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FINAL PERFORMANCE REPORT

FEDERAL AID GRANT NO. F-50-R-16

FISH RESEARCH FOR OKLAHOMA WATERS

PROJECT: 27 STOCK ASSESSMENT OF THE GRAND LAKE PADDLEFISH POPULATION

OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION

January 1, 2009 through December 31, 2009

FINAL REPORT

State: Oklahoma **Grant Number:** F-50-R-16

Grant Program: Sport Fish Restoration

Grant Title: Fish Research for Oklahoma Waters

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Project Leader: Brent Gordon

Project 27: Stock Assessment of the Grand Lake Paddlefish Population

Objective: The objectives of this study are to: 1) collect biological data from recreational angler-harvested paddlefish from the Grand Lake, Oklahoma system; 2) develop an annual recruitment index; 3) to survey paddlefish anglers to determine expectations of the fishery; and 4) use this information as the basis for formulating a long range paddlefish management plan for the Grand Lake system.

Abstract

As part of the assessment of the Neosho River-Spring River-Grand Lake paddlefish *Polyodon spathula* stock, extensive sampling was conducted in 2008 and 2009 on fish brought into the Paddlefish Research and Processing Center at Twin Bridges State Park in northeast Oklahoma. Length, weight, sex, testes and ovary weights, and dentaries (lower jaw bones used in age determination) were sampled from each of the more than 11,000 fish brought into the center. Ages for males ranged from 3 to 15 years and averaged 9.1. Females ranged from 8 to 27 and averaged 10.06. The harvest was dominated by fish of the 1999 year class (2008; 81% of all males and 60% of all females;

2009: 63% of all males and 79% of all females). No males exceeded age-15, and less than 1% of all females exceeded age-15. Nearly all (99%) of the males and females brought to the Center for processing were sexually mature. For females, weights of gonadal fat bodes (GFB), an indicator of energy storage, were highest (0.75 to 1% of fish weight) at age 8, 9, 10 and declined thereafter to about 0.25% of fish weight by age-20. GFB weights for females also declined in relation to egg weights as the fish aged.

An end-of-season survey of paddlefish anglers was implemented to determine expectations of the fishery, fishing participation in 2008, use of the PRPC, satisfaction with the experience, and the impact the PRPC may have had on paddlefish harvest. These results will enable the formation of a long-range paddlefish management plan for the Grand Lake system.

Data from this study are being analyzed in relation to historical data and data from tagging of adult paddlefish to provide an estimate of the population size and recruitment. A comprehensive Management Plan for sustainable harvest of the stock is under development.

Summary of Progress:

See attached Appendices I and II

Significant Deviations

none

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Date: January 1, 2010

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Appendix I

Current Status of Grand Lake paddlefish stock and implications for harvest management

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Executive summary

This brief report outlines current knowledge of the Grand Lake paddlefish *Polyodon spathula* stock and fishery as of August 1, 2009. We discuss possible harvest management implications for the stock and for Oklahoma paddlefish in general. Key results based an analysis of data from the Paddlefish Research and Processing Center (PRPC) are:

1. The paddlefish harvest brought into the PRPC from February through May consists of 95-99% sexually mature fish.
2. The paddlefish adult stock and harvest is dominated by fish between 5 and 15 years old.
3. The current robust fishery is sustained by one strong year class, produced in 1999.
4. Annual recruitment of Grand Lake paddlefish is highly irregular; recruitment of the 2000-2003 year classes into the harvestable stock is poor.
5. Grand Lake paddlefish are small compared to many other stocks, and smaller than historically harvested fish.
6. Males and females are closer to each other in age-at-maturity and in adult size than for more northerly stocks.
7. The total paddlefish harvest brought to the PRPC is spread among a large number of permits, not concentrated among a few high-liners.
8. The best paddlefishing in a given year will vary with river discharge; in 2008 and 2009 the most returns to the PPRPC occurred in the last week of March and first week of April.

9. The highest numbers of paddlefish were brought in to the PRPC in 2008 and 2009 on Saturday.

Overview

This brief report is intended to outline current knowledge of the Grand Lake paddlefish stock and fishery as of August 1, 2009. We discuss possible harvest management implications for the stock and for Oklahoma paddlefish in general. Although paddlefish investigations have been conducted on Oklahoma since the 1950s, the opening of the Research and Processing Center (PRPC) on Grand Lake in 2008 has provided us with detailed quantitative fishery information that was previously unavailable. This is the second year of intensive paddlefish research and stock assessment of Grand Lake paddlefish conducted jointly by the Oklahoma Department of Wildlife Conservation (ODWC) and the University of Idaho (UI). As part of this joint effort, we are currently assembling and analyzing all available historical paddlefish data into a comprehensive Oklahoma Paddlefish Plan involving all Oklahoma waters and paddlefish harvest management units. Such a plan will require one or more years to complete, however. It is important in the immediate future to develop a sustainable harvest management system for Grand Lake paddlefish. A sustainable plan for the species to accompany the successful roe donation/caviar processing activities at the PRPC are the two critical aspects by which the ultimate success of the Oklahoma

Paddlefish Management Program will be judged by state agencies, federal agencies, conservation organizations, and the public.

In 2008 and 2009, the higher than anticipated angler interest and harvest in the Grand Lake paddlefish snag fishery indicates that a timely review is warranted of stock status, existing harvest regulations, and possible harvest management options. This report has been prepared to facilitate such a review.

Previous Investigations of Oklahoma paddlefish.

Historical paddlefish stock assessments and studies prior to 2004 by Houser and Bross (1959) and Houser (1965), Linton (1961) Combs (1982), Ambler (1987; 1994), and Paukert and Fisher (2000, 2001) have resulted in improved understanding of general aspects of the species life history, movements and habitat requirements. Most of this work had been rather specific and not been designed for comprehensive stock assessment. In the earlier studies on Grand Lake paddlefish (Combs 1982, Ambler 1987, 1994), data collected lacked information on weight, sex and age of fish. Data collected from 2004, and especially in 2008 and 2009 have not suffered from those limitations and have greatly expanded our knowledge of stock status. The data collected over the past 5 years thus forms the basis of most of the following discussion. In the interest of organizing the available data in a form relevant to determining paddlefish stock status, the approach used is to identify a series of key results, followed by evidence supporting that result, followed by our assessment of the potential harvest management implications. Information on harvest rates is not included in this report because of ongoing accuracy checking of the database and evaluation of assumptions of population estimation.

Available information on Kansas harvest of Grand Lake paddlefish has been requested and is being provided, but is not yet available for this report.

Key Results – Grand Lake Paddlefish Stock

The Grand Lake paddlefish harvest brought into the PRPC from February through May consists of 95-99% sexually mature fish.

Evidence -- The spring fishery in the Grand Lake headwaters, Neosho River from Twin Bridges State Park, Miami Park, and into Kansas, and in the Spring River targets sexually mature fish on their pre-spawning upriver migration. In 2008, nearly all harvested males and females brought to the Center for processing were sexually mature. This conclusion is seen from the GSI (gonadosomatic index; gonad weight /fish weight); GSI weights by age provided information on maturation state. For males, GSI was low at ages 3-4, and remained nearly constant for fish up to age 15 (Figure 1). The age 3-4 fish were immature. For females, GSI was increasing in years 8-11, and peaking from ages 12-15, and declined thereafter (Figure 2). The maturity of females was clearly seen from the presence of black eggs, pre-ovulated in nearly all fish but ovulated and spawned out in a few fish later in the fishing season.

Of the few immature fish harvested, most are taken in the reservoir from trolling early in the spring harvest period (February and March). Detailed creel data from other seasons (when the PRPC is closed) is incomplete, but it is probable that a higher fraction of immature fish is taken at other seasons at reservoir locations by trolling when the immature fish and mature fish are intermixed. Small immature fish caught may also be

preferentially released by anglers at any time of the year.

This result of a fishery targeting on mature pre-spawners is similar to what is found for the Yellowstone-Sakakawea paddlefish stock in Montana and North Dakota during their May-June seasons (Scarnecchia et al. 2008).

Harvest Management Implications –Under the present regulations allowing immediate high-grading (sorting) of fish, the spring fishery will not harvest many immature fish. Even if retention of fish were mandatory as it was for this stock in Kansas in some past years, and as in Montana and North Dakota, the only significant numbers of immature fish likely to be harvested would be in the upper reservoir, not in the rivers. A river-based fishery would insure that no fish was harvested before it had at least a chance as mature fish to ascend a river to spawn. If any time-area closures were contemplated, either for benefits to the stock or fishery enforcement, closures would have the least negative impacts on a successful annual fishery if enacted in the reservoir, and in periods when adult paddlefish are not migrating, i.e., all months other than February through May. Based on 2008 and 2009 harvests and a historical analysis of river discharges in the Spring and Neosho Rivers, within the 4 month (February-through May) period, a narrower, more optimal window of harvest encompassing the prime harvest season could also be identified. That period would typically be the entire months of March and April.

The paddlefish adult stock and harvest is dominated by fish between 5 and 15 years old.

Evidence -- For 147 paddlefish collected in 2004 from Grand Lake, the Neosho River, and Miami Park, males ranged from 4 to 18 years and averaged 6.4 (N=55);

females ranged from 4 to 19 years and averaged 7.9 years (N=37). Fish of unknown sex ranged from 4 to 22 years and averaged 9.8 years. The most common age was 5 years for males (62%) and females (38%; Figures 3, 4). Only 5 of the 147 fish (3%) were older than age 15.

In 2008, 4,088 individually identified fish were measured, 2,392 males and 1,696 females. Ages were determined for 2385 males and 1688 females, or more than 96% of the 4,222 fish brought into the Center. Ages for males ranged from 3 to 15 years and averaged 9. Females ranged from 8 to 27 and averaged 10. Females of ages 10-15 were more abundant than males of those year classes. No males exceeded age-15, and less than 1% of all females exceeded age-15 (Figure 5).

In 2009, of 1354 randomly-selected paddlefish aged as of August 1, no fish exceeded age-15. Males ages ranged from 6 to 14 and averaged 9.7. Females ranged from 5 to 15 and averaged 10.2 (Figure 6).

It was not possible to ascertain whether the near absence of older fish (>15 years) in 2004, 2008 and 2009 is a result of fishing mortality or natural mortality associated with a naturally short lifespan of no more than 15-20 years. Past high harvests may have depleted older, larger fish. It is also probable, however, that at lower latitudes, the longer growing season and higher water temperatures throughout much of the year exact a high energetic demand on the paddlefish, resulting in a shorter lifespan than is observed in all the more northerly stocks. Paukert and Fisher (2001) reported that natural mortality rates for adult paddlefish in Keystone Reservoir were 27-34%. It is known that northern stocks live much longer than any fish found in this stock (Russell 1986, Scarnecchia et al. 2007), so the lack of larger fish has a strong environmental component. Future studies

will evaluate possible causes of the high total mortality of Grand Lake fish.

Harvest Management Implications -- If natural mortality limits the typical lifespan to about 15-18 years, the result has significant implications for harvest management. In more northern localities, mature recruited fish not harvested in a given year can survive for many years and can thus be stockpiled, much like storing funds in a bank, for later harvest. A large number of broodstock is therefore also protected with minimal loss to natural mortality. A future harvest model must account for the higher natural mortality of this stock than for more northerly stocks. In addition to the potential benefits of larger, older fish with higher fecundity and more caviar, older fish may be more successful spawners (Scarnecchia et al. 2007). Although the possibility for stockpiling large numbers of older fish does not seem to exist for the Grand Lake stock, some fish might be stockpiled with moderate harvest rates to insure sufficient annual spawners.

The current robust fishery is sustained by one strong year class, produced in 1999

Evidence – Dentary (jaw bone) sections collected in 2004, 2008 and 2009 all confirm that the sexually mature component of the Grand Lake stock is dominated by one strong year class, produced in 1999. In samples from 2004, the most common fish were age-5 (81% of all males and 60% of all females; Figures 3, 4). By 2008 this dominant year class was 9 years old (Figure 5) and constituted 81% of harvested males and 60% of harvested females. In 2009, the same year class, by then age-10 fish (1999 year class) constituted 63% of the males and 79% of the females brought to the PRPC (Figure 6). The evidence of the dominance of this one year class was based on annual marks on

dentaries (Figures 7, 8), but was also clearly observable by those weighing and measuring fish at the PRPC. In 2008 and 2009, most fish brought for cleaning were of uniform size and appearance, with few small, young fish and few fish with boat scars or other marks characteristic of older fish.

The exact cause of the strong year class is not known. However, preliminary results indicate that the strong year class was associated with exceptionally higher discharge during the spring period of 1999 on both the Neosho River and Spring River (See Inserted Table in Figure 5). Other investigators have also founds that higher discharge is associated with stronger year classes of paddlefish (See discussion in Scarnecchia et al. 2009).

Annual recruitment is highly irregular; recruitment of the 2000-2003 year classes into the harvestable stock is poor.

Evidence -- Although reproduction has been occurring in most or all years, the evidence indicates that reproductive success is highly variable and is much lower over the period 2000-2003 than in 1999 (Figures 5,6). Data on age and maturation from the 2004 harvest indicate that many Grand Lake male paddlefish mature as early as age 4 to 6, and females perhaps as little as 2 years later. In 2008, however, only 8% of the male fish brought to the PRPC were age 8 or less, even though mature male fish would be recruited by then, as they had been in 2004 (Figures 3,4). Among males, age-8 fish were the second most abundant group (7%), but few age-8 females were found (1% of all females; Figure 5). In 2009, only about 2% of fish brought to the PRPC were smaller than 9 kg (20 lbs.), which was consistent with the low number of younger fish (2000-2003 year

classes) found in the harvest.

The causes of these weaker year classes are not yet known. However, spring discharges in 2000-2003 were lower than in 1999, the year of the dominant year class (See inserted Table in Figure 5).

Some earlier data from Fort Gibson Reservoir (Houser and Bross 1959; Houser 1966) suggests that the highly irregular reproduction observed in Grand Lake has been a common pattern in Oklahoma paddlefish. Evidence from the other intensively studied stock in North America (Scarnecchia et al. 2009) also indicates that this pattern of highly irregular, uneven recruitment of wild fish is typical and to be expected for paddlefish.

Attempts were made to collect age-0 paddlefish in the Grand River system during the summers of 2008 and 2009 in an effort to assess recruitment. The methods used to sample were visual observations used by Fredericks and Scarnecchia (1997) and Scarnecchia et al. (1997). Cast nets and dip nets were also used in unsuccessful attempts to collect age-0 fish. In July 2008 two crews sampled from Riverview City Park in Miami, OK downstream to the upper reaches of Grand Lake. In 2009 sampling began in June to examine the possibility that we had missed the prime period of time in which this type of sampling was effective. In addition to sampling the upper reaches of Grand Lake, a 15 mile stretch of river above Miami's Riverview City Park (up to Step Ford Bridge) to the area sampled. No age-0 paddlefish were collected in 2009. Since the results of the two years of sampling resulted in no success, other methods of paddlefish young of year sampling are being investigated.

Harvest Management Implications -- The highly successful fisheries in 2008 and

2009 were sustained by the 1999 year class. Few fish are recruiting in the 3-4 years behind them, and few fish in older year classes were harvested. Until the size of the 1999 year class is accurately determined, a more cautious harvest approach is recommended than if all year classes from 1999-2003 had been important contributors to the harvests in 2008 and 2009. The year class must sustain the stock and the fishery until another strong year class develops. At this time, we do not know when the next strong year class will occur. The earliest future indication we can expect to detect in 2010 and 2011 would be a high number of fish in the harvest aged 5 or 6 (mostly males), as seen in 2004 (Figure 3).

Grand Lake paddlefish are small compared to many other stocks, and smaller than historically harvested fish.

Evidence -- Grand Lake paddlefish harvested in 2008 and 2009 were characterized by small size and slow growth. Less than 2 % of harvested fish reached 25 kg in 2008 and 2009. The current fish size is small compared to historical sizes documented by Ambler (1987) for this stock and other Oklahoma paddlefish (Houser and Bross 1959). A preliminary assessment of historical records from Grand Lake indicates that fish in past years have often reached weights of twice the typical fish caught in the two most recent years. The modestly sized GFBs, the large masses of lipids attached to paddlefish gonads, were typically only 2.5-3.5% of body weight for males and less than 1% for females (Figures 9,10), which indicated that energy storage in these fish is not great. Scarnecchia et al (2007) fund that GFB weights/fish weights were typically 5-8% for both young mature males and females. Larger GFBs in the Montana-North Dakota stock is associated with fast growth in the reservoir and high rates of energy storage

(Scarnecchia et al. 2009).

It is not yet known whether these fish are small because of changes in specific environmental factors such as reservoir productivity, inter-specific competition, or some intra-specific, density dependent growth, perhaps associated with a strong year 1999 class. It is possible that individual fish of the strong 1999 year class may have competed with each other for limited food, resulting in a smaller size at maturation for all of the fish. It is also possible that ecological conditions for rearing of paddlefish in Grand Lake create some seasonal bottlenecks resulting in slow growth and higher than expected natural mortality. These are topics for future investigation.

Harvest Management Implications -- If strong density-dependent growth of paddlefish is occurring, it suggests that the lake as of a few years ago was near carrying capacity for the species. In this situation, any hatchery propagation beyond that needed for age validation would not only have been unnecessary at that time but counterproductive. In theory, strong year classes such as in 1999 may also impede succeeding year classes if food is limiting. Specific proof of density dependence is lacking, however. Since paddlefish growth is greatly slowed following sexual maturation (Scarnecchia et al. 2007), it is not expected that 1999 year class fish will grow very much as their numbers are depleted by fishing and natural mortality. Any significant numbers of larger fish than those now observed will probably come from more recent year classes produced after 1999.

Males and females are closer to each other in age-at-maturity and in adult size than for more northerly stocks.

Evidence -- Males and females differ in age at maturity by only 2-3 years. Age at first maturity is still being determined, but von Bertalanffy growth curves indicate that males and females grow at similar rates to about age-5 when at least some males begin maturation. Females appear to begin maturation 2-3 years later, and as a result are larger at age after age-5 than males (Figures 11, 12). Males were distinguishable from females by their smaller size, seen both in the length and weight frequency distributions (Figure 13, 14) and in length and weight at age (Figures 11, 12). Males grew more slowly than females in the years leading up to male spawning migration.

Age at maturity can also be inferred from GFBs. Male GFB weights as a percentage of fish weight were low at ages 3-4, and fluctuated at about 1.5-4% of fish weight for years up to age 15 (Figure 11). For females, mean GFB/fish weights were highest at 0.8 to 1 % at ages 8, 9 and 10, and declined thereafter to about 0.24 % by age-20 (Figure 12). GFB weights for females also declined in relation to egg weight as the fish aged (Figure 15).

The difference in age and size at maturity between males and females in the Grand Lake stock is thus very modest compared to stocks farther north (North Dakota: commonly 8-10 year difference in age a maturity; 20 kg difference in weight; Scarnecchia et al. 2007).

Harvest management implications -- This comparatively small difference in size between males and females has significant implications for harvest management. In more northerly stocks, high-grading for larger fish is a major issue; nearly all females are much larger than nearly all males (typically twice or three times as heavy), resulting in the potential for a highly biased harvest in favor of females, the opposite of what would

typically be preferred to sustain broodstock. For the harvest management perspective, a harvest composed of more than half males would be preferred. High grading issues (along with other social issues such as crowding at fishing sites) have contributed to the enactment of mandatory retention regulations for paddlefish in Montana and North Dakota. In Oklahoma, however, the need for such a regulation based on biological grounds would be considerably less than for more northerly stocks. Although males of a given age tend to be smaller than females, the difference is not great, and the higher number of males in the catch than females in both 2008 and 2009 suggests that at most only moderate high-grading toward females is occurring. In future years, anglers could be informed that because of the higher gonadal weight of eggs than testes, the actual weight of finished filets for males and females would in most cases be comparable, even if males typically weighed a few pounds less. The comparatively small difference between males and females implies that regulations based on size limits designed to protect females would have limited usefulness for this stock.

Key Results – Fishery

The total paddlefish harvest brought to the PRPC is spread among a large number of permits, not concentrated among a few high-liners.

Evidence –Analysis of PRPC data of the frequency of total permit numbers (N=7,392) from 2009 indicates that half (49%) of the numbers appeared only once or twice (Table 2). Just under 70% of the PRPC catch was by permittees returning three or less fish; the remaining 30% of the fish brought to the PRPC were from permittees

returning 4 or more fish. The average number of fish returned to the PRPC per permit was 2 fish. This does not imply that the total catch per permittee was only two fish, because some snaggers may only have returned a portion of their total catch to the PRPC.

Harvest Management Implications- This information can be used, with caution, in many ways in formulating harvest management regulations. One way to interpret and use the information in Table 1 is that reducing an individual's bag limit from one fish per day (the current regulation) to four fish per year would have saved only 30% of the total harvest. The fish are already spread among a high number of snaggers. A few people caught and brought large numbers of fish to the PRPC (e.g. 6 or more), but unless they are catching many more fish outside the PRPC season, their impact on total harvest is not great.

Based on this result, how could a reduction in total harvest be brought about? Only a reduction of harvest to 2 fish per person per year would be expected to provide a reduction of harvest brought to the PRPC by about half. With the high number of snaggers, there would still be a substantial harvest. A reduction to three fish per year would be expected to reduce PRPC returned catch by 30%. Enacting any regulations such as a 4 or 5 fish annual bag limit would limit high harvest by a few, but would not be expected to affect catch by a significant amount.

A primary way that other states with active and effective management programs have dealt with needed harvest limitation has been by restricting, via a tag system, the number of fish caught per person per year. This approach is used in Nebraska, South Dakota, Montana, and North Dakota; in each state annual limits are one or two fish. If the stock will support it, more liberal annual regulations may also be used. An individual

harvest cap limits the ability of anglers to alter their fishing patterns to compensate for the intended effects of the regulation.

The best paddlefishing in a given year will vary with river discharge; in 2008 and 2009 the most returns to the PRPC occurred in the last week of March and first week of April.

Evidence -- Returns of paddlefish to the PRPC can be expected to vary annually according to factors such as river discharge. However, in both 2008 and 2009, returns were highest the week encompassing the last few days of March and first few days of April (Table 1; Figure 16). This time can be expected to be a typical period of peak fishing. However, peak fishing can be expected to vary by up to two weeks in either direction depending mainly on variations in annual flows as well as water releases from John Redmond Reservoir.

Harvest management implications -- Season closures may be considered in paddlefish fisheries for a variety of reasons, including avoidance of harvest of immature fish, social factors, and enforcement factors. For this stock, a March and April fishery will include the period of best fishing in all but highly unusual years. Thus is the same general pattern observed in Montana and North Dakota; their fisheries extend for 6 weeks and 4 weeks respectively. Other states typically have season closures outside of the spring season as well.

The highest numbers of paddlefish were brought into the PRPC in 2008 and 2009 on Saturday.

Evidence -- Analysis of daily catches brought into the PRPC in 2008 and 2009, showed that the largest returns by day occurred in order on Saturday. Next highest returns in 2008 were (in order) on Sunday, Friday and Thursday. Next highest returns in 2009 were (in order) on Friday, Sunday, and Thursday (Table 1; Figure 17).

Harvest Management Implications -- Assuming that Saturday, a prime recreational day, would remain a harvest day, any daily closures to spread out or slow harvest would be most effective if implemented on Friday or Sunday. A Monday closure would perhaps reduce Sunday harvest for out-of-state snaggers having to travel home on Sunday.

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Figure 1.

GSI (Testes weight / fish weight) vs. age for male paddlefish
(2008 Oklahoma harvest data)

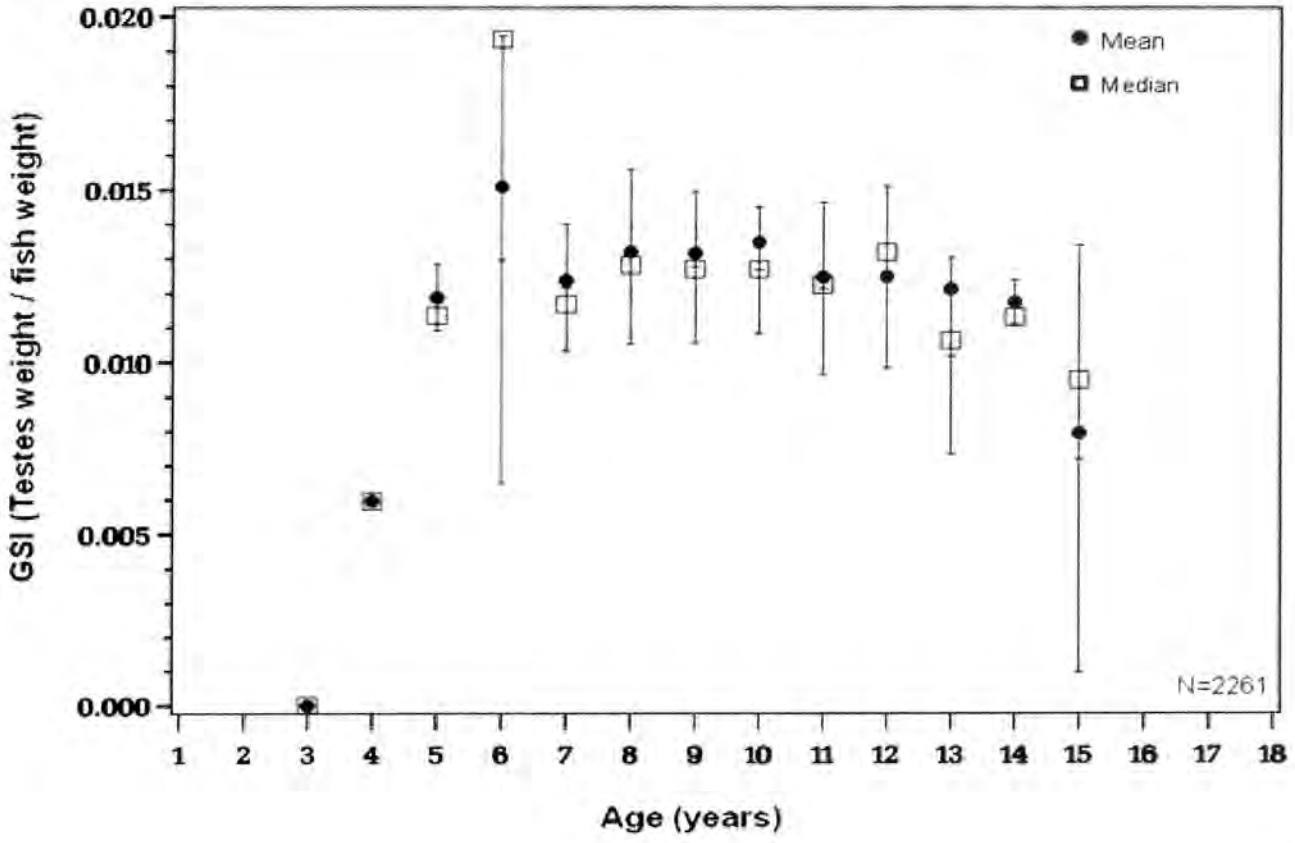


Figure 2.

GSI (Green egg weight / fish weight) vs. age for female paddlefish
(2008 Oklahoma harvest data)

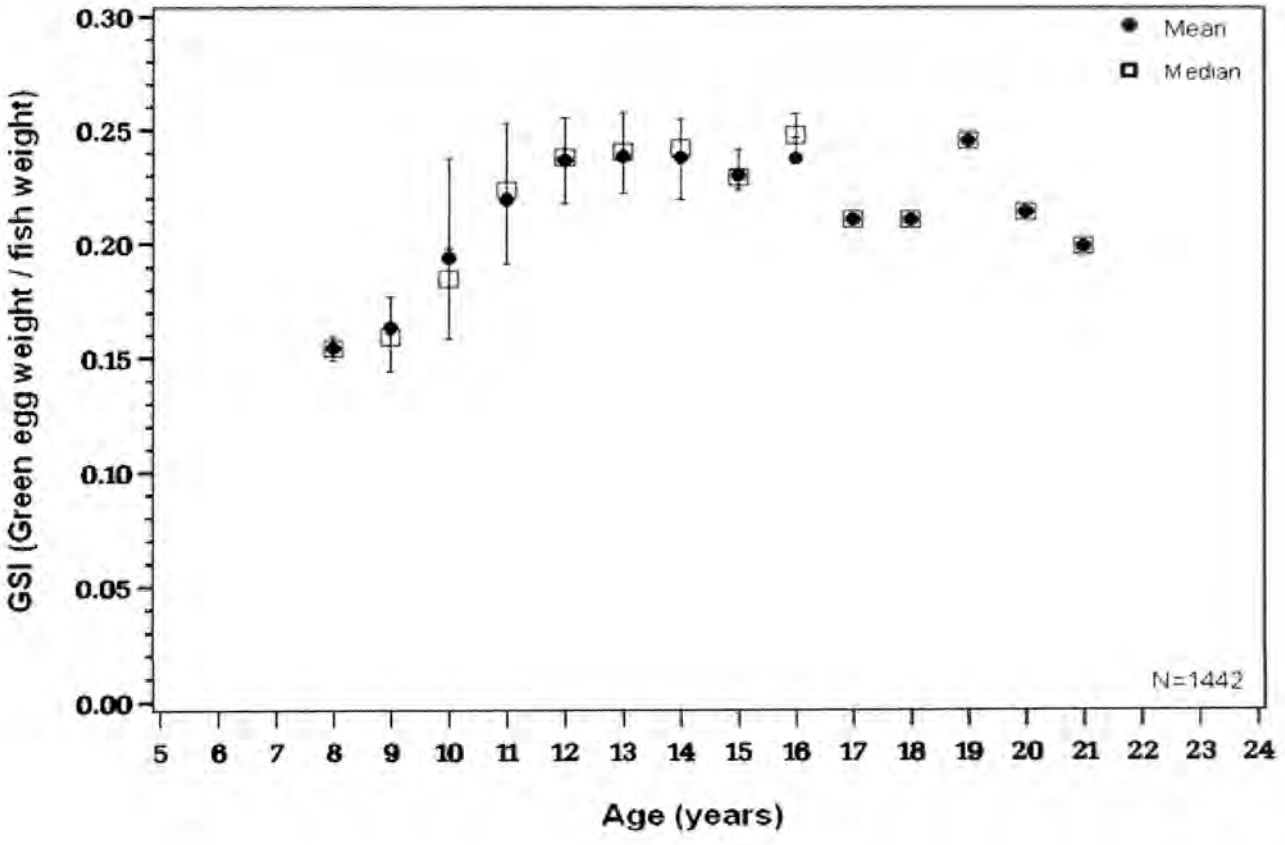


Figure 3.

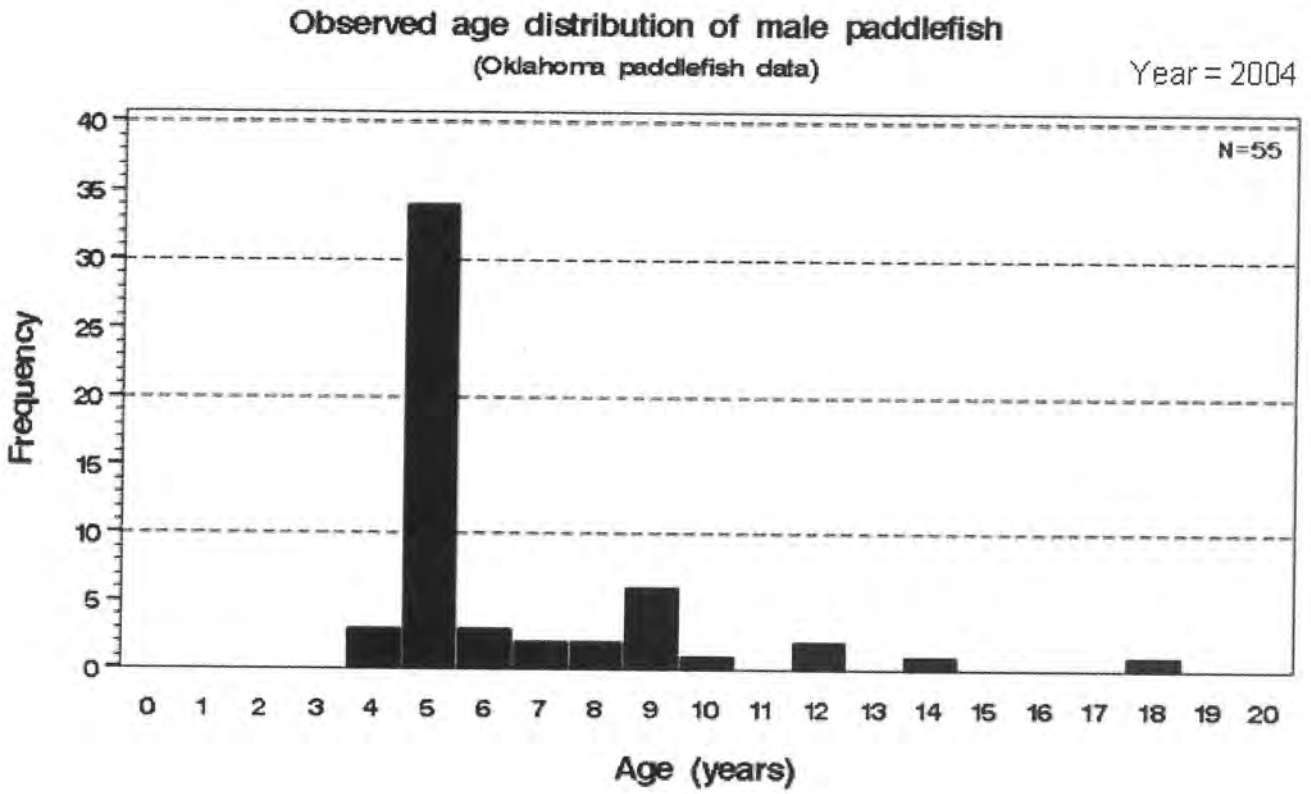


Figure 4.

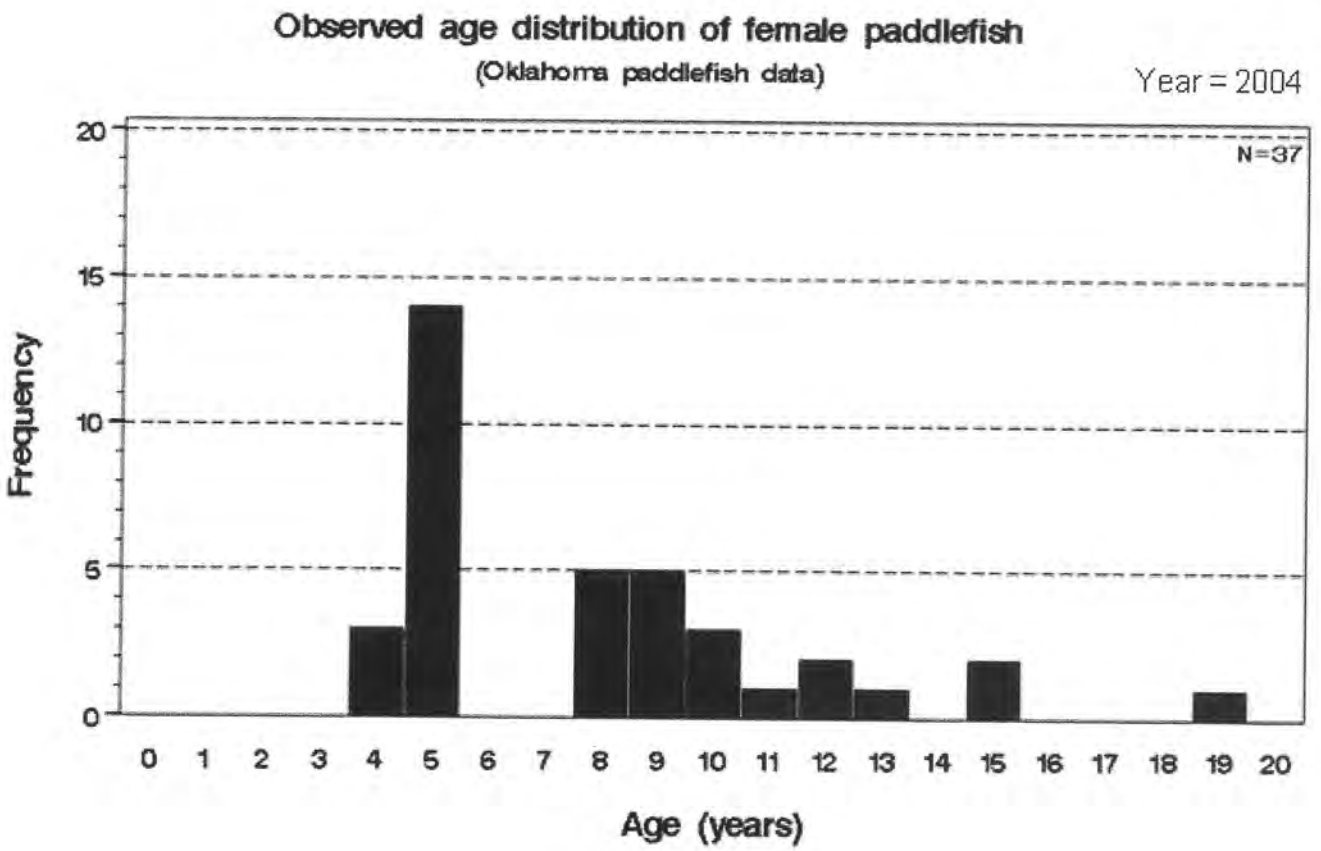
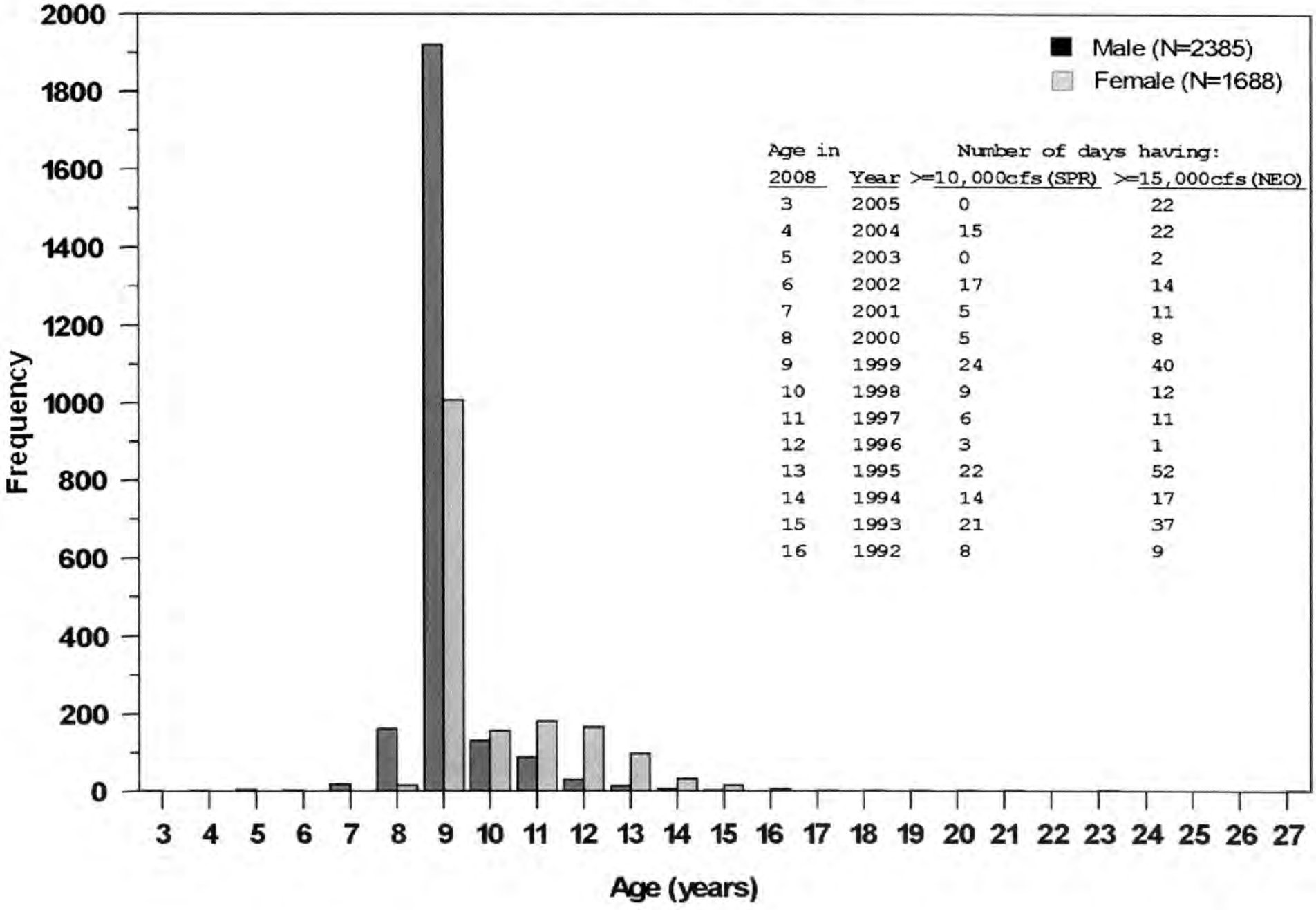


Figure 5.

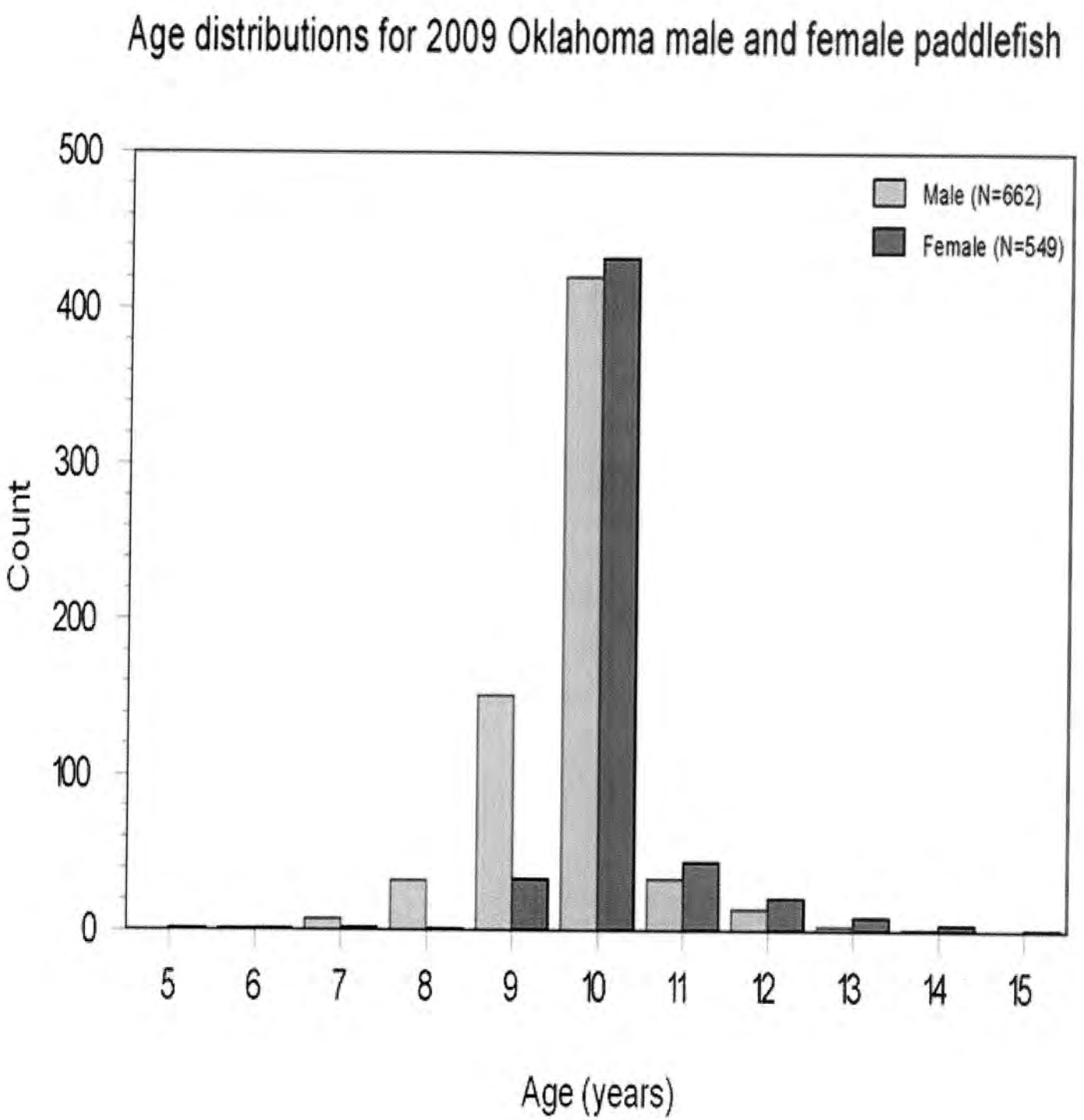
Frequency histograms for male and female paddlefish age

(2008 Oklahoma harvest data)



Age in 2008	Year	Number of days having: >=10,000cfs (SPR)	>=15,000cfs (NEO)
3	2005	0	22
4	2004	15	22
5	2003	0	2
6	2002	17	14
7	2001	5	11
8	2000	5	8
9	1999	24	40
10	1998	9	12
11	1997	6	11
12	1996	3	1
13	1995	22	52
14	1994	14	17
15	1993	21	37
16	1992	8	9

Figure 6.


Age distributions for 2009 Oklahoma male and female paddlefish
Male (N=662)
Female (N=549)
Count
0
100
200
300
400
500
5
6
7
8
9
10
11
12
13
14
15
Age (years)

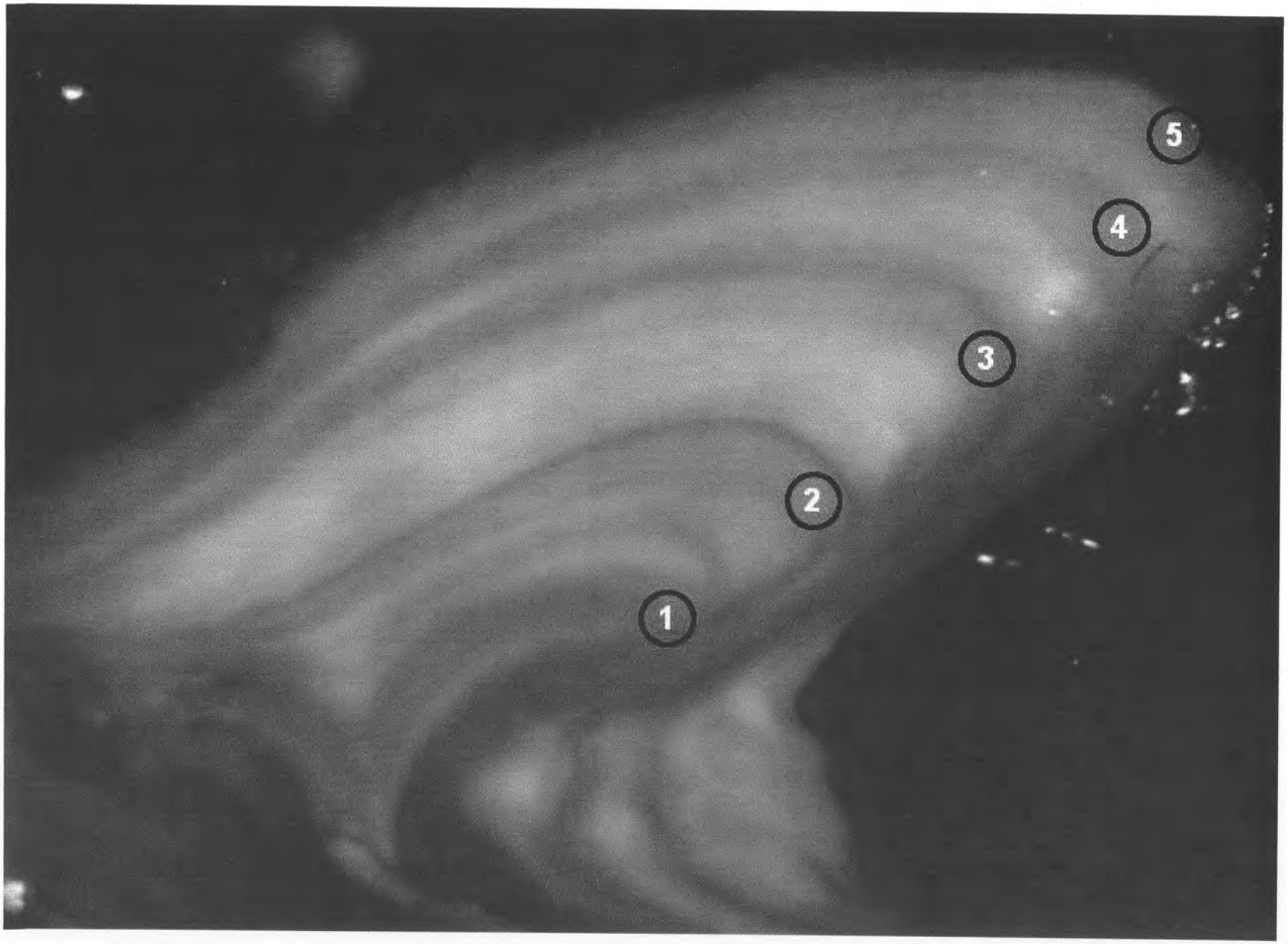


Figure 7. Grand Lake paddlefish, 1999 year class, sampled in 2004 as a 5-year old fish

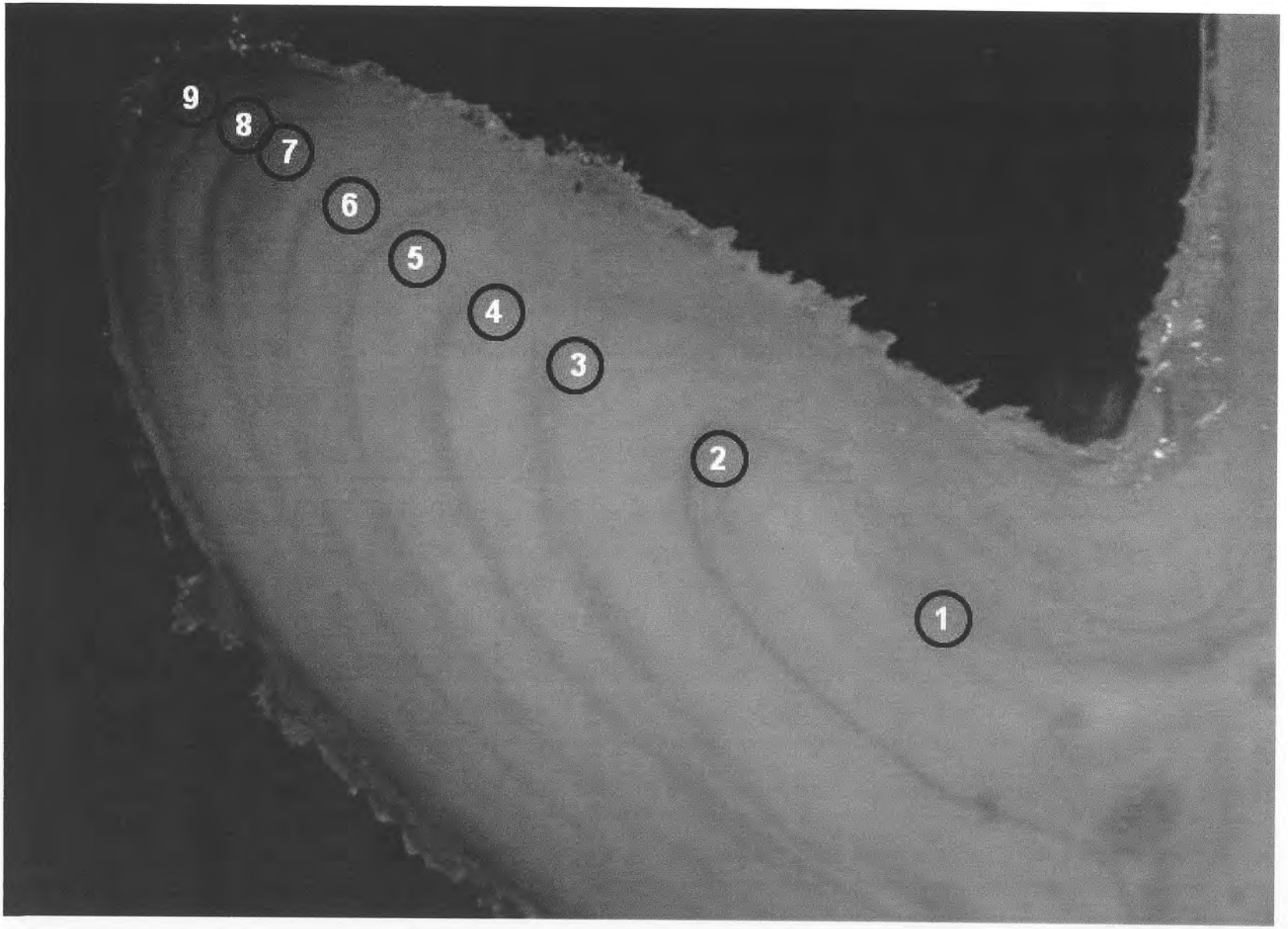


Figure 8. Grand Lake paddlefish, 1999 year class, sampled in 2008 as a 9-year old fish

Figure 9.

(GFB weight / fish weight) vs. age for male paddlefish
(2008 Oklahoma harvest data)

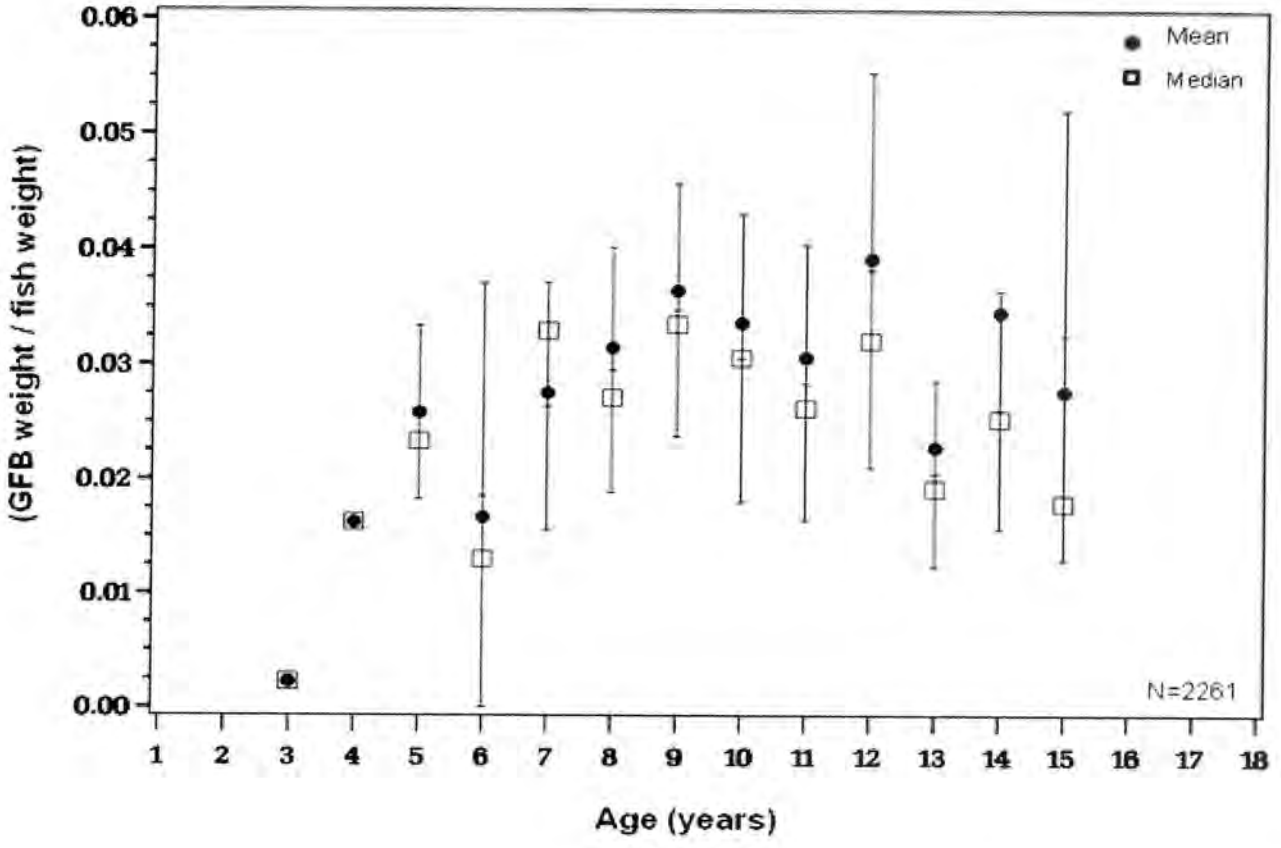


Figure 10.

(GFB weight / fish weight) vs. age for female paddlefish
(2008 Oklahoma harvest data)

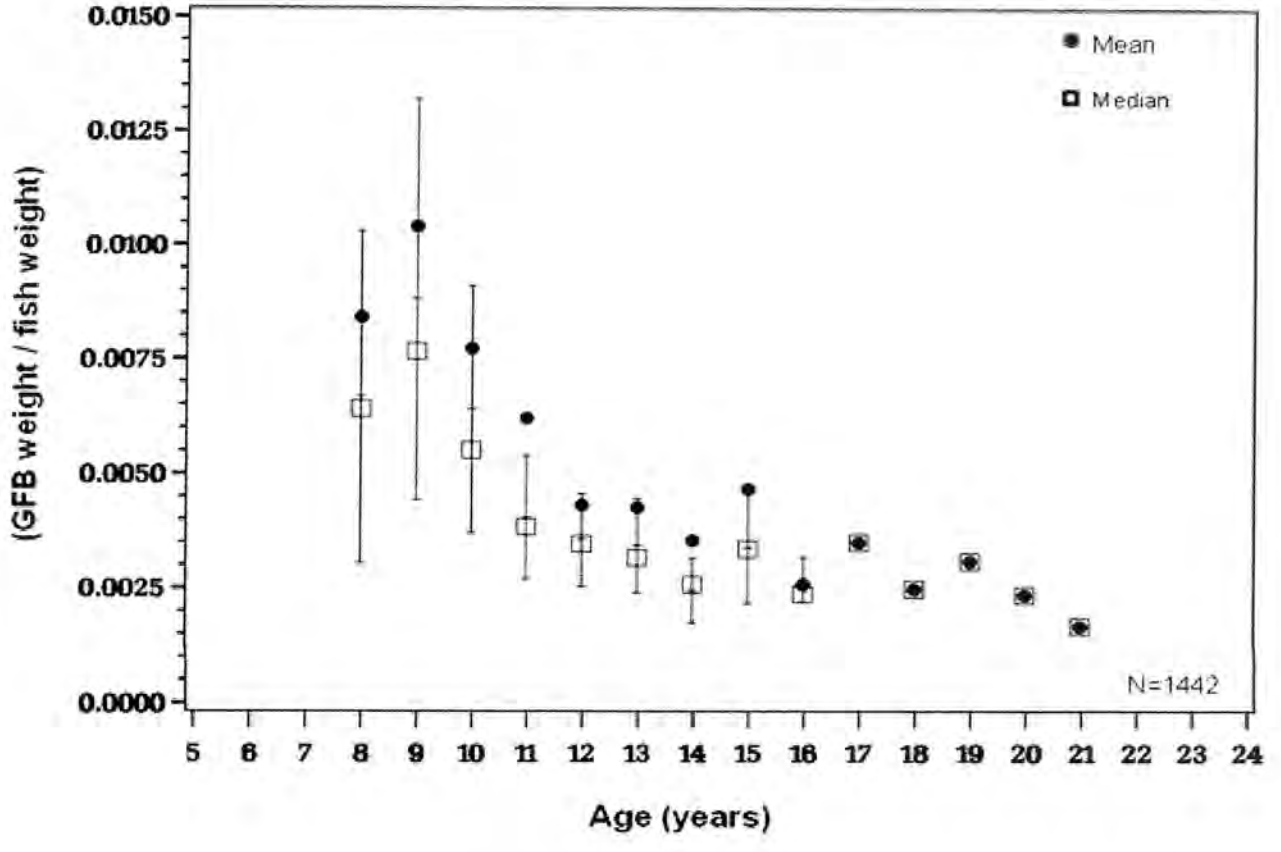


Figure 11.

Figure 12.

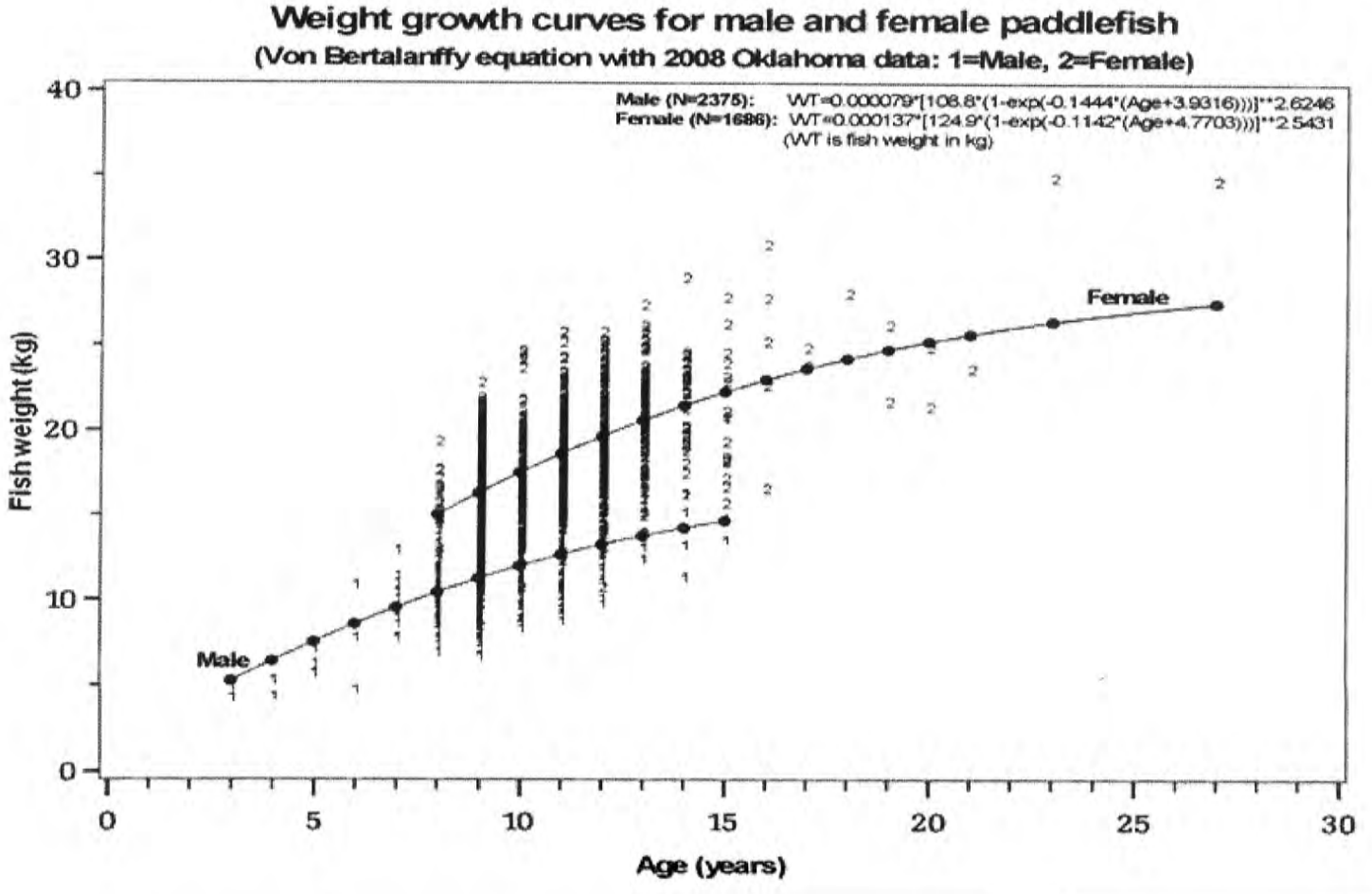


Figure 13.

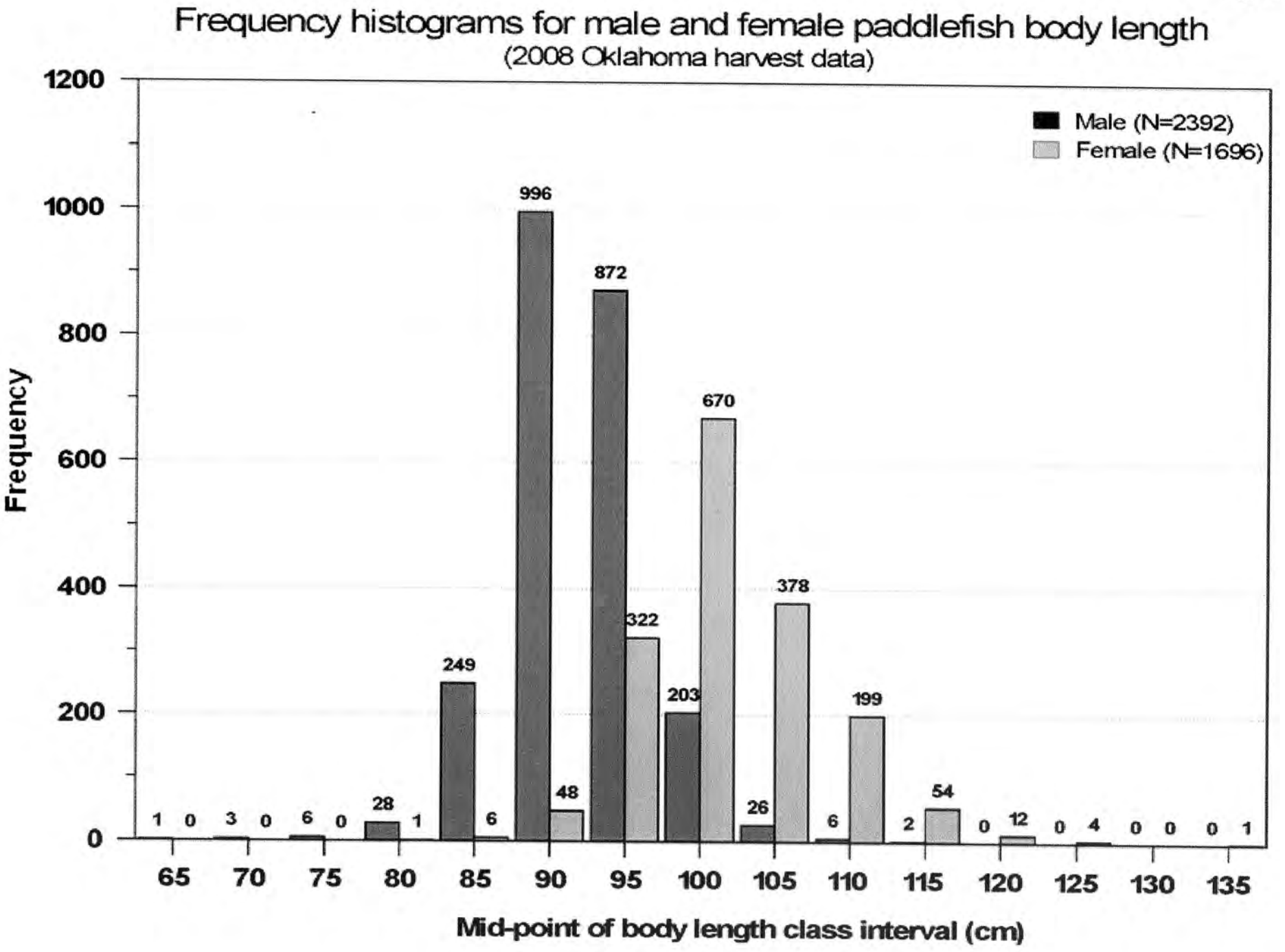

Frequency histograms for male and female paddlefish body length
(2008 Oklahoma harvest data)
Male (N=2392)
Female (N=1696)
Frequency
1200
1000
800
600
400
200
0
1 0 3 0 6 0 28 1 249 6 996 48 872 322 203 670 26 378 6 199 2 54 0 12 0 4 0 0 0 1
65 70 75 80 85 90 95 100 105 110 115 120 125 130 135
Mid-point of body length class interval (cm)

Figure 14.

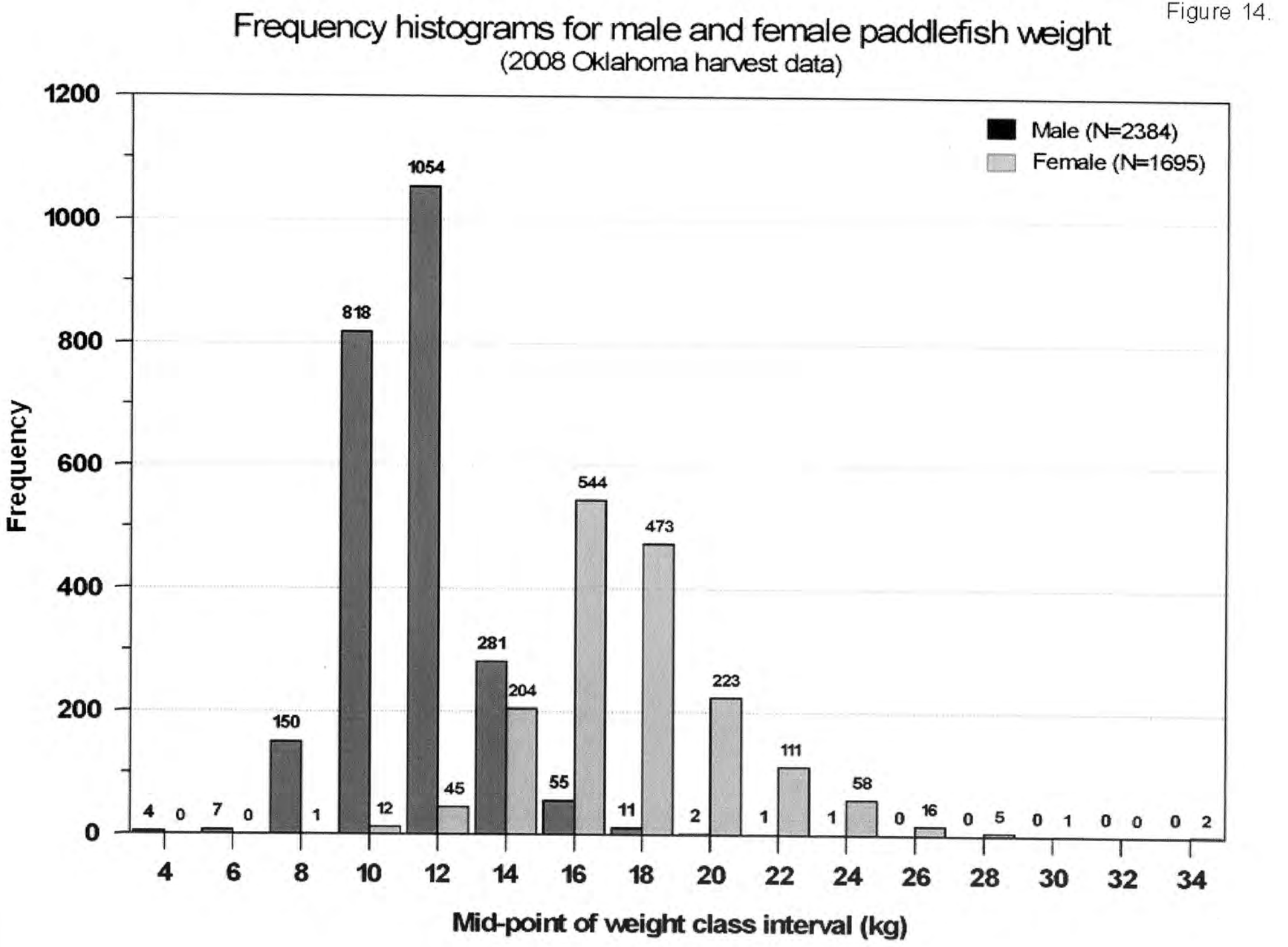

Frequency histograms for male and female paddlefish weight
(2008 Oklahoma harvest data)
Male (N=2384)
Female (N=1695)
Frequency
Mid-point of weight class interval (kg)
0
200
400
600
800
1000
1200
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
4
0
7
0
150
1
818
12
1054
45
281
204
55
544
11
473
2
223
1
111
1
58
0
16
0
5
0
1
0
0
0
2

Figure 15.

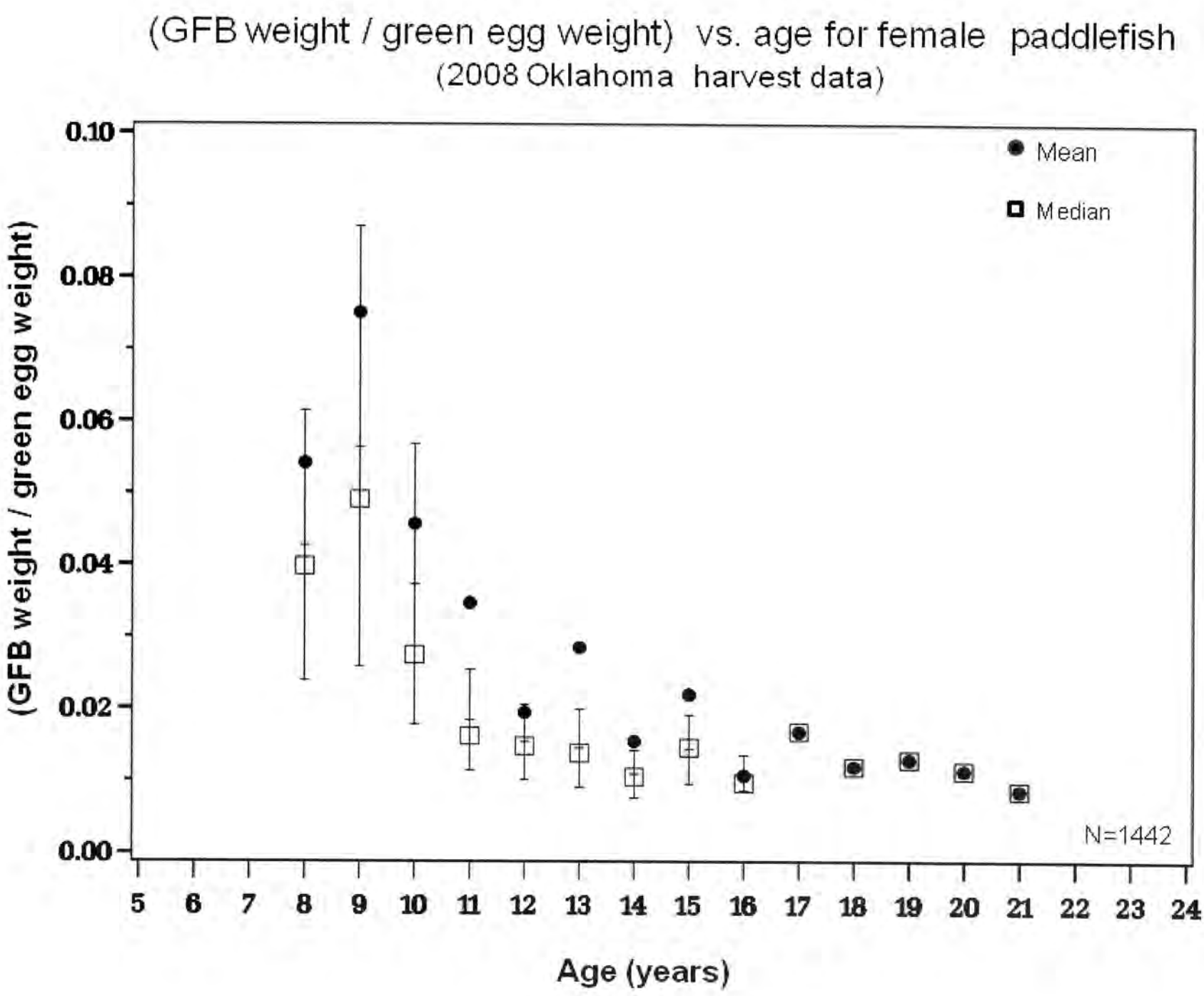

(GFB weight / green egg weight) vs. age for female paddlefish
(2008 Oklahoma harvest data)
(GFB weight / green egg weight)
0.10
0.08
0.06
0.04
0.02
0.00
Mean
Median
N=1442
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Age (years)

Figure 16.

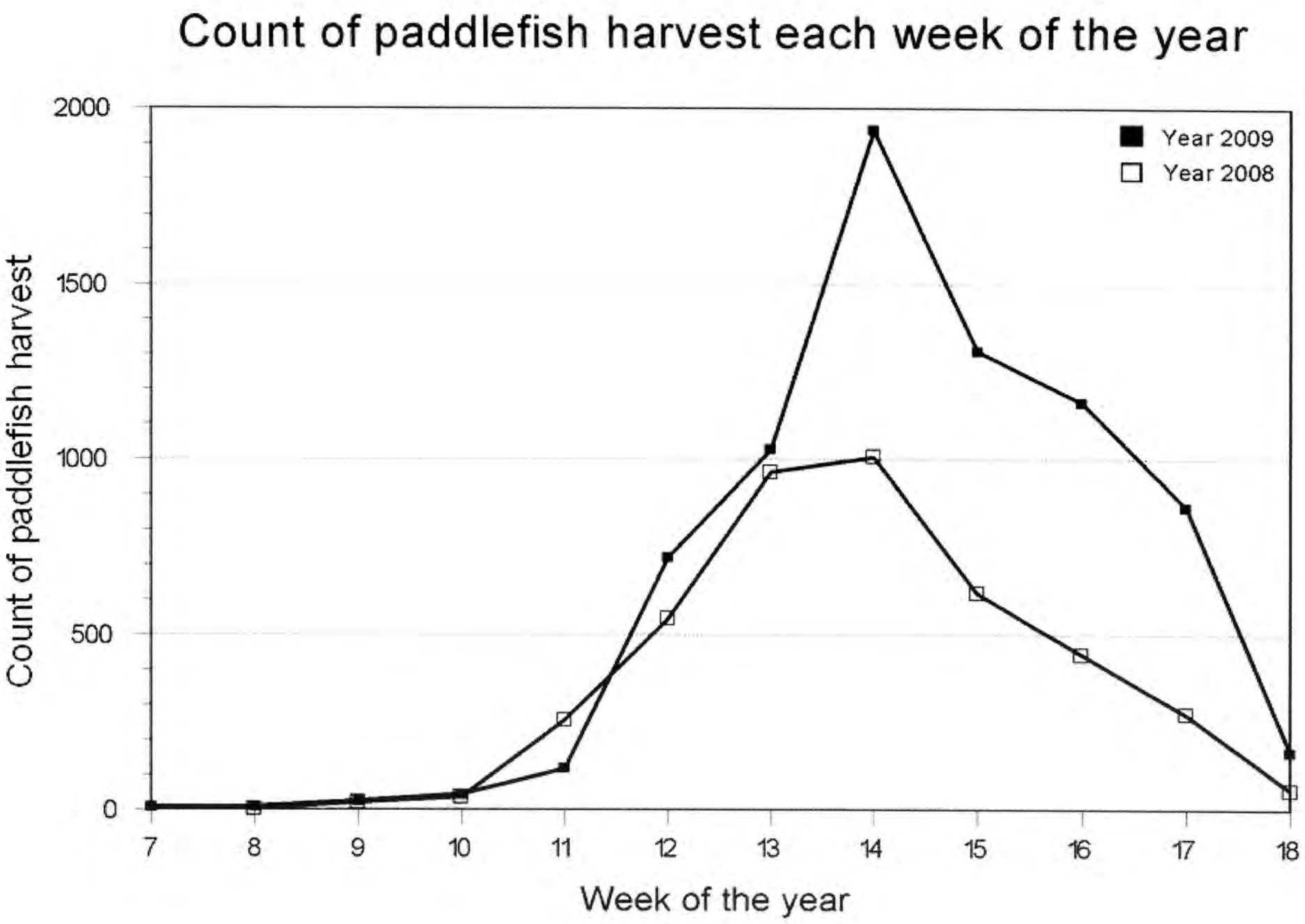
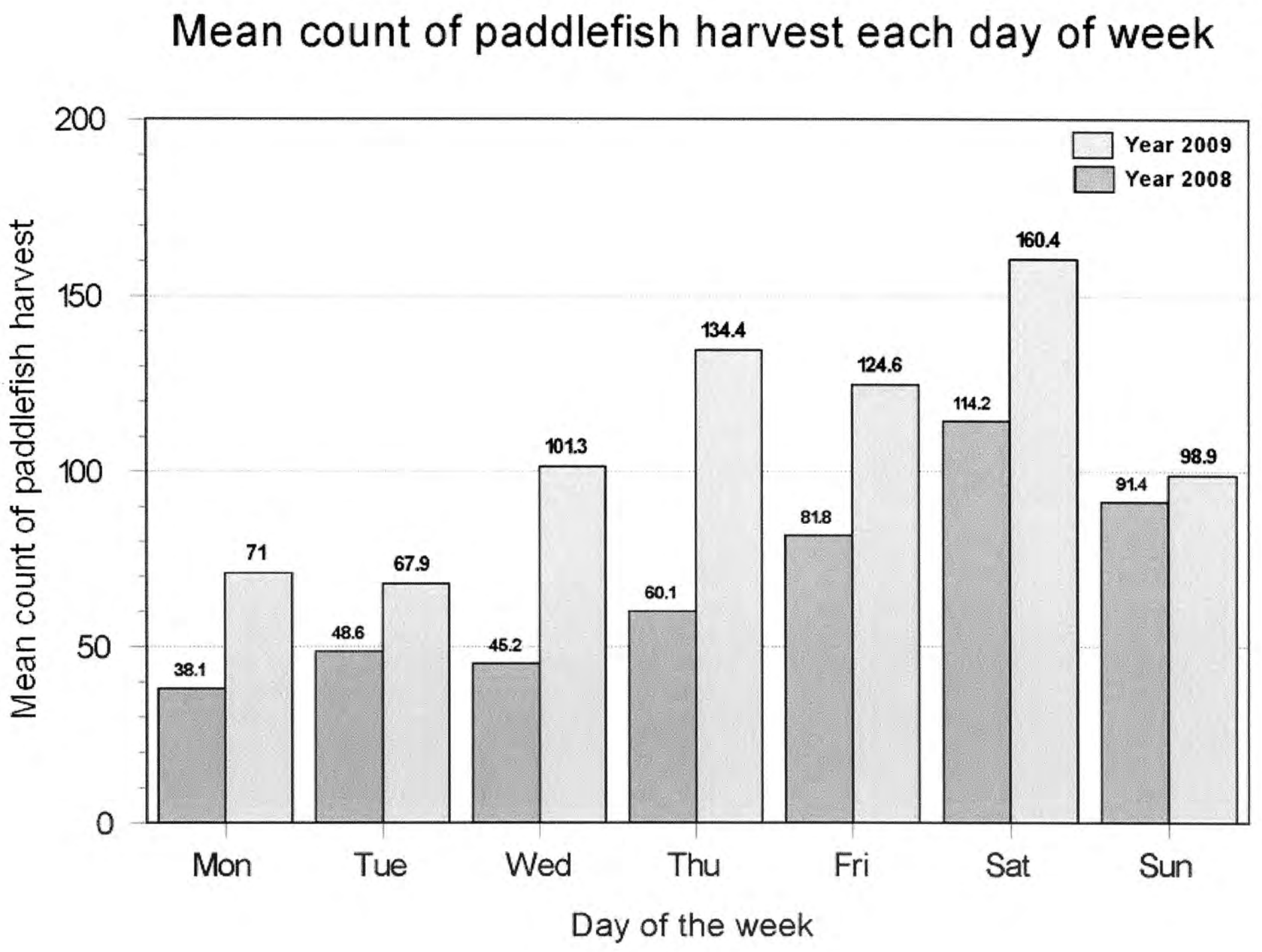

Count of paddlefish harvest each week of the year
Year 2009
Year 2008
Count of paddlefish harvest
2000
1500
1000
500
0
7
8
9
10
11
12
13
14
15
16
17
18
Week of the year

Figure 17.


Mean count of paddlefish harvest each day of week
Year 2009
Year 2008
Mean count of paddlefish harvest
200
150
100
50
0
38.1
71
48.6
67.9
45.2
101.3
60.1
134.4
81.8
124.6
114.2
160.4
91.4
98.9
Mon
Tue
Wed
Thu
Fri
Sat
Sun
Day of the week

Summary of harvested paddlefish by day of the week and week using 2008 and 2009 Oklahoma data

Year=2008 (N=4221)

Day	N	Count	Mean Count	Percent
Monday	9	343	38.1	8.13
Tuesday	7	340	48.57	8.06
Wednesday	9	407	45.22	9.64
Thursday	7	421	60.14	9.98
Friday	8	654	81.75	15.49
Saturday	10	1142	114.2	27.05
Sunday	10	914	91.4	21.65
(Total:		4221)		

Year=2009 (N=7389)

Day	N	Count	Mean count	Percent
Monday	8	568	71	7.69
Tuesday	9	611	67.89	8.27
Wednesday	9	912	101.33	12.34
Thursday	8	1075	134.38	14.56
Friday	11	1371	124.64	18.55
Saturday	11	1764	160.36	23.87
Sunday	11	1088	98.91	14.73
(Total:		7389)		

2008:

Period	Week	Frequency	Percent
2/17-2/23	8	3	0.07
2/24-3/01	9	22	0.52
3/02-3/08	10	37	0.88
3/09-3/15	11	256	6.06
3/16-3/22	12	546	12.94
3/23-3/29	13	963	22.81
3/30-4/05	14	1006	23.83
4/06-4/12	15	617	14.62
4/13-4/19	16	443	10.50
4/20-4/26	17	272	6.44
4/27-5/03	18	56	1.33

2009:

Period	Week	Frequency	Percent
2/08-2/14	7	8	0.11
2/15-2/21	8	10	0.14
2/22-2/28	9	25	0.34
3/01-3/07	10	44	0.60
3/08-3/14	11	118	1.60
3/15-3/21	12	721	9.76
3/22-3/28	13	1027	13.90
3/29-4/04	14	1938	26.23
4/05-4/11	15	1308	17.70
4/12-4/18	16	1162	15.73
4/19-4/25	17	864	11.69
4/26-5/02	18	164	2.22

2009 Oklahoma data summary concerning permit numbers and catch

Number of permits	Catch per permit	Total catch*
1966	1	1966
831	2	1662
494	3	1482
237	4	948
76	5	380
37 **	6	222
26 **	7	182
10 **	8	80
19 **	9	171
8 **	10	80
8	11	88
2	12	24
1	13	13
4	14	56
1 **	16	16
1 **	22	22
(Sum:3721)		(Sum:7392)

* Total catch = (Number of permits)*(Catch per permit)
** Some permits have inconsistent initials.

- Total number of permits were 3721.
- Total catches related to all permits were 7392.
- Overall mean of catch per permit=7392/3721= 1.99 catch/permit
- 954 catches out of 7392 were by 117 permits having 6 or more catches.