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Age and Growth of the Silver Perch (Bairdiella chrysura)

Scott F. Rhodes
College of William and Mary - Virginia Institute of Marine Science

AGE AND GROWTH OF THE SILVER PERCH

(BAIRDIELLA CHRYSURA)

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APPROVAL SHEET

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Scott F. Rhodes

Approved, August 1971

Jackson Davis, Ph.D.

Mark Chittenden, Jr.

Mark Chittenden, Ph.D.

Joseph Loesch

Joseph Loesch, Ph.D.

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ABSTRACT

The scale method for determining ages of silver perch was validated. Ages were determined from a sample of 341 silver perch obtained from June through October, 1970, in lower Chesapeake Bay and its tributaries. Only age groups 0, I, II, and III were found. Mean calculated lengths at time of formation of annuli for males were 127 mm, 156 mm, and 190 mm for ages I, II, and III respectively. Females grew slightly faster, calculated lengths being 132 mm, 164 mm, and 189 mm.

The scale radius-body length relationship was linear. No significant difference existed between sexes, so the data were pooled and yielded the following regression equation: $Y = 26.9 + 0.4X$, $r = 0.9$. The weight-total length regression equation for silver perch was $\text{Log } W = -5.0 + 3.1 \text{ Log } L$. Again no difference existed between sexes and the data were pooled.

INTRODUCTION

The silver perch (*Bairdiella chrysura* Lacepede) normally ranges from New York to Texas (Hildebrand and Schroeder, 1928) and strays north to Connecticut (Merriman, 1947). This sciaenid occurs in Chesapeake Bay and its tributaries from May through November and spawns during May and June (Hildebrand and Schroeder, 1928). Aspects of the life history and development of the silver perch were recorded by Kuntz (1913), Welsh and Breder (1924), and Hildebrand and Cable (1930).

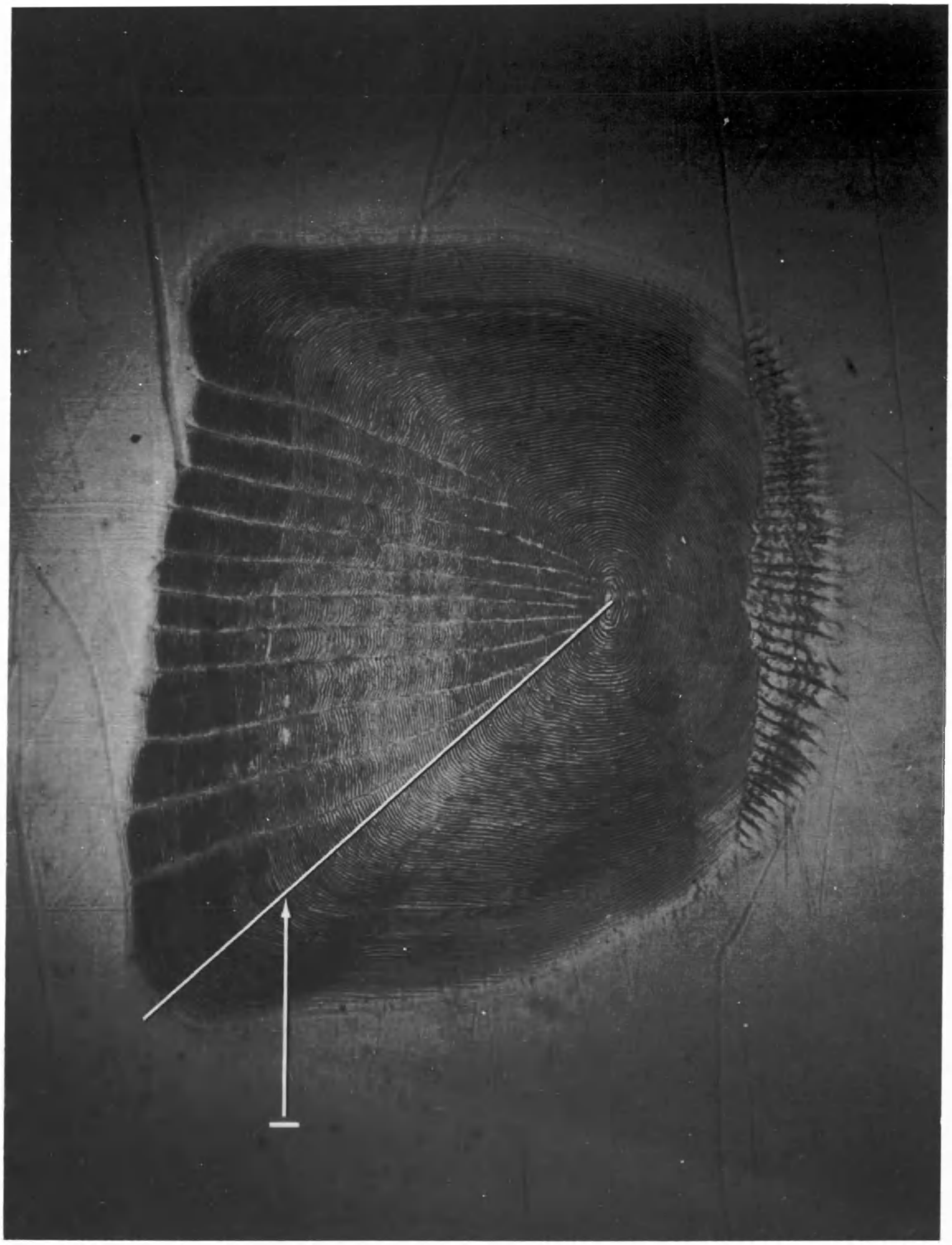
The purposes of this study were to validate scale markings as indicators of age and growth characteristics of silver perch in Chesapeake Bay and its tributaries and to determine relationships of body length to weight and of scale radius to body length. Age-growth data is necessary to understand the life history of fishes, but the age-growth information presented by Welsh and Breder (1924) and Hildebrand and Cable (1930) was not validated.

MATERIALS AND METHODS

Most specimens were caught with an unlined 30-ft semi-balloon otter trawl (1.25 inch cod end mesh), but some young were taken in a 50-ft beach seine (.25 inch mesh). Most fish were collected from the James, York, and Rappahannock rivers; a few were taken from the Chesapeake Bay, the Ware River, and the Piankatank River. The sampling period was from June through October, 1970.

Scales were taken from the midline of the body just posterior to the insertion of the pectoral fin. Five unregenerated scales of uniform size and shape were mounted on cellulose acetate sheets, and impressions were made by pressing the mounted scales at 22,000 psi for two minutes on a Carver Laboratory Press at 80 C. Scales were measured along a line from the focus to the dorsal anterior shoulder (Figure 1), and ages were determined on an Eberbach scale projector at 80X.

Figure 1. Scale of one-year-old silver perch showing line of measurement and annulus (I).



VALIDATION OF THE ANNULUS

Van Oosten (1929) and Hile (1941) proposed criteria for annulus validation. One annulus should be formed each year. Scale growth should be proportional to increase in fish length. Average observed length for each age group should be between the calculated length for its present age and the calculated length for the next oldest age group. Mean calculated lengths of age groups should coincide with modes in the length-frequency distribution.

Silver perch scales are slightly asymmetric, the distance from the focus to the dorsal anterior shoulder being longer than the distance to the other shoulder. Annuli are characterized by crowding of circuli in the anterior portion of the scale, and by cutting over at the shoulders and in the lateral fields. The annuli are most evident at the shoulders and in the lateral fields (Figures 1, 2, and 3).

The exact time of annulus formation could not be determined. Scale measurements from one and two-year-old fish caught in June and July showed that the distance between the scale margin and the most recent annulus was a minimum in June (40 mm for I's and 31 mm for II's), and increased by July (68 mm for I's and 39 mm for II's). The distance increased to 96 mm for age I fish in August. No measurements were taken from age II fish in August because so few were caught. Examination of age 0 fish (120 to 130 mm) taken in September showed that no annulus had been formed. This suggests that only one ring is formed each year.

Figure 2. Scale of two-year-old silver perch. Roman numerals indicate annuli.

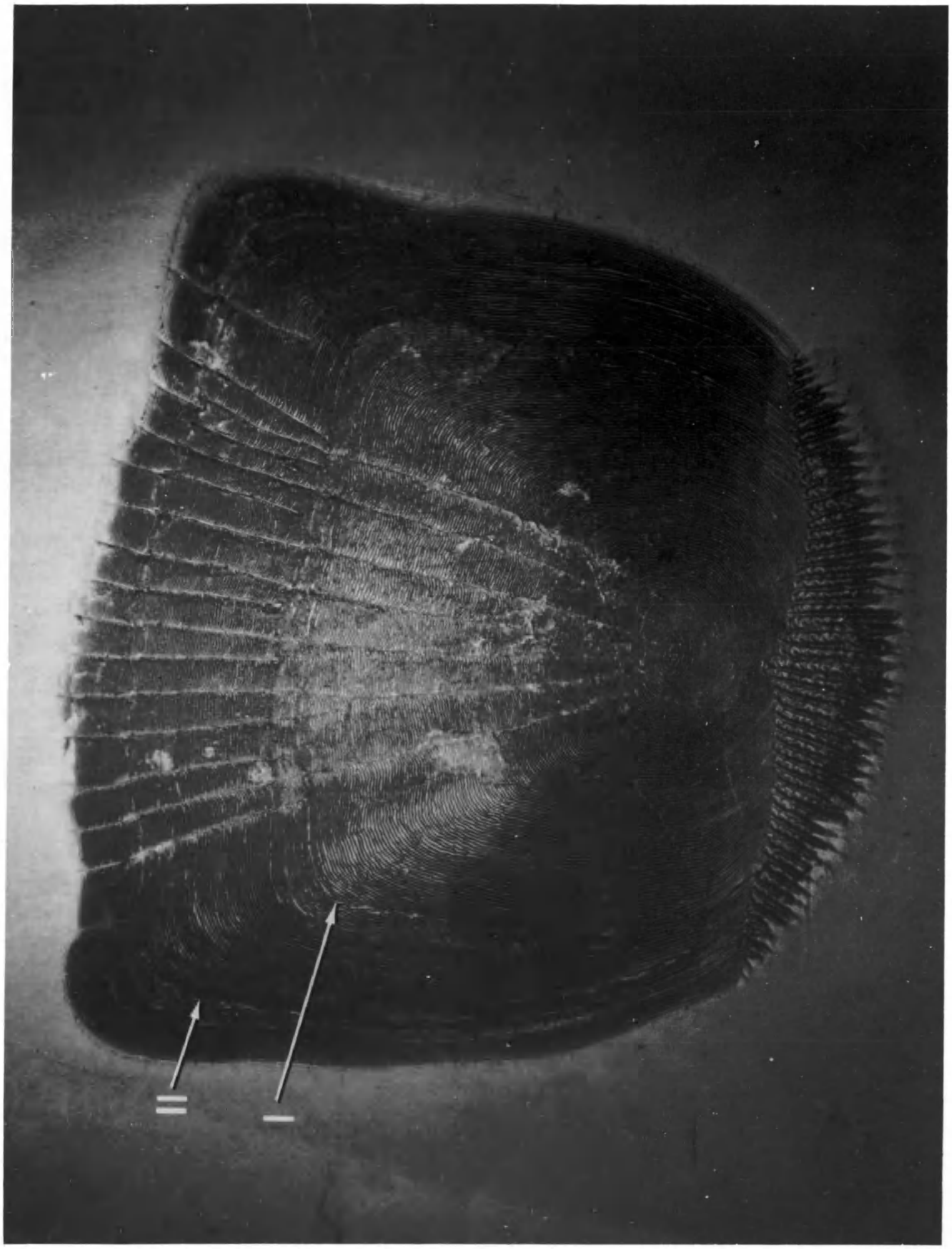
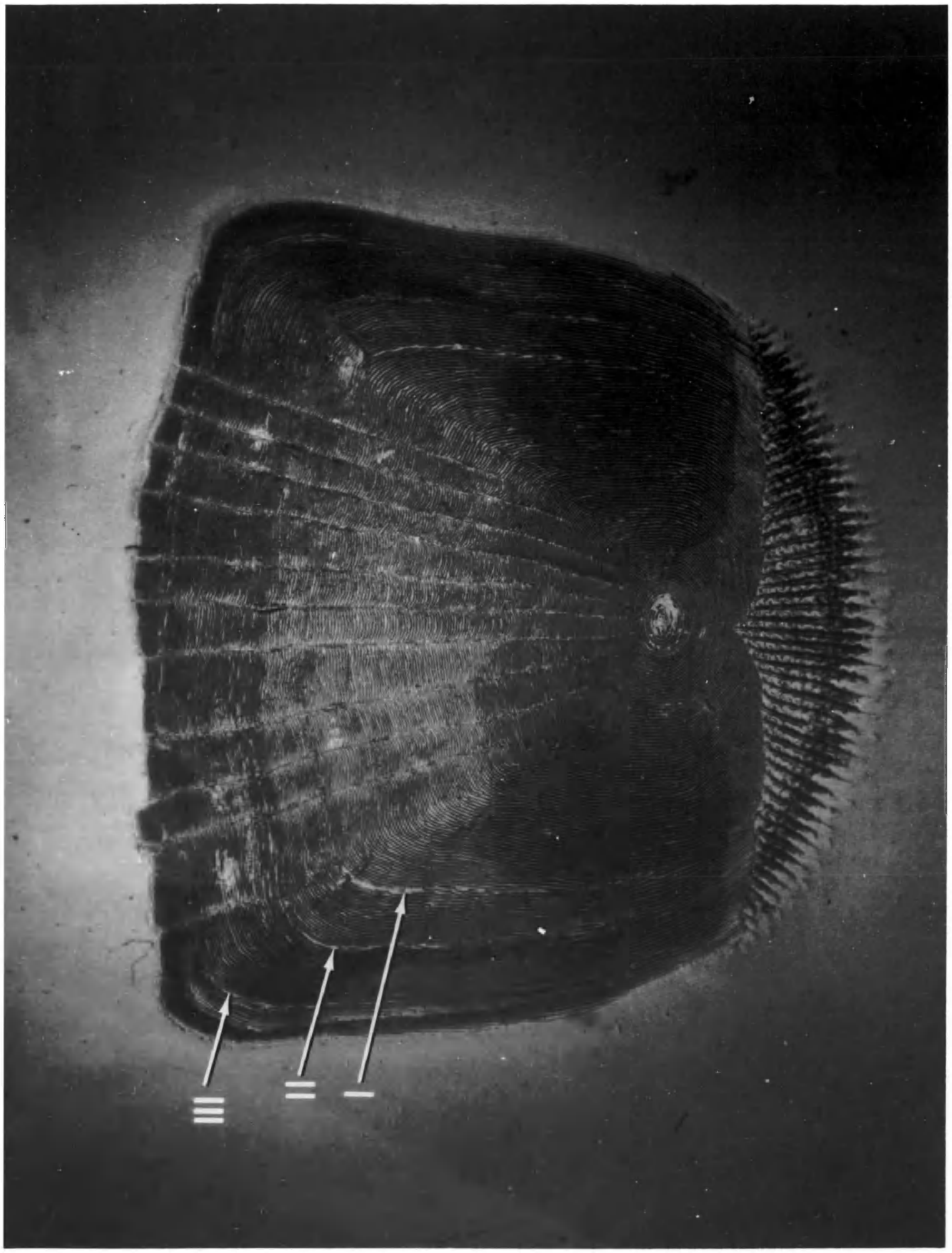


Figure 3. Scale of three-year-old silver perch. Roman numerals indicate annuli.


III
II
I

Plots of raw data showed a linear relationship between body length and scale radius (Figure 4). An analysis of covariance found no significant difference between sexes, so the data for 481 fish were combined. The regression equation was $Y = 26.9 + 0.4X$ where Y is total body length and X is the scale radius in mm at 80X. The correlation coefficient ($r = .9$) was significant, indicating that scale growth is proportional to increase in fish length.

Lengths at annulus formation were back calculated using the formula, $L_n = C + (S_n/S)(L-C)$, where L_n is fish length when annulus 'n' was formed; L is fish length at capture; S_n is the radius of annulus 'n'; and S is the total scale radius. C is the approximate length of the fish when scales form as determined from the regression of body length on scale radius. A linear analysis of covariance showed that observed lengths of males and females at each age were significantly different. This test was used because the relationship between age and length was linear for the three age groups in this study. Mean back calculated and observed lengths for each sex are given in Table 1.

The mean observed lengths for the age groups fall between the appropriate calculated lengths previously mentioned (Table 1). The modes of the length-frequency distribution reasonably coincide with the mean calculated lengths (Figure 5). The modes indicate smaller fish than do mean calculated lengths because fish were obtained throughout the growing season. Calculated lengths are lengths at the end of the growing season.

From the above evidence it appears that the scale method is valid for determining the age of silver perch.

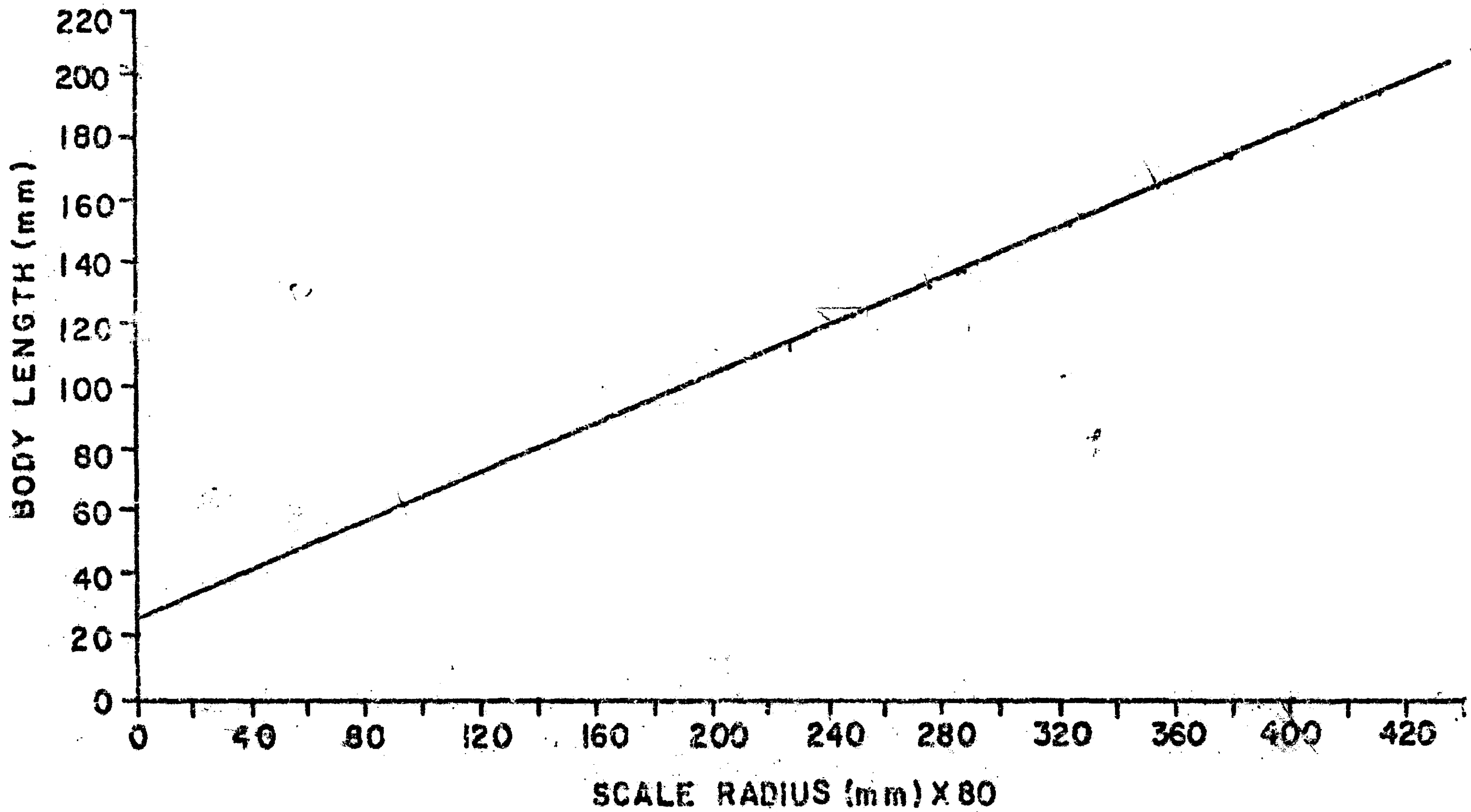


Figure 4. Scale Radius-body length relationship for silver perch.

TABLE 1

Observed and calculated total lengths (TL) in millimeters of male (M) and female (F) silver perch.

Age group	Number		Mean TL at capture		Mean calculated TL at end of year of life: 1		2		3	
	M	F	M	F	M	F	M	F	M	F
I	118	189	147	156	127	132	—	—	—	—
II	9	19	165	179	115	123	156	164	—	—
III	1	5	190	199	113	124	166	171	190	189
Weighted mean TL					126	131	157	165	190	189
Growth increment					126	131	31	.44	33	24
Standard error					1.19	1.16	5.64	4.60	—	3.17

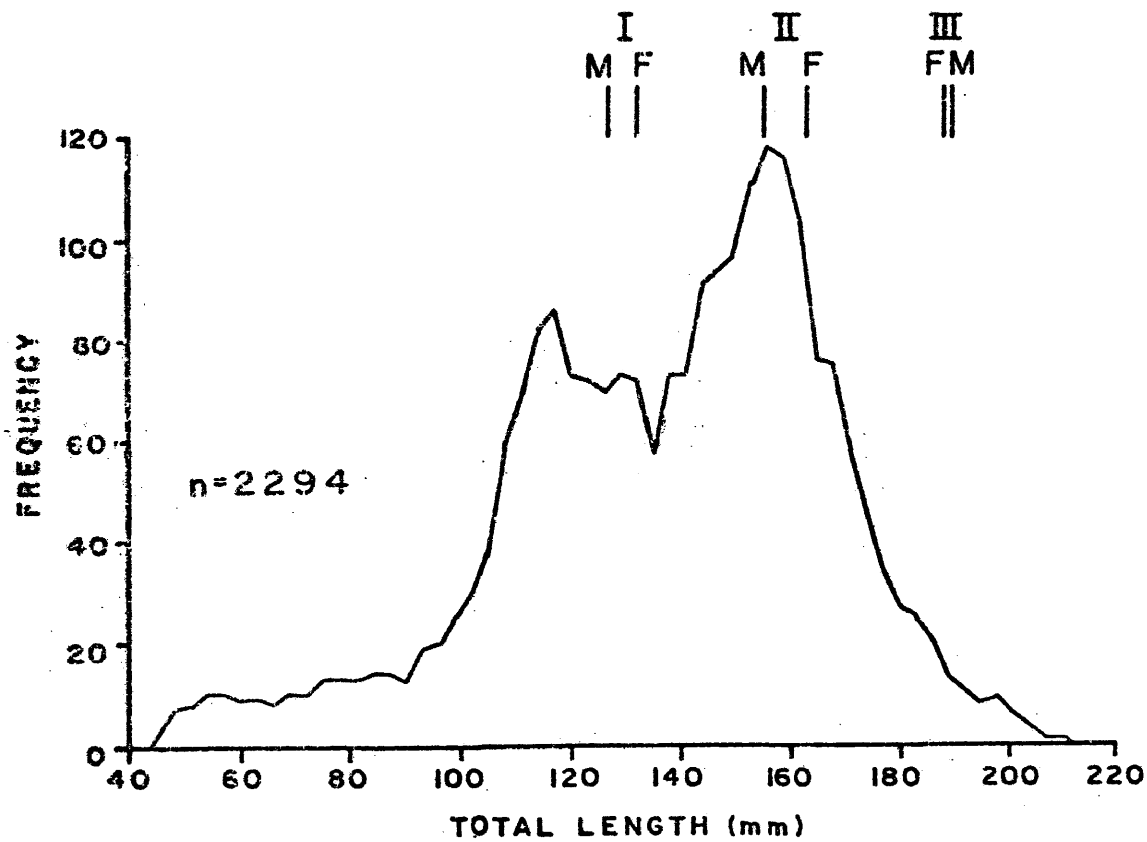


Figure 5. Frequency distribution of observed lengths of all fish examined (smoothed by moving averages of 3). Vertical lines indicate mean calculated lengths for various age groups for each sex.

GROWTH CHARACTERISTICS

During the first year both sexes attain more than 60% of their length at age III. Rate of growth in length decreases considerably after the first year, but rate of growth in weight increases (Figure 6). Monthly length histograms are presented in Figure 7. The first peak on the length histogram for October indicates that young-of-the-year grow to a length approximately equal to the mean calculated length for age I fish by early fall (Table 1).

Only age groups O and I are easily distinguishable (Figure 7). Fish 140 to 150 mm total length were dominant in June. The mean observed length of 124 age I fish in June was 144 mm. No distinct mode represents age II fish in June. The mean length of six age II fish in June was 160 mm.

Young-of-the-year 44 to 94 mm long appeared in July. The peak for age I increased to 155 to 160 mm, the average length of 162 fish being 154 mm. The 21 age II fish obtained in July had a mean length of 177 mm. There is a slight peak on the graph at 183 mm, which may represent age II fish.

The few fish taken in August illustrate continued growth of young-of-the-year. The peak representing age group I increased to 162 to 168 mm. Modes for other age groups are indistinguishable on the histogram as in July.

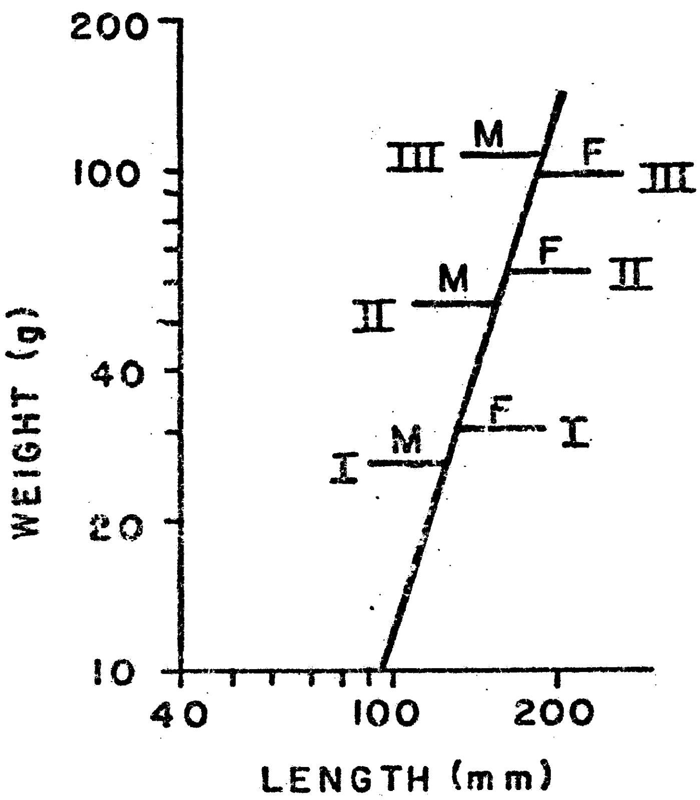


Figure 6. Length-weight relationship for silver perch. Horizontal lines indicate lengths and weights at various ages.

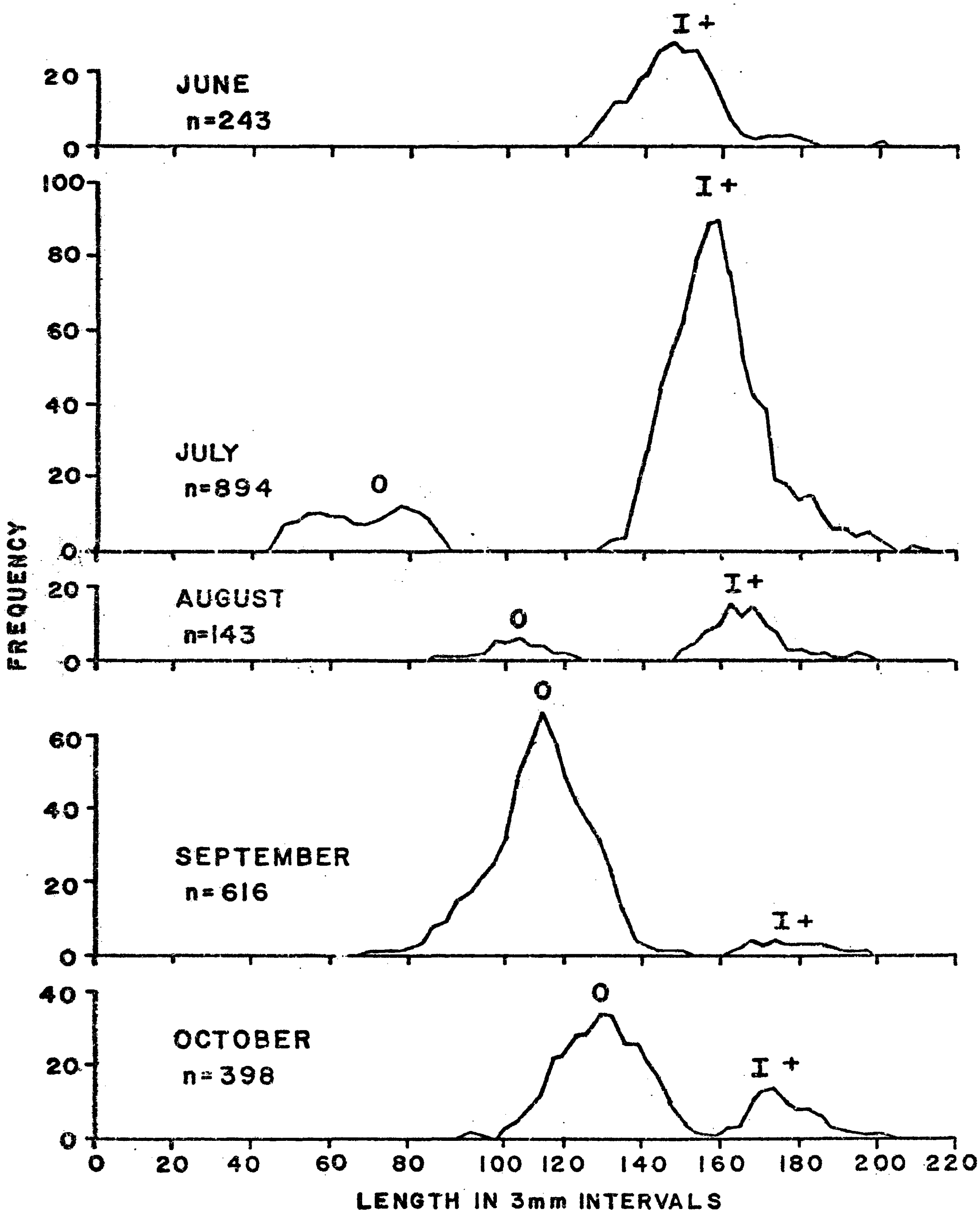


Figure 7. Monthly length histograms for silver perch (smoothed by moving averages of 3).

The 0 age group was dominant in September and October. More older fish were taken in October than in September.

Many more age II fish are suggested by Figure 5 than appear in Table 1. This occurs because the mode in Figure 5 actually consists of fish with one annulus which have grown to their two-year-old length. Similarly, the mode for age I represents age 0 fish which have grown to their one-year-old length.

LENGTH-WEIGHT RELATIONSHIP

Plots of the logs of raw data indicated that the regression of total weight on total length was linear. An analysis of covariance showed no significant difference between sexes, so data from 617 fish were pooled. The regression equation was Log W = -5.0 + 3.1 Log L where W is weight and L is total length. The correlation coefficient was significant (r = .9) (Figure 6).

DISCUSSION

Only four age groups were found in this study. By contrast, Welsh and Breder (1924) examined a six-year-old fish. These authors gave no indication of the number of fish older than age II they examined. Why older fish were not found is unclear, but there are three possible explanations if sampling techniques were adequate: 1) Fish of ages IV, V, and VI may not come into Chesapeake Bay, but remain offshore during the summer. 2) They may leave before June if they come into the Bay in the spring. This seems unlikely since examination of Virginia Institute of Marine Science's trawl data for previous years showed no indications of larger fish being caught before June. 3) Bairdiella chrysura may be a short lived species with a high mortality, so that few fish reach ages IV, V, and VI.

Another unanswered question is why the September and October catches were dominated by age 0 fish and showed a decrease in older fish. Age 0 fish increased probably because more of them migrated to the main stream, where most of the trawling was done, as they grew larger. Another explanation is that perhaps more were retained by the trawl because of their larger size. Older fish may have begun leaving the estuaries by September, causing the decrease in their number.

Yearly growth increments from this study agree with lengths given by Welsh and Breder (1924) who found that silver perch are

60 to 140 mm by the first winter and 120 to 200 mm by the second winter. Hildebrand and Cable (1930) give mean lengths of 31.9 mm in July and 81 mm in September for young-of-the-year silver perch. These lengths are consistently smaller than the data given in Figure 7.

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