# Morphology of gills of the seawater fish *Cathorops spixii* (Agassiz) (Ariidae) by scanning and transmission electron microscopy

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ABSTRACT. Gills of the seawater fish *Cathorops spixii* (Agassiz, 1829) were submitted to routine processing for observation in scanning and transmission electron microscopy. The wrinkled surface of the gill filaments showed well-defined cellular ultrastructures. Microridges on cellular surface were projected over all gill structures, including respiratory lamellae. Chloride cells were usually at primary lamellae. Some rodlet cells were found. Mucous secretory cells were uncommon at all parts of the gill arches. The pharyngeal region of the gill arches showed a lot of taste buds but no spines. There were small and strong rakers. Such morphology is indicative of fishes that swallow small food but do not have filtering habits. At the ultrastructural level the gills of *C. spixii* presented the typical morphological pattern of Teleostei fishes.
KEY WORDS. *Cathorops spixii*, gill, morphology, ultrastructures, fish

The fish *Cathorops spixii* (Agassiz, 1829), Ariidae family, is probably the most common catfish on the Brazilian coast. There are records about its occurrence on Western Atlantic, from Central American seacoast to the South region of Brazil (FIGUEIREDO & MENEZES 1978; BATISTA & REGO 1996; CHAVES & CORRÊA 1998; ISAAC & SOUZA DE MOURA 1998; TIJARO *et al.* 1998; AZEVEDO *et al.* 1999), and it is found throughout the year on seashore of Paraná State, southern Brazil.

Morphological studies of fishes on the Brazilian seashore and continental waters, especially on gill ultrastructures, have begun just a few years ago (FERNANDES & PERNA 1995; MORON & FERNANDES 1996; EIRAS-STOFELLA & CHARVET-ALMEIDA 1997, 1998, 2000; MAZON *et al.* 1998; EIRAS-STOFELLA *et al.* 2001).

The present research includes the morphological description of the gills of *C. spixii* with the observation of ultrastructural details. The relations between the morphology of the gills, the presence of certain cells, feeding habits, and some other characteristics of this species are also discussed.

## MATERIALS AND METHODS

*Cathorops spixii* fishes were collected in the Paraná coast (Brazil), near the 25°32'S-48°28'W and 25°15'S-48°20'W coordinates, with the use of trawl nets and lines.

After anaesthetizing them (MS 222), the second gill arches (BaII) of the collected fishes were extracted and fixed in a solution of buffered glutaraldehyde.

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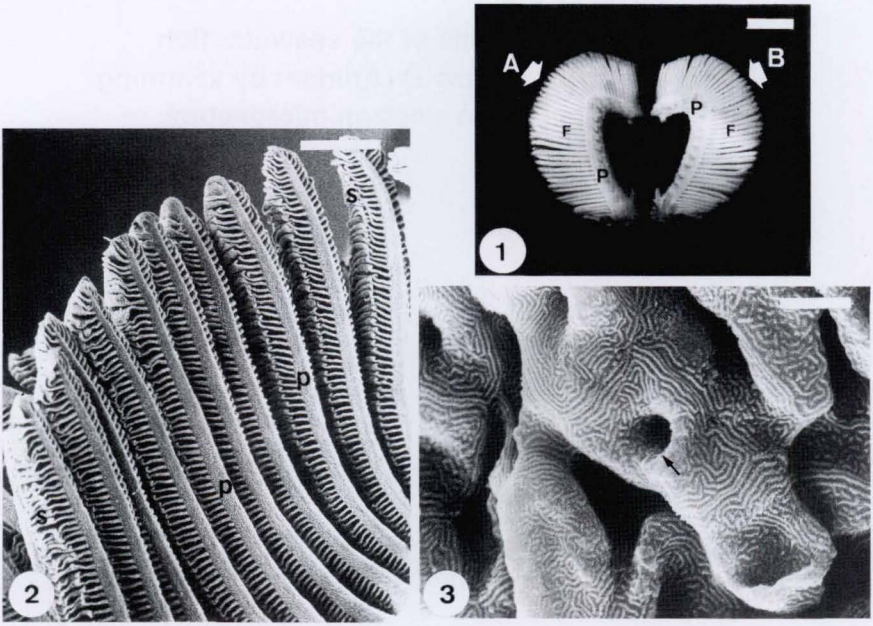



Figs 1-3. *Cathorops spixii.* (1) Stereoscopic photograph showing the general aspect of the second gill arch: (A) external face, (B) internal face, (F) gill filaments, (P) pharyngeal region; bar = 5 mm. (2) Scanning electron micrograph of the branchial filaments: (p) primary lamellae, (s) secondary lamellae; bar = 0,1 mm. (3) The extremely wrinkled surface of primary lamellae observed in scanning electron microscopy: (→) chloride cell; bar = 5 μm.

Then the arches were treated for observation in electron microscopy (EIRAS-STOFELLA & CHARVET-ALMEIDA 1997), using scanning (Philips SEM 505) and transmission (Jeol JEM 1200 EX II) techniques.

The selection of the BaII representing the other arches of the fish was done according to the methodology established in other studies (HUGHES 1972; HOSSLER *et al.* 1979; HOSSLER 1980; EIRAS-STOFELLA & CHARVET-ALMEIDA 1997; EIRAS-STOFELLA *et al.* 2001).

## RESULTS

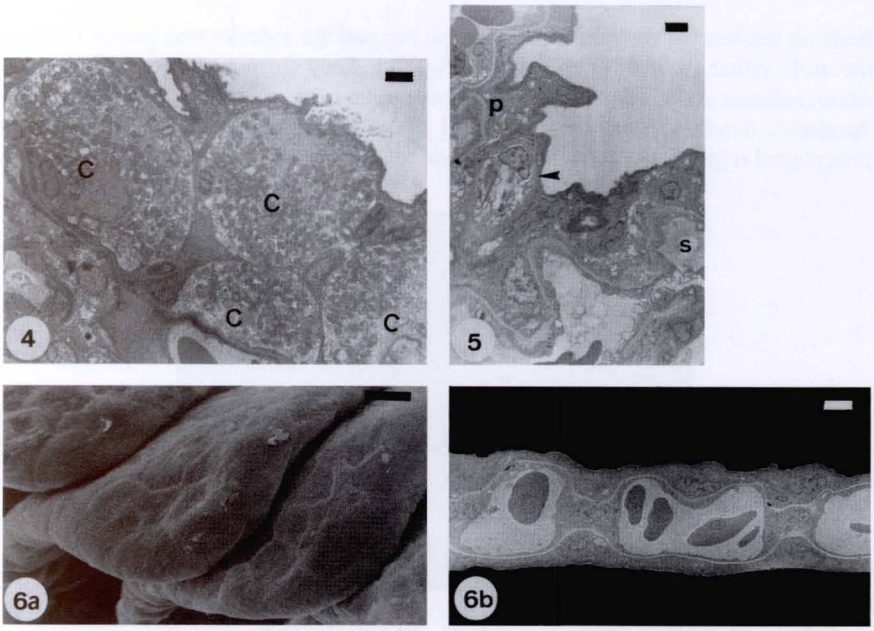
Gill arches, both BaII of each sample, from ten adult fishes ($L_t$ = 24.0-29.0 cm) were studied, revealing the characteristics below.

### General aspects

The dorsal region of the second branchial arch (BaII) of *C. spixii* presents a strong curvature angle. Gill filaments are shorter on the ceratobranquial region and on the ventral region of the arch (Fig. 1).

### Branchial filaments

The tip of the branchial filaments is thinner than the base (Fig. 2). There are 40-50 filaments on each row of the BaII.




Figs 4-6. *Cathorops spixii*. (4) Transmission electron micrograph of chloride cells (C) on primary lamellae; bar = 2 μm. (5) Transmission image of filament: (P) primary lamellae, (S) secondary lamellae, (▶) rodlet cell; bar = 5 μm. (6) Respiratory lamellae photographed by scanning electron microscopy (a) and transmission electron microscopy (b); 6a bar = 1 μm, 6b bar = 2 μm.

The surface of primary lamellae is extremely wrinkled. Chloride cells, seen as pit openings, are found among the protuberances and cavities of the surface (Fig. 3). Their abundance is showed on figure 4. Ultra fine sections shows the presence of rodlet cell near of the surface on primary lamellae (Fig. 5). The epithelial polygonal cells have microridges on all surfaces (Fig. 3), which are shorter toward the transition region with respiratory lamellae.

The transverse respiratory lamellae on gill filaments are regularly disposed in space from the proximal portion to the apex (Fig. 2). These lamellae are prominent and have creases on their edges. In general, the apex of the gill filaments are covered by respiratory lamellae and the surface of those structures are not wrinkled (Fig. 6 a, b). The polygonal epithelium cells present microridges all over the cell membrane (Fig. 6a). No chloride or rodlet cells on respiratory lamellae were found, only few mucous cells.

## Pharyngeal branchial region

Every part of the branchial arch, except the gill filaments, are considered pharyngeal branchial region. There are 12 to 18 gill rakers aligned on each side of each arch, following the dorsoventral arch configuration of BaII (Fig. 7a). Rakers are short and strong (Fig. 7a, b). The pharyngeal region surface is smooth. The stratified epithelium is very similar to that on gill filaments. There are a lot of taste

buds on the base of the rakers (Fig. 7a, b), beyond the anterior and lateral faces of the arch, either isolated or in groups (Fig. 7a). They form rows between the gill filament bases and the rakers, at the dorsoventral region of BaII (Fig 7a). The figure 7c shows details of one taste bud and the coated epithelium at the branchial pharyngeal region. A few holes of mucous secretory cells can be seen in this area.

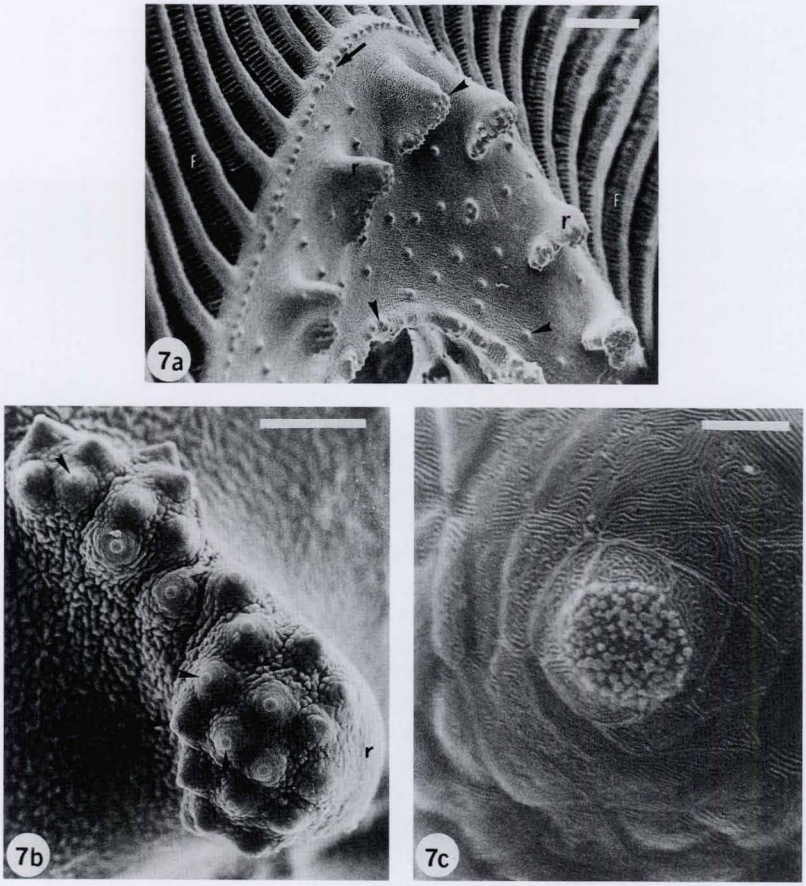



Fig. 7. Pharyngeal branchial region of *C. spixii*: (F) filaments, (r) rakers, (▶) taste bud, (→) row of taste buds); 7a bar = 50 μm, 7b bar = 100 μm, 7c bar = 0,25 μm.

## DISCUSSION

The wrinkled surface of gill primary lamellae is representative of *C. spixii* arches. Artifacts produced by inappropriate processing methodology were not found. The observation of respiratory lamellae confirmed this, since there were no wrinkles on surface while the morphology of microridges was integral, even though they are considered very sensitive and fragile under laboratory processing methods. The

ultrastructure of the gills of other fishes does not show the wrinkles on the gill filament surface pattern of the *Cathorops spixii*. The taste buds row on the sides of the pharyngeal region of BaII is also typical of this species. However, considering other Teleostei fishes, the gill arches of *C. spixii* present common morphology (HUGHES 1984; LAURENT 1984; HOSSLER *et al.* 1986; CICCOTTI *et al.* 1995; EIRAS-STOFELLA & CHARVET-ALMEIDA 1997, 1998, 2000; EIRAS-STOFELLA *et al.* 2001).

Rodlet cells have been found in different structures of fishes (liver, kidney, spleen, peritoneal serosa), including in gills. Its function is not clear yet (DESSER & LESTER 1975; BARBER & MILLS WESTERMANN 1985). However, there seems to be a relationship between their presence and the likelihood of stress to the fish (LEINO 1996; KOPONEN & MYERS 1999; DEZFULI *et al.* 2000). The catfish analyzed in this study were collected directly from the environment and sectioned under anaesthetic. There were no parasites observed on their gills. It is possible that these conditions favor a relative small incidence of rodlet cells in the branchial arches of the samples gathered.

The great amount of chloride cells found near of the surface of primary lamellae sometimes goes out to the exterior. That indicates osmotic regulation during fish collection. The structures and shape of the pharyngeal region of the gill arches are indicative of species that swallow small quarries and particles, which do not have food-filtering habits (ZAVALA-CAMIN 1996; EIRAS-STOFELLA & CHARVET-ALMEIDA 1997, 1998, 2000; EIRAS-STOFELLA *et al.* 2001). These data confirm literature information about feeding habits of this species, studied by other methods. ESPÍRITO SANTO & ISAAC (1999) affirm that zooplancton are the main food for *C. spixii* as juveniles and bivalves, shrimps, brittle stars and worms as adults. This is an omnivorous species. The large amount of taste buds found on the pharyngeal region of the arches, in the oral opening direction, suggests that chemical reception might be used to help food selection at swallowing.

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