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Characteristics of the Bluegill
Population of Three Soft-Water
Lakes in Vilas County, Wisconsin

By Steven L. Serns

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ABSTRACT

A study of the bluegill population of three soft-water lakes in northern Wisconsin was conducted in 1975. The percentage of bluegills 6.0 inches and larger captured in Flora Lake was considerably less than in Shannon or Bragonier Lakes. Population and biomass estimates on bluegills 6.0 inches and greater were 6.1/acre and 1.4 lb/acre in Shannon Lake, 60.0/acre and 9.3 lb/acre in Flora Lake and 49/acre and 10.3 lb/acre in Bragonier Lake. Bluegill biomass and population estimates in Bragonier and Flora Lakes were similar to other studies in the upper Midwest. Growth of bluegills in Shannon and Bragonier Lakes was greater than in Flora Lake with bluegills reaching 6.0 inches at age V in Shannon and Bragonier and not until age VI in Flora. Annual total mortality of bluegills was .55 in Flora Lake, and .35 in Shannon Lake. Average coefficients of condition (c) for bluegills from 3.0-8.9 inches collected in July, 1975, were 54.65 in Shannon Lake, 47.18 in Flora Lake and 56.41 in Bragonier Lake.

INTRODUCTION

According to a random mail survey of 1975 Wisconsin anglers, panfish were the most sought-after group of fish during the 1975 season (Churchill, 1976). Among the panfish species, the bluegill (*Lepomis macrochirus* Rafinesque) is perhaps the favorite, yet there is little data available on the dynamics of bluegill populations in Wisconsin lakes. Because information on standing crop, growth and mortality are essential for the wise management of a species, I decided to estimate these basic population parameters for the bluegill population in three north central Wisconsin lakes.

DESCRIPTION OF THE LAKES

The three study lakes, located in Vilas County, were Shannon, Bragonier and Flora (Figure 1). They are small, soft-water lakes with fisheries consisting primarily of largemouth bass and panfish (Table 1). Bragonier Lake also contains some northern pike and walleyes, but these are thought to be remnant populations of earlier stockings with no evidence of natural reproduction (Serns, 1976a). Flora Lake was stocked in 1972 with 1,500 brook trout but none have been caught by anglers since 1973. There is no record of any stocking of Shannon Lake.

The shorelines of Shannon and Flora Lakes are in a wilderness state, however, Bragonier has several cabins on its periphery. Flora Lake is within the boundaries of a private country club that maintains complete creel records on this and six other lakes. None of the study lakes experience any problems associated with poor water quality (e.g., algae blooms, nuisance aquatic macrophyte growths, winterkill).

METHODS

Fyke nets were fished in each lake during two separate time periods (Table 2). The nets were set at selected locations with approximately equal shoreline distance between the sites during the first netting period and were reset during the second period approximately midway between those sites utilized in the first netting. All bluegills captured during the first netting period were measured (total length to the nearest 0.1 inch) and were given a left ventral fin clip. Scales were taken from all bluegills collected during the first two days of the second netting periods in Shannon and Bragonier Lakes and the first day of the first netting period in Flora Lake. All bluegills caught during the second netting period were measured, weighed to the nearest 1.0 g and examined for fin clips.

Catch/net-day and percentage of bluegills having lengths of 6.0, 7.0 and 8.0 inches and greater in the total fyke net catches in July 1975 were calculated for each lake. Since Bragonier Lake was fished with an unequal number of small mesh and large mesh nets (Table 2), the size distribution of the catch of bluegills in the small mesh nets was compared with the catch of the large mesh nets. Since there were no serious differences, the catches of the two mesh sizes were combined for calculation of percent size distribution and compared directly with the size distribution of bluegills in Shannon and Flora Lakes where the effort of the two mesh sizes was equal.

Population and standing crop estimates were calculated on bluegills in each lake utilizing data gathered during the two netting periods. Since there was little difference between Schnabel estimates (Ricker, 1975) run during the recapture period and the Petersen method, Bailey's Modification of the Petersen Method (Ricker, 1975) was used to estimate population size using the totals of M (first netting period) and C and R (second netting period). For each of the estimates, the number marked times the catch exceeded four times the population estimate, a criterion indicating that this method did not seriously underestimate the population (Robson and Regier, 1964). The Petersen estimate was multiplied by the mean weight of bluegills in a particular size interval (i.e. 4.0-5.9 inches; ≥ 6.0 inches) to obtain an estimate of biomass.

Plots of total fish length (inches) on anterior scale radius (mm) appeared linear for bluegills in all three lakes. Therefore, a separate linear regression equation was calculated for bluegills in each lake and lengths at the various annuli were back-calculated using the respective equation. Catch curves of scale-aged bluegills were used to estimate instantaneous and annual total mortality rates (Ricker, 1975).

Length-weight regression formulae and condition factors were calculated for bluegills in each lake. The following formula was used to calculate condition:

$$C = \frac{W \times 10^5}{L^3}$$

Where: C = Condition factor
W = Weight to nearest 0.01 lb
L = Total length to nearest
0.1 inch

RESULTS AND DISCUSSION

Few bluegills less than 6.0 inches were captured in either Shannon or Bragonier during the study period, while several bluegills under 6.0 inches were captured in Flora Lake (Figure 2). Length-frequency distribution and a comparison of fyke net catches of bluegills 6.0, 7.0 and 8.0 inches and larger in each lake indicate that the bluegills in Flora Lake are generally smaller than in Shannon or Bragonier. Only 32.9% of the bluegills captured in Flora were 6.0 inches and greater while in Shannon and Bragonier the percentage of bluegills caught 6.0 inches or larger was 72.3 and 86.0 respectively (Table 3).

TABLE 1. Morphological, chemical, and biological characteristics of the study lakes.

Lake	Surface Acres	Maximum Depth (ft)	Alkalinity* (mg/l)	Conductivity (mmhos at 77°F)	pH	Color	Fishery+
Shannon	35	30	4	14	5.8	Clear	LMB,BG,YP
Bragonier	44	28	4	20	7.0	Clear	LMB,BG,YP RB,BCr,PK
Flora	100	32	2	22	6.2	Light Brown	LMB,BG,RB, PK

*Shannon and Bragonier - methyl purple alkalinity (MPA); Flora - total alkalinity
 +RB=rock bass; PK=pumpkinseed; BG=bluegill; LMB=largemouth bass; BCr=black crappie; YP=yellow perch

TABLE 2. Netting periods and gear used in sampling bluegills from Shannon, Bragonier, and Flora Lakes in 1975.

Lake	First Netting Period (Marking)	Second Netting Period (Recapture)	Gear
Shannon	28 - 30 May	8 - 10 July	Four fyke nets (two 3/8-inch and two 1-inch square mesh)
Bragonier	17 - 19 June	29 - 30 July	Five fyke nets (two 3/8-inch and three 1-inch square mesh)
Flora	13 - 16 July	25 - 27 July	Six fyke nets (three 3/8-inch and three 1-inch square mesh)

TABLE 3. Catch/effort data and percentage of total catch for three size groups of bluegills captured in Shannon, Bragonier, and Flora Lakes in July, 1975.

Lake	Total Catch (All Sizes)	Net-Days Effort	Catch \geq 6.0 inches		Catch \geq 7.0 inches		Catch \geq 8.0 inches	
			No. per Net-Day	% Total Catch	No. per Net-Day	% Total Catch	No. per Net-Day	% Total Catch
Shannon	264	12	15.9	72.3	10.3	46.9	5.0	22.7
Bragonier	201	10	17.3	86.0	10.9	54.2	1.6	7.9
Flora	826	18	15.1	32.9	6.6	14.3	0.1	0.5

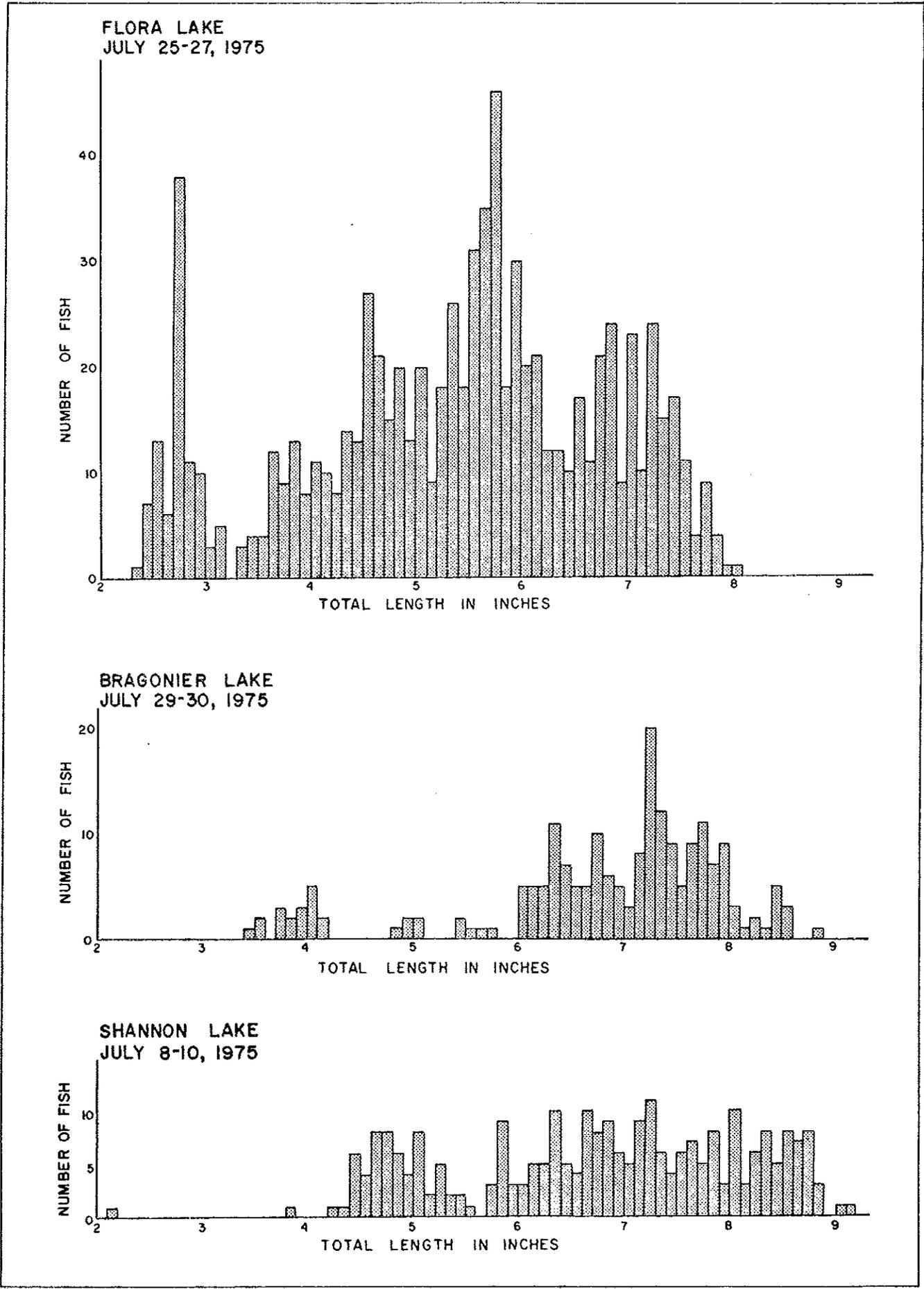


Figure 2. Length frequency distribution of bluegills captured in fyke nets in Shannon, Bragonier, and Flora Lakes, July, 1975.

Mark, capture and recapture data and population estimates for bluegills in various size groups in each lake are presented in Table 4.

Population and biomass estimates indicate that the population of bluegills 6.0 inches and larger in Shannon Lake is small with a low biomass when compared to Bragonier and Flora. Flora Lake has the greatest number of bluegills 6.0 inches and greater (60/acre) but Bragonier Lake has the highest biomass (10.3 lb/acre). Cooper and Latta (1954) reported a population of 63.1/acre for bluegills 6.0 inches and larger in Sugarloaf Lake, Michigan, while averages of estimates for six years in Jewett Lake, Michigan, and for two years in Lodge Lake, Michigan, were 56.3 and 53.4/acre respectively (Patriarche, 1968). T. D. Beard (unpublished data) found a population of bluegills 6.0 inches and larger in Raynard Lake, Wisconsin, of 39.7/acre with a biomass of 10.6 lb/acre. The low bluegill population density in Shannon Lake may be due to interspecific competition with or predation on young bluegills by a dense, slow-growing yellow perch population (Serns, 1976b).

Plots of total length (inches) on anterior scale radius (mm x 23) for males and females in each lake indicated little differences in growth between sexes. Therefore, sexes were combined in each lake for calculation of the body length-scale length regressions. Regression formulae were:

Shannon:	$Y = 1.384 + 0.036x$
Bragonier:	$Y = 1.273 + 0.035x$
Flora:	$Y = 1.723 + 0.033x$

Back-calculated total lengths in inches were similar for bluegills in each lake to age III. However, at ages IV-IX back-calculated lengths were smaller for bluegills from Flora than those from Shannon or Bragonier. Average growth increments at the intermediate ages were also lowest for bluegills from Flora Lake (Table 5).

Lengths at various annuli or end of growing seasons were about average in Shannon and Bragonier when compared to other lakes in the Midwest. The growth of bluegills in Flora Lake was below average in the intermediate ages, but was not as slow as bluegills in Clear Lake, Wisconsin (Table 6).

Total instantaneous mortality rates for age V - IX bluegills in Shannon and Flora Lakes were .429 and .787, respectively. Correlation coefficients (R) for the catch curves were -0.949 and -0.879 ($P < 0.05$), indicating little variation in year-class strength in these populations in recent years. The average total annual mortality rates were .35 for Shannon Lake and .55 for Flora Lake (Figure 3). The sample of aged fish from Bragonier was not adequate for a catch-curve estimate of mortality. Little is known about the sport-fishery of Shannon Lake, however, Flora Lake is surrounded by a private country club that keeps complete creel records on this and six other lakes (Serns, unpublished data). On the basis of these creel records and conversations with the club managers and members, I feel that there is essentially no harvest of bluegills from Flora Lake. There is a very limited amount of "fishing for fun" by children and some mortality probably occurs as a result of hooking and handling. It is doubtful that this mortality was more than .05 of the population of bluegills age V - IX. Therefore, the annual natural mortality rate for bluegills in Flora Lake was probably close to .50. This value is consistent with levels reported for bluegills in other lakes in the Midwest. However, the total annual mortality rate of bluegills in Shannon Lake was considerably less than that found by other investigators (Table 7). This may be due to the low bluegill population density and possible decreased intraspecific competition when compared to Flora Lake bluegills (Table 4).

TABLE 4. Population, standing crop, and biomass estimates for bluegills in three north central Wisconsin lakes.

Lake	Population Segment	Population Estimate				Standing Crop* (No/Acre)	Mean Weight lbs. (gms)	Biomass* (lbs/Acre)
		No. Mar.	No. Cap.	No. Rec.	Tot. Est.			
Shannon	≥ 6.0 inches	168	85	67	271	6.1(6.0-6.3)	0.23 (103.9)	1.4(1.3-1.5)
Bragonier	≥ 6.0 inches	422	178	34	2,158	49.0(34.8-63.3)	0.21 (95.1)	10.3(7.3-13.2)
Flora	≥ 4.0 inches	1,077	629	25	26,097	261.0(162-360)	0.10 (46.0)	26.4(16.4-36.4)
Flora	≥ 6.0 inches	407	235	15	6,003	60.0(31.6-88.4)	0.15 (70.2)	9.3(4.9-13.6)

*Numbers in parentheses represent 95% confidence intervals.

TABLE 5. Back-calculated total lengths in inches for bluegills collected in Shannon, Bragonier, and Flora Lakes, 1975.

Age Group	No. of Fish	Calculated Lengths at Successive Annuli								
		1	2	3	4	5	6	7	8	9
<u>SHANNON LAKE</u>										
II	3	2.0	3.0							
III	53	1.8	2.5	4.0						
IV	19	1.7	2.5	4.1	5.4					
V	32	1.7	2.3	3.9	5.3	5.9				
VI	16	1.8	2.4	3.9	5.4	6.4	7.6			
VII	8	1.8	2.7	4.0	5.3	6.3	7.1	7.6		
VIII	9	1.9	2.8	4.2	5.3	6.3	7.0	7.6	8.1	
IX	5	1.9	2.7	4.0	5.0	6.0	6.6	7.2	7.8	8.2
Avg. Length (Weighted)	145	1.8	2.5	4.0	5.3	6.1	7.2	7.5	8.0	8.2
Avg. Increment (Weighted)		1.8	0.7	1.5	1.3	0.8	0.9	0.3	0.5	0.2
<u>BRAGONIER LAKE</u>										
II	10	1.8	2.8							
III	2	2.1	3.2	4.1						
IV	21	2.0	3.3	4.5	5.7					
V	21	2.0	3.1	4.4	5.3	6.4				
VI	11	2.0	3.0	4.3	5.6	6.5	7.2			
VII	21	1.9	3.0	4.2	5.4	6.3	7.1	7.6		
VIII	9	1.9	2.7	3.9	5.1	6.0	6.9	7.6	8.0	
IX	6	1.9	2.7	3.9	5.2	6.0	6.7	7.3	7.7	8.1
Avg. Length (Weighted)	101	1.9	3.0	4.3	5.4	6.3	7.0	7.6	7.9	8.1
Avg. Increment (Weighted)		1.9	1.1	1.3	1.1	0.9	0.7	0.6	0.3	0.2
<u>FLORA LAKE</u>										
II	9	2.3	2.9							
III	14	2.4	3.1	3.9						
IV	70	2.3	3.0	3.8	4.6					
V	129	2.2	3.0	4.0	4.8	5.4				
VI	24	2.3	2.9	3.7	4.7	5.5	6.2			
VII	63	2.2	2.8	3.4	4.2	4.9	5.8	6.6		
VIII	17	2.2	2.8	3.5	4.1	5.1	5.8	6.6	7.1	
IX	3	2.3	2.9	3.7	4.8	5.6	6.3	7.0	7.7	8.0
Avg. Length (Weighted)	329	2.2	2.9	3.8	4.6	5.3	5.9	6.6	7.2	8.0
Avg. Increment (Weighted)		2.2	0.7	0.9	0.8	0.7	0.6	0.7	0.6	0.8

TABLE 6. Comparison of total lengths in inches for bluegills in the three study lakes with bluegills from other lakes in the northern Midwest.

Lake	No. of Fish	Annulus or Growing Seasons Completed								
		1	2	3	4	5	6	7	8	9
Shannon*	145	1.8	2.5	4.0	5.3	6.1	7.2	7.5	8.0	8.2
Bragonier*	101	1.9	3.0	4.3	5.4	6.3	7.0	7.6	7.9	8.1
Flora*	329	2.2	2.9	3.8	4.6	5.3	5.9	6.6	7.2	8.0
Bucks Lake, WI+ (Snow 1969)	790	1.8	3.8	6.0	7.0	8.2	9.2	10.5		
Murphy Flowage,+ Wis.(Snow, 1969)	5,888	1.5	2.9	4.1	5.3	6.1	6.7	7.1	8.0	9.0
Clear Lake, WI+ (Snow, 1969)	1,115	1.4	2.2	2.6	3.2	3.8	4.3	5.0	5.4	5.8
Northern WI+ Average (Snow, et.al.,1966)	--	2.1	3.8	5.0	5.7	6.5	7.1	7.6	8.1	
Buckeye Lake, Ohio* (Morgan, 1951)	--	1.6	2.9	4.1	5.2	6.0	7.1			
Lake Muphyresboro, Illinois* (Louder and Lewis, 1957)	212	1.7	2.9	3.8	5.1	5.9	6.3			
Red Haw Lake, Iowa* (Lewis, 1950)	133	1.4	3.4	6.1	7.2	8.1				

* Back-calculated lengths

+ Average length of scale-aged fish at end of growing season.

TABLE 7. Bluegill annual mortality rates in Shannon and Flora Lakes compared to rates in other midwestern lakes.

Lakes and Reference	Mortality Rates		Total
	Angling	Natural	
Shannon (Present Study)			.35
Flora (Present Study)	.05	.50	.55
Muskellunge Lake, Ind. (Ricker, 1945)	.19	.41	.60
Shoe Lake, Ind. (Ricker, 1945)	.32 .24	.44 .47	.76 .71
Sugarloaf Lake, Mich. (Cooper & Latta, 1954)	.21	.45	.66

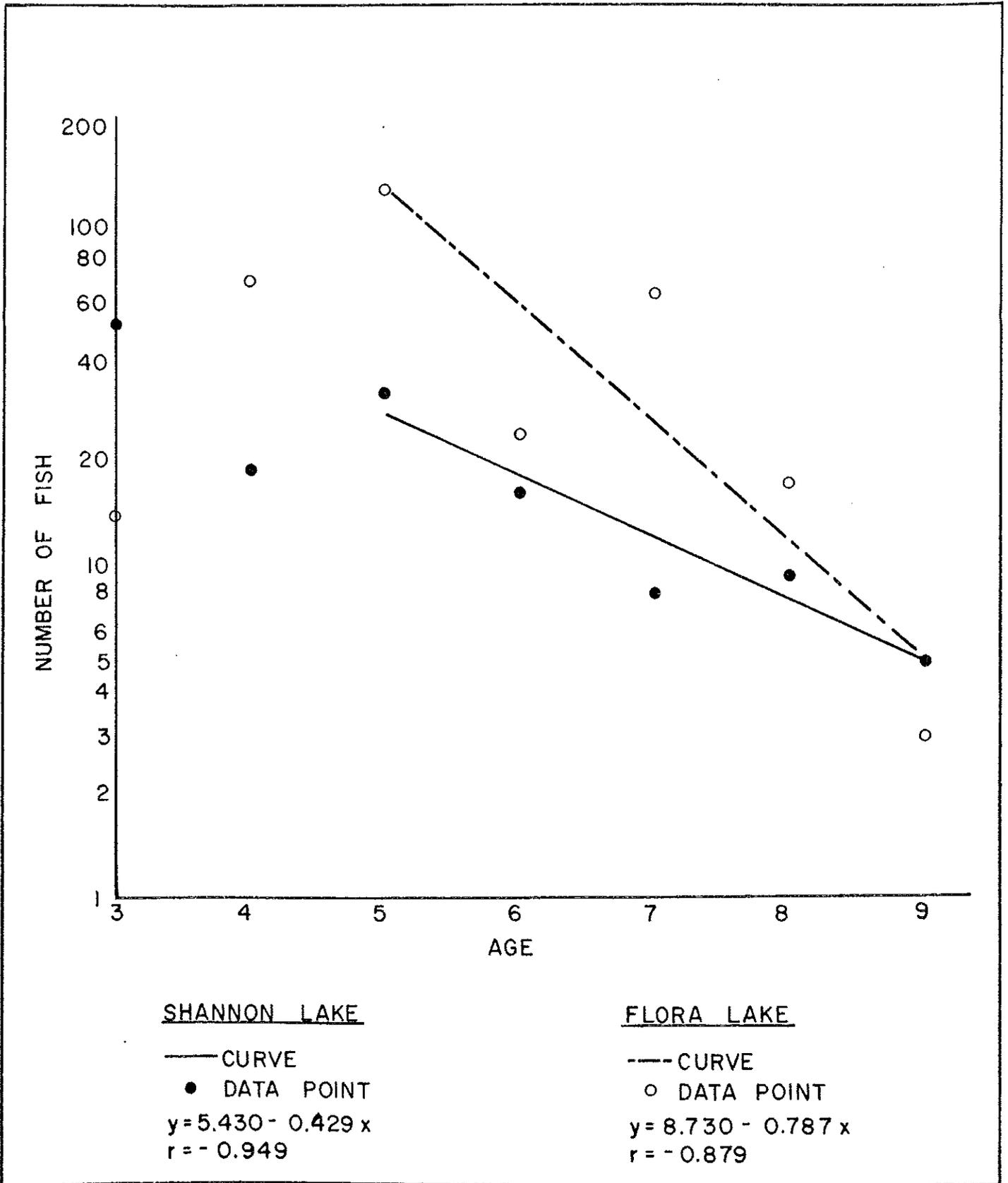


Figure 3. Catch curves for bluegills (ages V - IX) captured in fyke nets in July, 1975.

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Bluegills from Flora Lake had lower mean condition factors than fish from Shannon and Bragonier for each inch group where comparisons between the three lakes were possible. The average condition factor for all bluegills from 3.0-8.9 inches was also considerably lower in Flora Lake. There seemed to be a trend of higher condition factors with increased lengths in Flora Lake but this was not evident for bluegills in Shannon and Bragonier (Table 8). Visual examinations of plots of weight (g) on total length (in.) for male and female bluegills collected in each lake in July 1975 indicated no apparent sexual differences in length-weight relationships in any of the lakes. Therefore, sexes were combined in the log weight on log length regression formulae calculated for bluegills in each lake. These formulae, along with the number of bluegills weighed and measured and their total length range are: Shannon; $\log W = 0.56 + 2.93 \log L$ (N = 264; 2.7 - 9.1 in.), Bragonier; $\log W = -3.42 + 2.90 \log L$ (N = 200; 3.5 - 8.5 in.), Flora; $\log W = -4.06 + 3.21 \log L$ (N = 250; 2.4 - 8.0 in.).

SUMMARY

A study of the bluegill population of three soft-water lakes in north central Wisconsin was conducted in 1975. Population estimates for bluegills 6.0 inches and larger ranged from 6.1/acre in Shannon Lake to 60.0/acre in Flora Lake. Standing crop estimates for bluegills of equal size varied from 1.4 lb/acre in Shannon Lake to 10.3 lb/acre in Bragonier Lake. Bluegill growth was similar in Shannon and Bragonier Lakes but slower in Flora Lake. The annual total mortality for bluegills of age V and older was 0.35 in Shannon Lake and 0.55 in Flora Lake. The lower mortality rate in Shannon may be due to the lower population density. Bluegills from Flora Lake were in poorer condition than those from Shannon or Bragonier.

TABLE 8. Mean condition factors (C) for bluegills from Shannon, Bragonier and Flora Lakes in July 1975. Number of fish are listed in parentheses.

Total Length Range (in.)	Mean Condition Factors (C)		
	Shannon Lake	Flora Lake	Bragonier Lake
2.0-2.9	71.18(1)	46.28(86)	-----
3.0-3.9	48.26(1)	41.21(61)	64.57(10)
4.0-4.9	55.09(37)	43.63(152)	59.72(10)
5.0-5.9	55.09(35)	47.38(250)	54.65(7)
6.0-6.9	54.43(65)	49.58(157)	54.43(64)
7.0-7.9	53.55(64)	51.56(119)	56.19(93)
8.0-8.9	54.65(58)	51.56(1)	59.28(16)
9.0-9.9	52.23(2)	-----	-----
3.0-8.9	54.65*(260)	47.18*(740)	56.41*(200)

*Weighted averages

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