Name: Mable Cohen Date of Degree: May, 1967

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: SCALE AND BODY GROWTH OF YOUNG-OF-YEAR CENTRACHIDS IN TWO PAYNE COUNTY, OKLAHOMA FARM PONDS

Pages in Study: 16 Candidate for Degree of Master of Science

Major Field: Natural Science

Scope and Method of Study: Young-of-year bluegills (Lepomis macrochirus), green sunfish (Lepomis cyanellus), and bass (Micropterus salmoides) were collected from two Oklahoma farm ponds to study first year growth. Measurements were made on scale and body lengths.

Findings and Conclusions: Scales were found on bluegills 16 millimeters in length. This value agreed with the length at scale formation calculated from the body scale relationship. Growth of bluegills and bass apparently ceased in late October. Many of the sunfish collected were less than two inches long at the end of the growing season. First annuli would be very difficult to determine on scales from such fish.

ADVISER'S APPROVAL L. Herbert Brennan

SCALE AND BODY GROWTH OF YOUNG-OF-YEAR CENTRACHIDS IN TWO OKLAHOMA FARM PONDS

By

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Bachelor of Science

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1962

Submitted to the faculty of the Graduate College of
the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
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SCALE AND BODY GROWTH OF YOUNG-OF-YEAR CENTRACHIDS

IN TWO PAYNE COUNTY OKLAHOMA FARM PONDS

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ADVISER'S APPROVAL L. Herbert Bruncau

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CHAPTER I

INTRODUCTION

The purposes of this project were to determine the scale size and body lengths that centrachids in Oklahoma ponds may obtain in their first year of growth and to determine the body-scale relationship of sunfish based on collections of small fish. The difficulty biologists have in locating the first annulus and the scales of farm pond species is well documented in the literature (Burress, 1949; Proffitt, 1950; Regier, 1959; and Sprugel, 1950). Therefore, observations on young fish are of importance for age determinations in fish population studies.

CHAPTER II

COLLECTIONS

Fish Sampling

A 15 foot common-sense minnow seine was used to collect fish for this study. Samples were taken around all edges of the ponds. Pond I was sampled on September 9, 15, 23, October 1, 15, and 29, 1966, and on March 28, 1967. Collections were made on Pond II on the last four of these dates. Several seine hauls were made on each sampling date. The number of size groups was recorded and random samples of fish preserved in 10 percent formalin for laboratory study. Water temperatures were in the 70's in September and in the 60's in October. The water temperature on March 28, 1967 was 69° F.

Description of Ponds

Two farm ponds located south of Stillwater in Payne County, Oklahoma were available for study. Pond I was 1.5 acres with a depth of 12 feet. It was built in 1959 and stocked at that time with bass (Micropterus salmoides) and bluegills (Lepomis macrochirus). Fishing pressure was limited to an occasional visit by a fisherman. A few bass and practically no bluegills had been caught in the pond. The pond was muddy during its earlier years, but recently has maintained a bloom and evidenced reduced turbidity. Waste grain had been dumped into the pond. Samples taken by hook and line with a 15 foot common-sense seine,

and 50 and 150 foot seines indicated that six and seven inch bluegills in good condition and bass 9 to 11 inches in fair condition were present. No unstocked species were found. A slight overcrowding of bass was evident (personnel communication, Bradford E. Brown, Okla. Coop. Fish. Unit).

Pond II was located about one fourth mile southwest of Pond I. It was 1.25 acres, and eight feet deep. Built in 1963, it was originally stocked with bass and bluegills. In the fall of 1966, additional bass fingerlings were added. Green sunfish (Lepomus cyanellus) were present and a channel catfish (Ictalurus punctatus) had been reported caught. Essentially no fish were caught by anglers. This pond stayed very muddy much of the time.

CHAPTER III

RESULTS

Fall Growth

Bass - Pond I

A total of 14 fish was measured on September 15. Using a 95% confidence interval, the mean size was 40.7 $\pm$ 4.8 mm with a standard deviation of 9.3 mm. Eleven other bass were taken in the remaining sampling periods. These latter fish averaged 74.2 $\pm$ 4.1 mm with a standard deviation of 6.1 mm. The statewide slowest growth reported is 61.2 mm and the statewide average 134.8 mm (Houser and Bross, 1963).

Bluegills - Pond I

One hundred fifty-two bluegills were measured. The mean size with a 95% confidence interval was 52.2 $\pm$ 2.2 mm with a standard deviation of 13.4 mm. Since the size frequency (Fig. 1) is not multimodal there is no evidence for distinct spawning periods. Although the sampling was biased in that only a small seine was used, fish over 90 mm in length were aged as I+ by the scale method. This growth exceeded the slowest statewide growth rate of 38 mm but was far below the reported average of 93 mm (Jenkins et. al., 1955). The mean size with 95% confidence limits were plotted in Figure 2 for each collection. The growth rate increased up to the last fall seining date, however, no large amount of growth took place after the September 8th collection and thus the fish collected from September 15, through October 29 dates were pooled

and the overall averages were obtained.

Bluegills - Pond II

Ninety fish were measured. Using a 95 percent confidence interval, the mean size was 21.3 ± .8 mm with a standard deviation of 7.3. In comparison with the statewide growth calculations, (Jenkins et. al., 1955) the average size was less than that of the slowest growth fish.

Green sunfish - Pond II

Sixty-three fish were observed. Using a 95 percent confidence interval, the mean size was 25.2 ± 1.8 mm. This was less than the slowest statewide growth calculations (45.7 mm) (Jenkins et. al., 1955).

Changes in Size Distribution Over Winter

Bass - Pond I

On March 28, 1967, collections were made to observe changes in the size composition over the winter period. Four bass caught in Pond I averaged 65.8 mm. This is not significantly different from the 61.2 mm average observed the previous fall. These fish were very thin when observed from the dorsal view. Their stomachs were concave.

Bluegills - Pond I

Small bluegills were numerous in the 15 foot seine hauls. A total of 43 fish were measured and had a mean with 95 percent confidence interval of 61.0 ± 2.2 mm and a standard deviation of 7.3 mm. This is somewhat larger than the fall figure of 52.2 ± 2.2 mm. The increase could be a result of growth or it could be at least partially caused by selective mortality of the smaller individuals. The size range of 1966 year class bluegills in the spring sample was 46 to 76 mm while the distri-

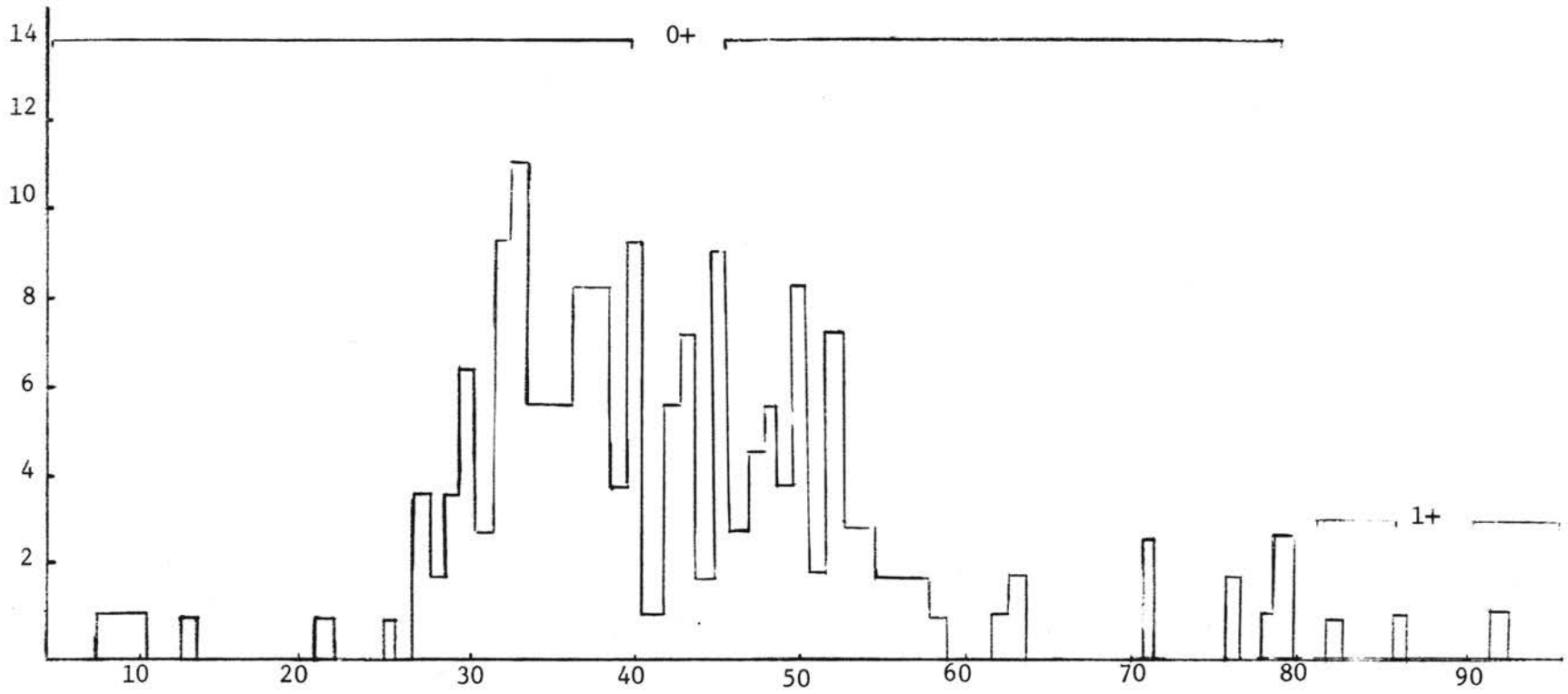

Figure 1. Length Frequency Distribution of Bluegills collected From September 18 to October 29, 1966 in Farm Pond I.

(Numbers Versus Total Length in Millimeters)

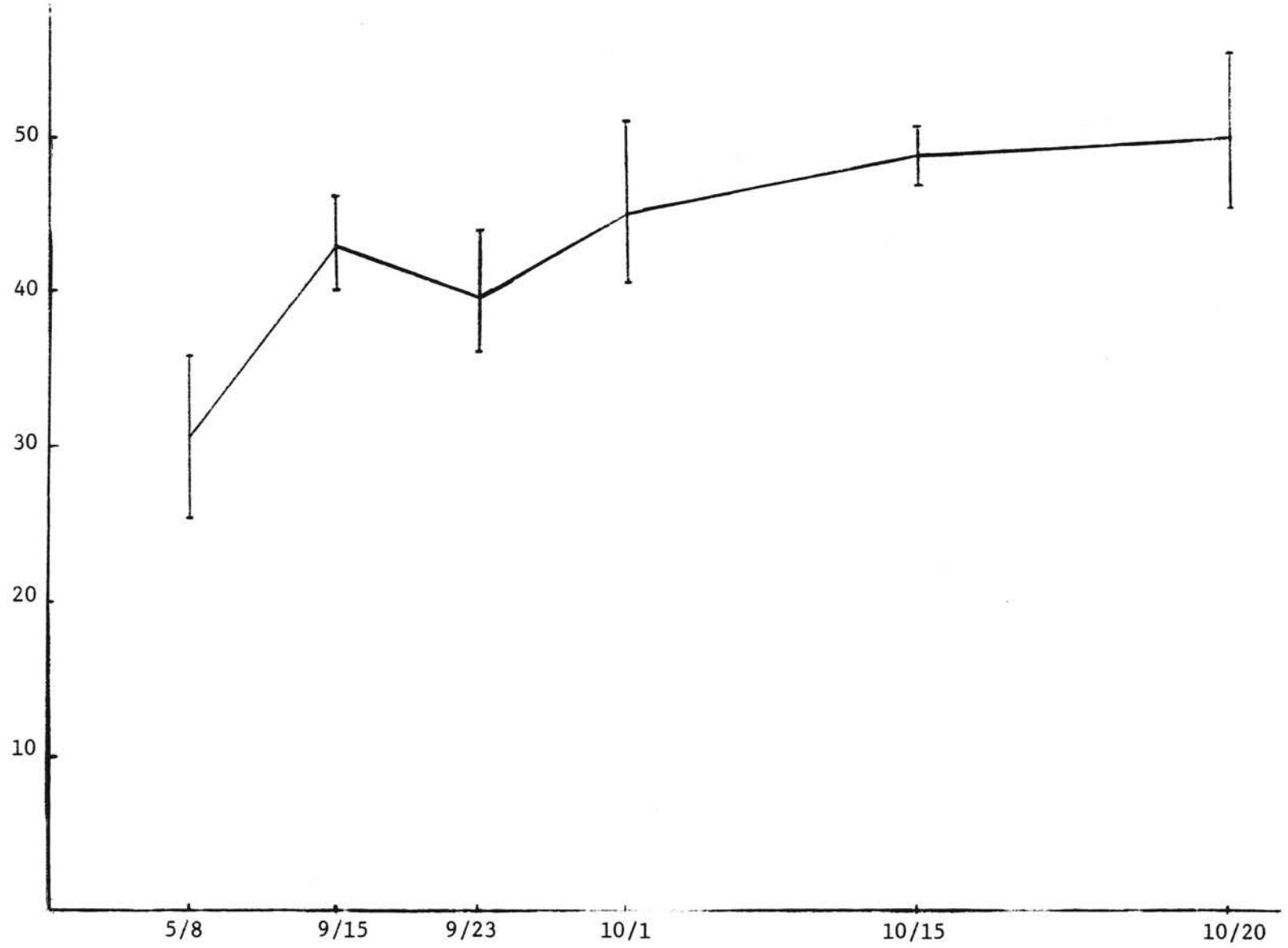

Figure 2. Mean Size With 95% Confidence Limits of Bluegills Captured in Farm Pond I. (Total Length in Millimeters Versus Date)

bution the previous fall was from 20 to 90 mm and 15 percent were smaller than 46 mm. A bass 70 mm can swallow a bluegill 34 mm long (Lawrence, 1958) and thus predation rather than growth could account for some of the shift in size.

Bluegills - Pond II

In Pond II bluegill fry were still present in the March collection. The average size with 95 percent confidence interval of 23 measured fish was 33.9 $\pm$ 1.4 mm with a standard deviation of 3.4 mm. This length was greater than the 21.3 $\pm$ .8 mm observed in the fall of 1966.

Fingerling bass had been stocked in the fall in this pond and one fish (48 mm long) was captured that October. Possibly differential predation occurred here also.

Green sunfish - Pond II

Only four 1966 year class green sunfish were captured in the March collection. Their average size was 53 mm. This was twice the size of the fish observed the previous October. However, the sample size was too small for any conclusion to be drawn.

Early Scale Formation

Study procedures

Several small sunfish were available for studying early scale formation. The smaller fish were stained with alizerine red as suggested by Brown and Bailey (1952), and observed under both a dissecting microscope and an Eberback microprojector. Pieces of skin containing scales were removed to examine scale structure in detail.

Bluegills

Scales from a total of 21 bluegills ranging from 16 mm - 29 mm were studied. No ctenii were present on the scales of 16 mm to 23 mm fish. In addition ctenii were also absent on the 29 mm fish. The number of ctenii on the scales of 24 mm to 25 mm were not a set pattern in these early stages of development as one to four ctenii were observed on the 24 mm and only two ctenii on the 25 mm fish.

Scales apparently begin growing by a roughly circular pattern (Fig. 3) and later formed the typical scale shape (Fig. 4). Circular scales had 3-9 circuli and were found on fish up to 23-25 mm in size. Rudimentary circuli varied in shape from square to circular. Formed scales began to occur in the 23-25 mm size fish. (Some of these had both circuli and formed scales.) Circuli on the formed scales were broken at various locations and apparently, as was observed in older fish circuli are added to the anterior end during growth, therefore, the posterior end has less circuli than the anterior end.

The addition of circuli and the flattening of the anterior end gives the scale its adult forms. At the magnification (80X) used in this study, the circular scales had roughly one circuli per millimeter of radius whereas the formed scales had this ratio at the posterior end but had approximately two circuli per millimeter at the anterior end. This agrees in general with the findings of Creaser (1926).

Scales did not cover the entire body of 16, 17, and 19 mm fish. The origin of scales apparently occurs at the caudal area, as reported by Proffitt (1950) as opposed to Potter's (1925) finding that scales were first found scattered over the body. In the 17 mm fish, scales were found mid-point of the dorsal fin area, whereas, in the 19 mm

Figure 3. Platelet Type Scale

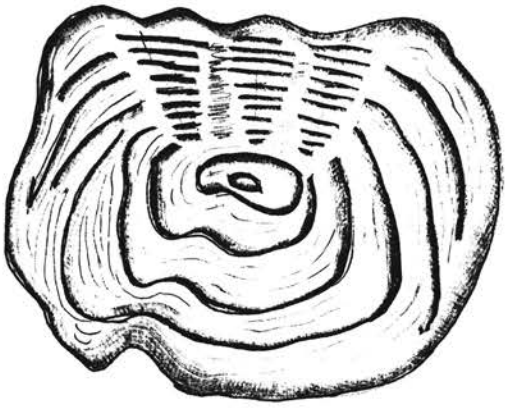

Figure 4. Scale With Adult Form but Still Without Ctenii

fish scales were found all the way to the anterior end of the dorsal fin. In the 16 mm fish scale formation only reached the posterior end of the dorsal fin. In all of the above cases scales reached the pectoral fin area in the lower half of the fish. These observations on size at scale formation were in general concurrence with those of Proffitt (1955) and Potter (1925).

Green sunfish

Observed green sunfish ranged from sizes 17 to 25 mm. There were 11 fish in the sample. Scales had already grown over the entire body of the 17 mm fish. However, on the 22 mm fish, most scales showed circuli beginning to crowd on the posterior end indicating a transition to adult shape. The 20 mm fish had some fully formed scales and some which were still circular.

Ctenii were formed on the 22 mm and larger fish. The green sunfish had more scales and more fully developed scales at smaller sizes than the bluegills. This concurred with Proffitt's (1950) findings in Michigan.

Body - Scale Analysis

Bass

A total of 33 fish scales were taken. The average fish length was 67 mm. The average scale radius was 44.8 mm with a 95 percent confidence interval of $\pm$ 3 mm.

Bluegills

The body scale relationship was calculated for 58 fish from the fall sample. Measurements of radii distance were made on three scales from

each fish. The fish ranged in sizes from 16-116 mm. The equation calculated was:

$$Y = 16.70 + .7099X$$

where Y equals total length of fish in mm and X equals 80X scale radius in mm. The b value is significantly different from zero thus a straight line relationship is valid.

The intercept value of 16.7 agrees with the observations on early scale growth made in the study and the values reported by Proffitt (1950).

The mean size fish in Pond I was 52 mm and the calculated scale radius 50.2. The mean size fish in Pond II was 21 mm and the calculated scale radius was 6.4.

Forty-eight fish were measured in the spring sample ranging in size from 20 to 118 mm. The radius distance of one scale was measured for each fish.

The equation for estimating length from scale measurements was

$$Y = 15.69 + .6284\ X$$

The b value is significantly different from zero, thus a straight line relationship is valid. The intercept value for scale growth agreed with the observed findings of this study as well as with Proffitt's (1950) observed values.

The mean size fish in Pond I was 61.0 mm with an estimated scale radius of 72.2. The fish from Pond II had a mean size of 33.9 mm with an estimated radius of 29.4 mm.

Scales from the larger fish were forming annuli. However, the smallest showed no signs of annuli formation.

Green sunfish

A total of twenty fish ranging from 17-46 mm was observed. The body-scale regression was:

$$Y = 11.14 + .7834\ X$$

Proffitt (1950) found green sunfish first had scales at 11 mm in length which agrees with the intercept value reported here.

The average size green sunfish in Pond II was 25 mm with an estimated radius of 18 mm.

CHAPTER IV

DISCUSSION AND CONCLUSIONS

Bluegills, green sunfish, and largemouth bass are important components in farm pond fish populations. In order to manage these ponds properly, knowledge is needed about the status of the population. Age structure and growth rates are often determined. Aging is usually done by an analysis of the scales for annuli. As mentioned previously the difficulty in correctly aging fish is critical. Consequently miscalculations could invalidate management conclusions.

In the two farm ponds in this study, first year growth was very slow. In addition, bluegills spawned on into the fall, as fry were found in all collections. Growth appeared to be ceasing by the end of October for the bluegill and the bass, when temperatures were in the sixties. Not enough green sunfish were collected to provide information on cessation of growth. Spring collections indicated a possible differential mortality of the smallest late fall spawned fish. However, this might not be the case in ponds where small fingerling bass were not present.

Annulus determination for sunfish which grow less than two inches in their first growing season may prove very difficult. Any check in the scale would come very close to the focus. In fact some fish collected in March still had scales only as platelets. For these fish no

annulus may form at all. Regier (1959) reported lack of first annulus formation in some New York farm ponds.

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