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Short Communication

Microstructures of barbels and bony plates of *Satyrichthys laticeps* (Actinopterygii: Peristediidae)

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Abstract

Barbels are sensory-appendage near the mouth of many fishes including Cyprinidae, Ictaluridae and Peristediidae and commonly used for identification of the species. Similarly scales and bony plates of fishes also being used in taxonomic studies. *Satyrichthys laticeps* commonly called armoured searobins, is a deep-sea peristediid that distributed in the Indo-West Pacific region of the world. However, surface structures of has been unknown. The aim of this study is to reveal the microstructures of barbels and bony plates of *S. laticeps*, occurring in the Andaman Sea of Thailand, for the first time by using a scanning electron microscopy method. The chin barbels were characterised by a pebble-like surface whereas lip barbels resemble wooden texture. Taste bud-like organs were only visible in chin barbels. Bony plates from heads contained small semispheres around spine. In dorsolateral of posterior body, pits appeared at the apices, and semispherical buds were present in the middle and basal parts of tubercles. The study results may be important in understanding the physiology in peristediid fish.

Keywords: Armoured searobins; *Satyrichthys laticeps*; peristediids; SEM; microstructures

1 | INTRODUCTION

In teleosts, barbel is slender process and an integumentary sensory organ of fishes; examples include carps, catfishes and goatfishes (Grover-Johnson and Farbman 1976; Lombarte and Aguirre 1997; LeClair and Topczewski 2010). Similar to scale of fishes bony plates of varying structures are also commonly found in some fish groups such as searobins, boxfish, sturgeon and seahorse that are used to defend the body against the smashing, scratching or predator attack (Porter *et al.* 2013; Qu *et al.* 2013; Yang *et al.* 2013, 2015). Porter *et al.* (2013) described that bio-inspired design from nature has led to a novel study of fracture-resistant structures.

Armoured searobins are peristediid teleosts belonging to the order Scorpaeniformes, an order comprising mostly marine deep-sea fish (Kawai *et al.* 2008; Van Oijen *et al.* 2013; Kawai 2016). *Satyrichthys laticeps* (Schlegel, 1852), a species of the family Peristediidae, is widely distributed in the tropical regions of the Indo-West Pacific including the Andaman Sea of Thailand (Kawai 2013, 2014; Pogoreutz *et al.* 2014). Recently morphological descriptions of *S. laticeps* from the deep-sea habitats of the Andaman Sea in the eastern Indian Ocean have been described by Kawai *et al.* (2017). Although the barbels are dominant

character in peristediids but its microstructures is still unknown. Therefore the aims of this work are to study the microstructures of barbels and some bony plates of *S. laticeps* from the Andaman Sea of Thailand.

2 | METHODOLOGY

In September 2017, 14 specimens of *S. laticeps*, including six male and eight females, were captured from the Andaman Sea of Thailand with the help of professional fishermen using a bottom trawl net. The fish individuals were euthanized by administering an overdose of a MS-222. Specimens were identified using the key for the peristediid genus *Satyrichthys* (after Kawai 2013). Barbels were cut from the lips and chins, and pieces of bony plates were stripped from the fish bodies (Figure 1). In scanning electron microscope (SEM), tissues and pieces were immediately fixed in 4% glutaraldehyde with 0.1 M phosphate buffer (pH 7.4) and left overnight at 25°C. Specimens were washed with 0.1 M phosphate buffer and post-fixed in 1% OsO_4 in the same buffer at 25°C for 60 minutes. Following OsO_4 fixation samples were rinsed with distilled water and dehydrated using an ethanol dehydration series (50, 60, 70, 80, 90, 95 and 100%) for 10 minutes in each concentration. Specimens were dried using a critical point drying apparatus surrounded by high pressure of CO_2, mounted on metal stubs with carbon tape, coated with gold using a sputter coater, analysed by a HITACHI SU-8010 SEM, and imaged at 10 kV.

3 | RESULTS AND DISCUSSION

The mean (± SD) total length including the stick-rostral projection of male armoured searobins was 30.1 ± 8.6 cm (range: 24 – 47.4 cm; *n* =6) whereas for female the mean length was 35.7 ± 9.2 cm (25.0 – 47.0 cm; *n* = 8). The SEM analysis of barbels, at high-magnification, showed that the surface of chin barbels are crumpled and covered by a pebble-like surface texture (Figures 1B – 1C). Some areas lip barbel surfaces were rough and had a wooden pattern and rest areas had a fold-like network alternating with wrinkles (Figures 1D – 1G). The surface of the branched end of the lip-barbel was covered by a narrow network of folds and wrinkles (Figures 1H – 1I). The rostral projection had margin on surfaces that are smooth and contained short digitiform tubercles with small branched prongs at the tips (Figure 1J). This study showed that the structure of chin barbels differed from lip barbels in many respects. Hussain and Bordoloi (2018) reported that the surface morphology of barbels in *Garra* spp. was peculiar and may aid the fish in adapting to their habitats. Kiyohara *et al.* (2002) described how the goatfish (*Parupeneus* spp.) uses the long chin barbels to scan for prey along the sea bottom. Therefore, sensory chin barbels of *S. laticeps* may play key role in searching food or catching prey in deep sea habitats.

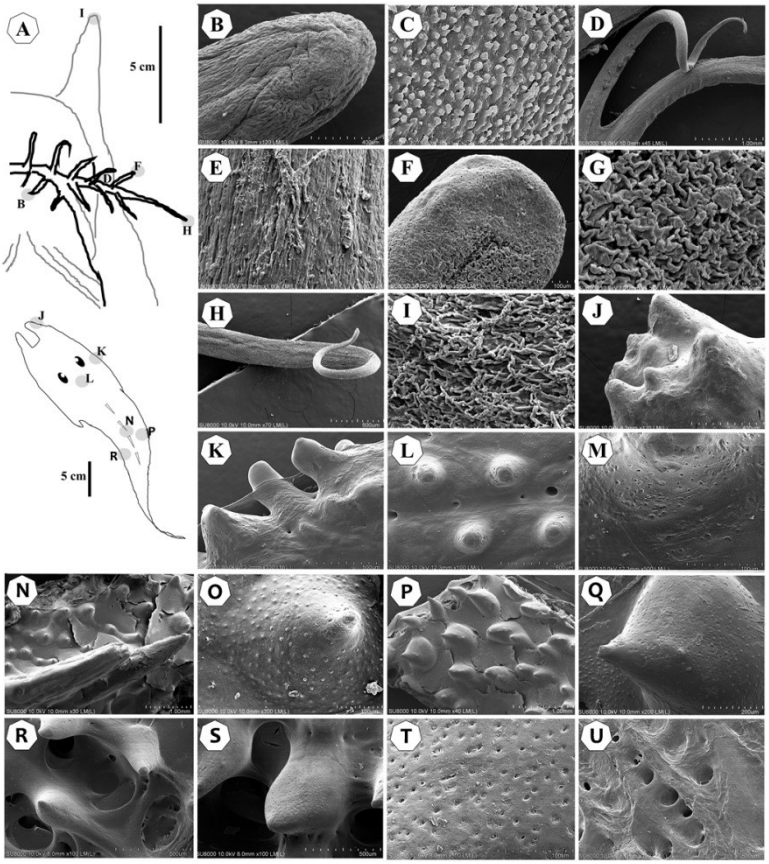

FIGURE 1 Scanning electron microscope (SEM) photopography of barbels (*B – I*) and bony plates (*J – U*) of *Satyrichthys laticeps*. Overall locations are presented in *A*. *B*, chin barbel; *C*, high-magnification view of *B*; *D*, lip barbel; *E*, high-magnification view of *D*. *F*, branched parts of lip barbel; *G*, high-magnification view of *F*; *H*, branched lip barbel at posterior end; *I*, high-magnification view of *H*; *J*, bony plate of snout; *K*, plate of lateral head; *L*, bony plate of head; *M*, high magnification view of *L*; *N*, dorsal spine; *O*, high magnification view of short spine of *N*; *P*, plate of dorsal body; *Q*, high-magnification view of *P*; *R*, plate of lateral body; *S*, high-magnification view of *R*; and *U*, overlapping surfaces of the posterior region of bony plate.

The SEM analysis of bony plates showed that the stout symmetric nodes and smooth surfaces at the tip and distal areas of the lateral side of head (Figure 1K). Surfaces of the frontal and parietal plates were decorated with cone-shaped tubercles. Some buds were found around the base of those tubercles (Figures 1L – 1M). In dorsal view, near the spines, cone-shaped tubercles were positioned on the surfaces of bony plates. Tubercles with small buds were quite spherical and smooth (Figure 1N – 1O). In the dorsolateral areas of the posterior part of the body, there were cone-shaped tubercles that appeared to be pitted at the apices and spherical buds were present in the middle and basal parts of the tubercles. Cone-shaped tubercles were also observed on the bony-plate surfaces along the posterior part of the body (Figures 1P – 1Q). For the bony plates below the antrose spines, the cone-shaped tubercles were stout and arranged in alternating rows with hollows. Tubercles were broadly covered by small pits. Along the surfaces of overlapping plates there were hollow areas without any tubercles (Figures 1R – 1U). Members of the family Peristediidae commonly live in the deep sea and are characterised by hard bony plates covering the body and rostral projections (Nelson 2006). Surface structure of bony plates of *S. laticeps* resembles that they may be related to their environment and may help in the movement, foraging and maintaining balance in the depth sea.

This study depicts the ultrastructure of barbels and bony plates of *S. laticeps*, a deep-sea peristediid, from the Andaman Sea of Thailand. The results are believed to have contributed to the knowledge about babel structure in Peristediidae that may be of help in understanding the biology of armoured searobins.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author.

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