Assessment of Advanced Walleye Fingerling Stockings at Northern Indiana Lakes

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EXECUTIVE SUMMARY

- Crooked (802 acres, Steuben County), Simonton (298 acres, Elkhart County), Sylvan (669 acres, Noble County), and Winona (562 acres, Kosciusko County) lakes were stocked from 2001 to 2005 with advanced fingerling walleye in order to evaluate the effectiveness of stocking large walleye in the fall. The stockings would be considered successful if the fall electrofishing catch rate of age-1 walleye was greater than or equal to 4.2 fish/hour in two out of three years.

- Sylvan and Winona lakes were stocked at 20/acre and Crooked Lake was stocked at a rate of 10/acre. Seven walleye per acre were stocked in Simonton Lake. Stockings were conducted in each lake from late September to early October in water temperatures ranging from 55 degrees to 72 degrees Fahrenheit. During the course of this study Crooked Lake was stocked with a total of 39,921 advanced fingerling walleye that averaged 6.8 inches. Simonton Lake received 9,700 6 to 8-inch walleye. Sylvan Lake was stocked with 65,960 advanced fingerling walleye that averaged 6.4 inches. The 55,490 advanced fingerling walleye stocked in Winona Lake averaged 6.8 inches.

- Crooked Lake fall electrofishing catch rates of age-1 walleye were above the 4.2/hour criteria for success in all four years. At Simonton, catch rates of age-1 walleye were greater than the 4.2 fish/hour success criteria in only two out of the four years sampled. Sylvan electrofishing catch rates of age-1 walleye greatly exceeded the success criteria in each year of the study. Catch rates of age-1 walleye were above the 4.2/hour criteria for success in three of the four years sampled at Winona. Consequently, stockings were considered successful at Crooked, Sylvan, and Winona lakes.

- All three lakes exhibited potential problems with growth. Over the course of the study there was little to no improvement in walleye size structure at each lake. At Crooked, Sylvan, and Winona, mean relative growth increments of walleye decreased significantly over time at age 1 and age 2. The relative growth increments of Simonton walleye were fairly consistent across all years at each age. Mean relative weights were well below 100 and typically averaged 85 indicating foraging problems.

- Recommendations are to continue fall evaluation at each lake in 2006 and creel surveys at each lake in 2007. Re-evaluate the fisheries after the 2006 fall evaluations and 2007 creel surveys and make recommendations for changes in stocking strategies and/or length and bag limits.

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INTRODUCTION

Indiana has a long history of stocking walleye fry and 1-2 inch fingerlings at numerous natural lakes and impoundments. Sixteen lakes and reservoirs in Indiana were stocked with these sizes of walleye in 1998. In addition, large fingerlings have been stocked on a limited basis in at least five lakes in the 1990's by lake associations. Despite this history, Indiana has failed to produce consistent quality walleye fishing opportunities in the natural lakes region. The 30-plus years of fry and small fingerling walleye stockings have resulted in limited success. Not surprisingly, according to the walleye subprogram, walleye populations are below ideal levels and limit angler use and satisfaction. However, walleye stockings at Pike, Clear, Bass, and Maxinkuckee lakes have met or exceeded the Fisheries Section's quality standards.

The stocking of walleye and walleye fishing in northern Indiana lakes is important to anglers as indicated by the 1994 statewide angler survey. A large percentage of these anglers also rated walleye fishing as important, yet most were unsatisfied in general with walleye fishing opportunities in Indiana. In response to the increasing demand for walleye, the Fisheries Section implemented the current study to create additional walleye fishing opportunities in northern Indiana lakes.

It is believed that large fingerlings stocked at an appropriate rate may survive where small fingerling stockings failed. Higher survival may be related to factors such as predator avoidance and lower susceptibility to water temperature at time of stocking (Hoxmeier et al. 1999). Brooks et. al. (2002), Lucchesi (1997), and Olson et. al. (2000) showed that larger fingerlings exhibited greater survival than smaller fingerlings. Predation on smaller walleye by largemouth bass can reduce survival (Brooking and Rudstam 2000). Brooks et. al. (2002) suggested that a 250-mm (10-inch) largemouth bass could just as easily eat a 100-mm (4-inch) walleye as a 50-mm (2-inch) walleye. The only advantage to stocking 4-inch walleye versus 2-inch walleye was a shortened period of susceptibility to predators. Larscheid (1995) showed the critical size for fingerling walleye survival was 5.1 inches (130 mm).

In 1999 the Fisheries Section initiated this study to evaluate the effectiveness of stocking large fingerling walleye in northern Indiana lakes. This project would satisfy two walleye subprogram strategies including stocking larger walleye fingerlings in selected lakes and purchasing walleyes from commercial sources where feasible. Additionally, this project should help the Fisheries Section accomplish an overall program goal of maintaining the annual

angler-days of walleye fishing at 64,185 and increasing angler satisfaction level to 50% by 2008 (strategic objective 1). If large fingerling walleye stockings are successful, other lakes may receive this type of stocking. This may be done by cost sharing with fishing groups which is an additional strategy within the walleye subprogram.

The specific objective of this project was to produce catch rates of age-1 walleye of greater than 4.2 fish/hour in 2 out of 3 years of sampling. Individual year-class stockings would be considered successful if fall electrofishing catch rates of age-1 walleye met these criteria. Additionally, data from the study was to be used to make recommendations regarding management options (stocking rates and length limit changes).

Study Lakes

Crooked Lake is an 802-acre natural lake located approximately five mile northwest of Angola, Indiana in Steuben County. Crooked Lake consists of three basins, averages 12 feet deep and has a maximum depth of 77 feet in the second basin. There are three inlets to the lake and these originate from Palfryman Ditch, Center Lake, and Loon Lake. The lone outlet of Crooked Lake is located at the west end of the third basin and drains west into Lake Gage (Koza 2003).

Land use surrounding Crooked Lake is variable, but primarily residential. The entire shorelines of the first and second basins are residential development with the exception of a county park and boat ramp on the east shore. The north shore of the third basin is almost completely developed as well. The south shore of the third basin is primarily undeveloped with the exception of a small area near the bridge separating the second and third basins. Additional development is found west of this area and consists primarily large lots with homes set back a substantial distance from the shoreline and very little shoreline alteration is evident. The remainder of the shoreline is wooded or agricultural (Koza 2003).

Crooked Lake fish community is diverse (21 species collected in 2001) and typical for northern Indiana natural lakes. Bluegill is the most abundant species followed by largemouth bass, redear sunfish, carp, spotted gar and yellow perch (Koza 2001). Walleye were stocked on ten occasions with small fingerlings and once with fry between 1980 and 1993 at variable stocking rates. Some success was documented based on YOY fall catch rates, but overall, the stockings were considered a failure. Larger fingerlings were stocked (3.5 inches) in the fall of

1991 and higher electrofishing catch rates of age-1 fish (4.3/h) were found in 1992 and in 1994 of gill netted fish age 3+ (5.1/lift). Walleye stockings were discontinued at the lake after 1993.

Simonton Lake is a 298-acre natural lake located in northern Elkhart County. The lake consists of two basins connected by a wide shallow channel. The maximum depth of 24 feet is in the west basin and very few areas in the east basin have depths greater than 5 feet. The average depth of the lake is 5.5 feet. Land use is primarily residential with 100% of the west basin and 60% of the east basin being developed. The remainder of the east basin, as well as most of the channel, has a natural shoreline.

Similar to Crooked Lake, Simonton has a diverse fish community dominated by bluegill, largemouth bass, spotted gar, warmouth, yellow perch, and redear sunfish (Ledet and Koza 1994). Large walleye fingerlings ranging from 3.5-7.0 inches were stocked in Simonton Lake from 1984-1986 at a rate of 4-8/acre. Electrofishing catch rates of age-1 fish were high each year after stocking ranging from 5-12/hour. The IDFW stocked small fingerlings in 1993 and 1994 with little survival to fall and thus Division stockings were discontinued. Since 1997, the local sportsman club has annually stocked the lake with 5-8 inch fingerling walleye at a rate of 7/acre.

Sylvan Lake is a 669-acre impoundment located at Rome City in northern Noble County. The maximum depth of the lake is 33 feet and average depth is 10 feet. Most of the shoreline is residentially developed but several substantial wetland and undeveloped shoreline areas are present on the east end of the lake (Pearson 1991). The 2002 Sylvan Lake general fisheries survey yielded 19 different species as well as a hybrid sunfish. The catch was dominated by bluegill, largemouth bass, and yellow perch (Pearson 2002).

Until 1960, historical accounts reveal that Sylvan Lake provided excellent bluegill fishing. However, in the 1960s to 1970s a large carp population developed and deteriorated fishing opportunities. Following the carp problem, aquatic vegetation became sparse, turbidity increased, and fishing activity declined. In 1984, Sylvan Lake and its tributaries were treated with rotenone in an attempt to kill the carp and renovate the fish community. The lake was then restocked with largemouth bass, bluegill, and channel catfish (Pearson 1991). Additionally, walleye fry were stocked in 1985 and 1986 while fingerlings were stocked in 1987 and 1991. Three of the four stockings were unsuccessful. Fry were again stocked in 1996 with little success as depicted by YOY catch rates.

Winona Lake is a 562-acre natural lake located in central Kosciusko County. The lake has an average depth of 30 feet and a maximum depth of 72 feet (Braun 1995). Land use in the watershed is primarily agricultural row crops, woodlots, and residential and commercial development. Approximately 95% of Winona's shoreline is residential and municipal development (Braun 1982). In 1995, 31 fish species were collected during the general fisheries survey. The catch was comprised mainly of yellow perch, bluegill, log perch, and largemouth bass. Black crappie and gizzard shad were also relatively abundant (Braun 1995).

Walleye fry were stocked in Winona Lake in 1986 while small fingerlings were stocked from 1987 through 1990. Year classes were collected at varying low levels (1.2-2.2/hour) each fall with only the 1987 year-class collected in higher numbers (10.3/hour). These stockings failed to consistently meet standard criteria and were discontinued after 1990.

METHODS

The four study lakes were stocked with advanced fingerling walleye from 2001 to 2005. These fish were purchased from private hatcheries and were to be stocked at an average size of approximately 6 to 8 inches total length. Crooked, Sylvan, and Winona lakes received walleye purchased by the DNR from Gollon Bait and Fish Farm, Dodgeville, WI. Simonton Lake was stocked with walleye from Laggis Fish Farm in Michigan. The Simonton Lake Sportsmen's Club purchased these walleye.

Stocking rates varied from 7/acre to 20/acre. Sylvan and Winona lakes were stocked at 20/acre and Crooked Lake was stocked at a rate of 10 /acre. Seven walleye per acre were stocked in Simonton Lake. Stockings were conducted in each lake from late September to early October in water temperatures ranging from 55 degrees to 72 degrees Fahrenheit. If the temperature differential between the stocking truck and lake was greater than 10 degrees, the truck was tempered with lake water until the temperature difference was substantially less (usually less than five degrees). Random samples of walleye were collected from each load of fish prior to stocking. Walleye were measured to the nearest 0.1-inch total length.

Sampling for all walleye year classes was conducted each fall from 2002 to 2005 to monitor changes in year class strength, size structure, and growth. Fall sampling followed the methods presented by Shipman (1991) for the monitoring of walleye year class strength. Each lake was electrofished in the fall from 2002 through 2005 to monitor CPUE and growth of

stocked walleye at age-1. Electrofishing was conducted between September 15 and October 30 each year with the same 15-minute stations used each year. Each lake was broken down into 1/3-mile shoreline sections by the district biologist and sampling order was drawn without replacement until all the sections were covered and eventually two lake circuits were completed.

Individual year class stockings were considered successful if fall electrofishing catch rates of age-1 walleye were above 4.2/hour. Since the standard criteria for success of YOY stockings is a fall catch rate of 7/hour, this accounts for at least 40% natural mortality from fall age-0 fish to fall age-1 fish. There is a strong relationship (R-value 72%) between the fall electrofishing catch rate of YOY fry/fingerling summer stocked walleye in a year and the fall catch rate of the same year class at age 1.

Standard experimental gill nets were also fished for additional size structure data of walleye between September 1 and October 15 all four years (2002-2005). Targeted effort was 8 lifts at Simonton, 12 lifts at Crooked, 11 lifts at Sylvan, and 10 lifts at Winona. Gill netting effort was reduced if mortality of walleye and other important gamefish was excessive.

For all captured walleye, total length was measured to the nearest 0.1 inch and lengths were used to calculate stock density indices (Gablehouse 1984) and length frequency distributions for each lake-year sample. Representative scale samples were also taken to facilitate age and growth analyses. Scales were aged, hard part measurements were entered into FishBC (Doll and Lauer 2002), and back-calculated lengths at age were computed. These data were then used to calculate mean relative growth increments for age-1, age-2, age-3, and age-4 walleye. Mean relative growth increment was calculated as $(L_{t2} - L_{t1})/L_{t1}$, where L_{t2} length at time 2 and L_{t1} is length at time 1. The age 1 increment is for the first summer of lake growth (length at first annulus formation to length at fall capture). For age 2, age 3, and age 4 walleye, the increment is length at annulus formation to length at the next annulus formation. In 2004 and 2005, weights were collected from captured walleye to compute relative weights (W_r). Mean relative weights were calculated for length-groups defined by the five-cell model of Gablehouse (1984).

An analysis of variance was used test for differences in mean lengths at stocking between years within each lake. Likewise, for each lake, ANOVA was used to test for differences in mean relative growth increments between years at age 1, age 2, and age 3. All levels of

significance were set at $\alpha < 0.05$ and all statistical comparisons were performed using SPSS (1999).

RESULTS

Crooked Lake

During the course of this study Crooked Lake was stocked with 39,921 advanced fingerling walleye. Stocking rates varied slightly from 10.0/acre ranging from 9.8/acre to 10.1/acre (Table 1). The stocked walleye ranged in size from 4.2 to 11.3 inches and averaged 6.8 inches (SE = 0.05). Walleye stocked in 2001 ($\bar{x}$ = 7.6 inches, SE = 0.2) were significantly larger than those stocked in each of the four proceeding years. Fish stocked in 2002 ($\bar{x}$ = 6.9 inches, SE = 0.08) and 2003 ($\bar{x}$ = 6.8 inches, SE = 0.09) were similar in size, while the walleye stocked in 2004 ($\bar{x}$ = 6.5 inches, SE = 0.2) and 2005 ($\bar{x}$ = 6.5 inches, SE = 0.1) were significantly smaller than fish stocked in other years ($F = 12.4$; $df = 4,614$; $p < 0.001$; Figure 1).

Fall electrofishing catch rates of age-1 walleye were above the 4.2/hour criteria for success in all four years. Catch rates were highest in 2002 (16.5/hour) and 2005 (15.9/hour). In 2003 and 2004, catch rates of age-1 walleye were 9.5/hour and 7.0/hour, respectively (Table 2).

In 2002, 233 walleye were collected in the fall electrofishing and gill netting samples. Of these, 60 were young-of-the-year, 170 were age 1, one was age 8, and two were age 10. The age-1 walleye averaged 11.7 inches (SE = 0.06) and ranged from 10.2 to 13.8 inches. A similar number of age-1 walleye were captured in 2003 (n = 106). The 2002 year-class had a mean length ($\bar{x}$ = 11.1 inches, SE = 0.1, range = 9.1 to 14.6 inches) slightly less than the 2001 year-class at age 1. The age-2 walleye in the 2003 sample (2001 year-class) averaged 14.4 inches (SE = 0.2, n = 60, range = 12.1 to 18.6 inches). One age-11 walleye was also captured in 2003 and total catch numbered 167 walleye.

The 2004 sample was comprised of three year-classes from the ongoing advanced fingerling walleye stockings. Total catch of walleye in this sample was 146 fish. Age-1 walleye made up the majority of the catch (n = 73) and averaged 10.7 inches (SE = 0.1, range = 9.1 to 12.7 inches). Fifty age-2 and 22 age-3 walleye were collected in this sample and had average lengths of 13.1 inches (SE = 0.1, range = 10.4 to 15.2 inches) and 16.9 inches (SE = 0.4, range = 14.1 to 20.9 inches), respectively.

In 2005, 218 walleye from age 1 to age 4 were captured. Age-1 walleye averaged 12.1 inches (SE = 0.1, n = 146, range = 10.0 to 16.0 inches) and made up the majority of the catch. Age-2 and age-3 walleye averaged 13.7 inches (SE = 0.3, n = 54, range = 10.2 to 17.1 inches) and 16.4 inches (SE = 0.4, n = 15, range = 15.1 to 20.5 inches), respectively. Three age-4 walleye from the 2001 year-class were also captured. These fish had an average length of 19.5 inches (SE = 0.3, range = 19.2 to 19.8 inches; Figure 2).

Proportional stock density (PSD) was low (2) in 2002. Likewise, the relative stock density of preferred sized walleye (RSD-P) was also 2. In 2003, PSD increased to 12 while RSD-P decreased slightly to 1. Proportional stock density also increased in 2004 (PSD = 16) and in 2005 (PSD = 17). Similar to 2002 and 2003, RSD-Ps were low in 2004 (RSD-P = 2) and 2005 (RSD-P = 1; Table 3).

Mean relative growth increments of walleye decreased significantly over time at age 1, and age 2. At age 1, the mean relative growth increment was 0.74 (SE = 0.02) in 2002 and was significantly greater than that increment in 2003 ($\bar{x}$ = 0.57, SE = 0.02), 2004 ($\bar{x}$ = 0.51, SE = 0.02), and 2005 ($\bar{x}$ = 0.31, SE = 0.03; $F = 48.6$; df = 3, 326; $p < 0.001$). The 2003 mean relative growth increment at age 1 was larger than in 2004 but the difference was not significant. In 2005, the age-1 mean relative growth increment was significantly smaller than the increment of all preceding years (Figure 3).

At age 2, the mean relative growth increments also decreased each year. In 2003, the relative growth increment for age-2 walleye averaged 0.79 (SE = 0.02) compared to 0.59 (SE = 0.03) and 0.26 (SE = 0.02) in 2004 and 2005, respectively. The decrease was significantly different between each year ($F = 62.7$; df = 2, 131; $p < 0.001$; Figure 3).

Mean relative growth increments at age 3 were similar ($F = 1.9$; df = 1, 33; $p = 0.2$). In 2004, the relative growth increment averaged 0.16 (SE = 0.02) in 2004 and 0.2 (SE = 0.02) in 2005. The mean relative growth increment at age 4 was calculated from only three walleye and averaged 0.06 (SE = 0.05; Figure 3).

Mean relative weights (W_r) at Crooked Lake in 2004 were 78 (SE = 0.6, n = 110), 80 (SE = 1.4, n = 15), and 77 (SE = 3.8, n = 2) for walleye in the S-Q, Q-P, and P-M length-groups, respectively. In 2005, W_r values for walleye in the S-Q length-group averaged 84 (SE = 0.6, n = 171). Quality to preferred-sized walleye averaged 81 (SE = 1.0, n = 31) and the W_r of the one fish captured in the Q-P length-group was 76 (Table 4).

Simonton Lake

From 2001 to 2005 approximately 9,700 6 to 8-inch walleye had been stocked into Simonton Lake. Stocking rates ranged from 5.0 to 7.4 walleye per acre (Table 1). Stockings were conducted by the Simonton Lake Sportsmen's Club and only one year of length data was collected. In 2003, 72 walleye were measured at the time of stocking. These fish averaged 6.0 inches (SE = 0.1).

Electrofishing catch rates of age-1 walleye were greater than the 4.2 fish/hour success criteria in two out of the four years sampled. The age 1 catch rates ranged from 2.4 age-1 walleye per hour in 2004 to 8.1/hour in 2005. In 2002 and 2003, the electrofishing catch rates or age-1 walleye were 3.2/hour and 5.7/hour, respectively (Table 2).

In 2002, a total of 59 walleye were collected by electrofishing and gill nets. The fish ranged from age 1 to age 7. Fifteen age-1 walleye were captured and averaged 11.5 inches (SE = 0.3, range = 10.3 to 13.9 inches). Age-2 walleye averaged 14.2 inches (SE = 0.1, n = 24, range = 13.0 – 15.5 inches) and age-3 fish were one inch larger ($\bar{x}$ = 15.2 inches, SE = 0.2, n = 12, range = 14.3 – 16.7 inches). Three other year-classes were captured in 2002: age 4 ($\bar{x}$ = 15.7 inches, SE = 0.2; n = 5, range = 15.2 – 16.0 inches), age 5 ($\bar{x}$ = 18.5 inches, SE = 0.0, n = 2), and age 7 ($\bar{x}$ = 19.5 inches, n = 1; Figure 4).

Fewer walleye were captured in 2003 (n = 45) than 2002. Ages ranged from one to seven with age-1 walleye being the most abundant year-class (n = 26) followed by seven at age 2, six at age 3, three at age 4, two at age 5, and one at age 7. Age-1 walleye averaged 10.9 inches (SE = 0.1) and ranged from 9.5 to 11.8 ininches. The age-2 walleye in the 2003 sample averaged 12.7 inches (SE = 0.2, range = 12.2 – 13.1 inches). The six age-3 fish ranged in length from 14.3 to 16.7 inches (SE = 0.3) and averaged 15.2 inches (SE = 0.3). Age-4 and age-5 walleye averaged 17.0 inches (SE = 0.3, range = 16.6 – 17.4 inches) and 18.5 inches (SE = 1.0, range = 17.4 – 19.3 inches), respectively. The one age 7 walleye captured measured 23.0 inches (Figure 4).

Sampling efforts collected 56 walleye ranging from age 0 to age 7 at Simonton Lake in 2004. The age-0 walleye ($\bar{x}$ = 6.5 inches, SE = 0.3, n = 13, range = 4.8 – 8.4 iches) were the second most abundant year-class following the age-1 fish (n = 15). The age-1 walleye averaged 11.0 inches (SE = 0.2, range = 9.6 – 12.3 inches). The 11 age-2 walleye averaged 13.0 inches

(SE = 0.4, range = 11.1 – 14.9 inches) and the age-3 fish averaged 13.6 inches (SE = 0.3, n = 8, range = 12.4 – 14.7 inches). Three age-4 and four age-5 walleye were captured and these fish averaged 14.5 inches (SE = 0.5, range = 14.0 – 15.4 inches) and 17.3 inches (SE = 0.7, range = 15.5 – 18.7 inches), respectively. The one walleye at age 6 was 19.5 inches and the two age-7 walleye averaged 19.8 inches (SE = 1.3, range = 18.5 – 21.2 inches; Figure 4).

More walleye were captured in the 2005 sample than in all previous years. Of these 94 fish, 40 were age 1, 27 were age 2, 21 were age 3, and two were age 7. One fish was collected in each of the remaining year-classes (age 4, age 5, age 6, and age 8). Age-1 fish captured in 2005 were similar in length to those captured in other years ($\bar{x}$ = 11.5 inches, SE = 0.1, range = 10.2 – 12.8 inches). Age-2 walleye averaged 13.3 inches (SE = 0.1, range = 12.2 – 14.5 inches) in 2005. Walleye length at age 3 averaged 14.6 inches (SE = 0.1, range = 13.1 – 15.6 inches). The age-4, age-5, age-6, and age-8 walleye measured 16.0 inches, 16.0 inches, 17.5 inches, and 29.0 inches, respectively. The two age-7 walleye averaged 17.8 inches (SE = 0.8, range = 17.2 – 18.5 inches; Figure 4).

Proportional stock densities were relatively constant throughout the study and ranged from 15 in 2005 to 32 in 2002. Similarly, RSD-P = 0 in 2002 and RSD-P = 2 in the remaining three years. In 2005, RSD-M was 1 and no walleye were captured greater than or equal to trophy size. No walleye were greater than memorable or trophy size in 2002, 2003, and 2004 (Table 3).

Mean relative growth increments of Simonton Lake walleye at age 1 were not significantly different between years (F = 0.4; df = 3, 70; p = 0.8). From 2002 to 2005, this increment averaged 0.62 (SE = 0.02, n = 74) and ranged from 0.17 to 1.23. The mean RGI of age-1 walleye was smallest in 2005 ($\bar{x}$ = 0.57, SE = 0.06) and largest in 2004 ($\bar{x}$ = 0.66, SE = 0.05). In 2002 and 2003, the mean RGIs for age-1 walleye were 0.64 (SE = 0.06) and 0.61 (SE = 0.05), respectively (Figure 5).

Similar to the age 1 increments, the mean RGIs for at age 2 did not differ between years (F = 0.6; df = 3, 51; P = 0.6; Figure 5). The mean relative growth increment for age-2 walleye was largest in 2003 ($\bar{x}$ = 0.71, SE = 0.1) followed by the increments in 2002 ($\bar{x}$ = 0.63, Se = 0.05), 2005 ($\bar{x}$ = 0.61, SE = 0.08), and 2004 ($\bar{x}$ = 0.54, SE = 0.08). The average age 2 RGI for Simonton Lake walleye during the study was 0.62 (SE = 0.05).

The age-3 mean relative growth increment was more variable than the age-1 and age-2 increments and the age-3 mean RGIs were significantly different between years (F = 7.9; df = 3.

32; $p < 0.001$). In 2003, the mean relative growth increment at age 3 ($\bar{x}$ = 0.26, SE = 0.04) was significantly larger than the increment in all other years. Conversely, the smallest increment was recorded in 2004 ($\bar{x}$ = 0.12, SE = 0.01) and was significantly smaller than the 2002 mean relative growth increment ($\bar{x}$ = 0.19, SE = 0.05). The 2005 age-3 increment ($\bar{x}$ = 0.16, SE = 0.01) was similar to the 2002 and 2004 increments (Figure 5).

No significant difference was detected in the age-4 mean relative growth increments from 2002 to 2004 ($F = 0.8$; df = 2, 9; $p = 0.5$). In 2002 the mean RGI was lowest and averaged 0.08 (SE = 0.01). The mean relative growth increments for 2003 and 2004 were 0.12 (SE = 0.02) and 0.13 (SE = 0.04), respectively (Figure 5).

In 2004, mean relative weights were calculated for walleye only in the stock-quality ($\bar{x}$ = 76, SE = 1.1, n = 26) and quality-preferred ($\bar{x}$ = 72, SE = 1.7, n = 7) length categories. Fish weights were collected from walleye in three length categories in 2005. Mean relatives weights for the stock-quality and quality-preferred categories were 77 (SE = 0.6, n = 81) and 73 (SE = 2.3, n = 12), respectively. One relative weight (W_r = 69) was calculated for a preferred-memorable sized walleye in 2005 (Table 4).

Sylvan Lake

Sylvan Lake was stocked with 65,960 advanced fingerling walleye from 2001 to 2005. Stocking rates varied slightly from the targeted 20.0/acre ranging from 18.9/acre to 20.0/acre (Table 1). The stocked walleye ranged in size from 3.7 to 12.0 inches and averaged 6.4 inches (SE = 0.03). Walleye stocked in 2004 ($\bar{x}$ = 7.2 in, SE = 0.1) were significantly larger than those stocked in each of the four other years ($F = 50.2$; df = 4; $p < 0.001$). While smaller than those stocked in 2004, the fish stocked in 2005 ($\bar{x}$ = 6.8 in, SE = 0.07) were also significantly larger than the walleye stocked in 2001 ($\bar{x}$ = 6.3, SE = 0.11), 2002 ($\bar{x}$ = 6.0, SE = 0.06), and 2003 ($\bar{x}$ = 6.0, SE = 0.06). The walleye stocked at Sylvan in 2001 and 2002 were significantly smaller than walleye stocked in other years ($F = 50.2$; df = 4, 1,322; $p < 0.001$; Figure 6).

Electrofishing catch rates of age-1 walleye greatly exceeded the success criteria (4.2/hour) in each year of the study. The lowest recorded catch rate of age-1 walleye in Sylvan Lake was 13.7 fish/hour in 2003. Catch rates in 2004 and 2005 were 14.3 fish/hour and 16.1

fish/hour, respectively. In 2002, 24.3 age-1 walleye were captured per hour of electrofishing (Table 2).

A total of 262 walleye were captured by electrofishing and gill netting in 2002. The majority of those fish were age 1 (n = 240). Additionally, 14 age-0, four age-6, and four age-7 walleye were captured in the sample. The age-0 walleye averaged 7.8 inches (SE = 0.6). The mean length of the captured walleye at age 1 was 12.5 inches (SE = 0.08, range = 9.3 – 16.3 inches). Age-6 and age-7 walleye averaged 21.8 inches (SE = 1.2, range = 19.9 – 24.1 inches) and 22.3 inches (SE = 1.2, range = 20.2 – 22.4 inches), respectively (Figure 7).

In 2003, 280 walleye were captured in the fall sample. Of these, 115 were age 1, 159 were age 2, two were age 6, and four were age 8. The 115 age-1 walleye averaged 10.1 inches (SE = 0.1) ranged in length from 8.4 to 14.1 inches. Age-2 walleye were 15.1 inches (SE = 0.1, range = 10.2 – 20.2 inches) on average. The walleye at age 6 and age 8 in 2003 averaged 20.3 inches (SE = 0.3, range = 19.9 – 20.5 inches) and 21.8 inches (SE = 1.7, range = 19.4 – 27.1 inches), respectively (Figure 7).

Only three year-classes of walleye were captured in Sylvan Lake in 2004. The majority of these fish were age 1 ($\bar{x}$ = 12.0, SE = 0.1, n = 148, range = 8.5 – 14.5 in). Age-2 walleye were the second most abundant group with 62 individuals captured. The age-2 walleye averaged 14.0 in (SE = 0.2, range = 11.9 – 19.0 in). Thirty-five age-3 walleye were captured and these fish had an average length of 18.2 in (SE = 0.5, range = 12.6 – 24.8: Figure 7).

In 2005, total of 333 walleye were captured in the gill netting and electrofishing samples. These fish ranged in age from age 0 to age 4. The age-0 year-class (n = 121) represented the majority of the sample followed by age 1 (n = 119), age 2 (n = 37), age 3 (n = 36) and age 4 (n = 20). The age-0 walleye ranged in length from 5.0 to 9.8 inches and averaged 7.6 inches (SE = 0.2). At age 1, walleye captured in 2005 averaged 11.8 inches (SE = 0.2) and ranged 10.4 - 14.2 inches. Age-2 walleye averaged 13.6 inches (SE = 0.2, range = 11.9 – 17.0 inches). Walleye averaged 15.3 inches (SE = 0.1, range = 14.3 – 17.0 inches) and 16.9 inches (SE = 0.6, range = 14.5 – 23.2 inches) at age 3 and age 4, respectively (Figure 7).

Proportional stock density of walleye was low in 2002 (7) and RSD-P was 3. In 2003, after the 2001 year-class recruited to quality length (15.0 in), PSD increased to 40 while RSD-P dropped slightly to 2. Proportional stock density decreased to 17 in 2004. Relative stock

density-preferred increased slightly to 3. In 2005, stock density indices were similar to 2004 with PSD = 20 and RSD-P = 2 (Table 3).

In 2002, the mean relative growth increment of age-1 walleye ($\bar{x}$ = 0.86, SE = 0.02) was significantly larger than that increment in 2003 ($\bar{x}$ = 0.55, SE = 0.02), 2004 ($\bar{x}$ = 0.43, SE = 0.02) and 2005 ($\bar{x}$ = 0.63, SE = 0.04). The age-1 mean RGI in 2004 was significantly smaller than the other increments. No difference was detected between the age-1 increments in 2003 and 2005 ($F = 116.7$; $df = 3, 379$; $p < 0.001$; Figure 8).

Analysis of the mean RGIs at age 2 showed a consistent decrease from 2003 to 2005. The mean age-2 RGI in 2003 ($\bar{x}$ = 0.96, SE = 0.02) was significantly larger than the increment in 2004 and 2005 ($F = 128.8$; $df = 2, 205$; $p < 0.001$). There was no difference between the age-2 mean RGIs from 2004 ($\bar{x}$ = 0.39, SE = 0.04) and 2005 ($\bar{x}$ = 0.31, SE = 0.04; Figure 8). Additionally, there was no significant difference between the age-3 mean RGIs in 2004 and 2005 ($F = 1.0$; $df = 1, 44$; $p = 0.3$). Mean relative growth increments in 2004 and 2005 averaged 0.17 (SE = 0.01) and 0.19 (SE = 0.02), respectively (Figure 8). The age-4 mean RGI for walleye collected at Sylvan Lake was 0.07 (SE = 0.01).

Mean relative weights for stock-quality and quality-preferred length walleye were 80 (SE = 1.0, n = 64) and 81 (SE = 2.0, n = 8) in 2004, respectively (Table 4). Preferred-memorable sized walleye had an average relative weight of 90 (SE = 5.9, n = 4). In 2005, the mean relative weight of S-Q length walleye increased to 87 (SE = 1.0, n = 54). Likewise, the mean relative weight of Q-P length fish increased to 86 (SE = 1.5, n = 29). Preferred-memorable sized walleye had a mean relative weight of 85 (SE = 1.2, n = 3).

Winona Lake

During the course of this study Winona Lake was stocked with 55,490 advanced fingerling walleye. Stocking rates varied slightly from the target of 20.0/acre and ranged from 19.1/acre to 20.1/acre (Table 1). The stocked walleye ranged in size from 3.7 to 11.5 inches and averaged 6.8 inches (SE = 0.04). Walleye stocked in 2003 ($\bar{x}$ = 7.5 inches, SE = 0.09) and 2005 ($\bar{x}$ = 7.3 inches, SE = 0.06) were significantly larger than those stocked in 2001, 2002, and 2004 ($F = 53.3$; $df = 4, 1{,}396$; $p < 0.001$). Fish stocked in 2001 ($\bar{x}$ = 6.6 inches, SE = 0.11) and 2004

($\bar{x}$ = 6.4 inches, SE = 0.07) were similar in size. Likewise the walleye stocked in 2002 ($\bar{x}$ = 6.3 inches, SE = 0.07) and 2004 ($\bar{x}$ = 6.4 inches, SE = 0.07) were of similar length (Figure 9).

Fall electrofishing catch rates of age-1 walleye were above the 4.2/hour criteria for success in three of the four years sampled. Catch rates were highest in 2004 (25.4/hour) and 2003 (15.7/hour). In 2002 and 2005, catch rates of age-1 walleye were 9.9/hour and 1.8/hour, respectively (Table 2).

Sampling efforts in 2002 resulted in the capture of five year-classes and 150 individual walleye (Figure 10). The majority of these fish were age 1 (n = 143) and the remaining seven were age 3, age 4, age 5, and age 7. The age-1 walleye averaged 12.8 inches (SE = 0.09) and ranged from 10.7 to 15.2 inches. Only one age 3 (19.0 inches) and one age 4 (19.5 inches) were captured. The two age-5 walleye measured 22.0 inches and the three age-7 fish averaged 21.5 inches (SE = 1.0, range = 20.3 – 23.6 inches).

In 2003, 159 age-1 and older walleye were collected in the fall electrofishing and gill net samples. Two of these walleye were age 5 ($\bar{x}$ = 22.8 inches, SE = 1.8, range = 21.1 – 24.3 inches) one was age 6 (21.5 inches), and one was age 8 (25.0 inches). Age-1 walleye comprised the largest portion of the catch (n = 96) and averaged 10.6 inches (SE = 0.14, range = 8.4 – 13.6 inches). The age-2 walleye ($\bar{x}$ = 16.1 inches, SE = 0.17, range = 13.8 – 20.9 inches) were the second most abundant year-class captured in 2003 (Figure 10).

A total of 231 walleye were captured in 2004. Age-1 walleye were the most abundant (n = 152) year-class captured and averaged 10.9 inches (SE = 0.08, range = 8.7 – 13.0 inches). The 67 age-2 fish ranged from 10.8 to 16.9 inches and averaged 13.5 inches (SE = 0.19). The mean length of age-3 walleye was 19.0 inches (SE = 0.69, n = 11, range = 13.4 – 22.1 inches). One age-7 walleye (22.5 inches) was also captured (Figure 10).

Only 93 age-1 and older walleye were captured in Winona Lake in 2005. Of these, 17 were age 1, 32 were age 2, 27 were age 3, and 17 were age 4 (Figure 10). Age-1 walleye ranged from 9.6 to 15.0 inches and averaged 12.6 inches (SE = 0.44). Mean length of walleye at age 2 from the 2005 sample was 14.7 inches (SE = 0.21, range = 11.9 – 16.9 inches) and age-3 walleye averaged 16.4 inches (SE = 0.31, range = 14.2 – 20.2 inches). Age-4 walleye averaged 19.4 inches (SE = 0.45, range = 16.8 – 22.4 inches).

Proportional stock density (PSD) was low (7) in 2002. Likewise, the relative stock density of preferred sized walleye was low (RSD-P = 3). In 2003, PSD increased to 41 and

RSD-P increased to 4. Proportional stock density dropped to 11 in 2004 and then increased again in 2005 to 58. Similar to 2002 and 2003, RSD-Ps were low in 2004 (RSD-P = 2). Relative stock density-preferred increased to 10 in 2005 (Table 3).

Mean relative growth increments of walleye decreased significantly over time at age 1, and age 2. At age 1, the 2002 mean relative growth increment was 0.81 (SE = 0.02) and was significantly greater than that increment in 2003 ($\bar{x}$ = 0.48, SE = 0.02), 2004 ($\bar{x}$ = 0.34, SE = 0.01), and 2005 ($\bar{x}$ = 0.29, SE = 0.03; F = 176.8; df = 3, 350; $p < 0.001$). Similarly, the 2003 mean relative growth increment at age 1 was significantly larger than in 2004 and 2005. There was no significant difference in the age 1 mean relative growth increment between 2004 and 2005 (Figure 11).

At age 2, the mean relative growth increments also decreased each year. In 2003, the relative growth increment for age-2 walleye averaged 0.9 (SE = 0.03) compared to 0.44 (SE = 0.02) and 0.29 (SE = 0.02) in 2004 and 2005, respectively. The decrease was significantly different between each year (F = 112.7; df = 2, 142; $p < 0.001$; Figure 11).

Mean relative growth increments at age 3 were also significantly different (F = 7.0; df = 1, 24; p = 0.01). The mean relative growth increment averaged 0.22 (SE = 0.02) in 2004 and 0.15 (SE = 0.02) in 2005. The mean relative growth increment at age 4 was calculated from 15 walleye and averaged 0.03 (SE = 0.01; Figure 11).

Mean relative weights (W_r) at Winona Lake in 2004 were 83 (SE = 0.9, n = 47), 82 (SE = 1.4, n = 6), and 90 (SE = 2.3, n = 2) for walleye in the S-Q, Q-P, and P-M length-groups, respectively. In 2005, W_r values for walleye in the S-Q length-group averaged 88 (SE = 1.8, n = 27). Quality to preferred-sized walleye averaged 86 (SE = 1.2, n = 21) and the mean W_r of the six fish captured in the Q-P length-group was 82 (SE = 1.4; Table 4).

DISCUSSION

The fingerling walleye stocked into Crooked, Sylvan, and Winona lakes during this project were purchased from Gollon Bait and Fish Farms in Dodgeville, WI. These fish were appropriate size, in good condition, and exhibited low initial stocking mortality. Although the mean lengths at stocking varied by lake and year there didn't appear to be a consistent trend. Walleye stocked in Crooked Lake in 2001 and 2002 were larger than those stocked in Sylvan and Winona. Conversely, Winona Lake received the largest fingerling walleye in 2003 and 2004,

whereas Sylvan received the largest walleye in 2004. Sylvan was stocked with the smallest fingerling in 2001, 2002, and 2003. Limited stocking data from Simonton makes comparisons between years impossible in terms of fingerling size.

The objective of this project was to determine whether or not the stocking of advanced fingerling walleye would result in a "successful" stocking. Success was measured by being able to capture at least 4.2 age-1 walleye per hour of electrofishing in two out of three years. Results of the fall electrofishing efforts show that these stockings were successful at Crooked, Sylvan, and Winona lakes. Crooked Lake exceeded the success criteria of 4.2 age-1 walleye/hour each of the four years sampled. In three of the four years, catch rates of age-1 walleye were more than double that targeted rate. Similarly, electrofishing catch rates of age-1 walleye at Sylvan Lake were high. The lowest recorded catch rate of age-1 walleye at Sylvan was 13.7 fish/hour in 2003. That catch rate is more than three times the success criteria. At Winona Lake, electrofishing efforts captured at least 9.9 age-1 walleye/hour in 2002, 2003, and 2004 and therefore met and exceeded the criteria for success. However, in 2005, the catch rate of age-1 walleye at Winona Lake plummeted to 1.8 fish/hour. For whatever reason, very few age-1 walleye were captured. Additionally, the overall catch of walleye with both electrofishing and gill nets was low compared to other years. Although Winona was sampled at the same time and at comparable water temperatures as in previous years, the 2005 sample was substantially smaller. Conversely, the total number of walleye captured in 2005 at the other three lakes was either the highest (Sylvan = 333 and Simonton = 94) or second highest (Crooked = 218) recorded during the course of the project.

Catch rates of age-1 walleye at Simonton Lake did not meet the success criteria. Catches of age-1 walleye only exceeded 4.2 fish/hour in 2003 (5.7 fish/hour) and 2005 (8.1 fish/hour). In 2002 and 2004, age-1 catch rates were only 3.2 fish/hour and 2.4 fish/hour, respectively. Simonton has been stocked with walleye on a relatively consistent basis since 1984. From 1984 to 1994, small or large fingerlings were stocked roughly every other year. Then, from 1997 to present, Simonton was stocked annually in the fall with 5 to 8-in walleye. Consequently, Simonton Lake is different than the other three lakes in that it has an established walleye population. That population, with its wide range of ages, may limit the success of fingerlings stockings and be an explanation for low age-1 catch rates compared to the other three lakes. As

more year-classes are added and established at Crooked, Sylvan, and Winona, age-1 catch rates of walleye may taper off and look more like those from Simonton.

With the exception of Simonton Lake, the advanced fingerling walleye stockings at the study lakes were successful based on the predetermined criteria. The next step in the study was to evaluate the newly created fisheries as a whole. More specifically, have the successful stockings translated into successful fisheries.

Observations of the four lakes' length frequency distributions reveal a common trend. Despite the success of the fall stockings, size structures at these lakes have not improved much over the course of the study. At Crooked Lake, stockings were considered successful each year (2001 to 2004) but very few walleye recruited to quality sized (15 inches). In 2002, no age-1 walleye were greater than or equal to 15 inches and the few fish that were holdover walleye from previous stockings. Collection efforts in 2003 showed that some of the 2001 year-class (age 2) grew to at least 15 inches but PSD was still relatively low (PSD = 12). In 2004, no age-2 walleye were greater than quality size. Age-3 fish were as large as 20.5 inches and PSD increased slightly to 16. Proportional stock density was nearly identical in 2005 (PSD = 17) and more age-2 walleye recruited to quality size compared to 2004. It was anticipated that with four year-classes in the lake in 2005, size structure would show substantial of improvement over previous years. This was not evident. Mean length at capture of age-1 walleye in Crooked Lake ranged from 10.7 inches in 2004 to 12.1 inches in 2005 and only two age-1 fish in four years of sampling were ever greater than quality size. At age 2, mean length at capture decreased from 2003 to 2004 but increased slightly in 2005. In 2004, mean length of age-3 walleye was 16.9 inches compared to 16.4 inches in 2005. Despite the relatively consistent mean lengths at capture for each age-class, mean relative growth increments decreased over time for age-1 and age-2 walleye. At age-1, the mean RGI decreased significantly from 2002 to 2003 and then again between 2004 and 2005. Similarly, there was a significant decrease in the mean RGI at age 2 from 2003 to 2005.

In addition to slowing growth, Crooked Lake walleye were also in poor condition. Mean relative weights were low in 2004 and 2005 indicating problems with foraging. Means for the S-Q, Q-P, and P-M length categories were all below 85.

Simonton Lake has been stocked annually with advanced fingerling walleye for the last decade. Consequently, the lake has a long-established walleye population. Despite the

numerous year-classes in the lake, there were very few large walleye and even limited numbers of fish greater than 15 inches. Proportional stock density was 32 in 2001 and consistently decreased each year to a low of 15 in 2005. Only a few walleye were captured larger than 20 inches and RSD-P was 0 in 2002 and 2 in 2003, 2004, and 2005.

Age-1 walleye from Simonton Lake averaged 10.9 inches in 2003 to 11.5 inches in 2002 and 2005. At age 2, mean length at capture ranged from 12.7 inches in 2003 to 14.6 inches in 2005. Simonton Lake walleye did not reach 15 inches until age 3 in 2002 and 2003, age 5 in 2004, and age 4 in 2005. Overall, growth was more constant at Simonton Lake than at the other three lakes. Mean relative growth increments were not significantly different between years at age 1, age 2, or age 4. However, there was a significant difference in the mean RGIs at age 3 with the 2003 increment being larger than the increments from 2002, 2004, and 2005. Less variability in growth (particularly at age 1 and age 2) is likely due to Simonton Lake having an established population with numerous year-classes.

Simonton walleye were in poor condition. Average relative weights for each size category were well below 85. In 2004, mean relative weights were 76 and 72 for the S-Q and Q-P length categories, respectively. Similarly, 2005 relative weights averaged 77 (S-Q) and 73 (Q-P).

The 2001, 2002, 2003, and 2004 walleye stockings at Sylvan Lake were considered highly successful. Length frequency distributions from the 2002 to 2005 samples show strong age-1 year-classes from each those stockings. In 2002, the large age-1 year-class (2001) exhibited some growth of walleye to greater than quality size. In 2003, a large proportion of the 2001 year-class recruited into the quality-preferred size category and resulted in a high PSD (40). The following year (2004), only handful age-2 walleye were captured greater than 15 inches and a few fish survived to age 3. Proportional stock density declined substantially from 2003 (PSD = 40) to 2004 (PSD = 17) while RSD-P increased slightly from 2 to 3. Similar to 2004, very few age-2 walleye in the 2005 sample were of quality size. This was also evident in the 2005 sample.

This is most likely explained by the obvious decreases in growth of most age-classes after the first few stockings. Age-1 walleye in 2002 averaged 12.5 inches compared to 10.1 inches at age 1 in 2003. During this time period there was a significant decrease in mean relative growth increment. Although the mean length of age-1 walleye was greater in 2004 than in 2003, the

2004 RGI was still significantly smaller than the mean RGIs of age-1 walleye in 2002 and 2003. Similar to walleye at age 1, there was a significant decrease in the mean relative growth increment of age-2 walleye between 2003 and 2004. Consequently, mean length of age-2 fish in 2003 was 15.1 inches compared to 14.0 inches in 2004. At age-3, no difference in mean RGI was detected between walleye captured in 2004 and 2005. However, age-3 walleye in 2004 were substantially larger than age-3 walleye captured in 2005. Walleye of all sizes in Sylvan are also in relatively poor condition. Mean relative weights of S-Q, Q-P, and P-M walleye in 2004 and 2005 were approximately 85 indicating problems with walleye foraging.

Similar to Crooked and Sylvan, the initial stocking of advanced fingerling walleye at Winona produced an abundant year-class of age-1 fish in 2002. This first year-class averaged 12.8 inches and five of the walleye captured were at least 15 inches. In 2003, the 2001 year-class recruited to quality size with 49 age-2 walleye being greater than or equal to 15 inches. The age-2 fish averaged 16.1 inches. This resulted in an increase in PSD from 7 in 2002 to 41 in 2003. The mean length at capture of age-1 walleye decreased substantially from 2002 (12.8 in) to 2003 (10.6 in). Consequently, very few age-2 walleye in the 2004 sample recruited to quality size and PSD decreased to 11. Likewise, mean length of age-1 walleye in 2004 was 10.9 inches and only a few of these fish recruited to quality size at age 2 in 2005. The difference in mean length at capture between years was also evident in terms of the mean relative growth increment. At age-1, the mean RGI decreased significantly from 2002 to 2003 and then again from 2003 to 2004. Mean length at capture of age-2 walleye also decreased over time. In 2003, the first year-class of age-2 walleye in Winona Lake averaged 16.1 inches. The next year, age-2 walleye averaged 13.5 inches. In 2005, mean length at capture of age-2 walleye increased to 14.7 inches. Similar to walleye at age 1, the mean relative growth increments at age 2 differed significantly between years. In 2003, the age-2 mean RGI was significantly larger than the increment in 2004 and 2005. The 2005 age 2 mean RGI was significantly smaller than that increment in the previous two years.

In 2004, 11 age-3 walleye were captured and contributed the most to PSD and RSD-P values. Twenty-seven age-3 walleye were captured in 2005. Mean length at capture of age-3 fish decreased substantially from 2004 to 2005. In 2004, age-3 walleye averaged 19.0 inches compared to 16.4 inches in 2005. However, there was no difference in the mean relative growth increments at age 3 between 2004 and 2005.

Walleye foraging may also be a problem at Winona. Mean relative weights in 2004 and 2005 were similar to those from Crooked and Sylvan. Relative weights for the S-Q, Q-P, and P-M length categories ranged, on average, from 82 to 90.

Walleye from Crooked, Sylvan, and Winona lakes exhibited very similar trends. After the initial stocking, and as more year-classes were added, growth on the fish began to decrease significantly. Over time, walleye at all three of these lakes showed decreases in the mean relative growth increments at age 1 and age 2. Additionally, walleye from these lakes were in poor condition. Mean relative weights were well below 100. For most year and size-group combinations, relative weights averaged approximately 85 indicating that the walleye are underweight and problems likely exist in food or feeding conditions (Anderson and Newman 1996). Specifically, the walleye may be too abundant for their food supply (Flickinger and Bulow 1993).

RECOMMENDATIONS

- Continue fall evaluation at each lake in 2006. At Crooked, Sylvan, and Winona lakes, stocking advanced fingerling walleye in the fall has resulted in success based on the criteria set forth in this study. However, how these stockings will respond to increasing densities of walleye needs to be evaluated.
- Conduct creel surveys at each lake in 2007. Although decreasing growth and poor condition seem to be the apparent causes of failure of these lakes to improve size structure, it would be difficult and inappropriate to make management recommendations without some measure of walleye exploitation.
- Re-evaluate the fisheries after the 2006 fall evaluations and 2007 creel surveys and make recommendations for changes in stocking strategies and/or length and bag limits.

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Table 1. Advanced fingerling walleye stocking statistics at Crooked, Simonton, Sylvan, and Winona lakes 2001 to 2005.

		Dates(s)	Planned Rate (#/acre)	Actual Rate (#/acre)	Number
Crooked (802 ac)					
	2001	9/25	10.0	9.8	7,860
	2002	9/27	10.0	10.0	8,080
	2003	10/03	10.0	9.8	7,881
	2004	10/6	10.0	10.0	8,020
	2005	10/04	10.0	10.0	8,020
Simonton (299 ac)					
	2001	10/11	7.0	6.7	2,000
	2002	10/01	7.0	7.4	2,200
	2003	10/21	7.0	6.7	2,000
	2004	10/11	7.0	6.7	2,000
	2005	10/10	7.0	5.0	1,500
Sylvan (669 ac)					
	2001	9/25+10/03	20.0	18.9	12,620
	2002	10/10+10/16	20.0	20.0	13,380
	2003	10/08+10/24	20.0	19.3	13,200
	2004	10/8+10/12	20.0	20.0	13,380
	2005	10/6 +10/11	20.0	20.0	13,380
Winona (562 ac)					
	2001	9/27	20.0	19.1	10,740
	2002	10/02+10/16	20.0	20.0	11,240
	2003	10/01+10/03	20.0	20.1	11,300
	2004	10/1+10/12	20.0	20.0	11,240
	2005	10/7 + 10/11	20.0	20.0	11,240

Table 2. Fall electrofishing catch rates of age-1 walleye from Crooked, Simonton, Sylvan, and Winona Lakes 2002 to 2005.

	Lake			
	Crooked	Simonton	Sylvan	Winona
2002	16.5	3.2	24.3	9.9
2003	9.5	5.7	13.7	15.7
2004	7.0	2.4	14.3	25.4
2005	15.9	8.1	16.1	1.8

Table 3. Walleye size structure indices at Crooked, Simonton, Sylvan, and Winona lakes, 2002 to 2005.

		Lake			
		Crooked	Simonton	Sylvan	Winona
2002					
	PSD	2	32	7	7
	RSD-P	2	0	3	3
	RSD-M	1	0	1	0
2003					
	PSD	12	23	40	41
	RSD-P	1	2	2	4
	RSD-M	0	0	0	0
2004					
	PSD	16	21	17	11
	RSD-P	2	2	3	2
	RSD-M	1	0	0	0
2005					
	PSD	17	15	20	58
	RSD-P	1	2	2	10
	RSD-M	0	1	0	0

Table 4. Mean relative weights of walleye at the stock to quality, quality to preferred, and preferred to memorable size-groups from Crooked, Simonton, Sylvan, and Winona lakes, 2002 to 2005. Standard error is reported in parentheses.

		Lake			
		Crooked	Simonton	Sylvan	Winona
2004					
	S-Q	80 (0.6)	76 (1.1)	80 (1.0)	83 (0.9)
	Q-P	80 (1.4)	72 (1.7)	81 (2.0)	82 (1.4)
	P-M	77 (3.8)	---	90 (5.9)	90 (2.0)
2005					
	S-Q	84 (0.6)	77 (0.6)	87 (1.0)	88 (1.8)
	Q-P	81 (2.0)	73 (2.3)	86 (1.5)	86 (1.2)
	P-M	76 (n=1)	69 (n=1)	85 (1.2)	82 (1.4)

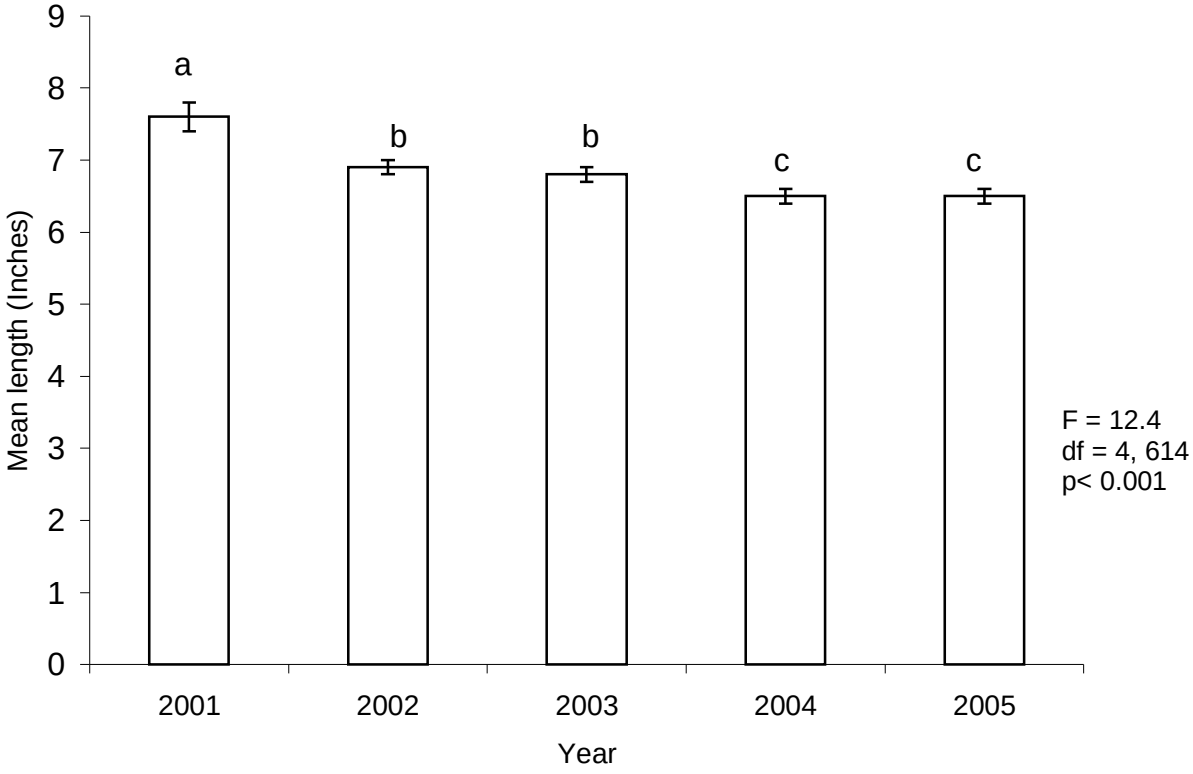

Figure 1. Mean length of walleye stocked into Crooked Lake, 2001 to 2005. Error bars represent ± 1 standard error. Bars with the same letter denote no significant difference (p = 0.05).

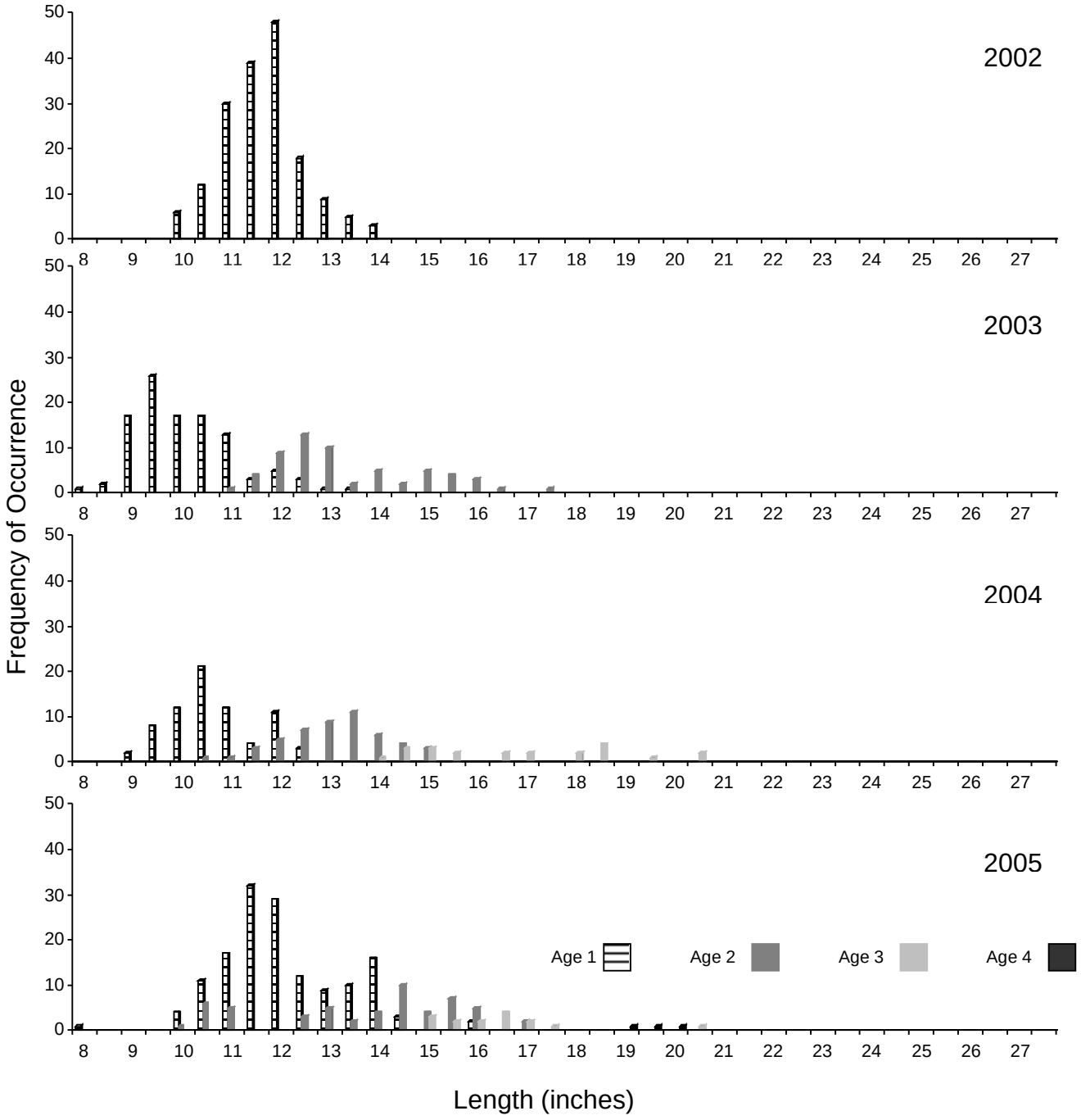

Figure 2. Length frequency distributions for Crooked Lake walleye by age and year, 2002 to 2005.

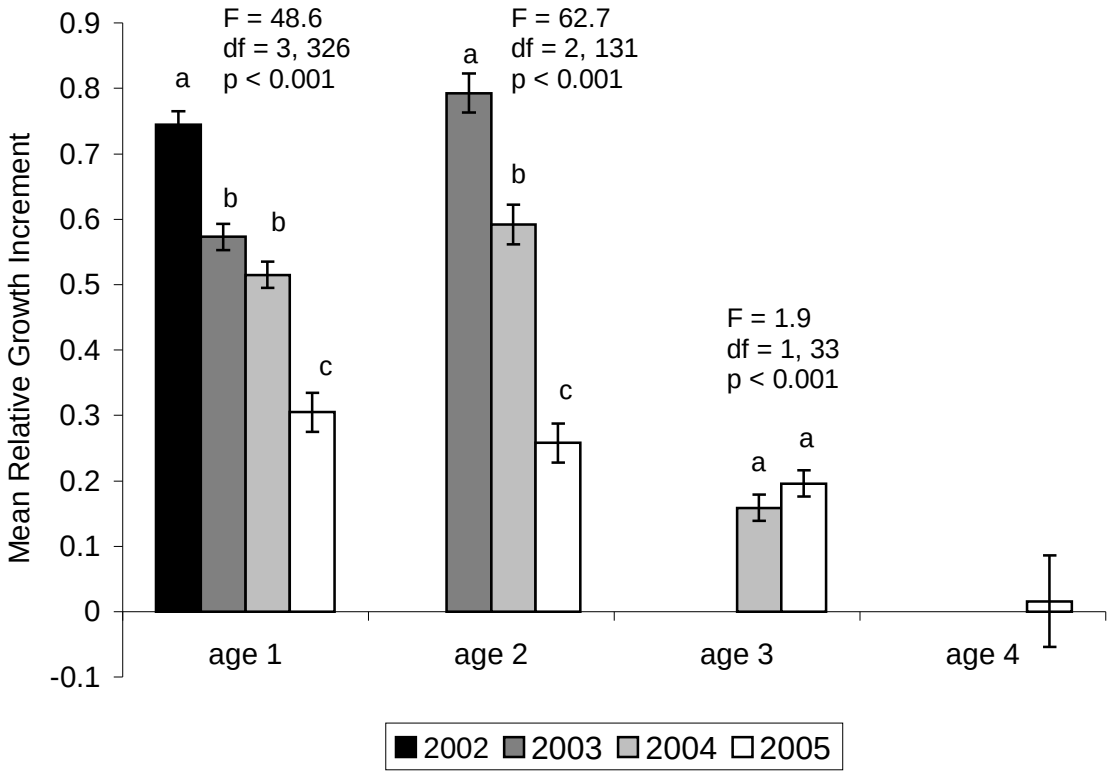

Figure 3. Mean relative growth increments at each age of Crooked Lake walleye, 2002 to 2005. Error bars represent ± 1 standard error. ANOVA tests are between years within each age group. Bars within each age group with the same letter denote no significant difference (p = 0.05).

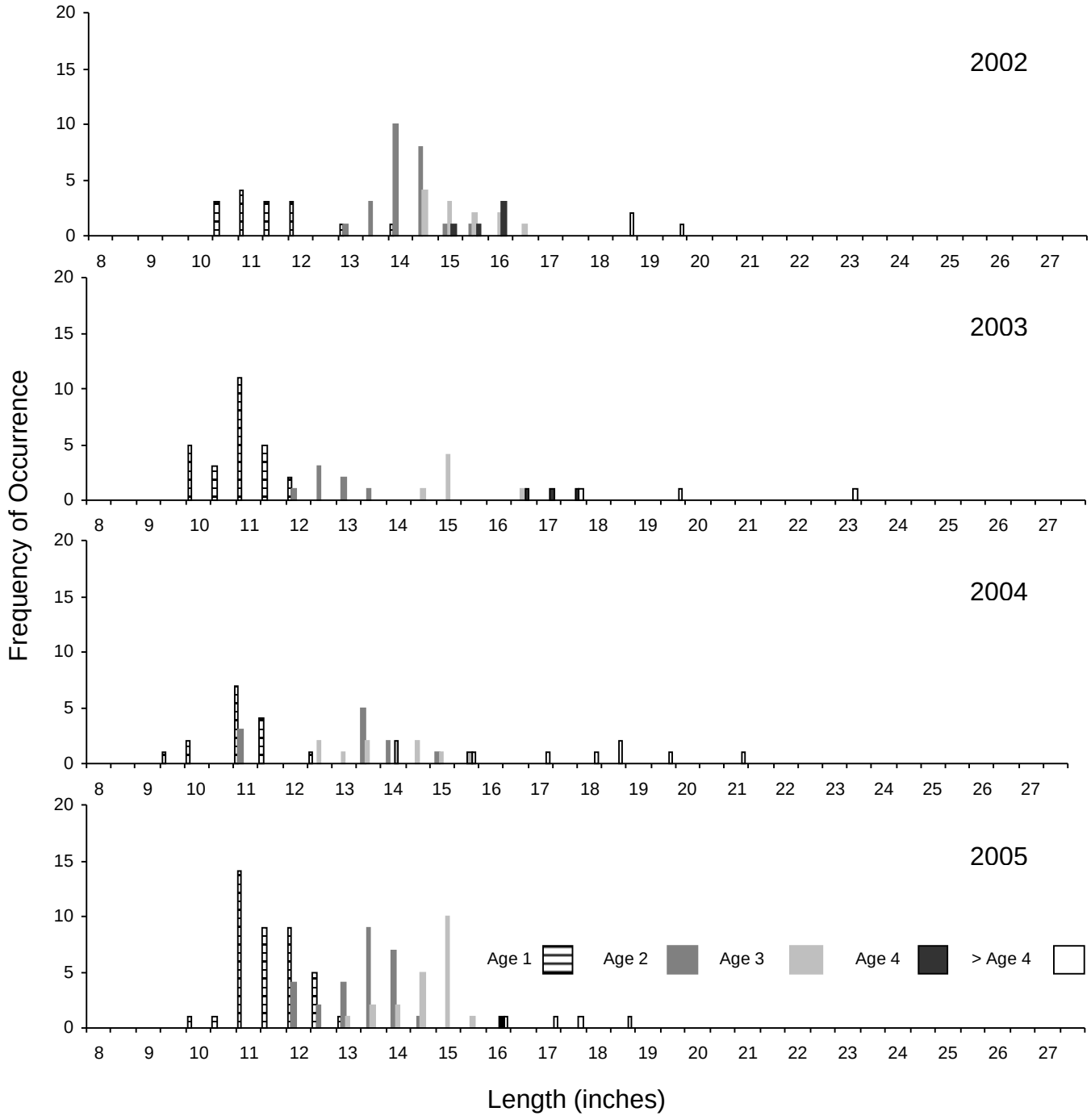

Figure 4. Length frequency distributions for Simonton Lake walleye by age and year, 2002 to 2005.

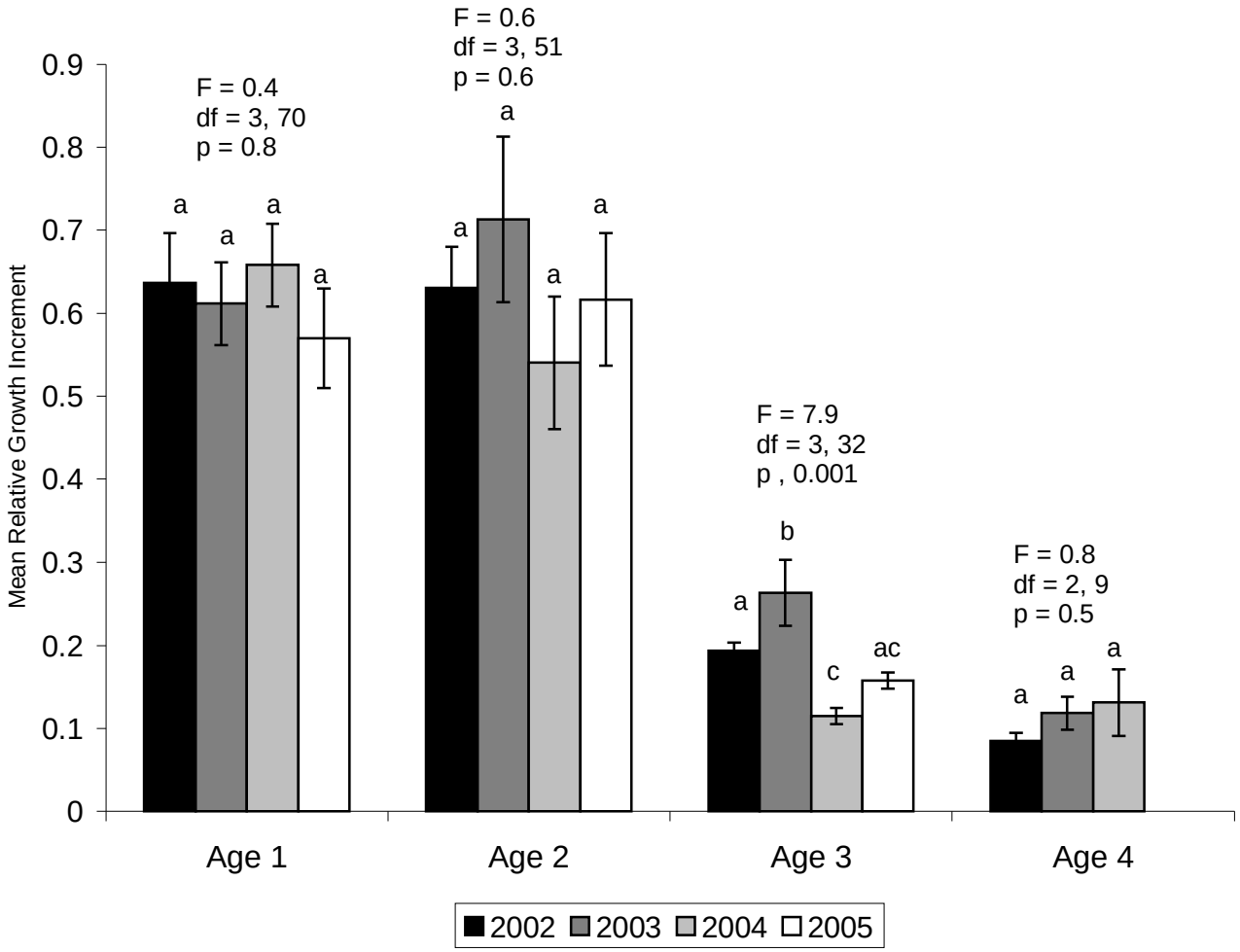

Figure 5. Mean relative growth increments at each age of Simonton Lake walleye, 2002 to 2005. Error bars represent ± 1 standard error. ANOVA tests are between years within each age group. Bars within each age group with the same letter denote no significant difference (p = 0.05).

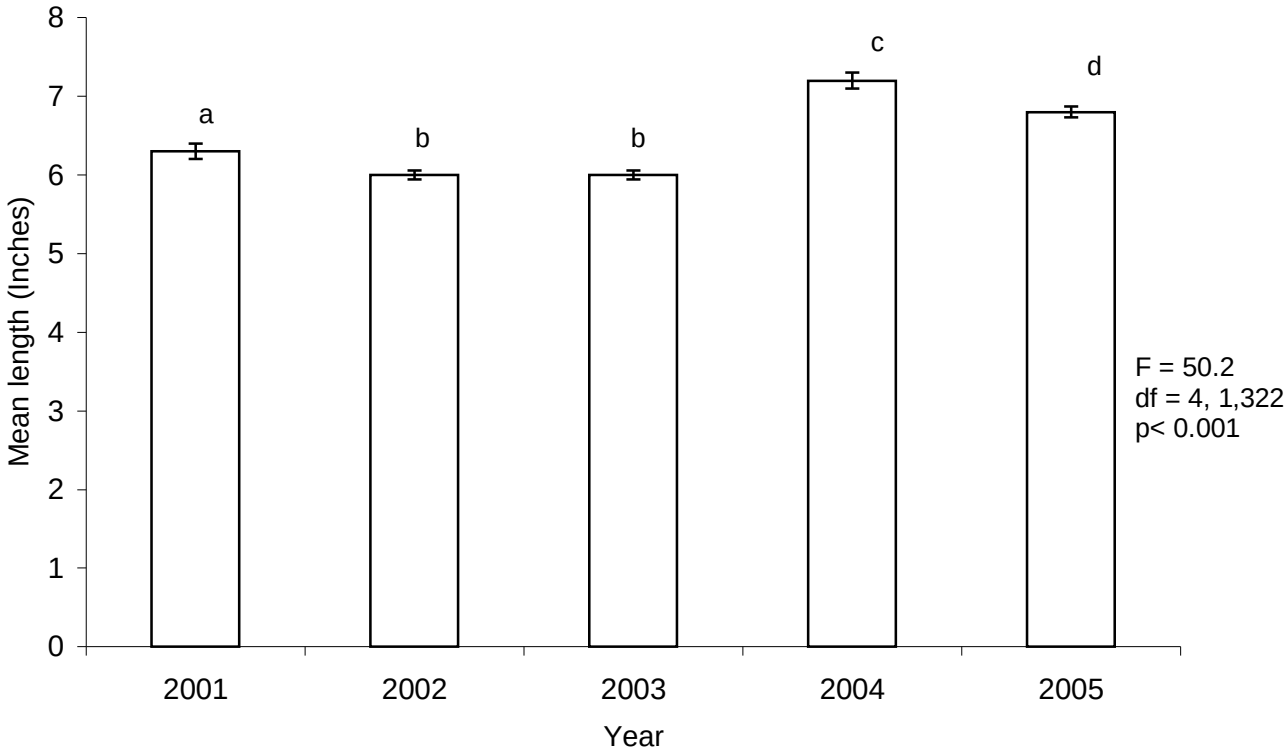

Figure 6. Mean length of walleye stocked into Sylvan Lake, 2001 to 2005. Error bars represent ± 1 standard error. Bars with the same letter denote no significant difference (p = 0.05).

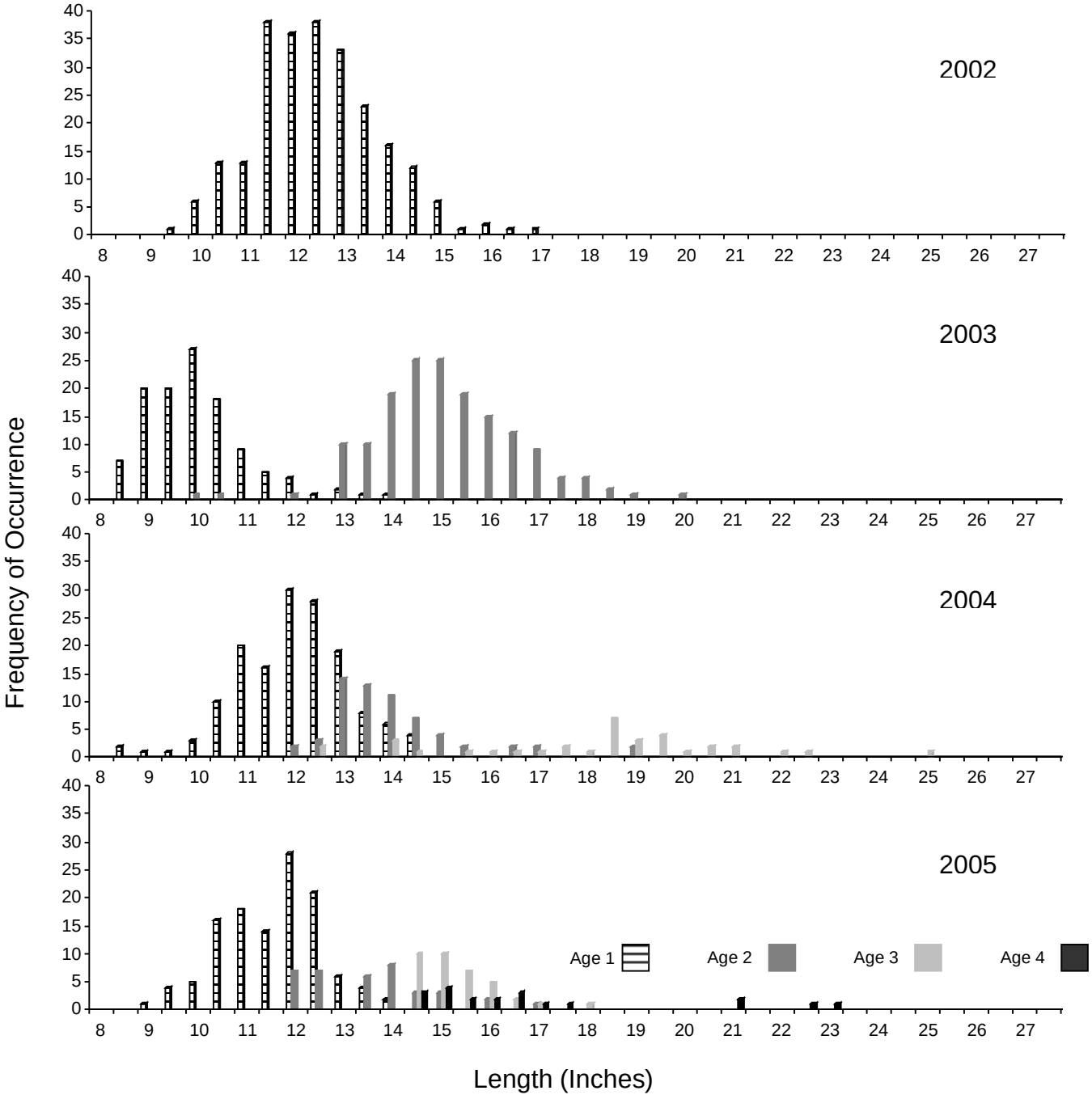

Figure 7. Length frequency distributions for Sylvan Lake walleye by age and year, 2002 to 2005.

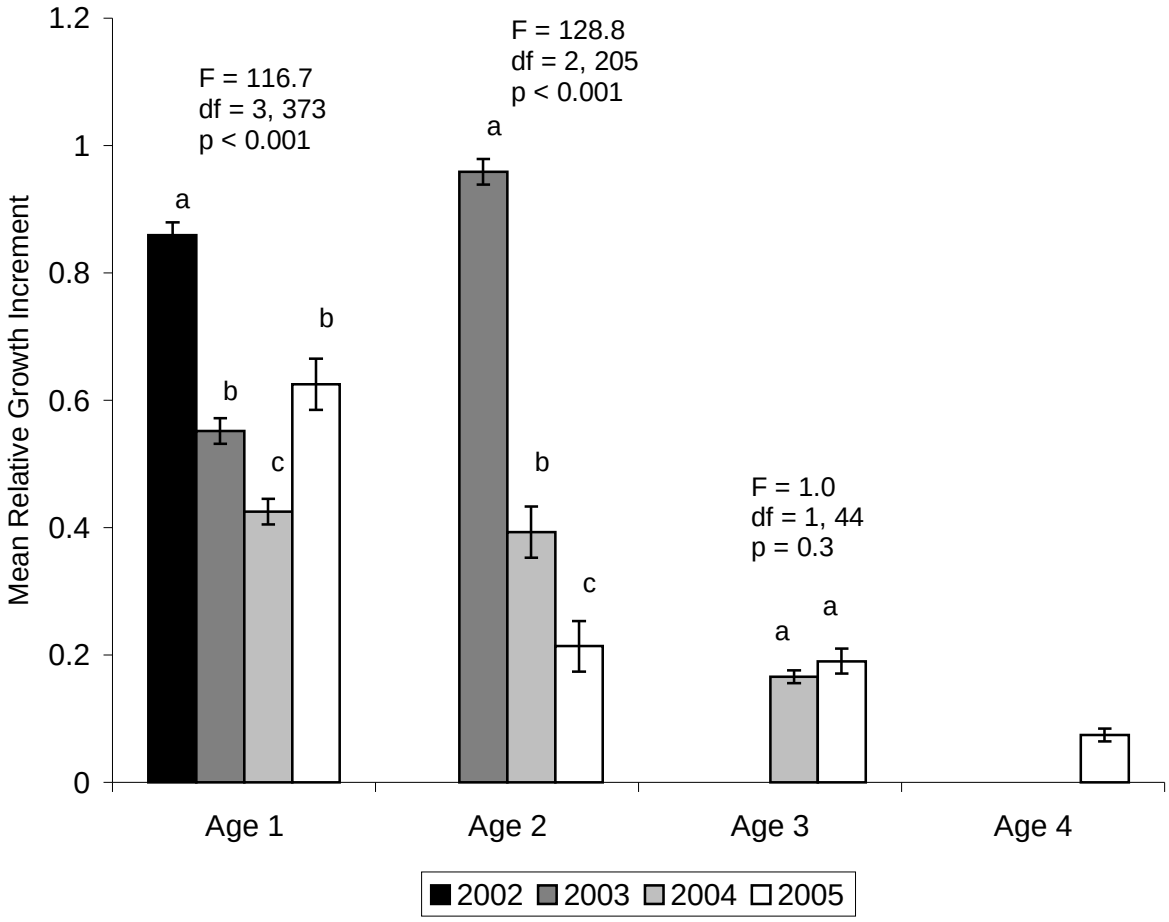

Figure 8. Mean relative growth increments at each age of Sylvan Lake walleye, 2002 to 2005. Error bars represent ± 1 standard error. ANOVA tests are between years within each age group. Bars within each age group with the same letter denote no significant difference (p = 0.05).

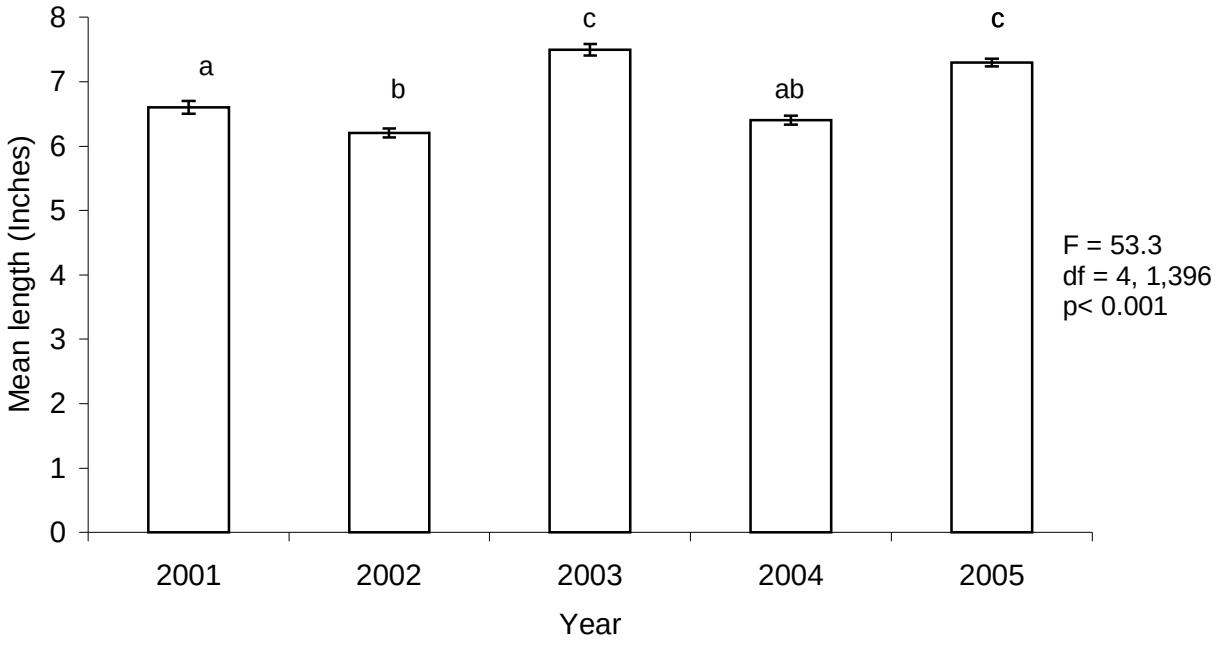

Figure 9. Mean length of walleye stocked into Winona Lake, 2001 to 2005. Error bars represent ± 1 standard error. Bars with the same letter denote no significant difference (p = 0.05).

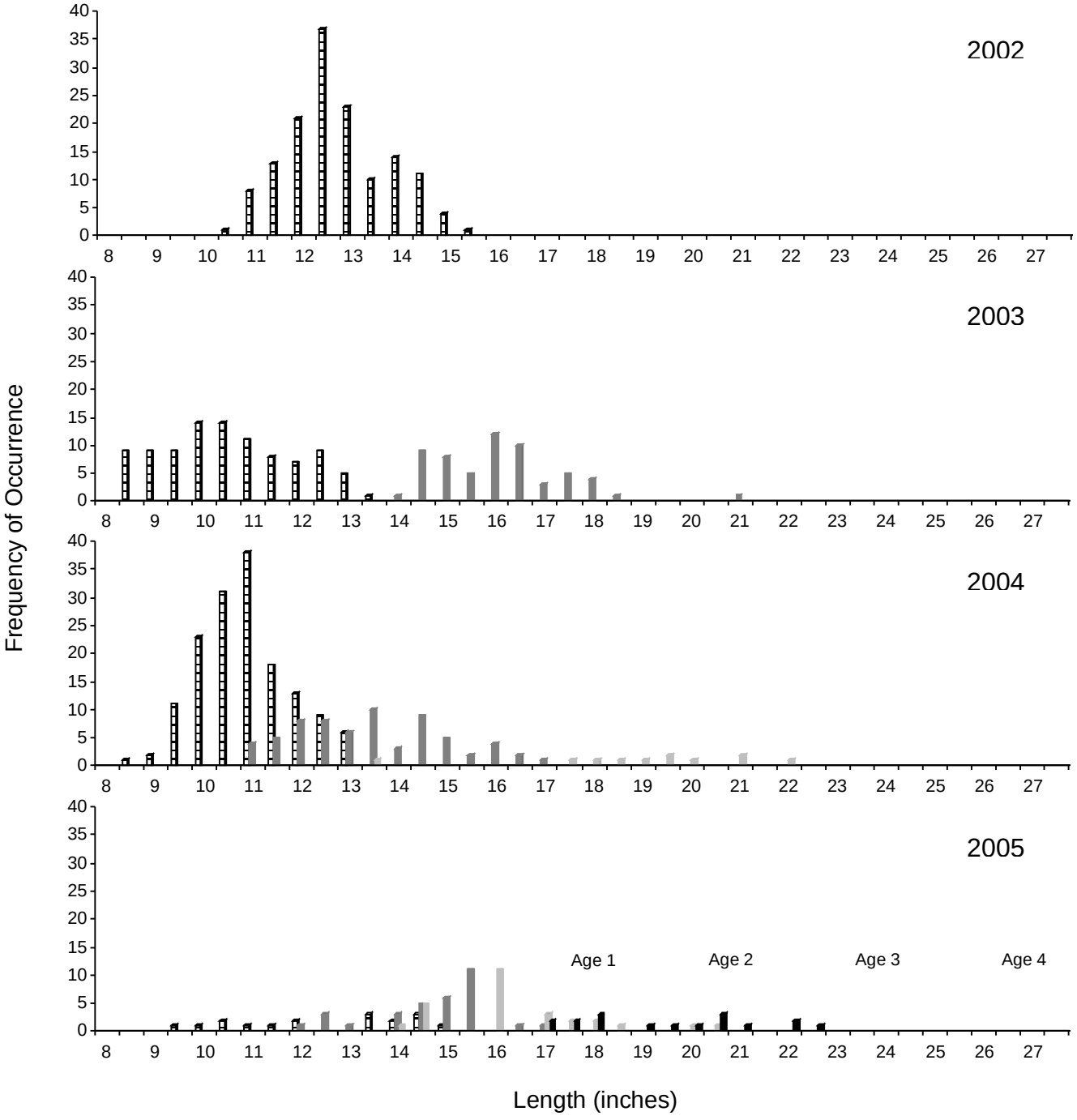

Figure 10. Length frequency distributions for Winona Lake walleye by age and year, 2002 to 2005.

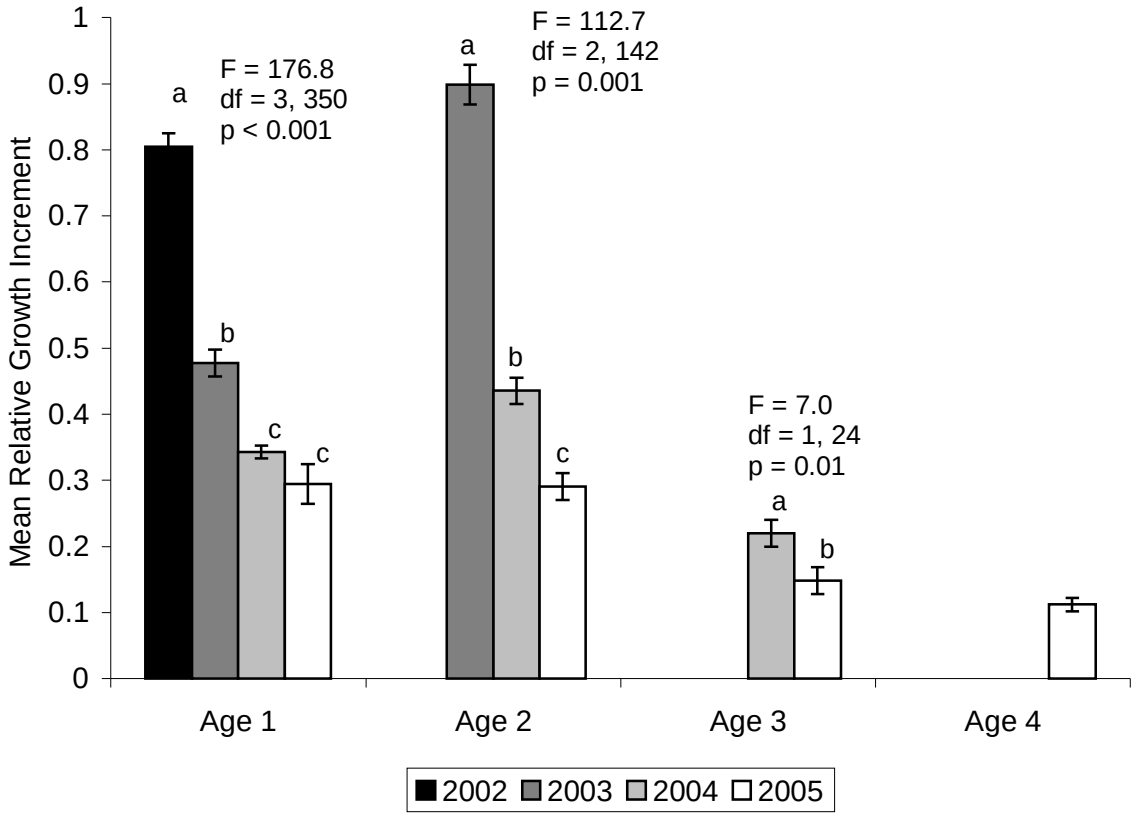

Figure 11. Mean relative growth increments at each age of Winona Lake walleye, 2002 to 2005. Error bars represent ± 1 standard error. ANOVA tests are between years within each age group. Bars within each age group with the same letter denote no significant difference (p = 0.05).

APPENDIX 1.

Age and Growth Tables of Walleye from Crooked Lake, 2002 - 2005

Crooke 2002

Average Back-Calculated Lengths (inches) For Each Age Class												
Year Class	**Age**	**n**		1	2	3	4	5	6	7	8	9	10
2001	1	117	6.76										
2000	2	0	0	0									
1999	3	0	0	0	0								
1998	4	0	0	0	0	0							
1997	5	0	0	0	0	0	0						
1996	6	0	0	0	0	0	0	0					
1995	7	0	0	0	0	0	0	0	0				
1994	8	1	7.73	11.12	14.81	18.21	19.56	20.34	21.02	21.6			
1993	9	0	0	0	0	0	0	0	0	0	0		
1992	10	2	6.16	14.26	18.86	21.02	22.29	23.4	24.47	25.34	25.93	26.68	
N		128	120	3	3	3	3	3	3	3	2	2	
All Classes			6.76	13.21	17.51	20.08	21.38	22.38	23.32	24.1	25.93	26.68	

Crooked 2003

Average Back-Calculated Lengths (inches) For Each Age Class														
Year Class	**Age**	**n**		**1**	**2**	**3**	**4**	**5**	**6**	7	8	9	10	11
2002	1	103	7.21											
2001	2	59	7.02	12.37										
2000	3	0	0	0	0	0								
1999	4	0	0	0	0	0	0							
1998	5	0	0	0	0	0	0	0						
1997	6	0	0	0	0	0	0	0	0					
1996	7	1	9.77	14.37	16.9	18.55	19.16	19.68	20.2					
1995	8	0	0	0	0	0	0	0	0	0	0			
1994	9	0	0	0	0	0	0	0	0	0	0	0		
1993	10	0	0	0	0	0	0	0	0	0	0	0	0	
1992	11	1	6.32	12.51	16.73	17.76	19.92	20.58	21.33	22.08	23.01	23.76	24.33	
N		164	164	61	2	2	2	2	2	1	1	1	1	
All Classes			7.15	12.4	16.81	18.16	19.54	20.13	20.76	22.08	23.01	23.76	24.33	

Crooked 2004

Year Class	Age	n	Average Back-Calculated Lengths (inches) For Each Age Class										
			1	2	3	4	5	6	7	8	9	10	11
2002	1	103	7.21										
2001	2	59	7.02	12.37									
2000	3	0	0	0	0								
1999	4	0	0	0	0	0							
1998	5	0	0	0	0	0	0						
1997	6	0	0	0	0	0	0	0					
1996	7	1	9.77	14.37	16.9	18.55	19.16	19.68	20.2				
1995	8	0	0	0	0	0	0	0	0	0			
1994	9	0	0	0	0	0	0	0	0	0	0		
1993	10	0	0	0	0	0	0	0	0	0	0	0	
1992	11	1	6.32	12.51	16.73	17.76	19.92	20.58	21.33	22.08	23.01	23.76	24.33
N		164	164	61	2	2	2	2	2	1	1	1	1
All Classes			7.15	12.4	16.81	18.16	19.54	20.13	20.76	22.08	23.01	23.76	24.33

Crooked 2005

Year Class	Age	n	Average Back-Calculated Lengths (inches) For Each Age Class			
			1	2	3	4
2004	1	37	9.56			
2003	2	27	10.35	12.8		
2002	3	13	9.24	12.75	15.18	
2001	4	3	10.16	15.16	17.26	18.4
N		80	80	43	16	3
All Classes			9.8	12.95	15.57	18.4

APPENDIX 2.

Age and Growth Tables of Walleye from Simonton Lake, 2002 – 2005

Simonton 2002

Year Class	Age	n	Average Back-Calculated Lengths (inches) For Each Age Class 1	2	3	4	5	6	7
2001	1	15	7.15						
2000	2	24	7.39	11.73					
1999	3	11	8.52	11.71	13.96				
1998	4	5	7.46	12.25	14.1	15.29			
1997	5	2	8.7	14.85	16.8	17.67	18.16		
1996	6	0	0	0	0	0	0	0	
1995	7	1	6.6	11.52	14.38	15.41	16.63	18.17	19.3
N		58	58	43	19	8	3	1	1
All Classes			7.58	11.92	14.32	15.9	17.65	18.17	19.3

Simonton 2003

Year Class	Age	n	Average Back-Calculated Lengths (inches) For Each Age Class 1	2	3	4	5	6	7
2002	1	27	6.9						
2001	2	6	6.67	11.27					
2000	3	6	6.99	11.34	14.22				
1999	4	3	9.64	12.74	14.34	16.04			
1998	5	2	8.48	13.41	15.59	17.03	18.02		
1997	6	0	0	0	0	0	0	0	
1996	7	1	6.08	13.62	16.42	18.35	19.86	21.37	22.66
N		45	45	18	12	6	3	1	1
All Classes			7.12	11.9	14.66	16.76	18.64	21.37	22.66

Simonton 2004

Year Class	Age	n	Average Back-Calculated Lengths (inches) For Each Age Class						
			1	2	3	4	5	6	7
2003	1	15	6.7						
2002	2	11	7.22	10.94					
2001	3	7	7.6	11.18	12.47				
2000	4	4	7.35	11.09	12.28	13.86			
1999	5	4	7.33	11.39	14.06	15.69	16.66		
1998	6	1	8.96	12.99	15.96	16.91	18.1	18.93	
1997	7	2	9.9	13.03	15.15	16.7	18.13	18.89	19.52
N		44	44	29	18	11	7	3	2
All Classes			7.29	11.29	13.27	15.32	17.29	18.9	19.52

Simonton 2005

Year Class	Age	n	Average Back-Calculated Lengths (inches) For Each Age Class							
			1	2	3	4	5	6	7	8
2004	1	17	7.48							
2003	2	14	7.47	11.58						
2002	3	12	7.73	11.74	13.58					
2001	4	1	8.17	12.55	14.23	15.35				
2000	5	1	6.23	10.76	13.68	14.79	15.29			
1999	6	1	7.74	9.66	12.05	14.44	15.87	17.02		
1998	7	2	8.81	12.87	14.44	16.02	16.85	17.1	17.52	
1997	8	1	12.02	18.4	20.85	22.45	25.03	27.11	28.1	28.83
N		49	49	32	18	6	5	4	3	1
All Classes			7.68	11.88	14.03	16.51	17.98	19.58	21.04	28.83

APPENDIX 3.

Age and Growth Tables of Walleye from Sylvan Lake, 2002 – 2005

Sylvan 2002

Year Class	Age	n	Average Back-Calculated Lengths (inches) For Each Age Class							
			1	2	3	4	5	6	7	8
2001	1	137	6.7							
2000	2	0	0	0						
1999	3	0	0	0	0					
1998	4	0	0	0	0	0				
1997	5	0	0	0	0	0	0			
1996	6	2	9.37	14.6	17.4	20.13	21.3	21.88		
1995	7	5	8.81	15.06	17.94	18.98	19.82	20.49	20.93	
1994	8	1	8.48	13.77	15.97	17.63	18.73	19.5	19.94	20.38
N		149	145	8	8	8	8	8	6	1
All Classes			6.82	14.79	17.56	19.1	20.05	20.71	20.77	20.38

Sylvan 2003

Year Class	Age	n	Average Back-Calculated Lengths (inches) For Each Age Class							
			1	2	3	4	5	6	7	8
2002	1	109	6.61							
2001	2	151	6.64	12.79						
2000	3	0	0	0	0					
1999	4	0	0	0	0	0				
1998	5	0	0	0	0	0	0			
1997	6	2	8.58	15.29	18.45	19.13	19.69	20.08		
1996	7	0	0	0	0	0	0	0	0	
1995	8	3	7.65	14.47	17.43	19.37	20.42	21.32	21.93	22.36
N		265	265	156	5	5	5	5	3	3
All Classes			6.65	12.86	17.84	19.27	20.13	20.83	21.93	22.36

Sylvan 2004

Year Class	Age	n	Average Back-Calculated Lengths (inches) For Each Age Class		
			1	2	3
2003	1	112	8.5		
2002	2	45	9.33	12.53	
2001	3	29	8.05	14.58	16.92
N		186	186	74	29
All Classes			8.63	13.33	16.92

Sylvan 2005

Average Back-Calculated Lengths (inches) For Each Age Class

Year Class	Age	n		1	2	3	4
2004	1	19	7.48				
2003	2	12	9.26	12.01			
2002	3	17	9.05	12.27	14.48		
2001	4	14	9.62	13.65	15.87	17	
N			62	62	43	31	14
All Classes				8.74	12.64	15.1	17

APPENDIX 4.

Age and Growth Tables of Walleye from Winona Lake, 2002 – 2005

Winona 2002

Average Back-Calculated Lengths (inches) For Each Age Class									
Year Class	Age	n	1	2	3	4	5	6	7
2001	1	103	7.26						
2000	2	0	0	0					
1999	3	1	12.21	17.11	18.78				
1998	4	1	12.45	16.21	17.92	18.94			
1997	5	1	11.98	17.84	21.14	21.63	22		
1996	6	0	0	0	0	0	0	0	
1995	7	3	10.46	15.42	17.82	18.99	20.06	20.79	21.39
N		127	109	6	6	5	4	3	3
All Classes			7.49	16.24	18.55	19.51	20.55	20.79	21.39

Winona 2003

Average Back-Calculated Lengths (inches) For Each Age Class										
Year Class	Age	n	1	2	3	4	5	6	7	8
2002	1	93	7.33							
2001	2	62	7.17	13.35						
2000	3	0	0	0	0					
1999	4	0	0	0	0	0				
1998	5	2	9.26	15.45	19.71	21.64	22.59			
1997	6	1	10.28	16.16	18.93	20.2	20.66	21.24		
1996	7	0	0	0	0	0	0	0	0	
1995	8	1	9.97	17.12	19.65	21.55	22.99	23.53	24.08	24.8
N		159	159	66	4	4	4	2	1	1
All Classes			7.33	13.51	19.5	21.26	22.21	22.39	24.08	24.8

Winona 2004

Year Class	Age	n	Average Back-Calculated Lengths (inches) For Each Age Class						
			1	2	3	4	5	6	7
2003	1	148	8.2						
2002	2	64	7.92	11.22					
2001	3	10	8.29	13.95	17.07				
2000	4	0	0	0	0	0			
1999	5	0	0	0	0	0	0		
1998	6	0	0	0	0	0	0	0	
1997	7	1	9.7	13.93	17.92	19.98	20.83	21.31	21.8
N		223	223	75	11	1	1	1	1
All Classes			8.13	11.62	17.14	19.98	20.83	21.31	21.8

Winona 2005

Year Class	Age	n	Average Back-Calculated Lengths (inches) For Each Age Class			
			1	2	3	4
2004	1	10	9.67			
2003	2	19	9.51	12.19		
2002	3	16	10.23	13.84	15.8	
2001	4	15	8.55	13.52	16.58	18.39
N		60	60	50	31	15
All Classes			9.49	13.12	16.17	18.39