PERFORMANCE REPORT

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FEDERAL AID IN SPORT FISH RESTORATION ACT

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FEDERAL AID PROJECT F-221-M-3

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2012 Fisheries Management Survey Report

Limestone Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Limestone Reservoir were surveyed in 2012 using electrofishing and in 2013 using gill netting. Historical data are presented with the 2012-2013 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:** Limestone Reservoir is a 13,680-acre reservoir within the Navasota River system in Limestone, Robertson, and Leon Counties, Texas. Bank fishing is limited to a few day-use areas. Boat access remains adequate and handicap facilities remain poor. Habitat features consisted mainly of natural shoreline and bulk head.

- **Management History:** Important sport fish include Blue and Channel Catfish, White Bass, Largemouth Bass, and White Crappie. The management plan from the 2008 survey report included annual monitoring of noxious vegetation, a 2012 to 2013 creel survey, educating angler groups and reservoir stakeholders on habitat loss, working with the Brazos River Authority (BRA) to determine the legality of habitat additions and placement within the reservoir, tracking the loss of shoreline habitat with a physical habitat survey every four years, and obtaining information on passive gears and their effects on the catfish fisheries via the 2012-2013 creel survey.

- **Fish Community**
  - **Prey species:** Forage species included Gizzard Shad, Threadfin Shad, Bluegill, Redear and Longear. Both shad species were collected above historical averages, but all sunfish species were collected below historical averages.

  - **Catfishes:** Blue and Channel Catfish were collected in record numbers and all individuals were in good to excellent condition. Two Flathead Catfish were sampled.

  - **White Bass:** White Bass were collected at rates just below their historical average and body condition was excellent.

  - **Black basses:** The Largemouth Bass electrofishing catch rate was well below the historical average and lower than the previous two surveys. Body condition for most size classes was excellent.

  - **Crappie:** Crappie were not sampled with trap netting due to low water levels in December 2012, however Black and White Crappie were collected in low numbers with gill netting.

- **Management Strategies:** Continue managing Limestone Reservoir with statewide regulations. Conduct standard monitoring with electrofisher and trap netting in 2016 and gill netting in 2017. Continue monitoring noxious aquatic vegetation annually.

INTRODUCTION

This document is a summary of fisheries data collected from Limestone Reservoir in 2012-2013. 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 2012-2013 data for comparison.

Reservoir Description

Limestone Reservoir is a 13,680-acre reservoir within the Navasota River system in Limestone, Robertson and Leon Counties, Texas. The reservoir was created in 1978 and is operated by the Brazos River Authority (BRA). Water uses include power plant cooling and recreation. Primary land use surrounding Limestone's 117 miles of shoreline is agriculture. The reservoir is eutrophic with water transparencies ranging from 1 to 2 feet, and average and maximum depths of 16.5 and 43 feet respectively. Habitat at time of sampling consisted mainly of natural shoreline and bulk heading (Table 4). Water elevations were four feet low during fall electrofishing, nearly six feet low during trap net season, and three feet low during gill net season. Other descriptive characteristics for Limestone Reservoir are in Table 1.

Angler Access

Bank and boat access on Limestone Reservoir remains adequate during normal water elevation periods. Bank fishing is limited to a few day-use areas on the reservoir, while boat access consists of six ramps, four public, and two marinas. All boat ramps became unusable during the recent 2011 and 2012 drought, highlighting access issues that occur during low water levels. No boating access is available at water levels below 355 feet above mean sea level. Additional boat ramp characteristics are in Table 2.

Management History

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

1. Conduct a creel in 2012 and 2013 to monitor exploitation of sport fish and obtain information on passive gear effects on Catfish fisheries.
   Action: The 2012-2013 creel survey was cancelled and replaced with a higher priority creel.
2. Continue annual noxious vegetation surveys.
   Action: Noxious vegetation surveys were conducted annually except in 2011 when water levels precluded access.
3. Promote fisheries and habitat loss topics to encourage better understanding by angler groups and stakeholders.
   Action: Limestone's excellent fisheries, and habitat degradation issues, have been promoted and discussed while speaking to a variety of angler groups, including Legacy Outfitters and Central Texas Flyrodders.
4. Work with the BRA to determine the legality of habitat removal, additions and placement within the reservoir, and distribute the information to constituents in hopes of preventing excessive habitat removal during drought.
   Action: District staff worked with the BRA during summer 2011 to create guidelines for habitat removal or additions within Limestone Reservoir. This literature was distributed by the BRA in various outlets.
5. Track the loss of shoreline habitat with a physical habitat survey every four years.
   Action: A standard physical habitat survey was conducted in summer 2009 and a non-standard physical habitat survey was conducted in summer 2012 as part of the BRA reservoir habitat project.

Harvest regulation history: Sportfishes in Limestone Reservoir have always been managed with statewide regulations (Table 3).

Stocking history: No recent fish stockings have occurred in Limestone Reservoir. The complete stocking history is in Table 3.

Vegetation/habitat management history: Annual vegetation surveys have been conducted since 2005. Hydrilla, (*Hydrilla verticillata*) was the only species of concern in the reservoir in 1997, covering an estimated 19 surface acres; however only trace amounts have been found since then. Water hyacinth (*Eichhornia crassipes*) coverage was estimated at 3.5 acres in 2001, 37.5 acres in 2002, and 35 acres from 2003 through 2004. Coverage had dropped to trace amounts by 2006, increased again to nearly 12 acres by summer 2008, fell to 7.7 in 2009 and then fell again to <0.1 acres in 2010. It has not been observed since. Eurasain watermilfoil (*Myriophyllum spicatum*), was first observed in 2006 (estimated 21 acres), and maintained a similar coverage through 2008. In 2009, there were 18.8 acres of watermilfoil, but that amount dropped to 2.7 acres in 2010. Low water precluded a survey in 2011, and no watermilfoil was observed in 2012. Giant cane (*Arundinaria gigantea*) was observed during the summer 2008 vegetation survey (<0.1 acres) but has not been seen since. Currently, none of these observed noxious species are causing access problems. A physical habitat survey was conducted in summer 2009 (Table 4). In 2012, a comprehensive habitat and access survey was completed as part of a broad scale habitat assessment in all BRA-controlled reservoirs. This information is included in Appendix D.

Water transfer: No interbasin transfers are known to exist.

Reservoir capacity: Limestone Reservoir was impounded in 1978. Original plans calculated the reservoir's capacity at conservation pool (363 feet above mean sea level) to be 225,400 acre-feet with a surface area of 14,200 acres. Two volumetric surveys have been conducted by the Texas Water Development Board (TWDB) on Limestone since impoundment; one in 1993 and another in 2002. The 2002 survey found a volume of 215,748 acre-feet and a surface area of 13,379 acres at conservation pool elevation. According to the TWDB, there has been an estimated reduction of 9,652 acre-feet, or 4.3% less than that recorded in the original permit. The reduction is assumed to be a combination of sedimentation, and improved data and calculation methodologies.

METHODS

Fishes were collected by electrofishing (2 hours at 24, 5-min stations) and gill netting (15 net nights at 15 stations). Efforts are not standard for the 2004-2005 or the 2008-2009 trap and gill netting seasons. Trap netting was not conducted during 2012 due to low water levels. 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 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 (Wr)] were calculated for target fishes according to Anderson and Neumann (1996). Index of vulnerability (IOV) was calculated for Gizzard Shad (DiCenzo et al. 1996). Standard error (SE) was calculated for structural indices and IOV. Relative standard error (RSE = 100 X SE of the estimate/estimate) was calculated for all CPUE and creel statistics. No age data was collected on sport fish species during 2012-2013.

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: A standard habitat survey was last conducted in 2008 (Tibbs and Baird 2009).

Creel: An angler creel survey was last conducted in 2004 (Tibbs and Baird 2005).

Prey species: Threadfin and Gizzard Shad were collected by electrofisher at 1,282.0/h and 299.5/h respectively in 2012, and these catch rates are among the highest on record for the reservoir. The Index of vulnerability (IOV) for Gizzard Shad was excellent as 97% of Gizzard Shad were available to existing predators as forage. Other important forage species collected were Bluegill (21.5/h), Longear Sunfish (9.0/h) and Redear Sunfish (2.0/h). Panfish seldom reach preferred size classes in Limestone Reservoir. (Figures 2 and 3; Appendices A and B).

Catfishes: Blue Catfish were collected with gill nets at 21.1/nn in 2013; this catch rate equates to 317 collected individuals, and is among the highest in the district for the species. Proportional size distribution values have declined over the past three surveys. The current PSD of 11 indicates an unbalanced population, mostly due to a large year class encompassing the 14 to 18-inch size classes, which were first observed as 8 to 10-inch size classes in the 2009 survey. Most Blue Catfish sampled were legal size, and good numbers exceeded the quality size category of 20 inches or more. Body condition was good, and improved with increasing length (Figure 4; Appendices A and B).

Channel Catfish were collected with gill nets at 14.0/nn in 2013; this catch rate equates to 210 collected individuals, and is the highest catch rate on record. Proportional size distribution values have remained good over the past three surveys indicating balanced recruitment, growth, and mortality. Many Channel Catfish sampled were legal size or larger, and good numbers approached the preferred size category of 24 inches. Body condition was excellent, and improved as length increased (Figure 5; Appendices A and B).
Flathead Catfish are present in the reservoir in low densities.

White Bass: White Bass were collected with gill nets at 4.5/nn in 2013; this catch rate equated to 67 collected individuals, and was near the historical average for the species. The PSD for White Bass has remained high for the past three surveys, indicating a population skewed towards larger individuals, likely due to good growth. Body condition was excellent (Figure 6; Appendices A and B).

Largemouth Bass: Largemouth Bass were collected by electrofisher at 25.5/h in 2012; this catch rate equates to only 51 collected individuals, and was the lowest catch rate on record. Proportional size distribution was low, illustrating a population out of balance, probably due to missing recruitment from the 2011 year class. The proportion of stock size individuals 14-inches and larger was 36. Body condition was excellent across most size classes. Florida Largemouth Bass influence has remained relatively constant as Florida alleles have ranged from 34 to 38% (Figure 7; Table 7; Appendices A and B).

Crappie: Trap netting for crappie could not be conducted during winter 2012 due to low water levels, however White and Black Crappie were collected at 2.6/nn and 0.8/nn respectively during spring 2013 gill net surveys. Proportional size distribution was good, indicating balanced recruitment, growth, and mortality. Body condition was excellent for all size classes sampled (Figures 8 and 9; Appendices A and B).

Fisheries management plan for Limestone Reservoir, Texas

Prepared – July 2013.

ISSUE 1: Exotic aquatic vegetation (i.e., hydrilla, water hyacinth, Eurasian watermilfoil, alligator weed and giant cane have been observed during past surveys. Exotic species can out-compete native vegetation species and expand rapidly causing access and boating problems among others. Recent drought conditions, logistics and survey methodologies have prevented accurate coverage estimations.

MANAGEMENT STRATEGIES

1. Continue performing annual noxious vegetation surveys, and estimate individual species coverage in acres.
2. Conduct a full native vegetation survey prior to the next report, and estimate individual species coverage in acres.
3. Provide survey data to BRA, stakeholders and other interested groups upon request.
4. Urge controlling authorities to eradicate/control species before they become problematic.

ISSUE 2: A 2002 Texas Water Development Board study suggested Limestone Reservoir has lost 4.3% of its volume to sedimentation since impoundment. This relatively rapid loss of fisheries habitat is the single most important issue facing Limestone's fishery. Sedimentation has also caused noticeable and severe effects in two other Navasota River reservoirs: Mexia and Fort Parker State Park, both upstream of Limestone Reservoir. Sedimentation, combined with declining woody habitat and increases in manmade bulk head throughout the reservoir, pose severe fishery habitat threats within the reservoir.

MANAGEMENT STRATEGIES

1. Share information on Limestone with the TPWD watershed coordinator, Gary Garrett, along with TPWD partnerships such as the Southeastern Aquatic Resources Partnership (SARP), and Reservoir Fisheries Habitat Partnership (RFHP).
2. Propose funding from SARP and RFHP to promote best management practice (BMP) work within the watershed, or other work to reverse the effects of erosion, sedimentation, and declining woody habitat.
3. Educate interested angler groups and reservoir stakeholders on these issues.
4. Track the loss of shoreline habitat with a full structural habitat survey prior to the next report.

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 when appropriate.
3. Make a speaking point about invasive species when presenting to constituent and user groups. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.

ISSUE 4: Limestone has experienced chronic low water levels since 2010 and boating access was impeded by low water levels in 2012 (Table 2).

MANAGEMENT STRATEGY

1. Discuss extension of boat ramps and options to increase shore-fishing access with the BRA, including funding options like the Boating Access Grant.

SAMPLING SCHEDULE JUSTIFICATION:

The proposed sampling schedule includes standard electrofisher, trap net, and gill net sampling in 2016-2017, annual monitoring of noxious vegetation, and a structural habitat, native vegetation and access survey prior to the 2016 report (Table 8).

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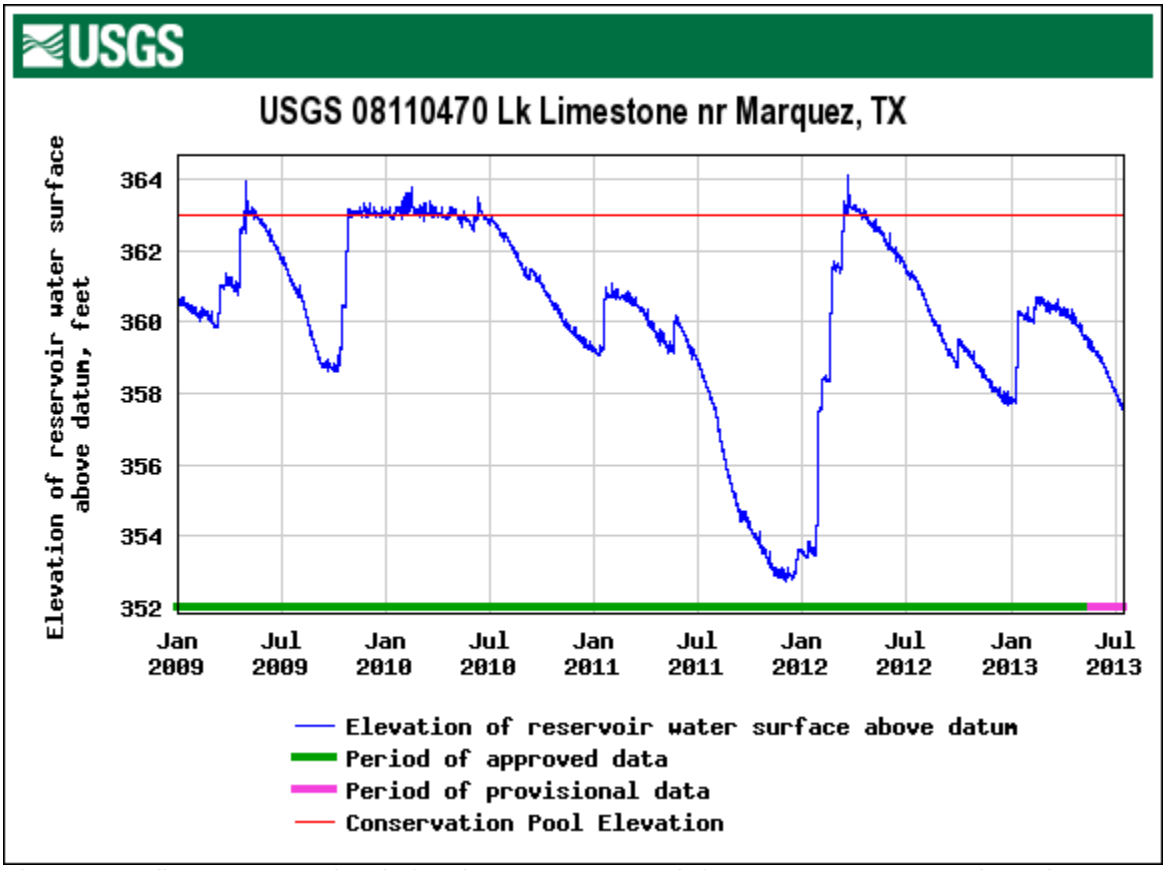


Figure 1. Daily mean water levels for Limestone Reservoir from January 15, 2009 through January 15, 2013. Conservation pool level is 363 feet above mean sea level. Figure from USGS website.

Table 1. Characteristics of Limestone Reservoir, Texas.

Characteristic	Description
Year Constructed	1978
Controlling authority	Brazos River Authority
Counties	Limestone, Robertson, and Leon
Reservoir type	Tributary
Shoreline Development Index (SDI)	7.9
Conductivity (um)	219 (average from the past three surveys)

Table 2. Boat ramp characteristics for Limestone Reservoir, Texas, August, 2012. Reservoir elevation at time of survey was 361.75 feet above mean sea level. Latitude; longitude are in decimal degrees. Elevation is elevation at the end of each boat ramp. * = Best candidates for extension.

Boat ramp	Latitude; Longitude	Public?	Parking	Elevation	Condition
BRA Park #1	31.32845; -96.33179	Y	16	**359**	Good, needs extended
Leon County Park*	31.33895; -9631066	Y	12	**357**	Good, needs extended
Limestone County #2*	31.43429; -96.37516	Y	10	**355**	Poor ramp and parking
Limestone County #3	31.44755; -96.37821	Y	10	**357**	Poor ramp and parking
Running Branch Marina	31.34379; -96.36858	Y	8	NA	Usable only at full pool
Limestone Marina	31.38628; -9631771	Y	10	NA	Good, gravel parking

Table 3. Harvest regulations for Limestone Reservoir, Texas.

Species	Bag limit	Length limit
Catfish: Channel and Blue Catfish, their hybrids and subspecies	25 (in any combination)	12-inch minimum
Catfish, Flathead	5	18- inch minimum
Bass, White	25	10-inch minimum
Bass, Largemouth	5[a]	14-inch minimum
Bass, Spotted	5[a]	None
Crappie: White and Black Crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

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

Table 4. Stocking history of Limestone 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)
Blue Catfish	1986	135,425	FGL	2.0
	1996	306,470	FGL	1.8
	1998	1,500	AFGL	9.8
	1998	78,575	FGL	2.3
	Total	521,970		
Channel Catfish	1979	338,237	AFGL	7.9
	Total	338,237		
Florida Largemouth Bass	1979	78,758	FGL	2.0
	1979	122,040	FRY	1.0
	1995	127	ADL	12.0
	1995	69,878	FGL	1.0
	1996	43,426	FGL	1.6
	1996	185,281	FRY	1.0
	Total	499,510		
Largemouth Bass	1994	151	ADL	11.8
	1996	45	ADL	12.0
	Total	196		
Palmetto Bass (Striped X White Bass hybrid)	1984	274,175	FGL	2.0
	Total	274,175		

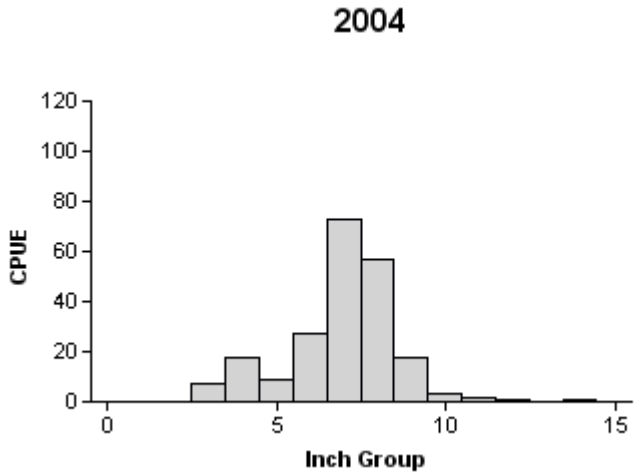
Table 5. Survey of structural habitat types, Limestone Reservoir, Texas, 2008. Shoreline habitat type units are in miles.

Habitat type	Estimate	% of total
Bulkhead	28.5	24.4
Gravel shoreline (rocks < 4”)	1.3	<1.0
Gravel shoreline (rocks > 4”)	8.0	<1.0
Natural shoreline	79.4	67.8
Giant reed	<0.1	<1.0
Boat Docks/Ramps	3.7	<1.0
Native emergents	1.0	<1.0

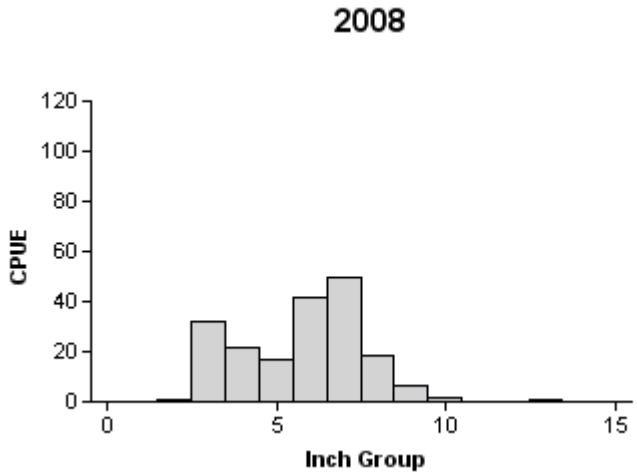
Table 6. Survey of noxious aquatic vegetation, Limestone Reservoir, Texas, 2009 – 2012. For 2009 and 2010, surface area (acres) is listed with percent of total reservoir surface area in parentheses. A vegetation survey not conducted in 2011 because there was no access. In 2012, the value represents the percentage of randomly selected points with alligator weed present during a habitat and access survey on June 20, 2012. By October 1, 2012, no noxious vegetation of any kind was present.

Vegetation	2009	2010	2012
Hydrilla		.01 (trace)	
Water hyacinth	7.7 (0.1)	.04 (trace)	
Eurasian Watermilfoil	18.8 (0.1)	2.7 (trace)	
Alligator weed			26.7% (20 of 75 points)

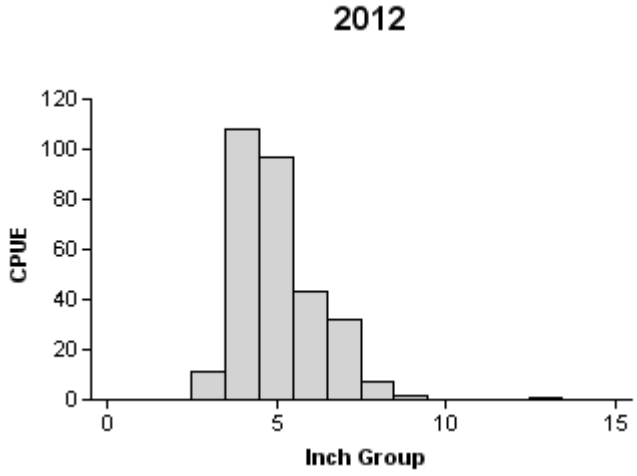
Gizzard Shad



Effort = 2.0
Total CPUE = 215.5 (13; 431)
Stock CPUE = 154.0 (15; 308)
IOV = 62 (4.7)



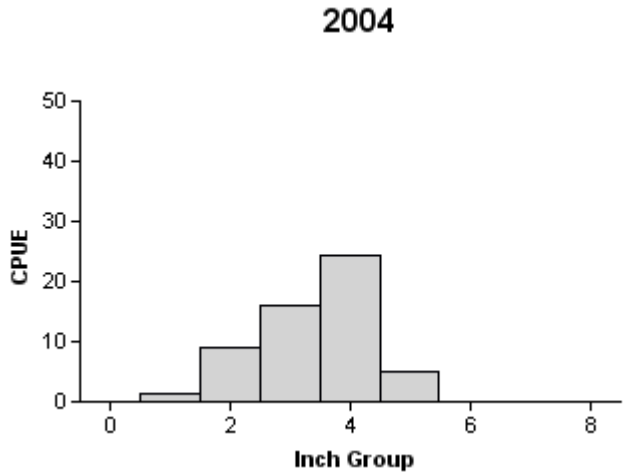
Effort = 1.5
Total CPUE = 190.0 (12; 285)
Stock CPUE = 77.3 (21; 116)
IOV = 85 (3.2)



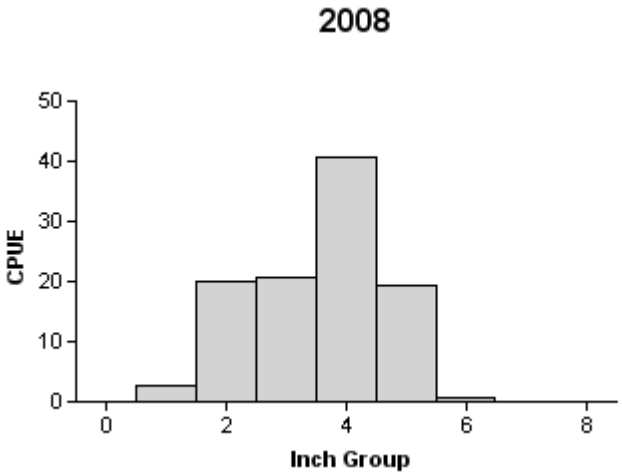
Effort = 2.0
Total CPUE = 299.5 (18; 599)
Stock CPUE = 41.0 (21; 82)
IOV = 97 (1)

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, Limestone Reservoir, Texas, 2004, 2008, and 2012.

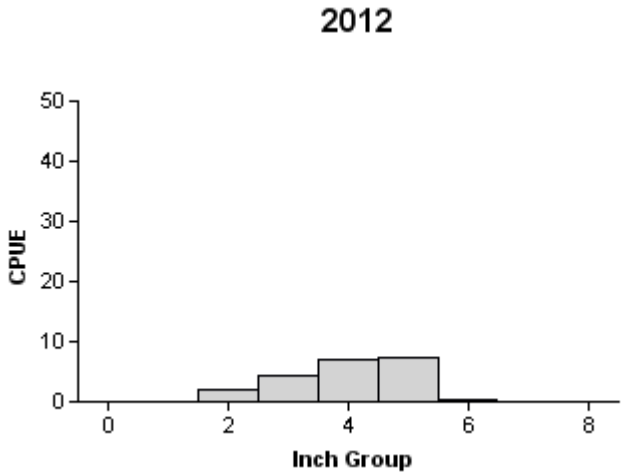
Bluegill



Effort = 2.0
Total CPUE = 56.0 (17; 112)
Stock CPUE = 45.5 (16; 91)
PSD = 0 (33.3)



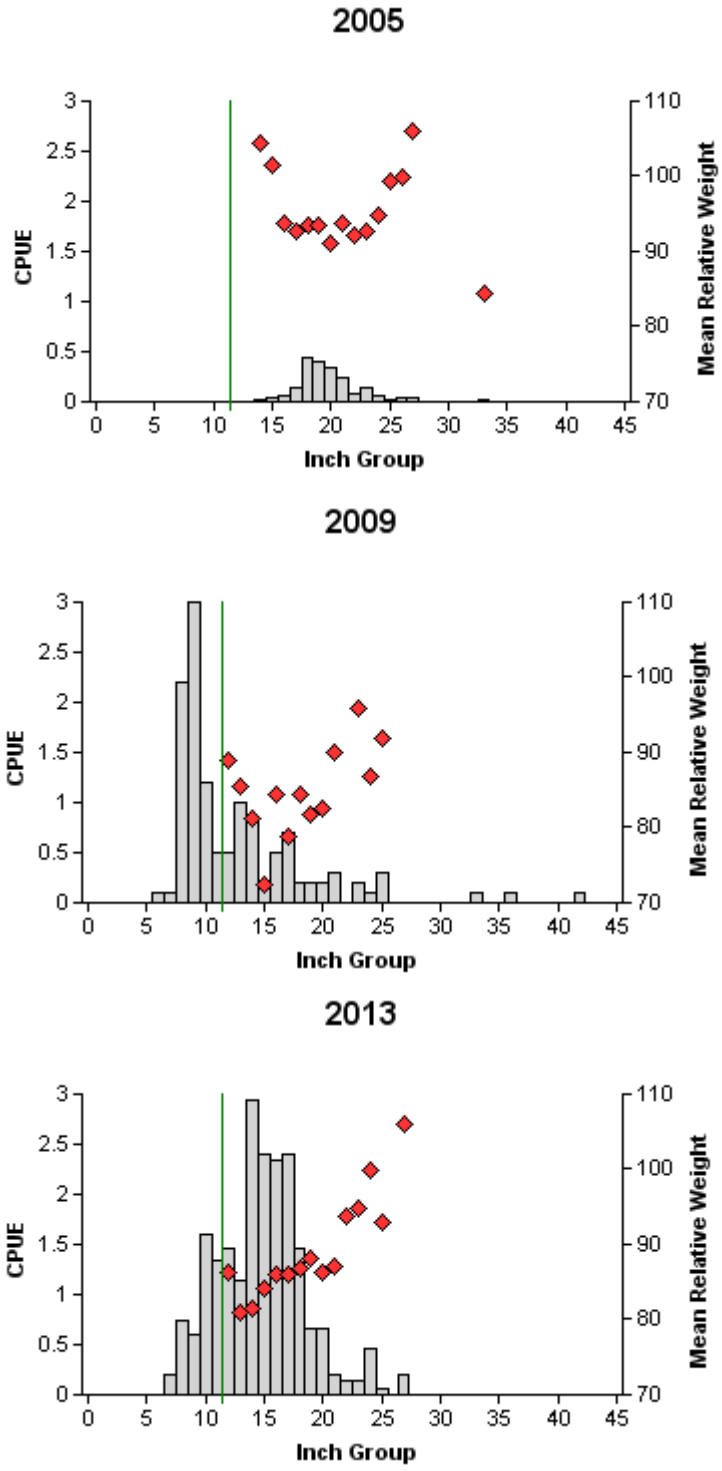
Effort = 1.5
Total CPUE = 104.0 (24; 156)
Stock CPUE = 81.3 (26; 122)
PSD = 1 (0.8)



Effort = 2.0
Total CPUE = 21.5 (31; 43)
Stock CPUE = 19.5 (31; 39)
PSD = 3 (2.3)

Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parenthesis) for fall electrofishing surveys, Limestone Reservoir, Texas, 2004, 2008, and 2012.

Blue Catfish



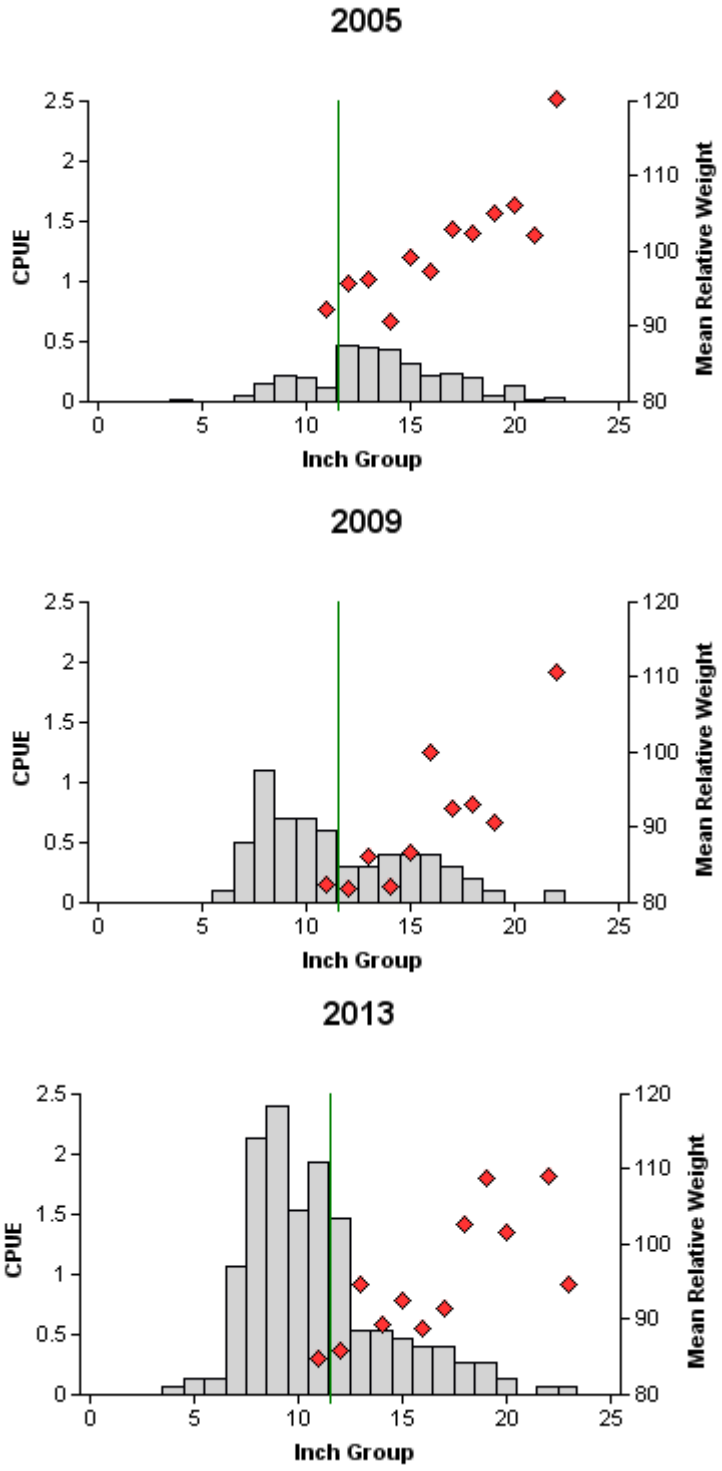
Effort =	60.0
Total CPUE =	2.1 (13; 125)
Stock CPUE =	2.1 (13; 125)
PSD =	47 (4.5)
PSD-12 =	100 (0)

Effort =	10.0
Total CPUE =	12.6 (26; 126)
Stock CPUE =	5.5 (25; 55)
PSD =	25 (6.5)
PSD-12 =	100 (0)

Effort =	15.0
Total CPUE =	21.1 (18; 317)
Stock CPUE =	16.7 (18; 250)
PSD =	11 (2.1)
PSD-12 =	100 (0)

Figure 4. Number of Blue Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Limestone Reservoir, Texas, 2005, 2009, and 2013. Minimum length limit represented by vertical line.

Channel Catfish



2005
Effort = 60.0
Total CPUE = 3.3 (13; 198)
Stock CPUE = 2.7 (14; 160)
PSD = 33 (3.7)
PSD-12 = 96 (1.9)

2009
Effort = 10.0
Total CPUE = 6.2 (27; 62)
Stock CPUE = 3.1 (26; 31)
PSD = 35 (9.6)
PSD-12 = 81 (8.1)

2013
Effort = 15.0
Total CPUE = 14.0 (18; 210)
Stock CPUE = 6.5 (21; 98)
PSD = 24 (4.7)
PSD-12 = 70 (5)

Figure 5. Number of Channel Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Limestone Reservoir, Texas, 2005, 2009, and 2013. Minimum length limit represented by vertical line.

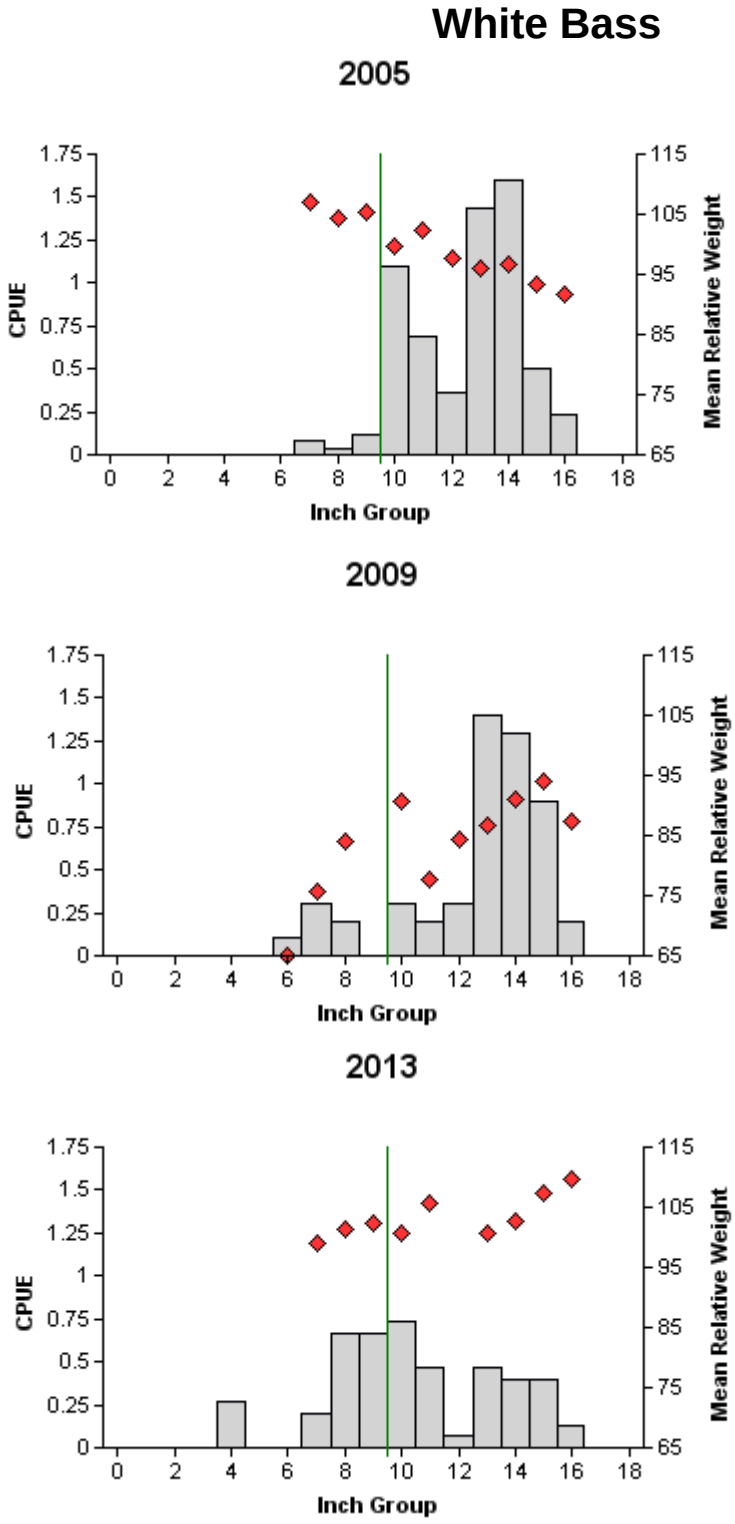


Figure 6. Number of White Bass caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Limestone Reservoir, Texas, 2005, 2009, and 2013. Minimum length limit represented by vertical line.

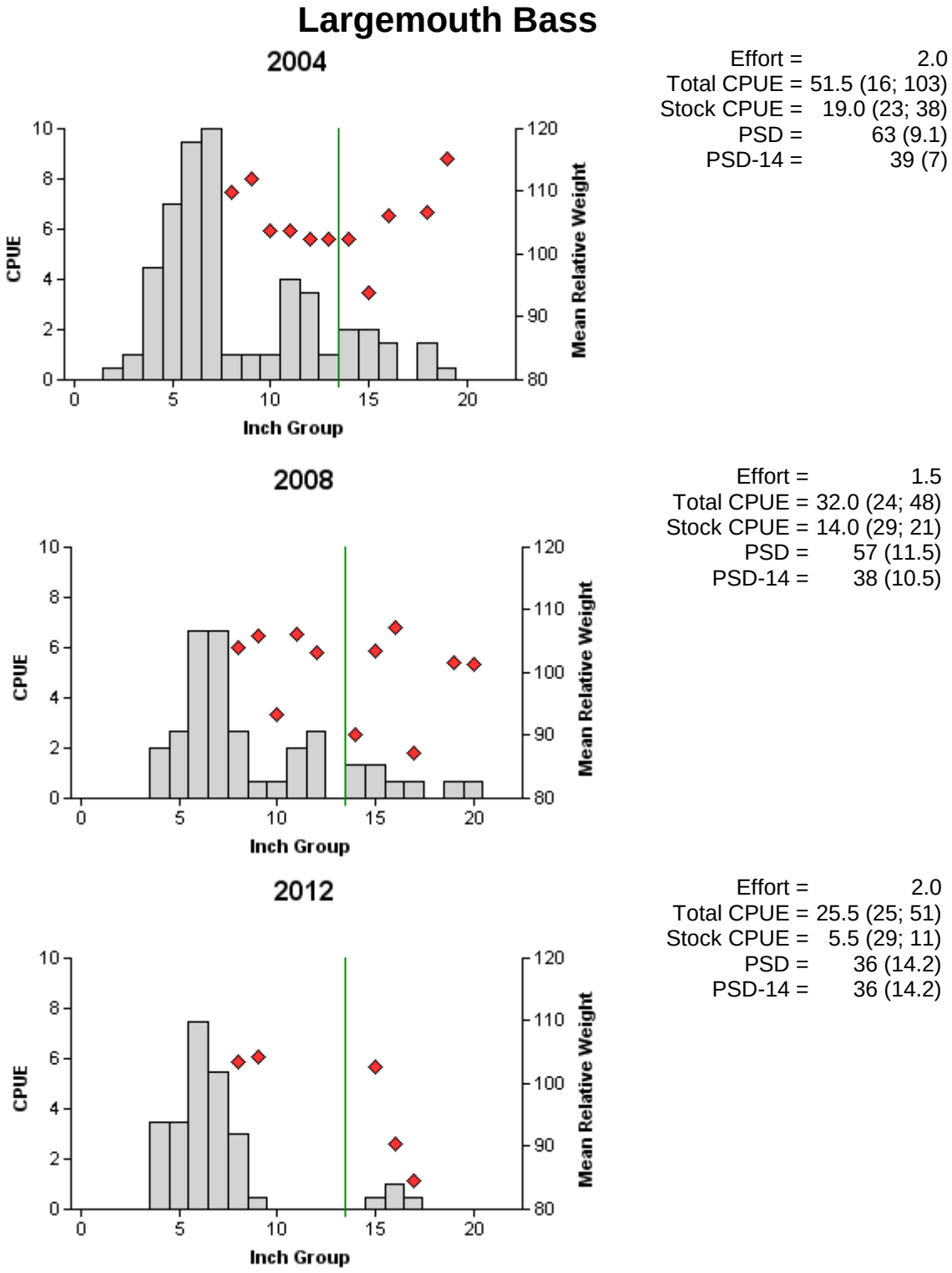


Figure 7. Number of Largemouth Bass caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Limestone Reservoir, Texas, 2004, 2008, and 2012. Minimum length limit represented by vertical line.

Table 7. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Limestone Reservoir, Texas, 2000-2012. 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.

		Number of fish				
Year	Sample size	FLMB	Intergrade	NLMB	% FLMB alleles	% FLMB
2000	30	0	25	5	34	0
2002	30	1	23	6	36	4
2004	30	1	22	7	32	3
2012	28	0	26	2	38	0

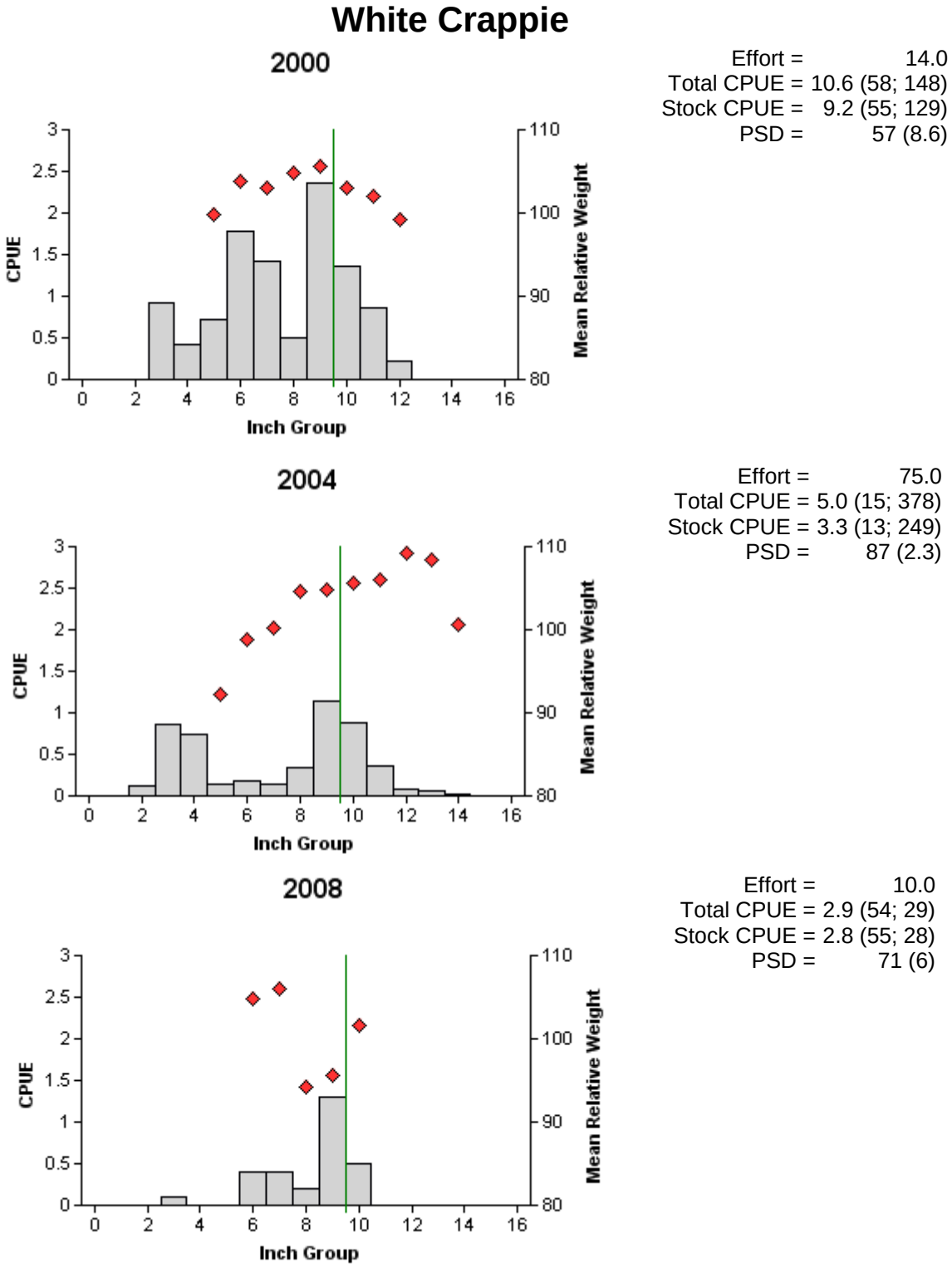


Figure 8. Number of White Crappie caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Limestone Reservoir, Texas, 2000, 2004, and 2008. Minimum length limit represented by vertical line.

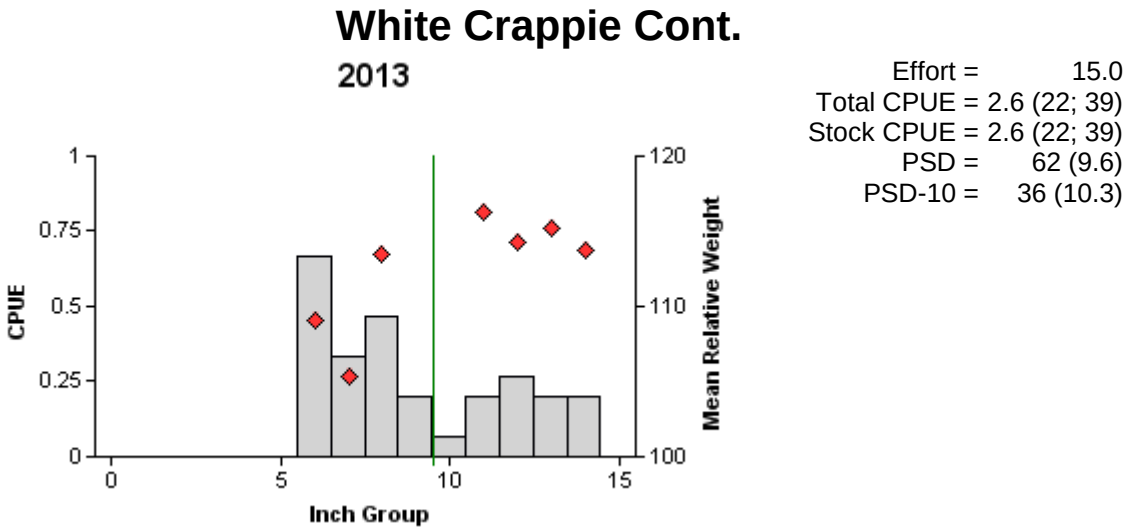


Figure 9. Number of White Crappie caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill netting, Limestone Reservoir, Texas, 2013. Trap netting was not conducted in fall 2012 due to low water levels.

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

Survey year	Electrofish Fall (Spring)	Trap net	Gill net	Habitat		Access	Creel survey	Report
				Structural	Vegetation			
2013-2014					A			
2014-2015					A			
2015-2016					A			
2016-2017	S	S	S	S	S	S	S	S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from electrofisher and gill netting from Limestone Reservoir, Texas, 2012-2013. Trap netting was not conducted due to low water levels.

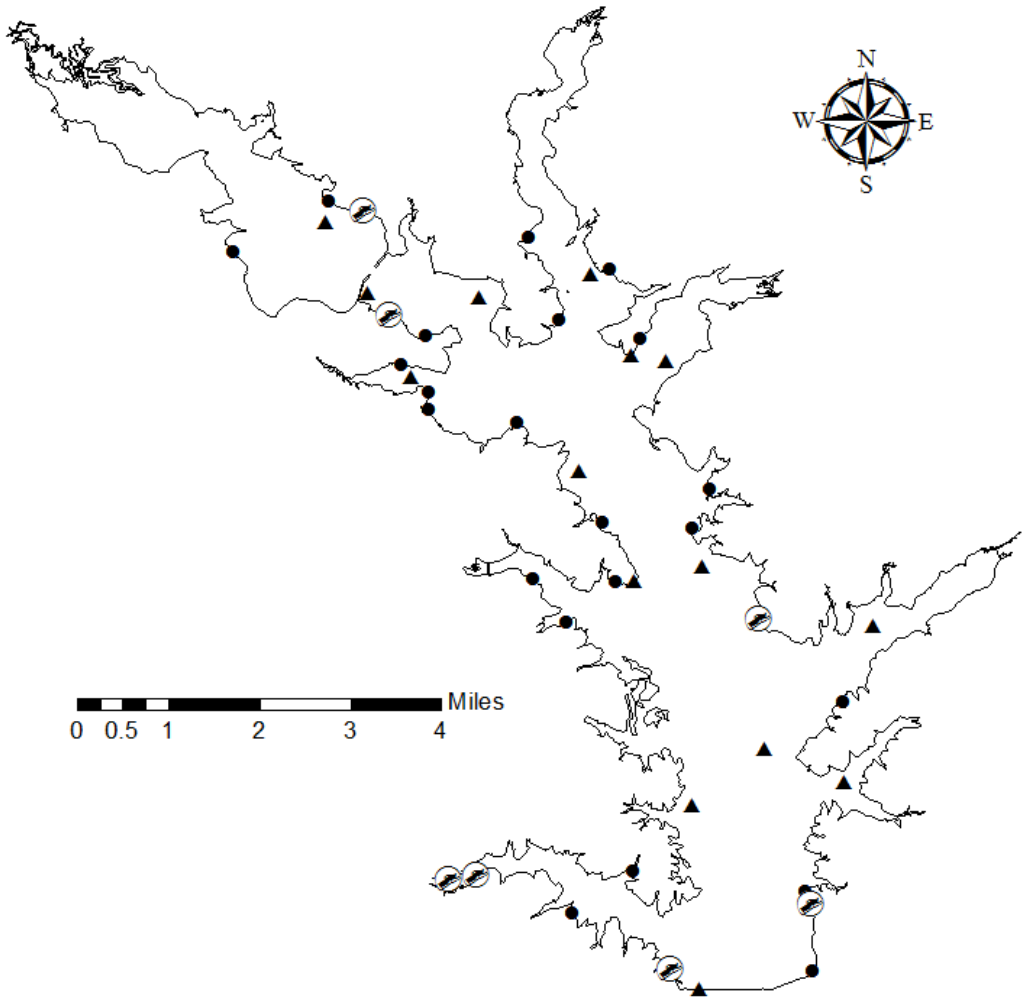
Species	Gill Netting		Electrofishing	
	N	CPUE	N	CPUE
Gizzard Shad			599	299.50
Threadfin Shad			2,564	1,282.0
Blue Catfish	317	21.13		
Channel Catfish	210	14.00		
Flathead Catfish	2	0.13		
White Bass	67	4.47		
Bluegill			43	21.50
Longear Sunfish			18	9.00
Redear Sunfish			4	2.00
Largemouth Bass			51	25.50
White Crappie	39	2.60		
Black Crappie	12	0.80		

APPENDIX B

Historical catch rates (CPUE) of targeted species by gear type for standard surveys on Limestone Reservoir, Texas, 1997 to present. All stations were randomly selected. Electrofishing stations were shocked with a 5.0 Smith-Root GPP (Gas Powered Pulsator) until 2010, when a 7.5 Smith-Root GPP began being used. Species averages are in bold. No trap netting was conducted in 2012 due to low water levels; white and Black Crappie collected in 2013 (*) were sampled with gill nets, and do not contribute to the historical average.

Gear	Species	1997	2000	2001	2004	2005	2008	2009	2012	2013	Avg.
Electrofisher											
	Largemouth Bass	86.0	60.0		51.5		32.0		25.5		**51.0**
	Gizzard Shad	265.0	94.0		216.0		190.0		299.5		**212.9**
	Threadfin Shad	700.0	109.0		1,609.0		1,302.0		1,282.0		**1,000.4**
	Bluegill	22.0	54.5		56.0		104.0		21.5		**51.6**
	Redear Sunfish	0.0	1.5		2.5		12.7		2.0		**3.7**
	Longear Sunfish	6.5	25.0		19.5		45.3		9.0		**21.1**
	Warmouth	1.0	1.5		1.5		0.7		0.0		**0.9**
Gill nets											
	Blue Catfish	0.5		2.3		2.1		12.6		21.1	**7.7**
	Channel Catfish	4.1		3.6		3.3		6.2		14.0	**6.2**
	Flathead Catfish	0.5		0.2		0		0		0.1	**0.3**
	White Bass	9.3		4.3		6.2		5.2		4.4	**5.9**
Trap nets											
	White Crappie	16.0		9.9		5.1		2.9		2.6*	**8.5**
	Black Crappie	0.1		0.4		0.1		0		0.8*	**0.2**

APPENDIX C



Location of electrofisher (circles), gill net (triangles), and boat ramp sites, Limestone Reservoir, Texas, 2012 and 2013. Water level was 3'-4' low at time of sampling.

APPENDIX D

Figures 1 through 4 represent summaries of data collected during June, 2012 as part of a habitat and access assessment for all BRA reservoirs. Data was collected using Hummingbird Side scan imaging and processed using ArcView and Dr. Depth. These figures were part of Appendix G-5 in the BRA operating plan titled "Operating guidelines to manage impacts on fisheries from reservoir level fluctuations" (2012).

Figure 1. Elevation specific littoral zone (< 4 ft. water depth) coverage in Lake Limestone, Texas, for upper, middle, and lower reservoir reaches and all reaches combined.

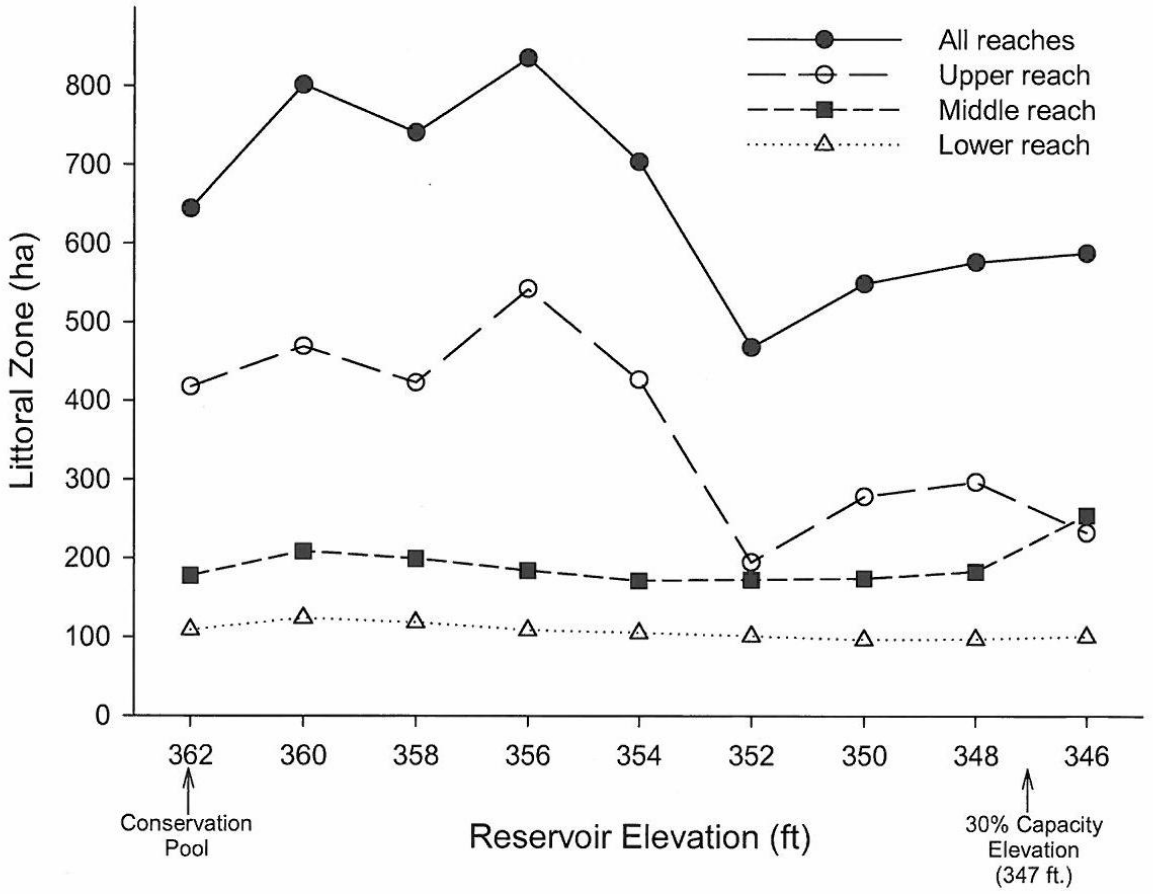


Figure 2. Elevation specific littoral zone (< 4 ft. water depth) coarse substrate availability in Lake Limestone, Texas.

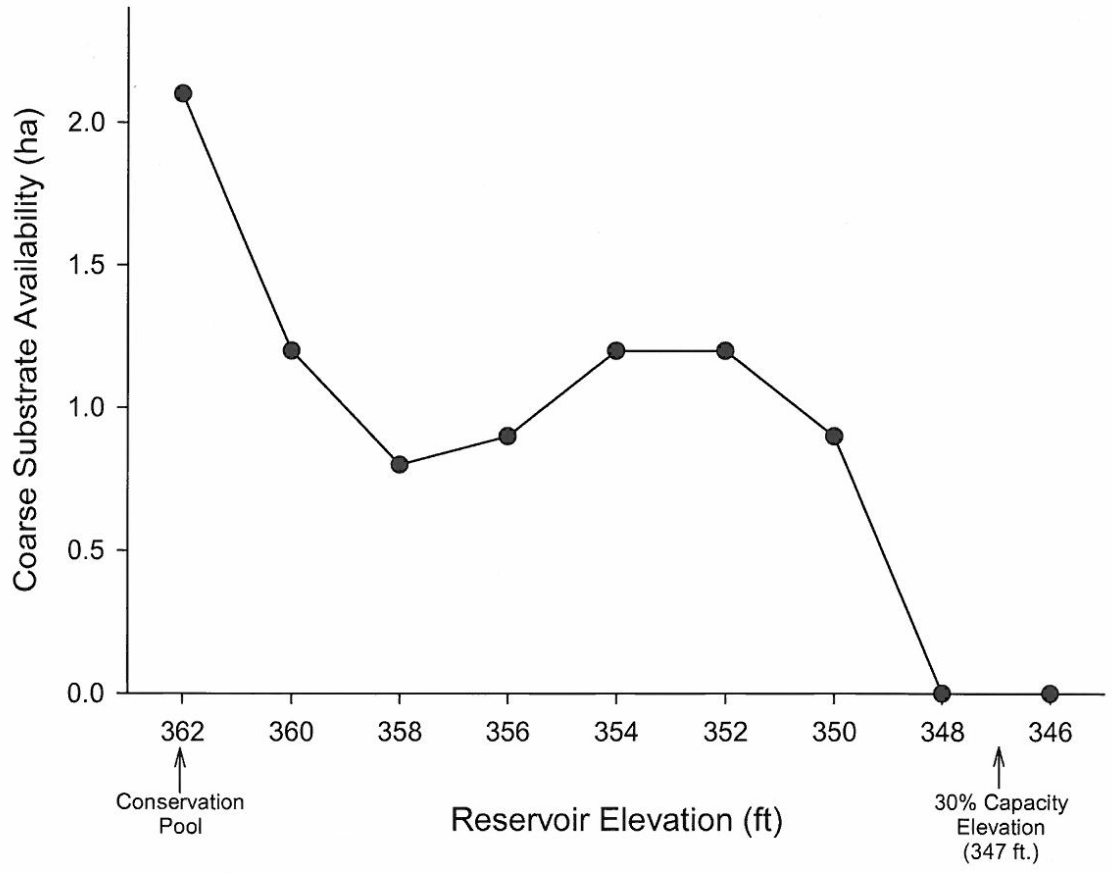


Figure 3. Elevation specific littoral zone (< 4 ft. water depth) woody habitat availability in Lake Limestone, Texas. Woody habitat was defined as one inundated standing tree, downed tree, or brush pile attractor.

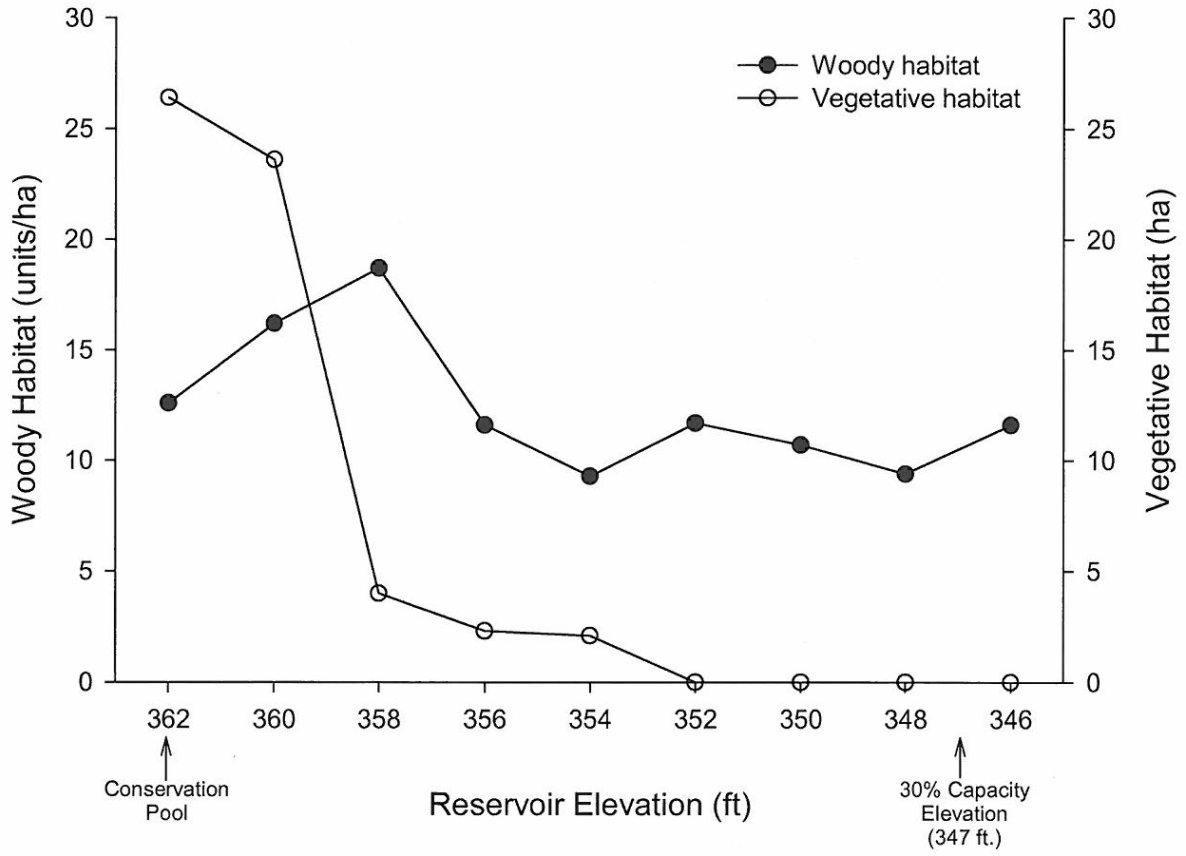


Figure 4. Elevation specific boat accessibility in Lake Limestone, Texas. The number of usable boat launches provided above each bar.