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The morphology of the scales of *Parachanna obscura* in River Owo, southwest Nigeria

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Abstract

A study was carried out to study the morphology of the scales of *Parachanna obscura* (African snakehead) from River Owo, South-West Nigeria. A total of 312 scales were found to be fit for analysis. Scales above and below the lateral lines of the species were removed, cleansed and observed under the microscope for growth rings. Interruptions of the regularly arranged circuli were interpreted as representing growth markings. Growth markings on these were interpreted as being laid once in a year during the rainy season, which coincided with the peak spawning period. Three year classes were identified as 0+, 1+ and 2+. Mean length at capture for the 0+, 1+ and 2+ were 15.8, 27.9 and 26.3cm respectively while mean total length at annulus formation for age 1+ is 27.45±8.1 and that of 2+ is 28.88±5.8cm at first annulus formation and 29.51±8.0cm at second annulus formation. It can be concluded that the life span of *P. obscura* in River Owo is not less than two years.

Keywords: Morphology, *Parachanna obscura*, Scale, River Owo

Introduction

The most frequently used method of age determination is the interpretation and counting of growth zones which appear on the hard parts of fish namely scales, spines, otolith, opercula and vertebrae. Bagenal and Tesch (1978) stated that the growth zones are considered to be formed annually and so they are called year marks, annual marks, annual rings or annuli while Daget (1952) found that the rings on scales and hard parts are not necessarily annual and may be associated with external factors such as dry season, changes in food supply, stock density and spawning. In tropical regions of the world, the determination of age in fish is often difficult (Fagade, 1974) but in the temperate regions, hard parts have been more easily used because of the marked differences between seasons. Bagenal and Tesch (1978) further observed that the period of little or no growth usually occurs between the beginning of winter and early summer. The authors concluded that the greater the seasonal temperature differences, the clearer the annual marks hence growth marks are not distinct in the northern and southern parts of the world with continental climates.

Although, it is generally not easy to determine the age of fish in the tropics using hard parts, some successes have been reported by some authors. In Nigeria, Bayagbona (1966) used the otolith to determine the age of *Pseudotolithus typus* (Croaker) while Fagade (1980a&b) used the otolith to determine the age of *Chrysichthys nigrodigitatus* and *Tilapia guineensis*. Ezenwa and Kusemiju (1981) determined the age of the catfish (*Chrysichthys nigrodigitatus*) using the dorsal spine while Fagade and Olaniyan (1972) made use of the length-frequency method for *Ethmalosa fimbriata*. This study was carried out to determine the age of this species using the scales.

Materials and Methods

A total of 900 scales from 150 fish samples were examined; of which 588 were rejected because of incompleteness, damaged edge and regeneration which could not be used for ageing purposes. The growth rings on each set of scales were examined repeatedly. After each examination, the number of growth rings was counted, scale radius and distance from the nucleus to the 1st annulus (and 2nd annulus where applicable) were recorded and where the results of the two examinations were inconsistent, the set of scales was rejected. The scale radius was (fig. 1) measured from the scale nucleus along the antero-lateral radius to the well defined line called the check, which appears at the inner edge of each growth ring (i.e. the edge of the

growth ring nearest the scale nucleus) as described by Wilson and Pitcher (1984). New scale growth was measured from the last check to the edge of the scale along the antero-lateral radius and the measurements were made to the nearest 0.1mm.

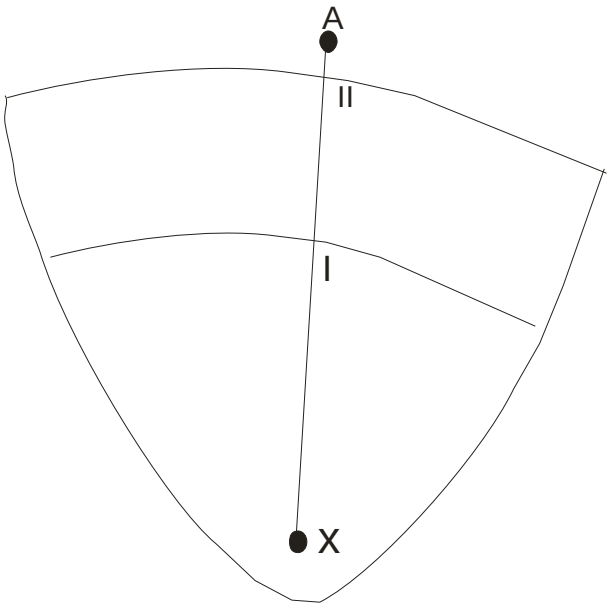

Fig. 1: Schematic Diagram of the scale of *P obscura* showing the axis (AX) used for back-calculation measurements, the annuli for years I-II and the point (X) taken as the center of growth of the bone.

Six (6) scales were carefully removed with a pair of forceps from each of the specimens just above the lateral line and on the left side of the fish. The scales were dipped for a few minutes in hot water to remove all adhering tissues on them. They were later washed, cleaned and mounted dry between two microscope slides tied together with cello tape at both ends. All the data pertaining to each specimen i.e. dates of collection, fish standard and total lengths, body weight, sex were recorded on each slide. The mounted scales were examined using a Scale Projector and binocular microscope at X 200 magnification. Body length at the time of formation of the last (most recent) annulus was calculated for each fish using the formula ((Ricker, 1968) :

$$Li = c + \frac{Si\,(L - c)}{S}$$

Li = calculated body length at the time of formation of the most recent annulus

Si = the distance from the scale nucleus to the most recent annulus along the antero-lateral radius

S = the scale radius

L= the body length of the fish at the time of capture and c is the constant obtained from the scale radius-body length regression line

Statistical analysis

Regression analysis was carried out to determine the relationship between the scale radius and total length of fish using SPSS package.

Results and Discussion

Ageing of fishes from tropical waters has been reported through annual increment in calcified structures such as scales (Werder and Soares, 1985), dorsal and pectoral spines (Ezenwa and Kusemiju, 1981), vertebra (Brown and Gruber, 1988) and otoliths (Fowler and Doherty, 1992). Scales are the easiest to collect and process. Using scales as structures for ageing also avoids sacrificing the specimens like in ageing methods employing otoliths.

Cycloid scales were observed to be present on the body of the specimens of *Parachanna obscura* (Plate 1) and growth rings were observed on the scales. These rings are of two types; complete and incomplete rings. All rings that stretch from one edge of the scale to the other edge forming a complete ring are regarded as annual rings. Here, the complete rings were formed annually and the circuli are closely parked together (Khan and Khan, 2009). Between successive rings were few incomplete rings and these incomplete rings were not interpreted as annual rings. The circuli are separated widely and do not stretch from one edge of the scale to the other, this may indicate interruption in metabolic activities such as spawning and inclement weather (Plate 1) as described by Beamish and McFarlane (1987) and Maceina and Sammons (2006).

Plate 2 shows a scale with a well defined nucleus with circuli and radii stretching from the nucleus to the edge of the scale with interruptions. In plate 1, the nucleus of the scale shows clearly the radii emanating from the nucleus towards the edge of the scale while plate 2 shows clearly two distinct annual rings (2+). Summarily, the maximum clear annual rings were only two representing year 1+ and 2+ respectively while the damaged and regenerated scales were discarded .Two types of growth checks, either incomplete or complete, were observed on the scales of the specimens. Between the successive complete growth rings, incomplete growth checks were present. These were interpreted as lunar rings and were estimated to be formed monthly, while the complete rings were interpreted as annual rings marked 1+ and 2+ representing year 1, 2 respectively (Fagade, 1980a & b) and Oben et al. (1998).

Age 1+ was prominent with 264 specimens while age 0+ and 2+ were 24 in numbers respectively. In age

class 0+, 24 specimens were observed and the mean total length and body weight were 15.8cm±1.72 and 35.7g±13.47 respectively. Age class 1+ with 264 fish had 26.88 cm±6.48 as their total length and 191.6g±151.8 as body weight while age group 2+ with 24 specimens had 26.33cm±3.69 as their mean total length and 164.6g±51.26 as bodyweight.

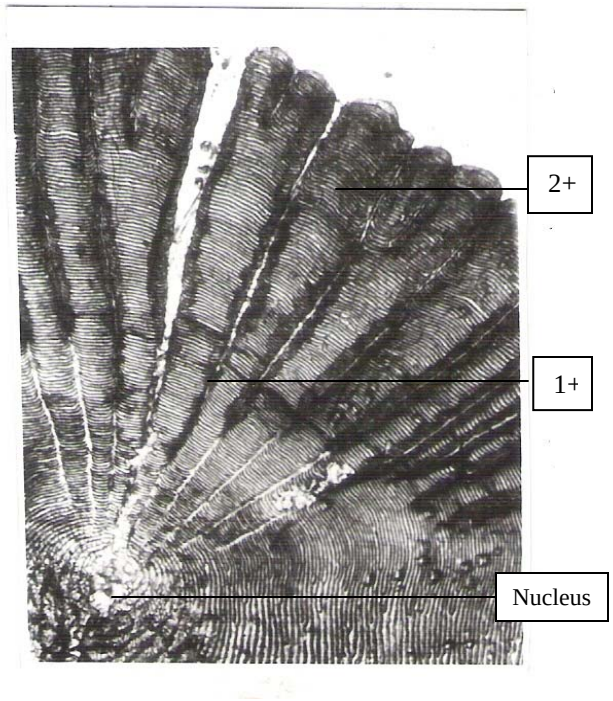

Plate 1: Photomicrograph of scale of *Parachanna obscura* showing a well defined nucleus, radii and circuli.

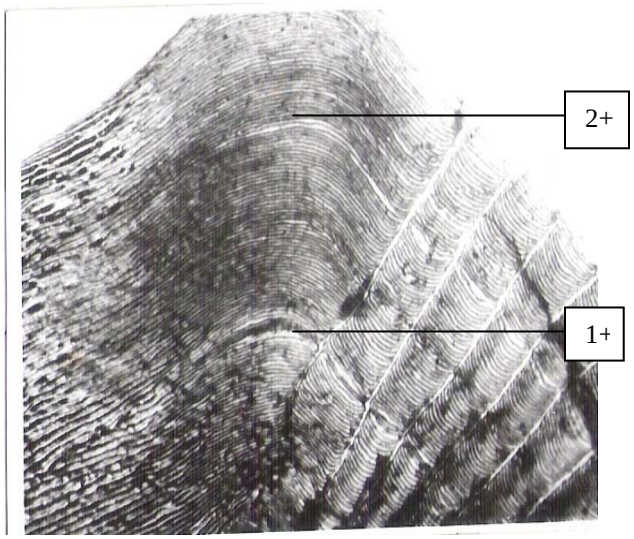

Plate 2: Photomicrograph of scale of *Parachanna obscura* showing two distinct rings (2+).

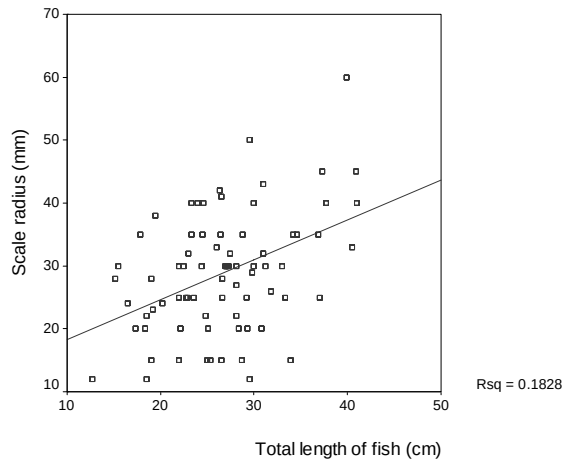

Fig. 2: Relationship between total lengths of *Parachanna obscura* and scale radius.

The number of males and females in each age group in 312 specimens of *P.obscura* were determined and presented. Sixteen (16) males were in age 0+ and 148 males were in age 1+ while 4 male samples were recorded in age 2+. Also, the number of females in ages 0+, 1+ and 2+ are 24, 264 and 24 respectively. This result shows that the catch was dominated by female specimens and that the females exhibited a fast growth rate, with the mean ages higher in females than the males in all year round contrary to Oben et al. (1998) who reported that the males *Hyperopisus bebe* live longer than the females in Lekki Lagoon, Nigeria. Although growth was continuous throughout the life of the fish, it was most rapid when the fish is young, decreasing progressively as the fish became older (Lagler et al., 1977). The relationship between fish growth and scale growth was determined graphically in fig. 2. The regression equation y = 11.91 – 0.63x. The growth of *P.obscura* was assumed by increment in total length while scale radius (distance from the focus to the midpoint of the anterior scale edge) was used to determine scale growth.

The growth rate in both sexes in each age class observed and calculated the length as shown in tables 1 and 2 revealed that the mean length at capture for age 0+ =15.8cm ±1.71.Specimens of age 1+ had mean length of 27.9cm±5.86 while that of age 2+ was 26.4 cm ±3.14. Also, the back-calculated length for age 1+ was 27.5cm±8.07 and that of age 2+ was 28.6±5.72. This result shows slight variation. This study agrees with the work of Zebe et al. (2010) who studied the age and growth of *Distichodus antonii* from Congo River.

In the current study, mean lengths determined from back calculation agreed with the size/ages obtained from the use of scales of the species. However, this serves as baseline study on age and growth for this species as there is no documented research on ageing using hard parts on this species in Nigeria.

Table 1: Mean Back-calculated Total Length (cm) of *Parachanna obscura* from Scale Measurements (Sexes combined)

Age	Mean total length at capture (CM)	Mean total length at annulus formation (CM)		No of fish
		I	II	
0+	15.8	-	-	24
1+	27.9	27.45 ± 8.1	-	264
2+	26.33	28.88 ± 5.8	29.51 ± 8.0	24

Average calculated

Table 2: Relationship between Back-Calculated and Observed Total Length of *Parachanna obscura* in River Owo

Age group	Sex	Observed length	Calculated length
0+	Male	15.5 ± 1.79 16	
	Female	16.5 ± 1.44 8	
	Both	15.8 ± 1.71 24	
1+	Male	26.5 ± 5.26 148	26.3 ± 8.52 148
	Female	29.8 ± 6.06 116	28.9 ± 7.24 116
	Both	27.9 ± 5.86 264	27.5 ± 8.07 264
2+	Male	31.2 ± 0.00 4	32.0 ± 0.00 4
	Female	25.4 ± 2.42 20	27.8 ± 6.05 20
	Both	26.4 ± 3.14 24	28.6 ± 5.72 24

Recommendation and Conclusion

Lagoon and River fishing are important sources of income, especially for men in the communities living around River Owo and Ologe Lagoon. Apart from providing a source of income, fish is the main source of protein for the communities. Management of the resources relevant to Lagoon fishery conservation is carried out through the institution of traditional rules in these areas. However, urbanization and industrialization have reduced the respect of such traditional rules and taboos, therefore, the government (State and local) through the fisheries agencies should formulate policies that will help in the conservation of the resources in the river.

The age of *P.obscura* in River Owo was determined by the assumption that one scale ring was formed per year and the relationship between the scale radius and fish length was found to be linear i.e. the growth pattern is positively allometric. The growth markings on the scales showed three year classes: 0+, 1+ and 2+, which infers that the fish has a life span of not less than 2 years.

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