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# Observations of the reduction of external gill filaments during larval development in *Heterotis niloticus*

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The arowana *Heterotis niloticus* (Cuvier, 1829) is distributed in the Sahelo-Sudanese freshwaters of West Africa (Daget & Durand, 1981; Paugy, 2003) (1) (2). Until recently included within Osteoglossidae in the subfamily Heterotidinae, this species is now considered to belong to the Arapaimidae family, along with the south american pirarucú *Arapaima gigas* (Schinz) (Ferraris, 2003) (3). Among other peculiarities, *H. niloticus* possesses externally projecting gill filaments at the earliest larval stages (Daget, 1957) (4). These gills have an endodermal origin and seem to have a purely respiratory function. Although the presence of external gills has been reported in most major groups of aquatic anamniotes, they can be observed in teleosts in only one other species, *Gymnarchus niloticus* Cuvier (Budgett, 1901; Assheton, 1907) (5) (6). In Elasmobranchs, external filaments which float in the albuminous fluid are present during the embryonic phase, before the formation of the yolk sac. They appear to have a respiration as well as a food absorption function (Bertin, 1958; Pelpster & Bemis, 1992) (7) (8). Smaller external gill filaments have been reported in Chondrosteans larvae (Bertin, 1958; Gisbert, 1999) (7) (9). Analogous gills are present in juvenile Polypterids and in the larvae of the African and South American lungfishes (Bertin, 1958; Romer & Parsons, 1986) (7) (10), but these external gills have an ectodermal origin and present a more complex structure which is very similar to those found in urodeles and caecilians. In anurans, two series of gills develop: the first consists of ectodermal external gills present at hatching. They regress and are replaced by endodermal internal gills during the tadpole stage. Finally, the branchial basket is completely resorbed during the metamorphosis (Del Conte & Sirlin, 1952; Packer, 1966; Channing, 1993) (11) (12) (13).

Samples of *Heterotis niloticus* were obtained from the Fishing and Aquaculture Institute of the University of Cheick Anta Diop (Dakar, Senegal). The fry was raised in natural conditions and collected in July 2005 and August 2005. Specimens were observed and dissected with a Leica M10 binocular microscope, and photographed with a Canon Powershot S50 camera.

At 6 hours post-hatching (PH), three branchial arches are present. Each bears several filaments of variable lengths. There is no trace of the opercular membrane and the arches are clearly visible in lateral view (Fig. 1). At 48 hours PH, gill filaments have lengthened and the opercular membrane is present. The fourth branchial arch is visible and bears some filaments. The longest filaments reach their maximal length at 72 hours PH. At this stage, the opercular membrane covers the two first branchial arches. At 96 hours PH, all the long filaments have dramatically regressed. The opercular membrane has increased in size but doesn't reach the fourth branchial arch. At 120 hours PH, all filaments have approximately the same size, and the opercular membrane completely covers the branchial basket.

The reduction of the gill filaments occurs simultaneously in all arches and appears to be progressive. There are two ways by which the obsolete tissues could be removed: it can either be lost, or it can be resorbed. In the case of a loss, the filaments would be broken at some point and the material would be freely released in the environment. In the case of a resorption, the size of the filaments would gradually decrease, as the material would be recovered to provide some energy used in the elaboration of new tissues. Here, it appears that the filaments are progressively decreasing in size after 72 hours PH until 120 hours PH, thus suggesting the occurrence of a phenomenon of resorption, with a probable recovery of the cellular material. Mechanisms of resorption that affect the whole body (involving hard and soft tissues) are already known in various teleosts during metamorphosis, such as in Carapidae (Parmentier et al., 2004) (14) and Elopomorpha (Pfeiler, 1996, 1999; Bishop & Torres, 1999) (15) (16) (17). Material resorption affecting gill tissues was previously described in anuran tadpoles (Warkentin, 2000; Brunelli et al., 2004) (18) (19), but this work is the first to highlight a similar phenomenon in teleosts at larval stage.

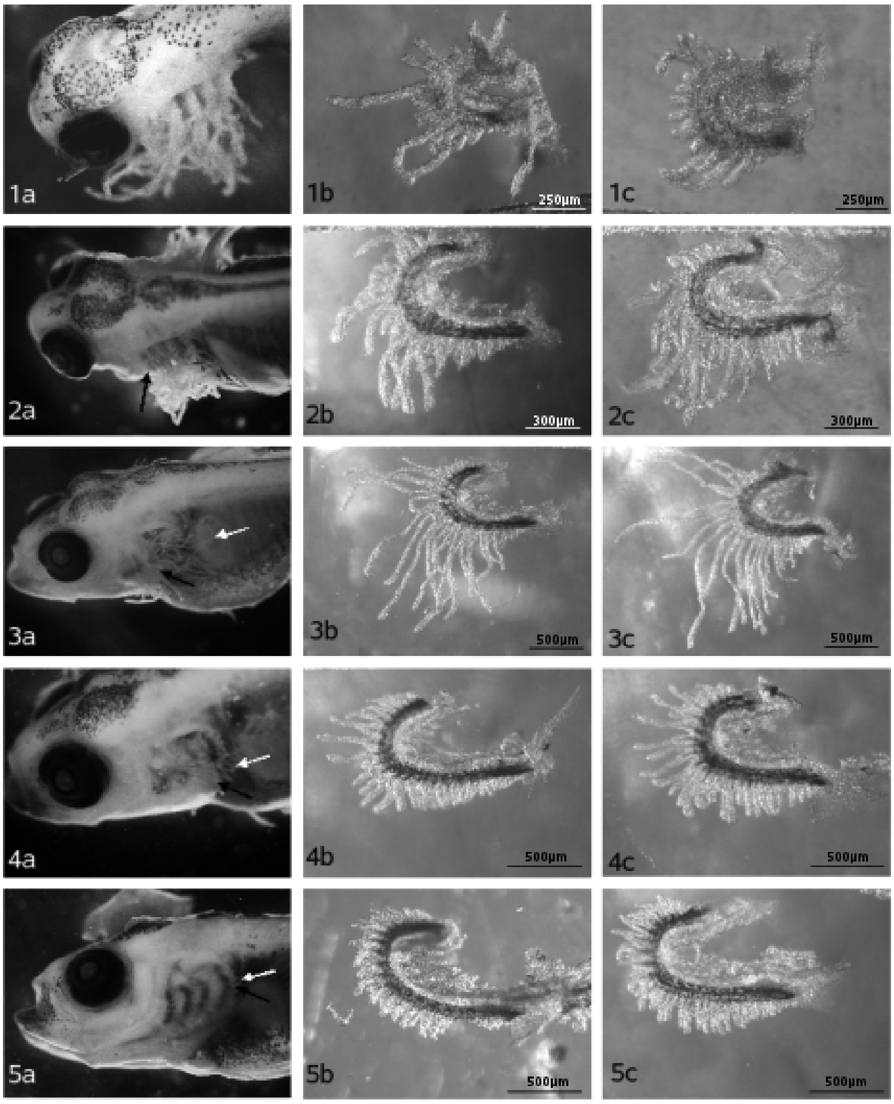


Fig. 1. – Photographs of *Heterotis niloticus* in external view (1a-5a) and of the first (1b-5b) and second (1c-5c) right branchial arch. **(1)** 6 hours PH. **(2)** 48 hours PH. **(3)** 72 hours PH. **(4)** 96 hours PH. **(5)** 120 hours PH. Black arrows show the distal tip of the opercular membrane. White arrows show the distal tip of the longest gill filament.

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