LAKE JAMES WALLEYE INVESTIGATION
SURVEY SUMMARY 1999-2004

Final Report

MOUNTAIN FISHERIES INVESTIGATIONS

Federal Aid in Fish Restoration Project
Project F-24

Project Type: Survey

Period Covered: November 1999 – October 2004

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2005


SPORT FISH RESTORATION

Abstract.—This report summarizes the findings of a walleye *Sander vitreus* gill net survey conducted on Lake James from November 1999 to October 2004. A total of 1,565 walleyes were captured, with an average catch rate of 21.1 walleyes/net night (range 19.0-23.2). Walleyes captured ranged from 225-635 mm total length (TL). Of the 1,565 walleyes collected, 52% were in the quality (≥ 380 mm) size class, 2% were in the preferred (≥ 510 mm) size class, ≤ 1% were in the memorable (≥ 630 mm) size class, and no trophy (≥ 760 mm) fish were obtained. Although the current size distribution shows very few large fish, 51% of the walleyes sampled were of legal harvestable size (≥ 381 mm). Walleye condition in Lake James was poor; the average Wr was 87 and ranged from 89 in 1999 to 82 in 2004. Walleyes up to age 12 were found, but the majority of walleyes were age 4 or less. Male and female walleyes began maturing at age 1 with the majority of male walleyes mature by age 1 and the majority of female walleyes mature by age 2. Walleye growth rates in Lake James are slow and differ by sex. Overall, walleyes reached the 381-mm size limit by age 2; however, by age 3 growth slows dramatically. The majority of male walleyes reached the minimum size limit by age 2. Females exceeded the minimum size limit by age 2 and more than likely reached the minimum size limit sometime at age 1 prior to sexual maturity. Population data for walleyes collected in Lake James from 1999-2004 were similar. The walleye population in Lake James is characterized by high numbers of stock-sized, slow growing fish in poor condition, which appear to be exploited at low levels. Walleyes in Lake James, particularly large (>400mm) individuals, do not appear to be able to exploit the gizzard shad *Dorosoma cepedianum* prey base effectively. Exploitation rates of gizzard shad are similar to the previous forage base of threadfin shad *D. petenense*. The inability of walleyes to utilize threadfin shad or gizzard shad may be limiting the growth rates and sizes of walleyes in Lake James.

Lake James, located in Burke and McDowell counties, is the uppermost reservoir on the Catawba River chain of Duke Power Company lakes. Impounded in 1923, the reservoir covers 2,634 ha at full pool, and has 242 km of shoreline with a watershed area of 984 km^2. Average water depth is 13.5 m, with a maximum depth of 43 m, and a mean hydraulic retention time of 228 days. Lake James is classified as an oligotrophic reservoir, with low alkalinity (9-14 mg/l $CaCO_3$), a pH range of 6.4-7.4, typical surface water temperature ranges of 2-28^oC, and an average Secchi depth of 2.8 m (NCDENR 1998).

In 1949, the North Carolina Wildlife Resources Commission (NCWRC) first introduced 35,000 walleye fry into Lake James. By 1955, over 1.1 million fry had been introduced. As a result of these stockings, walleyes became established and have remained a major game fish in Lake James.

Walleye stockings were halted after 1955 and the population sustained itself through natural reproduction. Historically, spawning has occurred in the Linville River, Catawba River, and in the main body of the reservoir. A section of the Linville River is closed to angling from 15 February through 15 April to protect spawning walleyes. Walleyes in Lake James are currently managed under a 381-mm minimum size limit and an 8-fish daily creel limit.

As a result of public pressure, the NCWRC resumed walleye stockings in 1980 to bolster natural reproduction. Approximately 1.5 million fry were stocked annually through 1985. Fingerling walleye stockings began in 1986 at a rate of 11/ha, or approximately 30,000 fingerlings annually. Actual numbers of walleye fingerlings stocked annually since 1986 ranged from 30,000-313,659 (mean 102,844). The large variations in annual numbers stocked were the result of public pressure to stock all walleyes produced into Lake James. Stocking rates from

1999 to 2004 were stabilized at 30,000 fingerlings annually. Stockings were discontinued after 2004 based on the results from the 2001-2003 study that determined that the percent contribution of age-1 hatchery reared walleyes to the overall population was consistently low (Besler 2004).

Cove rotenone samples were conducted on Lake James through the 1980's, but were designed to gather information on all fish species and did not provide detailed information on the walleye population. Intensive gill net and electrofishing surveys to gather population data on walleyes were first initiated by the NCWRC in 1983. These initial surveys were designed to gain a better understanding of walleye population dynamics, to determine relative abundance of year-classes, and to determine if the supplemental stocking of walleye fingerlings was having any noticeable impact on year class strength and the walleye fishery (Brown and Kearson 1984; Brown and Kearson 1986; Brown and Kearson 1987; Brown et al. 1987; Brown et al. 1989). Baseline data on walleye relative abundance, size structure, and some age and growth information was obtained during this time. No information was gathered on walleyes in Lake James between 1990-1998. Gill net sampling for walleyes was resumed by the NCWRC in 1999 and continued annually to 2004 (Besler 2000; Besler 2001a; Besler & Taylor 2002; Taylor 2003; Taylor 2004). This report summarizes walleye gill net surveys on Lake James from November 1999 to October 2004.

Methods

Gill net sample site locations were established during the 1999 survey and were located on lake points with a moderate slope of 25-45^{o} using a stratified non-random design to represent all areas of the lake. The 1999 survey was represented by 13 sample sites (Figure 1) while the 2000-2004 surveys consisted of 12 sample sites annually (Figure 1). One experimental gill net was set at each sample site on 15-18 November 1999, 1-4 November 2000, 6-9 November 2001, 4-7 November 2002, 20-23 October 2003, and 25-28 October 2004. Experimental gill net dimensions were 2.4 x 76.3 m and consisted of five 2.4 x 15.3 panels with 25-, 32-, 38-, 44-, and 51-mm bar mesh. Gill nets were bottom-set perpendicular to shore in water >3 m depth. The direction of mesh to shore, 25- or 51-mm bar mesh, was randomly chosen annually for the first net set of each day and alternated for each additional set. Nets were checked after 24 h, and water temperatures were recorded at each site.

All fish collected were separated by species. Non-target species were released or discarded. Walleyes were placed in a plastic bag labeled by site and gill net mesh size, placed on ice, and returned to the Marion State Fish Hatchery. All walleyes were weighed (g), measured (TL, mm) and sexed. Walleyes were considered immature if the gonads were not developed. Saggital otoliths were removed from all walleyes. Otoliths were air-dried for >14 days, broken perpendicular to the long axis, polished with 400 grit wet-dry sandpaper, and read under a 10X dissecting microscope using transmitted fiber optic light (Hammers & Miranda 1991). All otoliths were read independently by two readers. Age discrepancies among readers were rectified by jointly reading the age structure. If agreement could not be reached, the fish was omitted from age estimates.

Catch per unit effort (CPUE) was determined as the number of walleyes captured per net night (24 h). Relative weights (Wr) were calculated for walleyes >150 mm using the standard weight equation (Ws) of Murphy et al. (1990). Various relative stock density (RSD) indices were calculated for individual and combined species data following Gabelhouse (1984). The Von Bertalanffy growth model was used to estimate growth rates.

Results and Discussion

Effort.–A total effort of 13 net nights was expended on Lake James in 1999 while effort consisted of 12 net nights during the 2000-2004 surveys. Overall, the Catawba River arm of the reservoir received six gill net nights effort and the Linville River arm received six gill net nights effort. Effort in 1999 included one additional net set location on the Linville River arm of Lake James. Surface water temperatures from 1999-2004 ranged from 11.6-19.0^{o}C. All nets deployed from 1999-2004 captured walleyes.

Catch Per Unit Effort.–A total of 1,565 walleyes were collected during the 1999-2004 gill net samples. Catch rates of walleye were high in the 1999-2004 gill net samples with a range of 324 in 1999 to 228 in 2004 (Table 1). Mean combined gill net mesh size CPUE from 1999-2004 was 21.1 fish/net night and ranged from 23.2 in 1999 to 19.0 in 2004. Catch rates in 1999 were based on 13 net nights compared to 12 net nights during the 2000-2004 samples. The numbers of walleye captured per net ranged from 4-63. Catch rates among mesh sizes were fairly consistent; however, few walleyes were captured in the 25- and 51-mm mesh during the six year sampling period. Catch rate data from 1999-2004 indicate an overall decline in walleye numbers (Besler 2000; Besler 2001a; Besler & Taylor 2002; Taylor 2003; Taylor 2004).

Size Structure.–The walleye size structure from 1999-2004 has been skewed towards stock- (≥250 mm) and quality-sized (≥380 mm) walleyes. Walleyes captured ranged from 225-635 mm and is similar between years (Figure 2). Few fish (9%) over 450 mm were obtained during the six year sampling effort. Although the size distribution data shows very few large fish, the majority (51%) of the walleyes sampled during the six year sample period were of legal harvestable size (≥381 mm). However, the 2004 data indicated a significant decline in the percent (35%) of legal harvestable size walleyes captured. The majority of walleyes over 450 mm were females while males and immature fish dominated the size classes <425 mm. Overall, 52% of the walleyes collected were in the quality size class (≥380 mm). The percentage of walleyes in the quality size class was relatively stable prior to the 2004 sample where it declined to 39% indicating a significant decline in the number of walleyes reaching the larger size classes. Of the 1,565 walleyes obtained from 1999-2004, 2% were in the preferred (≥510 mm) size class, ≤ 1% were in the memorable (≥630 mm) size class and no trophy (≥760 mm) fish were captured (Table 2).

Sexual maturity for walleye in Lake James is strongly influenced by size. Data during the six year sampling period was similar and indicates that male walleyes on Lake James begin to mature around 325 mm, with the majority completely mature by 350 mm; females begin maturing around 350 mm, with the majority completely mature by 450 mm (Figure 2).

Condition and Diet.–Walleye condition in Lake James was below average during all sample years. The average Wr was 87 and ranged from 89 in 1999 to 82 in 2004 (Figure 3). Relative weights were similar between the Catawba River arm (mean 88) and the Linville River arm (mean 85). Relative weights decreased linearly with increasing total length and were similar between years. This trend suggests that the larger walleyes are less able to compete for forage than other piscivores in the lake.

Stomach contents of all captured walleyes were qualitatively examined during the 2000-2004 samples to gain some coarse diet information. Overall, 60% of the walleye stomachs examined were empty and is similar between years (Figure 4). No other prey items beside fish were present in the stomach samples in 2000-2004. Due to a winter kill of threadfin shad between the 2000 and 2001 samples, walleyes began exploiting gizzard shad in 2001 as the primary forage base. The 2000 stomach analysis data (Besler 2001a) indicated 90% of the fish species found were threadfin shad. However, it is possible that some gizzard shad were misidentified in the 2000 stomach analysis. It was previously suggested that the adult walleyes in Lake James are very much linked to the threadfin shad forage base, however it appears that gizzard shad do provide a similar forage base for walleyes. Although walleyes are pelagic in nature, walleyes in Lake James are routinely captured at depths >30 m in NCWRC gill net samples. Threadfin shad and gizzard shad are typically found within the pelagic zone above the thermocline. Even with the change in forage base, overall condition indices imply that walleyes are unable to exploit shad species effectively in Lake James due in part to the two species not occupying the same time and space for extended periods of time.

Age and Growth.–From 1999-2004, 1,561 walleyes were obtained for age and growth analysis. All age classes of walleyes, including age 0, were recruited to the gill net mesh sizes used. Electrofishing data on age-0 walleyes from Lake James in 2000 indicated that only the largest age-0 individuals are recruited to the smallest (25-mm bar mesh) panels used (Besler 2001b). However, the percent age-0 walleyes recruited to the gill nets have declined annually (Figure 5) indicating that growth rates of age-0 walleyes are more variable (Figure 6). Walleyes up to age 12 were captured during the 6 year sampling period. Overall, the majority of walleyes were age 4 or less (Figure 5). However, the presence of consistent year classes during the six year sampling period suggests that recruitment is fairly consistent and the population is being exploited at low levels. Overall, mortality rates were low (mean 35%) from 1999-2004 (Besler 2000; Besler 2001a; Besler & Taylor 2002; Taylor 2003; Taylor 2004). However, mortality rates have increased annually from 1999 (24%) to 2004 (58%).

The 1999-2004 data indicates that sexual maturity is strongly influenced by age. Overall, male walleyes are mature by age 1 while the majority of female walleyes are not mature until age 2 (Figure 5). Walleye growth rates in Lake James are very slow. Overall, walleyes reached the 381-mm size limit by age 2 (Figure 6). Although the initial growth is good, by age 3 growth slows dramatically. Based on the 1999-2004 growth rates, the Von Bertalanffy growth model predicts walleyes in Lake James should reach a mean asymptotic maximum length of 445 mm. That rate of growth predicts that very few preferred, memorable, or trophy walleyes will be produced in Lake James.

Walleye growth was also strongly influenced by sex. The majority of male walleyes reached the 381-mm size limit by age 2 (Figure 7). Females, however, exceeded the minimum size limit by age 2 and more than likely reached it sometime at age 1 prior to sexual maturity.

Conclusions

The walleye population in Lake James is characterized by high numbers of stock-sized, slow-growing fish in poor condition. The walleye resource in Lake James does not appear to be over-harvested by anglers. Walleyes in Lake James are apparently unable to effectively exploit the shad prey base, particularly at sizes >400 mm. Data from the white bass population in Lake James suggests that other predators are capable of having excellent growth rates, condition factors, and size structures utilizing the same prey base (Besler 2001c). In addition, the strong sexual dimorphism may be causing anglers to differentially exploit female walleyes in Lake James since the females are eligible for harvest 1-2 years before any males from the same year class.

Population data collected from 1999-2004 on walleyes in Lake James were similar between years. It does not appear that the 381-mm size limit is improving the overall sizes of walleyes in Lake James. In fact, it is likely that the current size limit is compounding slow growth through density dependent mechanisms, and is indirectly increasing the exploitation of the larger females. In addition, the removal of the larger females reduces the reproductive potential of the population.

Recommendations

1. Continue to manage walleyes on Lake James under the current statewide creel limit.

2. Collect walleye data again in fall 2006 to further assess the appropriateness of the current 381-mm size limit and to monitor population changes associated with the discontinuation of the stocking program.

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TABLE 1.–CPUE (fish/net night), standard deviations (SD) and coefficient of variation (C.O.V.) of walleyes captured in gill nets, 1999-2004.

Variable	Combined Panels	25	32	38	44	51
1999						
Net Nights	13	13	13	13	13	13
Total Catch	324	60	72	83	86	23
CPUE	23.2	4.6	5.5	6.9	6.6	1.8
SD	18.1	4.7	4.4	7.5	8.0	3.5
C.O.V. (%)	78	101	79	109	120	199
2000						
Net Nights	12	12	12	12	12	12
Total Catch	274	52	81	95	34	12
CPUE	22.8	4.3	6.8	7.9	2.8	1.0
SD	13.7	4.2	6.3	8.0	2.3	1.7
C.O.V. (%)	60	97	94	101	87	165
2001						
Net Nights	12	12	12	12	12	12
Total Catch	241	44	49	91	50	6
CPUE	20.1	3.7	4.1	7.6	4.2	0.5
SD	12.4	6.4	4.0	5.5	3.0	0.9
C.O.V. (%)	62	175	99	73	72	181
2002						
Net Nights	12	12	12	12	12	12
Total Catch	267	26	102	106	25	8
CPUE	22.3	2.2	8.5	8.8	2.1	0.7
SD	8.9	3.4	3.7	5.0	2.0	1.2
C.O.V. (%)	40	157	44	57	95	185
2003						
Net Nights	12	12	12	12	12	12
Total Catch	231	21	93	75	26	16
CPUE	19.3	1.8	7.8	6.3	2.2	1.3
SD	10.1	2.5	6.2	4.4	2.8	2.3
C.O.V. (%)	53	142	80	71	129	173
2004						
Net Nights	12	12	12	12	12	12
Total Catch	228	26	102	55	33	12
CPUE	19.0	2.2	8.5	4.6	2.8	1.0
SD	10.2	2.3	5.3	3.7	3.7	1.0
C.O.V. (%)	53	107	62	81	133	104

TABLE 2.–Relative stock densities of quality (380 mm), preferred (510 mm), memorable (630 mm), and trophy (760 mm) walleyes captured in fall gill net samples from Lake James, 1999-2004.

Year/Index	Combined Sites	Catawba Sites	Linville Sites
1999			
RSD_{380}	61	66	55
RSD_{510}	1	1	1
RSD_{630}	0	0	0
RSD_{760}	0	0	0
2000			
RSD_{380}	48	50	46
RSD_{510}	1	3	0
RSD_{630}	0	0	0
RSD_{760}	0	0	0
2001			
RSD_{380}	57	57	57
RSD_{510}	2	3	0
RSD_{630}	<1	1	0
RSD_{760}	0	0	0
2002			
RSD_{380}	57	53	63
RSD_{510}	2	1	2
RSD_{630}	0	0	0
RSD_{760}	0	0	0
2003			
RSD_{380}	56	67	52
RSD_{510}	3	4	2
RSD_{630}	0	0	0
RSD_{760}	0	0	0
2004			
RSD_{380}	39	36	40
RSD_{510}	4	2	4
RSD_{630}	0	0	0
RSD_{760}	0	0	0

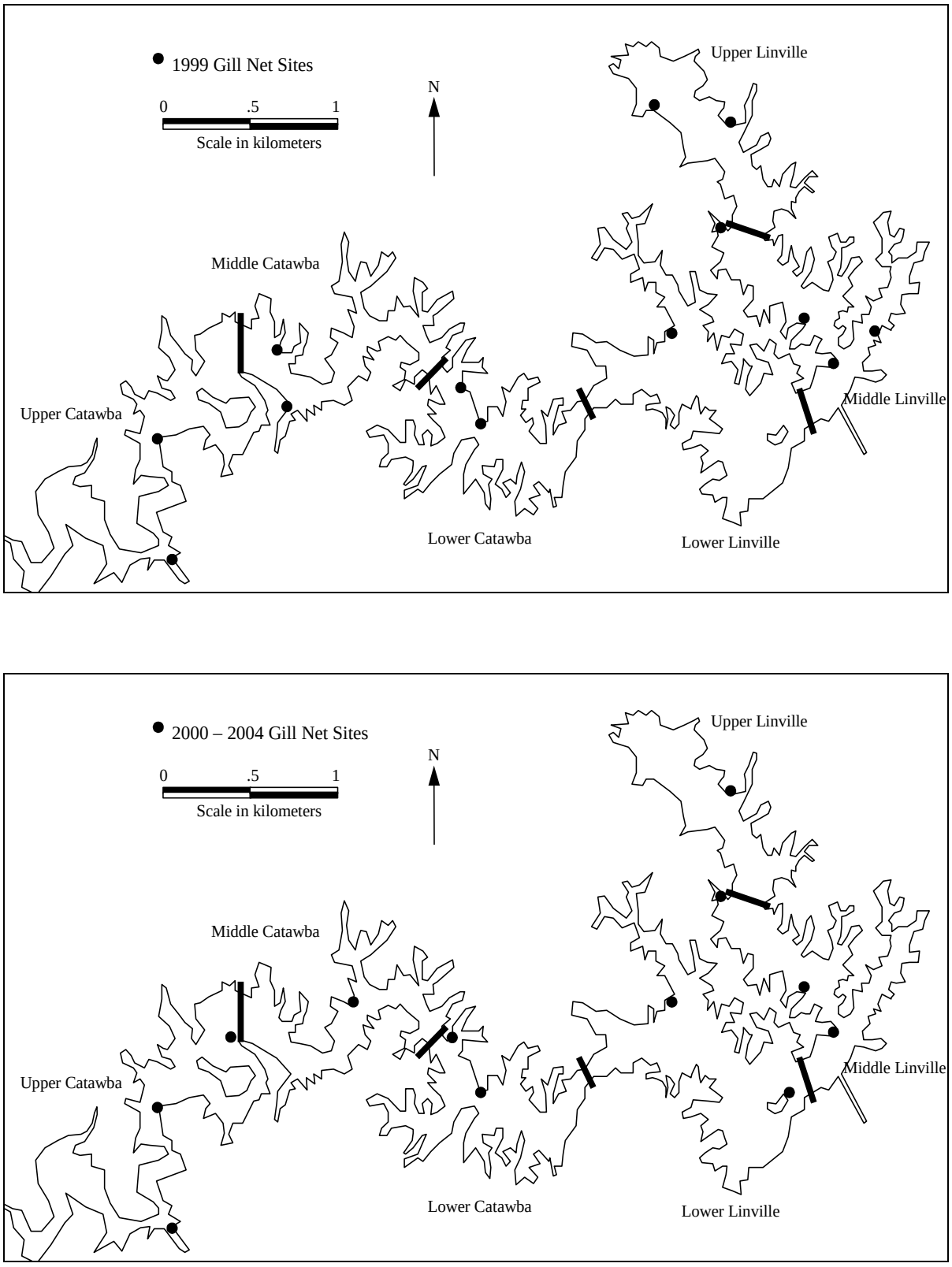

FIGURE 1.–Maps of Lake James showing lake regions and the 1999 (top map) and 2000-2004 (bottom map) walleye gill net site locations.

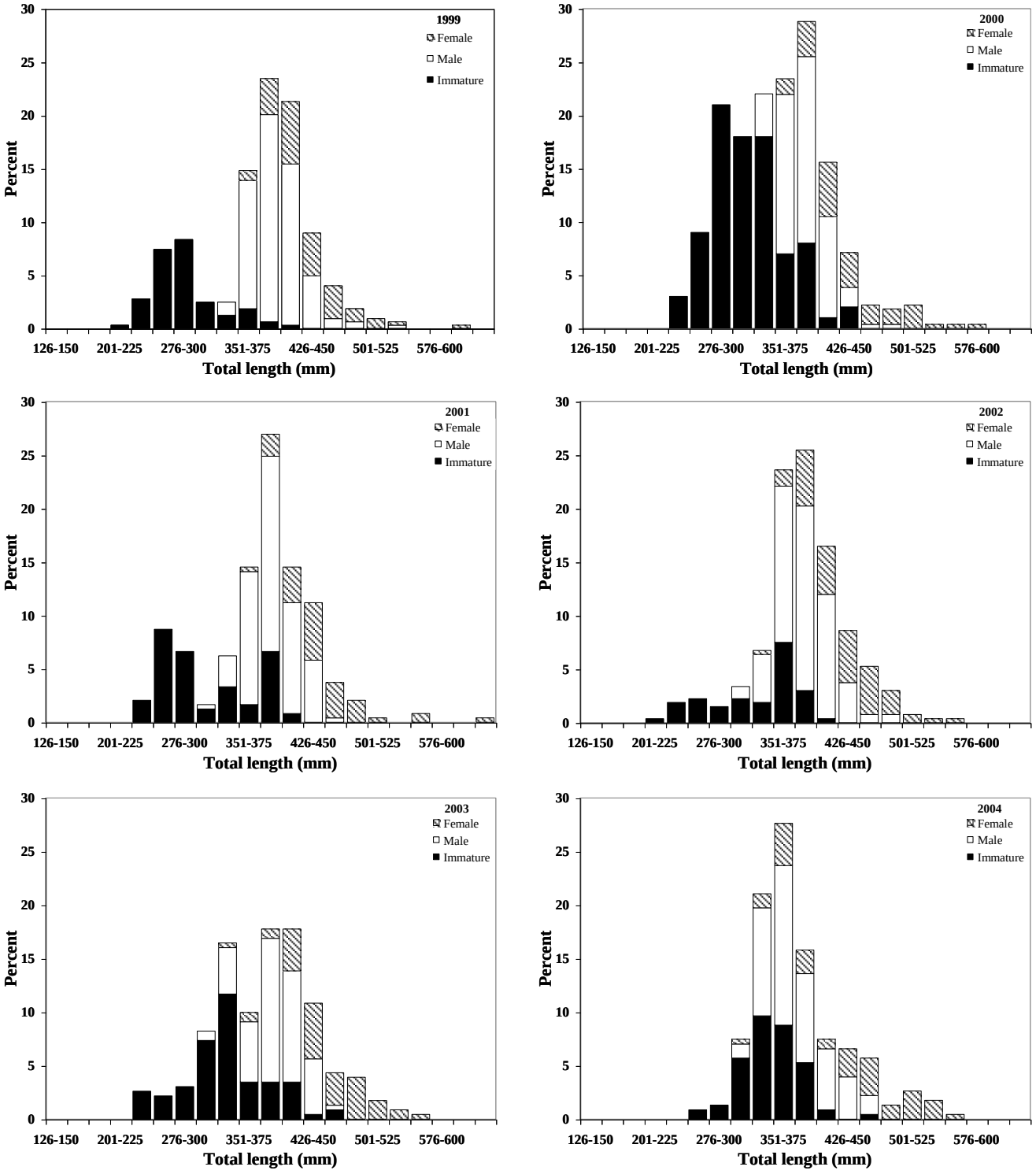

FIGURE 2.–Size distribution of walleyes, by sex, captured in gill nets from Lake James, 1999-2004.

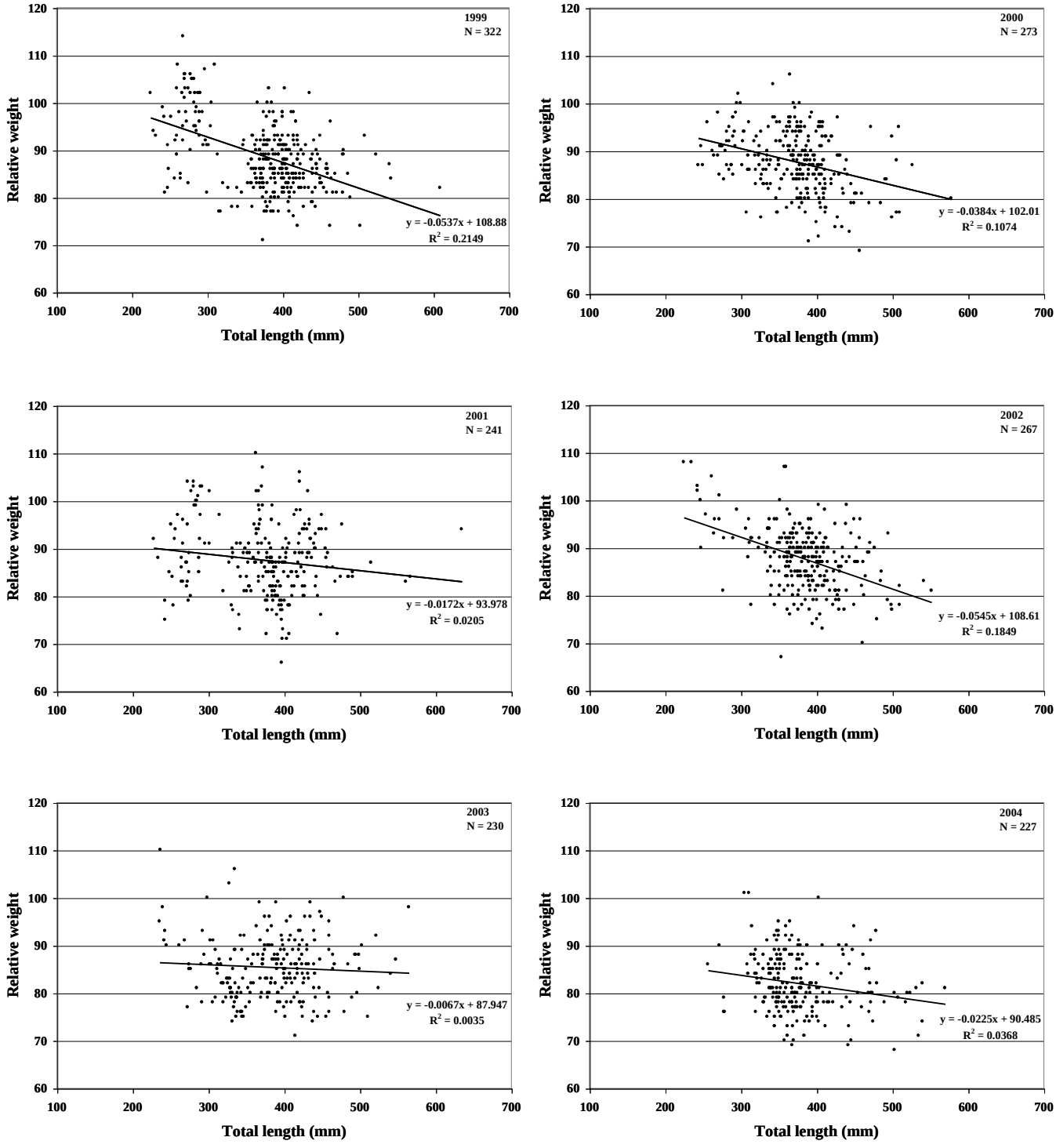

FIGURE 3.–Relative weights of walleyes captured in gill nets from Lake James, 1999-2004.

FIGURE 4.–Diet composition of walleye stomachs obtained from gill net samples on Lake James, 2000-2004.

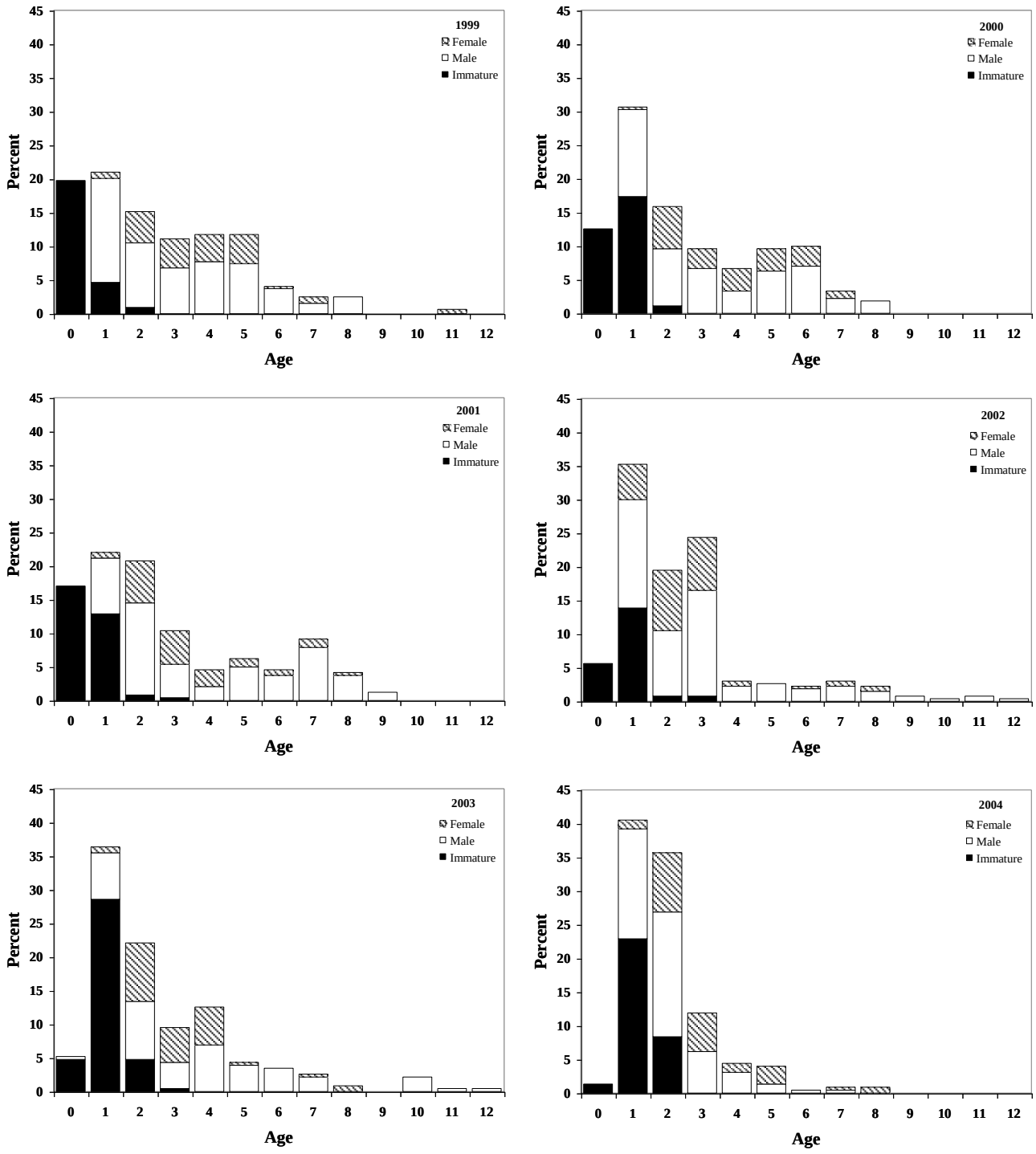

FIGURE 5.–Age distribution of walleyes, by sex, captured in gill nets from Lake James, 1999-2004.

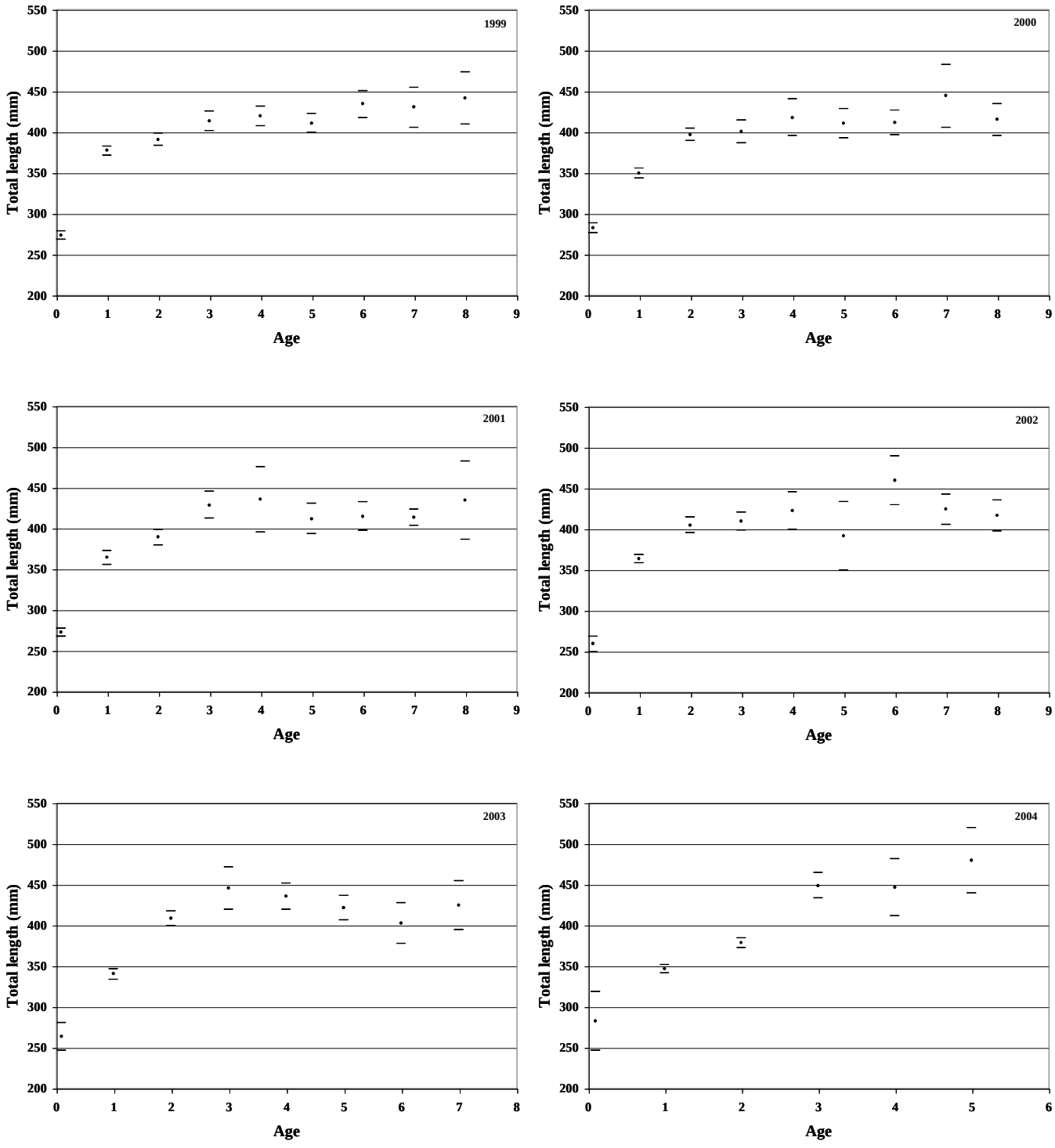

FIGURE 6.–Walleye mean total length (mm) at age at capture, with 95% confidence intervals. Walleyes were collected in gill net samples from Lake James, 1999-2004.

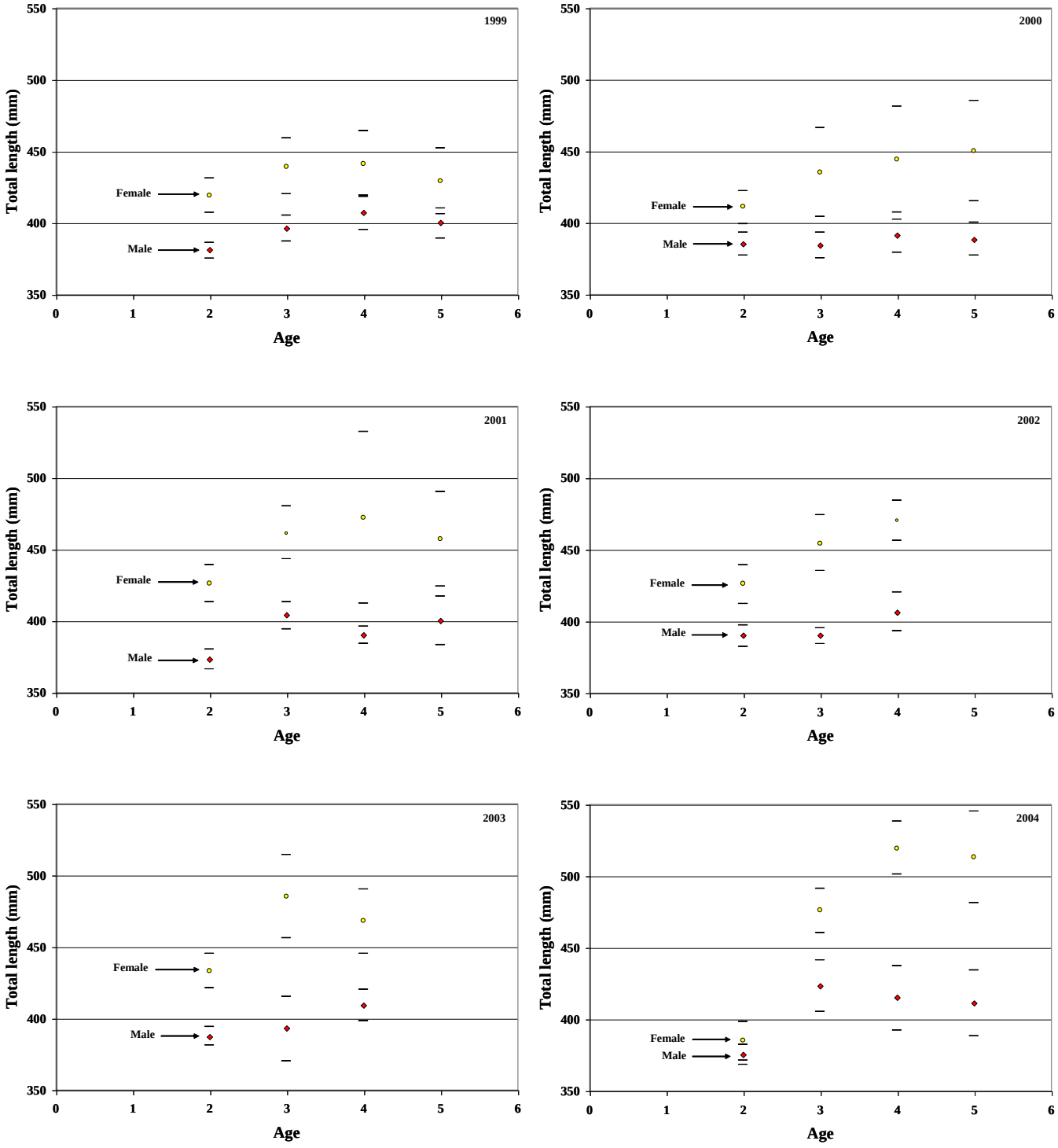

FIGURE 7.–Walleye mean total length (mm) at age, at capture, by sex, with 95% confidence intervals. Walleyes were collected in gill net samples on Lake James, 1999-2004.