

PERFORMANCE REPORT

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FEDERAL AID PROJECT F-221-M-3

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2012 Fisheries Management Survey Report

Lake Murvaul

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lake Murvaul were surveyed in 2012 using electrofishing and trap netting, and in 2013 using gill netting. This report summarizes the results of the surveys and contains a management plan for the reservoir based on those findings.

- **Reservoir description:** Lake Murvaul is a 3,820-acre impoundment constructed in 1958 on Murvaul Creek in the Sabine River Basin. Structural habitat is mainly inundated timber and natural shoreline features. Native aquatic plant abundance is limited. Hydrilla coverage has been problematic in previous years, but could not be found in the most recent survey due to low reservoir water elevation. Giant salvinia was found and removed from the Dodson Landing boat ramp.
- **Management history:** The trophy Largemouth Bass fishery at Lake Murvaul has been a focus of fisheries management efforts for many years. The fishery is currently managed with a 14- to 21-inch protective slot length limit with a 5-fish daily bag, of which only one fish can be greater than 21 inches. Florida Largemouth Bass were stocked in 2008, 2009, and 2011 to maintain this trophy fishery. Other important sport fish include Channel Catfish and crappie, which are managed with statewide harvest regulations.
- **Fish community:**
 - **Prey species:** Gizzard Shad and Threadfin Shad were both collected in the latest survey. Over 80% of Gizzard Shad were small enough to be available as prey to most sport fish. Bluegill is the most common sunfish species in the reservoir and serves as an abundant source of prey.
 - **Catfishes:** Gill netting catch rates of Channel Catfish were slightly lower in 2013 than in the past two surveys, but still the majority of fish collected were above the minimum legal length (12 inches).
 - **Largemouth Bass:** Electrofishing catch rates of Largemouth Bass in 2012 were similar to previous surveys, with a high number of fish collect within the 14- to 21-inch slot. Fish body condition was adequate, indicating adequate prey availability. The growth rate of Largemouth Bass was fast. Florida Largemouth Bass genetic influence has shown a slight increase.
 - **Crappie:** White Crappie catch rates in trap nets have increased in the most recent survey, while Black Crappie catch rates have declined. White Crappie growth is moderate. The average age of a 10-inch White Crappie is 2 years.
- **Management strategies:** Conduct electrofishing surveys every other year beginning in 2014, and general monitoring with trap nets in 2016 and gill nets in 2017. Conduct angler access survey in 2016. Invasive aquatic vegetation surveys will be conducted annually. Technical guidance will be given to the controlling authority regarding invasive aquatic vegetation management as necessary. Largemouth Bass will continue to be managed with a 14- to 21-inch slot length limit. Florida Largemouth Bass stocking is recommended every other year to maintain the trophy fishery. Spring-quarter (March through May) angler creel surveys will be conducted every 8 years beginning 2017.

INTRODUCTION

This document is a summary of fisheries data collected from Lake Murvaul from June 2012 through May 2013. 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 2012 and 2013 data for comparison.

Reservoir Description

Lake Murvaul is located on Murvaul Creek in the Sabine River Basin. It was constructed by the Panola County Fresh Water Supply District in 1957 for municipal and industrial water supply and public recreation. It has a drainage area of approximately 115 square miles. At conservation pool elevation, the reservoir covers 3,820 acres, shoreline length is 29 miles, and Shoreline Development Index is 6.7 (Table 1). Annual water level fluctuation is generally less than 2 feet; however, drought periods within the last 9 years have reduced the water level to approximately 5 feet below conservation pool elevation (Figure 1). Primary structural shoreline habitat consisted of natural shoreline. Almost 20% of shoreline has been modified with bulkhead. Lake Murvaul received national recognition during the 1960s for its trophy Largemouth Bass fishery. The introduction of Florida Largemouth Bass beginning in 1972 has further enhanced the trophy fishery. From 1987 to 1997, anglers caught six Largemouth Bass larger than 13 pounds that were entered into TPWD's ShareLunker Program. The current waterbody record for Largemouth Bass caught in 1993 is 14.87 pounds.

Angler Access

Lake Murvaul has four public boat ramps but shoreline access for anglers is limited. Further information related to elevation at end of boat ramps will be collected during future surveys. Additional boat ramp characteristics are in Table 2.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Bister and Brice 2009) included:

1. Continue to monitor invasive aquatic vegetation.
Action: Invasive vegetation has been monitored annually to ensure angler access has not been impacted.
2. Conduct a roving angler creel survey during the spring quarter every 4 years beginning 2013 to monitor angler utilization and fishing success for largemouth bass.
Action: To better allocate district resources, this angler survey was not conducted in 2013. The next spring creel survey is scheduled for March through May 2017.
3. Stock Florida Largemouth Bass annually at a rate of 50 fish/acre to enhance the trophy potential of the Largemouth Bass population.
Action: Florida Largemouth Bass stocking was conducted in 2011.
4. Investigate opportunities to implement a trophy Largemouth Bass volunteer angler reporting program at the reservoir.
Action: Due to uncertainty in ownership and operation of Lake Murvaul Marina, no action has been taken at this time.
5. Provide Largemouth Bass length-to-weight conversion table for Lake Murvaul to interested anglers.
Action: Table was created and published in the 2008 Survey Report.
6. Provide information to inform anglers of fishing opportunities.
Action: District staff provided fisheries information to the controlling authority and through written news releases.

Harvest regulation history: Sport fishes in Lake Murvaul are currently managed with statewide regulations with the exception of Largemouth Bass (Table 2). Largemouth Bass have been managed since September 1999 with a 14- to 21-inch slot length limit and 5-fish daily bag of which only one fish can be over 21 inches. The previous regulation was a 14-inch minimum length limit.

Stocking history: Lake Murvaul was stocked with advanced fingerling Channel Catfish between 1967 and 1979. These stockings were successful in establishing a self-sustaining population. The Channel Catfish fishery is popular among anglers at the reservoir. Florida Largemouth Bass were initially stocked in Lake Murvaul in 1972, one of the first reservoirs in the State of Texas to receive such stockings. The complete stocking history is presented in Table 3.

Vegetation/habitat management history: During past surveys, Lake Murvaul has exhibited moderate densities of aquatic vegetation, with hydrilla coverage at approximately 27% of the reservoir surface area in 1997 (Ryan and Brice 1998). From 2000 to 2007, submerged aquatic vegetation coverage was low. Following low-water conditions from drought in 2005, hydrilla coverage had increased in subsequent surveys until the reservoir elevation decreased in recent years. Waterhyacinth was discovered in 2000 (Ryan and Brice 2001), but following physical removal, it has not returned. Giant salvinia has been found and physically removed on two occasions with no further infestation observed.

Water transfer: Lake Murvaul was built for municipal and industrial water supply and public recreation and no interbasin water transfers are known to exist.

METHODS

Fishes were collected by electrofishing (1 hour at 12, 5-min stations), gill netting (5 net nights at 5 stations), and trap netting (5 net nights at 5 stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing and, for gill and trap nets, as the number of fish per net night (fish/nn). All survey sites were randomly selected and all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2011).

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 ($RSE = 100 \times SE \text{ of the estimate/estimate}$) was calculated for all CPUE and creel statistics. Ages for Largemouth Bass were determined using otoliths from 14 randomly-selected fish (range 12.9 to 14.4 inches) in 2010 and from 11 randomly-selected fish (range 12.9 to 15.0 inches) in 2012. Ages for White Crappie were determined from 13 randomly-selected fish (range 9.2 to 10.6 inches) in 2012.

Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2011). Micro-satellite DNA analysis was used to determine genetic composition of individual fish from 2005 through 2012 and by electrophoresis for previous years.

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

RESULTS AND DISCUSSION

Habitat: Natural features were present along 79% of the shoreline at Lake Murvaul. Bulkhead and boat docks accounted for 19% of the shoreline. Standing timber is present in 36% of the reservoir. Hydrilla was not found during the 2012 survey because of low reservoir water elevation. Native emergent vegetation covered 178 acres. Alligatorweed, a non-native emergent species, covered 4 acres, which was similar to past surveys. Details of the 2012 structural habitat and aquatic vegetation survey are found in Table 5 and Table 6. Giant salvinia was discovered at the Dodson Landing boat ramp in January 2013. Plants were physically removed from the water, but the presence of emergent vegetation, made it difficult to determine if giant salvinia remained undetected. Containment booms were deployed and the boat ramp was closed to monitor for giant salvinia growth and expansion within the area. No plants were found as the weather warmed, and the boom was removed in late May 2013 to allow boaters access to the ramp.

Prey species: The 2012 electrofishing CPUE of Gizzard Shad was 209/h, which was similar to the 2010 (221/h) and 2008 (188/h) surveys (Figure 2). However, Index of Vulnerability (IOV) was 84 in 2012, which was higher than the previous two surveys. The IOV indicated that 84% of Gizzard Shad were available to existing predators. Threadfin Shad were also present (201/h) (Appendix A). Bluegill was the most abundant prey species collected during the 2012 electrofishing survey (667/h) (Figure 4). Although Bluegill were not as abundant as in 2010 (991/h) or 2008 (773/h), high relative weights of Largemouth Bass indicated adequate prey. Redear Sunfish, Redbreast Sunfish, and Longear Sunfish serve as additional prey species. The presence of sunfish exceeding 6 inches provided a potential alternative fisheries resource.

Channel Catfish: Gill net CPUE of Channel Catfish in 2013 was 19.0/nn, which was similar to rates observed in 2009 (24.0/nn) and 2005 (21.2/nn) (Figure 7). The CPUE of fish ≥ 12 inches was 16.2/nn, which was also similar to previous surveys. Body condition was adequate with mean W_r for most inch groups above 90 (Figure 6).

Largemouth Bass: The electrofishing catch rate of Largemouth Bass has been relatively stable in recent surveys. Total CPUE was 123/h in 2012, 127/h in 2010, and 117/h in 2008. The CPUE of fish above 14 inches increased from 15/h in 2010 to 25/h in 2012 (Figure 7). There has also been an increase in Largemouth Bass growth rates in the most recent survey. The average age at 14 inches (13.1 to 14.9 inches) was 2.1 years (N = 12; range 2 – 3 years) in 2008 (Bister and Brice 2009). In 2010, the average age at 14 inches (12.9 to 14.4 inches) was 2.3 years (N = 14; range 2 – 4 years). However, in 2012, the average age at 14 inches (12.9 to 15.0 inches) was only 1.7 years (N = 11; range = 1 – 3 years). This increase in growth rate may be related to the apparent reduction in abundance of fish between 9 and 13 inches (Figure 7). Feeding efficiency of Largemouth Bass may have also improved following the decline in hydrilla coverage. Body condition of Largemouth Bass was desirable with mean W_r for most inch groups being above 95 (Figure 9). The influence of Florida Largemouth Bass (FLMB) genetics has increased in the population in recent years. The FLMB allele frequency in the population has been stable but has shown a slight increase from 33% in 2006 to 41% in 2012 (Table 7). This increase is likely attributable to FLMB stocking efforts in 2008, 2009, and 2011.

Crappie: Trap netting for crappie in Lake Murvaul has traditionally been an effective survey gear. Catch rate of White Crappie in fall 2012 (10.4/nn) was twice as high as 2008 (5.4/nn) and 2004 (5.0/nn) (Figure 8). Black Crappie catch rates were only 1.2/nn in 2012 compared to 9.2/nn in 2008 and 3.6/nn in 2004 (Figure 9). The average age of White Crappie at 10 inches (9.2 to 10.6 inches) was 2.0 years (N = 13; all fish were age 2). Insufficient numbers of Black Crappie were collected for age-and-growth analysis.

Fisheries management plan for Lake Murvaul, Texas

Prepared – July 2013

ISSUE 1: The presence of invasive aquatic vegetation at Lake Murvaul has the potential to threaten water quality, native aquatic vegetation, and angler access. Hydrilla coverage has been high in the past. Giant salvinia has been found and removed on two separate occasions. Even though no more giant salvinia has been found, the potential exists that it could still be re-introduced in the reservoir. Lake Murvaul's proximity to other water bodies that contain giant salvinia is a concern. The reservoir should be continuously monitored for giant salvinia infestations. Alligatorweed is present and may become problematic along certain shorelines.

MANAGEMENT STRATEGIES

1. Continue to provide technical guidance to the controlling authority regarding invasive aquatic plant management.
2. Conduct annual surveys to monitor trends and estimate coverage of invasive aquatic vegetation.

ISSUE 2: Lake Murvaul has traditionally had a high-quality Largemouth Bass fishery. The introduction of Florida Largemouth Bass and the 14- to 21-inch slot-length limit has enhanced the fishery.

MANAGEMENT STRATEGIES

1. Conduct spring-quarter (March through May) creel surveys every 8 years beginning in 2017 to monitor angling effort and catch rates for Largemouth Bass.
2. Conduct electrofishing surveys in fall every 2 years beginning 2014 to monitor relative abundance, growth, and size structure of Largemouth Bass and prey species populations.
3. Request stocking of Florida Largemouth Bass (50 fish/acre) every other year, beginning in 2014, to maintain the trophy aspect of the fishery.
4. Solicit input from the controlling authority and Lake Murvaul Marina regarding the potential to implement a trophy Largemouth Bass volunteer angler reporting program at the reservoir to document angler catches of Largemouth Bass >21 inches.

ISSUE 3: Anglers and stakeholders need to be informed about fisheries management activities, fishing opportunities, and other issues at Lake Murvaul.

MANAGEMENT STRATEGIES

1. Continue to provide news releases to the print, broadcast, and social media.
2. Continue to provide fisheries presentations to the public regarding issues/opportunities at Lake Murvaul.

SAMPLING SCHEDULE JUSTIFICATION:

The proposed sampling schedule includes annual invasive aquatic vegetation surveys, a supplemental electrofishing survey in 2014, spring-quarter creel survey 2017, and required electrofishing, trap netting, gill netting, and access surveys in 2016-2017 (Table 8). Annual vegetation surveys are necessary to monitor the status of invasive aquatic vegetation and to provide coverage estimates to the controlling authority. Spring-quarter creel surveys will be conducted to monitor angling effort and catch rates. Supplemental electrofishing in 2014 will be conducted to monitor the Largemouth Bass and prey fish populations.

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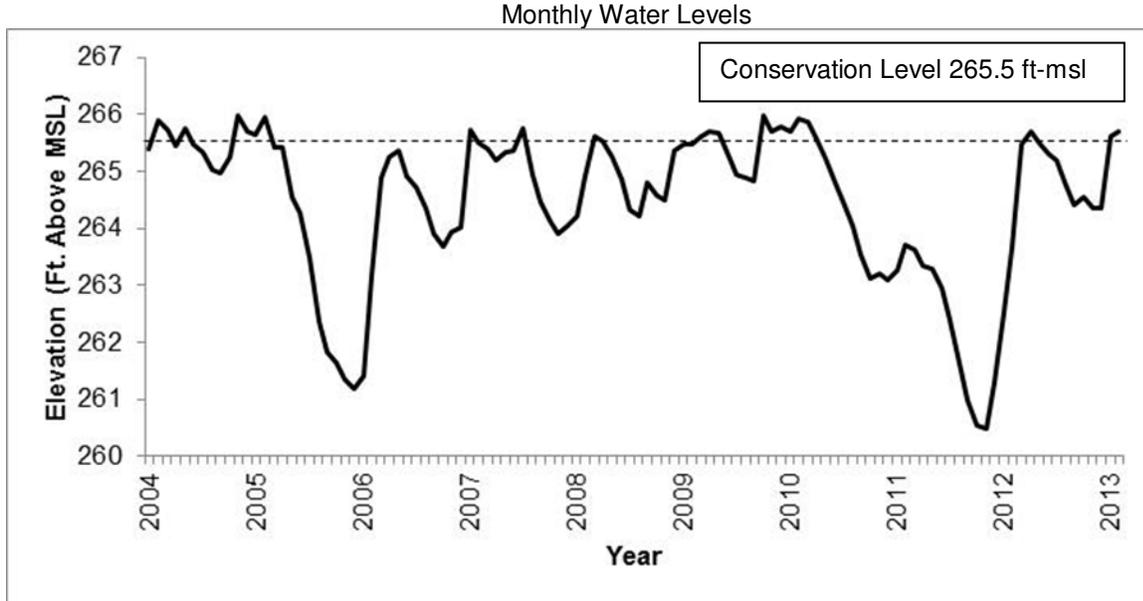


Figure 1. Monthly water level elevations in feet above mean sea level (MSL) recorded for Lake Murvaul, Texas. Horizontal line denotes conservation pool level (265.5 ft- msl).

Table 1. Characteristics of Lake Murvaul, Texas.

Characteristic	Description
Year constructed	1958
Controlling authority	Panola County Fresh Water District
County	Panola
Reservoir type	Tributary
Shoreline development index (SDI)	6.7
Conductivity	225 umhos/cm

Table 2. Boat ramp characteristics for Paradise Reservoir, Texas, August, 2012.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Condition
Decker-Hill Park	32.04120 -94.42994	Y	30	Excellent, no access issues
FM 1971 Bridge (Dodson Landing)	32.03379 -94.48235	Y	10	Excellent, no access issues
Rosie Jones Park	32.04475 -94.47401	Y	10	Excellent, no access issues
Tinkle Park	32.02006 -94.43595	Y	10	Excellent, no access issues

Table 3. Harvest regulations for Lake Murvaul, Texas.

Species	Bag Limit	Length limit
Catfish, Channel	25	12-inch minimum
Catfish, Flathead	5	18-inch minimum
Bass, Largemouth	5 (only 1 > 24 inches)	14- to 21-inch slot
Crappie, White and Black Crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

Table 4. Stocking history of Murvaul, Texas. FGL = fingerling; AFGL = advanced fingerling; ADL = adults; UNK = unknown.

Species	Year	Number	Life Stage
Channel Catfish	1967	3,000	AFGL
	1968	6,000	AFGL
	1969	5,000	AFGL
	1973	3,000	AFGL
	1979	181,084	AFGL
	Total	198,084	
Florida Largemouth Bass	1972	200	AFGL
	1980	380	ADL
	1989	6	ADL
	1997	95,235	FGL
	1998	95,000	FGL
	1999	102,680	FGL
	2008	171,250	FGL
	2009	177,523	FGL
	2011	172,038	FGL
	Total	814,312	
Largemouth Bass	1972	10,000	UNK
	Total	10,000	

Table 5. Survey of structural habitat types Lake Murvaul, Texas, 2012. Shoreline habitat type units are in miles and standing timber is acres.

Habitat type	Estimate	% of total
Bulkhead with boat docks	6.2 miles	18.8
Natural shoreline	17.5 miles	52.6
Natural shoreline with boat docks	8.7 miles	26.3
Rocky	0.8 miles	2.3
Standing timber	1377.0 acres	36.0

Table 6. Survey of aquatic vegetation, Lake Murvaul, Texas, 2008 – 2012. Surface area (acres) is listed with percent of total reservoir surface area in parentheses.

Vegetation	2008	2010	2012
Native submersed			13.0 (0.3)
Native floating-leaved			41.0 (1.1)
Native emergent	128.0 (3.4)		178.0 (4.7)
Non-native			
Alligatorweed	4.0 (0.1)		4.0 (0.1)
Hydrilla	250 (6.5)	339 (8.9)	

Gizzard Shad

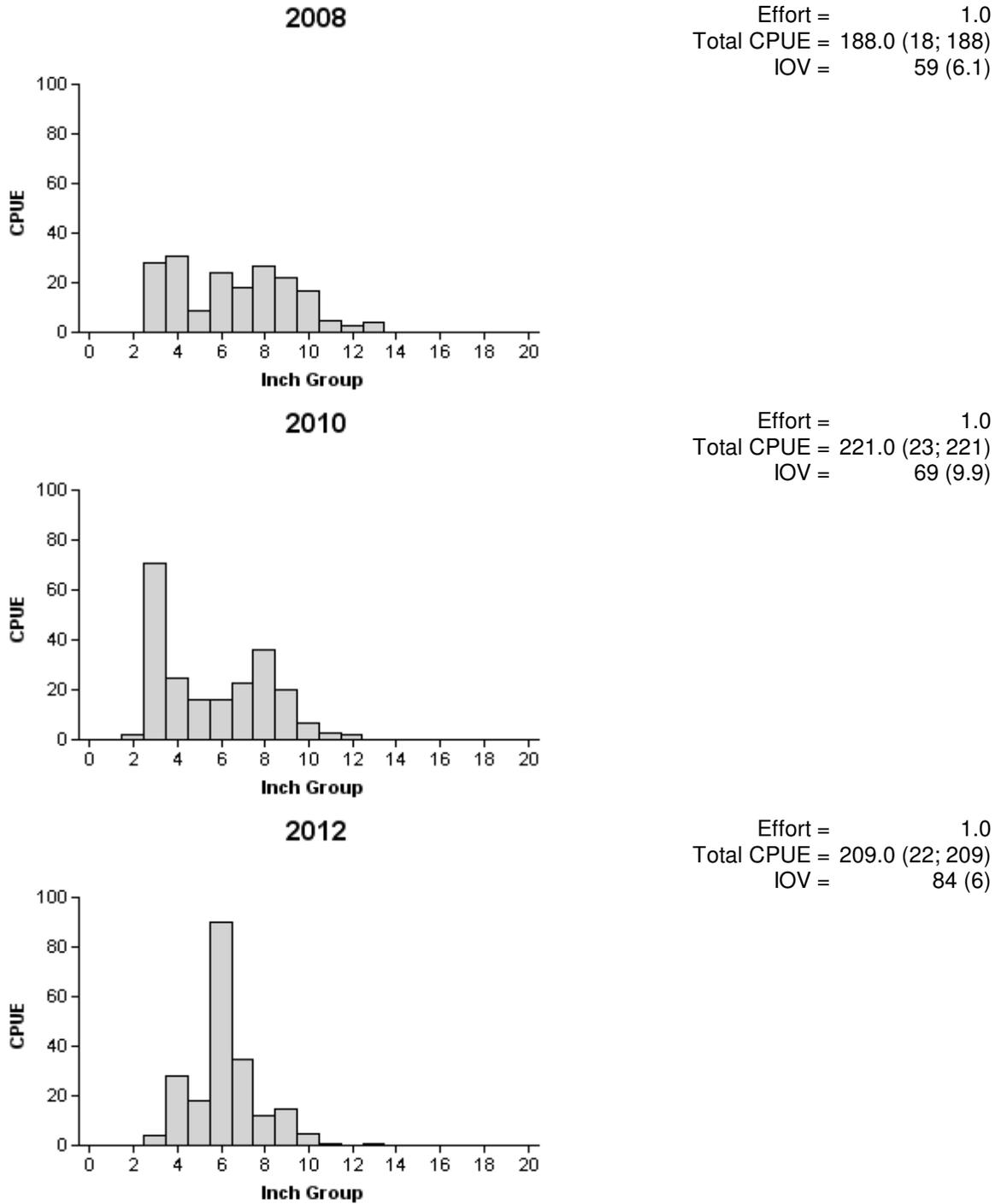
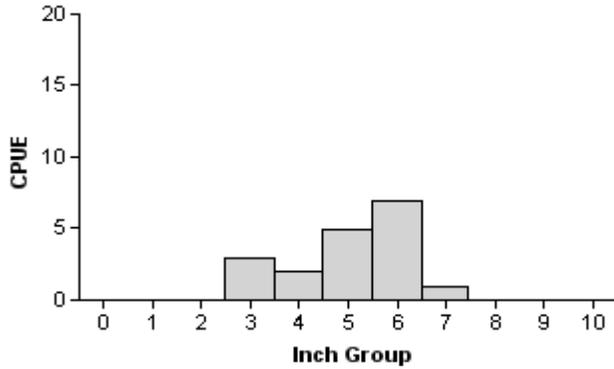


Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Murvaul, Texas, 2008, 2010, and 2012.

Redbreast Sunfish

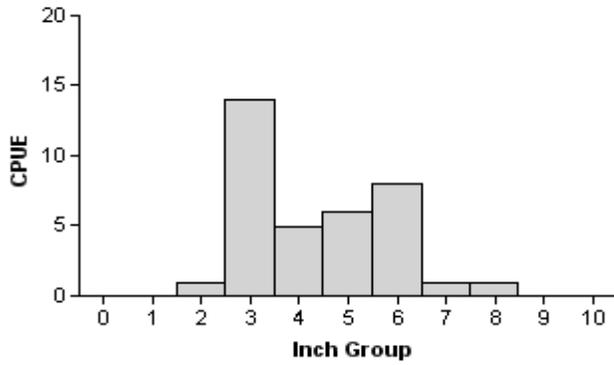
2008

Effort = 1.0
Total CPUE = 18.0 (39; 18)



2010

Effort = 1.0
Total CPUE = 36.0 (45; 36)



2012

Effort = 1.0
Total CPUE = 48.0 (26; 48)

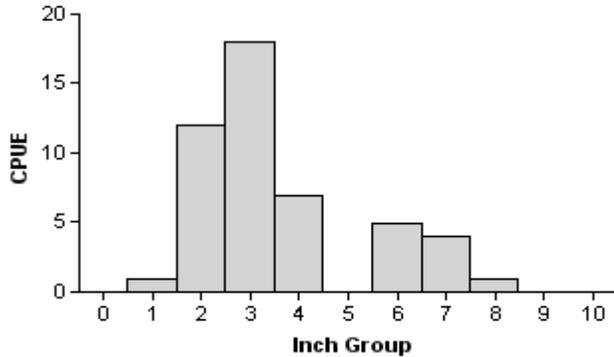
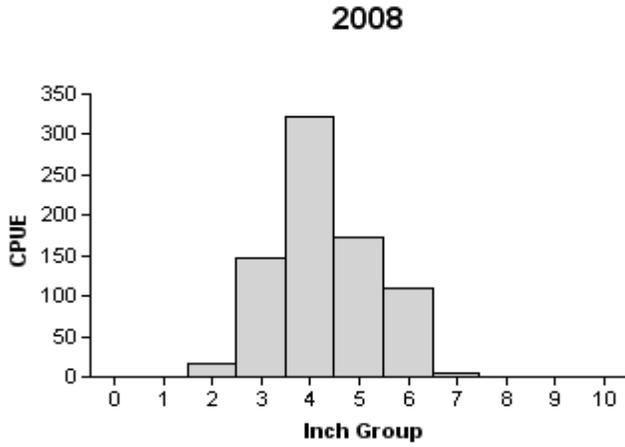
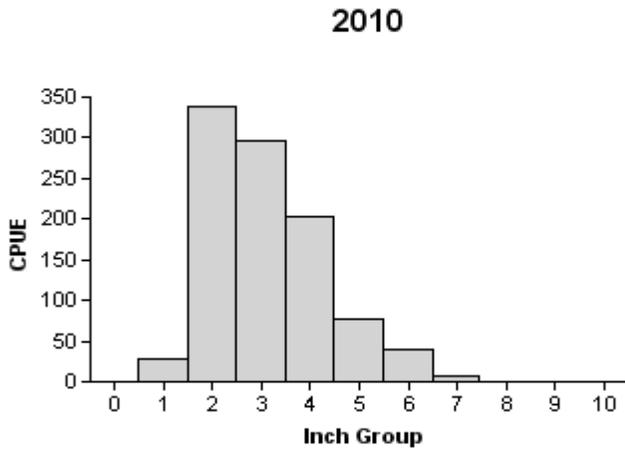


Figure 3. Number of Redbreast Sunfish caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Murvaul, Texas, 2008, 2010, and 2012.

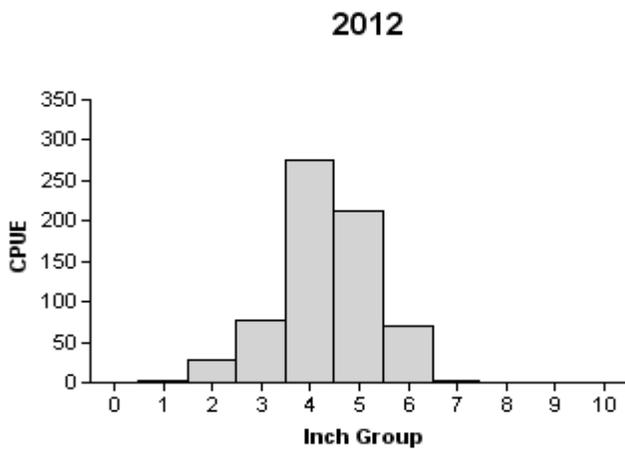
Bluegill



Effort = 1.0
 Total CPUE = 773.0 (16; 773)
 PSD = 15 (2.8)



Effort = 1.0
 Total CPUE = 991.0 (35; 991)
 PSD = 7 (3.7)



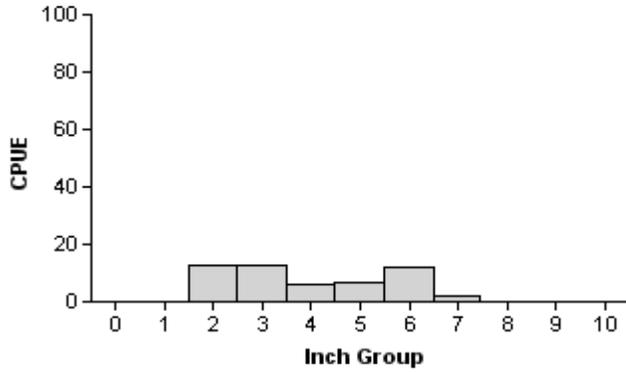
Effort = 1.0
 Total CPUE = 667.0 (14; 667)
 PSD = 11 (1.7)

Figure 4. 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, Lake Murvaul, Texas, 2008, 2010, and 2012.

Redear Sunfish

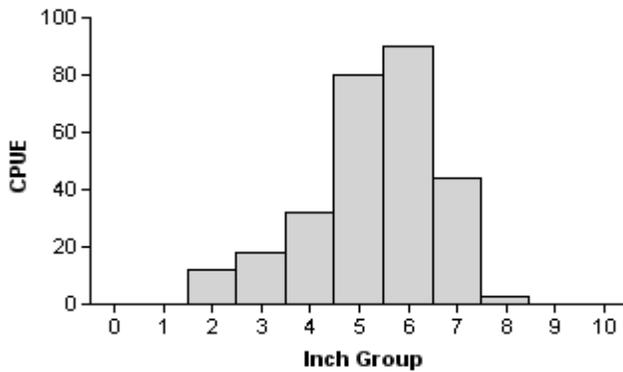
2008

Effort = 1.0
 Total CPUE = 53.0 (40; 53)
 PSD = 7 (4.5)



2010

Effort = 1.0
 Total CPUE = 279.0 (21; 279)
 PSD = 19 (5.4)



2012

Effort = 1.0
 Total CPUE = 27.0 (25; 27)
 PSD = 56 (7.3)

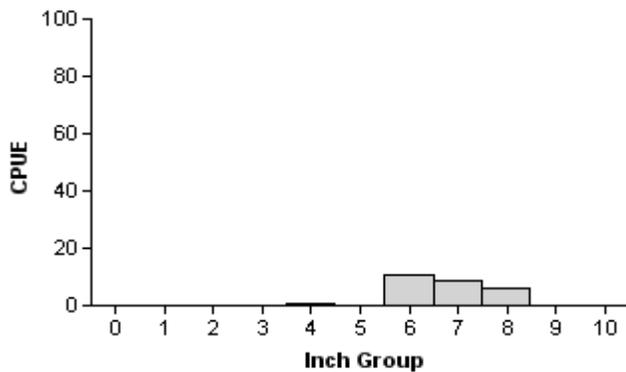


Figure 5. Number of Redear Sunfish caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Murvaul, Texas, 2008, 2010, and 2012.

Channel Catfish

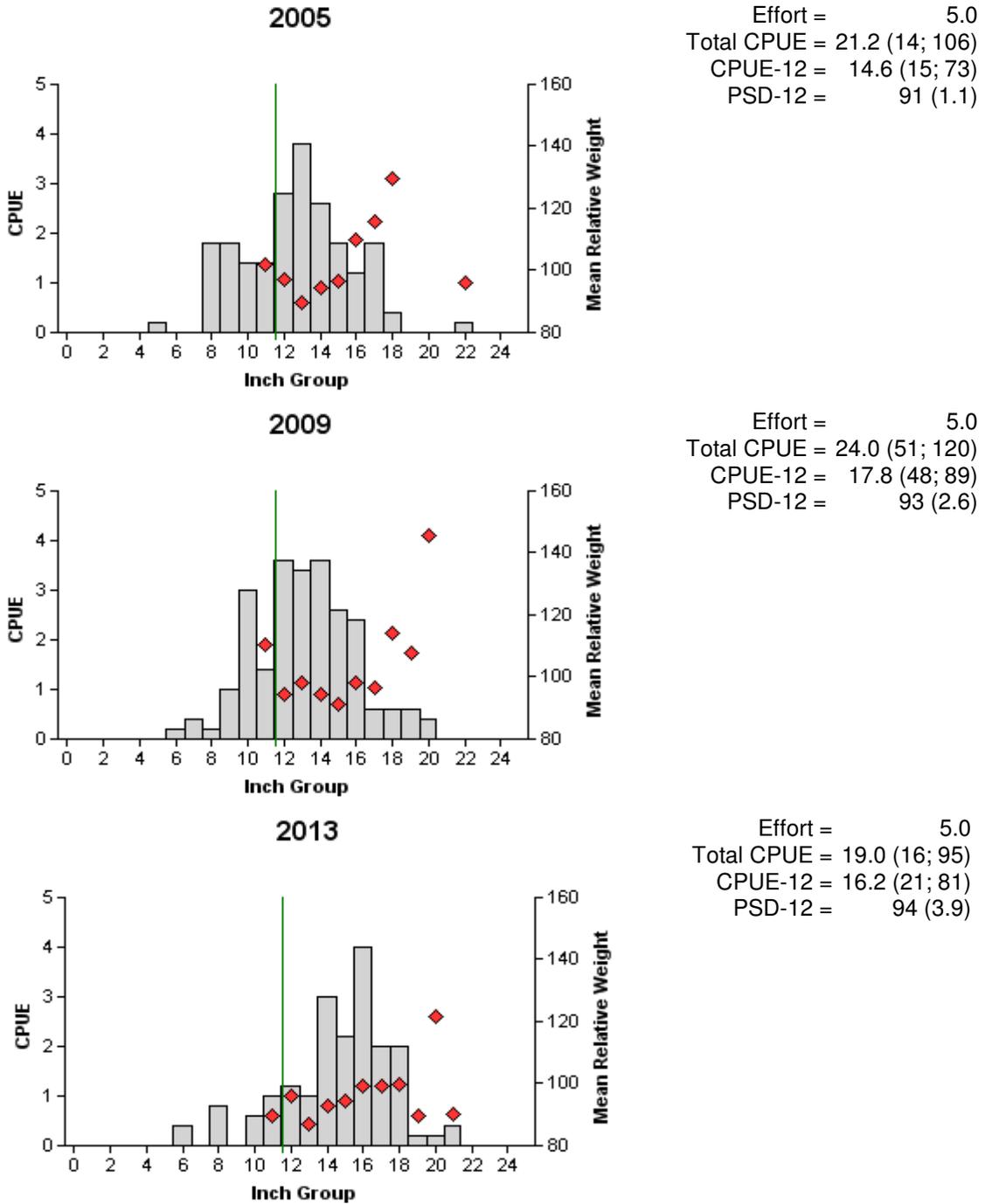


Figure 6. Number of Channel Catfish caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Lake Murvaul, Texas, 2005, 2009, and 2013. Vertical lines indicate the minimum length limit.

Largemouth Bass

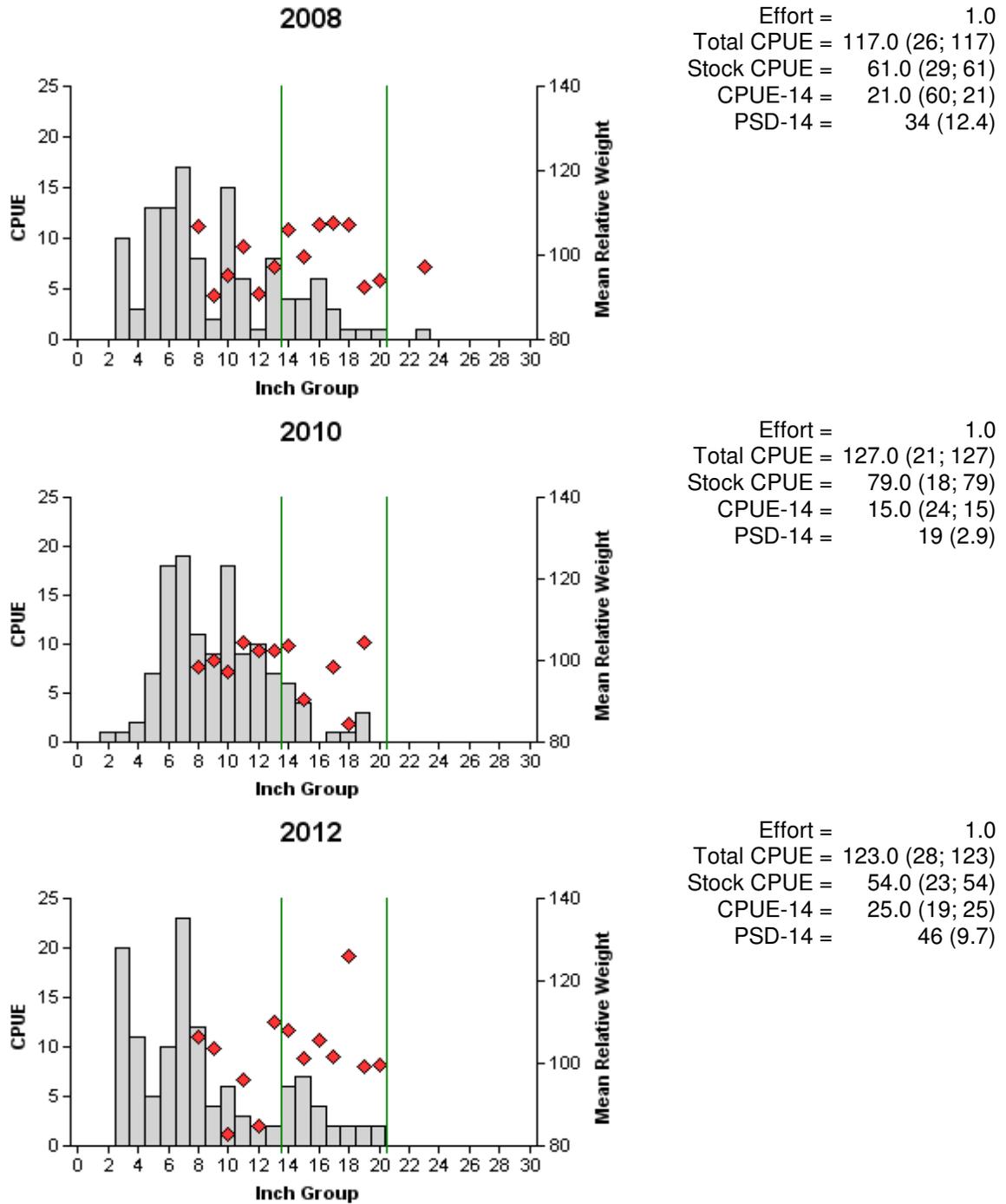


Figure 7. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Murvaul, Texas, 2008, 2010, and 2012. Vertical lines indicate the lower and upper end of the slot-length limit.

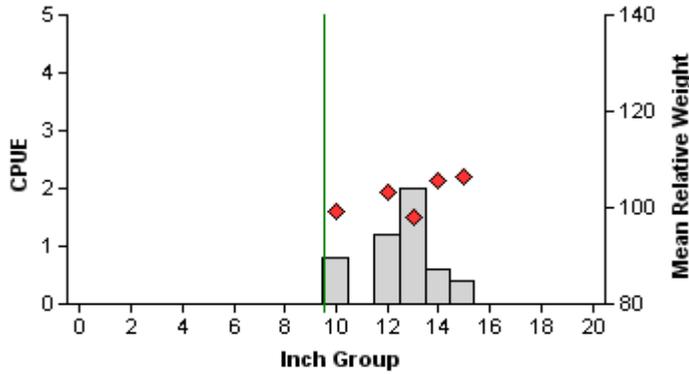
Largemouth Bass

Table 7. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Lake Murvaul, Texas, 2006, 2010, and 2012. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between an FLMB and an 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		
2006	30	0	29	1	33.0	0
2010	30	0	30	0	38.0	0
2012	30	1	28	1	41.0	3.3

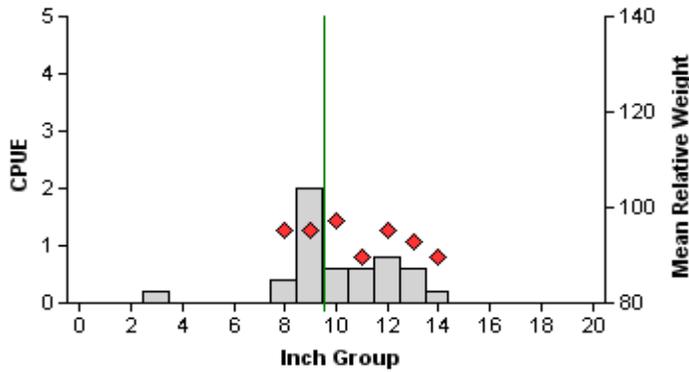
White Crappie

2004



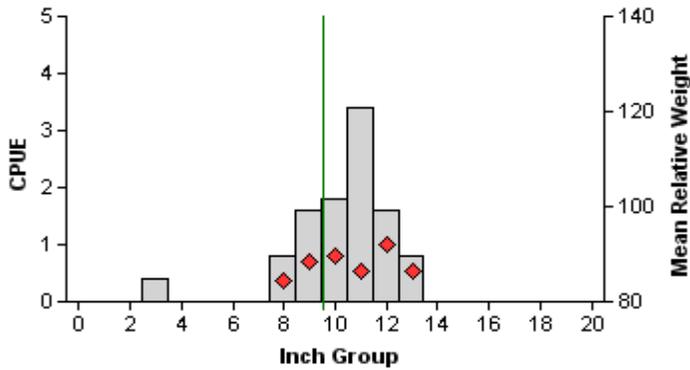
Effort = 5.0
 Total CPUE = 5.0 (36; 25)
 Stock CPUE = 5.0 (36; 25)
 CPUE-10 = 5.0 (36; 25)
 PSD-10 = 100 (0)

2008



Effort = 5.0
 Total CPUE = 5.4 (81; 27)
 Stock CPUE = 5.2 (86; 26)
 CPUE-10 = 2.8 (91; 14)
 PSD-10 = 54 (4.6)

2012



Effort = 5.0
 Total CPUE = 10.4 (19; 52)
 Stock CPUE = 10.0 (20; 50)
 CPUE-10 = 7.6 (17; 38)
 PSD-10 = 76 (4.2)

Figure 8. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Lake Murvaul, Texas, 2004, 2008, and 2012. Vertical line indicates the minimum length limit.

Black Crappie

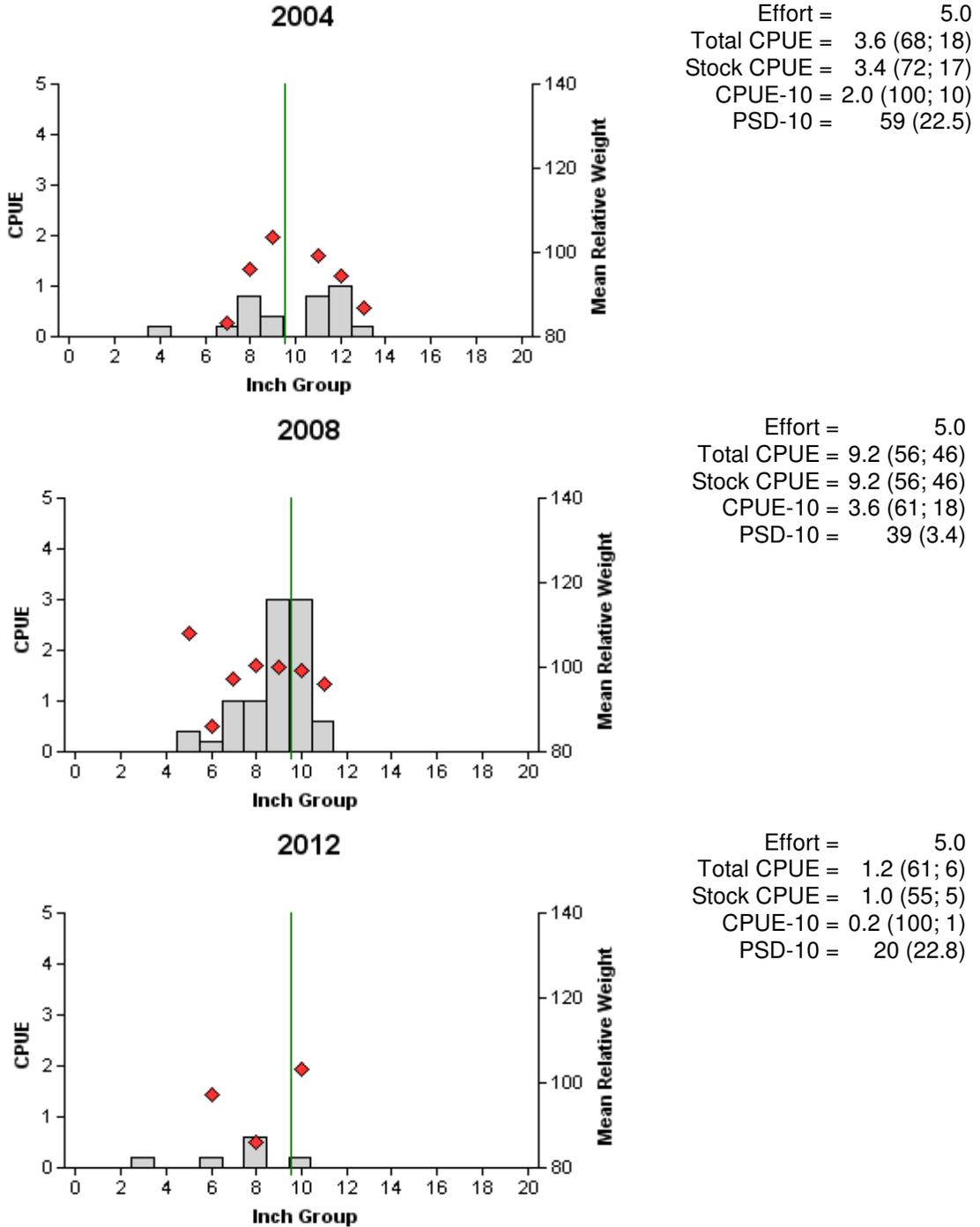


Figure 9. Number of Black Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Lake Murvaul, Texas, 2004, 2008, and 2012. Vertical line indicates the minimum length limit.

Table 8. Proposed sampling schedule for Lake Murvaul, Texas. Gill netting surveys are conducted in the spring, vegetation surveys are conducted in the summer, and electrofishing and trap netting surveys are conducted in the fall. Standard survey denoted by S and additional survey denoted by A.

Survey year	Electrofishing Fall	Trap net	Gill net	Habitat			Creel survey	Report
				Structural	Vegetation	Access		
2013-2014					A			
2014-2015	A				A			
2015-2016					A			
2016-2017	S	A	S		S	S	S ^a	S

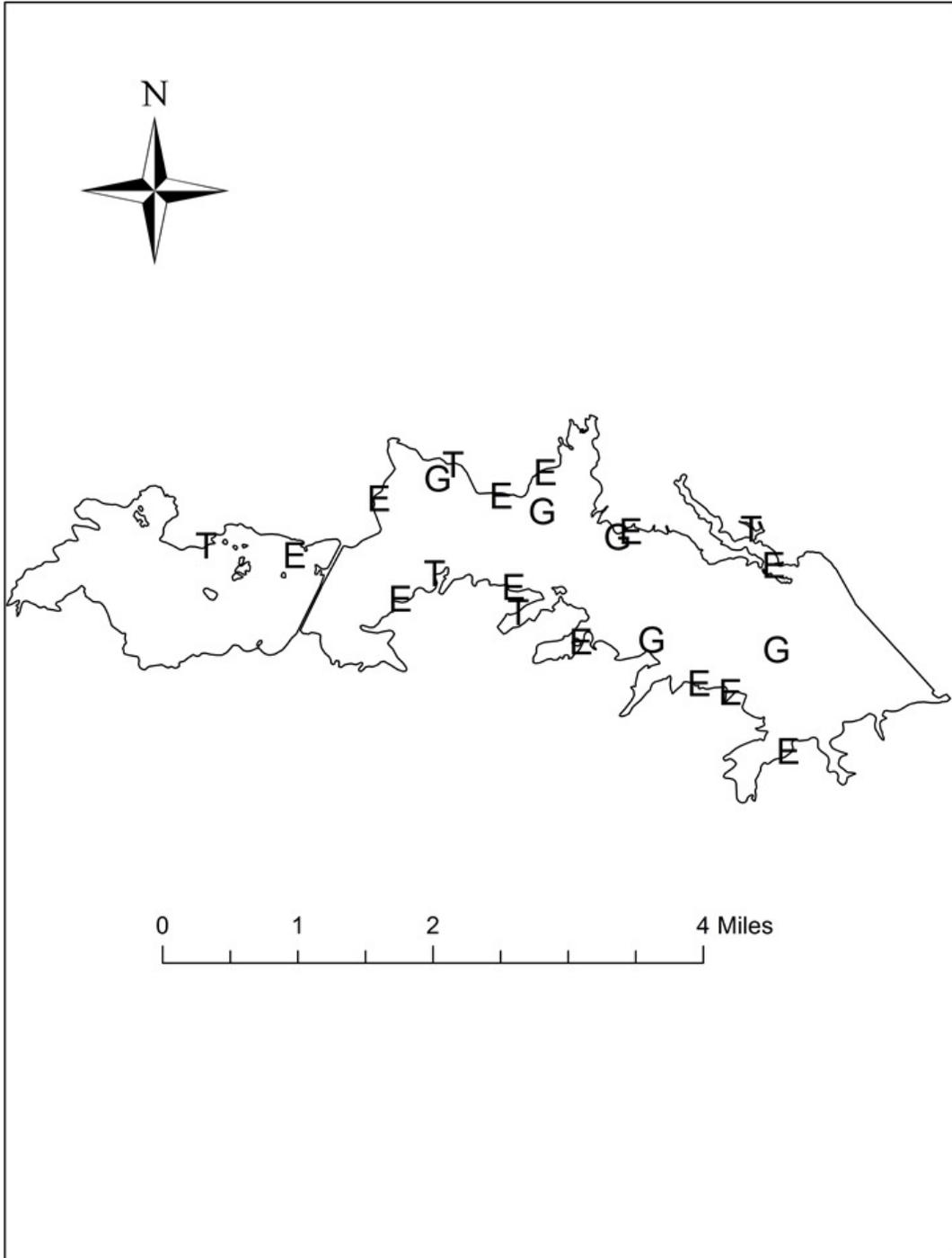
^a Spring quarter creel March through May 2017.

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Lake Murvaul, Texas, 2012-2013.

Species	Gill Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					209	209.0
Threadfin Shad					201	201.0
Channel Catfish	95	19.0				
Redbreast Sunfish					48	48.0
Bluegill					667	667.0
Longear Sunfish					43	43.0
Redear Sunfish					27	27.0
Largemouth Bass					123	123.0
White Crappie			52	10.4		
Black Crappie			6	1.2		

APPENDIX B



Location of sampling sites, Lake Murvaul, Texas, 2012-2013. Gill netting, trap netting, and electrofishing stations are indicated by G, T, and E, respectively.