PERFORMANCE REPORT

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FEDERAL AID IN SPORT FISH RESTORATION ACT

TEXAS

FEDERAL AID PROJECT F-221-M-6

INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2015 Fisheries Management Survey Report

H-4 Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in H-4 Reservoir were surveyed in 2016 with spring electrofishing, trap netting, and gill netting. Historical data are presented with the 2016 data for comparison. This report summarizes the results of the surveys and contains a management plan for the reservoir based on those findings.

- **Reservoir Description:** H-4 is a 696-acre reservoir on the Guadalupe River in Gonzales County and is controlled by the Guadalupe-Blanco River Authority (GBRA). The reservoir was impounded in 1931 to provide water for a hydroelectric generation and recreation. The substrate is composed primarily of silt, sand, clay, and some gravel and rock. Angler and boat access was limited to one pay-to-use boat ramp. There were no handicap-specific facilities. Primary habitat was composed of boat docks and piers, timber, native floating-leaved and submersed vegetation, hydrilla, and water hyacinth.

- **Management History:** Important sport fish species include Channel Catfish, Largemouth Bass, and crappie. Anglers have reported catching White, Palmetto, and Striped Bass from this reservoir but these species have not been collected in any survey. Palmetto and Striped Bass migrate downstream from a stocked upstream reservoir (Canyon Lake). Flathead Catfish were present in the reservoir in low abundance. Blue Catfish have been stocked, but relative abundance remains low. The 2012 management plan focused on working with GBRA on the control of water hyacinth, monitoring water lettuce and East Indian hygrophila, and publicizing fishing opportunities. Over the current study period, water hyacinth control was achieved with herbicides and temporary drawdowns during winter months. Hydrilla spread throughout the reservoir in 2014 and was controlled with an herbicide application. Sport fisheries were publicized through local media outlets.

- **Fish Community**

  - **Prey species:** Gizzard Shad and Bluegill formed the reservoirs forage base. Gizzard Shad abundance remained consistent while Bluegill abundance decreased from 2011.

  - **Catfishes:** Channel Catfish abundance was substantially reduced over the survey period yet size composition was dominated by larger individuals. Blue and Flathead Catfish were present in low abundance.

  - **Largemouth Bass:** Largemouth Bass abundance decreased slightly over the study period. Size composition was balanced and comprised both juvenile and adult fish. Mean age at legal length was 3.0 years.

  - **Crappie:** White Crappie was the predominant crappie species in the reservoir. Size structure was balanced and roughly half of the fish collected were available to anglers. Growth was average and mean age at legal length was 2.1 years.

- **Management strategies:** Continue managing fish populations under current regulations. Continue to work with GBRA on controlling water hyacinth and hydrilla. Monitor the spread and expansion of water lettuce and East Indian hygrophila. Conduct additional electrofishing and trap netting to monitor declines in Largemouth Bass and crappie abundance. Conduct exploratory tandem baited hoop net and low frequency electrofishing surveys as alternative means to collect population level data on catfishes.

INTRODUCTION

This document is a summary of fisheries data collected from H-4 Reservoir in 2016. 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 2016 data for comparison. Management strategies are included to address existing problems or opportunities.

Reservoir Description

H-4 is a 696-acre mainstream reservoir on the Guadalupe River in Gonzales County and is controlled by GBRA. The reservoir was impounded in 1931 for hydropower generation and recreation. The substrate is composed primarily of silt, sand, clay, and some gravel and rock. The reservoir is relatively shallow (3 – 4 ft) with the exception of the river channel. Angler and boat access was limited to one pay-use ramp. There were no handicap-specific facilities at this ramp. The reservoir is surrounded by private property, so public bank access was non-existent. Secchi disk measurements of water clarity ranged from 23 – 48 centimeters. Littoral habitat consisted of native aquatic vegetation (coontail, spatterdock, and American lotus), timber, piers, and boat docks. Non-native vegetation (water hyacinth, water lettuce, and hydrilla) was present in the reservoir. The GBRA lowered reservoir water level during extended periods of freezing temperatures and hired a private contractor to conduct herbicide treatments to control water hyacinth as needed. An herbicide application for hydrilla was conducted in 2014. Other descriptive characteristics for H-4 Reservoir are in Table 1.

Angler Access

H-4 Reservoir has one public boat ramp and several private boat ramps. Additional boat ramp characteristics are in Table 2. Shoreline access is very limited and accessed at the public boat ramp area.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Findeisen and Binion 2012) included:

1. Maintain collaborative relationship with GBRA to manage, control, and prevent the spread of non-native nuisance vegetation.

   Action: Assisted GBRA with meeting goals and objectives outlined in the nuisance aquatic vegetation management plan. District staff reviewed vegetation treatment proposals, conducted pre- and post-vegetation surveys, participated in stakeholder meetings, and provided GBRA with cost-share funding.

2. Publicize increases in relative abundance and size structure of important sport fish populations.

   Action: Press releases were disseminated to local media outlets.

3. Develop habitat enhancement project to diversify the native plant community.

   Action: Habitat enhancement project was not pursued.

Harvest regulation history: Sport fish in H-4 Reservoir are currently managed with statewide harvest regulations (Table 3).

Stocking history: No stockings occurred over the current study period. Species stocked into the reservoir have included Blue and Channel Catfish, Striped Bass, Florida Largemouth Bass, and Grass

Carp. A complete stocking history is in Table 4.

Vegetation/habitat management history: Water hyacinth has been a problematic species for years. Prior to 1998, TPWD controlled water hyacinth on this reservoir using herbicide. After 2001, the GBRA began herbicide treatments through a contractor to treat specific problematic sections of the reservoir. However, herbicide applications proved ineffective as water hyacinth expanded to the entire reservoir. More recent chemical control efforts, in conjunction with selective winter drawdowns, have been effective in control of water hyacinth. Water hyacinth weevils, have been utilized but provided little control. Water lettuce, while present, historically has not been as problematic as water hyacinth. Water lettuce weevils were introduced in 1997 (N=280) and 1998 (N=1,400). Shortly after the 1998 weevil release, the reservoir experienced a 100-yr flood, flushing most of the water lettuce downstream. Historically, hydrilla has been present in the boat ramp basin but has yet to create access problems. In 2014, coverage of hydrilla expanded and was controlled with herbicides. East Indian hygrophila was once well-established in the boat ramp slough but has been replaced by native submersed aquatic vegetation.

Water Transfer: H-4 Reservoir is primarily used for hydroelectric generation, recreation, and flood control to a lesser extent. Currently, there are no plans to build a pump station on this reservoir. No inter-basin transfers are known to exist.

METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for H-4 Reservoir (TPWD, unpublished data). Primary components of the OBS plan are listed in Table 5. Survey sites for electrofishing and gill netting were randomly selected, while trap nets sites were subjectively selected. All surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished revised manual 2015).

Electrofishing – Largemouth Bass, sunfishes, and Gizzard Shad were collected by electrofishing (1 hour at 12, 5-min stations). Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing. Mean age at length for Largemouth Bass was determined using otoliths from randomly-selected fish (TL range 13.0 to 14.9 inches). Largemouth bass were sampled in spring 2016 due to low water level and lack of access in fall 2015.

Trap netting – Crappie were collected using trap nets (7 net nights at 7 stations). CPUE for trap netting was recorded as the number of fish caught per net night (fish/nn).

Gill netting – Channel, Flathead, and Blue Catfish were collected by gill netting (10 net nights at 10 stations). CPUE for gill netting was recorded as the number of fish caught per net night (fish/nn).

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

Statistics – Sampling statistics (CPUE for various length categories), structural indices [Proportional Size Distribution (PSD), terminology modified by Guy et al. 2007], and condition indices [relative weight (W_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.

Habitat – A structural habitat survey was last conducted in 2007. Vegetation surveys were conducted in 2014, 2015, and 2016 to monitor expansion of water hyacinth and hydrilla. Habitat was assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

RESULTS AND DISCUSSION

Habitat: Primary structural shoreline habitat consisted of overhanging brush, eroded bank, and piers and boat docks (Findeisen and Binion 2008). Some woody debris is scattered about the reservoir and provided additional cover. In 2015, total native vegetation coverage was 149.9 acres (21.6%), similar to coverage in 2011 (164.1 acres, 24.2%; Table 6). Coontail, spatterdock, and American lotus were the most abundant native vegetation types in 2015. Three non-native plant species (water hyacinth, hydrilla, and water lettuce) were detected in 2015. Relative to 2011, all non-native vegetative coverage increased (Table 6). Water hyacinth abundance increased substantially from 3.1 acres (< 1.0%) in 2011 to 52.2 acres (7.5%) in 2015 (Table 6). Overall, the reservoir experienced a 38.3 acre (5.5%) increase in total vegetative coverage.

Prey species: Gizzard Shad abundance has remained consistent since 2013 (~100.0/h; Figures 1 and 2). Roughly half of the Gizzard Shad collected in 2016 were available to predator fish as prey (IOV = 55; Figure 2). While reduced from 2011 (276.0/h), Bluegill relative abundance in 2013 (158.0/h) and 2016 (168.0/h) indicated they continue to be an important component of the forage base and the size composition (PSD range: 2 – 8) indicated the majority were available to predators (Figures 3 and 4). Catch rates for Redear Sunfish have decreased since 2011 (Figures 5 and 6). Collections indicated the population was dominated by larger individuals (CPUE-6 = 14.0/h, PSD = 52; Figure 6); potentially providing added recreational value to anglers.

Channel Catfish: Relative abundance of Channel Catfish has trended down since 2008. Catch rates were 2.2/nn in 2016, compared to 9.6/nn and 7.6/nn in 2008 and 2012, respectively (Figure 7). Size structure was dominated by larger individuals evidenced by PSD (76) and CPUE-12 (2.1/nn). Quality-sized (≥ 16 in) fish comprised 73% of the sample. Channel Catfish exhibited good body condition; relative weights were generally at or over 100. Relative weights tended to increase with increasing length (Figure 7).

Largemouth Bass: Reduced relative abundance of Largemouth Bass was the general trend observed over the survey period (Figures 8 and 9). While not comparable to standard fall surveys, CPUE-total was 31.0/h in spring 2016 (Figure 9). Size structure indices (PSD = 53) indicated a balanced population and 55% of the fish collected were stock size (≥ 8 in). Relative weights of legal size (≥ 14 in) fish were generally below 90 and relative weight values tended to decrease with increased fish length (Figure 9). Growth was considered adequate; age at legal length (14 in) was 3.0 years (Table 7). Introgression of Florida Largemouth Bass genetics into the population increased slightly over the study period (2016 %FLMB allele = 54; Table 8), yet no fish sampled were pure Florida Largemouth Bass.

White Crappie: White Crappie abundance was similar and remained high until 2016 (Figures 10 and 11). The 2016 trap net catch rate was 10.9/nn, considerably lower than the last survey conducted in 2013 (32.8/nn). Size composition was similar (PSD range: 65 – 84) across years and dominated by larger individuals. Legal-size (≥ 10 in) fish comprised 47% of the sample in 2016. Relative weight values across the survey period were consistent and tended to decrease with increased fish length (Figures 10 and 11). Growth to legal-length in 2016 was 2.1 years, slowing from 2011 (1.7 years; Table 9).

Fisheries management plan for H-4 Reservoir, Texas.

Prepared – July 2016

ISSUE 1: Objective-based surveys indicated a general trend of decreased abundance of important reservoir sport fish populations.

MANAGEMENT STRATEGIES

1. Conduct additional sampling as outlined in the objective-based sampling plan to monitor important sport fish and prey populations.

ISSUE 2: Many invasive species threaten aquatic habitats and organisms in Texas and can adversely affect the state ecologically, environmentally, and economically. For example, zebra mussels 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 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. Historically, water hyacinth has been problematic on this reservoir and recently rooted colonies of hydrilla were found in the reservoir. Additionally, water lettuce and East Indian hygrophila are have been present in the reservoir but have yet to become problematic species.

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.
6. Continue to assist GBRA in nuisance vegetation control and acquiring cost-share funding.

Objective-Based Sampling Plan for H-4 Reservoir

2017 – 2020

Sport fish, forage fish, and other important fishes

Sport fish in H-4 Reservoir include Blue, Channel, and Flathead Catfishes, Largemouth Bass, and Black and White Crappies. Important forage species include Gizzard and Threadfin Shad, and Bluegill.

Low-density fisheries

Blue Catfish: Blue Catfish relative abundance is low as annual gill net total CPUE since 1988 has averaged 0.35/nn (N = 8, standard deviation = 0.19, range: 0.0 – 0.6nn) and mean stock size CPUE is 0.3/nn (N = 8, standard deviation = 0.2, range: 0.0 – 0.6/nn). Blue Catfish have always been managed with the statewide 12-inch minimum length (MLL) limit and 25 fish daily bag. Blue Catfish were stocked in 1985, 1986, 1988, 1994, 1995, and 1997 for a total of 267,457 individuals. Natural reproduction and recruitment appears to be limited. Exploratory use low-frequency electrofishing (LFE) will be conducted to determine if the Blue Catfish fishery is negligible and also for utility for use as alternative gear for collecting trend data for this species. Twenty randomly selected 3-minute LF electrofishing stations (effort will continue until fish no longer surface) will be sampled. No creel data exists for this reservoir. An online angling survey is planned to be conducted and will gather angler species preference data, useful to determine if there is a demand for Blue Catfish.

Flathead Catfish: Flathead Catfish are present in the reservoir in low abundance. Since 1988, the mean CPUE is 0.5/nn (N = 8, standard deviation = 0.3, range: 0.0/nn – 0.8/nn) and mean stock size CPUE is 0.5/nn (N = 8, standard deviation = 0.3, range: 0.0/nn – 0.8/nn). Flathead Catfish have always been managed with the statewide length and bag limits. Flathead Catfish have never been stocked in H-4. Exploratory use low-frequency electrofishing will be conducted to determine if the Flathead Catfish fishery is negligible and also for utility for use as alternative gear for collecting trend data for this species. Concurrent with Blue Catfish sampling, twenty randomly selected 3-minute LF electrofishing stations (effort will continue until fish no longer surface) will be sampled. Additionally, an online angling survey is planned to be conducted and will gather angler species preference data, useful to determine if there is a demand for Flathead Catfish.

Survey objectives, fisheries metrics, and sampling objectives

Channel Catfish: Channel Catfish are the predominant catfish species present in H-4 and are fairly abundant (average gill net CPUE = 8.2/nn (N = 8, standard deviation = 9.5, range: 1.8 – 30.8/nn) and mean stock size CPUE is 4.3/nn (N = 8, standard deviation = 3.1, range: 1.6/nn – 11.2/nn). Channel Catfish have always been managed under the statewide 12-inch MLL and 25 fish daily bag. Channel Catfish have been surveyed using gill nets typically once every 3-4 years from 1988 – 2012. The RSE values of CPUE data have never been in the target range of less than 25 for the eight gill net samples and only one of those eight gill net samples has yielded more than 50 stock size Channel Catfish (required to achieve our objective of monitoring for major changes in size structure, age/growth, and body condition of Channel Catfish). A minimum of 10 gill nets set at randomly selected stations will be used to collect Channel Catfish in the spring 2020 and should meet the target of collecting 50 stock size Channel Catfish. Exploratory use of baited tandem hoop nets will be conducted in May 2019 to determine utility of this sampling gear as compared to gill nets. A minimum of 8, randomly selected 3-night tandem hoop net sets will be deployed to document initial utility of the gear to collect Channel Catfish. Additionally, an online angling survey will be conducted and will gather angler species preference data, useful to determine if there is a demand for Channel Catfish.

Largemouth Bass: Relative abundance of Largemouth Bass has varied due to availability of suitable habitat (i.e., submersed aquatic vegetation). The mean historical total CPUE for Largemouth Bass is 39.4/h (N = 11, standard deviation = 20.6, range: 4.0 – 69.0/h) and mean stock-size CPUE is 20.7/h (N = 11, standard deviation = 13.9, range: 4.0 – 42.0/h). Largemouth Bass have always been managed with the statewide 14-inch minimum length limit and 5 fish daily bag. Trend data on CPUE, size structure, and body condition was collected every 3-5 years beginning in 1988 and at least every other year since 1999. The population appears to have adequate reproduction and recruitment when water hyacinth is treated and the submersed aquatic vegetation is able to flourish. Collection of trend data with fall electrofishing biennially will allow for determination of large-scale changes in population dynamics (relative abundance, size structure, body condition, age and growth) that may warrant further investigation and more intensive sampling. A minimum of 12 randomly selected electrofishing sites will be sampled in 2017 and 2019. Sampling will continue at additional random sites until 50 stock-size fish or 18 total electrofishing stations have been sampled, unless the water hyacinth infestation is too large. A Category 2 age and growth analysis [mean age at legal length (14 in), N = minimum of 13 fish between 13.0 – 14.9 in] will be conducted for each sample year to assess any changes in growth to the minimum length limit. An online angling survey will be conducted and will gather angler species preference data, useful to determine if there is a demand for Largemouth Bass.

Crappies: White and Black Crappie are both present in the reservoir with White Crappie being the predominant species. These species are currently being managed with the same regulations and data from both species will be pooled in the future. Mean historical trap net total CPUE of White Crappie at random stations was 10.7/nn (N = 8, standard deviation = 19.9, range: 4.4 – 25.0/nn), while mean historical total CPUE of White Crappie at biologist selected stations was 29.3/nn (N=5, standard deviation=14.6, range: 18.2/nn – 38.0/nn). Crappies have always been managed with the statewide 10 inch MLL and 25 fish daily bag. Trend data on CPUE, size structure, and body condition has been collected every 2-3 years beginning in 1988 and then every other year since 1999. Collection of trend data biennially will allow for determination of large-scale changes in population dynamics (relative abundance, size structure, body condition) that may warrant further investigation and more intensive sampling. A minimum of 7 subjectively selected sites will be sampled in 2017 and 2019 with a target of 50+ stock size crappies. Historically, using biologist selected stations, seven sampling sites resulted in the targeted 50+ stock-size fish. Additional trap net sampling will be conducted if the target sample size is not reached. Achieving a reasonable RSE (< 25) for CPUE-S will likely be unattainable with practical sampling effort. An online angling survey will be conducted and will gather angler species preference data, useful to determine if there is a demand for crappies.

Gizzard and Threadfin Shad and Bluegill: Gizzard and Threadfin Shad and Bluegill are the primary forage at H-4. Like Largemouth Bass, trend data on CPUE and size structure of Gizzard Shad and Bluegill have been collected at a minimum every 3-5 years beginning in 1988 and every other year since 1999. As with Largemouth Bass, Bluegill abundance is linked to the amount of submersed aquatic vegetation which in turn is often determined by the size of the water hyacinth infestation. Continuation of sampling, as per Largemouth Bass above, will allow monitoring of large-scale changes in Gizzard Shad and Bluegill relative abundance and size structure. Sampling effort based on achieving sampling objectives for Largemouth Bass will result in sufficient numbers for size structure estimation (Gizzard Shad IOV; 50 fish minimum and Bluegill PSD; 50 stock size fish minimum at 12 randomly selected 5-minute stations) and relative abundance estimates (Bluegill CPUE-Total; RSE $\leq$ 25, anticipated effort is 12 stations based on historical data). The objective of attaining an RSE ≤ 25 will only be set for Bluegill as Gizzard Shad CPUE-Total RSE's fluctuate substantially.

LITERATURE CITED

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated indices. Pages 447-482 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, second edition. American Fisheries Society, Bethesda, Maryland.

DiCenzo, V.J., M.J. Maceina, and M.R.Stimpert. 1996. Relationships between reservoir trophic state and Gizzard Shad population characteristics in Alabama reservoirs. North American Journal of Fisheries Management 16:888-895.

Findeisen, J. A. and G. R. Binion. 2008. Statewide freshwater fisheries monitoring and management program survey report for: H-4 Reservoir, 2007. Texas Parks and Wildlife Department, Federal Aid Report F-30-R, Austin.

Findeisen, J. A. and G. R. Binion. 2012. Statewide freshwater fisheries monitoring and management program survey report for: H-4 Reservoir, 2011. Texas Parks and Wildlife Department, Federal Aid Report F-221-M-2, Austin.

Guy, C. S., R. M. Neumann, D. W. Willis, and R. O. Anderson. 2007. Proportional size distribution: A further refinement of population size structure index terminology. Fisheries 32: 348.

Table 1. Characteristics of H-4 Reservoir, Texas.

Characteristic	Description
Year constructed	1931
Controlling authority	Guadalupe-Blanco River Authority
County	Gonzales
Reservoir type	Mainstream
Shoreline Development Index	2.91
Conductivity	450 µmhos/cm
Access: Boat	Adequate – one pay-to-use ramp
Bank	Inadequate – no public bank access
Handicapped	Inadequate – no handicapped access

Table 2. Boat ramp characteristics for H-4 Reservoir, Texas, August, 2016. Reservoir elevation at time of survey was 343 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Hill Shade Ramp	29.50518 -97.64340	Y	5	339	Excellent, no access issues

Table 3. Harvest regulations for H-4 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, Striped	5	18-inch minimum
Bass, Largemouth	5[a]	14-inch minimum
Bass: Spotted and Guadalupe	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 Guadalupe Bass = 5 fish in any combination.

Table 4. Stocking history of H-4 Reservoir, Texas. Sizes categories are: FGL = fingerling; ADL = adult.

Year	Number	Size
Blue Catfish		
1985	7,040	FGL
1986	7,000	FGL
1988	16	ADL
1994	114,199	FGL
1995	69,602	FGL
1997	69,600	FGL
Species Total	267,457	
Channel Catfish		
1972	53,000	FGL
1991	77	ADL
Species Total	53,077	
Striped Bass		
1978	6,650	FGL
Species Total	6,650	
Florida Largemouth Bass		
1978	27,900	FGL
1990	69,754	FGL
1991	69,722	FGL
Species Total	167,376	
Triploid grass carp*		
1995	25	ADL
1996**	5	ADL
1996**	6	ADL
Species Total	36	

* Radio-tagged fish
** Replace dead radio-tagged fish

Table 5. Objective-based sampling plan components for H4 Reservoir, Texas 2015 – 2016.

Gear/target species	Survey objective	Metrics	Sampling objective
Electrofishing			
Largemouth Bass	Abundance	CPUE – stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Age-and-growth	Age at 14 inches	N = 13, 13.0 – 14.9 inches
	Condition	W_r	10 fish/inch group (max)
	Genetics	% FLMB	N = 30, any age
Bluegill [a]	Abundance	CPUE – Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
Gizzard Shad [a]	Abundance	CPUE – Total	RSE ≤ 25
	Size structure	PSD, length frequency	N ≥ 50
	Prey availability	IOV	N ≥ 50
Gill netting			
Channel Catfish	Abundance	CPUE – stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	N ≥ 50 stock
	Condition	W_r	10 fish/inch group (max)
Trap netting			
Crappie	Size structure	PSD, length frequency	N = 50
	Age-and-growth	Age at 10 inches	N = 13, 9.0 – 10.9 inches

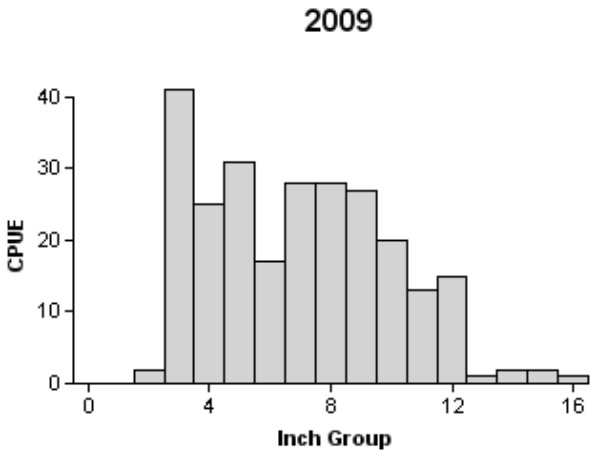
[a] No additional effort will be expended to achieve an RSE ≤ 25 for CPUE of Bluegill and Gizzard Shad if not reached from designated Largemouth Bass sampling effort. Instead, Largemouth Bass body condition can provide information on forage abundance, vulnerability, or both relative to predator density.

Table 6. Survey of aquatic vegetation, H-4 Reservoir, Texas, 2011 and 2015. Surface area (acres) is listed with percent of total reservoir surface area in parentheses.

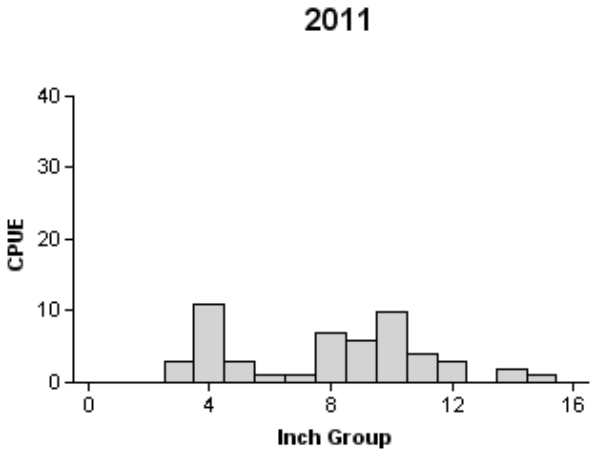
Vegetation	2011	2015
Native submersed	30.9 (4.4)	43.0 (6.2)
Native floating-leaved	132.4 (19.0)	106.9 (15.4)
Native emergent	0.8 (< 1.0)	
Non-native		
Hydrilla (Tier II)*	0.8 (< 1.0)	2.7 (< 1.0)
Water hyacinth (Tier II)*	3.1 (< 1.0)	52.2 (7.5)
Water lettuce (Tier III)*		1.5 (< 1.0)

* Tier II is Maintenance and Tier III is Watch Status

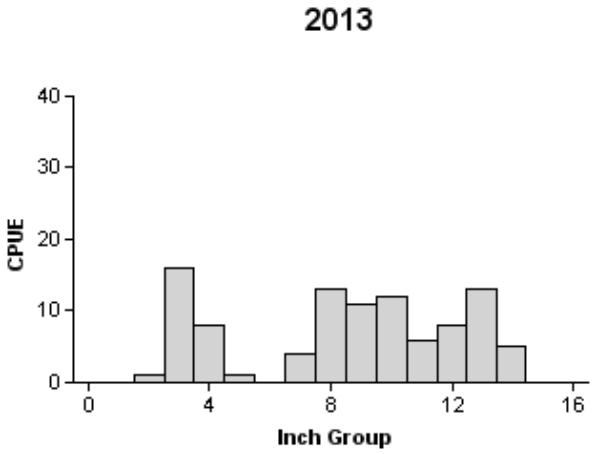
Gizzard Shad



Effort = 1.0
Total CPUE = 253.0 (24; 253)
IOV = 57 (10)



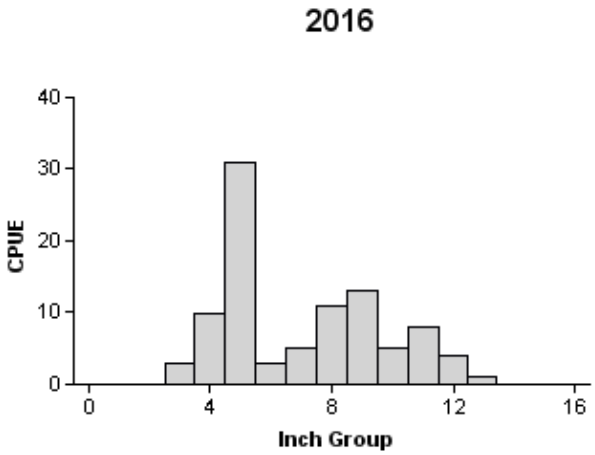
Effort = 1.0
Total CPUE = 52.0 (32; 52)
IOV = 37 (10)



Effort = 1.0
Total CPUE = 98.0 (21; 98)
IOV = 31 (11)

Figure 1. Comparison of the number of Gizzard Shad caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, H-4 Reservoir, Texas, 2009, 2011, and 2013.

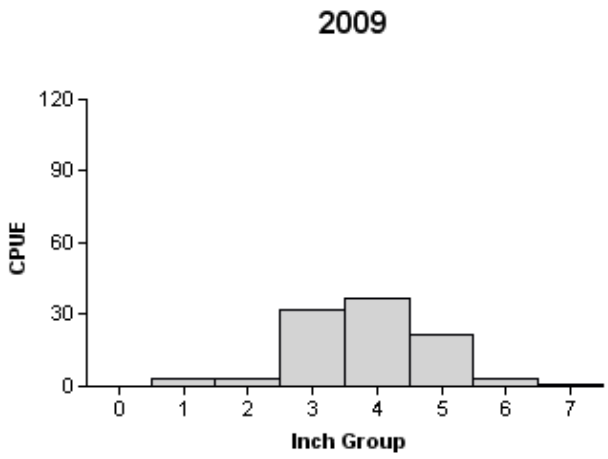
Gizzard Shad



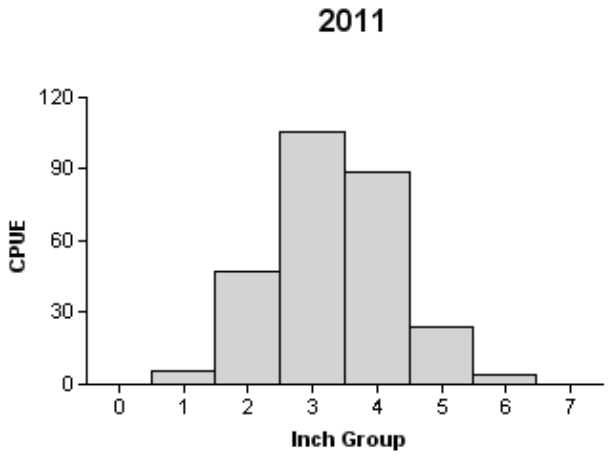
Effort = 1.0
Total CPUE = 94.0 (27; 94)
IOV = 55 (11)

Figure 2. Number of Gizzard Shad caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing survey, H-4, Reservoir, Texas, 2016.

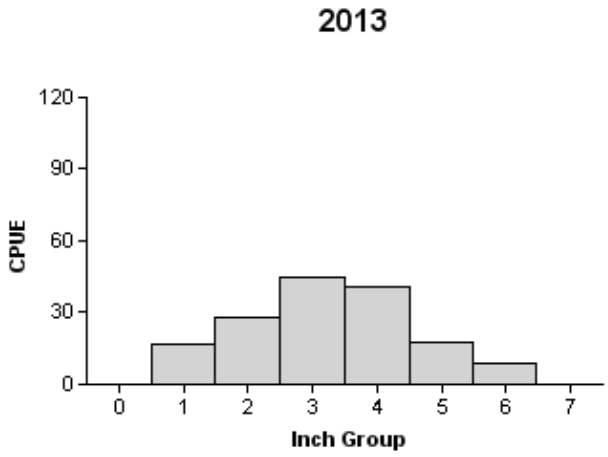
Bluegill



Effort = 1.0
Total CPUE = 101.0 (30; 101)
CPUE-6 = 4.0 (77; 4)
PSD = 4 (2)



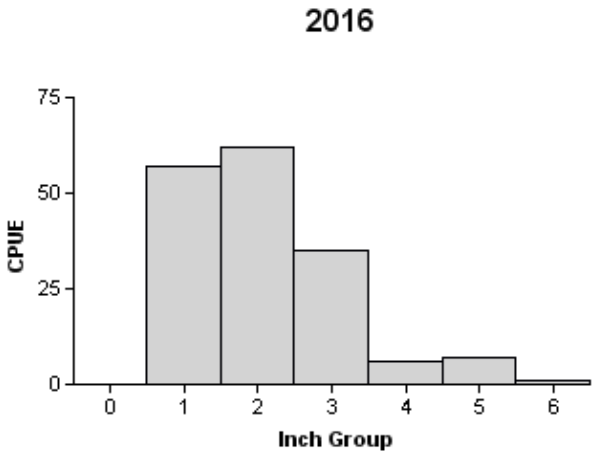
Effort = 1.0
Total CPUE = 276.0 (18; 276)
CPUE-6 = 4.0 (56; 4)
PSD = 2 (1)



Effort = 1.0
Total CPUE = 158.0 (23; 158)
CPUE-6 = 9.0 (29; 9)
PSD = 8 (3)

Figure 3. Comparison of the number of Bluegill caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, H-4, Reservoir, Texas, 2009, 2011, and 2013.

Bluegill

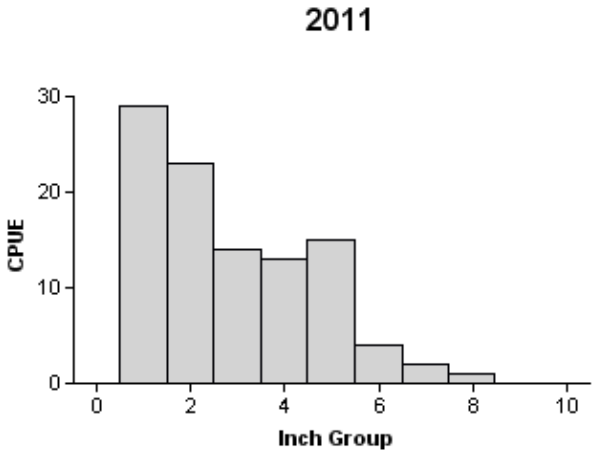


Effort = 1.0
Total CPUE = 168.0 (32; 168)
Stock CPUE = 49.0 (28; 49)
CPUE-6 = 1.0 (100; 1)
PSD = 2 (2)

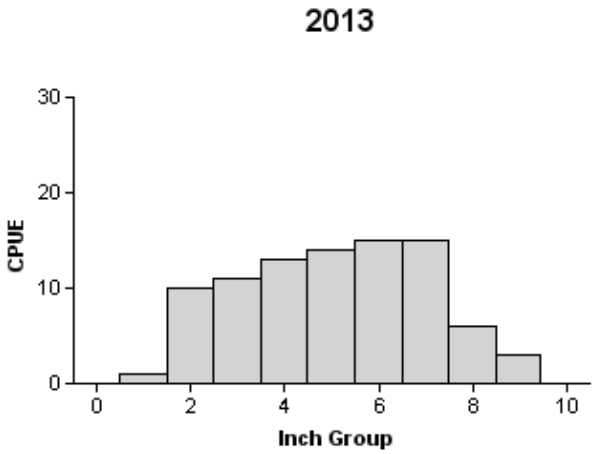
Figure 4. Number of Bluegill caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing survey, H-4, Reservoir, Texas, 2016.

Redear Sunfish

Effort = 1.0
Total CPUE = 58.0 (41; 58)
CPUE-6 = 13.0 (31; 13)
PSD = 35 (10)



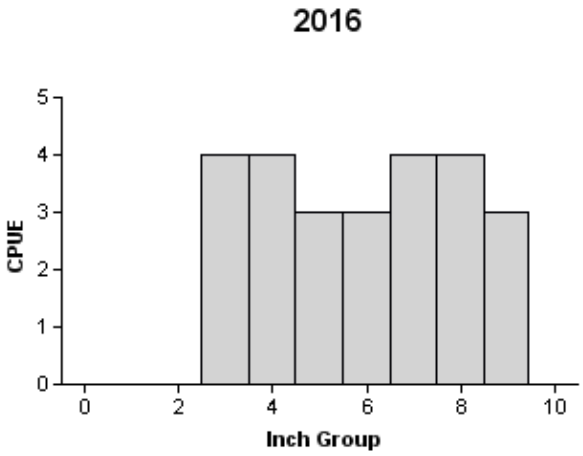
Effort = 1.0
Total CPUE = 101.0 (21; 101)
CPUE-6 = 7.0 (49; 7)
PSD = 9 (6)



Effort = 1.0
Total CPUE = 88.0 (30; 88)
CPUE-6 = 39.0 (37; 39)
PSD = 36 (9)

Figure 5. Comparison of the number of Redear Sunfish caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, H-4 Reservoir, Texas, 2009, 2011, and 2013.

Redear Sunfish



Effort =	1.0
Total CPUE =	25.0 (49; 25)
CPUE-6 =	14.0 (43; 14)
PSD =	52 (10)

Figure 6. Number of Redear Sunfish caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring electrofishing survey, H-4 Reservoir, 2016.

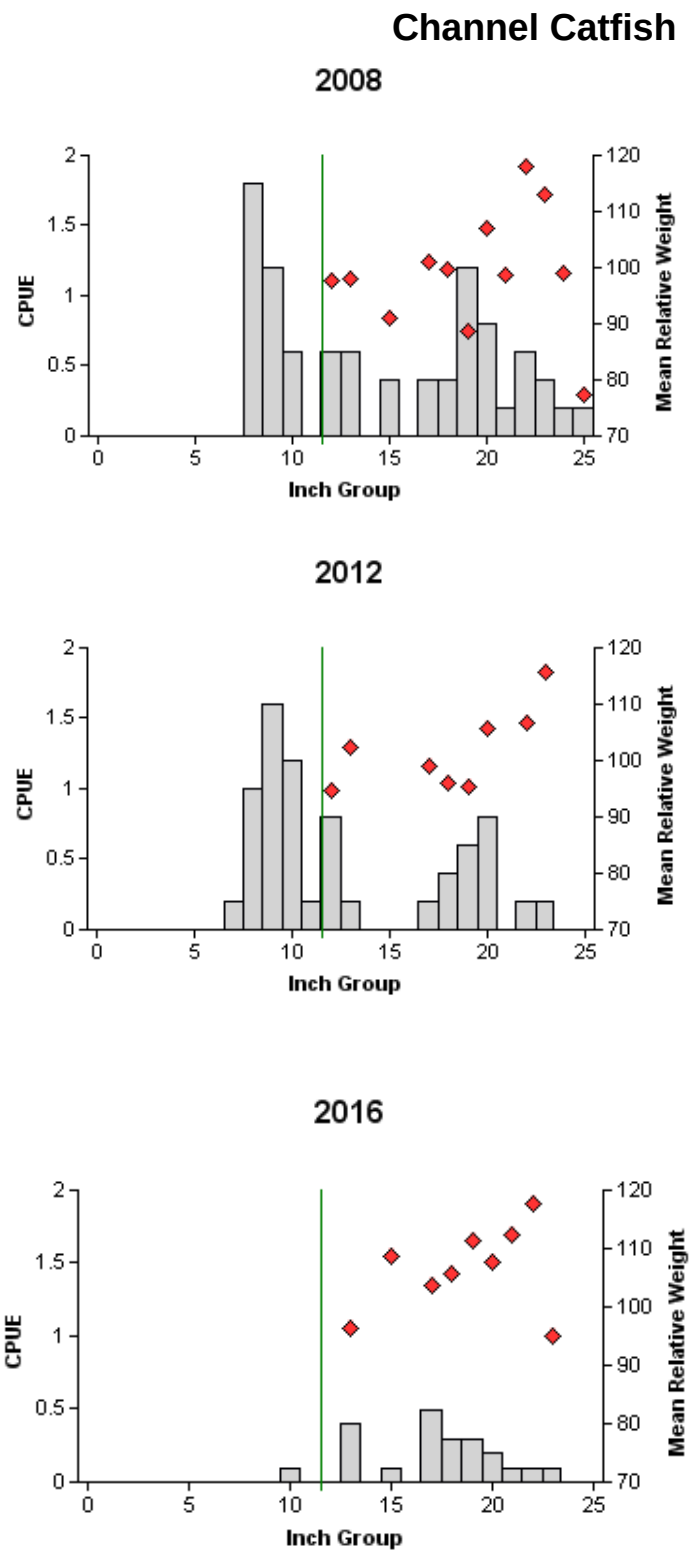
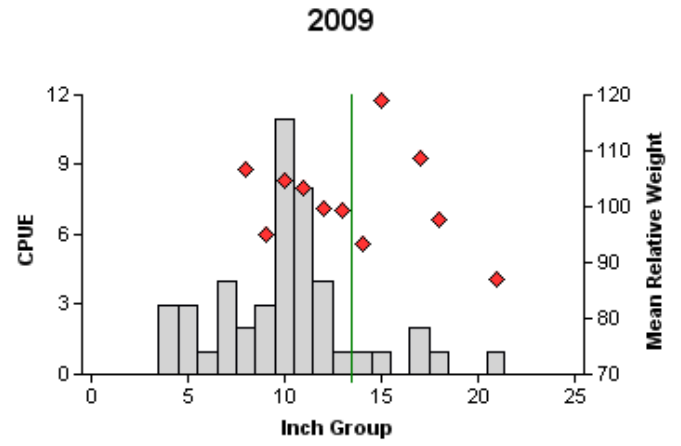
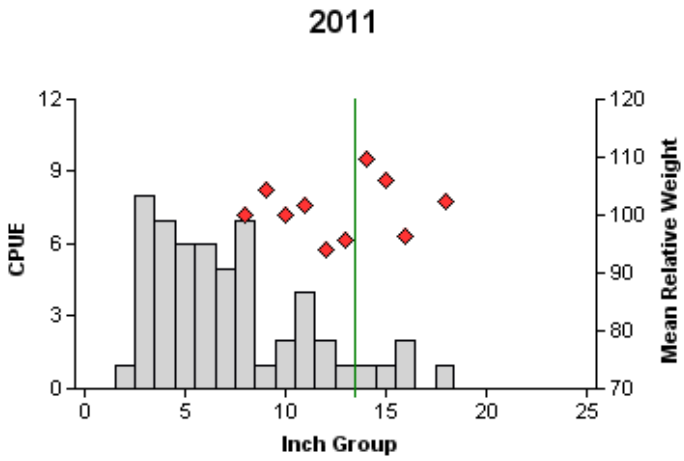


Figure 7. Comparison of the number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for spring gill net surveys, H-4 Reservoir, Texas, 2008, 2012, and 2016.

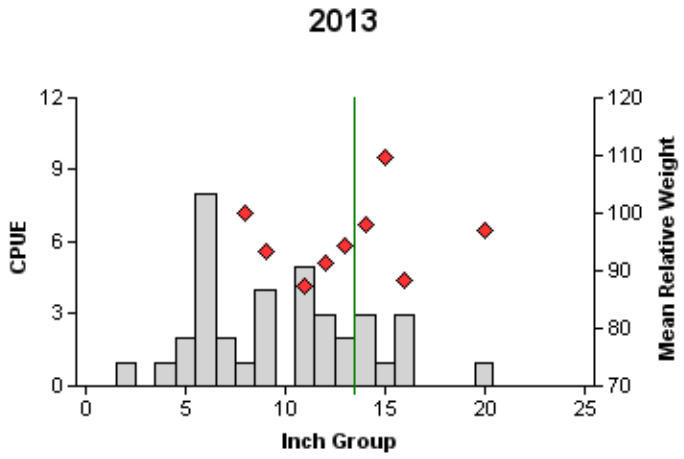
Largemouth Bass



Effort = 1.0
Total CPUE = 46.0 (50; 46)
Stock CPUE = 35.0 (64; 35)
CPUE-14 = 6.0 (46; 6)
PSD = 31 (8)



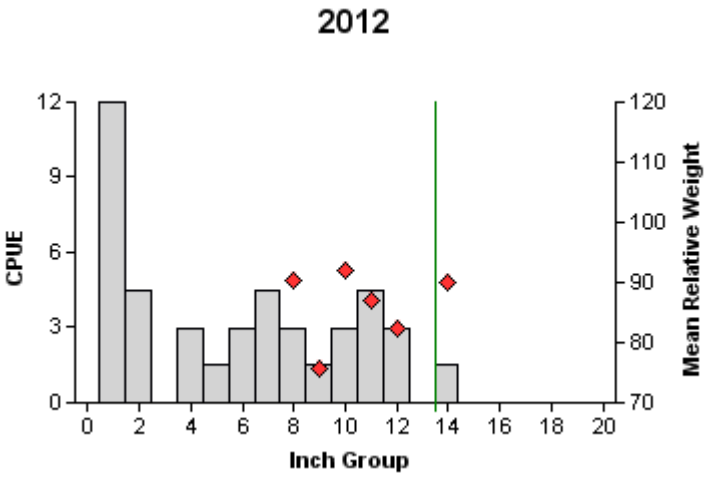
Effort = 1.0
Total CPUE = 55.0 (22; 55)
Stock CPUE = 22.0 (30; 22)
CPUE-14 = 5.0 (46; 5)
PSD = 36 (12)



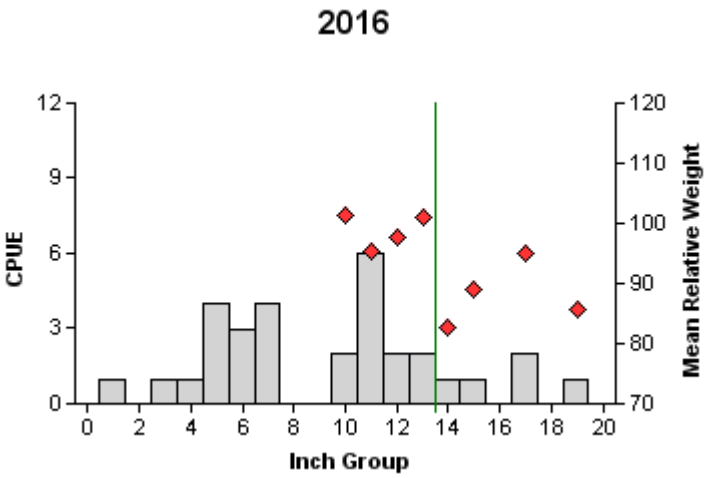
Effort = 1.0
Total CPUE = 37.0 (32; 37)
Stock CPUE = 23.0 (30; 23)
CPUE-14 = 8.0 (43; 8)
PSD = 57 (8)

Figure 8. Comparison of the 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, H-4 Reservoir, Texas, 2009, 2011, and 2013. Vertical lines denote 14-inch minimum length limit.

Largemouth Bass



Effort = 0.7
Total CPUE = 45.0 (36; 30)
Stock CPUE = 16.5 (40; 11)
CPUE-14 = 1.5 (100; 1)
PSD = 27 (18)



Effort = 1.0
Total CPUE = 31.0 (28; 31)
Stock CPUE = 17.0 (39; 17)
CPUE-14 = 5.0 (36; 5)
PSD = 53 (15)

Figure 9. Comparison of the 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 spring electrofishing surveys, H-4 Reservoir, Texas, 2012 and 2016. Vertical lines denote 14-inch minimum length limit.

Largemouth Bass

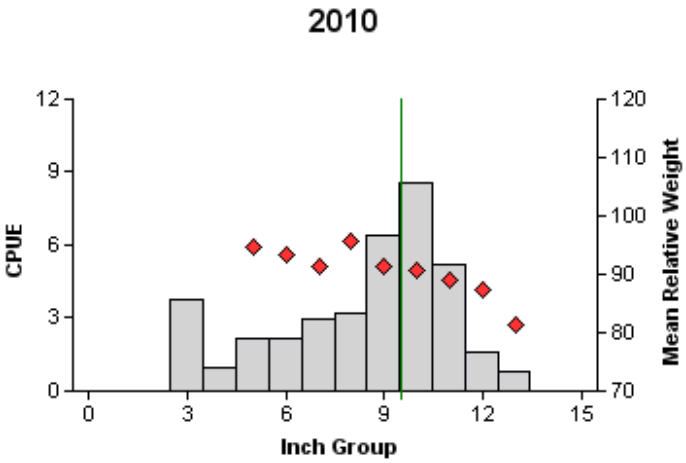
Table 7. Mean age at legal length (14 in) for Largemouth Bass collected by electrofishing, H-4 Reservoir, Texas. Standard deviations are in parenthesis.

Year	N	Age Range	Age-at-Length
2011	11	1 – 6	2.9 (1.30)
2016	13	2 – 4	3.0 (0.82)

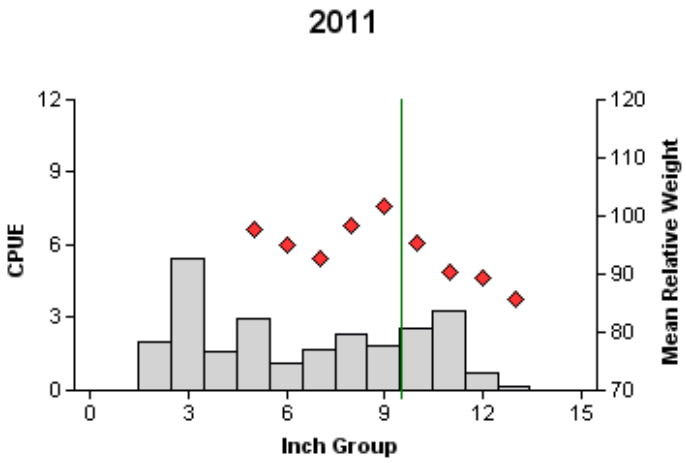
Table 8. Results of genetic analysis of Largemouth Bass collected by electrofishing, H-4 Reservoir, Texas, 2011 and 2016. FLMB = Florida Largemouth Bass, NLMB = Northern Largemouth Bass, Intergrade = hybrid between a FLMB and a NLMB. Largemouth Bass genetic composition was determined using micro-satellite DNA.

		Number of fish				
Year	Sample size	FLMB	Intergrade	NLMB	% FLMB alleles	% NLMB alleles
2011	30	0	30	0	47	53
2016	30	0	29	1	54	46

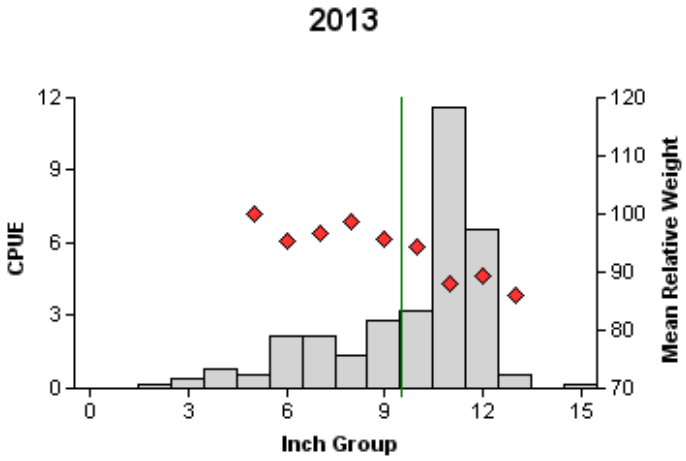
White Crappie



Effort = 5.0
Total CPUE = 38.0 (44; 190)
Stock CPUE = 33.2 (42; 166)
CPUE-10 = 16.2 (42; 81)
PSD = 78 (2)



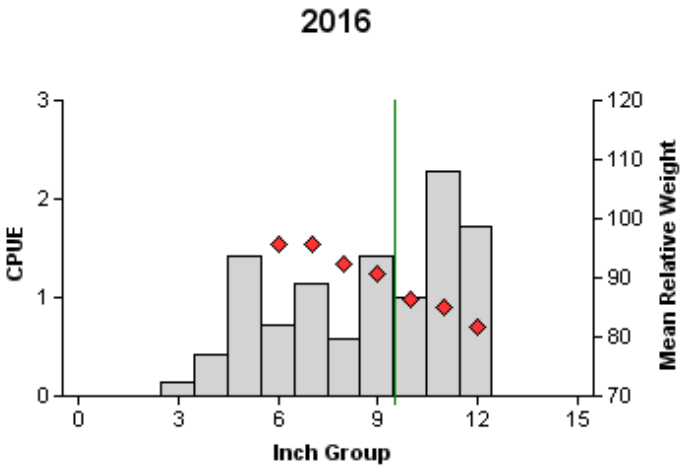
Effort = 7.0
Total CPUE = 25.7 (37; 180)
Stock CPUE = 16.7 (39; 117)
CPUE-10 = 6.7 (29; 47)
PSD = 65 (5)



Effort = 5.0
Total CPUE = 32.8 (64; 164)
Stock CPUE = 31.4 (68; 157)
CPUE-10 = 22.2 (83; 111)
PSD = 84 (11)

Figure 10. Comparison of the 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 biologist selected fall trap net surveys, H-4 Reservoir, Texas, 2010, 2011, and 2013. Vertical lines denote 10-inch minimum length limit.

White Crappie



Effort =	7.0
Total CPUE =	10.9 (32; 76)
Stock CPUE =	10.3 (32; 72)
CPUE-10 =	5.0 (41; 35)
PSD =	68 (8)

Figure 11. 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 biologist selected spring trap net survey, H-4 Reservoir, Texas, 2016. Vertical lines denote 10-inch minimum length limit.

Table 9. Mean age at legal length (10 in) for White Crappie collected by trap netting, H-4 Reservoir, Texas. Standard deviations are in parenthesis.

Year	N	Age Range	Age-at-Length
2011	26	1 – 4	1.7 (0.92)
2016	15	1 – 3	2.1 (0.70)

Table 10. Proposed sampling schedule for H-4 Reservoir, Texas. Survey period is June through May. Trap netting and electrofishing surveys are conducted in the fall and gill netting survey are conducted in the spring. Hoop net and low frequency electrofishing (LFE) surveys are conducted in the summer. Standard surveys are denoted by S and additional surveys are denoted by A.

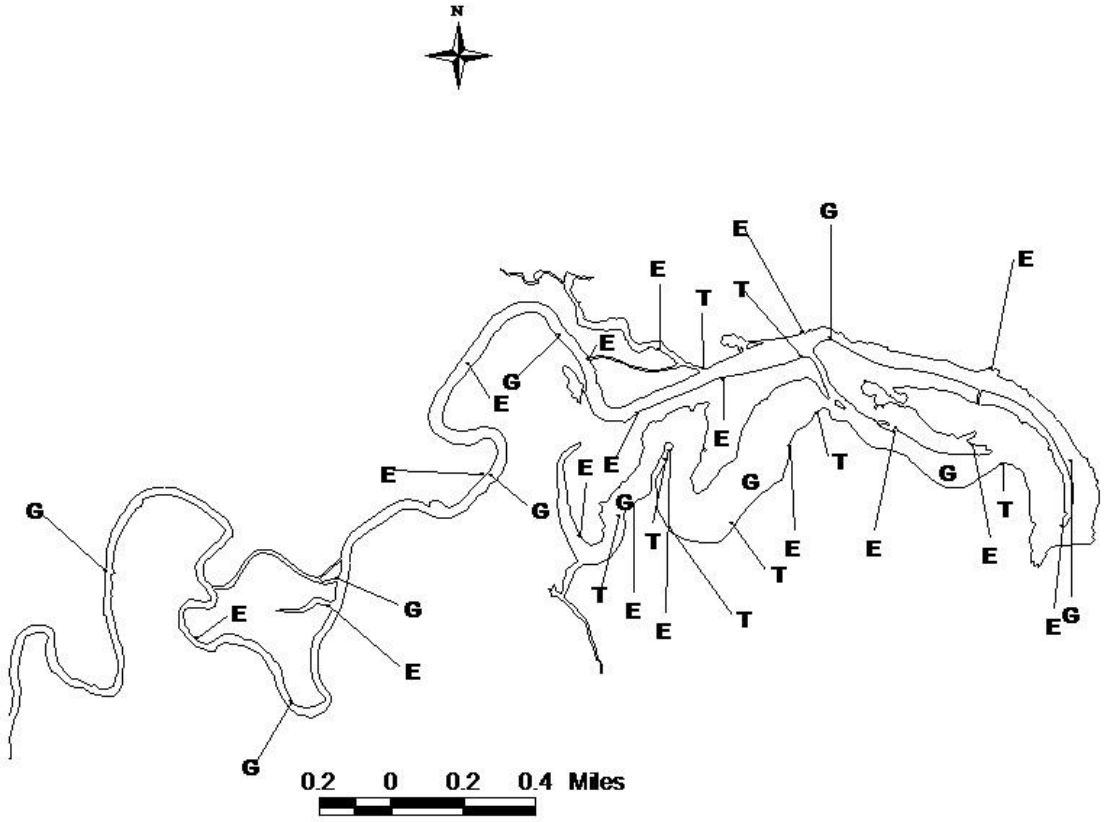
Survey year	Electrofish Fall(Spring)	LFE	Trap net	Gill net	Hoop net	Habitat		Access	Creel survey	Report
						Structural	Vegetation			
2016-2017							A			
2017-2018	A		A				A			
2018-2019		A			A		A			
2019-2020	S		S	S			S	S		S

APPENDIX A

Number (N) and catch rate (CPUE) of all species collected from all gear types from H-4 Reservoir, Texas, 2016. Sampling effort was 10 net nights for gill netting, 7 net nights for trap netting, and 1 hour for electrofishing.

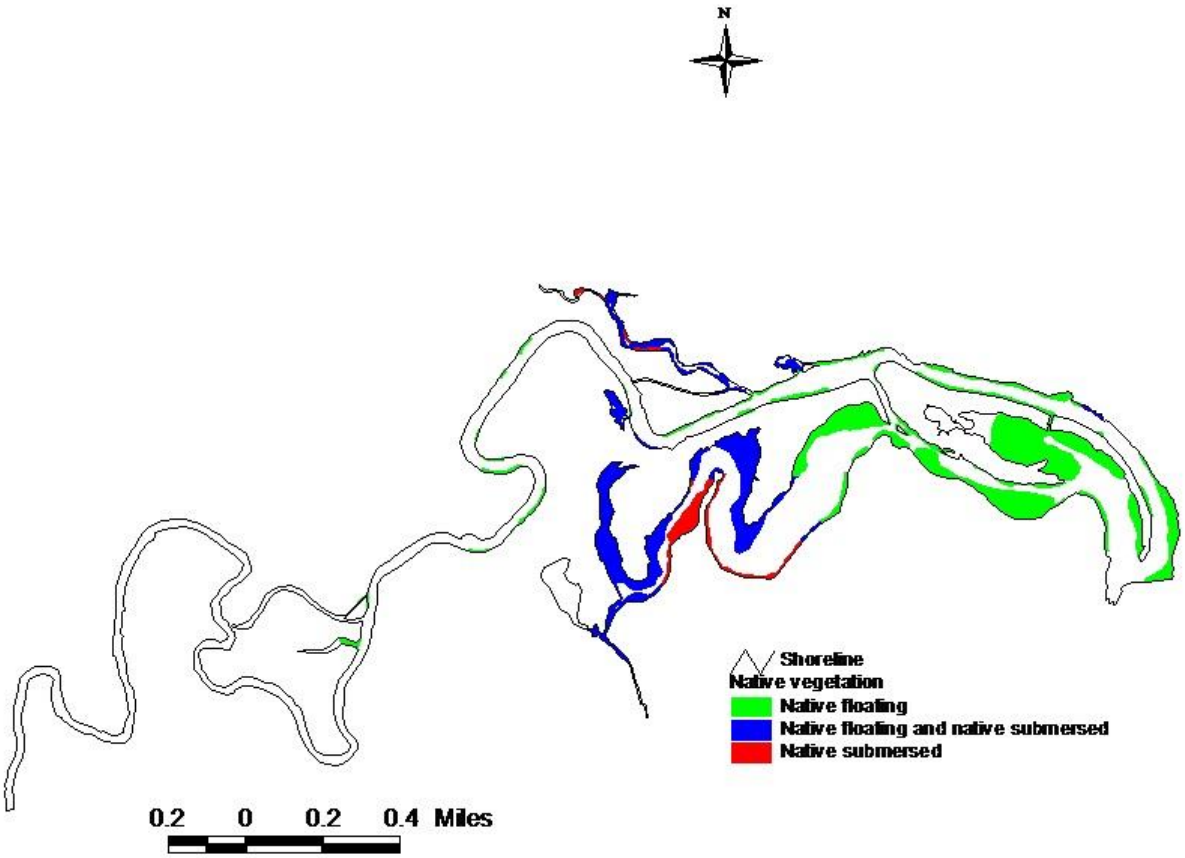
Species	Electrofishing		Gill Netting		Trap Netting	
	N	CPUE	N	CPUE	N	CPUE
Spotted Gar	1	1.0	24	2.4	2	0.3
Longnose Gar			15	1.5		
Alligator Gar			3	0.3		
Gizzard Shad	94	94.0	120	12.0	2	0.3
Threadfin Shad					4	0.6
Common Carp			5	0.5	1	0.1
Golden Shiner	4	4.0	2	0.2	1	0.1
Red Shiner	5	5.0				
Bullhead Minnow	23	23.0				
Smallmouth Buffalo			32	3.2	2	0.3
Blue Catfish			6	0.6		
Channel Catfish			22	2.2	2	0.3
Flathead Catfish			8	0.8	2	0.3
Redbreast Sunfish			1	0.1	1	0.1
Warmouth	1	1.0			4	0.6
Bluegill	168	168.0	3	0.3	26	2.7
Longear Sunfish	6	6.0			3	0.4
Redear Sunfish	25	25.0			39	5.6
Largemouth Bass	31	31.0				
White Crappie			7	0.7	76	10.9
Black Crappie					17	2.4
Freshwater Drum			1	0.1		

APPENDIX B



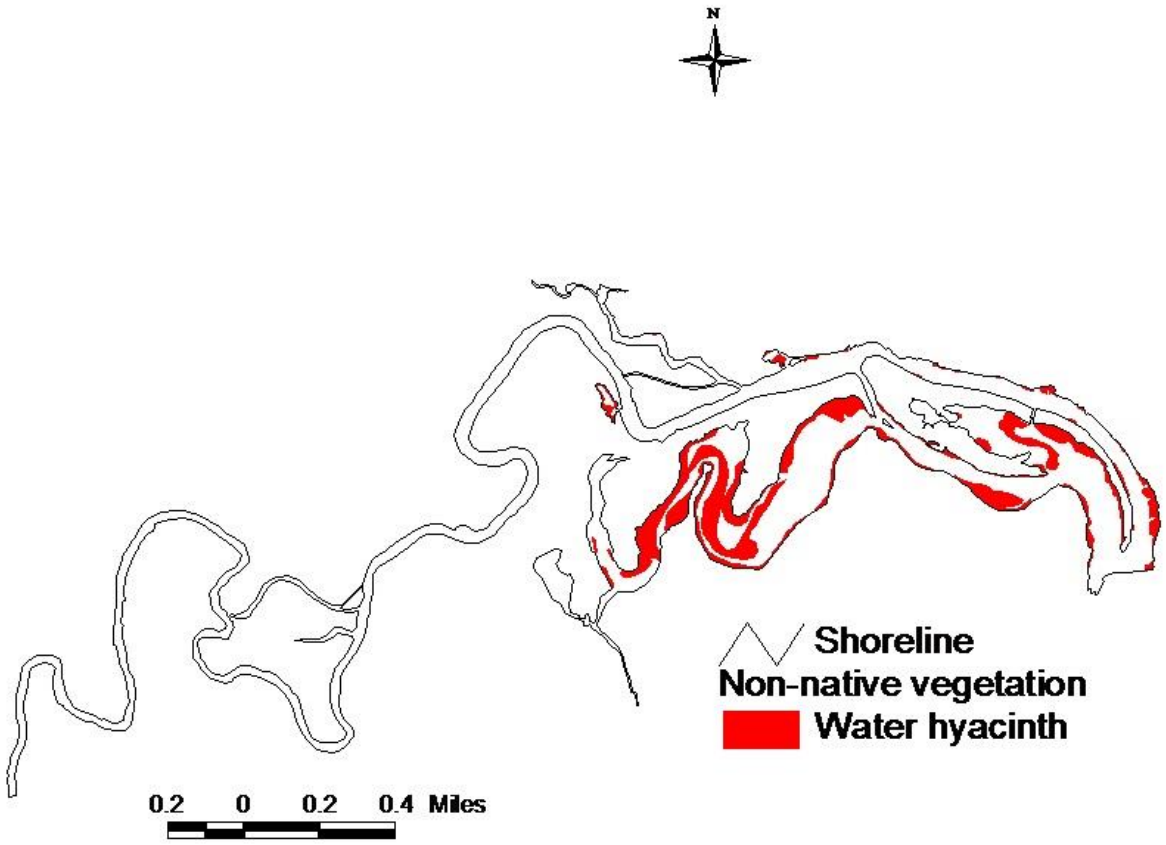
Location of sampling sites, H-4 Reservoir, Texas, 2016. Electrofishing, trap net, and gill net stations are indicated by E, T, and G respectively.

APPENDIX C



Native aquatic vegetation map for H-4 Reservoir, Texas, 2015.

APPENDIX D



Water hyacinth vegetation map for H-4 Reservoir, Texas, 2015.