PERFORMANCE REPORT

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FEDERAL AID PROJECT F-221-M-5

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2014 Fisheries Management Survey Report

Aquilla Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Aquilla Reservoir were surveyed in 2014 using electrofishing and trap netting and in 2015 using gill netting. Historical data are presented with the 2014-2015 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:** Aquilla Reservoir is a 3,066-acre impoundment supplied by Hackberry and Aquilla Creeks within the Brazos River Basin, Hill County. Water level has fluctuated from seven feet below to seven feet above conservation pool since January 2011, yet was typically about four feet low during this period. Aquilla is moderately productive, with water clarity ranging from two to four feet. Habitat features consisted mainly of natural shoreline.

- **Management History:** Important sport fish include Largemouth Bass, White Bass, White Crappie, and Catfishes. Blue Catfish and Florida Largemouth Bass were stocked in the early to mid 1980s. An 18-inch minimum length limit was initiated on Largemouth Bass during 1994 to provide additional protection of brood stock, improve densities, and maximize the trophy potential of this population. The regulation was replaced with the statewide, 14-inch minimum length limit in 2012 based on un-changed population indices during the period, and a 2006 creel which showed continued under-sized harvest for the species. Hydrilla was discovered in 2004 and monitored annually from 2004 through 2013. Recent efforts to mitigate the loss of important fish habitat from sedimentation and loss of reservoir volume have included native vegetation plantings and fish attractors in appropriate areas.

- **Fish Community**
  - **Prey species:** Threadfin and Gizzard Shad catch rates were above historical averages. Other forage species included Bluegill, Longear Sunfish, Green Sunfish, and Warmouth. Larger-sized sunfishes were not observed.

  - **Catfishes:** The Blue Catfish catch rate was higher than historical averages while the Channel Catfish catch rate was similar to historical averages. Individuals of both species were in good to excellent body condition.

  - **White Bass:** The White Bass catch rate was higher than the historical average and body condition was good.

  - **Largemouth Bass:** The Largemouth Bass catch rate was the highest on record and body conditions remained good. Recent recruitment appeared to be excellent.

  - **White Crappie:** White Crappie were collected at historically high rates, and body condition was average.

- **Management Strategies:** Manage sport fishes at Aquilla with statewide regulations. Maintain invasive species signage at boat ramps and inform the public about the negative impacts of aquatic invasive species when presenting to Aquilla user groups. Conduct access and vegetation surveys during summer 2018, and general monitoring surveys with trap nets, gill nets, and electrofishing surveys in 2018-2019.

INTRODUCTION

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

Reservoir Description

Aquilla Reservoir is a 3,066-acre reservoir located in Hill County, Texas. The reservoir was constructed in 1982 by the United States Army Corps of Engineers (USACE) to serve as a source of municipal water and for flood control (Table 1). The reservoir is in the Blackland Prairie Ecological Area and land use around the reservoir is primarily agricultural. Aquilla is moderately productive, with water clarity ranging from 2 to 4 feet. The conservation pool is 537.5 feet above mean sea level, and the reservoir has a maximum and average depth of 59.5 and 16 feet respectively (Figure 1). Fish habitat at time of sampling consisted primarily of natural and rocky shoreline, with large stands of timber (Table 5). Reservoir elevations were within 2.5' of conservation pool during 2014/2015 sampling (Figure 1). Vegetation of all types was scarce and only trace amounts of hydrilla was observed in 2014 (Table 6).

Angler Access

Aquilla Reservoir has three public boat ramps (Dairy Hill, Old School and Hackberry) and no private boat ramps. The Hackberry ramp is shallow due to sedimentation issues and is seldom used for launching anything other than small water craft. Dairy Hill and Old School ramps are available to anglers at reservoir levels above 532 feet (Table 2 and Appendix D). Much of Aquilla's shoreline is accessible to anglers through USACE property; however convenient shoreline access is limited to the public boat ramp areas.

Management History

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

1. Propose removing the 18-inch minimum length limit on Largemouth Bass, and implement the statewide 14-inch minimum length limit (5-fish daily bag) regulation.
   Action: The proposed regulation change was presented in September 2011 and the statewide regulation was implemented on September 1, 2012.
2. Continue annual monitoring for noxious vegetation through 2015 and share coverage information with USACE and interested constituents as needed or requested.
   Action: Annual monitoring was conducted for noxious vegetation as scheduled, and these data have been shared upon request.
3. Form a partnership with the USACE and interested user groups to introduce native vegetation to Aquilla. Request species of native vegetation from The Freshwater Fisheries Center (TFFC) in Athens and utilize partners to plant when appropriate. Monitor the plantings annually pending observations, and review the program at the next report writing and make recommendations.
   Action: A partnership was formed with the USACE and interested user groups to introduce native vegetation into Lake Aquilla. Six sites have been planted with Water Willow, Pickerel Weed and Bulrush with the help of Student Conservation Association (SCA) volunteers, TPWD summer interns and additional constituent volunteers. Plantings were performed during summers 2012 and 2014 and the program is reviewed later in this report.

4. Share information on Aquilla with the TPWD watershed coordinator, SARP and RFHP; propose funding from SARP and RFHP to perform best management practice (BMP) work within the watershed.

   Action: A short document was drafted to: 1) describe the status of Aquilla Reservoir and its fishery, 2) present the information to the Habitat Branch of the Inland Fisheries Division for their review and consideration, and 3) request their expertise in retaining grant funding to accomplish the needed work. Funding from organizations such as the (SARP) and (RFHP) could then be used to promote best management practices or other work to reverse the effects of erosion and sedimentation within this watershed. The document is included in this report as Appendix E.

5 Cooperate with the controlling authority to post appropriate invasive species signage at access points throughout the reservoir. Educate the public about invasive species through the use of media and the internet. Make a speaking point about invasive species when presenting to constituent and user groups. Keep track of (i.e., map) all existing and future inter-basin water transfer routes to facilitate potential invasive species responses.

   Action: Invasive species signage was posted at Aquilla access points during summer 2013. District biologists have made a speaking point about invasive species, how to prevent their spread, and potential effects on Aquilla Reservoir, while speaking to constituent groups such as the Central Texas Flyrodders, Legacy Outfitters, and Brazos River Sportsman's Club over the past several years. Inter-basin water transfers are a permanent fixture in this report now, and will be updated appropriately.

Harvest Regulation History: All sport fishes were managed with statewide regulations until 1994. From 1994 to 2012, Largemouth Bass were managed with an 18-inch minimum length limit, five fish daily bag, to try to provide additional protection of brood stock, improve densities, and maximize the trophy potential of the population. On September 1, 2012, the 18-inch minimum length limit, five fish daily bag, was removed and replaced with the current statewide 14-inch minimum length limit, five fish daily bag regulation. Current regulations are found in Table 3.

Stocking History: Blue Catfish, Florida Largemouth Bass and Coppernose Bluegill were stocked in the early to mid 1980s; no new stockings have occurred since 1985. The complete stocking history is in Table 4.

Vegetation/Habitat Management History: Hydrilla was discovered in 2004 at peak coverage (i.e., three acres), and has been monitored annually since. High water during 2007 reduced Hydrilla coverage to zero, and only trace amounts have been observed since that time. Several campaigns have been initiated around the state to introduce or reintroduce native aquatic vegetation into public reservoirs, and efforts on Aquilla have included Pickerel Weed, Water Willow and Bulrush at six sites during summer 2012 and 2014. Bamboo fish attractors (i.e., crappie condos) were deployed in 2014 with the help of USACE and constituent volunteers to help mitigate the losses of natural habitat. Additional habitat improvement projects like these are being planned for the future.

Water Transfer: Aquilla is primarily used for municipal water supply, flood control, and public access for limited recreation such as hunting and fishing. There are currently two permanent pumping stations that utilize a common intake structure and transfer water to other sites. The first is operated by the City of Cleburne and transfers untreated water to Lake Pat Cleburne to be used for municipal water supply. The other is operated by the Aquilla Water Supply Corporation, which provides water supply to a large rural area. The Brazos River Authority (BRA) contracted out a re-allocation study to the USACE in 2008 to explore the possibility of a 4.5' conservation pool rise, which would provide a more reliable water supply for long term regional needs. This re-allocation study was initially scheduled to be completed in 2011, but is still ongoing.

Reservoir capacity: Aquilla was impounded in 1983. Original plans calculated the reservoir's capacity at conservation pool (537.5 feet above mean sea level) to be 52,400 acre-feet. Recent reservoir capacity comparisons conducted by the Texas Water Development Board (TWDB) found the 2008 capacity to be 44,566 acre-feet. Further research indicates 84 to 218 acre-feet of reservoir volume is lost annually due to erosion and sedimentation from its watershed. Pool reallocation, mentioned in the previous section, might temporarily offset immediate consequences to the fishery and provide a more reliable water supply; however it won't address underlying watershed issues. See Appendix D for additional information.

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 2014).

No annual access-point or roving creel surveys have been conducted since 2007.

A structural habitat survey was conducted in 2010. Vegetation surveys were conducted in 2011- 2014 to monitor expansion of hydrilla. Habitat was assessed with the digital shape file method (TPWD, Inland Fisheries Division, unpublished manual revised 2014).

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 and creel statistics. Age and growth data were not collected in 2014 and 2015; however, age and growth data from previous reports are included.

Genetic analysis of Largemouth Bass was conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2014). Micro-satellite DNA analysis was used to determine genetic composition of individual fish from 2005 through 2014 and by electrophoresis for previous years.

Source for water level data was the United States Geological Survey (USGS 2014)

RESULTS AND DISCUSSION

Habitat: A habitat survey was last conducted in 2010 (Table 5; Tibbs and Baird 2011).

Creel: No creels were conducted during this survey period.

Prey species: Threadfin and Gizzard Shad were collected by electrofisher at catch rates of 881/h and 456/h respectively in 2014, and these catch rates were above historical averages (Figure 2 and Appendices A and B). The Index of vulnerability (IOV) for Gizzard Shad was good, and 82% of Gizzard Shad were available to existing predators as forage (Figure 2). Other forage species collected were Bluegill (54/h), Longear Sunfish (48/h), Warmouth (2/h), and Green Sunfish (2/h), (Figure 3 and Appendices A and B). Panfish seldom reach preferred size classes in Aquilla, and few anglers actively

seek them.

Catfishes: Blue Catfish were collected from gill nets at 9.0/nn in 2015; this catch rate equates to 45 collected individuals, and is higher than the historical average (Figure 4; Appendices A and B). The Proportional size distribution (PSD) for Blue Catfish is defined as the percentage of 12-inch and longer individuals which are also 20-inches and longer. Proportional size distribution values improved in 2015 as more individuals exceeded quality size (i.e., 20 inches; Figure 4). Body condition, expressed as relative weight (*Wr*), generally improved from good to excellent across size classes (Figure 4).

Channel Catfish were collected from gill nets at 4.8/nn in 2015; this catch rate equates to 24 collected individuals, and is slightly below the historical average (Figure 5; Appendices A and B). The PSD for Channel Catfish is defined as the percentage of 11-inch and longer individuals which are also 16-inches and longer. Proportional size distribution was low (i.e., 17), illustrating an imbalanced population, perhaps due to high recruitment or perhaps high mortality or harvest of larger fish (Figure 5). Body condition improved with increasing size classes (Figure 4).

Flathead Catfish exist in low density in Aquilla Reservoir but were not collected in 2015.

White Bass: White Bass were collected from gill nets at a catch rate of 5.2/nn in 2015; this equated to 26 collected individuals, and was above the historical average (Figure 6; Appendix A and B). The PSD for White Bass has remained high over the past three surveys, possibly indicating low recruitment, high mortality of smaller fish, and/or rapid growth. Fifty-eight percent of the sampled White Bass reached harvestable size, and body condition was good with relative weights averaging around 95 (Figure 6).

Largemouth Bass: Largemouth Bass were collected by electrofisher at 245.0/h in 2014; this catch rate equated to 245 collected individuals and was higher than both the previous two surveys and historical average for the reservoir (Figure 7 and Appendices A and B). The proportional size distribution (PSD) for Largemouth Bass is defined as the proportion of 8-inch and longer individuals which are also 12-inches and longer within the population. Proportional size distribution remained poor (16) and was lower than the PSD of 27 in 2010. This is likely indicative of uneven recruitment, with a strong spawn in 2014 indicated by the large numbers of small fish. Few legal-sized bass were present in the sample, indicating possible recruitment issues from previous years, drought effects, or illegal harvest as seen during the 2006/2007 creel survey (Tibbs and Baird 2007). Body conditions were excellent and ranged from approximately 87 to 110 (Figure 7). Largemouth Bass genetics were analyzed in 2014 and showed good Florida influence (50%; Table 7).

White Crappie: White Crappie were collected from trap nets at 35.2/nn in 2014; this catch rate was the highest on record for White Crappie in the reservoir (Figure 8 and Appendices A and B). The proportional size distribution (PSD) has remained good to excellent over the past three surveys. Nearly 30% of stock-sized fish (five inches) and longer were also longer than the legal size of 10-inches. Many approached the memorable size category of 12 inches or more. Body conditions, expressed as relative weight (*Wr*), were excellent to average and decreased with increasing lengths (Figure 8).

Fisheries management plan for Aquilla Reservoir, Texas

Prepared – July 2015

ISSUE 1: Hydrilla was discovered in 2004 and monitored annually from 2004 through 2013; because it has never posed a threat to access, and control efforts are unlikely, its presence in Aquilla fits the definition of a tier III infestation.

MANAGEMENT STRATEGIES

1. Re-classify the presence of Hydrilla in Aquilla Reservoir as a tier III infestation.
2. Monitor the reservoir for Hydrilla and other noxious vegetation every four years.
3. Share coverage information with the USACE and constituents upon request.

ISSUE 2: Several campaigns have been initiated around the state to introduce or reintroduce native aquatic vegetation into public reservoirs to improve fishery habitat and water quality. Given the decline of standing timber habitat, sparse aquatic vegetation and recent sedimentation of the upper ends of the reservoir, Aquilla is a good candidate for native aquatic vegetation introduction. Habitat improvement efforts on Aquilla have included Pickerel Weed, Water Willow and Bulrush plantings at six sites during summers 2012 and 2014. Additionally, 49 bamboo fish attractors (i.e., crappie condos) were deployed in 2014 with USACE and constituent partners to help mitigate the losses of natural habitat. Additional habitat improvement projects like these are being planned for the future.

MANAGEMENT STRATEGIES

1. Maintain partnerships with USACE and constituent groups to introduce native vegetation into Aquilla.
2. Request appropriate species of native vegetation from the Texas Freshwater Fisheries Center (TFFC) aquatic plant nursery, or culture them in the Waco Wetlands Aquatic Plant Nursery, and plant when appropriate.
3. Monitor the spread/growth of native vegetation plantings annually pending observations; review the program at the next report writing and make recommendations.

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 USACE to maintain appropriate signage at access points around the reservoir.
2. Educate the public about invasive species through the use of media and the internet.
3. Make a speaking point about invasive species when presenting to constituent and user groups.
4. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.

SAMPLING SCHEDULE JUSTIFICATION:

The proposed sampling schedule includes mandatory electrofishing and trap netting in 2018 and gill netting in 2019. Access and vegetation surveys will be conducted during summer 2018.

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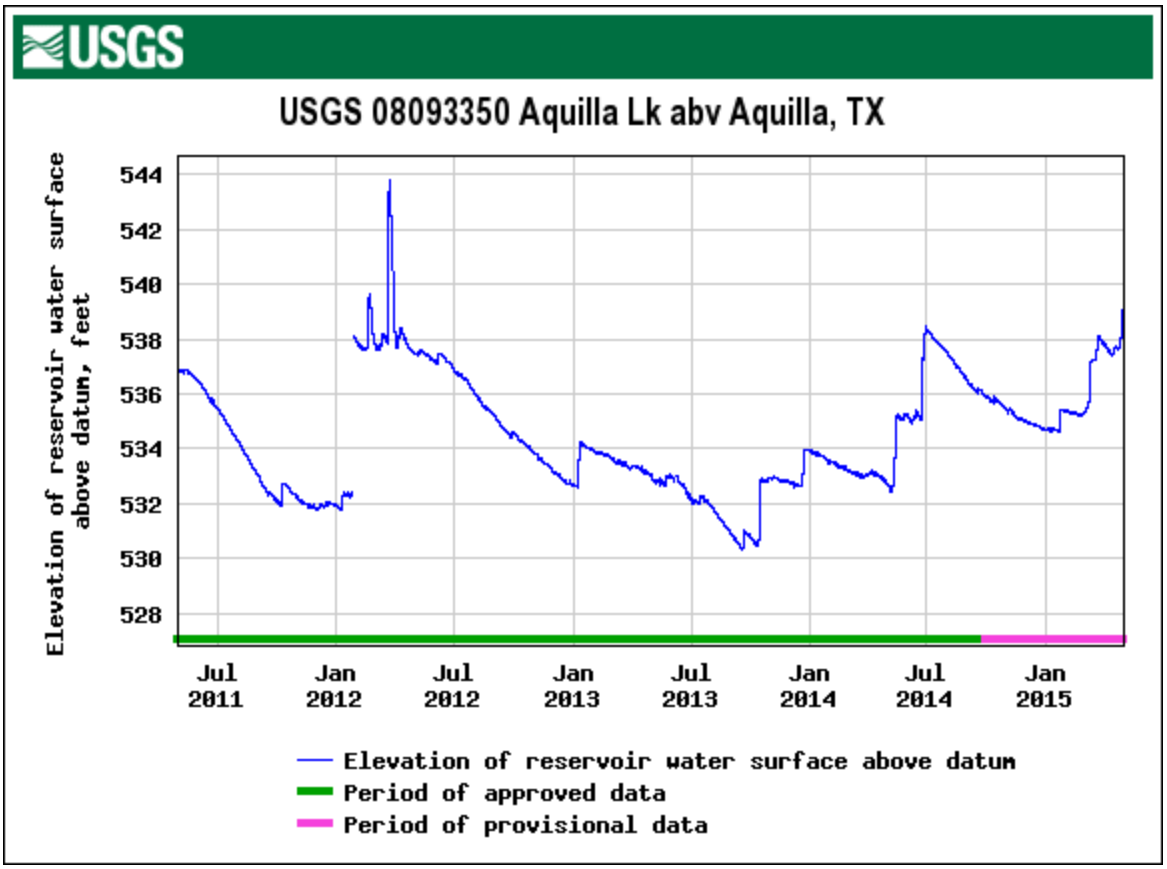


Figure 1. Daily mean water levels for Aquilla Reservoir from May 1, 2011 through May 1, 2015. Conservation pool level is 537.5 feet above mean sea level. Figure from the USGS website.

Table 1. Characteristics of Aquilla Reservoir, Texas.

Characteristic	Description
Year Constructed	1982
Controlling authority	United States Army Corps of Engineers
County	Hill
Reservoir type	Tributary

Table 2. Boat ramp characteristics for Aquilla Reservoir, Texas, October, 2014. Reservoir elevation at time of survey was 535.9 feet above mean sea level (1.6 feet below conservation pool).

Boat ramp	Latitude Longitude (dd)	Parking capacity (N)	Condition
Old School	31.9112/-97.22403	40	Good
Dairy Hill	31.92604/-97.18749	28	Good
Hackberry	31.93972/-97.17953	10	Good

Table 3. Harvest regulations for Aquilla Reservoir, 2014 - 2015.

Species	Bag Limit	Minimum-Maximum Length (inches)
Catfish: Channel and Blue Catfish, their hybrids and subspecies	25 (in any combination)	12 - No Limit
Catfish, Flathead	5	18 - No Limit
Bass, White	25	10 - No Limit
Bass: Largemouth	5	14 - No Limit
Crappie: White or Black Crappie, their hybrids and subspecies	25 (in any combination)	10 - No Limit

Table 4. Stocking history of Aquilla, 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	1983	33,261	UNK	UNK
	Total	33,261		
Coppernose Bluegill	1984	165,000	AFGL	2.0
	Total	165,000		
Florida Largemouth Bass	1982	31,900	FGL	2.0
	1983	164,000	FRY	1.0
	1984	164,753	FGL	2.0
	1985	72,559	FRY	1.0
	Total	433,212		

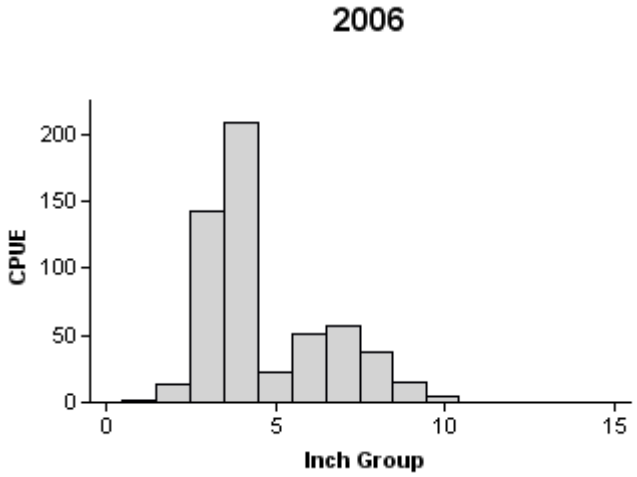
Table 5. Survey of structural habitat types, Aquilla Reservoir, Texas, 2010. Linear shoreline distance (miles) and percent of linear shoreline distance was recorded for each habitat type greater than one percent; otherwise noted as trace. Percent of total shoreline distance is blank for boat docks/piers because they were dually coded with adjacent habitat; counts are given instead. Survey was conducted using 2010 NAIP, 1-meter resolution satellite imagery.

Habitat type	Estimate	% of total
Bulkhead	trace	< 1.0
Rocky shoreline (rocks > 4”)	trace	< 1.0
Natural	48.1 miles	98.9
Standing timber	245.0 acres	3.4
Piers and boat docks	N = 2	

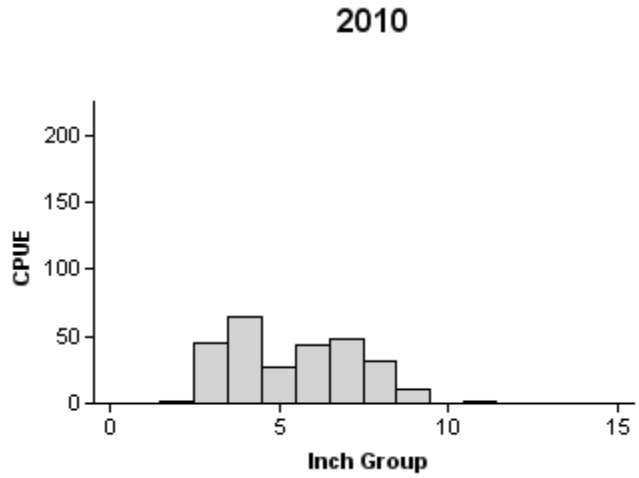
Table 6. Survey of aquatic vegetation, Aquilla Reservoir, Texas, 2011- 2014. Surface area (acres) is listed with percent of total reservoir surface area in parentheses for Hydrilla; linear shoreline distance (miles) and percent of linear shoreline distance is given for native species.

Vegetation	2011	2012	2013	2014
Water willow				0.6 (2.6)
Pickerel weed		trace	trace	trace
Bulrush		trace	trace	trace
Cattail				0.17 (0.7)
Clear shoreline				23.0 (96.7)
Hydrilla	trace	trace	trace	0

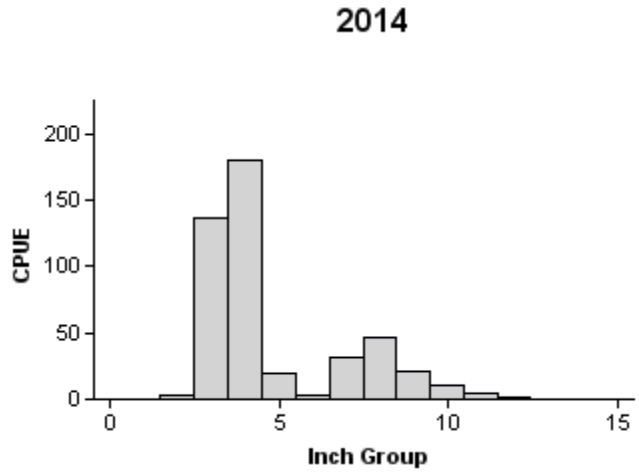
Gizzard Shad



Effort = 1.0
Total CPUE = 554.0 (23; 554)
Stock CPUE = 114.0 (24; 114)
PSD = 0 (183.8)
IOV = 90 (3.9)



Effort = 1.0
Total CPUE = 272.0 (18; 272)
Stock CPUE = 91.0 (18; 91)
PSD = 1 (1.1)
IOV = 84 (3.6)

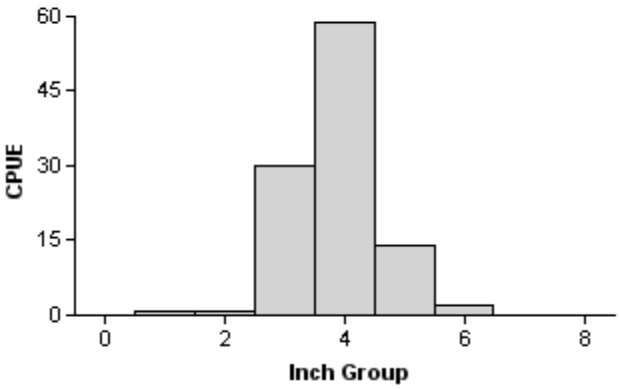


Effort = 1.0
Total CPUE = 456.0 (20; 456)
Stock CPUE = 115.0 (25; 115)
PSD = 5 (1.7)
IOV = 82 (3.6)

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, Aquilla Reservoir, Texas, 2006, 2010 and 2014.

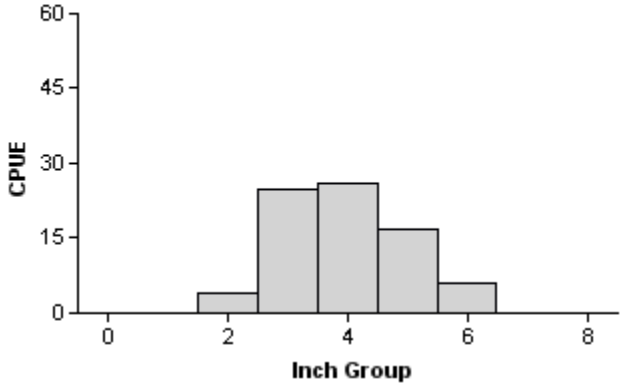
Bluegill

2006



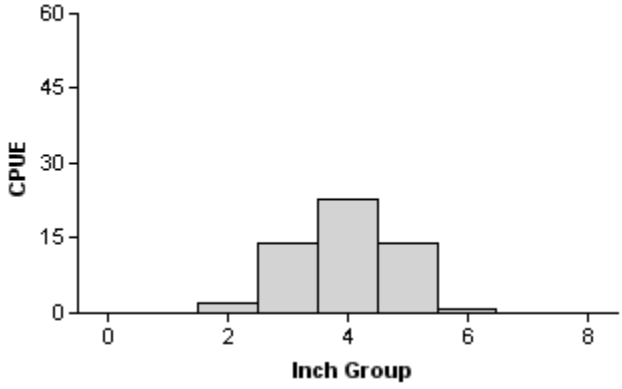
Effort = 1.0
Total CPUE = 107.0 (19; 107)
Stock CPUE = 105.0 (19; 105)
PSD = 2 (1.1)

2010



Effort = 1.0
Total CPUE = 78.0 (22; 78)
Stock CPUE = 74.0 (24; 74)
PSD = 8 (5.3)

2014



Effort = 1.0
Total CPUE = 54.0 (17; 54)
Stock CPUE = 52.0 (15; 52)
PSD = 2 (1.9)

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

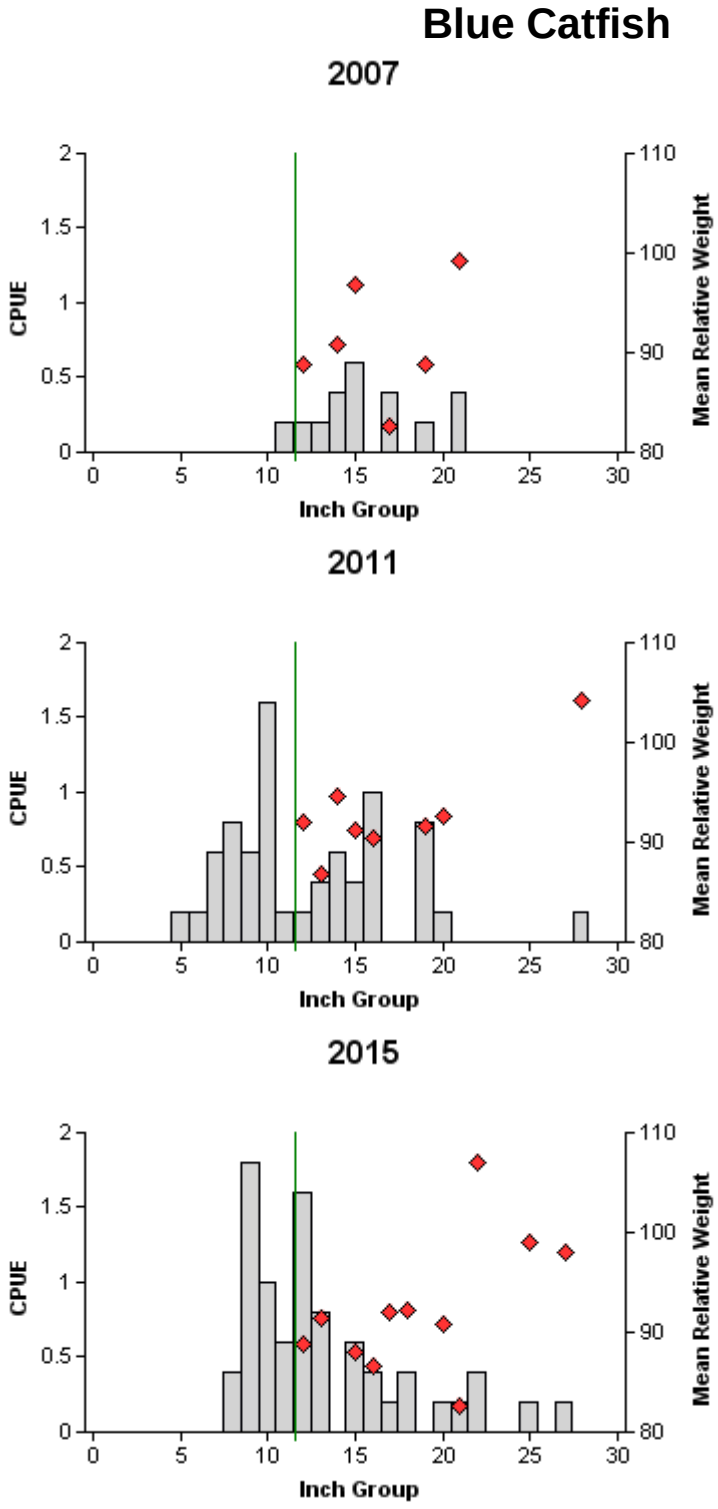


Figure 4. Number of Blue Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Aquilla Reservoir, Texas, 2007, 2011 and 2015.

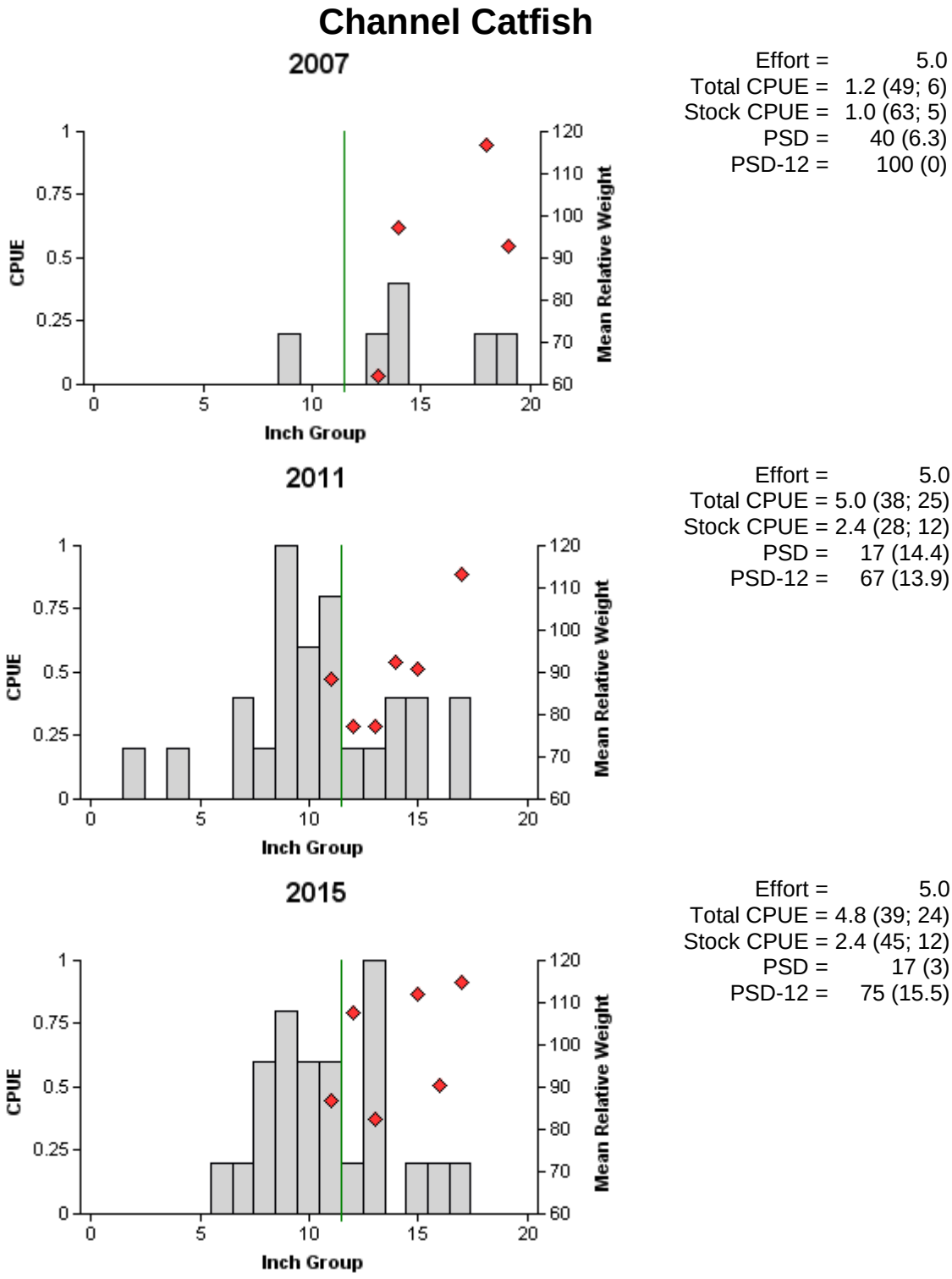


Figure 5. Number of Channel Catfish caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Aquilla Reservoir, Texas, 2007, 2011 and 2015.

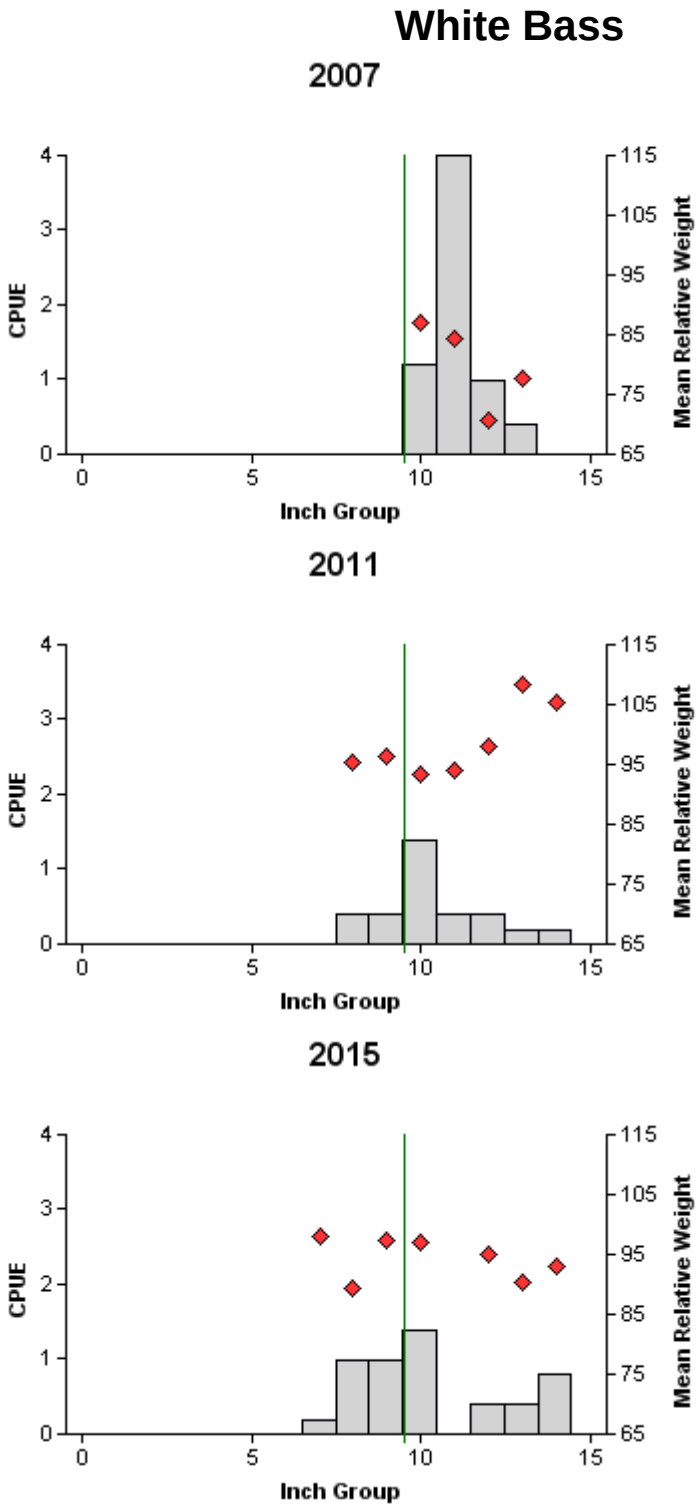
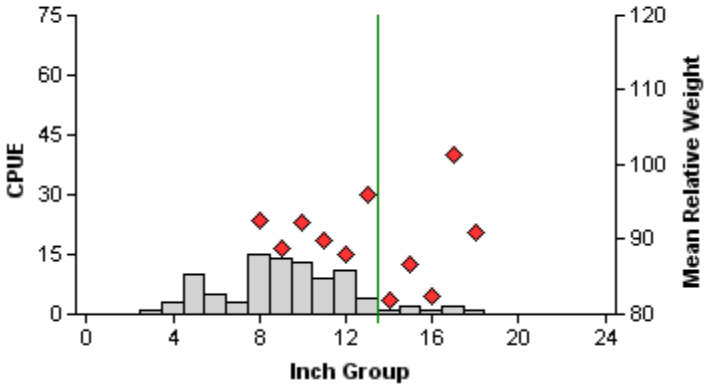


Figure 6. Number of White Bass caught per net night (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, Aquilla Reservoir, Texas, 2007, 2011 and 2015.

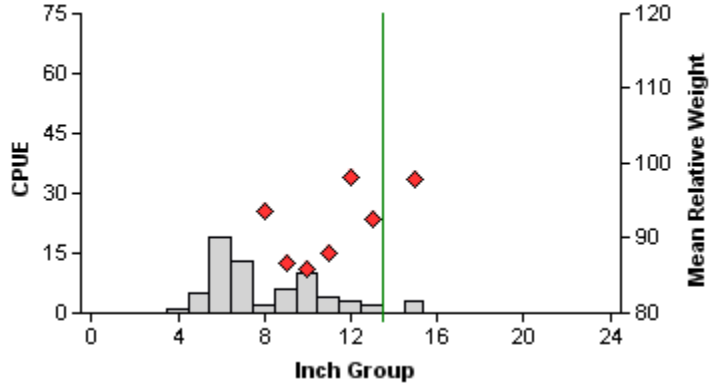
Largemouth Bass

2006



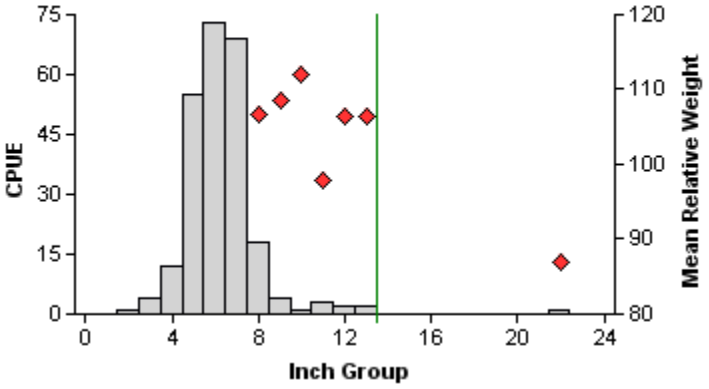
Effort =	1.0
Total CPUE=	95.0 (32; 95)
Stock CPUE=	73.0 (31; 73)
PSD =	30 (6)
PSD-14 =	10 (2.5)

2010



Effort =	1.0
Total CPUE=	68.0 (32; 68)
Stock CPUE=	30.0 (30; 30)
PSD =	27 (10.7)
PSD-14 =	10 (5.3)

2014



Effort =	1.0
Total CPUE =	245.0 (17;245)
Stock CPUE=	31.0 (21; 31)
PSD =	16 (6.7)
PSD-14 =	3 (3.2)

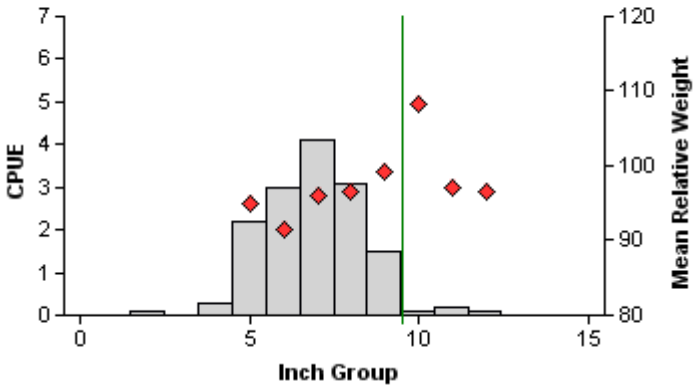
Figure 7. Number of Largemouth Bass caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Aquilla Reservoir, Texas, 2006, 2010 and 2014.

Table 7. Results of genetic analysis of Largemouth Bass collected by fall electrofishing, Aquilla Reservoir, Texas, 2002, 2006 and 2014. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB. Genetic composition was determined by electrophoresis prior to 2005 and with micro-satellite DNA analysis since 2005.

		Genotype				
Year	Sample size	%FLMB	%Hybrid	%NLMB	% FLMB alleles	% Northern alleles
2002	30	3	80	17	42	58
2006	30	7	93	0	59	41
2014	30	0	90	10	50	50

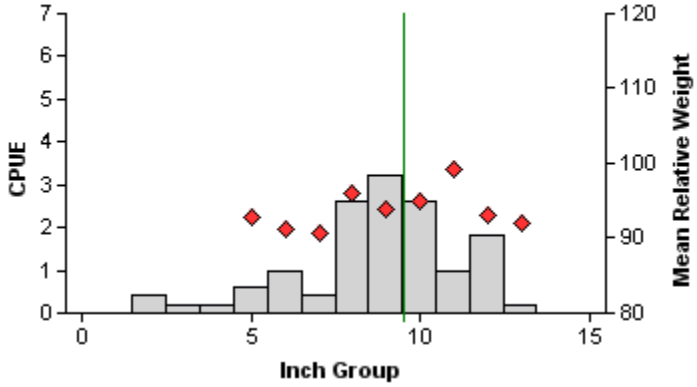
White Crappie

2008



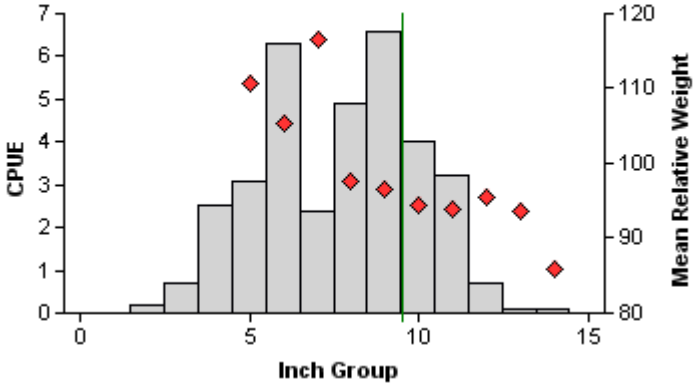
Effort = 10.0
Total CPUE = 14.7 (31; 147)
Stock CPUE = 14.3 (30; 143)
PSD = 35 (7)
PSD-10 = 3 (1.8)

2010



Effort = 5.0
Total CPUE = 14.2 (46; 71)
Stock CPUE = 13.4 (47; 67)
PSD = 85 (7.3)
PSD-10 = 42 (4.6)

2014



Effort = 10.0
Total CPUE = 35.2 (22; 352)
Stock CPUE = 31.4 (26; 314)
PSD = 62 (7.1)
PSD-10 = 26 (5.9)

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, Aquilla Reservoir, Texas, 2008, 2010 and 2014.

Table 8. Proposed sampling schedule for Aquilla 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. Structural habitat surveys are required only if large changes in structural habitat are suspected, i.e. increases in bulkhead, loss of standing timber, etc.

Survey year	Electrofish Fall	Trap net	Gill net	Habitat		Access	Creel survey	Report
				Structural	Vegetation			
2015-2016								
2016-2017								
2017-2018								
2018-2019	S	S	S		S	S		S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Aquilla Reservoir, Texas, 2014-2015.

Species	Gill Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Gizzard Shad					456	456.0
Threadfin Shad					881	881.0
Blue Catfish	45	9.0				
Channel Catfish	24	4.8				
White Bass	26	5.2				
Green Sunfish					2	2.0
Warmouth					2	2.0
Bluegill					54	54.0
Longear Sunfish					48	48.0
Largemouth Bass					245	245.0
White Crappie			352	35.2		

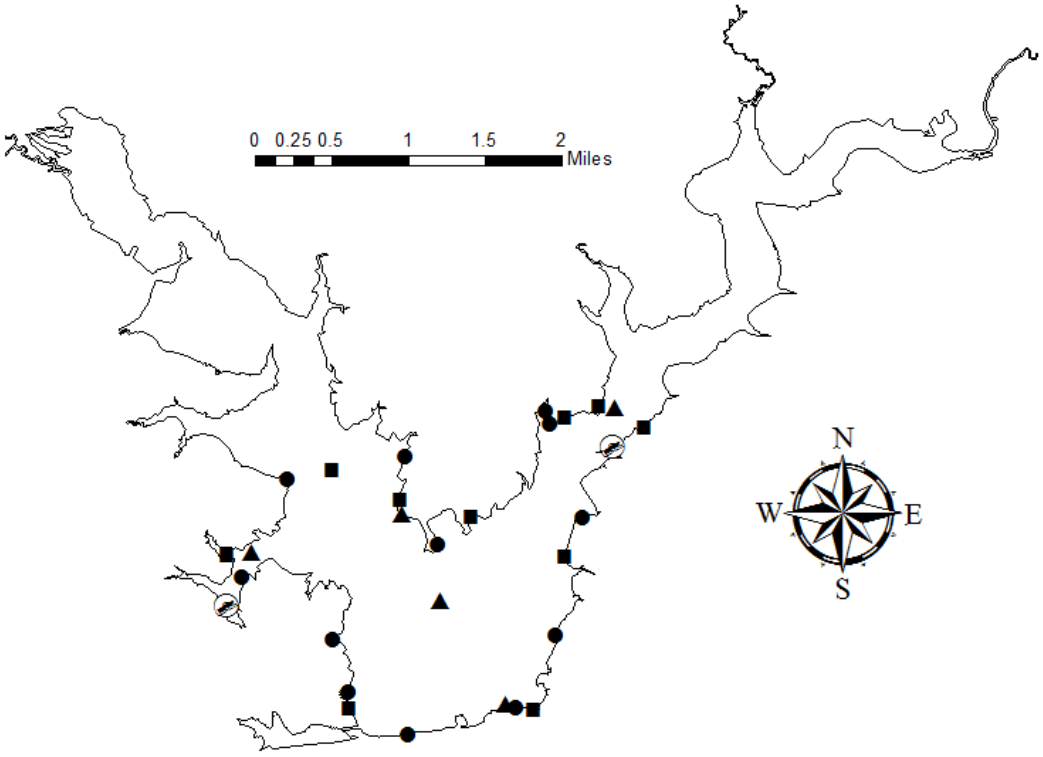
APPENDIX B

Catch rates (CPUE) of targeted species by gear type for standard surveys on Aquilla Reservoir, Texas, 1992 to present. Surveys prior to 1996 utilized biologist-selected stations while those after 1996 utilized randomly-selected stations. Electrofishing stations were shocked with a 5.0 Smith-Root GPP (Gas Powered Pulsator) until 2010, when a 7.5 Smith-Root GPP was used. Species averages are in bold. Asterisk denotes collection by a non-standard gear.

	Electrofisher							
	Bass		Shad		Sunfish			
Year	Largemouth	Spotted	Gizzard	Threadfin	Bluegill	Longear	Green	Warmouth
1992	26.0	0.0	114.7	44.7	24.7	0.0	0.0	0.0
1995	50.0	0.0	342.0	59.3	26.0	10.7	0.0	0.7
1998	58.0	1.0	228.0	32.0	25.0	10.0	2.0	0.0
2000	116.0	0.0	227.0	34.0	44.0	80.0	34.0	8.0
2002	200.0	0.0	77.0	94.0	110.0	55.0	70.0	2.0
2006	95.0	0.0	554.0	91.0	107.0	33.0	6.0	8.0
2010	68.0	0.0	272.0	49.0	78.0	37.0	3.0	3.0
2014	245.0		456.0	881.0	54.0	48.0	2.0	2.0
Avg.	**107.3**	**0.1**	**283.8**	**160.6**	**58.6**	**34.2**	**14.6**	**3.0**

	Gill nets				Trap nets	
	Catfish			Bass	Crappie	
Year	Blue	Channel	Flathead	White	White	Black
1992	0.0	7.6	0.0	3.2	16.4	0.0
1995	3.0	16.6	0.8	4.0	19.6	0.0
1998	2.2	2.0	0.0	3.8	12.0	0.0
2002	-	-	-	-	8.4	0.0
2003	7.4	1.4	0.0	2.8	-	-
2006	-	-	-	-	3.6	0.0
2007	2.6	1.2	0.0	6.6	-	-
2008	-	-	-	-	0.0	0.1
2010	-	-	-	-	14.2	0.0
2011	8.0	5.0	0.0	3.4	21.2*	0.8*
2015	9.0	4.8	0.0	5.2	35.2	0.0
Avg.	**4.6**	**5.5**	**0.1**	**4.1**	**14.5**	**0.1**

APPENDIX C



Location of sampling sites, Aquilla Reservoir, Texas, 2014-2015. Standard electrofishing, trap netting and gill netting stations are indicated by circles, squares, and triangles respectively. Water level was within 2.5' of full pool at time of sampling.

APPENDIX D

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

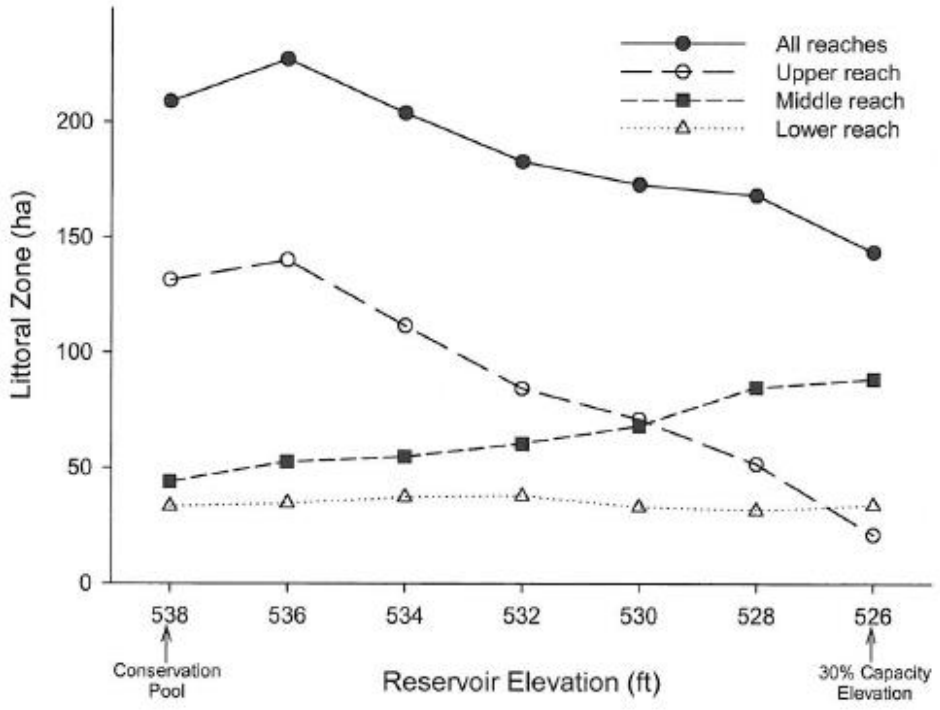


Figure 2. Elevation specific littoral zone (< 4 ft. water depth) coarse substrate availability in Lake Aquilla, Texas.

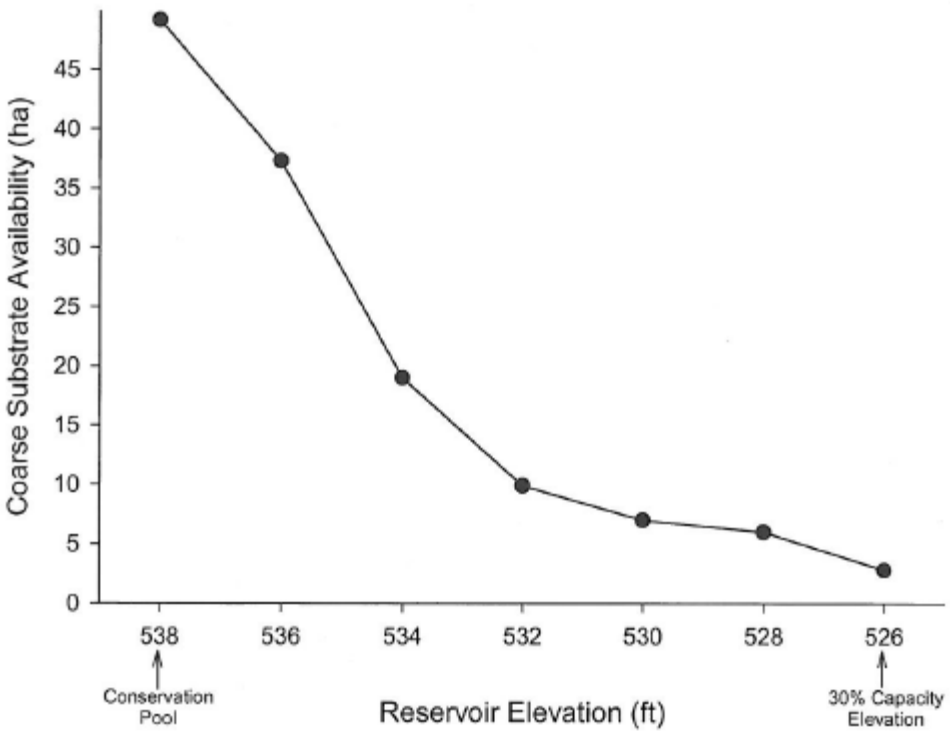


Figure 3. Elevation specific littoral zone (< 4 ft. water depth) woody and vegetative habitat availability in Lake Aquilla, Texas. Woody habitat was defined as one inundated standing tree, downed tree, or brush pile attractor.

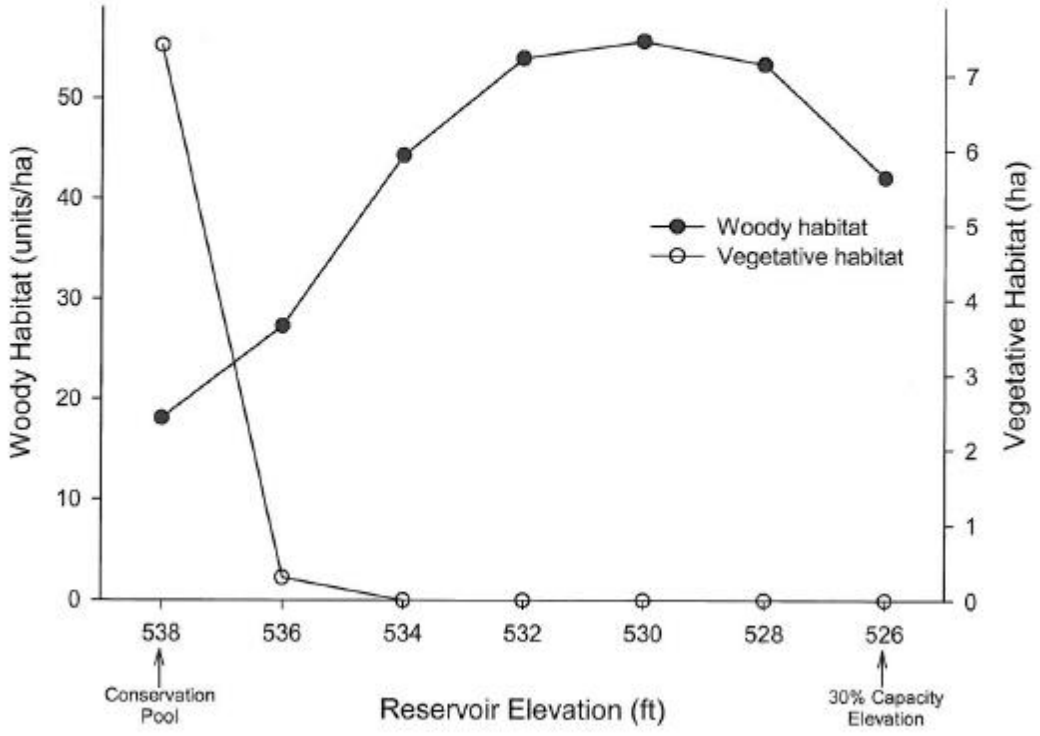
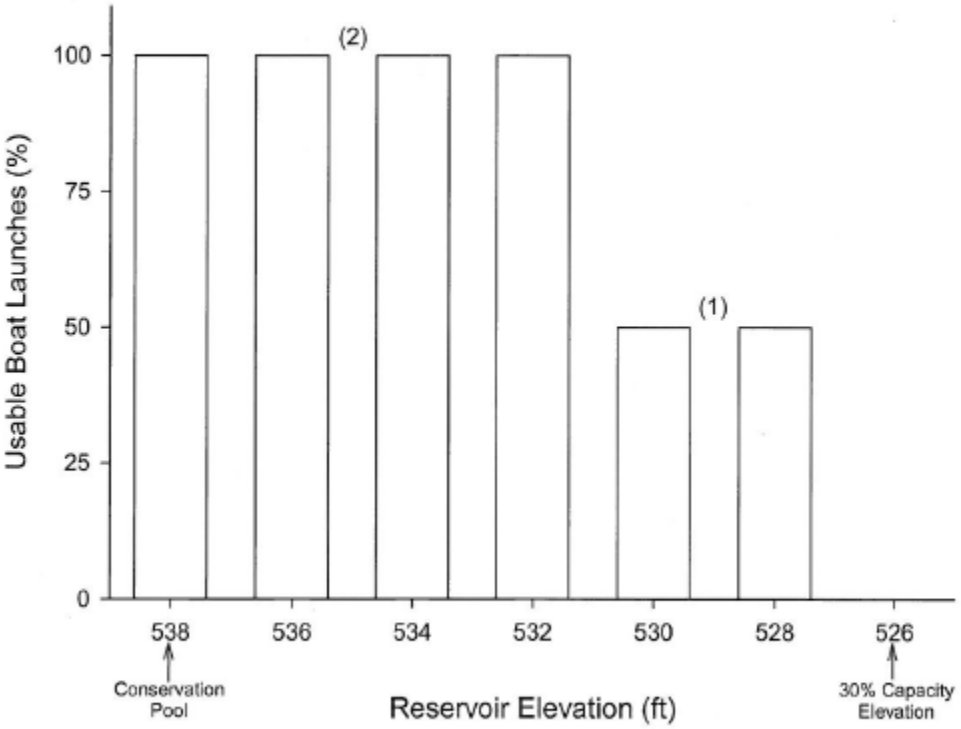


Figure 4. Elevation specific boat accessibility in Lake Aquilla, Texas. The number of usable boat launches provided above each bar.



APPENDIX E

Introduction

The Waco Inland Fisheries Management District encompasses a 12 county area of north central Texas. The district is responsible for fourteen major reservoirs, thirty small impoundments, and at least eight important, navigable rivers – all flowing into the Brazos River, whose drainage bisects the district from north-west to south-east. The district also contains two major ecoregions: Cross Timbers and Blackland Prarie. The Cross Timbers ecoregion dominates the western two-thirds of the district, while Blackland Prarie covers an eastern-most sliver of district including the eastern portions of Hill, McLennan, and Bell Counties, the western portion of Limestone County, and most of Falls County. Due to changes in native ground cover from agricultural and farming practices, these Blackland Prarie areas are highly susceptible to erosion by wind and especially water. As such, Aquilla, Mexia, Fort Parker, and Limestone Reservoirs have lost substantial amounts of volume since impoundment from erosion and sedimentation within their watersheds. The objective of this appendix is to describe the status of Fort Parker Reservoir and its fishery, and to provide the information to the Habitat Branch of the Inland Fisheries Division for their review and consideration of this regional problem – and for their expertise in securing grant funding opportunities with any future statewide watershed proposals.

Geographical Area

The Texas Blackland Prarie ecoregion is a 50,501 km^2 area which runs in a south-west to north-east direction, from San Antonio to the Oklahoma border. Historically, land cover within this ecoregion was dominated by rolling topography and tallgrass prairie species such as big bluestem, indiangrass, and switchgrass, with occasional forest and wetland areas near riparian bottomlands. Early settlers were drawn to the region by its black, fertile soils, and the majority of the land was soon converted to farmland. A recent estimate suggests as few as 5,000 acres remain in their natural condition in terms of land cover, plant species, etc. Today, land use is dominated by pastureland, supporting livestock such as beef cattle, and cropland, including hay, corn, wheat, sorghum, cotton, milo, soybeans and pecans. Clear cutting of the native trees and grasses, along with repeated plowing from heavy farming and agricultural practices, has led to severe soil loss by wind erosion and surface runoff. The development of agricultural best management practices (BMPs) have helped farmers and other landowners reduce soil loss in recent decades, however BMPs have not been implemented in many important areas of watershed, some existing BMPs are outdated, and much of the damage to streams and reservoirs has already occurred.

Reservoir Specifics

Aquilla is a 3,066-acre reservoir located in Hill County, approximately 10 miles southwest of Hillsboro, Texas. Land use throughout its 255 square mile watershed is primarily agriculture. The United States Army Corps of Engineers (USACE) constructed the reservoir for flood control, municipal water, and recreation, by impounding Aquilla, Hackberry, and Jacks Branch Creeks in 1983. The reservoir has mean and maximum depths of 16 and 59 feet respectively, and supplies drinking water to rural areas such as Hillsboro, Milford and Bynum as well as several water companies. There are currently two permanent pumping stations that utilize a common intake structure and transfer water to other sites. The first is operated by the City of Cleburne and transfers untreated water to Lake Pat Cleburne to be used as a municipal water supply. The other is operated by the Aquilla Water Supply Corporation. Aquilla is moderately productive, with water clarity ranging from 2 to 4 feet. Structural habitat consists primarily of natural and rip-rap shoreline, and extensive standing timber. Aquatic vegetation is scarce; however limited amounts of native species like Water willow and Cattail can be found. The Brazos River Authority (BRA) contracted out a re-allocation study to the USACE in 2008 to explore the possibility of a 4.5' conservation pool rise on Aquilla, which would provide a more reliable water supply for long term regional needs. This re-allocation study was initially scheduled to be completed in 2011. Although several facets of the reallocation study have been completed to date, the study is still ongoing.

Loss of Volume and Impacts to the Fishery

Original construction plans calculated Aquila's volume to be 52,400 acre-feet at conservation pool (537.5 feet above mean sea level) upon impoundment in 1983. The Texas Water Development Board (TWDB) has conducted three volumetric surveys on Aquilla: 1995, 2002 and most recently in 2008. The 2008 survey found Aquilla's capacity to be 44,566 acre-feet, and the TWDB further indicated that 84 to 218 acre-feet of reservoir volume is lost annually due to silt-loading and sedimentation. By way of comparison, Fort Parker Reservoir was constructed in 1935 by the Civilian Conservation Corps to cover an area of approximately 750 acres and hold 3,100 acre-feet of water. This makes it the oldest of the three reservoirs on the Navasota mainstem, predating its upstream neighbor, Mexia reservoir (constructed in 1961) as well as Limestone reservoir downstream (constructed in 1978). It is also older than Aquilla reservoir, which was completed in 1982 within the Blackland Prairie Ecosystem area. All four reservoirs lose volume annually to sedimentation by erosion within their watersheds. Although the loss of Fort Parker Reservoir capacity is unknown at this time, dredging operations initiated by the town of Groesbeck in 1994 were begun to remove 930 acre-feet of deposited silt in and adjacent to the Navasota River channel within the reservoir. Those efforts were abandoned in 2002 with little success. Studies of the other three reservoirs have also shown significant losses in volume since impoundment. For example, according to recent Texas Water Development Board surveys, Mexia looses 22 acre-feet of reservoir volume each year while Limestone has lost an estimated 9,652 acre-feet since impoundment. As stated above, the rate of loss within Aquilla could be as much as 218 acre-feet of volume every year. This relatively rapid loss of habitat is the single most important issue facing these reservoirs. Due to Fort Parker Reservoir's age and small size relative to its watershed, its loss of volume (and habitat for fishes) is much more obvious. Currently, the upper two-thirds of the reservoir are too shallow to access by boat, and fisheries management activities have been restricted to 250 acres of reservoir for over a decade. This provides a glimpse into what the future might hold for Mexia, Limestone and Aquilla reservoirs. Without action in the next couple of decades, it is likely that impacts to the fishery due to sedimentation in these four reservoirs will only become more severe.

Summary

Although Inland Fisheries Management staff can identify symptoms of larger, watershed-wide issues with the limnological, habitat and fisheries data we collect, we are not equipped logistically or financially to remedy problems on this scale. The objective of this appendix is to describe the status of Aquilla Reservoir and its fishery, to provide the information to the Habitat Branch of the Inland Fisheries Division for their review and consideration, and to request their expertise in securing grant funding from organizations such as the SARP and RFHP to promote BMPs or other work to reduce or reverse the effects of erosion and sedimentation within this watershed.