Notes on *Stygichthys typhlops* (Characiformes; Characidae): characterization of their teeth and discussion about their diet

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The Brazilian Blind Characid, *Stygichthys typhlops* Brittan & Böhlke, 1965 is an eyeless, depigmented stygobiont endemic to southeastern Brazil. Its distribution is restricted to phreatic waters in the Rio São Francisco basin[1] in a small area of northern Minas Gerais (Jaíba municipality). *Stygichthys typhlops* is one of two stygobiotic characids described. It lacks circumorbital bones, which suggests a more advanced stage of specialization to the subterranean environment than the other characin, the Mexican Blind Cave Fish, *Astyanax mexicanus*, which retains a fragment of these bones. Loss or reduction of circumorbital bones is strongly associated with the loss of eyes among cavefish[2]. *S. typhlops* is under extreme risk of extinction due to its highly restricted distribution and the marked lowering of the water table[3] of its habitat due to water diversion for irrigation. Little is known about life history of *S. typhlops*, particularly its diet. In this study we collected data in the laboratory and in the field about the diet and feeding behavior of *S. typhlops*, and present a description of their dentition based on scanning electron microphotographs (SEM).

Ten *S. typhlops* specimens (mean = 34.4 mm, S.E. = 0.84 mm, range 18.8–47.9 mm total length) were collected in May 2008 using a handheld dip net from a natural well, which was modified for water diversion. Such wells, locally called “cacimbas”, are found in areas where the water table is close to the surface and are used by local residents as a water source. The fish were transported to the laboratory in plastic bowls (volume of 26.6 L) and kept together in one 72 L aquarium at 19–20°C in the dark. Samples of macrophytes found at the sampling locality were collected together with the fish and kept in the same aquarium. They were fed 50 grams of a dry flocculated feed (Alcon Basic) twice daily. After about 5 months, all fish had died, and the specimens were fixed in 10% formalin and placed in the ichthyological collections of the Museu de Zoologia da Universidade de São Paulo (MZUSP 108165) and Coleção Ictiológica da Universidade Federal de Lavras (CI-UFLA 0090).

Field observations revealed that *S. typhlops* eats plant matter in nature. Fragments of an aquatic macrophyte (*Elodea* sp.) found at the collection site were observed as a green mass in the stomach and intestines of several individuals (Fig. 1A–F). They also fed on macrophytes in the laboratory. *S. typhlops* also consumed animal prey, as 20 mosquito larvae placed in the aquarium were consumed in a few hours.

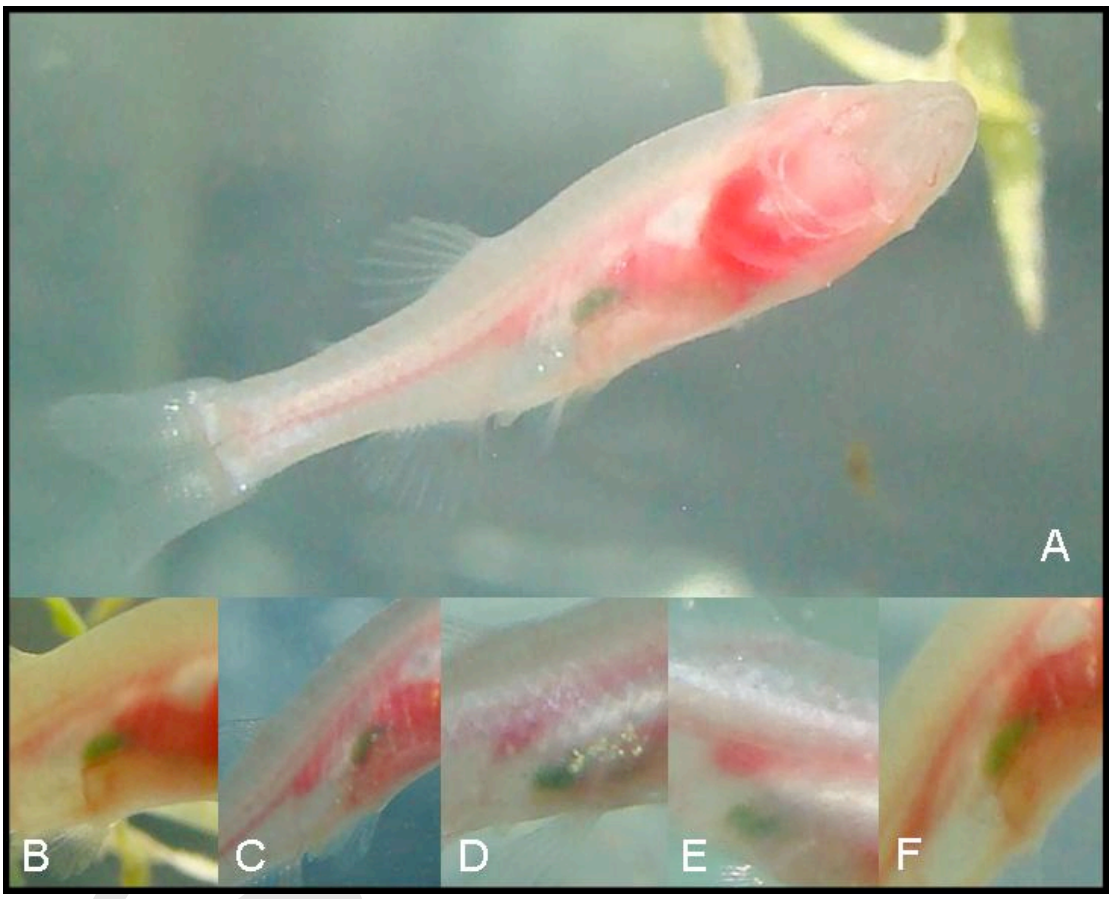

Figure 1. Plant matter (*Elodea* sp.) observed as green mass in stomachs of *Stygichthys typhlops* (A–F).

We also examined the dentition of *S. typhlops*. The upper and lower jaws were removed from one specimen (35.4 mm total length) and the bones were prepared with standard methods for examination under scanning electron microscopy[4]. Microphotographs revealed two premaxillary tooth series: an outer and an inner series. The outer left and right series each consisted of 8 uni- to tricuspid teeth, whereas the inner left and right series were asymmetrical: the left had 8 and the right 7 tri- to pentacuspid teeth (Fig. 2A–B). The anterior teeth in inner series were larger and multicuspid, with the central cusps being larger than the lateral ones (Fig. 2C), whereas the smaller posterior teeth were usually unicuspid (outer series). Maxillary teeth could not be counted because they were not visible in the microphotographs.

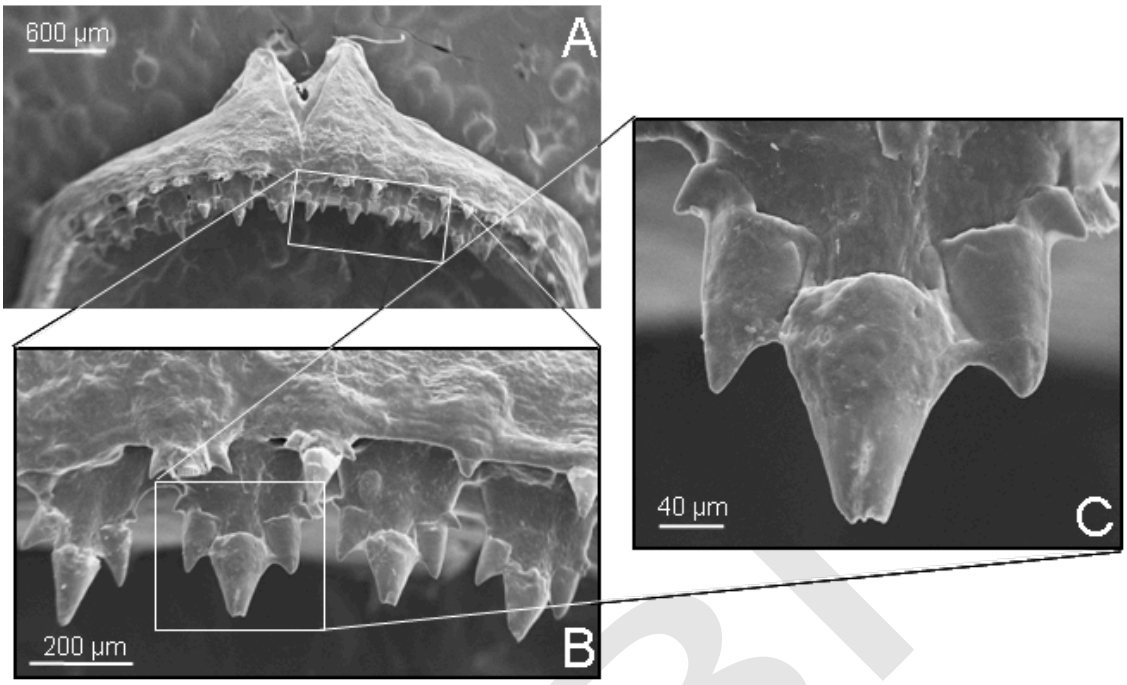

Figure 2. SEM of upper jaw of *Stygichthys typhlops*. A) View of the anterior part of the upper jaw. B) Detail of both series of teeth. C) Enlargement of a single tooth, showing the five cusps.

On the left side of the mandible there were 18 teeth (Fig. 3A): the 11 posterior-most teeth were unicuspid (Fig. 3B) and the 7 anterior-most teeth were tricuspid (Fig. 3C). On the right side there were 19 teeth: 12 unicuspids and 7 tricuspids. Similar to the inner premaxilla, the teeth changed from larger and tricuspid in the anterior to smaller and unicuspid toward the posterior.

The tooth patterns shown in this specimen of *S. typhlops* were unusual compared to other characids, especially with regard to the larger number of teeth (19) in the mandible. The terminal position of the mouth and the presence of multicuspid teeth are indications that this species feeds in the water column[1] and consumes assorted food items, which are part of an omnivorous diet. Multicuspid fish teeth are associated with leaf cutting and herbivory or omnivory in general[5]. An abundant floating layer of macrophytes can be found in the photic area of wells and *S. typhlops* may exploit this nutrient-rich resource in wells or karst windows. In addition to evidence from dentition, diet data from the field and in the laboratory showed that *S. typhlops* is omnivorous, as this fish consumed both plants (macrophytes) and animals (insect larvae) in the laboratory. In addition, ostracods have been found in the stomachs of 1/3 of the fish collected in another study[1]. Omnivory is common in fishes, particularly in Tetragonopterinae[6-9]. Although extensive use of living plant matter in subterranean environments is unlikely, *S. typhlops* might have retained the ability to consume plant matter from its now extinct surface ancestor to exploit a novel food source in an environment usually poor in such resources[10].

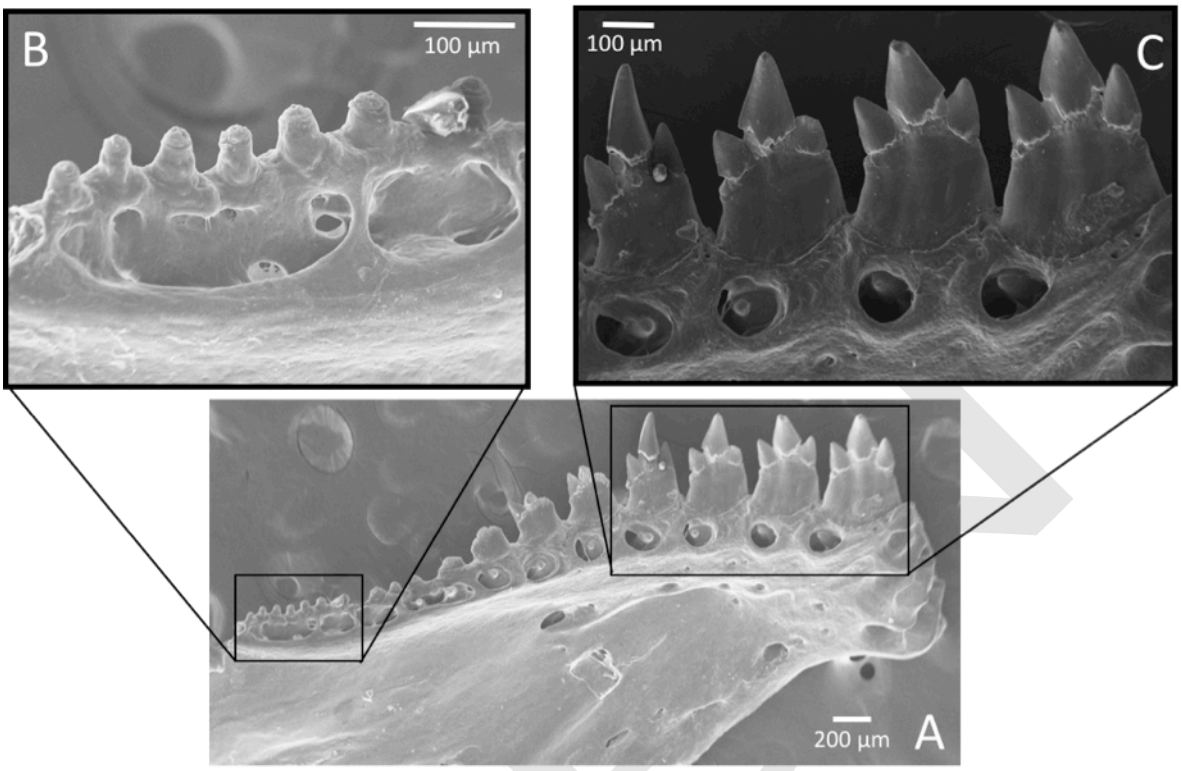

Figure 3. SEM of lower jaw of *Stygichthys typhlops*. A) View of the anterior part of the left lower jaw. B) Small teeth in the posterior margin of the left lower jaw. C) Detail of the series, showing the three cusps of each tooth.

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