SECTION G, CONSERVATION

Condition Factors and Growth in Length of a Stunted White Crappie Population in Boomer Lake, Payne County, Oklahoma

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INTRODUCTION

This paper presents the results of a study on the age and growth rate of white crappie, *Pomoxis annularis* Rafinesque, in Boomer Lake, Payne County, Oklahoma.

Burris (1956) and Crawley (1954) reported very slow growth for white crappie in Boomer Lake. The present study was designed to determine if such a situation continues to exist.

The plasticity of growth of white crappie is evident (Carlander, 1950 and 1953). Therefore, management methods may improve growth rates. The findings in this report provide data for evaluating methods designed to increase the growth rate of the white crappie population in Boomer Lake.

DESCRIPTION OF BOOMER LAKE

Boomer Lake was completed in 1925. The deepest portion of the lake is the old creek channel near the dam and the shallowest portion is on either side of the creek channel at the upper end where Boomer Creek widens into the lake.

The surface area is 102 hectares and the storage capacity is 3.08 cubic megameters. The mean depth of the lake is 2.98 meters.

The reservoir initially was used as a municipal water supply, but in 1951, due to high bacteria count of the water and increased water need, the city discontinued use of the lake for this purpose. Presently, the water is used for irrigation of the park around the lake and for cooling in the nearby power plant.

METHODS

Three methods were used in collecting the 150 white crappie used in this study: hoop net, gill net and angling. Each fish was measured to the nearest millimeter (total length) and weighed to the nearest 0.1 g.

These collections were made from February 1966 to March 1967.

Scales were taken from an area on the left side of the fish below the lateral line under the origin of the dorsal fin. Scales from each fish were placed in an scale envelope, bearing all pertinent data.

Permanent impressions of the scales were made on plastic slides and the impressions were read with the aid of an Eberback microprojector for the purpose of determining the age and growth of the fish. The scales were measured in millimeters along the anterior radii from the foci to

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each annulus and to the margin of the scale. An 80× magnification was used.

The length-weight relationship was determined by use of the equation for the general parabola:

$$W = CL^{b}$$

Condition factors were determined for each fish using Lagler's (1956) formula:

$$K_{c} = W \times 10^{5}/L^{3}$$

where W = weight in grams

L = total length in millimeters

The scale lengths (anterior radii) were plotted against the body length for each fish and least squares linear and curvilinear regressions computed. Back calculation of the growth rates were made by means of the following formula (Chugunova, 1959):

$$L_{i} = [a + S_{i}\ (L - a)]/S$$

where L_i = length of fish at annulus i

S_i = scale radius at annulus $i \times 80$

L = length of fish at time of capture

S = total scale radius × 80

a = intercept value obtained from the formula:

$$Y = a + b\,X$$

where Y = length of fish

X = scale radius

Length-Weight Relationship

The length-weight relationship of these white crappie was determined to be:

$$W = 0.4009 \times 10^{-5}\ L^{3.179}$$

or

$$\ln W = -12.427 + 3.179 \ln L$$

The mean condition factor K_{TL} was 9.8 with a population standard devation of 1.56. The 95% confidence limits of the mean were 9.8 ± 0.2. For comparison purposes, these values were converted to K_{SL} using the equation:

$$\text{Total length} = 1.3 \text{ standard length}$$

which is an average of the several equations given by Carlander (1950). The K value for the mean length (138 mm) and weight (25.7 g) was 2.16.

Carlander (1950, 1953) listed 37 K_{SL} measurements for white crappie from collection sites throughout the United States. These ranged from 1.48 to 3.88. Only three of the values reported by him fell below the average for white crappie in Boomer Lake. One of these lower values was for Lake Clinton, Washita County, Oklahoma (Thompson et al., 1951).

Schoffman (1964) studied the age and growth rate of white crappie in Reelfoot Lake, Tennessee, before and after the cessation of commercial fishing. He presented average length and weight at each age class for both periods, demonstrating a decrease in growth rate with increasing competition. In order to compare condition factors between that study and this one, the K_{TL} values were calculated for each of his mean lengths and weights. Although a decrease in condition was evident for each age class, both the overall average value (13.57) before cessation and afterward (12.41) were greater than the Boomer Lake value even when the 95% confidence level in the latter figure was considered. Estimated body weights at total lengths from 85 to 250 mm are presented in Table I.

TABLE I. LENGTH-WEIGHT RELATIONSHIP

Total Length (mm)	Body Wt. (g)	Total Length (mm)	Body Wt. (g)	Total Length (mm)	Body Wt. (g)
85-89	6	167	47	209	95
90-93	7	168	48	210	97
94-97	8	169	49	211	98
98-100	9	170-171	50	212	100
101-104	10	172	51	213	101
105-107	11	173	52	214	103
108-110	12	174	53	215	104
111-112	13	175	54	216	106
113-115	14	176	55	217	108
116-117	15	177	56	218	109
118-120	16	178	57	219	110
121-122	17	179	58	220	112
123-124	18	180	59	221	114
125-126	19	181	60	222	116
127-128	20	182	62	223	117
129-130	21	183	63	224	119
131-132	22	184	64	225	121
133-134	23	185	65	226	122
135-136	24	186	66	227	124
137	25	187	67	228	126
138-139	26	188	68	229	128
140-141	27	189	69	230	129
142	28	190	70	231	131
143-145	29	191	72	232	133
146	30	192	73	234	137
147	31	193	74	235	138
148-149	32	194	75	236	140
150	33	195	76	237	142
151	34	196	78	238	144
152-153	35	197	79	239	146
154	36	198	80	240	148
155	37	199	82	241	150
156-157	38	200	83	242	152
158	39	201	84	243	154
159	40	202	86	244	156
160	41	203	87	245	158
161-162	42	204	88	246	160
163	43	205	90	247	162
164	44	206	91	248	164
165	45	207	93	249	166
166	46	208	94	250	169

Body-scale Relationships

The linear and curvilinear regressions between the scale radius ×80 (X) and body length (Y) were calculated and then tested for significance by analyses of variance (Table II).

The straight-line regression was significant at the 0.01 level and the curvilinear regression was significant at the 0.05. Burris (1956) also found a significant second degree equation fit.

Table II. Analyses of Variance for Boomer Lake Body-scale Relationships

Linear Regression Source	Degree of Freedom	F	Significance
Total	149		
Regression	1	670.8	$P<0.01$
Residual	148		
Curvilinear Regression			
Total	149		
Regression	2	4.66	$0.05<P<0.01$
Residual	147		

The equations are as follows:

$$Y = 57.603 + 0.6270X$$

and

$$Y = 80.295 + 0.4961X + 0.00000278X^2$$

The curvature was very slight and, therefore, the linear equation formed the basis for back calculation. The intercept value 57.6 mm agrees very closely with the 55.3 mm found by Burris (1956). The second degree equation cannot be directly compared because he fitted the regression of the log body length versus scale radius. However, his second degree term was also very small, being $0.000005X^2$.

Time of Annulus Formation

No annuli were observed forming at the scale margin for the fish observed in this study. Whiteside (1964) and Hall et al. (1954) found annulus formation to occur in Oklahoma waters during April and May. The data from the present study show that annulus formation did not occur before the end of March in Boomer Lake in 1967.

Growth Rates

Table III shows the average back-calculated ages for the fish in this study. Table IV presents a comparison of age and size of white crappie in Boomer Lake during a period from 1950 to 1966, estimated by back-calculations.

Lee's phenomenon (the tendency for back-calculated body lengths to be smaller when calculated from older fish) was not evident when all ages were considered.

TABLE III. BACK CALCULATION

Age At Capture	No.	Annulus I	II	III	IV	V	VI	VII
I	9	97.2±7.8						
II	66	97.1±1.8	120.8±2.6					
III	52	94.1±2.2	115.8±2.0	131.1±2.8				
IV	13	91.3±3.9	112.4±5.2	127.0±7.2	139.3±10.9			
V	2	102.0	123.5	142.0	158.0	205.0		
VI	2	105.5	125.5	149.5	172.5	208.5	234.5	
VII	1	107.0	132.0	155.0	179.0	273.0	302.0	343.0
Average		99.2	121.6	140.9	182.2	228.8	268.2	343.0
Increment		22.4	19.3	41.3	46.6	39.4	74.8	

TABLE IV. COMPARISON OF SIZE IN mm OF WHITE CRAPPIE IN BOOMER LAKE IN 1950, 1953 and 1966

Year of collection	Age I	II	III	IV	V	VI	VII	Source
1950	98.0	128.5	156.2	179.3	222.2	254.0		Burris (1956)
1953	61.0	104.1	142.2	193.0	256.4	274.3	391.2	Crawley (1954)
1966	99.2	121.6	140.9	182.2	228.8	268.2	343.0	Present Study

The growth rate in comparison with the state average was above average for the first year but below average thereafter (Houser and Bross, 1963).

Growth increments for older fish were larger than those of the younger ages. This is also true for the slowest growth rates recorded in Oklahoma by Houser and Bross (1963). Possibly this is a result of the increasing importance of fish in the diet of fish over 150 cm in Boomer Lake as reported by Burris (1956).

DISCUSSION AND CONCLUSIONS

Slow growth rates have been found in Boomer Lake in studies of fish collected in 1950 (Burris, 1956), 1953 (Crawley, 1954) and the present study in 1966. Poor condition factors were also found. Boomer Lake was rotenoned in 1953 (McCoy, 1953) and then restocked. Any significant improvement in growth rates as a result of this management technique was not evident in fish collected in 1966-67, although growth apparently was faster than that just prior to reclamation. Such improvement as undoubtedly occurred was limited to the first six years at the very most.

Crawley (1954) reported that the first-year growth rate for fish in poor lakes was not noticeably different from that in better lakes and that growth was not retarded after the fish reached 150 mm, the size when fish became important in the diet. Few fish over 150 mm were collected in Boomer Lake. Boomer Lake fish fed mainly on *Hexagenia* during the period of this study (Wade, 1968). The *Hexagenia* population in Boomer Lake was relatively large when compared with other reported data (Craven, 1968). However, they made up a greater proportion of the total biomass in Boomer Lake than in Lake Texoma (Sublette, 1953), where growth of white crappie was faster (Whiteside, 1964). Possibly this difference in food supply would hold true for other comparisons. A reduction in turbidity of Boomer Lake (Craven, 1968) might improve the environment for bottom organisms and thus enhance white crappie growth. Hall et al. (1954) reported poorer growth of white crappie in turbid Oklahoma waters. A reduction in population numbers might decrease intraspecific competition for food and improve growth. However, the failure of the previous reclamation of Boomer Lake to provide favorable long-range growth conditions indicates that management should be continuous. Possibly heavy spring netting and annual removal of fish might be feasible. Hall et al. (1954) stated that in order to provide good fishing, white crappie must attain a length of 200 mm in three years and 254 mm in four years. Management techniques should be tested because of the prevalence of slow-growing white crappie populations in small Oklahoma lakes (Burris, 1956; Crawley, 1954 and Thompson et al., 1951).

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