

Olfactory Organs of a Hillstream Sisorid Catfish, *Pseudecheneis sulcatus* (McClelland) in Relation to Its Ecological Habitat

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The ovo-elongated rosette bears a large number of closely spaced lamellae with linguiform processes; the number of lamellae increases with an increase in the size and age of the fish as confirmed by the coefficient of correlation (0.9433) between the two parameters (standard length of the fish and the number of lamellae); the fish has small eyes and the olfactory area is much greater than the total retinal area.

Key Words: Rosette, Lamellae, Raphe, Olfactory area, Retinal area

Introduction

The structure and function of the fish olfactory organs have been studied by a number of workers including Bateson (1889), Burne (1909), Teichmann (1954), Pfeiffer (1963), Khanna and Singh (1965), Singh (1967), Kleerekoper (1969), Kapoor and Ojha (1972, 1973a, 1973b), Ojha and Kapoor (1973), Hara (1975), Datta et al. (1976), Rahmani and Khan (1977), Pandey and Misra (1978, 1979), Rana et al. (1978), and Singh and Singh (1979). However, very little information is available on the olfactory organs of Indian hillstream teleosts. Hence, it was considered desirable to study the nasal organs of *P. sulcatus*.

Material and Methods

The specimens of *P. sulcatus* were collected from the streams of Garhwal hills and fixed in 5% formalin. The heads were dissected from the dorsal side to study the olfactory organs and their relationship with the forebrain. The olfactory rosettes were taken out and observed under a stereoscopic binocular microscope. Fishes of different size range were selected to count the total number of olfactory lamellae. The correlation coefficient between the two parameters (standard length of the fish and the number of lamellae) was calculated. Teichmann's method was used for the calculation of the total olfactory and retinal areas.

Observations

The olfactory chambers situated on the antero-dorsal surface of the head (figure 1) open outside by two openings which lie close to each other (1.5 mm in a 20 cm long fish). The round anterior nasal opening is small and tubular with thickened outer margins in the form of a rim. The oval posterior nasal opening is comparatively larger in size with raised outer margins. A backwardly directed triangular nasal flap with pointed tip separates the two nasal openings.

Each chamber bears an ovo-elongated rosette which occupies the entire space in the olfactory chamber. The rosette has a linear raphe which supports a large number of bilaterally arranged, closely spaced, thin olfactory lamellae (figure 2). The lamellae are attached to the wall of the olfactory chamber by their convex inner margins, and to the raphe by their proximal ends. The outer concave margins bear well developed linguiform processes. The lamellae in the middle of the raphe are the largest and their size decreases towards each end of the raphe (figures 2 and 3). The anterior and posterior lamellae are attached obliquely to

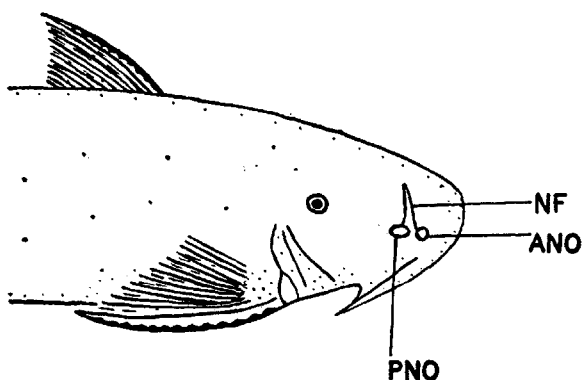


Figure 1 Lateral view of the head of *P. sulcatus* showing the nasal apertures and flap

ANO, Anterior nasal opening; NF, Nasal flap; PNO, Posterior nasal opening

Table 1 Number of olfactory lamellae in fishes of different length

Standard length of the fish (cm)	Number of olfactory lamellae		Total number of olfactory lamellae
	Left rosette	Right rosette	
9.8	55	53	108
10.3	58	58	116
12.0	71	72	143
14.8	78	79	157
17.0	82	80	162

the raphe whereas the middle ones are almost perpendicular to it.

After examining the rosettes of several specimens it was found that the total number of lamellae in both the rosettes increases with a corresponding increase in the size of the fish (table 1). The calculated value of the coefficient of correlation 'r' between the two parameters viz., standard length and the number of lamellae, is highly significant (0.9433). The total olfactory surface area of the fish measuring 14 cm (standard length) and having 152 lamellae in both the rosettes was calculated as follows and found to be about 1591% of its total retinal area.

$$\text{Area of lamellae in both the rosettes} = 400 \text{ mm}^2$$

$$\text{Area of the two retinae of the fish} = 25.14 \text{ mm}^2$$

$$\text{Hence, olfactory area} = 400 \times 100 / 25.14 \text{ or } 1591\% \text{ of retinal area}$$

A dissection of the head from the dorsal side shows the olfactory chambers with rosettes and their relationship with the forebrain (figure 2). The narrow elongated olfactory tracts connect the olfactory bulbs and the telencephalic lobes of the forebrain.

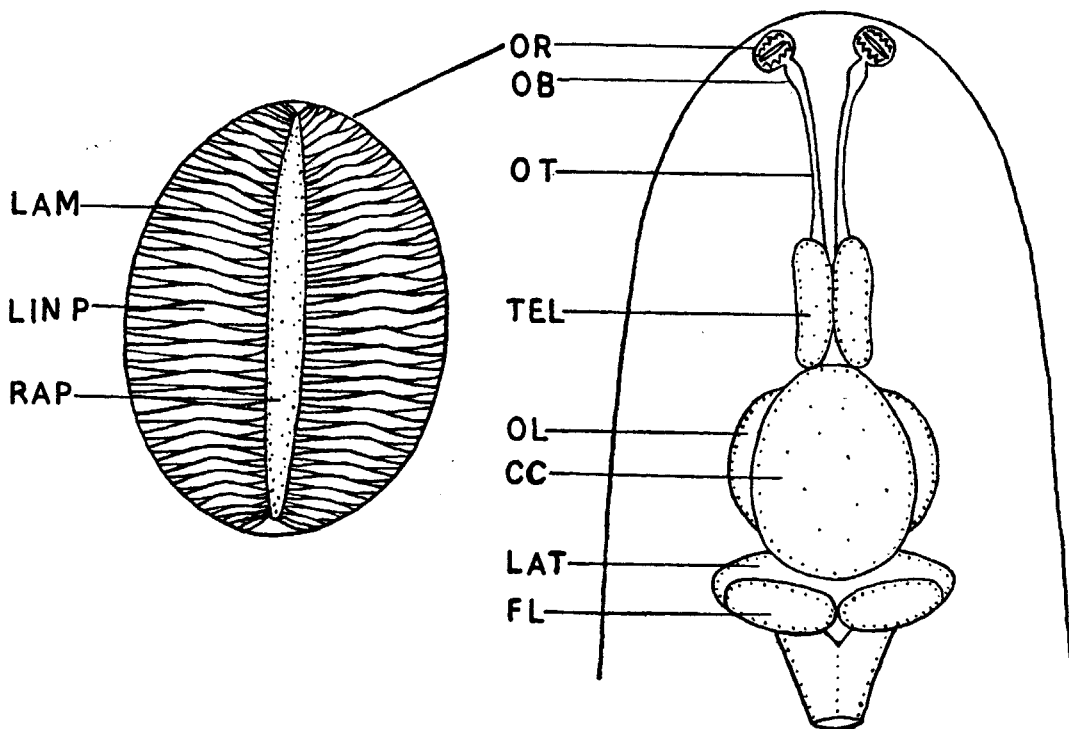


Figure 2 Dissection of the head of *P. sulcatus* from the dorsal side to show the relation of forebrain with the nasal organs

CC, Corpus cerebelli; FL, Facial lobe; LAM, Lamellae; LAT, Lateral acoustic tubercle; LIN, *P. Linguliform* process; OB, Olfactory bulb; OL, Optic lobe; OR, Olfactory rosette; OT, Olfactory tract; RAP, Raphe; TL, Telencephalic lobe

Discussion

The nasal organs of *P. sulcatus* are in conformity to its ecological habitat. The anterior nasal opening is in the form of a small tube with thickened outer margins and both the nasal openings are separated from each other by a short distance. This is in accordance with the findings of Kapoor and Ojha (1972, 1973a) who described that when the anterior and posterior openings in a fish are separated by some distance, the former is invariably borne on a tube. Pandey and Misra (1979) also noted that fishes with burrowing or bottom-living habits have

nasal tubes in relation to anterior nasal openings.

An ovo-elongated olfactory rosette of *P. sulcatus* bears a large number of olfactory lamellae in which the middle lamellae are the largest. Their size decreases towards the ends of the raphe. The total number of olfactory lamellae in both the rosettes increases with a corresponding increase in the size of the fish as in *Centrarchidae* (Eaton 1956), *Salmon* (Pfeiffer 1963), *Channa punctatus* (Kapoor & Ojha 1973a) and *Glyptothorax telchitta* (Ojha & Kapoor 1973). So, there is a positive correlation between the number of lamellae and the size of the

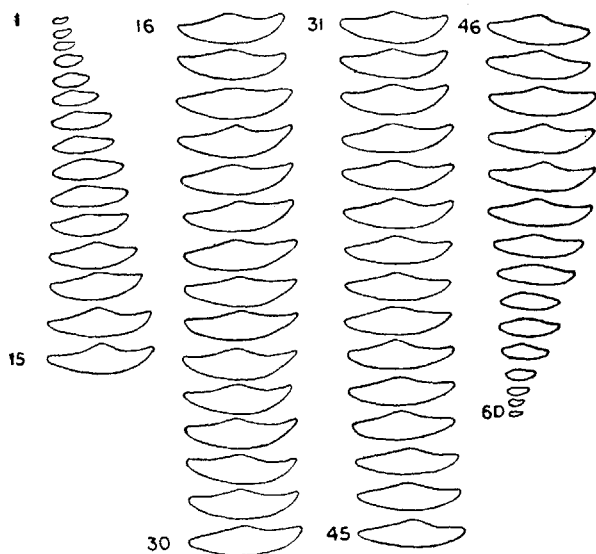


Figure 3 Complete set of 60 lamellae of the right rosette of a 11 cm (SL) long specimen

fish. This has been confirmed by the most significant value of coefficient of correlation ($r=0.9433$) between the two parameters viz., standard length of the fish and the number of lamellae.

Pandey and Misra (1979) pointed out that the bottom-living fishes have a device in the form of accessory nasal sac to retain water for a long time possibly to adequately stimulate the receptor sites. Kapoor and Ojha

(1973a, 1973b) also reported the presence of well developed accessory nasal sacs in bottom-living fishes like *Channa punctatus* and *Cynoglossus oligolepis*. They stated that accessory sacs are necessary for sedentary habit. But there are no accessory nasal sacs in the present fish. Moreover, the presence of accessory nasal sacs has been reported in *Barilius bendelisis* (Singh & Singh 1979) which is a surface feeder (Badola & Singh 1980). Therefore, the present authors agree with Burne (1909) who opined that there is no connection between the presence of accessory sacs and the general life habit of the fish.

P. sulcatus is a typical hillstream fish with a burrowing habit. It has a subterminal mouth and a thoracic sucker for attachment to the bottom. The eyes are very small and consequently the olfactory organs are well developed. The fish possesses a much greater olfactory area as compared to its retinal area. Hence, it is a macrosomatic species with a predominantly developed olfactory faculty and can be placed under Teichmann's group 3 of nose fishes.

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