AGE AND GROWTH OF THE BLUE-GILLS AND THE LARGE-MOUTH BLACK BASS IN REELFOOT LAKE[1]

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I. INTRODUCTION

The investigation reported upon in this paper was undertaken to determine the age and growth in Reelfoot Lake of (1) blue-gills, *Helioperca macrochira* (Rafinesque), and (2) large-mouth black bass, *Huro salmoides* (Lacepede). Conservationists, sportsmen, and commercial fishermen have indicated the need for a study which would give specific information relative to the age and growth of these species in this body of water and which should serve as a basis for establishing better game laws.

This study has been based on an examination of the scales of 951 blue-gills and 100 large-mouth black bass. Collections were made at the commercial fish docks located at the Spillway on the south shore, at Samburg on the east shore, at Walnut Log near the northeast end, and from sportsmen at Walnut Log Lodge. The commercial catches were made by wire nets, barrel nets, and trammel nets. The collections are representative of the daily catches.

The value of the scale method used to determine the information contained in this paper cannot be over-emphasized and is a direct answer to the question of whether or not Reelfoot Lake is producing rapid or slow growing fish.

II. METHOD OF PROCEDURE

In this investigation the standard method of scale analysis was not used. Instead a new method was developed involving the use of polarized light and unprepared scales. Two ways of using polarized light were adopted. The first consisted of polaroids combined with an ordinary compound microscope equipped with an Abbe condenser. One polaroid, which acted as the polarizer, was placed directly below the condenser and held in place by two small aluminum brackets fastened to the condenser frame. The second polaroid, the analyzer, was placed on top of the slide and left free to rotate, in order that the

[1]Contribution from the Reelfoot Lake Biological Station No. 13. The study here reported on was made possible by a grant from the Reelfoot Lake Biological Station of the Tennessee Academy of Science, to whom the author wishes to express his appreciation.

desired degree of polarization could be obtained. To reduce the magnification, the lower half of the low power (16 m.m.) objective was removed and a 6X ocular used, this method being used only as a check. The second method, used for routine study, utilized a polarscope, an instrument producing polarized light by means of a dark glass polarizer, and a Nicol prism analyzer. The lens, being between the polarizer and analyzer, produces a magnification of about three diameters.

It was found that mounted and cleared scales did not give as good results with polarized light as unprepared scales. For routine work, scales that were dirty or curled were dipped in warm water to clean them before they were placed on the slides. To unusually thick or dark scales a drop of water was added, thereby increasing their clearness. For mounting, two ordinary microscope slides were hinged together with a narrow strip of adhesive tape, which, when folded over and placed beneath the slide holders, held the scales firmly in position. This type of holder will accommodate from four to six scales, depending upon their size. This enables several scales from a single fish to be examined without changing slides.

The advantages of using this method of study over the projection method are:

(1) Either day light or artificial light can be used with equally good results.

(2) The instrument can be easily carried any place, and is always ready for immediate use.

(3) It eliminates the cost of slides and cover glasses.

(4) It materially reduces the time of preparation.

(5) It simplifies the filing of scales.

(6) It allows a number of scales from each specimen to be examined at one time.

I found this method of study to be as accurate as the standard method of scale analysis.

All scales were taken from the left side, dorsal and ventral to the lateral line, this region being bounded anteriorly by the pectoral fin and posteriorly by the anal fin. Length measurements were made from the tip of the snout (the premaxillary and dentary bones) to the end of the caudal fin. A flat measuring board with a verticle head and side piece, calibrated in centimeters, was used, and measurements were made to the nearest half centimeter.

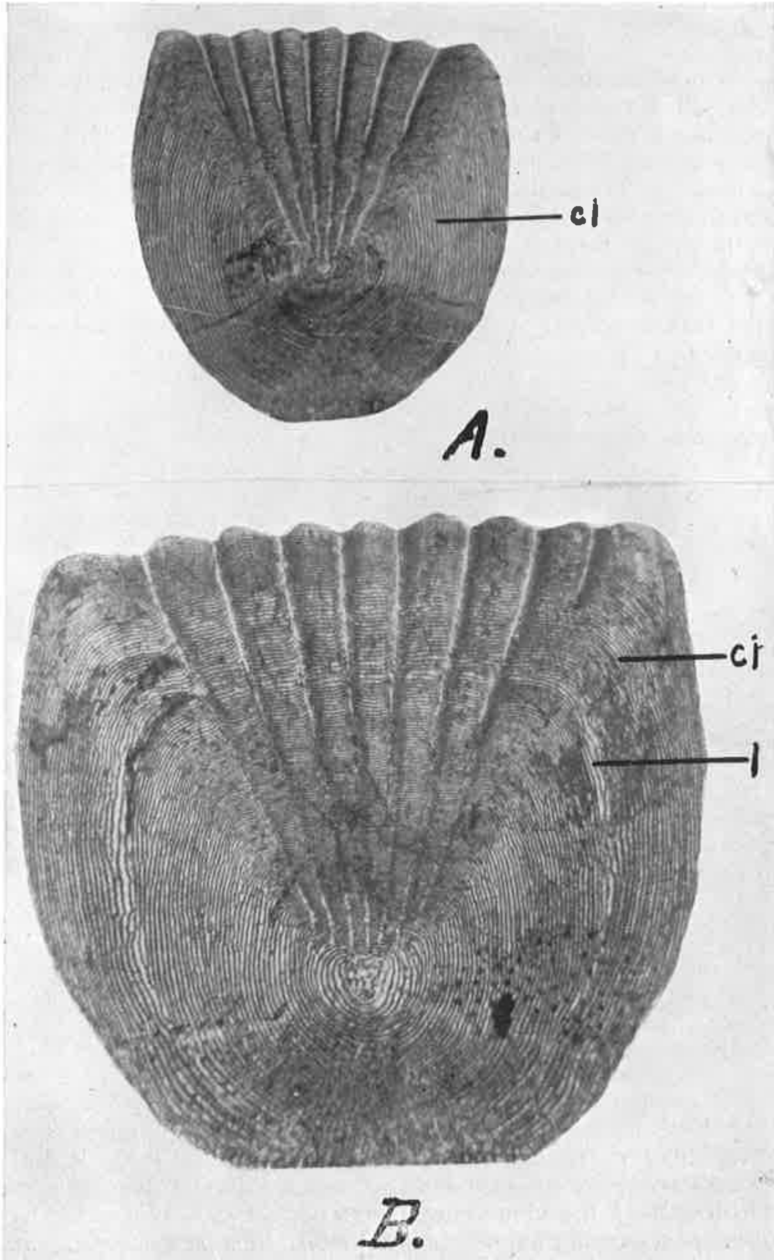

Fig. 1. Scales of blue-gills from Reelfoot Lake showing respectively 0 and 1 annuli. In addition all scales show circuli (ci). Annuli are marks formed during the winter or non-growing season, while circuli (ci) or growing marks are formed during the summer.

III. Scale Analysis

Age determinations for this study were made by analyzing the scales of each fish collected for the presence of annuli or winter marks. Annuli or winter marks are formed in the scales of fish during the winter months when the fish tend to go to the bottom of the lake and hibernate. This is true because they are cold-blooded vertebrates (poikilothermal) which means that their body temperature corresponds to the temperature of their environment. Thus in the winter the temperature of the water is low and their body temperatures are correspondingly low. This means that metabolism is low and only a small amount of food and oxygen is needed to maintain life with a

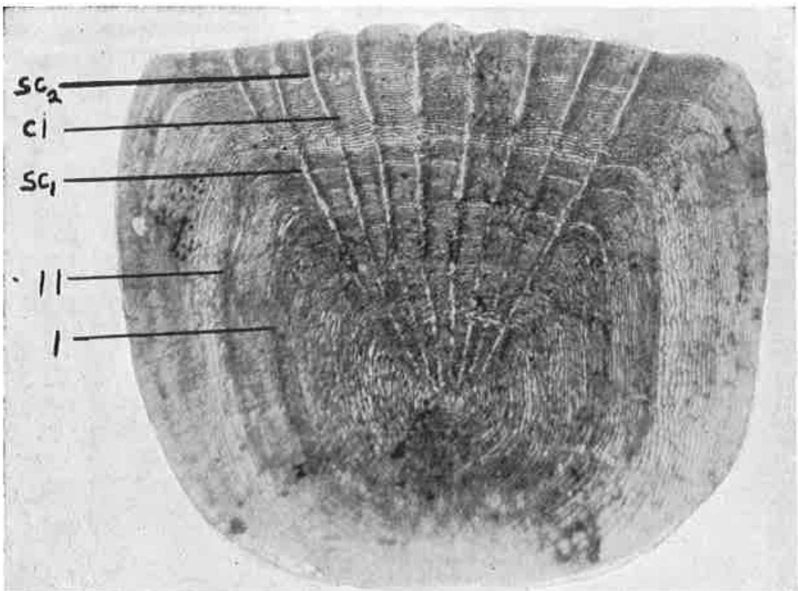

Fig. 2. A scale of a blue-gill from Reelfoot Lake showing two annuli. In addition it shows circuli (ci) and spawning checks (sc). Spawning checks (sc) are formed during the spawning season when there is a slowing up of the growth rate.

correspondingly lessened amount of activity to meet these needs. With a low metabolic rate the growth rate is also correspondingly low, and during this period annuli or winter marks are formed in the scales.

Scales are living structures that grow in direct proportion to the growth of the fish, and in the summer when the metabolic rate is high with a corresponding growth rate in the fish the scales show the same corresponding growth, which is manifested by the presence of circuli or growing marks. During the winter when the temperature of the water is low with a correspondingly low metabolic and growth rate in the fish the circuli do not form, but the cells that are formed are laid down in a different manner forming the annuli. In addition, many scales show a second mark near the annuli, which might be mistaken for new annuli or may appear as "double annuli." This mark is formed during the spawning season when there is a slowing up of the growth rate due to a lack of food consumption, while the males and females are busy building and guarding the nest. This mark is most clearly shown at the anterior portion and lateral edges where the mark curves out to meet the annuli. This mark shows that the growth after spawning is anteriorly, and that the scales tend to bury themselves, making a more firm attachment. These marks have been demonstrated by Hubbs and Cooper (1934) to be checks in growth during the spawning, and have been termed spawning checks.

The scales of a fish born in May of this year (1937) and caught in the latter part of August of the same year will show only the presence of circuli. This is shown by figure 1, *A* and is in its first summer of life. Similarly the scales of a fish born in May of the previous year (1936) and caught in the latter part of August of this year (1937) will show in addition to the circuli for the summer of 1936 one annulus for the winter of 1936 with additional circuli for this summer's growth (1937) (Fig. 1, *B*.). Thus this latter fish has gone through one winter, completed one year of life, and is in its second summer of life, the beginning of its second year of growth. The same is true of the fish born in 1935, 1934, 1933, 1932, and 1931 which show two, three, four, five, six, and seven summers of life respectively. This is illustrated by figures 2, 3, 4, and 5. These constitute the summers of life represented in this study. Figures 2-5 show the presence of spawning checks.

This scale method of age determination for fish in the family Centrachidae, has been demonstrated by Creaser (1926), Barney and Anson (1923), Potter (1925), Wright (1929), Bolen (1924), Hiel (1931), Tester (1932), and Hubbs and Hubbs (1931, 1933).

It is believed by Hansen (1937) that the annular ring formation in the scales of white crappies takes place in the summer and its formation occurs by absorption of the scale margin at spawning time. However, the scales examined in this investigation show no evidence of formation at this time, even though the white crappie belongs to the family Centrachidae.

IV. Distribution and Age Groups of Blue-Gills

The histograms given in figure 6 show the distribution of 951 blue-gills arranged according to age groups for summers of life. Thus a fish in age group 3 is two years old and in its third summer, beginning its third year of life.

Age groups 4 and 5 represent the greatest number caught, both by sportsmen and commercial fishermen. Age group 4 represents 56 per cent of all the fish recorded in this study. The males represent

55 per cent of all the males and 72 per cent of this age group. The females represent 63½ per cent of all the females and 12½ per cent of this age group. Age group 5 represents 30½ per cent of the fish recorded in this study. The males represent 31½ per cent of all the males and 75½ per cent of this age group. The females represent 18½ per cent of all the females and 3½ per cent of this group. Age groups 4 and 5 represent 86½ per cent of all the fish used for this investigation. The males represent 73.18 per cent and the females 11.15 per cent of the total of age groups 2 to 7 inclusive. Age group 4 represents those that have just passed the legal length (6 inches) and are less than 7 inches long and shows that over 50 per cent of the blue-gills caught have just passed the legal length. Age group 5, representing 30½ per cent, were just one inch longer than age group 4.

The large number of males, 73 per cent, and the small number of females, 11¼ per cent, of the total number for all 7 age groups can be accounted for in that blue-gills move in schools and are summer spawners. The schools, it was evident, contained mainly males, the females being engaged in preparation for, or in the act of spawning. That spawning lasted the entire summer can be shown by the fact that my investigation started on June 12 and continued until August 20.

The largest fish caught was a male of age group 6, measuring 10.62 inches, and the heaviest fish a female of age group 7, weighing 20 ounces (Fig. 7).

V. Rate of Growth of Blue-Gills

The average rate of growth and weight of 951 blue-gills is shown in the upper curve of figure 7. Since the growth in the first two summers of life was 5.57 inches, the assumption of a constant growth rate gives 2.78 inches as the growth in the first summer of life. The increment curve shows that from the second to the third summer of life the growth rate decreased to .4 of an inch per year, from the third to the fourth summer it increased to .8 of an inch per year, from the fourth to the fifth summer it increased slightly to .9 of an inch per year, and from the fifth to the sixth summer the growth rate dropped .8 of an inch per year. The weight for the first two summers of life was 1.83 ounces and, assuming a constant weight increase, the weight for the first summer of life was .91 of an ounce. The increment curve shows that from the second to the third summer the weight increased to 1 ounce per summer for the males. From the third to the fourth summer the weight increased to 1.3 ounces per summer for the females and 1.7 ounces per summer for the males, with a steady rise to 1.9 ounces per summer for the females and 2.1 ounces per summer for the males from the fourth to the fifth summer. The female

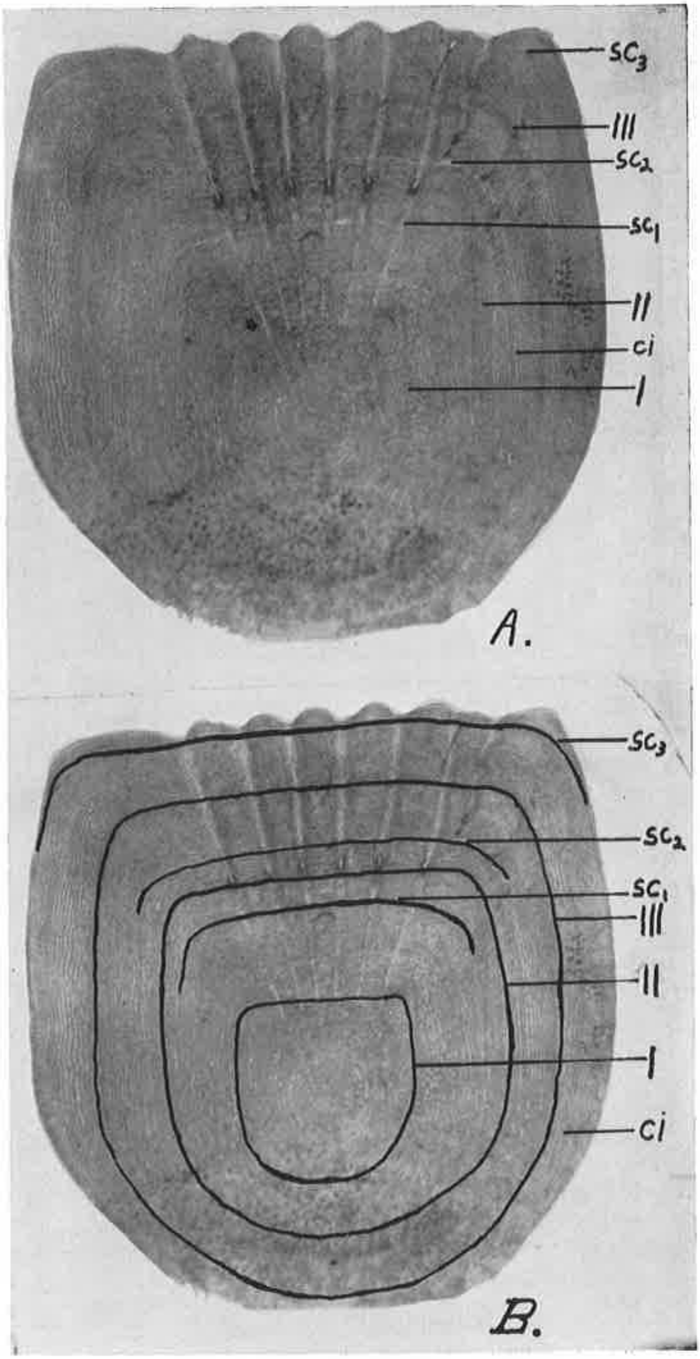

Fig. 3. Scales of blue-gills from Reelfoot Lake showing three annuli. In *B* inked lines show more clearly the position of the annuli and the spawning checks (sc_1, sc_2, sc_3).

weight increment remained unchanged and the male weight increment decreased to that of the females, 1.9 ounces per summer from the fifth to the sixth summer. Both sexes have attained the same weight in the sixth summer. The greatest weight for the length was attained during

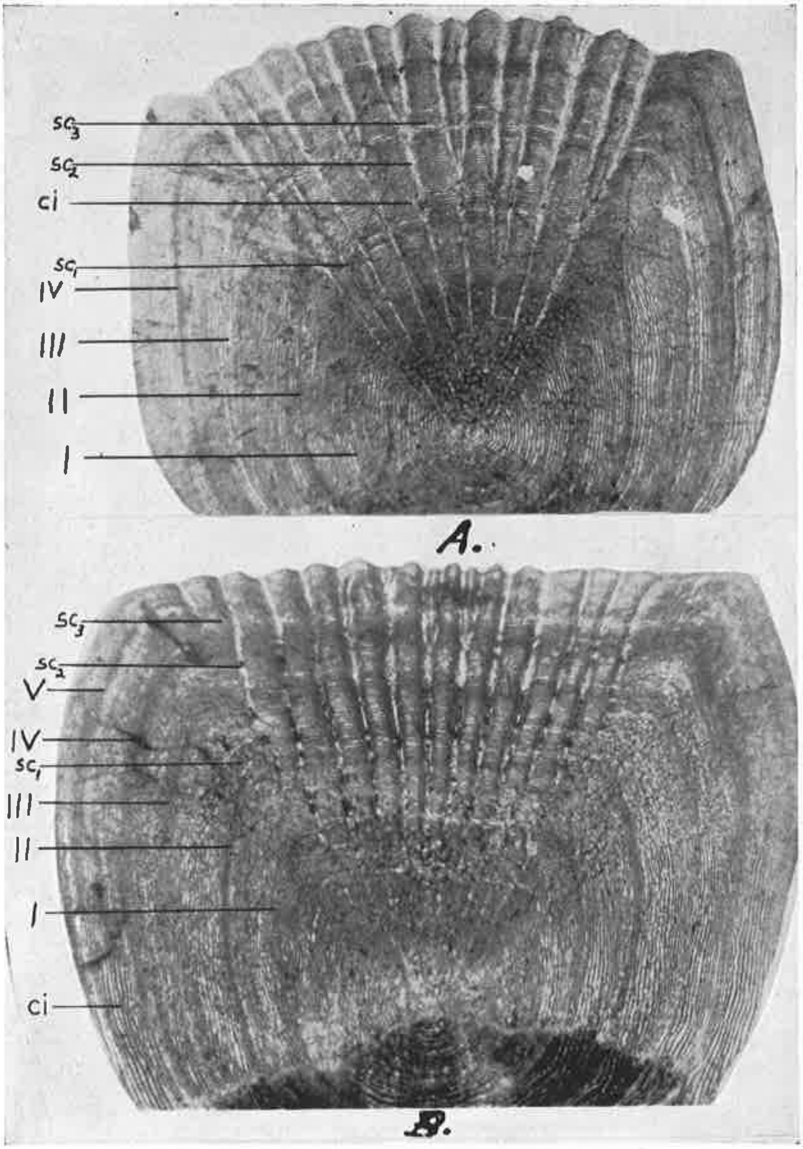

Fig. 4. Scales of blue-gills from Reelfoot Lake showing (above) four annuli and (below) five annuli.

the fifth summer of life. During the early years of life, the length increased more rapidly than the weight, but later the weight increased more rapidly in proportion to the increase in length.

Figure 8, a graph of the length and weight relationship, shows a constant increase for the males. The female increase remained constant until a length of eight and one-half inches was reached. The increase in weight over the length of the larger females was due to the

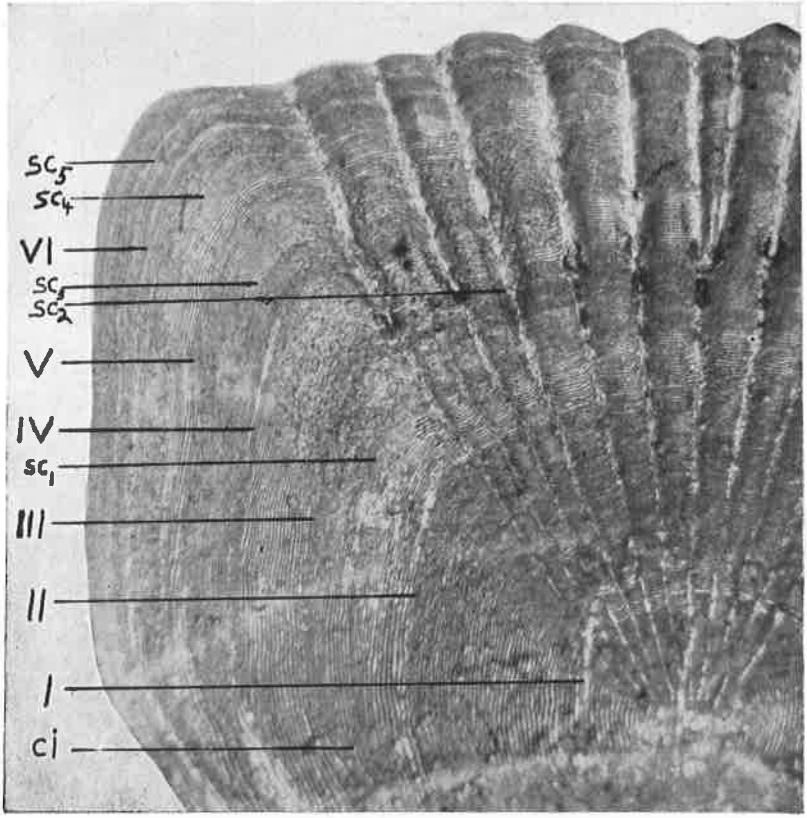

Fig. 5. Scale of a blue-gill from Reelfoot Lake showing six annuli.

fact that they had not spawned and the ovaries still contained large egg masses, or they were preparing to spawn the second time.

The material presented in Table 1 shows that the average length of blue-gills for the second summer is 5.57 inches and 1.83 ounces in weight, for the third summer 5.98 inches and 2.78 ounces, for the fourth summer 6.78 inches and 4.5 ounces. The legal length is reached sometime during the fourth summer. Sexual maturity is reached during the second summer and the females have an opportunity to spawn three or four times—depending on the time of the fourth summer that they are caught—before reaching the legal size. After becoming sexually mature the yearly increase in length rarely exceeds one inch and weight one ounce. Variations in length are represented

TABLE 1. *Average total lengths and weights, shortest, longest, lightest, and heaviest specimens as unclassified, males, females, and total groups for each summer of life for blue-gills from Reelfoot Lake*

CLASS	NUMBER	AGE IN SUMMERS	AVERAGE LENGTH IN INCHES	SHORTEST IN INCHES	LONGEST IN INCHES	AVERAGE WEIGHT IN OUNCES	LIGHTEST IN OUNCES	HEAVIEST IN OUNCES
Unclassified..	6	3	5.85	5.510	5.900	2.63	2.00	3.00
Unclassified..	79	4	6.79	5.900	7.280	4.90	3.00	7.00
Unclassified..	51	5	7.44	7.080	8.070	6.62	5.00	10.00
Unclassified..	12	6	8.20	7.480	8.460	9.44	7.00	10.00
Males............	3	2	5.57	5.310	5.708	1.83	1.75	2.00
Males............	62	3	6.00	5.510	6.690	2.79	2.00	4.00
Males............	386	4	6.80	5.708	7.670	4.49	2.50	7.00
Males............	221	5	7.70	7.080	8.260	6.58	4.00	9.00
Males............	24	6	8.52	8.260	10.620	8.40	8.00	9.00
Females........	12	3	6.02	5.708	6.290	2.83	1.75	3.25
Females........	68	4	7.75	6.100	7.480	4.12	3.00	6.00
Females........	20	5	7.64	7.280	8.070	6.01	5.00	7.00
Females........	5	6	8.29	8.070	8.260	7.86	8.00	8.00
Females........	2	7	10.23	10.030	10.040	18.00	16.00	20.00
Total..............	3	2	5.57	5.310	5.708	1.83	1.75	2.00
Total..............	80	3	5.98	5.510	6.690	2.78	2.78	4.00
Total..............	533	4	6.78	5.708	7.670	4.50	2.50	7.00
Total..............	292	5	7.66	7.080	8.260	6.55	4.00	10.00
Total..............	41	6	8.40	8.070	10.620	8.64	8.00	10.00
Total..............	22	7	10.23	10.030	10.040	18.00	16.00	20.00

in figure 7 which shows the longest and shortest specimens. Since food is plentiful, at no time has there been any evidence of insufficient supply, the only explanations that can be offered for these variations are the long spawning and growing seasons. The spawning season begins in May and continues until September, the growing season averages 215 days with an annual mean temperature of 58.3° F. Thus fish hatched early would have a much better start than those hatched later. Those hatched late would only have sufficient time to reach a size that would allow them to pass through their first winter which would give them an unequal advantage in all succeeding years of growth. This is illustrated by figure 9 which shows thirteen different individuals all of which were hatched in the summer of 1937, while figure 10 shows seven individuals whose ages ranged from the first summer of life through the seventh summer.

The two extremely large individuals in their seventh summer of life are not representative of this age and may be explained by the statements of Hubbs and Cooper (1934). "The positive correlation between the growth of the first and of the second year at one locality may be due to any of four reasons:

"(1) The individuals which attain a greater growth during their first year, owing to early hatching or any other factor, may possess

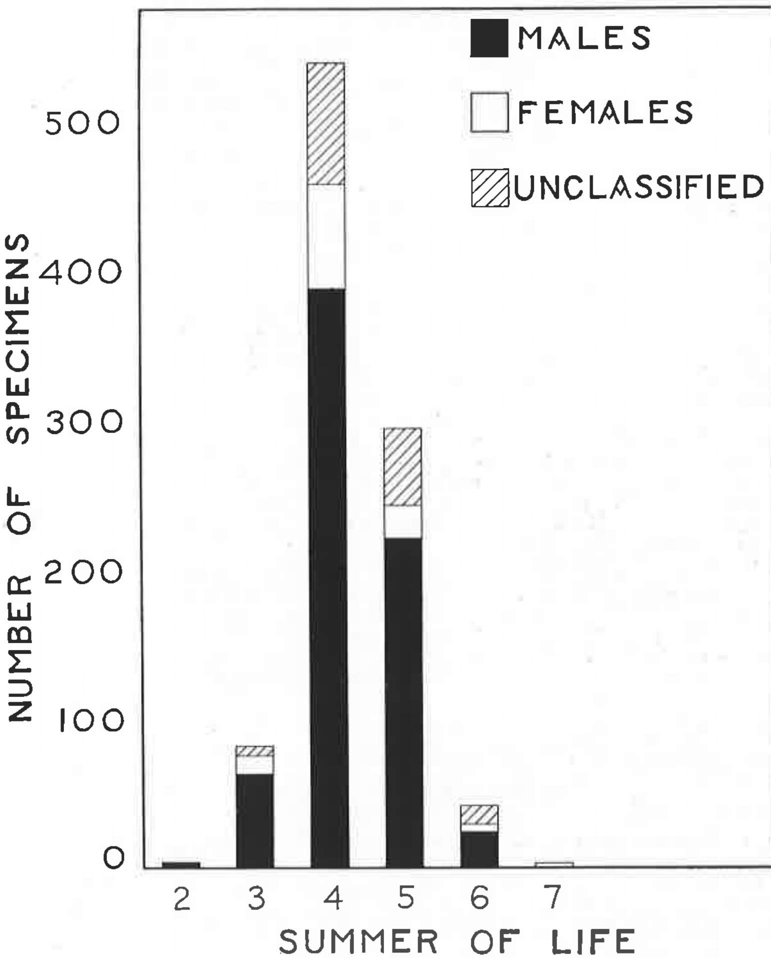

Fig. 6. Frequency distribution of 951 blue-gills grouped into age and sex groups.

such a competitive advantage over the slowly growing fish of the same age that they obtain more food during the second year. In rearing sunfish in aquaria it was obvious that the larger fish became the masters, obtaining food first and worrying the smaller individuals in combat, at times to the point of death.

"(2) Some fish may select and inhabit through both years ecological niches particularly conducive to rapid growth, or the reverse.

"(3) The rate of growth in the first year may in some physiological way similarly affect the growth of the second year.

"(4) There may be genetic differences in growth potential between different individuals."

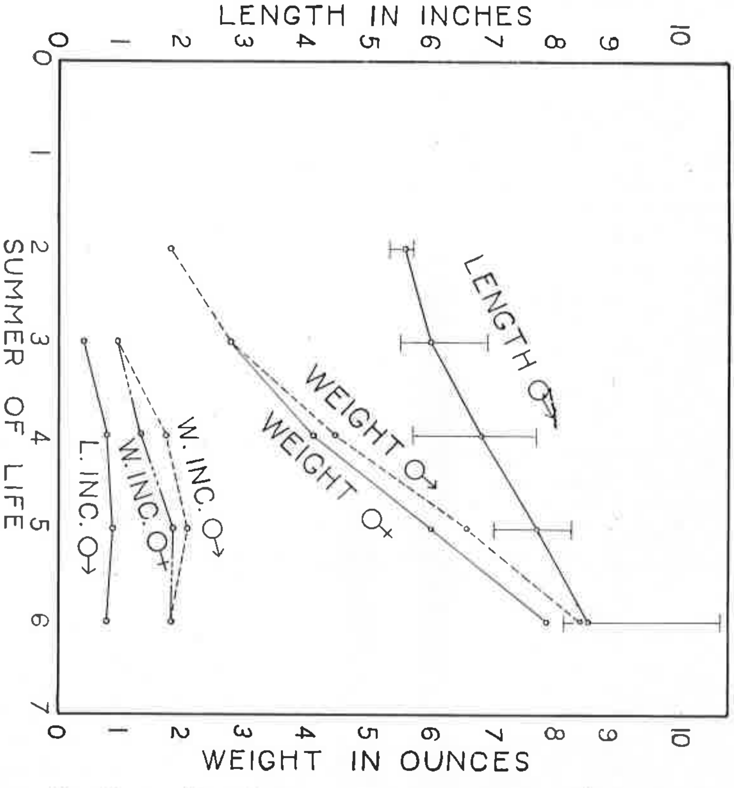

Fig. 7. Growth, weight, and increment curves of 951 blue-gills. The vertical lines represent the longest and shortest specimens for each summer of life. The increment curves represent the annual increase in length and weight. The length of the females was not plotted because only a slight difference was manifested between them and the length of the males.

Points (1) and (3) might explain this difference in rapid growth, but as food is so plentiful in Reelfoot Lake it is more likely that points (2) and (4) might explain this unusually rapid growth.

The variations in all age groups might in part be explained by any one, or a combination of the reasons stated by Hubbs and Cooper (1934). However, I believe the primary reasons are, as previously stated, the length of the spawning and growing season.

VI. Comparative Growth of Blue-Gills in Reelfoot Lake and Iowa

Data from the growth rate of blue-gills in Iowa (Potter, 1925) shows that fish in their second summer of life in Reelfoot Lake are nearly three times as long as Iowa blue-gills (Table 2). The greatest yearly increase in length in both Reelfoot Lake and Iowa takes place during the first year.

TABLE 2. *Average total lengths of blue-gills from Reelfoot Lake, compared with Iowa (Potter, 1925)*

Reelfoot Lake		Iowa		
Summers of Life	Average Length	Years of Life	Average Length	
	in.		*cm.*	*in.*
2	5.57	1	1.7–4.7	0.66–1.85
3	5.98	2	5.3–6.2	2.08–2.44
4	6.78	3	8.1–8.8	3.19–3.46
5	7.66	4	10.0–13.0	3.94–5.11
6	8.40	5	14.0	5.51
7	10.23	6	15.1	5.94
-	....	9	18.5	7.28

This comparison indicates that the blue-gills of Reelfoot Lake grow considerably faster than those in Iowa and suggests that more study should be done on the effects of temperature and of growing season. The growing season at Reelfoot Lake lasts 7 months and in Iowa probably 5 months.

VII. Necessity of Changing the Game Laws for Blue-Gills at Reelfoot Lake

It is evident that a change must be made in the game laws for blue-gills at Reelfoot Lake, if the number and desired size is to be maintained. Figure 1 shows that 56 per cent of this species are caught in their fourth summer of life, shortly after they have attained the present legal length of 6 inches and 30½ per cent more are caught in their fifth summer of life when less than 1 inch longer then the preceding summer. Figure 7 shows that the maximum weight in relationship to the length is reached during the fifth summer. Thus, if the greatest number of fish are to be obtained of the most ideal size, it will be necessary to increase the legal length 1 inch. In doing this it will also increase the numbers in the older age groups allowing more of those to be caught. The present legal length (6 inches) also endangers the perpetuation of the present numbers since over 50 per cent are taken after they have spawned, on the average, two or three times only, depending on the time of the summer that they are caught. Increasing the legal length would also remedy this latter condition.

In making such a change it must be pointed out to opponents that the decrease in daily or yearly catches will be only temporary and that within a year or two the number and size of their catches will increase. Such a change would be of value to the sportsman because of the increased pleasure of catching large fish and to the commercial fisherman because his revenue is derived from the number of pounds he catches.

VIII. Rate of Growth of Large-Mouth Black Bass

The average rate of growth and weight of 100 large-mouth black

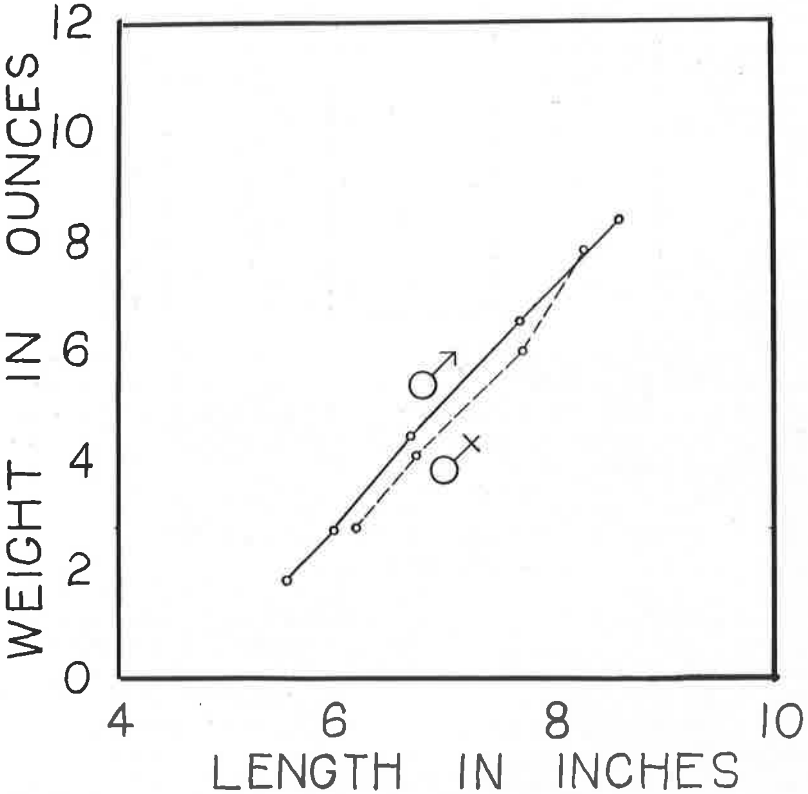

Fig. 8. Length and weight relationships of 949 blue-gills.

bass is shown in figure 11. The annual increase in length and weight is represented by the increment curve in this figure.

Since the growth rate in the first three summers of life is 9.65 inches, the assumption of a constant growth rate gives 3.22 inches as the growth per year. The increment curve shows that from the third to the fourth summer of life the growth rate decreases to 2.1 inches per year. From the fourth to the sixth summer the growth rate decreases to 1.3 inches per year, remaining constant from the sixth to the seventh summer with a moderate rise to 1.8 inches from the seventh to the eighth summer. The growth rate then falls off sharply to .6 of an inch from the eighth to the ninth summer, followed by a moderate increase to 1.1 inches from the ninth to the tenth summer, again dropping to .6 of an inch from the tenth to the eleventh summer. The

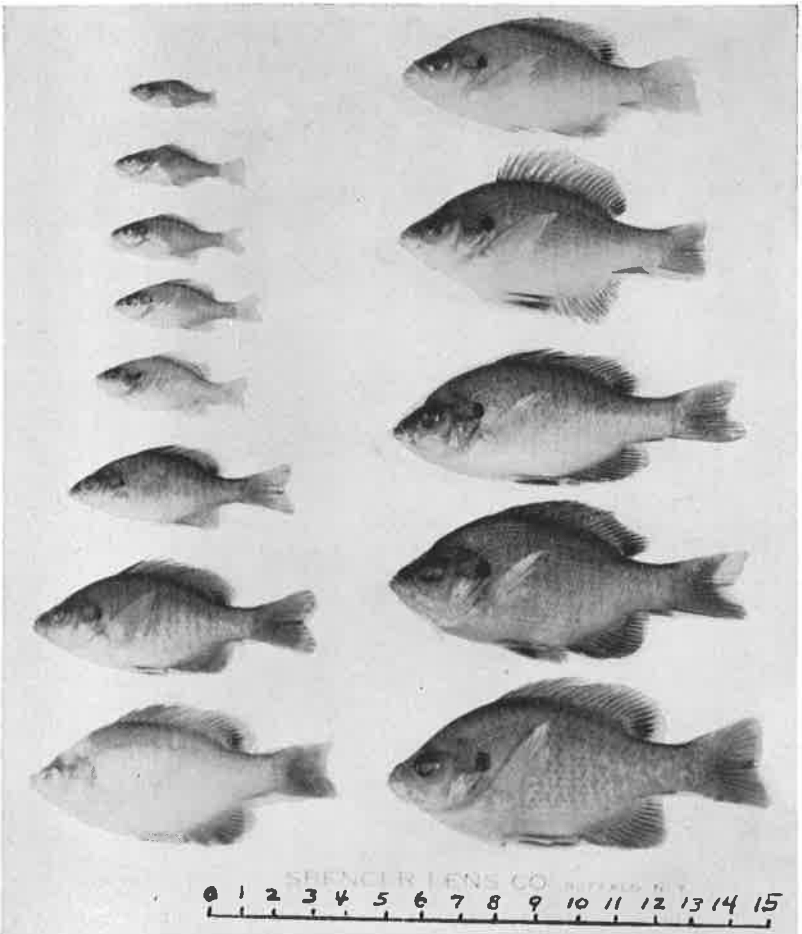

Fig. 9. Blue-gills hatched in the summer of 1937 showing the variations of spawning and the length of the season in Reelfoot Lake.

weight for the first three summers of life is 7 ounces and the assumption of a constant weight increase gives 2.33 ounces as the weight increase per summer. The increment curve shows that from the third to the fourth summer the weight increases 7.5 ounces per summer, dropping slightly to 6.5 ounces per year from the fourth to the fifth summer. A sharp increase to 12½ ounces per summer from the fifth to the sixth summer is followed by a sharp drop to 6 ounces per summer from the sixth to the seventh summer. A steadily marked increase to 10 ounces per summer occurs from the seventh to the eighth summer and continues to rise until a weight increase of 17 ounces per summer is reached for the eighth to the ninth summer. This is followed by a sharp drop to 3 ounces per year for the ninth to

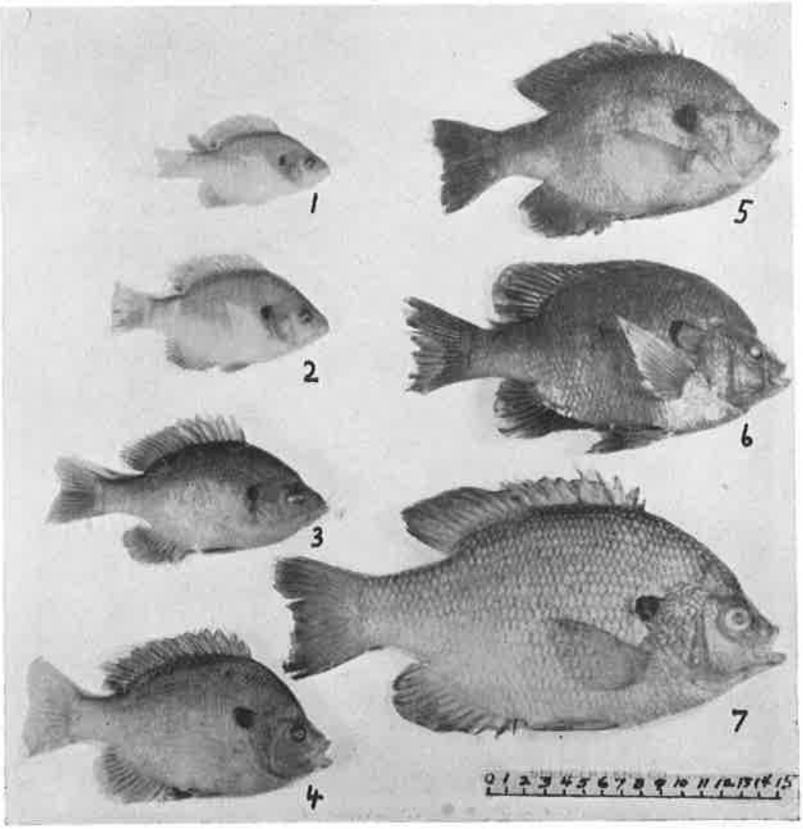

Fig. 10. Blue-gills showing the average size of various summers of life in Reelfoot Lake. From the top to the bottom and left to right, 1 summer of life, 2 summers of life, 3 summers of life, 4 summers of life, 5 summers of life, 6 summers of life, and 7 summers of life.

the tenth summer. From the tenth to the eleventh summer the weight increase remains constant. The greatest weight for the length is attained in the ninth summer. During the early years of life, the length increases more rapidly than the weight, but later the weight increases more rapidly in proportion to the increase in length.

The material presented in Table 3 shows the average length of large-mouth black bass for the third summer of life as 9.66 inches and 7 ounces in weight, for the fourth summer 11.77 inches and 14.31 ounces. The legal length (11 inches) is reached sometime during the fourth summer. Variation in size is also shown in figure 11 and may be the result of the larger individuals becoming predatory or other predatory fish as gar or grindel disturbing their feeding. Langlois (1936) speaks of small-mouth bass reared in ponds as follows:

TABLE 3. *Age, average length and weight, shortest, longest, lightest, and heaviest specimens for 100 large-mouth black bass from Reelfoot Lake*

AGE IN SUMMERS OF LIFE	NUMBER OF FISH	AVERAGE LENGTH IN INCHES	SHORTEST FISH IN INCHES	LONGEST FISH IN INCHES	AVERAGE WEIGHT IN INCHES	LIGHTEST FISH IN OUNCES	HEAVIEST FISH IN OUNCES
1	....	....	....	....	....	....	....
2	....	....	....	....	....	....	....
3	1	9.66	....	....	7.000	....	....
4	16	11.77	10.59	12.59	14.310	10	18
5	24	13.58	12.2	14.56	23.450	16	35
6	23	15.00	13.77	15.94	33.680	24	40
7	14	16.36	15.74	17.33	43.071	35	54
8	6	18.10	17.75	18.50	50.500	48	64
9	7	18.81	18.11	19.29	67.570	60	80
10	4	20.027	19.68	20.47	72.000	69	78
11	5	20.59	20.47	20.86	77.000	66	88

"Small fish expend a larger proportion of their total available energy for activity than larger fish, because they are obliged to eat nearly constantly while large bass fingerlings may eat only once in several days, and activity is required for food apprehension. This is particularly true in rearing ponds where food is provided in such a way that it may be obtained with little effort. Moreover, in ponds where small fish are in danger of losing their lives to predators, the pursuit of safety compels energetic physical and nervous activity." This same condition is undoubtedly true for large-mouth black bass in their natural environment and is especially indicative because the greatest variations occur in the earlier years of life when they are exposed to predators, mainly of other species. Thus the young bass have an unfair start in life and a retarded early growth. This condition is especially true of Reelfoot Lake because there is no closed season on bass and they may be taken legally during the spawning season. This allows for the removal and destruction of the males, who guard the young for many days after they are hatched, thus leaving the young as prey for predatory fish. Variations of individuals may also be due to any of the reasons stated for the blue-gills.

VIII. Length and Weight Relationships of Large-Mouth Black Bass

The length and weight relationships, presented in figure 12, remain about constant from nine and one-half inches to thirteen and one-half inches. From this length to twenty and a half inches, there is a great variation in length over weight and weight over length. The causes for this variation are not fully understood, but may be the result of predatory individuals gaining an advantage while young, the retarded growth of individuals who were molested by predatory fish while in the early stages of development, or points 3 and 4 previously stated for the blue-gills.

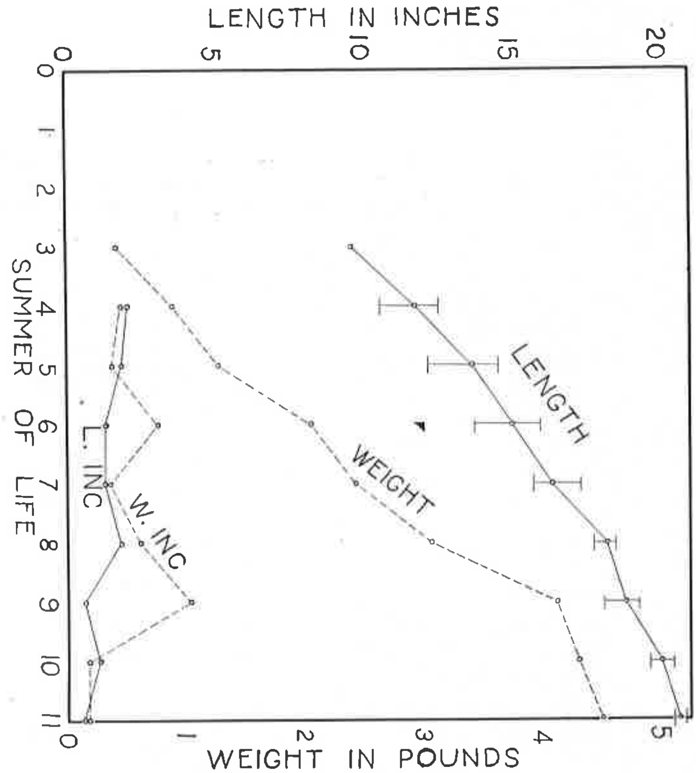

Fig. 11. Growth, weight, and increment curves of 100 large-mouth bass. The vertical lines represent the longest and shortest specimens for each summer of life.

X. Distribution of Large-Mouth Black Bass

The curve given in figure 13 shows that the largest number of individuals, 24 per cent or nearly one-fourth of the total, are caught in the fifth summer of life; in the sixth summer, 23 per cent; in the fourth summer, 16 per cent; and in the seventh summer, 14 per cent. Thus Table 3 shows that nearly ¼ are caught shortly after they reach the legal length, 11 inches (fourth summer of life), and 3/5 of the total by the time they have reached a length of 16 inches (5, 6, 7 summers of life). The oldest specimen represented in this collection was in its eleventh summer of life. The oldest specimen was also the longest and heaviest, having attained a length of 20.8 inches and a weight of 5½ pounds.

XI. Comparative Growth of the Large-Mouth Black Bass in Illinois, Wisconsin, Nebraska, and Louisiana

Data for this comparison was obtained from the following sources: Illinois (Thompson and Hansen, 1937); Wisconsin, Nebraska, and Louisiana (Bennett, 1937). The comparison is in Table 4.

TABLE 4. *Average total length of the large-mouth black bass from Reelfoot Lake, compared with those from Illinois, Wisconsin, Nebraska, and Louisiana*

Age	Average total length in inches recorded in summers of life for Reelfoot Lake.	Average total length in inches recorded to the nearest summer of life ~~for~~ Ill.	Average Calculated total length in inches at end of each stated year of life.		
			Wiscon-sin	Ne-braska	Louis-iana
1	....	5.7	3.3	3.6	7.6
2	....	9.2	7.4	7.6	11.3
3	9.660	9.9	10.5	10.9	14.5
4	11.770	11.7	12.5	13.5	18.8
5	13.580	12.8	14.0	15.8	20.9
6	15.000	12.9	15.1	17.6	23.5
7	16.360	11.4	16.3	18.9	24.8
8	18.100	14.5	17.4	19.8	25.9
9	18.810	15.5	18.1	20.4	27.1
10	20.027	16.6	18.7	22.1	27.8
11	20.590	13.6	19.5	....	28.3

This comparison is of little significance because of the difference in recording the age in years. Thompson and Hansen of Illinois (1937) recorded the average length to the nearest summer of growth, Bennett of Wisconsin (1937) recorded the average calculated total length at the end of the stated year of life, and the average lengths of this investigation are recorded for summers of life. However, it indicates that bass in Louisiana grow most rapidly, followed by those in Nebraska and in Wisconsin, for the first seven years. For the last three years Reelfoot Lake bass are the fastest and Illinois bass the slowest growing. The growing season in Louisiana lasts about 9 months, at Reelfoot Lake, 7 months; in Illinois, 5-7 months; in Nebraska, 5-6 months; and in Wisconsin, 4-5 months.

This comparison indicates a need for further study of the growth of each species of fish in order that a better understanding of the effects of temperature and growing season may be obtained.

XII. Necessity of Closing the Fishing Season of Large-Mouth Black Bass During the Spawning Season

This investigation shows that during the first seven years the bass in Reelfoot Lake grow slower than the bass in other states. This condition is probably due to the removal of the males which allows predatory fish to disturb the early growth. To eliminate this condition it will be necessary to close the season during or shortly after spawning.

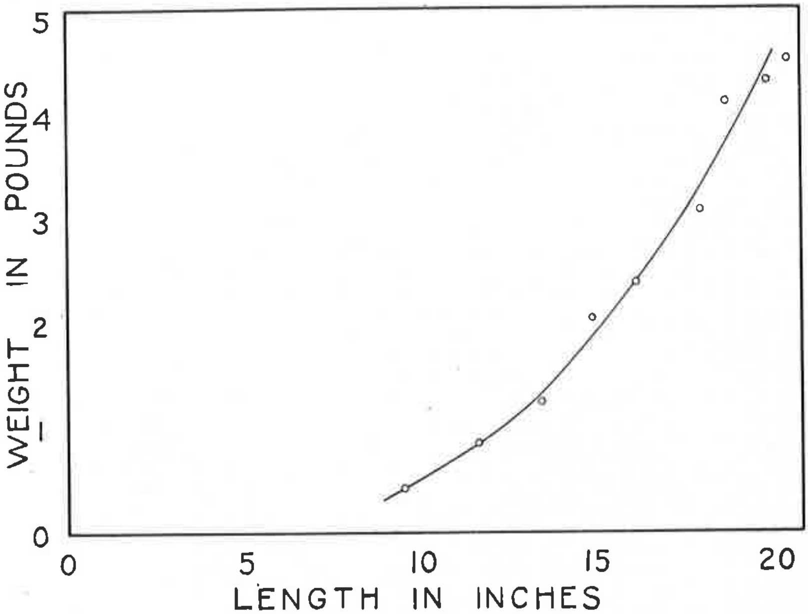

Fig. 12. Length and weight relationships for 100 large-mouth black bass. The length and weight relationship remains constant until a length of 13½ inches is reached. From this point on they oscilate about the mean curve.

XIII. Summary

1. This study was based on the age determinations of 951 blue-gills and 100 large-mouth black bass from Reelfoot Lake.

2. A new method of scale analysis was developed involving the use of polarized light and unprepared scales.

3. The average blue-gill reaches legal length (6 inches) in Reelfoot Lake during the fourth summer of life and this group represents 56 per cent of all of the blue-gills investigated in this study.

4. Over one-half of the blue-gills are caught soon after reaching legal length.

5. The average large-mouth black bass reaches legal length (11 inches) in Reelfoot Lake during the fourth summer of life.

6. Nearly one-half (47 per cent) of the large-mouth black bass caught are in their fifth and sixth summers of life.

7. The oldest blue-gill specimen was in its seventh summer of life and was also the heaviest specimen, weighing 20 ounces. The longest specimen was in its sixth summer of life and measured 10.62 inches in length.

8. The oldest large-mouth black bass specimen was in its eleventh summer of life and was also the largest specimen, measuring 20.86 in length and weighed 5½ pounds.

9. The blue-gills of Reelfoot Lake show practically no difference between the sexes in growth rate.

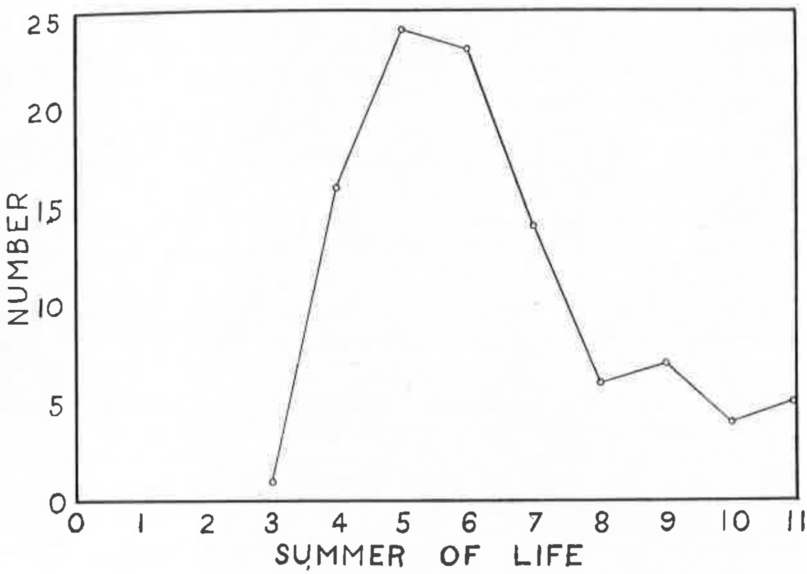

Fig. 13. Distribution curve for 100 large-mouth black bass.

10. A comparison of growth rates of blue-gills from Reelfoot Lake and Iowa indicates that Reelfoot Lake blue-gills have a faster growth rate.

11. A comparison of the growth rates of the large-mouth black bass in Reelfoot Lake, Illinois, Wisconsin, Nebraska, and Louisiana shows a great variation and indicates the importance of temperature, length of the growing season, and game laws in relation to growth rate.

12. New game laws are needed in order to maintain the desired number and size of the blue-gills and to increase the early growth rate of large-mouth black bass.

ACKNOWLEDGMENTS

The author's gratitude is extended to Dr. G. D. Kinzer of St. Viator College for his assistance in developing the use of polarized light and for many helpful suggestions, to Dr. C. L. Baker, Director of the Reelfoot Lake Biological Station for his cooperation in the production of the set of illustrations. I wish also to acknowledge my indebtedness to Mr. O. T. Wallaston of Walnut Lodge for his assistance in obtaining sportmen's catches, to Raleigh McBride of Walnut Log, E. Spicer of Samburg, and Charles Hinson of Tiptonville for their assistance in obtaining commercial catches.

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SOUTH LEADS IN THE MILL USE OF COTTON

Fifty years ago, only one-fifth of the cotton spun in the United States was consumed in mills located in the cotton-growing States.

In recent years, however, more than four-fifths of the total mill consumption in the United States has been in the cotton-growing States, according to the Bureau of Agricultural Economics of the United States Department of Agriculture. The cotton-growing States now have more than 70 per cent of the cotton spindles in use in the United States.

Although practically all kinds of cotton goods are produced by southern mills, the proportion of coarse and medium fabrics is larger than in other States. Mills in New England are noted for their output of fine yarns and fabrics.