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Edmond J. Bacon Jr.
University of Arkansas, Fayetteville

Raj V. Kilambi
University of Arkansas, Fayetteville

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Some Aspects of the Age and Growth of the Longear Sunfish, **Lepomis Megalotis**, in Arkansas Waters[1]

Edmond J. Bacon, Jr. and Raj V. Kilambi
Department of Zoology, University of Arkansas
Fayetteville, Arkansas

INTRODUCTION

The longear sunfish, *Lepomis megalotis megalotis* (Rafinesque) in Arkansas is a native of headwater streams in the Ozark-Ouachita highlands. Although this centrarchid now thrives in highland reservoirs, it is generally absent in the downstreams, lowland portions of rivers flowing from the highland onto the Gulf Coastal Plain (Neill, 1967). Its distribution is somewhat affected by its intolerance of turbidity and siltation (Trautman, 1957). The most favorable habitats in streams are among brush, rocks, and logs whereas in the reservoirs they are found in the littoral zone. The chief importance of the longear is its value as a forage species and its predation on the eggs of many game fishes, especially those of the black basses.

The longear sunfish ranges from 1.2 in. to 2.8 in. at the end of the first season of growth; adults range from 2.8 in. to 7.0 in. with the maximum length recorded being 9.0 in. (Trautman, 1957).

Published information concerning the rate of growth of this species is meager. Hubbs and Cooper (1935) correlated the rate of growth of the dwarfed longear, *Lepomis megalotis peltastes* (Cope), with the length of the growing season in Michigan. Jenkins, Elkin, and Finnell (1955) determined the growth rate of the longear sunfish in reservoirs, lakes, ponds, and streams in Oklahoma. Growth studies on this species in streams in Missouri and Illinois have been conducted by Patriarche and Lowry (1953) and Durham (1955) repectively. Applegate, Mullan, and Morais (1966) studied the food and growth of the longear in Bull Shoals Reservoir, Arkansas.

One of the important aspects in fisheries management is the age at which a fish reaches a catchable size, designated as 5.0 in. for the sunfishes (Jenkins *et al.*, 1955). Man made activities such as the construction of dams and creating reservoirs bring about changes in water levels and alter the physiochemical conditions of both the reservoir and the stream. Due to the intrinsic capability of fishes to alter their growth rates to changing environmental conditions, growth rates of fishes reflect the suitability of an environment.

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Objectives of the present study are: (1) to determine the growth rate of longear sunfish from Kings River and Beaver Reservoir, (2) to compare the growth rates of males and females from each area, and (3) to gain information concerning maximum size and maximum age.

MATERIALS AND METHODS

Collection sites were established along the Kings River at Highway 68, eight miles northeast of Huntsville. Several collection sites were selected in Beaver Reservoir to obtain representative samples from different areas of the reservoir. Sites at the upper end were War Eagle Creek, Pine Creek Cove, and Hickory Creek Cove; sites at the lower end were Prairie Creek, Shady Grove Cove, and Rocky Branch (Fig. 1). Monthly collections from Kings River and Beaver Reservoir were taken from June, 1967, to April, 1968, with the exception of November, January, and February from Beaver Reservoir. A variety of gear was employed to circumvent selectivity for particular size groups. A seine, a boat-mounted electroshocker, and a 110 volt back-pack electroshocker were used for stream collecting. Winter collecting was difficult, and samples could be taken only with a boat-mounted 220 a. c. electroshocker. Because of the depth, turbidity, and topography of the shoreline collecting in the reservoir was a problem. Electroshockers, barrel traps, an otter trawl, a mid-water trawl, and rotenone were used for reservoir collecting. Seventy-eight percent of the 424 fish from Beaver Reservoir were taken from rotenone treatments conducted by the Bureau of Sport Fisheries and Wildlife, Fayetteville, Arkansas. Eighty-eight percent of the 278 fish from Kings River were collected by the use of an electroshocker.

After capture, the fish were brought back to the laboratory in plastic containers. The location, total length, weight, sex, state of sexual maturity, method of collection, and date of collection were recorded for each fish. Fish were then placed in 10% formalin for two weeks and later changed to 30% isopropyl alcohol. Sex was not determined for specimens less than 60mm in total length. Approximately 25 scales were taken from the left side below the lateral line and at the tip of the pectoral fin. Plastic impressions of 5-10 scales from each fish were made by pressing the scales into cellulose acetate sheets by the use of a standard press. A standard microprojector with a magnification of 40 diameters was used for reading the scales. The distances in mm from the focus to each annulus and from the focus to the anterior margin of the scale were recorded. The data were recorded on IBM cards and later analyzed by an IBM 7040 computer.

RESULTS AND DISCUSSION

The scale method of determining the age and growth of fishes

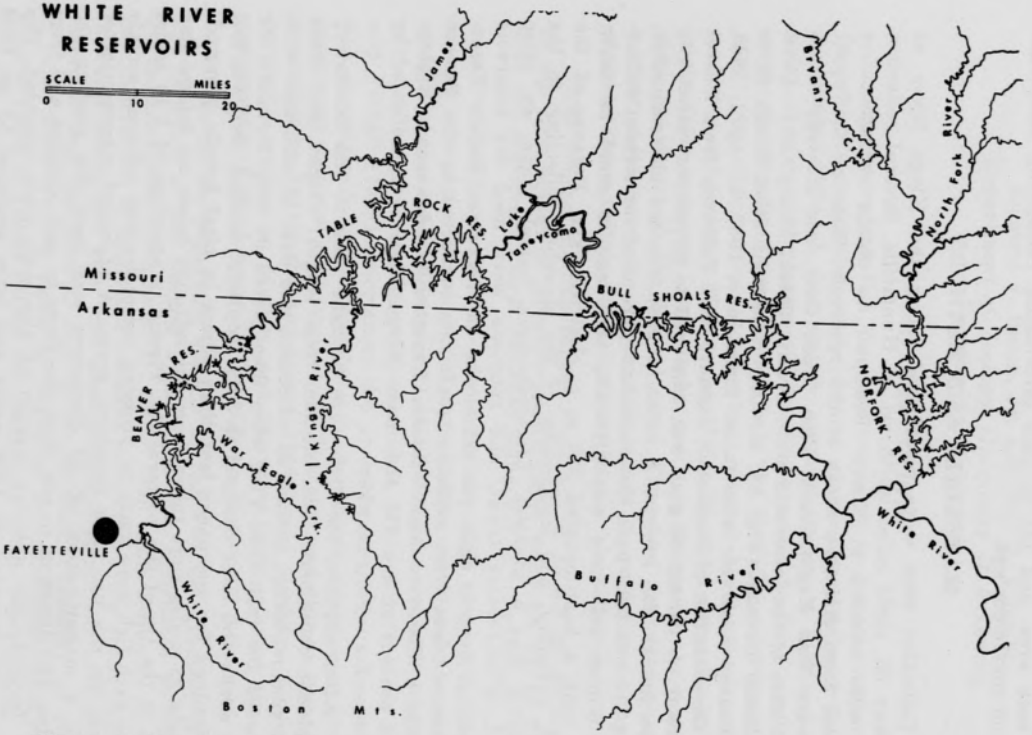


Figure 1. Locations of the collection sites in Kings River and Beaver Reservoir (*)

is probably the most widely used technique today. Creaser (1926) validated the scale method for the family Centrarchidae. Sprugel (1953) and Regier (1962) validated the annulus as a year mark for the bluegill. Validity of age determinations from scales confirmed for longear in Arkansas because: (1) from rotenone samples assumed young of the year collected in August ranged from 35 to 45mm in total length and did not possess an annulus even though total scale lengths ranged from 23 to 33mm (40x), (2) longear collected in June and July ranged from 52 to 75mm in total length and exhibited one annulus, (3) modes of the length-frequency distribution corresponded to the calculated lengths, during the early years of life (Fig 2) and (4) the actual total lengths of specimens collected in February when the season's growth had been attained corresponded to the calculated lengths (Table 1).

Growth Rates

The largest specimen found in these collections was 155mm, was six years of age, and was taken from Kings River. Based upon this study, longear from Beaver Reservoir and Kings River reach the catchable size of 5.0 in. at the end of five years. Some individuals attain this length after four growing seasons while others may not attain the designated catchable size for sunfishes at all.

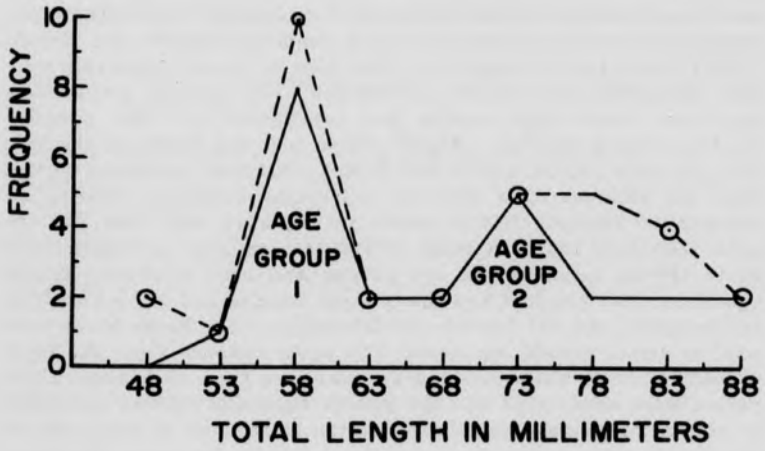


Figure 2. The total lengths of longear sunfish with age determination by scales (o - - - o) and with age determinations by length-frequency distribution (———) taken in February in Kings River.

Table 1. The average total length at the time of capture and average calculated length of longear sunfish in Kings River collected in February, 1968 after the growth season.

Age in Years	Number of Fish	Average Total Length at Time of Capture (mm)	Average Calculated Total Length (mm)
1	12	56	50
2	14	74	75
3	5	90	94
4	11	111	110
5	6	124	124
6	4	146	139

Total Length-Scale Radius Relationship

Plotting of the emperical data indicated that the body length-scale radius relationship was probably linear. In such a case, the relationship between the length of the fish and the scale radius could be expressed by a first degree linear equation of the form $L=a+bS$ where L is the total body length in mm, S is the scale radius in mm, and a and b are constants. In recent years, age and growth data have been found to be best represented by complex curvilinear equations which are easily obtained by a computer. Houser and Bryant (1968) found that the data for white bass in Beaver Reservoir were best represented by complex polynomials. The complex polynomials for total length-scale radius are represented by the equation $L=\Theta_0+\Theta_1 S+\Theta_2 S^2+\ldots\Theta_K S^k$ where L is the length of the fish, S is the scale radius, and Θ and K are constants. Equations of this form are obtained by a step-wise polynomial technique utilizing an analysis of variance test to select the equation that best fits the data (Graybill, 1961). A total of 702 fish ranging in length from 37 to 155mm including six age groups was used to obtain growth equations. Two hundred and thirty-three females and 157 males from the reservoir and 121 females and 114 males from Kings River were used to derive growth equations. The mean distance from the focus to each annulus was calculated for each sex from each area. These values were substituted into the growth equations derived previously to obtain the average calculated lengths at the end of each year of life. In all cases except for males from Beaver Reservoir, the equation that best fitted the data was linear ($p=.01$). Since similar results were obtained from the linear equations and the curvilinear equations for males from Beaver, a linear equation was used so that comparisons of the growth equations could be simplified. Sprugel (1953) utilized third degree polynomials and linear equations with

the bluegill and obtained similar results, but the polynomial was slightly more accurate. The relationship between the total length and scale radius was represented by similar equations in each area and for each sex (Table 2). An anlysis of covariance test indicated that the total length-scale radius equations of the sexes within each area and between the two areas were not significantly different ($p=.01$). The combined equation for males and females from Beaver Reservoir was $L=22.79+1.07S$, and the pooled equation for males and females from Kings River was $L=14.04+1.18S$.

Calculated Total Length

The average calculated total lengths in mm of female longear from Kings River at the end of each year of life were 50, 75, 93, 108, and 121, and those of males were 49, 75, 94, 111, 126, and 139 (Fig. 3). The average calculated lengths of females from Beaver Reservoir were 55, 79, 98, 113, 124, and 134; the total lengths of males were 56, 79, 100, 117, 129, and 137 (Fig. 4). Female longear from Beaver were 5mm longer at the end of the first four years of life and 3mm longer at the end of the fifth year than those from Kings River. At the end of the first year of life, male longear from the reservoir were 7mm longer than those from Kings River; the difference was 4mm at the end of the second year, and 6mm during the next two years with negligible differences thereafter. The largest difference in the rate of growth between the two areas was in the growth rates of the males. Differences between the rate of

Table 2. Growth equations for longear sunfish in Kings River and Beaver Reservoir.

Location	Sex	Equation
Kings River	Females	$L=15.24+1.16S$
Kings River	Males	$L=13.94+1.18S$
Beaver Reservoir	Females	$L=23.11+1.06S$
Beaver Reservoir	Males	$L=22.23+1.10S$

Figure 3. The absolute growth rate (mm) of the female (———) and male (- - -) longear with annual increments (mm) of female (———) and male (- - -) longear in Kings River.

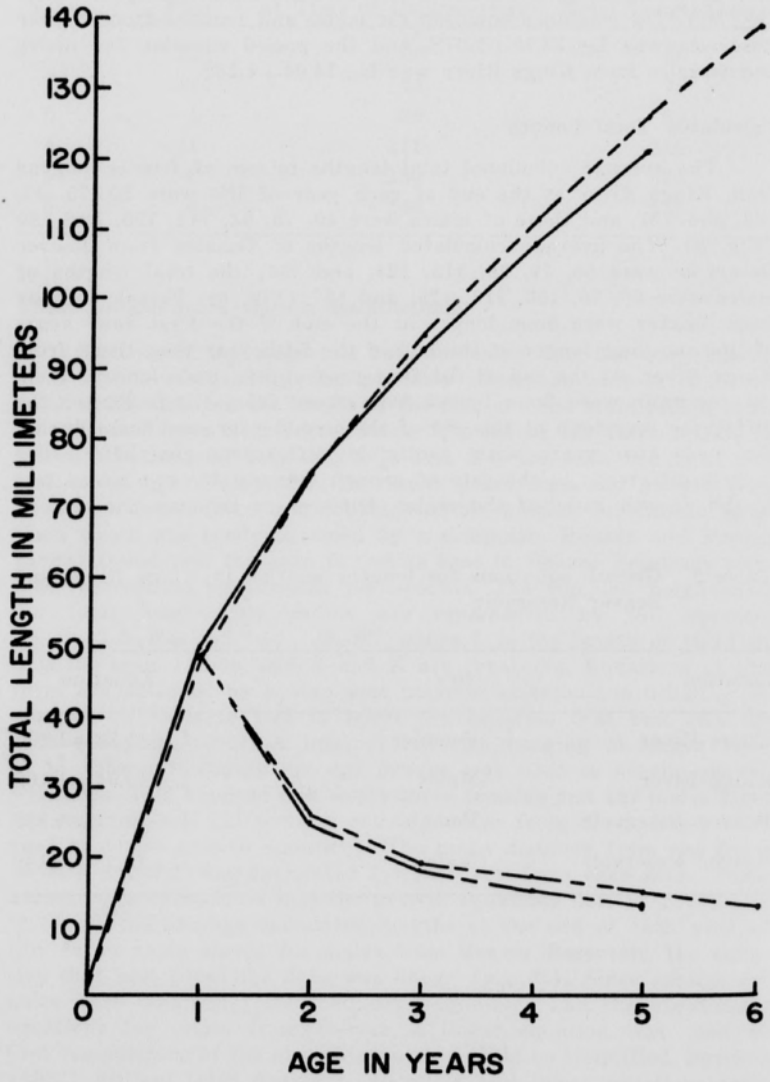
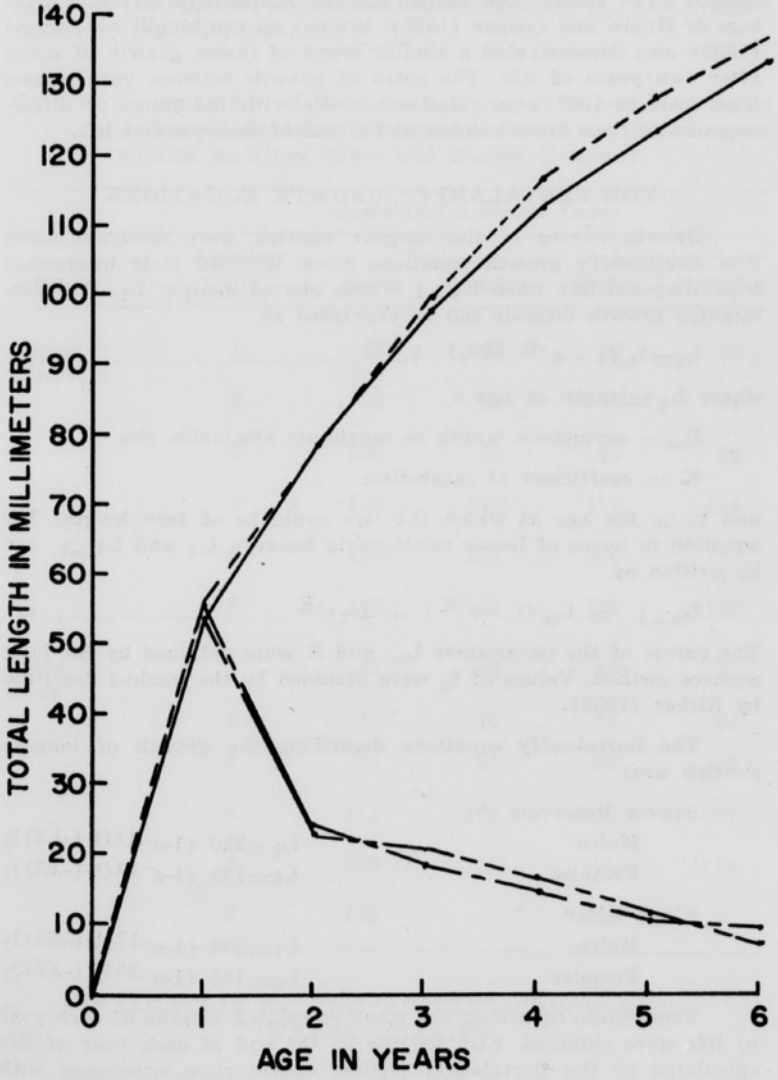


Figure 4. The absolute growth rate (mm) of female (———) and male (- - -) longear with annual increments (mm) of female (———) and male (- - -) longear in Beaver Reservoir.



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growth of males and females within each area became apparent after the second year. Male longear sunfish from the reservoir were approximately 4mm longer than females from age 3 to age 6. In the Kings River, male longear were 1mm longer after the third year of life and approximately 4mm longer thereafter. The fact that male longear grow faster than female longear agrees with previous findings of Hubbs and Cooper (1935). Studies on the blugill by Sprugel (1953) also demonstrated a similar trend of faster growth of males after two years of life. The rates of growth between year classes from 1961 to 1967 were relatively stable with the range of differences being from 3mm to 8mm at the end of each year of life.

VON BERTALANFFY GROWTH EQUATIONS

Growth curves of the longear sunfish were analyzed using Von Bertalanffy growth equations since Walford plots intersected a 45° diagonal line when L_{t+1} was plotted against L_t. The Bertalanffy growth formula can be expressed as

$$L_t = L_\infty (1 - e^{-K\ (t-t_0)}) \quad \text{.....(1)}$$

where L_t = length at age t

L_∞ = asymptotic length or maximum attainable size

K = coefficient of catabolism

and t_0 = the age at which the fish could be of zero length. The equation in terms of linear relationship between L_t and L_{t+1} can be written as

$$L_{t+1} = L_\infty (1 - e^{-K}) + L_t e^{-K} \quad \text{.....(2)}$$

The values of the parameters L_∞ and K were obtained by the least squares method. Values of t_0 were obtained by the method described by Ricker (1958).

The Bertalanffy equations describing the growth of longear sunfish are:

Beaver Reservoir	
Males	$L_t = 220\ (1-e^{-.14(t-(-1.2))})$
Females	$L_t = 169\ (1-e^{-.24(t-(-.63))})$
Kings River	
Males	$L_t = 203\ (1-e^{-.17(t-(-.65))})$
Females	$L_t = 165\ (1-e^{-.23(t-(-.60))})$

From these equations, the mean calculated lengths of each year of life were obtained. Fish lengths at the end of each year of life calculated by the Bertalanffy method are in close agreement with those of the back-calculated lengths (Table 3).

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From the analysis it is evident that the male longear from Beaver Reservoir and Kings River have a large asymptotic length and grow towards it at a slower rate. Whereas, the females from both areas have a lower asymptotic length and approach the limit more quickly. From the data it is also evident, as in many other species of fish, that an inverse relationship between L_{oo} and K exists (Beverton and Holt, 1959).

Table 3. A comparison of the calculated lengths in mm from scales and by the Bertalanffy method of female and male longear sunfish in Kings River and Beaver Reservoir.

		Calculated Lengths (mm)			
	Age in	Scales		Bertalanffy	
Area	Years	Males	Females	Males	Females
Beaver Reservoir	1	56	55	57	56
	2	79	79	79	79
	3	100	98	99	98
	4	117	113	114	113
	5	129	124	128	125
	6	137	134	139	135
Kings River	1	49	50	49	51
	2	75	75	76	74
	3	94	93	98	92
	4	111	108	113	107
	5	126	121	128	119
	6	139	—	140	—

EVALUATION OF THE RESULTS CONCERNING WATER QUALITY

Sampling sites in Kings River and in the coves and creeks of Beaver Reservoir were characterized by turbid waters during the

major part of the year. Surface water temperatues were higher in the reservoir during the summer months but were similar to those in Kings River during the winter months (Table 4).

A total of 702 *L. megalotis* were used in the age and growth analysis. There was a higher sex ratio of females to male in Beaver Reservoir. The Kings River collections were dominated by younger age groups and smaller fish whereas the fish from the reservoir were consistently older and larger. Total fish length-scale radius equations for the two areas were not significantly different, and the calculated lengths at the end of each year of life were similar. Other growth characteristics such as the length-weight relationship, coefficient of condition, and asymptotic lengths were also similar for these two areas.

In reference to water quality, the results of this study indicate that subsequent to impoundment (approximately 4 years later) both the Kings River and Beaver Reservoir collecting sites have similar environmental conditions that are equally favorable for the growth of longear sunfish, *Lepomis megalotis*.

Table 4. Surface water temperatures in Kings River and Beaver Reservoir at the time of collection of longear sunfish.

Location	Date	Surface Water Temperature C°
Kings River	6-13-67	17.0
	7-15-67	21.9
	8-22-67	23.0
	9-15-67	19.1
	10-12-67	11.0
	11-12-67	9.9
	1-25-68	6.5
	2-10-68	6.0
Beaver Reservoir	6-22-67	27.0
	7- 7-67	26.0
	7-10-67	26.0
	7-12-67	26.0
	7-17-67	27.0
	7-24-67	27.1
	8-15-67	26.1
	8-17-67	26.0
	8-23-67	25.4
	9-17-67	20.4
	10-23-67	11.8
	12-15-67	7.2

SUMMARY

A total of 702 *L. megalotis* was collected from the Kings River and Beaver Reservoir to determine the rate of growth, maximum size, and maximum age. The largest specimen taken from these two areas was 155mm long and six years of age. Based upon this study, longear reach a catchable size of 127mm at the end of their fifth growing season; some attain this length at the end of the fourth year, while others may not ever attain this length. The fish length-scale radius equations for males and females from each area were similar. Males were found to grow faster than females after the second year of life. The rate of growth was found to be slightly faster in Beaver reservoir than in Kings River. The average calculated lengths in mm for longear from Beaver Reservoir were 56, 79, 99, 115, 127, and 136, and the lengths at the end of each year of life in Kings River were 50, 75, 94, 110, 124, and 139. The rate of growth was faster than in northern areas, but the life span was shorter.

Asymptotic lengths of males from Beaver Reservoir and Kings River were larger than those of females. The maximum lengths for males and females from the reservoir were 220 and 169mm respectively. The mean calculated lengths obtained by Bertalanffy equations were similar to those obtained from scales.

LITERATURE CITED

Applegate, Richard L., James W. Mullan, and David I. Morais. 1966. Food and growth of six centrarchids from shoreline areas of Bull Shoals Reservoir. Proc. Twentieth Annual Con. South. Assoc. of Game and Fish. Comm., pp. 469-482.

Beverton, R. J. H. and S. J. Holt. 1959. A review of the lifespans and mortality rates of fish in nature and their relation to growth and other physiological characteristics. Ciba Foundation Colloquia on Aging, 5: 142-180.

Creaser, Charles W. 1926. The structure and growth of the scales of fishes in relation to the interpretation of their life history with special reference to the sunfish, *Eupomots gibbosus*. Univ. Mich. Museum. Zool. Misc. Pub. No. 17, pp. 1-82.

Durham, Leonard. 1955. Ecological factors affecting the growth of smallmouth bass and longear sunfish in Jordan Creek, Illinois, Ill. Acad. Sci. Trans., 47: 25-34.

Graybill, F. A. 1961. Introduction to Linear Statistical Models. McGraw-Hill, New York. 463 pp.

Houser, Alfred and Horace Bryant. 1968. Age, growth, sex composition, and maturity of white bass in Bull Shoals Reservoir. Technical Paper. BSFW, SCRI, Fayetteville, Arkansas, 27 pp.

Hubbs, Carl. and Gerald P. Cooper. 1935. Age and growth of the longeared and the green sunfishes in Michigan. Pap. Mich. Acad. Sci., Arts, Lett., 20: 669-696.

Jenkins, Robert M., Ronald E. Elkins, and Joe C. Finnell. 1955. Growth rates of six sunfishes in Oklahoma. Okla. Fish. Res. Lab. Rept. No. 49, 73 pp.

Neill, William H. 1967. Factors affecting heat resistance and temperature selection in the longear sunfish, *Lepomis megalotis*. M.S. Thesis. University of Arkansas, Fayetteville, Arkansas. 63 pp.

Patriarche, Mercer H. and Edward M. Lowry. 1963. Age and growth of five species of fish in Black River, Missouri. In Funk et al. The Black River Studies, The University of Missouri Studies, Columbia. pp. 85-109.

Regier, Henry A. 1962. Validation of the scale method of estimating age and growth of bluegills. Trans. Am. Fish. Soc., 91: 362-374.

Ricker, W. E. 1958. Handbook of Computations for Biological Statistics of Fish Populations. Bull. Fish. Res. Bd. Canada, No. 119, 300 pp.

Sprugel, George, Jr. 1953. Growth of bluegills in a new lake with particular reference to false annuli. Trans. Am. Fish. Soc., 91 (4): 362-374.

Trautman, M. B. 1957. The Fishes of Ohio. The Ohio State University Press, Columbus, Ohio. 683 pp.

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