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# Maturation and Fecundity of Redear Sunfish

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## ABSTRACT

Based on gonosomatic indices and ovum diameter frequency distributions, the redear sunfish spawns from May through July. Fast growing 2-year-old (above 150 mm) and older fish attain sexual maturity. Mature ovum diameter ranged from 0.60 to 1.30 mm. Fecundity - total length, - total weight, and - age relationships were:  $\ln F = 5.95242 + 0.01967L$  ( $r^2 = 0.90$ ),  $\ln F = 8.80328 + 0.00594W$  ( $r^2 = 0.92$ ), and  $\ln F = 8.19332 + 0.50231A$  ( $r^2 = 0.83$ ), respectively.

The redear sunfish, *Lepomis microlophus*, is most common in large warm rivers, bayous, and lakes (Emig, 1966). The fish can reach maturity in the first year of life in Texas (Brown, 1951) and Florida (Dineen, 1968) but generally matures at 2 years of age (Schoffman, 1939; Cole, 1951; Gerking, 1952; Lopinot, 1961).

Although the redear sunfish is an important sport fish, published information regarding fecundity is meager. Lawrence (1957) reported that females had 5,000 eggs and according to Lopinot (1961) the redear ovaries contained 2,000 - 10,000 ova. In Florida, fecundity varied from 13,000 to 30,000 (Wilbur, 1969). Meyer (1970) collected six eggs ranging from 1.3 to 1.6 mm in diameter from Folsom Lake, California.

This paper deals with spawning frequency and maturation based on the ovum diameters. Mathematical relationships between fecundity and total length, total weight, and age of the redear sunfish are determined.

## MATERIALS AND METHODS

Monthly collections of redear sunfish from November, 1971 to October, 1974 were obtained from the 24 ha Crystal Lake, Benton County, Arkansas, by gill nets and a boat-mounted 240-volt AC electroshocker. The fish were brought on ice to the laboratory, and data on total length (mm), total weight (g), and sex were recorded for each fish. Age determinations were made by the number of annuli on the scales taken from the left side of the body at the tip of the appressed pectoral fin.

The ovaries, preserved in 10% formalin, were washed and trimmed of excess tissue. After blotting and air drying for 15 minutes, the ovaries were weighed to the nearest 0.001 g. The diameters of 200 ova from a 20% sample from the midsection of one of the ovaries were measured to the nearest 0.05 mm, and all the mature ova in the sample were counted. Fecundity, the total number of mature ova present in both the ovaries prior to spawning, was estimated as:

$$\text{Fecundity} = \frac{\text{No. of mature ova in sample} \times \text{weight of both ovaries}}{\text{weight of sample}}$$

## RESULTS AND DISCUSSION

### Spawning time and age at maturity

Gross morphology of the ovaries and the gonosomatic indices (percentage of ovary weight to fish weight) were used in determining the time of spawning and age of maturity. In late April and May the ovaries increased in size over the previous months occupying almost the entire body cavity. Three-year-old and older female redear with distended abdomens were collected in early May and the ova could be easily stripped by late May. Whitish ovary color of early April changed to a yellow-orange by late May.

The monthly gonosomatic values were low from August through February, gradually increasing to a peak in late May, denoting full maturation (Fig. 1). The indices decreased during June and July. During May - July, Crystal Lake water temperature ranged from 19 to 25°C with 19-21°C in mid May when gonosomatic indices were highest. In Alabama (Swingle, 1949), Illinois (Lopinot, 1961) and Michigan (Clugston, 1966) waters, the temperatures at redear spawning were 24, 20-21, and 21°C, respectively. These temperatures correlated with the Crystal Lake temperatures during the spawning period.

One-year-old females showed no increase in the gonosomatic indices during the summer; however, the maximum value occurred in October. Since no larval fish were either observed or collected during October, it is reasonable to assume that the gonadal development of this age group was not related to spawning at this time of the year. Olmsted (1974) reported similar observations with largemouth bass from Lake Fort Smith, Arkansas.

Only 50 percent of 2-year-old females were mature. The immature fish ranged from 100 to 164 mm, and the mature fish size ranged from 151-213 mm. All 3-year-old and older females were mature, and the smallest mature 3-year-old fish was 166 mm. Attainment of sexual maturity in redear may be a function of length rather than of age (Wilbur, 1969). Dineen (1968) reported that in South Florida redear spawned initially at eight months and at a length of 138 mm. According to Gerking (1952) the mature 2-year-old redear in Lake Gordy, Indiana, averaged 138 mm. Due to these correlations of length with sexual maturity, we concluded that in Crystal Lake, fast growing 2-year-old (>150 mm) and older redear attain sexual maturity.

### Ova development and spawning periodicity

Ovum diameter studies are useful in assessing spawning time and frequency of spawning (Clark, 1934; Prabhu, 1956). Comparison of ovum diameter distributions between the anterior, middle and posterior sections within the ovaries of three 3-year-old (184, 187, and 203 mm) redear by the Kolmogorov-Smirnov test (Sokal and Rohlf, 1969) indicated random distribution of ova. Therefore ovum diameter measurements and counts were made from a cross section from the midregion of one of the ovaries.

Ovum diameter frequency distributions (Clark, 1934) for mature redear of ages two through six showed similar annual patterns. Therefore, 3- and 5-year-old fish were selected to present the monthly progression of ovum frequency distributions (Fig. 2). From September through February the ova were less than 0.30 mm in diameter and were platelet in form with transparent cytoplasm. Ova matured from March to May.

A spawn occurs in late May as evidenced by the lack of ova in the last mode (0.95-1.30 mm). By the middle of June the ova size increased, and the ova (0.85-1.25 mm) were extruded by the end of June. The July ovaries are the last evidence of spawning for the season, and the residual ova in the August ovaries indicate that the ova above 0.60 mm were extruded during spawning activities. Appearance and disappearance of the ova in the last mode from May through July indicate multiple spawning by the redear sunfish during the spawning season (May-July). The maximum gonosomatic index in

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May (Fig. 1) coincided with the presence of the full complement of maturing to mature ova (0.60-1.30 mm) in the ovaries. The gradual decrease of the indices for June and July is due to spawning of the ova as they attain larger size.

Based on the ovum diameter distributions, the redear exhibit multiple spawning. In Florida spawning may start in late February and continue until October (Clugston, 1966). Redear sunfish in Alabama spawn in spring and again in the fall, but sparingly in summer (Swingle, 1949; Swingle and Smith, 1950). In Tennessee (Schoffman, 1939) and Illinois (Lopinot, 1961) the redear spawn from May to September and during May-June, respectively.

**Fecundity**

Since the ova of the size range 0.60-1.30 mm were extruded during the spawning season, fecundity was estimated as the total number of ova ( $\geq 0.60$  mm) present in both the ovaries prior to spawning. The 15 fish collected in May were used in fecundity estimates as these fish contained the full complement of the mature ova.

The total length, weight, and age of redear were exponentially related to the fecundity estimates. The fecundity - total length relationship (Fig. 3) was  $\ln F = 5.95242 + 0.01967L$  with the correlation

coefficient and standard error of estimate of 0.95 and 0.18775, respectively.

The fecundity - total weight relationship (Fig. 4) was  $\ln F = 8.80328 + 0.00594W$  with 0.96 and 0.16272 as correlation coefficient and standard error of estimate.

Of the 15 redear used in this study, there was one fish each in age groups II, and VI, two in age group V, and the remainder were 3-year-olds. The fecundity-age relationship (Fig. 5) was expressed as  $\ln F = 8.19332 + 0.50231A$ . The correlation coefficient and the standard error of estimate were 0.91 and 0.25239, respectively.

Wilbur (1969) gave fecundity data for the Florida redear, but he gave standard length measurements. These lengths were converted to total lengths using the total length - standard length relationship for bluegill (Carlander, 1977). The total length - fecundity relationship was calculated as:  $\ln F = 8.01624 + 0.00773L$ . Covariance analysis showed significant difference between the Crystal Lake redear and Florida redear ( $F_{2,24} = 55.73$ ). For a given size range of 200 - 260 mm, that were common in our and Wilbur's collections, the Crystal Lake redear sunfish were more fecund than the Florida fish. Redear of 230 and 260 mm in total length from Crystal Lake produce 35,500 and 64,000 mature ova compared to 17,900 and 22,600 ova by the Florida redear.

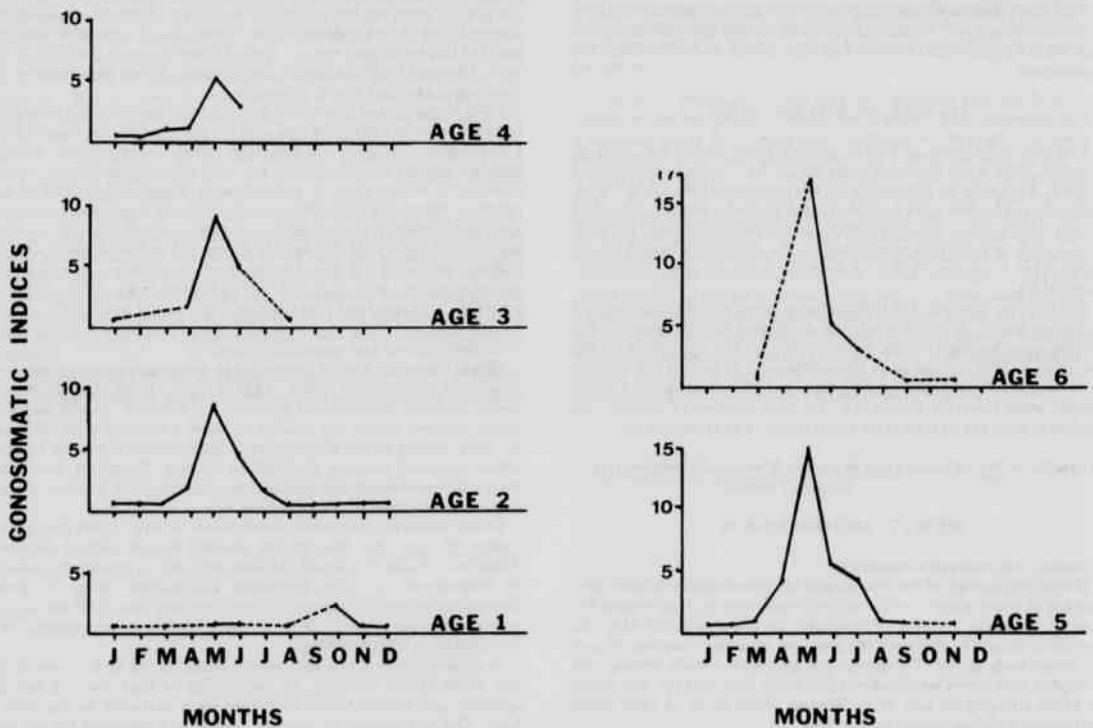


Figure 1. Gonosomatic indices for female redear sunfish of ages one through six.

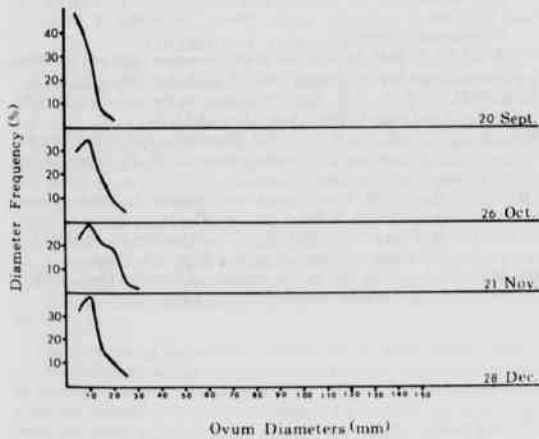
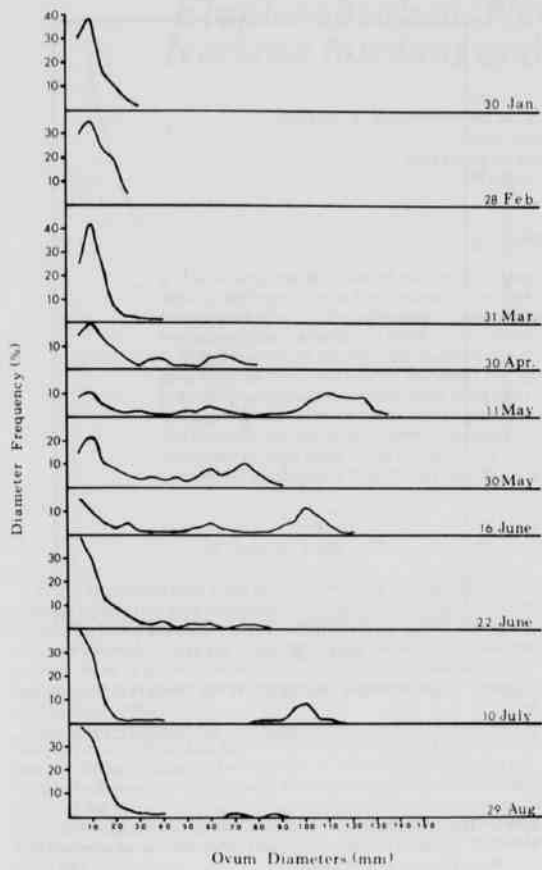


Figure 2. Monthly frequency distributions of ova diameter measurements of three and five year old redear sunfish.

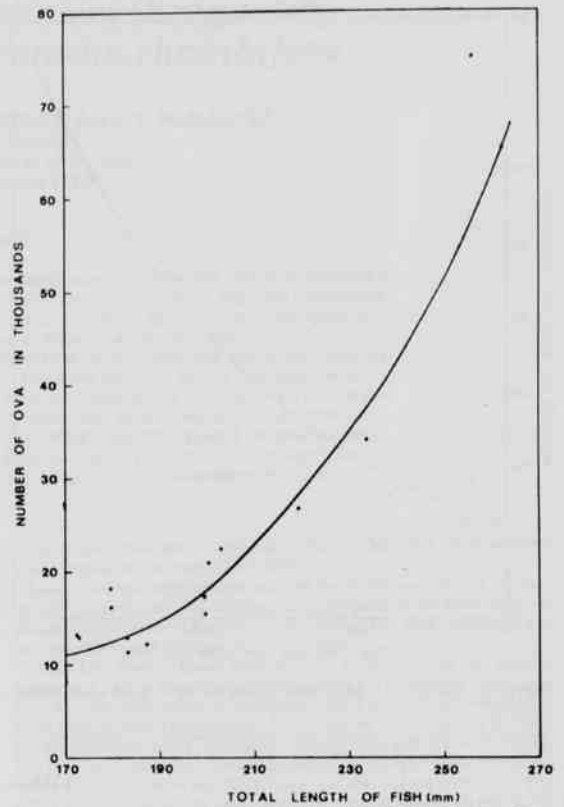


Figure 3. Length-fecundity relationship of the Crystal Lake redear sunfish.

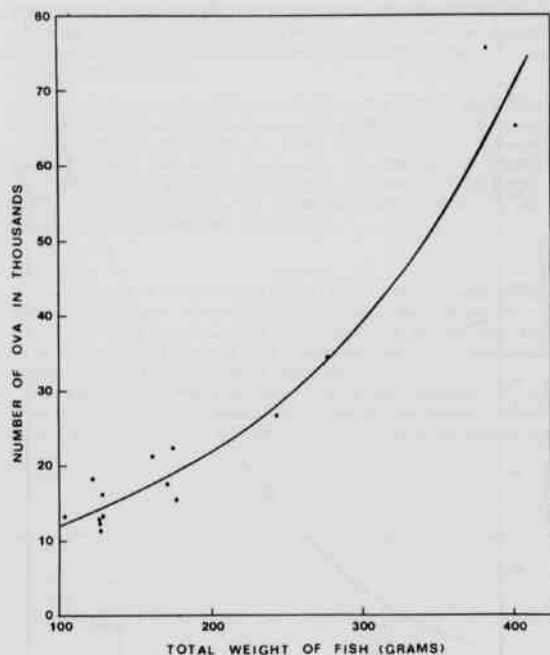


Figure 4. Weight-fecundity relationship of the Crystal Lake redear sunfish.

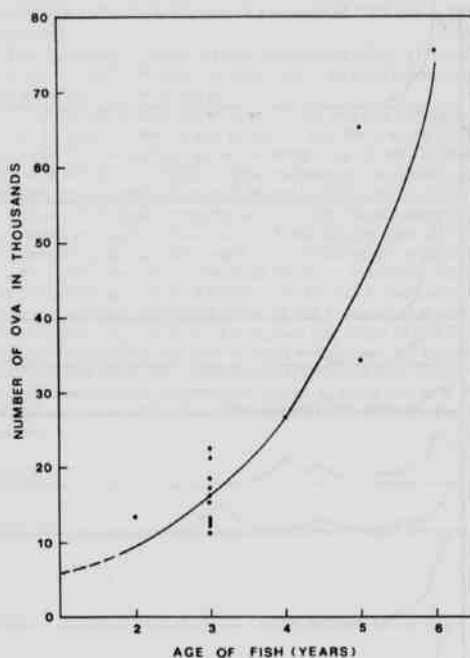


Figure 5. Age-fecundity relationship of the Crystal Lake redear sunfish.

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