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Abstract. Age and growth of 281 largemouth bass, *Micropterus salmoides,* collected from Clear Lake during the years 1947 through 1963 were determined by the scale method. The body-scale relationship had an intercept of 1.00 inch in total length. The weight increased as the 3.091 power of the length and a slight increase in average condition was found for fish from 15 to 20 inches in length. The growth curve was somewhat above the median of 30 curves reported for other waters. Lee's phenomenon was not evident, suggesting sampling was not size selective. All year classes, 1943 to 1962, were included in the sample. Annual growth was correlated with water level but with neither temperature nor turbidity.

Data on the fishes of Clear Lake, Iowa, have been collected each summer since 1947 by students in the Iowa Cooperative Fisheries Research Unit. Clear Lake is a 3,600-acre shallow (maximum depth, 20 feet) eutrophic lake in north-central Iowa (Bailey and Harrison, 1945; Pearcy, 1953). The largemouth bass, *Micropterus salmoides,* is not an abundant fish in Clear Lake and only occasionally do they appear in the angler's catch.

Methods And Materials

From 1947 through 1963 scales and other data were collected from 281 largemouth bass. The methods of collection included 30-, 500-, and 3,000-foot seines, gill nets, bag seines, fyke nets, electric shocker, and angling. Information recorded for each fish included length, weight, date, method, and approximate location of capture. As a result of the extended period of collection varying amounts of information were recorded and different units of measure were used.

All length measurements were converted to inches and tenths and all weights to pounds and hundredths of pounds. Total length as used in this study is that distance from the tip of the snout to the tip of the caudal fin compressed; fork length is that distance from the tip of the snout to the fork of the caudal fin; and standard length is that distance from the tip of the snout to the hidden bases of the caudal fin rays where a groove forms naturally when the tail is bent from side to side. Conversion

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factors based on 85, 82, and 86 bass respectively, and ranging in length from 1.8 to 20.5 inches, are as follows:

Total length = 1.22 standard length
Total length = 1.04 fork length
Fork length = 1.17 standard length

Conversion factors were computed by inch groups but no trend in the factors with length of fish was evident.

The scale method was used in determination of age and growth as described by Van Oosten (1929). Impressions were made of the scales on clear plastic strips by means of a roller press of the type described by Smith (1954). The impressions were examined at 42X magnification by means of a projector similar to that described by Van Oosten, Deason, and Jobes (1934). Generally speaking the annuli became harder to distinguish as the age of the fish increased. The determination of the first annulus presented a problem in interpretation, probably affected by the time the largemouth bass first began feeding on forage fish and also by the time of hatch (Burgess, 1949). The characteristics used to identify annuli were: (1) incomplete circuli or cutting over as described by Lagler (1955) and (2) relative distance between circuli. Once the annuli had been determined their relative locations to the focus of the scales were recorded on paper strips to be used later with a nomograph. Anterior field measurements were used since the ctenii of the posterior portion obscured any clear view of all annuli in that region. In determining the number of annuli, 153 scales were read twice; 72 were read a third time; and 13 a fourth time before agreement was reached.

BODY-SCALE RELATIONSHIP

The scale radii as measured on the paper strips were arranged in 0.5 inch groups with only five selected from a group when there were more. The total length of the fish was plotted against the scale radius for each of the 114 used to fit a straight line with a slope of 1.496 and an intercept of 1.00 inch (Figure 1). Since the straight line appeared to give a good fit and the correlation coefficient, r, was 0.969, it was assumed that the growth of the scales was proportional to body growth in length after the first inch. The total length at each annulus was then calculated with a nomograph using the intercept of 1.00 inch (Carlander and Smith, 1944).

AGE AND GROWTH

The largemouth bass ranged from age I through IX (Table 1). The growth curve is somewhat above the median of 30 other waters reported (Carlander, 1953, p. 361). The fact that the
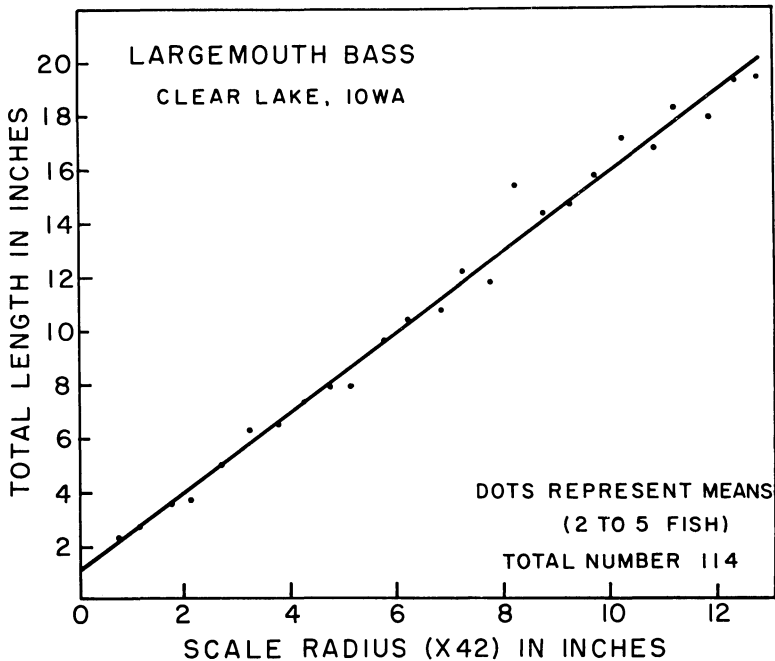
Figure 1.

data do not show Lee's phenomenon of apparent change of growth (Van Oosten, 1929, and Lagler, 1956) suggest that the sampling was not size selective. Increments were arranged by years (1941 to 1962) to show the growth in a given calendar year (Table 2). These data were used to compute indexes to "goodness of growth" in each calendar year using the method described by Hile (1941). The growth indexes indicate below average growth for the years 1957 through 1960 when water levels were dropping and the volume of the lake was about 30 per cent below normal (Figure 2). No correlations between the growth indexes and average summer temperatures or turbidity were evident over the years studied.

The fact that bass from each year class 1945 through 1962 were collected even though the total numbers were small is indication that reproduction is apparently at least partially successful each year. Very few bass have been stocked in the period of time here covered. The number of bass taken from various year classes appear to be more nearly related to difference in the amount of fishing effort in various years than to actual difference in abundance. However, data suggest that the 1946, 1947, and 1951-57 year classes may have been more abundant than the others.

Table 1. Average total lengths at each year for largemouth bass from Clear Lake arranged by age groups.

Age group	Number	Year of life									At capture	
		1	2	3	4	5	6	7	8	9	Mean	Range
I	41	4.08									7.20	3.3–10.5
II	44	3.99	9.11								10.77	7.3–12.5
III	37	4.16	9.34	11.92							12.78	10.0–14.9
IV	18	4.39	9.54	13.06	14.20						14.99	10.8–16.8
V	32	4.49	10.14	13.48	14.82	15.69					16.10	14.3–18.3
VI	17	4.62	10.03	13.19	15.00	15.98	16.69				17.12	14.3–18.9
VII	9	4.54	9.48	13.30	15.26	16.22	17.03	17.57			17.93	16.5–20.0
VIII	5	5.02	10.72	13.96	15.82	17.08	18.08	18.86	19.42		19.86	18.8–20.5
IX	3	4.40	10.13	13.00	14.3	15.96	16.77	17.47	18.07	18.50	18.60	18.1–19.3
Total No.		206	165	121	84	66	34	17	8	3		
Mean		4.08	9.52	12.89	14.81	15.95	16.97	17.93	18.91	18.50		
Calculated weight in pounds		.04	.52	1.32	2.02	2.54	3.08	3.65	4.30	4.02		

Table 2. Average annual increments for each year class arranged according to calendar year.

Year of life	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	Average (weighted)
9																	0.5			0.3			0.43
8								1.1							0.5	0.3	0.5			0.3			0.58
7							1.1	0.9					0.5	0.8	0.5	0.7	0.5			0.4	0.6		0.69
6						0.9	1.4					0.7	1.1	0.8	0.7	0.7	0.5			0.6			0.76
5					0.8	1.3					1.3	1.4	1.3	1.0	0.8	0.9	1.0		1.2		0.9		0.98
4				2.0	3.2						3.2	1.7	1.7	1.5	1.4	1.3	1.3	1.7			1.4		1.58
3			2.7	3.3				2.1	2.5		4.0	2.6	3.8	3.4	3.3	3.5	3.1	2.4		2.6	3.5	2.3	3.13
2		5.3	1.9			1.5	5.0	4.7	4.2	3.9	5.5	5.1	5.4	5.6	5.7	5.3	4.7	5.5	5.8	5.6	6.2	5.6	5.26
1	6.2	6.3			3.7	4.1	4.1	5.7	3.7	4.5	4.1	4.4	4.6	4.3	4.6	4.1	3.7	3.7	3.2	2.8	4.2	4.0	4.08

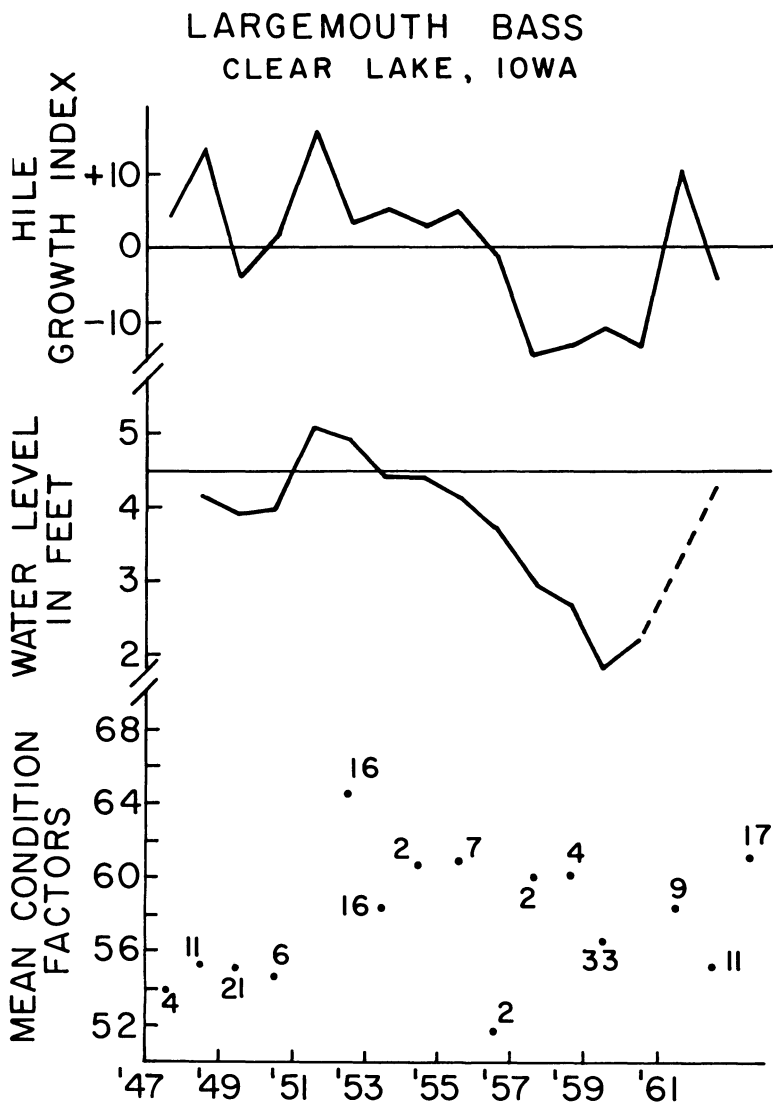| Numbers taken at each age	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	
IX										2		1											
VIII	1									3	1												
VII		1						1		1	4		1	1									
VI											4	9			4								
V									1		1	3	11	14		1		1					
IV											3	3	5	3	4								
III						10	4			1	1	9	1		2	5		1	2	1			
II				1		12	9	1			9		1		1		8			1	1		
I											19	1	3		4		3	1			1	1	5

Figure 2.

CONDITION FACTORS AND
LENGTH-WEIGHT RELATIONSHIP

The condition factor, C, is a measure of the well-being or plumpness of a fish:

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

Where: W = weight in pounds
        L = total length in inches

There was a slight increase in average condition from 15 to 20 inches as the fish grew in length (Table 3). In comparing the condition means of a given year with the change of growth and changes in water level, temperature, and turbidity, no correlations were shown (Figure 2).

The length-weight relationship for 172 largemouth bass (Figure 3) was described by the equation:

Log W = −1.3124 + 3.0910 (Log L)
Where: W = weight in hundredths of pounds
L = total length in inches and tenths

Table 3. Conditions factors of largemouth bass from Clear Lake, 1947-1963, arranged by size classes.

Total length in inches	Number	Condition factor Mean	Range
2-2.9	8	55.9	46-73
3-3.9	13	57.5	37-74
4-4.9	5	50.2	38-66
5-5.9	5	54.0	45-64
6-6.9	6	61.1	57-66
7-7.9	7	63.4	49-70
8-8.9	7	60.0	51-78
9-9.9	8	57.4	51-69
10-10.9	18	56.4	39-72
11-11.9	16	53.8	47-72
12-12.9	8	58.4	49-72
13-13.9	9	60.4	51-73
14-14.9	7	56.8	53-62
15-15.9	11	55.9	33-68
16-16.9	12	61.5	49-67
17-17.9	4	65.5	51-71
18-18.9	11	68.3	49-84
19-19.9	4	69.2	62-76
20-20.9	3	66.7	56-72

A "t" test (Snedecor, 1956) indicated that the slope of the line differs significantly from 3.00 at the 95 per cent level of confidence. Thus the bass tend to be slightly plumper with an increase of length over the size range covered. The regression was used to determine the average weights at various ages (Table 1).

Studies of the largemouth bass of Clear Lake will be continued this summer under a grant from the National Science Foundation. Work will be directed toward distribution, food habits, parasites, and homing abilities.

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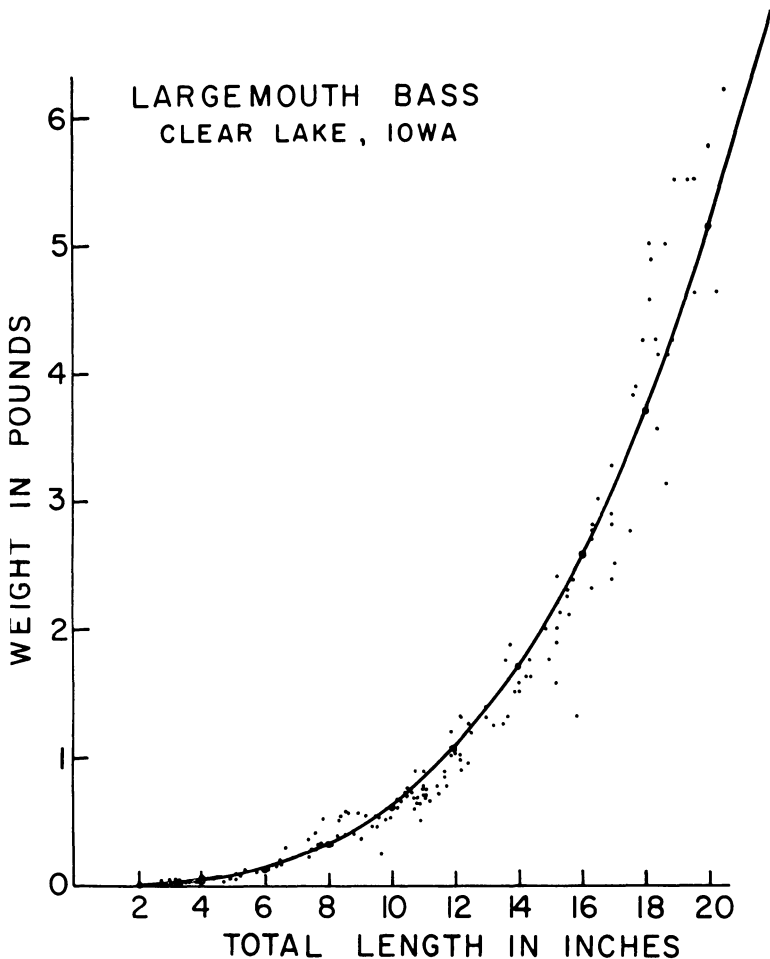Bailey, R. M. and H. M. Harrison, Jr. 1945. Iowa State J. Sci. 20:57-77.

Figure 3.

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