

Early Development of the Squamation in *Tilapia sparrmani*

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According to the studies on the scale development, fishes can be classified into two groups by the area where the scales first appear: scales appear (1) at the anterior portion of the trunk, and (2) at the posterior end of the caudal peduncle, along the lateral line (Kubo and Yoshiwara, 1961). The carp, *Cyprinus carpio* (Nozawa, 1941; McCrimmon and Sweet, 1967), the oikawa, *Zacco platypus* (Okada and Seishi, 1936), and the brown trout, *Salmo trutta* (Klaatsch, 1890) are included in the former group. And the following species are included in the latter group: the ayu, *Plecoglossus altivelis* (Nakai and Matsui, 1936), the red salmon, *Oncorhynchus nerka* (Koo, 1955), the chum salmon, *Oncorhynchus keta* (Matsui and Kogure, 1941; Sano and Kobayashi, 1952), the pond smelt, *Hypomesus olidus* (Amemiya and Hiyama, 1940; Shiraishi *et al.*, 1955), the himedaka, *Aplocheilichthys latipes* (Inaba and Nomura, 1950), the konoshiro, *Clupanodon punctatus* (Yoshida, 1937), the sardine, *Sardinops melanosticta* (Kubo *et al.*, 1949), the smallmouth bass, *Micropterus dolomieu* (Everhart, 1949), the walleye, *Stizostedion vitreum vitreum* (Priegel, 1964), the freshwater drum, *Aplodinotus grunniens* (Priegel, 1966), the white crappie, *Pomoxis annularis* (Siefert, 1965), the black crappie, *Pomoxis nigromaculatus* (Oosten, 1957; Ward and Leonard, 1954), and so on.

In the family Cichlidae, *Herichthys cyanoguttatus*, *Tilapia macrocephala*, *T. nilotica*, and *T. tholloni* are reported to belong to the second group (Balon, 1959; Fishelson, 1966).

In the present work, the formation and the subsequent development of the scale pattern in another species of the Cichlidae, *Tilapia sparrmani* Smith were examined in order to

elucidate the specificity of the formation of the scales.

Material and Methods

The specimens used were in a single brood which hatched on June 4, 1967, at the Ichthyological Laboratory of Tokyo University of Fisheries. About 15 specimens were fixed everyday in five percent formalin solution for study. The specimens, 241 in total, ranged 6.5 to 18.5 mm in total length.

For observation the skin which was removed from the left side, or the right when the left one was damaged, was cleaned in 10 percent solution of concentrated hydrogen peroxide for 10 to 30 minutes. And then it was stained with alizarin red (Franklin and Smith, 1960), and the skin was observed under a binocular microscope with 16–40× magnification.

The fish used were reared in aquaria, and crushed pieces of pellet for common carp were given as food.

The rearing temperature was 25.2°C on average, ranging from 23.6°C to 27.0°C.

Results and discussion

Length of body when the scales first appear

The scales first appear along the longitudinal mesial plane of the posterior end of the caudal peduncle in *T. sparrmani* as in three species of the genus *Tilapia* (*T. macrocephala*, *T. nilotica*, *T. tholloni*). When the fish grew up to 7 mm length-class, after 15 days from hatching, only 3 out of the 20 specimens had scales which were just formed, but the rest were still without scales. In the 8 mm class, 16 out of the 29 specimens had some scales, and all specimens grown up to

Table 1. Frequency distribution of young *Tilapia sparrmani* with or without scales.

Class in mm (total length)	Days after hatching	Without scales	With scales
6	12-13	2	0
7	13-15	17	3
8	14-17	13	16
9	16-18	0	34
10	18-21	0	21
11	20-23	0	19

the length of more than 9 mm had some scales. Table 1 gives the frequency distribution of the specimens with or without scales in relation to body length class.

In the majority of specimens of *T. sparrmani* the formation of the scales starts at the length-class of 8 and 9 mm. The total length in which scales started to develop was 8.56 mm

in average. Although there were some range of variation in the growth of the body among samples studied, the present species takes 14 to 18 days after hatching to attain the length-classes of 8 to 9 mm, under the given condition.

Enlargement of scaled area in sequence of growth

The scaled area expands anteriorly along the lateral line, with increase in number and size of scales. About 4 horizontal rows of scales were observed in some specimens of 8 mm length-class (17 days after hatching). The number of scales on the lateral line in this length-class ranges from 27 to 28, which is less than that of the adult having 29 to 30 scales.

Some individuals in 9.0 mm length-class have 6 rows of scales in the horizontal direc-

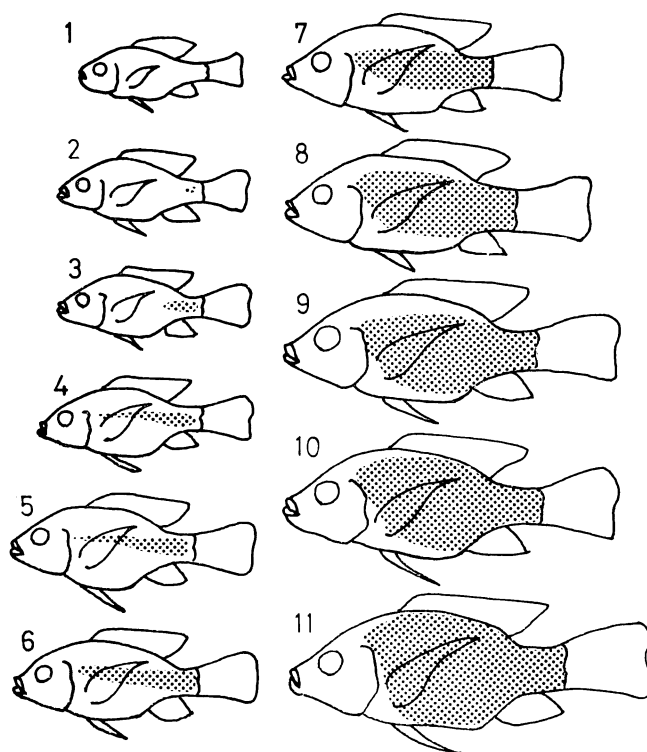


Fig. 1. Diagrammatical presentation of the development of scale pattern in *Tilapia sparrmani*. The figures in parentheses show the number of rows of the scales. 1, 6 mm class; 2-3, 7 mm class (1-4); 4-6, 8-9 mm class (3-6); 7, 10 mm class (6-8); 8, 11 mm class (8-10); 9, 12 mm class (9-12); 10, 13 mm class (10-13); 11, 16 mm class (14).

tion, and there were more rows on the ventral side than on the dorsal side of the lateral line. The number of scales on the mid-line at this stage was same as in the adult.

Fig. 1 shows a typical pattern of the scaled area which gradually expands toward the anterior and dorsoventral portions, from the middle point of the caudal peduncle. Scales in the 21-days-old young do not overlap yet.

Some of 22-days-old individuals in 11 mm class, had 10 rows of scales, and the scales began to overlap because of their rapid growth during these periods. When the total length reached 13 mm, 24 days after hatching, 13 longitudinal rows of the scales were observed, and the surface of the trunk was almost entirely covered with scales. Some specimens in 16 mm length-class, which were 27-days-old, had 14 rows of scales as in adult.

According to Fishelson (1966), the scales first appeared 15 days after hatching in *T. macrocephala*, 20 days in *T. nilotica*, and 24 days in *T. tholloni* which is the substratum spawner. Fishelson assumed that the necessary time for scale development in substratum spawners was longer than that in mouth-breeders. But, the result of the present study indicates that in *T. sparrmani*, substratum spawner, the time of the appearance of scales was 14–18 days, and it was earlier than in abovementioned species.

It seems that the necessary time for the scale development depends on the species, but not on the difference in breeding habits. Scales first appeared at 10.8–11.2 mm in total length in *T. macrocephala*, 13.8–14.1 mm in *T. nilotica*, and 11.0–11.5 mm in *T. tholloni*, respectively (Fishelson, 1966). In the present study, the size at which the scales first appeared in *T. sparrmani* was 7.9–8.9 mm. This was the smallest in size among abovementioned tilapia species.

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* Papers with the asterisk were not seen by the author.

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ティラピア・スバルマニ (*Tilapia sparrmani*) の初生鱗の形成

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カワスズメ科 (Cichlidae) の 1 魚種, *Tilapia sparrmani* Smith の初生鱗の形成について, 1967 年 6 月 4 日に孵化した 1 腹の稚魚 241 尾を, 水温 23.6—27.0°C (平均 25.2°C) の水槽で飼育し, 毎日, 約 15 尾の個体をホルマリン固定し, 調べた. 標本の左体側の皮膚をはがし, 10% の過酸化水素水で脱色した後, アリザリンレッド溶液で染色し, 観察した. 初生鱗は孵化後, 14—18 日, 全長 7.9—8.9 mm (平均 8.56 mm) で出現する. 初生鱗は尾柄中央側線付近にでき, その後, 頭部の方へと広がる. また, 鱗列数も背方, および腹方へと増し, 孵化後, 27 日, 全長 16 mm クラスで成魚と同じ鱗列数に達する.

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