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Age and Growth of Bluegills, Lepomis macrochirus Ra:finesque, from Selected Central Iowa Farm Ponds

Jerome V. Shireman
University of Southwestern Louisiana

Age and Growth of Bluegills, *Lepomis macrochirus* Rafinesque, from Selected Central Iowa Farm Ponds[1]

JEROME V. SHIREMAN[2]

Abstract. Population estimates were made on five farm ponds in central Iowa during 1965. Age and growth determinations were made from scales of 638 bluegills collected from these ponds. Bluegills standing crops averaged 248 pounds per acre, ranging from 201 to 321 pounds per acre. Growth rates of bluegills from the balanced ponds were average when compared with growth rates of bluegills from other Iowa lakes and ponds.

On June 1, 1964, the Iowa Cooperative Fisheries Research Unit began studies relating to the physiology of fish in farm ponds with different population densities. As part of this program, collections of bluegills were made from five study ponds in central Iowa to estimate populations and gather data on bluegill age and growth. These data were later correlated with physiological parameters.

MATERIALS AND METHODS

Preliminary observations to determine the species present, and whether the ponds were balanced or unbalanced (Swingle, 1956), were made with a minnow swine or 25-foot bag seine. Seining for population estimation was done with a 60-foot bag seine (one-fourth-inch bar mesh bag and one-half-inch bar mesh wings). Fish larger than 2.5 inches were marked by removing one or two pelvic fins. It was necessary to remove two fins from fish that had been marked the previous year. Additional seining was delayed for at least 48 hours to allow marked fish to become redistributed. In the initial seinings, bluegills were not randomly distributed throughout the ponds but were found in schools. Therefore, an attempt was made to sample as much of each pond as possible on each sampling day to capture bluegills from as many areas as possible. Populations were estimated by Schnabel (1938) and Schumacher-Eschmeyer (1943) formulas.

Age and growth determinations were made for 638 bluegills from the five study ponds. Scales for study were removed from the right side of each fish at a point adjacent to the posterior margin of the depressed pectoral fin. Total lengths were measured to the nearest 0.1 inch, and weights obtained to the nearest gram. Bluegills were classified as immature if the gonads were poorly developed and the fish could not be sexed without microscopic examination. They were

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[2]Assistant Professor, University of Southwestern Louisiana, Lafayette, Louisiana.

classified as mature if the gonads were large and the fish could be easily sexed.

Impressions of uncleaned scales were made on clear plastic strips by using a roller press (Smith, 1954). Impressions were analyzed at a magnification of 44X with a scale projector similar to that described by Van Oosten, Deason, and Jobes (1934).

The positions of the focus, annuli, and anterior margin of the scale were marked on paper tab strips. These tab strips were used on a nomograph as described by Carlander and Smith (1944). Each scale was read at least twice without knowing the length of the fish; some scales were read more than twice or until agreement as to the position of the annulus was reached.

Population Estimates

Using the same data, both the Schnabel and Schumacher-Eschmeyer formulas gave similar population estimates. Since there is a greater chance to underestimate fish populations (Buck and Thoits, 1965), the formula giving the greater estimate was used.

Bluegill standing crops averaged 248 pounds per acre, ranging from 201 to 321 pounds per acre (Table 1). The mean standing crop is greater than that reported by Carlander and Moorman (1956), but within the range of standing crops reported by them. McLain Pond, which was overcrowded with bluegill and green sunfish (*Lepomis cyanellus,* Rafinesque), had standing crops of 254 pounds of bluegill and 129 pounds of green sunfish per acre. Carlander and Moorman (1956) found that ponds overcrowded with bluegill usually had small standing crops and attributed this to the fact that bluegill in these ponds were usually less than 3 inches in total length and thus not included in their estimates. Bluegill and green sunfish in McLain Pond were stunted; however, all were larger than 2.5 inches and were included in the estimates.

Body Scale Relationships

The linear distances between the focus and anterior scale edge were plotted against bluegill total lengths for each pond. A linear regression line fitted by the least-square method was drawn through the plotted points. The general formula for the regression was:

$$L = a + bS$$

where $S =$ anterior scale radius in inches ($\times$ 44)

and $L =$ total length in inches

A straight line seemed to fit these data adequately, with the exception of Sparks Pond, where small numbers of bluegills of extreme lengths deviated from the regression line slightly. Sprugel (1954) found that McFarland Pond bluegill growth data fit a curvilinear regression better than a linear regression. When growth calculations based on both

Table 1

Population Estimates and Pounds Per Acre for the Five Study Ponds, 1965

Pond	Species	Estimate Fish/acre	Percent Error of Estimate	Pounds per Acre (forage fish)	Total Pounds per Acre (all species)	Total Fish per Acre (all species)
Sparks	Bluegill	2,904	4.7	243	243	3,059
	Bass	155	59.7	*		
Link	Bluegill	3,042	3.6	201	222	3,227
	Bass	185	51.0	21		
Huffacker	Bluegill	3,895**		221	221	3,972
	Bass	77**		*		
Kimberley	Bluegill	5,932	3.0	321	321	6,613
	Bass	341**		*		
McLain	Bluegill	4,186	3.0	254		
	Bass	341**		*		
	Greenfish	5,081	4.0	129	383	9,608

*Present but representative weights were not obtained.
**Schnabel estimates.

formulas were compared; however, the linear regression formula appeared satisfactory for describing growth histories.

The mathematical expressions for bluegills are: Sparks, $L = 0.66 + 1.1096S$ (n=60); Link, $L = 0.65 + 1.4235S$ (n=66); Huffacker, $L = 0.42 + 1.0956S$ (n=60); Kimberley, $L = 1.00 + 0.9513S$ (n=68); and McLain, $L = 1.9 + 0.7292S$ (n=57). The intercept on the body length axis seems overestimated for the McLain Pond data. Data for this pond were concentrated on one portion of curve (4.3-5.3 inches total length). Regier (1962) found that body scale relationships based on few data or data poorly distributed over the range of total length gave variable intercepts and slopes. Therefore, Regier used a mean intercept to calculate growth histories, disregarding those based on poorly distributed data.

In the present study, the "a" intercept for McLain Pond was not used. Data were used from the other study ponds to calculate a mean "a" intercept of 0.7 inch. This intercept was used for all growth calculations.

Growth Analysis of Bluegills

Ponds were initially selected on the basis of population analysis. Four of the study ponds were considered balanced, while McLain Pond was judged unbalanced.

Table 2

Calculated and Measured Total Lengths of 163 Bluegills from Sparks Pond (1.1 acres), (T81N, R21W, S19), Polk County, Iowa, 1965

Year Class	Number of Fish	Average Calculated Length in Inches at Annulus 1	2	3	4	Average Length at Capture
1963	38	2.1	4.3			5.2
1962	113	1.8	3.7	5.0		5.5
1961	12	2.0	3.8	5.0	6.0	6.4
Mean weighted total length inches		1.9	3.8	5.0	6.0	
Mean annual increments		1.9	1.9	1.4	0.9	

Table 3

Calculated and Measured Total Lengths of 121 Bluegills from Kimberley Pond (0.8 acre), (T81N, R21W, S35), Story County, Iowa, 1965

Year Class	Number of Fish	Average Calculated Length in Inches at Annulus 1	2	3	4	Average Length at Capture
1963	86	1.8	3.0			4.5
1962	17	2.0	3.2	4.6		5.4
1961	18	1.8	3.2	4.7	6.2	6.8
Mean weighted total length inches		1.8	3.1	4.7	6.2	
Mean annual increments		1.8	1.3	1.4	1.5	

Table 4

Calculated and Measured Total Length of 123 Bluegills from Huffacker Pond (2.5 acres), T81N, R21W, S19), Polk County, Iowa, 1965

Year Class	Number of Fish	Average Calculated Length in Inches at Annulus					Average Length at Capture
		1	2	3	4	5	
1963	32	2.5	4.1				5.1
1962	51	2.4	3.9	5.1			5.7
1961	37	2.3	3.7	5.1	6.0		6.5
1960	3	1.7	3.3	4.7	5.8	6.6	7.2
Mean weighted total length, inches		2.4	3.9	5.1	6.0	6.6	
Mean annual increments		2.4	1.5	1.2	0.9	0.6	

Table 5

Calculated and Measured Total Length of 114 Bluegills from Link Pond (1.3 acres), (T81N, R22W, S15), Polk County, Iowa, 1965

Year Class	Number of Fish	Average Calculated Length in Inches at Annulus					Average Length at Capture
		1	2	3	4	5	
1964	1	2.3					4.4
1963	13	1.7	3.7				5.0
1962	76	2.4	3.9	4.9			5.5
1961	23	2.4	3.7	4.7	5.5		5.9
1960	1	1.6	2.9	3.8	5.1	5.9	6.4
Mean weighted total length, inches		2.3	3.8	4.8	5.5	5.9	
Mean annual increments		2.3	1.5	1.0	0.8	0.8	

Table 6

Calculated and Measured Total Length of 117 Bluegills from McLain Pond (1.0 acre), (T81N, R21W, S19), Story County, Iowa, 1965

Year Class	Number of Fish	Average Calculated Length in Inches at Annulus					Average Length at Capture
		1	2	3	4	5	
1962	10	2.1	3.4	4.2			4.5
1961	90	1.5	2.8	3.9	4.5		4.8
1960	17	1.3	2.7	3.7	4.3	4.7	5.0
Mean weighted total length, inches		1.5	2.9	3.8	4.4	4.7	
Mean annual increments		1.5	1.4	0.9	0.6	0.3	

Growth histories were calculated for each pond (Tables 2, 3, 4, 5, and 6). The range of population estimates for balanced ponds varied from 3,059 to 6,616 fish per acre (Table 1). Although the bluegill population in the most crowded balanced pond was more than double the lowest population estimate (Sparks Pond), the growth rates were quite similar. Bluegill in Sparks Pond exhibited faster growth rates during their first three growing seasons (Table 2), but not by substantial increments in their third year. By their fourth growing season, Kimberley Pond bluegill (Table 3) had reached a greater average total length than Sparks Pond bluebill (1961 year class). Bluebill growth rates from the other two balanced ponds (Table 4 and 5) were similar. Huffacker Pond contained more bluegills per acre than Sparks or Link Ponds, but the average growth rates were slightly better. From the data it appears that the average growth rates in these balanced ponds were not affected greatly by the number of bluegills present. However if wider ranges of population estimates had been obtained, differences might have been more evident.

McLain Pond bluegills were stunted and exhibited extremely slow growth rates. The 1960 year class averaged only 4.7 inches total length in their fifth year (Table 6).

To compare growth rates within the year, the populations were estimated, the growth increments were plotted for 1965 (Figure 1). Kimberley Pond bluegills grew faster during this year than those collected from the other study ponds, but the bulk of the bluegills collected were younger (2 years) than those collected from the other ponds (3 to 5 years). Huffacker and Link Pond bluegills exhibited similar growth rates during this period. Bluegills from Sparks Pond grew slower than bluegills from the other balanced ponds. The relative ranking of bluegill growth rates determined by plotting the growth increments did not follow the rankings of population estimates, except for McLain Pond bluegills, which were stunted. Growth increments of bluegills from this pond did not increase until August. As evidenced by the growth rates of these fish, the carrying capacity of this pond was exceeded. As a result, annulus formation was delayed.

Discussion

In the process of this study approximately 25 farm ponds in Polk, Jasper, and Story Counties, Iowa, were checked. The five ponds chosen were quite typical of the ponds in this area. Ponds that were rejected were omitted because they were either not seinable, or were too large for our study purposes. Growth rates from the study ponds are considered representative of central Iowa ponds.

Growth rates were compared with previous studies of Iowa lakes and ponds (Table 7). Growth rates for bluegills in balanced ponds were not exceptional when compared to other Iowa waters and were similar to those reported by Moorman (1957) for unbalanced ponds, Ruhr (1952), and Hennemuth (1955), but were slower than those reported by Moorman (1957) for balanced ponds, Lewis (1950), and DiCostanzo (1957).

Growth rates of McLain Pond bluegills were slowest of any of the ponds studied, and were slower than any reported from Iowa lakes and

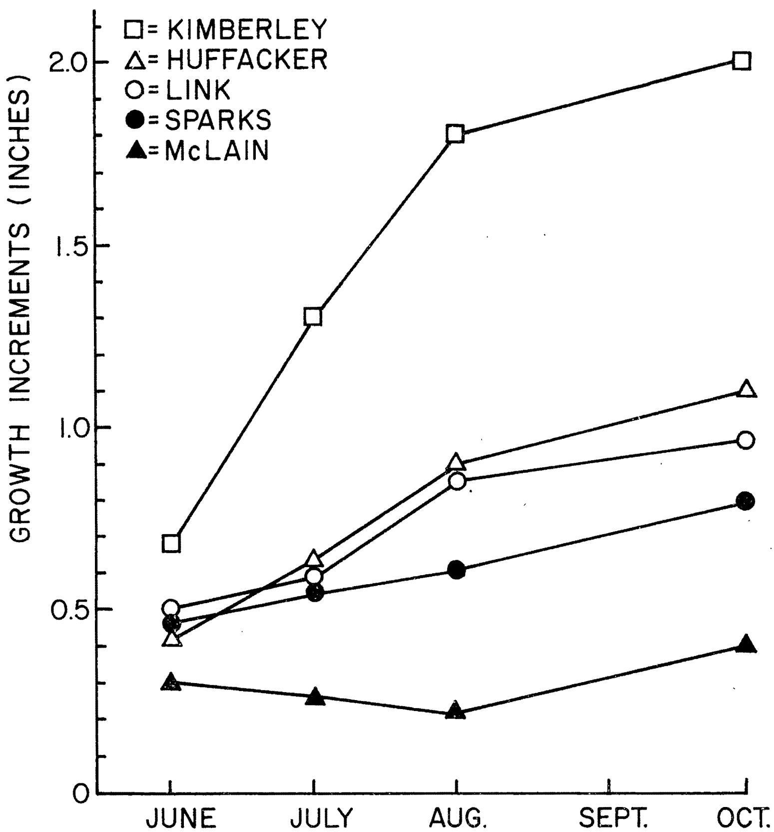

Figure 1. Growth increments in 1965 for bluegill from Kimberley, Huffacker, Link, Sparks and McLain Ponds.

ponds. McLain Pond was judged as unbalanced. Ricker (1942) reported exceptionally slow blugill growth for Springwood Lake, Indiana. The average length after five growing seasons was only 3.6 inches, indicating very slow growth. Excessive turbidity, caused by cattle, limited the abundance of plankton and filamentous algae in McLain Pond. Swingle (1949) states that turbidity of a permanent or semipermanent nature not only affects the growth of planktonic algae, but also affects the feeding of bass by reducing visibility. Small bass, *Micropterus salmoides,* 3 and 4 years old, but averaging only 5 to 6 inches total length, demonstrated the poor growing conditions in this pond. McLain Pond was checked again during the summer of 1966, after the cattle had been removed for 2 years. Turbidity had decreased, allowing growth of some filamentous algae. The average size of the bluegills had increased; however, there was no apparent increase in

Table 7
Average Growth of Bluegills from Iowa Lakes and Ponds

Locality	Number of Fish	Calculated Total Length in Inches at Each Annulus 1	2	3	4	5	Authority
Sparks	163	1.9	3.8	5.0	6.0		***
Huffacker	123	2.4	3.9	5.1	6.0	6.6	***
Link	114	2.3	3.8	4.8	5.5	5.9	***
Kimberley	121	1.8	3.1	4.7	6.2		***
McLain	117	1.5	2.9	3.8	4.4	4.7	***
Southern Iowa balanced ponds	374	1.7	4.1	6.1	7.0		Moorman, 1957
Southern Iowa unbalanced ponds	153	1.2	3.0	5.0	5.8		Moorman, 1957
Ike Lake	308	1.4	3.2	4.2	6.4		Ruhr, 1952
Red Haw Lake	133	1.4	3.4	6.1	7.2	8.1	Lewis, 1950
East Lake	145	1.7	3.6	5.6	7.0	7.5	Lewis, 1950
Lake Aquabi	1,139	1.9	3.7	4.7	5.6	6.3	Hennemuth, 1955
Clear Lake	1,215	2.4	4.2	5.6	6.2	7.8	DiCostanzo, 1957

***Present study.

the size of the small bass. One young-of-the-year bluegill was collected, indicating that some bluegill reproduction had occurred.

As evidenced by this study, bluegill growth rates from central Iowa farm ponds are not exceptional. Bluegills in the balanced ponds did not reach a catchable size of 6 inches until their fourth growing season. Fish of this size are not heavily fished; therefore, other methods of harvest must be used to crop these fish, or the pond becomes unbalanced and is of little use to the fisherman. For these reasons, it might be better to use other fish species in Iowa ponds.

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