B.A. Steinhagen Reservoir

2017 Fisheries Management Survey Report

PERFORMANCE REPORT

As Required by

FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-3

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

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Survey and Management Summary

Fish populations in B.A. Steinhagen Reservoir were surveyed in 2017 using electrofishing and trap netting and in 2018 using gill netting. Historical data are presented with the 2017-2018 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: B.A. Steinhagen Reservoir was impounded in 1951 on the Neches River; other tributaries include the Angelina River and Wolf, Sandy, Spring, and Rush creeks. The U.S. Army Corps of Engineers (USACE) is the controlling authority; primary uses are to regulate intermittent water releases from Sam Rayburn Reservoir, produce hydropower, and provide recreational opportunities. At conservation pool (82.5 feet mean sea level), B.A. Steinhagen Reservoir covers 10,687 acres and has a shoreline length of 160 miles. Mean depth is 4 feet and littoral areas (< 15 feet) comprised 95 percent of the reservoir. Boat access is excellent, with 11 access points and adequate parking at each. Bank access is provided by two lighted fishing piers at Martin Dies, Jr. State Park. Most of the land around the reservoir is used for timber production.

Management History: Important sport fishes include Largemouth Bass, crappies, and catfishes. Non-native vegetation has been problematic in the reservoir and included salvinia (both common and giant), hydrilla, alligatorweed, and water hyacinth. The USACE conducted a water level draw down from May 2006 through June 2007 to reduce vegetative coverage. Since 2008, the USACE has funded and managed extensive herbicide treatments in cooperation with the Lower Neches Valley Authority (LVNA), Texas Parks and Wildlife Department (TPWD), and private applicators. In January 2010, the USACE conducted a short term winter draw down during a freeze event to further reduce problematic vegetative coverage. Blue and Channel Catfish fingerlings were stocked following the water level draw down that occurred during 2006 and 2007 to improve recruitment.

Fish Community

- **Prey species:** Threadfin Shad were present in the reservoir. Electrofishing catch of Gizzard Shad was low, and 34% of Gizzard Shad were available as prey to most sport fish. Electrofishing catch of Bluegill was low, with no fish observed over 6-inches long.
- **Catfishes:** Blue and Channel Catfish were present in the reservoir. Since 2014, Blue Catfish and Channel Catfish abundance has slightly increased. Blue Catfish was the predominate species.
- **Temperate basses:** White bass were present but abundance was low.
- **Black basses:** Spotted Bass were present in low numbers. Largemouth Bass were moderately abundant and in good condition. Size structure was relatively similar over the last three surveys; most fish were < 14 inches in length.
- **Crappies:** White Crappie and Black Crappie were present in the reservoir, with White Crappie as the predominate species.

Management Strategies: Continue to manage the fishery with statewide harvest regulations. Continue to monitor trends of vegetative coverage through annual aquatic vegetation surveys (2018-2021). Conduct standard population monitoring with fall electrofishing and trap net surveys in 2021, and a gill net survey in 2022.

Introduction

This document is a summary of fisheries data collected from B.A. Steinhagen Reservoir in 2017-2018. 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 2017-2018 data for comparison.

Reservoir Description

B.A. Steinhagen Reservoir (impounded in 1951) is an impoundment of the Neches River (Table 1); other tributaries include the Angelina River and Wolf, Sandy, Spring, and Rush Creeks. The U.S. Army Corps of Engineers (USACE) is the controlling authority; primary uses are to regulate intermittent water releases from Sam Rayburn Reservoir, produce hydropower, and provide recreational opportunities. At conservation pool (82.5 feet mean sea level), B.A. Steinhagen Reservoir covers 10,687 acres and has a shoreline length of 160 miles. Mean depth is 4 feet and littoral areas (< 15 feet) comprised 95 percent of the reservoir. Although water levels are relatively stable (Figure 1), during May 2006 to June 2007 the reservoir was drawn down 12 feet for dam repairs and to help reduce problematic vegetation. The reservoir was temporarily drawn down again in the winter of 2009 during a freeze event to reduce problematic vegetation. Currently, non-native plants include water hyacinth, salvinia (both common and giant), and hydrilla. Most of the land around the reservoir is used for timber production.

Angler Access

Boat access is excellent at B. A. Steinhagen Reservoir, with 11 access points and adequate parking at each. Bank access is provided by two lighted fishing piers at Martin Dies, Jr. State Park. Handicap specific facilities are limited to fishing piers. During times of peak vegetation coverage, angler access can become limited, especially in the upper end of the reservoir. B.A. Steinhagen Reservoir also has three designated paddling trails that range from 3 to 16 miles in length. Additional boat ramp characteristics are in Table 2.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Ashe and Driscoll 2014) included:

1. Conduct annual aquatic vegetation surveys and recommend treatment if necessary.

   Action: Annual aquatic vegetation surveys were conducted in August of 2014 through 2017 to monitor vegetation coverage. The USACE has managed and maintained an aggressive aquatic vegetation treatment program.

Harvest regulation history: Sport fishes in B.A. Steinhagen Reservoir are currently managed with statewide regulations (Table 3).

Stocking history: During the last ten years, only Blue Catfish (70,159) and Channel Catfish (210,557) were stocked (Table 4). Florida Largemouth Bass were last stocked in 2000 (408,432).

Vegetation/habitat management history: Historically, B.A. Steinhagen Reservoir has suffered from continual problems associated with excess aquatic vegetation coverage exacerbated by the average depth of 4 feet. Abundant species have included American lotus, water hyacinth, hydrilla, salvinia, and alligatorweed. A 12-foot reservoir drawdown was conducted in 2006 and 2007, followed by another temporary drawdown in 2009 (Figure 1) to help reduce problematic vegetation coverage. Furthermore, the USACE, in cooperation with the LNVA and TPWD, has funded and managed extensive aquatic herbicide treatments via private contractors since 2008. During most years, annual treatments have ranged from 2,000 to 3,000 acres.

Water transfer: The LNVA is authorized to draw a maximum of 2,000 cubic feet per second from the reservoir. This water allotment is available to the agency whenever needed and water is drawn directly through the Town Bluff Dam tainter gates. However, if the normal pool capacity is not adequate to satisfy the requirements over an extended period of time, Sam Rayburn Dam can release conservation water directly into B. A. Steinhagen Reservoir. No interbasin water transfers exist.

Methods

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for B.A. Steinhagen Reservoir (TPWD, unpublished). 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 2015), with the exception of the fall electrofishing survey. Electrofishing was conducted during daylight hours due to the turbid nature of the reservoir.

Electrofishing – Black basses, sunfishes, Gizzard Shad, and Threadfin Shad were collected by electrofishing (1.7 hours at 20, 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 11 randomly-selected fish (range 13.0 to 14.9 inches).

Trap netting – Crappies were collected using trap nets (20 net nights at 20 stations). CPUE for trap netting was recorded as the number of fish caught per net night (fish/nn).

Gill netting – Catfishes and White Bass were collected by gill netting (10 net nights at 10 stations). 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.

Habitat – A structural habitat survey was conducted in 2002 (Smith and Driscoll 2003). Vegetation surveys were conducted annually from 2014–2017. Habitat was 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 2018).

Results and Discussion

Habitat: A habitat survey conducted in 2002 indicated that the littoral zone included primarily overhanging brush and dead timber (Smith and Driscoll 2003). Problematic plants in the reservoir included salvinia (both common and giant), water hyacinth, and hydrilla. Giant salvinia was first discovered in 2007 and peak coverage occurred in 2012 and again in 2014 (8% coverage both years) (Table 6). Since 2015, salvinia coverage has been mixed with surface mats of American lotus and water hyacinth throughout the reservoir, ranging from 1,000 – 1,500 surface acres (Table 6). During 2017, 3,103 acres of aquatic vegetation was observed (29% coverage). In 2017, hydrilla coverage increased to 1,720 acres and was also problematic, but primarily at access points and boat lanes. Private contractors treated approximately 3,195 acres of aquatic vegetation in 2017.

Prey species: The most abundant prey species captured in electrofishing surveys consisted of Threadfin Shad, Gizzard Shad, and Bluegill (Figures 2, 3, 4, and 5; Appendix A). Gizzard shad catch rate was low in 2017 (17.4/h) with most fish unavailable as prey (IOV=34) (Figure 3). Bluegill was the predominant sunfish species; catch rate was 42.6/h in 2017 (Figure 5). Electrofishing was conducted during the day in 2017, so abundance trends relative to previous surveys were not discussed. Regardless, Gizzard Shad and Bluegill catch rates were relatively low during the last three surveys.

Catfishes: Blue Catfish gill net catch rates have increased over the past three surveys (12.7/nn in 2018; 9.3/nn in 2014; 3.2/nn in 2010) (Figure 6). PSD values have remained consistent over the past 3 surveys

(range = 14-19). The majority of the fish observed over the past three surveys were ≥ 12 inches in length.

Historically, Channel Catfish abundance has been low but appears to be stable. The 2018 gill net catch rate (4.8/nn) was similar to catch rates observed in 2014 (3.1/nn) and 2010 (3.2/nn) (Figure 7). Relative weights exceeded 80 and were similar to the past three survey years.

Temperate basses: During the last three survey years, catch rates of White Bass ranged from 0.3 – 1.9/nn and reflected a low-density population in the reservoir (Figure 8). Yellow bass were present (Appendix A).

Black basses: Spotted Bass were present but in low abundance. Electrofishing catch rates were < 7.0/h over the last three surveys (Figures 9 and 10).

Electrofishing catch rates of Largemouth Bass ranged from 42.0 to 64.0/h during the last three surveys (Figures 11 and 12), and population size structure was consistently dominated by smaller individuals < 14 inches in length (PSD range: 25 – 47). Relative weights were moderate (range = 83 – 107), indicating that growth is not limited by lack of forage. Growth of Largemouth Bass was adequate; average age at 14 inches (13.5 to 14.5 inches) was 3.1 years (N = 11; range = 2 - 4 years).

Crappies: White and Black Crappie were present in the reservoir (Figures 13 and 14). White Crappie has historically been the predominate species. In 2017, White Crappie abundance (6.6/nn) decreased when compared to the 2013 survey (18.4/nn) (Figure 13). Black Crappie abundance from the 2017 survey (1.0/nn) was similar to 2013 (0.6/nn) but significantly less than 2009 (19.4/nn) (Figure 14). However, during the 2009 survey a single net yielded a disproportionate number of fish and skewed the data upward.

Fisheries Management Plan for B.A. Steinhagen Reservoir, Texas

Prepared – July 2018

ISSUE 1: 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.

Historically, vegetative coverage in B.A. Steinhagen Reservoir has exceeded 50%, mostly by problematic plants (water hyacinth, salvinia, hydrilla, and alligatorweed). In 2005, problematic plants covered approximately 3,255 acres (30.5%) of the reservoir. In 2006 to 2007, a reservoir drawdown was conducted to allow desiccation of problematic plants followed by a temporary draw down in 2009 during a winter freeze event. Beginning in 2008, the USACE has maintained an aggressive aquatic herbicide program during each growing season to further control problematic plants.

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. 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.
6. In cooperation with AHE staff, recommend that the USACE continue annual aquatic herbicide treatments to maintain public access and control large areas of problematic plant infestations. LNVA has agreed to assist USACE with funding for herbicide treatments.
7. Recommend that the USACE conduct drawdowns during predicted winter freeze events to further control problematic aquatic plant infestations.
8. If salvinia coverage expands and plants are not accessible for herbicide treatments, assist AHE staff with salvinia weevil introduction in these areas.

Objective-Based Sampling Plan and Schedule (2018–2022)

Sport fish, forage fish, and other important fishes

Sport fishes in B.A. Steinhagen Reservoir include Largemouth Bass, Spotted Bass, crappies, Blue Catfish, Channel Catfish, Flathead Catfish, and White Bass. Important forage species include Bluegill, Threadfin Shad, and Gizzard Shad.

Low-density fisheries

Historically, White Bass population abundance has been low. Anecdotal information indicates few anglers target White Bass. Although no future directed sampling is planned, White Bass catch will be recorded from gill net surveys directed at catfishes (see below).

Survey objectives, fisheries metrics, and sampling objectives

Largemouth Bass: Historically, Largemouth Bass have been managed with the statewide 14-inch minimum length limit. Since 2002 - 2013, trend data on CPUE, size structure, and body condition have been collected every four years with nighttime, fall electrofishing. Population abundance is relatively low but stable, and size structure has been consistent. Due to the shallow and turbid nature of the reservoir, daytime fall electrofishing (2021, and every four years thereafter) will allow for determination of any large-scale changes in the Largemouth Bass population. The anticipated effort to meet sampling objectives (N = 50 stock-size fish; RSE-S $\leq$ 25) is approximately 20 5-min stations with 80% confidence. An additional 5-10 sites will be sampled if objectives are not attained.

Average age of Largemouth Bass between 13.0 and 14.9 inches (Category 2; N = 13) will be estimated in 2021, and every four years thereafter.

Catfishes: Anecdotal information indicates that the passive gear fishery is popular. Catfish populations have always been managed with statewide regulations. Since 2003, gill netting has been conducted every four years and data has indicated relatively stable Channel and Blue Catfish recruitment and abundance. Blue Catfish are more abundant than Channel Catfish. Continuation of this sampling frequency should provide adequate population-level insight relative to large-scale changes that would dictate further investigation. A minimum of 10 randomly selected gill netting sites will be sampled in 2022, but sampling will continue at random sites (5-10 additional sites) until 50 stock-size Blue Catfish are collected and the RSE of CPUE-S is $\leq$ 25 (the anticipated effort to meet both sampling objectives is 10 stations with 80% confidence).

Crappies: Since 1995, trap netting has been conducted every four years, and catch rates have averaged 10-15/nn. Continuation of this sampling frequency should provide adequate population-level insight relative to large-scale changes that would dictate further investigation. A minimum of 10 randomly selected trap netting sites will be sampled in 2021, but sampling will continue at random sites (5-10 additional sites) until 50 stock-size crappie are collected and the RSE of CPUE-S is $\leq$ 25 (the anticipated effort to meet both sampling objectives is 10-15 stations with 80% confidence).

Prey species: Bluegill, Threadfin Shad, and Gizzard Shad are the primary forage at B.A. Steinhagen Reservoir. Fall electrofishing every four years (per Largemouth Bass sampling) will likely result in sufficient numbers of Bluegill and Gizzard Shad to achieve sampling objectives (N = 50 stock-size fish; RSE-S $\leq$ 25). Largemouth Bass body condition (fish $\geq$ 8” TL) will be used to provide additional information on forage abundance and vulnerability.

Habitat: Historically, excess aquatic vegetation has been significant issue at B.A. Steinhagen, preventing access to as much as 50% of the reservoir. Problematic plants have included water hyacinth, salvinia, hydrilla, and alligatorweed. Aquatic vegetation will be monitored annually to document trends in abundance and recommend appropriate management strategies.

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Tables and Figures

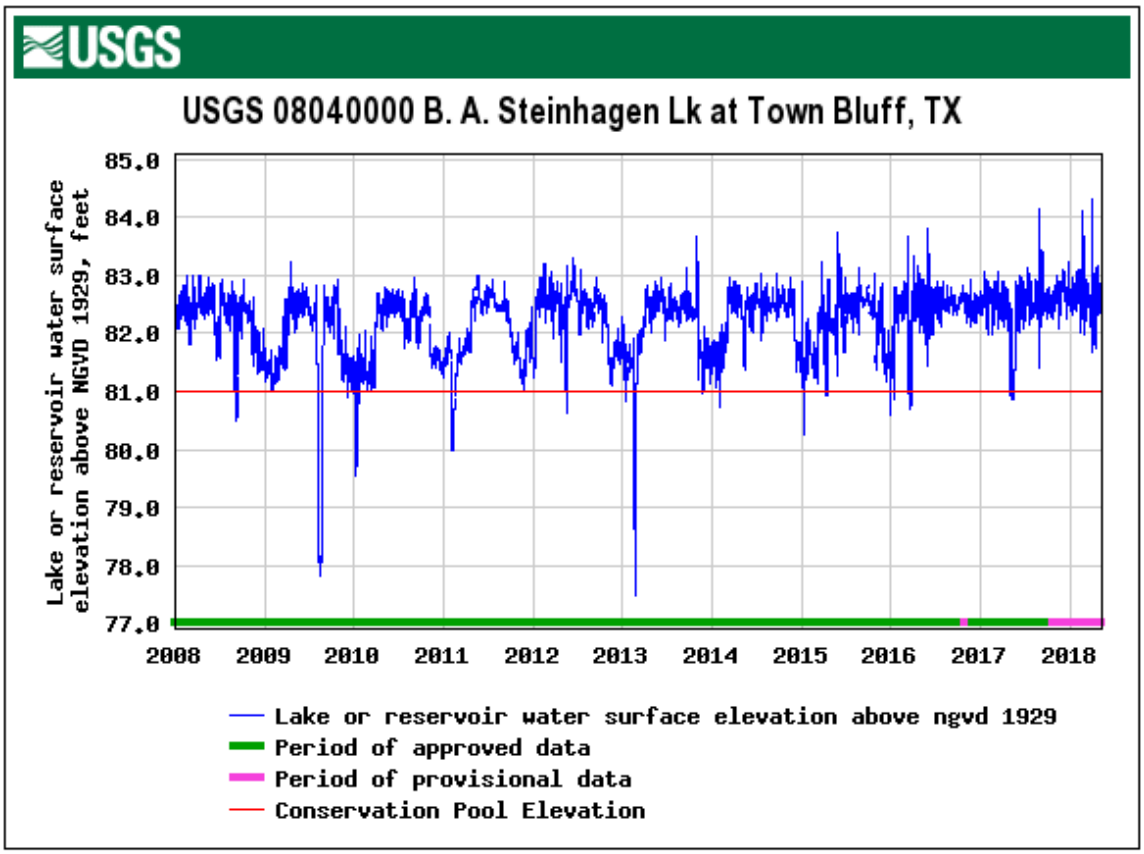


Figure 1. U.S. Geological Survey daily water level elevations in feet above mean sea level (MSL) recorded for B.A. Steinhagen Reservoir, Texas.

Table 1. Characteristics of B.A. Steinhagen Reservoir, Texas.

Characteristic	Description
Year constructed	1951
Controlling authority	U.S. Army Corps of Engineers
Counties	Jasper and Tyler
Reservoir type	Mainstream
Shoreline Development Index	5.0
Conductivity	180 µS/cm

Table 2. Boat ramp characteristics for B.A. Steinhagen Reservoir, Texas, May, 2018. Reservoir elevation at time of survey was 82.9 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Camper's Cove	30.82559 - 94.20559	Y	15	76	No access issues
Magnolia Ridge	30.87973 - 94.23164	Y	15	76	No access issues
Sandy Creek Park	30.81839 - 94.17083 30.83127 - 94.15888	Y	25	77-78	No access issues
Bar-Pit	30.85449 - 94.21381	Y	20	78	No access issues
Cherokee Park	30.85176 - 94.21009	Y	20	79	No access issues
Walnut Ridge	30.86287 - 94.18279	Y	30	77	No access issues
Hen House Ridge	30.84305 - 94.17474 30.84505 - 94.17485	Y	20	78	No access issues
Beech Grove	30.85266 - 94.17317	Y	20	78	No access issues
Bevilport	30.92399 - 94.15666	Y	25	78	No access issues
State Park Ramp (N 190)	30.87010 - 94.17593	Y	5	80	No access issues
CR 155 Ramp	30.89275 - 94.23797	Y	10	78	No access issues

Table 3. Harvest regulations for B.A. Steinhagen 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] (only 1 > 24 inches)	14-inch minimum
Bass: Spotted	5[a]	None
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 4. Stocking history of B.A. Steinhagen Reservoir, Texas. FRY = fry; FGL = fingerling; AFGL = advanced fingerling; UNK = unknown.

Species	Year	Number	Size
Blue Catfish	2007	70,159	FGL
	Total	70,159	
Channel Catfish	1973	8,000	AFGL
	2007	210,557	FGL
	Total	218,557	
Florida Largemouth Bass	1990	339,035	FRY
	2000	408,432	FGL
	Total	747,467	
Largemouth Bass	1973	16,670	UNK
	Total	16,670	
Mixed Largemouth Bass	1990	271	
	Total	271	
Paddlefish	1989	31,986	
	1990	84,371	
	1992	10,827	
	Total	127,184	
Walleye	1976	2,750,000	FRY
	Total	2,750,000	

Table 5. Objective-based sampling plan components for B.A. Steinhagen Reservoir, Texas 2017–2018.

Gear/target species	Survey objective	Metrics	Sampling objective
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	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
Gizzard Shad [a]	Abundance	CPUE–Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
	Prey availability	IOV	N ≥ 50
Trap netting			
Crappie	Abundance	CPUE-Stock	RSE-Stock $\leq$ 25
	Size structure	PSD, length frequency	N $\geq$ 50 stock
Gill netting			
Blue Catfish	Abundance	CPUE–stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock

[a] No additional effort was expended to achieve an RSE ≤ 25 for CPUE of Bluegill and Gizzard Shad if not reached from designated Largemouth Bass sampling effort. Instead, Largemouth Bass body condition provided information on forage abundance, vulnerability, or both relative to predator density.

Table 6. Survey of aquatic vegetation, B.A. Steinhagen Reservoir, Texas, 2013–2017. Surface area (acres) is listed with percent of total reservoir surface area in parentheses.

Species	2013	2014	2015	2016	2017
American lotus	1,134 (11)	1,893 (18)	85 (1)		
Hydrilla (Tier II)*	756 (7)	306 (3)	756 (7)	455 (4)	1,720 (16)
Water hyacinth (Tier II)*	Trace	438 (4)		724 (7)	
Salvinia (both common and giant) (Tier II)*	Trace	824 (8)			
Cattail	0	47 (<1)	47 (<1)	0	47 (<1)
Pondweed	0	0	102 (1)	383 (4)	341 (3)
Combined mat of American lotus, water hyacinth, and salvinia			1,134 (11)	1,558 (15)	995 (9)

*Tier II is Maintenance

Gizzard Shad

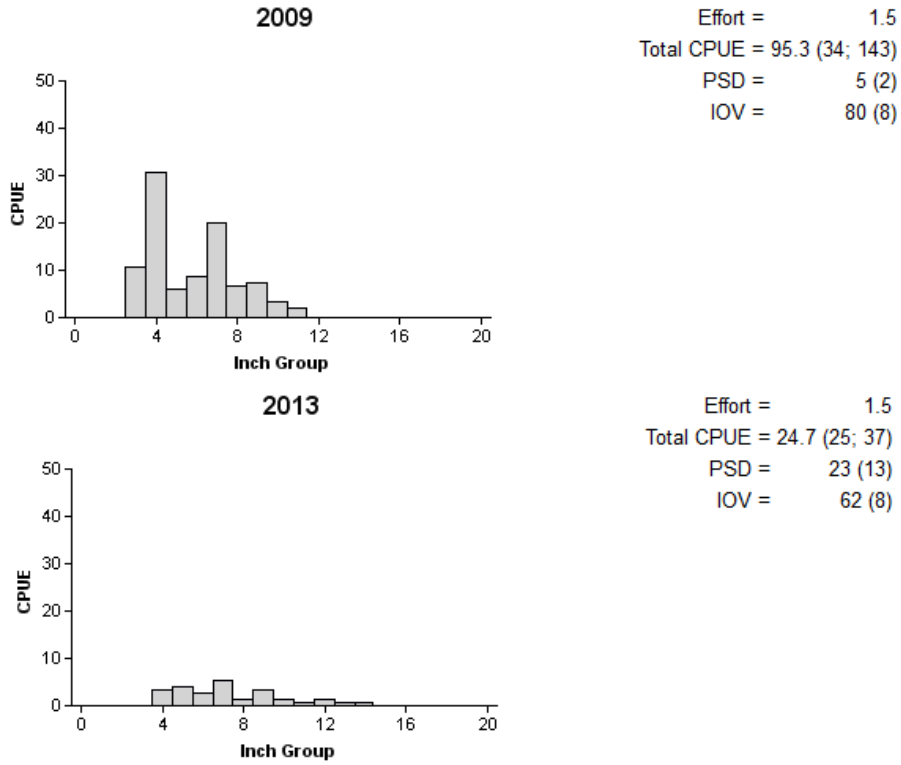


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, B.A. Steinhagen Reservoir, Texas, 2009 and 2013.

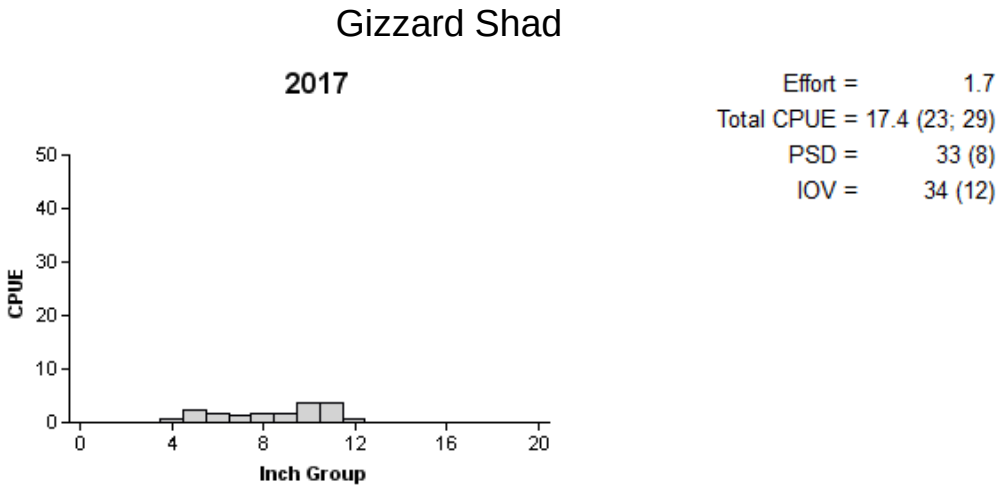


Figure 3. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for the 2017 fall electrofishing survey, B.A. Steinhagen Reservoir, Texas. This survey was conducted during the day.

Bluegill

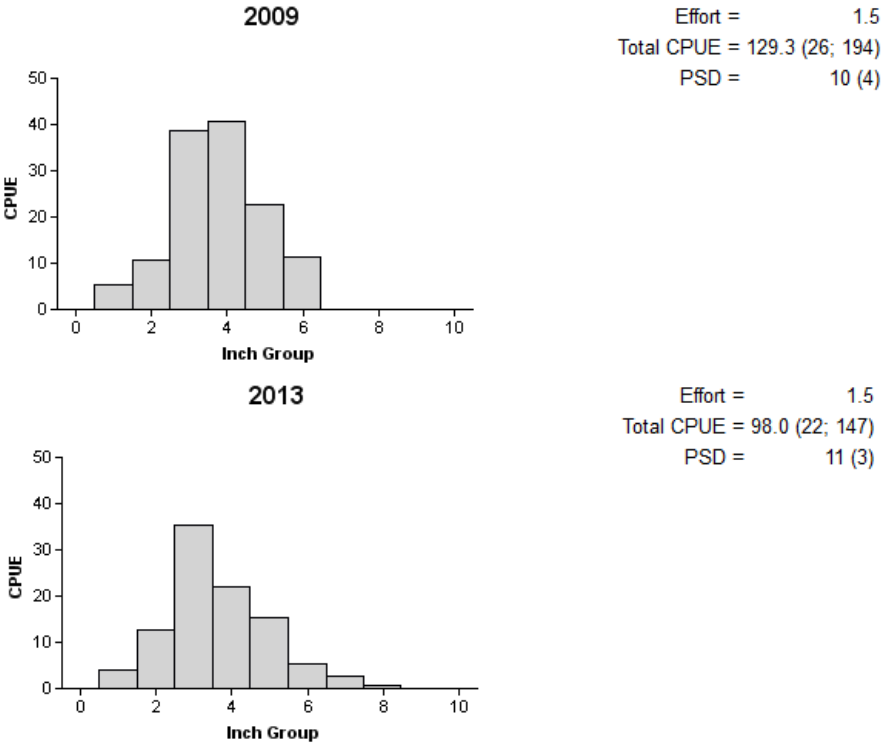


Figure 4. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, B.A. Steinhagen Reservoir, Texas, 2009 and 2013.

Bluegill

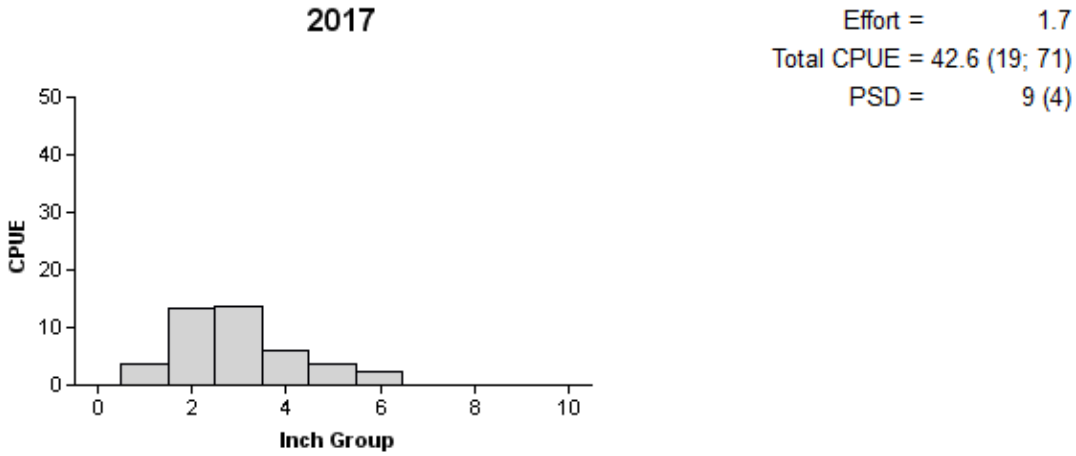


Figure 5. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for the 2017 fall electrofishing survey, B.A. Steinhagen Reservoir, Texas. This survey was conducted during the day.

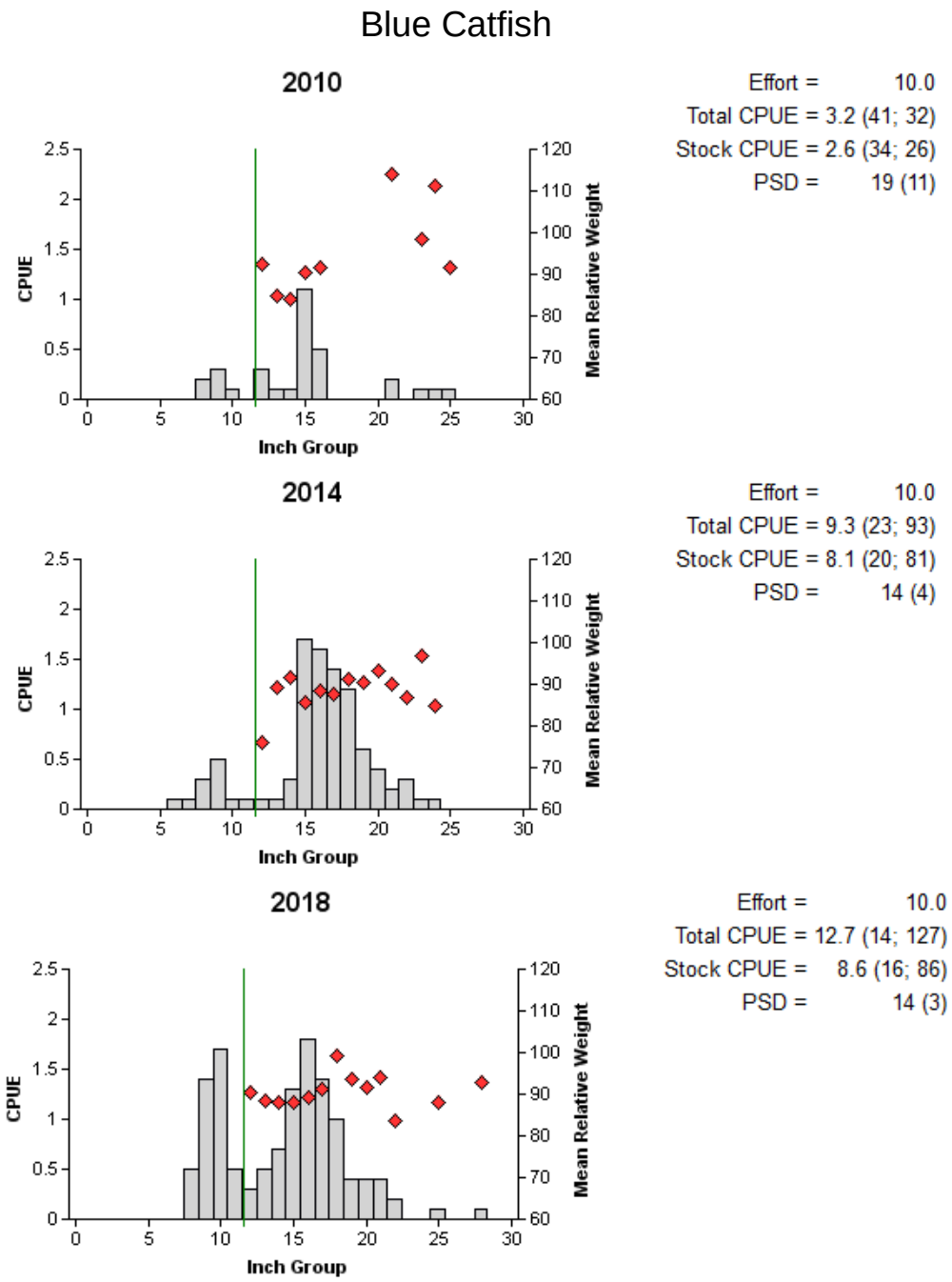


Figure 6. Number of Blue Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, B.A. Steinhagen Reservoir, Texas, 2010, 2014, and 2018. Vertical lines indicate minimum length limit at time of survey.

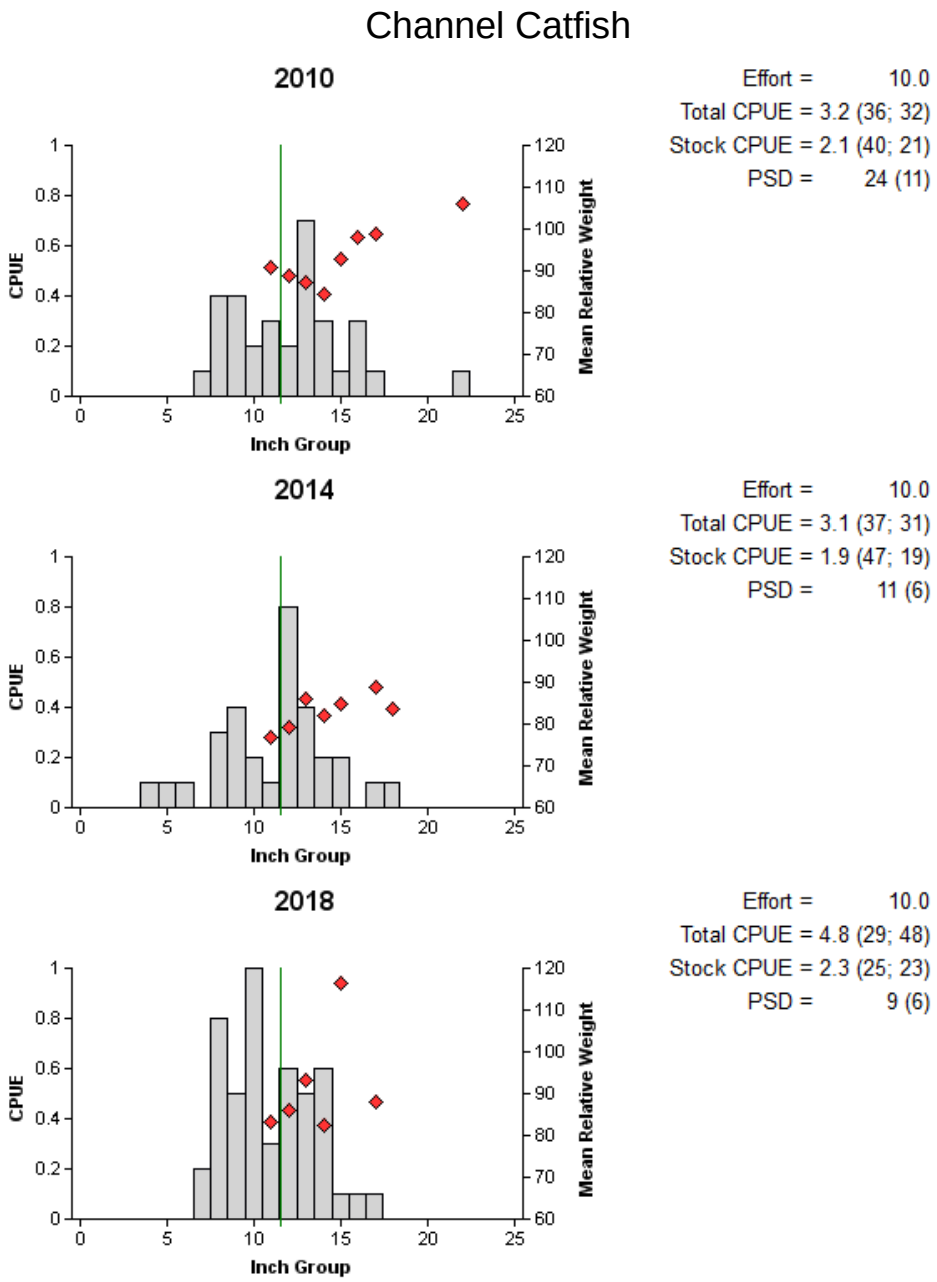


Figure 7. Number of Channel Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, B.A. Steinhagen Reservoir, Texas, 2010, 2014, and 2018. Vertical lines indicate minimum length limit at time of survey.

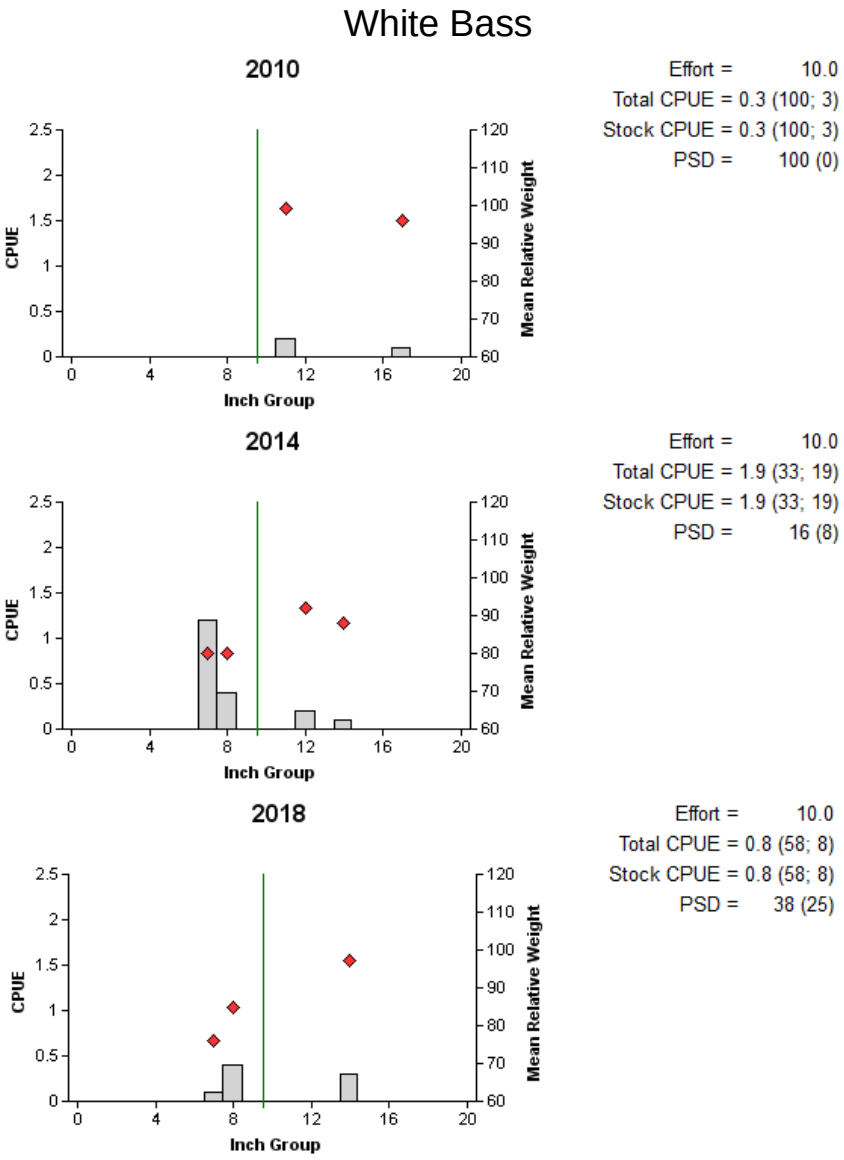


Figure 8. Number of White Bass caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, B.A. Steinhagen Reservoir, Texas, 2010, 2014, and 2018. Vertical lines indicate minimum length limit at time of survey.

Spotted Bass

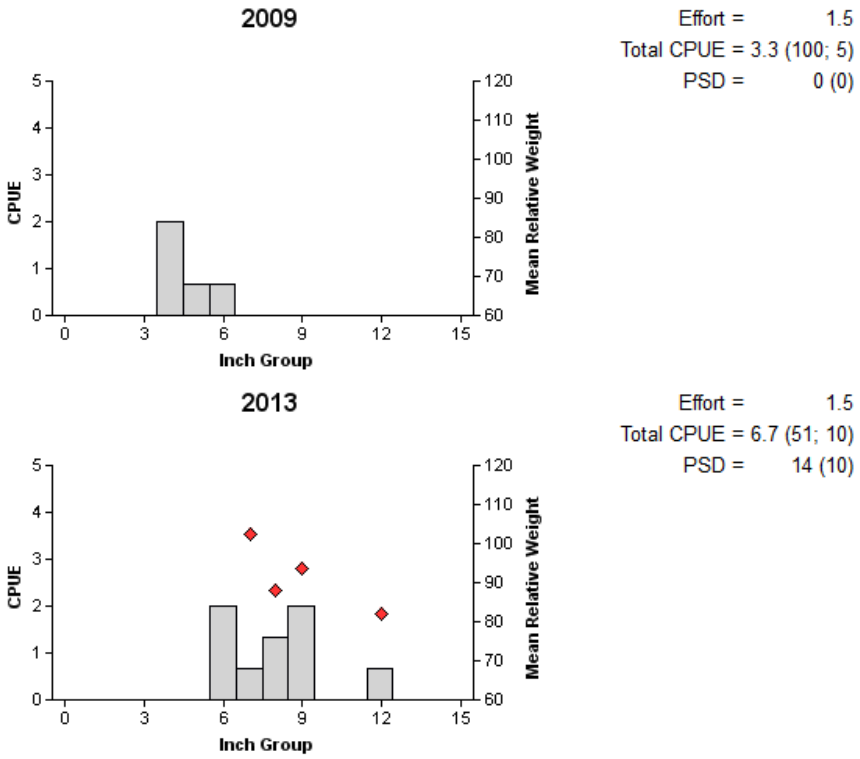


Figure 9. Number of Spotted Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, B.A. Steinhagen Reservoir, Texas, 2009 and 2013.

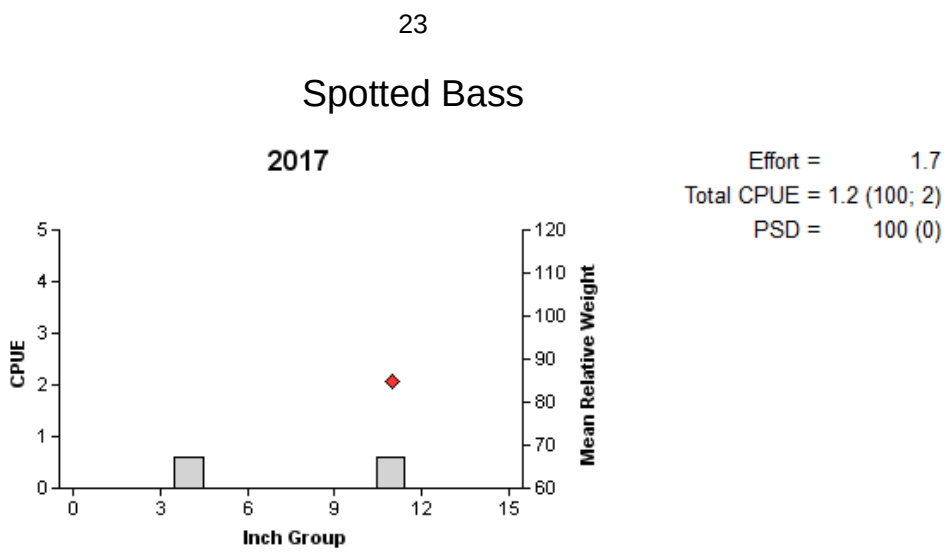


Figure 10. Number of Spotted Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for the 2017 fall electrofishing survey, B.A. Steinhagen Reservoir, Texas. This survey was conducted during the day.

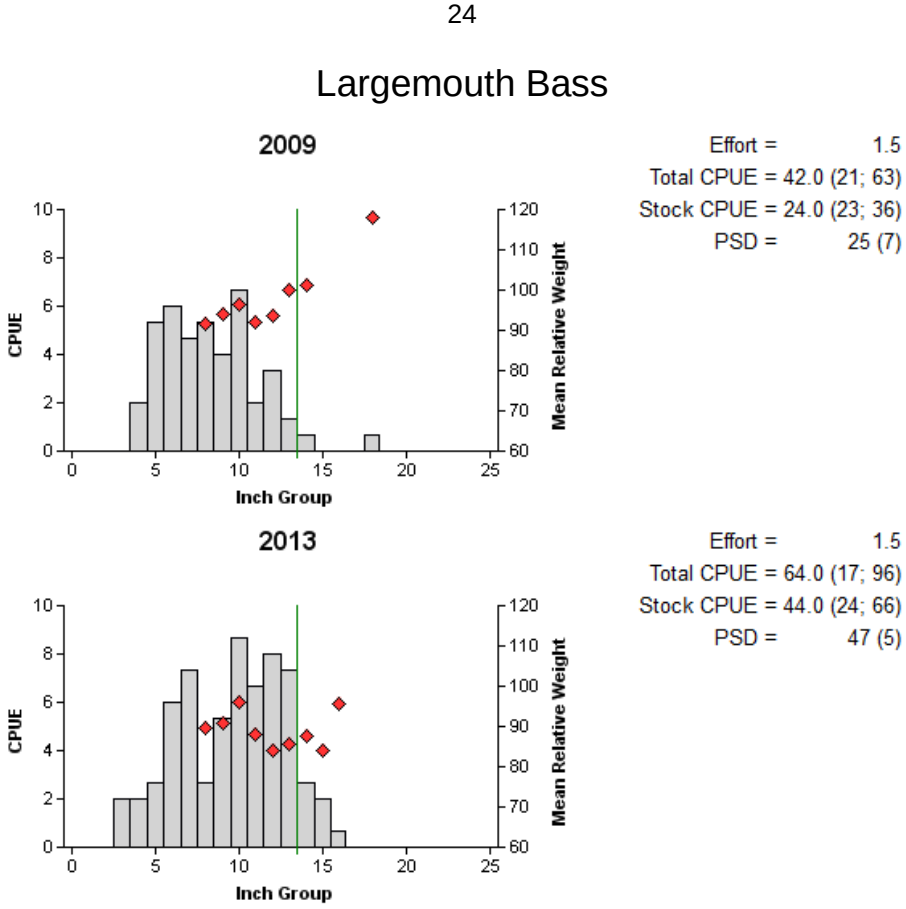
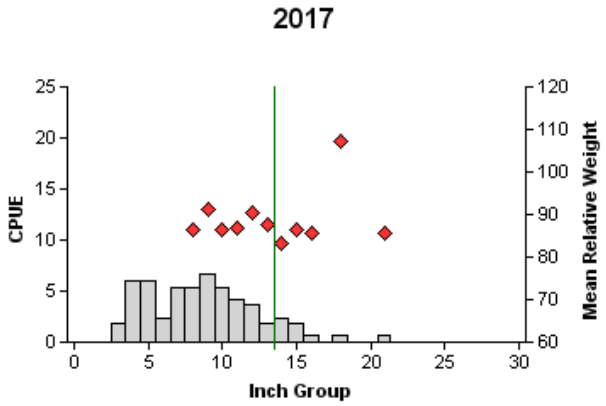


Figure 11. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, B.A. Steinhagen Reservoir, Texas, 2009, and 2013. Vertical lines indicate minimum length limit at time of survey.

Largemouth Bass



Effort = 1.7
Total CPUE = 54.6 (16; 91)
Stock CPUE = 33.0 (18; 55)
PSD = 35 (7)

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 2017 fall electrofishing survey, B.A. Steinhagen Reservoir, Texas. Vertical line indicates minimum length limit at time of survey. This survey was conducted during the day.

White Crappie

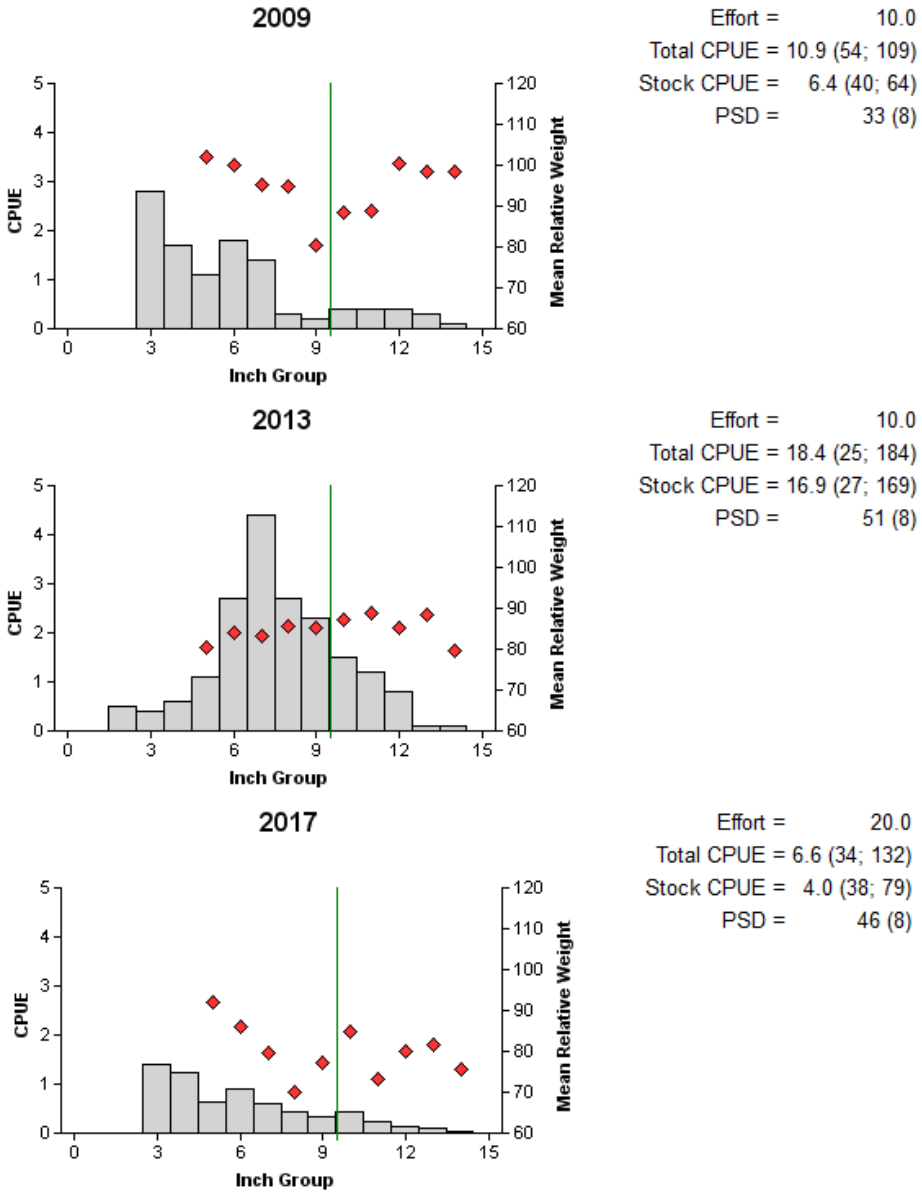


Figure 13. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, B.A. Steinhagen Reservoir, Texas, 2009, 2013, and 2017. Vertical line indicates minimum length limit.

Black Crappie

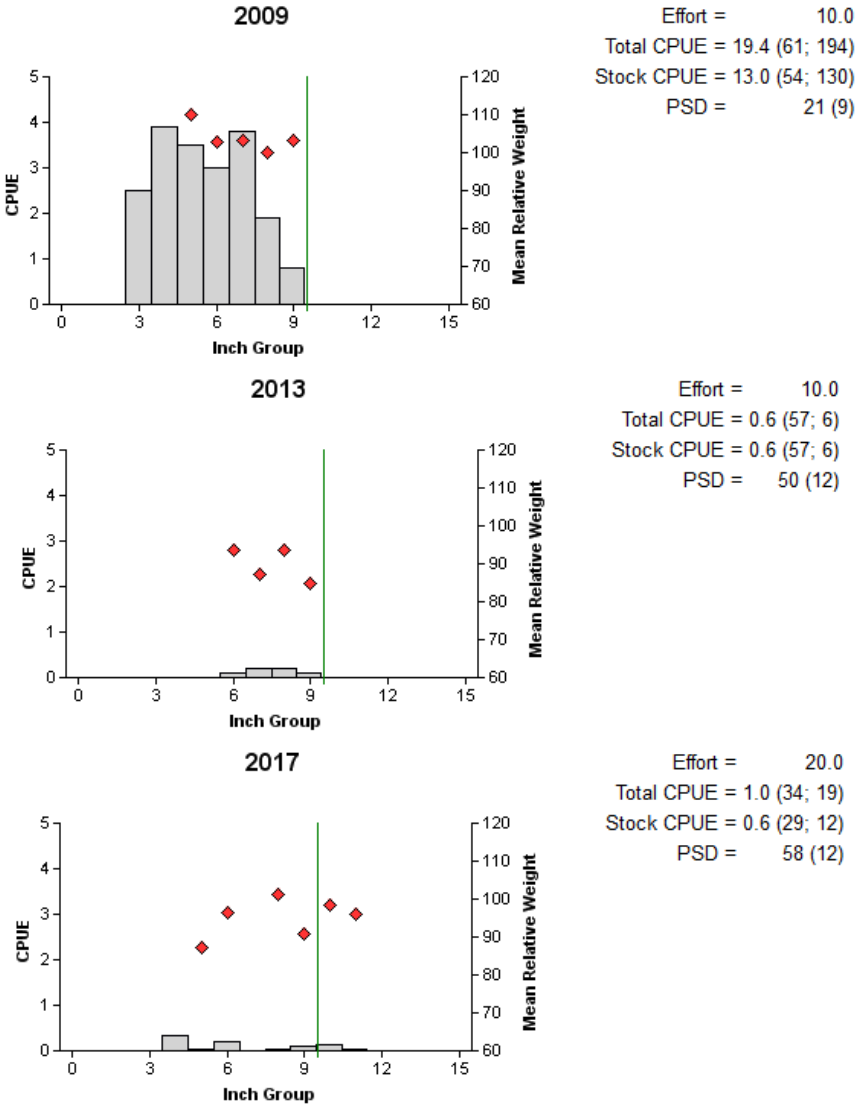


Figure 14. Number of Black Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap netting surveys, B.A. Steinhagen Reservoir, Texas, 2009, 2013, and 2017. Vertical line indicates minimum length limit.

Proposed Sampling Schedule

Table 7. Proposed sampling schedule for B.A. Steinhagen Reservoir, Texas. Survey period is June through May. Electrofishing surveys are conducted in the fall, while trap netting and gill netting surveys are conducted in the winter. Standard survey denoted by S and additional survey denoted by A.

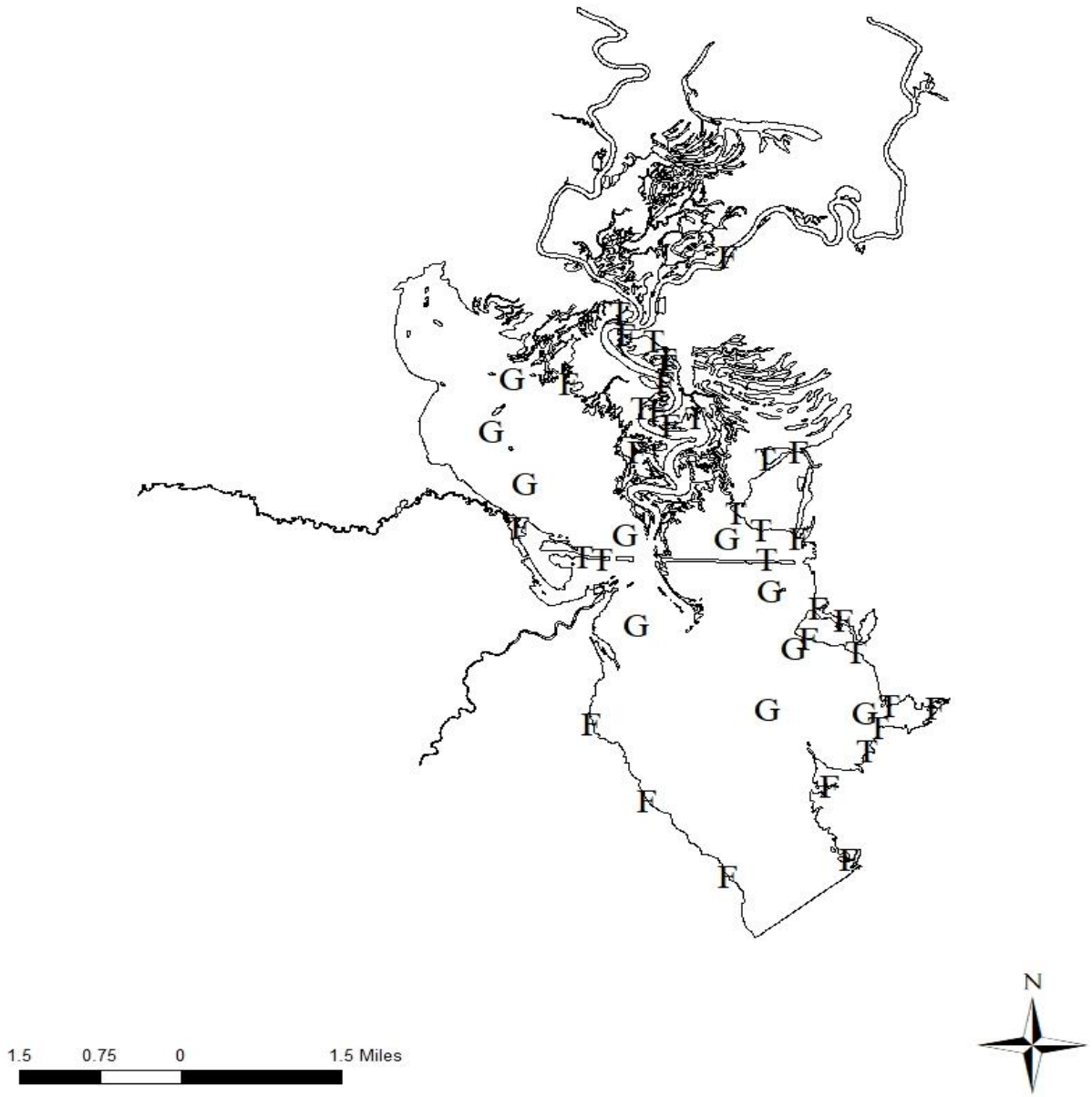
	Survey year			
	2018-2019	2019-2020	2020-2021	2021-2022
Angler Access				S
Structural Habitat				S
Vegetation	A	A	A	S
Electrofishing – Fall				S
Trap netting				S
Gill netting				S
Report				S

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

Number (N) and catch rate (CPUE) (RSE in parentheses) of all species collected from all gear types from B.A. Steinhagen Reservoir, Texas, 2017-2018. Sampling effort was 10 net nights for gill netting, 20 net nights for trap netting, and 1.67 hours for electrofishing.

Species	Gill Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Spotted Gar	2	0.2 (67)				
Longnose Gar	4	0.4 (41)				
Bowfin	1	0.1 (100)				
Gizzard Shad					29	17.4 (23)
Threadfin Shad					204	122.4 (47)
Common Carp	2	0.2 (100)				
Smallmouth Buffalo	19	1.9 (28)				
Spotted Sucker	2	0.2 (100)				
Blue Catfish	127	12.7 (14)				
Channel Catfish	48	4.8 (29)				
White Bass	8	0.8 (58)				
Yellow Bass	38	3.8 (24)				
Warmouth					2	1.2 (69)
Bluegill					71	42.6 (19)
Longear Sunfish					4	2.4 (100)
Redear Sunfish					42	25.2 (33)
Spotted Bass					2	1.2 (100)
Largemouth Bass					91	54.6 (16)
White Crappie			7	0.7 (43)		
Black Crappie			4	0.4 (55)		
Freshwater Drum			37	3.7 (35)		

APPENDIX B – Map of sampling locations



Location of sampling sites, B.A. Steinhagen Reservoir, Texas, 2017-2018. Trap net, gill net, and electrofishing stations are indicated by T, G, and F, respectively. Water level was near full pool at time of sampling.

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