PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2014 Fisheries Management Survey Report

Nasworthy Reservoir

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SURVEY AND MANAGEMENT SUMMARY

Fish populations in Nasworthy Reservoir were surveyed in 2013 using gill netting, and in 2014 using electrofishing and trap netting. Historical data are presented with the 2014 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:** Nasworthy Reservoir is a 1,598-acre impoundment located on the southwestern edge of San Angelo, Texas in Tom Green County. It is a shallow, turbid reservoir with stable water levels and extensive emergent vegetation. Access is good with numerous public boat ramps and parks.

- **Management History:** Important sport fish include Largemouth Bass, White Crappie, and Channel Catfish. Palmetto Bass (Striped Bass x White Bass hybrid) were stocked from the 1970s through 2007. Red Drum were once an important game species, but the discontinued operation of the power plant on Nasworthy Reservoir in 2003 eliminated this fishery that was dependent on the plant's heated water effluent.

- **Fish Community**
  - **Prey species:** Gizzard Shad and Bluegill abundance increased in the most recent survey, and availability of shad to predators also increased. The prey base at Nasworthy Reservoir was in better shape than it had been in several years.
  - **Catfishes:** Blue Catfish and Flathead Catfish were present in low abundance. Channel Catfish abundance was good, with many fish between 12 and 15 inches. Individuals up to 25 inches were sampled.
  - **Largemouth Bass:** Largemouth Bass abundance was good. Size structure and body condition were not adequate, and growth to 14 inches was slow. An estimated 5,150 Largemouth Bass (> 6 inches) were in the reservoir, including approximately 800 bass > 14 inches.
  - **White Crappie:** White Crappie catch rate was good, and consistent with previous years; however, more individuals > 10 inches were present in the latest survey. Growth to 10 inches was improved, with average 10-inch crappie being 2.5-years old.

- **Management Strategies:** Communicate with anglers, community groups, and city officials about the new Largemouth Bass regulation and how it will work to improve bass fishing. Communicate with the public about preventing spread of invasive species.

INTRODUCTION

This document is a summary of fisheries data collected from Nasworthy Reservoir in 2014. 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 2014 data for comparison.

Reservoir Description

Nasworthy Reservoir is a 1,598-acre impoundment constructed in 1930 on the South Concho River. It is located in Tom Green County on the southwestern edge of San Angelo and is operated and controlled by the City of San Angelo. Primary water uses included municipal water supply, irrigation and recreation. Water level remains fairly constant (Figure 1) due to supplemental flows from upstream Twin Buttes Reservoir. The reservoir was used for power plant cooling until 2003, when the plant ceased operation. Nasworthy Reservoir was eutrophic with a mean trophic state index (TSI) chl-*a* of 54.74, which was higher than the 2008 sample (Texas Commission on Environmental Quality 2011). The reservoir experienced a mild golden alga fish kill in spring 2014, but the impacts were minimal. Habitat consisted mainly of bulkhead, riprap, boat docks, and native emergent vegetation (bulrushes and water willow). Other descriptive characteristics for Nasworthy Reservoir are in Table 1.

Angler Access

Nasworthy Reservoir has 13 public boat ramps and an unknown number of private boat ramps (Table 2). Under normal conditions, all ramps are in the water and useable due to water supplementation from the Twin Buttes Reservoir dam just upstream. In the extreme drought of spring 2014 Twin Buttes was too low for supplementation, so about half of the ramps at Lake Nasworthy became unusable due to low water. The situation was corrected by early summer 2014 as water level rose to near conservation pool. Shoreline access is abundant at city-maintained parks around the lake, and a disabled-access public fishing pier is available near the San Angelo Nature Center.

Management History

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

1. Propose to change the Largemouth Bass length limit to attempt to improve growth and size structure in this population.
   Action: Several constituent meetings, press releases and an online survey were conducted to garner support for a regulation change. A 14- to 18-inch slot limit was proposed in 2014/2015 and passed by the TPWD Commission. The new regulation will go into effect September 1, 2015.
2. Encourage awareness of invasive species risks and ways to prevent their spread.
   Action: Educational materials were distributed throughout the district, and press releases were made.

Harvest regulation history: Sport fishes in Nasworthy Reservoir are currently managed with statewide regulations (Table 3). In 2005, the minimum length limit and bag limit on Red Drum were removed to allow harvest of any remaining Red Drum after the closure of the reservoir's power plant; the discontinuation of hot-water discharge from the power plant made the reservoir unsuitable for this species. On September 1, 2015, the length limit for Largemouth Bass will change to a 14- to 18-inch slot limit.

Stocking history: Species stocked have included Channel Catfish, Largemouth Bass, Palmetto Bass and Red Drum. Palmetto Bass stockings were discontinued after 2007 because of poor growth and lack of a fishery. Red Drum stockings were discontinued after 2002 because the power plant on the reservoir stopped operation, eliminating the heated water effluent that enabled overwinter survival of Red Drum. The complete stocking history is in Table 4.

Vegetation/habitat management history: The City of San Angelo dredged the reservoir in 1999 to remove excess sediment. The city also periodically controls spread of bulrushes with chemical methods.

Water transfer: Nasworthy Reservoir is primarily used for municipal water supply, irrigation, and recreation. When the Twin Buttes dam gates are opened by the City of San Angelo, the water feeds directly into downstream Nasworthy Reservoir. Water from Nasworthy Reservoir is fed downstream directly into the South Concho River which flows through south San Angelo to a pumping station near Ave L, supplying municipal water for San Angelo. An irrigation canal is sometimes used to provide water to Concho River watershed farmers. No interbasin transfers are known to exist.

METHODS

Fishes were collected by electrofishing (1 hour at 12, 5-min stations), trap netting (10 net nights at 10 stations, and gill 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 trap netting and gill netting, 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).

Additional sampling was conducted in 2014-2015 to meet the objectives in the new Objective-Based Sampling (OBS) Plan for Nasworthy Reservoir (see Appendix C). Largemouth Bass were evaluated in a mark-recapture study to estimate population size. Gill netting was not conducted in 2015 because those species targeted by gill nets, besides Channel Catfish, were deemed negligible in the Objective- Based Sampling Plan (Blue and Flathead Catfish, White Bass, and Palmetto Bass). A 2-quarter roving creel survey and a tandem hoop-netting survey of Channel Catfish were begun in spring 2015, also to meet OBS objectives, but results were not yet available because the sampling period included summer 2015. These results will be reported in the 2018-2019 report.

In the Largemouth Bass mark-recapture study, 480 fish >6 inches were double-tagged with a batch t-bar tag in the dorsal region; the tagging period lasted 6 weeks. Fish were collected during the standard nighttime electrofishing stations as well as additional daytime random and biologist-selected stations. The study culminated with data collection at an open bass tournament weigh-in. All tournament participants were interviewed to find out how many bass they caught and how many of those were tagged. A Schnabel population estimator was used to estimate population size with upper and lower 95% confidence limits.

A vegetation survey was conducted in fall 2014 using the digital shapefile 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 index [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). Relative standard error (RSE = 100 X SE of the estimate/estimate) was calculated for all CPUE statistics, and standard error (SE) was calculated for structural indices and IOV.

Ages for Largemouth Bass and White Crappie were determined using otoliths. We collected 64 Largemouth Bass >6 inches for aging in the spring 2014 daytime electrofishing sample. In fall 2012 we collected 26 White Crappie between 9 and 11 inches to calculate mean age at 10-inch length (TPWD, Inland Fisheries Division, unpublished manual revised 2014).

Water level data was provided by the City of San Angelo Water Utilities Department in daily e-mail correspondence to the author.

RESULTS AND DISCUSSION

Habitat: Structural habitat consisted mainly of bulkhead and boat docks. The most recent structural habitat survey results can be found in Van Zee 2003. In 2014 there were 115 acres of native emergent plants and 8 acres of floating-leaved plants, a slight increase since 2006 (Table 5).

Prey species: Electrofishing catch rate of Gizzard Shad in 2014 was 230.0/h, double the 2013 catch rate (116.0/h; Figure 2). Gizzard shad relative abundance in 2008 and 2011 was similar to the most recent survey, but the 2010 sample showed higher relative abundance (438.0/h). Availability to predators increased substantially in 2014; IOV was 84, the highest value since 2008. The shift can most likely be attributed to a sudden increase in water level in May 2014 after a year-long drought.

Bluegill abundance also increased (to 246/h) after the 2014 water rise, and more small individuals were present (Figure 3). This was a substantial improvement over previous catch rates, especially 2008 (102.0/h) and 2010 (104.0/h). Most Bluegill captured were between two and six inches long. The prey base at Nasworthy Reservoir was in better shape that is had been in several years.

Channel Catfish: Gill net catch rate in 2013 was 8.6/nn, an increase over 2011 and 2009 results (Figure 4). Catch rate of stock-sized fish was also higher, but PSD decreased slightly. Many of the fish fell between stock-length (11 inches) and 15 inches in length. Body condition was fair (average W_r 80s and 90s) for fish in this size range, but was excellent (>100) for the larger fish. Individuals up to 25 inches in length were sampled. Channel catfish should provide excellent angling opportunities.

Largemouth Bass: Electrofishing catch rate of Largemouth Bass was 113/h in fall 2014, similar to catch rates from 2010, 2012 and 2013 (Figure 5). Catch rate was lower in 2008 (86.0/h) and higher in 2011 (156.0/h). Size structure seemed to improve as PSD in 2014 was 60 versus previous values in the 20s; however, this was mainly due to a drop in catch rate of stock-size fish, not an increase in catch rate of 12-inch fish. Relative weights in the 80s and 90s indicated lack of forage for Largemouth Bass between 10 and 15 inches, which has been the case for many years.

The spring 2014 electrofishing survey was conducted during low-water conditions shortly after a mild golden alga fish kill. The survey showed that the Largemouth Bass population was not severely impacted (Figure 6). By fall 2014, electrofishing survey results were similar to previous years' results (Figure 5).

The spring 2014 age-and-growth results showed that it took Largemouth Bass about four years to reach 14 inches (Figure 7) giving more evidence that overabundance of small fish and intraspecific competition may be stunting Largemouth Bass growth.

We marked a total of 480 Largemouth Bass by the final recapture event of the mark-recapture study. Of those, 65 were marked in nighttime random stations, 71 in daytime random stations, 176 in additional daytime bass-only non-random stations, and 168 during the recapture phase (daytime, non-random stations). Overall, we recaptured 20 fish that were tagged, including 5 that were reported in the bass tournament (final recapture event). The study revealed that there are around 5,150 (95% CL: 2,831—7,470, RSE = 23) Largemouth Bass (>6 inches in length) in Lake Nasworthy. This amounts to 3.2 bass per acre for the entire reservoir. In reality, Largemouth Bass are not evenly distributed throughout a water body, and concentrations are probably higher than 3.2 per acre in littoral zones and lower in open-water zones.

We did not collect enough 14-inch and larger bass to calculate a population estimate for fish ≥ 14 in. However, we found that 15.6% (N = 75) of the fish in our entire length frequency distribution (480 marked fish) were over 14 inches. If we apply that percentage to our total population estimate (5,150), we can conclude that there are about 803 bass over 14 inches in the reservoir (0.5/acre).

White Crappie: White Crappie relative abundance remained about the same in 2014 (13.5/nn) compared to 2012 and 2010 (Figure 8). Size structure was improved, however, with more fish over 10-inches. Also, body condition increased, with most W_r values over 100. Growth of crappie improved as well. In 2012, average age-at-length for 10-inch crappie was 2.5 years, compared to 3.5 years in 2010 (Scott and Farooqi 2011).

Fisheries management plan for Nasworthy Reservoir, Texas

Prepared – July 2015.

ISSUE 1: A new Largemouth Bass regulation will go into effect on September 1st, 2015. Nasworthy Reservoir anglers and area residents will need to be well aware of this change and its potential benefits so the regulation can be effective at improving size structure and growth of Largemouth Bass.

MANAGEMENT STRATEGIES

1. Post signage around the reservoir at boat ramps and park areas.
2. Alert media outlets and the public with press releases and social media posts.
3. Communicate with area angling groups, the Lake Nasworthy Homeowners Association, and City of San Angelo staff about the regulation and its potential benefits so they can spread the information.
4. Monitor changes in Largemouth Bass population with additional, objective-based sampling.

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 (*Dreissena polymorpha*) can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches and plugging engine cooling systems. Giant Salvinia (*Salvinia molesta*) and other invasive vegetation species can form dense mats, interfering with recreational activities like fishing, boating, skiing and swimming. The financial costs of controlling and/or eradicating these types of invasive species are significant. Additionally, the potential for invasive species to spread to other river drainages and reservoirs via watercraft and other means is a serious threat to all public waters of the state.

MANAGEMENT STRATEGIES

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

Objective-Based Sampling Plan and Schedule
Prepared for 2015-2019 Sampling Years

Sport fish, forage fish, and other important fishes

Sport fishes in Nasworthy Reservoir include Bluegill, catfish species, Largemouth Bass, and White Crappie. Known important forage species include Bluegill and Gizzard Shad.

Negligible fisheries

White Bass and Hybrid Striped Bass: Hybrid Striped Bass are present in Nasworthy Reservoir but were targeted in only 0.4% of angling effort in 2003-2004, when regular stockings were occurring. Hybrid Striped Bass stockings were discontinued after 2007 and only 1.4/nn were captured in the 2013 survey. White Bass are present in low numbers (0.2-1.4/nn in past three surveys) but were targeted in only 1% of angling effort. Sampling these populations is unnecessary in FY 2015-2019.

Survey objectives, fisheries metrics, and sampling objectives

A compete sampling schedule is in Table 6.

Blue Catfish and Flathead Catfish: Although not usually mentioned by name as species preferred by Lake Nasworthy anglers, Blue Catfish and Flathead Catfish are important because many anglers at this reservoir target "any catfish", based on preliminary 2014 creel survey data. Gill net catch rates are typically low and sometimes zero in a particular year, and achieving precise data (RSE ≤ 25) would require over 25 gill net-nights. Our survey objectives are to monitor presence/absence, and also angler preferences for these two species.

Our sampling objectives are:

1) Perform gill-netting survey in spring 2019 with 7 or more gill nets to determine presence or absence of each species in the reservoir. If either species is missing from the gill netting survey results, additional low-frequency electrofishing (at least 20 random, 3-min stations) will be conducted to check for presence/absence.

2) Conduct year-round roving creel survey in 2018-2019 sampling year to monitor angler effort targeting these species, as well as changes in catch and harvest rates.

Channel Catfish: Channel Catfish are the most sought-after species in the reservoir. Gill net catch rates have ranged from 3.5/nn to 9.5/nn for the past 15 years. This species provides one of the most important fisheries at Nasworthy, therefore, intensive sampling and management is warranted to see that the fishery is maintained. Our survey objectives are to determine abundance of Channel Catfish, evaluate whether the population has adequate recruitment to legal size (12 inches), and determine exploitation of the Channel Catfish population.

Our sampling objectives are:

1) Estimate abundance of Channel Catfish ≥ 12" TL using a mark-recapture study. For the mark-recapture study, 5 baited tandem hoop net series will be set at biologist-selected stations within a randomly-chosen sampling area in the lake and pulled on the third day. All Channel Catfish will be

measured to nearest mm, marked with an adipose fin clip and released. Fin clips will be recorded if found, unmarked Channel Catfish will be fin-clipped, and all will be released. This will be repeated until at least 100 Channel Catfish are marked and released within that sampling area, or one week of sampling has occurred in that area, whichever comes first. Then, the 5 net-series will be moved to the next sampling area and the process will be repeated until at least 4 sampling areas have been sampled, and at least 400 Channel Catfish have been marked and released reservoir-wide.

After the final sampling area has been processed, we will set 10 net-series at 10 randomly-chosen stations throughout the lake to gather recapture data as well as standard tandem hoop-net data. This will be repeated up to three times if necessary to collect recaptures. A Schnabel estimation will be made with the mark-recapture data to estimate population size. Sampling will occur in late Spring-Summer 2015.

2) Total CPUE and CPUE-12 will be determined from the random sampling stations used in the mark-recapture study in 2015, and also in additional tandem hoop-netting in summer 2017. Sampling will be repeated until RSE for each statistic is 25 or less.

3) Proportion of fish that are legally-harvestable will be determined with a length-frequency histogram and PSD indices. Lengths collected from the 2015 and 2017 tandem hoop-netting surveys should provide more than the 170 stock-length fish that are necessary for valid assessments.

4) Harvest will be estimated with a roving creel in Spring-Summer 2015. A two-quarter roving creel survey will be conducted March-August 2015 to determine directed effort, catch rates, and harvest of Channel Catfish and all other game species in Nasworthy. At least 6 weekend days and 5 weekdays will be sampled per quarter. Total estimated harvest will be divided by the population estimate to derive an estimate of exploitation.

Largemouth Bass: Overall, Largemouth Bass is the second-most popular sport fish at Nasworthy, and it is the most popular species with boat anglers. It has been managed with a 14-inch MLL, but a new harvest regulation (14-18 inch slot limit) will go into effect on September 1st, 2015. Growth rate to 14 inches has been slow for at least 15 years, with the average age of 14-inch bass being between 4 and 4.5 years. Harvest of legal fish was high (nearly 50%) in the 2003-2004 creel survey. The popularity of the fishery, along with the proposal of a regulation change, warrants intensive sampling.

Our survey objectives will make a thorough assessment of the post-regulation-change population to assess the effectiveness of the slot limit. Specific objectives are: 1) estimate overall population size of bass, as well as number of bass ≥ 14 inches, 2) assess size structure and body condition, 3) assess growth rates to important milestones (14 inches and 18 inches), and 4) estimate number of harvested bass and size distribution of harvested bass.

Our respective sampling objectives to meet these survey objectives are:

1) Estimate density (fish/acre) for stock-length and ≥14-inch bass using a mark-recapture study. For the mark-recapture study, at least 400 bass including 100 legal-size (>14 inches) bass will be double-marked with t-bar tags in the dorsal area and released in all areas of the reservoir. Tag color will be different from any of the colors used in the 2014 survey to avoid confusion with any previously-tagged fish. The bass will be marked during the standard (random-station) daytime electrofishing survey and additional bass-only sampling as needed to reach the targets. To collect at least 400 stock-size fish, we expect to need to sample at least 12, 5-minute stations (random) plus 18, 10-minute stations (biologist-chosen).

Approximately two weeks after the marking period, 24 (or more) random stations will be sampled, this time using 10-minutes of electrofishing time per station, to record recapture data. Also, recapture data will be collected from an open-tournament weigh-in if possible to ensure that larger fish are included in the sample. A Schnabel estimation will be made with the mark-recapture data from all recapture events to estimate population size. This sampling will occur in fall 2018.

2) Determine size structure indices, including PSD and PSD-14 and a length-frequency histogram and average relative weight for each inch-group between 8 and 15 inches from the electrofishing surveys. We expect to capture the recommended 160 stock-length bass during the initial marking surveys. This sampling will occur in fall 2018.

3) Determine age-at-length for 14-inch and 18-inch bass from otoliths of 14-inch (13-14.9) and 18-inch (17-18.9) fish. At least 13 fish of each category will be aged. Fish will be collected in springtime bass-only daytime electrofishing, 2017 and 2019.

4) Determine number of bass harvested and the harvest size distribution with a roving creel survey in 2018-2019.

White Crappie: In the 2003-2004 creel survey, anglers spent over 4,900 hours pursuing White Crappie at Lake Nasworthy. All of the legal-sized fish in the creel were harvested, totaling an estimated 1,912 fish harvested in that year. Shoreline-set single-cod trap nets have produced catch rates between 13/nn and 18/nn in the past three surveys.

Our survey objectives are for general monitoring of this population: 1) compare recent abundance to long-term trend, and 2) assess size structure.

To meet these survey objectives, our sampling objectives are:

1) Calculate total CPUE with RSE <25 using single-cod trap nets at ≥10 random stations throughout the reservoir. Historical data indicate that this number of net-nights should be sufficient; however, an additional 5 random stations will be selected in case additional sampling is warranted. Sampling will be conducted in fall 2016 and 2018.

2) Collect ≥50 crappie and measure each to nearest mm to formulate a length-frequency histogram and calculate PSD indices. If 10 net-nights do not produce 50 stock-size crappie, then additional net-nights at random sites will be sampled until the goal is met. Historical data indicate that 10 net-nights should be sufficient. Sampling will be conducted in fall 2016 and 2018.

Bluegill and Gizzard Shad: Bluegill and Gizzard Shad are the primary forage at Nasworthy Reservoir. Also, Bluegill make up a substantial part of the targeted game species due to the abundance of bank anglers. Like Largemouth Bass, trend data on CPUE and size structure of Bluegill and Gizzard Shad have been collected at least biennially since 1998.

Our survey objectives for these species are to monitor for large-scale changes in relative abundance and size structure. Data will be collected on these species during the electrofishing surveys for Largemouth Bass. This should result in sufficient numbers of Bluegill and Gizzard Shad for size structure estimation (PSD and IOV; 50 fish minimum at 5-12 stations with 80% confidence), and relative abundance estimate of Bluegill, but not for relative abundance estimate of Gizzard Shad (RSE ≤ 25 of CPUE-Total; anticipated effort is 15-20 stations). No additional effort will be expended to achieve an RSE25 for CPUE of Gizzard Shad. The total picture provided by the daytime and nighttime stations combined should be sufficient to make judgments on any large-scale changes in the Gizzard Shad population.

We will also gather information on directed effort, catch, and harvest of Bluegill during the creel surveys.

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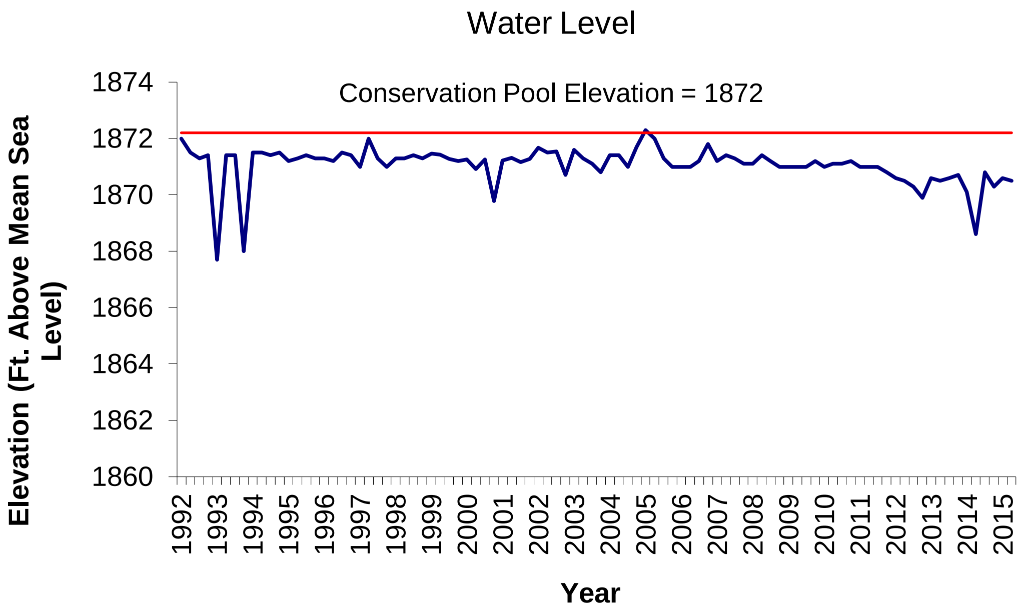


Figure 1. Quarterly water level elevations in feet above mean sea level recorded for Nasworthy Reservoir, Texas.

Table 1. Characteristics of Nasworthy Reservoir, Texas.

Characteristic	Description
Year constructed	1930
Controlling authority	City of San Angelo
County	Tom Green
Reservoir type	Mainstream
Shoreline Development Index	7.01
Conductivity	1,250 µmhos/cm

Table 2. Boat ramp characteristics for Nasworthy Reservoir, Texas, August, 2014. Reservoir elevation at time of survey was 1870.5 feet above mean sea level.

Boat ramp	Latitude Longitude (dd)	Public	Parking capacity (N)	Elevation at end of boat ramp (ft)	Condition
Red Bluff Road	31.38603 -100.5045	Y	2	unknown	Poor (closed, needs repair)
Spring Creek Marina W	31.3771 -100.5129	Y	5	1865	Excellent, no access issues
Spring Creek Marina E	31.3786 -100.5068	Y	5	1867	Excellent, no access issues
Middle Concho Park W	31.37856 -100.5208	Y	3	1867	Excellent, no access issues
Middle Concho Park E	31.37803 -100 5121	Y	5	1865	Excellent, no access issues
Fisherman's Road	31.37283 -100.4968	Y	10	1867	Excellent, no access issues
Bass Club Lagoon	31.37558 -100.4912	Y	3	1867	Excellent, no access issues
Nasworthy Marina	31.37731 -100.4899	Y	3	1867	Excellent, no access issues
Goodfellow AFB	31.37817 -100.4859	Y	3	1867	Excellent, no access issues
Pecan Creek North	31.36772 -100.4812	Y	20	1867	Excellent, no access issues
Pecan Creek South	31.36281 -100.4762	Y	5	1868	Excellent, no access issues
Knickerbocker North	31.39763 -100.4841	Y	20	1867	Excellent, no access issues
Power Plant	31.39201 -100.4895	Y	25	1866	Excellent, no access issues

Table 3. Harvest regulations for Nasworthy Reservoir, Texas.

Species	Bag limit	Length limit
Catfish: Channel and Blue, their hybrids and subspecies	25 (in any combination)	12-inch minimum
Catfish, Flathead	5	18-inch minimum
Bass, White	25	10-inch minimum
Bass, Palmetto (Hybrid Striped)	5	18-inch minimum
Bass, Largemouth	5	14-inch minimum[a]
Crappie: White and Black, their hybrids and subspecies	25 (in any combination)	10-inch minimum

[a] Length limit changes to 14- to 18-inch slot on September 1st, 2015.

Table 4. Stocking history of Nasworthy Reservoir, Texas. FRY =<1 inch; FGL = fingerling; ADL = adult, and UNK = unknown.

Species	Year	Number	Size
Threadfin Shad	1984	8,800	UNK
Bluegill	2010	360	ADL
Channel Catfish	1966	32,000	UNK
	1968	26,000	UNK
	1969	15,000	UNK
	1970	20,000	UNK
	1971	10,000	UNK
	1972	20,425	UNK
	1973	15,000	UNK
	1974	10,000	UNK
	1990	16,637	FGL
	1991	16,191	FGL
	1993	400	FGL
	2011	157	ADL
	2012	4,422	FGL
	Total	186,232	
Palmetto Bass	1974	17,767	UNK
	1975	16,000	UNK
	1977	16,000	UNK
	1979	8,430	UNK
	1981	16,000	UNK
	1982	16,176	UNK
	1994	28,600	FGL
	1995	1,500	FGL
	1996	23,897	FGL
	1997	25,164	FGL
	1998	24,021	FGL
	1999	24,140	FGL
	2002	24,108	FGL
	2003	19,410	FGL
	2004	19,386	FGL
	2005	6,933	FGL
	2006	6,775	FGL
	2007	8,611	FGL
	Total	302,918	
Red Drum	1984	101,276	FGL
	1985	195,387	FGL
	1986	159,604	FGL
	1991	164,950	FGL
	1994	165,732	FGL
	1995	171,200	FGL
	1996	161,805	FGL
	1997	161,401	FGL
	1999	194,089	FGL
	2000	197,515	FGL

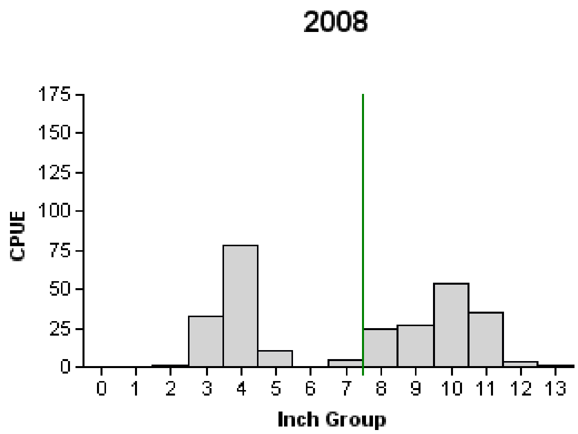
Table 4. Stocking history continued.

Species	Year	Number	Size
Red Drum	2002	239,895	FGL
	Total	1,912,854	
Largemouth Bass	1968	440	UNK
	1969	24,000	UNK
	1970	271,000	UNK
	1972	68,700	UNK
	1993	145	ADL
	1997	52,600	FGL
	Total	416,885	
Florida Largemouth Bass	1980	8,100	FGL
	1986	201,600	FGL
	1987	2,159	ADL
	1990	159,799	FRY
	1991	159,854	FGL
	1995	159,840	FGL
	1995	172	ADL
	Total	691,524	
White Crappie	1972	16,000	UNK
Redear Sunfish	1970	4,900	UNK
Green X Redear Sunfish	1966	14,700	UNK

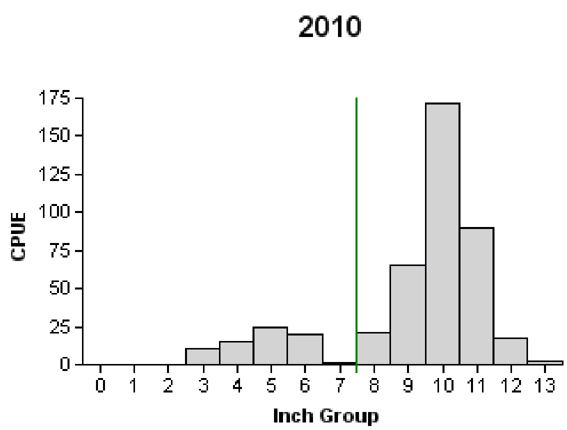
Table 5. Survey of aquatic vegetation, Nasworthy Reservoir, Texas, 2014. Surface area (acres) is listed with percent of total surface area in parentheses. Floating-leaved plant was American lotus, and native emergent plants were bulrush and waterwillow.

Vegetation	2006	2014
Native submersed	0 (0)	0 (0)
Native floating-leaved	Unknown	8 (1)
Native emergent	92 (6)	115 (7)

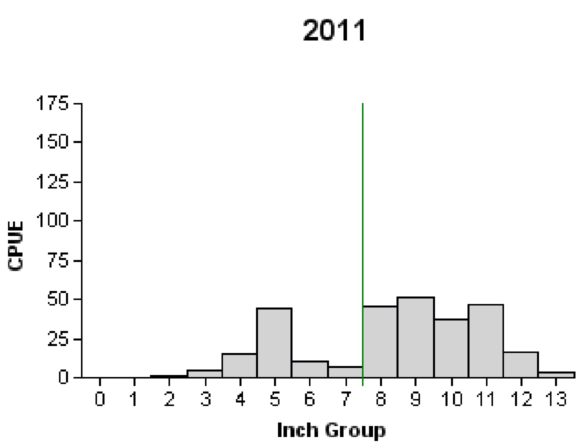
Gizzard Shad



Effort = 1.0
Total CPUE = 272.0 (30; 272)
IOV = 47 (13)



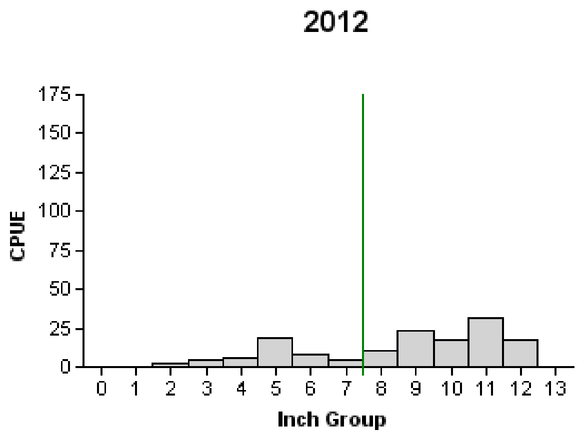
Effort = 1.0
Total CPUE = 438.0 (15; 438)
IOV = 16 (4)



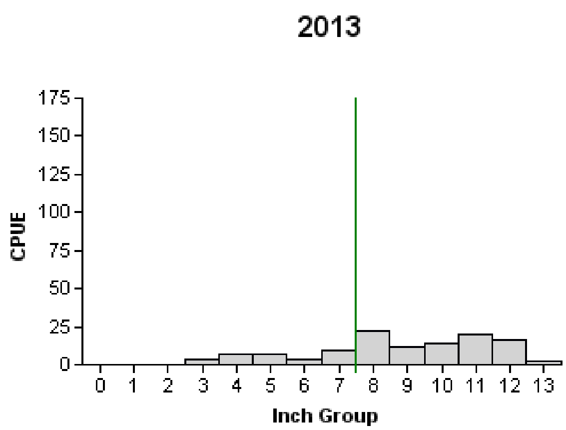
Effort = 1.0
Total CPUE = 283.0 (22; 283)
IOV = 29 (5)

Figure 2. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N are in parentheses) for fall nighttime electrofishing surveys, Nasworthy Reservoir, Texas, 2008-2014. Vertical line represents the size above which shad are unavailable to predators.

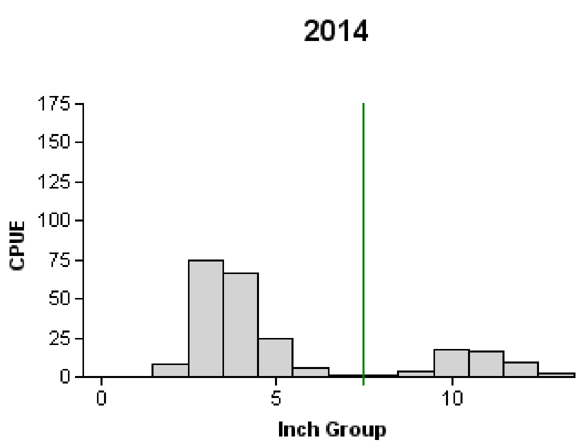
Gizzard Shad



Effort = 1.0
Total CPUE = 145.0 (16; 145)
IOV = 31 (9)



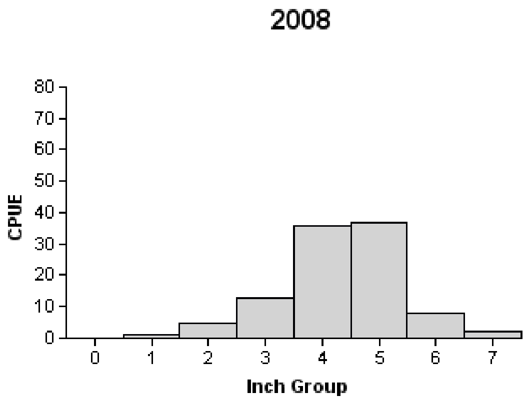
Effort = 1.0
Total CPUE = 116.0 (28; 116)
IOV = 26 (8)



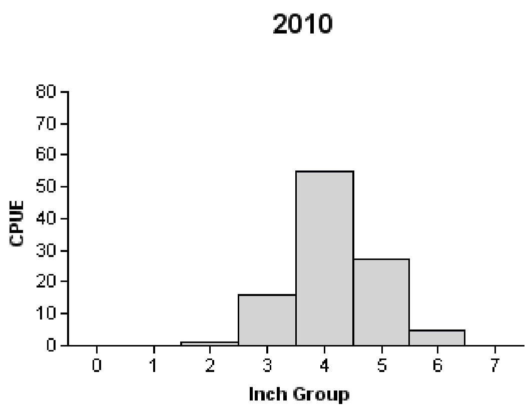
Effort = 1.0
Total CPUE = 230.0 (21; 230)
IOV = 84 (2)

Figure 2, cont. Number of Gizzard Shad caught per hour (CPUE) and population indices (RSE and N are in parentheses) for fall nighttime electrofishing surveys, Nasworthy Reservoir, Texas, 2008-2014. Vertical line represents the size above which shad are unavailable to predators.

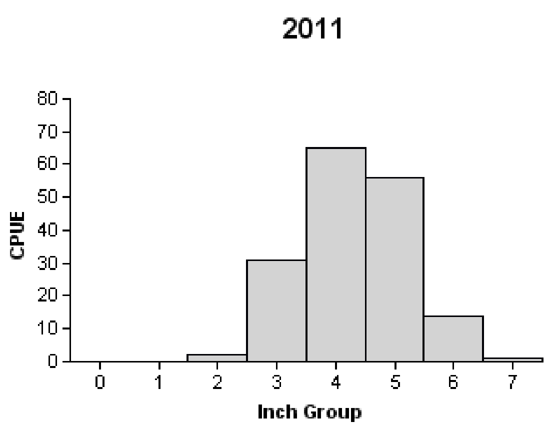
Bluegill



Effort = 1.0
Total CPUE = 102.0 (23; 102)
PSD = 10 (3)



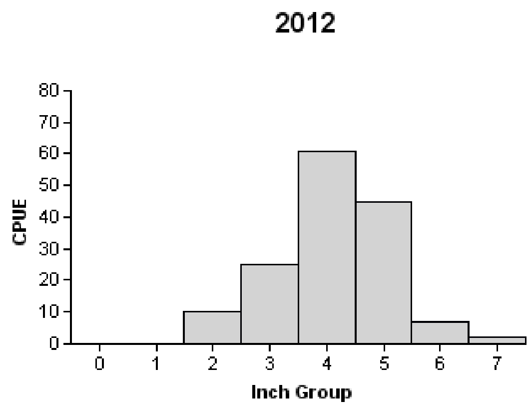
Effort = 1.0
Total CPUE = 104.0 (30; 104)
PSD = 5 (3)



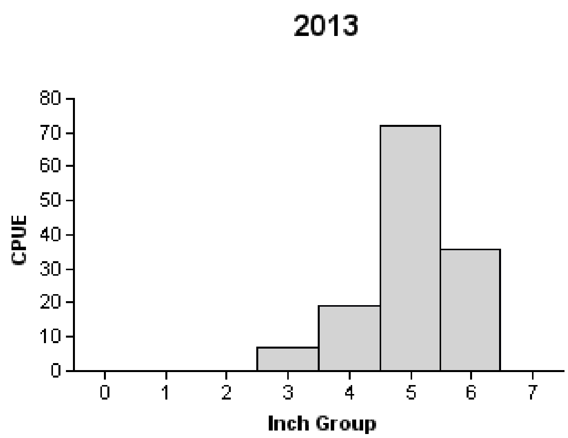
Effort = 1.0
Total CPUE = 169.0 (31; 169)
PSD = 9 (4)

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 nighttime electrofishing surveys, Nasworthy Reservoir, Texas, 2008-2014.

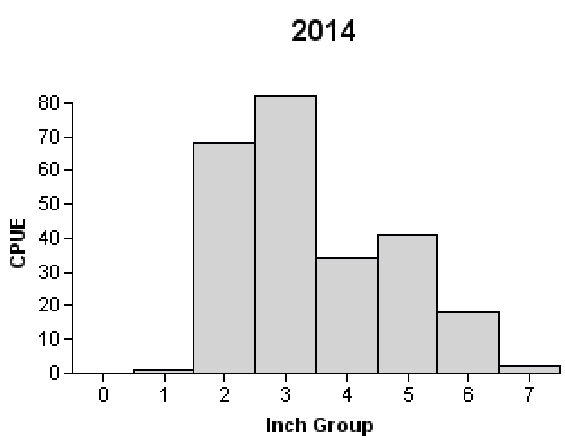
Bluegill



Effort = 1.0
Total CPUE = 150.0 (27; 150)
PSD = 6 (2)



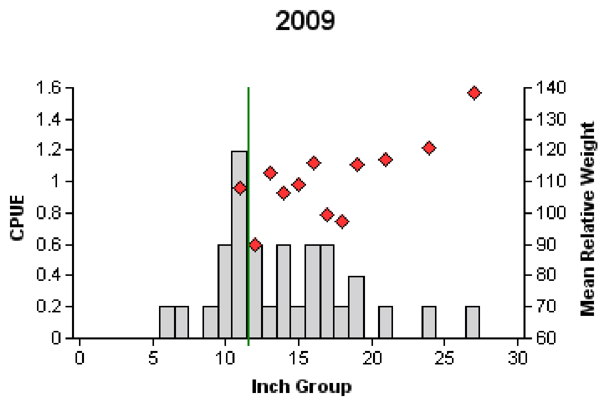
Effort = 1.0
Total CPUE = 134.0 (21; 134)
PSD = 27 (4)



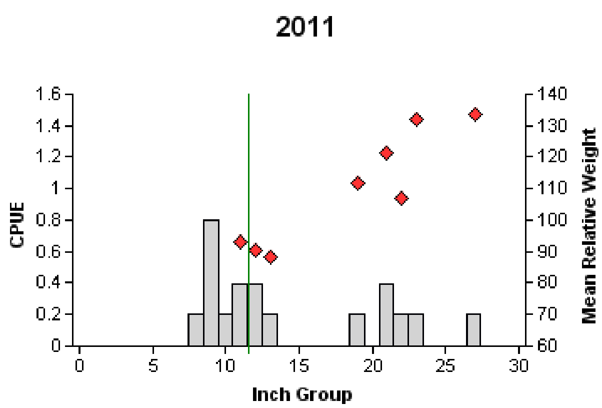
Effort = 1.0
Total CPUE = 246.0 (41; 246)
PSD = 11 (3)

Figure 3. Number of Bluegill caught per hour (CPUE) and population indices (RSE and N for CPUE and SE for size structure are in parentheses) for fall nighttime electrofishing surveys, Nasworthy Reservoir, Texas, 2008-2014.

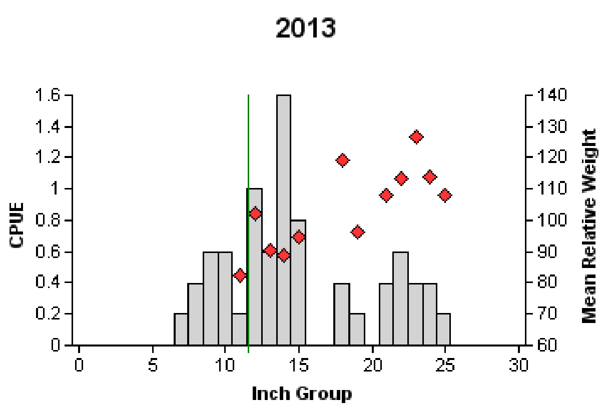
Channel Catfish



Effort =	5.0
Total CPUE =	6.4 (19; 32)
Stock CPUE =	5.2 (21; 26)
PSD =	46 (5)
PSD-P =	8 (6)



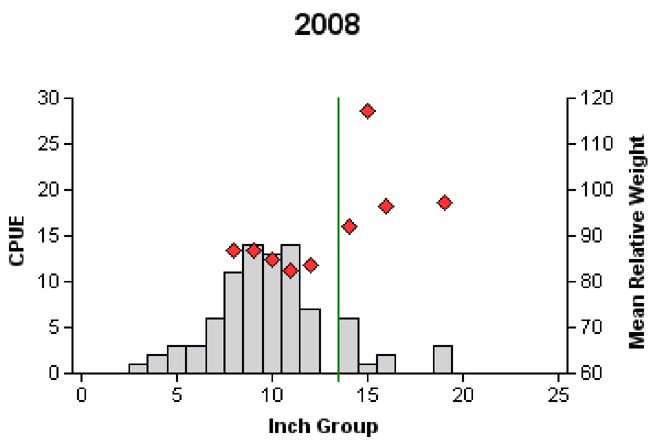
Effort =	5.0
Total CPUE =	3.4 (20; 17)
Stock CPUE =	2.2 (27; 11)
PSD =	55 (8)
PSD-P =	9 (7)



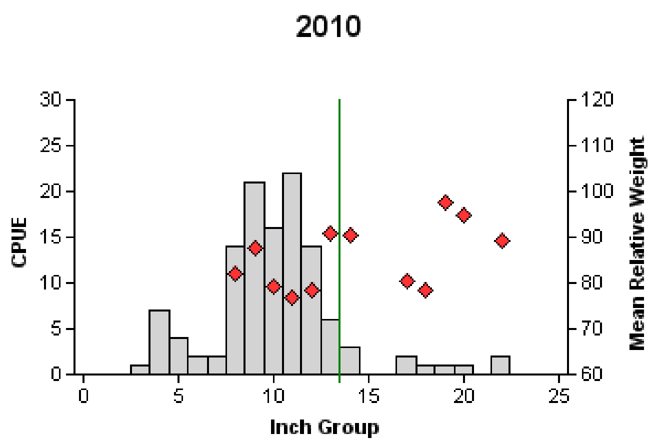
Effort =	5.0
Total CPUE =	8.6 (29; 43)
Stock CPUE =	6.8 (34; 34)
PSD =	38 (16.4)
PSD-P =	9 (7)

Figure 4. Number of Channel Catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for spring gill net surveys, Nasworthy Reservoir, Texas, 2009, 2011, and 2013. Vertical line represents minimum length limit.

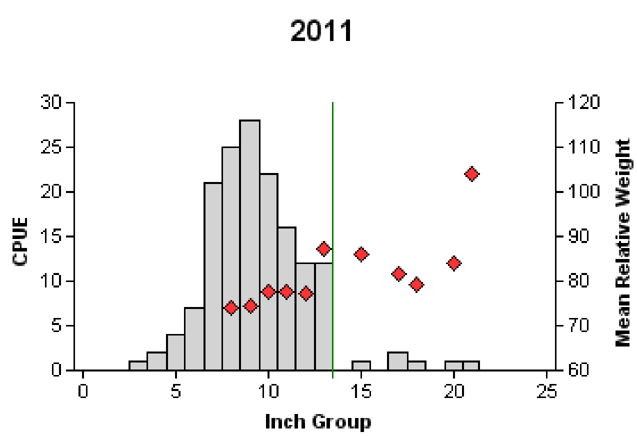
Largemouth Bass



Effort =	1.0
Total CPUE =	86.0 (14; 86)
Stock CPUE =	71.0 (16; 71)
CPUE-14 =	12.0 (28; 12)
PSD =	27 (7)
PSD-14 =	17 (4)
PSD-18 =	4 (3)



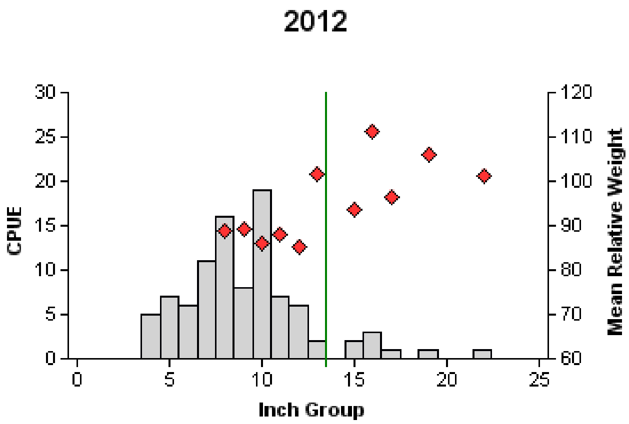
Effort =	1.0
Total CPUE =	119.0 (20; 119)
Stock CPUE =	103.0 (18; 103)
CPUE-14 =	10.0 (32; 10)
PSD =	29 (6)
PSD-14 =	10 (3)
PSD-18 =	5 (2)



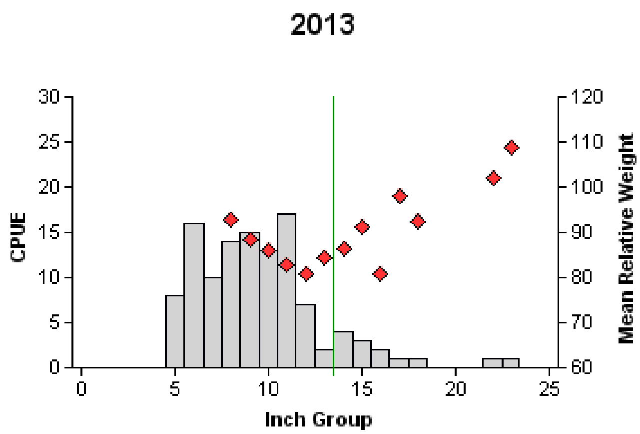
Effort =	1.0
Total CPUE =	156.0 (17; 156)
Stock CPUE =	121.0 (16; 121)
CPUE-14 =	6.0 (39; 6)
PSD =	25 (4)
PSD-14 =	5 (2)
PSD-18 =	2 (1)

Figure 5. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for fall nighttime electrofishing surveys, Nasworthy Reservoir, Texas, 2008-2014. Vertical line represents minimum length limit.

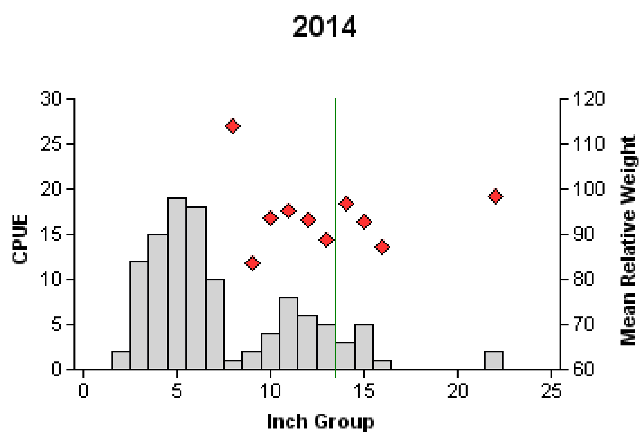
Largemouth Bass



Effort =	1.0
Total CPUE =	95.0 (20; 95)
Stock CPUE =	66.0 (18; 66)
CPUE-14 =	8.0 (43; 8)
PSD =	24 (7)
PSD-14 =	12 (5)
PSD-18 =	3 (2)



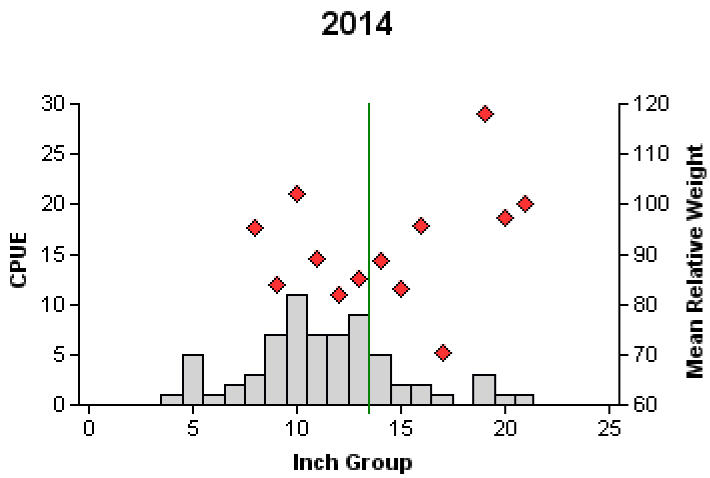
Effort =	1.0
Total CPUE =	115.0 (11; 115)
Stock CPUE =	81.0 (11; 81)
CPUE-14 =	13.0 (24; 13)
PSD =	27 (5)
PSD-14 =	16 (4)
PSD-18 =	4 (2)



Effort =	1.0
Total CPUE =	113.0 (24; 113)
Stock CPUE =	37.0 (23; 37)
CPUE-14 =	11.0 (21; 11)
PSD =	59 (9)
PSD-14 =	30 (9)
PSD-18 =	5 (4)

Figure 5, cont. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for fall nighttime electrofishing surveys, Nasworthy Reservoir, Texas, 2008-2014. Vertical line represents minimum length limit.

Largemouth Bass



Effort =	1.0
Total CPUE =	68.0 (18; 68)
Stock CPUE =	59.0 (18; 59)
CPUE-14 =	15.0 (44; 15)
PSD =	53 (7)
PSD-14 =	25 (9)
PSD-18 =	8 (6)

Figure 6. Number of Largemouth Bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for daytime spring electrofishing survey, Nasworthy Reservoir, Texas, 2014. Vertical line represents the minimum length limit.

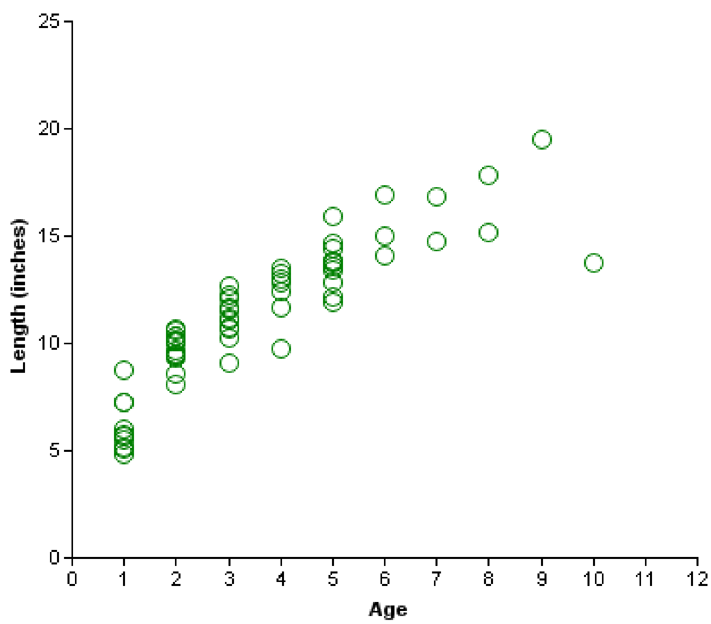
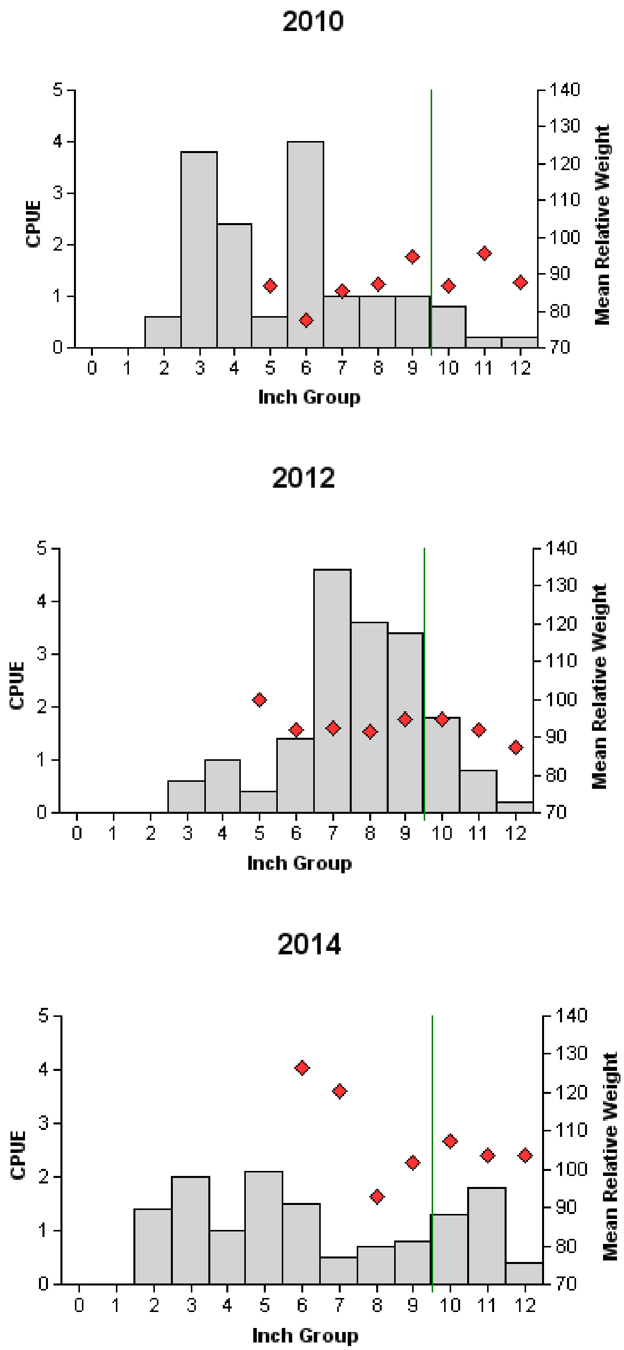


Figure 7. Length at age for Largemouth Bass collected by daytime spring electrofishing at Nasworthy Reservoir, Texas, April 2014 (N = 64).

White Crappie



2010

Effort =	5.0
Total CPUE =	15.6 (9; 78)
Stock CPUE =	8.8 (24; 44)
CPUE-10 =	1.2 (81; 6)
PSD =	36 (16)

2012

Effort =	5.0
Total CPUE =	17.8 (49; 89)
Stock CPUE =	16.2 (51; 81)
CPUE-10 =	2.8 (47; 14)
PSD =	60 (13)

2014

Effort =	10.0
Total CPUE =	13.5 (15; 135)
Stock CPUE =	9.1 (17; 91)
CPUE-10 =	3.5 (30; 35)
PSD =	55 (11)

Figure 8. Number of White Crappie caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for fall trap netting surveys, Nasworthy Reservoir, Texas, 2010, 2012, and 2014. Vertical line represents minimum length limit.

Table 6. Proposed sampling schedule for Nasworthy Reservoir, Texas. Survey period is June through May. Tandem hoop netting is conducted in summer, electrofishing and trap netting are conducted in fall, and gill netting is conducted in spring. Standard survey denoted by S, and additional survey denoted by A. If gill netting does not produce both Blue Catfish and Flathead Catfish, additional low-frequency electrofishing will be conducted to check for presence of these species.

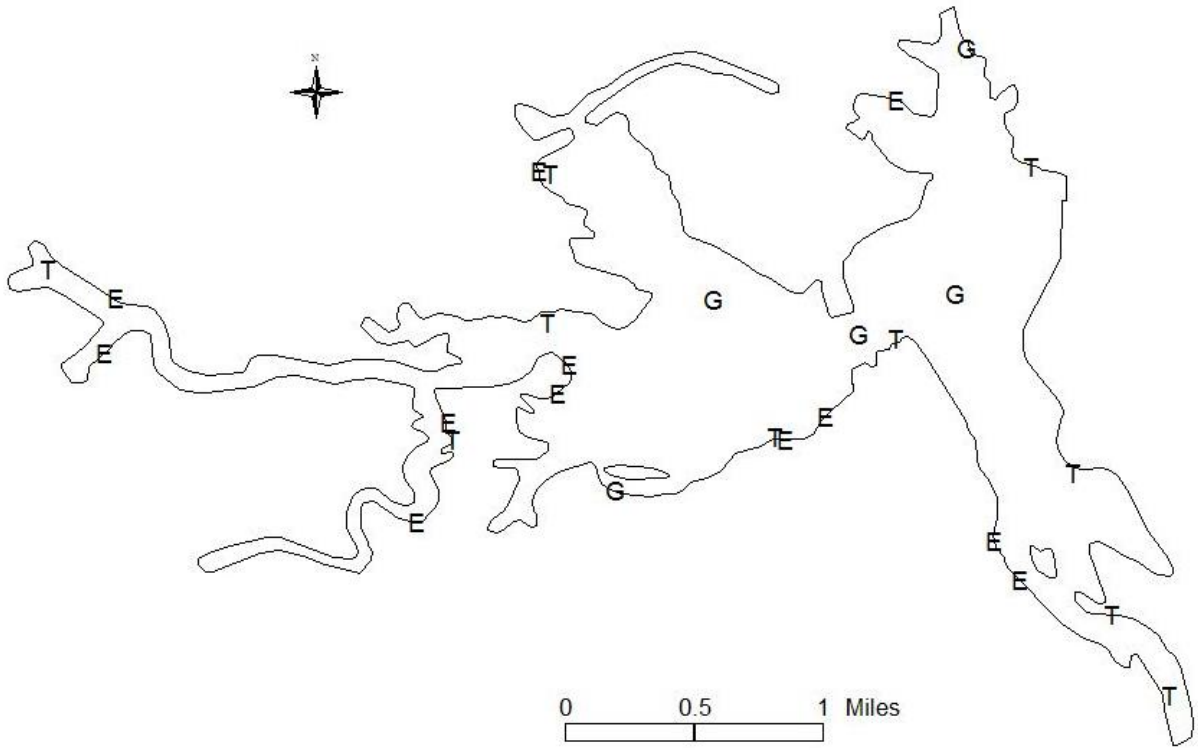
Survey year	Electrofish Fall (Spring)	Trap net	Gill net	Hoop net	Vegetation	Access	Creel survey	Report
2015-2016				A			A	
2016-2017	(A)	A						
2017-2018				A				
2018-2019	S (A)	S	S		S	S	A	S

APPENDIX A

Number (N) and catch rate (CPUE) of all species collected from trap netting and electrofishing in 2014 and gill netting in 2013 at Nasworthy Reservoir, Texas.

Species	Gill Netting		Trap Netting		Electrofishing	
	N	CPUE	N	CPUE	N	CPUE
Longnose Gar	10	2.0				
Gizzard Shad	199	39.8	5	0.5	230	230.0
Common Carp	9	1.8				
Blue Catfish	12	2.4				
Channel Catfish	43	8.6	2	0.2		
Flathead Catfish	1	0.2				
Redbreast Sunfish			1	0.1		
Green Sunfish					3	3.0
Warmouth					2	2.0
Bluegill			85	8.5	246	246.0
Longear Sunfish			3	0.3	29	29.0
White Bass	2	0.4				
Hybrid Striped Bass	7	1.4				
Largemouth Bass					113	113.0
White Crappie	1	0.2	135	13.5		
Freshwater Drum	1	0.2				

APPENDIX B



Location of sampling sites, Nasworthy Reservoir, Texas, 2013-2014. Trap net (2014), gill net (2013), and electrofishing (2014) stations are indicated by T, G, and E, respectively. Water level was approximately 1.5 feet below conservation pool at time of sampling.

APPENDIX C

Objective-Based Sampling Plan for Nasworthy Reservoir

Prepared for 2014-2015 Sampling Year

Sport fish, forage fish, and other important fishes
Sport fishes in Nasworthy Reservoir include Bluegill, Channel Catfish, Largemouth Bass, and White Crappie. Known important forage species include Bluegill and Gizzard Shad.

Negligible fisheries

Blue catfish and flathead catfish: Blue catfish and flathead catfish are present in Nasworthy Reservoir, but population abundance is consistently low. Gill net surveys from 2002-2013 showed CPUE of blue catfish ranged from 0.0 to 2.4 fish/nn, and CPUE of flathead catfish ranged from 0.2 to 2.8/nn. A creel survey in 2003-2004 indicated that minimal directed effort occurred toward flathead catfish (0.4 %) and all catfishes (non-specific; 1.3 %). Sampling these populations is unnecessary in FY 2015.

White bass and hybrid striped bass: Hybrid striped bass are present in Nasworthy Reservoir but were targeted in only 0.4% of angling effort in 2003-2004, when regular stockings were occurring. Hybrid striped bass stockings were discontinued after 2007, and only 1.4/nn were captured in the 2013 survey. White bass are present in low numbers (0.2-1.4/nn in past three surveys) but were targeted in only 1% of angling effort. Sampling these populations is unnecessary in FY 2015.

Survey objectives, fisheries metrics, and sampling objectives

Channel Catfish: Channel Catfish are the most sought-after species in the reservoir. Gill net catch rates have ranged from 3.5/nn to 9.5/nn for the past 15 years. This species provides one of the most important fisheries at Nasworthy, therefore, intensive sampling and management is warranted to see that the fishery is maintained. Our survey objectives are to determine abundance of Channel Catfish, evaluate whether the population has adequate recruitment to legal size (12 inches), assess the relationship of hoop-net CPUE to a population size estimate, and determine exploitation of the Channel Catfish population.

Our sampling objectives are:

1) Estimate actual abundance of Channel Catfish $\geq$ 10” TL and of Channel Catfish $\geq$ 12” TL using a mark-recapture study. For the mark-recapture study, 5 baited hoop net series will be set at biologist-selected stations within a randomly-chosen sampling area in the lake and pulled the next day. All Channel Catfish will be measured to nearest mm, marked with an adipose fin clip and released. Net series will be immediately reset at different locations within the same sampling area and then pulled again the next day. All fish will be measured, fin-clips will be recorded if found, unmarked fish will be fin-clipped, and all will be released. This will be repeated until at least 100 Channel Catfish are marked and released within that sampling area, or four days of pulling nets has occurred, whichever comes first. Then, the 5 net-series will be moved to the next sampling area and the process will be repeated until at least 4 sampling areas have been sampled, and at least 400 Channel Catfish have been marked and released reservoir-wide.

After the final sampling area has been processed, we will return to the first sampling area and set the 5 hoop net series overnight to gather recapture data. Each sampling area will be sampled for recapture data with one-night sets of all 5 net-series, in the same order they were initially processed. The recapture period should last no longer than 6 weeks from initial marking to ensure minimal population changes from mortality (including harvest), immigration and emigration, and recruitment to the gear. A Lincoln-Peterson estimation will be made with the mark-recapture data to estimate population size within each sampling area.

2) CPUE-10 and CPUE-12 will be determined from the random sampling design used in population size estimation. CPUE will be calculated for each of the sampling areas using first-night data, and CPUE plotted against the respective population estimates in a linear regression model to see if a significant relationship exists.

3) Proportion of fish that are legally-harvestable will be determined with a length-frequency histogram and PSD indices. Lengths collected from the initial marking period should provide more than the 170 stock-length fish that are necessary for valid assessments.

4) Harvest will be estimated with a roving creel in Spring-Summer 2015. A two-quarter roving creel survey will be conducted March-August 2015 to determine directed effort, catch rates, and harvest of Channel Catfish and all other game species in Nasworthy. At least 7 weekend days and 6 weekdays will be sampled per quarter. Passive-gear anglers will be included in the survey, and counts of visible juglines/trotlines will be made during each creel period. Harvest will be compared to the PE to derive an exploitation rate.

Largemouth Bass: Overall, Largemouth Bass is the second-most popular sport fish at Nasworthy, and it is the most popular species with boat anglers. It has been managed with a 14-inch MLL, but a new harvest regulation is being considered (14-18 inch slot limit). Growth rate to 14 inches has been slow for at least 15 years, with the average age of 14-inch bass being between 4 and 4.5 years. Harvest of legal fish is high (nearly 50%). The popularity of the fishery, along with the proposal of a regulation change, warrants intensive sampling.

Our survey objectives will make a thorough assessment of the population for comparison with post-regulation-change data. Specific objectives are: 1) estimate overall population size of bass, as well as number of bass over 14 inches, 2) compare daytime and nighttime electrofishing CPUE to see if they are potentially interchangeable on Nasworthy Reservoir, 3) assess size structure for entire population and body condition for bass that have experienced slow growth, 4) assess growth rates to important milestones (14 inches and 18 inches), and 5) estimate number of harvested bass and size distribution of harvested bass.

Our respective sampling objectives to meet these survey objectives are:

1) Estimate density (fish/acre) for stock-length and ≥14-inch bass using a mark-recapture study. For the mark-recapture study, at least 400 bass including 100 legal-size (>14 inches) bass will be double-marked with t-bar tags in the dorsal area and released in all areas of the reservoir. The bass will be marked during the nighttime survey, the daytime survey, and additional bass-only sampling as needed to reach the targets. To collect at least 400 stock-size fish, we expect to need to sample at least 46 5-minute stations. Instead of this approach, we will first conduct our 12 (or more) 5-minute nighttime stations and 12 (or more) 5-minute daytime stations, adding biologist-chosen 10-minute daytime stations afterward to

collect additional bass for marking. This should result in meeting our goal with an extra 11 or 12 10-minute stations. We will also attempt to collect some bass for marking through pole-and-line sampling.

Approximately two weeks after the marking period, the same 24 (or more) random stations will be resampled, this time using 10-minutes of electrofishing time per station, to record recapture data. Also, recapture data will be collected from an open-tournament weigh-in at Concho Bass Club on October 11th to ensure that larger fish are included in the sample. A Schnabel estimation will be made with the mark-recapture data from both recapture events to estimate population size.

2) Calculate electrofishing CPUE with both a daytime and nighttime survey. We will conduct two separate electrofishing surveys, one at night and one during the day. Each time we will begin with 12, 5-minute stations and continue adding stations until CPUE-Stock has an RSE of 25 or less. Judging from previous surveys, 12 stations will be enough to reach the target RSE. All metrics, including CPUE, size indices, and effort required to reach RSE target, will be compared between the two surveys.

3) Determine size structure indices, including PSD and PSD-14 and a length-frequency histogram and average relative weight for each inch-group between 8 and 15 inches from the 12-station nighttime and daytime surveys. We expect to capture the recommended 160 stock-length bass during these surveys.

4) Determine age-at-length for 14-inch and 18-inch bass from otoliths of 14-inch (13-14.9) and 18-inch (17-18.9) fish during the recapture period. At least 13 fish of each category will be aged. To avoid violating the mortality assumption of mark-recapture studies, fish will be collected on last day of Concho Bass Club tournament and thereafter.

5) Determine number of bass harvested and the harvest size distribution with a roving creel survey in spring-summer 2015. Data on Largemouth Bass and bass anglers will be collected concurrently with the catfish creel survey in March-August 2015. At least 7 weekend and 6 weekday surveys will be conducted each quarter.

White Crappie: In the 2003-2004 creel survey, anglers spent over 4,900 hours pursuing White Crappie at Lake Nasworthy. All of the legal-sized fish were harvested, totaling 1,912 fish harvested in that year. Shoreline-set single-cod trap nets have produced catch rates between 8/nn and 18/nn in the past three surveys.

Our survey objectives are for general monitoring of this population: 1) compare recent abundance to long-term trend, and 2) assess size structure.

To meet these survey objectives, our sampling objectives are:

1) Calculate CPUE with RSE <25 using single-cod trap nets at ≥10 random stations throughout the reservoir. Historical data indicate that this number of net-nights should be sufficient; however, an additional 5 random stations will be selected in case additional sampling is warranted.

2) Collect ≥50 crappie and measure each to nearest mm to formulate a length-frequency histogram and calculate PSD indices. If 10 net-nights do not produce 50 stock-size crappie, then additional net-nights at random sites will be sampled until the goal is met. Historical data indicate that 10 net-nights should be sufficient.

Bluegill and Gizzard Shad: Bluegill and Gizzard Shad are the primary forage at Nasworthy Reservoir. Also, Bluegill make up a substantial part of the targeted game species due to the abundance of bank anglers. Like Largemouth Bass, trend data on CPUE and size structure of Bluegill and Gizzard Shad have been collected at least biennially since 1998.

Our survey objectives for these species are to monitor for large-scale changes in relative abundance and size structure. Data will be collected on these species during the initial electrofishing surveys for Largemouth Bass (12, 5-minute stations, both nighttime and daytime). This should result in sufficient numbers of Bluegill and Gizzard Shad for size structure estimation (PSD and IOV; 50 fish minimum at 5-12 stations with 80% confidence), and relative abundance estimate of Bluegill, but not for relative abundance estimate of Gizzard Shad (RSE $\leq$ 25 of CPUE-Total; anticipated effort is 15-20 stations). No additional effort will be expended to achieve an RSE25 for CPUE of Gizzard Shad. The total picture provided by the daytime and nighttime stations combined should be sufficient to make judgments on any large-scale changes in the Gizzard Shad population.

We will also gather information on directed effort, catch, and harvest of Bluegill during the two-quarter creel survey in March-August 2015.

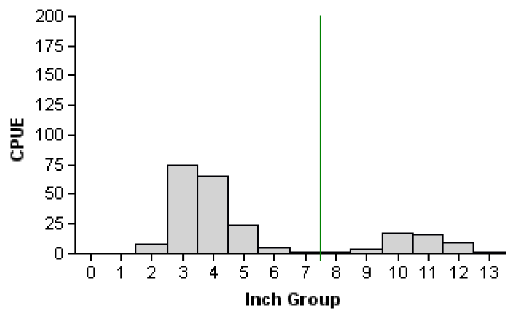
APPENDIX D

Comparison of Daytime versus Nighttime Fall Electrofishing

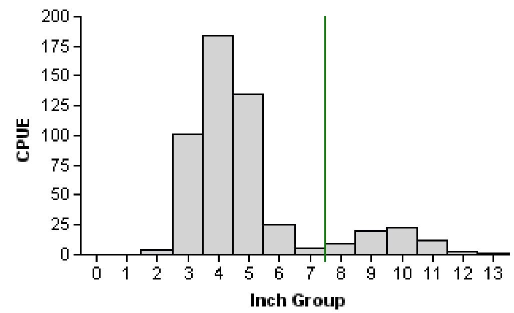
Gizzard Shad Results

Length Frequency Histogram

Nighttime
2014



Daytime
2014

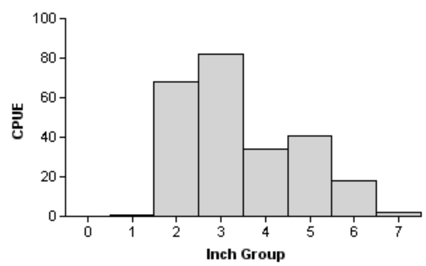


	Nighttime	Daytime
CPUE (RSE)	230.0 (21)	526.0 (18)
IOV (SE)	84 (2)	84 (3)

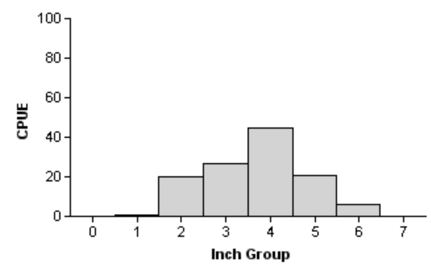
Bluegill Results

Length Frequency Histogram

Nighttime
2014



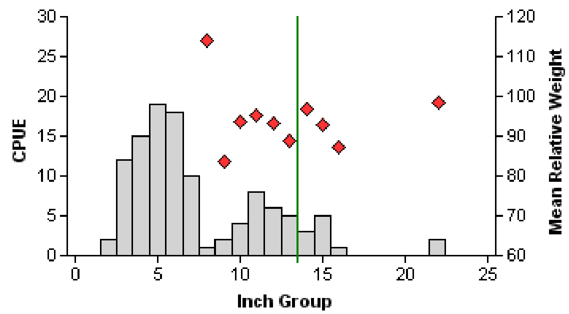
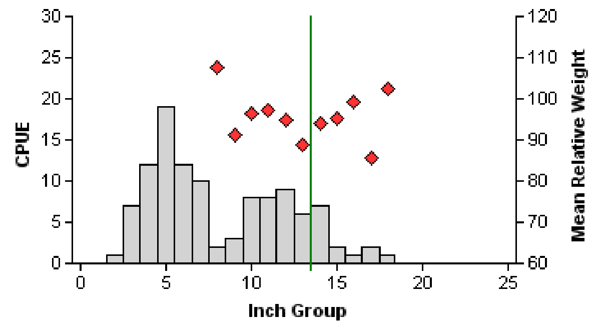
Daytime
2014



	Nighttime	Daytime
CPUE (RSE)	246.0 (41)	120.0 (20)
PSD (SE)	11 (3)	6 (3)

APPENDIX D, CONTINUED

Comparison of Daytime versus Nighttime Fall Electrofishing

	Largemouth Bass Results	
	Nighttime	Daytime
	2014	**2014**
Length Frequency Histogram		
CPUE (RSE)	113.0 (24)	110.0 (13)
Stock CPUE (RSE)	37.0 (23)	49.0 (26)
CPUE-14 (RSE)	11.0 (21)	13.0 (29)
PSD (SE)	59 (9)	57 (4)
PSD-P	22 (9)	12 (3)
PSD-M	5 (4)	0 (0)
PSD-T	0 (0)	0 (0)
PSD-14	30 (9)	27 (5)
PSD-18	5 (4)	2 (2)