# Broken Bow Lake Management Plan

## Background

Broken Bow Lake is located approximately 9 miles north of the town of Broken Bow in McCurtain county, southeast Oklahoma (Figure 1). The lake is operated by the U. S. Army Corps of Engineers (USACE), Tulsa District. Congress authorized the project with the Flood Control Act of July 3, 1958, and the Flood Control Act of October 23, 1967. Construction was completed in October 1968, which impounded approximately 22 miles of the Mountain Fork River. The conservation pool was filled in 1970. The reservoir contains 918,070 acre/feet of water at normal elevation of 599.50 ft. asl with 14,200 surface acres. Elevation at the top of the flood control pool is 627.50 ft. asl. The watershed consists of approximately 754 square miles of forestland within Polk County, Arkansas and LeFlore and McCurtain Counties, Oklahoma. The mountainous terrain is mostly comprised of rocky substrate causing low primary productivity, and slightly acidic pH values for waters in this portion of the state. Table 1 contains a list of physical and chemical characteristics of Broken Bow Lake.

For more information on current and historical reservoir data, visit http://www.swt-wc.usace.army.mil/BROK.lakepage.html.

The dam stands 225 ft. above the streambed, allowing maximum depths to reach 180 ft. beneath the surface of Broken Bow Lake. Well oxygenated, cold water (<45˚F) found in the hypolimnion is released downstream during hydropower production. Bubble plume diffusers lie at the bottom of Broken Bow Lake near the dam. If the hypolimnetic water heats up during the summer months, air is pumped to the diffusers. While bubbles rise towards the surface, they create an upwelling of colder water. This cold water supports a year-round trout fishery in a 12 mile stretch of the river below the dam. The Oklahoma Department of Wildlife Conservation (ODWC) began stocking rainbow trout and brown trout in the Lower Mountain Fork River in 1989 to compensate for cold water releases displacing the native warm water fishery.

Attention – Special regulations apply for the trout stream.

Please visit http://www.wildlifedepartment.com/fishregs.htm to review current license requirements and fishing regulations. Copies of "Regulation Guides" are available at the nearest hunting/fishing license dealer.

## Habitat

Fish habitat in Broken Bow Lake is primarily comprised of rock and some flooded timber. Additional habitat includes man-made structures such as rip-rap, brush piles, and boat docks. Steep rocky banks are not suitable for much aquatic vegetation. The ODWC has established and maintained 21 brush piles in Broken Bow Lake. Locations of brush piles are listed in Figure 2 and can be found on the Department's Interactive Digital Wildlife Atlas at http://www.wildlifedepartment.com/wmas2.htm.

## Water Quality

Broken Bow Lake is classified as an oligotrophic reservoir with low primary productivity. Water quality data collected through the Oklahoma Water Resources Board (OWRB) as part of their Beneficial Use Monitoring Program (BUMP) classifies Broken Bow Lake as not supporting to fully supporting the outlined Fish and Wildlife Propagation (FWP) beneficial uses. The complete BUMP report of Broken Bow Lake can be viewed at

http://www.owrb.ok.gov/quality/monitoring/bump/pdf_bump/Current/Lakes/brokenbow.pdf. Results presented in this report were obtained quarterly from October 2005 through July 2006. A brief overview of several water quality parameters is included below.

Thermal and Chemical Stratification

Broken Bow Lake was thermally stratified between 29 and 36 ft. during the fall. Dissolved oxygen (D.O.) concentrations below 2.0 ppm accounted for up to 66% of the water column. During the winter, the lake was not thermally stratified and had D.O. values $\geq$ 6.0 ppm. The water column during the spring was weakly stratified with D.O. values remaining above 6.0 ppm. A metalimnetic oxygen deficit occurred throughout the lake during the summer quarter. D.O. values fell below 2.0 ppm between 29 and 36 ft. then increased again. The same phenomena occurred in the past but the cause still remains a mystery. Sites in the upper end of Broken Bow Lake had D.O. values <2.0 ppm for 48 and 62% of the water column during the summer. All D.O. values meet the Oklahoma Water Quality Standards, partially supporting assigned FWP beneficial use.

Productivity

A Trophic State Index (TSI), using Carlson's TSI (chlorophyll-a), was calculated to measure the lake's productivity. The average TSI was 35, classifying the lake as oligotrophic, indicative of low primary productivity and nutrient levels. This value is similar to that calculated in 2004 (TSI=40), placing the lake within the same trophic category. Chlorophyll-a values remained consistent throughout the year, except one site with mesotrophic values during the winter. Broken Bow Lake is considered fully supporting the FWP beneficial use with lake-wide turbidity values below the criteria of 25 Nephelometric Turbidity Units (NTU). The average secchi disk depth was 115 inches.

Conductivity

Specific conductivity ranged from 25.3 µS/cm to 66.4 µS/cm, indicating extremely low concentrations of ionized salts in Broken Bow Lake. These values are much lower than others typically recorded in Oklahoma lakes. Waters with these values have little buffering capacity and are pH sensitive.

pH

The pH values ranged from 5.73 to 7.56 representing a slightly acidic to neutral system. With 69% of recorded values outside the acceptable range, Broken Bow Lake is not supporting the FWP beneficial use based on pH. Low soil pH in this portion of the state is to blame for slightly acidic conditions.

## Fishery

Biologists use a variety of gear types and standardized sampling procedures (SSP) to monitor resident fish populations. Sampling locations in Broken Bow Lake are listed in Figure 3. The major sportfish found in Broken Bow Lake include largemouth bass, spotted bass, smallmouth bass, white bass, hybrid striped bass, white crappie, black crappie, walleye, channel catfish, and flathead catfish. The primary forage species include gizzard and threadfin shad.

The ODWC hatchery system is responsible for species hybridization and mass producing fish for distribution throughout Oklahoma. The fish stocking history for Broken Bow Lake is included in Table 2.

Attention – Special fishing regulations apply for Broken Bow Lake, from the slab at the narrows downstream to the dam: 1) Largemouth and/or Smallmouth bass have a 13 – 16 inch protected slot limit and a creel limit of six combined per day.

Please visit http://www.wildlifedepartment.com/fishregs.htm to review current license requirements and fishing regulations. Copies of "Regulation Guides" are available at the nearest hunting/fishing license dealer.

**Black Bass**

Broken Bow Lake offers some of the best bass fishing in the region with three species of black bass; largemouth bass (*Micropterus salmoides*), spotted bass (*Micropterus punctulatus*), and smallmouth bass (*Micropterus dolomieu*). Tournament results for Broken Bow Lake are summarized in Table 3. Ranking of Oklahoma Lakes depends on the number of tournament reports submitted by tournament directors. A black bass creel survey was conducted in 1996 – 1997 at Broken Bow Lake. The survey results are included in Table 4.

Largemouth Bass

The Florida Largemouth Bass (FLMB) subspecies is routinely introduced into Broken Bow Lake because of their potential to reach trophy size. Genetic evaluation is required at least every three years after stocking FLMB. In the past, liver samples were required for 2-loci electrophoresis genetic testing. Advances in genetic research have provided a method of testing using external tissues. Fin clips from 40 age-1 largemouth bass are collected for 3-loci Microsatellite DNA analysis. The new method offers a better approach to determine the success of Florida strain introductions. A 3-year mean percentage of FLMB and/or F1 phenotypes >30% is necessary criteria for stocking requests. Electrophoretic results for Broken Bow Lake largemouth bass are included in Table 5. Based on catch rate criteria, Broken Bow Lake has a low total abundance and a low number of quality sized largemouth bass. Trends show Broken Bow Lakes's largemouth bass had low relative weights in the past. However, 2009 electrofishing results show the largemouth bass ≥14 inch group with acceptable relative weights. Over three quarters (78%) of the sample was < 14 inches and 21% was between 13-16 inches in length, with the 13-14 inch group contributing 11% to both. Only 12.2% of the sample was > 16 inches in length. Catch rates and size structure of largemouth bass are included in Table 6 and Figure 4, respectively. Sixty Largemouth bass from Broken Bow Lake were tested for Largemouth Bass Virus (LMBV) in 2003. LMBV was never confirmed at Broken Bow Lake. Otoliths were collected from 20 largemouth bass per inch group during the 2009 electrofishing sample and evaluated to determine a baseline for age and growth (Table 7 and Figure 7). Three different age classes (3-5) had at least some fish < 16 inches long. The slot appears to protect the target length group with relative weights remaining high (13-16 inch Wr = 96). Once largemouth reach 17 inches, their numbers fall off the chart. Largemouth bass must reach 6 years old to see lengths > 16 inches, but growth rates increase after competition is reduced. Broken Bow Lake currently holds the state record largemouth bass that weighed 14 .7 lbs. (28 inches long) caught on 3-14-1999 by William Cross.

Spotted Bass

Spotted bass are abundant (mean catch rates of 48.7 per hour; high total abundance is >30 per hour) in Broken Bow Lake and compete with largemouth bass for the same forage. With "quality" sized (≥ 14") spotted bass moderate in abundance, management goals changed. All creel and size limits were removed from spotted bass regulations statewide in 2009. Spotted bass catch rates and size structure of spotted bass are included in Table 8 and Figure 5, respectively. Otoliths were collected from 20 spotted bass per inch group during the 2009 electrofishing sample. These otoliths were evaluated to determine a baseline for age and growth (Table 7 and

Figure 7). The age 2 class was 54% of the spotted bass sample with a mean length of 8.6 inches. Mean length at age 3 was 12.6 inches and made up another 29% of the sample. Relative weights are typically good for 8-12" length groups. After spotted bass reach 14 inches at age 4, growth slows to around 1 inch per year. The current lake record spotted bass is 2.4 lbs. at 17 inches long, caught on 12-14-2008 by Bryce Archey.

Smallmouth Bass

A genetic survey across the natural range of smallmouth bass conducted in the 1990s demonstrated that the native populations in eastern Oklahoma represent the two most divergent lineages of the species; referred to as the Ouachita and Neosho smallmouth bass (Stark and Echelle 1998). The ODWC previously stocked "Tennessee lake strain" smallmouth bass into Broken Bow Lake in 1993. Based on an allozyme survey by Stark el al. (1995), the ODWC discontinued stockings over concerns of losing genetic diversity. The genome of the Broken Bow Lake population is about 40% non-native. A small amount (3%) of non-native material has made its way into the Mountain Fork River. The upper end of Broken Bow Lake acts as a partial barrier to dispersal. However, increased introgression of the "lake strain" into the tributaries is likely to occur. The quality of the smallmouth bass fishery may be dependent on the growth and survival of the "lake-strain" or $F_1$ hybrid (Boxrucker et al. 2004). Smallmouth bass total abundance is currently below recommended levels. Zero quality sized smallmouth bass were collected during the spring electrofishing survey. Relative weights are acceptable for the 10-12 inch group. Age and growth results from the 2004 study are included in Table 9. Otoliths were also collected from 15 smallmouth bass during the 2009 electrofishing sample and evaluated for age and growth (Table 7 and Figure 7). In 2009, mean length at ages 2-3 resembled spotted bass results. Age/growth data from the 2004 survey shows lengths of individual ages from Broken Bow Lake and the Mountain Fork River are statistically different. By age 4, "Lake" smallmouth bass mean lengths were 5 inches longer than the "River" smallmouth bass. Catch rates and size structure of smallmouth bass are included in Table 10 and Figure 6, respectively. The current lake record smallmouth bass weighs 5.7 lbs. (22 inches long) caught on 2-9-2008 by Chuck Tillman. Broken Bow produced two former state record smallmouth bass that weighed 5.1 lbs. and 5.6 lbs., in 1980 and 1983, respectively.

**Temperate Bass**

White Bass

White Bass (*Morone chrysops*) are very important to the Broken Bow Lake recreational fishery. There is a moderate total abundance and a high abundance of quality sized ($\geq$ 12") white bass in Broken Bow Lake. White bass create a popular spring fishery in the narrows of Broken Bow Lake and its tributaries during their spawning run. Relative weights are good at 103; acceptable values are $\geq$ 90. Catch rates and size structure of the Broken Bow Lake white bass fishery are included in Table 11 and Figure 8, respectively.

Hybrid Striped Bass

The ODWC hatchery system has collected white bass from the narrows as part of a reciprocal hybrid striped bass ($F_1$: female *Morone chrysops* x male *M. saxatilis*) experimental stock in some Oklahoma lakes. Hybrid striped bass (likely $F_1$: male *Morone chrysops* x female *M. saxatilis*) were recently found in Broken Bow Lake in moderate abundance with a mean catch rate of 4.7 per 24 hours. The ODWC is not responsible for their presence in Broken Bow Lake. Circumstances surrounding the introduction of this species remain unknown. Hybrid striped bass reach large sizes, creating exciting fishing opportunities. Recent SSP results show a high percentage of the catch in the 12-14 inch length groups. However, 2 individuals represented the 23 inch group (~ 6 lbs.) suggesting separate age classes. A complete overview of the Broken Bow Lake hybrid striped bass fishery is included in Figure 9.

**Crappie**
Broken Bow Lake contains both white crappie (*Pomoxis annularis*) and black crappie (*P. nigromaculatus*). Anglers typically target crappie around standing timber and brushy cover in lakes. In the spring, they inhabit the shallow end of coves to spawn, and later move off to 15 or more feet deep. Crappie can be caught year-round and make excellent table fare. Gillnetting results show an overall low abundance, but a moderate abundance of quality fish (≥ 8") and good relative weights. Crappie catch rates and size structure are presented in Table 12 and Figure 10, respectively. Fyke nets are a crappie specific gear type to attempt in the future.

**Walleye**
Walleye (*Stizostedion vitreum*) is a favorite among meat fishermen. A walleye fillet is considered gourmet table fare. Walleye were stocked into Broken Bow Lake in the late 1980s and early 1990s to introduce the species. They have since established a natural spawning population with a moderate total abundance. To identify a walleye, check the spiny dorsal fin for spots. The walleye will have no spots on the dorsal fin and the bottom portion of the tail will have a white tip. Walleye have a light gathering feature in their eyes, allowing them to feed at night. Broken Bow Lake currently has a moderate abundance of quality sized (≥ 16") walleye, but relative weights are below acceptable values. Catch rates and size structure of the Broken Bow Lake walleye fishery are included in Table 13 and Figure 11, respectively.

**Catfish**
Channel Catfish
Channel catfish **(***Ictalurus punctatus***)** are omnivorous, feeding on a wide variety of organic matter, dead and alive. Some of the more common foods are fish, mussels, snails, insects and crayfish. Channel catfish have a forked tail, because they spend most of their time swimming around in search of food. Broken Bow Lake sampling results show a low abundance of channel catfish. Relative weights are good. Catch rates and size structure of the Broken Bow Lake channel catfish fishery are included in Table 14 and Figure 12, respectively.

Flathead Catfish
Adult Flathead Catfish **(***Pylodictis olivaris***)** are found near cover in larger pools and deep holes. They like old brushy tangles, submerged logs and undercut banks. A flathead's tail will not be forked. Their bigger tail allows them to attack prey with quick bursts of speed. Most are taken while trotlining, juglining, limblining, noodling, or by SCUBA divers with spearguns. Relative weights were above average in the 2006 results. Abundance of quality fish (≥ 28") is down according to sampling results; 1995 is the most recent year a quality sized flathead appeared in results. Catch rates and size structure of the Grand Lake flathead catfish fishery are included in Table 15 and Figure 13.

**Shad**
Gizzard Shad
Gizzard Shad *(Dorosoma cepedianum)* provide forage for most game species. The species is often used by anglers as bait for other fish species. Catch rates and size structure of the Broken Bow Lake gizzard shad fishery are included in Table 16 and Figure 14.

Threadfin Shad
Threadfin Shad *(Dorosoma petenense)* are quite temperature sensitive, with die-offs reported at temperatures below 45°F. They have been introduced as forage fish in Broken Bow Lake. Adults are considerably smaller than gizzard shad adults, rarely exceeding 6 inches in length. The species is often used by anglers as bait for other fish species. Catch rates of the Broken Bow Lake threadfin shad fishery are included in Table 17.

According to the 2008 gillnetting results, both species of shad were low in abundance. Additional species specific sampling in the future is needed using floating shad gillnets. Sampling locations in the upper reaches of the reservoir may better represent our forage base.

**Fish Consumption Advisories**

Fish consumption advisories are issued by the Oklahoma Department of Environmental Quality (ODEQ). Current advisories can be viewed at www.deq.state.ok.us/mainlinks/press.htm.

Mercury

Mercury concentrations in precipitation soared during industrialization of the United States. Today, coal-fired facilities continue to have local, even global impacts. Southeast Oklahoma's rainfall (wet deposition) totals are higher than other parts of our state. ODEQ Air Quality Division funded a survey in 2008. The target species for this survey was black bass only. The data was intended to identify lakes needing more intensive sampling for lake-specific consumption advice. Broken Bow Lake black bass had excessive mercury levels under the Environmental Protection Agency guidelines. Tissue from 17 largemouth bass was collected in July 2008. The mean concentration was 0.66 µg/g. At this concentration, the advisory cautions pregnant women and young children to limit their fish consumption to 2 meals per month. Again, these results are only preliminary. Other predator fish typically harvested by anglers should be tested, so species-specific advisories can be issued in the future.

## Threats to the Fishery

**Aquatic Nuisance Species (ANS)**

People often visit different bodies of water within the same day. It is very easy for invasive species to hitchhike from one lake to another unless the following precautions are taken: 1) Remove any visible mud, plants, fish or animals before transporting equipment. 2) Drain all water from boat and equipment including bilges, bait buckets, live wells and coolers. 3) Clean and dry anything that comes into contact with water (boats, trailers, equipment, clothing, dogs, etc.). 4) Never release plants, fish or animals into a body of water unless they came out of that body of water.

The ODWC follows strict Hazard Analysis and Critical Control Point (HACCP) procedures to avoid transporting invasive species to uninfected water bodies. For more information, visit www.wildlifedepartment.com/nuisancespecies.htm.

Zebra Mussels

Zebra mussels (*Dreissena polymorpha)* have not been confirmed in Broken Bow Lake. However, periodic inspections should be coordinated with USACE and other appropriate agencies and universities. It is likely that some of these invaders were spread to many lakes in Oklahoma by anglers, boaters, and other outdoor enthusiasts. Zebra mussels can cause ecological and economic harm once a population is established. Large numbers attach themselves to water intake pipes, boats, and native plants and animals. Zebra mussels filter feed nutrients that native organisms require for growth and survival. Documenting sightings will be critical to monitoring their expansion.

Asian (Grass) Carp

Grass carp (*Ctenopharyngodon idella*) are commonly used in private ponds as a biological control for aquatic vegetation. Unfortunately, sometimes they escape when water is

overflowing, so fish barriers or sterile triploid forms are recommended when this type of control is necessary. These fish are gluttonous, eating up to three times their weight a day in plants. They can harm native plants if released into public waters. Grass carp have not been confirmed in Broken Bow Lake. Documenting sightings will be critical to monitoring their expansion.

Bighead Carp

Adult bighead carp (*Hypophthalmichthys nobilis*) are invasive fish that feed on plankton and compete for food with larval fishes and mussels. Bighead carp have not been confirmed in Broken Bow Lake, but have been reported in the Kiamichi River below Hugo Lake and the Red River. Documenting sightings will be critical to monitoring their expansion.

Silver Carp

Silver carp (*Hypophthalmichthys molitrix*) were imported to use in the aquaculture industry. This species competes for plankton with larval and juvenile fishes as well as shad. Silver carp have not been confirmed in Broken Bow Lake, but have been reported in the Arkansas and Red Rivers in Oklahoma. Documenting sightings will be critical to monitoring their expansion.

Northern Snakehead

The snakehead (*Channa argus*) was introduced by asian fish markets. They can spawn up to five times a year, and the young receive care from both parents (unlike native fish), which improves their survival rate. Also, they are aggressive predators, eating most fish species. With the recent discovery of snakeheads in Eastern Arkansas, the Arkansas Game and Fish Commission made plans to eradicate the population with a chemical called rotenone. Rotenone kills all fish species; unfortunately, this is the only method that will eradicate northern snakeheads. Broken Bow Lake does not have snakeheads. Please report any sightings in Oklahoma to the appropriate agencies.

**Land Use Practices**

Farming and forestry practices within the drainage basin can potentially degrade the water quality of Broken Bow Lake. Nutrient and sediment loading can have negative impacts on fish and other aquatic organisms that are sensitive to environmental changes. Forest investment companies own thousands of acres in southeastern Oklahoma with the primary goal of timber production. The companies also believe that fish and wildlife management and other outdoor recreational activities should be an integral part of the management plans for their properties. Cooperative agreements between the ODWC and the commercial timber industry will improve and protect fish and wildlife habitat.

## Management Objectives

**Goals**

- Collect SSP trend data on the major sportfish and forage species.
- Conduct creel survey to determine angling pressure, success, harvest, satisfaction, and regional economic impact of the fishery.
- Enhance aquatic habitat.
- Monitor water quality.
- Develop and/or maintain boating and fishing access.
- Conduct public outreach and solicit feedback regarding fisheries management issues.
- Coordinate and assist with the documentation and monitoring of aquatic nuisance species.

**Strategies**

1. Sampling goals for the major sportfish and forage species will be as follows:
    a. Largemouth Bass - Conduct Standardized Sampling Protocol (SSP) spring electrofishing at night for largemouth bass annually to determine catch rates by size groups and relative weights. Due to upcoming hatchery system renovations, FLMB stocking will temporarily cease in Broken Bow Lake. The normal stocking rotation should resume after renovations are complete. Fin clips from forty age-1 individuals will provide MDNA for genetic evaluation following FLMB stocking. Bass tournament results will be monitored annually to evaluate overall trends. Bass clubs will be asked to return more tournament reports. Largemouth bass will be tested for LMBV if it is believed to be the cause of a fish kill.
    b. Spotted Bass – Conduct SSP spring electrofishing at night for spotted bass annually to determine catch rates by size groups and relative weights.
    c. Smallmouth Bass – Conduct SSP spring or fall electrofishing at night for smallmouth bass annually to determine the catch rates by size groups and relative weights. Monitor the genetic composition of the smallmouth bass populations in Broken Bow Reservoir and the Mountain Fork River to assess the introgression rates of non-native alleles. If $F_x$ individuals are "less fit" than the "lake-strain" or first generation crosses with native strains ($F_1$), periodic stocking of "lake-strain" individuals may be needed to maintain existing smallmouth bass population characteristics. Also, inform the public of potential harmful effects (not limited to genetics) of moving fish from one body of water to another (Boxrucker et al. 2004).
    d. White Bass – Conduct SSP fall gillnetting for white bass every other year to determine catch rates by size groups and relative weights.
    e. Hybrid Striped Bass – Conduct SSP fall gillnetting for hybrid striped bass every other year to determine catch rates by size groups and relative weights.
    f. White Crappie – Conduct SSP fall trapnetting for white crappie every other year to determine catch rates by size groups and relative weights. Age and growth data will be collected when sampled.
    g. Black Crappie – Conduct SSP fall trapnetting for black crappie every other year to determine catch rates by size groups and relative weights. Age and growth data will be collected when sampled.
    h. Walleye – Conduct SSP fall gillnetting for walleye every other year to determine catch rates by size groups and relative weights.
    i. Channel Catfish – Conduct SSP fall gillnetting for channel catfish every other year to determine catch rates by size groups and relative weights.
    j. Flathead Catfish – Conduct SSP fall gillnetting for flathead catfish every other year to determine catch rates by size groups and relative weights.
    k. Gizzard Shad – Conduct SSP fall gillnetting for gizzard shad every other year to determine catch rates by size groups. Additional species specific sampling with floating shad gillnets is needed to estimate shad abundance.
    l. Threadfin Shad – Conduct SSP fall gillnetting for threadfin shad every other year to determine catch rates by size groups. Additional species specific sampling with floating shad gillnets is needed to estimate shad abundance.

2. Design, implement, and analyze a creel survey that will determine angling pressure, success, harvest, satisfaction, and regional economic impact of the fishery. Every effort should be made to coordinate with the USACE to ensure both agencies' needs are addressed, and effort is distributed appropriately between ODWC and USACE.

3. Maintain fish attractors utilizing natural materials. Brush piles constructed of natural materials will be refurbished as needed. Fish attractor buoys will be replaced or retrieved as needed. Work with appropriate agencies to host an annual Broken Bow Lake "Appreciation Day." The project will offer anglers an opportunity to work along side ODWC personnel to improve aquatic habitat.

4. Monitor several water quality parameters at fixed sampling locations in the upper and lower portions of the lake each month for a 12 month period. After the initial 12 month period, monitoring will be reduced to the summer period annually. Results from each year will be summarized, provided to appropriate resource agencies.

5. Develop and/or maintain boating and fishing access projects at Broken Bow Lake. This will be accomplished through the solicitation of appropriate agencies and entities willing to cooperate on access development or maintenance.

6. Conduct one (1) public meeting to present agency efforts regarding fisheries management and solicit public feedback. Meet with bass clubs to explain the importance of submitting their tournament reports.

7. Perform outreach to educate the public about the threats, prevention, and spread of ANS. Investigate and report all sightings of ANS to the ODWC ANS biologist, USACE, other resource agencies, and the media when appropriate.

# Literature Cited

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Stark, W. J., A. A. Echelle, and W. L. Fisher. 1995. Genetic structure of stream populations of smallmouth bass in eastern Oklahoma. Final Report, Federal Aid Project F-41-R, Job 17, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma.

Boxrucker, J., A. A. Echelle, and Van Den Bussche. 2004. Determining the degree of hybridization in the smallmouth bass population of Broken Bow Reservoir and the Mountain Fork River. Final Report, Federal Aid Project F-50-R, Job 19, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma.

# Tables

Table 1. Physical and chemical characteristics of Broken Bow Lake.

| | |
|---|---|
| Operating Agencies: | U. S. Army Corps of Engineers |
| Impoundment Date | 1970 |
| Surface Area | 14,200 acres |
| Shoreline | 180 miles |
| Shoreline Development Ratio | 10.8 |
| Mean Depth | 65 ft. |
| Maximum Depth | 180 ft. |
| Water Exchange Rate | 1.0 |
| Watershed | 754 square miles |
| Secchi Disk | 115 inches |
| Conductivity | 25.3 to 66.4 μS/cm |
| pH | 5.73 to 7.56 |
| Carlson's Trophic State Index (chlorophyll a) | 35; Oligotrophic |

Table 2. Stocking Record for Broken Bow Lake.

| Species | N | Size |
|---|---|---|
| Florida Largemouth Bass | | |
| 1987 | 160,200 | Fingerlings |
| 1988 | 29,950 | Fingerlings |
| 1989 | 115,510 | Fingerlings |
| 1998 | 86,249 | Fingerlings |
| 2000 | 251,990 | Fingerlings |
| 2001 | 195,831 | Fingerlings |
| 2002 | 214,490 | Fry |
| 2004 | 285,236 | Fingerlings |
| 2006 | 196,500 | Fingerlings |
| Smallmouth Bass | | |
| 1993 | 185,840 | Fingerlings |
| Walleye | | |
| 1986 | 100,000 | Fingerlings |
| 1988 | 250,000 | Fry |
| 1989 | 1,400,000 | Fry |
| 1990 | 142,590 | Fingerlings |
| 1991 | 150,000 | Fingerlings |
| Channel Catfish | | |
| 1990 | 100,760 | Fingerlings |
| 1994 | 102,275 | Fingerlings |
| 1995 | 102,250 | Fingerlings |
| 1996 | 32,019 | Fingerlings |
| Rainbow Trout | | |
| 1983 | 95,128 | Growouts |
| 1984 | 145,108 | Growouts |
| 1988 | 49,960 | Fingerlings |
| 1989 | 134,892 | Fingerlings |
| 1990 | 31,288 | Fingerlings |
| 1991 | 59,700 | Fingerlings |
| 1992 | 49,996 | Fingerlings |

Table 3. Broken Bow Lake Tournament Results. Ranking of Lakes Statewide from which 10 or more Tournament Reports were Received. Ranked According to Quality Fishing Indicators. Broken Bow Lake Ranking listed in parentheses.

| Year | Number of Reports | Total Number of Anglers | Number of Bass Caught | Number of Bass Weighed In per 8-Hour Day | | Bass/ Tourn | Bass Weighed In/Angler | Percent Successful Anglers | | Average Weight per Bass (lbs.) | | Number of Bass Weighing In Over 5 lbs. | Angler-Hours per Bass Weighing In Over 5 lbs. | Number of Bass Weighing In Over 8 lbs. | Avg. Big Bass | Avg. 1st Place Weight (lbs.) | | Overall Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | 8 | 250 | 651 | 2.1 | | 81.4 | 2.6 | 58 | | 1.6 | | 5 | | 0 | 6.1 | 14.8 | | |
| 2002 | 5 | 149 | 400 | 2.0 | | 80.0 | 2.7 | 84 | | 1.8 | | 1 | | 1 | 9.2 | 18.7 | | |
| 2003 | 19 | 600 | 1144 | 2.6 | (# 1) | 60.2 | 1.9 | 85 | (# 3) | 1.8 | (# 20) | 13 | (# 13) | 1 | 9.4 | 14.0 | (# 3) | # 2* |
| 2004 | 11 | 976 | 1143 | 1.3 | (# 6) | 103.9 | 1.2 | 75 | (# 4) | 1.9 | (# 17) | 10 | (# 22) | 0 | 7.7 | 15.1 | (# 2) | # 5* |
| 2005 | 20 | 1637 | 1991 | 2.1 | (# 4) | 99.6 | 1.2 | 81 | (# 3) | 1.9 | (# 19) | 12 | (# 24) | 1 | 11.4 | 14.7 | (# 1) | # 4* |
| 2006 | 6 | 254 | 660 | | | 110.0 | 2.6 | 80 | | 1.8 | | 0.3 | | 0 | 4.2 | 12.4 | | |
| 2007 | 3 | 124 | 309 | | | 103.0 | 2.5 | 94 | | 1.7 | | 0 | | 0 | 4.0 | 11.7 | | |
| **Avg** | **10** | **570** | **900** | **2.0** | **3.7** | **91.2** | **2.1** | **80** | **3.3** | **1.8** | **18.7** | **5.9** | **19.7** | **0.4** | **7.4** | **14.5** | **2.0** | **3.7** |

*Values were tied with other lake(s) for that indicator.

Table 4. Broken Bow Lake Black Bass Creel Survey: April – November 2006 and March – June 1997. All Fishing Included.

| Year | No. Interviews | Hours Fished | LMB Kept/ Hour | SPB Kept/ Hour | %LMB Kept | %SPB Kept |
|---|---|---|---|---|---|---|
| 1996 | 278 | 1749 | 0.174 | 0.381 | 31 | 69 |
| 1997 | 195 | 1176.5 | 0.337 | 0.383 | 47 | 53 |

Table 5. Broken Bow Lake Largemouth Bass Electrophoresis Results.

| Year | N | %N | %F | %F1 | %FX | %F+F1 |
|---|---|---|---|---|---|---|
| 1999 | 40 | 68 | 0 | 4 | 28 | 4 |
| 2003 | 36 | 25 | 9 | 36 | 31 | 45 |
| 2005 | 40 | 28 | 5 | 17 | 50 | 22 |

Table 6. Total number (No.), catch rates (C/f), and relative weights (Wr) by size groups of **largemouth bass** collected during spring electrofishing in ***Broken Bow Reservoir***. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable Wr values are ≥90.

| | Total | | <8 in. | | 8-12 in. | | ≥12 | | ≥14 in. | | 13-16 | | >16 in. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (≥40) | | (15-45) | | (15-30) | | (≥15) | | (≥10) | | | | | |
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ |
| 1991 | 265 | 44.2 | 13.8 | 95 | 18.3 | 86 | 12.0 | 83 | 4.5 | 83 | 6.5 | 84 | 1.3 | 80 |
| 1992 | 266 | 59.1 | 8.0 | 91 | 9.3 | 89 | 41.8 | 89 | 14.9 | 87 | 20.0 | 90 | 6.0 | 85 |
| 1993 | 218 | 37.9 | 9.0 | 91 | 9.4 | 89 | 19.5 | 87 | 13.4 | 86 | 10.6 | 86 | 5.4 | 86 |
| 1994 | 140 | 31.1 | 6.4 | 91 | 8.4 | 87 | 16.2 | 83 | 8.9 | 81 | 7.6 | 84 | 4.0 | 84 |
| 1995* | 276 | 61.3 | 16.2 | 93 | 13.1 | 89 | 32.0 | 86 | 18.2 | 86 | 13.8 | 87 | 9.3 | 86 |
| 1996 | 251 | 27.1 | 7.2 | 91 | 7.9 | 93 | 12.0 | 89 | 6.9 | 88 | 5.8 | 90 | 2.8 | 85 |
| 1997 | 250 | 55.6 | 16.9 | 100 | 14.0 | 98 | 24.7 | 87 | 17.6 | 85 | 10.0 | 87 | 10.7 | 83 |
| 1998 | 123 | 30.8 | 4.5 | 99 | 9.0 | 91 | 17.5 | 86 | 9.0 | 84 | 10.3 | 86 | 2.0 | 81 |
| 1999 | Did not spring electrofish (water too high) | | | | | | | | | | | | | |
| 2000 | 321 | 107.0 | 17.7 | 90 | 56.0 | 90 | 33.3 | 89 | 15.7 | 87 | 17.3 | 88 | 5.7 | 85 |
| 2001 | 247 | 52.0 | 9.7 | 84 | 12.6 | 83 | 29.7 | 84 | 14.3 | 83 | 17.1 | 85 | 5.3 | 80 |
| 2002 | 102 | 51.0 | 6.5 | 89 | 5.0 | 90 | 39.5 | 86 | 32.0 | 85 | 27.5 | 86 | 9.5 | 82 |
| 2004 | 174 | 29.0 | 3.5 | 88 | 3.2 | 90 | 22.3 | 88 | 15.5 | 88 | 9.5 | 90 | 9.6 | 86 |
| 2006 | 255 | 42.5 | 6.67 | 96 | 20.33 | 93 | 16.33 | 84 | 8.00 | 82 | 7.67 | 84 | 3.5 | 79 |
| 2009 | 181 | 30.2 | 11.2 | 96 | 9.67** | 93** | ** | ** | 5.83 | 94 | 6.00 | 96 | 3.5 | 91 |

*These catch rates are probably higher than past years, because we targeted largemouth bass habitat.
**These values were calculated using the 8-14 inch group opposed to the 8-12 inch group in the past. Also, ≥12 inch C/f and Wr was not calculated.

Table 7. Age frequencies from **black bass** age data collected during spring electrofishing in ***Broken Bow Reservoir***.

| | Largemouth Bass | | | Spotted Bass | | | Smallmouth Bass | | |
|---|---|---|---|---|---|---|---|---|---|
| Age | Freq. | % | Mean Length at age (in.) | Freq. | % | Mean Length at age (in.) | Freq. | % | Mean Length at age (in.) |
| 1 | 47 | 29.75 | 7.54 | 10 | 5.43 | 7.28 | 0 | 0.00 | 0.00 |
| 2 | 68 | 43.04 | 12.17 | 99 | 53.80 | 8.65 | 13 | 86.67 | 9.61 |
| 3 | 27 | 17.09 | 15.31 | 54 | 29.35 | 12.60 | 2 | 13.33 | 12.07 |
| 4 | 8 | 5.06 | 16.89 | 15 | 8.15 | 14.02 | 0 | 0.00 | 0.00 |
| 5 | 3 | 1.90 | 16.17 | 1 | 0.54 | 15.00 | 0 | 0.00 | 0.00 |
| 6 | 2 | 1.27 | 17.28 | 3 | 1.63 | 15.56 | 0 | 0.00 | 0.00 |
| 7 | 2 | 1.27 | 18.29 | 2 | 1.09 | 17.26 | 0 | 0.00 | 0.00 |
| 8 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 9 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 10 | 1 | 0.63 | 21.54 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |

Table 8. Total number (No.), catch rates (C/f), and relative weights ($W_r$) by size groups of **spotted bass** collected during spring electrofishing in ***Broken Bow Reservoir***. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are ≥90.

| | Total | | <8 in. | | 8-12 in. | | ≥12 in. | | ≥14 in. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (≥40) | | (15-45) | | (15-30) | | (≥15) | | (≥10) | |
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ |
| 1987 | 235 | 27.6 | 14.0 | 89 | 12.4 | 80 | 1.3 | 78 | 0.1 | 80 |
| 1989 | 333 | 66.6 | 28.2 | 76 | 32.0 | 85 | 6.4 | 82 | 2.6 | 82 |
| 1991 | 132 | 22.0 | 16.3 | 81 | 5.2 | 79 | 0.5 | 80 | 0.2 | 84 |
| 1992 | 227 | 50.4 | 16.0 | 79 | 26.7 | 83 | 7.8 | 85 | 2.2 | 85 |
| 1993 | 383 | 66.6 | 37.2 | 80 | 25.9 | 80 | 3.5 | 80 | 0.9 | 82 |
| 1994 | 310 | 68.9 | 41.8 | 82 | 24.2 | 80 | 2.9 | 82 | 0.7 | 79 |
| 1995* | 196 | 43.6 | 15.3 | 85 | 24.0 | 86 | 4.2 | 81 | 0.9 | 78 |
| 1996 | 240 | 25.9 | 5.6 | 84 | 13.4 | 83 | 6.9 | 83 | 2.3 | 86 |
| 1997 | 186 | 41.3 | 21.6 | 90 | 15.1 | 90 | 4.7 | 79 | 1.6 | 78 |
| 1998 | 292 | 73.0 | 50.8 | 87 | 20.3 | 85 | 2.0 | 83 | 1.8 | 83 |
| 1999 | Did not spring electrofish (water too high) | | | | | | | | | |
| 2000 | 121 | 40.3 | 8.3 | 96 | 23.0 | 96 | 9.0 | 92 | 3.7 | 91 |
| 2001 | 59 | 12.4 | 5.3 | 76 | 2.7 | 86 | 4.4 | 84 | 1.7 | 81 |
| 2002 | 172 | 86.0 | 55.5 | 88 | 25.5 | 96 | 5.0 | 85 | 3.0 | 86 |
| 2004 | 239 | 39.8 | 21.7 | 95 | 10.2 | 93 | 8.3 | 87 | 3.0 | 89 |
| 2006 | 117 | 19.5 | 8.3 | 99 | 7.7 | 92 | 3.7 | 88 | 0.7 | 79 |
| 2009 | 292 | 48.7 | 23.5 | 98 | 18.8** | 100** | ** | ** | 3.0 | 89 |

*These catch rates are probably lower than past years, because we targeted largemouth bass habitat.
**These values were calculated using the 8-14 inch group opposed to the 8-12 inch group in the past. Also, ≥12 inch C/f and Wr was not calculated.

Table 9. Mean length (inches) at age data for smallmouth bass populations from Broken Bow reservoir and Mountain Fork River in 2004. Lengths of individual ages from Broken Bow Reservoir and Mountain Fork River are statistically different (one-way ANOVA; $\alpha = 0.05$). Numbers in parentheses are the sample sizes.

| | Age 0 | Age 1 | Age 2 | Age 3 | Age 4 |
|---|---|---|---|---|---|
| Broken Bow Reservoir | (22) 4.5 | (60) 8.4 | (18) 11.4 | (2) 16.0 | (2) 18.3 |
| Mountain Fork River | (32) 4.0 | (45) 7.6 | (10) 9.0 | (4) 14.7 | (3) 13.7 |

Table 10. Total number (No.), catch rates (C/f), and relative weights ($W_r$) by size groups of **smallmouth bass** collected during spring electrofishing in ***Broken Bow Reservoir***. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are ≥90.

| | Total | | <8 in. | | 8-12 in. | | ≥12 in. | | ≥14 in. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (≥40) | | (15-45) | | (15-30) | | (≥15) | | (≥10) | |
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ |
| 1987 | 16 | 1.9 | 1.2 | - | 0.6 | 88 | 0.1 | 75 | 0.0 | - |
| 1989 | 19 | 3.8 | 1.4 | - | 2.4 | 91 | 0.0 | - | 0.0 | - |
| 1991 | 0 | 0.0 | - | - | - | - | - | - | - | - |
| 1992 | 1 | 0.2 | 0.0 | - | 0.0 | - | 0.2 | 88 | 0.2 | 88 |
| 1993* | 1 | 0.2 | - | - | 0.2 | 88 | - | - | - | - |
| 1994 | 9 | 2.0 | 1.3 | - | 0.7 | 86 | - | - | - | - |
| 1995 | 1 | 0.2 | 0.2 | - | 0.0 | - | - | - | - | - |
| 1996 | 30 | 3.2 | 0.8 | 87 | 1.9 | 77 | 0.2 | 92 | 0.2 | 93 |
| 1997 | 20 | 4.4 | 2.9 | 82 | 1.6 | 90 | 0.0 | - | 0.0 | - |
| 1998 | 57 | 14.3 | 9.3 | - | 5.0 | - | 0.0 | - | 0.0 | - |
| 1999 | Did not spring electrofish (water too high) | | | | | | | | | |
| 2000 | 11 | 3.7 | 2.3 | 79 | 1.0 | 86 | 0.3 | 89 | 0.0 | - |
| 2001 | 34 | 7.2 | 2.9 | 109 | 3.6 | 80 | 0.6 | 75 | 0.4 | 71 |
| 2002 | 35 | 17.5 | 6.5 | 82 | 10.0 | 89 | 1.0 | 85 | 1.0 | 85 |
| 2004 | 51 | 8.5 | 4.7 | 91 | 3.5 | 92 | 0.3 | 83 | 0.3 | 83 |
| 2006 | 4 | 0.6 | - | - | 0.1 | 78 | 0.5 | 88 | 0.1 | 86 |
| 2009 | 15 | 2.5 | 0.3 | 88 | 2.2** | 89** | - | - | - | - |

*1993: Reservoir strain smallmouth were stocked.
** These values were calculated using the 8-14 inch group opposed to the 8-12 inch group in the past.

Table 11. Total number (No.), catch rates (C/f), and relative weights ($W_r$) by size groups of **white bass** collected while gill netting in ***Broken Bow Reservoir***. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are ≥90.

| | Total | | <8 in. | | 8-12 in. | | ≥12 in. | |
|---|---|---|---|---|---|---|---|---|
| | ( ≥ 4.8 ) | | ( ≥ 1.2 ) | | (1.2-7.2) | | (≥ 2.4) | |
| Year | No. | C/f | C/f | Wr | C/f | Wr | C/f | Wr |
| 1987 | 75 | 6.24 | 0.00 | - | 0.07 | 87 | 6.00 | 109 |
| 1989 | 118 | 8.64 | 0.00 | - | 0.24 | 109 | 8.40 | 114 |
| 1991 | 76 | 5.76 | 0.00 | - | 0.24 | 91 | 5.52 | 99 |
| 1992 | 153 | 11.04 | 0.07 | 95 | 0.07 | 102 | 10.80 | 107 |
| 1993 | 97 | 7.68 | 0.24 | 90 | 0.48 | 116 | 6.96 | 100 |
| 1994 | 106 | 6.96 | 0.00 | - | 0.24 | 94 | 6.96 | 103 |
| 1995 | 84 | 6.00 | 0.50 | 96 | 0.57 | 100 | 4.80 | 103 |
| 1996 | 70 | 4.8 | 0.48 | 89 | 0.14 | 88 | 4.32 | 98 |
| 1997 | 108 | 7.92 | 0.00 | - | 0.14 | 104 | 7.68 | 100 |
| 1998 | 30 | 2.16 | 0.14 | 104 | 0.31 | 94 | 1.92 | 95 |
| 1999 | 80 | 6.24 | 0.07 | 109 | 0.38 | 107 | 5.76 | 104 |
| 2000 | 40 | 2.88 | 0.28 | 87 | 0.28 | 91 | 2.25 | 97 |
| 2004 | 140 | 9.84 | 0.00 | - | 0.50 | 112 | 9.45 | 106 |
| 2006 | 66 | 4.80 | 4.84 | 100 | 0.72 | 99 | 4.12 | 101 |
| 2008 | 66 | 5.28 | 0.00 | - | 0.07 | 92 | 5.13 | 103 |

Table 12. Total number (No.), catch rates (C/f), and relative weights ($W_r$) by size groups of **crappie** collected while gill netting in ***Broken Bow Reservoir***. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are ≥90.

| | Total | | ≤8 in. | | ≥8 in. | | ≥10 in. | |
|---|---|---|---|---|---|---|---|---|
| | (≥4.8) | | (1.2-7.2) | | (≥ 1.92) | | (≥ 0.96) | |
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ |
| 1987 | 1 | 0.07 | 0.0 | - | 0.07 | 87 | 0.07 | 87 |
| 1989 | 2 | 0.14 | 0.0 | - | 0.14 | 100 | 0.14 | 100 |
| 1991 | 3 | 0.24 | 0.0 | - | 0.24 | 90 | 0.07 | 86 |
| 1992 | 3 | 0.24 | 0.0 | - | 0.24 | 86 | 0.14 | 86 |
| 1993 | 10 | 0.72 | 0.0 | - | 0.72 | 95 | 0.72 | 95 |
| 1994 | 5 | 0.33 | 0.0 | - | 0.34 | 92 | 0.26 | 92 |
| 1995 | 14 | 0.17 | 0.24 | 109 | 0.77 | 90 | 0.70 | 90 |
| 1996 | 12 | 8.4 | 0.0 | - | 0.84 | 90 | 0.62 | 88 |
| 1997 | 6 | 0.07 | 0.0 | - | 0.43 | 95 | 0.43 | 95 |
| 1998 | 14 | 1.05 | 0.07 | 97 | 0.98 | 89 | 0.84 | 88 |
| 1999 | 14 | 1.10 | 0.00 | - | 1.03 | 93 | 0.48 | 89 |
| 2000 | 4 | 0.29 | 0.00 | - | 0.29 | 103 | 0.14 | 105 |
| 2001 | Did not gill net | | | | | | | |
| 2002 | Did not gill net | | | | | | | |
| 2004 | 1 | 0.07 | 0.00 | - | 0.07 | 102 | 0.07 | 102 |
| 2006 | 1 | 0.07 | 0.07 | 98 | 0.07 | 98 | 0.07 | 98 |
| 2008 | 31 | 2.54 | 0.10 | - | 2.45 | 107 | 0.41 | 104 |

Table 13. Total number (No.), catch rates (C/f), and relative weights ($W_r$) by size groups of **walleye** collected while gill netting in ***Broken Bow Reservoir***. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are ≥90.

| | Total | | <12 in. | | 12-16 in. | | >16 in. | |
|---|---|---|---|---|---|---|---|---|
| | (>2.4) | | (≥1.44) | | (≥0.48) | | (≥0.48) | |
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ |
| 1987 | 12 | 0.96 | 0.24 | 87 | 0.48 | 86 | 0.24 | 87 |
| 1989 | 30 | 2.16 | 1.44 | 101 | 0.07 | 81 | 0.48 | 100 |
| 1991 | 24 | 1.92 | 0.48 | 85 | 0.48 | 92 | 0.96 | 84 |
| 1992 | 23 | 1.68 | 0.00 | - | 0.72 | 85 | 0.96 | 79 |
| 1993 | 18 | 1.44 | 0.24 | 91 | 0.24 | 85 | 1.20 | 82 |
| 1994 | 27 | 1.92 | 0.24 | 84 | 0.48 | 84 | 0.96 | 81 |
| 1995 | 19 | 1.44 | 0.72 | 86 | 0.07 | 82 | 0.72 | 81 |
| 1996 | 9 | 0.72 | 0.24 | 82 | 0.07 | 80 | 0.48 | 81 |
| 1997 | 8 | 0.48 | 0.24 | 91 | 0.07 | 80 | 0.24 | 88 |
| 1998 | 13 | 0.96 | 0.48 | 89 | 0.22 | 88 | 0.48 | 79 |
| 1999 | 65 | 5.04 | 4.08 | 93 | 0.17 | 89 | 0.96 | 80 |
| 2000 | 22 | 1.68 | 0.29 | 84 | 0.50 | 81 | 0.77 | 84 |
| 2004 | 39 | 2.88 | 1.46 | 85 | 0.22 | 85 | 1.13 | 83 |
| 2006 | 24 | 1.68 | 0.41 | 89 | 0.14 | 78 | 1.18 | 77 |
| 2008 | 47 | 3.84 | 2.33 | 95 | 0.48 | 83 | 0.70 | 84 |

Table 14. Total number (No.), catch rates (C/f), and relative weights ($W_r$) by size groups of **channel catfish** collected while gill netting in ***Broken Bow Reservoir***. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are ≥90.

| | Total | | <12 in. | | ≥12 in. | | ≥16 in. | |
|---|---|---|---|---|---|---|---|---|
| | (≥ 4.8) | | (≥ 2.4) | | (≥ 2.4) | | (≥ 1.2) | |
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ |
| 1987 | 4 | 0.24 | 0.00 | - | 0.24 | 91 | 0.24 | 95 |
| 1989 | 3 | 0.24 | 0.00 | - | 0.24 | 105 | 0.24 | 105 |
| 1991 | 5 | 0.48 | 0.00 | - | 0.48 | 103 | 0.24 | 109 |
| 1992 | 3 | 0.24 | 0.00 | - | 0.24 | 81 | 0.24 | 81 |
| 1993 | 3 | 0.24 | 0.00 | - | 0.24 | 87 | 0.24 | 87 |
| 1994 | 6 | 0.48 | 0.07 | 110 | 0.34 | 79 | 0.26 | 81 |
| 1995 | 8 | 0.48 | 0.07 | 77 | 0.50 | 92 | 0.43 | 94 |
| 1996 | 11 | 0.72 | 0.14 | 156 | 0.62 | 84 | 0.48 | 86 |
| 1997 | 12 | 0.96 | 0.14 | 81 | 0.72 | 86 | 0.72 | 86 |
| 1998 | 10 | 0.72 | 0.07 | 105 | 0.67 | 92 | 0.67 | 92 |
| 1999 | 4 | 0.24 | 0.00 | - | 0.31 | 95 | 0.17 | 108 |
| 2000 | 8 | 0.48 | 0.07 | 100 | 0.50 | 97 | 0.50 | 97 |
| 2001 | Did not gill net | | | | | | | |
| 2002 | Did not gill net | | | | | | | |
| 2004 | 6 | 0.48 | 0.00 | - | 0.41 | 105 | 0.41 | 105 |
| 2006 | 1 | 0.07 | 0.00 | - | 0.07 | 103 | 0.07 | 103 |
| 2008 | 6 | 0.48 | 0.00 | - | 0.48 | 93 | 0.24 | 101 |

Table 15. Total number (No.), catch rates (C/f), and relative weights ($W_r$) by size groups of **flathead catfish** collected while gill netting in ***Broken Bow Reservoir***. Acceptable $W_r$ values are ≥90.

| | Total | | <12 in. | | ≥12 in. | | ≥20 in. | | ≥24 in. | | ≥28 in. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | No. | C/f | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ | C/f | $W_r$ |
| 1987 | 6 | 0.48 | 0.00 | - | 0.48 | 85 | 0.24 | 84 | 0.17 | 86 | 0.07 | 97 |
| 1989 | 4 | 0.24 | 0.00 | - | 0.24 | 95 | 0.24 | 94 | 0.00 | - | 0.00 | - |
| 1991 | 10 | 0.72 | 0.00 | - | 0.72 | 84 | 0.48 | 88 | 0.00 | - | 0.00 | - |
| 1992 | 5 | 0.48 | 0.00 | - | 0.48 | 87 | 0.24 | 88 | 0.00 | - | 0.00 | - |
| 1993 | 7 | 0.48 | 0.00 | - | 0.48 | 101 | 0.24 | 105 | 0.00 | - | 0.00 | - |
| 1994 | 5 | 0.24 | 0.00 | - | 0.24 | 91 | 0.24 | 91 | 0.07 | 85 | 0.00 | - |
| 1995 | 4 | 0.24 | 0.00 | - | 0.24 | 93 | 0.24 | 93 | 0.07 | 102 | 0.07 | 102 |
| 1996 | 3 | 0.24 | 0.00 | - | 0.24 | 87 | 0.07 | 86 | 0.07 | 86 | 0.00 | - |
| 1997 | 5 | 0.48 | 0.00 | - | 0.48 | 87 | 0.29 | 87 | 0.00 | - | 0.00 | - |
| 1998 | 7 | 0.48 | 0.00 | - | 0.48 | 83 | 0.22 | 82 | 0.00 | - | 0.00 | - |
| 1999 | 2 | 0.24 | 0.00 | - | 0.24 | 91 | 0.07 | 86 | 0.00 | - | 0.00 | - |
| 2000 | 6 | 0.48 | 0.00 | - | 0.48 | 84 | 0.07 | 88 | 0.00 | - | 0.00 | - |
| 2001 | Did not gill net | | | | | | | | | | | |
| 2002 | Did not gill net | | | | | | | | | | | |
| 2004 | 6 | 0.48 | 0.00 | - | 0.48 | 76 | 0.29 | 79 | 0.00 | - | 0.00 | - |
| 2006 | 4 | 0.29 | 0.00 | - | 0.29 | 110 | 0.22 | 120 | 0.07 | 76 | 0.00 | - |
| 2008 | 8 | 0.62 | 0.00 | - | 0.62 | 89 | 0.31 | 85 | 0.07 | 85 | 0.00 | - |

Table 16. Total number (No.), catch rates (C/f), and relative weights ($W_r$) by size groups of **gizzard shad** collected during spring electrofishing and fall gill netting in ***Broken Bow Reservoir***. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable $W_r$ values are ≥90.

| | Spring Electrofishing | | | | Fall Gillnetting | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | | <8 in. | | Total | | < 8 in. | |
| | (≥40) | | (≥20) | | (≥ 4.8) | | (≥ 2.4) | |
| Year | No. | C/f | C/f | $W_r$ | No. | C/f | C/f | $W_r$ |
| 1987 | 2 | 1.6 | 0.0 | - | 59 | 4.8 | 0.00 | - |
| 1989 | 8 | 1.6 | 0.0 | - | 23 | 1.7 | 0.00 | - |
| 1991 | 1 | 4.0 | 0.0 | - | 16 | 1.2 | 0.48 | - |
| 1992 | 12 | 6.9 | 0.0 | - | 26 | 1.9 | 0.00 | - |
| 1993 | 0 | 0.0 | 0.0 | - | 67 | 5.3 | 0.72 | 110 |
| 1994 | 0 | 0.0 | 0.0 | - | 56 | 3.8 | 0.07 | 80 |
| 1995 | 2 | 4.0 | 4.0 | 82 | 55 | 3.8 | 0.00 | - |
| 1996 | 3 | 2.4 | 0.0 | - | 42 | 2.9 | 0.00 | - |
| 1997 | 7 | 9.3 | 0.0 | - | 51 | 3.8 | 0.00 | - |
| 1998 | 0 | 0.0 | 0.0 | - | 80 | 6 | 0.00 | - |
| 1999 | Did not spring electrofish (water too high) | | | | 46 | 3.6 | 0.00 | - |
| 2000 | 16 | 21.3 | 1.3 | - | 35 | 2.4 | 0.00 | - |
| 2001 | 6 | 12.0 | 0.0 | - | Did not gill net | | | |
| 2002 | 3 | 12.0 | 0.0 | - | Did not gill net | | | |
| 2004 | No sample | - | - | - | 68 | 4.8 | 0.00 | - |
| 2006 | No sample | - | - | - | 29 | 2.1 | 0.00 | - |
| 2008 | No sample | - | - | - | 21 | 1.6 | 0.07* | - |

* <6 in.

Table 17. Total number (No.) and catch rates (C/f) of **threadfin shad** collected during spring electrofishing and fall gill netting in ***Broken Bow Reservoir***.

| | Spring Electrofishing | | Fall Gillnetting | |
|---|---|---|---|---|
| | Total | | Total | |
| Year | No. | C/f | No. | C/f |
| 1987 | 0 | 0.0 | 0 | - |
| 1989 | 2 | 0.4 | 0 | - |
| 1991 | 3 | 12.0 | 5 | 0.48 |
| 1992 | 1 | 0.6 | 0 | - |
| 1993 | 2 | 8.0 | 1 | 0.07 |
| 1994 | 0 | 0.0 | 0 | - |
| 1995 | 0 | 0.0 | 0 | - |
| 1996 | 0 | 0.0 | 0 | - |
| 1997 | 13 | 17.3 | 0 | - |
| 1998 | 0 | 0.0 | 2 | 0.02 |
| 1999 | Did not spring electrofish | | 0 | - |
| 2000 | 0 | 0.0 | 7 | 0.50 |
| 2001 | 1 | 2.0 | Did not gillnet | |
| 2002 | 0 | 0.0 | Did not gillnet | |
| 2004 | Not sampled | | 1 | 0.07 |
| 2006 | Not sampled | | 0 | 0.00 |
| 2008 | Not sampled | | 1 | 0.07 |

# Figures

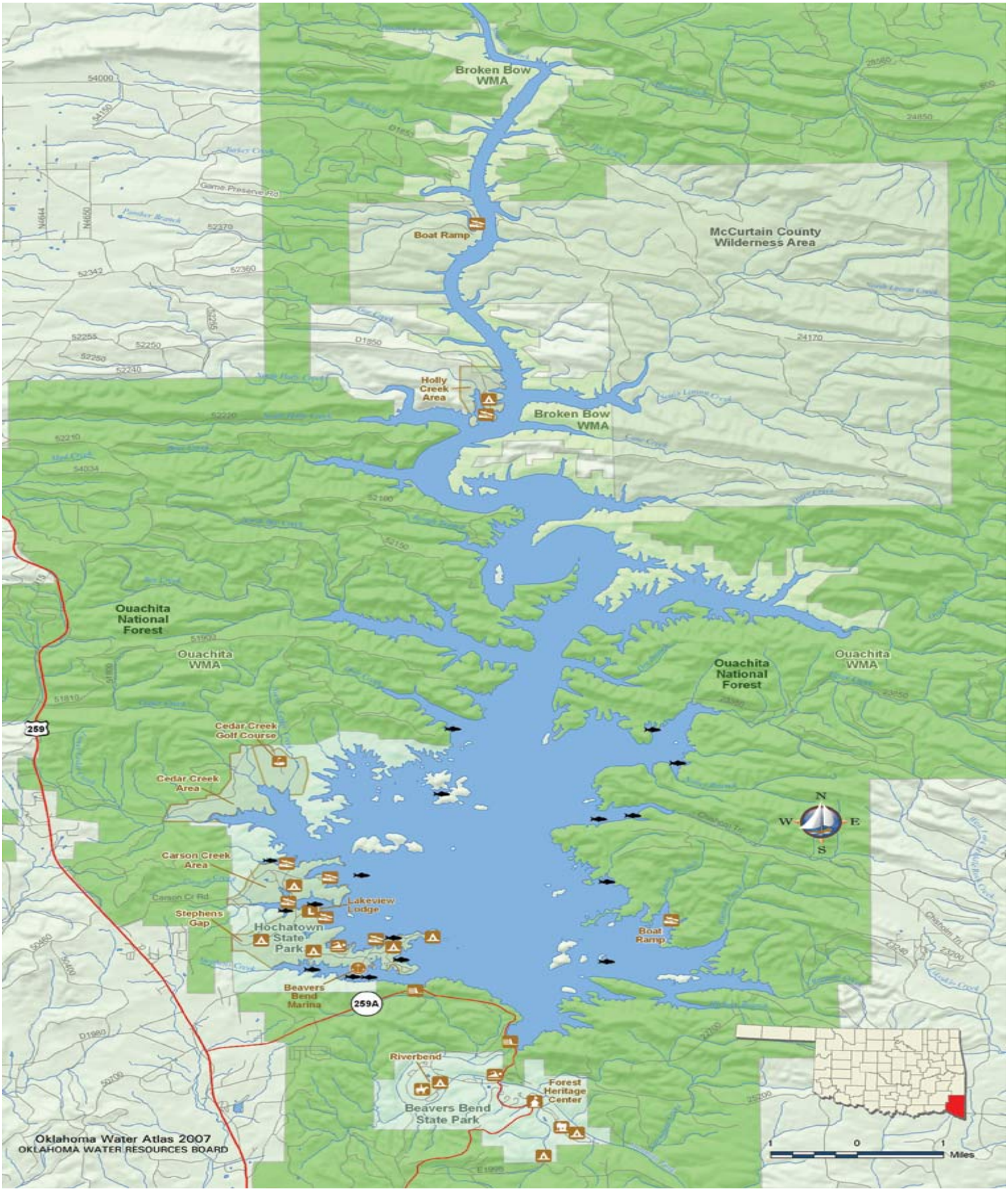


Figure 1. Map of the Broken Bow Lake vicinity.

# BROKEN BOW RESERVOIR

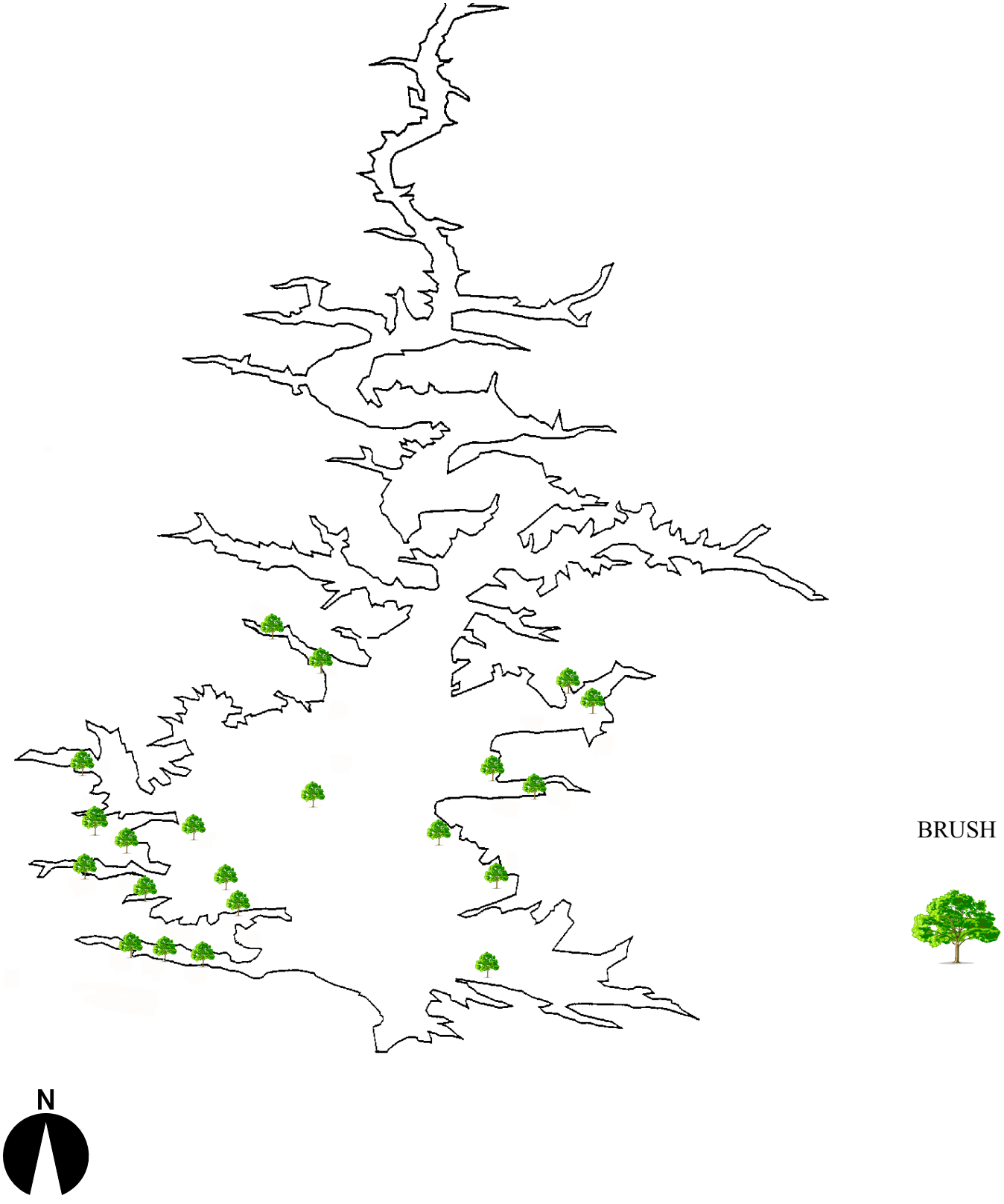


Figure 2. Fish habitat structures in Broken Bow Lake.

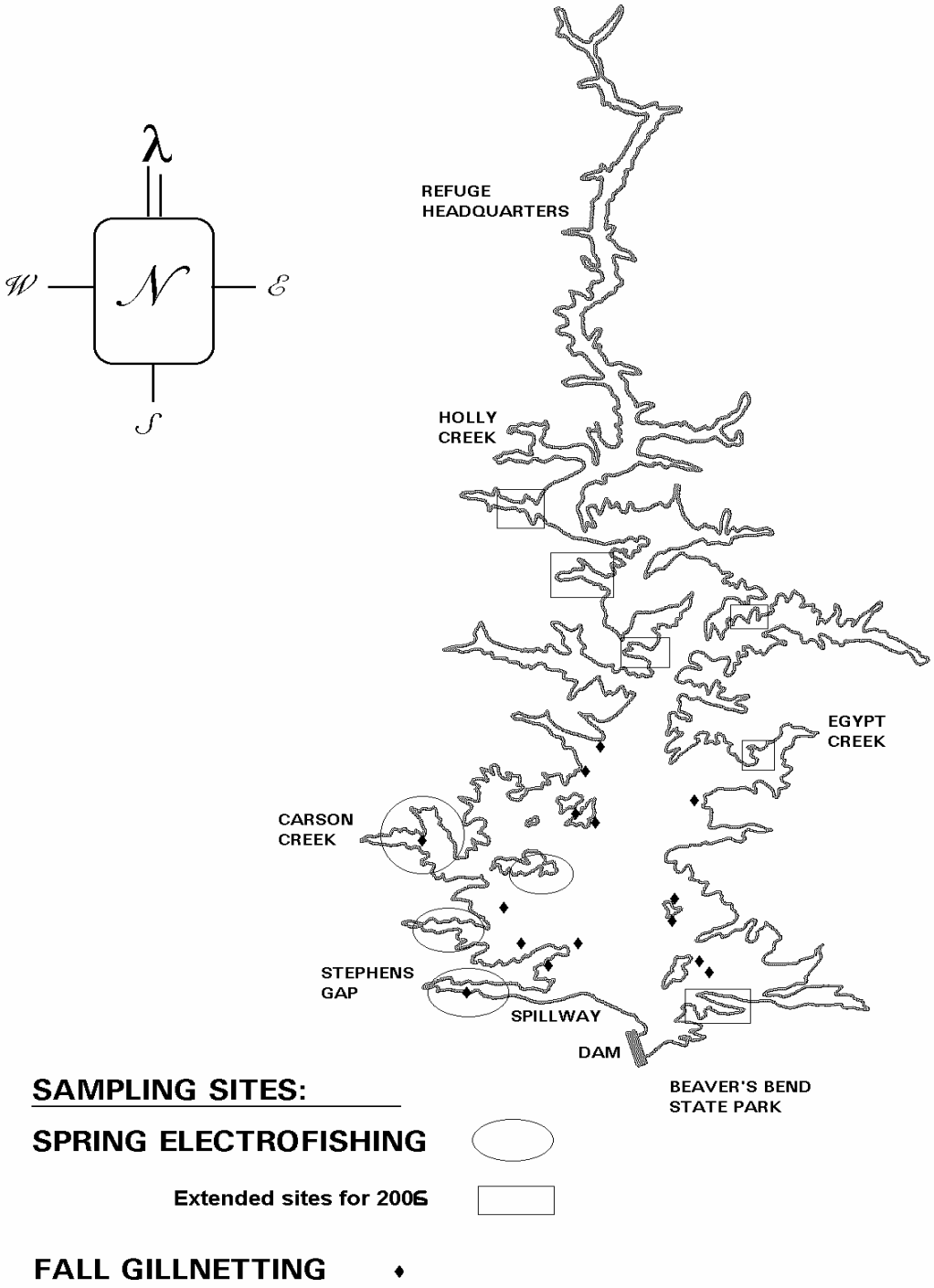


Figure 3. Broken Bow Lake Sampling sites.

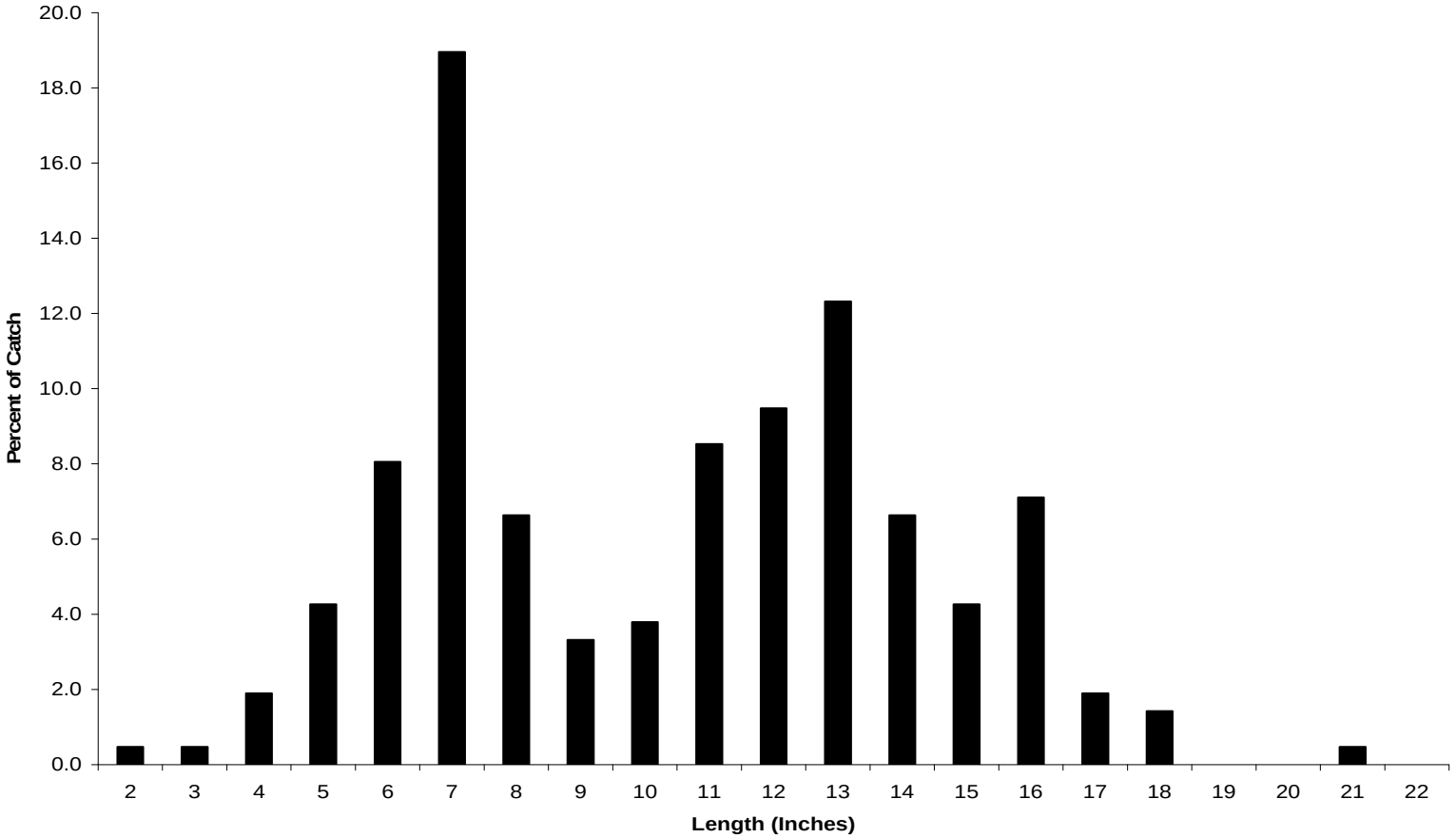


Figure 4. 2009 Electrofishing at Broken Bow Lake. Length Frequency Distribution for Largemouth Bass, N = 211.

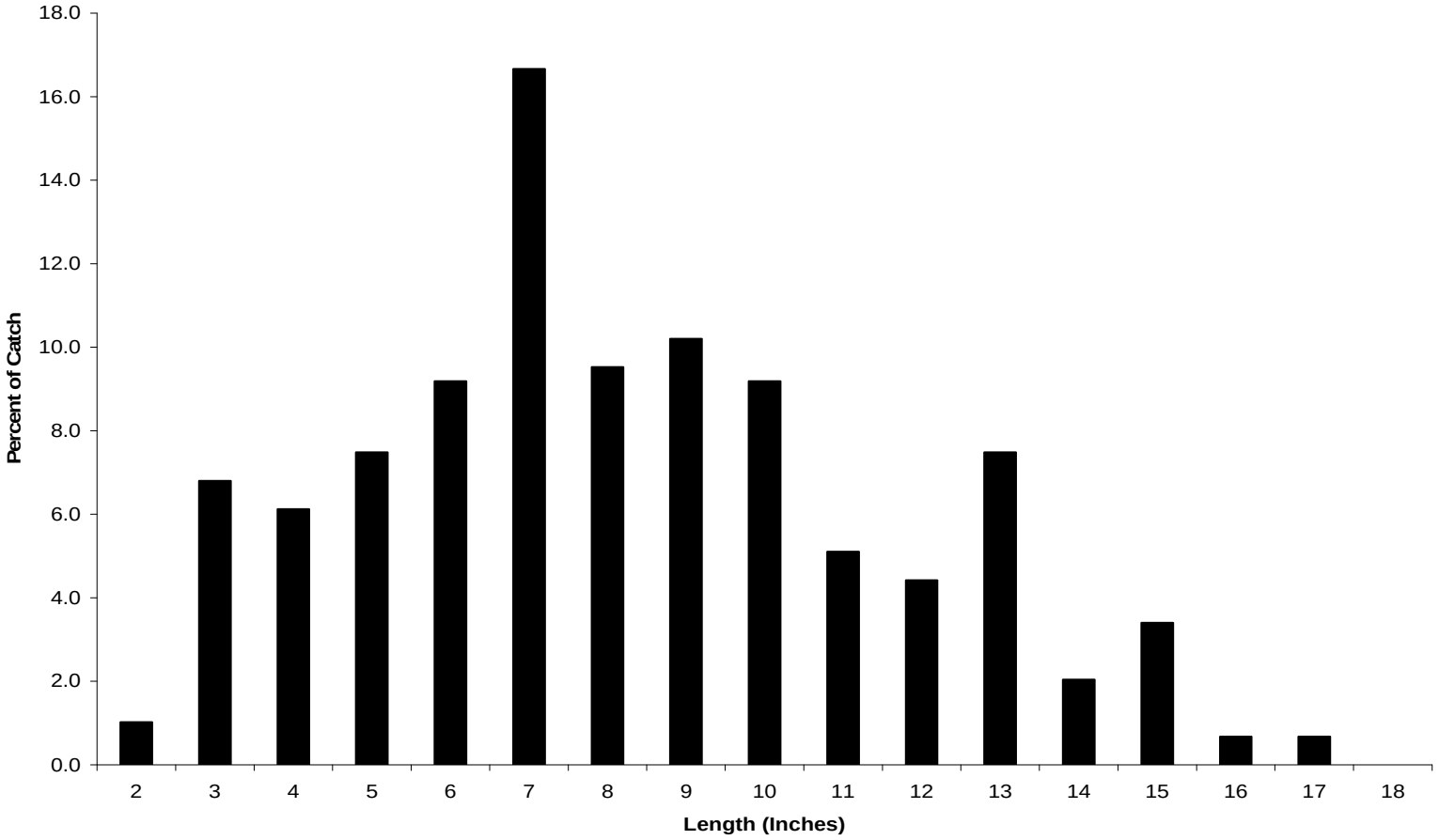


Figure 5. 2009 Electrofishing at Broken Bow Lake. Length Frequency Distribution for Spotted Bass, N = 294.

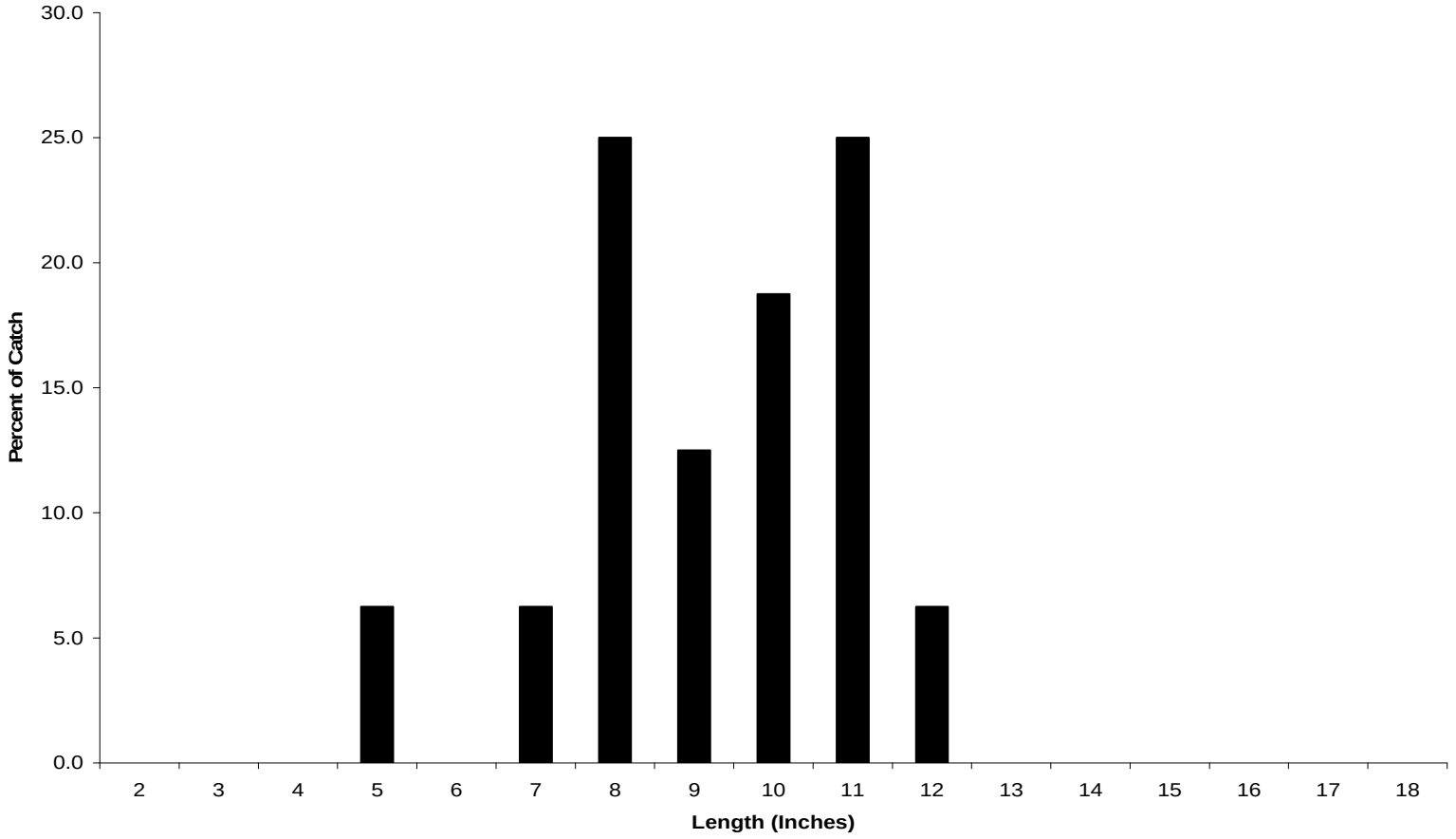


Figure 6. 2009 Spring Electrofishing at Broken Bow Lake. Length Frequency Distribution for Smallmouth Bass, N = 16.

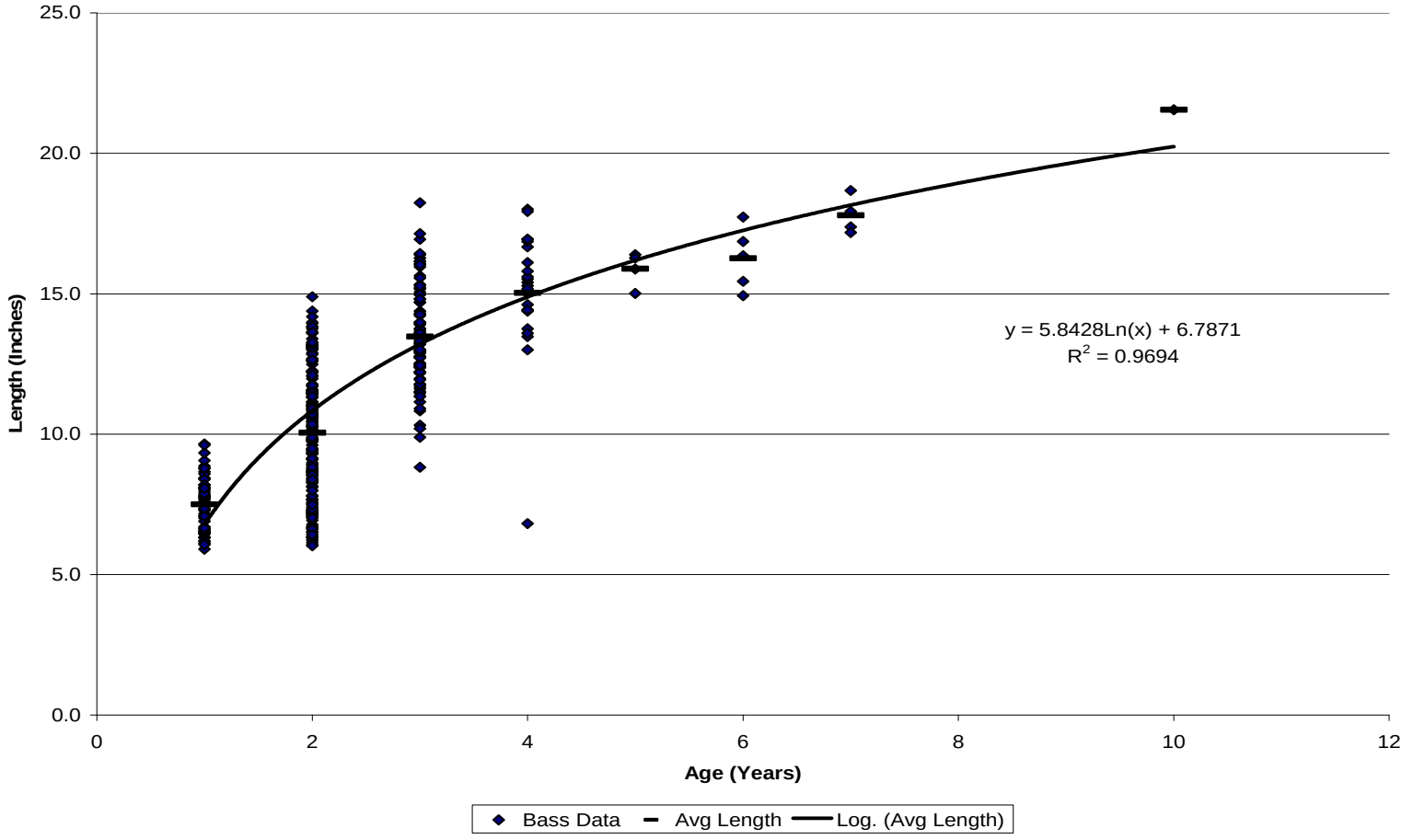


Figure 7. 2009 Spring Electrofishing at Broken Bow Lake. Growth Curve for All Black Bass, N = 357.

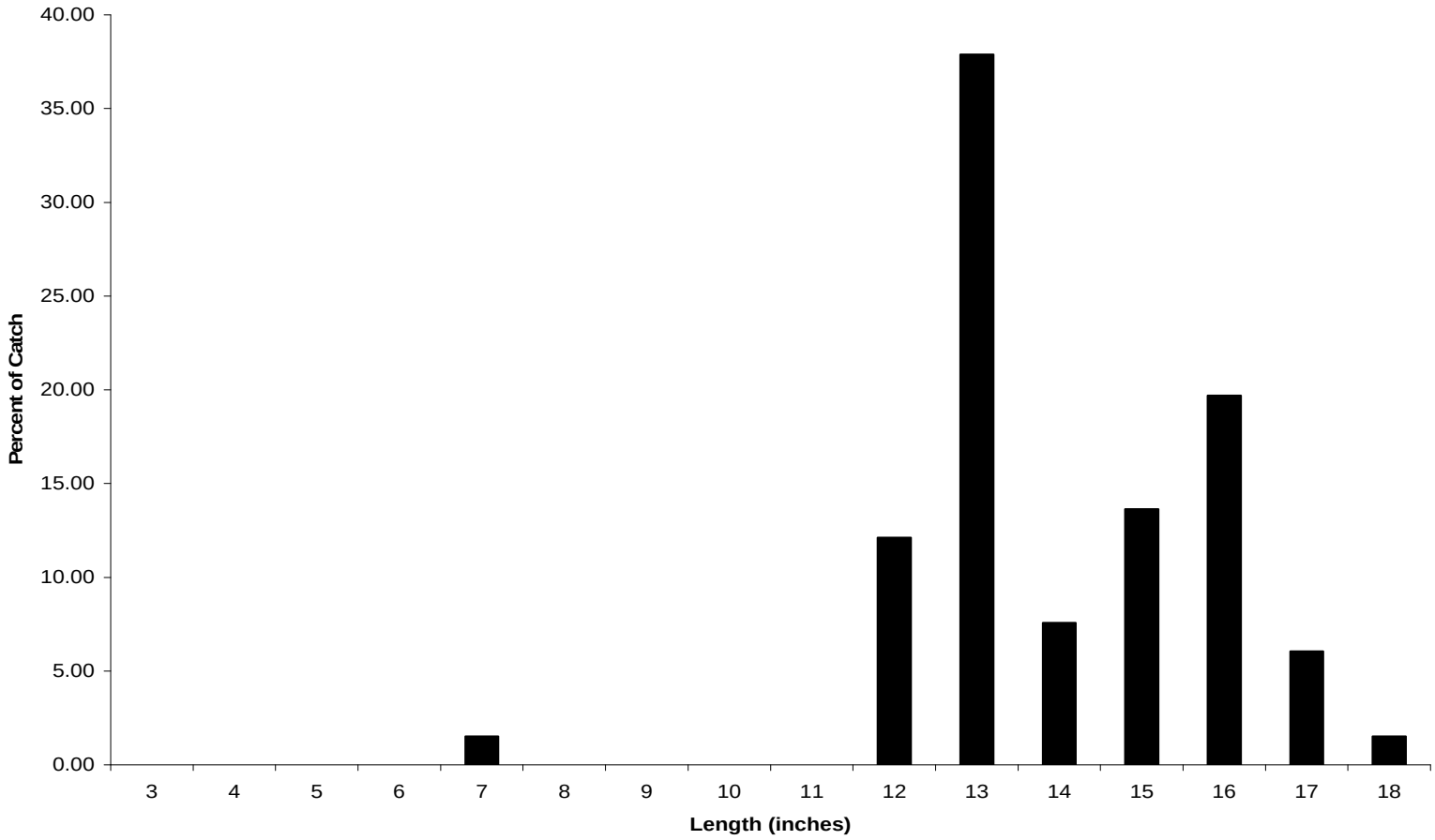


Figure 8. 2008 Gill Netting at Broken Bow Lake. Length Frequency Distribution for White Bass, N = 66.

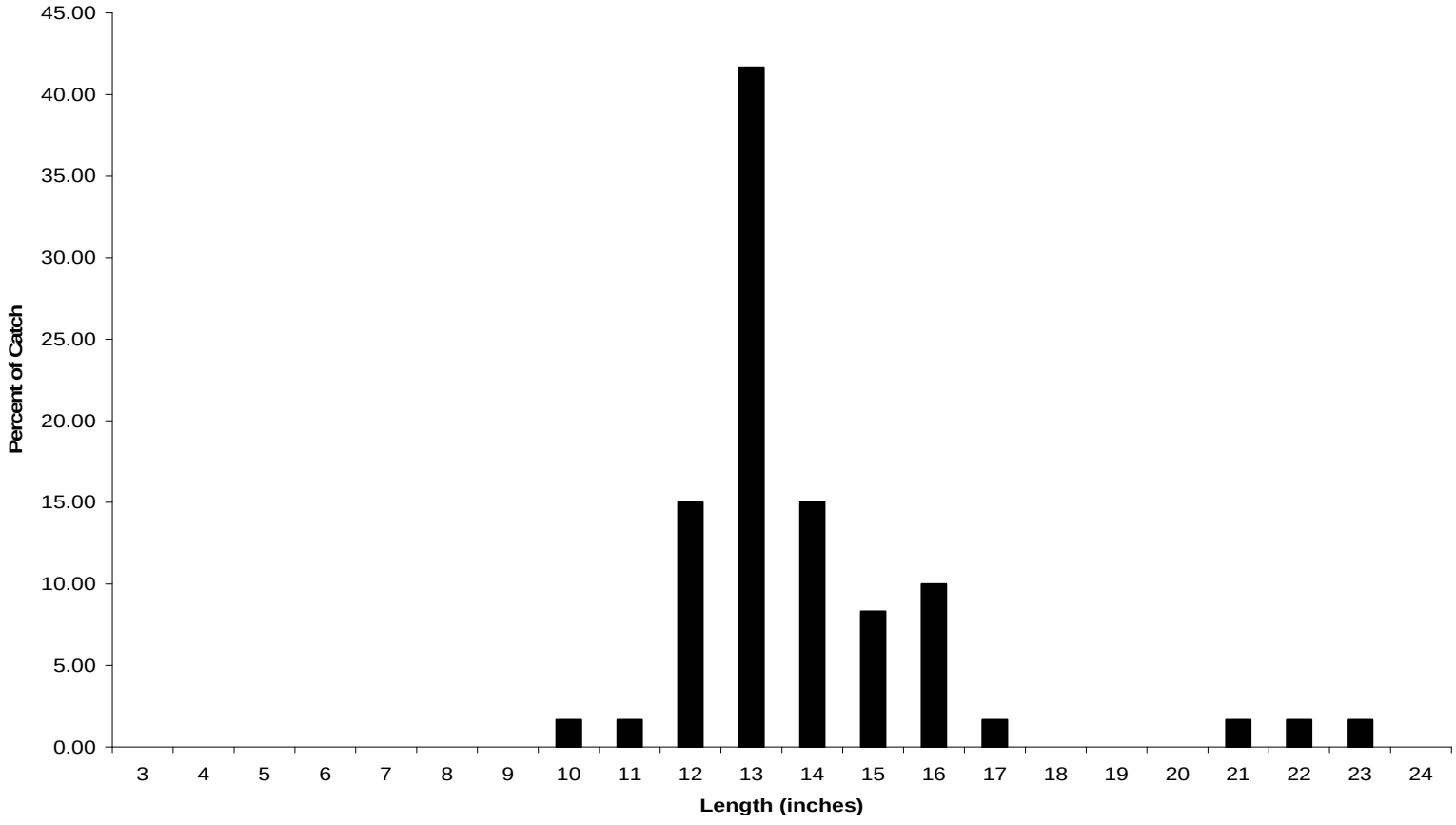


Figure 9. 2008 Gill Netting at Broken Bow Lake. Length Frequency Distribution for Hybrid Striped Bass, N = 60.

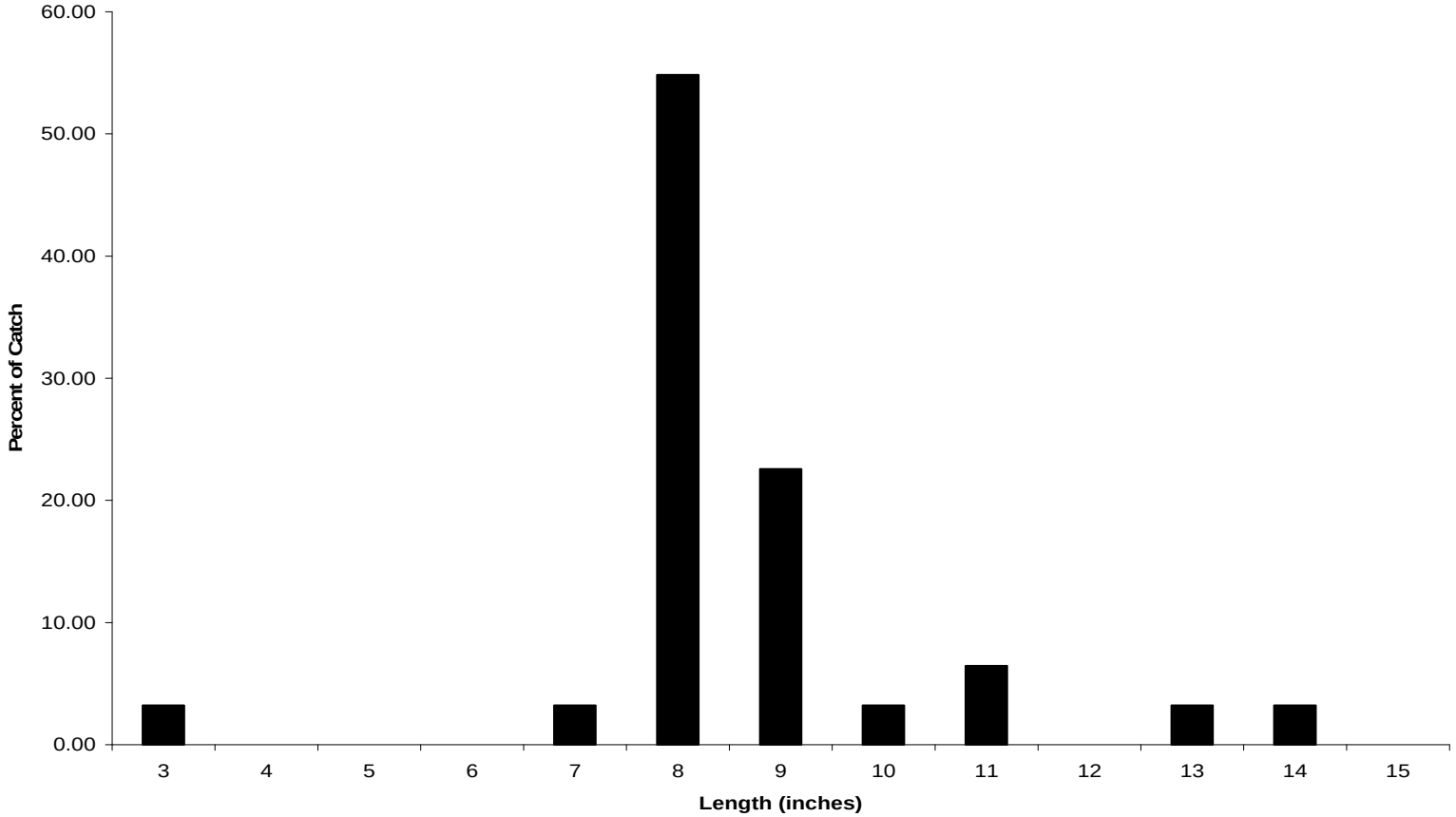


Figure 10. 2008 Gill Netting at Broken Bow Lake. Length Frequency Distribution for All Crappie Combined, N = 31.

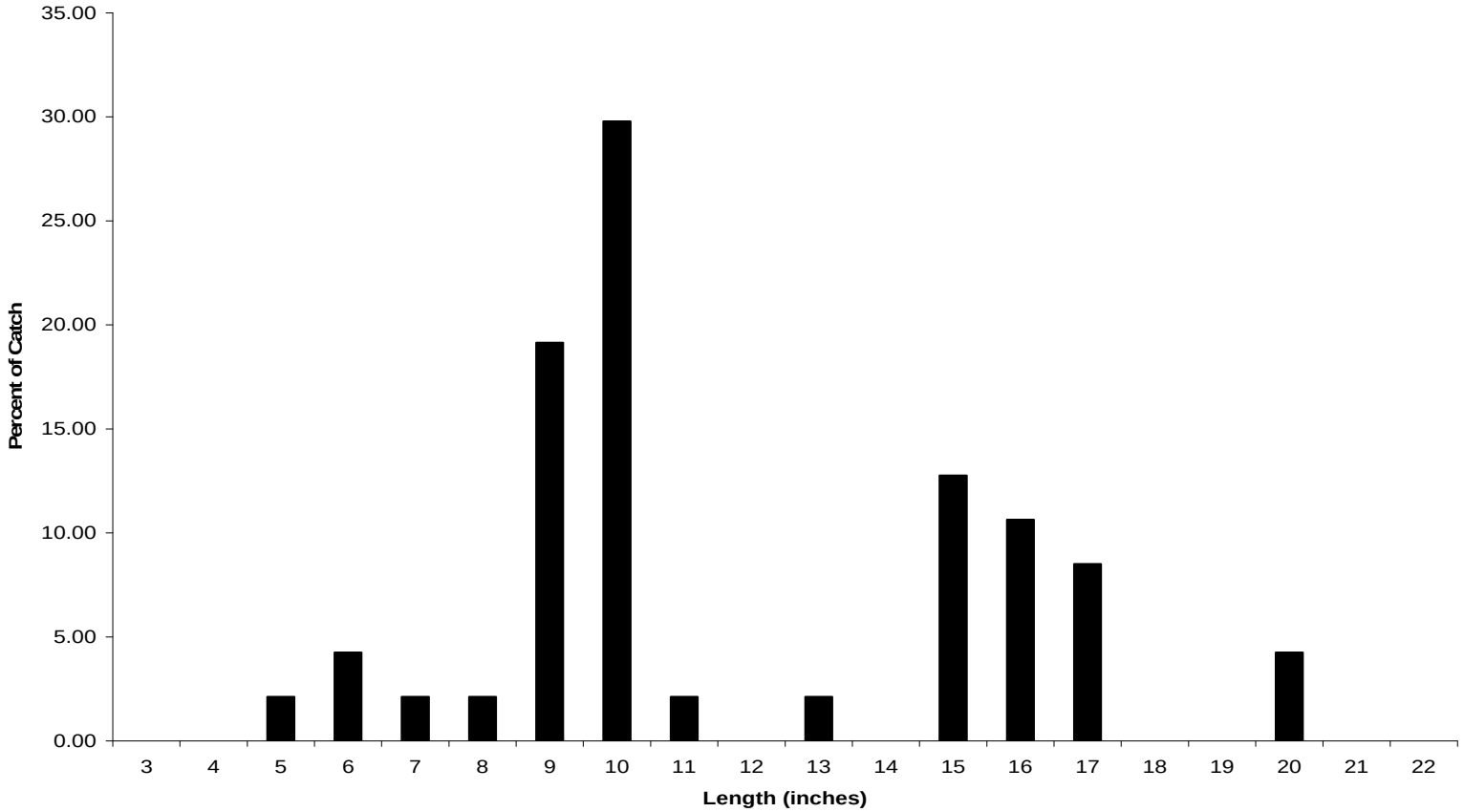


Figure 11. 2008 Gill Netting at Broken Bow Lake. Length Frequency Distribution for Walleye, N = 47.

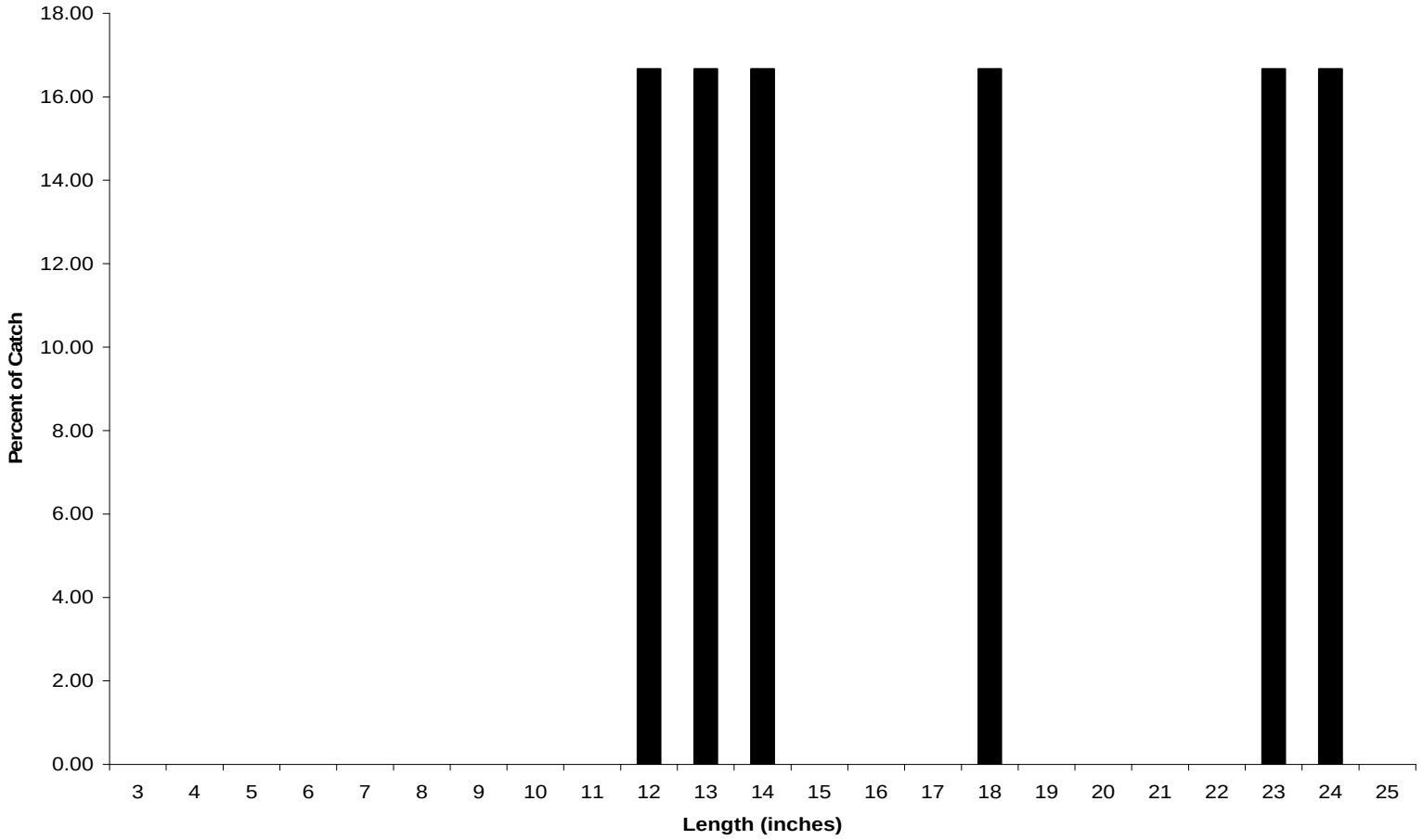


Figure 12. 2008 Gill Netting at Broken Bow Lake. Length Frequency Distribution for Channel Catfish, N = 6.

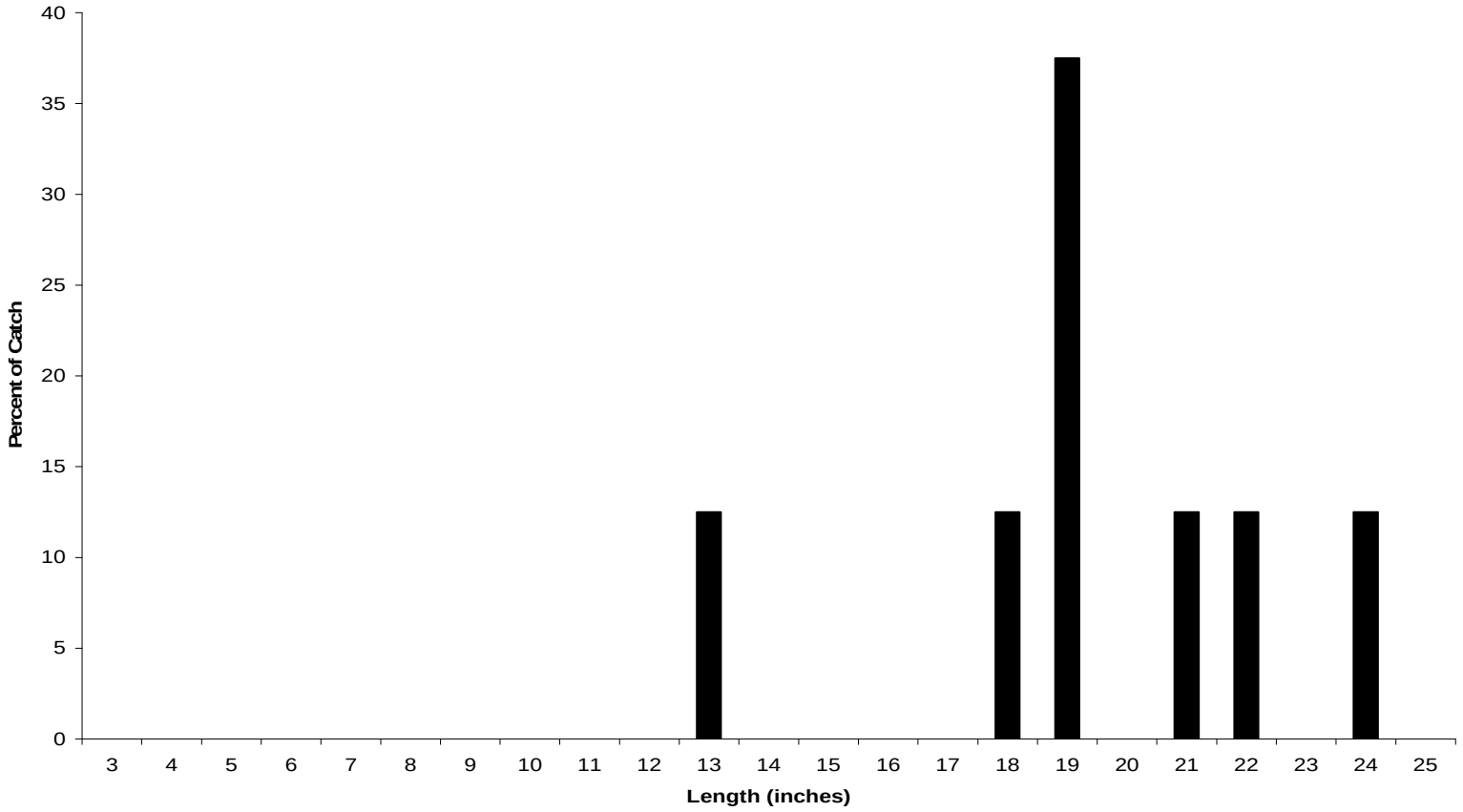


Figure 13. 2008 Gill Netting at Broken Bow Lake. Length Frequency Distribution for Flathead Catfish, N = 8.

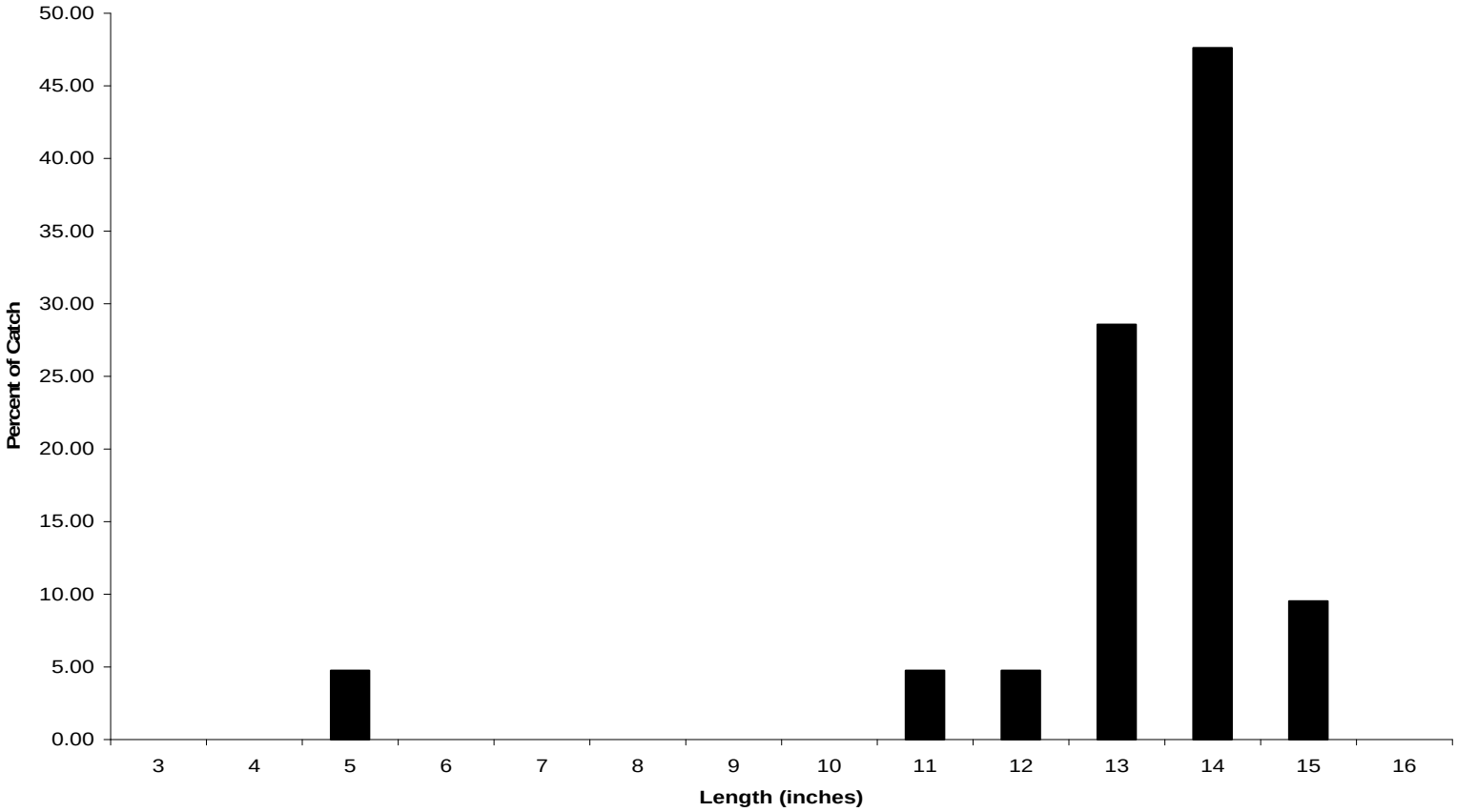


Figure 14. 2008 Gill Netting at Broken Bow Lake. Length Frequency Distribution for Gizzard Shad, N = 21.