FINAL REPORT

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OKLAHOMA PADDLEFISH INFORMATION FOR CONSERVATION MANAGEMENT

OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION

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FINAL REPORT

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Abstract

Paddlefish *Polyodon spathula* populations in the Grand Lake system and Ft. Gibson Reservoir were investigated during 2003, 2004 and 2005 to estimate the population size, size structure, emigration and harvest exploitation. In the Grand Lake system there were 3,088 paddlefish tagged in 2003 and 2004. There were 1,011 paddlefish tagged and released during 2005 in the Ft. Gibson Reservoir system for determination of population parameters and exploitation. The creel survey in 2003 and 2004 on Grand Lake showed consistency with total harvest rates of n= 2,932 and n = 2,696 respectively. Low flows in 2005 yielded a slower harvest rate on Ft. Gibson reservoir of n = 315. The population parameters of size and structure were gathered from gillnetting operations. Record populations estimates were recorded for both 2003 and 2004 on the Grand Lake system (n = 80,808; 2003) and (n = 55,404; 2004). Recommendations were made for future research and management needs to provide a stable and self sustaining sport fishery.

Introduction:

Paddlefish (*Polyodon spathula)*, commonly referred to as spoonbill catfish, are a native, naturally dominant freshwater North American fish. Their original distribution includes large rivers throughout the Mississippi River basin and peripheral gulf coast drainages of the central United States (Reed 1989). Habitat degradation combined with over-fishing has limited their distribution and reduced the abundance of paddlefish throughout much of their native range (Carlson and Bonislawsky 1981). Paddlefish have a large historical range in Oklahoma. Their distribution includes the Arkansas River drainage as far west as the Great Salt Plains and Overholser Lake, and distribution in the Red River drainage includes the Wichita, Washita, Clear, Muddy Boggy, Kiamichi and Little Rivers (Miller and Robison 1973). Historically, Oklahoma is on the western edge of their natural distribution. Seasonal scarcity of permanent water limited their distribution in western Oklahoma. Currently, the population status in all but Grand Lake and its tributaries remains unknown (Gengerke 1986).

In Oklahoma, paddlefish were studied in Fort Gibson Reservoir by Bross (1959) and Houser (1965). These studies were concerned with early growth rates of paddlefish. Harvest was estimated in three separate studies on the Grand Lake-Neosho River population (Combs 1982, Ambler 1987, Ambler 1994). Historically, the Grand River is the only system in Oklahoma where

paddlefish have been observed and harvested by both sport and commercial fisheries (Combs 1981).

Although baseline data have been reported for both the Grand Lake population and to a much lesser extent the Ft. Gibson Lake population, the long-term effects of an increasing nutrient load on the Neosho watershed, the recent discovery of zebra mussels (*Dreissena polymorpha*) in Grand Lake, and the presence of bighead carp (*Hypophthalmichtys nobilis*), a nuisance exotic, on paddlefish populations are unknown. Previous studies on the Grand Lake/Neosho River paddlefish population (Combs 1982, Ambler 1987 and Ambler 1994) identified a need to monitor the population in the face of such ecological/environmental factors. This study was necessary to plan for long-term paddlefish population stability and reduce the need to list it as an endangered species.

Project Objectives

Paddlefish population size, size structure, natural mortality, emigration, water quality assessments, identification of spawning sites and requirements, assessment of flow variances on spawning success, emigration of paddlefish from Grand to downstream reservoirs, and harvest exploitation of the Grand/Neosho River system including Grand, Hudson and Fort Gibson reservoirs paddlefish population will be determined by a five-year three-phase project. All information will be compiled and analyzed to aid in a comprehensive system wide management plan. The three phases will include:

Phase I:

To estimate the population size, size structure, emigration and harvest exploitation of the Grand Lake paddlefish population.

Phase II:

To estimate the population size, size structure and harvest exploitation of the impoundments downstream of Grand Lake (Hudson and Fort Gibson) and to determine what actual contribution of paddlefish from Grand Lake is to these fisheries.

Phase III:

To identify paddlefish spawning locations and success under various flows and velocities on Grand Lake, and whether conditions and spawning requirements are met in the tailwaters of the downstream impoundments (Hudson and Fort Gibson lakes).

Methods:

Netting and Tagging (2003-2005)

Grand Lake and Ft. Gibson Reservoir are located in the northeast portion of Oklahoma and are two of three lakes that make up the chain of lakes called the Lakes O' The Cherokees. Paddlefish were collected in Grand Lake at six sites. Capture and tagging sites extend from the dam site of Grand Lake, upstream to 3.2 kilometers north of the Elk River arm. The majority of the fish were captured in two areas: adjacent to Monkey Island and the Elk River arm. Paddlefish were captured using gillnets (9 m x 91 m, 152 mm bar mesh). Gill-netting sets were suspended at different depths (3 m to 10 m) depending on water depth and recent netting success. All sets were made perpendicular to the channel or shoreline. The gill netting usually occurred over, or near the inundated river channel. The frequency that gill nets were fished was determined by the mortality rates observed. As the water temperature approached 10 C, mortality increased as did the frequency each net was fished during a 24-hour period (Gordon 2003).

Captured paddlefish were measured by body length in millimeters (anterior orbit of the eye to the fork of the tail (EFL)) (Ruelle and Hudson 1977) and weighed (kg) (weights were only taken on paddlefish collected in 2004). Before release, each paddlefish was tagged with a consecutively numbered

Monel jaw tag (size #16) on the anterior portion of the mandible. All tags were marked with an identifying number and the agency contact information for return. Tagged fish were released approximately 0.5 km or greater upstream from the netting location. Recaptures were counted while tagging continued. Netting and tagging operations were terminated when lake temperatures reached 10 C and/or when the creel surveys began.

Population size estimates were made from mark and recaptures statistics from gill netting. A modified Schnabel estimate was used as the estimator. (Ricker 1975)

$$N = E\,(C_t \quad M_t)/R+1,$$

Where: C_t **= Number of fish caught that date,**

M_t **= Total marked at large less removals,**

R = Number of recaptures in the sample,

N = the population present through out the investigation)

Dentary bones were removed for age analysis in 2004 from 147 paddlefish (655 mm - 1314 mm in body length) and from 97 paddlefish (455mm-1230 mm in body length) in 2005 that died either from netting or angling in 2004 from Grand Lake and Ft. Gibson Reservoir, respectively. Age, sex, length, and weight were recorded from each of these fish.

Descriptive statistics for the three variables [age, length (EFL - anterior orbit of the eye to the fork of the tail in mm) and weight (WT - kg)] were obtained by running PROC UNIVARIATE in SAS. Age distributions of each sex were explored using PROC FREQ in SAS. Dr. Dennis. L. Scarnecchia, Professor, Department of Fish and Wildlife Resources, University of Idaho completed all of Grand Lake statistical analyses.

The von Bertalanffy growth equation was used to examine the growth pattern of EFL over age for each sex. Fitted EFL growth equations for each sex were used to fit the length-weight relationship of corresponding sex by substituting length with corresponding fitted EFL growth equation. Specifically, the EFL growth pattern and length-weight relationship were examined by:

1. **fitting 2-parameter von Bertalanffy length growth model to each sex data to use for consequent fitting of length-weight relationship to corresponding data; and**
2. **fitting 3-parameter von Bertalanffy length growth model to each sex data to use for subsequent fitting of length-weight relationship to corresponding data.**

Fitting the von Bertalanffy model to the data was done using PROC NLIN in SAS.

Creel Surveys

During the 2003 and 2004 paddlefish spawning run, three simultaneous abbreviated creel censuses were conducted on Grand Lake and the Neosho River (Figure 1). A roving creel survey was conducted on the Neosho River above Twin Bridges State Park to Miami Riverview Park, (24km; Figure 1) A stationary creel was conducted at the low water dam area in Oklahoma's Miami Riverview Park. A roving creel was conducted on Grand Lake that ran from the Reeds point on the Elk River arm to Twin bridges State Park (25km; Figure 1).

The abbreviated creel survey at Miami Riverview Park began when the instantaneous angler pressure count exceeded 20 anglers (March 20th - May 15th 2003 and Mach 15th – May 20th 2005). The creel was restricted to the east and west banks of the Neosho River below the dam to the park's boat ramp (approximately 300 meters downstream)(Figure 2), the abbreviated creel randomly sampled 15 of 45 paddlefish harvest days each year. Two creel sections (east and west banks) were sampled randomly for interview and pressure periods. One interview period (six hours in duration), randomly selected over a 24-hour period, was conducted on selected creel days. Pressure counts were made at the beginning, middle, and end of the interview period. The abbreviated creel was the last selected creel day or when pressure decreased to no anglers for three creel periods (days).

The two roving creel surveys were comprised of 20 randomly selected days from February 15^{th} to May 15^{th}. The Neosho River roving creel survey encompassed the area along the river upstream from Twin Bridges State Park to just below the Miami Riverview Park (approximately 24 km)(Figure 3). The Grand Lake roving creel survey encompassed the area from Reeds Point (Elk River arm) north to the Twin Bridges State Park (approximately 25 km) (Figure 4). Interviews were conducted on selected creel days during a six-hour daylight period. The two roving creels included only daylight hours because of safety concerns about traveling the river at night. Anglers in boats and at access sites along the river (bank anglers) were interviewed until the end of the creel period. Pressure counts for both roving creels were conducted simultaneously and were made by Grand River Dam Authority (GRDA) helicopter on selected creel pressure days. The GRDA helicopter pressure counts were made twice on the selected days (a.m. and p.m. pressure count).

During the 2005 paddlefish spawning run two simultaneous abbreviated roving creels were done on Ft. Gibson Reservoir. Creels were conducted by ODWC fisheries personnel on the upper end of Ft. Gibson Reservoir in the Neosho River (Figure 5). The two roving creels were comprised of 20 randomly selected days from March 15^{th} to May 15^{th}. The Markham Ferry roving creel survey encompassed the area along the river from the 412 Hwy Bridge north to the low water dam (10 km) (Figure 5). The Chouteau Bend creel encompassed the area from Hwy. 412 bridge south to the Three Finger Bay area (20 km)

(Figure 5). The Markham Ferry creel was conducted on selected creel days during a six hour duration over a 24 hour period. The Chouteau Bend creel survey was conducted over a six hour daylight period. Anglers in boats and at access sites along the river (bank anglers) were interviewed until the end of the creel period. Pressure counts were made at the beginning, middle, and end of the interview period.

Exploitation rate was calculated from the equation:

U=R/M,

Where: U = exploitation rate

R = number of tag returns

M = number of marked fish available in the system

Paddlefish harvested during the 2003, 2004 and 2005 creel censuses were measured for body length (mm) and examined for ODWC tags. Data obtained from the creel censuses provided information on number and size of paddlefish harvested, pressure (angler-hours), catch rates and angler residences.

Results & Discussion:

Phase I:

Grand Lake Population Characteristics:

A total of 3,218 paddlefish were collected in Grand Lake during the winters of 2003-2004. There were 3,088 tagged with jaw tags (1,553-2003, 1,535-2004). The remaining fish were netting mortalities (147). The mortalities were used for age and growth information. Of these 147 paddlefish, 55 were of unknown sex, 37 were female, and 55 were male (Table 5, Table 6). [Overall sampling mortality for the first two years of this study was 4.04%]; [mortalities increased substantially when water temperature exceeded 10 C.]

The population estimate made for the Grand Lake-Neosho River population was much higher than any estimate made before 2003 (86,195 and 55,508 in 2003 and 2004 respectively (Table 1, Table 2.)). However, in examining the data in Table 2; it appears that the daily estimates stabilize in the 55,000 - 65,000 to 75,000 range, which brings the two estimates into closer agreement. However, with a low number of recaptures, confidence intervals around the estimates are so broad that no inference between years could be made. The population estimates from 2003 and 2004 appear to be inconsistent. However, examination of Table 2 indicates the 2004 daily estimate of the population stabilized in the 55,000 to 65,000 range. By applying the Chapman

Adjustment to the population estimate for 2003, the population was estimated at 80,808 (Table 1).

Comparison of the length frequencies of paddlefish tagged during 2003 to the length frequency of paddlefish tagged during 2004 (Figure 6) indicated a continued maturation of the population. Paddlefish in Grand Lake typically reach sexual maturity at about 1,000mm and approximately age 9 (Combs, 1981).

Body length and weight of both male and female paddlefish showed stronger correlation than the other correlations tested. [Like male and female fish, unknown-sex paddlefish also produced a significant correlation between body length and weight.] Stronger correlations for age-body length and weight with female paddlefish suggest that Grand Lake female paddlefish grow more uniformly than male paddlefish.

Differences between sexes in variables tested were observed. For example, with male data, means of age, body length, and weight were 6.36 years, 861 mm, and 9.417 kg, respectively, while those with female data were 7.95 years, 945 mm, and 13.911 kg, respectively. With respective median values, it observed difference were even greater: for male, 5 years, 834 mm, and 8.10 kg, respectively, and, for female, 8 years, 1020 mm, and 16.6 kg, respectively. Although most frequently observed age (i.e., mode) of both male and female were the same (5 years), these seem to support obvious differences between average male and female paddlefish in terms of age and size measures.

Both male and female age distribution (Figure 7, Figure 8) show a distinct spike at age 5 (62 % for male and 38 % for female). Thirty-three percent of males were age 6 or older, while 54% of females were age 8 or older. Age distribution of unknown-sex paddlefish is also presented in Figure 9, which indicates a mix of male and female paddlefish with two distinct clusters (Gordon 2003).

Results from the von Bertalanffy growth model were:

- With 2-parameter model and consequent length-weight relationship,

Male:

$$LT = 104.7*[1-\exp(-0.3032* Age)]$$

$$WT = a*LT**b = 0.000020*\{104.7*[1-\exp(-0.3032* Age)]\}**2.9242$$

Female:

$$LT = 117.9*[1-\exp(-0.2380* Age)]$$

$$WT = a*LT**b = 0.000003482*\{117.9*[1-\exp(-0.2380* Age)]\}**3.330$$

- With 3-parameter model and consequent length-weight relationship,

Male:

LT = 105.3*[1-exp (-0.2821* (Age+0.2930))]

WT = a*LTb = 0.000022*{105.3*[1-exp (-0.2821* (Age+0.2930)]}**

****2.9126**

Female:

LT = 117.6*[1-exp (-0.2427* (Age-0.0758))]

WT = a*LTb = 0.000003388*{117.6*[1-exp (-0.2427* (Age-0.0758)]}**

****3.336**

It should be noted that asymptotic body lengths for each model are similar.

Male:

104.7 for 2-parameter model and 105.3 for 3-parameter model, and

Female:

117.9 and 117.6, respectively

Plots of predicted LT and observed LT versus Age were produced for each model (Figure 10, Figure 12). Consequent plots of WT versus Age were also produced for each model (Figure 11, Figure 13).

<u>Grand Lake Length Frequencies and Population Structure:</u>

The length frequencies from both the 2003 and 2004 samples indicate the population is dominated by immature fish (less than 1,000 mm EFL) but does suggest a very large maturing population (Figure 6). The length frequency from the 2004 tagging data suggests that dominant length groups (less than

1,000mm EFL) are maturing and increasing the scale in length by about 20 to 40 mm per year. Also indicated in the 2004 gillnetting length frequency are past successful recruitment years. The absence of fish between 626 mm and 750 mm and between 900 mm and 1,000 mm in the 2004 data is likely related to the low flow conditions of 1998 (age 6), 2000 (age 4), and 2001 (age 3). In all population studies, collection of all ages of paddlefish is essential to determine recruitment. Because younger age fish (i.e. age 0) are usually more abundant than older age fish in a population (Van Den Avyle 1993), gill nets used to sample them should sample in proportion to their abundance. However, this is not what we have seen in our studies and, according to other paddlefish studies; small mesh gill nets do not necessarily collect small paddlefish (Hoffnagle and Timmons 1989). No standard technique has been developed to quantitatively sample juvenile paddlefish (Fredericks and Scarnecchia 1997). Further research is needed on the habitats of and collection methods of age-0 paddlefish (Gordon 2003).

The failure of paddlefish to successfully reproduce and recruit during the low flow events indicates the necessity of adequate flows at critical times for natural reproduction to sustain the fishery. The current paddlefish population structure is a result of natural mortality, angler exploitation, good reproduction, and recruitment in the mid and late 90's.

Grand Lake Creel Survey:

Concern about the sport fishery impact on this species of concern began in spring of 2002 with ODWC game wardens reporting increased fishing pressure. Emergency regulation changes on the fishery for paddlefish were approved by the Oklahoma Wildlife Conservation Commission and became effective January 1, 2003. These regulations allowed for catch and immediate release of paddlefish by use of rod and reel, trotlines and throw lines year-round. Paddlefish caught with rod and reel must be released back into the water immediately after being caught, unless kept for the daily limit of one (no culling). Anglers fishing with trotlines or throw lines must release all paddlefish before leaving their lines unless keeping one for a daily limit.

Overall angling pressure was substantial differences between years at Twin Bridges and Miami Riverview Park but the total harvest of the two creels add together were similar in 2003 and 2004 (Table 3, Table 4). Estimated harvests were 2,932 fish for 2003 and 2,706 fish for 2004.

Exploitation rates were computed from tag returns of harvested fish. Most tag recaptures were made in the creel survey area with additional recaptures made farther down in Grand Reservoir. Of the 1535 tagged in 2004, 31 (2%) were recaptured by anglers. The harvest in Miami Riverview Park and the Neosho

River in 2003 and 2004 was limited due to low rainfall amounts on the upper watersheds of the Neosho River. Fish failed to move up river.

Low numbers of tag returns in 2003 and 2004 resulted in exploitation rate estimates with low confidence. Exploitation estimates conducted since 1979 have varied considerably. Problems associated with recovering tags reduce confidence in the exploitation estimates. Tag recoveries and exploitation rates gathered from the censuses after 1979 have been problematic due to poor angler return of tags, the inability to accurately observe creel areas and subsequent angler harvests, removal of incentives for tag returns, suspicions about how the tag information would be used "against" anglers, and apathy. A method to assure better recovery of tags, and thus better data for analysis of parameters is needed.

Phase II:

Ft. Gibson Reservoir Population Characteristics:

A total of 1,120 paddlefish were collected in Ft. Gibson Reservoir during the winter months of 2005. There were 1,011 tagged with jaw tags. The remaining (109) were taken for age and growth information. Of those taken there were 25 of unknown sex, 23 females and 29 males (Table 7, Table 8). Overall sampling mortality for Ft. Gibson reservoir in 2005 was 27 (2.41%).

Due to the low number of recaptures caught in gillnets (< 1%) a good population estimate was unattainable. However, high catch rates and good length weight structures of fish netted indicate a strong population. The length frequency of paddlefish tagged in Ft. Gibson Reservoir gill netting in 2005 appears in Figure 14. The length frequencies of paddlefish tagged during the winter of 2005 indicated a good number of mature fish as well as recruitment of young paddlefish. Paddlefish in the Neosho River drainage typically reach sexual maturity at about 1,000mm EFL and around age four. (Combs 1981) The percentage of paddlefish greater than 1,000mm B.L. was 21% which reflects a population dominated by sexually immature paddlefish.

Reproduction and recruitment is indicated by the appearance of small paddlefish in the gillnetting, however, as mentioned in the Grand Lake population studies, younger age fish (i.e. age 0-3) usually do not show up in gillnets. As previously mentioned further research is needed on the habits of and collection methods of age 0-3 paddlefish.

The populations of both male and female paddlefish produced relatively higher significant correlation between body length and weight than the other correlations. Stronger correlations for age-body length and weight with female paddlefish suggest that Ft. Gibson Reservoir like the Grand Lake female paddlefish have more uniform growth rates than male paddlefish (Figure 15, Figure 16, and Figure 17).

There were differences between each sex in terms of observed values. For example, with male data, means of age, body length, and weight were 6.4 years, 887 mm, and 8.964 kg, respectively, while those with female data were 7.5 years, 976 mm, and 11.762 kg, respectively.

Both male and female age distribution (Figure 18, Figure 19) show a distinct spike at age 6 (44 % for male and 24 % for female). Seventy-five percent of males were age 6 or older, while 55% of females were age 8 or older. Age distribution of unknown-sex paddlefish is also presented in Figure 20, which indicates a mix of male and female paddlefish with two distinct clusters.

Ft. Gibson Reservoir Creel Survey:

In recent years increased fishing pressure on the upper end of Ft. Gibson Reservoir at Chouteau Bend has become a concern because of the sport fishery impact on this species. Game Wardens in the area have reported a large increase in fishing pressure since 1999. Prior to that paddlefish pressure had been very low and considered insignificant to the overall paddlefish exploitation. With the increased popularity of snagging, the area has become crowded with resident snaggers.

During the 2005 angling harvest seasons, two simultaneous abbreviated creel censuses were conducted on the Grand River above Ft. Gibson Reservoir

(Figure 5). Since this was the first paddlefish creel census to take place on this Reservoir there was no harvest data to compare however, since water flows and rainfall were average for this period it appeared to be an average harvest year.

Overall angling pressure was very similar to that seen at Miami park in 2003 and higher than that seen in 2004 (Table 3, Table 4). An estimated harvest for the combined creels on Ft. Gibson Reservoir was 315 with a catch rate of 0.253/hr (Table 4).

Of the 1011 paddlefish tagged in 2005, 25 (2.4%) were recaptured by anglers. The harvest in both creel areas in 2005 was limited due to low rainfall amounts on the upper watersheds of the Neosho River.

Since there was not enough recaptures caught during the mark and recapture portion of the study there was no population estimate made. However, angler exploitation was calculated from this creel. The number of tags returned by Ft. Gibson Reservoir anglers in 2005 was 25 (2.4%) tag return which compares to 31 (2%) tags returned by Grand Lake anglers in 2004.

Low numbers of tag returns in 2003, 2004 and 2005 resulted in exploitation rate estimates with low confidence. Exploitation estimates conducted since 1979 have varied considerably. This has been problematic in paddlefish creels since 1979, and as previously stated, a method to assure greater tag recovery in order to gather better data for analysis of parameters is needed.

Ft. Gibson Reservoir Length Frequencies and Population Structure:

The length frequencies from the 2005 samples indicate the population is dominated by immature fish (less than 1,000 mm EFL) but does suggest a very large maturing population (Figure 14). The length frequency from the 2005 tagging data suggests that dominant length groups (less than 1,000mm EFL) are maturing and increasing the scale in length by about 20 to 40 mm per year. Also indicated in the 2005 gillnetting length frequency are past successful recruitment years. The absence of fish between 600 mm and 725mm is consistent with the related low flow conditions of 1998, 2000 (age 4), and 2001 (age 3) which would coincide with the data collected on Grand Lake in 2003 and 2004.

Part of the objectives to phase II was also to estimate the population size, size structure and harvest exploitation of the impoundments of both Hudson Lake and Fort Gibson and to determine what actual contribution of paddlefish from Grand Lake is to these fisheries. Due to the abundance of fish that were encountered on Ft. Gibson Reservoir, Hudson Lake was never studied. The Hudson Lake part of the objective will be continued under a Sports Fish Restoration Grant.

Phase III:

The objectives of phase III to identify paddlefish spawning locations and success under various flows and velocities on Grand Lake, and whether conditions and spawning requirements are met in the tail-waters of the downstream impoundments (Hudson and Fort Gibson lakes) will be addressed under a Sports Fish Restoration Grant.

Overall Recommendations for the Neosho-Grand River Paddlefish:

Paddlefish populations are vulnerable to overexploitation for two reasons: First, reproductive behavior results in relatively low recruitment, and growth rates make it difficult for them to withstand heavy fishing pressure (Pasch and Alexander, 1986). Second, because paddlefish are very susceptible to environmental changes, such as low water dams, and habitat disruption, such as dredging and channelization. Also of interest to the paddlefish fishery in the future, is the recent discovery of the herbivore bighead carp (*Hypophthalmichtys nobilis*) (Richardson) in the Neosho River and the ongoing threat of the introduction of Zebra Mussels (*Dreissena polymorpha*) into the Neosho River system.

As angler interest in paddlefish grows, exploitation increases may make it necessary to monitor paddlefish populations in Grand Lake, Hudson Lake and Ft. Gibson Reservoir. A yearly creel survey of the sport snagging and trotline snag line fisheries could aid in gathering harvest rates and trends. The

paddlefish fishery is expanding and is located at different sites during different flow regimes. [Annual fluctuations in paddlefish spawning runs are related to changes in water level, flows and temperature (Ambler 1994)]. The fisheries of the paddlefish can no longer be thought of as being just centered on the upper part of Grand Lake to Miami Riverview Park. Future surveys should take into account the snagging fisheries from Ft. Gibson Reservoir Dam to Chetopa, Kansas and in the Spring River. The monitoring of the paddlefish spawning runs to determine the impact of our current regulations should continue. This information will also be valuable for writing a paddlefish management plan for Oklahoma. Further investigations will be warranted to determine whether regulation changes or a combination of new regulations are needed to best meet management objectives.

Although no tagged paddlefish from Grand Lake were recaptured in Ft. Gibson in 2005 and no angler tag returns of fish tagged from Grand Lake it is possible that downstream fisheries (Ft Gibson and Lake Hudson) are supported by fish leaving Grand Lake. [The contribution of fish from Grand Lake to these fisheries should also be determined. Recruitment of paddlefish in the reservoirs and tail-waters below Grand Lake needs to be assessed.] A continued investigation of paddlefish populations in these reservoirs needs to be undertaken so that a proper management plan for the fisheries in these reservoirs, tail-waters, and river system can be developed.

The most critical research need concerning paddlefish in the Neosho River-Grand River system is that identification and protection of spawning locations

and success under various flows and velocities needs to be determined. Strong-year class data from both Grand Lake and Ft Gibson Reservoir coincides with high flows and velocities and low harvest of adults during those years. The reproduction and recruitment of paddlefish have been studied by Pash, Hackney and Holbrook (1978, 1980), Hevel and Alexander (1983) and Wallus (1983) but remain relatively unknown for Oklahoma paddlefish populations. Protection of the spawning sites will allow paddlefish reproduction to continue and possibly enhance the fisheries. Success of spawning paddlefish in Grand Lake may affect the paddlefish populations in downstream impoundments. Determination of whether flow conditions and spawning requirements are met in the tail-waters of the downstream impoundments would allow development of a system wide management plan to enhance paddlefish stocks in the lower reservoirs and tail-waters. Management plans have been completed for paddlefish in Missouri (Graham et al. 1975), Louisiana (Reed et. al., 1992), Texas (Pitman 1991), and for the Mississippi River Basin (Graham et al. 1993, Rakes, 1993). A telemetry study of adult paddlefish behavior to determine spawning areas and utilization at various flows is recommended. The habitat suitability and usage by paddlefish has been investigated by Anderson, Southall, and Crance (1984), Southall and Hubert (1984), Crance (1987), Moen, Scarnecchia, and Ramsey (1992, 2000). The suitability of various velocities for larval and age-0 paddlefish remains unknown. (Ambler 1984) and the movement of larval paddlefish away from the

spawning sites and their subsequent dispersal into nursery areas are critical research needs for maintaining of a self-sustaining population.

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Total Costs:

PRINCIPAL INVESTIGATOR: ______________________________

Brent Gordon, Fisheries Biologist
Oklahoma Dept. of Wildlife Conservation

DATE: November 17, 2005

APPROVED BY: ______________________________

Ron Suttles, Coordinator
Oklahoma Dept. of Wildlife Conservation

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John Stafford, Federal Aid Coordinator
Oklahoma Dept. of Wildlife Conservation

Table 1. Summary of paddlefish tagging by ODWC gill netting from Dec. 18 through April 17, 2003and population estimate.

Date	# Caught Total	# Cum. Tagged	# Recaptures	Population Estimate	Chapman Adjustment
12/18/02	6	6	0	0	28
12/19/02	6	12	0	0	95
12/20/02	15	27	0	0	446
01/08/03	1	28	0	0	474
01/09/03	1	29	0	0	503
01/10/03	1	30	0	0	533
01/14/03	164	194	0	0	27,069
01/15/03	215	397	0	0	105,782
01/21/03	50	447	0	0	127,588
01/22/03	12	447	0	0	136,081
01/23/03	38	485	0	0	154,186
01/24/03	21	497	1	0	164,623
01/28/03	9	506	0	169,157	84,579
01/29/03	35	441	0	187,876	93,938
01/30/03	44	585	0	213,157	106,579
01/31/03	41	626	0	238,423	119,212
02/11/03	167	790	1	112,718	91,289
02/12/03	132	922	0	160,297	120,223
02/13/03	47	953	3	87,526	75,002
03/11/03	125	1077	0	109,169	93,573
03/12/03	107	1184	0	129,643	111,123
03/13/03	33	1216	1	116,817	102,215
03/25/03	39	1252	2	96,246	86,622
03/26/03	42	1278	1	91,989	83,627
04/01/03	114	1343	0	106,889	97,172
04/02/03	69	1406	1	105,858	97,036
04/03/03	53	1447	2	95,471	88,652
04/17/03	35	1480	2	**86,195**	**80,808**

Number of recaptures equal 1%.

Table 2. Summary of paddlefish tagging by ODWC gill netting from Jan 21, 2004 through March 25, 2004 and population estimate.

Date	# Caught Total	# Cum. Tagged	# Recaptures	Population Estimate
1/21/04	22	0	0	
1/22/04	47	47	0	2,163
1/23/04	63	110	0	18,044
1/27/04	58	168	0	52,148
1/28/04	44	212	0	93,347
1/29/04	70	282	1	30,446
1/30/04	98	380	0	73,329
2/03/04	67	447	0	113,896
2/04/04	107	554	1	79,667
2/05/04	111	665	3	41,512
2/06/04	49	714	0	50,189
2/10/04	24	738	1	43,562
2/11/04	50	788	0	52,146
2/12/04	40	828	1	48,602
2/13/04	33	861	2	38,998
3/03/04	68	928	0	48,493
3/04/04	89	1010	0	63,215
3/09/04	75	1067	1	65,695
3/10/04	93	1151	1	71,370
3/11/04	67	1213	2	64,473
3/12/04	67	1265	1	66,598
3/18/04	29	1288	1	63,779
3/23/04	96	1384	4	54,827
3/24/04	18	1388	0	56,662
3/25/04	65	1453	2	55,404

Number of recaptures equal 1.4%

Table 3. Paddlefish angling pressure, harvest, and catch rates on the Neosho River/Grand Lake, 2003- 2004.

Creel Survey	Pressure (Hrs.)	Caught & Released #'s	Catch /Hour CPUE (Effort = 1hr.)	# Total Harvest
Grand Lake				
2003	11,116	2,249	0.20	1,161
2004	10,057	2,263	0.23	1,303
Twin Bridges				
2003	9,412	2,818	0.30	1,324
2004	20,043	1,493	0.07	1,335
Miami Park				
2003	5,882	3,247	0.55	447
2004	709	440	0.62	58
Total				
2003	**26,410**	**8,314**	**.35 ***	**2932**
2004	**30,809**	**4,196**	**.31 ***	**2696**

* Average of CPUE

Table 4. Paddlefish angling pressure, harvest, and catch rates on Fort Gibson Lake, 2005.

Creel Survey	Pressure (Hrs.)	Caught & Released #'s	Catch / Hour CUPE (Effort = 1hr.)	# Total Harvest
Upper				
Weekday	1046.3	8	0.076	21.4
Weekend	1457.2	302	0.326	78.6
Lower				
Weekday	1770.1	33	0.174	151.8
Weekend	1372.4	171	0.209	63.4
Totals	**5646**	**514**	**0.196 ***	**315.2**

* Average of CPUE

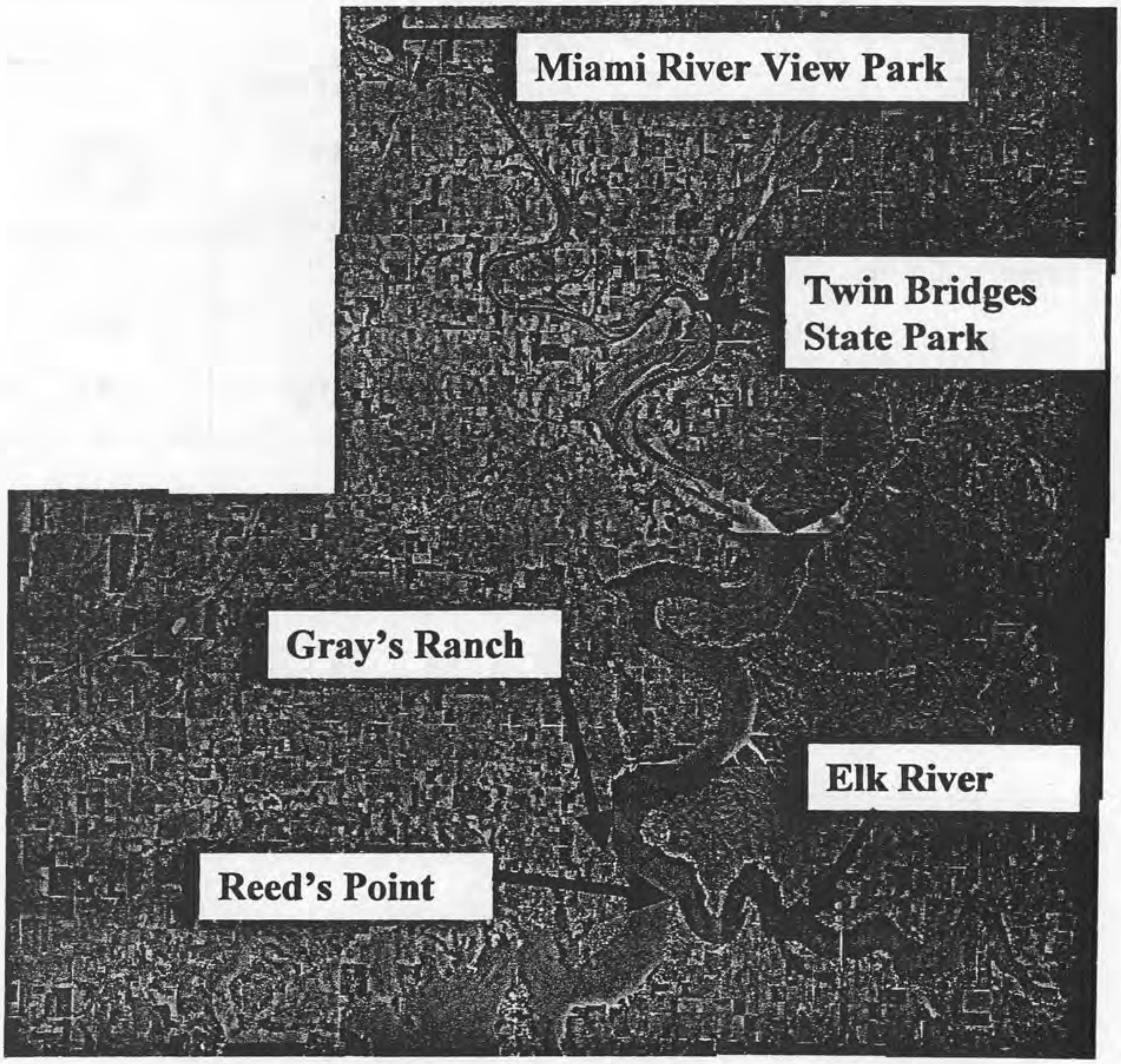


Figure 1. Total paddlefish creel survey area of Neosho River and Grand Lake, 2003-2004. Distance between Reed's Point and Twin Bridges State Park is 29 kilometers.

Figure 2. Paddlefish creel survey area of Miami Riverview Park, Neosho River 2003-2004.

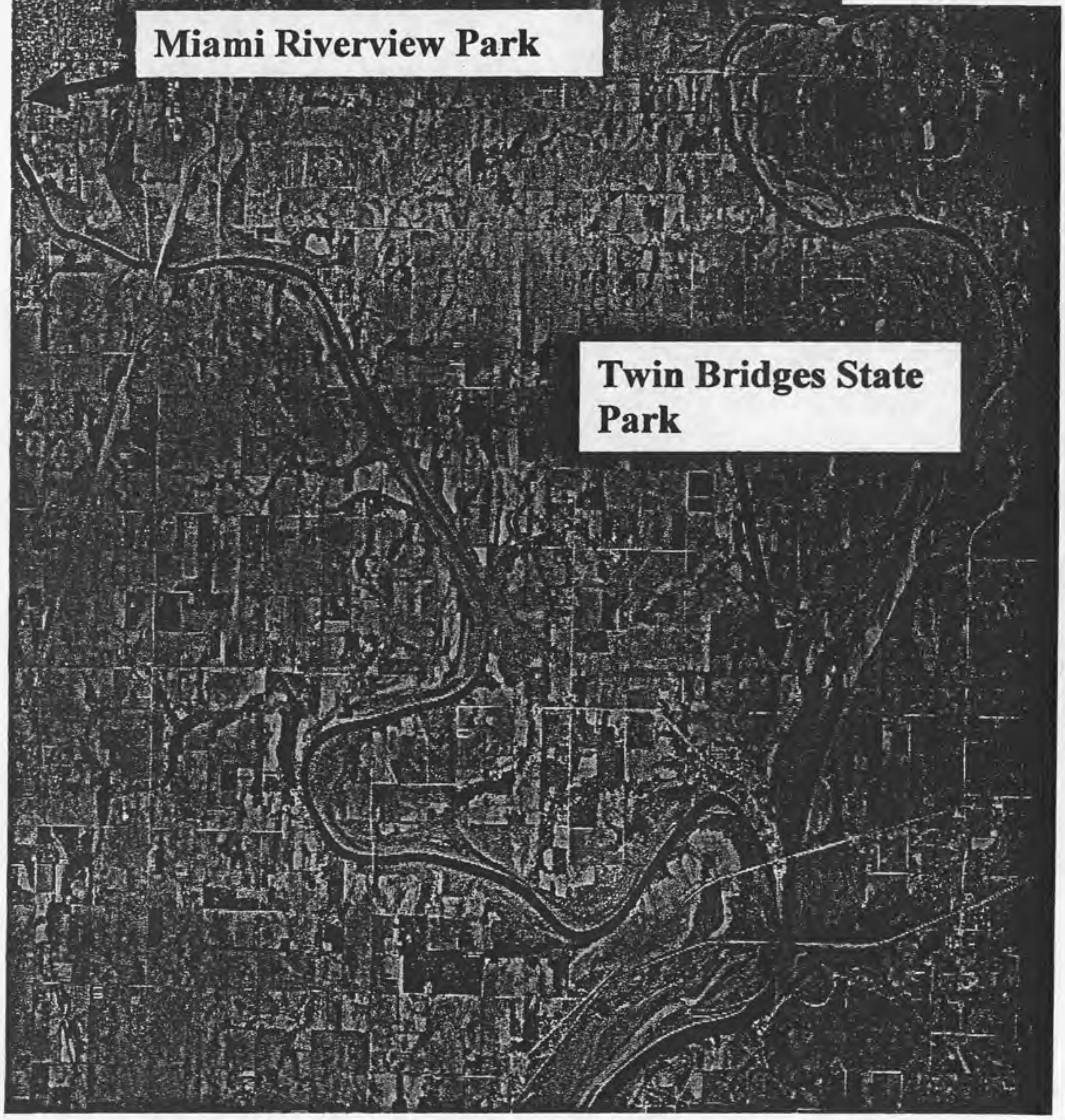
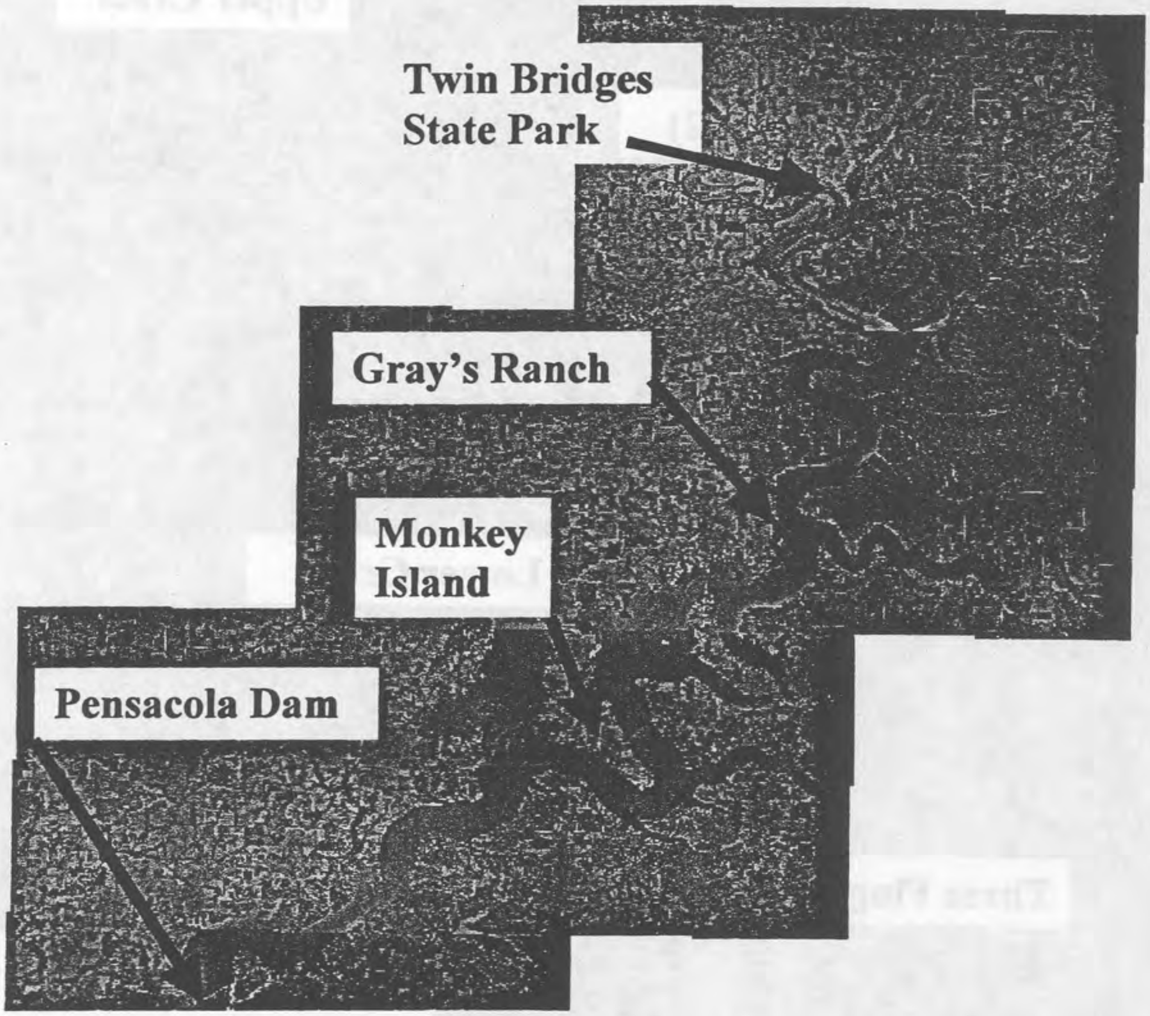


Figure 3. Paddlefish creel survey area of the Neosho River, 2003-2004. Distance between Miami Riverview Park and Twin Bridges State Park is 20km.



ure 4. Aerial photo of Grand Lake showing creel areas and netting/tagging sites 2003-2004. The"X's"
cate netting/tagging sites. Distance between Gray's Ranch and Pensacola Dam is 43 kilometers

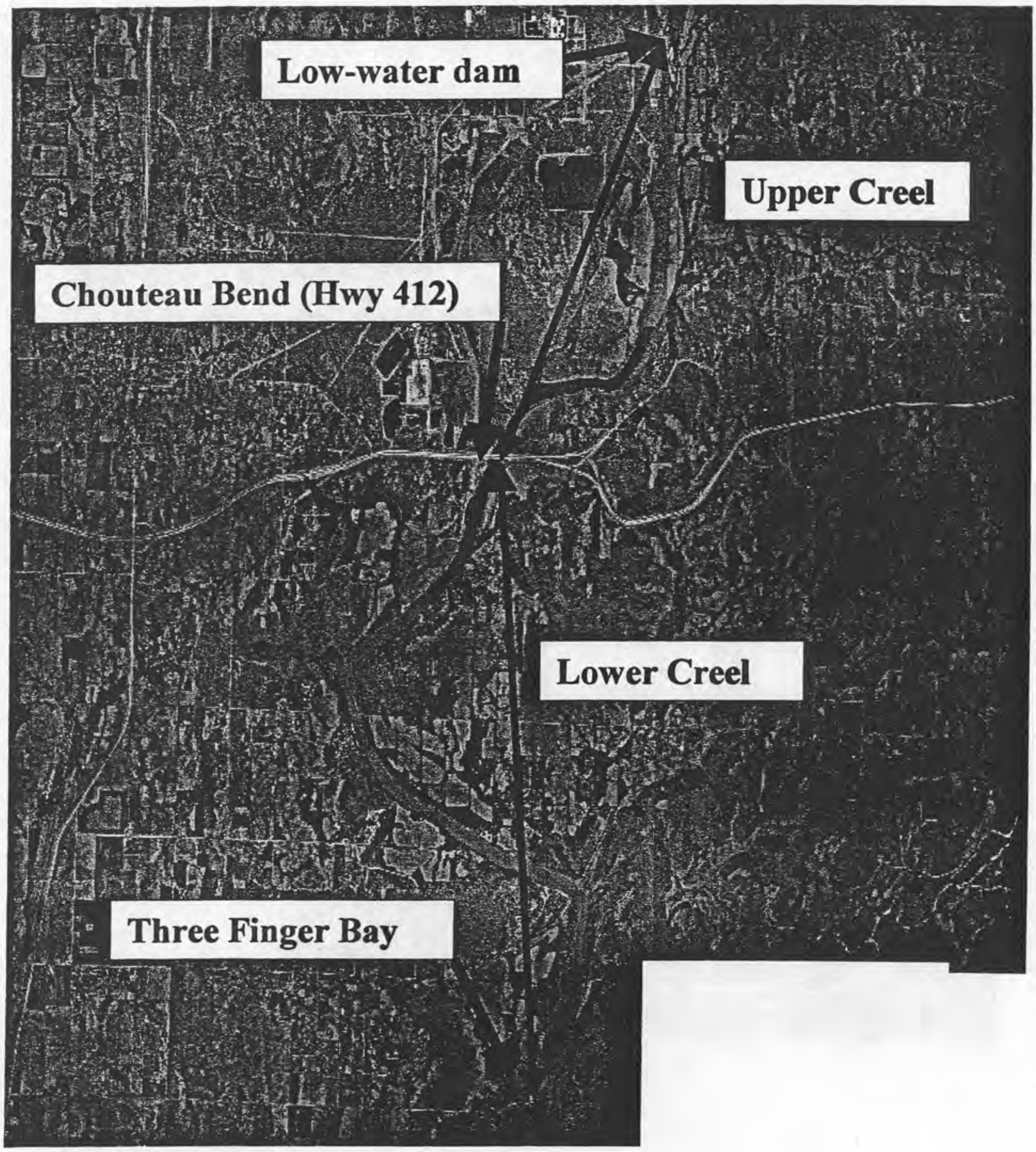


Figure 5. Total paddlefish creel survey area of Neosho River/Fort Gibson 2005. Distance from low-water dam to Three Finger Bay is 18 kilometers. Distance from Three Finger Bay to beginning of netting sites is 12 kilometers

Table 5. 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 6. 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

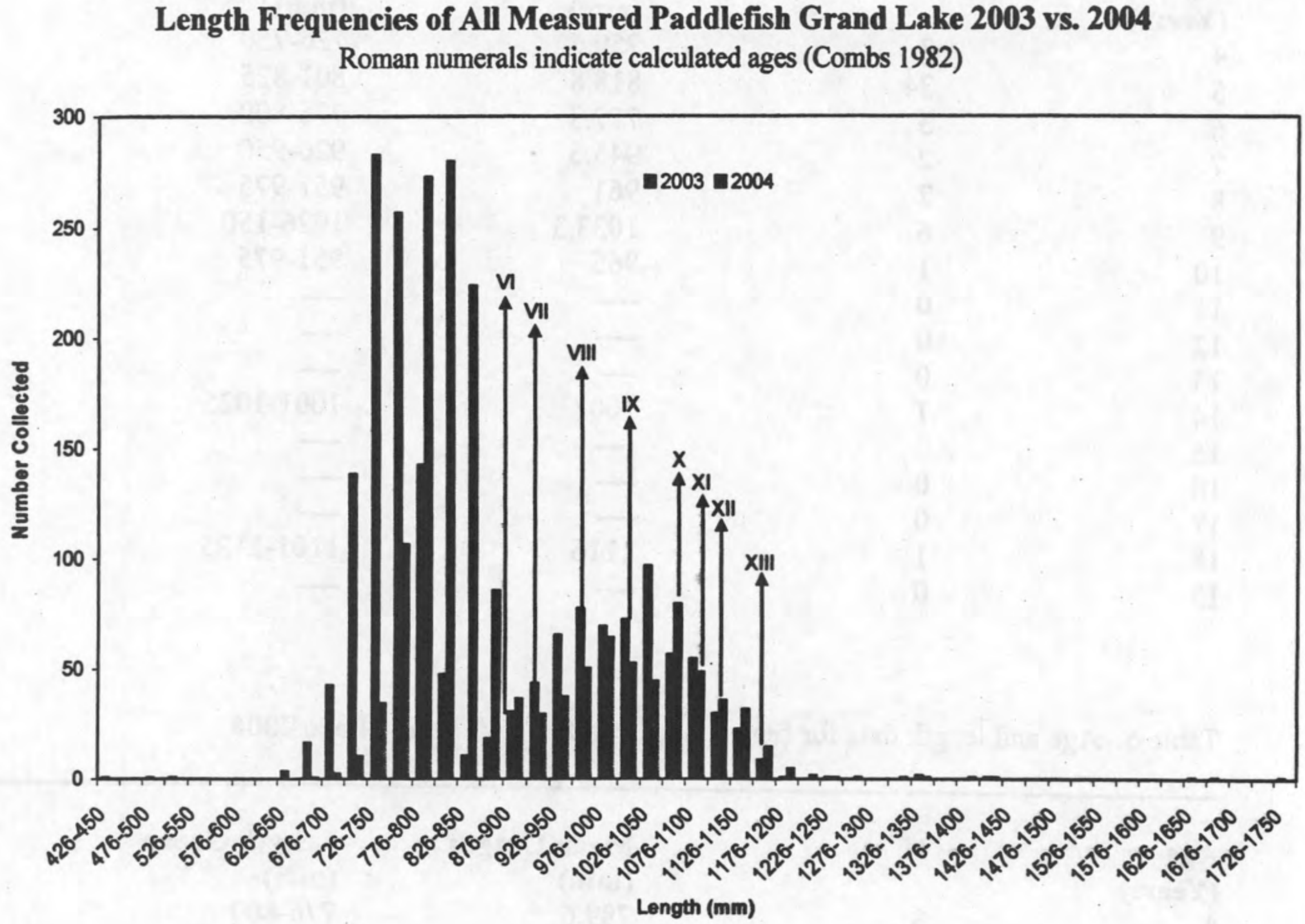


Figure 6. A comparison of length frequencies of all paddlefish collected in Grand Lake from 2003 and 2004.

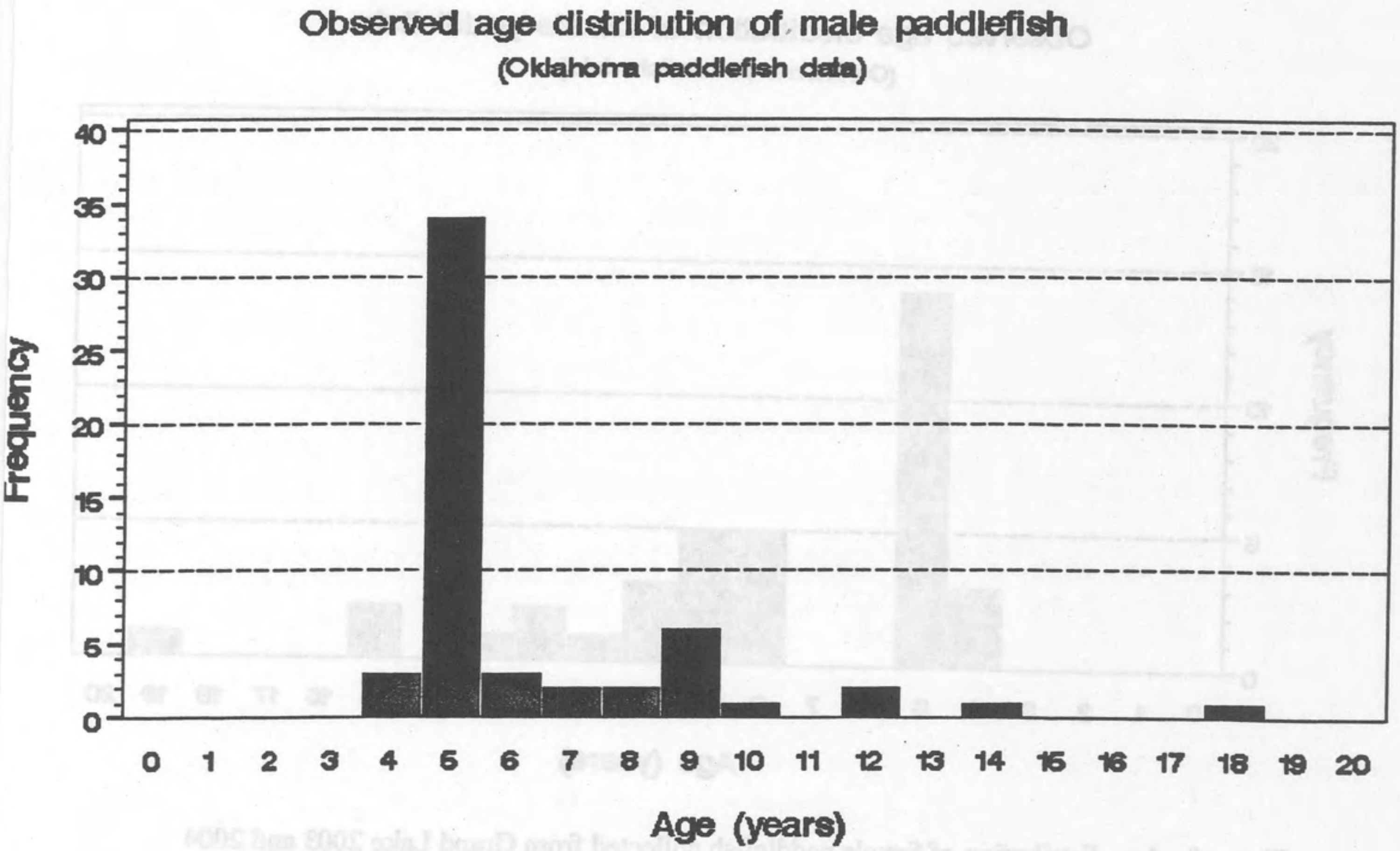


Figure 7. Age distribution of male paddlefish collected from Grand Lake 2003 and 2004.

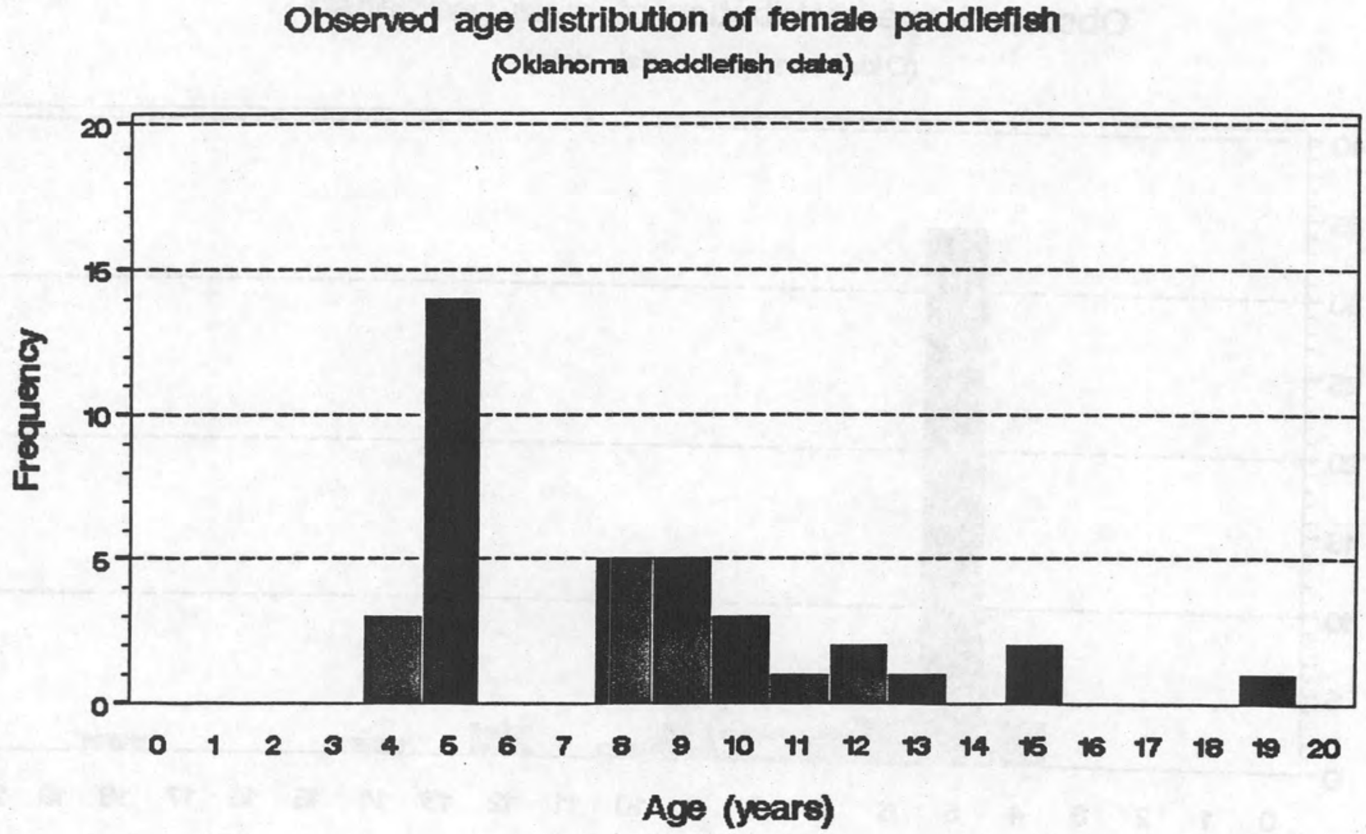


Figure 8. Age distribution of female paddlefish collected from Grand Lake 2003 and 2004

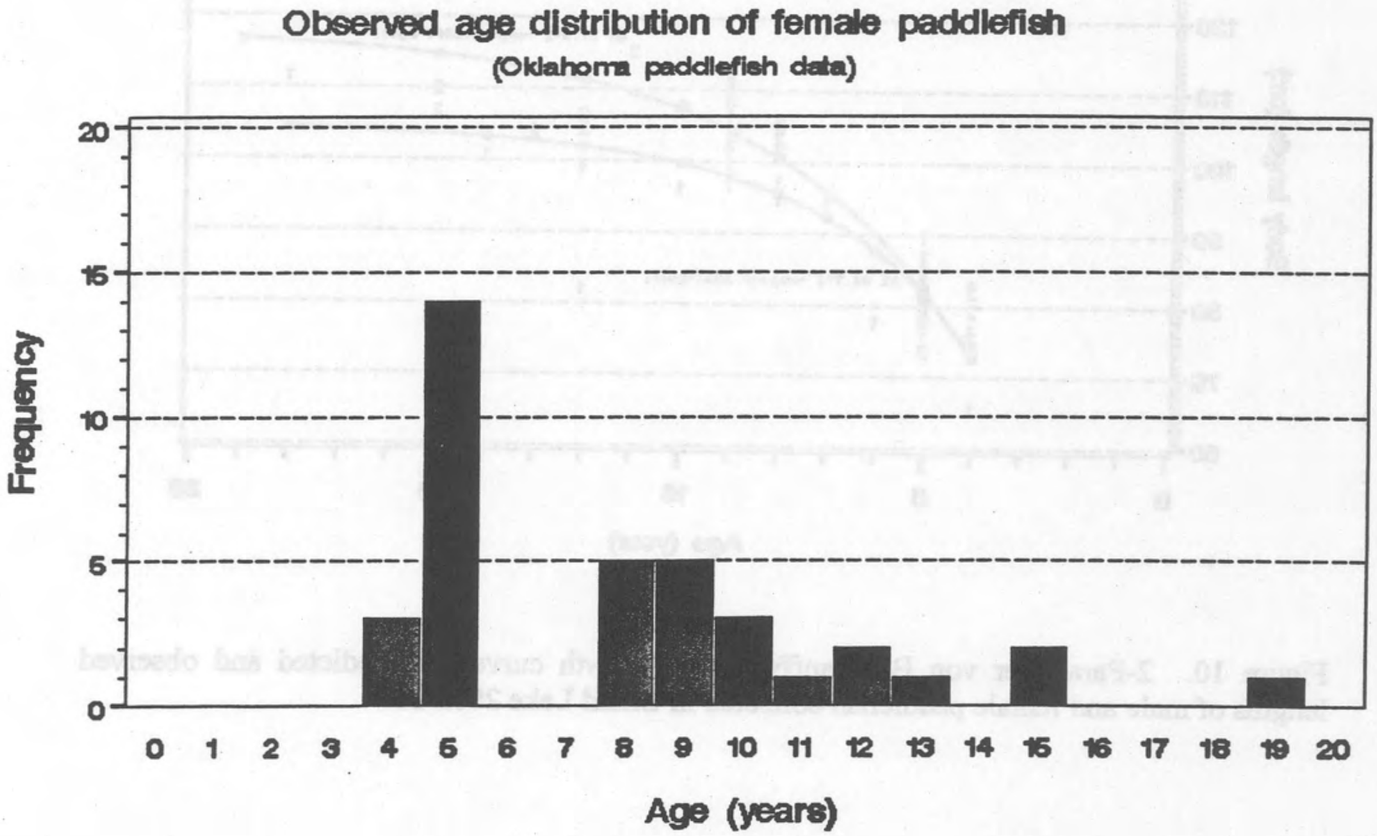


Figure 8. Age distribution of female paddlefish collected from Grand Lake 2003 and 2004

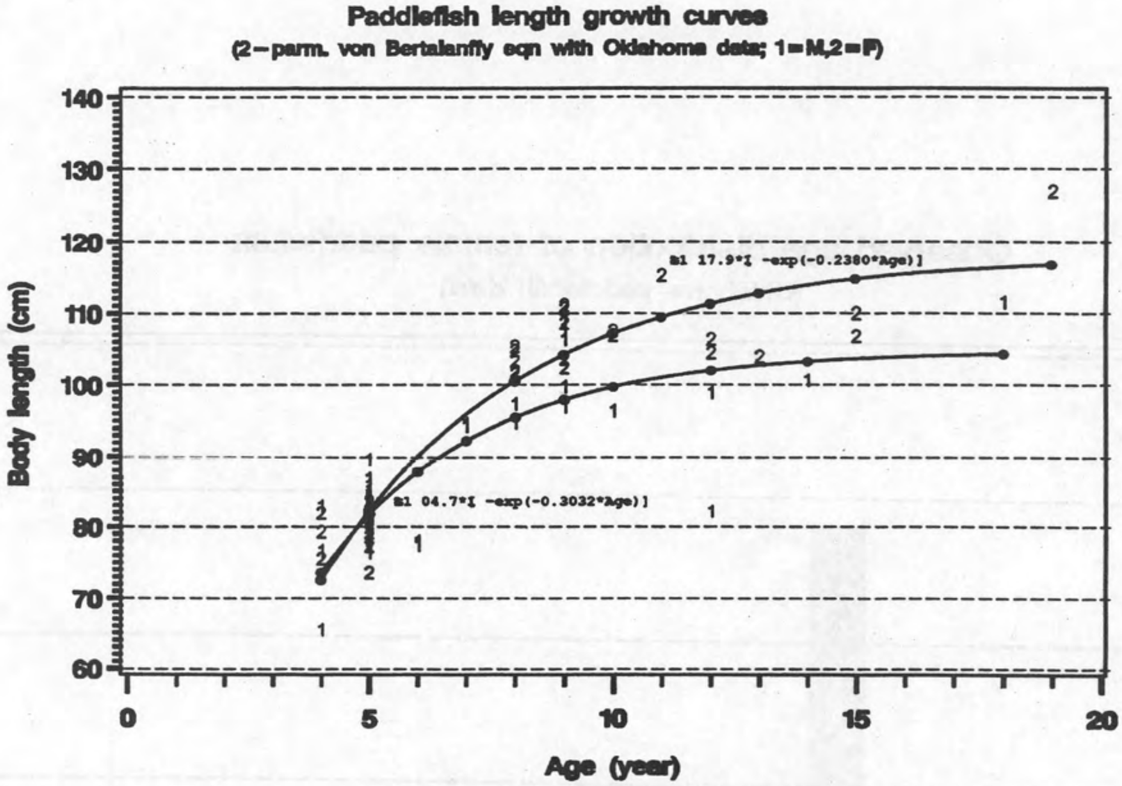


Figure 10. 2-Parameter von Bertalanffy length growth curves of predicted and observed lengths of male and female paddlefish collected in Grand Lake 2003/2004.

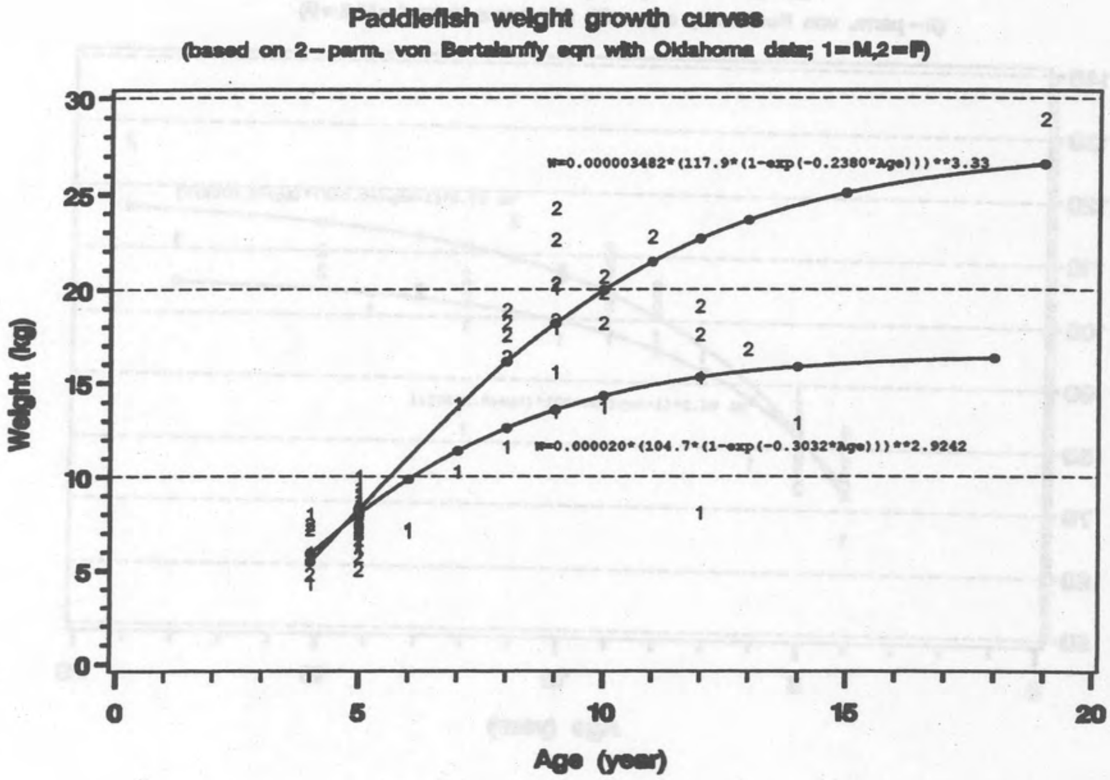


Figure 11. 2-Parameter von Bertalanffy weight growth curves of predicted and observed weights of male and female paddlefish collected in Grand Lake 2003/2004.

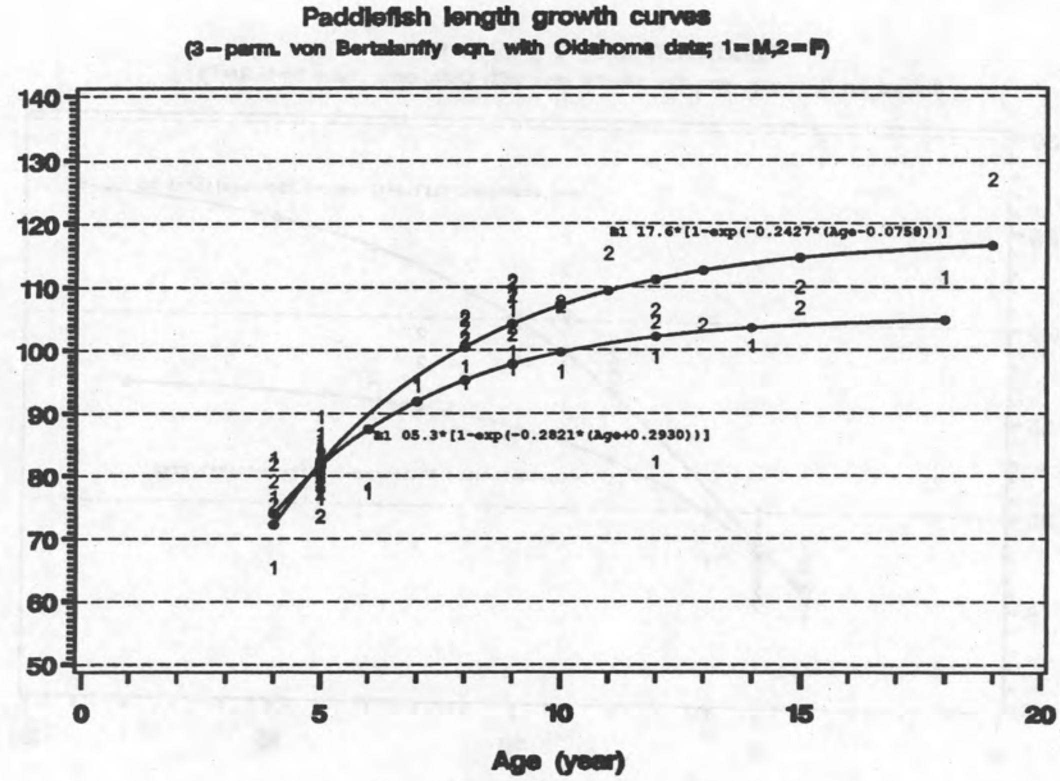


Figure 12. 3-Parameter von Bertalanffy length growth curves of predicted and observed lengths of male and female paddlefish collected in Grand Lake 2003/2004.

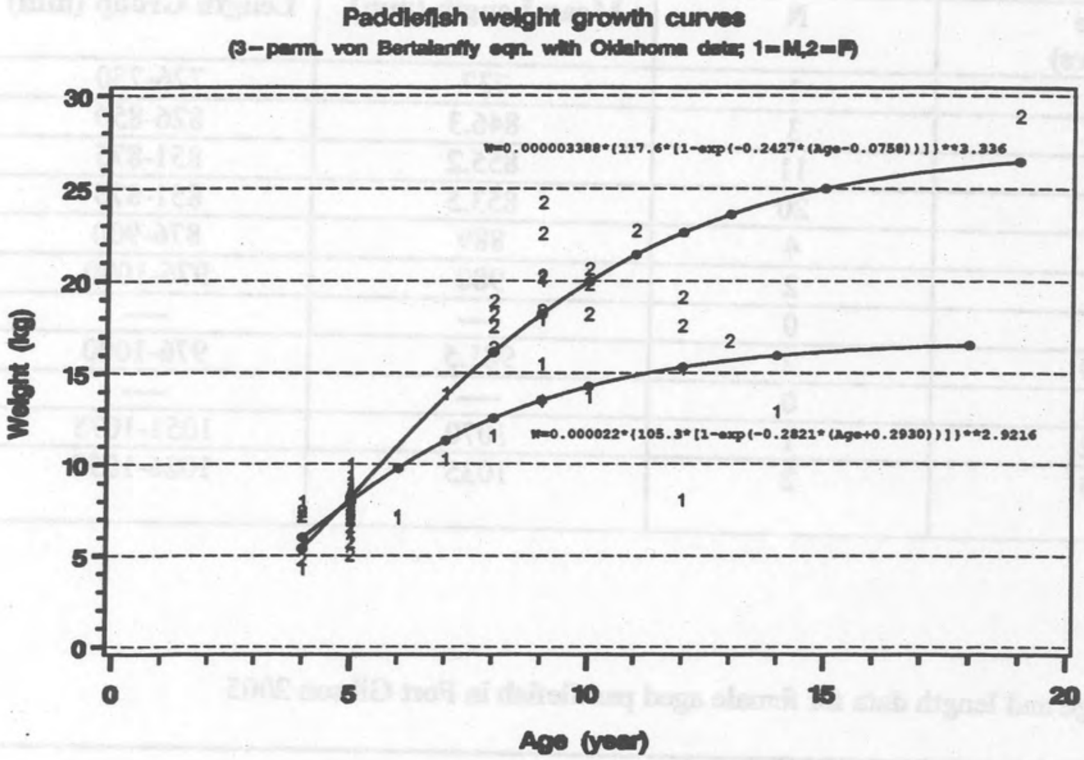


Figure 13. 3-Parameter von Bertalanffy weight growth curves of predicted and observed weights of male and female paddlefish collected in Grand Lake 2003/2004.

Table 7. Age and length data for male aged paddlefish in Fort Gibson 2005

Age (Years)	N	Mean Length (mm)	Length Group (mm)
3	1	737	726-750
4	3	846.3	826-850
5	11	855.2	851-875
6	20	853.5	851-875
7	4	889	876-900
8	2	980	976-1000
9	0	----	----
10	2	981.5	976-1000
11	0	----	----
12	1	1070	1051-1075
13	2	1035	1026-1050

Table 8. Age and length data for female aged paddlefish in Fort Gibson 2005

Age (Years)	N	Mean Length (mm)	Length Group (mm)
3	0	----	----
4	0	----	----
5	4	870	851-875
6	9	866.4	851-875
7	5	1017.8	1001-1025
8	1	1035	1026-150
9	0	----	----
10	7	1059.7	1051-1075
11	0	----	----
12	0	----	----
13	0	----	----
14	1	1155	1151-1175

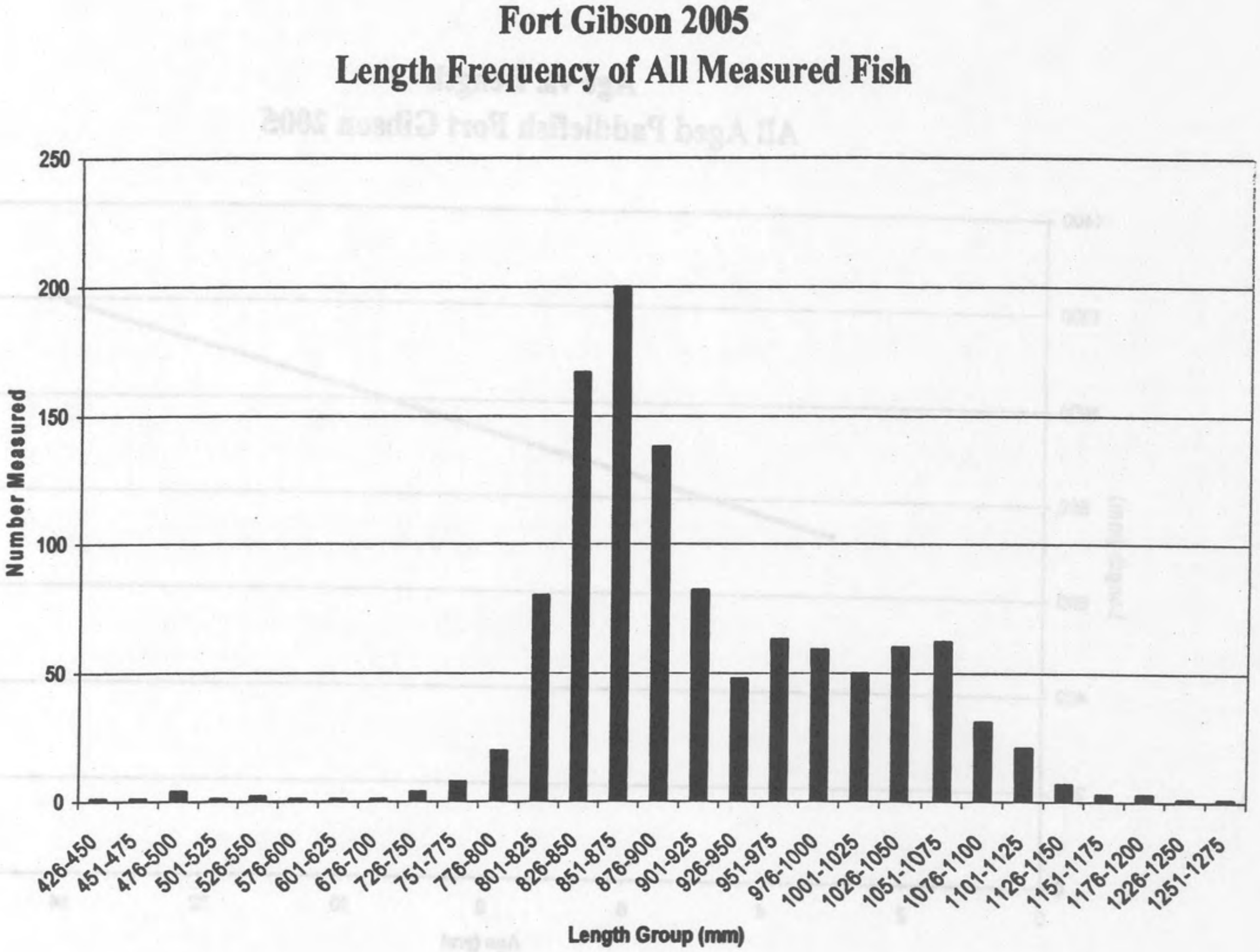


Figure 14. Length frequency of all measured paddlefish collected from Fort Gibson Lake 2005.

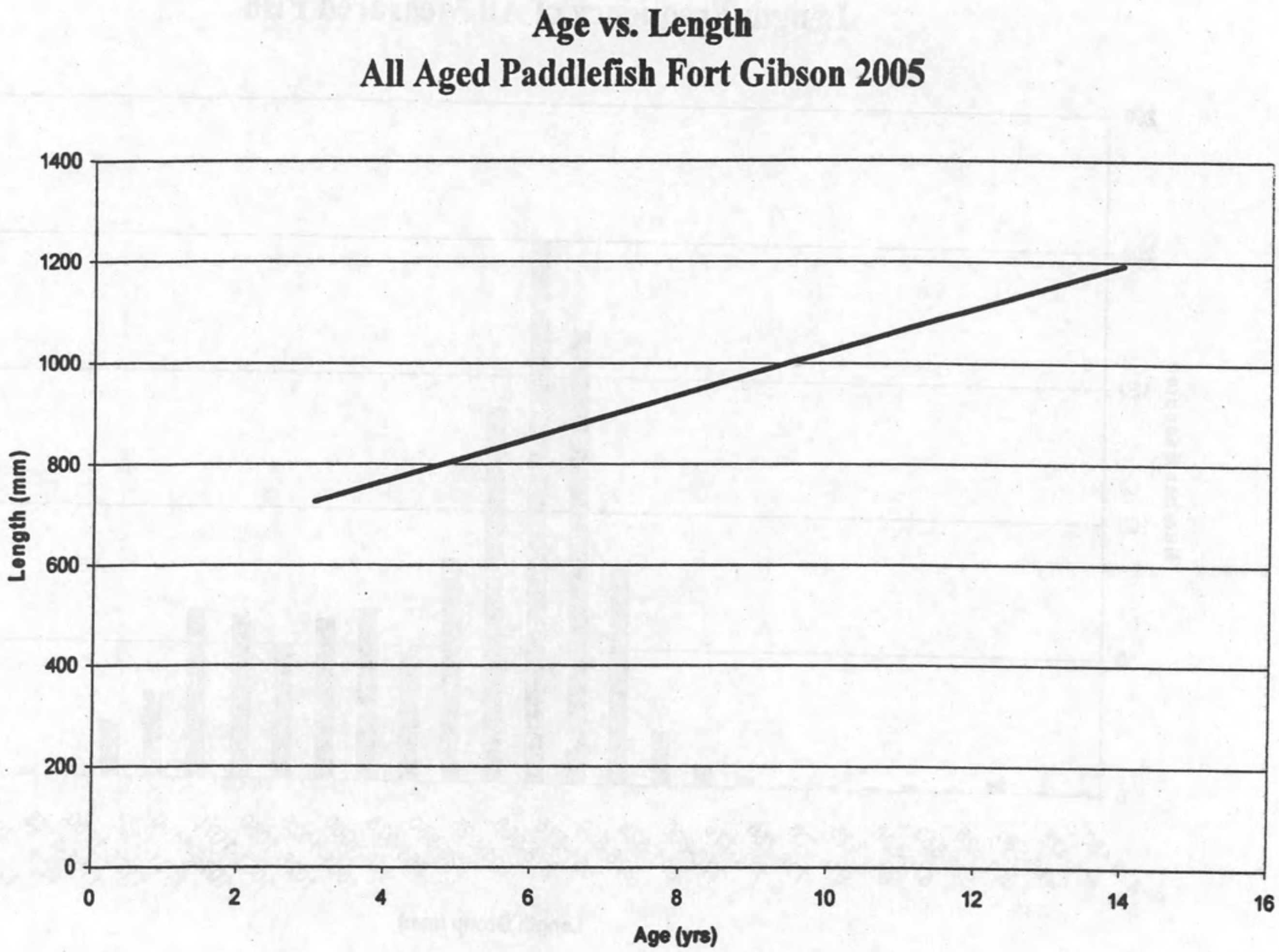


Figure 15. Age vs. length trend of all aged paddlefish from Fort Gibson Lake 2005

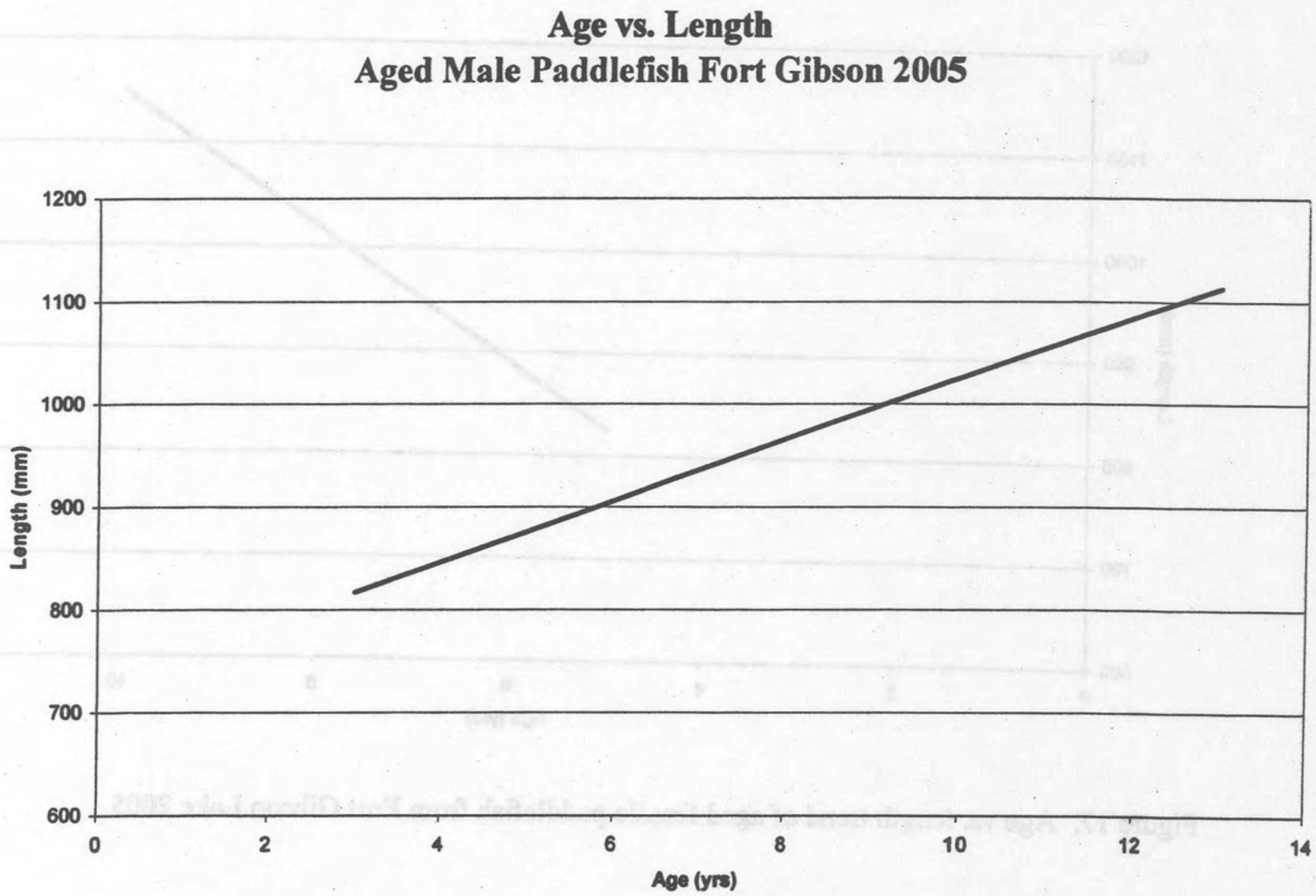


Figure 16. Age vs. length trend of aged male paddlefish from Fort Gibson Lake 2005

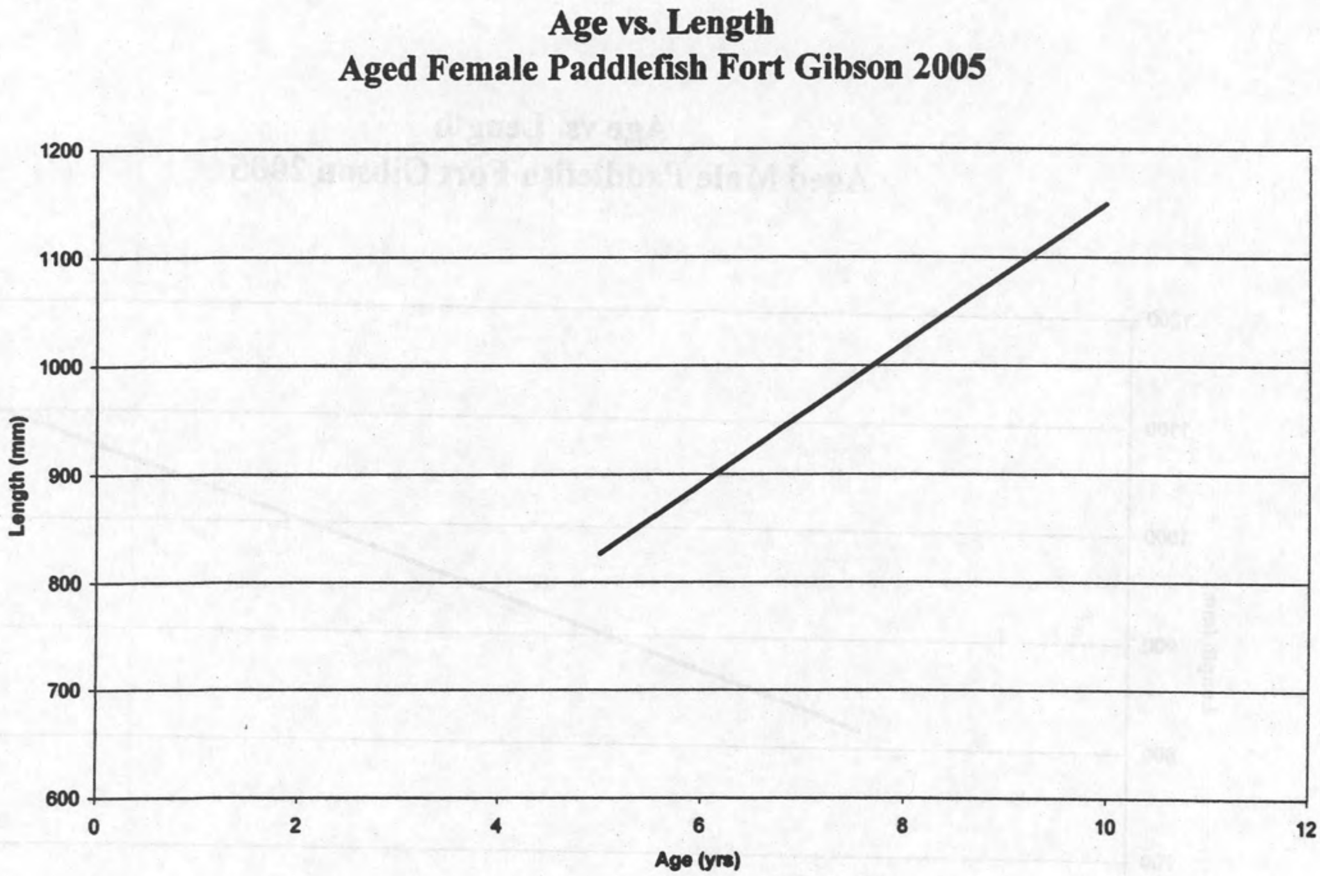


Figure 17. Age vs. length trend of aged female paddlefish from Fort Gibson Lake 2005

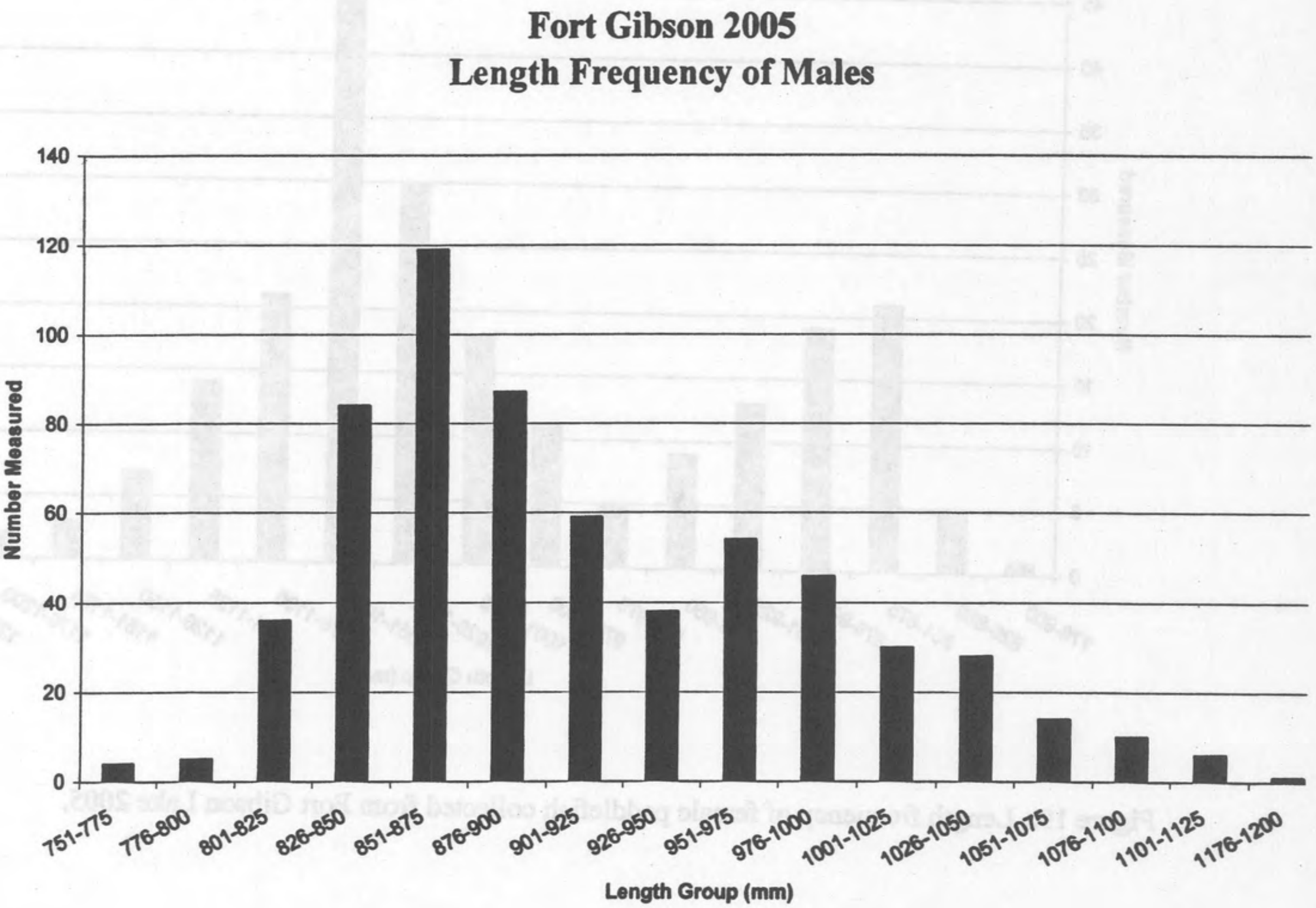


Figure 18. Length frequency of male paddlefish collected from Fort Gibson Lake 2005

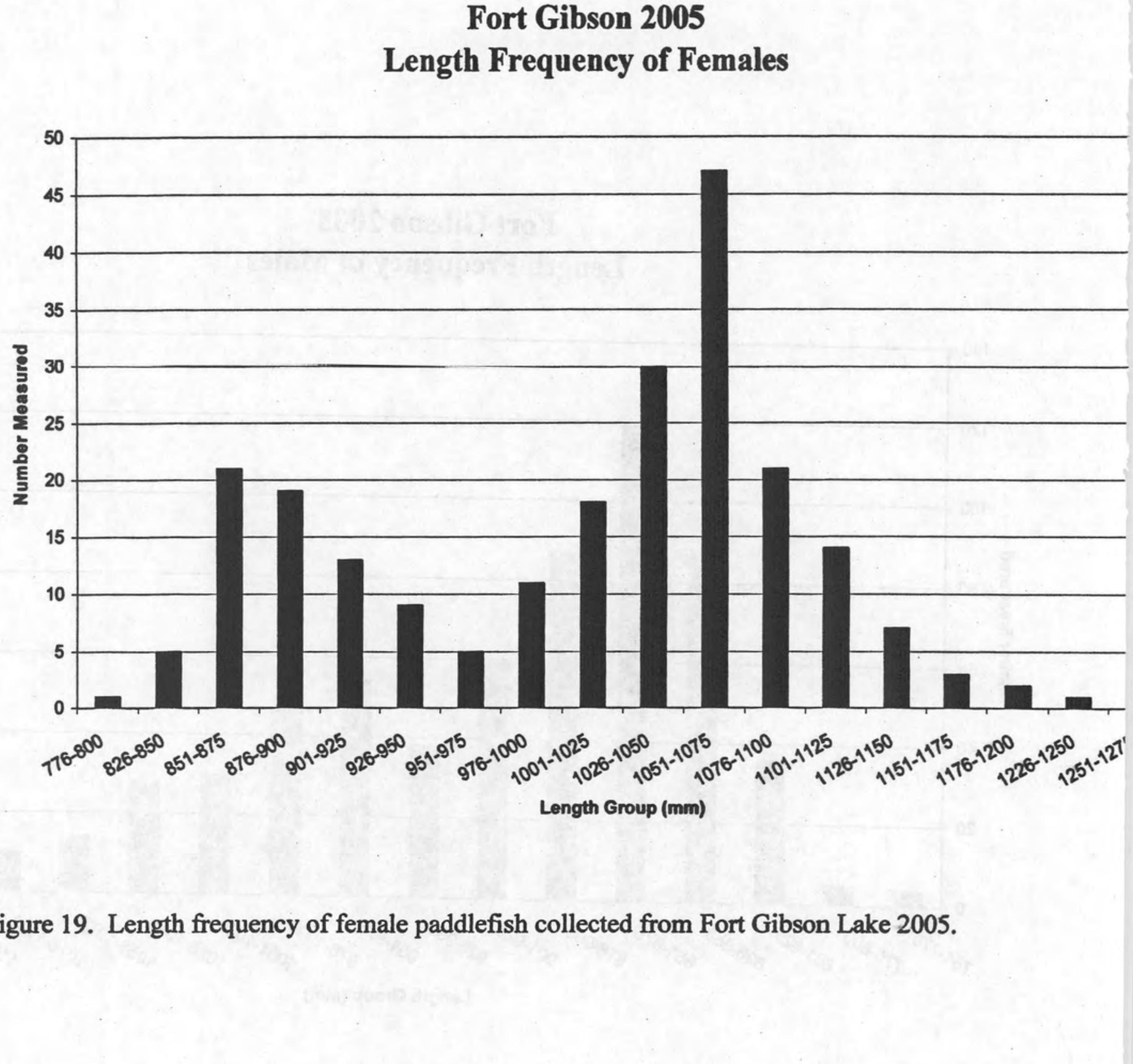


Figure 19. Length frequency of female paddlefish collected from Fort Gibson Lake 2005.

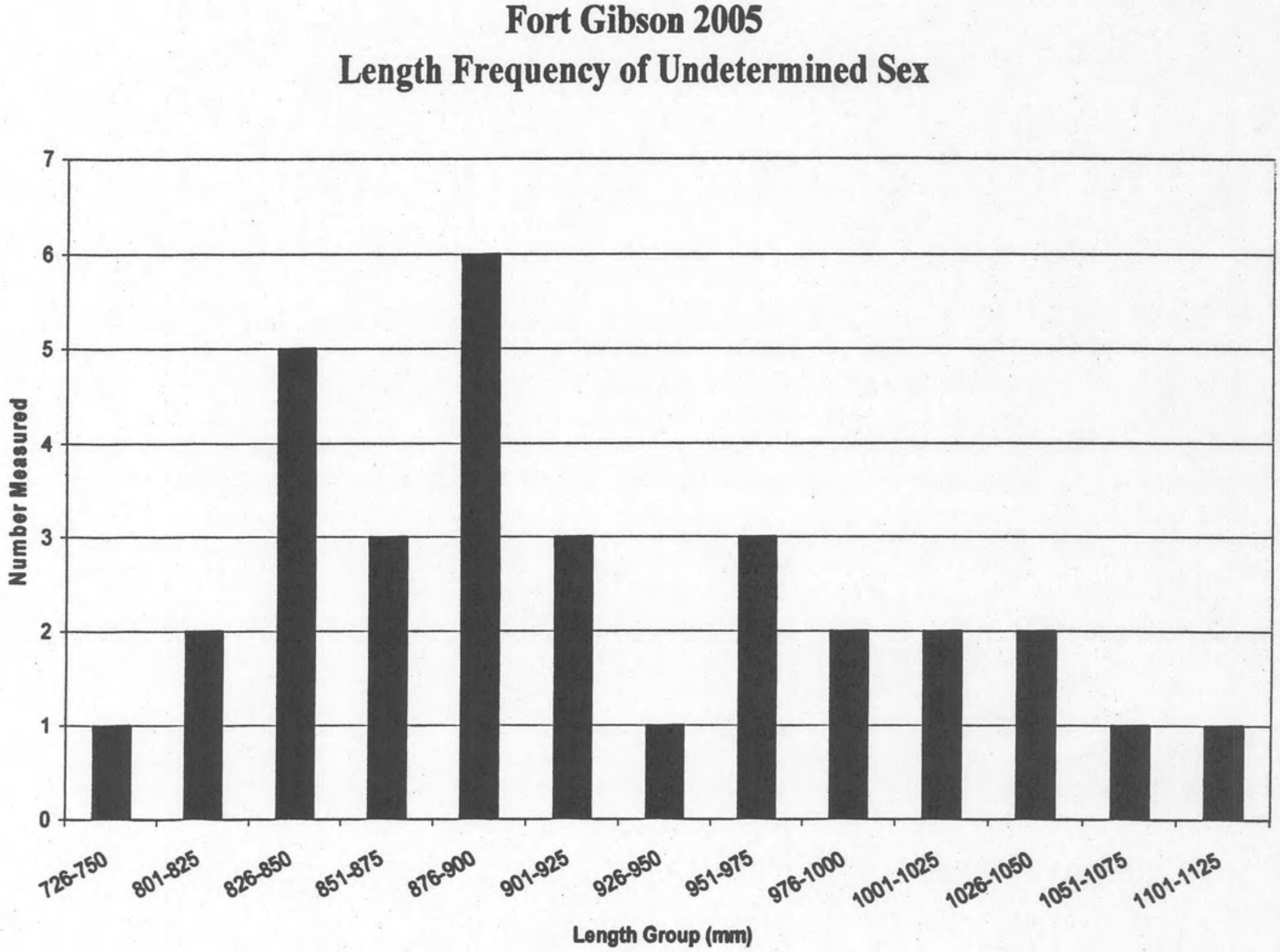


Figure 20. Length frequency of immature paddlefish collected from Fort Gibson Lake 2005.