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# Age and growth determination in *Sarotherodon galilaeus* by use of scales and opercular bones (Pisces: Cichlidae)

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**Resumen:** Las marcas de crecimiento en escamas y huesos operculares del pez cíclido *Sarotherodon galilaeus* se usaron para determinar su crecimiento y edad en un embalse de Ibadan, Nigeria. Se examinó 880 especímenes (nov. 1985- oct. 1987) con edades de 0+ a 7+ años. A la edad 1+ la longitud estándar media fue de 122 mm (293 mm en edad 7+). La alta tasa de crecimiento disminuyó luego del primer año y no dependió del sexo. Hubo correlaciones lineales significativas entre los conteos de escamas y huesos operculares, y la longitud total.

**Key words:** Age, growth, opercular bone, scales, *Sarotherodon galilaeus*.

*Sarotherodon galilaeus* (Linnaeus) is one of the dominant, endemic and comercially exploited cichlids of nigerian inland water bodies. Some aspects of the biology of this species have been published (Hickling 1962, Fryer and Iles 1972, Fagade 1982). There is paucity of knowledge on its life span and growth in Nigeria.

Age and growth studies of tropical fish species are at their infancy when compared with the extensive studies done in the temperate regions.

This is attributable to the assumption that growth marks on scales, spines, otoliths, opercular bones and vertebrae will not develop in the absence of drastic seasonal changes, a normal condition in the tropics.

In spite of the difficulties encoutered in estimating the age of tropical fishes, some degree of success has been achieved. Opercular bones have been used in age determination (Fagade 1974, Tweddle 1975, Blake and Blake 1978). Fagade (1980a, b) used otoliths to determine age and growth in *Chrysichthys nigrodigitatus* (Lapecede) and *Tilapia guineensis* (Dumeril). Spines were used to age *Clarias ganepinus* (Burchell) and *Chrysichthys nigrodigitatus* (Lacepede) (Vanderwaal and Schnoobee 1975, Ezenwa and Ikusemiju 1981).

Fagade (1983) used scales to determine age in *Chromidotilapia guntheri*.

This study on *Sarotherodon galilaeus*, shows that the age of a tropical species can be determined by growth marks, and that scales and opercular bones are useful in determining the age of this particular fish.

A total of 880 specimens on *S. galilaeus* were collected from a man-made lake at the International Institute of Tropical Agriculture (I.I.T.A.), Ibadan, Nigeria, from November 1985 to October 1987. The standard length, weigth and sex of the fish were recorded in the laboratory. Five scales were removed from the region between the pectoral and dorsal fins. The two opercular bones were carefully dissected out. Both the scales and opercular bones were cleaned and stored in dry envelopes.

Age determination was carried out by examination of scales and opercular bones under the binocular microscope and interpretation of growth checks observed on both scales and opercular bones. Age determination was carried out separately with each of the structures, often the number of growth rings on each of the two structures corresponded (Figs. 1 and 2). The radii of scale and opercular bones were measured using a micrometer eye piece. The relationship between scale radii and total length and between opercular bone radii and total body length were described by the equation $y = a + bx$.

where $y$= total scale and opercular bone radii

$x$= total length
$a$= intercept
$b$=slope

The formula proposed by Fraser (1916) and Lee (1920) as presented by Bagenal (1978) was used for the back-calculation of total length at annulus formation. The equation was given as follows:

$$L_n - a = \frac{S_n}{S}(L - a)$$

Where $L_n$= length of fish when annulus 'n' was formed

$S_n$= radius of annulus 'n' (at fish length $L_n$)

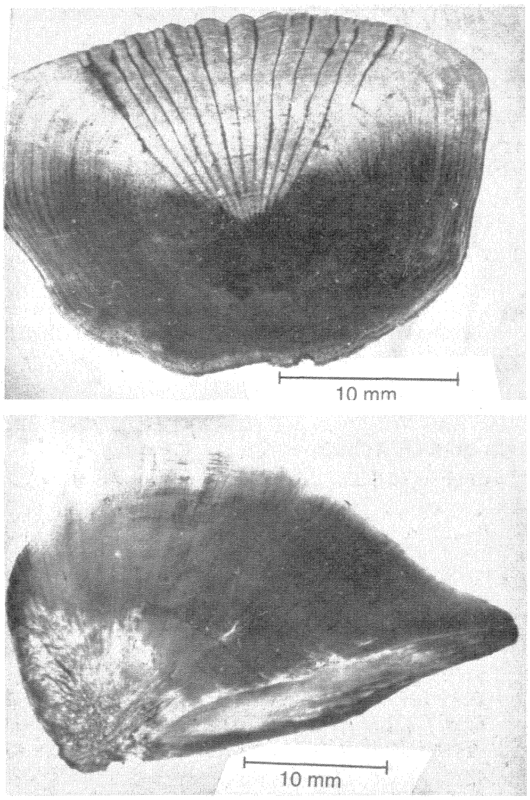
$L$= length of fish at the time scale/opercular bone samples were taken

$S$= total scale/opercular bone radii

$a$= value of intercept on Y- axis.

Growth checks ocurred at regular intervals on the scales and opercular bones. These growth checks were bands (Figs. 1 and 2).

From age determination, lengths and weigths at each age group were established. Population: 339 females and 398 males (Table 2). The females attained a mean standard length of 120 mm at age 1+ while it was 126 mm at the same age in the male. At age 3+ males reached 202 mm (193 mm in female).




**Figs. 1 & 2. Growth bands in *Sarotherodon galilaeus* from Nigeria. Scale 10 mm.**

Males were 258 mm at age 5+ (females 248 mm). Age 7+; males 298 mm, females 292 mm. Statistical F-ratios were not significant ($P > 0.05$).

The relationship between total body length and scale (Fig. 3) was described by the regression equation.

$Y = 0.812x - 0.0614$

The correlation coefficient ($r$) for the length-scale radii relationship was 0.9728 ($P = 0.001$, $n = 880$). The relationship between total body length and opercular bone radii (Fig. 3) was described by the equation

$Y = 1.748x - 0.836$

The correlation coefficient($r$) for length-opercular bone radii was 0.9860 ($P = 0.001$, $n = 880$). The results of back-calculated total lengths at annulus formation are presented in Table III.

The back- calculated average total length in the first year was 152 mm and 414 mm in the seventh year (Table 3).

TABLE No. 1

*Range, mean length (mm) and weight (g) of* Sarotherodon galilaeus *from a man-made lake in Ibadan, Nigeria*

| | | Standard length | | Weight | |
|---|---|---|---|---|---|
| Age (years) | Number of specimens | Range (mm) | Mean (mm) | Range (g) | Mean (g) |
| 0+ | 143 | 20-106 | 64 | 0.4- 72.3 | 38.7 |
| 1+ | 86 | 108-148 | 122 | 75.4- 208.0 | 126.6 |
| 2+ | 83 | 147-177 | 158 | 124 - 317 | 265.8 |
| 3+ | 78 | 180-210 | 195 | 227.2- 512.4 | 458.4 |
| 4+ | 124 | 206-245 | 230 | 384.6- 713.5 | 663.0 |
| 5+ | 167 | 240-280 | 256 | 683 -1,052.5 | 886 |
| 6+ | 155 | 268-310 | 277 | 853.2-1,428.4 | 1,062.7 |
| 7+ | 43 | 283-345 | 293 | 887.7-1,546.6 | 1,228.8 |

TABLE No. 2

Range, mean length (mm) of male and female *Sarotherodo galilaeus* from a man-made lake in Ibadan, Nigeria

| | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | | Standard length | | | Standard length | |
| Age (years) | Total No. | Range (mm) | Mean (mm) | Total No. | Range (mm) | Mean (mm) |
| 1+ | 42 | 110-148 | 126 | 44 | 108-140 | 120 |
| 2+ | 40 | 151-177 | 168 | 43 | 147-171 | 155 |
| 3+ | 44 | 180-210 | 202 | 35 | 180-206 | 193 |
| 4+ | 74 | 208-245 | 236 | 50 | 206-230 | 225 |
| 5+ | 93 | 243-280 | 258 | 74 | 240-253 | 248 |
| 6+ | 79 | 270-310 | 281 | 76 | 268-291 | 272 |
| 7+ | 26 | 286-345 | 298 | 17 | 283-331 | 292 |

The age of *S. galilaeus* was successfully determined using scales and opercular bones. The results showed that the fish population were between 0+ and 7+ years old. *S. galilaeus* had the highest growth rate in length during the first year of life, followed by a gradual decrease (Table 1). Sex did not significantly affect growth rate.

Although the tropics often lack drastic changes in climatic conditions, there were distinct changes in the lake. In the rainy season from April to September, the water level was high and visible changes in water transparency occurred. Rainfall resulted in materials being washed into the lake and this increased turbidity and reduced the amount of light penetrating the water (Achionye 1989). Consequently primary production was reduced and in turn zooplankton production decreased resulting in little or no food availability for this fish species. A similar observation was made at Asejire lake, Ibadan, where increased turbidity decreased phytoplankton production leading to ultimate reduction in fish food (Eborge 1978). Such changes in the environment seem to be reflected in the growth marks formed on the hard structures.

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