

**SCALE CHARACTERISTICS AND ANNULUS FORMATION
OF THE CICHLID FISH *TILAPIA NILOTICA* L.**

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INTRODUCTION

Scales of fish have been used extensively for the study of age and growth of numerous marine and fresh water species. The use of the scale method for age and growth studies of *Tilapia* species was proved to be valid : Halden, 1935; Jensen, 1958; Elester and Jensen, 1960; El-Bolock and Koura, 1960; 1961; El-Zarka 1961.

The aim of this paper is to study scale characteristics, annulus formation, accessory ring, time of annulus formation and relation between temperature and time of annulus formation for *Tilapia nilotica* L.

MATERIALS AND METHODS

Scales samples for this study was based upon monthly collections from fish caught from Lake mariut. Total lengthes of fish were measured to the nearest millimeter. Collections were made from Nov. 1957 to Jan. 1959 covering a period of 15 months. The scales were taken from fish caught using experimental gears and nets of different mesh sizes to get as much range of sizes of fish as possible. In addition, selected samples were taken from the commercial catch to cover lengthes not caught by the experimental fishing.

The scales were taken from the left side of the fish below the lateral line and in the area of the pectoral fin. The location of the scales were consistent through out all the sampling procedure. The consistency was shown by Joris. 1957 and by El-Zarka, 1959 to be a necessary precaution to avoid all kinds of discrepanceis that might arise during growth calculations. The scales were cleaned in 10% solution of ammonia and mounted dry between two glass slides, then examined and measured under a binocular stereoscopic microscope.

Scale characteristics of *Tilapia Nilotica* L.

The scales of *Tilapia nilotica* are typical ctenoid. They are fan-shaped and strongly inbricated in the skin. Concentric ridges or circuli are arranged, about a focus. This focus may be central or slightly posterior to the center of the scale. There are radial grooves extended from the focus to the anterior edge of the csale.

The size of the scales vary from one location on the fish to another. In general the larger scales are on the pesterolateral surface of the body and the smaller scales are located about the fin bases and the anteroventral and anterodorsal surfaces.

Samples for study were taken from the region of the pectoral fin below the lateral line and thus did not include either the smallest or the largest scales of the individual fish. From the scales taken from each fish, the larger symmetrical are

* Lake Mariut is a shallow lake of about one meter dpth, adjoining the city of Alexandria.

selected for age determination. The spacing of circuli on the scales appear to indicate periods of fast and slow growth. The wider spacing is found typically at the beginning of the new growing season. The closely spacing circuli are laid down on the scales at the end of the growing season.

Characteristic of the annulus :

Annular markings on *Tilapia nilotica* scales are generally distinct and somewhat clear and easily recognised. They are however easily recognised on some parts of the scale than others. False annulii and accessory rings are also noticed and the structure of them will be discussed later.

The true annulii formed on the scales of this fish varies according to its location with respect to the focus of the scales. The first annulus has a special characteristic than the others. It is formed simply by cutting in one or two circuli. A light narrow band exists along these circuli and is clear around the anterior and the lateral regions of the scales.

The location of the latter annular rings could be revealed by one or more of the following characteristic arrangements which are found to be the same as that of *Tilapia zillii* from Lake Qaroun (El-Zarka, 1961). On the whole, the appearance of the true annulii in scales of this species could be described in as the following:

1.—The narrowing of the spaces between circuli taking place at the end of the growing season appear as dark bands.

2.—The cutting which take place in two or more circuli appear as light band. The degree of cutting-over varies according to its location on the scales. Sometimes it is complete along the whole circumference of the scale and become more pronounced on the lateral side. In some other scales, the cutting is not complete in the median region of the scale and is only shown in some parts of the ring. This area is considered to be the winter annulus of the scale.

3.—Traces of the annulii are sometimes observed as a faint dotted ridge in the skin embedded portion of the scale.

In conclusion, an annulus is usually located by the combination of the above mentioned criteria, rather than any one of them alone. It is more distinct on some scales than the others and more easily seen on some parts of the scale than elsewhere.

Accessory rings :

During the examination of the scales of *Tilapia nilotica*, there were observed annulus-like structure on some scales called false rings. These false rings has been discussed by many fishery biologists. They have classified them into accessory and spawning ones and gave several characteristics for each kind (Zamakhaev, 1940; Tehgounova, 1940, 1959; Blackburn, 1950, 1951).

These false annuli, formed on scales of *Tilapia zillii* from Lake Qaroun were fully described by El-Zarka (1961). Those of *Tilapia nilotica* from Lake Maruit were found to agree in their structure with that for *Tilapia zillii* from Lake Qaroun.

The assumption that these annuli mark the spawning period is rejected, since they are not regularly repeated in the fish scale or even absent in some individuals with true annuli. So, these false annuli might be due to some other internal or environmental changes.

Time of annulus formation :

The formation of winter annuli on the scales of fish population ordinarily take place over a range of time. The actual dates vary with species from year to year and according to age within a single stock. This variability can lead to difficulties in age determination for samples collected during the period of annulus formation.

It is of special interest to study the time of annulus formation of the scales of our marine and freshwater fishes. The annulus formation on scales of *Tilapia zillii* Gerv. was first studied by El-Zarka (1961). In this paper, another important commercial fish, *Tilapia nilotica*, is also studied. The monthly collection of scale samples for one complete year permits a thorough study of the progress of growth and the pattern of appearance of year marks. The amount of season's growth estimated by calculating the weighted means of growth increments calculated at different months of capture. This was found to be more efficient in following the annulus formation and the progress of seasonal growth.

In Table (1) the results of such studies are recorded, where the sexes were kept separate because of the apparent variation in the amount of growth. It is evident from the table that the annuli began to appear on the scales of some fishes during March. There are 40.7% of fishes of age group I have clear annulus either at the edge or with mean extra growth of 5.8 mm. For fishes belonging to age group II, 4% of them have the second annulus either at the edge of the scales or with extra growth calculated to be 2 mm on the average.

On April 12, 1958 all the scales of the fish of age group I had their annuli and showed extra growth of about 17.4 mm., but for age group II, 10% of the fish had their 2nd annulus and the average extra growth was 11.8 mm.

On May 11, 1958 fishes of age group I showed extra growth of about 27.7 mm. For fish of age group II, 87.7% of the scales had completed annuli and extra growth of about 19.0 mm.

On June 5, 1958 all the scales on fish of different age groups had completed their annuli. The grand average of the extra growth for age group I was found to be about 43.3 mm. and for age group II about 30.4 mm.

On July 12, 1958 the fish added an extra growth of about 61.7 mm. for age group I, and about 40.7 mm. for age group II; while on August 12, 1958 the extra growth was found to be about 83.3 mm. for age group I and about 52.6 mm for age group II.

On September 13, 1958 and October 30, 1958 no data was available for age group II. For age group I the extra growth was 103.1 mm. and 128.3 mm. for September and October respectively.

TABLE 1.— AVERAGE INCREMENT OF GROWTH (IN MILLIMETER) COMPLETED AT DIFFERENT DATES OF CAPTURE BY *Tilapia nilotica*. L.

Date of Capture	Age Group I						Age Groupe II	
	Male		Female		Both Sexes		Both Sexes	
	Ext. gr.	No. of fish	Ext. gr.	No. of fish	Ext. gr.	No. of fish	Ext. gr.	No. of fish
November, 1957	—	—	—	—	126.2	19	77.4	8
December	—	—	—	—	130.4	11	75.1	15
January 1958	—	—	—	—	129.3	13	76.0	11
February	—	—	—	—	124.0	23	68.3	5
March	5.6	15	6.4	12	5.8	27	2.0	2
April	18.3	78	16.4	71	17.4	149	11.8	1
May	31.7	36	23.8	36	27.7	72	19.0	13
June	47.3	44	41.2	83	43.3	127	30.4	6
July	64.4	41	58.5	36	61.7	77	40.7	7
August	86.0	30	78.7	18	83.3	48	52.6	4
September	104.1	18	102.4	27	103.1	45	—	—
October	—	—	—	—	128.0	10	—	—
November	—	—	—	—	127.6	21	78.1	10
December	—	—	—	—	126.3	18	72.2	13
January 1959	—	—	—	—	124.0	26	73.5	11

From data in Table (1) and Figure (1), it is possible to locate the time at which the annulus was formed. It is clear that the full season's growth was attained on October. After this month, there was practically no change in the amount of extra growth until the next season's growth. From this study it was found that the annuli was shown on the scales of the fish on March. The annuli were completely formed on all the scales of fish of age group I on April and for fish for age group II on June. Therefore, it can be concluded that the annuli were formed on the scales of *Tilapia nilotica* from Lake Maruit from late February and through March for fishes of age group I and during April and May for fishes of age group II. The period over which the annuli became clear in all the individuals of the population were about 6 weeks in comparison with that of *Tilapia zillii* from Lake Qaroun which was only 15 days (El-Zarka, 1961).

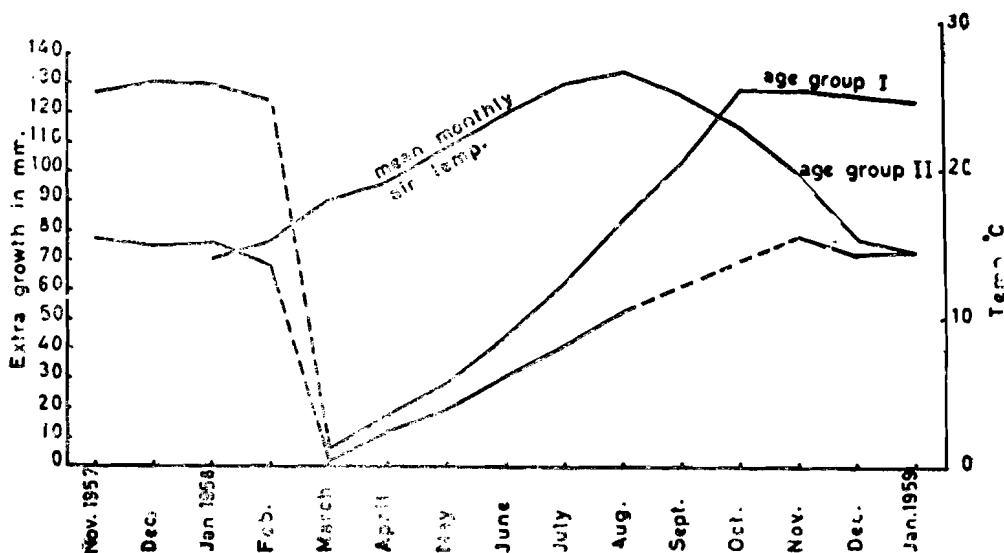


FIG. 1.—Average increase of growth completed at dates of capture.

Relation between temperature and annuli formation :

Generally thermal conditions has a profound effect on the biological characteristics. The annuli were found to be formed on the scales of *Tilapia nilotica* as temperature increase after the cold season in winter.

The water temperature at the day of sampling and the mean monthly air temperature was recorded in conjunction with the percentage of fish scales of age group I and II which had completed their annuli together with date of sampling (Table 2.). Since the lake is extremely shallow, its water temperature is generally affected by air temperature. The mean air temperature may thus represent the monthly thermal condition of the lake in preference to the water temperature at day of sampling.

From this table it is found that the annuli began to be formed on 40% of the scales of fish of age group I and 4.6% for fish of age group II in March. The mean air temperature in the previous month i.e. February was 15.3°C and relatively low during March and April where they were 18.6°C and 19.2°C respectively. During the first half of April, the annuli was completed on all the scales of fish of age group I and 10% of fish of age group II had shown their annuli. On May with mean air temperature 21.6 °C the majority of fish (87.7%) of age group II had completed their annuli.

It is thus obvious that the annuli were formed on the scales of the fish for age groups I and II at a temperature range 15.0 to 19.0°C.

TABLE 2.—PERCENTAGE OF FISH WITH SCALES HAVING COMPLETED TO FORM ANNULI OF AGE GROUP I AND II AT DIFFERENT DATES OF CAPTURE AND THE MEAN MONTHLY AIR TEMPERATURE IN 1958.

Month	Date of Capture	Water temperature at date of capture °C	Mean air temperature °C	Percentage of scales having completed annuli	
				Age Group I	Age Group II
February	12	13.7	15.3	—	—
March	9	20.9	18.0	40.7	4.0
April	12	21.7	19.2	100.0	10.0
May	11	25.5	21.6	—	87.7
June	5	25.9	23.8	—	100.0

SUMMARY

The investigation of scale characteristics and annulus formation of *Tilapia nilotica* L. was proceeded for the aim of studying age and growth of this fish. Scales were collected monthly from Lake Maruit from November 1957 to November 1959.

The true annulus rings were easily identified on the scales of this fish by the "cutting over" of sclerites but varies according to its location with respect to the focus of the scales. The first annulus was formed simply by cutting in one or two circuli, while the latter annuli could be revealed by cutting in more of the circuli. Accessory rings were also noticed on some scales and were found to agree in their structure with those of *Tilapia zillii* from Lake Quarun (El-Zaka, 1961). These rings were remarked to be not of the spawning type and might be due to some other internal or environmental changes.

The annuli first appear on the scales which were collected on March 1958. In addition to the annuli formed extra growth of 5.8 mm for fishes of age group I, and of 2.0 mm for fishes of age group II were recorded. The mean monthly extra growth increased progressively from March till October when the full season's growth was attained.

It was noticed that there was a good relation between the annuli formation and temperature. The annuli were formed on the scales of the fish for age groups I and II at a temperature range of 15.0° to 19.0°C.

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