

PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2016 Fisheries Management Survey Report

Lake Raven

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Lake Raven were surveyed in 2016 using electrofishing and in 2017 using hoop netting. Anglers were surveyed from March 2017 through May 2017 with a roving creel survey. Historical data are presented with the 2016-2017 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:** Lake Raven is a 203-acre reservoir located in Huntsville State Park. The reservoir was repaired and re-impounded in 1956 by the Texas Parks & Wildlife Department for recreational use.
- **Management History:** Lake Raven has a history of producing trophy Largemouth Bass. The population has been managed with a catch-and-release regulation since September 1996. The regulation allows the angler to retain Largemouth Bass measuring ≥ 24 inches for weighing on a personal scale in the boat with subsequent release or, if weighing 13 pounds or more, donation into the Toyota ShareLunker Program. Lake Raven has been included in Operation World Record (OWR), a program to compare growth of selectively bred ShareLunker Largemouth Bass fingerlings to resident bass fingerlings.

Alligatorweed, hydrilla, giant salvinia and water hyacinth have all been problem exotic plants to varying degrees at different times. Various herbicides have been used for chemical treatments. In addition, Grass Carp, hydrilla flies, and alligatorweed flea beetles have been used as biological control agents. Mechanical control and manual removal have also been used as part of an integrated pest management approach.

- **Fish Community**
 - **Prey species:** The prey fish community at Lake Raven consisted primarily of Bluegill, and Redear Sunfish. Gizzard Shad and Threadfin Shad were also present but provided limited forage.
 - **Catfishes:** Blue Catfish and Channel Catfish have been present in Lake Raven as a result of stocking but the populations have limited natural reproduction and recruitment.
 - **Largemouth Bass:** Largemouth Bass were abundant in Lake Raven and provided high quality angling opportunities. The lake has a history of producing trophy Largemouth Bass. Lake Raven has received regular stockings of ShareLunker offspring as part of the selective breeding program.
 - **Crappie:** Crappie were present but not a significant component of the fishery at Lake Raven.
- **Management Strategies:** Largemouth Bass will continue to be managed for big fish potential by continuation of the catch and release regulation and annual stockings of Florida Largemouth Bass. An effort to establish an adult Channel Catfish population will be made through the addition of spawning structures. Implement strategies to improve the aquatic vegetation community including native vegetation plantings and control efforts of invasive exotic species to improve bank access. Improve pier fishing success by adding fish attractors.

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INTRODUCTION

This document is a summary of fisheries data collected from Lake Raven during 2016 and 2017. 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 2016 through 2017 data for comparison.

Reservoir Description

Lake Raven is a 203-acre reservoir located within Huntsville State Park. The drainage area for Lake Raven is approximately 1,556 square miles with rainfall in the watershed averaging 46.2 inches per year. The reservoir has a maximum depth of 28 feet, a mean depth of 6 feet, a shoreline length of 6.3 miles, and a shoreline development ratio of 2.3. Lake Raven lies within the Piney Woods Land Resource Area. Land use around the reservoir is recreational. Boat and bank access are excellent. Other descriptive characteristics from Lake Raven are found in Table 1.

Angler Access

Lake Raven is located entirely within Huntsville State Park and has one public boat ramp. The boat ramp was available to anglers throughout the period covered by this report. Additional boat ramp characteristics are presented in Table 2. Shoreline access is outstanding with the exception of times when overabundant nuisance aquatic vegetation limits casting from some areas of the shore. Two fishing piers located within campground areas are open to day use and are in good condition.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Webb et al., 2013) included:

1. Continue to manage the Largemouth Bass population under a catch-and-release regulation with the caveat that anglers may retain a bass 24 inches or greater for immediate weighing with a personal scale and release or donation to the ShareLunker Program (if qualifying).
Action: The Lake Raven Largemouth Bass population continues to be managed under the catch-and-release regulation.
2. Annually monitor the Largemouth Bass population relative abundance, size distribution, and condition with electrofishing.
Action: The Largemouth Bass population was monitored in the fall of 2015, and 2016.
3. Continue to support Operation World Record (OWR) selective breeding study.
Action: OWR Largemouth Bass fingerlings were stocked again in Lake Raven in 2013 and district staff assisted with subsequent sampling as part of the selective breeding evaluation in 2017.
4. Monitor catfish populations with gill nets in the spring.
Action: Gill netting was conducted in the spring of 2014 but was discontinued after 2015 as dictated by the Objective Based Sampling (OBS) Plan.
5. Stock catfish to support the catfish fishery in Lake Raven.
Action: In 2015, 25,020 surplus Blue Catfish and 852 Channel Catfish were stocked in Lake Raven.
6. Monitor the sunfish populations by fall electrofishing.
Action: Sunfish populations were monitored with electrofishing in fall of 2015 and 2016.
7. Conduct a spring creel survey from March through May every four years to reassess angling effort.
Action: A spring creel survey was conducted in March through May 2017. Largemouth Bass were the most sought after species.

8. Lake Raven is subject to an overabundance of hydrilla, giant salvinia, water hyacinth, and alligator weed but lacks a diverse native aquatic plant population.
Action: Hydrilla has been surveyed annually at Lake Raven with herbicide treatments conducted by Inland Fisheries Staff whenever needed. Four hundred Triploid Grass Carp were stocked into Lake Raven in fall of 2009 as part of the integrated pest management approach to hydrilla control and hydrilla coverage has been minimal since. Giant salvinia, water hyacinth and alligator weed have been controlled annually during the growing season through herbicide application.
9. Assist Huntsville State Park personnel with an annual reservoir drawdown during January for vegetation control.
Action: Plans for an annual drawdown were never implemented due to concerns over drought conditions causing difficulty in refilling the reservoir, but levels were drawn down in 2016 for dam maintenance and this aided in vegetation management.
10. Seek funding for enhancement of native aquatic vegetation population to provide both quality fish habitat and increased competition with exotic plant species.
Action: \$30,000 was received as part of a mitigation settlement from a fuel spill in Walker County. These funds were combined with TPWD's exotic vegetation control funds to institute native vegetation restoration as part of an integrated pest management approach to control nuisance aquatic vegetation at Lake Raven. A native aquatic vegetation nursery has been constructed at the Snook Inland Fisheries Office to supply native aquatic plants for the project. Twelve species of plants are being raised at the nursery and planted into Lake Raven. An evaluation of the project is being conducted as a joint effort between TPWD and Texas A&M University.
11. Work with Huntsville State Park personnel to develop fishing "hot spots" consisting of submersed brush and other fish attractors located around the reservoir in 10 to 15 feet of water.
Action: The "hot spot" fish attractor concept was implemented through the deployment of artificial fishing structures within casting distance of the fishing piers in Spring 2017.
12. Enhance fishing piers with lights and fish attracting structures to increase angler access to catfish and sunfish.
Action: Enhancements to fishing piers are under consideration.
13. Work with Huntsville State Park Personnel to create a brochure highlighting all available fisheries. Include angling techniques and best areas to fish for different species.
Action: Although no specific angling brochure has been developed, Huntsville State Park has an updated park brochure including angling opportunities at Lake Raven.
14. Support Huntsville State Park staff in creating tackle packages for sale in the Park Store specific to different angling opportunities available at Lake Raven.
Action: This idea is still under consideration.
15. Support Huntsville State Park personnel in developing paddling trails for angling and interpretation. Incorporate paddling trails into Park's "Saddles to Paddles" program bridging equestrian packages at their riding livery with canoe rentals.
Action: Paddling trails are still under consideration for Lake Raven. The livery program at Huntsville State Park has been discontinued
16. Provide educational support and materials regarding zebra mussel infestation to Huntsville State Park personnel and visitors.
Action: Zebra mussel information has been provided to staff and in news releases and magazine articles in the Huntsville area. Zebra mussel information is posted at the Lake Raven boat ramp.
17. Install Portland Samplers under the courtesy pier at the Lake Raven boat ramp and under the boat house to monitor for possible zebra mussel infestations.
Action: In lieu of Portland Samplers, the Lake Raven boat ramp and shoreline are sampled for zebra mussel infestations on a regular basis.

Harvest regulation history: Largemouth Bass at Lake Raven have been managed under a catch-and-

release regulation with the caveat that anglers may retain a bass 24 inches or greater for immediate weighing with a personal scale and release or donation to the ShareLunker Program (if qualifying) since 1996. Prior to that, the fishery was under a 14-21 inch slot length limit. Other species have been managed under statewide regulations, except Blue and Channel Catfish which are managed under the special regulations applied to Community Fishing Lakes. Current regulations are found in Table 3.

Stocking history: Fish stockings began at Lake Raven in 1966 with the introduction of Channel Catfish. Periodic stockings of Channel Catfish continued over the next 40 years, but a self-sustaining population has never been created. Florida Largemouth Bass were first introduced in 1979 and have been stocked seven times for a total of over 64,000 fingerlings. In 2005, 2007, 2010, and 2013 ShareLunker advanced fingerling Largemouth Bass were stocked as part of Operation World Record, a research project designed to compare growth of selectively bred ShareLunker fingerlings to that of resident bass fingerlings. Both hybrid and triploid Grass Carp have been stocked for the control of aquatic vegetation. A complete stocking history is provided in Table 4.

Vegetation/habitat management history: The primary habitat in Lake Raven is aquatic vegetation, both native and exotic. Hydrilla has caused access problems in past years and has been controlled by stocking 400 Triploid Grass Carp in 2009 and by herbicide treatments in 2009, 2010, 2012, and 2014. Water hyacinth, giant salvinia, and alligator weed also persist as problem nuisance aquatic species. These species were treated chemically in 2009, 2010, 2012, 2014, 2015, and 2016. In addition, 6,000 alligator weed flea beetles were stocked in 2014 as part of an integrated pest management approach.

Water transfer: Lake Raven is a recreational reservoir contained completely within Huntsville State Park. No interbasin water transfers exist.

METHODS

Surveys were conducted to achieve survey and sampling objectives in accordance with the objective-based sampling (OBS) plan for Lake Raven. Primary components of the OBS plan are listed in Table 5. All survey sites were randomly selected and all surveys were conducted according to the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Electrofishing – Largemouth Bass, sunfishes, Gizzard Shad, and Threadfin 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.

Triple hoop nets – Channel Catfish and Blue Catfish were collected using 4 triple hoop-net series at 4 stations. Nets were baited with soap and deployed for 2-night soak durations. CPUE for triple hoop netting was recorded as the number of fish caught per triple hoop net series (fish/series).

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.

Creel survey – A roving creel survey of boat and bank anglers was conducted in 2017. The creel period was March 1 through May 31. Angler interviews were conducted on 5 weekend days and 4 weekdays to assess angler use and fish catch/harvest statistics in accordance with the Fishery Assessment Procedures (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

Habitat – A structural habitat survey was conducted in 2016. Vegetation surveys were conducted annually from 2011 – 2016 to monitor expansion of hydrilla and or other exotic species and to classify the

vegetation community. Habitat was assessed with the digital shapefile method (TPWD, Inland Fisheries Division, unpublished manual revised 2015).

RESULTS AND DISCUSSION

Habitat: Littoral zone structural habitat consisted primarily of natural shoreline with minimal bulkhead (Table 6). In 2014, herbicide application targeting water hyacinth, giant salvinia, and hydrilla reduced nuisance aquatic vegetation coverage but also impacted native floating-leave vegetation, primarily American lotus, which dropped from 87.2 acres (43 % of water surface) in 2013 to 0 acres by 2016. In 2016, water levels at Lake Raven were lowered by 5 feet during the fall and winter to perform dam renovations, leaving most aquatic vegetation out of the water during the time of the survey. At the time of the fall 2016 survey, native emergent and floating leaved species inhabited less than 1% of the reservoir (0.15 acres) and consisted primarily of bulrush, pickerel weed, and spatterdock. In 2016, nuisance exotic vegetation was also reduced in abundance to less than 1% of the reservoir (0.14 acres) and consisted of water hyacinth intermixed with giant salvinia (Table 7).

Creel: Directed fishing effort by anglers was highest for Largemouth Bass (60%), followed by anglers fishing for anything (27%) (Table 8). Total fishing effort and expenditures continued to increase across years. Effort increased from 21,292 hours in 2013 to 27,631 hours in 2017 with expenditures increasing from \$96,124 in 2013 to \$172,188 for the spring quarter of 2017 (Table 9). The majority of this fishing effort was from bank and pier anglers (60%) as opposed to boat anglers (40%). Both boat and bank anglers targeted Largemouth Bass primarily (80% of boat anglers, 47% of bank angler) and anything (14% of boat anglers, 35% of bank anglers). Most anglers who reported fishing for anything caught Bluegill and Redear Sunfish and catch rates were highest for Largemouth Bass and sunfish, while few crappie or catfish were caught (Table 10).

Prey species: Gizzard shad were present but provided limited forage with a catch rate of 12/h and an IOV of 25 (Figure 1). Electrofishing catch rates of Threadfin Shad, Bluegill, and Redear Sunfish were 49/h, 197/h, and 449/h, respectively (Appendix A, Figure 2, and Figure 3). Catch rates were similar to those of 2013. Bluegill and Redear Sunfish populations were well balanced, with many individuals available to predators, but quality fish of 6 to 9 inches were also available to anglers (Figures 2, 3). Angling effort for sunfish increased to 1,055 h in 2017 and harvest of sunfish species increased to 1,089 fish (5.4 fish per acre) in 2017 (Table 11).

Catfish: In 2017 Blue Catfish and Channel Catfish were targeted with hoop nets following the Objective Based Sampling Plan; however, only one Channel Catfish and no Blue Catfish were collected (Appendix A). Catfish populations in Lake Raven are dependent on stockings and historically exhibited increased gill net catch rates after stocking years, followed by decreasing population abundances (Webb et. al. 2013).

Largemouth Bass: Electrofishing catch rates at Lake Raven are commonly high with minor variations between years. Most recent electrofishing catch rates of Largemouth Bass were 109/hr in 2013, 99/hr in 2015 and 95/h in 2016 (Figure 6). PSD was 59 in 2015 and 45 in 2016 indicating balanced population and the size structure of the population showed high relative abundance of quality fish (> 15 inch). Most fish reached 14 inches between 2 and 3 years.

Directed fishing effort has remained high over the last 3 creel surveys with estimates of 72 h/acre in 2010, 91 h/acre in 2013, and 82 h/acre in 2017 (Table 11). Past catch rates were 0.5 fish/h in 2010 and 0.4 fish/h in 2013, and the catch rate in 2017 was to 0.2 fish/h. Declining catch rates could be due to changing the creel survey from an access point survey in 2010 and 2013 to a roving creel survey in 2017 that covered all shoreline activity, including camp ground areas. Additionally, boat anglers reported higher catch rates (0.3 fish/h) than bank anglers (< 0.1 fish/h, Table 9) and more bank anglers were included in the roving creel in 2017. An estimated 2,619 Largemouth Bass were caught and released

from Lake Raven during the March through May creel period in 2017 (2,317 were less than 4.0 lbs; 269 were 4.0 to 6.9 lbs; and 34 were over 7.0 lbs; Table 12).

Crappie: Trap netting was discontinued after 2013 under the Objective Based Sampling protocol and Black Crappie and White Crappie have been monitored since on a presence/absence basis via electrofishing. Persistence of Black Crappie and White Crappie was documented in 2016 electrofishing surveys (Appendix A). Previous surveys indicate that Black Crappie were more abundant than White Crappie and most crappie were small (Webb et.al. 2013). Few anglers target crappie at Lake Raven (Table 7) and few crappie were recorded in the creel for 2017.

Fisheries management plan for Lake Raven, Texas

Prepared – July 2017.

ISSUE 1: Largemouth Bass, managed for big fish potential with a catch and release regulation, continue to be a popular sport fish at Lake Raven providing an outstanding fishery. Efforts to evaluate the fishery and maintain big fish potential should continue.

MANAGEMENT STRATEGY

1. Continue to support selective breeding research using Lake Raven as a study site. Request annual stockings of Florida Largemouth Bass to maximize.
2. Maintain and evaluate current catch-and-release-only regulation for Largemouth Bass population and fishery according to the OBS plan.
3. Continue to promote the Largemouth Bass fishery through available media resources.

ISSUE 2: Lake Raven is subject to an overabundance of hydrilla, giant salvinia, water hyacinth, and alligator weed that has historically impeded fishing access but lacks a diverse native aquatic plant population.

MANAGEMENT STRATEGIES

1. Use Endothol to control hydrilla for improved shoreline access as needed.
2. Use Glyphosate to control giant salvinia, water hyacinth and alligator weed to improve shoreline access as needed.
3. Continue to establish native emergent, submersed, and floating leaved plants to improve fish habitat.
4. Use biocontrols and mechanical removal of exotic nuisance species as needed as part of the integrated pest management approach.

ISSUE 3: Channel Catfish populations in Lake Raven are limited by natural recruitment and are currently maintained as a low density population by stocking.

MANAGEMENT STRATEGIES

1. Place catfish spawning structures into Lake Raven to see if increased natural spawning will help establish a self-sustaining catfish fishery in the presence of Largemouth Bass predation.
2. Stock 9-inch Channel Catfish into Lake Raven to establish a spawning population.
3. Determine effectiveness of spawning structures in establishment of an adult Channel Catfish population as described in OBS plan.

ISSUE 4: Lake Raven is heavily utilized by bank and pier anglers as well as boat anglers but fishing success is much lower for bank and pier anglers than for those fishing from boats.

MANAGEMENT STRATEGIES

1. Place fish attractors under and around fishing piers to attract sunfish and Largemouth Bass.
2. Add fish attracting structures near shorelines around camping and day use areas to improve angling opportunities for bank anglers and consult with Parks Staff about adding green light fish attractors around fishing piers.
3. Place "how to fish" signs on piers and along shorelines to better educate occasional anglers on appropriate angling methods.

ISSUE 5: 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.

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.

Objective Based Sampling Plan for Lake Raven 2017-2021

Largemouth Bass are the primary sport fishes in Lake Raven, and Blue Catfish, Channel Catfish, Black Crappie and White Crappie are also present. Forage species include Gizzard Shad, Threadfin Shad, and Bluegill.

Low Density fisheries

Crappie: During the March - May creel survey in 2017, directed angler effort for crappie was 7.8 h/acre but catch rate for anglers targeting crappie was < 0.1fish/h in 2017. Harvest also declined from an estimated 315 crappie in 2005, to 12 crappie in 2013 and 0 in 2017. Historically, crappie have been sampled every four years with 5 single-cod, shoreline set trap nets in late fall, with catch rates ranging from 0.2nn – 0.4nn (2009 – 2013). Based on bootstrap analysis of historical data, it would take greater than 15 trap nets to attain acceptable precision (RSE < 25, N > 50). Therefore, crappie data will be measured as presence/absence during normal electrofishing efforts and a spring quarter creel survey.

Blue Catfish: Catfish populations in Lake Raven are dependent on stockings and 31,768 fingerling Blue Catfish have been stocked between 2000 and 2015 (Table 4). The gill net catch rate of Blue Catfish declined with a catch rate of 8.2/nn in 2006, 10.0/nn in 2010, and 3.0/nn in 2014. The presence/absence of Blue Catfish (**this is the survey objective**) will continue to be monitored through creel surveys every four years (**this is the sampling objective**).

Survey objectives, fisheries metrics, and sampling objectives

Channel Catfish: Channel Catfish populations are dependent on stockings and 28,195 Channel Catfish have been stocked since 2010. However, the gill net catch rate of Channel Catfish was 0.2/nn in 2013, much lower than it was in 2006 and 2010 (8.0/nn and 2.6/nn respectively). One Channel Catfish was collected during the hoop net survey in 2017 and catfish accounted for 3.6% of directed angler effort during the 2017 creel survey. In an attempt to overcome the recruitment limitation of Channel Catfish in Lake Raven and establish an adult population, spawning structures will be added. Channel Catfish will then be surveyed for relative abundance and population size structure (**this is the survey objective**). Relative abundance will be measured using CPUE-Total with an RSE < 25, and population size structure will be measured by the length frequency of a minimum of 50 fish (**this is the sampling objective**). A minimum of four triple hoop net series will be deployed annually and a maximum of an additional four

triple hoop net series will be deployed to meet survey objectives. A creel survey in 2021 will be used to compare trend data from angler catch of Channel Catfish.

Largemouth Bass: Largemouth Bass are the most popular sport fish in Lake Raven. The popularity and reputation for quality Largemouth Bass fishing and alternative management regulation for Largemouth Bass at Lake Raven warrant sampling time and effort. Angler effort is high at Lake Raven and this species accounting for approximately 60% of the total directed angling effort during the March - May 2017 creel survey. Electrofishing surveys conducted during 2015 and 2016 produced CPUE's ranging from 95 to 99 fish/h (with RSE's from 18 to 19). Continuation of biennial trend data in this reservoir with night electrofishing in the fall with a spring quarter creel survey every 4 years will allow for determination of any large-scale changes in the Largemouth Bass population (relative abundance, size structure, body condition, and growth) that may spur further investigation (**this is the survey objective**). Bootstrap analysis of this data suggests reliable population metrics (CPUE, $RSE < 25$; PSD and W_r which require $N > 50$ stock size individuals) would require 12 randomly selected 5-minute electrofishing stations (**this is the sample objective**). Up to 4 additional biologist selected sites will be sampled for Largemouth Bass only in an attempt to collect 13 specimens of 13.0-14.9 inches in length to estimate mean age at 14 inches if 13 specimens in this size range are not collected in the first 12 stations (**this is the secondary sample objective**).

Threadfin Shad, Bluegill, and Redear Sunfish: Threadfin Shad, Bluegill, and Redear Sunfish are the primary forage species at Lake Raven. Gizzard Shad are present, but provide limited forage. Sampling Threadfin Shad, Bluegill, and Redear Sunfish at the same intensity as is proposed for Largemouth Bass will provide trend information to detect large-scale changes in general population characteristics (size structure, relative abundance) of sunfish and shad species (**this is the survey objective**). Relative weight estimates for Largemouth Bass will be used for supplemental qualitative assessment of prey suitability. No additional effort will be expended beyond the effort required to collect for Largemouth Bass.

Creel Survey: A roving angler creel survey will be conducted March 1, 2021 – May 31, 2021 to estimate directed angling effort, catch, harvest, and expenditures for all game fish species. This is a general monitoring creel survey that intends to capture information about all species sought by anglers, economic expenditures, travel distances for anglers and angling pressure on Lake Raven fisheries. Creel data will also be used to evaluate Channel Catfish recruitment into the fishery as a result of increased spawning success because of added spawning structures.

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Table 1. Characteristics of Lake Raven, Texas.

Characteristic	Description
Year constructed	1956
Controlling authority	Texas Parks and Wildlife Department
Counties	Walker (location of dam)
Reservoir type	State Park
Shoreline Development Index (SDI)	2.3
Conductivity	160 μ mhos/cm

Table 2. Boat ramp characteristics for Lake Raven, Texas, September, 2016. Reservoir elevation at time of survey was 284 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Huntsville State Park	30.61044 -95.53413	Y	15	282	Excellent, no access issues

Table 3. Harvest regulations for Lake Raven, Texas.

Species	Bag Limit	Minimum-Maximum Length (inches)
Bass, Largemouth	0	Catch-and-release-only*
Catfish, Flathead	5	18 – No limit
Catfish, Channel and Blue Catfish, their hybrids and subspecies	5 (in any combination)	No limit
Crappie, White and Black Crappie, their hybrids and subspecies	25 (in any combination)	10 – No limit

* Catch and release only for Largemouth Bass except that any bass 24 inches or greater caught may be weighed on personal scales and then immediately released or donated to the ShareLunker Program.

Table 4. Stocking history of Lake Raven, Texas. FGL = fingerling; AFGL = advanced fingerling; ADL = adults.

Year	Number	Size	Year	Number	Size
Northern Pike			Black Crappie		
1974	1,160	FGL	1968	30	ADL
Tripliod Grass Carp			1970	4,120	ADL
2005	400	ADL	Species Total	4,150	
2009	400	ADL	Florida Largemouth Bass		
Species Total	800		1979	10,800	FGL
Grass Carp X Bighead			1980	338	ADL
1989	3,083	ADL	1987	16,850	FGL
1990	400	ADL	1991	22,487	FGL
Species Total	3,483		1996	142	ADL
N Pike X Muskellunge			1998	952	AFGL
1976	2,100	FGL	2013	12,451	AFGL
Blue Catfish			Species Total	64,202	
2000	1,591	AFGL	Sharelunker Largemouth Bass		
2003	5,157	AFGL	2005	5,901	AFGL
2015	25,020	FGL	2007	5,088	AFGL
Species Total	31,768		2010	2,375	AFGL
Channel Catfish			2013	12,375	AFGL
1966	9,900	AFGL	Species Total	25,739	
1971	52,000	AFGL	Redear X Green Sunfish		
1972	57,400	AFGL	1968	13	ADL
1980	80	ADL	1972	300	FGL
1982	2,016	AFGL	Species Total	313	
1987	21,087	AFGL			
1992	5,252	AFGL			
1996	5,250	AFGL			
1998	5,256	AFGL			
1999	5,251	AFGL			
2000	3,672	AFGL			
2001	5,253	AFGL			
2002	5,237	AFGL			
2004	2,034	AFGL			
2005	12,084	AFGL			
2006	2,930	ADL			
2010	25,476	AFGL			
2012	1,860	ADL			
2015	859	FGL			
Species Total	222,897				

Table 5. Objective-based sampling plan components used to survey Lake Raven in 2016, and 2017.

Gear/target species	Survey objective	Metrics	Sampling objective
<i>Electrofishing</i>			
Largemouth Bass	Abundance	CPUE – stock	RSE-Stock ≤ 25
	Size structure	PSD, length frequency	$N \geq 50$ 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	$N \geq 50$
Redear Sunfish ^a	Abundance	CPUE – Total	RSE ≤ 25
	Size structure	PSD, length frequency	$N \geq 50$
Crappies	Presence / Absence		
Gizzard Shad ^a	Abundance	CPUE – Total	RSE ≤ 25
	Size structure	PSD, length frequency	$N \geq 50$
	Prey availability	IOV	$N \geq 50$
<i>Triple hoop netting</i>			
Channel Catfish	Presence / Absence		
Blue Catfish	Presence / Absence		

^a No additional effort was expended to achieve an RSE ≤ 25 for CPUE of Bluegill, Redear Sunfish, and Gizzard Shad if not reached from designated Largemouth Bass sampling effort. Instead, Largemouth Bass body condition provided information on forage abundance, vulnerability, or both relative to predator density.

Table 6. Survey of structural habitat types, Lake Raven, Texas, 2016. Shoreline habitat type units are in miles.

Habitat type	Estimate	% of total
Bulkhead	0.4 miles	6.6
Natural	5.9 miles	93.4

Table 7. Survey of aquatic vegetation, Lake Raven, Texas, 2011 - 2016. Surveys in 2013 and 2016 were conducted for all species, while surveys in 2011, 2012, 2014, and 2015 dealt only with aquatic nuisance species. Surface area (acres) is listed with percent of total reservoir surface area in parentheses. Water level was lowered in 2016 during the survey period leaving little vegetation in the water.

Vegetation	2011	2012	2013	2014	2015	2016
Native floating-leaved			87.2 (43.0)			< 0.1 (< 0.1)
Native emergent			57.2 (28.1)			0.1 (< 0.1)
Non-native						
Alligator weed (Tier II)*	18.8 (9)	24.5 (12)	4.2 (2.1)	1.9 (1.0)	< 0.1 (< 0.1)	< 0.1 (< 0.1)
Giant salvinia (Tier II)*	14.6 (7)	2.8 (1)	3.0 (1.5)	< 0.1 (< 0.1)	0.1 (< 0.1)	0.1 (< 0.1)
Hydrilla (Tier II)*	51.3 (25)	0.1 (0)	0.3 (0.2)	3.3 (1.6)	0 (0)	0 (0)
Water hyacinth (Tier II)*	13.8 (7)	3.5 (2)	24.7 (26.9)	29.3 (14.4)	< 0.1 (< 0.1)	< 0.1 (< 0.1)

*Tier II is maintenance control status.

Table 8. Percent directed angler effort by species for Lake Raven, Texas, 2010, 2013, and 2017. Survey periods were from 1 March through 31 May.

Species	2010	2013	2017
Catfish	2.4	0.0	3.6
Sunfishes	3.6	1.5	3.8
Largemouth Bass	83.9	87.1	60.0
Crappie	4.2	3.4	5.7
Anything	5.9	8.0	26.9

Table 9. Total fishing effort (h) for all species and total directed expenditures at Lake Raven, Texas, 2010, 2013, and 2017. Survey periods were from March 1 to May 31. Relative standard error is in parentheses where applicable.

Creel statistic	2010	2013	2017
Total fishing effort	17,403 (30)	21,292 (28)	27,631 (13)
Total directed expenditures	\$81,933 (61)	\$96,124 (57)	\$172,188 (72)

Table 10. Total fishing effort (h) for all species, total direct expenditures, present direct effort by species, and catch of anglers fishing from boat and bank for Lake Raven, Texas 2017. Bank anglers included those on natural shoreline, bulkhead, or fishing pier. Relative standard error is in parentheses where applicable. Survey periods were from March 1 to May 31.

Creel statistic	Bank anglers	Boat anglers
Total fishing effort	16711 (21)	10919 (10)
Percent fishing effort	60%	40%
Total directed expenditures	\$87,213 (99)	\$84,975 (105)
Percent directed expenditures	51%	49%
Percent directed effort		
Catfish	5.9	
Sunfishes	3.4	4.5
Largemouth Bass	46.4	80.8
Crappie	9.5	
Anything	34.8	14.7
Total catch		
Catfish	40 (311)	0
Sunfishes	998 (81)	3,146 (83)
Largemouth Bass	363 (81)	2,256 (82)
Crappie	161 (156)	0
Catch rate (fish/h)		
Catfish	< 0.1	0
Sunfishes	1.8	6.4
Largemouth Bass	< 0.1	0.3
Crappie	< 0.1	0

Gizzard Shad

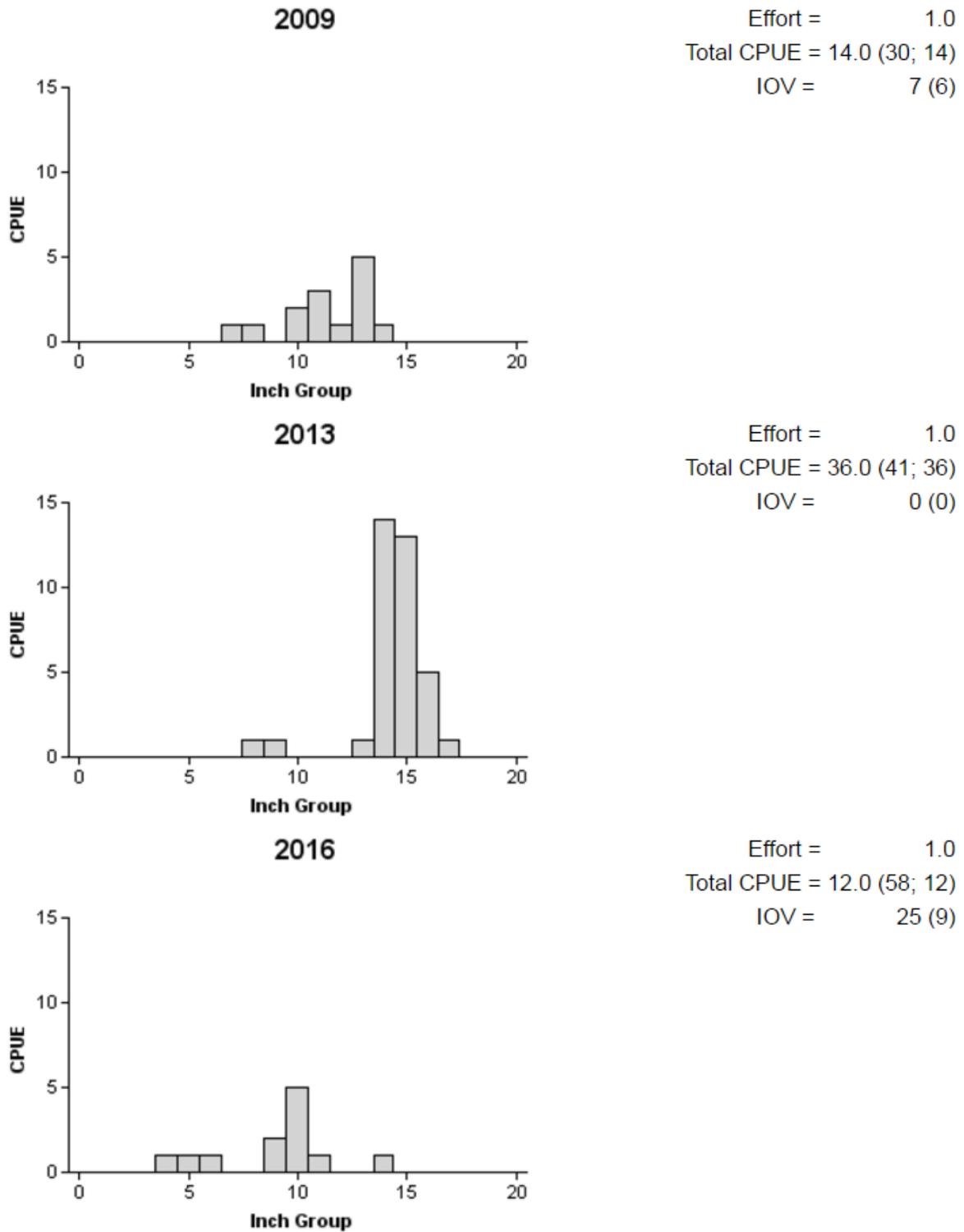


Figure 1. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for IOV are in parentheses) for fall electrofishing surveys, Lake Raven, Texas, 2009, 2013, and 2016.

Bluegill

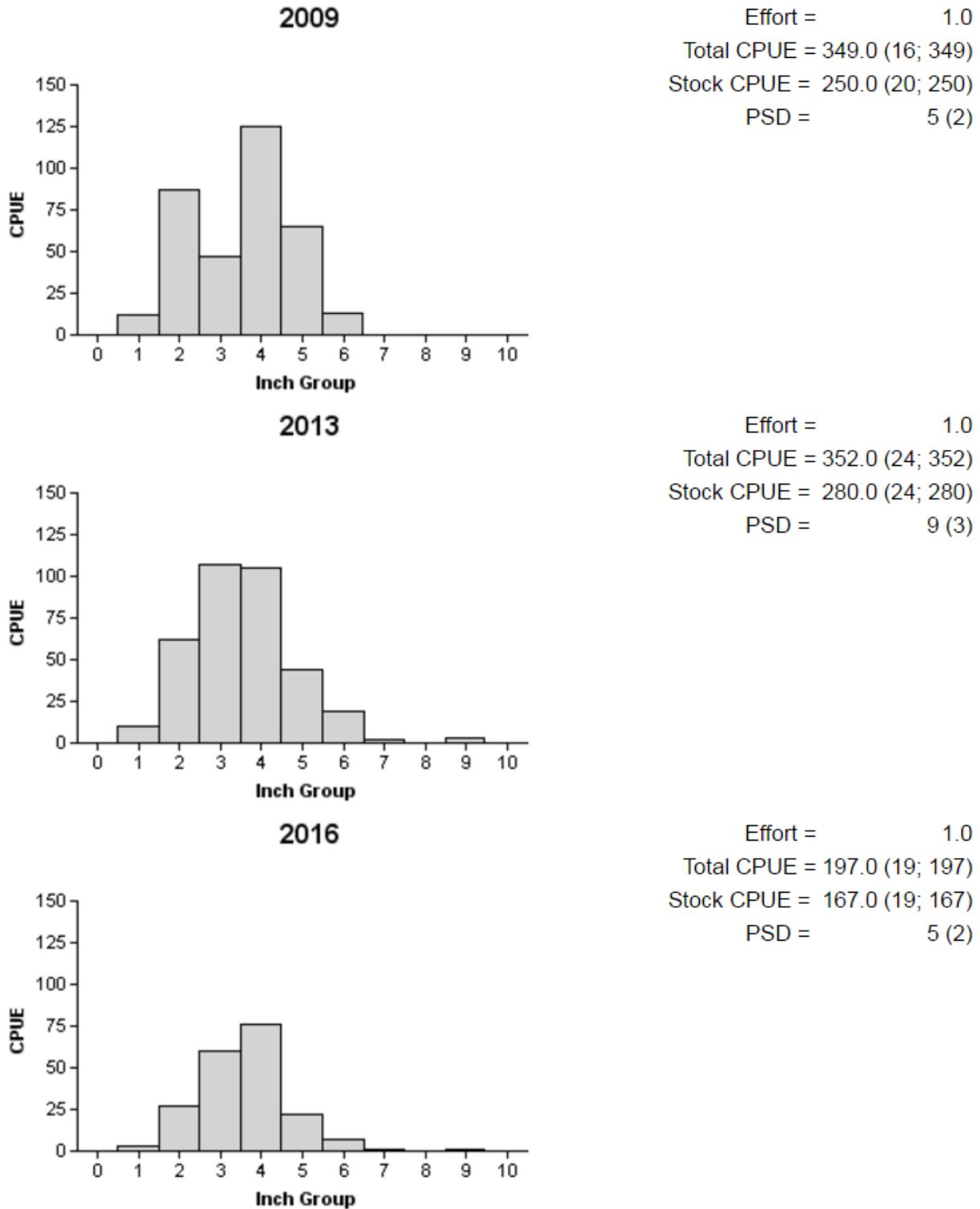


Figure 2. Number of Bluegill caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Raven, Texas, 2009, 2013, and 2016.

Redear Sunfish

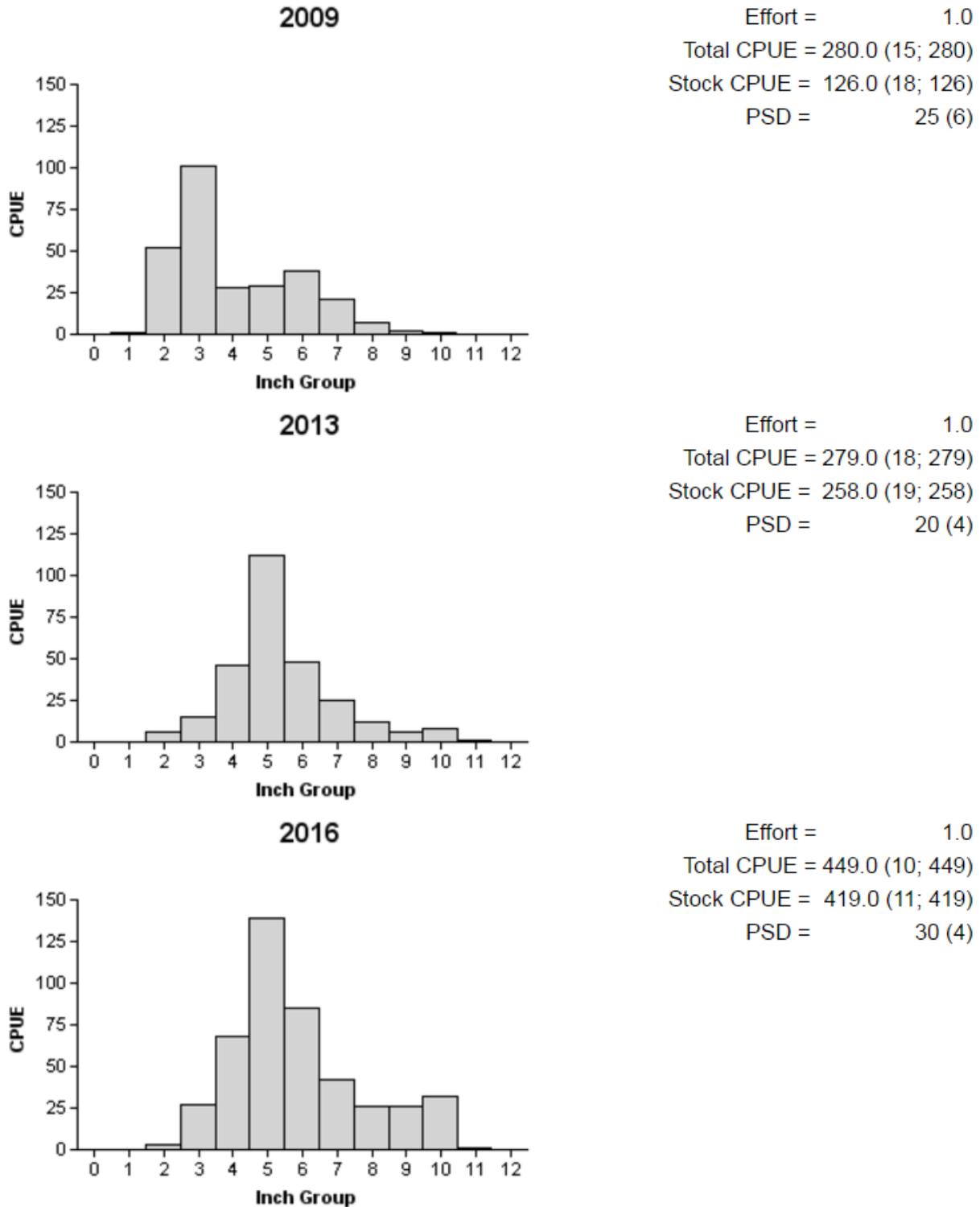


Figure 3. Number of Redear Sunfish caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Raven, Texas, 2009, 2013, and 2016.

Sunfish

Table 11. Creel survey statistics for all sunfish at Lake Raven from March 2010 through May 2010, March 2013 through May 2013, and March 2016 through May 2016. Total catch per hour is for anglers targeting sunfish and total harvest is the estimated number of sunfish harvested by all anglers. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year		
	2010	2013	2017
Directed effort (h)	626.6 (88)	637.4 (85)	1,054.7 (69)
Directed effort/acre	3.1	3.1	5.2
Total catch per hour	4.7 (185)	0.5 (233)	3.9
Total harvest	154 (100)	12 (100)	1,089 (81)
Harvest/acre	0.8 (100)	0.1 (233)	5.4

Largemouth Bass

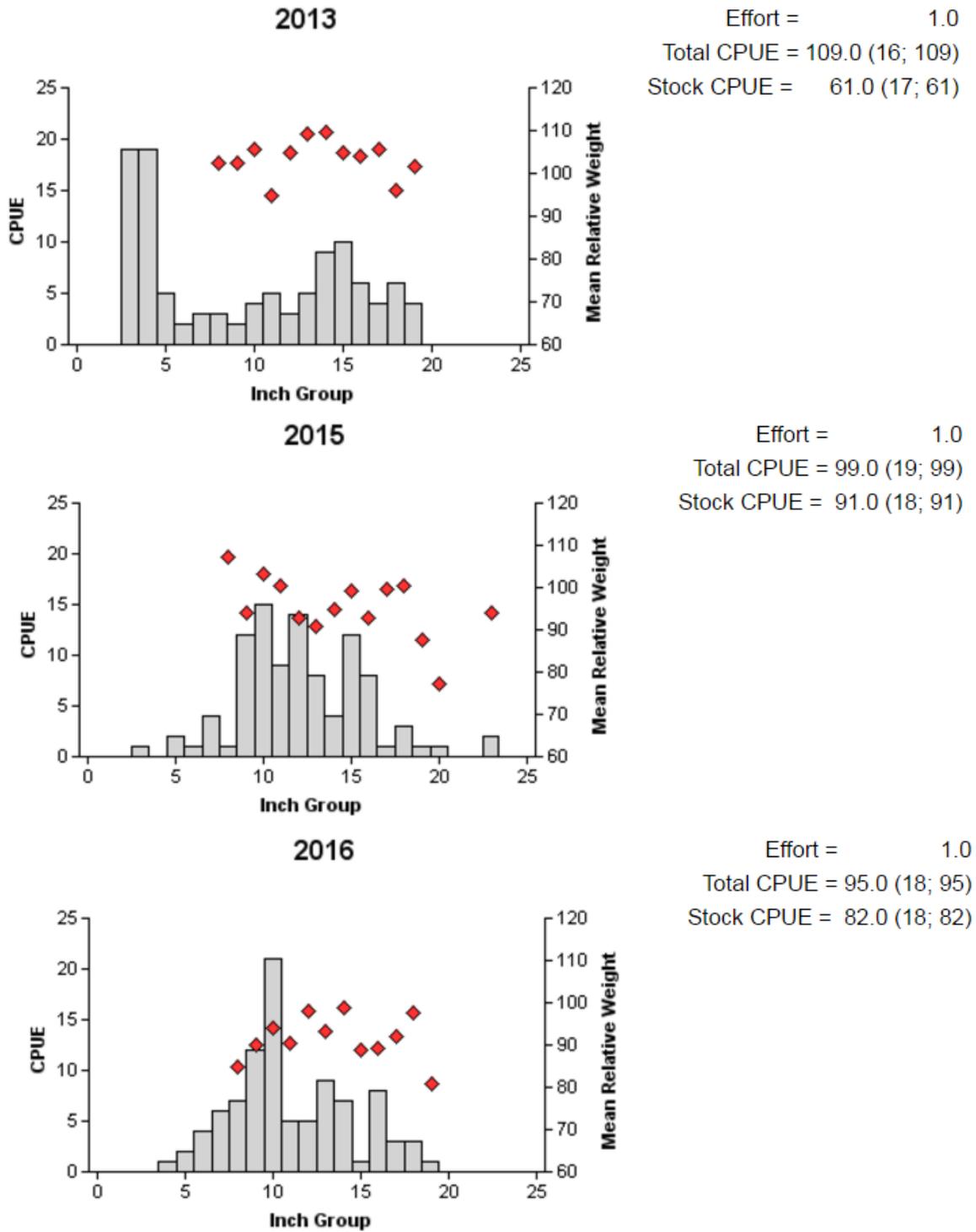


Figure 4. Number of Largemouth Bass caught per hour (CPUE, bars) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall electrofishing surveys, Lake Raven, Texas, 2013, 2015, and 2016.

Largemouth Bass

Table 12. Creel survey statistics for Largemouth Bass at Lake Raven, TX from March through May 2010, 2013, and 2017. Catch rate is for all anglers targeting Largemouth Bass. The estimated number of fish released by weight category is for anglers targeting Largemouth Bass. Relative standard errors (RSE) are in parentheses.

Creel survey statistic	Year		
	2010	2013	2017
Directed angling effort (h)			
Non-tournament	14,603.0 (32)	18,372.8 (72)	16,580.1 (15)
Angling effort/acre	71.9	90.5	81.7
Catch rate (number/hr)	0.5 (35)	0.4 (60)	0.2 (12)
Release by weight	NA		
<4.0 lbs		6,740 (34)	2,317 (72)
4.0-6.9 lbs		1,212.0 (46)	269 (75)
7.0-9.9 lbs		76.0 (139)	34 (92)
≥10 lbs		0	0

Table 13. Proposed sampling schedule for Lake Raven, Texas. Survey period is June through May. Hoop netting surveys are conducted in the spring while electrofishing surveys are conducted in the fall. Standard survey denoted by S and additional survey denoted by A.

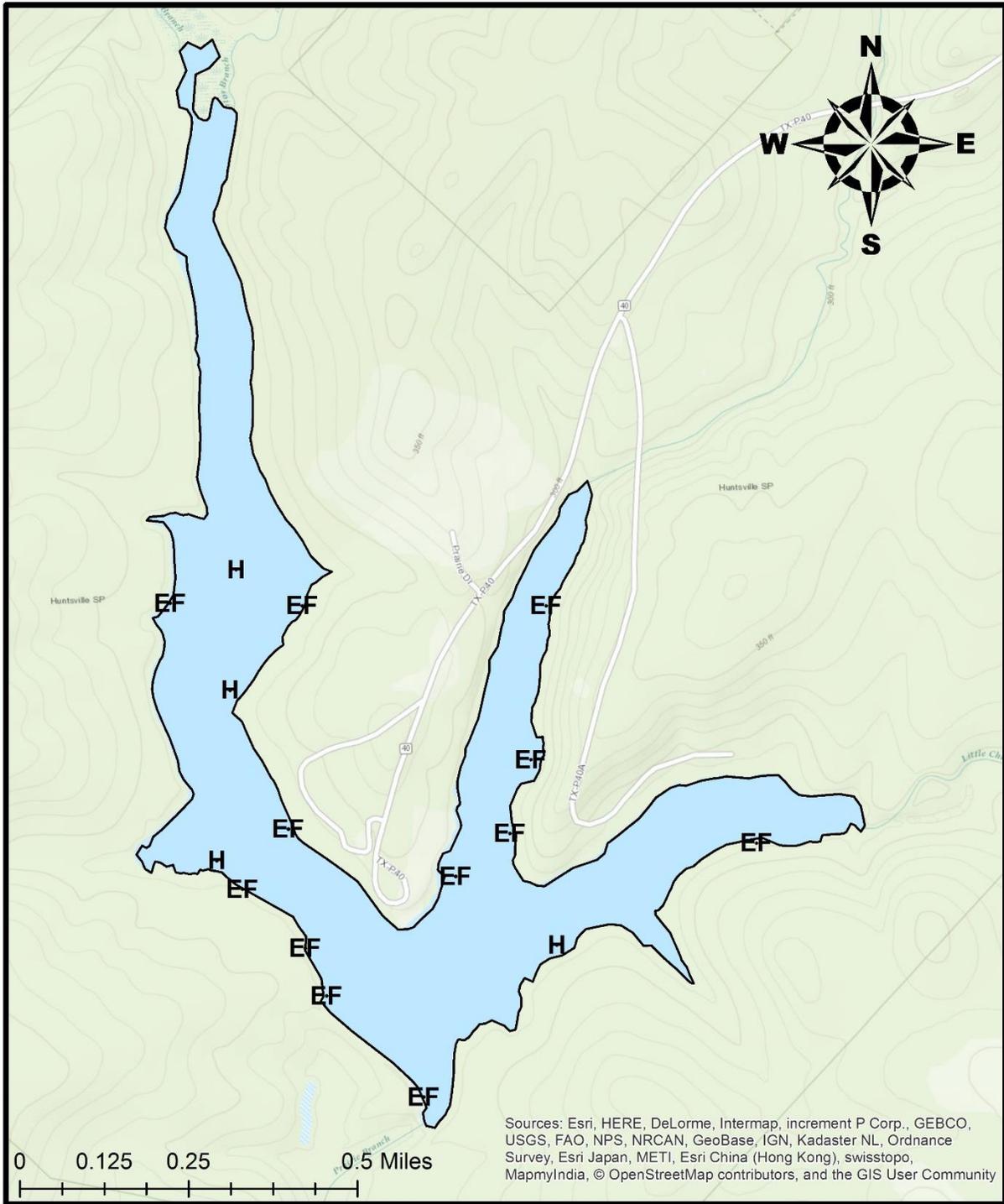
Survey year	Electrofishing	Hoop Net	Habitat			Spring creel survey	Report
			Structural	Vegetation	Access		
2017-2018		A		A			
2018-2019	A	A		A			
2019-2020		A		A			
2020-2021	S	S	S	S	S	A	S

APPENDIX A

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Lake Raven, Texas, 2016-2017. Sampling effort was 4 nets for hoop netting and 1 hour for electrofishing.

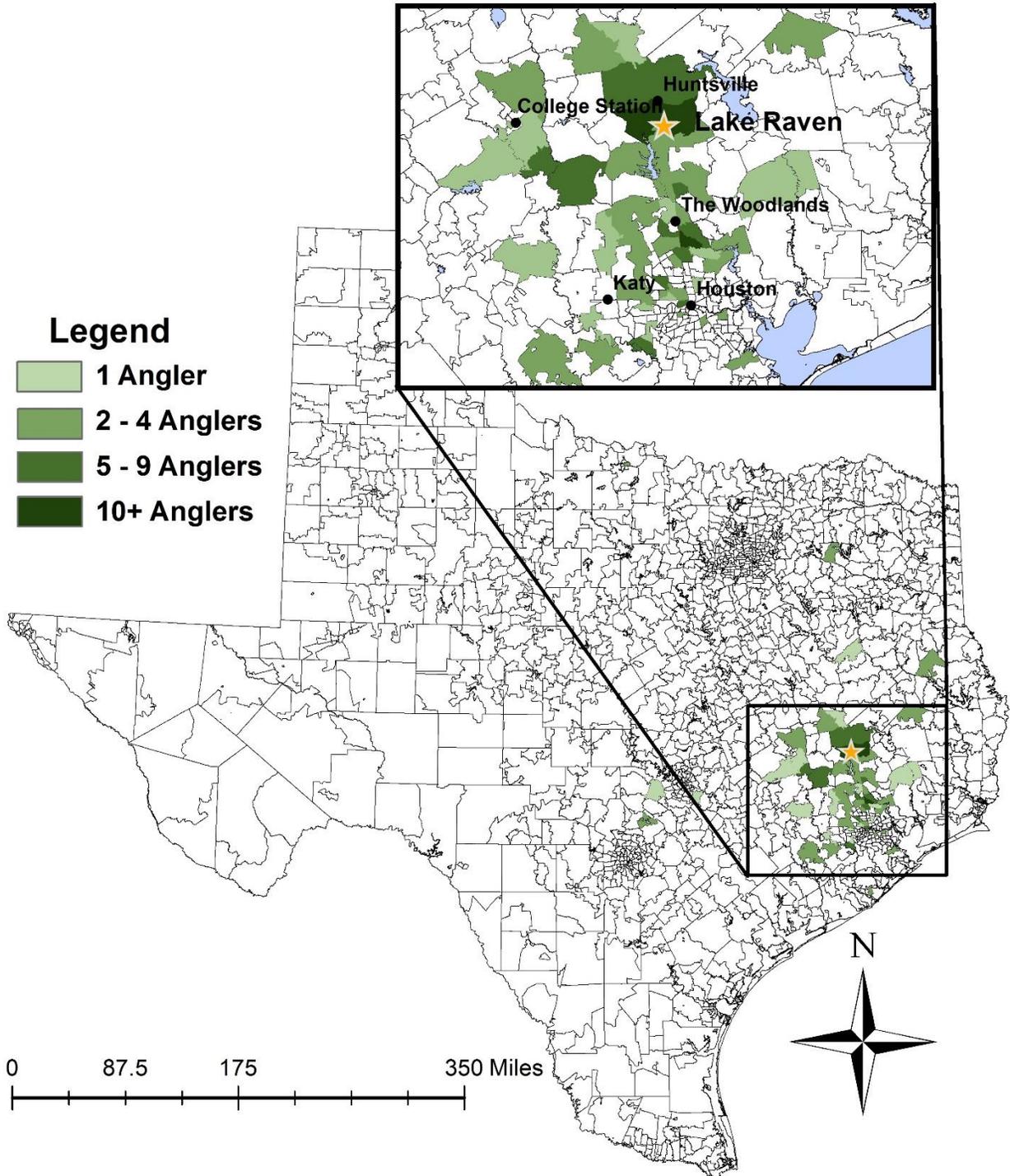
Species	Electrofishing		Hoop Netting	
	N	CPUE	N	CPUE
Gizzard Shad	12	12.00		
Threadfin Shad	49	49.00		
Golden Shiner	10	10.00		
Brook Silverside	2	2.00		
Blue Catfish	1	1.00		
Channel Catfish			1	0.25
Warmouth	1	1.00		
Orange spotted Sunfish	2	2.00		
Bluegill	197	197.00		
Longear Sunfish	2	2.00		
Redear Sunfish	449	449.00		
Largemouth Bass	95	95.00		
White Crappie	1	1.00		
Black Crappie	4	4.00		
Triploid Grass Carp	2	2.00		

APPENDIX B

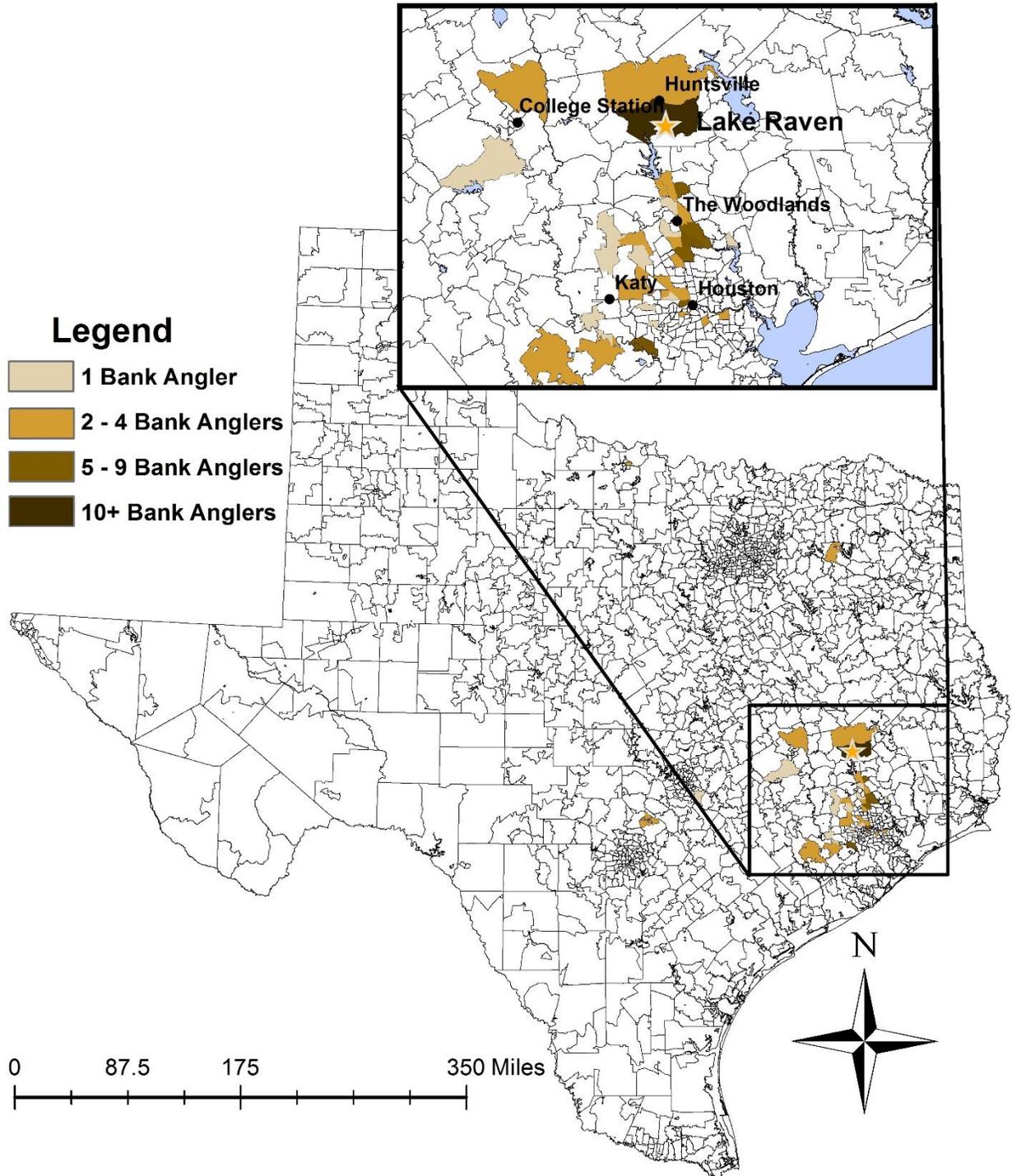


Location of sampling sites, Lake Raven, Texas, 2016-2017. Hoop netting and electrofishing stations are indicated by H and EF, respectively. Water level was near full pool at time of sampling.

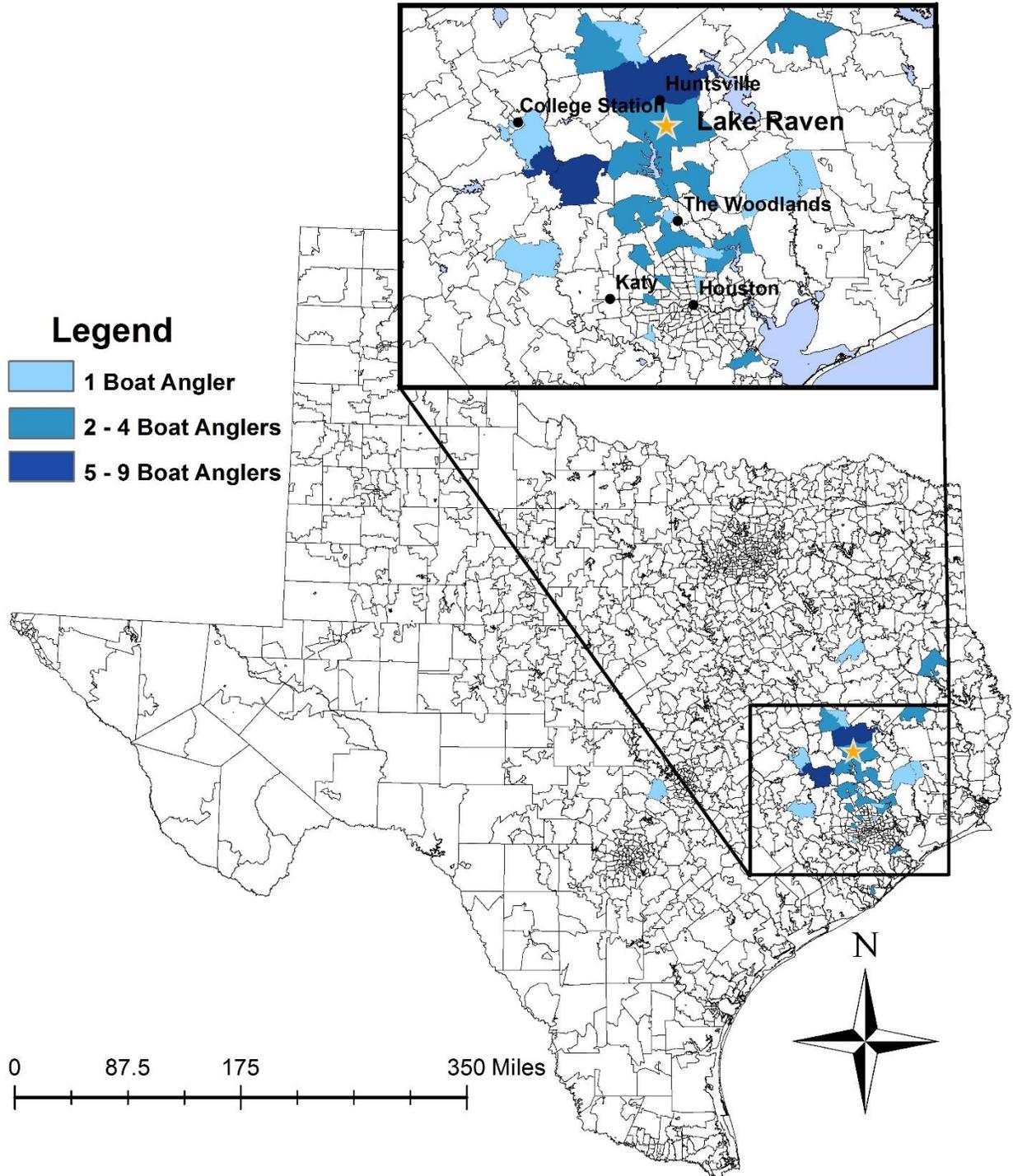
APPENDIX C



Location, by ZIP code, and frequency of total anglers (both bank and boat anglers) that were interviewed at Lake Raven, Texas, during the March through May 2017 creel survey.



Location, by ZIP code, and frequency of bank anglers that were interviewed at Lake Raven, Texas, during the March through May 2017 creel survey.



Location, by ZIP code, and frequency of boat anglers that were interviewed at Lake Raven, Texas, during the March through May 2017 creel survey.