Bixhoma Lake Management Plan

Oklahoma Department of Wildlife Conservation

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Background

Physical Characteristics

Bixhoma Lake was constructed in 1965 by the City of Bixby for use as a water supply lake and for recreation. The lake impounds Mountain Creek and is located approximately eight miles southeast of Bixby in Wagoner County, Oklahoma (Figure 1). The dam is located at Latitude: 35° 53' 48" North, and Longitude: 95° 47' 39" West.

Bixhoma Lake has a shoreline length of three miles, a surface area of 110 acres, a normal pool capacity of 3,130 acre-feet, and a normal water surface elevation of 691 feet above mean sea elevation. Average depth of the lake is about 33 feet with a maximum depth of 56 feet. Bixhoma Lake has a shoreline development ratio of 2.0:1 and a secchi visibility of 59 inches in August. The water exchange rate is unknown as the lake is no longer used for water supply and the only flow through is over the spillway. The rolled earthfill dam structure is about 995 feet long at an elevation of 716 feet above mean sea level. The spillway is an uncontrolled, flow over concrete structure with an access road available to drive along the dam and spillway.

Notable characteristics of Bixhoma Lake are that it is a small, deep, relatively clear lake located in a deep valley surrounded by steep hills. Habitat consists of rocky outcrops and vegetation, mostly water willow, along the shoreline with some shallow mud flats and submerged timber at the upper end of the lake.

Public use facilities include two boat ramps, restrooms, a pavilion, and two fishing docks. State fishing license is required, unless exempt, along with a fishing/boating permit purchased from the City of Bixby. Speed limit on the water is five miles per hour with motors limited to 15 horsepower.

Chemical Characteristics

Bixhoma Lake was sampled by the Oklahoma Water Resources Board (OWRB) to assess the water quality and chemistry from October 2005 through July 2006. Water clarity for the lake was found to be excellent with an average turbidity of 5 NTU, true color of 23 units, and an average secchi depth of 57.5 inches in 2006. The trophic state index (TSI, chlorophyll-a) was 45 indicating mesotrophic conditions, showing moderate productivity and nutrient conditions. TSI values found by OWRB ranged from oligotrophic conditions in the spring and summer, to mesotrophic in the winter, and eutrophic in the fall. Salinity values ranged from 0.01 parts per thousand (ppt) to 0.05 ppt, which is lower than many Oklahoma lakes. Specific conductivity ranged from 47.4 µS/cm to 127.5 µS/cm, also showing limited salt content and ion levels in the lake. Values for pH were generally neutral, ranging from 6.44 to 8.63 in the summer. Thermal stratification was not evident in winter and spring, but the lake did stratify between 16 and 20 feet in the fall where dissolved oxygen (DO) dropped below 2 mg/L in 42 to 56 % of the water column, and between 10 to 13 feet in the summer where the DO dropped below 2 mg/L for greater than 70% of the water column (OWRB 2007).

History of Fishery

Major Sport Fisheries

Bixhoma Lake contains both northern and Florida strain largemouth bass (*Micropterus salmoides*), crappie (*Pomoxis spp*.), channel catfish (*Ictalurus punctatus*), and several species of sunfish. Species stocked into Bixhoma include Florida largemouth bass, channel catfish, grass carp (*Ctenopharyngodon idella)*, and threadfin shad (*Dorosoma petenense)* (Table 1). No additional sportfish stockings have occurred in Bixhoma Lake since 2004 Florida largemouth bass were last stocked. Stocking of threadfin shad was resumed in spring 2011 to help improve the forage base for sportfish in the lake. Stocking of Florida largemouth bass will resume in spring 2012. Largemouth bass are the most sought after species of fish as many of the fish can reach sizes in excess of five pounds, and some fish exceeding ten pounds.

Bixhoma Lake has rules defined by city ordinance by the City of Bixby and not Oklahoma Title 800 and therefore, enforcement is primarily the responsibility of the City. Currently, the lake has a 13 to 23 inch protected slot on largemouth bass and a daily creel limit of five fish. Catfish and crappie each have a 10-inch length limit and daily creel limits of five fish. Trotlines, limb lines, jug lines, fish traps, and throw nets are prohibited.

Sportfish Population Information

Black Bass (largemouth and spotted)

Bixhoma Lake was last sampled in 2010 by spring electrofishing to determine black bass abundance and condition. Also, fish were sub-sampled to determine age and growth.

1. Largemouth bass catch rates (C/f = 125.3) showed that abundance was well above the minimum acceptable value for a quality fishery (C/f ≥ 40; Table 2). Overall, population trends have begun to stabilize at over 100 fish per hour. Body conditions for all fish were below the minimum acceptable value of 90. Reasons for poor condition could be a result of too many fish within the protected slot and few shad available for forage.
   Otoliths (bone structures within the fish commonly used for aging) were pulled from one-inch (25 millimeter) length groups of largemouth bass to determine age and growth for the population (Figures 2-4). Figure 4 shows how the growth of largemouth bass slows after fish reach about 15 inches in length, with the oldest fish being 11 years old and 18 inches in length. Approximately 55% of fish sampled were contained within the protected slot with no fish exceeding the maximum of 23 inches, indicating that the regulation combined with limited forage availability may be hindering fish growth by the increased competition of similar sized fish protected by the slot.

   Further sampling may be needed, though, as insufficient numbers of fish greater than 17 inches were collected to accurately determine growth rates for those fish. The late timing of the sample may have also influenced the data. Angler habits

and attitudes toward harvesting of largemouth bass are not known for the lake but are assumed to be similar to other areas in that, even if the restrictions are eased, anglers still may not harvest the fish in the quantity needed to reduce competition and increase growth.

2. Even though spotted bass abundance (C/f = 8.0) shows a gradual increase in abundance from previous years and all size groups have poor body condition (Table 3), the data is still insufficient to determine accurate population information for spotted bass.

Crappie (white and black)

Bixhoma Lake was sampled in 2008 by fall gillnetting to determine abundance and condition of various sportfish. Crappie abundance from 2008 sampling (C/f = 2) was less than the minimum acceptable value for a quality fishery (C/f = 4.8; Table 4). Catch rates are too low to accurately determine population dynamics for crappie in the lake. Fall gill netting has not been effective in assessing and monitoring crappie populations in Bixhoma Lake.

Channel Catfish

Bixhoma Lake was sampled in 2008 by fall gillnetting to determine abundance and condition of various sportfish. Channel catfish abundance from 2008 sampling (C/f = 0.04) was less than the minimum acceptable value for a quality fishery (C/f = 4.8; Table 5) with catch rates declining over time. Body conditions for fish 12 inches and greater were excellent with no fish less than 12 inches represented in the sample, possibly due to bass predation.

Forage Population Information

Shad

In 2010, new floating shad nets were use in an attempt to better sample shad populations in Bixhoma Lake. Gizzard shad abundance from samples (C/f = 0.6) was well below the minimum acceptable value for a quality fishery (C/f = 4.8), with only three gizzard shad being caught in the samples (Table 6). No threadfin shad were found in the sample despite repeated attempts at stocking to produce a self-sustaining population. The lack of a shad population could be a result of winter kills and/or the low primary productivity of the lake. However, in spring 2011, threadfin shad stocking was resumed in an attempt to increase the sportfish forage base in the lake.

Sunfish

Sunfish found in Bixhoma Lake electrofishing and gillnet samples include warmouth sunfish, longear sunfish, redear sunfish, green sunfish, and hybrid sunfish (Table 7). Only three bluegill sunfish were caught in the 2008 fall gillnetting sample.

Other fish Species

Non-game fish species

Bixhoma Lake has a large population of spotted suckers, an indicator species of good water quality (Table 8).

Threats to Fishery

Water Quality

Bixhoma Lake is a deep, clear, mesotrophic lake with relatively good water quality. Dissolved oxygen levels, however, can drop below 2 mg/L for over 70% of the water column during the summer, limiting available habitat and causing stress on the fish populations.

Water Quantity

Normal pool elevation for Bixhoma Lake is 691 feet with a capacity of 3,130 acre-feet. During drought periods, the pool elevation could drop several feet from evaporation and lack of input from Mountain Creek. Such lake level fluctuations can limit available habitat for the fish populations.

Aquatic Nuisance Species (ANS)

At this time, no ANS species have been identified in Bixhoma Lake. However, the spreading of these organisms is a growing concern and a top priority for the ODWC. Hazard analysis critical control point (HACCP) plans have been developed in an effort to control the spread of ANS. The biologist will work with the ANS biologist to carry out surveys and monitor Bixhoma Lake for ANS. Angler education will also play an important role to prevent the introduction of ANS into Bixhoma Lake.

Largemouth Bass Virus (LMBV)

Even though Bixhoma Lake has not tested positive for LMBV, the spread of the virus throughout the state and its possible effects on larger fish do present special concerns for the lake.

A list of ANS for the state of Oklahoma, ODWC HACCP plans, and other information regarding ANS and the control of ANS in Oklahoma by the ODWC can be found at: http://www.wildlifedepartment.com/nuisancespecies.htm

Management Objectives

Overall management objectives for Bixhoma Lake fishery will include:

Largemouth Bass:

- Maintain a catch rate of 100 fish per hour or greater over next five years.
- Obtain greater than 25% of Florida bass plus F1 fish through genetic evaluations for Florida genes to increase trophy fish potential within 5 years.
- Attempt to increase largemouth bass condition values ($Wr \geq 90$) by increasing the available forage base within 5 years.

- Increase growth rates (age 3 fish ≥ 14 inches) by increasing the available forage base within 5 years.
- Cooperate with the City of Bixby to develop and enforce necessary regulations to achieve mutual management objectives.

All Fish Species:

- Conduct a complete shoreline habitat assessment for the lake.
- Use GIS analysis of the habitat assessment with the biological data to determine habitat preferences of sportfish populations within the lake and then use the analysis to determine habitat enhancement needs.
- After habitat needs are determined, prepare and begin habitat enhancement program if practical.
- Determine angler habits and pressure through the use of angler surveys and creel surveys for all fish species.
- Cooperate with the City of Bixby to promote fishery and improve accessibility
- Use data from fish sampling and angler surveys to determine if management objectives are being met.

Management Strategies by Species

Largemouth Bass

- Continue threadfin shad stocking every one to two years in attempt to establish a reproducing population for a forage base for bass.
- Black bass population structure will be monitored bi-annually by electrofishing continuing in 2013 to continue monitoring growth and determine success of forage stocking within the lake.
- Angling pressure and habits will need to be researched by creel and angler surveys to assess angler impacts on black bass populations.
- Florida strain largemouth bass will continue to be stocked bi-annually unless deemed unnecessary by future data; therefore, genetic evaluations of the largemouth bass population will need to be conducted every 3-5 years to determine success of the Florida largemouth bass genes.

Crappie (white and black)

Tentatively, trap nets may be used, if practical, to attempt to get better sample data to better determine population dynamics. When trap netting, otoliths will be pulled from one-inch (25 millimeter) length groups to determine age and growth for the population. Angling pressure and habits will need to be researched by creel and angler surveys to assess angler impacts on the crappie population.

Channel Catfish

The channel catfish population in Bixhoma Lake has not been significantly sampled by regular gill netting efforts and may need to be sampled by other methods (i.e., baited hoop nets) to determine if channel catfish make up a significant portion of the fishery. If the catch rates are still low, then the lake may be added to the seven-inch catfish stocking

program, during which regular monitoring will determine success or failure of channel catfish as part of the fishery.

Strategies to Achieve Sampling Goals

A tentative sampling schedule will be provided to the Regional Supervisor, including dates, locations, and staff/equipment needs. Water level and temperatures will be monitored to determine specific sampling schedule. Equipment will be treated according to HACCP plans. Data will be entered and sent to the Oklahoma Fish Research Lab in Norman, Oklahoma in a timely fashion and reports will be written upon data analysis. Any issues that arise from a sample will be worked into the sampling plan. Changes to the sampling plan will be provided to the Regional Supervisor for comments and approval.

Regulations

For now, it is recommended that the 13 to 23 inch protected slot limit on largemouth bass and the daily creel limit of five fish be continued until additional sampling can be done to get better trend data for the population. However, if supplementing forage stocking does not improve growth for largemouth bass, then the regulation may need to be changed and harvest encouraged to reduce predator competition for fish protected by the current protected slot, although such regulation changes rarely affect fish populations as most anglers often practice catch and release of largemouth bass. It is also recommended that the 10-inch length limits and daily creel limits of five fish each for catfish and crappie be continued to protect these species from over harvest until sampling can be completed to obtain better population data. Due to the small size of the lake, the prohibition of trotlines, limb lines, jug lines, fish traps, and throw nets should continue as well. Additional regulation changes will be determined after angler and creel surveys can be conducted and after approval from the City of Bixby.

Angler Satisfaction

Creel Surveys, Angler Opinion Surveys

Currently, little is known about angler habits, harvest, or satisfaction of Bixhoma Lake. Angling pressure and habits will need to be researched by creel and angler surveys to assess impacts on the available sportfish populations. This information can then be used to determine best management practices and regulation changes that would best benefit the fish populations and the anglers. Follow up surveys will be conducted when needed to determine angler satisfaction with management objectives. Projected timeline for conducting surveys would be no sooner than 2014 and will be based on available personnel and time.

Boating and Fishing Access Needs

There are currently no boating and fishing access projects scheduled for Bixhoma Lake. Future projects will be based on need and availability of funds. Needs will be determined through cooperative agreement from the City of Bixby and ODWC.

Meetings with Anglers

A public meeting will be held in 2012 to discuss the Bixhoma Lake Management Plan. Public input and input from the City of Bixby will be sought on management objectives, angler satisfaction and opinions, habitat enhancement, boating and fishing access, and other topics covered in the plan. Follow-up meetings and angler surveys may be conducted when needed to determine success of the management plan in relation to angler satisfaction.

Literature Cited

Oklahoma Department of Wildlife Conservation. Fish management survey and recommendations for Bixhoma Lake. 2008. Annual Performance Report.

Oklahoma Department of Wildlife Conservation. Oklahoma aquatic nuisance species management plan. 2009. http://www.wildlifedepartment.com/nuisancespecies.htm

Oklahoma Water Resources Board. 2007 Report of the Oklahoma's Beneficial Use Monitoring Program - Lakes sampling, 2006-2007. Draft report: 56-59. http://www.owrb.ok.gov/quality/monitoring/bump/pdf_bump/2007/BUMPLakes Report.pdf

Oklahoma Water Resources Board. The Oklahoma Water Atlas. 2007. http://www.owrb.ok.gov/news/publications/wa/lakes/Bixhoma.php

Figure 1. Map of Bixhoma Lake (OWRB, 2007).

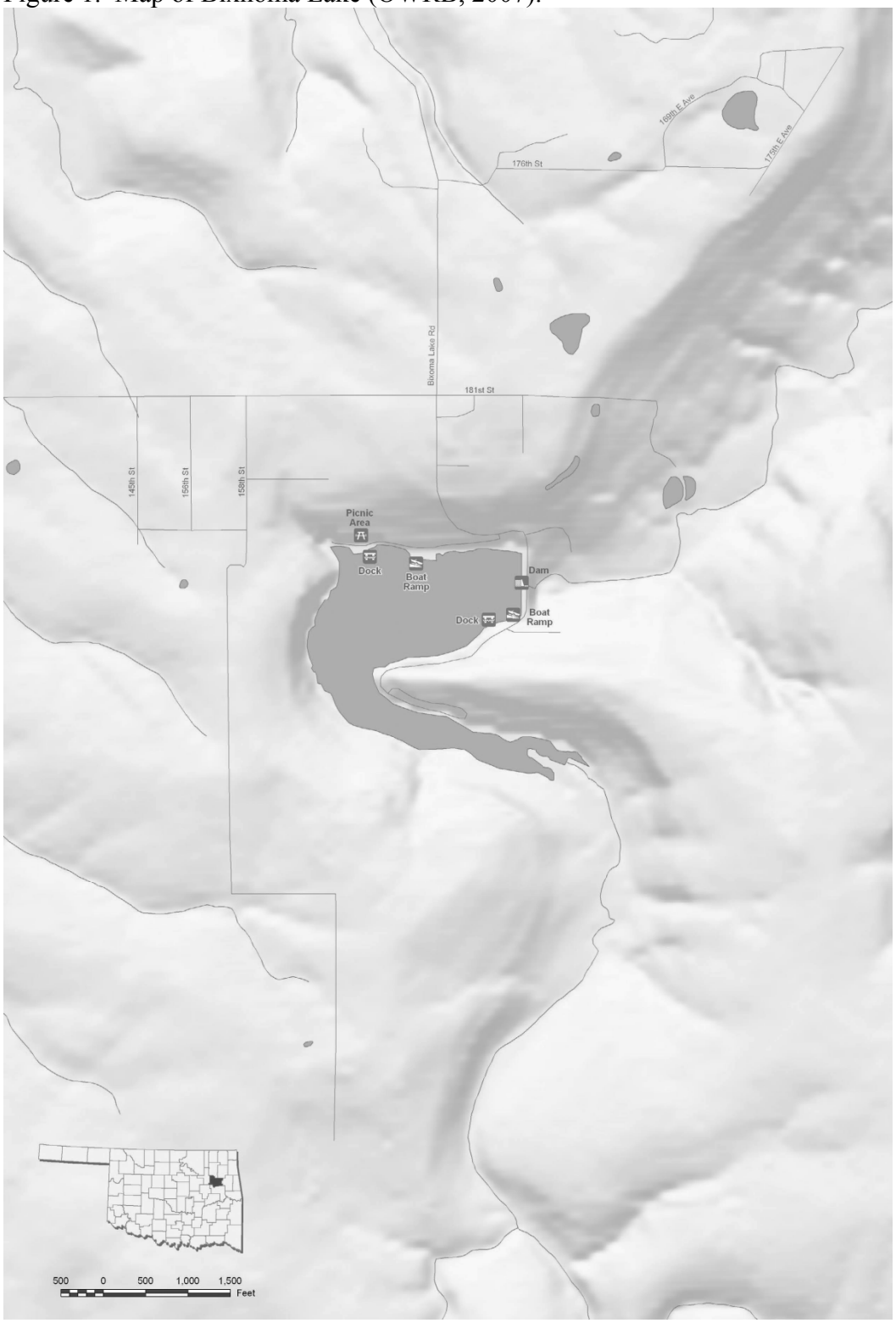

Table 1. Species, number, and size of fish stocked in Bixhoma Lake through July 2011.

Date	Species	Number	Size
1974	Threadfin Shad	10000	-
1976	Channel Catfish	15000	3”
1978	Flathead Catfish	2500	3”
1978	Channel Catfish	1500	4.5”
1981	Channel Catfish	2520	5”
1982	Channel Catfish	3160	10”
1982	White Crappie	10000	-
1985	Channel Catfish	2000	7”
1986	Largemouth Bass	3600	Advanced Fry
1986	Channel Catfish	8066	3”
1987	Channel Catfish	8000	Fingerling
1988	Channel Catfish	3040	Fingerling
1989	Grass Carp	200	Growout
1991	Florida LMB	110000	Advanced Fry
1994	Florida LMB	104000	Fingerling
1996	Threadfin Shad	250	Adults
1997	Threadfin Shad	250	Adults
1998	Threadfin Shad	1150	Adults
1998	Florida LMB	250	Fingerling
2004	Threadfin Shad	500	Adults
2004	Florida LMB	2200	3”
2011	Threadfin Shad	800	Adults

Table 2. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **largemouth bass** collected by spring electrofishing from Lake Bixhoma. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r values are ≥90.

	Total (≥40)		<8 inches (15-45)		8-13 inches (15-30)		≥14 inches (≥10)		≥16 inches (≥8)		≥21 inches (≥2)	
Year	No.	C/f	C/f	W_r	C/f	W_r	C/f	W_r	C/f	W_r	C/f	W_r
1981	103	31.7										
1983	49	9.1										
1984	106	20.0										
1986	103	24.2										
1990	154	68.4										
2003	215	143.3	40.7	99	66.7	85	32.7	82	18.7	85	3.3	89
2004	143	95.3	29.3	89	44.0	82	17.3	81	11.3	85	2.7	91
2005	154	102.6	28.7	99	34.7	88	25.3	83	12.0	79	3.3	70
2009	158	105.3	22.0	98	35.3	92	38.0	84	16.7	84	4.0	78
2010	188	125.3	3.3	80	28.0	82	58.7	81	16.0	80	0.7	86

Figure 2. Average length of **largemouth bass** by age caught during 2010 spring electrofishing.
* indicates insufficient sample size to calculate average length.

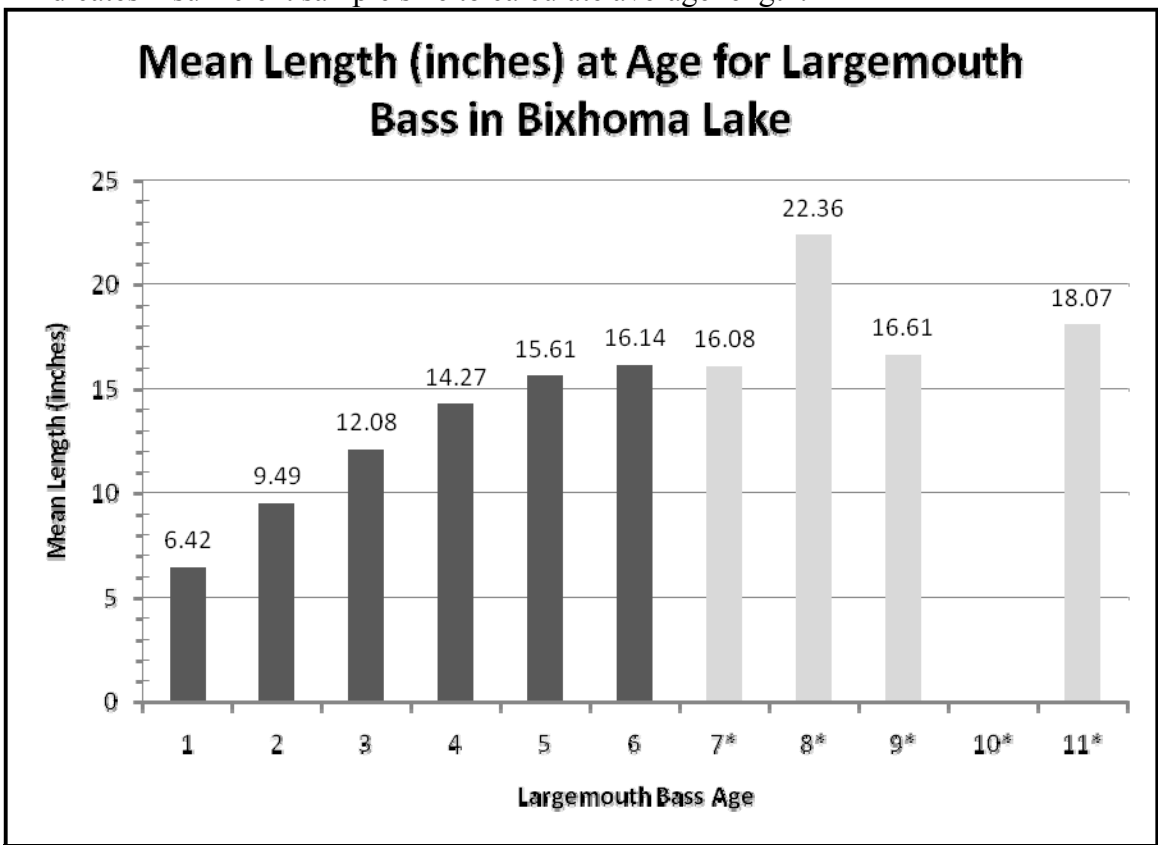

Figure 3. Growth curve for **largemouth bass** caught during 2010 spring electrofishing. Dashed lines represent the 13-23 inch protected slot limit for the lake.

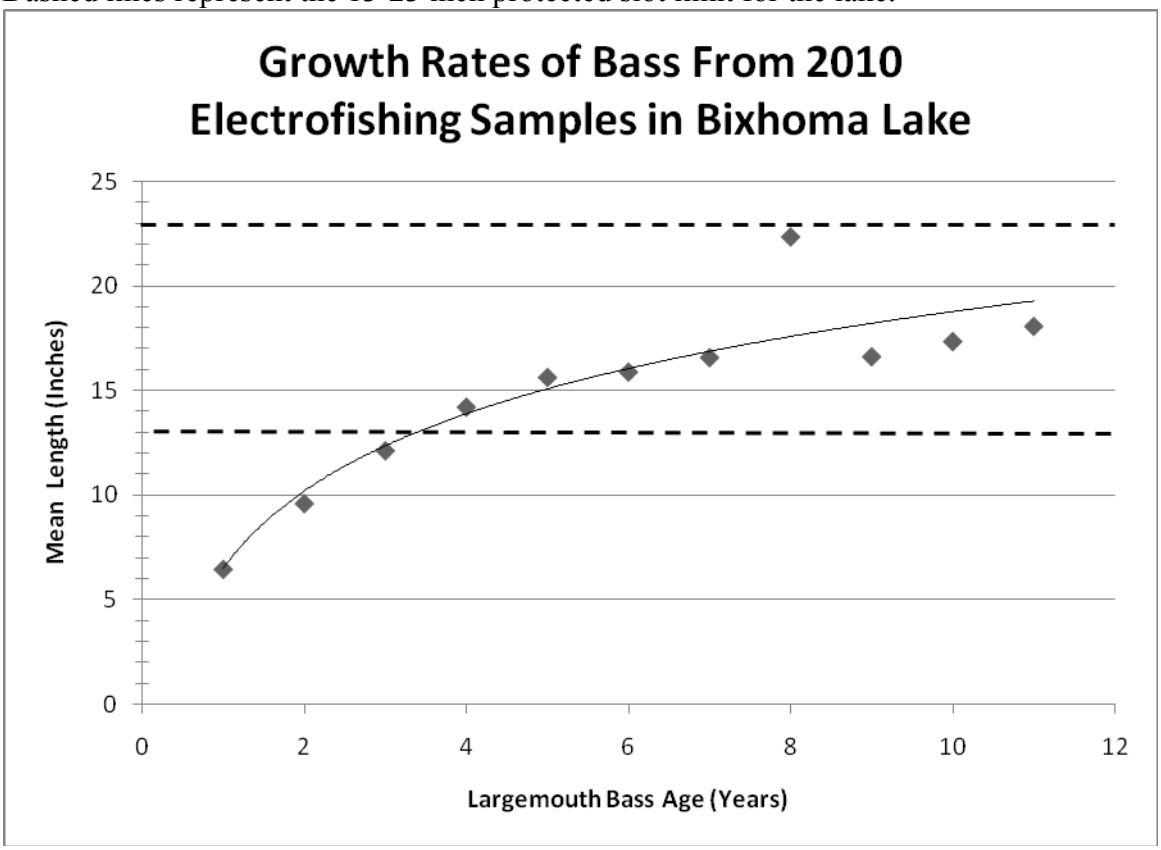

Table 3. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **spotted bass** collected by spring electrofishing from Lake Bixhoma. Acceptable W_r values are ≥90.

	Total		<8 inches		8-13 inches		>14 inches	
Year	No.	C/f	C/f	W_r	C/f	W_r	C/f	W_r
1981								
1983								
1984								
1986								
1990								
2003	5	3.3	3.3					
2004								
2005	1	0.7	0.7	83				
2009	5	3.3	0.7	-	0.7	90	1.3	91
2010	12	8.0	3.3	83	1.3	74	0.7	75

Table 4. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **crappie** collected by fall gillnetting from Lake Bixhoma. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r values are ≥90.

	Total (C/f ≥ 4.8)		<8 inches (7.2-12)		≥8 inches (≥ 1.9)		≥10 inches (≥ 1)	
Year	No.	C/f	C/f	Wr	C/f	Wr	C/f	Wr
1997	6	1.2	0.2	77	1.0	85	0.6	86
1998	6	1.8	0.3	77	1.5	84	0.9	85
1999	2	0.8			0.8	101	0.8	101
2001	4	1.6			1.6	91	1.6	91
2008	5	2.0	0.8	78	1.2	92	0.4	105

Table 5. Total number (No.), catch rates (C/f), and relative weights (W_r) by size groups of **channel catfish** collected by fall gillnetting from Lake Bixhoma. Numbers in parentheses represent acceptable C/f values for a quality fishery. Acceptable W_r values are ≥90.

	Total (C/f ≥ 4.8)		<12 inches (≥ 2.4)		≥12 inches (≥ 2.4)		≥16 inches (≥ 1.2)	
Year	No.	C/f	C/f	Wr	C/f	Wr	C/f	Wr
1997	4	0.8	0.2	100	0.6	94	0.6	94
1998	3	0.9			0.9	101	0.9	101
1999	1	0.4			0.4	80		
2001	7	2.8			2.8	105	2.0	112
2008	1	0.4			0.4	111	0.4	111

Table 6. Total number (No.) and catch rates (C/f) by size groups of **gizzard and threadfin shad** collected by fall gillnetting from Lake Bixhoma. Numbers in parentheses represent acceptable C/f values for a quality fishery.

	Gizzard Shad				Threadfin Shad	
	Total (≥ 4.8)		<6 inches (≥ 2.4)			
Year	C/f	Wr	C/f	Wr	No.	C/f
1997	0.8	75	--	--		
1998	1.5	83	0.6	85	3	0.9
1999	3.4	82	2.1	83	7	3.0
2001	1.2	91	0.4	97		
2008	0.4	--	0.4	--		
2010	0.6	--	0.6	--		

Table 7. Total number (No.) and catch rates (C/f) of **sunfish** collected by spring electrofishing from Bixhoma Lake by year.

	Bluegill Sunfish		Redear Sunfish		Longear Sunfish		Warmouth		Green Sunfish	
Year	No.	C/f	No.	C/f	No.	C/f	No.	C/f	No.	C/f
1981	72	22.12	42	12.92	103	31.68				
1983	68	10.80	15	2.40	62	9.84				
1984	117	39.00	70	23.32	155	51.68	40	13.32	15	5.00
1986	128	30.08	100	23.52	104	24.44	34	8.00	24	5.64
1990	161	128.80	21	16.80	4	3.20	8	6.40	2	1.60
1995	243	142.941	30	17.647	32	18.824	25	14.706	12	7.059

Table 8. Total number (No.) and catch rates (C/f) of **non-game** fish collected by fall gillnetting from Bixhoma Lake.

	Spotted Sucker		Grass Carp	
Year	No.	C/f	No.	C/f
1981	7	1.7		
1984	1	0.2		
1986	2	0.2		
1997	14	2.7		
1998	22	6.5		
1999	32	13.5		
2001	35	14.0	1	0.4
2008	43	17.2		