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

Granger Reservoir

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July 31, 2013

TABLE OF CONTENTS

SURVEY AND MANAGEMENT SUMMARY

Fish populations in Granger Reservoir were surveyed in 2012 using electrofishing and trap netting and in 2013 using gill netting. Historical data are presented with the 2012-2013 data for comparison. This report summarizes results of the surveys and contains a fisheries management plan for the reservoir based on those findings.

- **Reservoir Description:** Granger Reservoir is a 4,009-acre impoundment of the San Gabriel River in Williamson County. The reservoir is located approximately 40 miles northeast of Austin, Texas, within the Brazos River drainage. It was constructed in 1980 by the U. S. Army Corps of Engineers (USACE) for purposes of flood control and water conservation. Granger Reservoir has a drainage area of approximately 709 square miles and a shoreline length of about 40 miles. High turbidity and fluctuating water levels have deterred the establishment of aquatic vegetation. Reservoir bank slope is relatively flat and small changes in water level (1-2 feet) can have a large impact on the abundance of shoreline habitat and river/reservoir connectivity.

    - **Management History:** Important sport fish include White Crappie, White Bass, Largemouth Bass, and catfish. A creel survey conducted in the spring of 2005 showed White Crappie was the most sought-after species (61.5% directed angler effort) followed by catfishes (16.8%), White Bass (5.1%), and Largemouth Bass (2.5%; Bonds and Magnelia 2005). Blue Catfish were stocked in 1995 and 1996 to provide additional angling opportunities and utilize an abundant shad population. No additional stocking has been conducted since 1996.

    - **Fish Community**
        - **Prey species:** Threadfin Shad and Gizzard Shad were the predominant prey species available. The index of vulnerability for Gizzard Shad was 99 indicating that most remained available as prey to most sport fish.

        - **Catfishes:** Total catch per unit effort for blue and Channel Catfish species was relatively low. Flathead Catfish were not recorded.

        - **White Bass:** Total catch per unit effort and catch rate of harvestable size fish had decreased since the previous survey, but fish up to 15 inches in length were present. On average, White Bass reached harvestable size (10 inches) between age 1 and 2.

        - **Largemouth Bass:** Electrofishing catch rate for Largemouth Bass had significantly decreased since the 2008 survey. The only harvestable size fish caught was 15 inches in length.

        - **White Crappie:** White Crappie were abundant and had good body condition. On average, White Crappie reached harvestable size (10 inches) between age 1 and 2.

    - **Management Strategies:** Based on current information, the reservoir should continue to be managed with existing regulations. White Crappie is by far the most sought-after species at this reservoir; therefore trap net surveys should be conducted annually to better monitor the population dynamics of this species.

INTRODUCTION

This document is a summary of fisheries data collected from Granger Reservoir from 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 species of 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

Granger Reservoir is a 4,009-acre impoundment of the San Gabriel River in Williamson County. The reservoir is located approximately 40 miles northeast of Austin, Texas, within the Brazos River drainage. It was constructed in 1980 by the U. S. Army Corps of Engineers (USACE) for purposes of flood control and water conservation. Granger Reservoir is eutrophic with a mean TSI chl-*a* of 48.46, which was higher than previous samples (Texas Commission on Environmental Quality 2011). Hydrilla (*Hydrilla verticillata*), a non-native aquatic plant, was first discovered near Wilson Fox boat ramp in 2003. It was eliminated with an herbicide applied by the USACE. Water level has fluctuated since 2004. In late 2004 and most of 2007, persistent rains caused the reservoir to increase significantly above conservation pool (Figure 1). Since July 2008, the reservoir level has remained below conservation pool for the majority of the time. Most of this can be attributed to recent drought conditions and USACE dam maintenance, which required a reduction in water level. Land management in the watershed and non-existent shoreline and riparian vegetation has led to increased bank erosion and siltation around the reservoir. A structural habitat survey in 2012 revealed that the majority of the shoreline was natural with large stands of flooded timber. Other descriptive characteristics for Granger Reservoir are in Table 1.

Angler Access

Boat access consisted of five public boat ramps. Bank fishing access is good within the San Gabriel Wildlife Management Area, which includes a primitive boat launch for canoes and kayaks. The USACE operates four parks with good bank access. Wilson Fox Park contained a fishing pier with accommodations for the physically challenged. Additional boat ramp characteristics are in Table 2.

Management History

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

1. Promote the Blue Catfish fishery with press releases.
   Action: Granger catfish opportunities were promoted in outdoor media as magazine articles.
2. Continue visual inspections for exotic aquatic vegetation species on routine sampling surveys.
   Action: A visual inspection for exotic aquatic vegetation species was conducted in August 2012.
3. If exotic aquatic vegetation species are documented, conduct a reservoir-wide aquatic vegetation survey.
   Action: No exotic aquatic vegetation species were observed thus a reservoir-wide aquatic vegetation surveys was not necessary.
4. Recommend proper course of action to controlling authority should treatment be required.
   Action: No treatment was required.
5. Consult with USACE about implementing a native emergent aquatic plant introduction pilot project.
   Action: Discussions were held with USACE park manager and Sun City Hunting and Fishing Club to pursue aquatic vegetation planting project. All groups committed and a plan was drawn to plant native aquatic vegetation.
6. If the pilot project is successful, seek funding for reservoir-wide introductions of native emergent aquatic plant species.

Action: Still to be determined.

7. Try low-frequency electrofishing in the fall of 2012 to compare to spring gill netting.
   Action: Low-frequency electrofishing was cancelled after consultation with staff at Heart of the Hills research facility revealed that this technique has been shown to be ineffective for Blue Catfish at this particular reservoir.
8. If low-frequency electrofishing is more effective, use as a standard sampling method for Blue Catfish.
   Action: This method will not be pursued (see above).

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

Stocking history: Granger Reservoir has not been stocked since 1996. Blue Catfish were stocked in 1995 and 1996. Channel Catfish were stocked in 1979, 1990, and 1996. The complete stocking history is in Table 4.

Vegetation/habitat management history: High turbidity and fluctuating water level of Granger Reservoir make it difficult for aquatic vegetation to become established. Water clarity (Secchi depth) is typically less than 1 foot. Few aquatic plants were observed in Granger Reservoir prior to 2003. In 2003, hydrilla was discovered near Wilson Fox Park boat ramp and was eliminated by the USACE with an aquatic herbicide. In 2004, water hyacinth was observed in the upper San Gabriel arm of the reservoir, but has not been documented since 2004.

Water Transfer: No interbasin water transfers are known to exist at Granger Reservoir.

METHODS

Fishes were collected by electrofishing (1.0 hour at 12, 5-min stations), gill netting (5 net nights at 5 stations), and trap netting (15 net nights at 15 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 Manual (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 X SE of the estimate/estimate) was calculated for all CPUE statistics. Ages were determined using otoliths for White Bass (n=16) and White Crappie (n=67) (TPWD, Inland Fisheries Division, unpublished manual revised 2011). Source for water level data was the USACE Granger Reservoir website.

RESULTS AND DISCUSSION

Habitat: In 2012 littoral habitat consisted primarily of natural shoreline (Table 4). Exotic aquatic vegetation species were not present when visual inspections were conducted during routine sampling surveys. Of native species, American lotus was found near Willis Creek ramp and spike rush was present on some shorelines. In 2012, the Brazos River Authority (BRA), in negotiations with TPWD, asked for a fishery assessment to be provided for all eleven BRA jurisdictional reservoirs. These assessments would be taken into consideration for a multi-year system operating plan for the Brazos River Basin. Assessments for Granger reservoir included habitat availability, river/reservoir connectivity, and access at various lake levels. Based on these multiple assessments, threshold recommendations were provided to decrease potential impacts to the fishery during future basin-wide water level manipulations. The shallow nature and low-gradient shoreline slopes of Granger Reservoir make it vulnerable to minimal water fluctuations (Appendix C). River/reservoir connectivity, essential for many fish life cycles, especially seasonally-migrating species, is estimated lost at about 6 feet below conservation pool. Littoral habitat availability at all reaches of the reservoir declines significantly with a minimal drop in lake level (Appendix D); but overall, littoral areas are significantly compromised below 498 ft.-msl (Appendix E). Similar trends are seen for woody and vegetative habitat in this reservoir (Appendix F). Recreational access is also affected by reduced lake levels. Of five public ramps on Granger Reservoir, only one remains functional below 496 ft.-msl, and access is completely lost below 494 ft.-msl, which is a mere 10 feet below conservation pool (Appendix G). Based on these assessments and lake characteristics, the Granger Reservoir management threshold recommendation was 504 ft.-msl, which is the same as top of conservation (TOC) or conservation pool (Appendix H). A critical threshold for fisheries applications was set at 498 ft.-msl. Future water level models under predicted BRA management potential scenarios show that duration of low-water periods reaching the critical threshold will be minimal and not significantly greater than what it is today (Appendix I).

Prey species: Gizzard Shad total electrofishing CPUE in 2012 was 96.0/h, which was lower than that recorded in 2008 (129.0/h). The index of vulnerability (IOV) for Gizzard Shad was 99 (Figure 2), which indicates that most Gizzard Shad were less than 8 inches in length, making them susceptible to most predators. High IOV values were also obtained in 2008 (91) and 2004 (100). Threadfin Shad were collected at the rate of 228.0/h in 2012, which is much higher than the three previous surveys (2008 = 62.0/h, 2004 = 21.0/h). Bluegill total electrofishing CPUE is typically relatively low for this reservoir, but in 2012 total CPUE (6.0/h) was considerably lower than previous surveys (2008 = 77.0/h, 2004 = 40.0/h) (Figure 3). Inland Silverside, Blacktail Shiner, and Longear Sunfish were also available as forage.

Catfishes: In 2013, total CPUE for Blue and Channel Catfish species was relatively low. The total gill net catch rate of Blue Catfish was 1.4/nn in 2013 and was slightly lower than catch rates of 2.4/nn in 2009 and 3.0/nn in 2005 (Figure 4). In 2012, all Blue Catfish were above harvestable size with the largest fish measuring 25 inches in length. Body condition for the specimens collected in 2013 was sub-optimal (W_r between 80 and 90). Gill netting catch rate for Channel Catfish was 1.0/nn in 2013 which is comparable to the catch rates in 2009 (1.8/nn) and 2005 (0.9/nn) (Figure 5). Flathead Catfish were not captured in the 2013 survey and were present in relatively low numbers in previous surveys; total CPUE was 0.4/nn in both 2009 and 2005 (Figure 6).

White Bass: The total gill net catch rate of White Bass was 3.2/nn in 2013. This was lower than that recorded in 2009 (5.8/nn) and similar to that obtained in 2005 (2.9/nn) (Figure 7). The gillnet CPUE of harvestable White Bass (≥10 inches) decreased in 2013 (2.0/nn) compared to 2009 (4.4/nn). Furthermore, most individuals sampled were of legal size with the largest fish up to 15 inches in length. This decline may reflect poor year classes attributed to low lake levels in spring 2010. White Bass year class strength is correlated to spring inflow (DiCenzo and Duval 2002). On average, White Bass reached harvestable size (10 inches) between age 1 and 2 (Figure 8).

Largemouth Bass: Total CPUE has been low for the last three surveys and was particularly poor in 2012. The total catch rate of Largemouth Bass was 5.0/h in 2012 compared to catch rates of 33.0/h in 2008 and 7.0/h in 2004 (Figure 9). In 2012, the only harvestable size fish caught was 15 inches in length. The lack of aquatic vegetation habitat in this reservoir and fluctuating water levels has hindered the

production of Largemouth Bass.

White Crappie: The total trap net catch rate for White Crappie increased to 20.0/nn in 2012 from 6.4/nn in 2011, 13.5/nn in 2010, and 9.7/nn in 2009) (Figure 10). The trap net CPUE of harvestable White Crappie (≥10 inches) increased in 2012 (1.7/nn) compared to 2011 (0.4/nn), 2010 (0.5/nn), and 2009 (0.1/nn). Low water levels in spring 2009 and 2010 might have led to weak year classes and poor recruitment seen in subsequent years. Flooded habitat in spring 2013 should lead to a strong year class, and if lake levels remain high this summer, recruitment should be good. The 2013 fall survey would reveal the potential improvement in population structure. Relative weights were near optimal for all size classes (W_r = 95 to 104). On average, White Crappie reached harvestable size (10 inches) between age 1 and 2 (Figure 11 and 12).

Fisheries management plan for Granger Reservoir, Texas

Prepared – July 2013.

ISSUE 1: Granger Reservoir has a low amount of shoreline habitat, which has resulted in dismal abundance of Largemouth Bass. Historically, abundance of this species seems to improve each time water level increases (i.e. strong year classes are produced due to flooded terrestrial vegetation). Furthermore, eroding shorelines and siltation continues to cause concern, exacerbating turbidity that impedes the establishment of aquatic vegetation. Planting emergent aquatic vegetation could help improve habitat for Largemouth Bass. It could also stabilize shorelines and improve water clarity. The reservoir is also a popular waterfowl hunting destination and emergent vegetation could improve the reservoir's attraction to migrating waterfowl.

MANAGEMENT STRATEGY

1. In summer of 2013, work with local partners to plant waterwillow colonizing patches in hopes to establish shoreline vegetation to address habitat and erosion issues.

ISSUE 2: Boating access at one public access site (Willis Creek Park) is impeded by minimal reduction of water level. The boat ramp at Willis Creek Park only extends to a depth of 3 feet, and the end of the ramp is silted in, making it unusable at 503 ft.-msl. This access point is a popular site for White Bass and crappie anglers seeking spawning fish in the spring.

MANAGEMENT STRATEGY

1. Approach USACE to discuss the need for dredging the ramp. A broader management option to improve habitat in this area should be pursued conjunctively; as well as the recruitment of or invited involvement of an existing Friends of Reservoirs group to partner in a large-scale project.

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. Contact and educate marina owners about invasive species, and provide them with posters, literature, etc… so that they can in turn educate their customers.
3. Educate the public about invasive species through the use of media and the internet.
4. Make a speaking point about invasive species when presenting to constituent and user groups.
5. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.

SAMPLING SCHEDULE JUSTIFICATION:

The proposed sampling schedule includes annual trap net sampling and mandatory monitoring in 2016/2017 (Table 6). Annual trap net sampling is necessary to help manage the important White Crappie fishery. Electrofishing surveys are only necessary every four years to monitor Largemouth Bass and prey species. Gill net surveys are only necessary every four years to monitor presence of Blue Catfish, Channel Catfish, Flathead Catfish, and White Bass. An additional vegetation survey is necessary in August 2014 to monitor the establishment of water willow from the proposed planting project.

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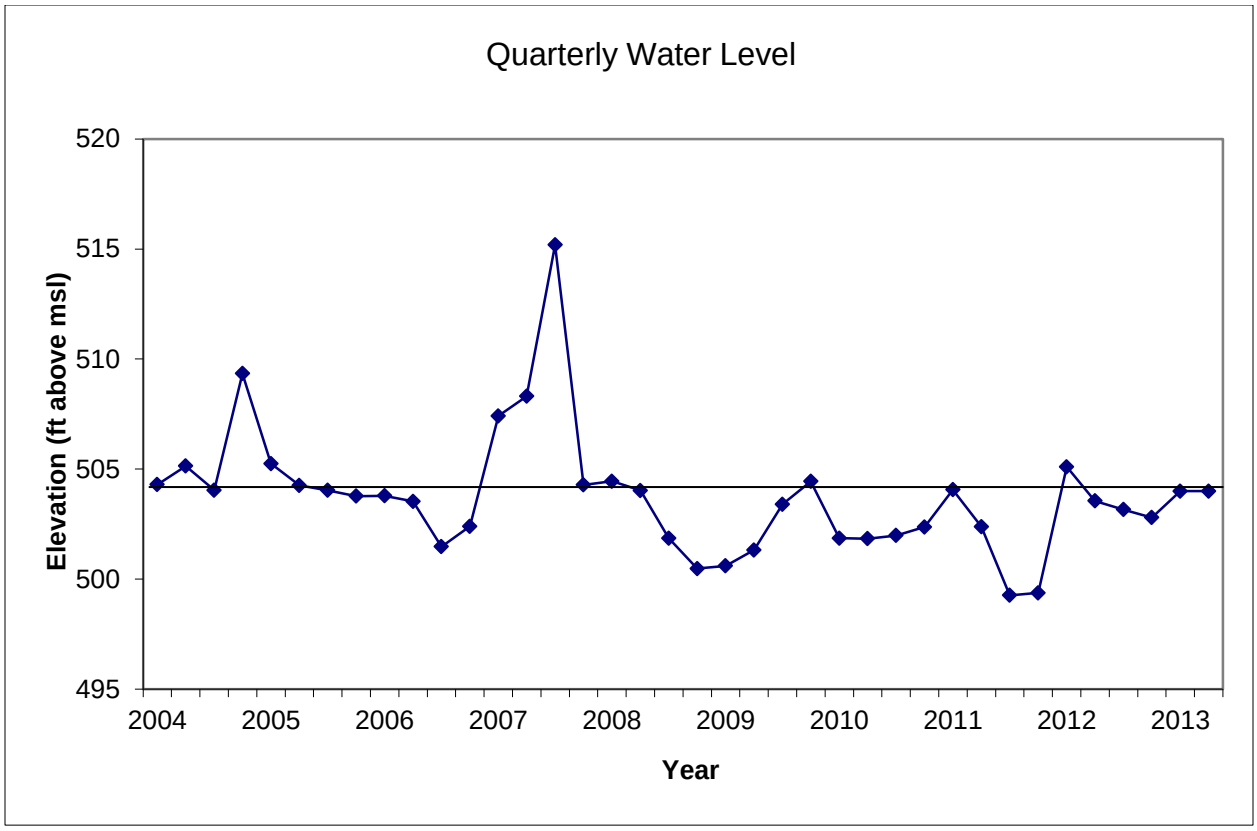


Figure 1. Quarterly water level elevations in feet above mean sea level (MSL) recorded for Granger Reservoir, Texas 2004-2013.

Table 1. Characteristics of Granger Reservoir, Texas.

Characteristic	Description
Year constructed	1980
Controlling authority	United States Army Corps of Engineers
County	Williamson
Reservoir type	Mainstream: San Gabriel River
Shoreline Development Index (SDI)	4.3
Conductivity	450 µS/cm

Table 2. Boat ramp characteristics for Granger Reservoir, Texas, August, 2012. Reservoir elevation at time of survey was 504 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft.)	Condition
Taylor Park	30.67578 -97.36425	Y	51	495	Good
Fox Park North	30.68333 -97.36389	Y	20	494	Good
Fox Park South	30.68303 -97.35450	Y	50	494	Good
Willis Creek	30.69667 -97.38517	Y	38	501	Poor (Silted in)
Friendship Park	30.71758 -97.33647	Y	36	501	Good

Table 3. Harvest regulations for Granger 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	14-inch minimum
Crappie: white and black crappie, their hybrids and subspecies	25 (in any combination)	10-inch minimum

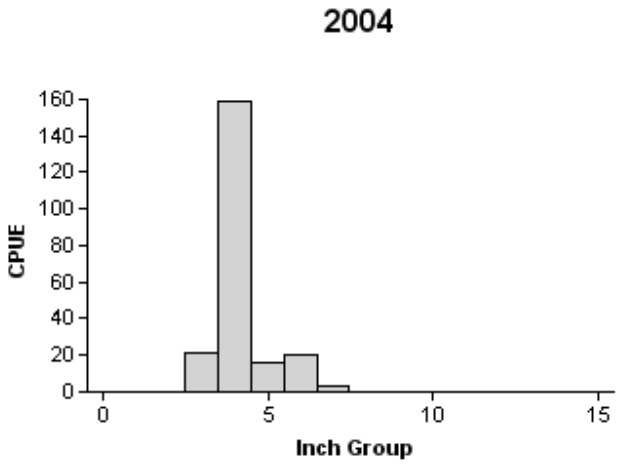
Table 4. Stocking history of Granger Reservoir, Texas. Life stages are fry (FRY), fingerlings (FGL), advanced fingerlings (AFGL), adults (ADL) and unknown (UNK). Life stages for each species are defined as having a mean length that falls within the given length range. For each year and life stage the 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	1995	247,224	FGL	1.9
	1996	220,000	FGL	1.7
	Total	467,224		
Channel Catfish	1979	31,860	AFGL	7.9
	1990	64,998	AFGL	4.0
	1996	220,429	FGL	1.8
	Total	317,287		
Coppernose Bluegill	1981	100,000	UNK	UNK
	Total	100,000		
Florida Largemouth Bass	1980	50,584	FRY	1.0
	1992	44,470	FGL	1.1
	1992	175,696	FRY	0.9
	1994	220,976	FGL	1.3
	Total	491,726		
Striped Bass	1981	110,371	UNK	UNK
	1983	15,927	UNK	UNK
	Total	126,298		

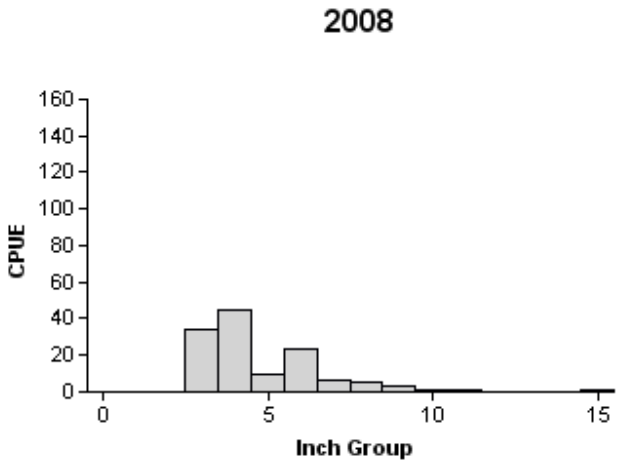
Table 5. Survey of structural habitat types, Granger Reservoir, Texas, 2012. Shoreline habitat type units are in miles and standing timber is acres.

Habitat type	Estimate	% of total
Gravel	2.1 miles	7
Natural	24.2 miles	83
Rocky	2.7 miles	9

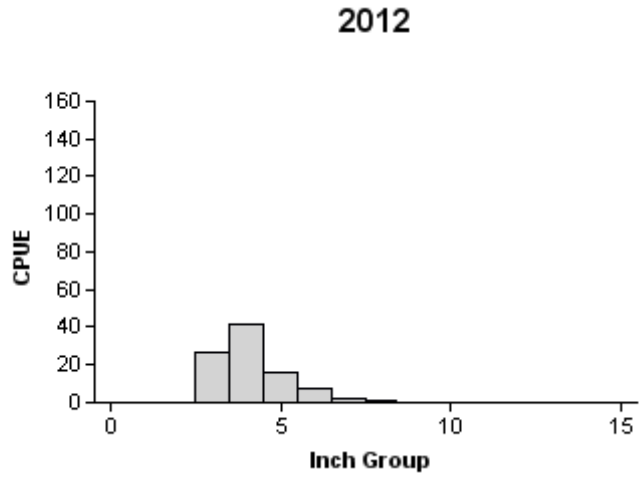
Gizzard Shad



Effort = 1.0
Total CPUE = 219.0 (31; 219)
IOV = 100 (0)



Effort = 1.0
Total CPUE = 129.0 (14; 129)
IOV = 91 (4.3)



Effort = 1.0
Total CPUE = 96.0 (16; 96)
IOV = 99 (1)

Figure 2. Number of Gizzard Shad caught per hour (CPUE) population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Granger Reservoir, Texas, 2004, 2008 and 2012.

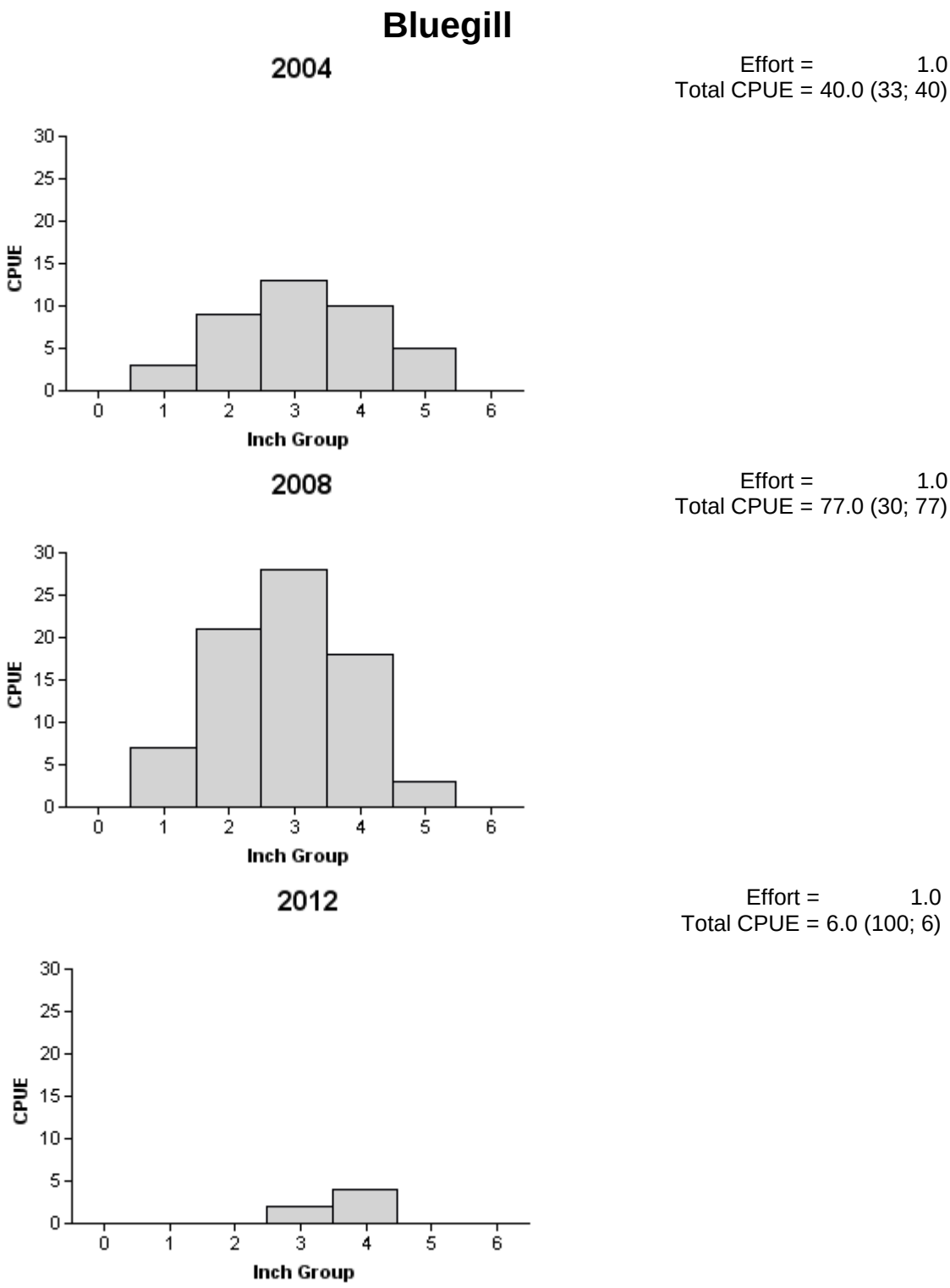


Figure 3. Number of bluegill caught per hour (CPUE) population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Granger Reservoir, Texas, 2004, 2008 and 2012.

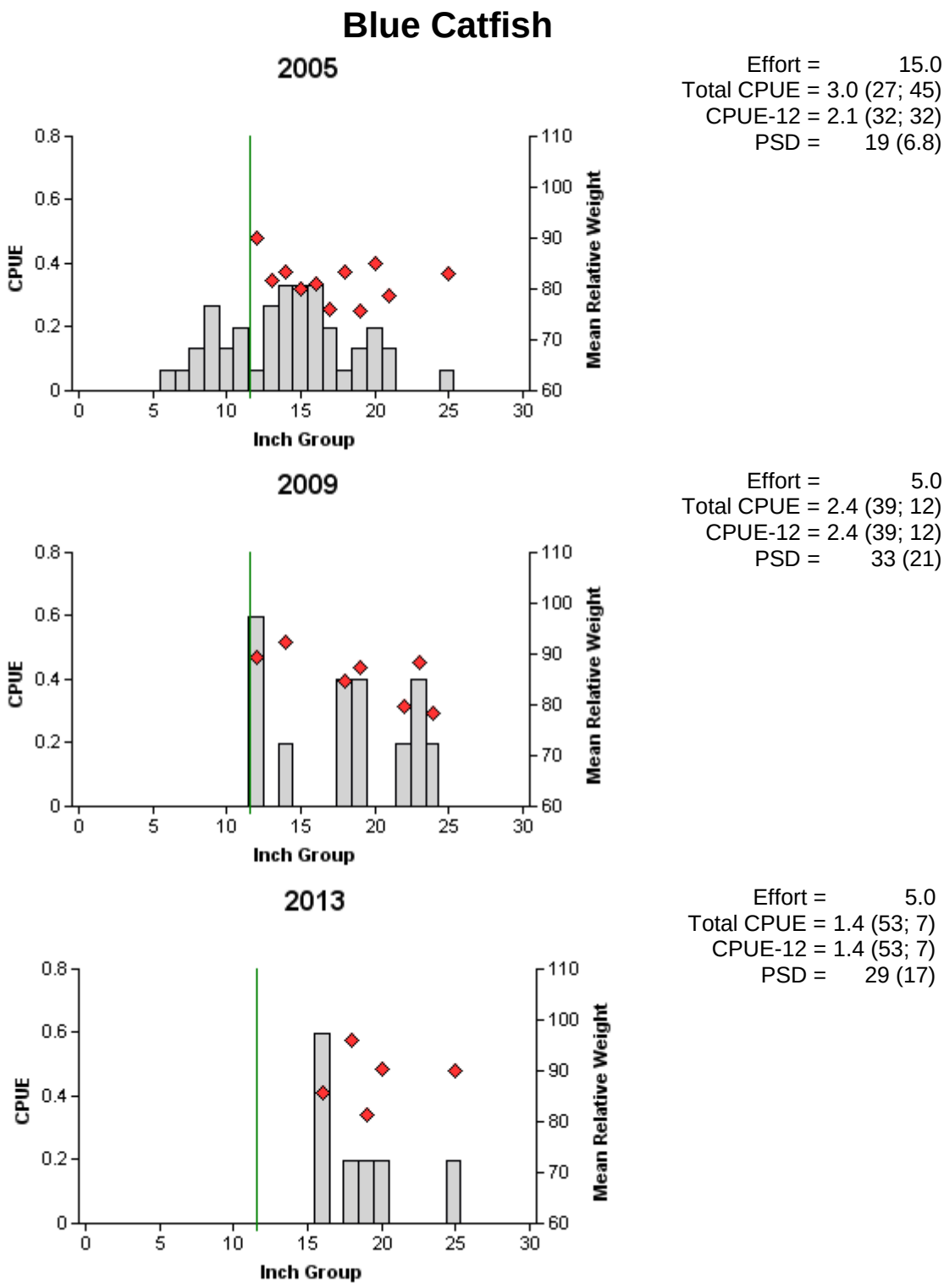


Figure 4. Number of Blue Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Granger Reservoir, Texas, 2005, 2009 and 2013. Vertical line represents minimum length limit at the time of sampling.

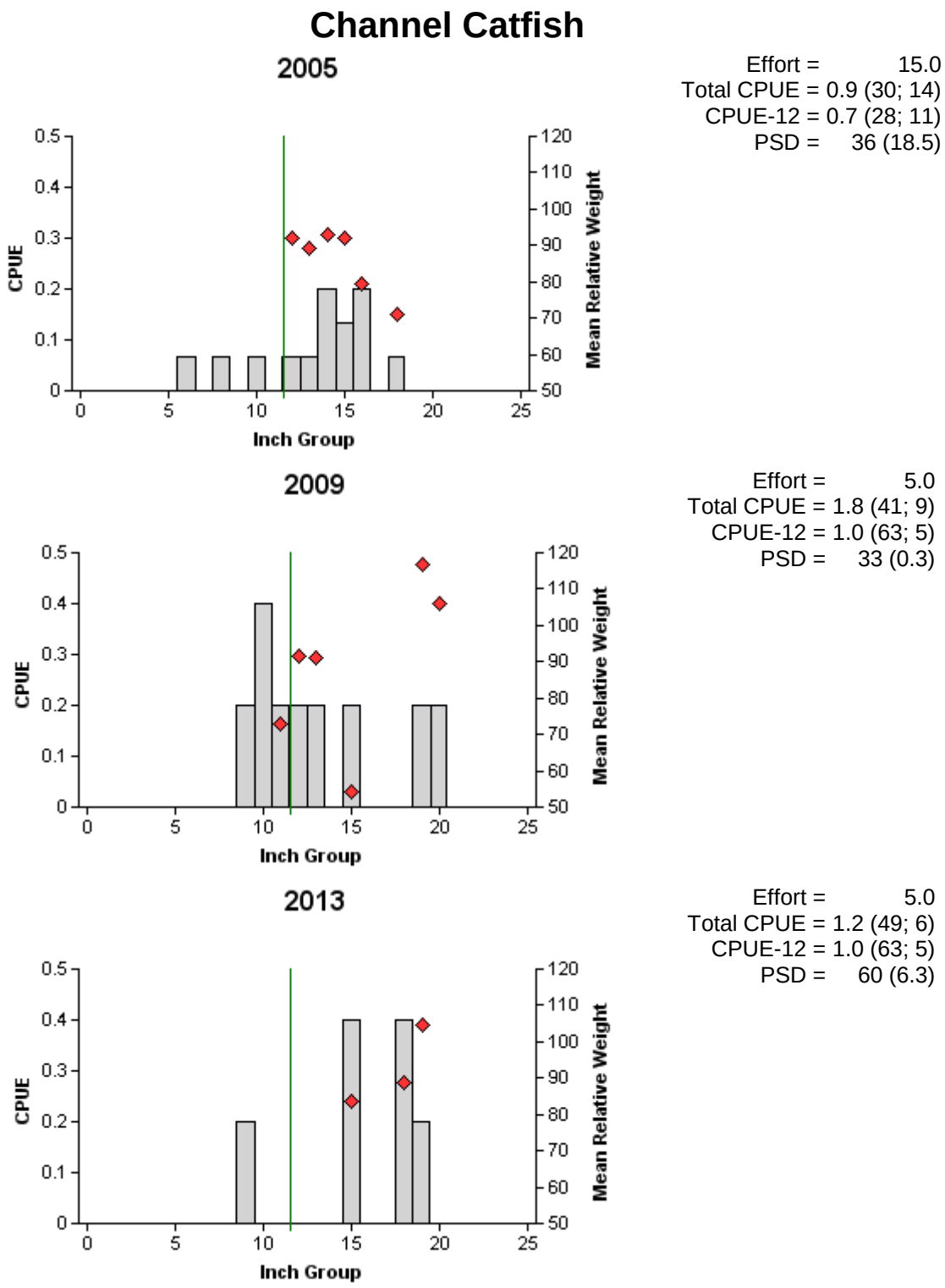
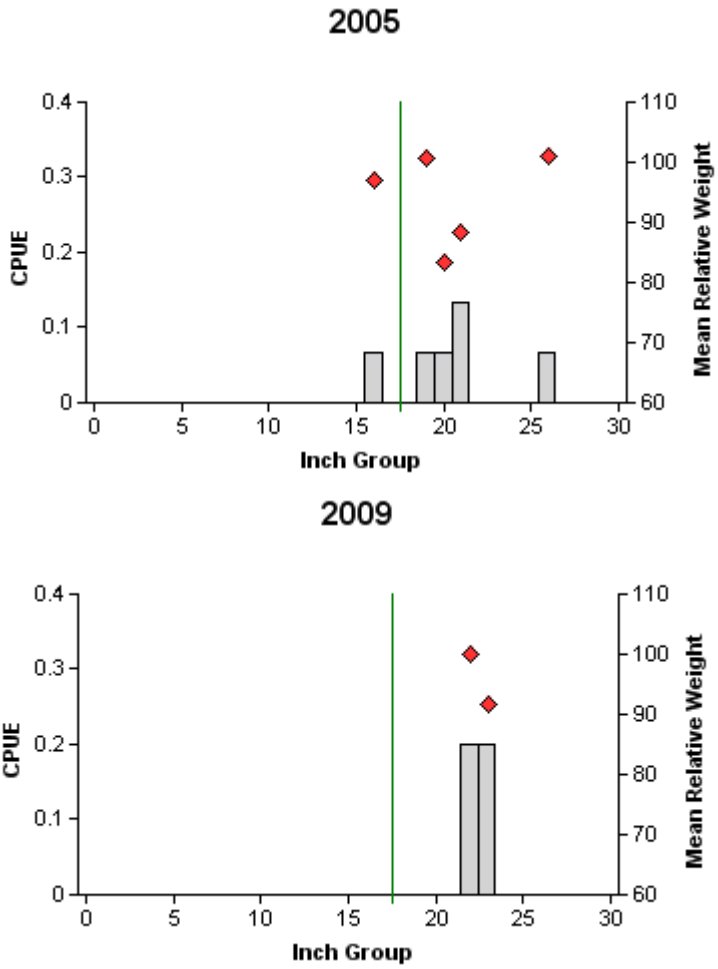


Figure 5. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Granger Reservoir, Texas, 2005, 2009 and 2013. Vertical line represents minimum length limit at the time of sampling.

Flathead Catfish



Effort = 15.0
Total CPUE = 0.4 (33; 6)
CPUE-18 = 0.3 (38; 5)
PSD = 67 (19.9)

Effort = 5.0
Total CPUE = 0.4 (100; 2)
CPUE-18 = 0.4 (100; 2)
PSD = 100 (0)

Figure 6. Number of Flathead Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Granger Reservoir, Texas, 2005, 2009. No Flathead Catfish were caught in 2013. Vertical line represents minimum length limit at the time of sampling.

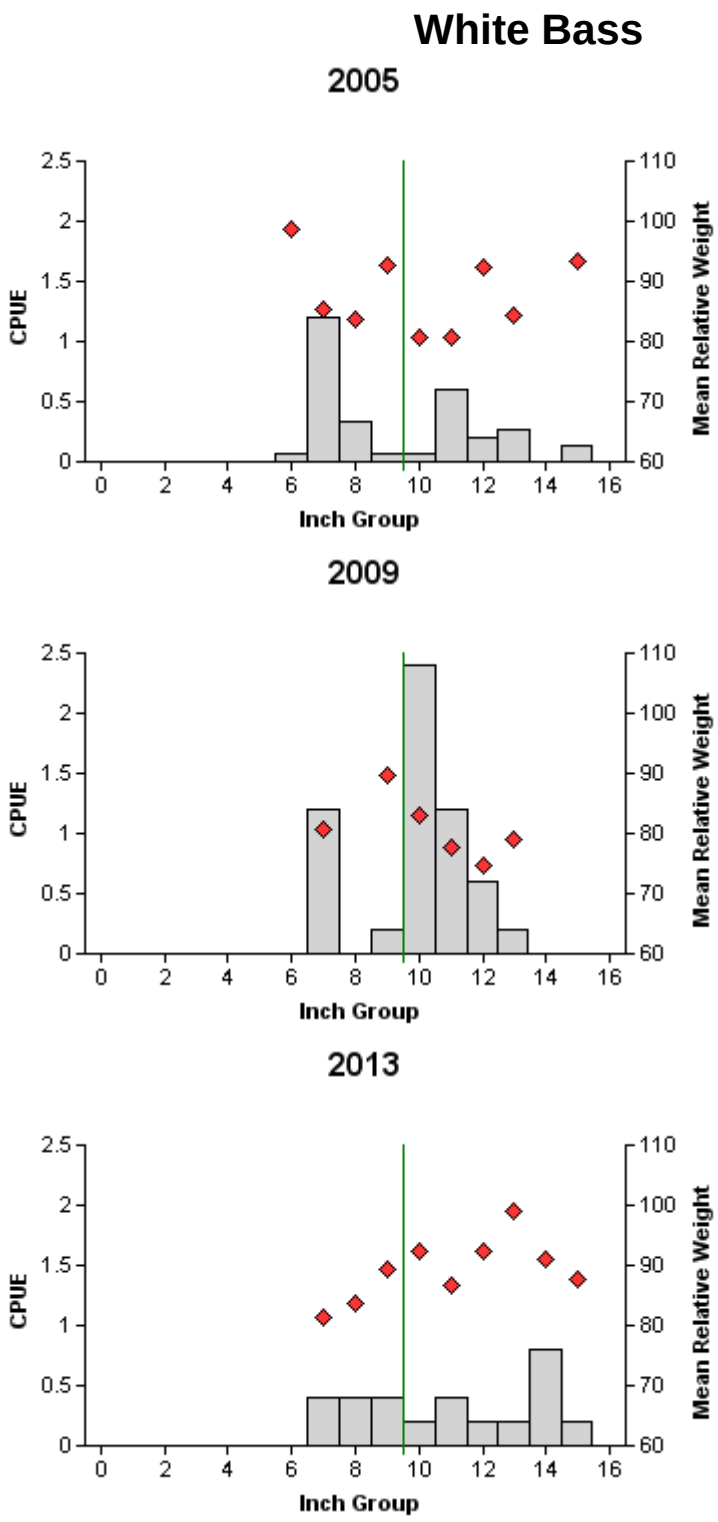


Figure 7. Number of White Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Granger Reservoir, Texas, 2005, 2009 and 2013. Vertical lines represent minimum length limit at the time of sampling.

White Bass

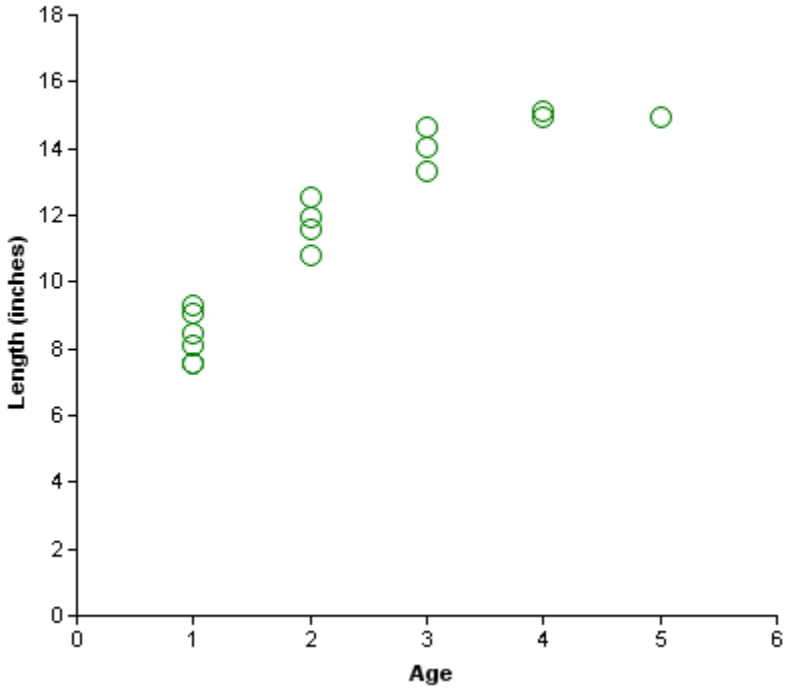


Figure 8. Length at age for White Bass collected from trap nets at Granger Reservoir, Texas, April 2013.

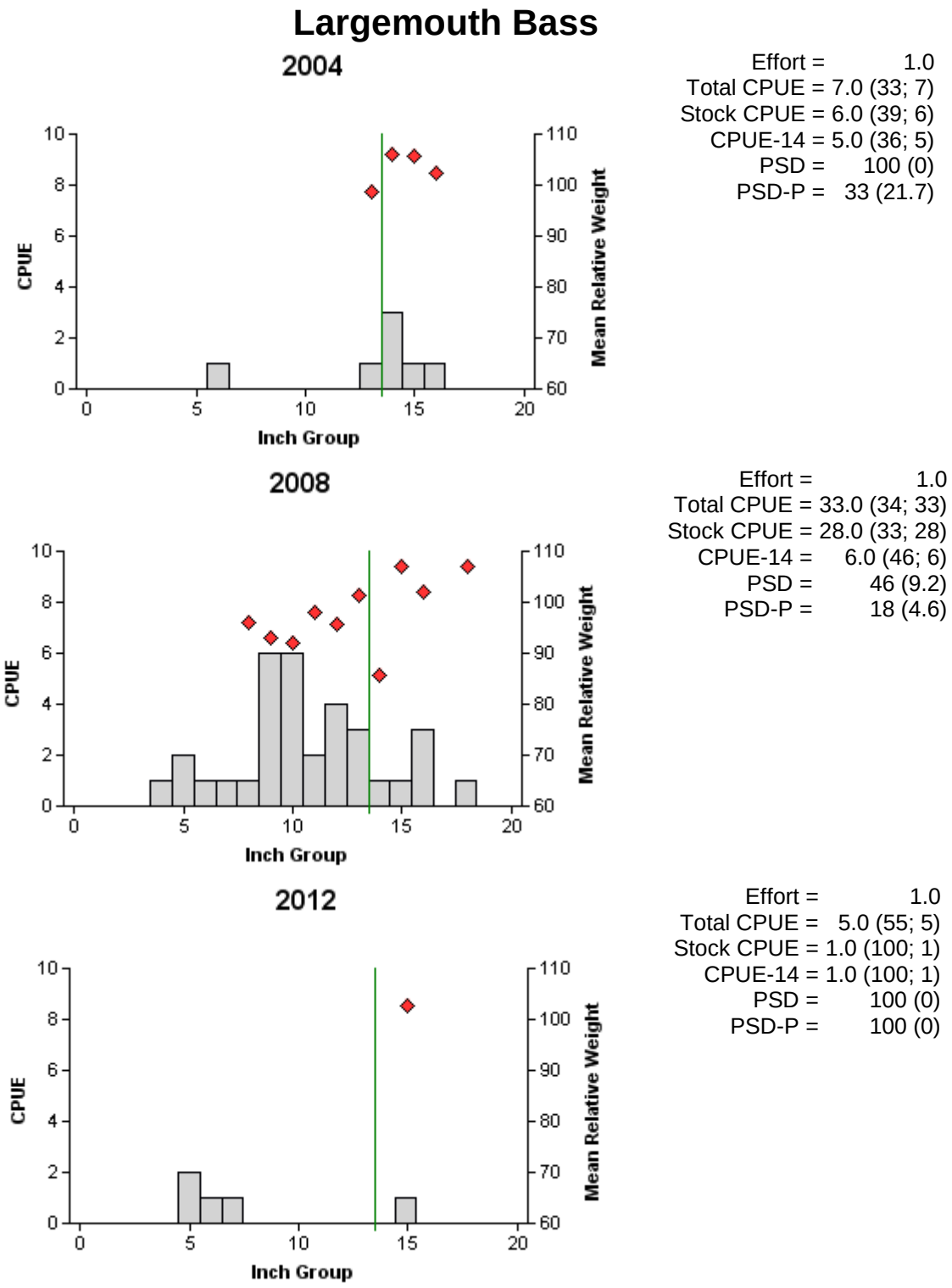


Figure 9. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Granger Reservoir, Texas, 2004, 2008 and 2012. Vertical lines represent minimum length limit at the time of sampling.

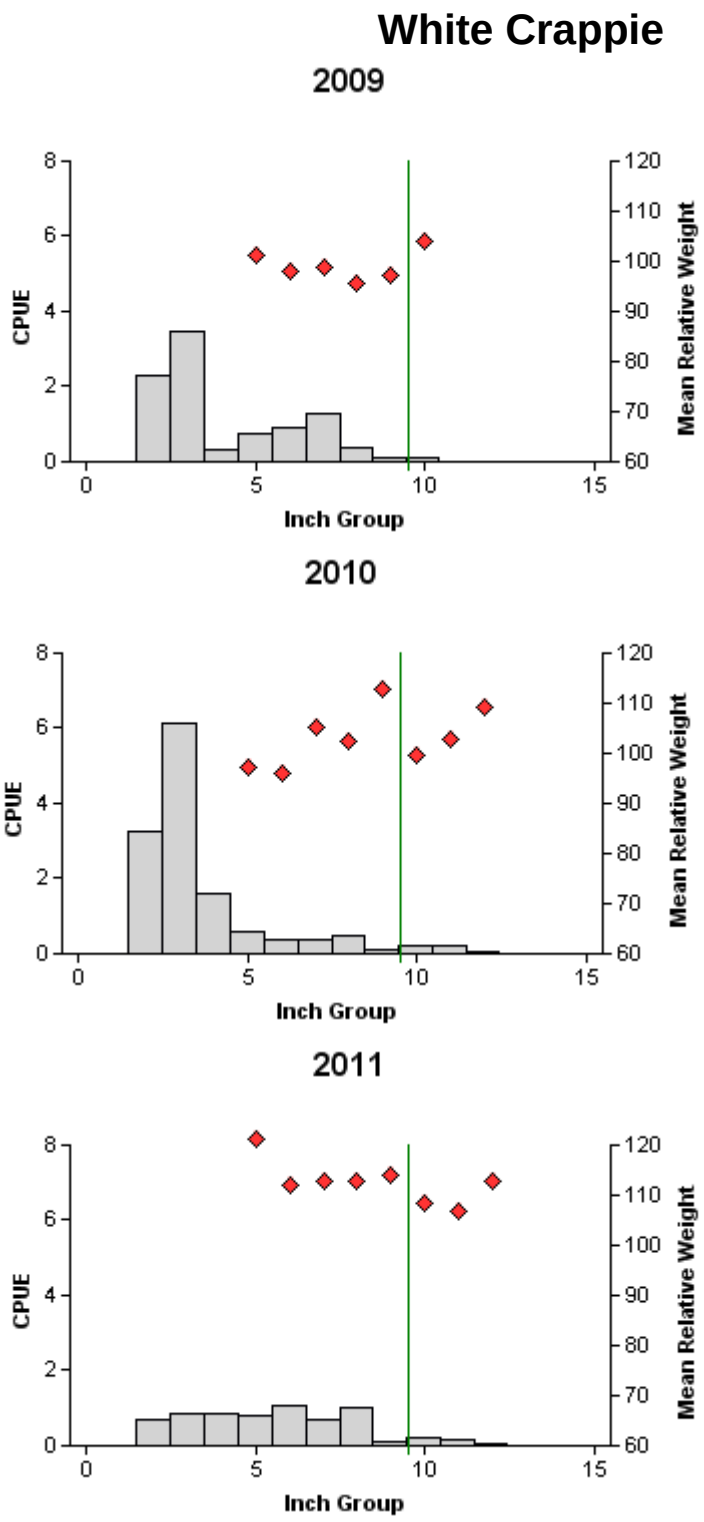


Figure 10. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Granger Reservoir, Texas, 2009, 2010 and 2011. Vertical line represents minimum length limit at the time of sampling.

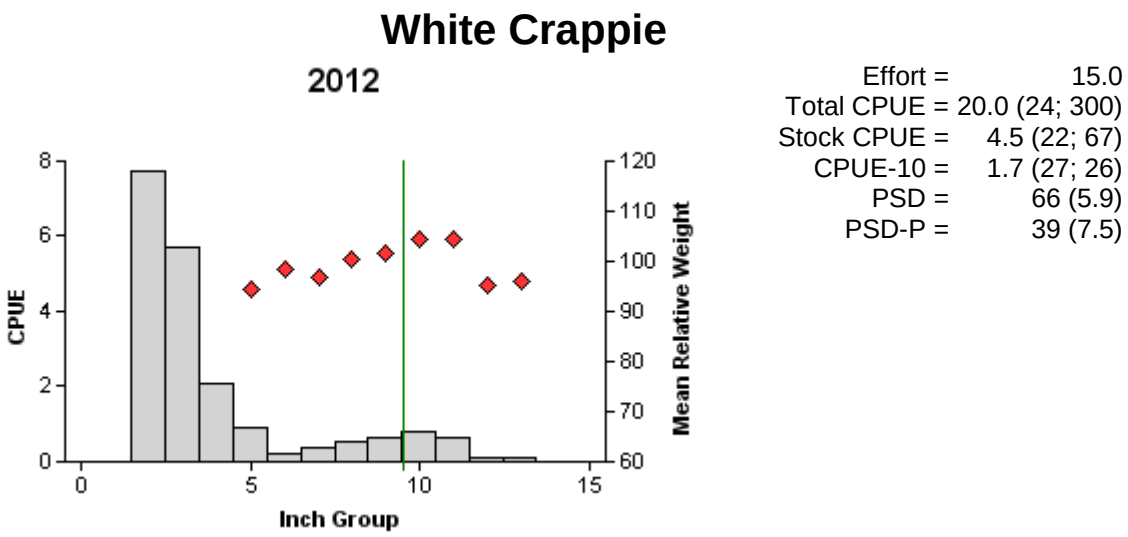


Figure 10 (cont.). Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall trap net surveys, Granger Reservoir, Texas, 2012. Vertical line represents minimum length limit at the time of sampling.

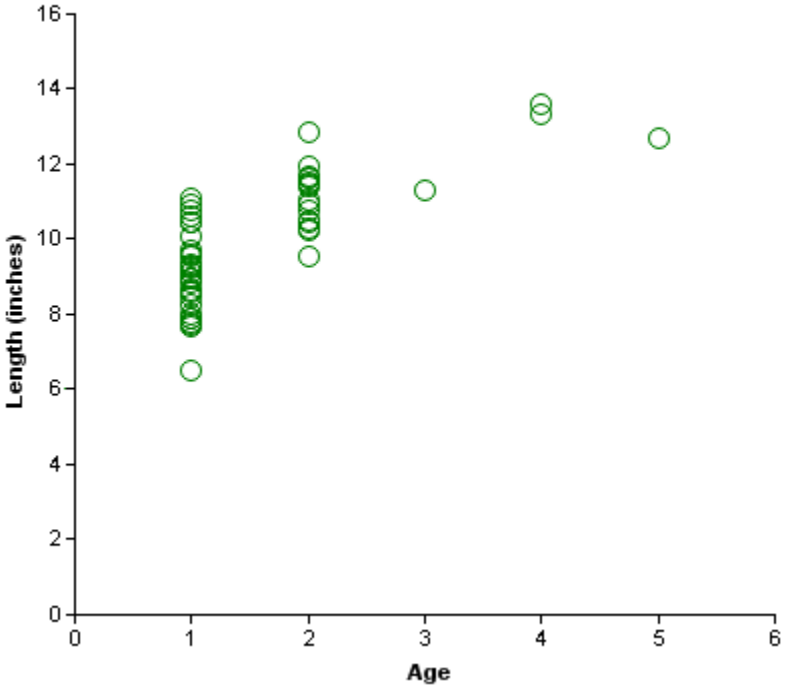
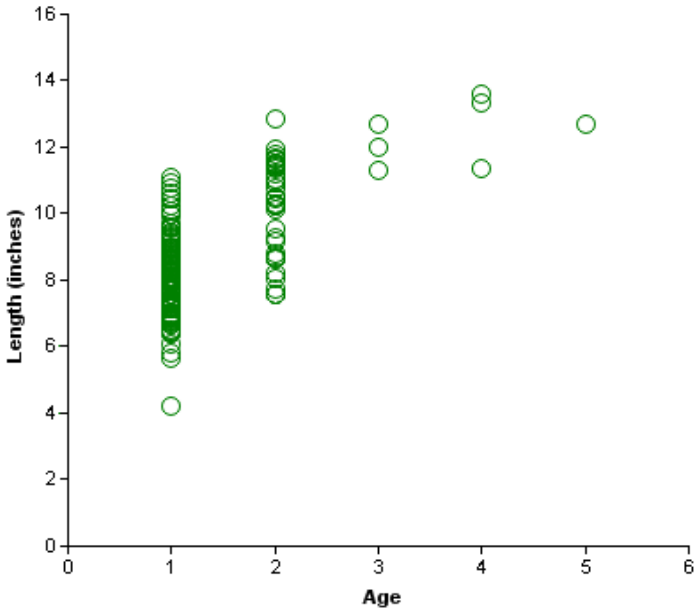


Figure 11. Length at age for White Crappie collected from trap nets at Granger Reservoir, Texas, December 2012 (N = 68; Range 0 – 5 years). Age-0 fish removed from the graph.

White Crappie



Total Length	Survey Year	Age	Number of Fish
5.706588	2009	0	19
7.215747	2009	1	25
8.648293	2009	2	12
4.669044	2010	0	32
7.607372	2010	1	22
10.866141	2010	2	6
12.007874	2010	3	1
6.159101	2011	0	34
8.089988	2011	1	35
10.275590	2011	2	6
12.677165	2011	3	1
11.338582	2011	4	1
5.536416	2012	0	16
9.093217	2012	1	31
11.124507	2012	2	16
11.299212	2012	3	1
13.444881	2012	4	2
12.716535	2012	5	1

Figure 12. Cumulative length at age for White Crappie collected from trap nets at Granger Reservoir, Texas, December 2009 - 2012 (N = 185; Range 0 – 5 years). Age-0 fish removed from the graph.

Table 6. Proposed sampling schedule for Granger 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 (except where noted). Standard survey denoted by S and additional survey denoted by A.

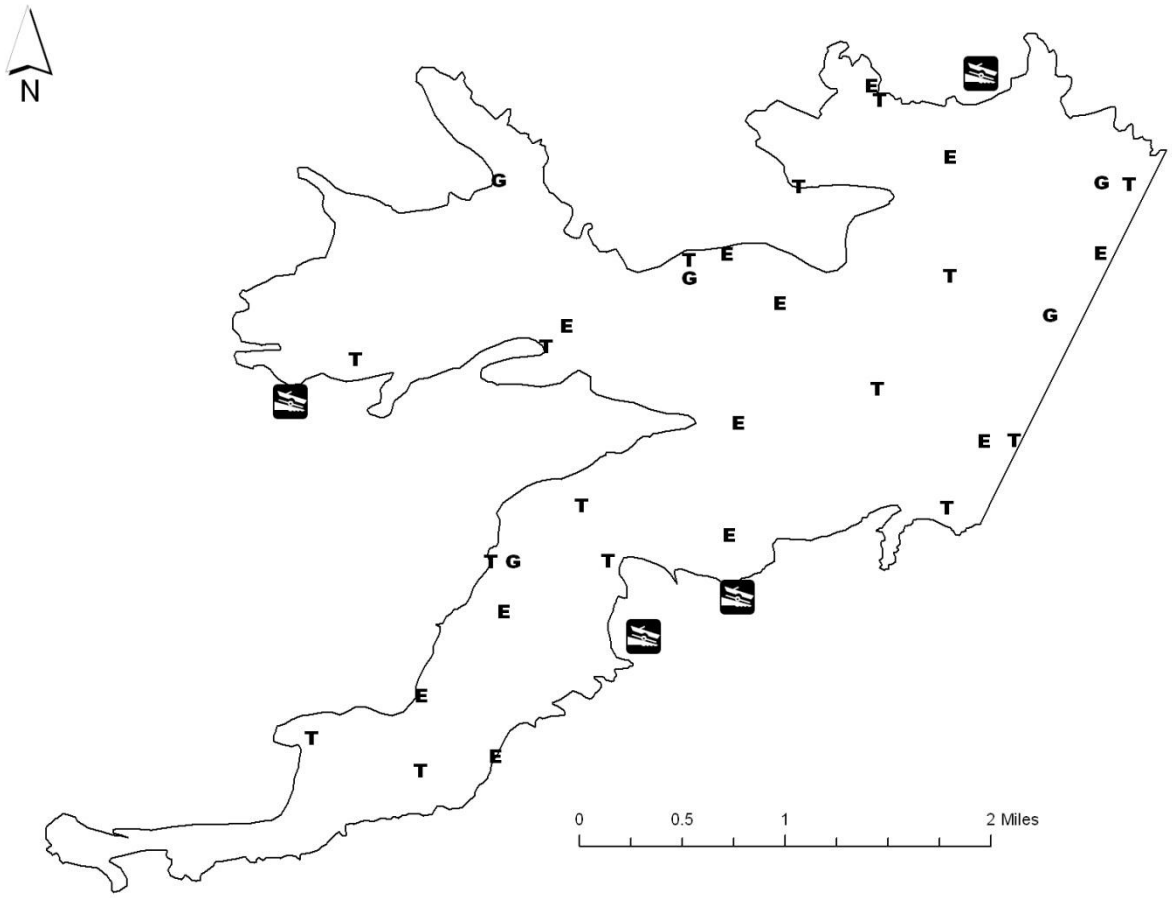
Survey year	Electrofish Fall(Spring)	Trap net	Gill net	Habitat		Access	Creel survey	Report
				Structural	Vegetation			
2013-2014		A						
2014-2015		A			A			
2015-2016		A						
2016-2017	S	S	S		S	S		S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Granger Reservoir, Texas, 2012-2013. Sampling effort was 5 net nights for gill netting, 15 net nights for trap netting, and 1 hour for electrofishing.

Species	Gill Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					96	96
Threadfin Shad					228	228.0
Inland Silverside					63	42.0
Blacktail Shiner					23	23
Blue Catfish	7	1.4				
Channel Catfish	6	1.2				
White Bass	16	3.2				
Bluegill					6	6.0
Longear Sunfish					10	10.0
Largemouth Bass					5	5.0
Logperch					1	1.0
White Crappie			300	20.0		

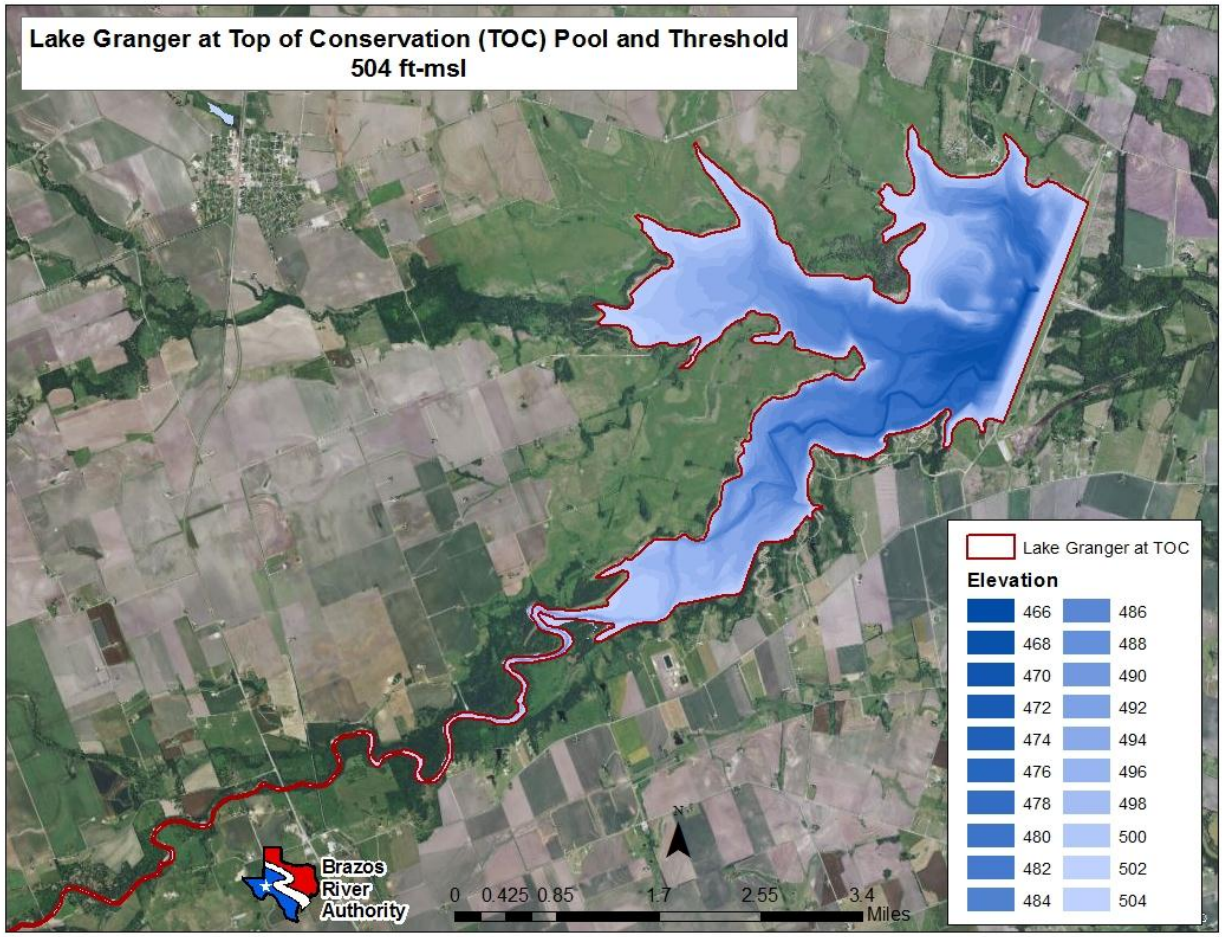
APPENDIX B



Location of sampling sites, Granger Reservoir, Texas, 2012-2013. Trap net, gill net, and electrofishing stations are indicated by T, G, and E respectively. Boat ramps are indicated by the boat ramp symbol (). Water level was near full pool at the time of sampling.

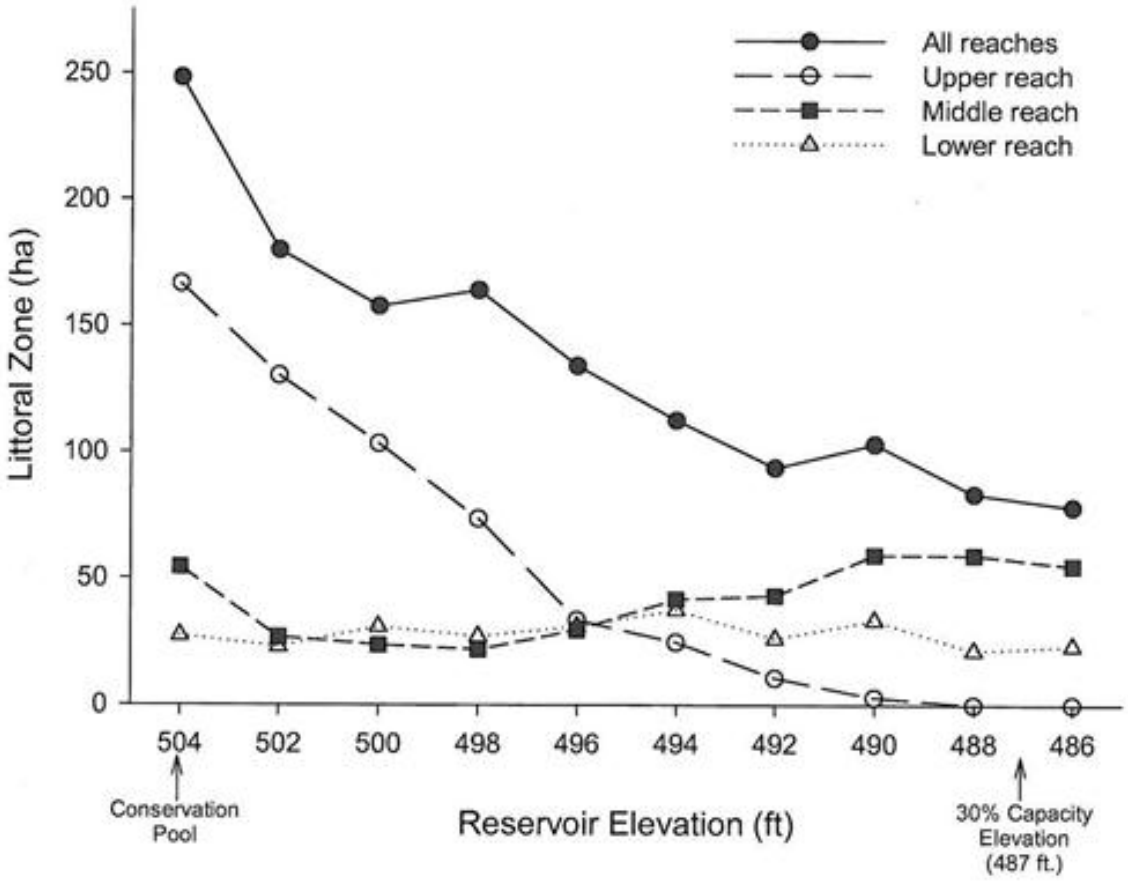
APPENDIX C

Bathymetric map of Granger Reservoir, Texas, 2012.



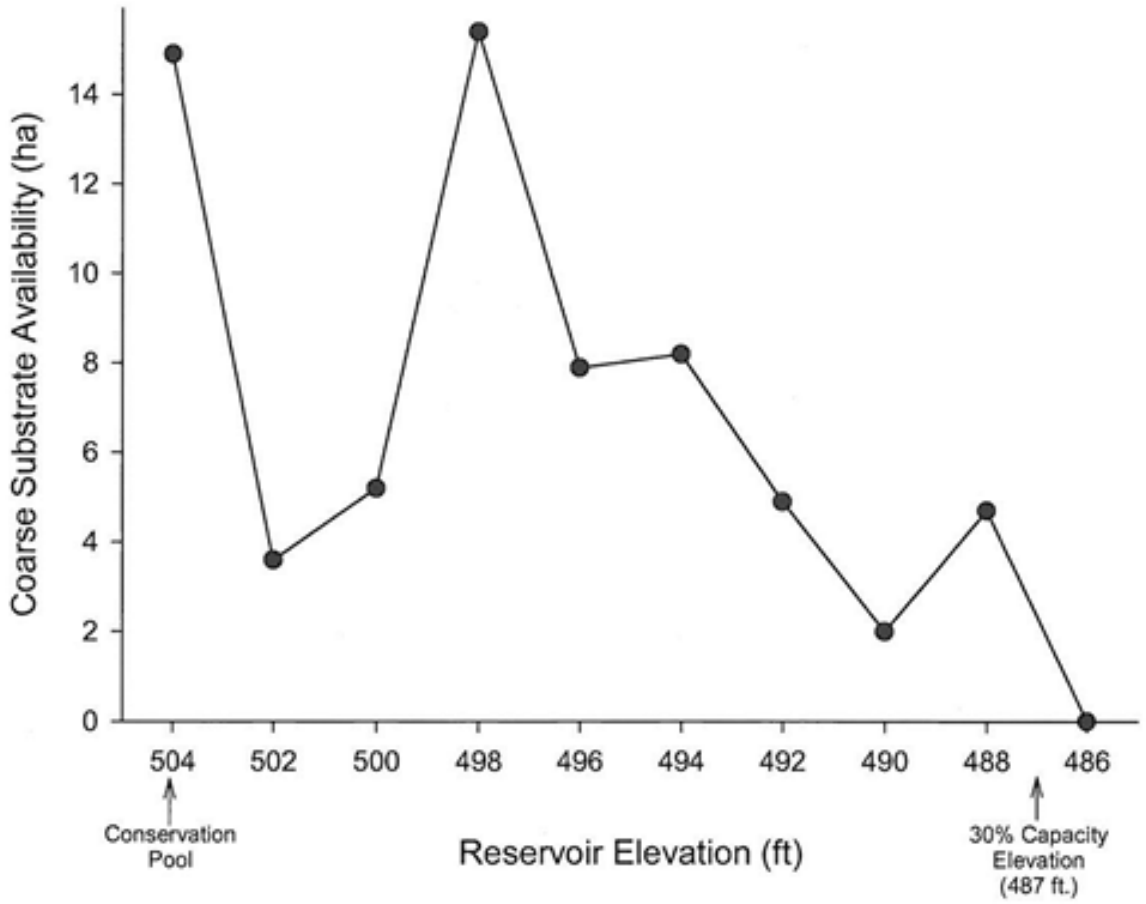
APPENDIX D

Elevation specific littoral zone (< 2 ft. water depth) coverage in Granger Reservoir, Texas for upper, middle, and lower reservoir reaches combined.



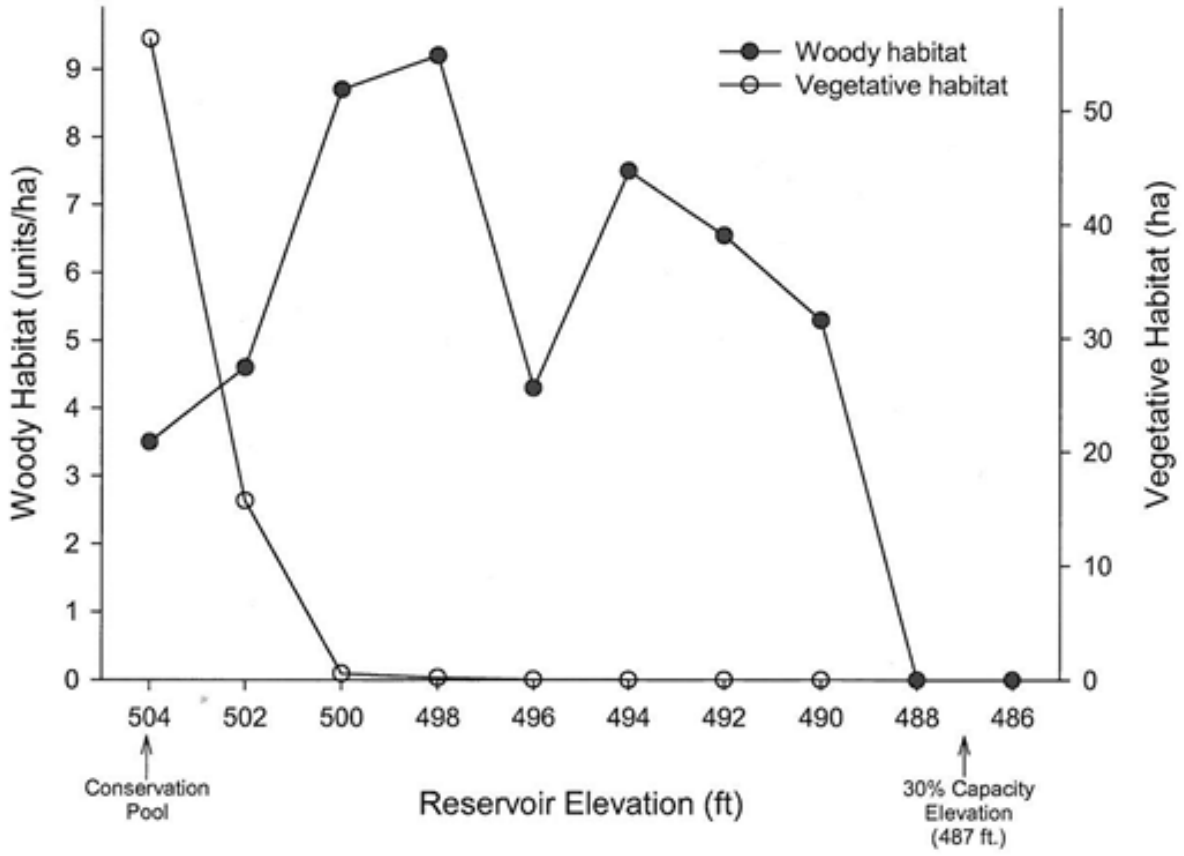
APPENDIX E

Elevation specific littoral zone (< 2 ft. water depth) coarse substrate availability in Granger Reservoir, Texas.



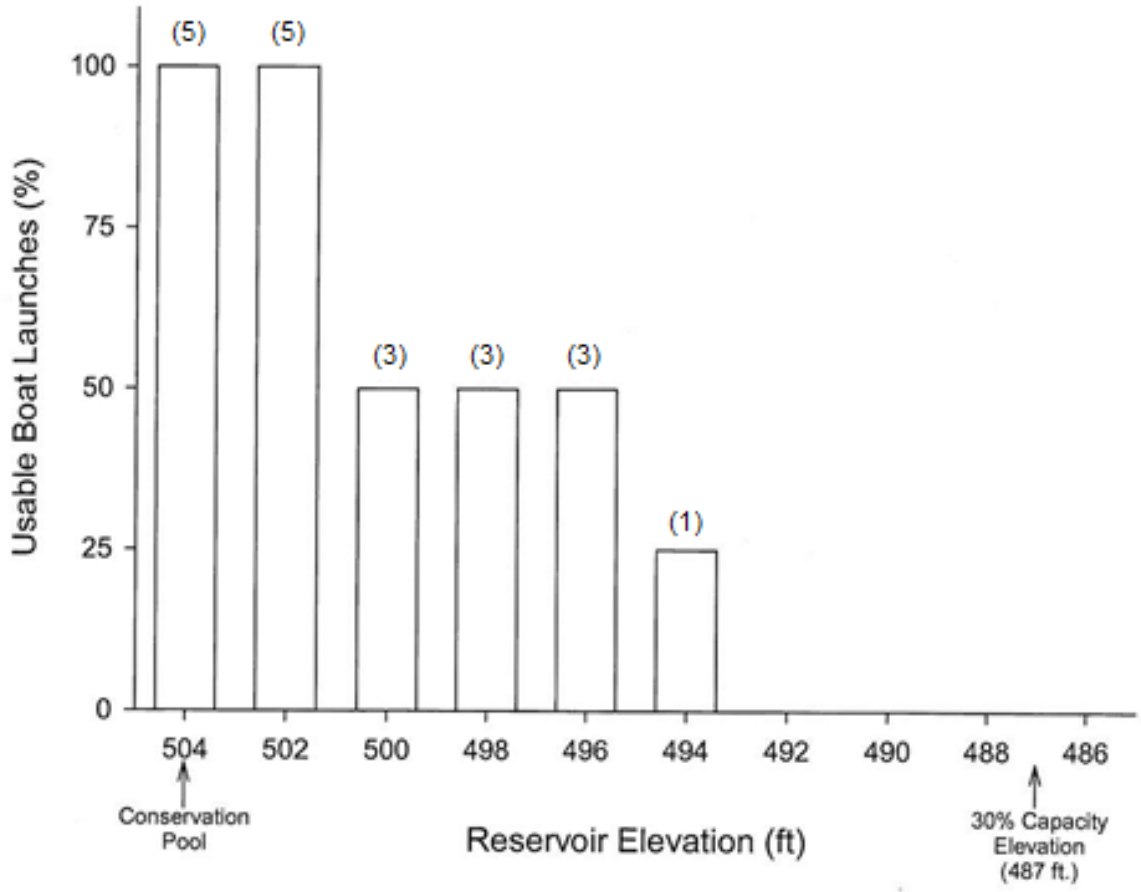
APPENDIX F

Elevation specific littoral zone (< 2 ft. water depth) woody and vegetative habitat availability in Granger Reservoir, Texas. Woody habitat was defined as one inundated standing tree, drowned tree, or brushpile attractor.



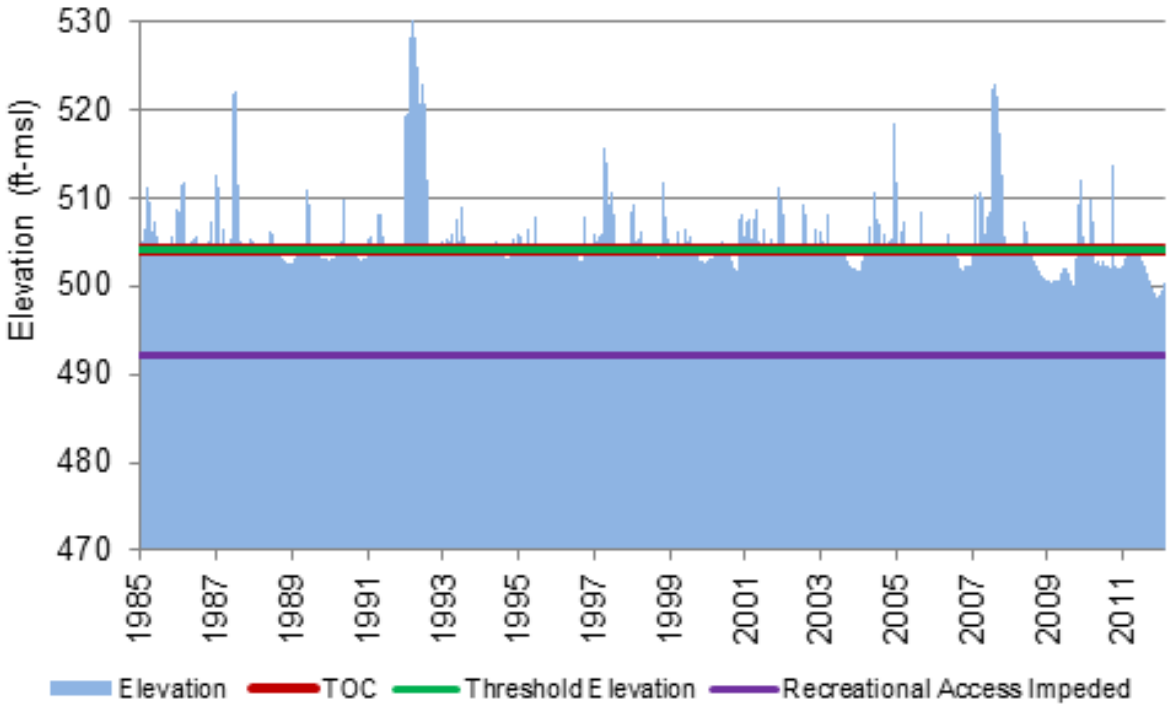
APPENDIX G

Elevation specific boat ramp accessibility in Granger Reservoir, Texas. The number of usable boat launches provided above each bar.



APPENDIX H

Historical elevation for threshold occurrences at Granger Reservoir, Texas. Top of conservation (TOC) is 504 ft. above mean sea level (msl). Thirty percent (30%) capacity elevation is 487 ft. above msl.



APPENDIX I

Predicted BRA water management models for 2025 for Granger Reservoir and their relation to recommended fishery thresholds. Three possible scenarios exist, which include the potential operation of a new power plant with the river basin.