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ACKNOWLEDGMENTS

Thanks are extended to the following who rendered assistance: Brandon Carter, Pat Ryan, John Bellinger, Kenneth Allen, and R. O. Smitherman.

AGE AND GROWTH OF RIVER REDHORSE, Moxostoma carinatum (Cope) FROM THE CAHABA RIVER, ALABAMA

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ABSTRACT

The river redhorse, *Moxostoma carinatum* (Cope), is a Catostomid fish of east-central North America. In rivers where it is common, the river redhorse frequently affords a sport fishery, especially during its spawning period.

During the period July, 1966, to July, 1968, 339 river redhorse were collected from the Cahaba River, Alabama. Scales from 183 of these specimens were aged and back calculated. An additional 52 pond-reared specimens were utilized for scalation and length-weight studies. Length-weight equations were computed.

Female river redhorse were significantly heavier than males throughout the data ranges studied. Male river redhorse from the Cahaba River were greater in length at age groups I, II, III, and IV than were females. Specimens from the Duck River, Tennessee, grew more slowly than those from the Cahaba River although larger sizes were reached in Duck River.

INTRODUCTION

The river redhorse, *Moxostoma carinatum* (Cope), is a Catostomid fish of east-central North America. The northern limit of its range is from Iowa east to western Pennsylvania (Trautman, 1957), with an apparent relic population remaining in the St. Lawrence River (Vlady-

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kov, 1942). The species is distributed southward in the Ohio River system through western North Carolina and northern Georgia (Hubbs and Lagler, 1957) and west in the Mississippi Valley to Louisiana and Oklahoma (Moore, 1957). It ranges to the Gulf of Mexico in the Mobile Bay, the Escambia River (Smith-Vaniz, 1968) and the Pearl River drainages (Robins and Raney, 1957). In rivers where it is common, it affords sport fisheries of local importance during the spawning period (Hackney, *et al.*, 1968).

Apparently the only information published on age and growth of river redhorse is that by Elkin (1956) for four small specimens in Oklahoma. However, the species is one of the larger, if not the largest, of the Moxostomine fishes. Material pertaining to maximum observed size is slightly more common. Trautman (1957) records an Ohio specimen of 29.0 inches and 10.5 pounds. Forbes and Richardson (1920 and Jordan and Everman (1896) indicated lengths of up to 30 inches. Vladykov (1942) reported a Quebec specimen of 655 millimeters (25.8 inches) and 8 pounds, 2 ounces. Stubbs (per. comm.) [2] has a record of a 13.5 pound female taken from the Duck River near Shelbyville, Tennessee, and an unconfirmed report of a 15 pound fish taken in the Harpeth River, Cheatham County, Tennessee. Redhorse fishermen interviewed by Hackney reported a 16 pound fish taken from the Flint River, Alabama.

MATERIALS AND METHODS

This study is based on 391 river redhorse collected from the Cahaba River, Alabama, and/or reared from eggs stripped from ripe specimens taken from this stream. Fish were captured with a boat-mounted electric shocker. The study area, electric shocker and reared specimens are described by Hackney, *et al.* (1968). Fish were collected during July, August and September of 1966; January, March and July of 1967; and February and July of 1968. Specimens were weighed to the nearest one-hundredth pound, measured to the nearest millimeter total length, sexed, and at least 5 scale samples collected from below the lateral line anterior to the dorsal fin.

Total length at scale imbrication was estimated with pond-reared specimens. Scale impressions for each fish were made in cellulose-acetate strips and magnified 42x by a microprojector. Radius of scale margins and annuli was measured to the nearest millimeter from the focus in the anterior field.

Scale checks were considered to be annuli only if they appeared in all scales of the sample series and could be traced around the anterior field. Annuli positions were verified by three readers. Roman numerals corresponding to the number of annuli were utilized to designate age groups.

Calculated growth in length was computed by the formula $L' = C + S'/S\ (L-C)$ (Rounsefell and Everhart, 1953). Length-weight relationships were determined by the standard equation $W = aL^b$ with a digital computer utilizing a modification of the program reported by Swingle (1964). In the computations, W equals weight in pounds and L equals total length in inches.

LENGTH-WEIGHT RELATIONSHIPS

Growth of males and females was assumed to be different, therefore, equations describing the length-weight relationships for 69 mature male and 79 mature female river redhorse were computed. Additional data were available for pond-reared and immature or unsexed specimens over a length interval of 22 millimeters (0.87 inch) to 460 millimeters (18.1 inches). These observations were combined with the sexually

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differentiated data and a third equation was derived for sexes undifferentiated (n = 166). In Figure 1 the sexes are described by the following equations: Males, $W = 11.25 \times 10^{-5}L^{3.41}$; Females, $W = 16.14 \times 10^{-5}L^{3.31}$ and sexes undifferentiated, $W = 38.25 \times 10^{-5}L^{3.01}$. Swingle (1965) calculated a length-weight relation of $W = 46.2 \times 10^{-5}L^{2.94}$ for 30 unsexed river redhorses.

Analysis of covariance revealed that females were significantly heavier ($F = 425.7^{**}$, df = 1/143) than males throughout the data ranges studied. This superiority in female weight increased from 41 grams (0.09 pound) for 381 millimeter (15-inch) specimens to 64 grams (0.14 pound) in 635 millimeter (25-inch specimens. A test of the regression coefficients was not significant ($F = 0.69$ ns, df = 1/144) indicating homogeneity, or estimates of a common slope.

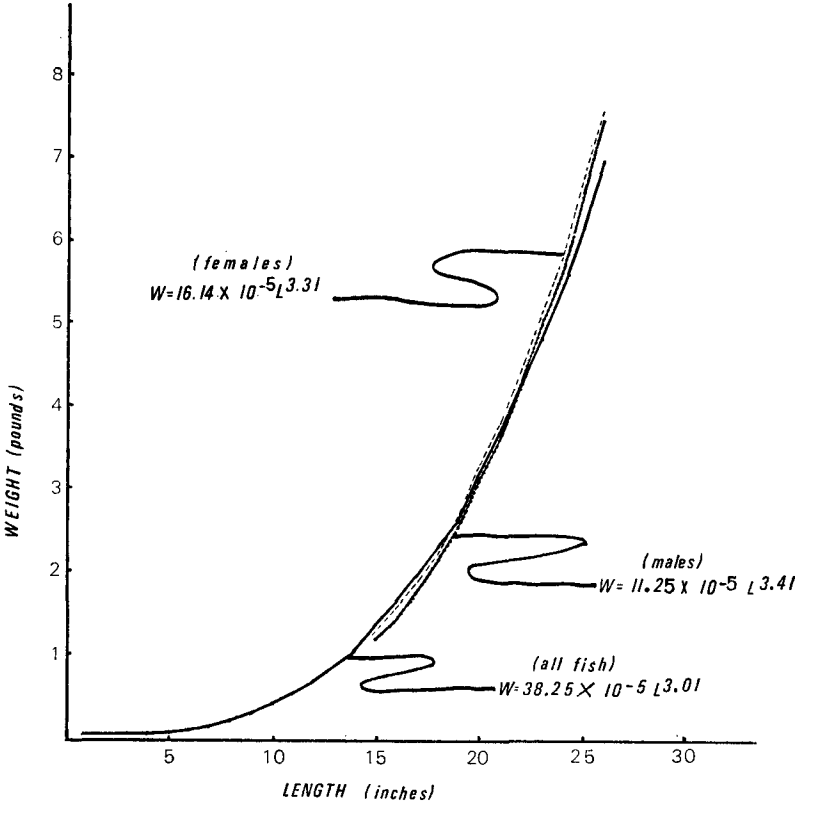

Figure 1. Length-weight relationships of river redhorse in the Cahaba River, Alabama.

AGE AND GROWTH

Scale Development

Early scale development could not be determined precisely due to the lack of a complete series of specimens. Scales were restricted to the caudal peduncle and lateral line regions in a pond reared specimen of 22 millimeters total length. Imbrication was about 70 percent complete in a 26-millimeter individual. Only the dorsal portion of the head and the ventral area between the pectoral and pelvic fins lacked scales. A specimen of 36 millimeters length was fully imbricated. From these limited data, a total length of 30 millimeters was estimated as the length at which scale development is completed in river redhorse. This value was utilized as the correction factor for age-growth calculations.

Annulus Formation and Interpretation

River redhorse from the Cahaba River evidenced a spring-summer annulus formation. The observed formation interval of May to July was a month earlier than that noted by Meyer (1962) for *Moxostoma* of the Des Moines River, Iowa. This somewhat unusual time of checking apparently results in a false annulus (Figure 2) during the first summer of life since spawning occurs from 1 to 4 months earlier. Interpretation of this check was an annulus resulting in calculated lengths of approximately 75 millimeters (3 inches) to 175 millimeters (7 inches) for age group I. However, pond-reared specimens of known age far surpassed this rate of growth as did wild individuals in the first year of life (Hackney, *et al.*; 1968). In the pond-reared specimens, this false annulus was present although not as pronounced.

A double check (Figure 2) of close interval was noted on many scales. This accessory check first appeared after annulus II. It became obscure in older age groups due to decreased annulus interval. Calculations of the first instance of double checking resulted in lengths agreeing closely with the observed minimum sizes of sexual maturity. The first of these double checks is thought to be a spawning and/or migration mark, the second or true annulus being formed one to four months later.

Population Composition

Scale samples from 183 river redhorse were utilized in the aging portion of this study. Age groups I, II, III, IV, and V were represented. Only 1.5% of the fish were in the I+ year class at time of capture. Age groups II+, III+, and IV+ were well represented with 45.8%, 37.4%, and 14.5%, respectively. Attempts to capture young-of-year (0) and yearling (I) river redhorse have been very unsuccessful (Hackney *et al.*, 1968). These younger fish were clearly absent in the riffle habitat, where adults were effectively collected with the shocker. Since samples omitted these younger fish, bias of the II+, III+, and IV+ groupings is obvious.

Both sexes became sexually mature at three years of age. The smallest mature specimens were a male and female of 424 and 411 millimeters (16.7 and 16.2 inches) total length, respectively.

Growth

Females were smaller than males in every age group (Table 1). Aging of scale samples from 12 river redhorse collected during April, 1966, from the Duck River, Tennessee,[3] revealed that males were larger than the females in age group I; equal in size in age group II; but smaller than the females in age groups III and greater. A growth relationship similar to that of the Duck River specimens has been observed for silver redhorse, *Moxostoma anisurum*, in the Flint River, Alabama.

The maximum age recorded for river redhorse in the Cahaba River

[3] Scales supplied by John M. Stubbs, Tennessee Game and Fish Commission, Nashville, Tennessee.

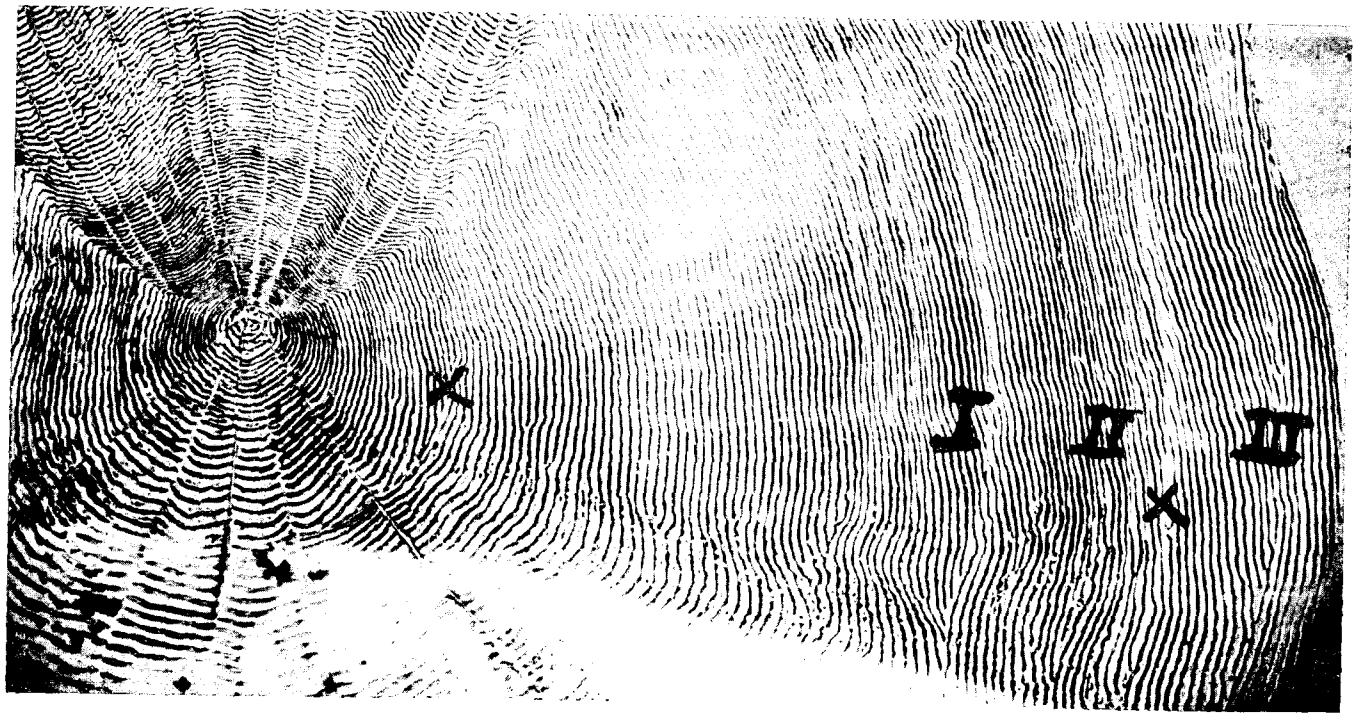

Figure 2. Scale of a III+ age group river redhorse collected in August from Cahaba River, Alabama. The "X" indicates a false annulus near the focus and after annulus II.

was V+. Only one female was of this age and evidently few river redhorse live as long as five years. In contrast, females from the Duck River, Tennessee, commonly reached the ages of VI and VII with one individual attaining the age of VIII.

TABLE 1. Calculated size in millimeters of river redhorse collected from the Cahaba River, Alabama, July, 1966, to July, 1968

Sex	No. Fish	Year Class I	II	III	IV	V
Male	79					
mean		282	408	491	541	
range		150–407	329–486	428–558	456–586	
Female	69					
mean		274	396	488	516	553
range		183–458	281–514	390–597	435–572	
All Fish	183					
mean		279	402	488	529	
range		150–458	281–514	390–597	435–586	

TABLE 2. Average calculated length in millimeters of river redhorse collected from the Cahaba and Duck Rivers

Location	No. Fish	Age group I	II	III	IV	V	VI	VII	VIII
Cahaba R., Alabama	183	279	402	488	528	553			
Duck R., Tenn.	12	188	312	409	475	559	604	650	701

Specimens from the Cahaba River grew faster than those from the Duck River during the first four years (Table 2). Cahaba River fish were 90 millimeters (3.54 inches) longer than Duck River specimens at age groups I and II, 80 millimeters (3.15 inches) longer at age group III, and 50 millimeters (1.97 inches) longer at age IV. At age group V the Duck River fish were slightly longer (6 millimeters) than the one specimen from the Cahaba. Apparently river redhorse in Tennessee grew to larger sizes as a result of the longer life spans.

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OBSERVATIONS ON EARLY DEVELOPMENT OF WHITE BASS, ROCCUS CHRYSOPS (Rafinesque)

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INTRODUCTION

Very little published information is available regarding the development of white bass with the exception of those described from Lake Texoma (Taber, 1969). This study describes certain developmental stages of white bass by culturing the eggs obtained from ripe adults.

MATERIALS AND METHODS

On April 2, 1969, about 17 ripe white bass were obtained by electroshocking from Brush Creek of Beaver Reservoir. At the time of collection, the water temperature was 55 F (air 62 F). The water was clear with the gravel bottom visible up to 8 feet. A pair of ripe fish were stripped in the field and the fertilized eggs were brought to the laboratory and reared at 62 F. Developmental stages were outlined by camera lucida. Due to fungal attack after 24 hours, most of the eggs and larvae perished. All the larvae perished by 150 hours.

OBSERVATIONS

Soon after fertilization, eggs became invested with sticky white gelatenous mass, and firmly adhered to solid surfaces. The unfertilized eggs turned opaque after 30 minutes.

Rate of development slowed down in eggs kept at 55 F and none of them progressed up to hatching stage even after 72 hours, while those kept at 68 F had approached gastrulation within 6 hours and died. The optimum temperature for development appeared to be 60 - 62 F. Large scale mortalities were observed in the first hour, at about 24 hours after fertilization and at hatching. Heavy fungal infestation was noticed.