Grand Lake Management Plan

Background

Grand Lake O' The Cherokees is a 46,500 acre reservoir located in Delaware, Mayes, and Ottawa counties in northeast Oklahoma (Figure 1). The lake is owned and operated by the Grand River Dam Authority (GRDA), an agency of the State of Oklahoma. GRDA operates the Pensacola Project (including Grand Lake) under authorization granted in their 1992 license issued by the Federal Energy Regulatory Commission (FERC). Grand Lake was created by the completion of the Pensacola Dam in 1940, which impounded approximately 53 miles of the Grand River System. The watershed consists of approximately 10,000 square miles of runoff that originate in, and flow across multiple states including Arkansas, Kansas, Missouri, and Oklahoma. The eastern portion of the Grand Lake watershed is made up of the Ozark Plateau. The western portion of the watershed is indicative of the Prairie Plains. Grand Lake's substrate is comprised of limestone, sandstone, chert, and shale. Table 1 contains a list of physical and chemical characteristics of Grand Lake.

GRDA manages Grand Lake elevations in accordance with Article 401 of the 1996 license amendment issued by FERC. The FERC license defines a rule curve or seasonal lake level plan for Grand Lake as follows:

May 1 – Raise elevation from 742 to 744 feet PD
Jun 1 – Elevation 744 feet PD
Aug 1 – Lower elevation from 744 to 743 feet
Aug 16 – Lower elevation from 743 to 741
Sep 1 – Elevation at 741 feet PD
Oct 16 – Raise elevation from 741 to 742 feet PD
Nov 1 – Elevation at 742 feet PD

Pensacola Datum (PD) is 1.07 feet lower than National Geodetic Vertical Datum, which is a national standard for measuring elevations above sea level.

While elevations outlined in Article 401 are target elevations, Grand Lake can fluctuate greatly due to flood control and hydropower concerns. Since the 1996 rule curve amendment, Grand Lake has fluctuated between 740.5 to 755 feet PD, with five to seven foot deviations from the rule curve being fairly common. Average daily elevations for Grand Lake are presented in Figure 2. Grand Lake is part of the Arkansas River Basin system of flood control and navigation. The United States Army Corps of Engineers (USACOE) has flood control authority when the lake reaches the top of the conservation pool. The flood control pool is between elevations 745 and 755 feet PD.

GRDA is currently in the process of developing a shoreline management plan and updating the recreation management plan for Grand Lake. These plans are expected to be finalized in 2009. Draft copies of these documents can be viewed at http://www.grda.com/Water/SMP/smp.html.

Habitat

Shoreline habitat in Grand Lake is primarily comprised of rock and gravel. Additional habitat includes man-made structures such as rip-rap, brush piles, and boat docks. Very little aquatic

vegetation or standing timber exists within the lake. Aquatic vegetation plantings were initiated in 2004 with the goal of determining what plants could be successfully established. This program was a cooperative effort between the ODWC, Oklahoma Water Resources Board (OWRB), Lewisville Aquatic Ecosystems Research Facility and GRDA. A total of 10 founder colonies and 12 acres of aquatic plants have been established and maintained. Evaluation of these sites is still ongoing. A report on this program can be found at http://www.owrb.ok.gov/studies/reports/reports_pdf/GrandLakeRevegProject2007.pdf.
The ODWC has established and maintained 13 brush piles on Grand Lake. Locations of the brush piles can be found on the Department's Interactive Digital Wildlife Atlas at http://www.wildlifedepartment.com/wmas2.htm.

Water Quality
Grand Lake is classified as a eutrophic reservoir with high primary productivity. Water quality data collected through the OWRB as part of their Beneficial Use Monitoring Program (BUMP) classifies Grand Lake as supporting or partially supporting the outlined Fish and Wildlife Propagation (FWP) beneficial uses. The complete BUMP report for Grand Lake can be viewed at http://www.owrb.ok.gov/quality/monitoring/bump/pdf_bump/Current/Lakes/grand.pdf. A brief overview of several water quality parameters is included below.

Thermal and Chemical Stratification
The upper portion of Grand Lake (Elk River Arm to Twin Bridges) is well mixed during the fall, winter, and spring. During the summer, up to 43% of the water column will have D.O. values less than 2.0 mg/l. At mid-lake (Elk River Arm downward, including Horse Creek Cove and the Honey Creek Arm), thermal stratification is not present during the fall and winter. The water column during the spring is weakly stratified. Stratification during the summer is more evident with anoxic conditions present for 22-47% of the water column. The lower lake (Horse Creek Cove to Pensacola Dam) is not stratified during the winter, and weakly stratified during the fall and spring. Stratification during the summer is more evident with anoxic conditions present for 47-62% of the water column. All D.O. values meet the Oklahoma Water Quality Standards, partially supporting assigned FWP beneficial use. The thermocline will normally form in June at 30-40 feet below the surface.

Productivity
A trophic state index (TSI), using Carlson's TSI (chlorophyll-a), was calculated to measure the lake's productivity. The average TSI was 59, classifying the lake as eutrophic, indicative of variable oxygen concentrations, nutrient rich conditions, and limited benthic species diversity. This value is similar to that calculated in 2004 (TSI=57) and 2001 (TSI=59), placing the lake within the same trophic category. Chlorophyll-a values varied by site and season at Grand Lake. The TSI values ranged from oligotrophic (2%) to hypereutrophic (33%), although most values were in the mesotrophic (21%) or eutrophic categories (44%). The lowest TSI average was at the lower end of the lake and the most productive sites were in the tributary arms, Honey Creek and Spring/Neosho River arm.

Conductivity
Specific conductivity ranged from 264 µS/cm to 374 µS/cm, indicating low to moderate concentrations of ionized salts in Grand Lake.

pH
The pH values ranged from 7.07 to 8.68 representing a neutral to slightly alkaline system. All values are within the acceptable range, supporting the beneficial use based on pH.

Tailrace
Anoxic water from beneath the chemocline is released downstream into the tailrace during generation. Low D.O. values are typical below most hydropower dams in Oklahoma. Grand River Dam Authority is currently working with the Tennessee Valley Authority and other appropriate resource agencies to prevent any negative impacts to aquatic communities in the tailrace.

Fishery

The major sportfish in Grand Lake include largemouth bass, spotted bass, white bass, hybrid striped bass, white crappie, black crappie, blue catfish, channel catfish, flathead catfish, and paddlefish. The primary forage species include threadfin and gizzard shad. Special fishing regulations which apply to Grand Lake, all tributaries upstream to the state line, and below Pensacola Dam downstream to the SH 82 bridge include: 1) all species of black bass have a minimum size limit of 14 inches and a creel limit of six combined per day; 2) all crappie have a minimum size limit of 10 inches and a creel limit of 15 per day; 3) striped bass hybrids and/or white bass have a creel limit of 20 combined per day, of which only five may be 20 inches or longer.

The fish stocking history for Grand Lake is included in Table 2.

Black Bass

Grand Lake is one of the best black bass lakes in the state and region. Tournament results for Grand Lake are summarized in Table 3. Grand Lake contains three species of black bass; largemouth bass (*Micropterus salmoides*), spotted bass (*M. punctulatus*), and smallmouth bass (*M. dolomieu*).

Largemouth Bass
The largemouth bass is the dominant black bass species in Grand Lake. Catch rates and size structure of largemouth bass are included in Table 4 and Figures 3 and 4, respectfully. Largemouth bass from Grand Lake were tested for Largemouth Bass Virus (LMBV) from 2000 through 2003. These results indicated that approximately one-third of the population carried LMBV. LMBV test results from Grand Lake are listed in Table 5. Fish kills resulting from LMBV were never confirmed at Grand Lake; however fishing success did decline from 2000 to 2003. Since 2003, the largemouth population has maintained consistently high recruitment and fishing success has remained above average. Otoliths were collected from largemouth bass during the 2008 sample. These otoliths will be evaluated to determine a baseline for age and growth in Grand Lake.

Spotted Bass
Spotted bass make up a small portion of the black bass population at Grand Lake. Size structure of the spotted bass population is listed in Figures 5-6. Otoliths were collected from spotted bass

during the 2008 sample. These otoliths will be evaluated to determine a baseline for age and growth in Grand Lake.

Smallmouth Bass

Smallmouth bass abundance in Grand Lake is unknown. Few smallmouth are caught in the lake, with most of these reports coming from the upper reaches of the tributaries. Smallmouth bass are native to the Grand Lake watershed. 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 basses). The genetic uniqueness of these populations along with the desire to protect against contamination of their genetic diversity, led the ODWC to place a moratorium on the stocking of non-native smallmouth bass in watersheds containing these native strains.

Temperate Bass

White Bass

White Bass (*Morone chrysops*) are an important portion of the Grand Lake recreational fishery. They are abundant in number and support numerous, year-round guides on Grand Lake. White bass also create a popular spring fishery in the upper portions of Grand Lake and its tributaries during their spawning run. Catch rates and size structure of the Grand Lake white bass fishery are included in Table 6 and Figures 7 and 8, respectfully.

Hybrid Striped Bass

Hybrid striped bass (F_1: male *Morone chrysops* x female *M. saxatilis*) were first stocked in Grand Lake in 1981 and additional stocking records are included in Table 7. Historically, stocking rates and frequency have not been at the desired levels to produce a quality hybrid striped bass fishery in Grand Lake. However, years following increased stocking efforts have resulted in increased fishing success. Hybrids also pass through the dam during hydropower and floodwater releases to create a recreational tailrace fishery below Pensacola Dam as well as other reservoirs and tailraces located downstream. Hybrid striped bass reach large sizes within and below Grand Lake. A former state record hybrid was caught in the Pensacola Dam tailrace (19.2 lbs) while another was caught in the upper portion of the lake (22.2 lbs.). Catch rates and size structure of the Grand Lake hybrid striped bass fishery are included in Table 7 and Figures 9 and 10, respectfully.

Crappie

Grand Lake contains both white crappie (*Pomoxis annularis*) and black crappie (*P. nigromaculatus*). White crappie is the more prevalent of the two species, accounting for approximately 95% of the population. Over the past five years, the Grand Lake crappie population has declined due to several consecutive years of below average rainfall. Low inflows reduce the abundance of essential nutrients that drive plankton production. Young-of-the-year crappie feed on plankton until they reach approximately 5 inches long. The high inflows experienced in 2007, resulted in a relatively large year class of young crappie. Crappie catch rates, growth rates, and size structure from fall 2007 trapnetting are presented in Tables 8 and 9 and Figures 11, 12 and 13.

The daily creel limit is 15, white and black crappie combined, with a 10-inch minimum length limit.

Catfish

Blue Catfish

The development of the Grand Lake blue catfish (*Ictalurus furcatus*) fishery has steadily increased over the past 10 years. Blue catfish have become an important and commonly sought after sportfish at Grand Lake. The current blue catfish Grand Lake record was caught in 2008 using rod and reel near Sailboat Bridge (43.0 lbs.). Catch rates and size structure of the Grand Lake blue catfish fishery are included in Table 10 and Figures 14 and 15.

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. Catch rates and size structure of the Grand Lake channel catfish fishery are included in Table 11 and Figures 16 and 17.

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. Most are taken while trotlining, juglining, limblining or noodling. A former state record was caught from Grand Lake in 1968, using rod and reel near Big Hollow (44 lbs.). Catch rates and size structure of the Grand Lake flathead catfish fishery are included in Table 12 and Figures 18 and 19.

Paddlefish

Paddlefish (*Polyodon spathula*) have a large historical range in Oklahoma. Grand Lake had population estimates for both 2003 and 2004 (n = 80,808 and n = 55,404, respectively). The spawning migration into Grand Lake's tributaries congregates a large number of fish each year from March – April. Anglers can snag paddlefish over 50 lbs during this period. In the past, paddlefish in the Grand River System were also harvested by commercial fishermen. The threat of overexploitation exists due to heavy fishing pressure and low recruitment. Paddlefish are susceptible to problems with habitat disruption, and low water dams. ODWC recently opened the Paddlefish Research and Processing Center (RPC) at Twin Bridges State Park to learn more about this valuable resource. The center was open during snagging season for anglers to have their fish safely cleaned and packaged free of charge. The RPC opened for the first time on February 20, 2008 and processed 4,221 paddlefish through April 30, 2008. Carcasses and remains from processed fish were recycled into heating oil. Biological data, including length and weight, dentary bones for age analysis, and gonad data was gathered from the fish brought to the RPC. A total of 147 paddlefish jaws were collected during the winters of 2003-2004 from netting mortalities (Sampling mortality was 4.04% during these two years; mortalities increase when water temperatures exceed 10°C). Both male and female age distribution show a spike at age 5 (62% for male and 38% female). Thirty-three percent of males were age 6 or older, while 54% of females were age 8 or older (Tables 13 and 14, Figures 20 and 21). With the help of anglers, the ODWC was able to collect 4,221 paddlefish jaws during the 2008 spawning migration. An ultrasonic telemetry study was initiated during the winter of 2007 to identify migration routes

and spawning areas that will need protection in the future. Success of spawning paddlefish in Grand Lake may affect the paddlefish populations in downstream impoundments. As angler interest grows and exploitation increases, it will be necessary to closely monitor paddlefish populations in Grand Lake. Catch rates and size structure of the Grand Lake paddlefish fishery are included in Figure 22. ODWC is currently working with the U.S. Fish and Wildlife Service to obtain 2,000 juvenile paddlefish each year. These fish will be marked with coded wire tags, indicating the year in which they are stocked. These stockings will be valuable in determining known age fish from the Grand Lake population. Fish brought to the RPC will be scanned for the presence of coded wire tags in the future.

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 Grand Lake gizzard shad fishery are included in Table 15 and Figures 23 and 24.

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 Grand 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 and size structure of the Grand Lake threadfin shad fishery are included in Table 16 and Figures 25 and 26.

Fish Consumption Advisories

Fish consumption advisories are issued by the Oklahoma Department of Environmental Quality (ODEQ) and can be viewed at www.deq.state.ok.us/mainlinks/press.htm. The most recent advisory at the time of this document was issued on March 12, 2008. That advisory cautioned against the exposure to lead from consumption of fish from waters impacted by the Tar Creek Superfund site and the Tri-State Mining District.

A 2007 study conducted by ODEQ titled "Fish Tissue Metals Analysis in the Tri-State Mining Area Follow-up Study" can be viewed at www.deq.state.ok.us/csdnew/2007TCFishReport.pdf

Threats to the Fishery

Aquatic Nuisance Species

Zebra Mussels

Adult zebra mussels (*Dreissena polymorphawere*) first confirmed in Grand Lake in February of 2005 at the Disney State Park boat ramp. An additional confirmed zebra mussel was found in Ketchum Cove in July of 2006. Since this time, no other reports of zebra mussels have been confirmed at Grand Lake. Zebra mussels will continue to be a threat to Grand Lake and the entire Grand River Watershed. Monitoring of zebra mussels in Grand Lake should be coordinated with efforts of GRDA and other appropriate agencies and universities.

Bighead Carp

Adult bighead carp (*Hypophthalmichthys nobilis*) have been confirmed in Grand Lake. The most recent, confirmed bighead carp was snagged at Miami Park, in the Neosho River in May of 2008. Bighead carp are invasive fish that feed on plankton and compete for food with larval fishes and mussels. Documenting Asian carp sightings will be critical to monitoring their expansion.

Pacu

Sightings of pacu occur in Grand Lake, however they are rare. They are commonly misidentified as piranha, and occasionally receive unwarranted media attention. Pacu are readily available from pet stores and are likely released into Grand Lake once they have outgrown their aquaria. They are classified under a number of genera, but the most common species found in pet stores include the Black Pacu (*Colossoma macropomumand*) and the Red-bellied Pacu (*C. brachypomum*). Pacu are native to South America and are not believed to survive the low temperatures experienced during winters in Oklahoma. They are mainly herbivores, but will also eat small fish, insects, and meat on fishing lures. Their teeth, which may resemble human teeth, are used to cut through vegetation and crush seeds that fall into the water. Pacu and piranha are distinguished from each other by their teeth and jaw alignments; piranha have pointed, razor-sharp teeth in a pronounced underbite, whereas pacu have square, straight teeth in a less severe underbite, or a slight overbite. Pacu are not believed to pose a serious threat to native species at Grand Lake, however they do cause unwanted fear and concern from the general public. Documenting pacu sightings will be critical to monitoring their survival and population increase.

Pollution

Tar Creek Superfund Site and the Tri-State Mining District.

The Tar Creek Superfund Site is a 40 square-mile site that is part of the Tri-State Mining District, which includes northeastern Oklahoma, southeastern Kansas, and southwestern Missouri. Specifically, the site includes the Old Picher Field lead and zinc mining area located in northeastern Ottawa County. The population in the surrounding area is approximately 19,556 people. The Site consists of five mining cities, Picher, Cardin, Quapaw, Commerce, and North Miami, and other areas within Ottawa County. Mining occurred there from the early 20th Century until the 1960's-1970's. The milling process for lead and zinc ore produced waste mile tailings, also known as chat. Chat piles are located throughout the site. In addition to chat, another by-product of the mining operation is highly acidic mine water. The principal pollutants are lead, cadmium, and zinc. When the lead and zinc mines were abandoned, they began filling with water. In the late 1970's, acid mine drainage containing high concentrations of heavy metals began discharging into Tar Creek from natural springs, boreholes, and open mine shafts. Heavy metal contamination in this region has resulted in fish consumption advisories being issued by the ODEQ. Information on fish consumption advisories is discussed in the previous section of this plan. Efforts to monitor and evaluate heavy metal contamination at Grand Lake should be coordinated with the appropriate agencies and universities.

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.
- Protect and enhance aquatic habitat.
- Work with GRDA and other appropriate agencies to improve water quality in the tailrace.
- Work with GRDA and other appropriate entities to enhance boating and/or fishing access.
- Conduct public outreach and solicit feedback regarding fisheries management issues.
- Coordinate and assist with the documentation and monitoring of aquatic nuisance species.
- Coordinate and assist with the monitoring and evaluation of heavy metal contamination.

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 for largemouth bass every other year to determine catch rates by size groups and relative weights. Age and growth data will be collected every three years. Bass tournament results will be monitored annually to evaluate overall trends. 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 for spotted bass every other year to determine catch rates by size groups and relative weights. Age and growth data will be collected every three years.
    c. Smallmouth Bass – Conduct SSP spring electrofishing for smallmouth bass every other year to determine if a reservoir population exists, the catch rates by size groups and relative weights. Tissue samples for genetic analysis and age and growth data will be obtained from each smallmouth bass collected.
    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. Age and growth data will be obtained from each hybrid striped bass collected.
    f. White Crappie – Conduct SSP fall trapnetting for white crappie annually to determine catch rates by size groups and relative weights. Age and growth data will be collected each year.
    g. Black Crappie – Conduct SSP fall trapnetting for black crappie annually to determine catch rates by size groups and relative weights. Age and growth data will be collected each year.
    h. Blue Catfish – Conduct electrofishing surveys annually in accordance with findings from ongoing study to optimize sample size and timing. Conduct SSP fall gillnetting for blue catfish 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. Paddlefish – Conduct mark and recapture population estimate over a two year period. Utilize telemetry techniques to identify the migration routes and spawning sites of paddlefish in the Neosho and Spring Rivers. Collect biological data annually at the Research and Processing Center. Collect known age fish with coded wire tags for age and growth verification. Conduct mail survey to paddlefish permit holders to determine angler attitudes, effort and harvest.
l. Gizzard Shad – Conduct SSP fall gillnetting for gizzard shad every other year to determine catch rates by size groups.
m. Threadfin Shad – Conduct SSP fall gillnetting for threadfin shad every other year to determine catch rates by size groups.

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 GRDA to ensure both agencies' needs are addressed, and effort is distributed appropriately between ODWC and GRDA. This survey should begin in 2009.

3. Aquatic habitat will be protected and enhanced in the following ways:
    a. Oppose habitat degradation and shoreline development that does not comply with the Grand Lake Shoreline Management Plan and does not require adequate mitigation. ODWC will propose adequate and reasonable mitigation measures when necessary.
    b. Maintain a minimum of eight (8) aquatic vegetation founder colonies. Maintenance and evaluations of these sites will be conducted during the spring, summer, and fall of each year. A final report on the feasibility of establishing aquatic vegetation in Grand Lake will be prepared at the conclusion of this lake management plan.
    c. Maintain twelve (12) brush piles utilizing natural and artificial materials. Brush piles constructed of natural materials will be recharged at least twice during this lake management plan. Brush piles constructed of artificial materials will be recharged once during this lake management plan.

4. Monitor and assess water quality in the forebay and the tailrace of Pensacola Dam during the summer period annually. Results from each year will be summarized, provided to GRDA and other appropriate resource agencies. Continue to provide technical assistance to GRDA and other resource agencies with the goal of increasing water quality in the Grand Lake tailrace.

5. Develop and/or maintain two (2) boating and fishing access projects at Grand Lake. This will be accomplished through the solicitation of appropriate agencies and entities willing to cooperate on access development or maintenance. A minimum of one (1) boating and fishing access project will be conducted annually with the City of Miami.

6. Conduct one (1) public meeting per year to present agency efforts regarding fisheries management and solicit public feedback.

7. Investigate and report all sightings of aquatic nuisance species to the ODWC Aquatic Nuisance Species biologist, GRDA, other resource agencies, and the media when appropriate.

8. Coordinate the efforts of other agencies and assist, when requested, with the monitoring and evaluation of heavy metal contamination.

Tables

Table 1. Physical and chemical characteristics of Grand Lake O' The Cherokees.

Operating Agencies:	
Hydropower, Lake Patrol	Grand River Dam Authority
Flood Control	U.S. Army Corps of Engineers
Impoundment Date	1940
Surface Area	46,500 acres
Shoreline	1,300 miles
Shoreline Development Index	1.74
Mean Depth	36
Maximum Depth	140
Water Exchange Rate	3.2
Watershed	10,000 square miles
Secchi Disk	36 inches
Conductivity	264 to 374 µS/cm
pH	7.07 to 8.68
Carlson's Trophic State Index (chlorophyll a)	59, Eutrophic

Table 2. Stocking Record for Grand Lake.

Species	N	Size(inches)
Largemouth Bass		
1974 (Florida)	11,000	Fry
1975 (Hybrid)	75,000	Fry
1975 (Florida)	1,500	Fingerlings
1981-83 (Florida)	269,938	1 1/2-3
1986 (Florida)	1,716	3 1/2-8 3/4
1989 (Florida)	1,258	4-6 1/2
1993 (Florida)	51,516	3
1994 (Florida)	34,710	2 1/2-3
1995 (Florida)	30,280	3
Walleye		
1968-72	2,968,487	Fry
1989	464,900	1 1/4
1990	324,755	1 1/4
2001	264,540	1 1/2
Striped Bass		
1973	2,700,000	Advanced Fry
1975-78	9,400,000	Advanced Fry
Hybrid Striped Bass		
1981-83	12,717,000	Advanced Fry
1982	232,000	1 1/2
1984-87	1,472,576	1-2
1989	122,300	1 1/4-1 1/2
1991	404,940	1-1 3/8
1994	3,780,000	Fry
1997	102,000	1 1/4
1998	98,000	1 3/4
2001	150,000	1
2005 (Reciprocal)	690,000	Fry
2007	104,960	1-2
Threadfin Shad		
1976	16,600	Spawning adults
2000	400	Spawning adults

Table 3. Grand Lake Tournament Results. Ranking of Lakes Statewide from which 10 or more Tournament Reports were Received. Ranked According to Quality Fishing Indicators. Grand 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
1994	47	2880	4723	1.5	(# 9)	100.5	1.6	72	(# 5)	2.8	(# 1)	215	(# 2)	4	8.5	19.2	(# 1)	# 2
1995	58	3043	5718	1.4	(# 6)	98.6	1.9	75	(# 5)	2.4	(# 7)	167	(# 2*)	0	7.8	17.6	(# 1)	# 1
1996	63	3902	6416	1.5	(# 6)	101.8	1.6	71	(# 6)	2.5	(# 7)	211	(# 6)	2	8.2	17.7	(# 1)	# 2
1997	69	4295	6377	1.0	(# 14)	92.4	1.5	74	(# 5)	2.8	(# 5)	334	(# 13)	3	8.9	18.2	(# 1)	# 3*
1998	53	3821	6308	1.0	(# 17)	119.0	1.7	70	(# 6)	2.6	(# 7)	244	(# 15)	2	9.1	17.3	(# 1)	# 3
1999	45	3718	6308	1.2	(# 12)	140.2	1.7	73	(# 4)	2.7	(# 4)	267	(# 16)	0	9.0	20.1	(# 1)	# 4
2000	49	4537	7147	1.2	(# 10)	145.9	1.6	76	(# 7)	2.5	(# 11)	142	(# 18)	1	8.3	17.5	(# 2)	# 7
2001	51	5363	7253	1.0	(# 12)	142.2	1.4	72	(# 3)	2.3	(# 7)	79	(# 13)	0	7.1	14.5	(# 2)	# 4
2002	45	4968	5041	0.7	(# 13)	112.0	1.0	64	(# 7)	2.4	(# 6)	64	(# 13)	0	7.1	13.2	(# 2)	# 6
2003	77	8986	7242	1.1	(# 18)	94.1	0.8	63	(# 12)	2.3	(# 9)	79	(# 21)	1	8.4	12.5	(# 7)	# 15
2004	38	6415	6738	1.1	(# 12)	177.3	1.1	63	(# 13)	2.5	(# 4)	185	(# 19)	0	7.8	9.7	(#15)	# 15
2005	56	5887	7339	1.7	(# 9)	131.1	1.2	69	(# 11)	2.3	(# 8)	133	(# 13)	2	9.9	13.2	(# 8)	# 3
2006	23	3508	4209	1.2	(# 16)	183.0	1.2	77	(# 5)	2.2	(# 12)	64	(# 19)	0	5.5	15.1	(# 2)	# 12
Avg	**52**	**4717**	**6217**	**1.2**	**11.8**	**126.0**	**1.4**	**71**	**6.8**	**2.5**	**6.8**	**168**	**13.1**	**1**	**8.1**	**15.8**	**3.4**	**5.9**

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

Table 4. Total Number (No.), Catch Rates (C/f), and Relative Weights (W_r) by Size Groups of Largemouth Bass Collected by Spring Electrofishing from Grand Lake Reservoir. Numbers in Parentheses Represent Acceptable C/f Values for a Quality Fishery. Acceptable W_r Values are ≥90.

		<7.9 In.		7.9–11.8 In.		≥11.8 In.		≥14 In.	
Total		<200 mm		200-299mm		≥300 mm		≥356 mm	
(≥40)		(15-45)		(15-30)		(≥15)		(≥10)	
Year	No.	C/f	W_r	C/f	W_r	C/f	W_r	C/f	W_r
1996	300	100	15.3	93	15.7	95	69	104	41	105
1998	286	95.3	8	104	22.3	102	65	102	43.3	103
2000	290	145	13	98	33.5	94	98.5	96	55.5	95
2001	279	223	30.4	92	58.4	93	134	96	99	95
2002	286	114	14.4	95	28	96	72	104	48.5	105
2003*	1013	168.8	45.3	93	48.5	96	79.8	103	45.8	105
2005	731	121.8	20.8	103	27.3	100	74.8	98	37.5	98

* Denotes Changed Electrofishing SSP

Table 5. Year, sample size, number of fish testing positive, and percent of the sample testing positive for Largemouth Bass Virus from Grand Lake.

Year	Sample size	No. Positive	% Positive
2000	38	14	37
2001	36	12	33
2002	36	10	28
2003	36	12	33

Table 6. Total Number (No.), Fish Per Net Night (C/f), and Relative Weights (Wr) by Size Groups of White Bass Collected by Gill Netting from Grand Lake.

Total			< 8 in. < 200 mm		≥ 8 in. ≥ 200 mm		8 – 12 in. 200 – 299 mm		≥ 12 in. ≥ 300 mm	
Year	No.	C/f	C/f	Wr	C/f	Wr	C/f	Wr	C/f	Wr
1998	279	0.775	.056	90	0.719	93	0.231	95	0.489	92
2000	192	0.533	.158	96	0.375	94	0.131	91	0.244	96
2003	231	0.642	.056	92	0.586	94	0.217	94	0.369	94
2007	139	0.4	0.1	118	0.3	102	0.1	110	0.3	100

Table 7. Total Number (No.), Fish Per Net Night (C/f), and Relative Weights (Wr) by Size Groups of Hybrid Striped Bass Collected by Gill Netting from Grand Lake.

Total			< 12 in. < 300 mm		12 – 20 in. 300 – 499 mm		≥ 20 in. ≥ 500 mm	
Year	No.	C/f	C/f	Wr	C/f	Wr	C/f	Wr
1998	0							
2000	2	0.006					0.006	92
2003	1	0.003			0.003	91		
2007	4	0.013	0.010	88	0.003	92		

Table 8. Total Number (No.), Fish Per Net Night (C/f), and Relative Weights (Wr) by Size Groups of All Crappie Collected by Trap Netting from Grand Lake. Numbers in Parentheses Represent Acceptable C/f Values for a Quality Fishery.

	Total (≥25)		<5" (≥5)		≥5" (10-40)		≥8" (≥10)		≥10" (≥4)	
Year	No.	C/f	C/f	Wr	C/f	Wr	C/f	Wr	C/f	Wr
1999	367	18.4	0.8	104	17.5	92	16.8	101	8.4	101
2001	286	11.4	0.5	93	11.0	89	9.7	90	5.2	90
2003	429	20.4	0.3	83	20.1	98	19.3	98	13.4	96
2007	175	4.2	2.6	109	1.8	104	1.3	104	0.9	101

Table 9. Mean length at Age of Crappie Collected by Trap Netting from Grand Lake. Numbers in Parentheses Represent Values for Acceptable Growth Rates.

	Age 1	Age 2	Age 3	Age 4
Year	(≥ 6.3 in.)	(≥ 7.9 in.)	(≥ 8.9 in.)	(≥ 9.8 in.)
1990	7.2	9.9	10.4	
1991	8.4	9.6	10.9	12.6
1992	7.2	10.0	11.7	8.3
1993	7.3	9.6	11.4	13.2
1995	7.7	9.7	12.1	12.3
1996	7.7	9.9	10.4	13.2
1997	8.6	10.2	11.4	
1998	8.4	10.3	11.4	
1999	8.8	10.7	12.3	12.5
2001	8.1	10.2	11.2	11.9
2003	8.0	10.7	12.0	12.6
2007	9.6	11.8	12.5	14.2

Table 10. Total Number (No.), Fish Per Net Night (C/f), and Relative Weights (Wr) by Size Groups of Blue Catfish Collected by Gill Netting from Grand Lake.

	Total		< 12 in.		12 – 16 in.		≥ 12 in.		≥ 16 in.	
			< 300 mm		200 - 399 mm		≥ 300 mm		≥ 400 mm	
Year	No.	C/f	C/f	Wr	C/f	Wr	C/f	Wr	C/f	Wr
1998	24	0.067	.019	114	0.028	111	0.047	106	0.031	109
2000	18	0.050	.031	103	0.028	85	0.019	85	0.011	91
2003	11	0.031	.003	92	0.008	85	0.028	92	0.022	86
2007	26	0.072	.008	79	0.014	78	0.063	81	0.058	81

Table 11. Total Number (No.), Fish Per Net Night (C/f), and Relative Weights (Wr) by Size Groups of Channel Catfish Collected by Gill Netting from Grand Lake.

	Total		< 12 in.		12 – 16 in.		≥ 12 in.		≥ 16 in.	
			< 300 mm		200 - 399 mm		≥ 300 mm		≥ 400 mm	
Year	No.	C/f	C/f	Wr	C/f	Wr	C/f	Wr	C/f	Wr
1998	113	0.314	.069	89	0.203	85	0.244	89	0.103	96
2000	206	0.572	.333	86	0.383	82	0.239	85	0.117	91
2003	118	0.328	.120	88	0.219	86	0.208	86	0.083	92
2007	209	0.565	.240	87	0.461	85	0.325	84	0.075	88

Table 12. Total Number (No.), Fish Per Net Night (C/f), and Relative Weights (Wr) by Size Groups of Flathead Catfish Collected by Gill Netting from Grand Lake.

Total			≥ 12 in. ≥ 300 mm		≥ 20 in. ≥ 500 mm		≥ 24 in. ≥ 600 mm		≥ 28 in. ≥ 700 mm	
Year	No.	C/f	C/f	Wr	C/f	Wr	C/f	Wr	C/f	Wr
1998	4	0.011	0.006	120	0.003	118				
2000	5	0.014	0.014	106	0.011	101	0.008	105	0.003	102
2003	2	0.006	0.006	103	0.006	103	0.003	101		
2007	2	0.006	0.006	91	0.006	91				

Table 13. Age and Length data for male aged paddlefish in Grand Lake 2004

Age (Years)	N	Mean Length (mm)	Length Group (mm)
4	3	750.6	726-750
5	34	818.8	801-825
6	3	777.3	776-800
7	2	945.5	926-950
8	2	961	951-975
9	6	1033.3	1026-150
10	1	965	951-975
11	0	----	----
12	0	----	----
13	0	----	----
14	1	1007	1001-1025
15	0	----	----
16	0	----	----
17	0	----	----
18	1	1116	1101-1125
19	0	----	----

Table 14. Age and length data for female aged paddlefish in Grand Lake 2004

Age (Years)	N	Mean Length (mm)	Length Group (mm)
4	3	789.6	776-800
5	14	793.7	776-800
6	0	----	----
7	0	----	----
8	5	1034.8	1026-1050
9	5	1073.4	1051-1075
10	3	1072	1051-1075
11	1	1153	1151-1175
12	2	1054.5	1051-1075
13	1	1040	1026-1050
14	0	----	----
15	2	1084	1076-1100
16	0	----	----
17	0	----	----
18	0	----	----
19	1	1270	1251-1275

Table 15. Total Number (No.), Fish Per Net Night (C/f), and Relative Weights (Wr) by Size Groups of Gizzard Shad Collected by Gill Netting from Grand Lake.

	Total		< 6 in. < 150 mm	≥ 6 in. ≥ 150 mm
Year	No.	C/f	C/f	C/f
2003	250	4.531	4.006	0.525
2007	395	1.956	1.013	0.943

Table 16. Total Number (No.), Fish Per Net Night (C/f), and Relative Weights (Wr) by Size Groups of Threadfin Shad Collected by Gill Netting from Grand Lake.

	Total		< 5 in. < 125 mm	≥ 5 in. ≥ 125 mm
Year	No.	C/f	C/f	C/f
2003	150	4.989	4.989	.
2007	444	8.051	7.842	0.209

Figures

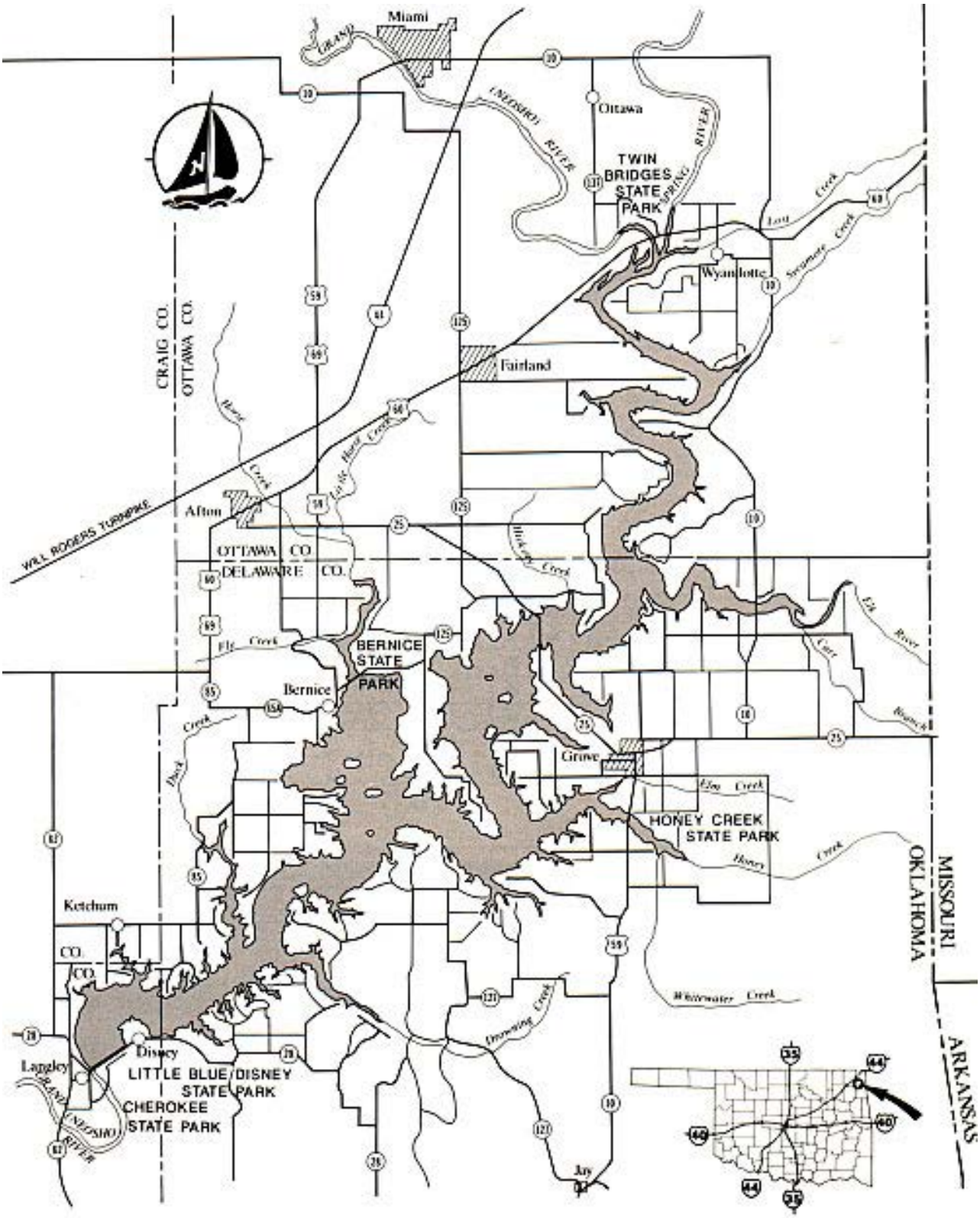

Figure 1. Map of Grand Lake and vicinity.

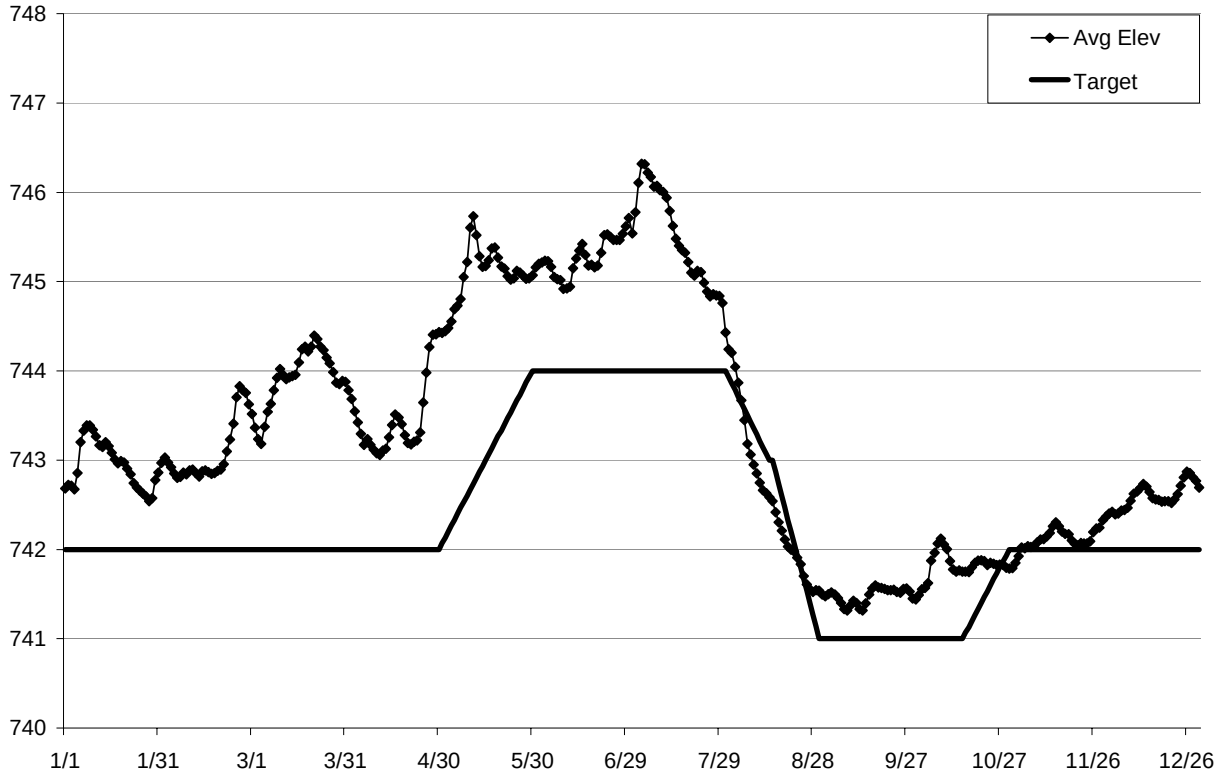

Figure 2. Mean surface elevations for Grand Lake from 1997 through 2007, and target elevations as defined in Article 401 of the 1996 rule curve amendment.

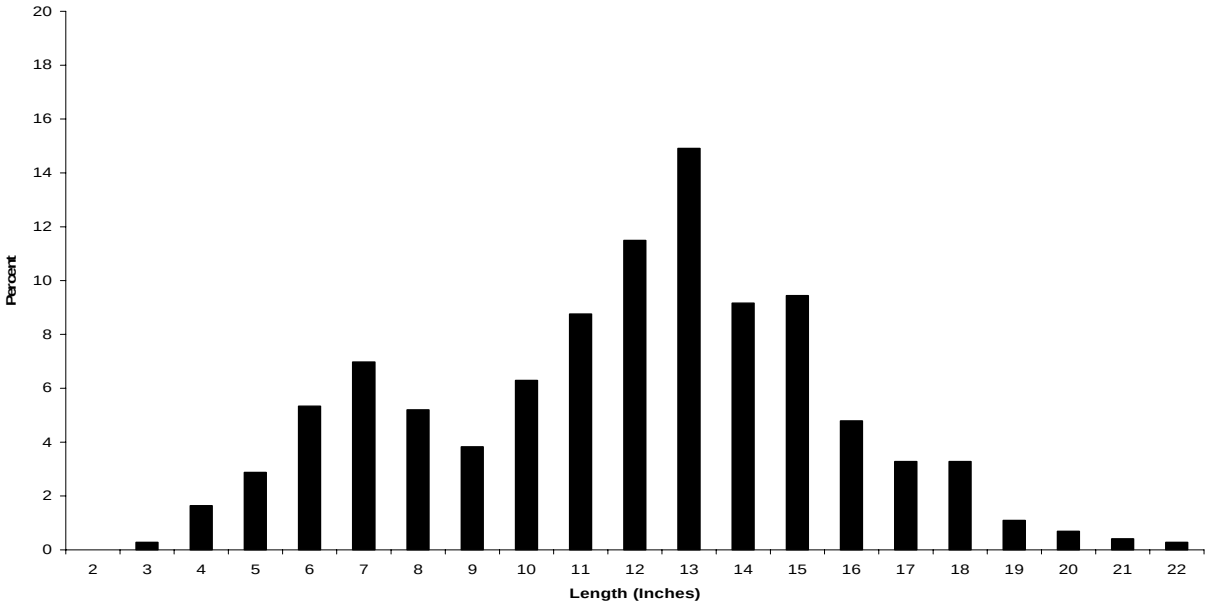

Figure 3. 2005 Electrofishing at Grand Lake. Length Frequency Distribution for Largemouth Bass, N = 731.

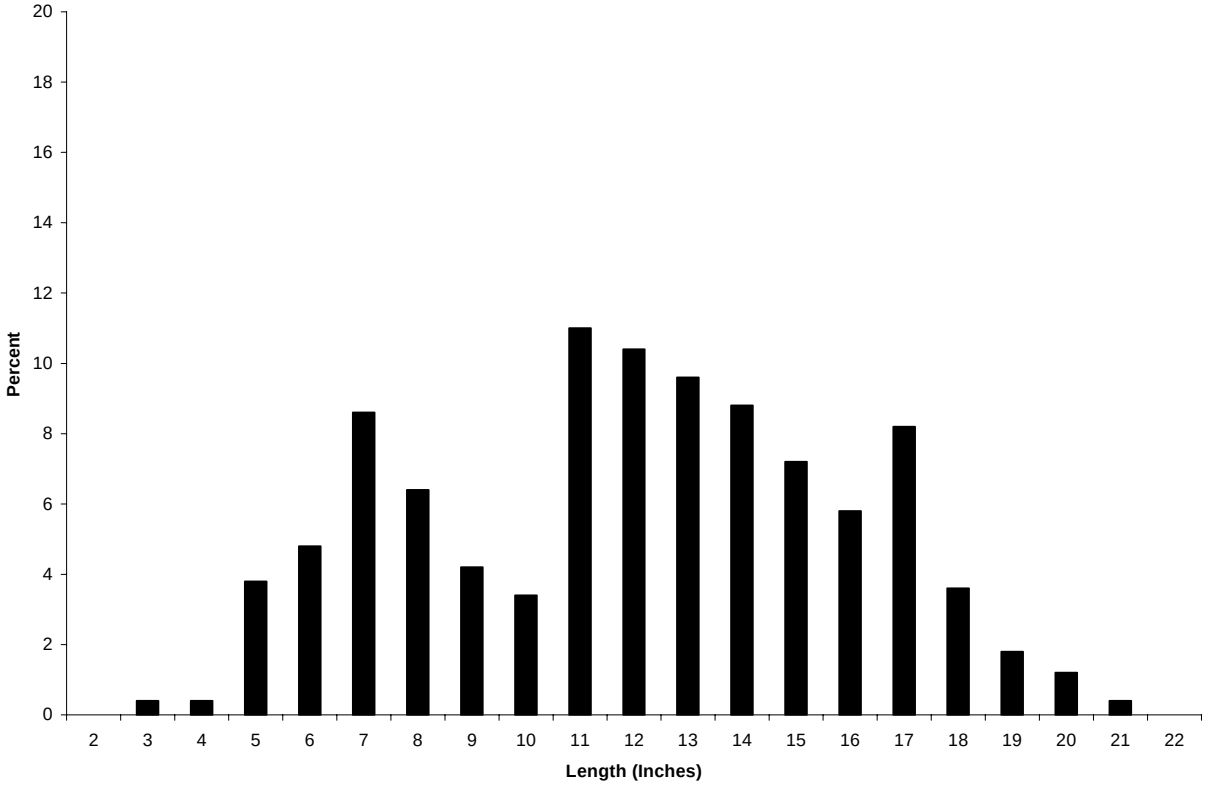

Figure 4. 2008 Electrofishing at Grand Lake. Length Frequency Distribution for Largemouth Bass, N = 500.

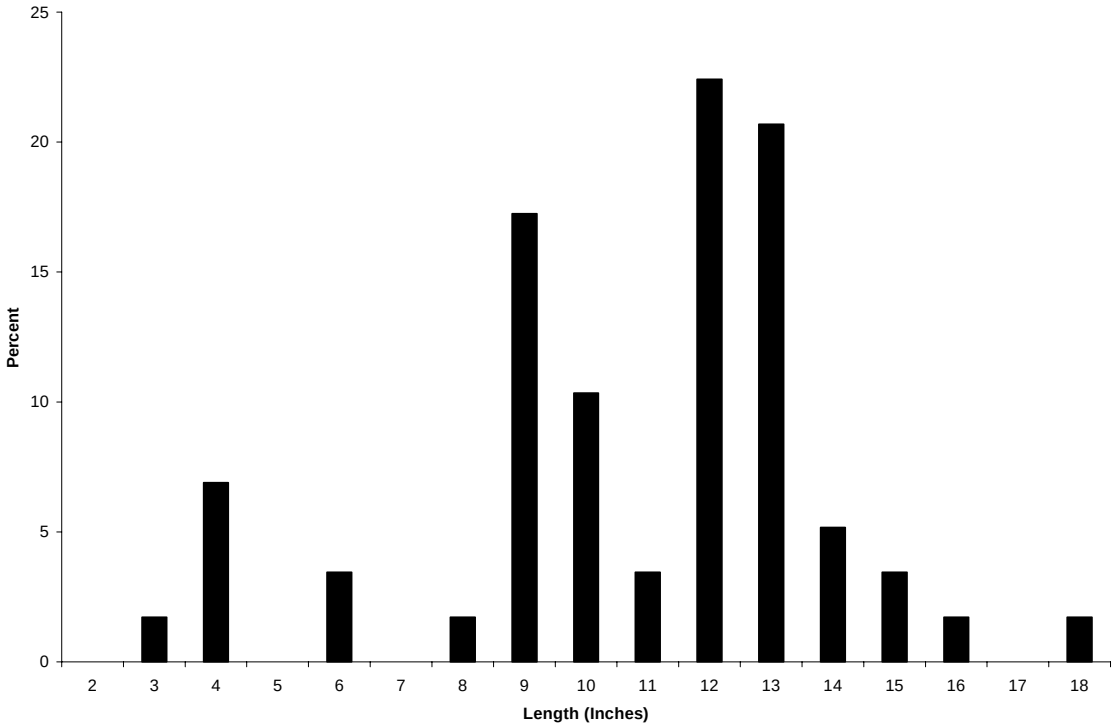

Figure 5. 2005 Electrofishing at Grand Lake. Length Frequency Distribution for Spotted Bass, N = 58.

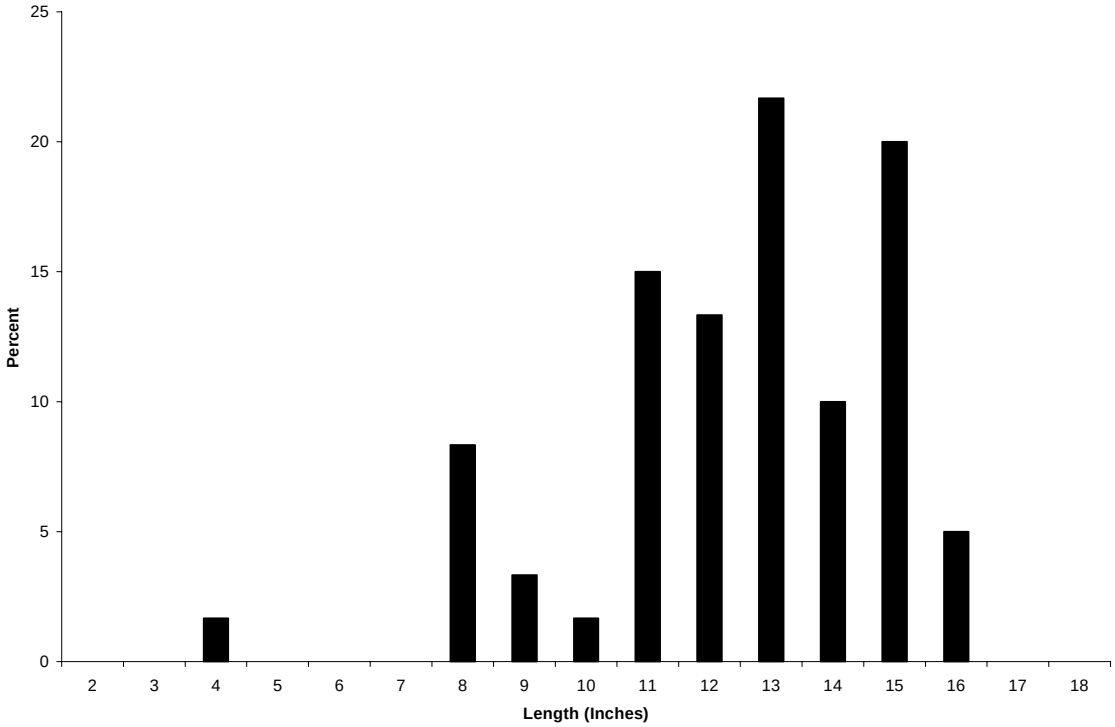

Figure 6. 2008 Electrofishing at Grand Lake. Length Frequency Distribution for Spotted Bass, N = 60.

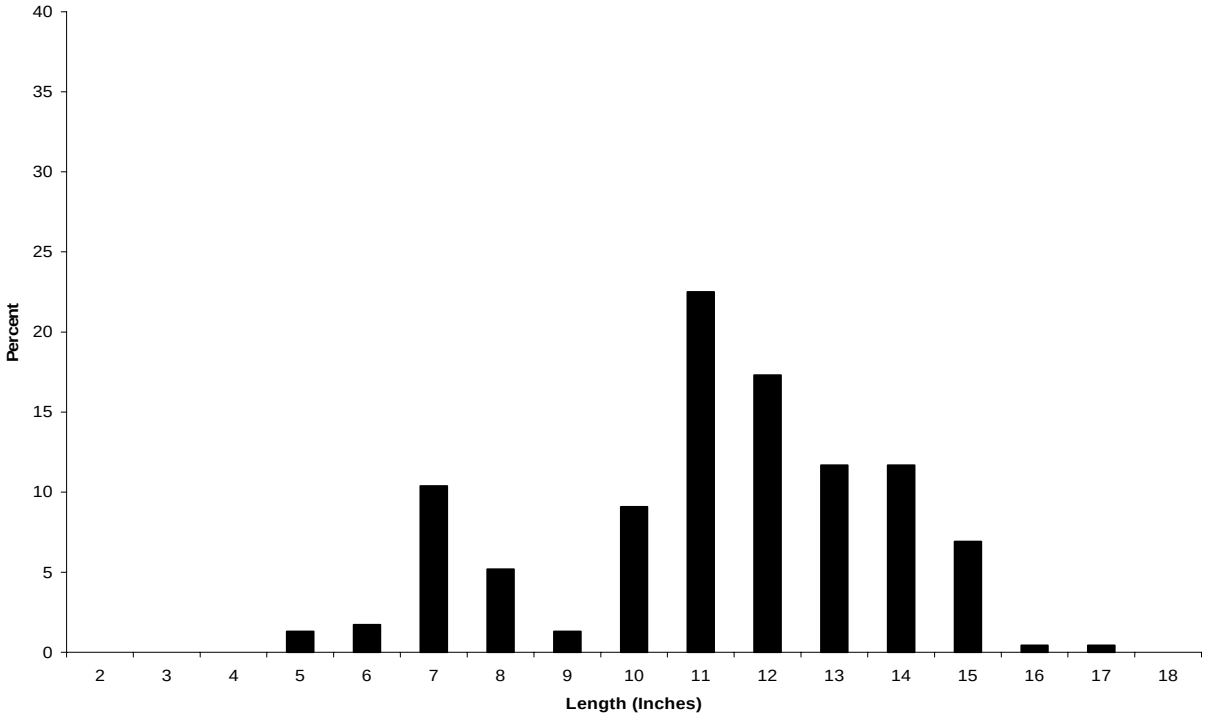

Figure 7. 2003 Gill Netting at Grand Lake. Length Frequency Distribution for White Bass, N = 231.

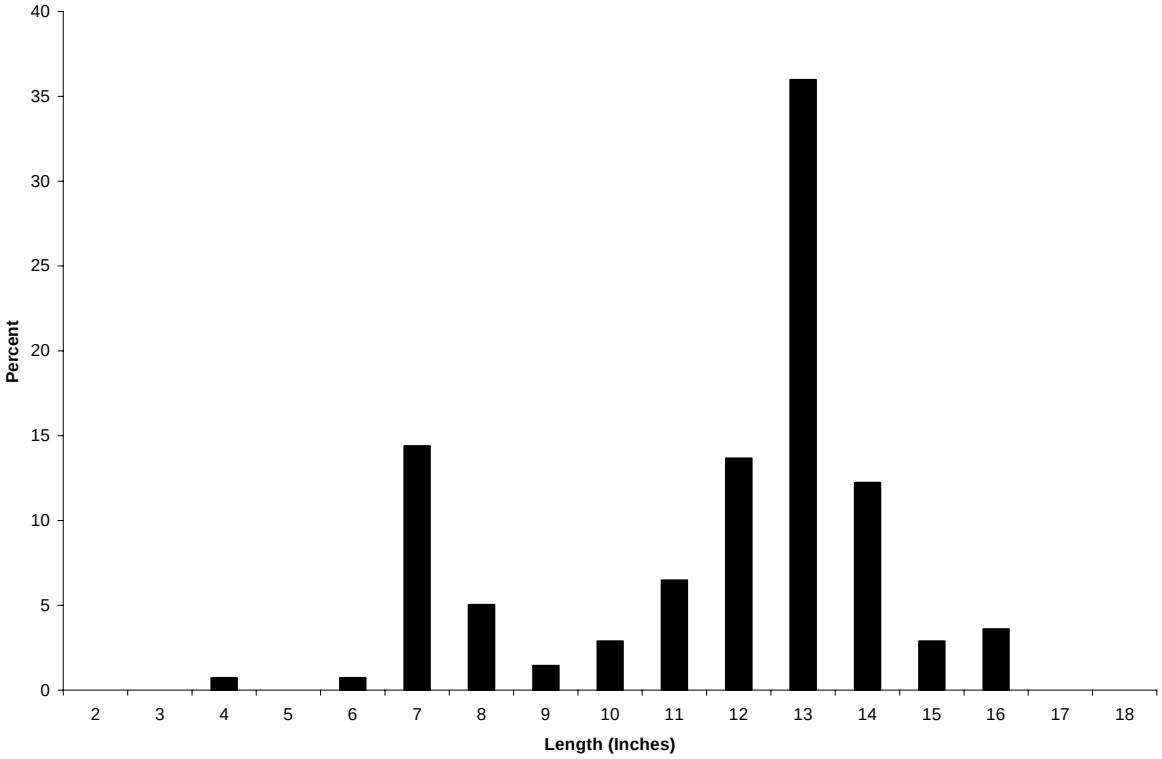

Figure 8. 2007 Gill Netting at Grand Lake. Length Frequency Distribution for White Bass, N = 139.

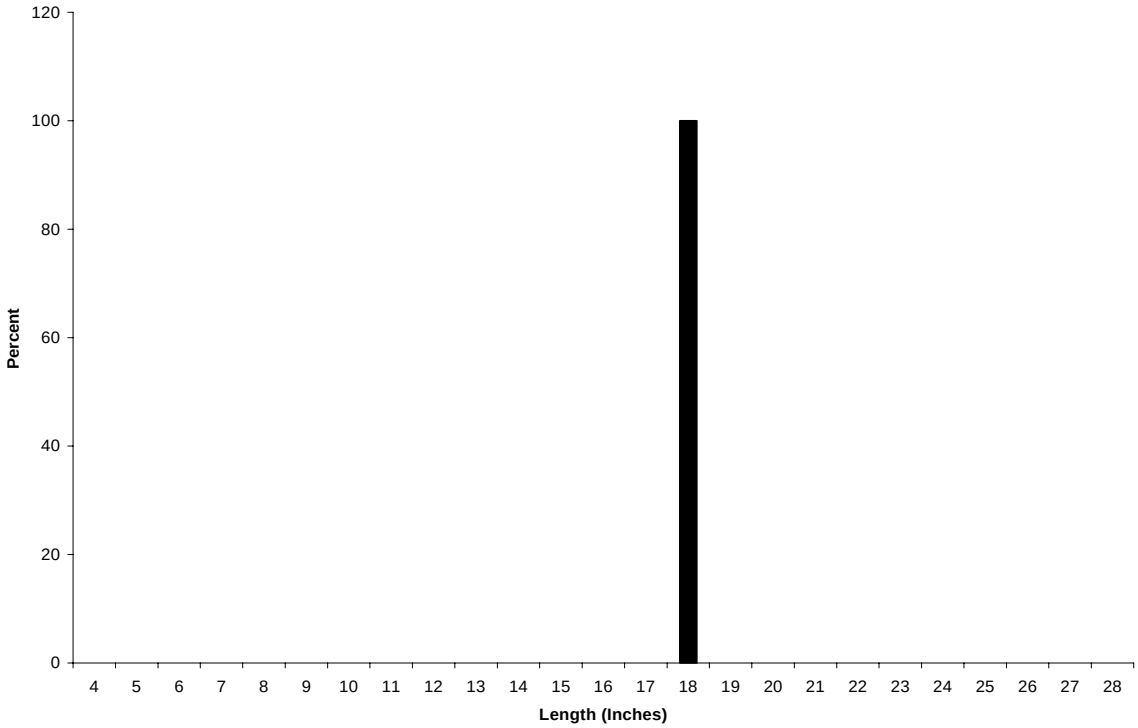

Figure 9. 2003 Gill Netting at Grand Lake. Length Frequency Distribution for Striped Bass Hybrids, N = 1.

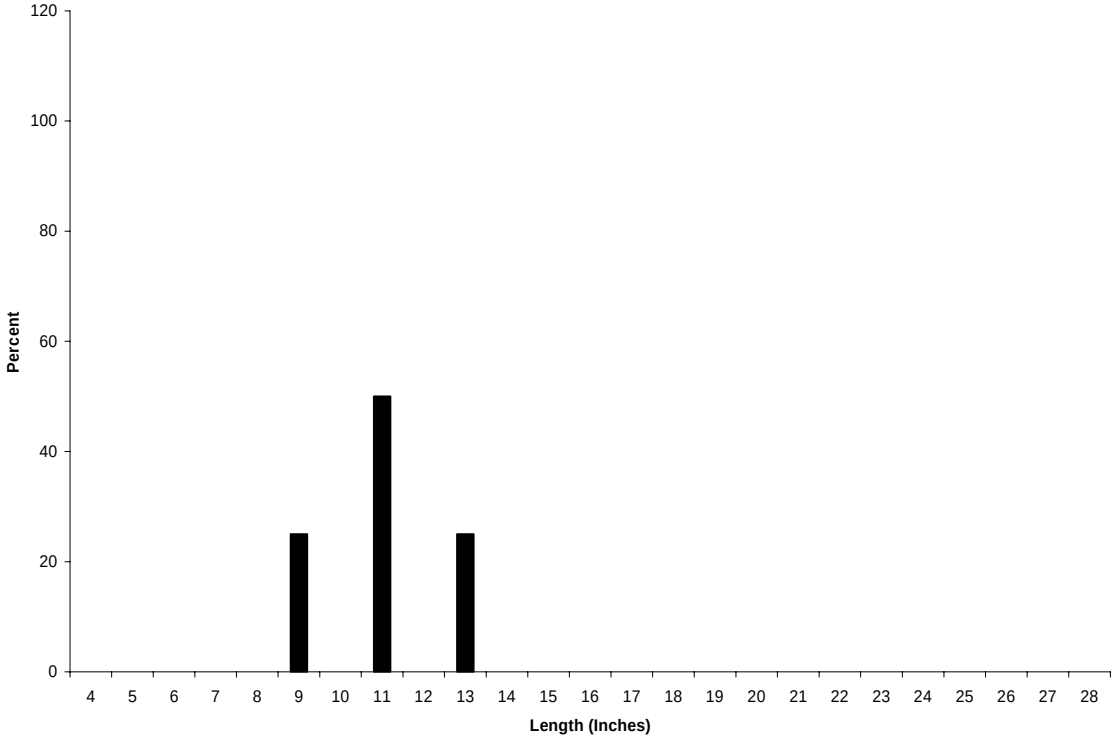

Figure 10. 2007 Gill Netting at Grand Lake. Length Frequency Distribution for Striped Bass Hybrids, N = 4.

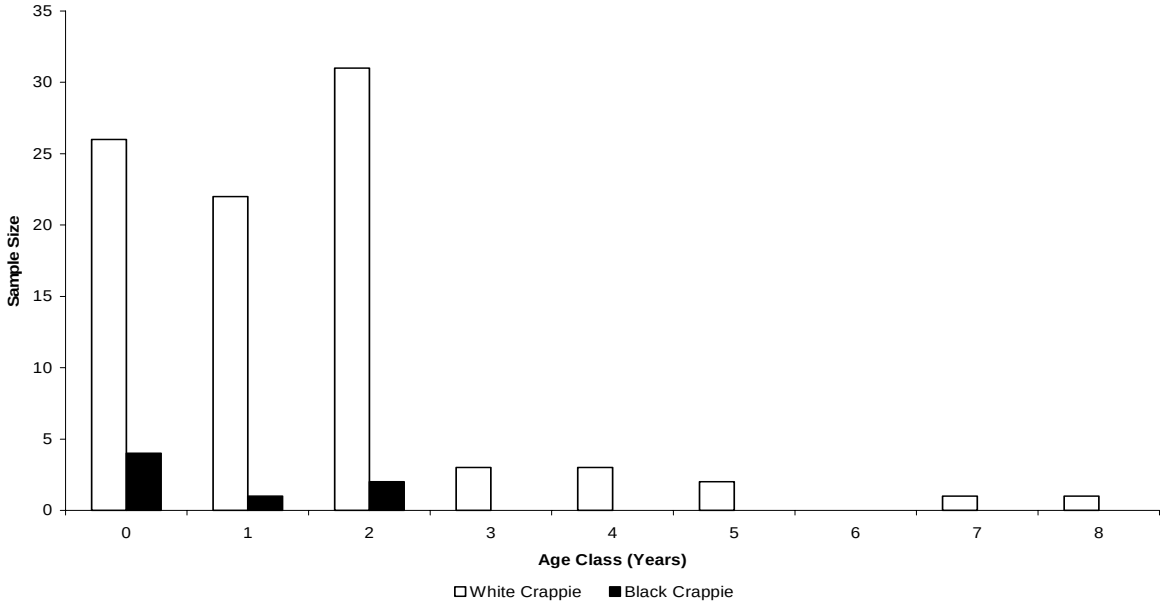

Figure 11. 2007 Trap Netting at Grand Lake. Sample Size by Age of White Crappie and Black Crappie from Otolith Data.

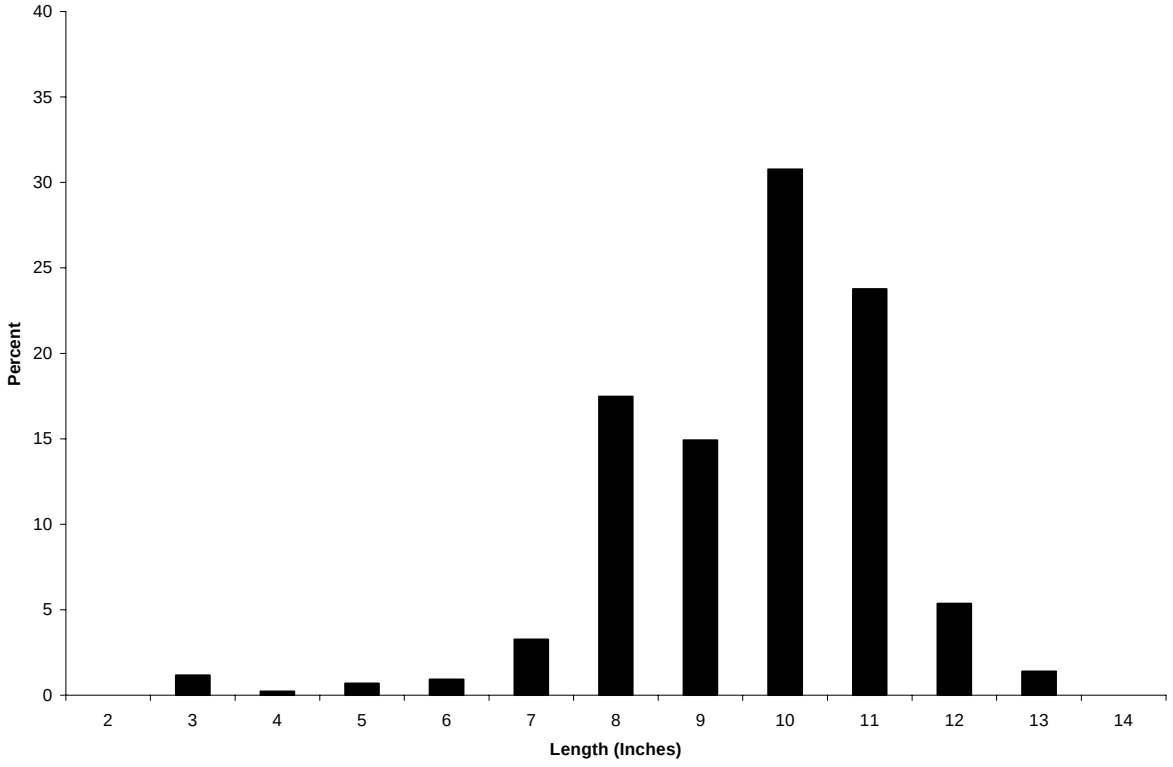

Figure 12. 2003 Trap Netting at Grand Lake. Length Frequency Distribution, All Crappie Combined, N = 429.

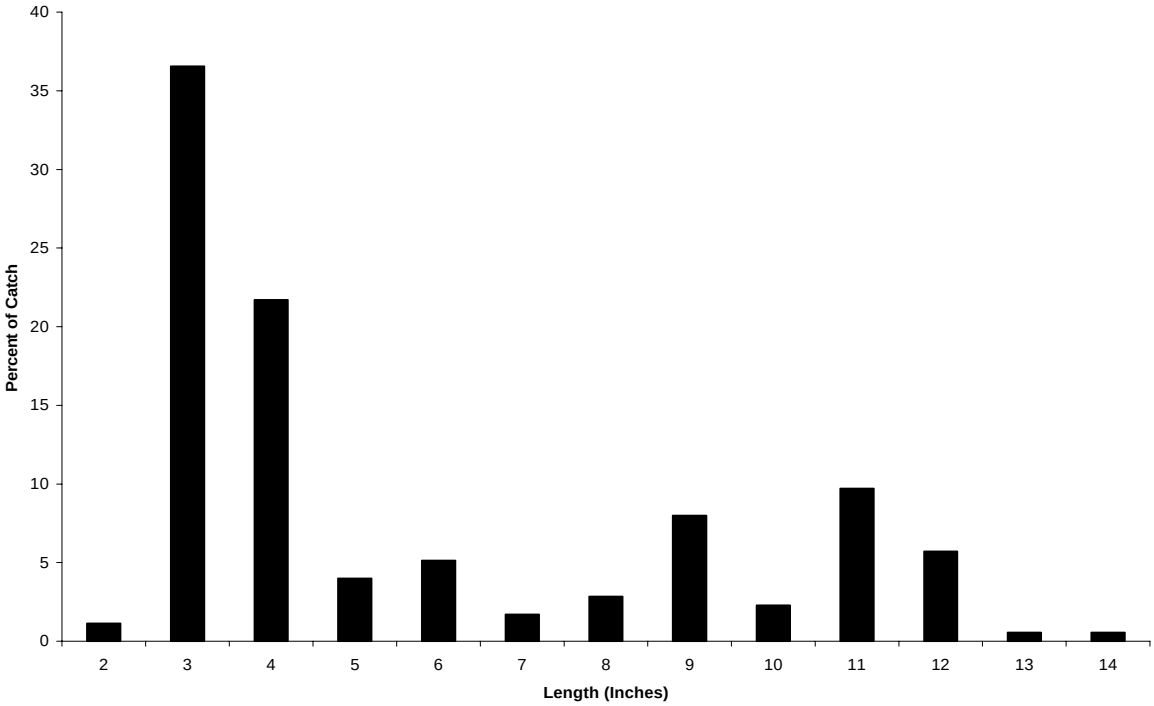

Figure 13. 2007 Trap Netting at Grand Lake. Length Frequency Distribution, All Crappie Combined, N = 175.

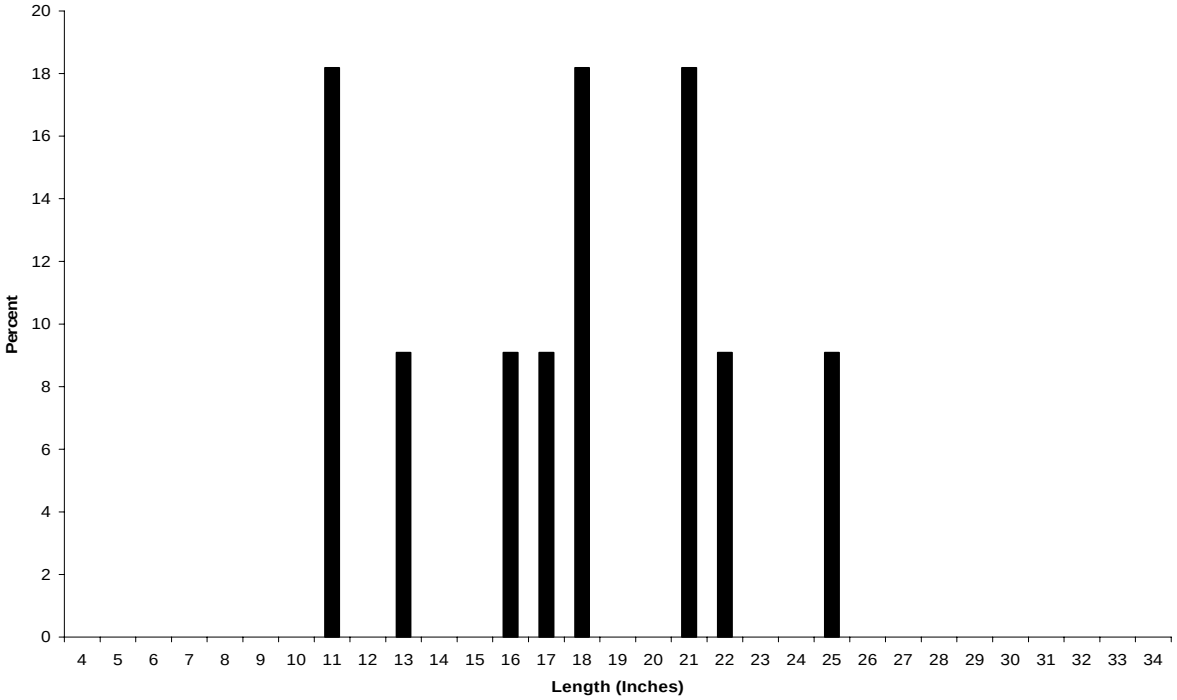

Figure 14. 2003 Gill Netting at Grand Lake. Length Frequency Distribution for Blue Catfish, N = 11.

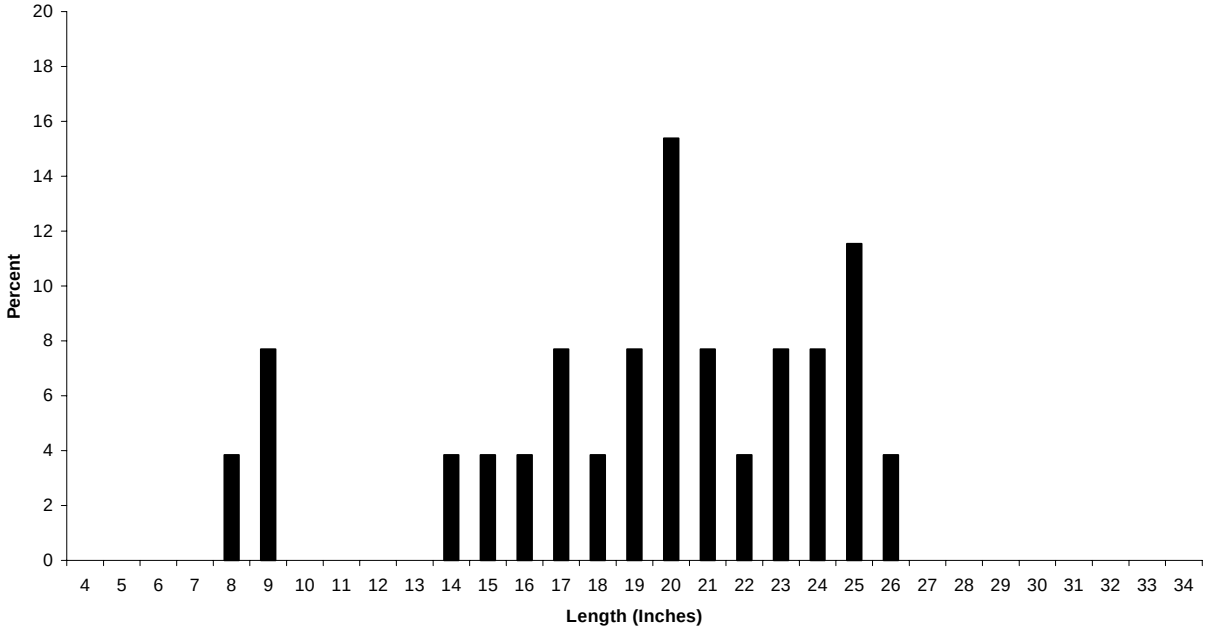

Figure 15. 2007 Gill Netting at Grand Lake. Length Frequency Distribution for Blue Catfish, N = 26.

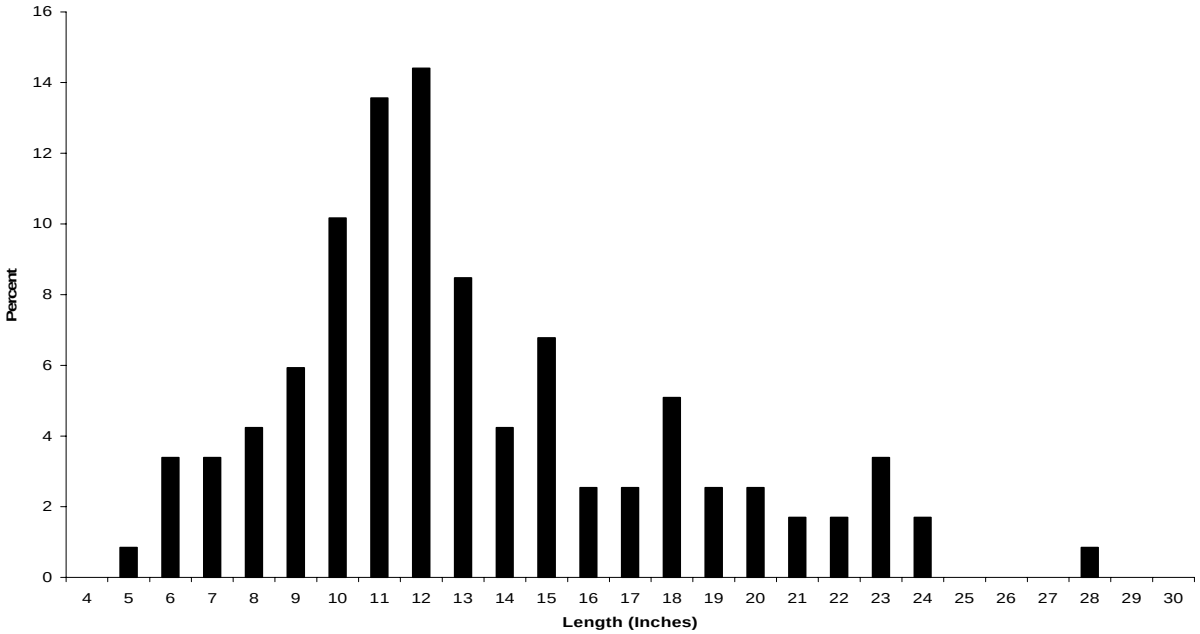

Figure 16. 2003 Gill Netting at Grand Lake. Length Frequency Distribution for Channel Catfish, N = 118.

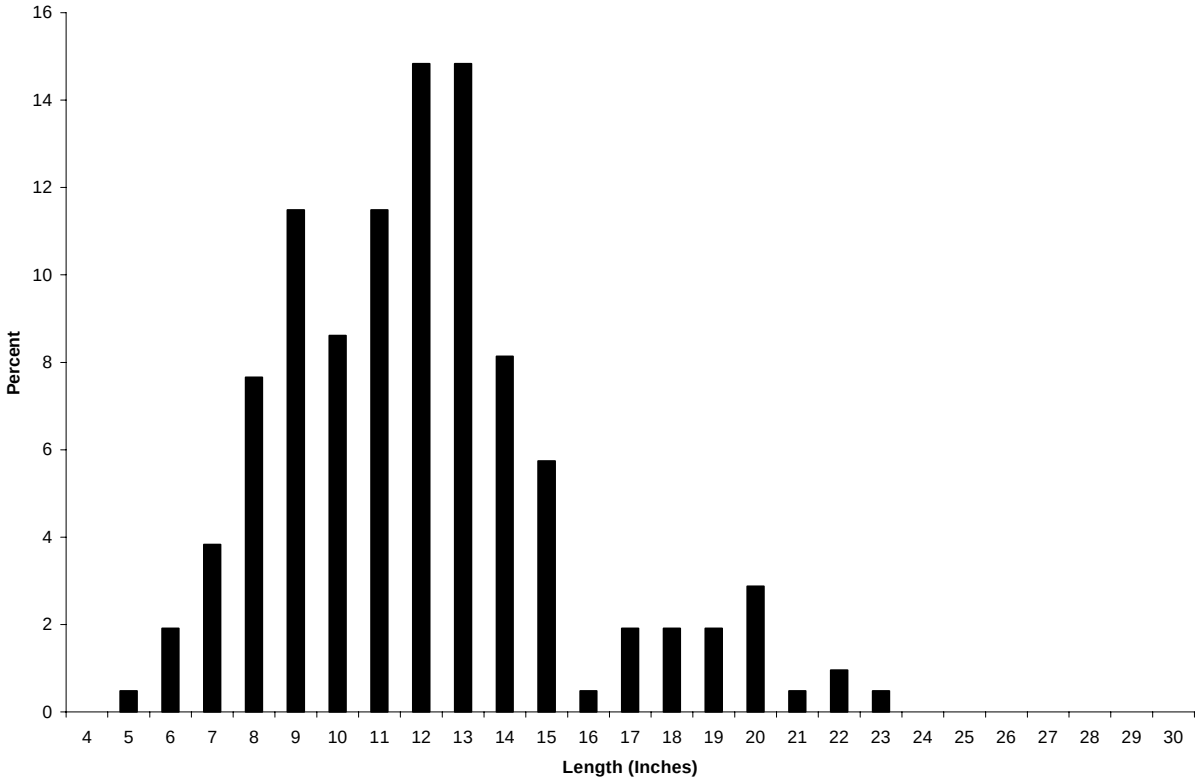

Figure 17. 2007 Gill Netting at Grand Lake. Length Frequency Distribution for Channel Catfish, N = 209.

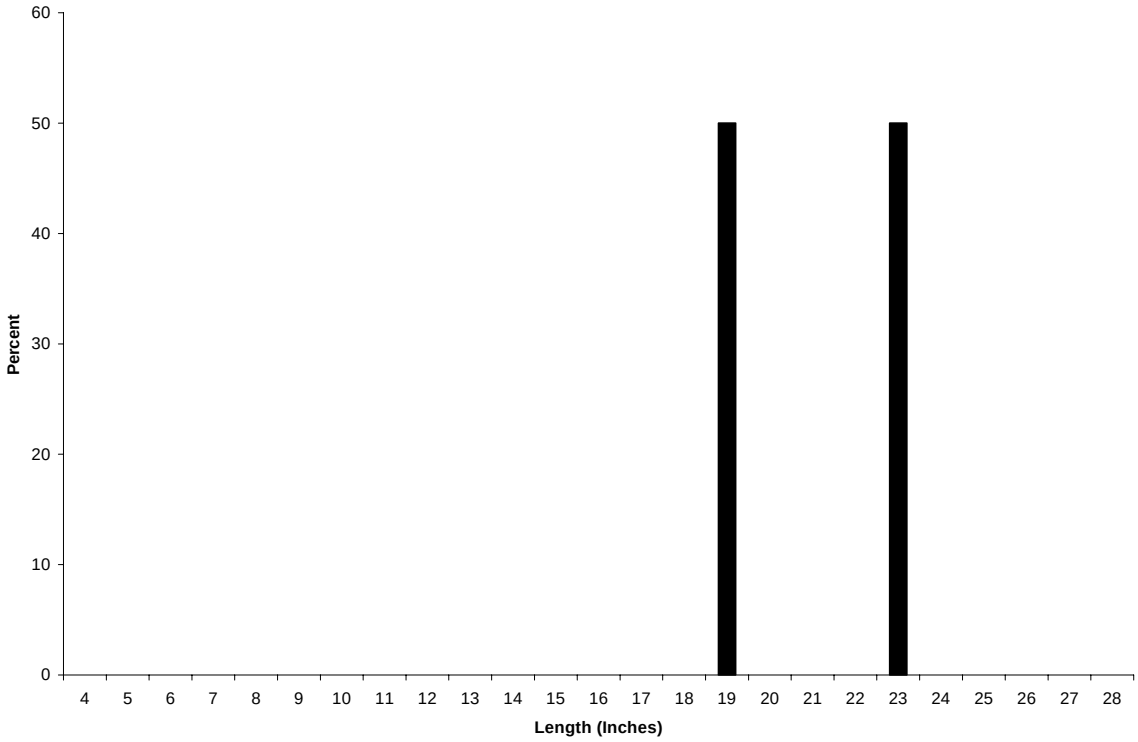

Figure 18. 2003 Gill Netting at Grand Lake. Length Frequency Distribution for Flathead Catfish, N = 2.

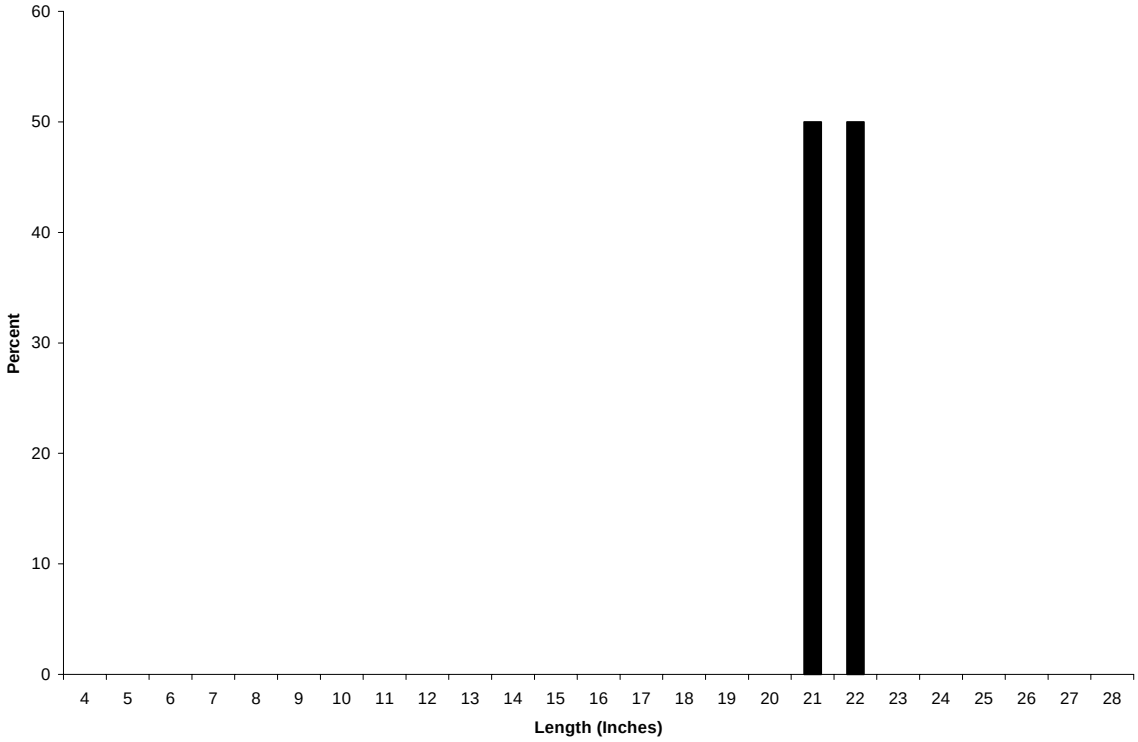

Figure 19. 2007 Gill Netting at Grand Lake. Length Frequency Distribution for Flathead Catfish, N = 2.

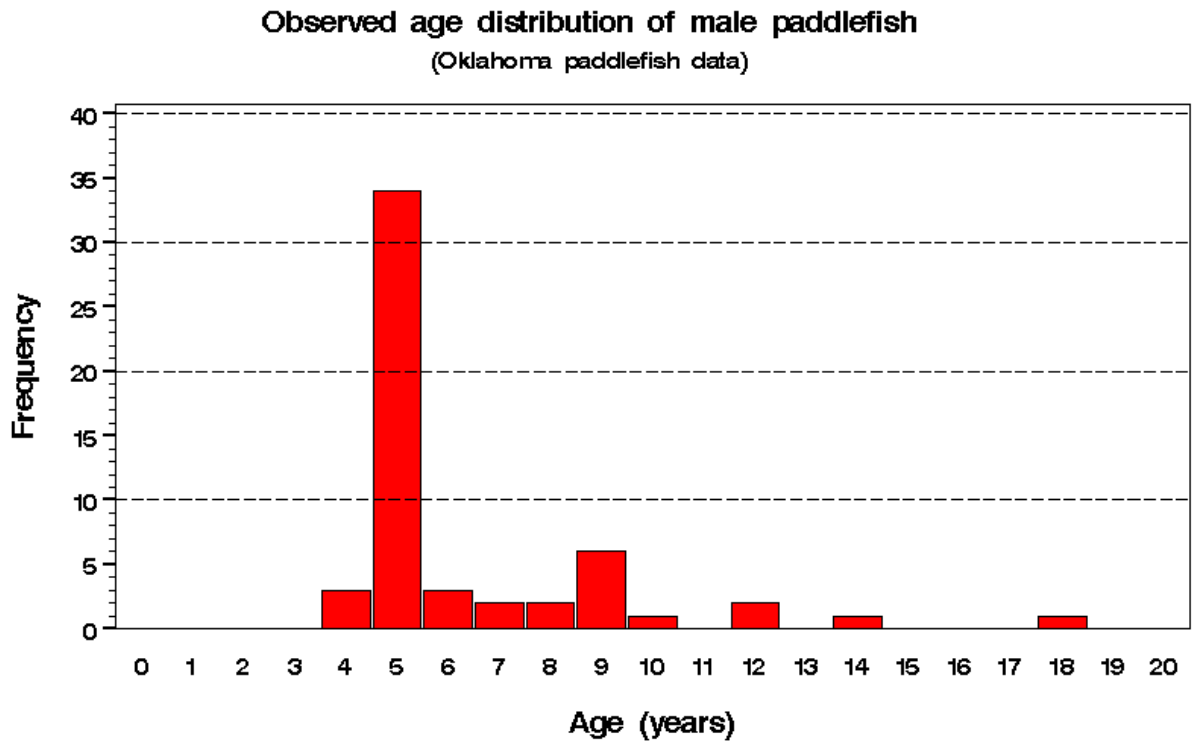

Figure 20. Age distribution of male paddlefish collected from Grand Lake 2003 and 2004.

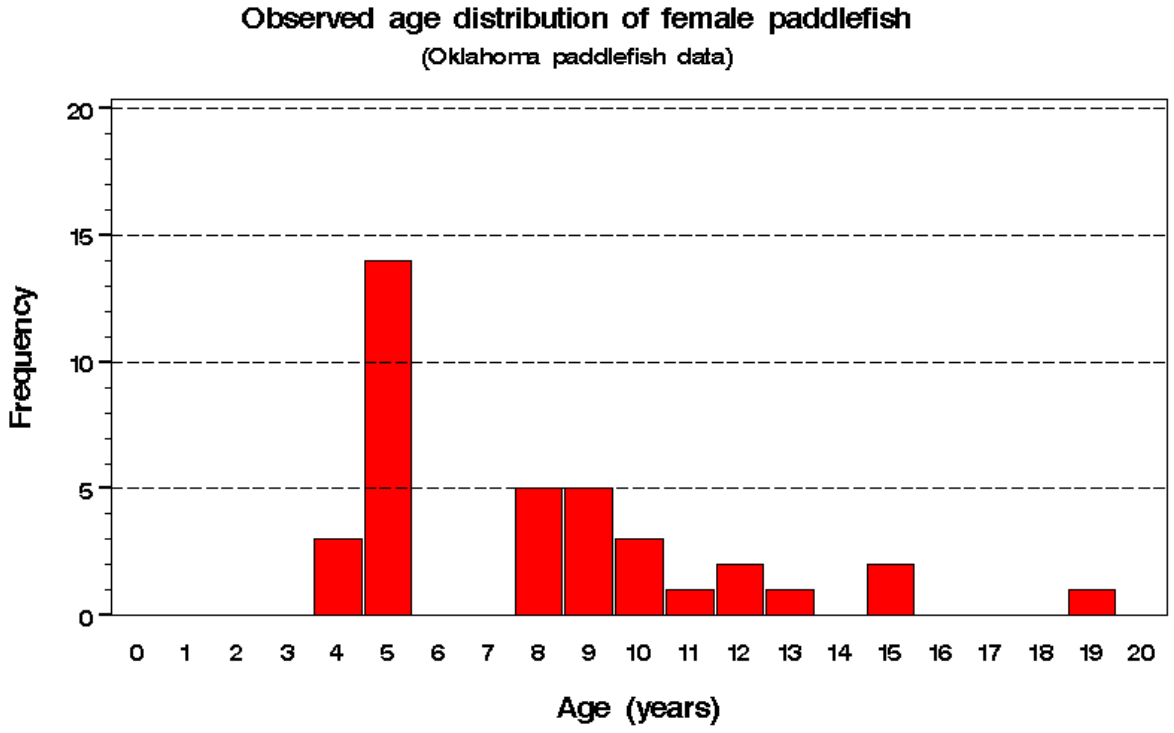

Figure 21. Age distribution of female paddlefish collected from Grand Lake 2003 and 2004

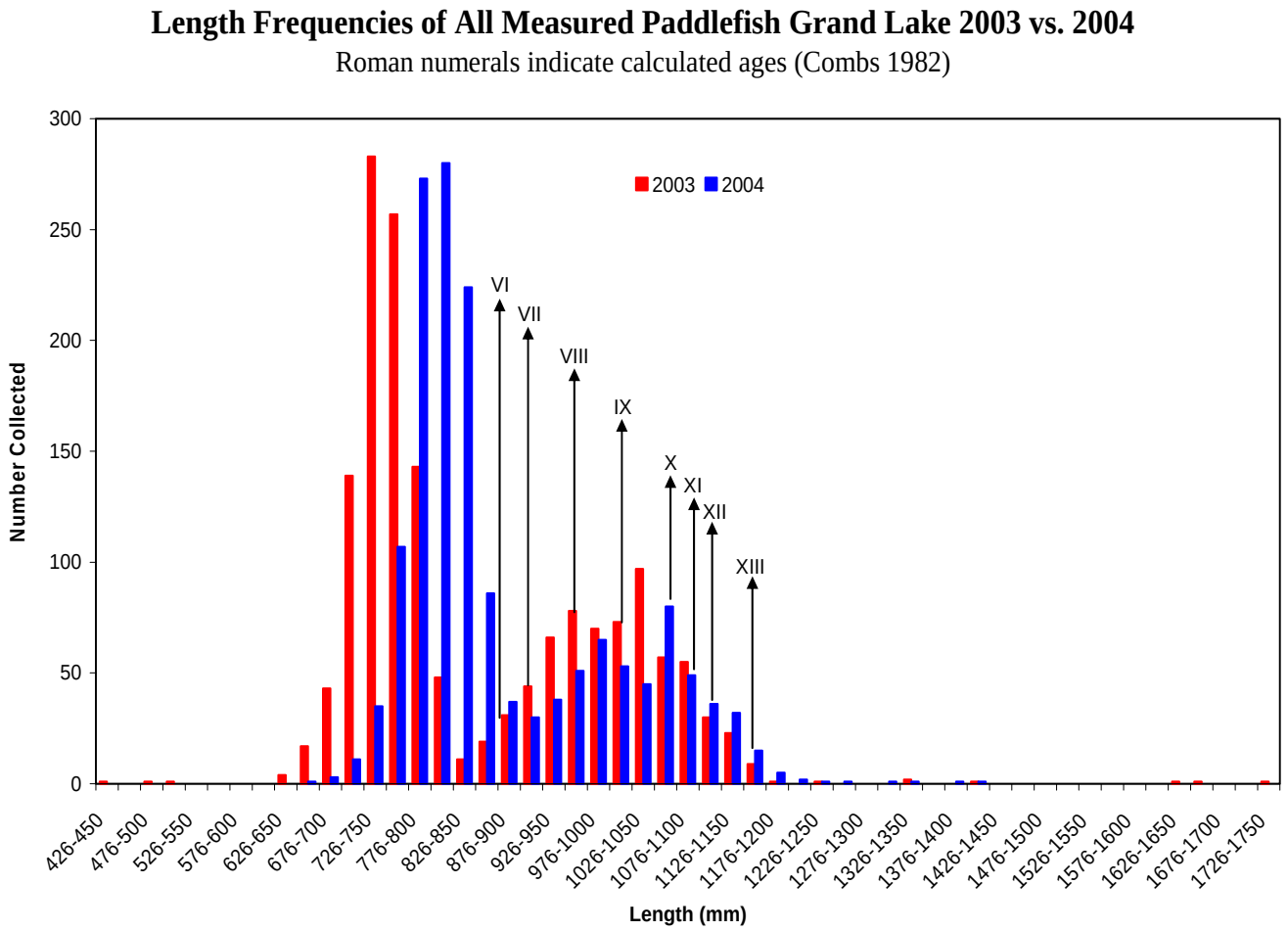

Figure 22. A comparison of length frequencies of all paddlefish collected in Grand Lake from 2003 and 2004.

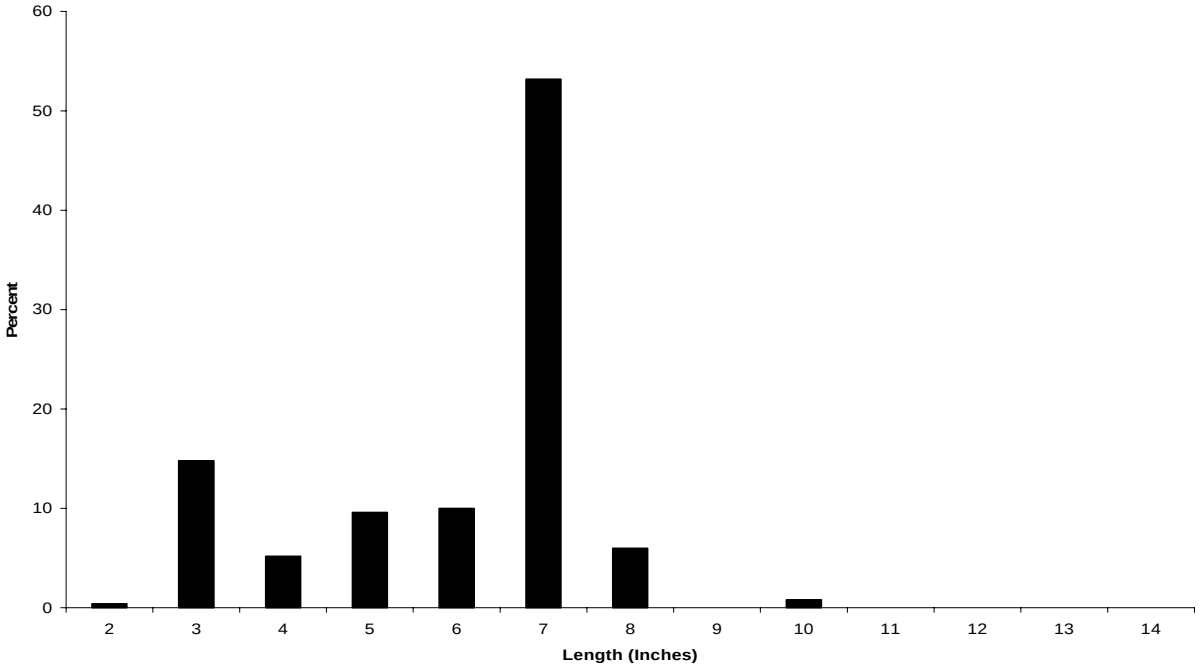

Figure 23. 2003 Gill Netting at Grand Lake. Length Frequency Distribution for Gizzard Shad, N = 250.

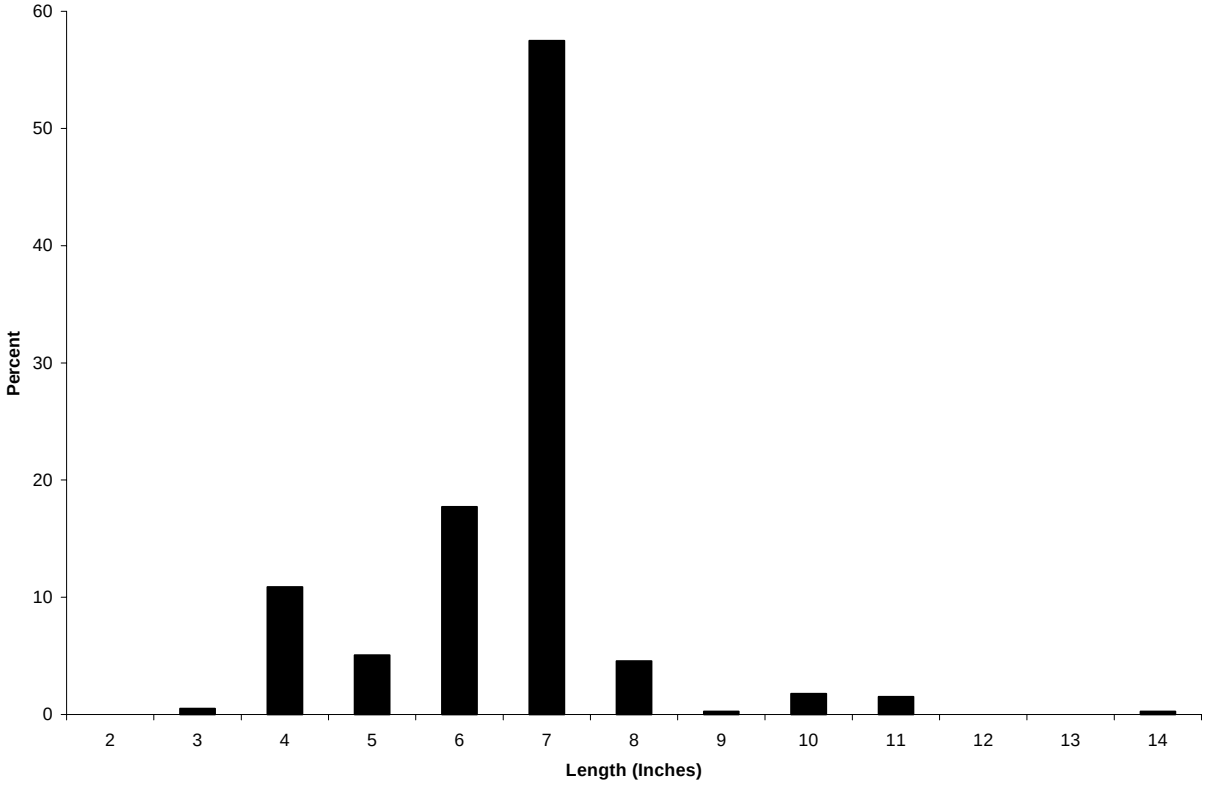

Figure 24. 2007 Gill Netting at Grand Lake. Length Frequency Distribution for Gizzard Shad, N = 395.

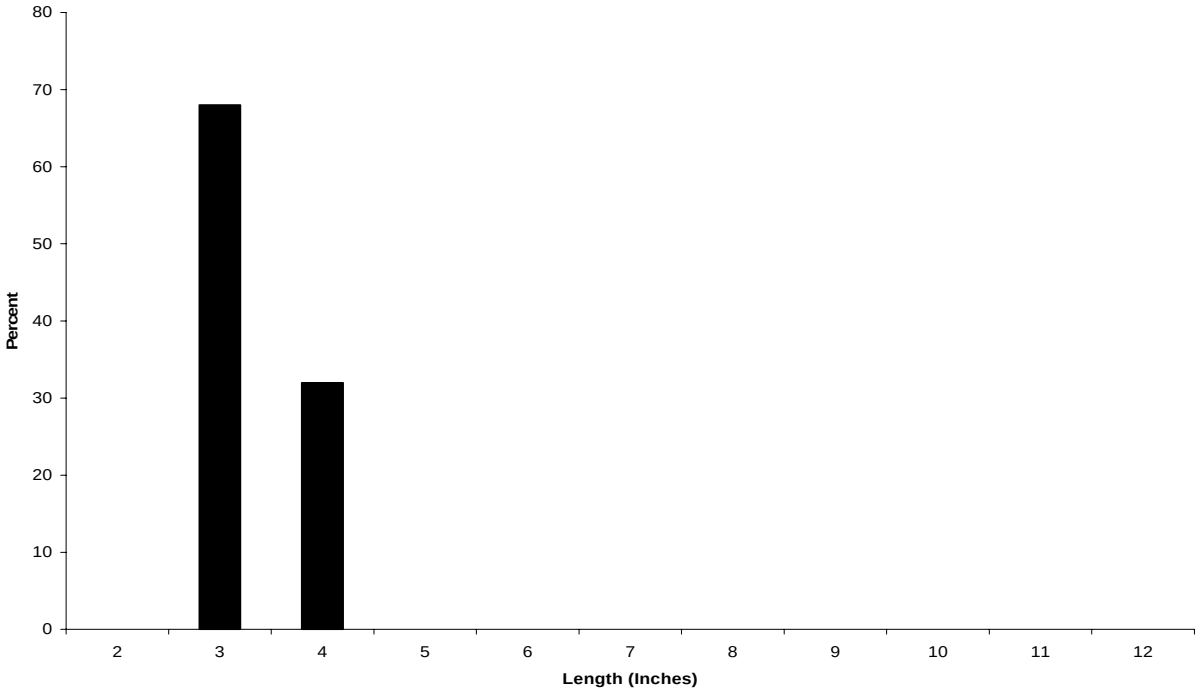

Figure 25. 2003 Gill Netting at Grand Lake. Length Frequency Distribution for Threadfin Shad, N = 150.

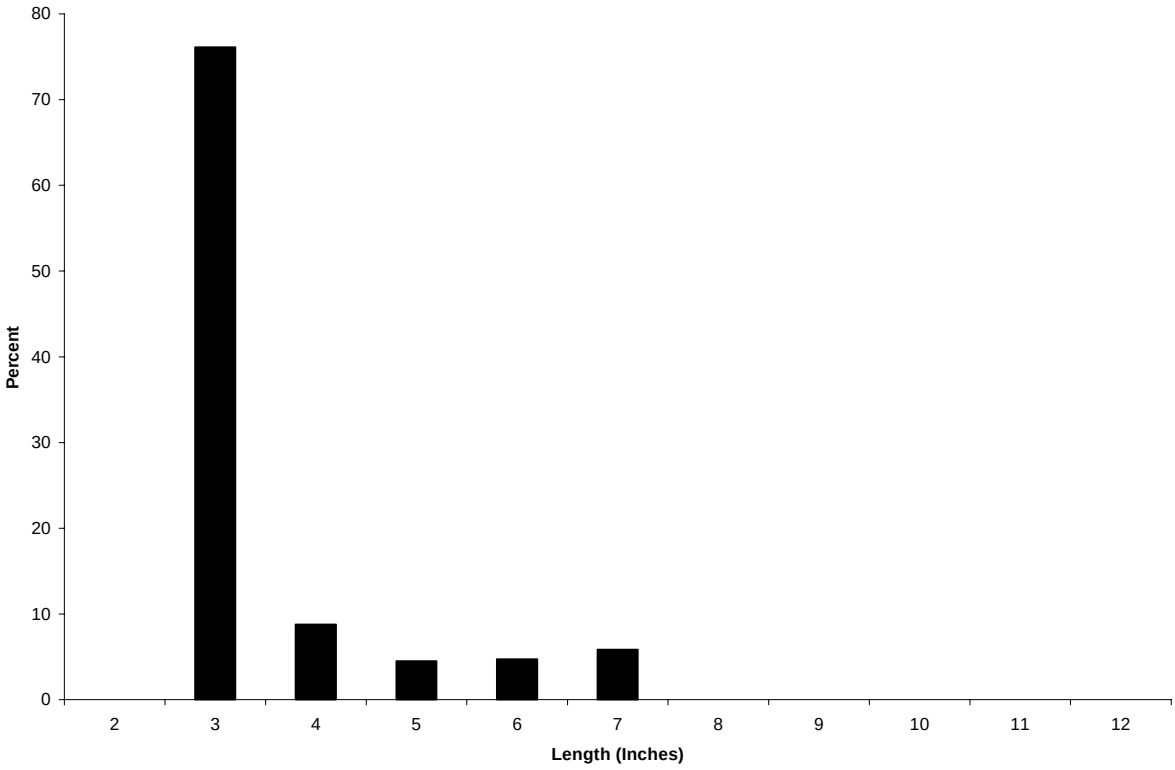

Figure 26. 2007 Gill Netting at Grand Lake. Length Frequency Distribution for Threadfin Shad, N = 444.