

PERFORMANCE REPORT

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FEDERAL AID PROJECT F-221-M-2

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2016 Fisheries Management Survey Report

**Mill Creek Reservoir**

*Prepared by:*

Evan C. Cartabiano, Assistant District Management Supervisor  
and  
Kevin W. Storey, District Management Supervisor

Inland Fisheries Division  
Tyler North District  
Tyler, Texas



Carter Smith  
Executive Director

Craig Bonds  
Director, Inland Fisheries

July 31, 2017

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## SURVEY AND MANAGEMENT SUMMARY

Fish populations in Mill Creek Reservoir were surveyed in 2016 using electrofishing and trap netting. An aquatic vegetation survey was conducted on Mill Creek Reservoir in July 2016 and a bathymetric survey was completed in 2017. An additional electrofishing survey was conducted in fall 2014 to monitor Largemouth Bass. Historical data are presented with the 2016 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:** Mill Creek Reservoir is a 237-acre impoundment located in Van Zandt County, Texas, on Mill Creek, a tributary of the Sabine River. The reservoir was constructed by the City of Canton in 1976 for municipal water supply. At conservation elevation, most of the available habitat in the reservoir consists of emergent aquatic vegetation, which occurs along much of the shoreline. In recent surveys, native submerged vegetation has been scarce.
- **Management History:** Largemouth Bass and crappies are the most important sport fishes. The management plan from the 2012 survey report recommended conducting routine monitoring of the Largemouth Bass population. The lack of habitat in the reservoir has been identified as a topic of concern.
- **Fish Community**
  - **Prey species:** The prey fish community of Mill Creek Reservoir is dominated by Bluegill, Redear Sunfish, and other sunfish species. Electrofishing CPUE of Bluegill was high, with most fish measuring less than 5 inches in length. Redear Sunfish were also abundant, with many greater than 6 inches observed. Threadfin Shad were less abundant than Gizzard Shad. The majority of Gizzard Shad collected were an appropriate size for predators.
  - **Catfishes:** No Channel or Blue Catfish were collected in the spring 2013 gill netting survey. A few large Blue Catfish were captured in 2005, the last year when either species was collected. These species are suffering from poor recruitment, likely the result of predation by Largemouth Bass and insufficient spawning habitat was noted during mapping.
  - **Largemouth Bass:** Largemouth Bass were fairly abundant, with moderate numbers of fish collected in the protective 14- to 21-inch slot length limit. Largemouth Bass had average growth, reaching 14 inches in 2.1 years. Body condition of Largemouth Bass tended to be good, indicating an adequate supply of prey.
  - **Crappies:** Both White and Black Crappie were reasonably abundant. Nearly half of the fish collected were above the 10-inch size limit.

**Management Strategies:** Continue to manage the LMB population as a big-fish fishery with a 14-21" slot limit. Stock FLMB to maintain big-fish potential. Improve fish habitat by planting native aquatic vegetation. Educate the public about the threat of invasive species.

## INTRODUCTION

This document is a summary of fisheries data collected from Mill Creek Reservoir from June 2016 through May 2017. The purpose of this 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 2016-2017 data for comparison.

### *Reservoir Description*

Mill Creek Reservoir is a 237-acre impoundment constructed in 1976 on Mill Creek, a tributary of the Sabine River. The reservoir is in Van Zandt County approximately 34 miles west of Tyler, Texas, and is operated and controlled by the City of Canton. The reservoir is used as a municipal water supply by the City of Canton. Habitat at time of sampling consisted of natural shoreline with limited amounts of vegetative cover as water level was estimated to be approximately 2.5 feet below conservation pool elevation (cpe). Other descriptive characteristics for Mill Creek Reservoir are in Table 1.

### *Angler access*

Mill Creek Reservoir has one public boat ramp and no private boat ramps. Boaters using the ramp are required to obtain a launch permit from the City of Canton Police Department. Additional boat ramp characteristics are in Table 2. Shoreline access is limited to the public boat ramp area, along the city park and included one fishing pier. The City of Canton replaced the decking on the fishing piers and loading docks in 2015 which will improve access for anglers and boaters.

### *Management History*

**Previous management strategies and actions:** Management strategies and actions from the previous survey report (Storey and Bennett 2013) included:

1. Monitor Largemouth Bass relative abundance, condition, and population size structure by conducting electrofishing surveys every other year beginning in 2014.  
**Action:** Mill Creek Reservoir was sampled using electrofishing in fall 2014 and 2016. Specimens were collected in fall 2016 for genetic assessment and age and growth analysis. FLMB fingerlings were stocked in 2015, 2016, and 2017 and 347 adult Largemouth Bass of mixed genetic heritage were stocked from a contract lake. District staff were unable to conduct a creel survey in spring 2017 because of conflicts with two other creel surveys.
2. Enhance structural habitat in Mill Creek Reservoir by planting native aquatic vegetation and installing fish attractors to influence growth rates, reproduction and recruitment of sport fishes.  
**Action:** District staff initiated a native vegetation project in 2013 by planting waterwillow in 2013 and 2014. A mixture of American pondweed and Illinois pondweed were planted in enclosure cages in 2014, 2015, and 2016 and waterstargrass was introduced in 2015. Three additional emergent species, arrowhead, bull tongue, and giant bulrush, were planted in 2015. An attempt was made to introduce wild celery from Lake Athens in fall 2015. In 2015 District staff secured money from the TPWD Largemouth Bass Conservation License Plate to purchase materials to construct 15 Georgia-style PVC fish attractors. The attractors were placed in groups of five at three sites in approximately 20 feet of water. A map showing the coordinates of the sites was posted on the TPWD website. A bathymetric survey was completed in 2017.
3. Conduct assessment of the Crappie populations in Mill Creek Reservoir.  
**Action:** White Crappie and Black Crappie populations were sampled in fall 2016 using

single cod trap nets and age and growth samples were collected for both species. District staff were unable to conduct a creel survey in spring 2017 because of conflicts with two other creel surveys.

**Harvest regulation history:** Sport fishes in Mill Creek Reservoir continue to be managed under statewide regulations except for Largemouth Bass, which are managed using a 14- to 21-inch protective slot length limit and a five-fish daily bag limit; of which one fish 21 inches or longer may be retained (Table 3). Current regulations are found in Table 3.

**Stocking history:** Florida Largemouth Bass (FLMB) were initially introduced in 1976 (26,400 fingerlings) and stocked six more times between 1978 and 1999. Two special stockings of advanced-fingerling (6 inches) ShareLunker offspring (from the Toyota ShareLunker selective breeding program) were introduced in fall 2005 and 2007. In 2010, a donation of 17,950 FLMB fingerlings was received from a private hatchery. FLMB fingerlings were stocked annually from 2015-2017 and 347 adult Largemouth Bass of mixed genetic heritage were stocked from a private contract lake in 2017. Blue catfish were stocked in 1992 and Channel Catfish in 1978, 1991 and 1993. Threadfin shad were introduced in 1982 and 1983. In 1976, 9,000 Northern Pike x Muskellunge hybrids (aka Tiger Muskies) were introduced but the stocking failed to establish a fishery. The complete stocking history is in Table 4.

**Vegetation/habitat history:** As recently as 2004, Mill Creek Reservoir contained a substantial amount of native submersed vegetation, representing 43% of reservoir surface area (Storey and Jubar 2005). Following extended droughts (2005-2006 and 2010-2015) when reservoir water elevations were markedly reduced, submersed vegetation declined and has not recovered. Vegetative cover is comprised of native emergent species and non-native alligator weed. A native vegetation enhancement project involving native submersed and native emergent species was initiated in 2013. See Previous management strategies and actions above for details on habitat management.

**Water transfer:** Mill Creek Reservoir is a water supply for the City of Canton and no inter-basin transfers are known to exist.

## METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan listed in Table 5. All survey sites were randomly selected and all surveys were conducted according to the Fishery Assessment Procedures (Texas Parks and Wildlife Department (TPWD), Inland Fisheries Division, unpublished manual revised 2015).

*Electrofishing* – Largemouth Bass, Sunfishes, Gizzard Shad, and Threadfin Shad were collected by electrofishing in fall 2016 (1.3 hour at 15, 5-min stations) and an optional additional Largemouth Bass only survey was conducted in fall 2014 (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 were determined using otoliths from 13 Largemouth Bass (length range 13.2 to 14.7 inches), collected by electrofishing in October 2012.

*Trap netting* – Crappie were collected with trap netting in fall 2016 (5 net nights at 5 stations). CPUE for trap netting was recorded as the number of fish caught per net night (fish/nn). Ages were determined using otoliths from 15 White Crappie (length range 9.1 – 10.8 inches) and 15 Black Crappie (length range 9.6 – 10.9 inches) collected in trap netting in November 2016.

*Genetics* – Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015). Micro-satellite DNA analysis was used to determine genetic composition of 30 individual fish from fall 2016.

*Habitat* – An aquatic vegetation survey was performed according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015). Shoreline distances and areas of vegetation were estimated using ESRI ArcGIS software.

*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 ( $W_t$ )] 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 CPUEs.

*Water level* – No gauging station exists on Mill Creek Reservoir, and reported elevations were based on estimates made during sampling.

*Bathymetric Survey* – Water depths were collected with a Humminbird Helix 9 (Gen 1) multifunction depth finder/chart plotter (Johnson Outdoors Inc. 2017). Processing was accomplished with ReefMaster v1.8 (ReefMaster Software Ltd. 2017). In areas where water depth precluded boat operation, the area was defined as 1-foot deep. Due to the lack of water level gage, elevation at the time of sampling had to be estimated, and was determined to be less than a difference of 6 inches during the sampling period.

## RESULTS AND DISCUSSION

**Habitat:** Water elevation was estimated to be at cpe at the time of the vegetation survey, and aquatic vegetation coverage was limited (Table 6). Total aquatic vegetation coverage was estimated at 3.9% of reservoir area and consisted of alligator weed and a variety of emergent aquatic vegetation species. No hydrilla was observed during the 2016 survey. Attempts by District staff to establish a variety of native aquatic species continues.

**Prey species:** Total electrofishing CPUE of Gizzard Shad has been historically low, with few (20%) fish suitably sized as prey; however, in 2016 the number suitable as prey increased to 67% (Figure 1). In 2016, Threadfin Shad were less abundant (88.0/h) than Gizzard Shad (148.0/h) (Appendix A). Prey populations in Mill Creek Reservoir were dominated by sunfishes, mostly Bluegill and Redear Sunfish (Appendix A), despite limited aquatic vegetation. Electrofishing CPUE of Bluegill in 2016 (320.8/h) was similar to 2008 (320.0/h), and considerably lower than in 2012 (583.0/h) with most measuring less than 5 inches in length (Figure 2). Redear Sunfish were substantially less abundant in 2016 (55.2/h) than in 2012 (330.0/h) (Figure 3). Overall, prey abundance and size composition should not be a limiting factor to the growth and condition of sport fishes.

**Catfishes:** Historically, gill net CPUEs of Blue and Channel Catfish have been low, likely from Largemouth Bass predation. No Channel or Blue Catfish were collected in the spring 2013 gill netting survey. The most recent year either species was collected was 2005, when a few large Blue Catfish were captured. These fish were likely remnants from a 1992 stocking of adult fish. Gill netting was discontinued in 2017.

**Largemouth bass:** Largemouth Bass continued to be moderately abundant. Total CPUE in fall electrofishing since 2012 ranged from 81.0/h to 126.4/h with catches peaking in 2016 (Figure 4). Size structure was inadequate as PSD was 34 in 2016 but is an improvement from 2014 (PSD = 10) (Figure 4). However, this value is still lower than the PSD for the 2008-2010 period which averaged 60 (Appendix C). Body condition was moderate too good for all size classes of fish (range: ~85 – ~120), indicating an ample supply of prey. Growth in fall 2016 was moderately fast, with fish ages averaging 2.1 years (N = 14; range = 2 – 3 years) at 14.0 inches. Genetic analyses found one first generation hybrid between a FLMB and a NLMB. The rest of the sample consisted of second or higher generation hybrids between

FLMB and NLMB (F<sub>x</sub>) and those hybrids with a higher percentage of FLMB alleles (F<sub>x</sub>-F) represented 50% of the sample. The FLMB allele frequency in 2016 (59%) was similar to the two previous assessments performed in 2008 (52%) and 2012 (58%) (Table 7; Figure 5).

**Crappie:** Both White and Black Crappie were collected in trap net sampling in 2016. White Crappie (11.0/nn) were more abundant than Black Crappie (7.6/nn) and a larger percentage of White Crappie collected were of legal size (42%) as opposed to Black Crappie (34%) (Figures 6 and 7). The PSD was 93 for White Crappie (Figure 6) and 63 for Black Crappie (Figure 7). White Crappie growth was excellent and mean age at legal length (10 in) was 1.0 years (N = 15, range = 0 – 2 years) whereas Black Crappie growth was adequate and fish reached legal length in 2.0 years (N = 15, range: 1 – 4 years).

## Fisheries management plan for Mill Creek Reservoir, Texas

Prepared – July 2017

**ISSUE 1:** Mill Creek Reservoir has a history of producing trophy Largemouth Bass. The lake record, a 16.77-pound fish caught in 1990, is the 10th heaviest Largemouth bass ever caught in Texas. The lake has produced four TPWD ShareLunker entries, most recently in February 2006 and anecdotal reports of angler-caught trophy ( $\geq 8$  lb) fish are frequent. The management goal is to manage the Largemouth Bass population as a big-fish fishery.

### MANAGEMENT STRATEGIES

1. Monitor Largemouth Bass population to evaluate if the 14-21in slot limit is meeting the objective of producing potential trophy bass. Metrics to be evaluated are included in the OBS plan (Appendix E).
2. Stock Florida Largemouth Bass to maintain trophy potential.

**ISSUE 2** Structural habitat and aquatic vegetation are limited in Mill Creek Reservoir. Enhancement projects may improve recruitment of sport fishes, as well as increase angling success. Efforts on other reservoirs within Tyler North District to establish native vegetation and add structural habitat have proven successful, and these techniques should be applied in Mill Creek Reservoir.

### MANAGEMENT STRATEGIES

1. Inform the City Manager of the City of Canton of enhancement projects in advance.
2. Continue attempts to increase the diversity of aquatic vegetation by working to establish a variety of native submersed and native emergent species to provide fish habitat.

**ISSUE 3:** 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. 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. 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.



## Mill Creek Reservoir Objective-Based Sampling Plan and Schedule for 2017-2021

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

Sport fishes in Mill Creek Reservoir include Largemouth Bass, sunfish, and crappie. Sunfish and Shad are the primary prey species for sport fishes.

### Low-density fisheries

**Catfish:** The population abundance of Blue Catfish and Channel Catfish in Mill Creek Reservoir is low. Previous gill net sampling in 2009 and 2013 did not capture either species so sampling using this gear was discontinued in 2017.

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

**Largemouth Bass:** Mill Creek Reservoir supports a moderately abundant Largemouth Bass population managed under a 14-21-inch slot-length limit regulation. The fishery has an impressive history of producing trophy Largemouth Bass including the lake record, a 16.77-pound fish caught in 1990, the 10<sup>th</sup> heaviest Largemouth Bass ever caught in Texas and four TPWD ShareLunker entries (1988, 1991, 1992, 2006). Trend data on catch per unit effort (CPUE), size structure, body condition, growth, and FLMB influence is desired for monitoring this fishery. These data will allow for determination of any large-scale changes in the Largemouth Bass population that may initiate further investigation. Analysis of electrofishing data from the four most recent surveys predicts a sample of 50 stock-sized Largemouth Bass can be obtained at the 80<sup>th</sup> percentile by sampling between 12 and 18 stations, yielding an RSE  $\leq$  25 at the 80<sup>th</sup> percentile. A minimum effort of 12 randomly-selected nighttime electrofishing stations will be conducted and an additional six random stations will also be generated in the event additional sampling is required to meet OBS plan objectives for Largemouth Bass in fall 2018. This sampling plan will be repeated in fall 2020 and it will involve collecting a genetic sample of 30 randomly-selected fish along with a sample of 13 fish for aging near the lower bound of the slot-length limit (13.0 to 14.9 inches).

**Crappie:** Both White and Black Crappie are present in Mill Creek Reservoir although White Crappie tends to be the more abundant species. CPUE of the combined species from single-cod, shoreline trap netting surveys in 1997, 2000, 2004, and 2008 were 0.4/nn, 140.8/nn, 5.4/nn, and 10.2/nn respectively. This sampling method was discontinued after 2008 because catches in the most recent surveys were insufficient to assess the fishery. A further survey using single-cod, shoreline trap netting was conducted in fall 2016 to assess the status of the Crappie populations in the reservoir. Minimal sampling effort will continue to determine long term trend information of basic population parameters (relative abundance, body condition, and size structure) of these species with 5 single-cod, shoreline trap net sets. No additional sampling effort beyond 5 trap net sets will be expended.

**Sunfish and other prey species:** Bluegill, Redear Sunfish, Gizzard Shad and Threadfin Shad are the primary prey species in Mill Creek Reservoir. Long term monitoring trend data is desired for these populations to evaluate their CPUE and size structure (PSD). Relative weights of the Largemouth Bass population, along with size structure of the sunfish and clupeid communities will be used to gauge prey fish availability for sport fishes. In the previous three comprehensive electrofishing surveys (2008, 2012, and 2016) a minimum of 300 Bluegill were collected during each survey and analysis of these data predicts a sample of 150 Bluegill can be obtained at the 80<sup>th</sup> percentile by sampling less than 12 stations, yielding an RSE  $<$  25 at the 80<sup>th</sup> percentile. Although CPUE of Redear Sunfish in surveys was lower than

Bluegill it is desirable to determine CPUE and size structure of this population. No additional sampling effort beyond that needed to obtain sampling objectives for Largemouth Bass will be expended for Bluegill or Redear Sunfish. CPUE of Gizzard Shad in electrofishing surveys in 2004, 2008, 2012 and 2016 were 75.0/h, 64.0/h, 90.0/h, and 148.0/h. The availability of suitably-sized as prey has improved in the most recent catch. CPUE of Threadfin Shad in the same surveys were 59.0/h, 46.0/h, 761.0/h, and 88.0/h respectively. Sampling for Clupeids using electrofishing will be used to document their relative abundance. No additional effort will be expended to achieve an RSE25 for Gizzard or Threadfin Shad, but Largemouth Bass body condition (fish > 8" TL) will be used to provide additional information on forage abundance and vulnerability.

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Table 1. Characteristics of Mill Creek Reservoir, Texas.

Characteristic	Description
Year constructed	1976
Controlling authority	City of Canton
Surface area	237 acres
County	Van Zandt
Reservoir type	Off-stream
Mean depth	10.0 ft.
Maximum depth	25.0 ft.
Shoreline Development Index (SDI)	3.5
Conductivity	75 $\mu$ mho / cm
Secchi disc range	1 – 4 ft.

Table 2. Boat ramp characteristics for Mill Creek Reservoir, Texas, July 2016. Reservoir elevation at time of survey was at conservation pool elevation.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Lakeside Marina	32.53693 -95.85003	Y	15	5.5 ft below cpe	Excellent, no access issues

Table 3. Harvest regulations for Mill Creek 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: Largemouth	5 (1 fish 21 inches or longer)	14 – 21 slot length limit
Crappie: White and Black Crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

Table 4. Stocking history of Mill Creek Reservoir, Texas. Size categories are: FRY =<1 inch; FGL = 1-3 inches; AFGL = 6 inches, and ADL = adults.

<u>Year</u>	<u>Number</u>	<u>Size</u>
<u>Threadfin Shad</u>		
1982	4,000	ADL
<u>1983</u>	<u>1,000</u>	ADL
Species total	5,000	
<u>Northern Pike x Muskellunge</u>		
<u>1976</u>	<u>9,000</u>	FGL
Species total	9,000	
<u>Blue Catfish</u>		
<u>1992</u>	<u>577</u>	ADL
Species total	577	
<u>Channel Catfish</u>		
1978	15,500	FGL
1991	9,120	FGL
<u>1993</u>	<u>9,090</u>	FGL
Species total	33,710	
<u>Florida Largemouth Bass</u>		
1976	26,400	FGL
1978	1,085	AFGL
1980	39,845	FGL
1983	52,902	FGL
1998	166	ADL
1998	36,603	FGL
1999	36,000	FGL
2005*	5,949	AGFL
2007*	5,928	AFGL
2010	45,822	FGL
2015	24,025	FGL
2016	25,091	FGL
2017	347	ADL
<u>2017</u>		FGL
Species total	300,163	

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\*ShareLunker advanced fingerlings

Table 5. Objective-based sampling plan components for Mill Creek Reservoir, Texas for 2016 – 2017.

Gear/ target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing – Fall 2016</i>			
<i>(Effort =12 – 18 stations)</i>			
Largemouth Bass	<i>Monitor trend in:</i>		
	Abundance	CPUE – stock	RSE-Stock $\leq 25$
	Size structure	PSD, length frequency	$N \geq 50$ stock
	Condition	$W_r$	10 fish/inch group (max)
	Genetics	% FLMB	$N = 30$ , any age
	Age-and-growth	Age at 14 inches	$N = 13$ , 13.0 – 14.9 inches
Bluegill <sup>a</sup>	Abundance	CPUE – Total	RSE $\leq 25$
	Size structure	PSD, length frequency	$N \geq 150$ total
Redear Sunfish <sup>a</sup>	Abundance	CPUE – Total	RSE $\leq 25$
	Size structure	PSD, length frequency	$N \geq 50$
Gizzard Shad	Abundance	Presence/ Absence	
Threadfin Shad	Abundance	Presence/ Absence	
<i>Trap netting – Fall 2016</i>			
<i>(Effort=5 single-cod, shoreline sets)</i>			
Crappie	Abundance	Presence/ Absence	

<sup>a</sup> No additional effort will be expended to achieve an RSE  $\leq 25$  for CPUE of Bluegill or Redear Sunfish if not reached from designated Largemouth Bass sampling effort. Instead, Largemouth Bass body condition can provide information on forage abundance, vulnerability, or both relative to predator density.

Table 6. Survey of aquatic vegetation, Mill Creek Reservoir, Texas, 2004, 2008, 2012, and 2016. Surface area (acres) is listed with percent of total reservoir surface area in parentheses. Reservoir water level was estimated to be at conservation pool elevation at time of survey in July 2016. Individual native species observed during surveys are listed in footnotes.

Vegetation	2004	2008	2012	2016
Native emergent	6.8 (2.9) <sup>1</sup>	0.5 (0.2) <sup>3</sup>	Trace <sup>5</sup>	2.8 (1.2) <sup>6</sup>
Native submersed	102.4 (43.5) <sup>2</sup>	0.2 (<0.1) <sup>4</sup>		
Invasive				
<i>Alligatorweed</i>		2.3 (1.0)	0.8 (0.3)	6.4 (2.7)
<i>Hydrilla</i>	5.4 (2.3)	<0.1 (<0.1)	-	-
Total	114.6 (48.6)	3.0 (1.3)	0.8 (0.3)	9.2 (3.9)

<sup>1</sup> *American lotus, cattail, common reed, smartweed, waterprimrose*

<sup>2</sup> *Bushy pondweed, coontail, muskgrass*

<sup>3</sup> *Bulrush, common reed, maidencane*

<sup>4</sup> *Bushy pondweed, muskgrass*

<sup>5</sup> *American lotus*

<sup>6</sup> *American lotus, buttonbush, common reed, smartweed, waterprimrose, waterwillow*

## Gizzard Shad

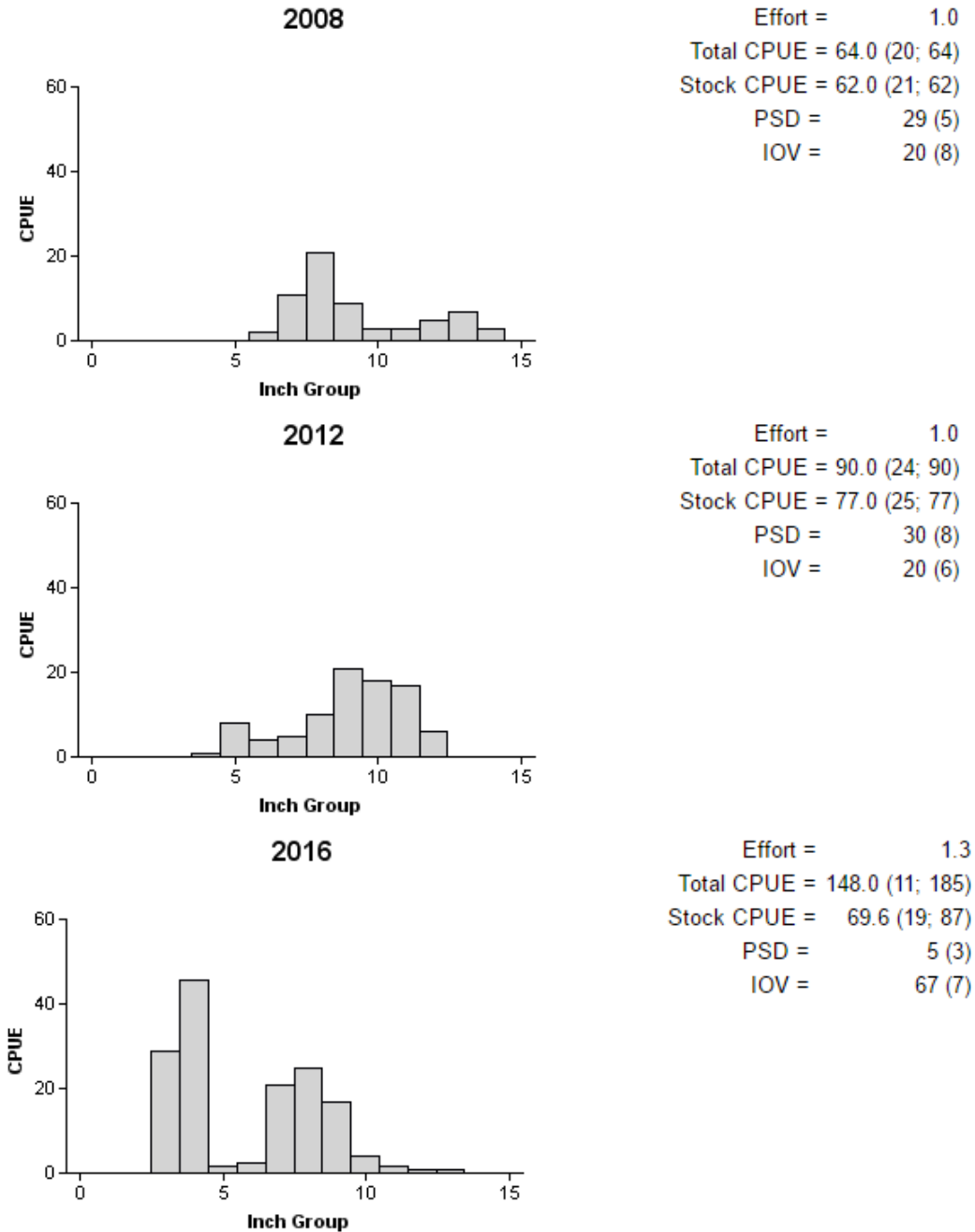


Figure 1. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Mill Creek Reservoir, Texas, 2008, 2012, and 2016.



## Bluegill

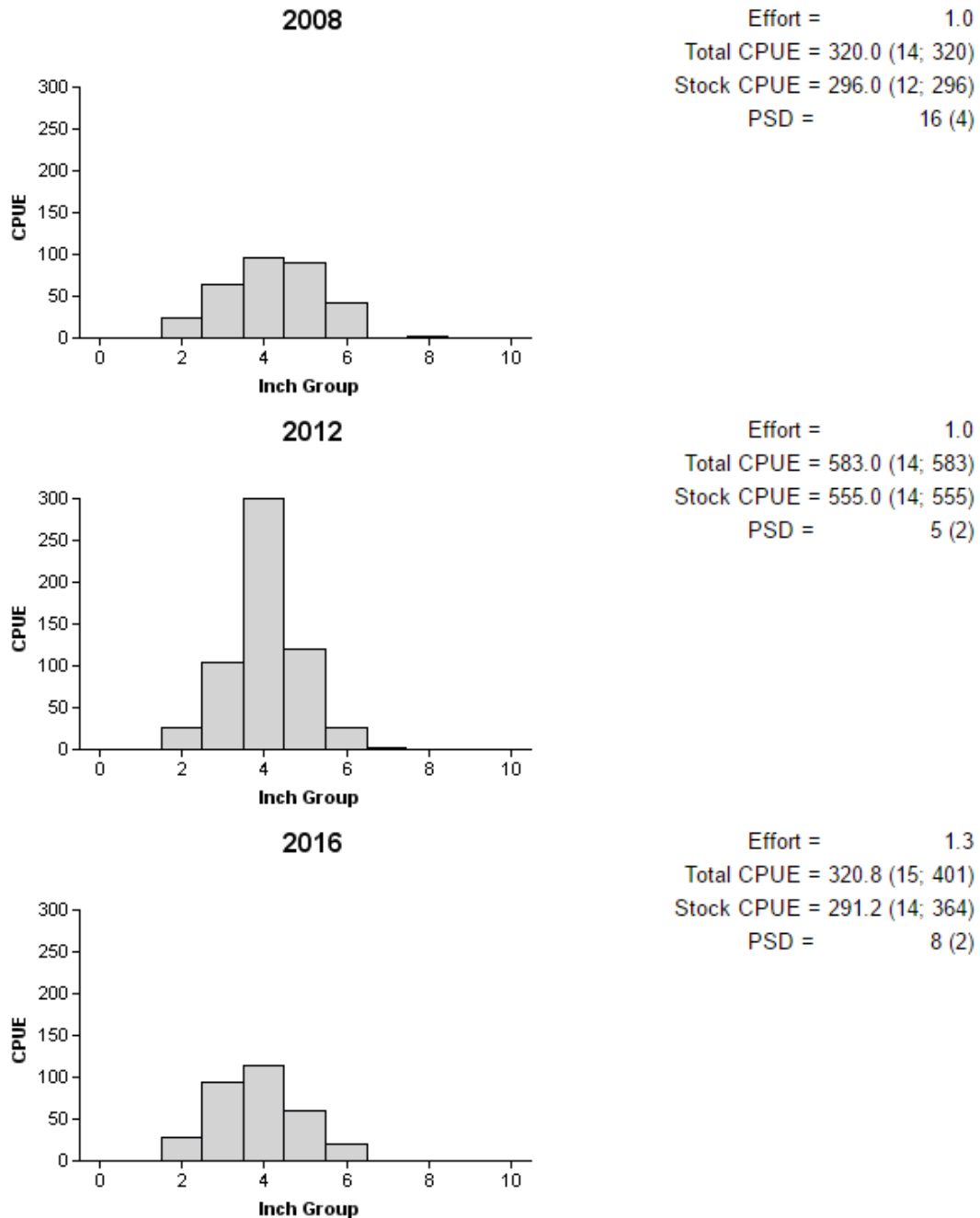


Figure 2. Number of Bluegill caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Mill Creek Reservoir, Texas, 2008, 2012, and 2016.

## Redear Sunfish

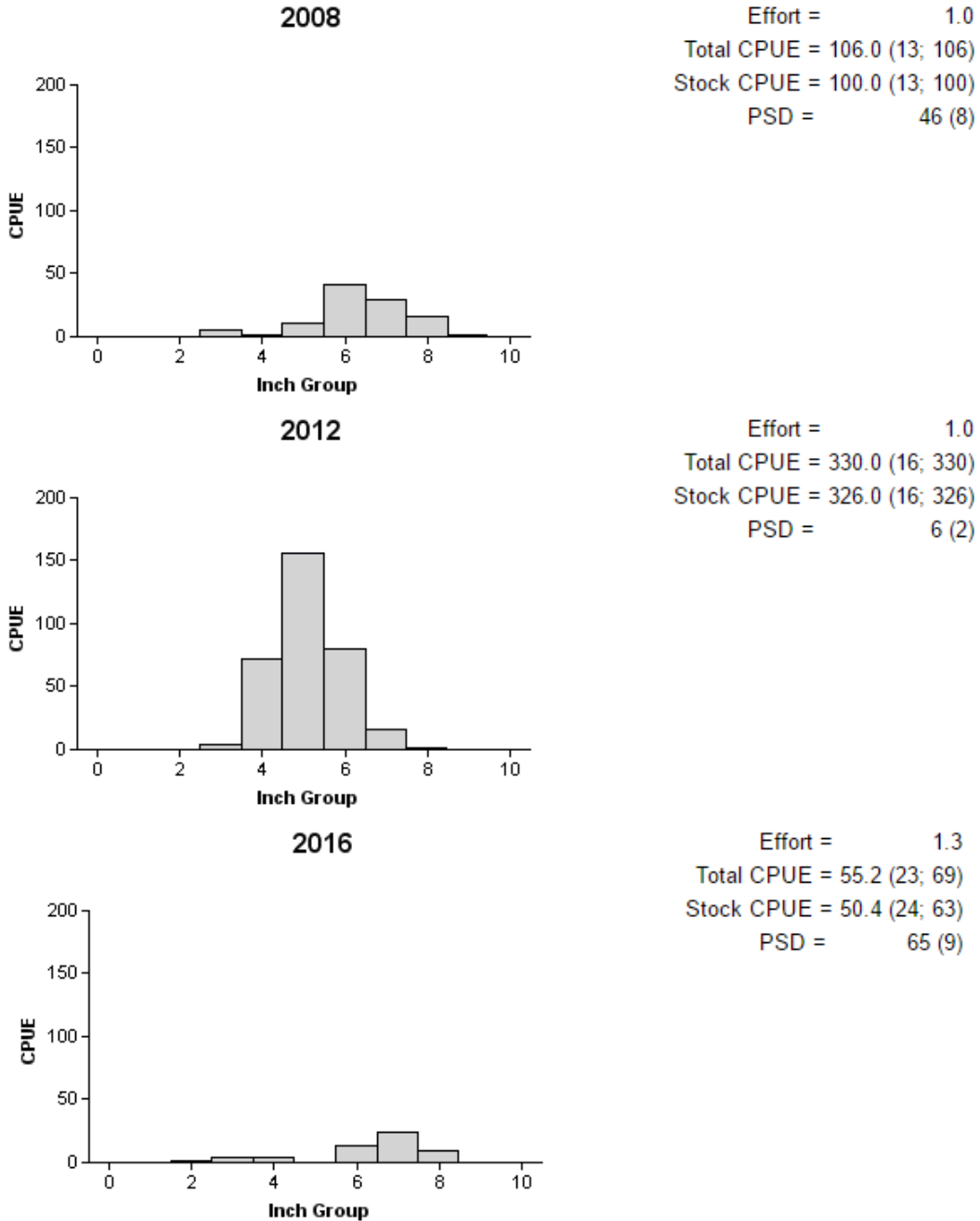


Figure 3. Number of Redear Sunfish caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Mill Creek Reservoir, Texas, 2008, 2012, and 2016.

## Largemouth Bass

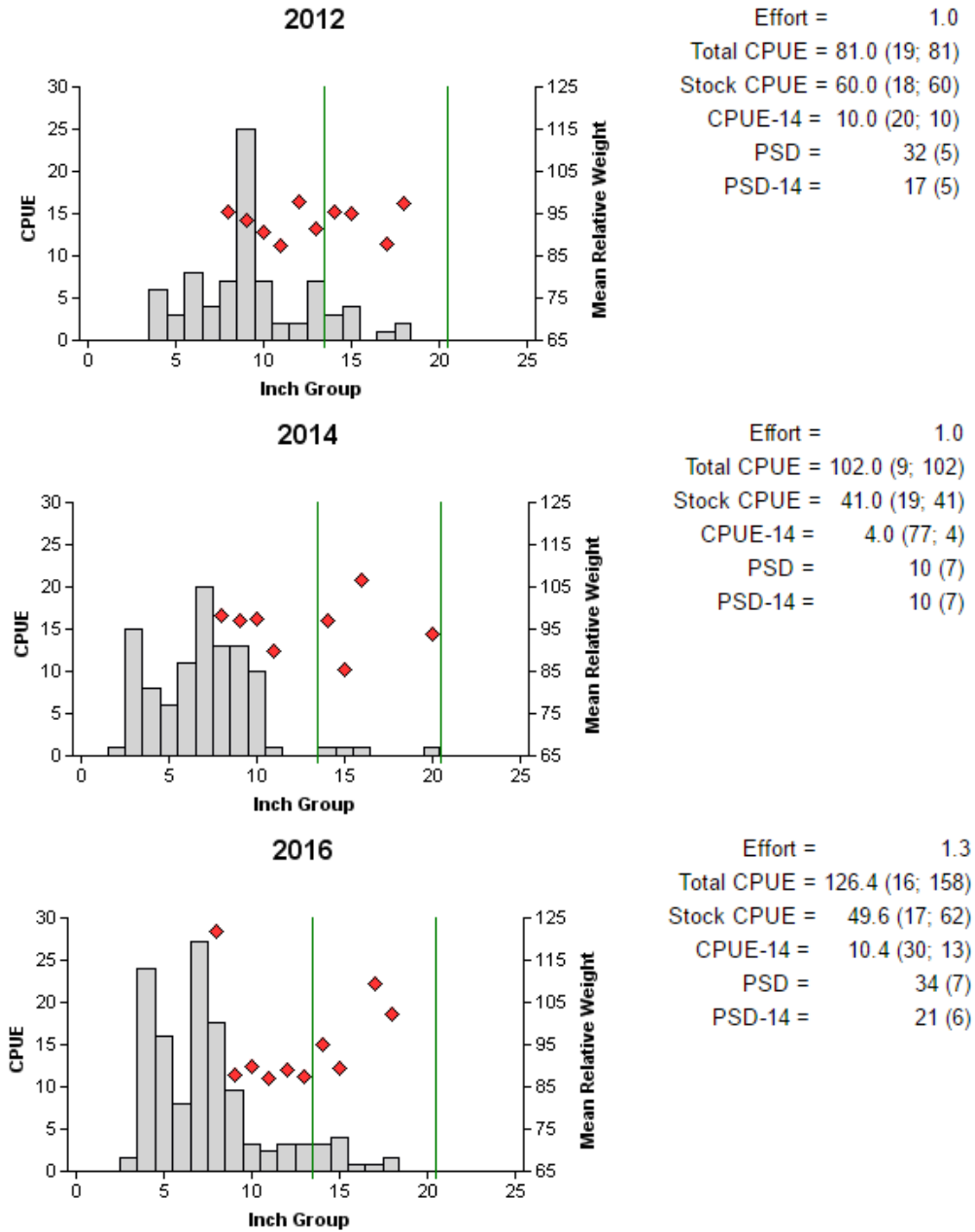


Figure 4. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Mill Creek Reservoir, Texas, 2012, 2014, and 2016. The 2014 survey was for Largemouth Bass-only. Vertical lines indicate minimum and maximum limits of protective slot.

## Largemouth Bass

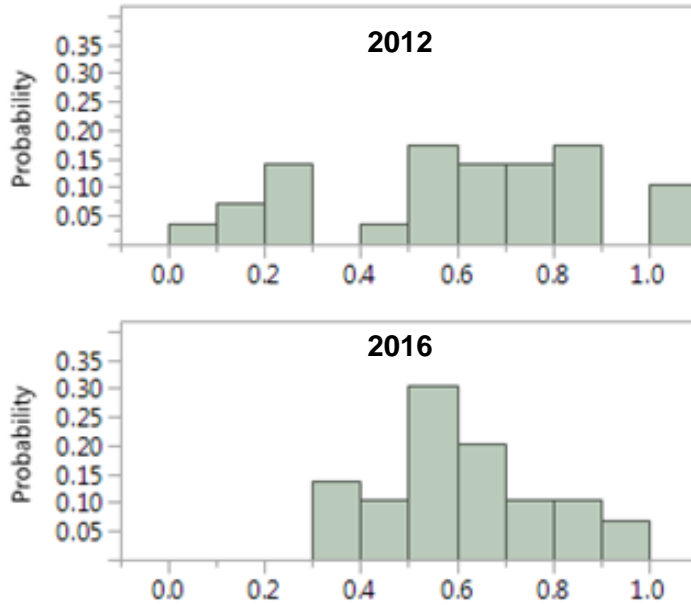


Figure 5. Distribution of genetic composition of Largemouth Bass in Mill Creek Reservoir by individual from 2012 and 2016 (0 = NLB, 1 = FLB).

Table 7. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Mill Creek Reservoir, Texas, 2008, 2012, and 2016. 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 an FLMB and an NLMB, Fx-F = second or higher generation hybrid between a FLMB and a NLMB with a higher percentage of FLMB alleles, Fx-N = second or higher generation hybrid between a FLMB and a NLMB with a higher percentage of NLMB alleles. Genetic composition was determined with micro-satellite DNA analysis.

Year	Sample size	Number of fish					NLMB	% FLMB alleles	% FLMB
		FLM B	F1	Fx	Fx-F	Fx-N			
2008	30	1	2	27	-	-	0	52.0	3.0
2012	29	1	0	28	-	-	0	58.0	3.0
2016	30	0	1	7	15	7	0	59.0	0.0

# White Crappie

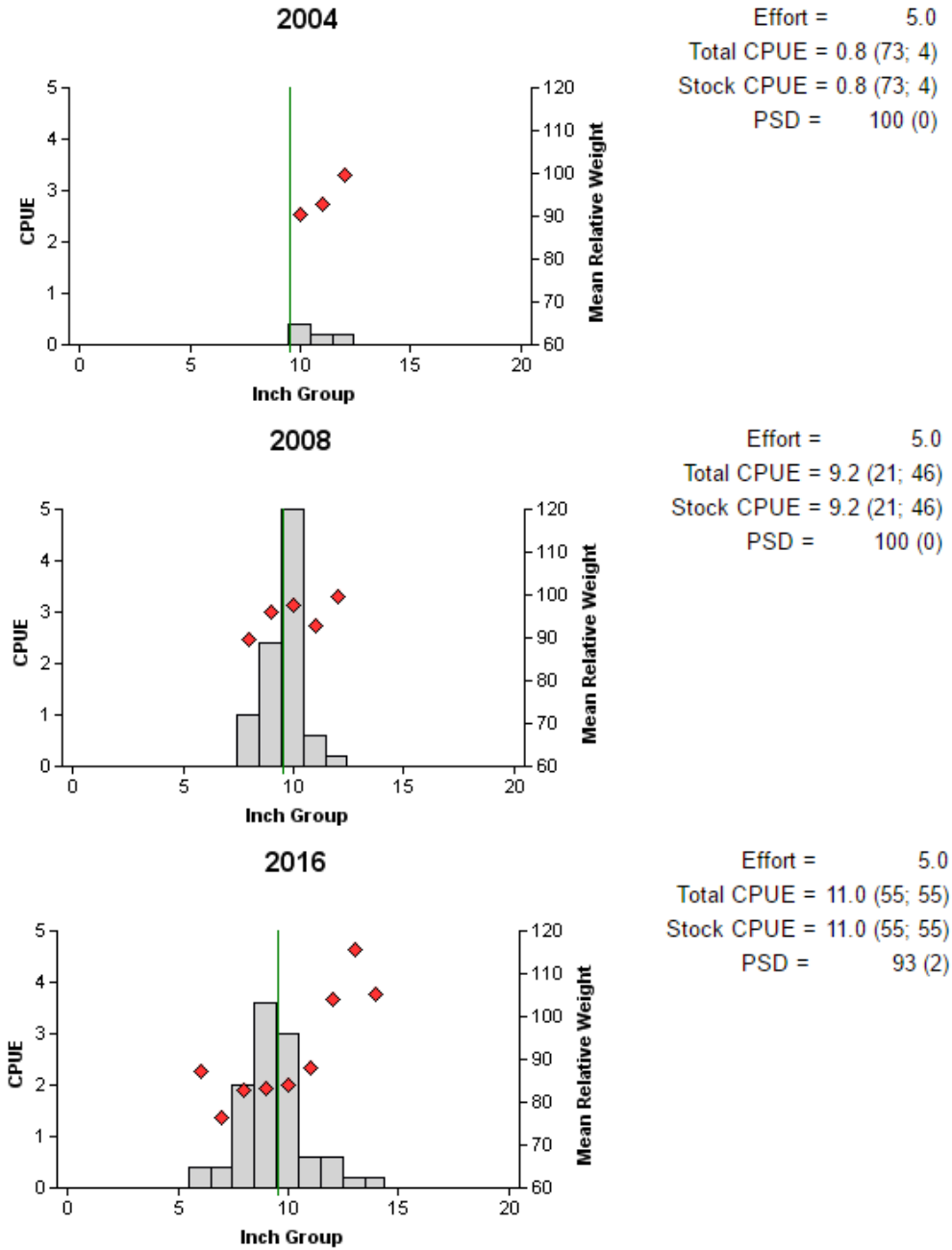


Figure 6. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Mill Creek Reservoir, Texas, 2004, 2008, and 2016. Vertical lines indicate minimum length limit.

## Black Crappie

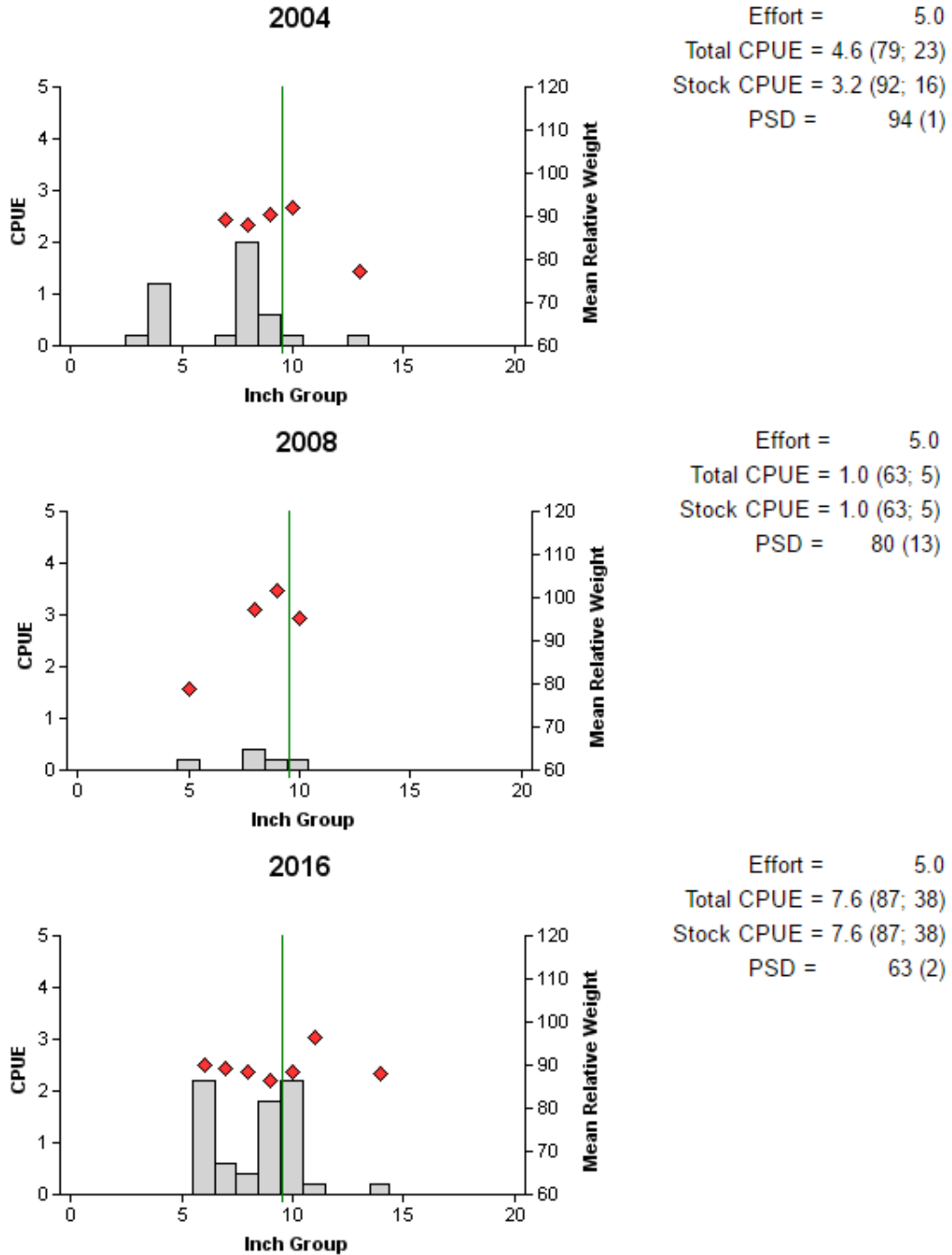


Figure 7. Number of Black Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Mill Creek Reservoir, Texas, 2004, 2008, and 2016. Vertical lines indicate minimum length limit.

Table 8. Proposed sampling schedule for Mill Creek Reservoir, Texas. Survey period is June through May. Electrofishing and trap netting surveys are conducted in the fall. Standard survey denoted by S, additional survey denoted by A.

Survey year	Electrofishing Fall	Trap net	Vegetation	Access	Report
2017-2018					
2018-2019	A				
2019-2020					
2020-2021	S	A	S	S	S

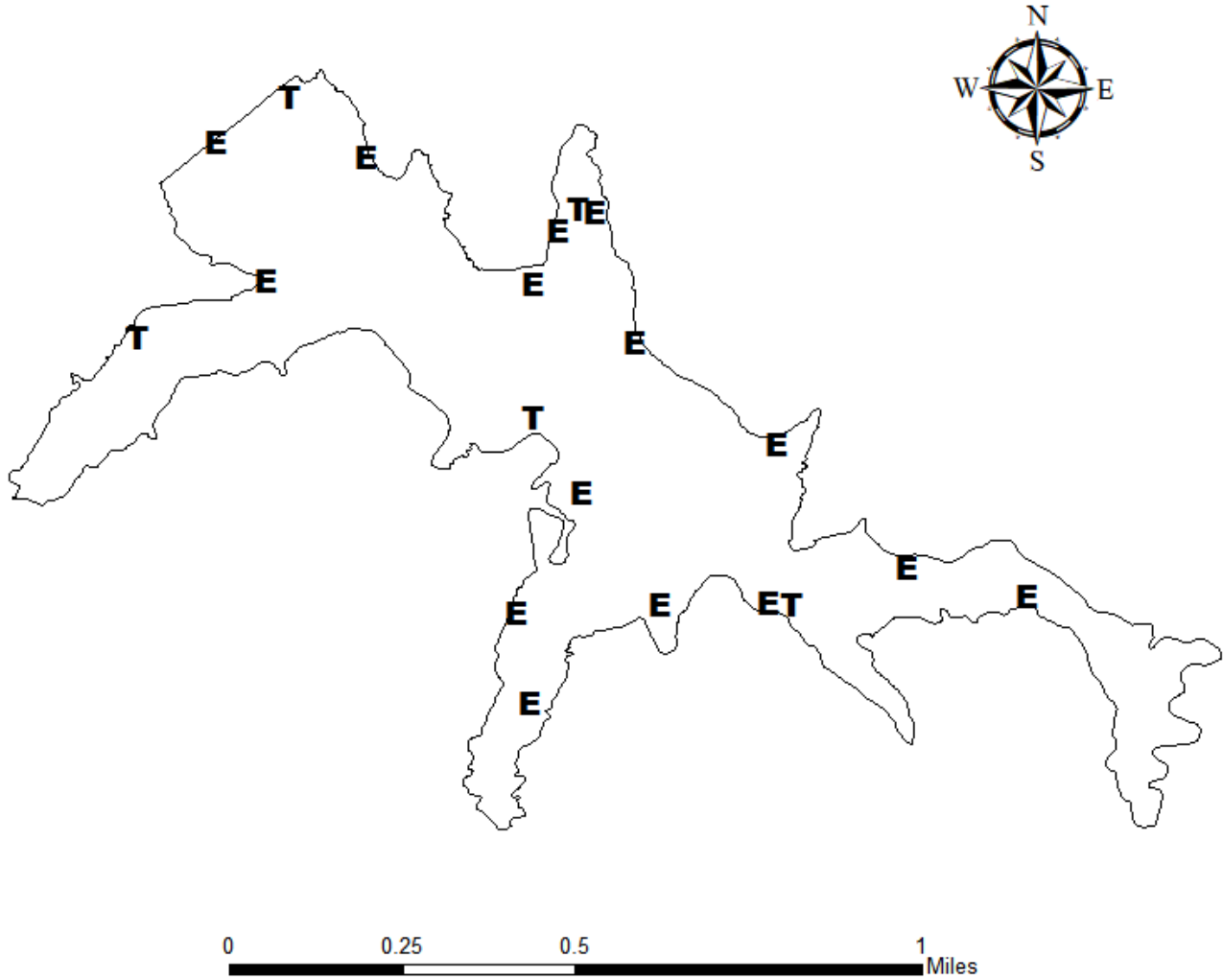
**APPENDIX A**

Number (N) and catch rate (CPUE) of all target species collected by fall electrofishing (1.25 h) and fall trap netting (5 net nights) from Mill Creek Reservoir, Texas, 2016-2017.

Species	Electrofishing		Trap netting	
	N	CPUE	N	CPUE
Gizzard Shad	185	148.0		
Threadfin Shad	110	88.0		
Warmouth	67	53.6		
Bluegill	401	320.8		
Longear Sunfish	51	40.8		
Redear Sunfish	69	55.2		
Largemouth Bass	158	126.4		
White Crappie			55	11.0
Black Crappie			38	7.6



APPENDIX B

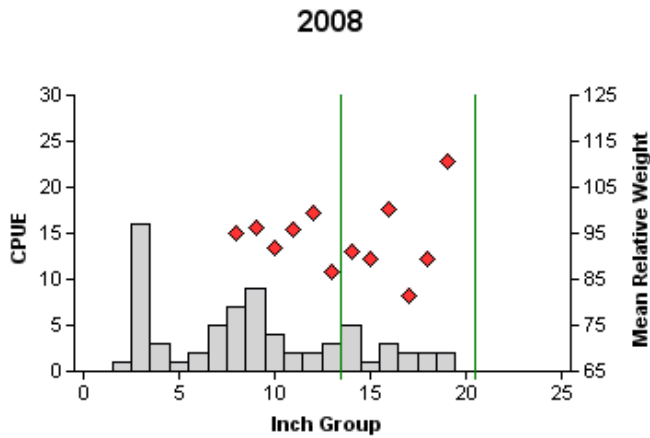


Location of electrofishing (E) and trap netting (T) stations, Mill Creek Reservoir, Texas, 2016-2017.

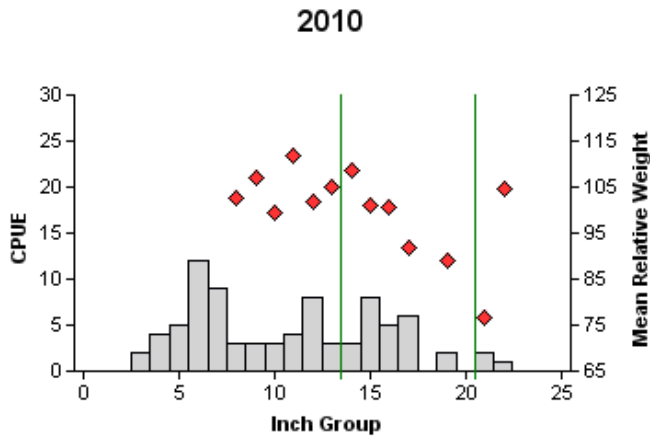
APPENDIX C



Effort = 1.0  
 Total CPUE = 85.0 (12; 85)  
 Stock CPUE = 61.0 (14; 61)  
 CPUE-14 = 29.0 (22; 29)  
 PSD = 56 (6)  
 PSD-14 = 48 (6)



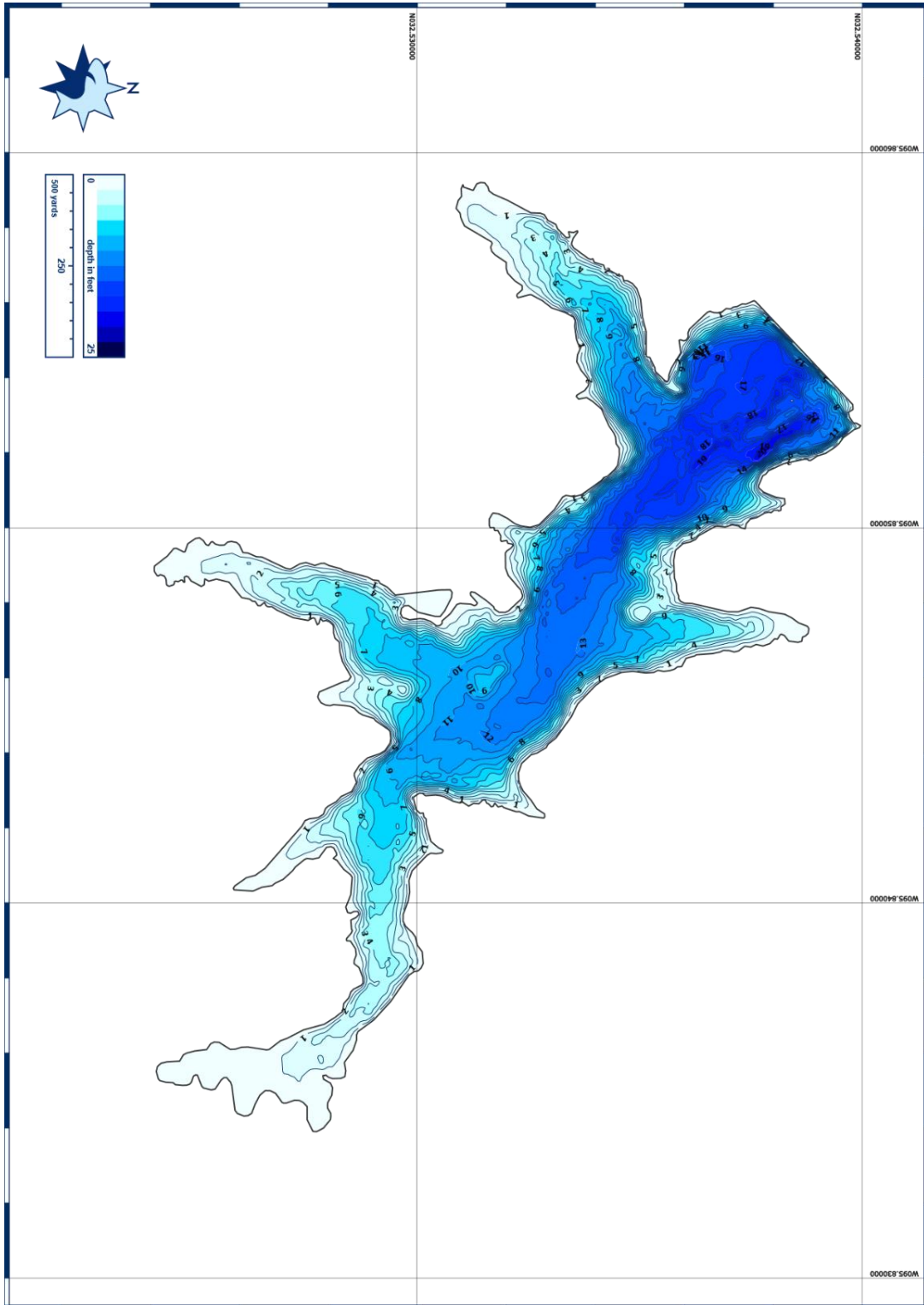
Effort = 1.0  
 Total CPUE = 70.0 (14; 70)  
 Stock CPUE = 42.0 (24; 42)  
 CPUE-14 = 15.0 (30; 15)  
 PSD = 48 (10)  
 PSD-14 = 36 (9)



Effort = 1.0  
 Total CPUE = 83.0 (10; 83)  
 Stock CPUE = 51.0 (14; 51)  
 CPUE-14 = 27.0 (21; 27)  
 PSD = 75 (10)  
 PSD-14 = 53 (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, Mill Creek Reservoir, Texas, 2006, 2008, and 2012. The 2006 and 2010 surveys were for Largemouth Bass-only. Vertical lines indicate minimum and maximum limits of protective slot.

APPENDIX D



Bathymetric map of Mill Creek Reservoir

## APPENDIX E

Objective-based sampling plan components for Mill Creek Reservoir, Texas for 2017 – 2021.

Gear/ target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing – Fall 2018</i>			
<i>(Effort =12 – 18 stations)</i>			
Largemouth Bass	<i>Monitor trend in:</i>		
	Abundance	CPUE – stock	RSE-Stock $\leq$ 25
	Size structure	PSD, length frequency	N $\geq$ 50 stock
	Condition	$W_r$	10 fish/inch group (max)
<i>Electrofishing – Fall 2020</i>			
<i>(Effort =12 – 18 stations)</i>			
Largemouth Bass	<i>Monitor trend in:</i>		
	Abundance	CPUE – stock	RSE-Stock $\leq$ 25
	Size structure	PSD, length frequency	N $\geq$ 50 stock
	Condition	$W_r$	10 fish/inch group (max)
	Genetics	% FLMB	N = 30, any age
	Age-and-growth	Age at 14 inches	N = 13, 13.0 – 14.9 inches
Bluegill <sup>a</sup>	Abundance	CPUE – Total	RSE $\leq$ 25
	Size structure	PSD, length frequency	N $\geq$ 150 total
Redear Sunfish <sup>a</sup>	Abundance	CPUE – Total	RSE $\leq$ 25
	Size structure	PSD, length frequency	N $\geq$ 50
Gizzard Shad	Abundance	CPUE-Total	
Threadfin Shad	Abundance	CPUE-Total	
<i>Trap netting – Fall 2020</i>			
<i>(Effort=5 single-cod, shoreline sets)</i>			
Crappie	<i>Monitor trend in:</i>		
	Abundance	CPUE – stock	
	Size structure	PSD, length frequency	
	Condition	$W_r$	

<sup>a</sup> No additional effort will be expended to achieve an RSE  $\leq$  25 for CPUE of Bluegill or Redear Sunfish if not reached from designated Largemouth Bass sampling effort. Instead, Largemouth Bass body condition can provide information on forage abundance, vulnerability, or both relative to predator density.