	0.4 (54)	0.1 (111)
Total catch per hour	0.5 (40)	1.6 (66)	1.6 (70)
Total harvest	418 (90)	2,068 (57)	582 (160)
Harvest/acre	0.2 (90)	0.9 (57)	0.3 (160)
Percent legal released	0	5	10

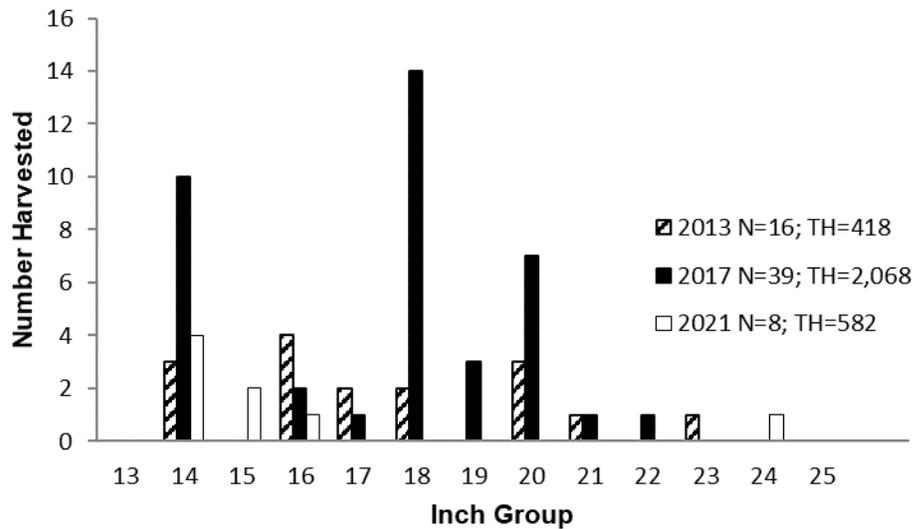


Figure 5. Length frequency of harvested Channel Catfish observed during creel surveys at Lake Nacogdoches, Texas, March through May 2013, 2017, and 2021, all anglers combined. N is the number of harvested Channel Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period.

## Spotted Bass

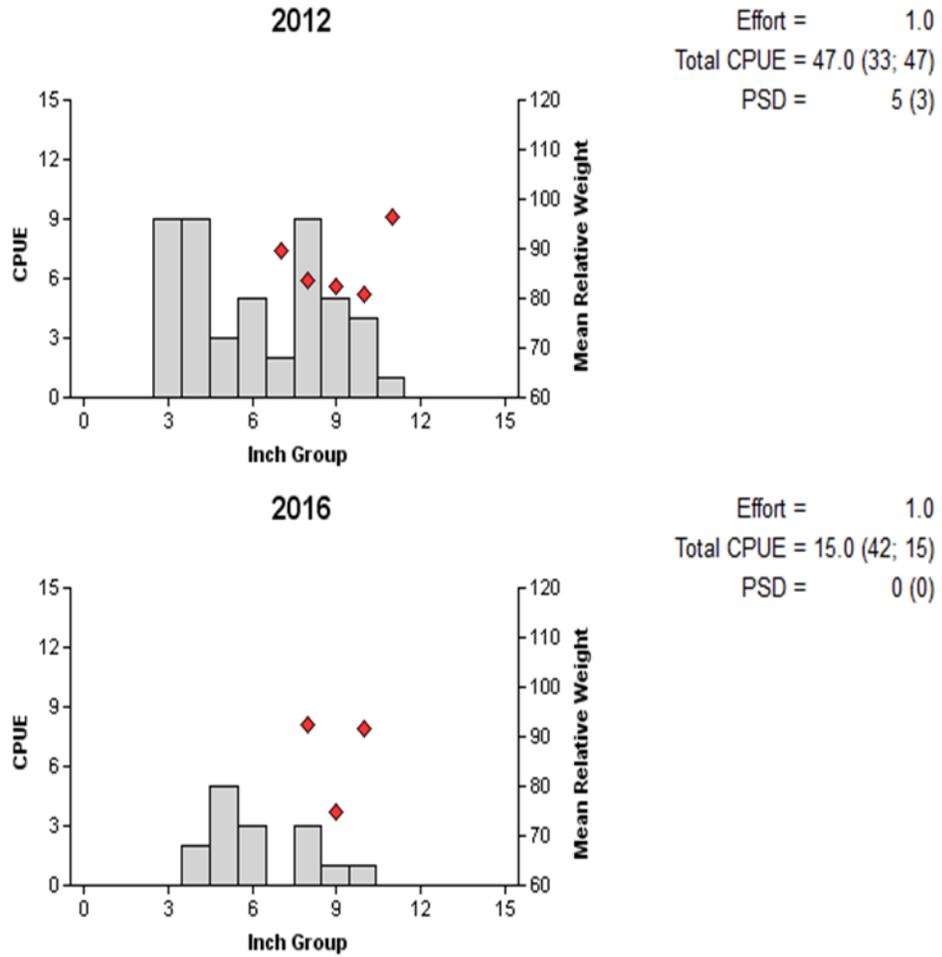


Figure 6. Number of Spotted Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing survey, Lake Nacogdoches, Texas, 2012 and 2016. No Spotted Bass were collected during the 2020 fall electrofishing survey.

## Largemouth Bass

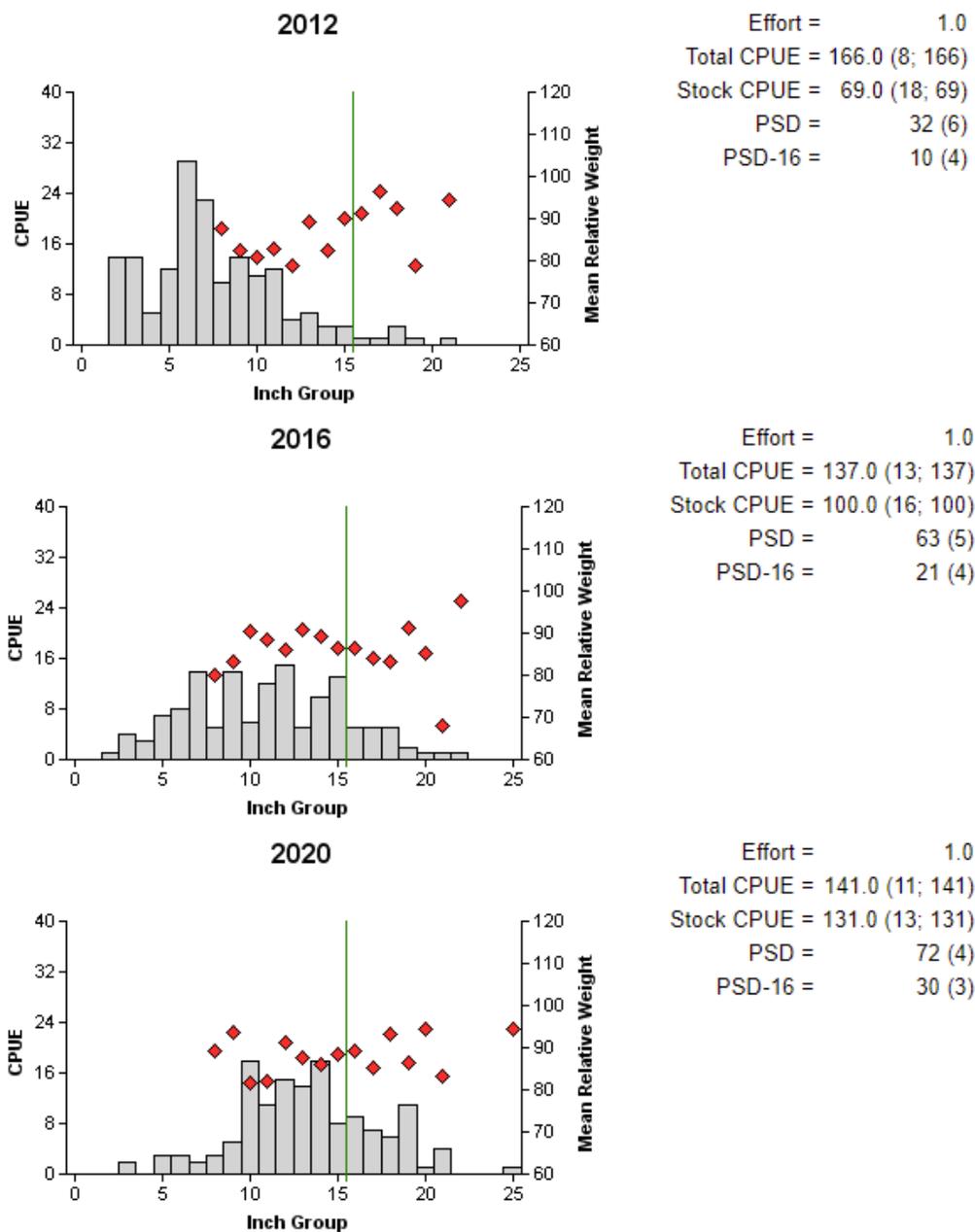


Figure 7. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Nacogdoches, Texas, 2012, 2016, and 2020. Vertical lines indicate maximum length limit.

## Largemouth Bass

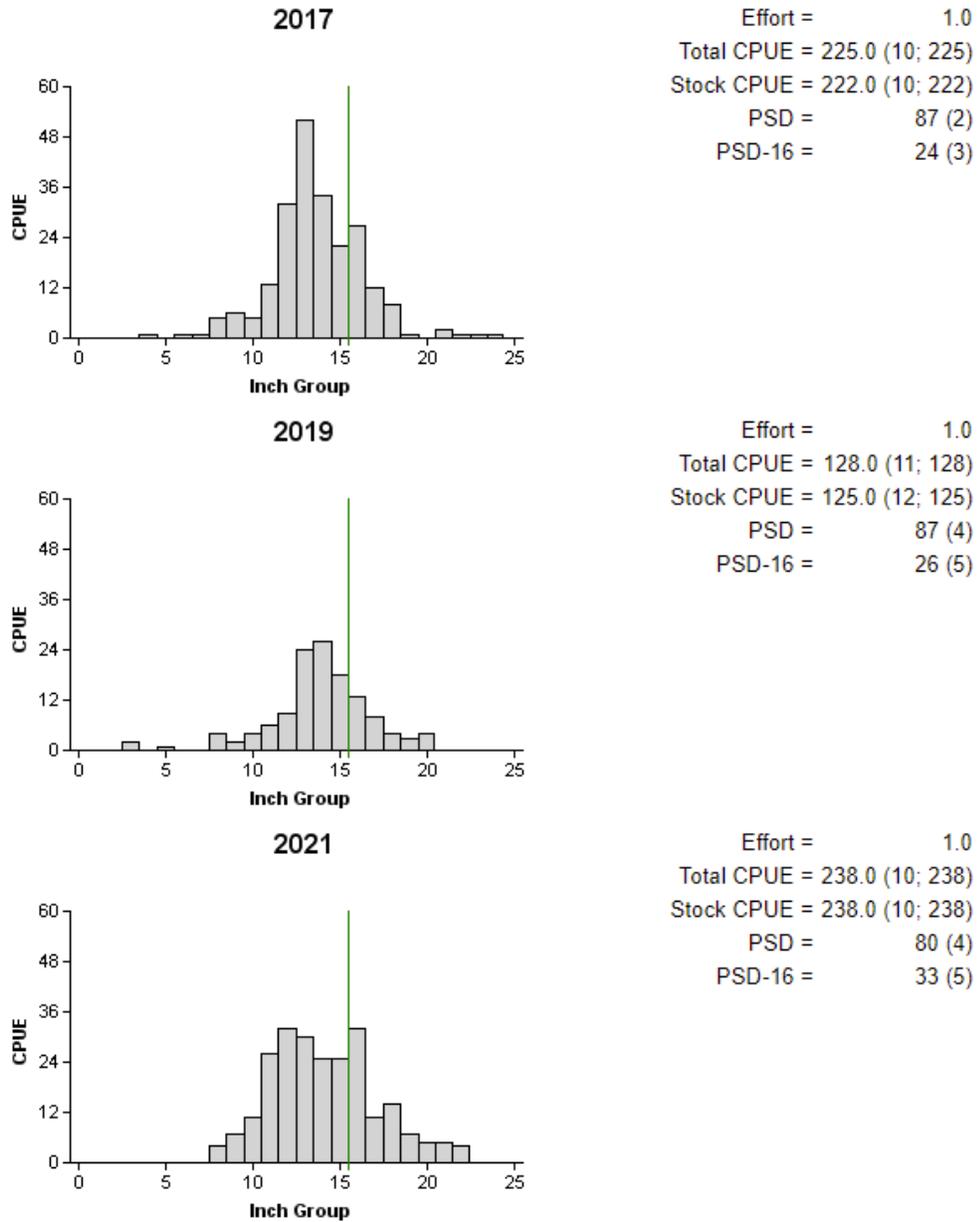


Figure 8. Number of Largemouth Bass caught per hour (CPUE, bars), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing surveys, Lake Nacogdoches, Texas, 2017, 2019, and 2021. Vertical lines indicate maximum length limit.

## Black Basses

Table 11. Creel survey statistics for black basses at Lake Nacogdoches, Texas, March through May 2013, 2017, and 2021. Catch rate is for all anglers targeting black basses. Harvest is partitioned by the estimated number of fish harvested by non-tournament anglers and the number of fish retained by tournament anglers for weigh-in and release. The estimated number of fish caught by weight category is for all anglers. Relative standard errors (RSE) are in parentheses.

Statistic	2013	2017	2021
Surface area (acres)	2,212	2,212	2,212
Directed angling effort (h)			
Tournament	0	4,821 (29)	0
Non-tournament	10,871 (29)	21,014 (23)	37,637 (12)
All black bass anglers combined	10,871 (29)	25,835 (23)	37,637 (12)
Angling effort/acre	4.9 (29)	11.7 (23)	17.0 (12)
Catch rate (number/h)	1.3 (15)	1.0 (12)	1.3 (9)
Harvest			
Non-tournament harvest	627 (57)	3,261 (40)	2,108 (32)
Harvest/acre	0.3 (57)	1.5 (40)	1.0 (32)
Tournament weigh-in and release	0	0	0
Release by weight			
< 4.0 lbs	16,347 (35)	25,276 (28)	41,971 (30)
≥ 4–6.9 lbs	1,017 (57)	1,239 (46)	2,766 (47)
≥ 7–9.9 lbs	170 (118)	59 (175)	207 (116)
≥ 10 lbs	34 (255)	0	0
Percent legal released (non-tournament)	90	84	93

## Largemouth Bass

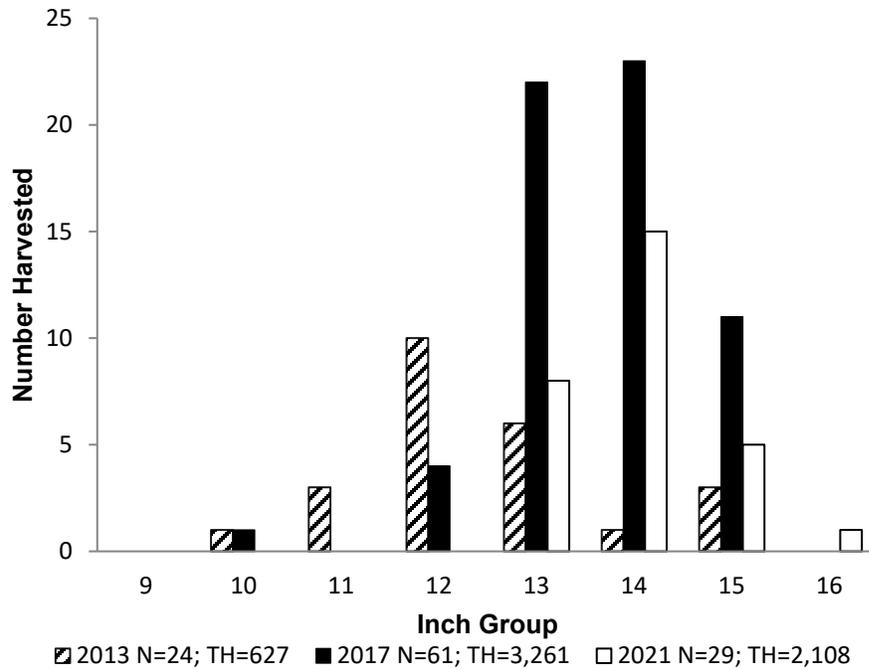


Figure 9. Length frequency of non-tournament harvested Largemouth Bass observed during creel surveys at Lake Nacogdoches, Texas, March through May 2013, 2017, and 2021, all anglers combined. N is the number of harvested Largemouth Bass observed during creel surveys, and TH is the estimated non-tournament harvest for the creel period.

## Crappies

Table 12. Creel survey statistics for crappies at Lake Nacogdoches, Texas, from March through May 2013, 2017, and 2021. 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.

Creel survey statistic	Year		
	2013	2017	2021
Surface area (acres)	2,212	2,212	2,212
Directed effort (h)	2,452.49 (37)	2,429.87 (36)	4,011.09 (28)
Directed effort/acre	1.11 (37)	1.10 (36)	1.81 (28)
Total catch per hour	1.76 (46)	1.52 (39)	2.27 (24.2)
Total harvest	2,376.31 (68)	5,195.49 (24)	8,215.18 (28)
Harvest/acre	1.07 (68)	2.35 (24)	3.7 (28)
Percent legal released	12	5	9

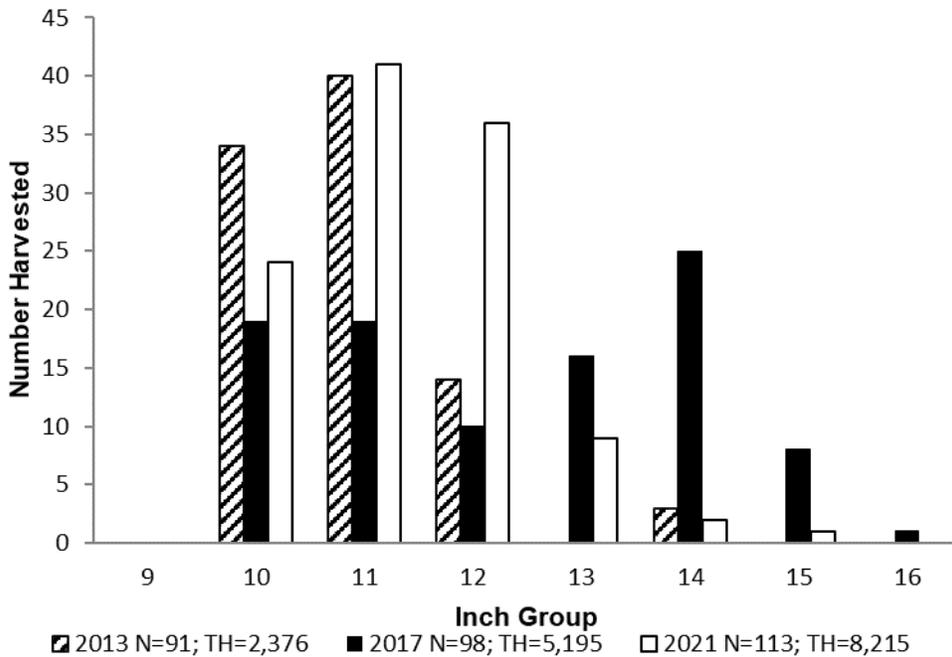


Figure 10. Length frequency of harvested crappies observed during creel surveys at Lake Nacogdoches, Texas, March through May 2013, 2017, and 2021, all anglers combined. N is the number of harvested crappies observed during creel surveys, and TH is the total estimated harvest for the creel period.

## Proposed Sampling Schedule

Table 13. Proposed sampling schedule for Lake Nacogdoches, Texas. Survey period is June through May. Electrofishing surveys are conducted in the fall and the spring.

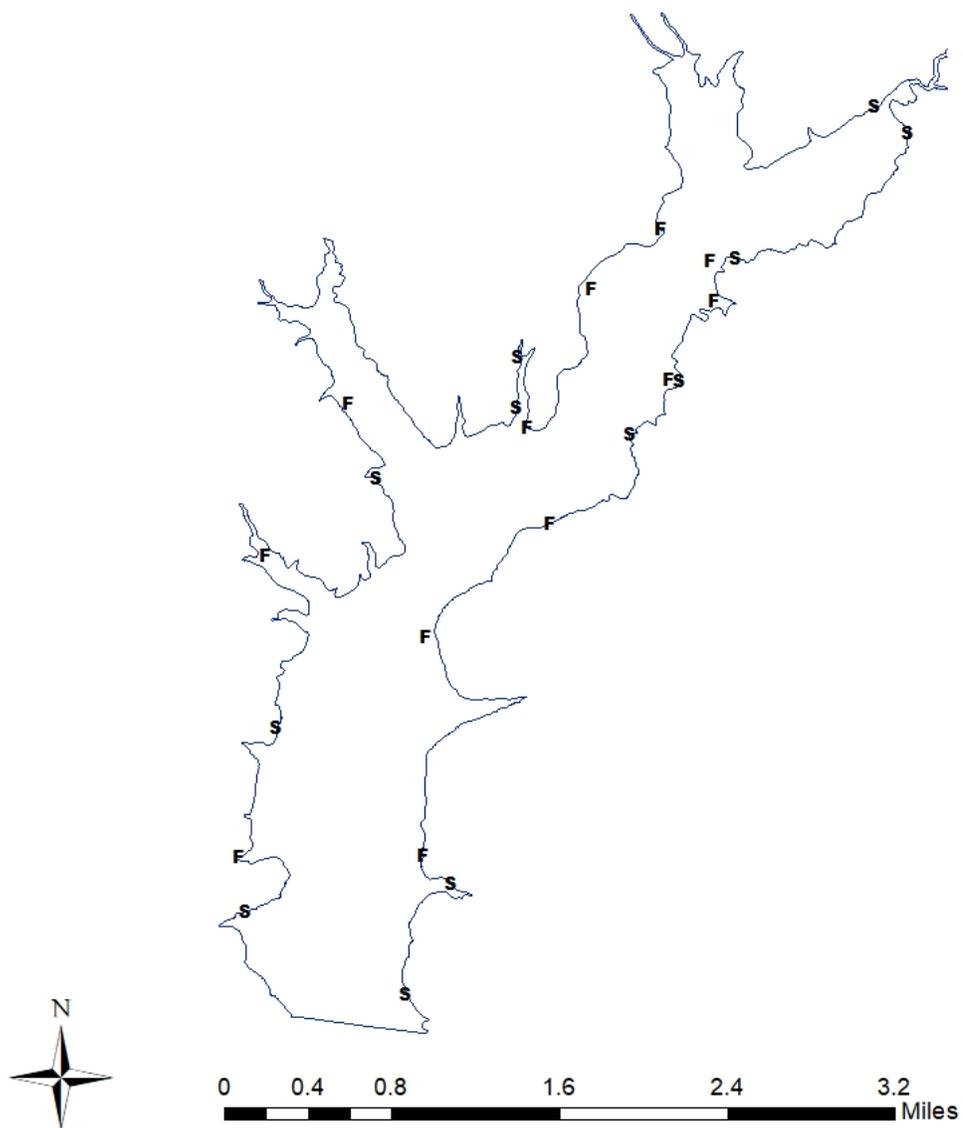
	Survey year			
	2021-2022	2022-2023	2023-2024	2024-2025
Angler Access				X
Vegetation	X	X	X	X
Electrofishing – Fall				X
Electrofishing – Spring (bass only)		X		X
Creel survey				X
Report				X

## APPENDIX A – Catch rates for all species from all gear types

Number (N) and catch rate (CPUE) (RSE in parentheses) of all target species collected from all gear types from Lake Nacogdoches, Texas, 2020-2021. Sampling effort was 1 hour for electrofishing.

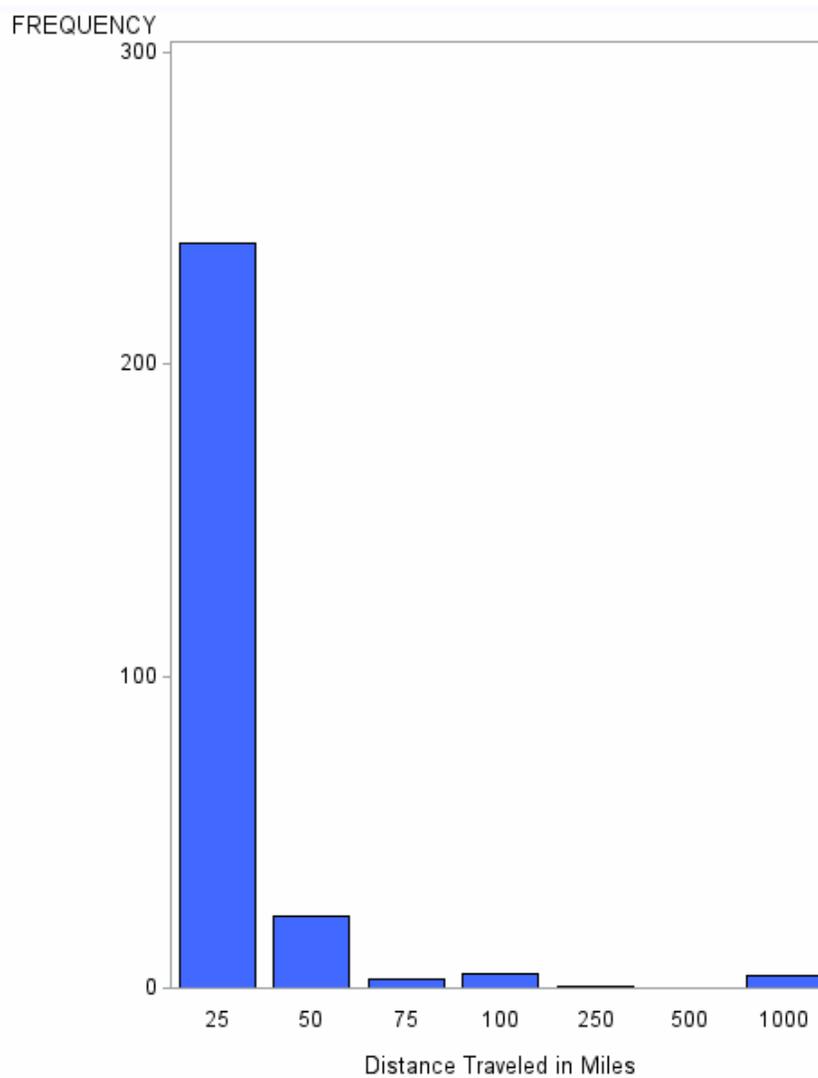
Species	Fall Electrofishing		Spring Electrofishing	
	N	CPUE	N	CPUE
Gizzard Shad	43	43.0 (39)		
Threadfin Shad	925	925.0 (45)		
Warmouth	3	3.0 (72)		
Bluegill	213	213.0 (22)		
Redear Sunfish	25	25.0 (49)		
Redspotted Sunfish	3	3.0 (100)		
Largemouth Bass	141	141.0 (11)	238	238.0 (10)

## APPENDIX B – Map of sampling locations



Location of sampling sites, Lake Nacogdoches Reservoir, Texas, 2020-2021. Fall electrofishing and spring electrofishing stations are indicated by F and S, respectively. Water level was near full pool at time of sampling.

## APPENDIX C – Reporting of creel ZIP code data



Frequency of anglers that traveled various distances (miles) to Lake Nacogdoches, Texas, as determined from the March through May 2021 creel survey.



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