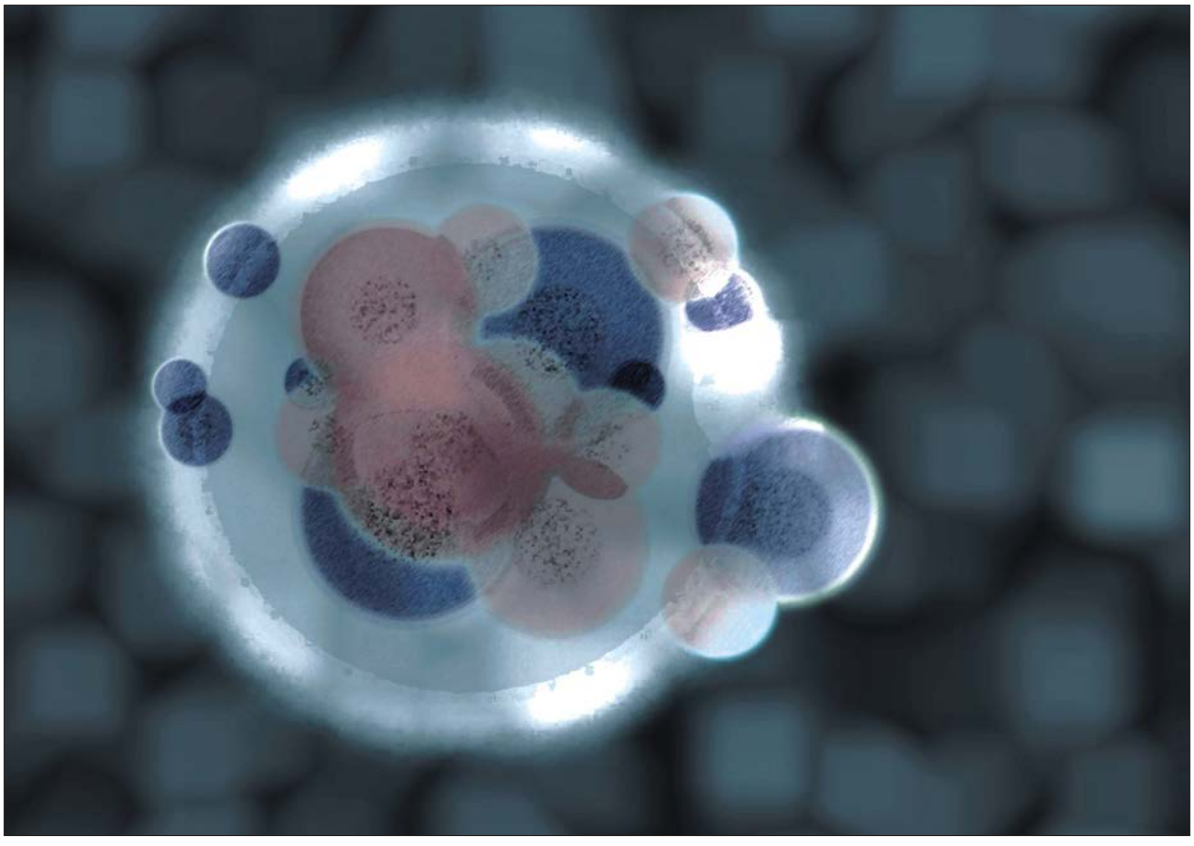

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# Scale Morphology of Tank Goby *Glossogobius giuris* (Hamilton-Buchanan, 1822) (Perciformes: Gobiidae) using Scanning Electron Microscope

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**Abstract:** Concerning the importance of scale morphology in fish taxonomy, scale ultrastructure of tank goby fish *Glossogobius giuris* from Makran basin of Iran, was studied using scanning electron microscopy. Scales from below the dorsal fin and from the head region were removed, cleaned in potassium hydroxide solution and were prepared for the scanning electron microscopy. Variations are found in scale morphology of this fish in different body parts. Ctenoid and cycloid scales are present on the head and body regions, respectively. Focus which is located in the posterior part of scale, is clear and has mucous pores. Rradii are found only on the anterior part of scale and numbers of primary radii are more than the second and tertiary radii. These radii divide the anterior part of scale into several regions and thus the scale is sectioned. Tongues or lobes of the anterior part are distinct. Inter circular space is without granules and bifurcation is observed in some circuli. Absence of the lepidonts on the crest of circuli is another character of this fish scale. It seems that position and shape of focus, absence of lepidonts and arrangement of cteni on the scales of this fish could be used as important taxonomic characters.

**Key words:** Scale morphology, taxonomy, *Glossogobius giuris*, scanning electron microscopy

## INTRODUCTION

Detailed structure of the fish scale can be helpful in the identification of fishes up to major groups and species levels, phylogeny, sexual dimorphism, age determination, past environment experienced by fish, discriminating between hatchery reared and wild populations, migration, pathology of fish scale due to water pollution of the water body and for the growth studies (Meunier and Castanet, 1982; Sire and Geraudie, 1983; Lippitsch, 1989, 1990; Jawad, 2005a-c; Johal *et al*., 2006; Esmaeili and Niknejad, 2007; Esmaeili and Gholami, 2007; Jawad and Al-Jufaili, 2007).

Shape, size and number of scale are suitable tools in fish taxonomy and using it dates back to first half of 19th century when Agassiz (1833-1843) used it in fish taxonomy for the first time. He classified the fishes into 4 groups based on the scale morphology (Jawad and Al-Jufaili, 2007).

During the late 19th century and the first half of the 20th century and with the great advancements in the field of light microscopy, the importance of scale morphology in systematics increased significantly. The importance of scale morphology used in classification was strengthened with the introduction and development of Scanning Electron Microscopy (SEM), so that scales of many different fish species have been studied using SEM (Jawad and Al-Jufaili, 2007). With regards to the importance of scale morphology, in this research, ultrastructures of scale of tank goby fish *Glossogobius giuris* from Makran basin of Iran were studied. The gobies of genus *Glossogobius* are found in fresh, brackish and marine waters in the Indo-West Pacific area. Most species are freshwater residents and there are about 24 species with one in Iran (Coad, 2009). *Glossogobius giuris* is found mainly in freshwater and estuaries, but also enter the sea (Talwar and Jhingran, 1991). In Iran it is known as gel-ye mahi cheshm navari (= band- or bar-eyed goby) or gavmahi-ye cheshmnavari.

## MATERIALS AND METHODS

The specimens of tank goby were collected from Sarbaz River (Fig. 1), Makran Basin, Southesat Iran during September 2007 to November 2008. To study scale structure of tank goby fish (Fig. 2), the scales were gently removed with fine forceps from the left side of the body below the dorsal fin and also from head region (Fig. 3), in such way that while removing the scales no damage is being done to the scale (Lippitsch, 1989, 1990). Immediately after their removal, they were cleaned mechanically using the fine brush and potassium

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hydroxide solution and then rinsed with triple distilled water. Cleaned scales were dehydrated in 30, 50, 70 and 90% ethanol and dried on filter paper (Lippitsch, 1989, 1990). The scales were not put in absolute alcohol as 100% ethanol caused the scale margins to curl. To avoid curling, after 90% ethanol, the scales were kept between the two micro slides for 2-3 days. The cleaned and dried scales were mounted on the metallic stubs by double adhesive tape with dorsal surface upward and ventral surface sticking to the tape and coated with a thick layer of gold in gold coating unit (SC7640 SPUTTER COATER, Model: FISONS). The scales were then viewed under vacuum in Leica Cambridge Scanning Electron Microscope (SEM) at an accelerating voltage of 20 kv at low probe current. Various images of the scales were saved in computer attached to the system.

Fig. 1: Sarbaz River, Habitat of *Glossogobius giuris*

Fig. 2: Schematic shape of *Glossogobius giuris*

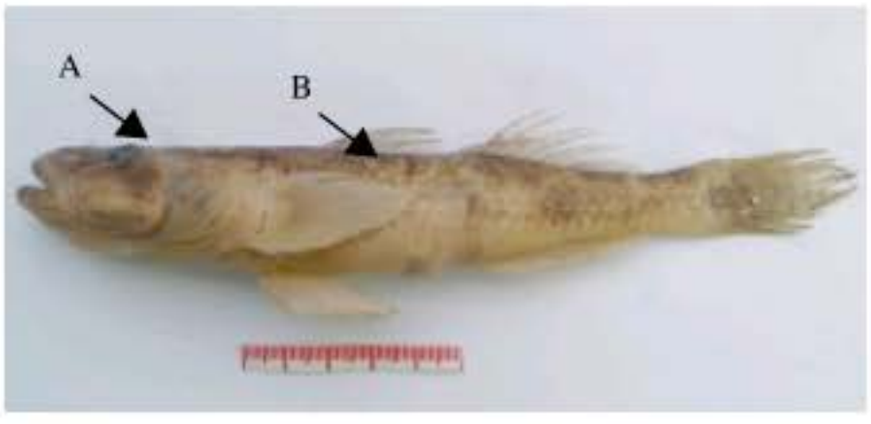


Fig. 3: Photo of *Glossogobius giuris*; showing the position of removed scales, (A) Scale of head region, (B) Scale below dorsal fin

## RESULTS

Ctenoid and cycloid scales were found on the head and body regions of the fish respectively (Fig. 4 and 5). Both scales of tank goby fish *Glossogobius giuris*, like the scale of other fishes, can be divided into anterior (A), posterior (P) and lateral (L) fields (Fig. 4). The anterior field is embedded into the skin and overlapped by the posterior side of the preceding scale. Scales are usually not smooth, but show a characteristic surface ornamentation that, in the simplest case, consists of ridges and grooves forming circular rings around a centre called the focus. The focus in both ctenoid and cycloid scales is located in the posterior part of scale and is clear (Fig. 6A). Radii were found only on the anterior part of scale. The radii are in primary, secondary and tertiary

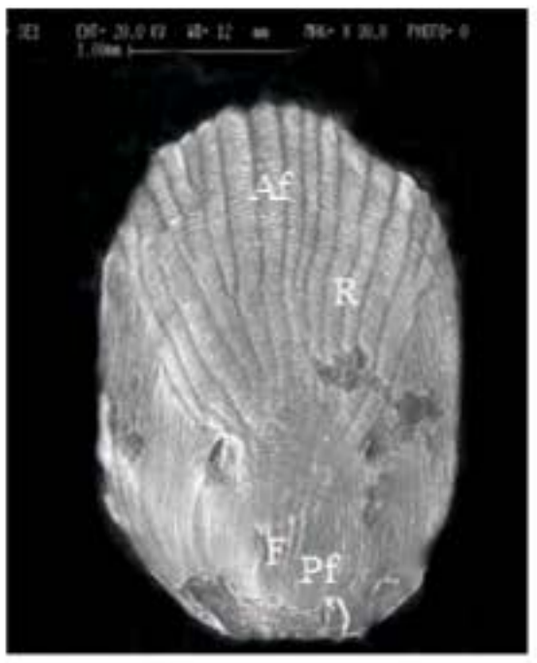


Fig. 4: Cycloid scale of *Glossogobius giuris*. (Af) Anterior; (Lf) Lateral; (Pf) Posterior; (R) Radii and (F) Focus

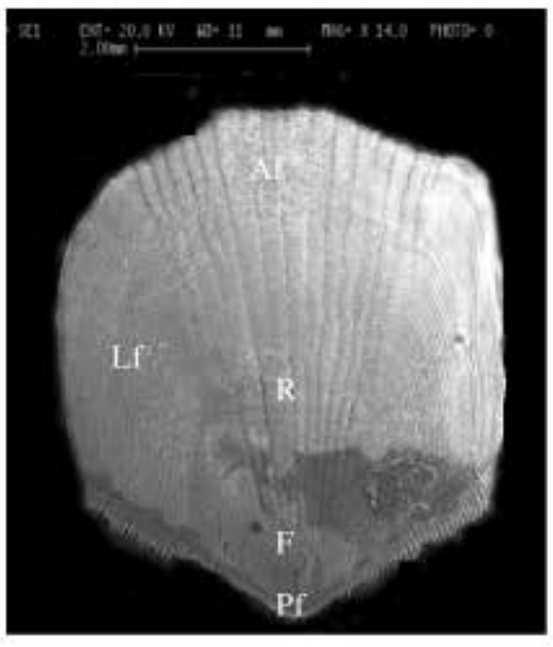


Fig. 5: Cteniod scale of *Glossogobius giuris*. (Af) Anterior; (Lf) Lateral; (Pf) Posterior; (R) Radii and (F) Focus

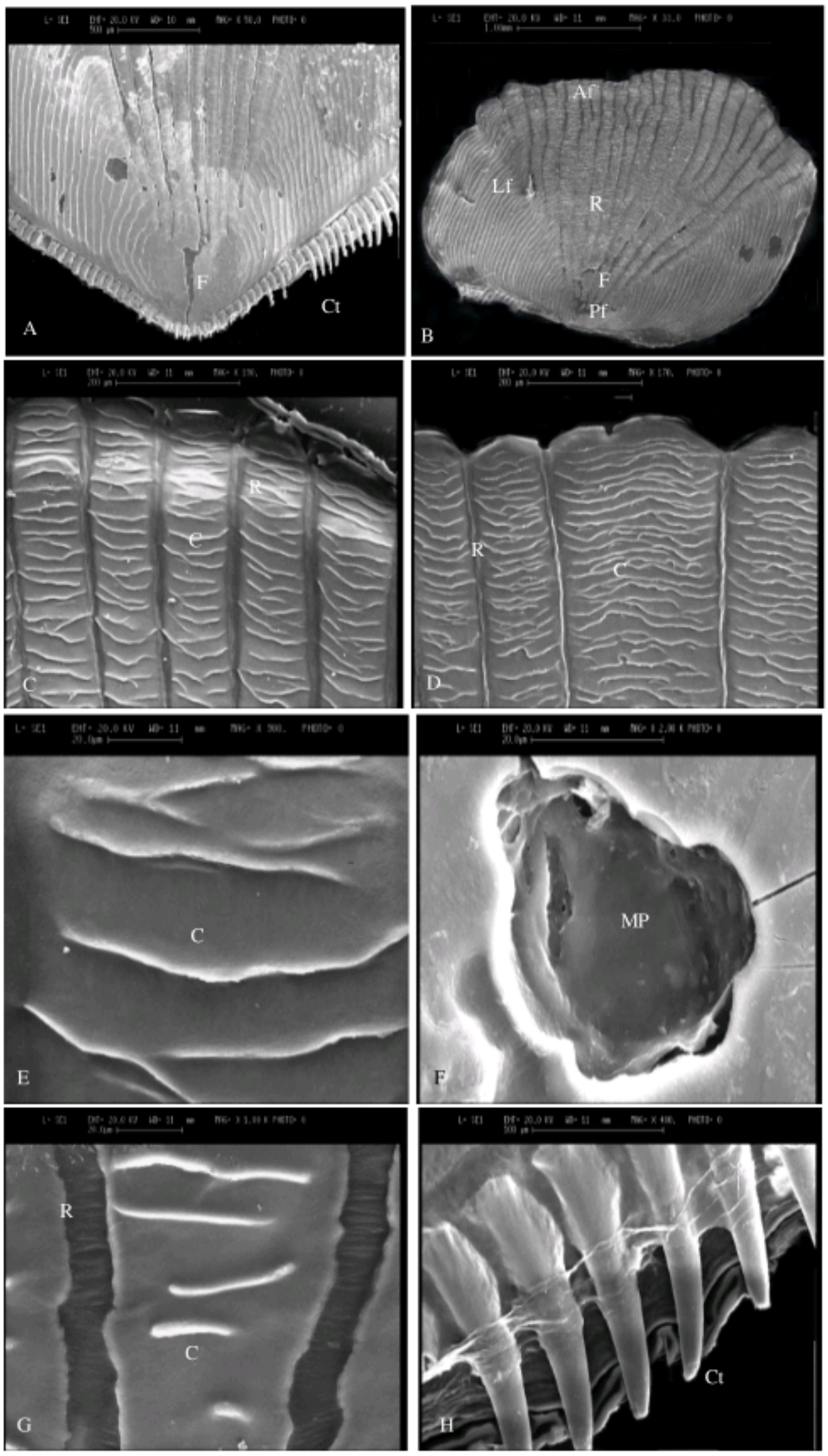


Fig. 6: SEM microphotographs of scale of *Glossogobius giuris*: Anterior (Af); Lateral (Lf); Posterior (Pf); Radius (R); Focus (F); Circuli (C); Ctenus (Ct); Mocus Pore (MP)

type. Numbers of primary radii are more than the second and tertiary radii (Fig. 6B). These radii divided the anterior part of scale into several regions. Hence, the scale is sectioned (Fig. 6C). Tongue or lobes of the anterior part are very distinct (Fig. 6D). The circuli on the anterior part of scale are close to each other (Fig. 6D). Inter circular space is without granules. Bifurcation is found in some circuli (Fig. 6E). The focus is located in the posterior part

of scale and is clear and has mucous pores (Fig. 6F). There are no lepidonts on the crest of circuli. This is another character of this fish scale (Fig. 6E,G). The posterior part of ctenoid scale, demarcated with the sharp conical structures called ctenii (Fig. 6H). It seems that focus shape, number, shape and absence of lepidonts, ornamentation of tubercles and ctenii are important in taxonomy of this fish.

## DISCUSSION

Recently it has been highlighted that due to loss of fish habitat as a result of water management practices, release of effluents in to the natural water bodies and several anthropogenic activities, most of the fish species of developing and underdeveloped countries including Iran are under different types of threats as is evidenced from the squeezing of geographical limits and the reduction in the stocks of most of the fish species. In some cases the fish community structure is completely disrupted. Due to the reduction in the fish stocks, the fish biologists are unable to get large number of specimens for the studies relating to fish bionomics. Under these circumstances, lepidological study is the best alternatives as fish scale is consider being the best tool in fish biology. Hence, this study describes the scale morphology of tank goby fish *Glossogobius giuris* from Makran basin of Iran for the first time. It shows the general architectural pattern of a cycloid and ctenoid scale having focus, circuli and radii. Scales on the head are mostly cycloid while body scales are ctenoid. Presence of both cycloid and ctenoid scales in fish has been reported in some other fishes especially cichlids (Lippitsch, 1990; Kuusipalo, 1998). The exposed portion of flank scales are diamond-shaped (Coad, 2009). Scales are rectangular with a rounded anterior margin which may be slightly indented above and below the mid-point, parallel dorsal and ventral margins and a posterior margin with two straight edges meeting at a rounded central tip (Coad, 2009). The anterior dorsal and ventral corners are sharp. There are fine ctenii on the posterior margin of ctenoid scales. The focus of the scale is clear and sharp located in the posterior field and is the first part of the scale to be formed during ontogenesis. The position of the scale focus remains the same throughout life (Liu and Shen, 1991; Miranda and Escala, 2000). Circuli are observed in all fields. The arrangement of the circuli corresponds to the scale shape. The circuli formation is due to the excess calcium salts secreted by the skin and their subsequent deposition on the scale and distance between circuli indicates fast and slow growth period. Lepidonts (teeth-like structures) are absent on the circuli. Lepidonts are important structures known to support species distinctness (Kaur and Dua, 2004; Jawad and Al-Jufail, 2007). The taxa usually differ with regard to shape, texture, attachment and orientation of lepidonts on the crest of circuli (Kaur and Dua, 2004). Lepidnots of different size and shape have been reported in many fish species (Lippitsch, 1990; Delmater and Courtenay, 1974; Jawad and Al-Jufaili, 2007). They might characterize genera and may even distinguish some taxa at the specific level (Delmater and Courtenay, 1974). Lepidonts are not homologous to breeding tubercles and contact organs (Delmater and Courtenay, 1974).

Three types of radii including primary, secondary and tertiary were found only on the anterior part of scale. There is no significant relationship between number of radii and scale size, as the numbers of radii depend on location of the scale on the fish body. However, in some other teleotes such as *Mullus surmuletus* L., 1758 and *M. barbatus* L., 1758, the number of radii is correlated to fish size (Jawad and Al-Jufaili, 2007). The presence of primary and secondary radii is a growth phenomenon and obviously only weakly influenced by genetic factors (Lippitsch, 1990). The radii formation is considered to be related to the accommodation power of the large surface area of the anterior and lateral parts of the scale in the lesser space as these two parts of the scale are overlapped by the posterior part of the preceding scale. The higher number of radii is correlated with the better nutritive conditions of the fish (Johal *et al*., 1984; Tandon and Johal, 1996). Radii represent the line of scale flexibility.

The above observations regarding the architectural specification of scales such as focus shape and position, circuli, absence of lepidonts, position of radii might be used as important taxonomic tools.

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