

PERFORMANCE REPORT

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FEDERAL AID IN SPORT FISH RESTORATION ACT

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FEDERAL AID PROJECT F-221-M-5

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2014 Fisheries Management Survey Report

Moss Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Moss Reservoir were surveyed in 2014 using electrofishing and trap netting and in 2015 using gill netting. Habitat, vegetation, and angler access were surveyed in 2014. A creel survey was conducted from June 2014 through May 2015. This report summarizes the results of the surveys and contains a management plan for the reservoir based on those findings.

- **Reservoir description:** Moss Reservoir is a 1,140-acre impoundment on Fish Creek, a tributary of the Red River, in Cooke County. Water level was below conservation level most of time between June 2011 and March 2015. Heavy rains during April-May 2015 caused the water levels to remain above conservation level through May 2015. Habitat features consisted mainly of rocky shoreline and native submerged and emergent vegetation.
- **Management history:** Important sport fish include Channel Catfish, Largemouth Bass, and White Crappie. The management plan from the 2010 survey report included a recommendation to obtain more age and growth information on Largemouth Bass. The last stocking occurred in 2010 and consisted of 97 surplus brood Florida Largemouth Bass.
- **Fish community**
 - **Prey species:** Electrofishing catch rate of Gizzard Shad was the highest on record. The relative abundance of prey-size Gizzard Shad (≤ 7 -inches) was also the highest on record. Electrofishing catch rates of Bluegill have decreased from previous surveys, but catch rates of Longear Sunfish were just above the reservoir average. No Threadfin Shad were collected.
 - **Channel catfish:** Gill net catch rate of Channel Catfish was similar to the 2011 survey, and most of the population was legal size and in fair condition. Recruitment was evident. They were the third most sought-after fish by anglers with good sizes and numbers being harvested.
 - **White Bass:** The historical catch rate of White Bass has always been low, but this survey had the highest catch rate on record. A White Bass die-off in 2008 had depressed the population in recent years. The sample was made up of 97% legal-size fish. Their relative weights were below recommended levels. Few are harvested by anglers and there is very little directed effort. Moss Reservoir may not be suitable for White Bass.
 - **Black Basses:** Spotted and Largemouth Bass electrofishing catch rates were the highest on record. Their body condition was good for bass less than 12 inches, but below recommended levels for bass above 12 inches. There could be an overabundance of bass less than 12 inches. Largemouth Bass were the most sought-after fish with very little harvest by anglers, but good catch rates.
 - **White Crappie:** White Crappie trap netting survey indicated 58% of the sample population was legal size. The crappie were in fair condition. Crappie were the second most sought-after fish by anglers with good harvest.
- **Management strategies:** Stock adult Threadfin Shad. Explore ways to encourage harvest of over abundant bass less than 12 inches. Communicate fishing information on TPWD website and District Facebook page. Inform the City of Gainesville about new exotic species threats to Texas waters and provide outreach assistance. Partner with the City of Gainesville to treat yellow floating-heart vegetation. Conduct standard monitoring with electrofishing, trap netting, and gill netting in 2018-2019.

INTRODUCTION

This document is a summary of fisheries data collected from Moss Reservoir in 2014-2015. The purpose of the document is to provide fisheries information and make management recommendations to protect and improve the sport fishery. While information on other species of fishes was collected, this report deals primarily with major sport fishes and important prey species. Historical data are presented with the 2014-2015 data for comparison.

Reservoir Description

Moss Reservoir is a 1,140-acre impoundment on Fish Creek, a tributary of the Red River, in Cooke County. It was constructed in 1966 by the City of Gainesville for municipal and industrial water supply and recreation. The average depth is 20.6 feet with a maximum depth of 68 feet. Water level has been below conservation level (715 feet above mean sea level) most of the time from June 2011 to March 2015, when the water levels reached conservation level and more (Figure 1). Moss Reservoir has a drainage area of approximately 65 square miles, a shoreline length of 16 miles, and a shoreline development index of 3.43. Other descriptive characteristics for Moss Reservoir are in Table 1. Approximately 42% of the reservoir was \leq 15 feet deep. Moss Reservoir was slightly eutrophic with a mean TSI chl-a of 47.1 (Texas Commission on Environmental Quality 2011). A TSI chl-a index between 45 and 55 is considered eutrophic. Average Secchi disk transparency was 141 cm for 2014 and suggested mild eutrophic conditions as per Carlson's Trophic State Index (Texas Commission on Environmental Quality 2011). The watersheds of South and North Fish Creeks, which are very clear water streams running over limestone bedrock, contributed very little nutrients. However, agriculture has increased on the South Fish Creek watershed, thereby increasing nutrients entering the reservoir. Also new houses are being built on the shoreline, which could increase nutrient inflow. Habitat at time of sampling consisted of native emergent vegetation, native submerged vegetation, rocky shoreline, and dead trees. Native aquatic plants present were southern naiad, muskgrass, cattail, coontail, and water willow. Hydrilla, a non-native aquatic plant, was first discovered in two coves in August, 2003. Presently it is confined to one cove near the north launch ramp. Yellow floating-heart, another invasive, has increased since 2010 and spread to numerous small areas around the reservoir. The area near the south boat ramp, which was encroaching on the boat ramp, has been treated in 2013 and 2014 with limited success.

Angler Access

The City of Gainesville charges \$35 for an annual (January 1 to December 31) boat access permit. There is no charge for bank angling. Boat access consisted of two public boat ramps on the north and south sides of the reservoir. Access at the south boat ramp was threatened by the yellow floating-heart. The two public boat ramps are in good shape and have ample lighting. Bank fishing access near each boat ramp was augmented by a fishing pier. Additional boat ramp characteristics are in Table 2. Boarding piers/docks are available at each ramp. Further information about Moss Reservoir and its facilities can be obtained by visiting the Texas Parks and Wildlife Department (TPWD) web site at www.tpwd.state.tx.us and navigating within the fishing web page.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Moczygemba and Hysmith 2011) included:

1. Collect additional (13) Largemouth Bass in the 13- and 14-inch groups in fall of 2011 for aging.
Action: Largemouth Bass in the 13- and 14-inch groups were collected by electrofishing and angling (Gainesville Bass Club Tournament). Results presented in this report.
2. Cooperate with the City of Gainesville to post appropriate signage on invasive species,

especially zebra mussels, at access points around the reservoir. Educate the City of Gainesville on other invasive aquatic vegetation in the reservoir.

- Actions:** a) Personnel with the City of Gainesville installed appropriate signage.
b) City personnel were notified of the south boat ramp area was in danger of encroachment from yellow floating-heart. TPWD aquatic vegetation management team treated the area in 2013 and 2014.

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

Stocking history: In 2010, 97 adult Florida Largemouth Bass were stocked into Moss Reservoir. Refer to Table 4 for a comprehensive stocking list for this reservoir.

Vegetation/habitat history: Rocky shoreline provides the most fishery habitat in Moss Reservoir (Moczygemba and Hysmith 2011). Moss Reservoir supported submerged and emergent aquatic vegetation (Table 6). Historically, submerged aquatic vegetation (muskgrass, southern naiad, and coontail) was common, but not problematic (Moczygemba and Hysmith 2011). These species persist currently and provide fish habitat. Historically, water willow was abundant along a third of the shoreline, but is no longer common. Hydrilla was first observed in August 2003 in two coves. Presently hydrilla is found only sparsely in one cove near the north boat ramp and is not problematic. Yellow floating-heart was first observed in 2010. Although not problematic in 2010, it was growing towards the south boat ramp by 2013. TPWD invasive vegetation crew treated it in 2013 and 2014. Yellow floating-heart is still abundant in south boat ramp area

Water Transfer: Moss Reservoir is primarily used for municipal water supply, recreation, and to a lesser extent, flood control. The City of Gainesville operates one pumping station for the City's water supply. There is no water pumped into Moss Reservoir.

METHODS

Moss Reservoir was sampled with an objective-based sampling plan to achieve survey and sampling objectives in accordance with the plan (Appendix D). The plan called for additional electrofishing necessary to collect 50 stock-size Largemouth Bass with a RSE of $CPUE-S \leq 25$. Since single-cod trap netting produced low catches of White Crappie with RSE's above 25 for CPUE-T and CPUE-S, dual-cod trap netting was used to collect 50 stock-size White Crappie and reduce the sampling RSE's. Additional gill netting was necessary to collect adequate numbers of Channel Catfish with acceptable sampling RSE values. Fishes were collected by electrofishing (2 hours at 24 5-min stations), gill netting (10 net nights at 10 stations), and dual-cod trap netting (10 net series at 10 stations). Each dual-cod trap net series equaled 3 nights of fishing. Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing, for gill netting as the number of fish caught per net night (fish/nn), and dual-cod trap netting as number of fish caught per net series (fish/ns). All survey sites were randomly selected and all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2014).

A roving creel survey was conducted from June, 2014 through May, 2015. 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 2014).

Structural habitat and aquatic vegetation surveys were conducted in 2014. Aquatic vegetation survey monitored the spread of hydrilla and yellow floating-heart as per Tier III (TPWD, Inland Fisheries Division, unpublished manual revised 2014).

Sampling statistics (CPUE for various length categories), structural indices [Proportional Size Distribution (PSD), as defined by Guy et al. (2007)], and condition indices [relative weights (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). Relative standard error (RSE = 100 X SE of the estimate/estimate) was calculated for all CPUE statistics and SE was calculated for structural indices and IOV. Ages were determined using Category 2 protocol and otoliths from 13 fish according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2014). The manual specifies for Largemouth Bass only, but we adapted White Crappie to the protocol for identifying the sizes of White Crappie to sample.

Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2014). Genetic composition was determined by micro-satellite DNA analysis.

Source for water level data was the United States Geological Survey (USGS 2015).

RESULTS AND DISCUSSION

Habitat: Littoral zone habitat consisted primarily of rocky and natural shoreline with lesser amounts of bulkhead, dead trees, and native emergent and native submerged vegetation (Tables 5 and 6). Yellow floating-heart was discovered near the south boat ramp in 2010 and has spread to various areas of the reservoir. Access at the south boat ramp was threatened by the yellow floating-heart. The area was treated in 2013 and 2014 and the plant still persisted and spread.

Creel: Directed fishing effort by anglers was highest for Largemouth Bass (42%), followed by anglers fishing for White Crappie and Channel Catfish (Table 7). Bass Tournaments accounted for 8.9% of the total directed fishing effort. Anglers fishing for anything accounted for 18.7% of the fishing time. Total fishing effort for all species and direct expenditures for 2014/2015 at Moss Reservoir are presented in Table 8.

Prey species: Electrofishing catch rate of Gizzard Shad was 82.5/h, which was the highest on record (Figure 2 and Appendix C). Index of vulnerability (IOV) for Gizzard Shad in 2014 (51) was the highest for the last three surveys (Figure 2). Threadfin Shad were not collected. The winter of 2013-2014 was extremely cold and may have severely reduced the population. The total CPUE of Bluegill was 140.0/h in 2014, well below the reservoir average of 223.2/h. For the past three surveys, the size structure of Bluegill was dominated by small individuals ≤ 3 inches (Figure 3), making more Bluegill available as prey. Longear Sunfish contributed to the prey base with a total CPUE of 71.0/h, which was above the reservoir average of 51.9/h (Appendix C).

Channel Catfish: The gill net catch rate of Channel Catfish was 3.5/nn in 2015, close to the 2011 survey results (Figure 4 and Appendix C). Due to high RSE's for the first gill net survey (5 nn), a second survey of 5 nn was conducted as directed by the objective-based sampling plan (Appendix D). The additional survey resulted in lower RSE values and a more reliable picture of the Channel Catfish population. Relative weights were variable, ranging from 74 to 117, with most Channel Catfish in fair condition. Over 85% of the sample was legal size and larger. As in past surveys catch of sub-legal size fish was low, but the catch verified reproduction. Channel Catfish were the third-most sought after fish by anglers, who harvested almost 4,000 fish (Table 9) ranging from 13 to 21 inches (Figure 5). The Channel Catfish fishery is a harvest-oriented fishery with only 5.6% of legal-size fish being released (Table 9).

White Bass: The gill net CPUE of White Bass was 5.3/nn in 2015 (Figure 6), an all-time high for surveys dating to 1987 (Appendix C). The historical catch rate has always been low. As with Channel Catfish,

the first gill net survey produced few White Bass and high RSE's (81). The next survey brought the overall RSE to 39, which shows a more reliable representation of the White Bass population (Figure 6). The population sample was 97% legal size and larger. A White Bass die-off was observed on Moss Reservoir in 2008. The population seems to have recovered. The Wr's dropped below 80 for fish over 14 inches. Only 3.4% of the angling time was spent fishing for White Bass (Table 7) with a harvest of 237 fish (Table 10) ranging from 10 to 14 inches (Figure 7). Moss Reservoir may be unsuitable for White Bass.

Black Basses: The electrofishing CPUE of Spotted Bass in 2014 was the highest on record (101.5/h; Appendix C). Size structure indicated a successful 2014 spawn as the sub-stock fish were very numerous in the sample population (Figure 8). However there were very few Spotted Bass over 11 inches. Relative weights were near 100 for 7- to 11-inch fish, but were lower for the bigger size groups (Figure 8). There was no directed angler effort for Spotted Bass nor was there directed catch. There were 2,109 Spotted Bass released by anglers.

The 2014 electrofishing total CPUE (126.5/h) for Largemouth Bass went from the lowest on record in 2011 to the highest and above the reservoir average of 90.7/h (Figure 9 and Appendix C). Fish up to 22 inches were collected as well as bass in the 14- to 16-inch groups. As in the past two surveys, young-of-the-year contributed most to the total catch rate. A high PSD (41) indicated the size structure should be good, which was observed in the 2011 survey, but the low abundance of fish over 14 inches showed the sample stock population was comprised mostly of sub-legal bass (8-13 inches). Largemouth Bass growth was slow for Cross Timbers and Prairie Ecological Regions (Figures 10 and 11), where Largemouth Bass should be 15.4 inches in 3+ years (Prentice 1987). Body condition in 2014 was below the Wr range of 95-100 recommended by Anderson for all size classes of fish over 11 inches (Figure 9). Percent of Florida Largemouth Bass alleles was still high at 43% and all 30 Largemouth Bass in our sample were intergrades (Table 11). Directed angling effort for Largemouth Bass comprised over 41% of the angling time at Moss Reservoir (Table 7). Bass tournaments accounted for 8.9% (included in the directed effort for Largemouth Bass) of the angling effort. Non-tournament bass anglers accounted for 181 fish, while tournament (catch-and-release) anglers brought 454 fish to the weigh-in. This produced a tournament catch/non-tournament harvest ratio of 2.5, which indicates tournaments likely do not have an effect on the Largemouth Bass size structure (Allen et al. 2004). Figure 12 depicts the sizes of Largemouth Bass taken (tournament and non-tournament) from the reservoir. With a release of 94% of legal-sized fish (non-tournament), the Largemouth Bass fishery at Moss Reservoir can be characterized as catch-and-release (Table 12).

The combined CPUE of Spotted and Largemouth Bass was 228/h. The CPUE of bass less than 12 inches was 218.5/h with Wr's all being above 90, while bass above 11 inches had Wr's less than 90. There seems to be an overabundance of black bass less than 12 inches with possibly a forage problem for black bass over 14 inches.

White Crappie: The trap net catch rate of White Crappie increased each survey from 2002 to 2010, but the RSE ranged from 44 to 65 (Figure 13). Dual-cod trap netting was used in 2014 to get a more reliable picture of the population (Appendix D). The CPUE of the dual-cod trap netting was 13.6/ns with a RSE of 24 (Figure 14). This met our sampling objective (Appendix D) for the White Crappie population. The CPUE of White Crappie \geq 10 inches (legal size) was 7.9/ns, which accounted for 58% of the total catch. Relative weights were in the upper 80's for all inch groups. White Crappie averaged 10 inches at 1+ years (N = 13; range = 1 – 2 years). White Crappie were the second most sought-after sport fish with 18.4% of the angling time spent for them (Table 7). Almost 6,000 White Crappie were harvested (Table 13), ranging from 10 to 14 inches (Figure 15).

Fisheries management plan for Moss Reservoir, Texas

Prepared – July 2015.

ISSUE 1: Threadfin Shad may no longer be present in Moss Reservoir due to abnormally cold winter of 2014-2015. This species was an important part of the forage base, which is under pressure from the present predator population of Channel Catfish, White Bass, Spotted Bass, Largemouth Bass, and White Crappie.

MANAGEMENT STRATEGY

Stock adult threadfin shad (1/acre) when available to ensure their presence in the fishery.

ISSUE 2: The size structure of black bass population (Spotted Bass and Largemouth Bass) is predominantly made up of fish less than 12 inches. The condition of the bass less than 12 inches is at recommended levels, but bass greater than 12 inches have W_r values below that recommended by Anderson (1996). Because there is good reproduction and recruitment of bass to 12 inches, there seems to be an overabundance of sublegal bass. This condition may be adversely affecting the body condition of bass over 12 inches.

MANAGEMENT STRATEGIES

1. Conduct scoping meetings for public input from user groups on the management of the black bass fishery at Moss Reservoir.
2. Pending outcome of scoping meetings, a change in the harvest regulations of black bass may be made to allow the harvest of smaller bass with the expected result of making more forage available for larger bass.
3. If a new black bass regulation is implemented then provide outreach (signage at the boat ramps, news articles, social media) to inform anglers.
4. Provide outreach to encourage the harvest of Spotted Bass, especially those under 12 inches total length.

ISSUE 3: Increasing societal demands on people's time are creating a competitive atmosphere in how a person's time is spent. TPWD is a brand name which supports and promotes fishing, among other exploits, and should always be on the forefront of advertising quality fishing and fishing opportunities.

MANAGEMENT STRATEGY

Through the use of the TPWD website and the Denison District Facebook page communicate to the public unique and exceptional information about Moss Reservoir fisheries in order to promote fishing.

ISSUE 4: Many invasive species threaten aquatic habitats and organisms in Texas and can adversely affect the state ecologically, environmentally, and economically. For example, zebra mussels (*Dreissena polymorpha*) 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 (*Salvinia molesta*) and other invasive vegetation species can form dense mats, interfering with recreational activities like fishing, boating, skiing and swimming. Yellow floating-heart has spread into many areas of Moss Reservoir to the point of encroaching upon access at the south boat ramp. Despite treatment in 2013 and 2014 the aquatic plant is still spreading around the reservoir. 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 City of Gainesville to post appropriate signage at access points around the reservoir.
2. Educate the public about invasive species through the use of media and the internet.
3. Make a speaking point about invasive species when presenting to constituent and user groups.
4. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.
5. Advise and cooperate with the City of Gainesville to initiate a comprehensive treatment plan for the control of yellow floating-heart.

Objective-Based Sampling Plan and Schedule 2015 – 2019

Sport fish, forage fish, and other important fishes

Sport fishes in Moss Reservoir include Channel Catfish, White Bass, Spotted Bass, Largemouth Bass, and White Crappie. Known important forage species include Gizzard and Threadfin Shad, Bluegill, and Longear Sunfish.

Negligible fisheries

WHITE BASS: White Bass is considered a negligible fishery due to fluctuating abundance and marginal directed angling effort. However, if we continue gill net sampling for Channel Catfish, White Bass will be inadvertently sampled as well.

SMALLMOUTH BASS: Smallmouth Bass is considered a negligible fishery because of low abundance and no directed angling effort, but since they are vulnerable to electrofishing, they will be sampled along with other black basses during fall nighttime electrofishing.

Survey objectives, fisheries metrics, and sampling objectives and schedule

CHANNEL CATFISH: Channel Catfish are present in Moss Reservoir and managed with the statewide regulation of 12-in MLL with 25 fish daily bag limit. They comprise the third-most-sought-after species by anglers. Trend data on CPUE-TOTAL, size structure, and body condition have been monitored via 4-year interval collections with open water spring gill netting since 1990. Average CPUE-TOTAL since 1990 was 5.5/nn. Current population abundance is below the average (3.5/nn; RSE=27), but has a tendency to fluctuate. Continuation of the 4-year interval gill netting surveys will permit us to determine any large-scale changes in the population abundance and structure. The RSE-TOTAL for the last survey was 27, therefore we feel spring gill netting accurately measures the trend data and gill netting should continue in the spring of 2019. Five additional random sites may be sampled with gill nets once we determine data shortcomings.

BLACK BASSES: Largemouth Bass were the most-sought-after sport fish in Moss Reservoir. Smallmouth Bass and Largemouth Bass are managed with the statewide 14-in MLL and 5 fish daily bag. Spotted Bass are also managed with the statewide no length limit and are part of the 5 fish daily bag for black bass. Trend data on CPUE-TOTAL, size structure, and body condition of Largemouth Bass have been collected at four-year intervals since 1990 with fall nighttime electrofishing. The population has a

PSD of 41, but W_r values are low for fish over 12 inches. Continuation of four-year trend data in this relatively clear reservoir with nighttime electrofishing in the fall will allow for determination of any large-scale changes in the Largemouth Bass population that may invite further investigation. A minimum of 12 randomly selected 5-min electrofishing sites will be sampled in fall 2018, but sampling will continue at random sites until 50 stock-size fish are collected and the RSE of CPUE-STOCK is ≤ 25 (the anticipated effort to meet both sampling objectives is 12-15 stations with 80% confidence). If failure to achieve either objective has occurred after one night of sampling and objectives can be attained with 6-12 additional random stations, another night of effort will be expended.

WHITE CRAPPIE: White Crappie were the second most sought-after species by anglers. They are managed with the statewide 10-inch MLL and 25 daily bag limit. Dual-cod trap netting in 2014 produced a reliable picture of the White Crappie population in 2014 with a sampling RSE-TOTAL of 24. Dual-cod trap netting should be used again in fall 2018 to gain trend data with the same sampling objectives as 2014. An additional five random sites will be sampled with dual-cod trap nets if required.

GIZZARD AND THREADFIN SHAD AND BLUEGILL: Gizzard and Threadfin Shad, Bluegill, and Longear Sunfish are the primary forage at Moss Reservoir. Like Largemouth Bass, trend data on CPUE-TOTAL and size structure of Bluegill and Gizzard Shad have been collected at four-year intervals since 1990 with fall electrofishing. CPUE-TOTAL was also calculated for Threadfin Shad and Longear Sunfish. Continuation of four-year trend data in this relatively clear reservoir with nighttime electrofishing in the fall will allow for determination of any large-scale changes in the Gizzard and Threadfin Shad, Bluegill, and Longear Sunfish populations that may need further investigation. A minimum of 12 randomly selected 5-min electrofishing sites will be sampled in fall 2018, but sampling will continue in conjunction with Largemouth Bass sampling and/or until sufficient numbers for PSD and IOV (50 fish) have been collected. No additional effort will be expended to achieve an RSE25 for CPUE-stock of Bluegill and Gizzard and Threadfin Shad. Instead, Largemouth Bass body condition (relative weight of Largemouth Bass ≥ 8 " Total Length) can provide information on forage abundance, vulnerability, or both, relative to predator density.

SAMPLING SCHEDULE: Table 14 summarizes the proposed sampling schedule for Moss Reservoir from 2015 to 2019.

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Figure 1. USGS real time water data for USGS 07315950 Moss Reservoir near Gainesville, Texas. <http://waterdata.usgs.gov/nwis/dv>, Texas, June 2011-May, 2015.

Table 1. Characteristics of Moss Reservoir, Texas.

Characteristic	Description
Year constructed	1966
Controlling authority	City of Gainesville
County	Cooke
Reservoir type	Offstream
Shoreline development index	3.43
Conductivity	255 μ mhos/cm

Table 2. Boat ramp characteristics for Moss Reservoir, Texas, August, 2014. Reservoir elevation at time of survey was 711.12 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
North Ramp	33.77352 -97.22267	Y	30	709.5	Good. Extension is feasible
South Ramp	33.75696 -97.21550	Y	15	710.0	Good. Extension is feasible

Table 3. Harvest regulations for Moss Reservoir.

Species	Bag Limit	Length Limit (inches)
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, Smallmouth	5 ^a	14-inch minimum
Bass, Spotted	5 ^a	None
Bass, Largemouth	5 ^a	14-inch minimum
Crappie: White and Black Crappie, their hybrids and subspecies	25	10-inch minimum

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

Table 4. Stocking history of Moss Reservoir, Texas. Life stages are fry (FRY), fingerlings (FGL), advanced fingerlings (AFGL), adults (ADL) and unknown (UNK). Life stages for each species are defined as having a mean length that falls within the given length range. For each year and life stage the species mean total length (Mean TL; in) is given. For years where there were multiple stocking events for a particular species and life stage the mean TL is an average for all stocking events combined.

Species	Year	Number	Life Stage	Mean TL (in)
Channel Catfish	2008	118,276	FGL	3.1
	Total	118,276		
Florida Largemouth Bass	1981	38,500	FGL	2.0
	1982	58,064	FGL	2.0
	2010	97	ADL	18.8
	Total	96,661		
Largemouth Bass	1967	10,000	UNK	UNK
	1971	260,000	UNK	UNK
	Total	270,000		
Smallmouth Bass	1985	13	ADL	16.0
	1986	22,080	FGL	2.0
	1987	22,300	FRY	1.0
	1988	56,304	FRY	0.5
	Total	100,697		
Threadfin Shad	1984	1,170	AFGL	3.0
	1985	6,500	AFGL	2.0
	Total	7,670		
Walleye	1977	341,100	FRY	0.2
	1978	339,500	FRY	0.2
	1979	339,910	FRY	0.2
	Total	1,020,510		

Table 5. Survey of structural habitat types, Moss Reservoir, Texas, 2014. Shoreline habitat type units are in miles and piers and docks and standing timber are acres.

Habitat type	Estimate	% of total
Bulkhead	2.0 miles	12.5
Piers and docks	3.0 acres	0.3
Natural	3.8 miles	23.8
Rocky	10.2 miles	63.7
Standing timber	71.0 acres	6.3

Table 6. Survey of aquatic vegetation, Moss Reservoir, Texas, 2003, 2006, 2010, and 2014. Surface area (acres) is listed with percent of total reservoir surface area in parentheses.

Vegetation	2003	2006	2010	2014
Native submersed	452.0 (39.7)	100 (9.0)	57.8 (5.1)	72.5 (6.3)
Native floating-leaved	0.2 (<0.1)		0.1 (<0.1)	
Native emergent	26.9 (2.4)	36 (3.0)	8.5 (0.7)	<1.0 (0.1)
Non-native				
Yellow floating-heart (Tier III)*			1.0 (0.1)	10.2 (0.9)
Hydrilla (Tier III)*	6.1 (0.5)	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)

*Tier III is Watch Status

Table 7. Percent directed angler effort by species for Moss Reservoir, Texas, 2014-2015. Survey period was from 1 June through 31 May.

Species	2014/2015
Channel Catfish	17.5
White Bass	3.4
Largemouth Bass	41.7 ^a
White Crappie	18.4
Anything	18.7

^a This included 8.9% for black bass tournaments.

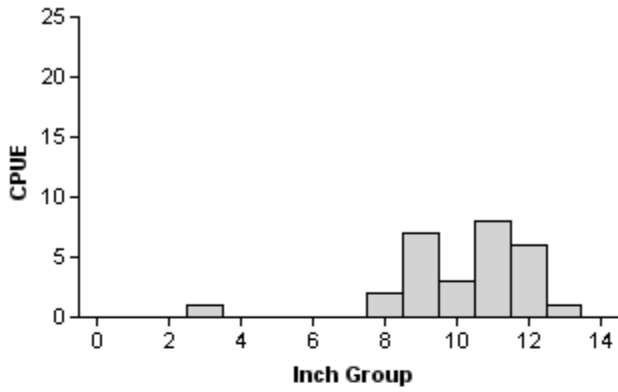
Table 8. Total fishing effort (h) for all species and total directed expenditures at Moss Reservoir, Texas, 2014- 2015. Survey period was from 1 June through 31 May. Relative standard error is in parentheses.

Creel statistic	2014/2015
Total fishing effort	29,568 (13)
Total directed expenditures	\$229,619 (30)

Gizzard Shad

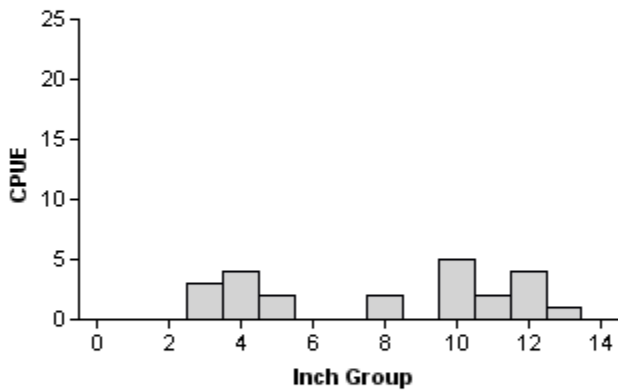
2006

Effort = 1.0
 Total CPUE = 28.0 (32; 28)
 IOV = 4 (4)



2010

Effort = 1.0
 Total CPUE = 23.0 (23; 23)
 IOV = 39 (13.5)



2014

Effort = 2.0
 Total CPUE = 82.5 (20; 165)
 IOV = 51 (9.6)

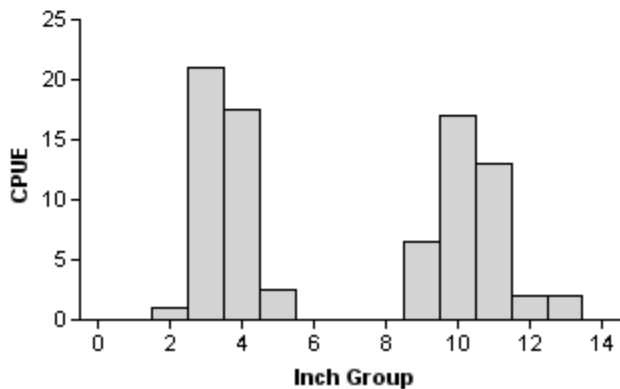


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV structure are in parentheses) for fall electrofishing surveys, Moss Reservoir, Texas 2006, 2010, and 2014.

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Bluegill

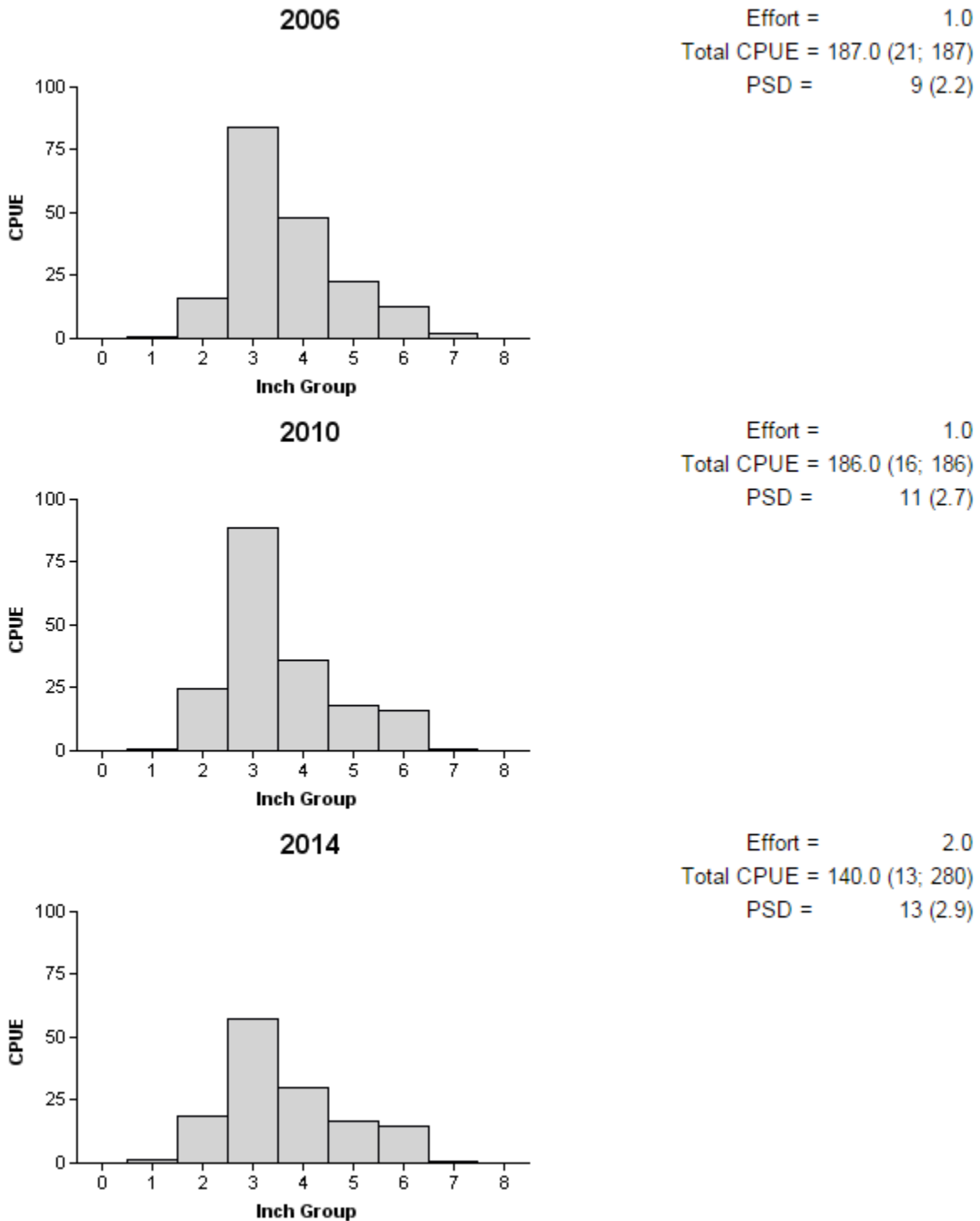


Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Moss Reservoir, Texas, 2006, 2010, and 2014.

Channel Catfish

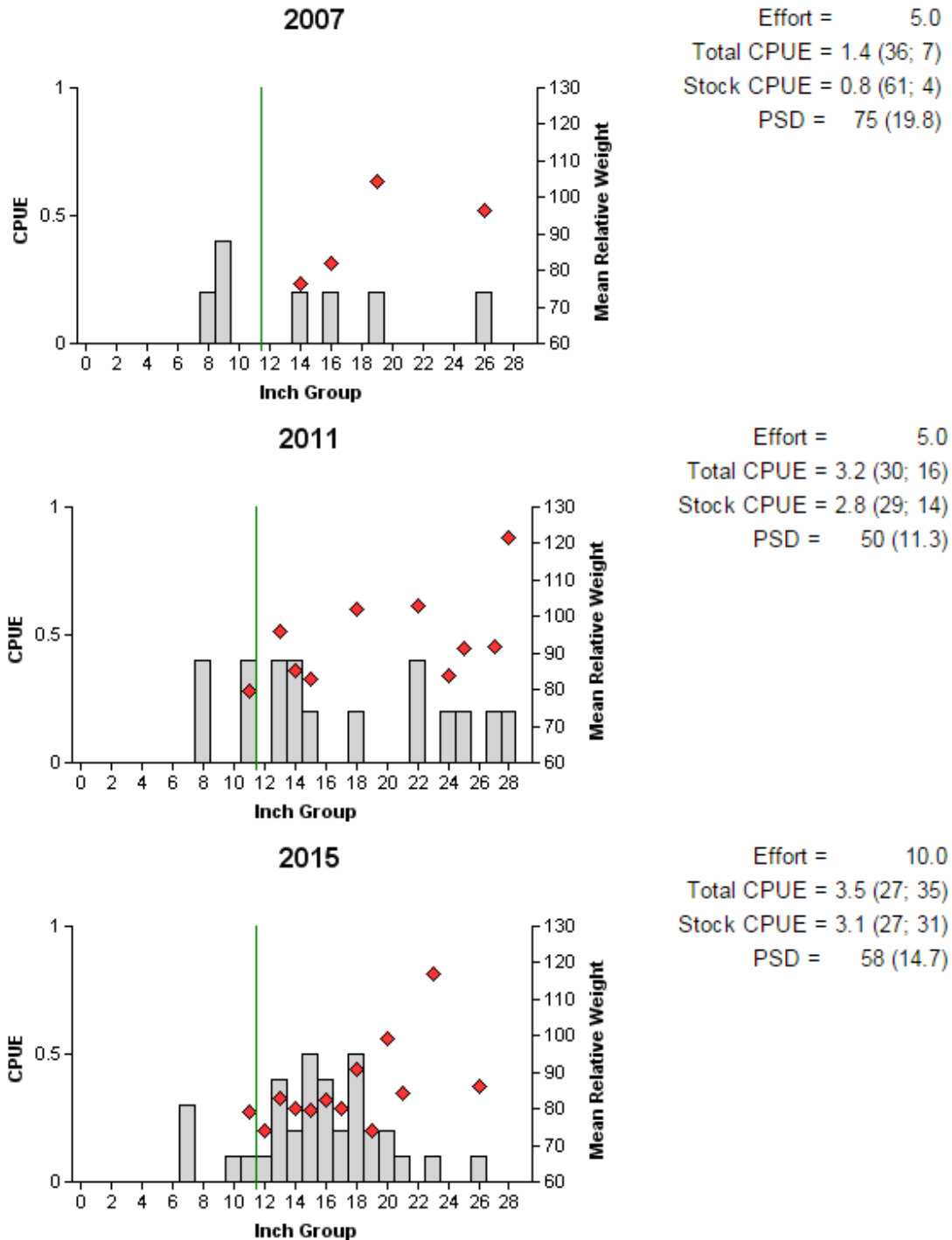


Figure 4. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Moss Reservoir, Texas, 2007, 2011, and 2015. Vertical lines represent length limit at time of collection.

Table 9. Creel survey statistics for Channel Catfish at Moss Reservoir, Texas from June 2014 – May 2015, where total catch per hour is for anglers targeting Channel Catfish and total harvest is the estimated number of Channel Catfish harvested by all anglers. Relative standard errors are in parentheses.

Creel survey statistic	Year
	2014/2015
Surface area (acres)	1,016.0
Directed effort (h)	5,185.5 (22)
Directed effort/acre	5.1 (22)
Total catch per hour	1.2 (89)
Total harvest	3,977.0 (46)
Harvest/acre	3.9 (46)
Percent legal released	5.6

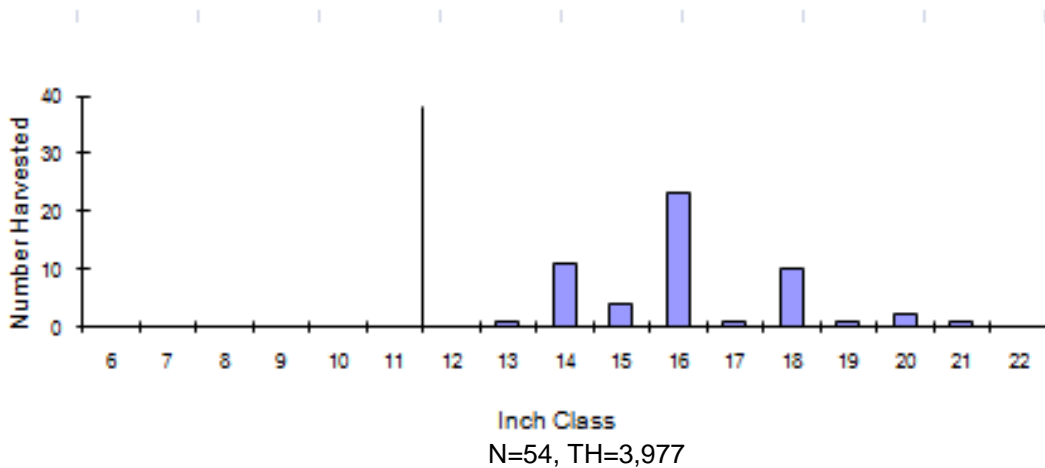


Figure 5. Length frequency of harvested Channel Catfish observed during creel surveys at Moss Reservoir, Texas, June 2014 - May 2015, all anglers combined. N is the number of harvested Channel Catfish observed during creel surveys, and TH is the total estimated harvest for the creel period. Vertical line represents length limit at time of creel survey.

White Bass

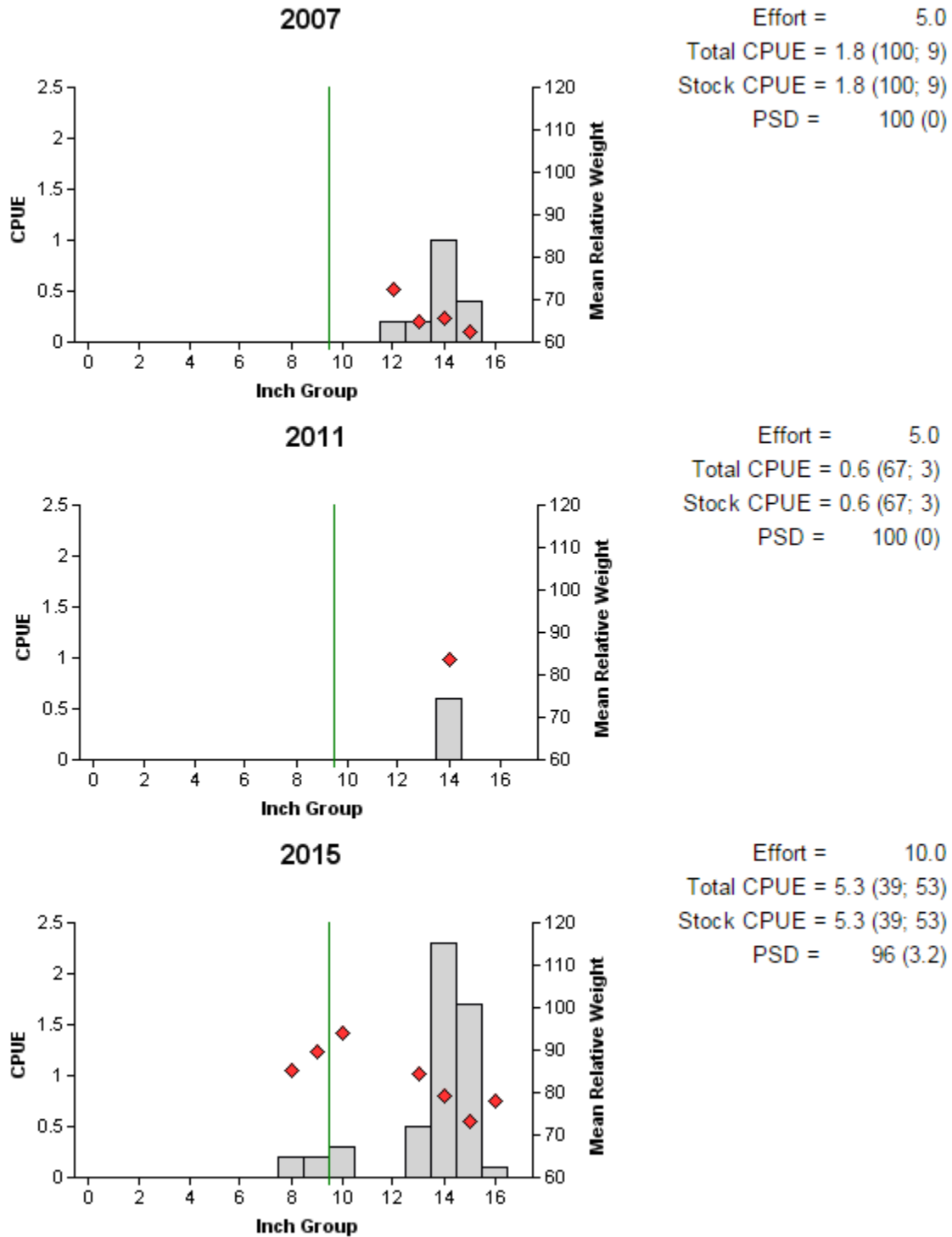
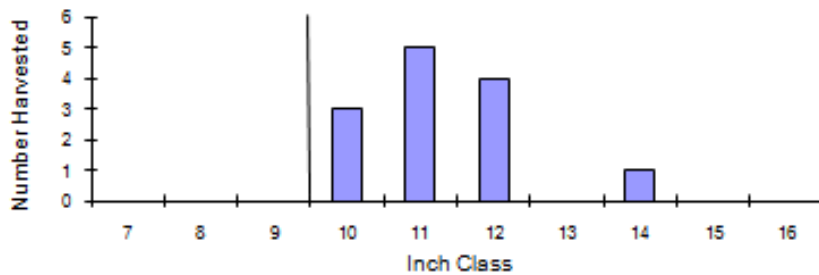


Figure 6. Number of White Bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Moss Reservoir, Texas, 2007, 2011, and 2015. Vertical lines represent length limit at time of collection.

Table 10. Creel survey statistics for White Bass at Moss Reservoir, Texas from June 2014 – May 2015, where total catch per hour is for anglers targeting White Bass and total harvest is the estimated number of White Bass harvested by all anglers. Relative standard errors are in parentheses.

Creel survey statistic	Year
	2014/2015
Surface area (acres)	1,016.0
Directed effort (h)	1,016.6 (49)
Directed effort/acre	1.0 (49)
Total catch per hour	0.2 (00)
Total harvest	237.0 (94)
Harvest/acre	0.2 (94)
Percent legal released	2.1



N=13, TH=237

Figure 7. Length frequency of harvested White Bass observed during creel surveys at Moss Reservoir, Texas, June 2014 – May 2015, all anglers combined. N is the number of harvested White Bass observed during creel surveys, and TH is the total estimated harvest for the creel period. Vertical line represents length limit at time of creel survey.

Spotted Bass

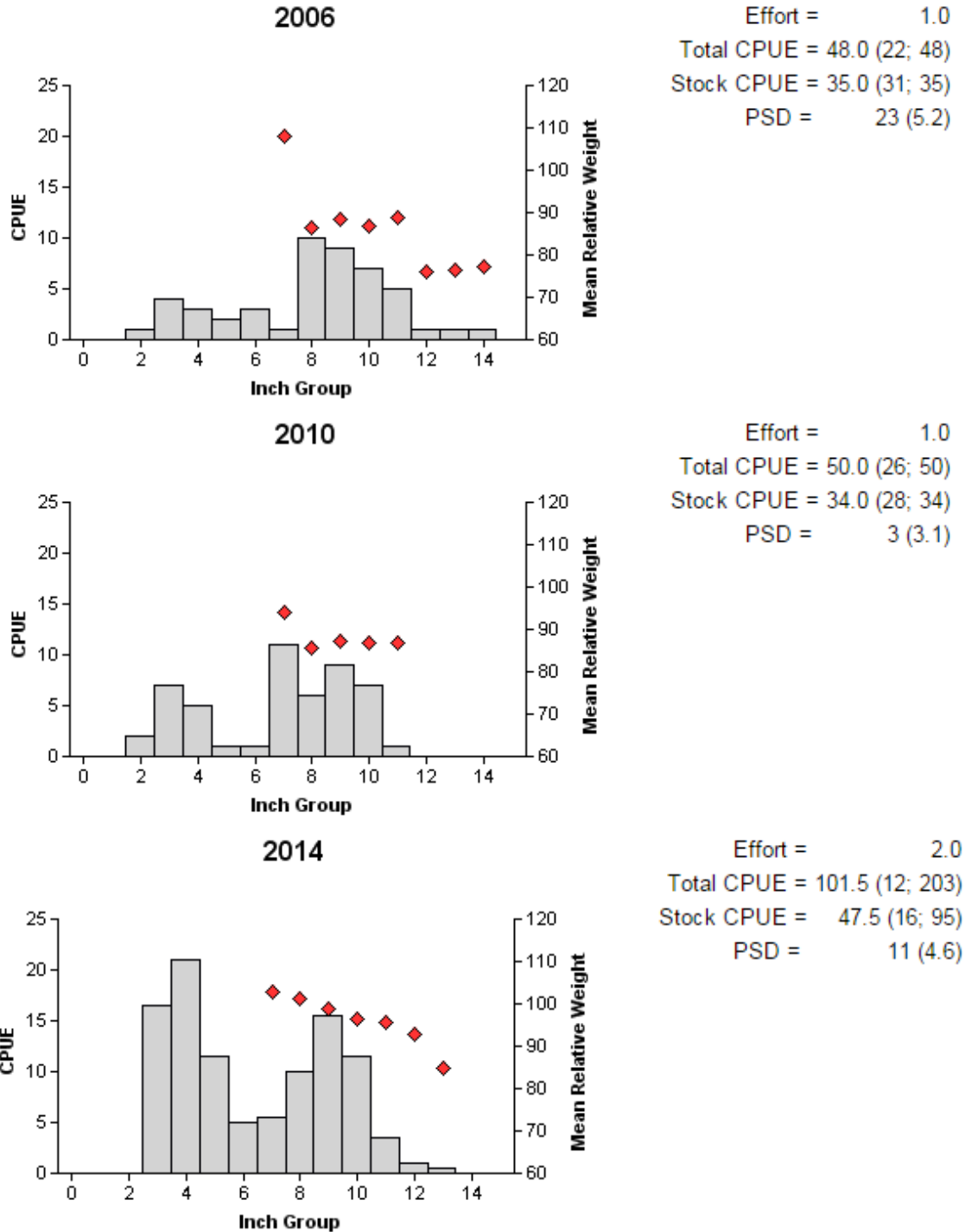


Figure 8. Number of Spotted Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Moss Reservoir, Texas, 2006, 2010, and 2014.

Largemouth Bass

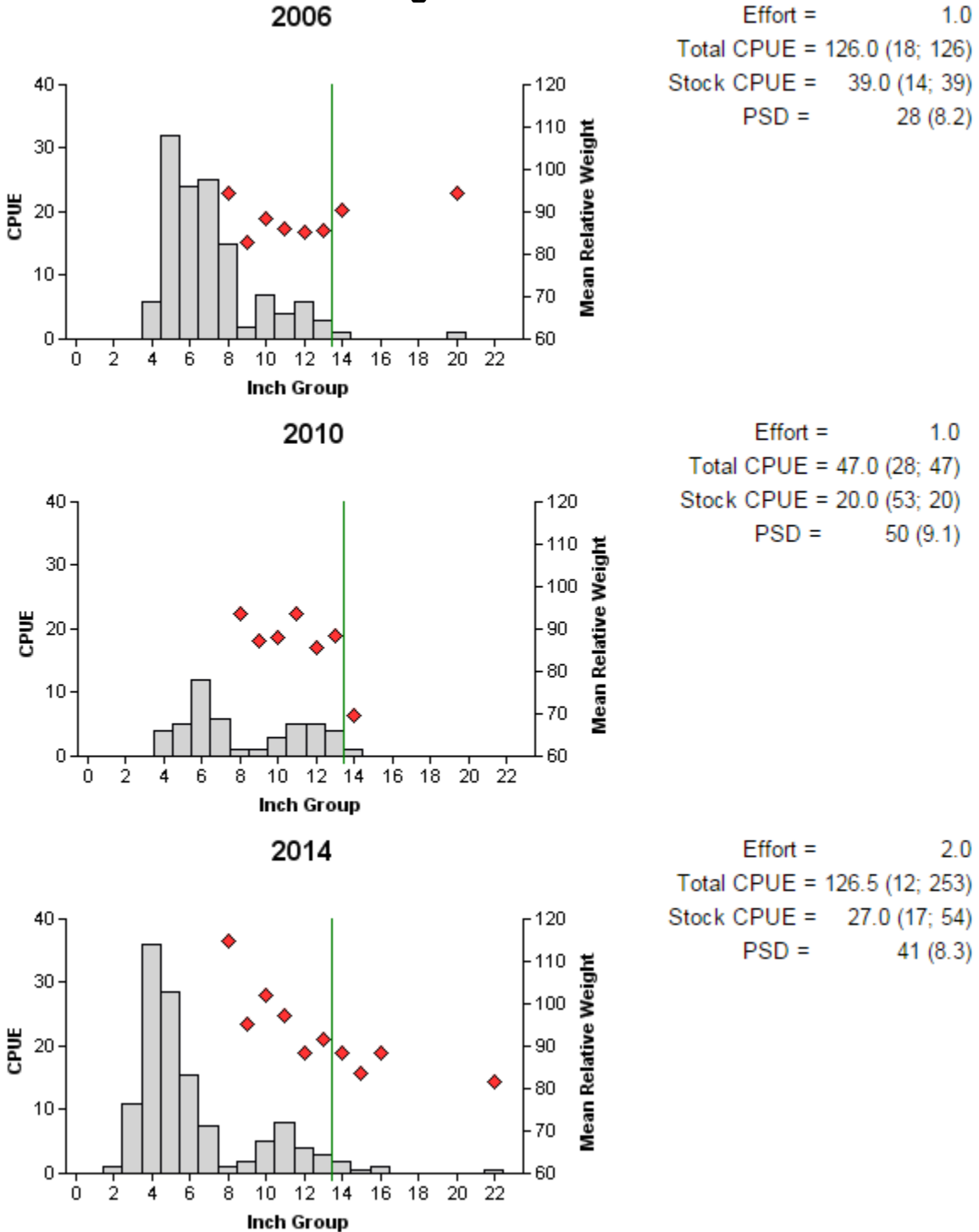
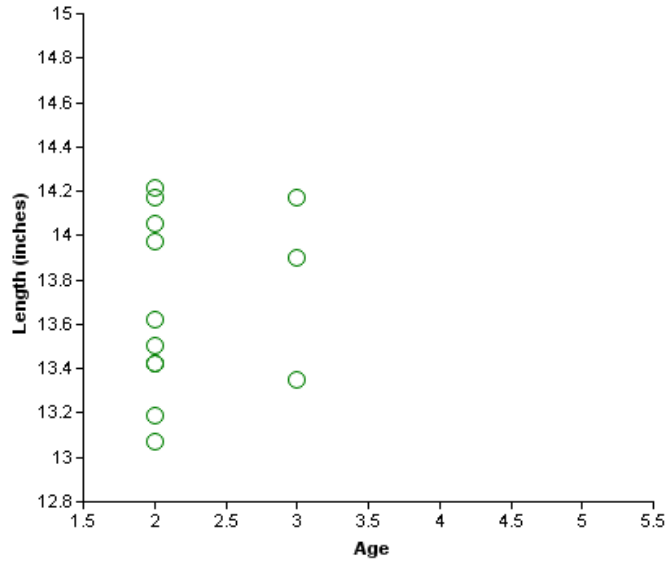
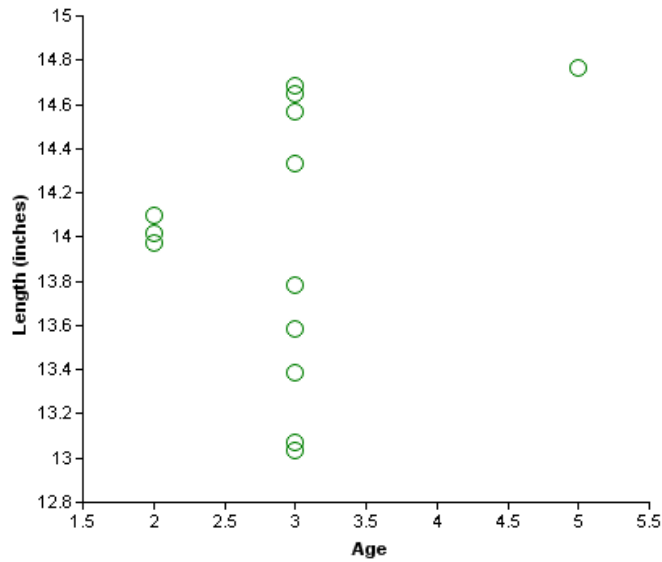


Figure 9. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Moss Reservoir, Texas, 2006, 2010, and 2014. Vertical lines represent length limit at time of collection.



Average Total Length (inches)	Year Class	Number
13.67	2012	10
13.81	2011	3

Figure 10. Length at age for Largemouth Bass collected from electrofishing at Moss Reservoir, Texas, October 2014.



Average Total Length (inches)	Year Class	Number
14.03	2009	3
13.90	2008	9
14.76	2006	1

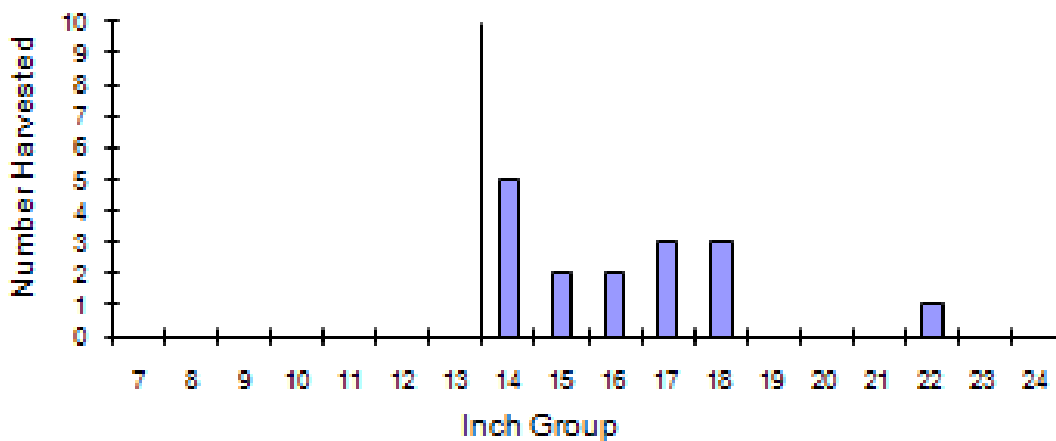
Figure 11. Length at age for Largemouth Bass collected from electrofishing at Moss Reservoir, Texas, October 2011.

Table 11. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Moss Reservoir, Texas, 1989, 2002, 2006, and 2014. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB. Genetic composition was determined by electrophoresis prior to 2005 and with micro-satellite DNA analysis since 2005.

Year	Sample size	Number of fish			% FLMB alleles	% FLMB
		FLMB	Intergrade	NLMB		
1989	33	1	31	1	63.6	3.0
2002	26	0	19	7	34.9	0.0
2006	30	1	28	1	46.0	3.0
2014	30	0	30	0	43.0	0.0

Table 12. Creel survey statistics for Largemouth Bass at Moss Reservoir, Texas from June 2014 – May 2015, where total catch per hour is for anglers targeting Largemouth Bass and total harvest is the estimated number of Largemouth Bass harvested by all anglers. Relative standard errors are in parentheses.

Statistic	2014/2015
Surface area (acres)	1,016.0
Directed angling effort (h)	
Tournament	2,625.2 (30)
Non-tournament	9,696.7 (17)
All black bass anglers combined	12,321.9 (15)
Angling effort/acre	12.1 (15)
Catch rate (number/h)	0.6 (51)
Harvest	
Non-tournament harvest	181.0 (89)
Harvest/acre	0.2 (89)
Tournament weigh-in and release	454.0 (72)
Percent legal released (non-tournament)	94.0

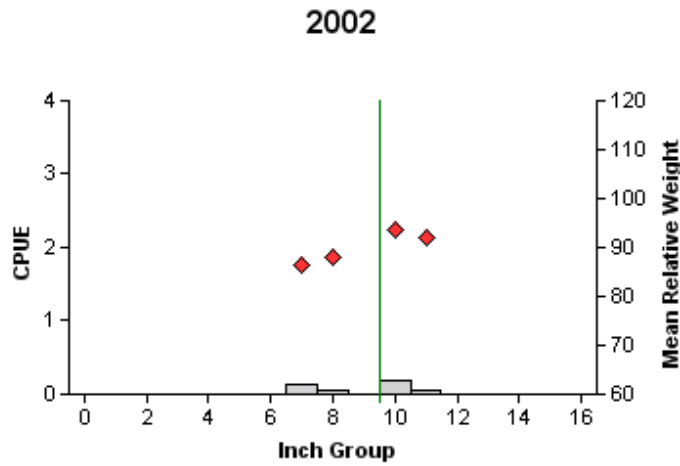


N=16, NT=15

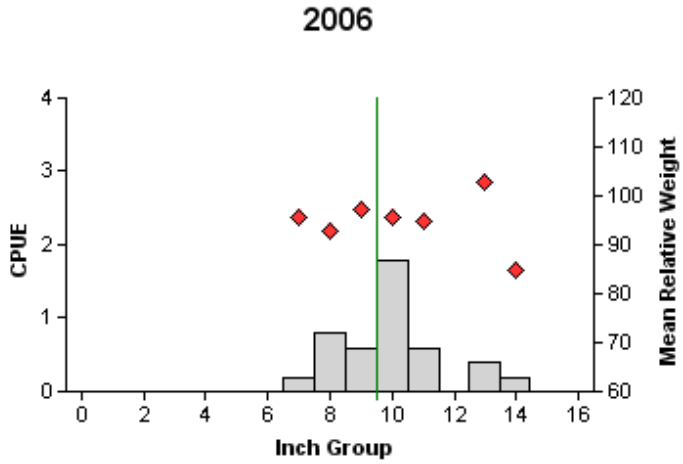
TH=181, TT=454

Figure 12. Length frequency of harvested Largemouth Bass (tournament and non-tournament) observed during creel surveys at Moss Reservoir, Texas, June 2014 – May 2015, all anglers combined. N is the number of harvested Largemouth Bass and NT is the number of Largemouth Bass brought in for weigh-in observed during creel surveys. Total estimated harvested (non-tournament) Largemouth Bass for the creel period is TH and TT is the total estimated Largemouth Bass brought in for weigh-in for the creel period. Vertical lines represent the length limit at time of creel survey.

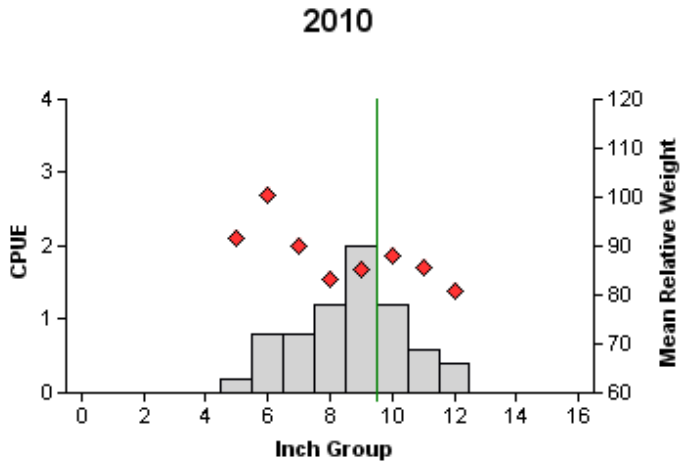
White Crappie



Effort = 15.0
 Total CPUE = 0.5 (59; 7)
 Stock CPUE = 0.5 (59; 7)
 PSD = 71 (12.4)



Effort = 5.0
 Total CPUE = 4.6 (44; 23)
 Stock CPUE = 4.6 (44; 23)
 PSD = 96 (2.8)



Effort = 5.0
 Total CPUE = 7.2 (65; 36)
 Stock CPUE = 7.2 (65; 36)
 PSD = 75 (1.1)

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, Moss Reservoir, Texas, 2002, 2006, and 2010. Vertical lines represent length limit at time of collection.

White Crappie

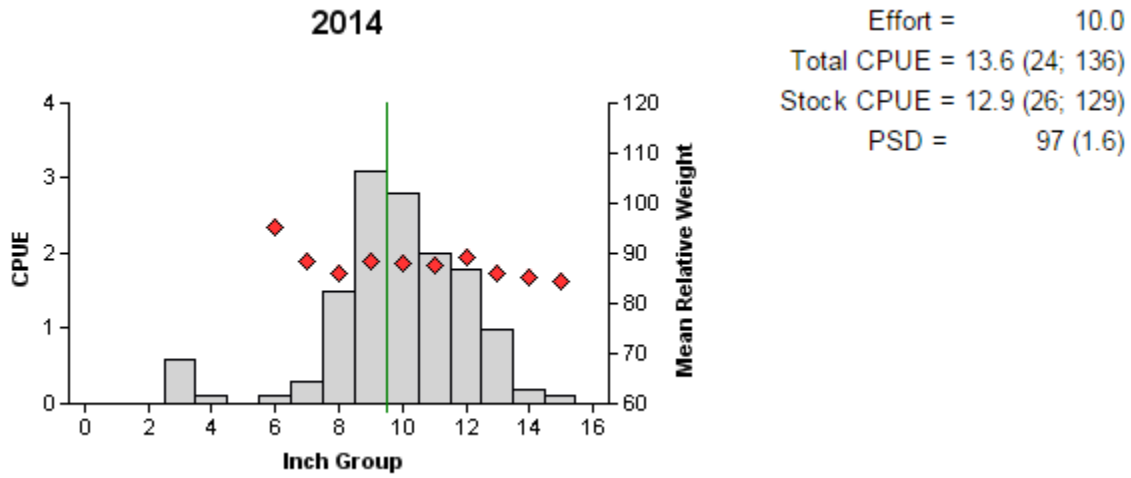
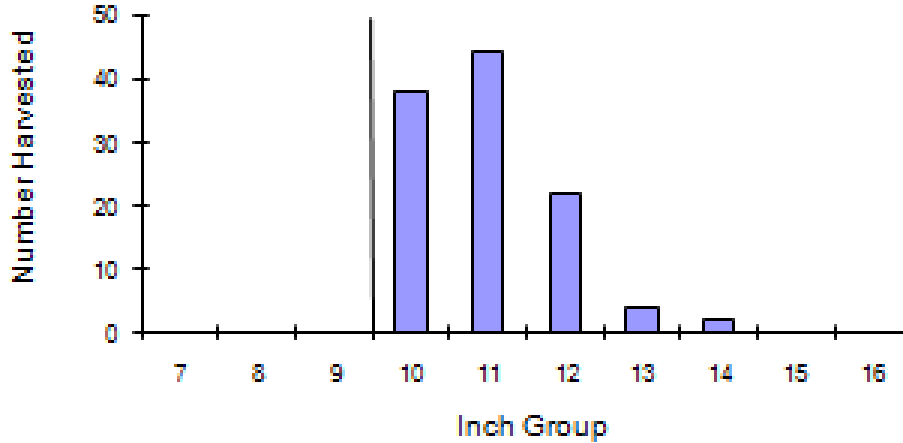


Figure 14. Number of White Crappie caught per net series (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall dual-cod trap netting survey, Moss Reservoir, Texas, 2014. Vertical lines represent length limit at time of collection.

Table 13. Creel survey statistics for White Crappie at Moss Reservoir, Texas from June 2014 – May 2015, where total catch per hour is for anglers targeting White Crappie and total harvest is the estimated number of White Crappie harvested by all anglers. Relative standard errors are in parentheses.

Creel survey statistic	Year
	2014/2015
Surface area (acres)	1,016.0
Directed effort (h)	5,451.1 (22)
Directed effort/acre	5.4 (22)
Total catch per hour	2.0 (42)
Total harvest	5,976.0 (41)
Harvest/acre	5.9 (41)
Percent legal released	28.5



N=110, TH=5,976

Figure 15. Length frequency of harvested White Crappie observed during creel surveys at Moss Reservoir, Texas, June 2014 – May 2015, all anglers combined. N is the number of harvested White Crappie observed during creel surveys, and TH is the total estimated harvest for the creel period. Vertical line represents length limit at time of creel survey.

Table 14. Proposed sampling schedule for Moss 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.

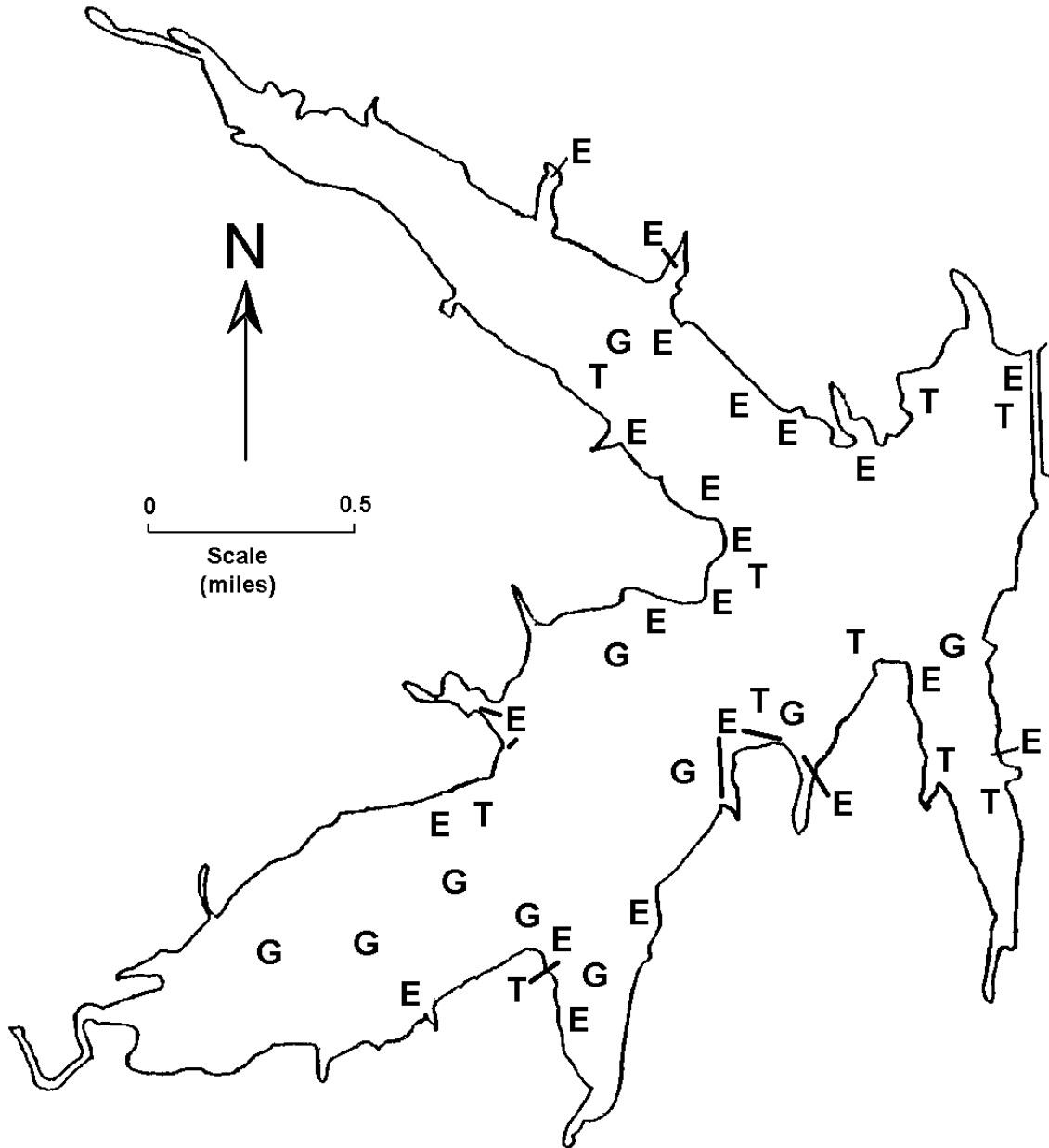
Survey year	Electrofishing Fall(Spring)	Dual- cod Trap net	Gill net	Habitat			Creel survey	Report
				Structural	Vegetation	Access		
2015-2016								
2016-2017								
2017-2018								
2018-2019	S	S	S		S	S		S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Moss Reservoir, Texas, 2014-2015. Sampling effort was 10 net nights for gill netting, 10 net series for dual-cod trap netting, and 2 hours for electrofishing.

Species	Gill Netting		Dual-cod Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					165	82.5
Channel Catfish	35	3.5				
White Bass	53	5.3				
Green Sunfish					7	3.5
Warmouth					16	8.0
Bluegill					280	140.0
Longear Sunfish					142	71.0
Redear Sunfish					32	16.0
Spotted Bass					203	101.5
Largemouth Bass					253	126.5
White Crappie			136	13.6		

APPENDIX B



Location of sampling sites, Moss Reservoir, Texas, 2014-2015. Electrofishing, trap netting, and gill netting sampling stations are indicated by E, T, and G, respectively. Water level was 4.1 feet below conservation level for trap netting, 3.9 feet below conservation level during electrofishing, and full during gill netting.

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APPENDIX C

Historical catch rates of targeted species by gear type for Moss Reservoir, Texas, 1987, 1990, 1994, 1997, 2002, 2006, 2010, and 2014.

Gear	Species	Year								Avg.
		1987 _a	1990 _a	1994 _a	1997 _b	2002 _{b,c}	2006 _{b,c}	2010 _{b,c}	2014 _{b,c}	
Gill Netting (fish/net night)	Channel Catfish	9.6	11.0	6.6	3.8	4.6	1.4	3.2	3.5	5.5
	White Bass	0.6	1.8	3.6	2.0	3.8	1.8	0.6	5.3	2.4
Electrofishing (fish/hour)	Gizzard Shad	20.0	43.0	20.0	36.0	8.0	28.0	23.0	82.5	32.6
	Threadfin Shad	0.0	273.0	32.0	0.6	7.0	173.0	3.0	0.0	61.1
	Green Sunfish	38.0	81.0	32.0	19.3	18.0	6.0	8.0	3.5	25.7
	Warmouth	6.7	18.0	24.7	7.3	23.0	10.0	15.0	8.0	14.1
	Bluegill	229.3	289.0	304.7	187.3	262.0	187.0	186.0	140.0	223.2
	Longear Sunfish	73.3	94.0	28.0	18.7	53.0	31.0	46.0	71.0	51.9
	Redear Sunfish	4.7	28.0	29.3	19.3	18.0	18.0	22.0	16.0	19.4
	Smallmouth Bass	0.0	5.0	0.0	0.0	0.0	2.0	0.0	0.0	0.9
	Spotted Bass	40.7	73.0	40.7	34.7	69.0	48.0	50.0	101.5	57.2
Largemouth Bass	51.3	117.0	108.7	94.0	55.0	126.0	47.0	126.5	90.7	
Trap Netting (single cod; fish/net night)	White Crappie	0.7	0.8	1.8	0.4	0.5	4.6	7.2		3.7
Trap Netting (dual cod; fish/net series)								13.6		13.6

^a All sampling stations for all gear were subjectively selected.
^b All sampling stations for all gear were randomly selected.
^c Gill netting was conducted in the spring of the following year.

APPENDIX DObjective-Based Sampling Plan for Moss Reservoir
2014 – 2015Sport fish, forage fish, and other important fishes

Sport fishes in Moss Reservoir include Channel Catfish, White Bass, Spotted Bass, Largemouth Bass, and White Crappie. Known important forage species include Gizzard and Threadfin Shad and Bluegill.

Negligible fisheries

WHITE BASS: White Bass is considered a negligible fishery due to low abundance and marginal directed angling effort. Therefore, gill netting for them should cease. However, if we continue gill net sampling for Channel Catfish, White Bass will be inadvertently sampled as well.

SMALLMOUTH BASS: Smallmouth Bass is also considered a negligible fishery because of low abundance and no directed angling effort, but since they are vulnerable to electrofishing, they will be sampled along with other black basses during fall nighttime electrofishing.

Survey objectives, fisheries metrics, and sampling objectives

CHANNEL CATFISH: Channel Catfish are present in Moss Reservoir and managed with the statewide regulation of 12-in MLL with 25 daily bag limit. They comprise the third-most-sought-after species by anglers. A creel survey in 1984 (February 1 – April 30, 1984) indicated that directed angling effort for Channel Catfish was 7.7% and 87 fish were harvested. Trend data on CPUE-TOTAL, size structure, and body condition have been monitored via 4-year interval collections with open water spring gill netting since 1990. Current population abundance is low (3.2/nn; RSE=30), but has a tendency to fluctuate. Average CPUE-TOTAL since 1990 was 5.1/nn. A gill net survey in 1990 showed CPUE-TOTAL was 11.0/nn, but in 2007 CPUE-TOTAL dropped to 1.4/nn. Decline in Channel Catfish CPUE-TOTAL may have been related to fluctuating forage CPUE-TOTAL after 1990. Continuation of the 4-year interval gill netting surveys will permit us to determine any large-scale changes in the population abundance and structure. The RSE for the last three surveys ranged from 26 to 36, therefore we feel spring gill netting accurately measures the trend data and gill netting should continue in the spring of 2015. Five additional random sites may be sampled with gill nets once we determine data shortcomings.

BLACK BASSES: Based on a creel survey from February 1 – April 30, 1984 directed angling effort for Largemouth Bass was 33.6% and 853 fish were harvested. While Largemouth Bass were the second-most-sought-after sport fish in Moss Reservoir, other black basses were not as popular. Spotted Bass, although abundant showed no directed angling effort, but 96 fish were harvested and Smallmouth Bass, not abundant at all also showed no directed angling effort and no fish were harvested. The popularity and reputation for quality angling for Largemouth Bass at Moss Reservoir warrant sampling time and effort. Largemouth Bass and Smallmouth Bass have been managed with the statewide 14-in MLL and 5 fish daily bag limit regulation since 1986. Prior to 1986, all black basses were managed with a statewide 10-in MLL and 10 fish daily bag limit regulation. Since 2000, Spotted Bass have been managed with no MLL and 5 fish daily bag limit. Prior to 2000 there was a brief period when they were managed with a 12-in MLL and 5 fish daily bag limit (it is noteworthy here that bag limits for black basses is 5 fish; Largemouth, Spotted, and Smallmouth Bass in aggregate). Trend data on CPUE-TOTAL, size structure, and body condition have been collected at four-year intervals since 1990 with fall nighttime electrofishing. The population appears to be in good shape, and anglers are anecdotally satisfied with the fishing. Continuation of four-year trend data in this relatively clear reservoir with nighttime electrofishing in the fall will allow for determination of any large-scale changes in the Largemouth Bass population that may invite further investigation. A minimum of 12 randomly selected 5-min electrofishing sites will be sampled in 2014, but sampling will continue at random sites until 50 stock-size fish are collected and the RSE of

CPUE-STOCK is ≤ 25 (the anticipated effort to meet both sampling objectives is 12-15 stations with 80% confidence). During nighttime fall electrofishing in 2010 RSE = 28. While our standard error was close to the objective of 25, we only collected 20 stock fish. Twelve random stations will be determined and sampled in 2014. If failure to achieve either objective has occurred after one night of sampling and objectives can be attained with 6-12 additional random stations, another night of effort will be expended.

WHITE CRAPPIE: Previous spring-quarter creel survey (1984) indicated White Crappie angling comprised >35% of TOTAL angling effort and were the most-sought-after species (38.5% directed angling effort). Since 1990 single-cod, shoreline trap netting CPUE-TOTAL averaged 2.6/nn, providing only a small sample of stock-size and larger fish per survey. These data only allowed us to determine presence or absence of the population. We would like to collect information providing us with a lower RSE for CPUE-TOTAL to monitor abundance and size structure over time. We propose switching from single-cod, shoreline trap nets set overnight to dual-cod, offshore trap nets set for three nights. We anticipate that setting a minimum of 5 dual-cod trap nets, with a soak time of 3 nights, will achieve our sampling objective (50 White Crappies >5 inches, and 13 between 10 and 11 inches for aging). An additional five random sites will be sampled with dual-cod trap nets if required.

GIZZARD AND THREADFIN SHAD AND BLUEGILL: Bluegill and Gizzard and Threadfin Shad are the primary forage at Moss Reservoir. Like Largemouth Bass, trend data on CPUE-TOTAL and size structure of Bluegill and Gizzard Shad have been collected at four-year intervals since 1990 with fall electrofishing. CPUE-TOTAL was also calculated for Threadfin Shad. The populations appear to be in good shape, providing excellent forage to predator species. Continuation of four-year trend data in this relatively clear reservoir with nighttime electrofishing in the fall will allow for determination of any large-scale changes in the Gizzard and Threadfin Shad and Bluegill populations that may invite further investigation. A minimum of 12 randomly selected 5-min electrofishing sites will be sampled in 2014, but sampling will continue in conjunction with Largemouth Bass sampling and/or until sufficient numbers for PSD and IOV (50 fish) have been collected. No additional effort will be expended to achieve an RSE25 for CPUE-stock of Bluegill and Gizzard and Threadfin Shad. Instead, Largemouth Bass body condition (relative weight of Largemouth Bass $\geq 8\%$ T) can provide information on forage abundance, vulnerability, or both, relative to predator density.