

PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2015 Fisheries Management Survey Report

Highlands Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Highlands Reservoir were surveyed in 2015 using electrofishing and trap netting and in 2016 using gill netting. This report summarizes the results of the surveys and contains a management plan for the reservoir based on those findings.

- **Reservoir Description:** Highlands Reservoir is a 1,437-acre impoundment and canal system located on Goose Creek in the San Jacinto River Basin. The reservoir is located approximately 1 mile upstream from McNair, Texas and two miles north of Interstate Highway 10 in east central Harris County. The reservoir is owned by the San Jacinto River Authority and has a normal capacity of about 3,800 acre-feet. The twelve-foot-high Highlands Reservoir Dam has a crest length of 37,000 feet; it was constructed by the Federal Works Agency in 1943. The reservoir is used for local water supply. Highlands Reservoir has moderate productivity. Habitat features consist of standing timber, riprap, and non-native vegetation.
- **Management History:** Highlands Reservoir was opened to the public in 2015; therefore, no previous fisheries data had been collected. Previous management strategies were solely for water supply.
- **Fish Community**
 - **Prey species:** Threadfin Shad and to a lesser extent, Gizzard Shad, were both present in the reservoir. Longear Sunfish were moderately abundant providing an additional prey item to predator species. Several other sunfish species, including Bluegill, Green Sunfish, Redear Sunfish, and Warmouth were all present at low densities.
 - **Catfishes:** Channel Catfish and Blue Catfish were both present in the reservoir. Initial survey results suggest Blue Catfish are more abundant.
 - **Temperate basses:** Initial survey results suggested Yellow Bass and White Bass were present at low densities within the reservoir.
 - **Largemouth Bass:** Few Largemouth Bass were collected.
 - **White Crappie:** White Crappie were highly abundant with 88% being stock sized or larger.

Management Strategies: The primary goal is to continue to characterize the reservoir's habitat and fish populations through surveys and to improve the fishery by continuing to stock Florida Largemouth Bass when hatchery production allows. Efforts will be made to inform the public about the negative impacts of aquatic invasive species. Standard monitoring surveys (trap net, gill net, electrofishing, habitat, and access) will be conducted again in 2019-2020 with additional vegetation surveys being conducted in 2016-2017, 2017-2018, and 2018-2019.

INTRODUCTION

This document is a summary of popular sport fisheries data collection from Highlands Reservoir in 2015-2016. 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 not available and thus will not be presented with the 2015-2016 data for comparison.

Reservoir Description

Highlands Reservoir is a 1,437-acre impoundment located on Goose Creek in the San Jacinto River Basin made up of 3 components: a lower section, an upper section, and a canal system that runs a total of 28 miles (Figure 1). The regularly inundated portion of the reservoir is 518 acres, but during high water the lower and upper sections cover 931 and 509 acres respectively. The canal system is comprised of 3 sections: the 11 mile long main canal that supplies water from Lake Houston to Highlands Reservoir, the 8 mile long south canal, and the 9 mile long east canal (Figure 1). Highlands Reservoir is located in Harris County approximately one mile upstream from McNair and two miles north of Interstate 10; it is operated and controlled by the San Jacinto River Authority (SJRA). Primary water use is municipal water supply, but it was opened to the public in 2015 for recreational use. Habitat at time of sampling consisted of riprap, standing timber, and non-native emergent vegetation. Water level was 3-4 feet low at time of habitat survey. Other descriptive characteristics for Highlands Reservoir are recorded in Table 1.

Angler Access

Highlands Reservoir does not have a boat ramp, but as of July 2016 non-motorized watercraft are allowed to launch from the shore. Fishing is allowed from the shoreline, and the southern half has excellent maintained shoreline access. The northern half, located farther away from the parking area, has good bank access but with less vegetation maintenance.

Management History

Previous management strategies and actions: Highlands Reservoir was opened to the public in 2015. No prior sampling had been conducted by TPWD.

Harvest regulation history: There is no previous harvest regulation history. The reservoir is currently managed under statewide regulations (Table 2).

Stocking history: Grass Carp were stocked in 2008, 2011, and 2015. Florida Largemouth Bass and Bluegill were stocked in 2016 (Table 3).

Vegetation/habitat management history: Historically, vegetation has been managed by SJRA with glyphosate herbicide. Riprap areas have been treated for alligator weed as needed with the exception of a section along the northern half of the reservoir that is inaccessible; alligator weed is abundant along that edge. Triploid Grass Carp were stocked by SJRA in 2015 for hydrilla control in the water supply canals and were stocked in 2008 and 2011 by SJRA prior to the reservoir being made public.

Water transfer: Highlands Reservoir is primarily used for municipal and industrial water supply. One permanent pumping station on Lake Houston supplies water to the canal system that feeds Highlands Reservoir. Control gates at the top of Highlands Reservoir control the amount of water flowing into the reservoir with another set of control gates at the bottom controlling the outflow to the rest of the canal system. The lower canals provide water for industrial customers.

METHODS

Surveys were conducted to form a baseline understanding of the fish populations present in Highlands Reservoir. Methods were based on TPWD standard sampling protocols with the exception that electrofishing was conducted in the daytime for logistic reasons and 5 gill nets (instead of 10) were set due to limited water over 6 feet deep. All survey sites were randomly selected, and 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 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 White Crappie were determined using otoliths from 4 randomly-selected fish (range 9.0 to 10.9 inches).

Trap netting – Crappie were collected using trap nets (10 net nights at 10 stations). CPUE for trap netting was recorded as the number of fish caught per net night (fish/nn). Ages for White Crappie were determined using otoliths from 15 randomly-selected fish (range 9.0 to 10.9 inches).

Gill netting – Catfish were collected by gill netting (5 net nights at 5 stations). CPUE for gill netting was recorded as the number of fish caught per net night (fish/nn).

Genetics – Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures using DNA analysis (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

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.

Habitat – A structural habitat survey and a vegetation survey were conducted in 2015. Habitat was assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Water level – Water level was visually monitored by SJRA staff, and water levels fluctuated regularly to meet customer demand.

RESULTS AND DISCUSSION

Habitat: Littoral zone structural habitat consisted primarily of riprap and natural shoreline (Table 4). No native vegetation was found. Non-native vegetation covered less than 1% of the reservoir's surface area (Table 5) and included alligator weed. Historically, hydrilla has been present in the reservoir, but none was observed. Triploid Grass Carp were stocked in 2015. Water levels were 3-4 feet low at the time of the survey

Prey species: Electrofishing catch rates of Gizzard Shad, Bluegill, and Longear Sunfish were 4.0/h, 16.0/h, and 113.0/hr, respectively (Figures 2, 3, and 4). Index of vulnerability (IOV) for Gizzard Shad was excellent, indicating that 100% of Gizzard Shad were available to existing predators. However, according to gill net surveys the population may have been underestimated during electrofishing (gill net CPUE of 12.2), and due to lack of length data, IOV cannot be calculated for those samples.

Catfish: The gill net catch rate of Channel Catfish was 4.8/nn (Figure 5) in 2016, and gill net catch rate

of Blue Catfish was 13.2/nn (Figure 6). PSD was 33 and 20, respectively. Relative weight for Channel Catfish was less than ideal for fish less than 17 inches (W_r less than 90). Condition of Blue Catfish was worse with most individuals having relative weights around 80.

Temperate bass: There were no White Bass sampled during standard surveys. However, one individual was observed during supplemental electrofishing. Yellow Bass were collected during electrofishing surveys (CPUE of 7.0).

Largemouth Bass: The electrofishing catch rate of stock-length Largemouth Bass was 2.0/h in 2015 (Figure 7). Initial genetic analysis from the three Largemouth Bass collected indicated no Florida Largemouth Bass influence. This prompted a supplemental collection and analysis of an additional 26 fish collected by electrofishing in 2016, showing 97.4% Northern alleles and 77.6% Northern genotypes (Table 6). Body condition in 2016 was good (relative weight over 90) for stock-size fish.

White Crappie: The trap net catch rate of White Crappie was 21.4/nn, with a PSD of 41 (Figure 8). Mean relative weight was over 90 for most size classes in 2015. Some White Crappie reached 10 inches in total length (legal size) by age 1, and most were legal size by age 2 (Figure 9). No Black Crappie were observed.

Fisheries management plan for Highlands Reservoir, Texas

Prepared – June 2016.

ISSUE 1: Largemouth Bass population is minimal and genetic analysis suggests Florida Largemouth Bass influence is very low.

MANAGEMENT STRATEGY

1. Stock Florida Largemouth Bass annually at 100 fish/acre if available.

ISSUE 2: Trap net surveys indicate a quality White Crappie population at Highlands Reservoir.

MANAGEMENT STRATEGY

1. Promote crappie fishery through press releases and social media.

ISSUE 3: Gill net surveys indicate adequate Blue Catfish and Channel Catfish populations at Highlands Reservoir. Anecdotal angler information indicate an interest in the fishery.

MANAGEMENT STRATEGY

1. Promote Catfish fishery through press releases and social media.

ISSUE 4: Lower portion (main section) of the reservoir has poor habitat.

MANAGEMENT STRATEGY

1. Consult with San Jacinto River Authority to discuss the possibility of structural habitat improvement and establishment of native vegetation in the reservoir.

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 posters, literature, etc. so that they can in turn educate their customers.
3. Educate the public about invasive species through the use of media and the internet.
4. Make a speaking point about invasive species when presenting to constituent and user groups.
5. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.

Objective-Based Sampling Plan and Schedule

Sport fish, forage fish, and other important fishes

Since Highlands Reservoir was opened to the public in 2015 and has only been sampled in 2015-2016, we are still compiling baseline fisheries information.

Low-density fisheries

Additional data collection using standard survey methods will be needed to determine negligible fisheries.

Survey objectives, fisheries metrics, and sampling objectives

All Species: Since only one year of fisheries data has been collected from Highlands Reservoir, additional sampling is necessary to establish baseline data. Because there is no boat ramp at Highlands Reservoir, boat access must be gained from a channel in a secured area of San Jacinto River Authority property. Due to limited boat access, daytime electrofishing will continue to be conducted with 12 randomly selected 5 minute stations in the fall of 2019. Additionally, random trap netting will be conducted in the fall of 2019 (10 nn) and random gill netting will be conducted in the spring of 2020 (5 nn) (Table 7).

LITERATURE CITED

- Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.
- DiCenzo, V. J., M. J. Maceina, and M. R. Stimpert. 1996. Relations between reservoir trophic state and Gizzard Shad population characteristics in Alabama reservoirs. North American Journal of Fisheries Management 16:888-895.
- Guy, C. S., R. M. Neumann, D. W. Willis, and R. O. Anderson. 2007. Proportional size distribution (PSD): a further refinement of population size structure index terminology. Fisheries 32(7): 348.

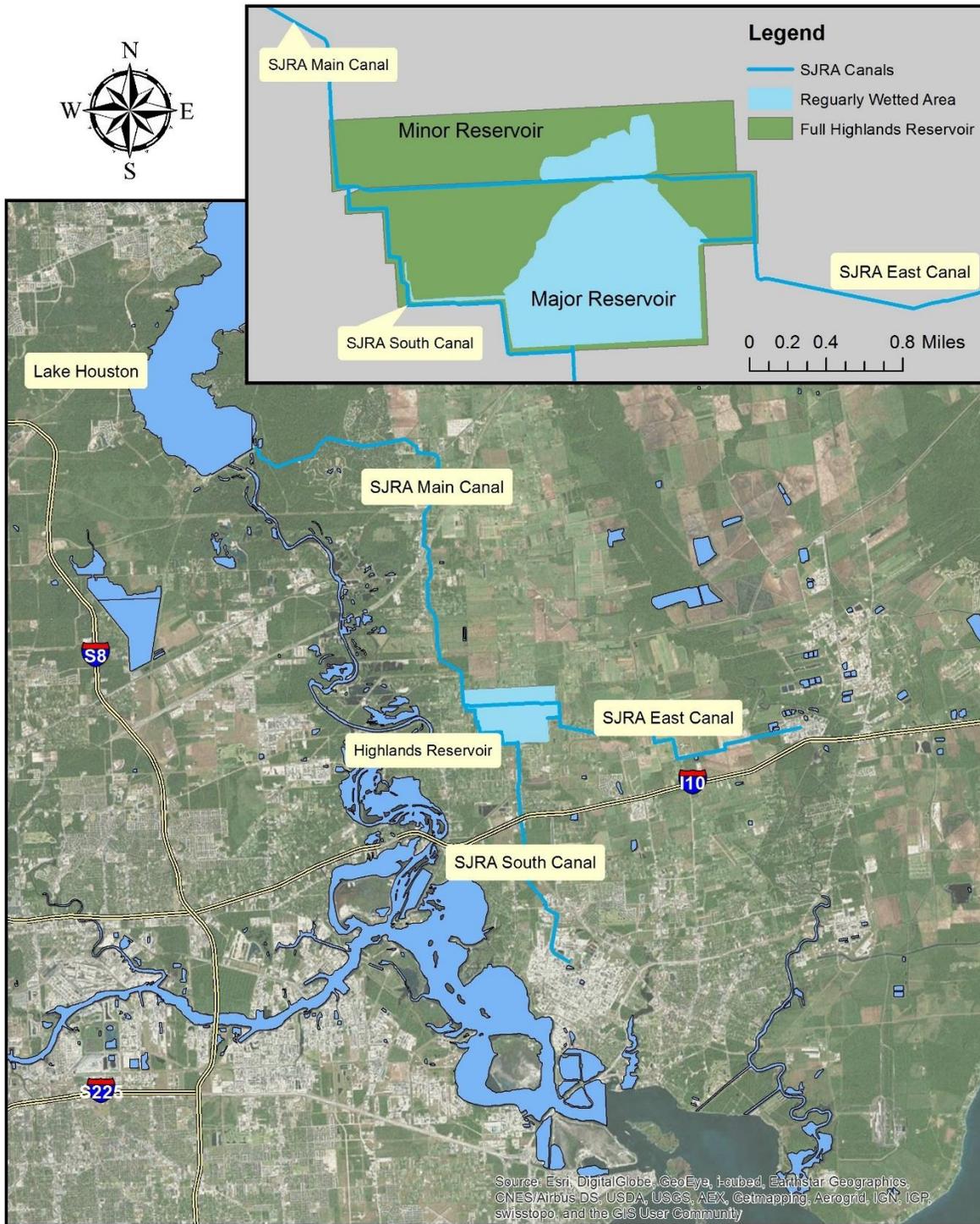


Figure 1. Map of Highlands Reservoir, Texas with associated San Jacinto River Authority canals.

Table 1. Characteristics of Highlands Reservoir, Texas.

Characteristic	Description
Year constructed	1943
Controlling authority	San Jacinto River Authority
County	Harris
Reservoir type	Water Supply
Conductivity	83 μ S/cm
Major section area	931 acres
Minor section area	509 acres
Total reservoir area	1437 acres
Regularly inundated area	518 acres
Main canal length ^a	11 miles
South canal length ^a	8 miles
East canal length ^a	9 miles
Total canal length ^a	28 miles

^a Average canal width is 20 feet

Table 2. Harvest regulations for Highlands Reservoir, 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, White	25	10-inch minimum
Bass, Largemouth	5 ^a	14-inch minimum
Crappie: White and Black crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

^a Daily bag for Largemouth Bass and Spotted Bass = 5 fish in any combination.

Table 3. Stocking history of Highlands Reservoir, Texas. FGL = fingerling, ADL = adults.

Species	Year	Number	Size
Grass Carp	2008	9,000	ADL
	2011	4,000	ADL
	2015	4,000	ADL
Bluegill	2016	109,429	FGL
Florida Largemouth Bass	2016	136,478	FGL

Table 4. Survey of structural habitat types, Highlands Reservoir, Texas, 2015. Shoreline habitat type units are in miles.

Habitat type	Estimate	% of total
Natural	0.7 miles	19.4
Rocky	2.1 miles	58.3
Standing timber	0.8 miles	22.2

Table 5. Surface area (acres) of aquatic vegetation, Highlands Reservoir, Texas, 2016

Vegetation	2016
Non-native	
Alligator weed (Tier III)*	< 1.0

*Tier III is Watch Status

Gizzard Shad

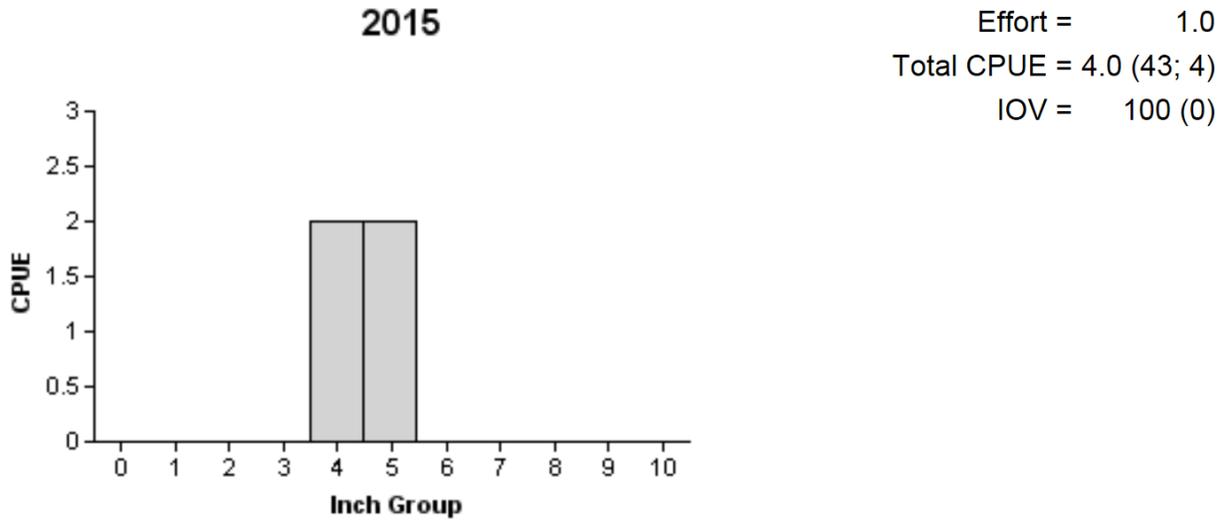


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for the fall electrofishing survey, Highlands Reservoir, Texas, 2015.

Bluegill

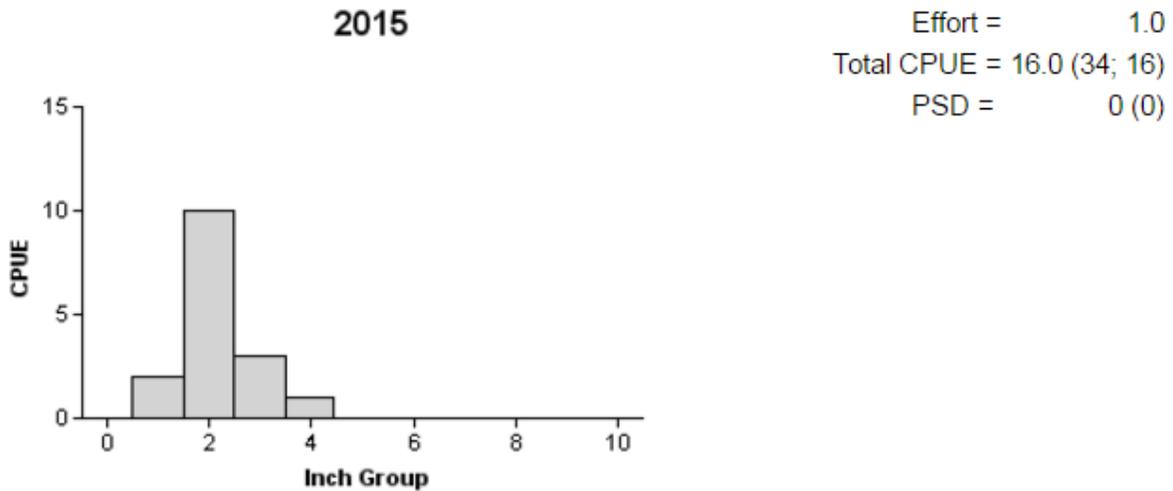


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for the fall electrofishing survey, Highlands Reservoir, Texas, 2015.

Longear Sunfish

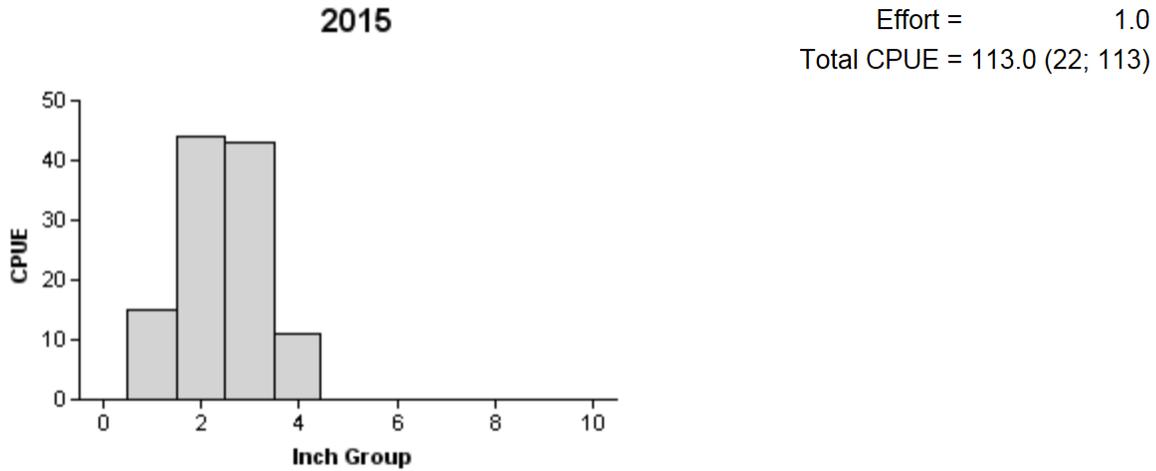


Figure 6. Number of Longear Sunfish caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for the fall electrofishing survey, Highlands Reservoir, Texas, 2015.

Channel Catfish

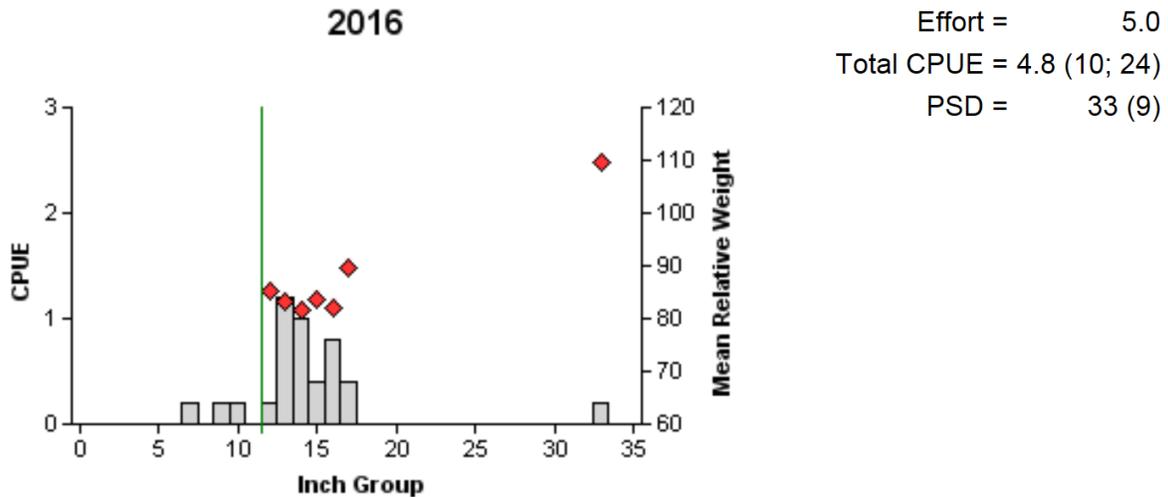


Figure 4. Number of Channel Catfish caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for the spring gill net survey, Highlands Reservoir, Texas, 2016. Vertical line indicates minimum length limit.

Blue Catfish

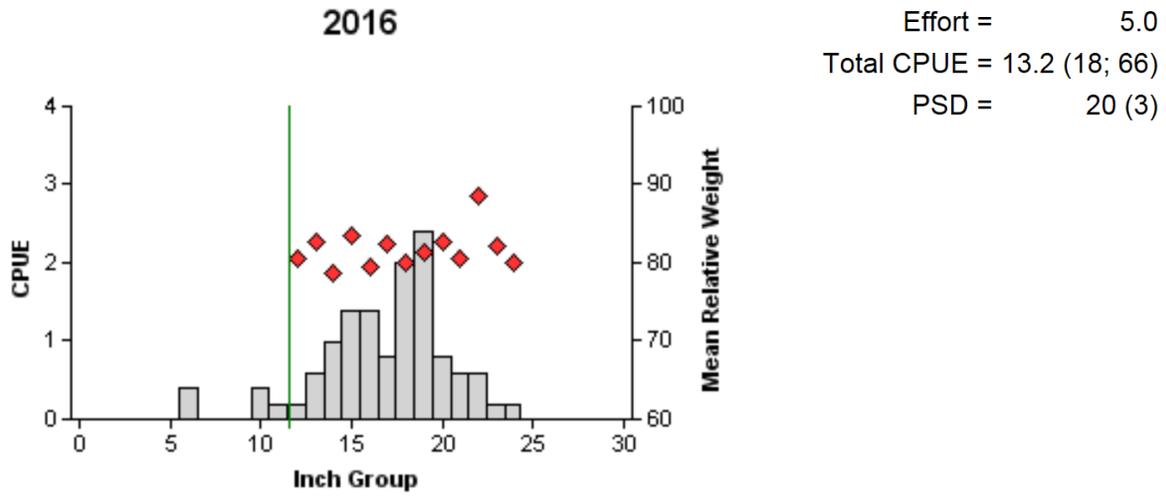


Figure 5. Number of Blue Catfish caught per net night (CPUE), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for the spring gill netting survey, Highlands Reservoir, Texas, 2016. Vertical line indicates minimum length limit.

Largemouth Bass

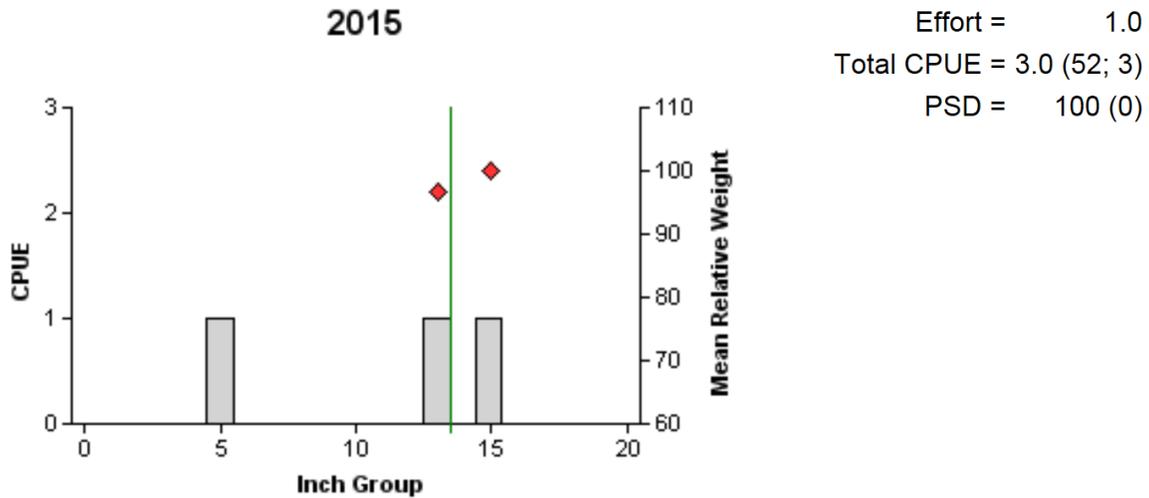


Figure 7. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for the fall electrofishing survey, Highlands Reservoir, Texas, 2015. Vertical line indicates minimum length limit.

Table 6. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Highlands Reservoir, Texas. 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 a NLMB. Genetic composition was determined with micro-satellite DNA analysis.

Year	Sample size	Number of fish				% FLMB alleles	% pure FLMB
		FLMB	F1	Fx	NLMB		
2015	29	0	0	7	22	3	0

White Crappie

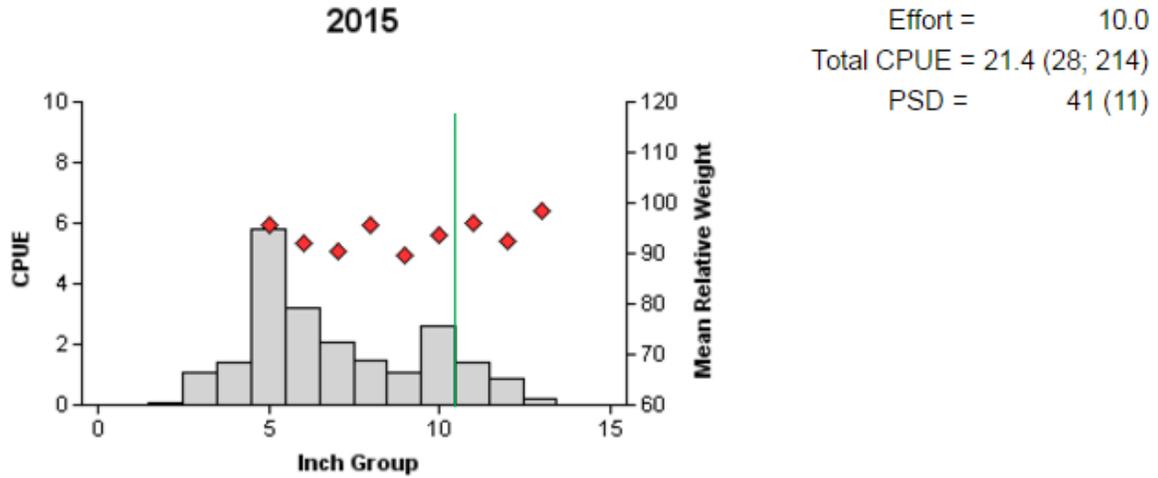


Figure 8. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for the fall trap netting survey, Highlands Reservoir, Texas, 2015. Vertical line indicates minimum length limit.

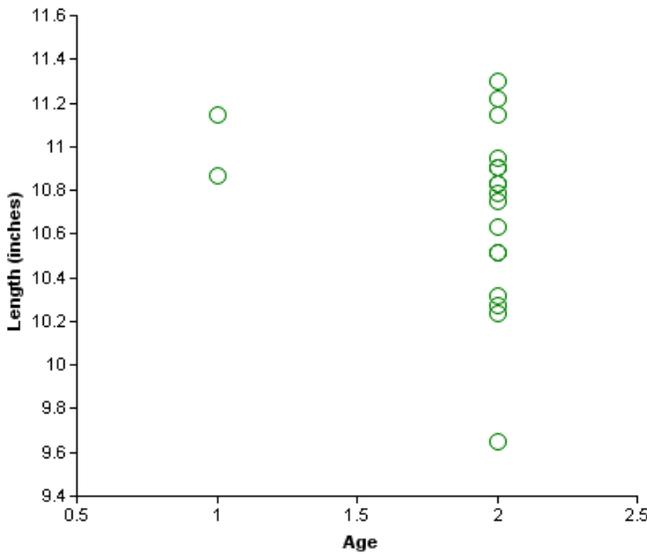


Figure 9. Length at age for White Crappie collected from trap netting and electrofishing at Highlands Reservoir, Texas, 2015.

Table 7. Proposed sampling schedule for Highlands Reservoir, Texas. Survey period is June through May. 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.

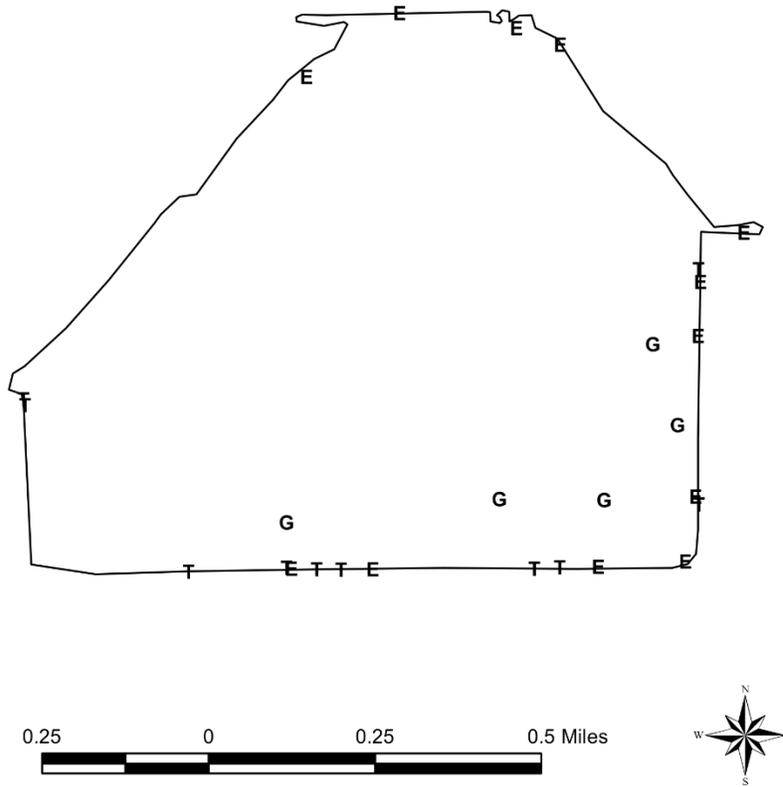
Survey year	Electrofishing Fall(Spring)	Trap netting	Gill netting	Habitat		Access	Report
				Structural	Vegetation		
2016-2017					A		
2017-2018					A		
2018-2019					A		
2019-2020	S	S	S	S	S	S	S

APPENDIX A

Number (N) and catch rate (CPUE) of all species collected from all gear types from Highlands Reservoir, Texas, 2015-2016. Sampling effort was 5 net nights for gill netting, 10 net nights for trap netting, and 1 hour for electrofishing.

Species	Gill Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Spotted Gar	7	1.4			2	2.0
Gizzard Shad	61	12.2			4	4.0
Threadfin Shad					151	151.0
Common Carp					2	2.0
Bullhead Minnow					24	24.0
Smallmouth Buffalo	34	6.8			12	12.0
Channel Catfish	24	4.8				
Blue Catfish	66	13.2			2	2.0
Yellow Bullhead					3	3.0
Yellow Bass	1	0.2			7	7.0
Green Sunfish					1	1.0
Warmouth					1	1.0
Bluegill					16	16.0
Longear Sunfish					113	113.0
Redear Sunfish					5	5.0
Largemouth Bass					3	3.0
White Crappie	9	1.8	214	21.4	17	17.0
Freshwater Drum	34	6.8			3	3.0
Grass Carp	1	0.2				

APPENDIX B



Location of sampling sites, Highlands Reservoir, Texas, 2015-2016. Trap net, gill net, and electrofishing stations are indicated by T, G, and E, respectively. Water level was 3-4 feet low at time of sampling.