DESCRIPTION OF SOME ACCESSORY STRUCTURES OF THE UROGENITAL SYSTEM IN THE NEOTROPICAL FAMILY *ASTROBLEPIDAE* (*PISCES, SILUROIDEI*)

por

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Resumen

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Como parte de un estudio relacionado con la biología general de algunas especies del género *Astroblepus*, reportamos el hallazgo de vejiga urinaria y vesícula seminal en los machos de las especies de este grupo. También se describen e ilustran algunos rasgos del dimorfismo.

Palabras claves: Vesículas seminales, testículos, vejiga urinaria y dimorfismo sexual.

Abstract

As a part of a study concerning the general biology of some species of the genus *Astroblepus*, we report the finding of a urinary bladder and a seminal vesicle in males. We also describe and draw some sexual dimorphic features present in this group.

Key words: Seminal vesicles, testes, urinary bladder and sexual dimorphism.

Introduction

The males of the monogeneric astroblepid family have testes, each with a differentiated seminal vesicle. **Lauzanne & Loubens** (1985) implied that astroblepid species are viviparous; in contrast we have arguments to suggest that these species present a probable copulation and a particular kind of internal fecundation that does not lead to viviparism; and hence the eggs are laid under the stones after being fertilized. This study presents some data of anatomy and histology of the reproductive structures in species of this family. Some data concerning the reproductive behavior are also described.

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Materials and methods

Fifty males and forty-five females were dissected in order to describe the structure and anatomy of the reproductive organs in both sexes. External dimorphism of the copulatory organ and enlargement of the anal fin were compared and differentiated in males and females. Some specimens were treated by Dingerkus & Uhler's (1977) method to permit observation of differences in bony structure of the anal fins rays between sexes.

Histological slides were made of testes, ovaries, seminal vesicles, urinary bladder and copulating organ. The drawings were made using a stereomicroscope equiped with a camera lucida. The examined specimens were collected throughout the year.

The ninety-five studied specimens are deposited in the Instituto de Ciencias Naturales (ICN) and The Museo de la Salle (MLS), Santafé de Bogotá.

Results

Sexual dimorfism

Astroblepid males are different from females in the following features: 1.) they present a copulatory organ (figs. 1, 3 and 8c), 2.) enlargement of the anal fin represented by connective tissue (compare figs 1 to 4), 3.) the second, third, and fourth anal fin rays are more close set in males than in females; this arrangement is evident in the adult individuals (comp. figs. 5 and 6) and 4.) the third anal fin ray is thick in males (comp. fig. 5 and 6). The last two features are evident in those specimens treated with Dingerkus & Uhler's method.

The cross sections of the copulatory organ show a central mass which is a dense fibroelastic tissue with thin walls (fig. 7a). The orifice of the kidneys (urinary bladder in this case) is in the center of this mass (fig. 7b).Around of the central mass there is also a layer of diffuse tissue with many cavities or channels (fig. 7c); the function of the channels is unknown. Both tissues are joined by conective tissue (fig. 7d). The external region of the copulating organ is covered by epidermis.

Testes

According to the observations, every testis has a posterior gland that will be described later. The testes in astroblepid males, like most of the catfishes, are compacted in a solid gland (fig. 8b). They occupy the posterior region of the coelome and ventrally form a cavity in which the stomach rests at its greatest extention.

Microscopic examination of the histological sections from every portion of the testes revealed many spermatic tubes and tails of spermatozoa in the lumina (fig. 9a). The largest nuclei or spermatic cells developing into sperma-

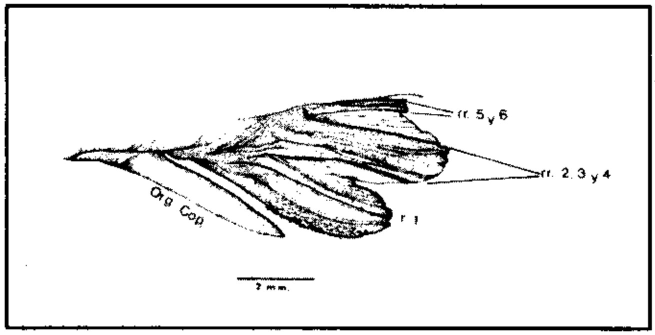

Figura 1. External appearance of the sexual dimorphism in ***Astroblepus homodon***. Org. Cop.= copulating organ, r = ray, rr = rays. Compare the external arrangement of rr 2,3 & 4 with figure 3. This feature is present in all adult males of the species of the genus ***Astroblepus***.

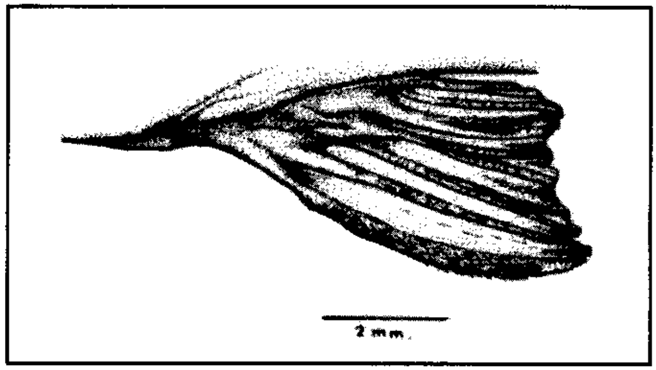

Figura 2. External appearance of the anal fin in females of ***Astroblepus homodon***. Females of all species of this genus do not have the special arrangement of the rr 2, 3 & 4. Compare and contrast with figures 1, 3, and 4.

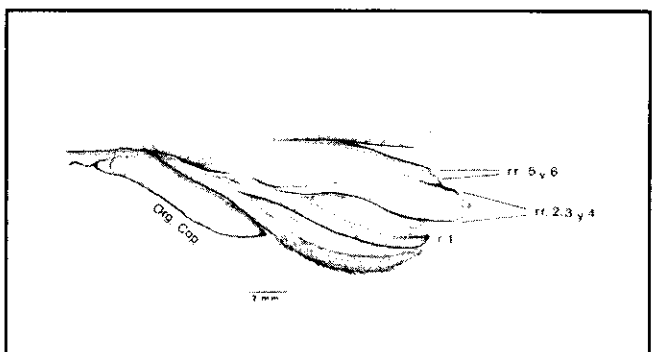

Figura 3. External dimorphism in males of ***A. longifilis***. Org. Cop. = copulating organ, r = ray, rr = rays. See explanation in the text and in figure 1.

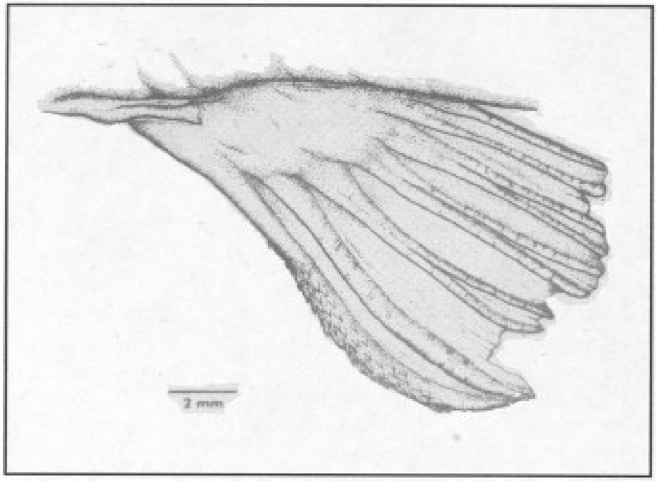

Figura 4. External morphology in females of ***A. longifilis***.

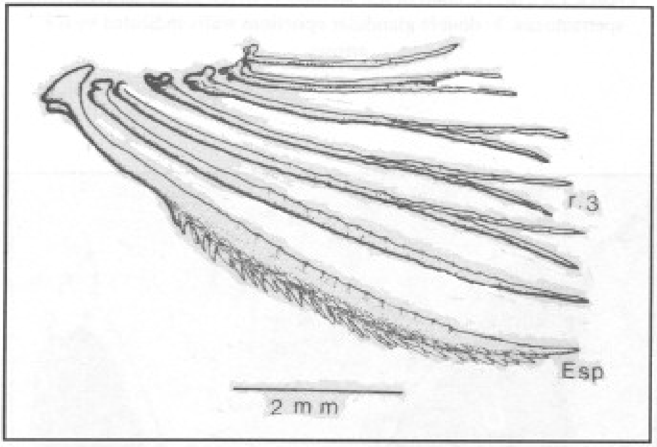

Figura 5. Bony struture of the anal fin in males. Esp = spine. r 3 = ray three. This ray is thicker than the others and considerable greater than ray 3 in females. Even more, these rays are closer in males than they are in females. Compare figures 5 & 6.

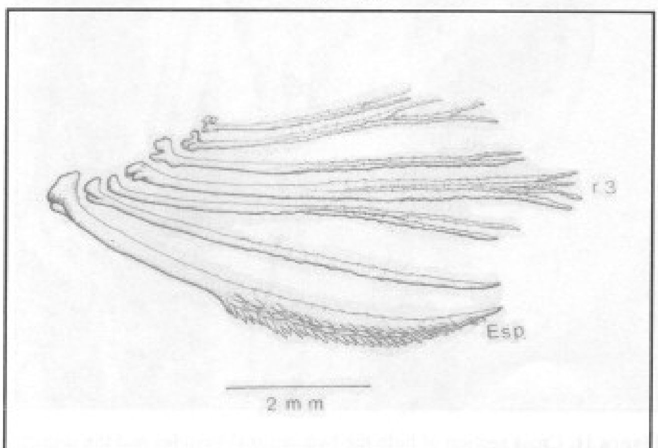

Figura 6. Bony structure in the anal fin in females. See explanations above.

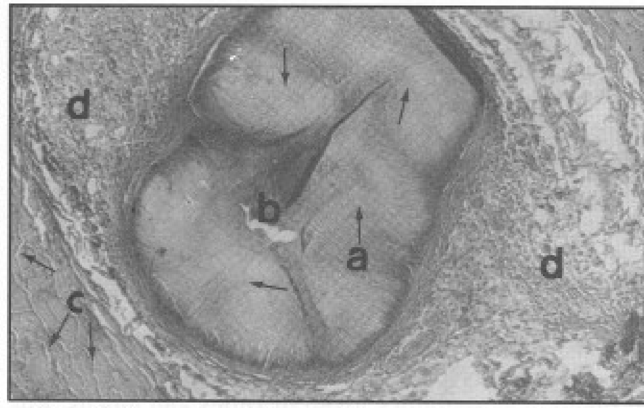

Figura 7. Cross section of the copulating organ. a: dense fibroelastic tissue, the arrows in this region indicate the thin walls. b: orifice. c: channels and d: connective tissue.

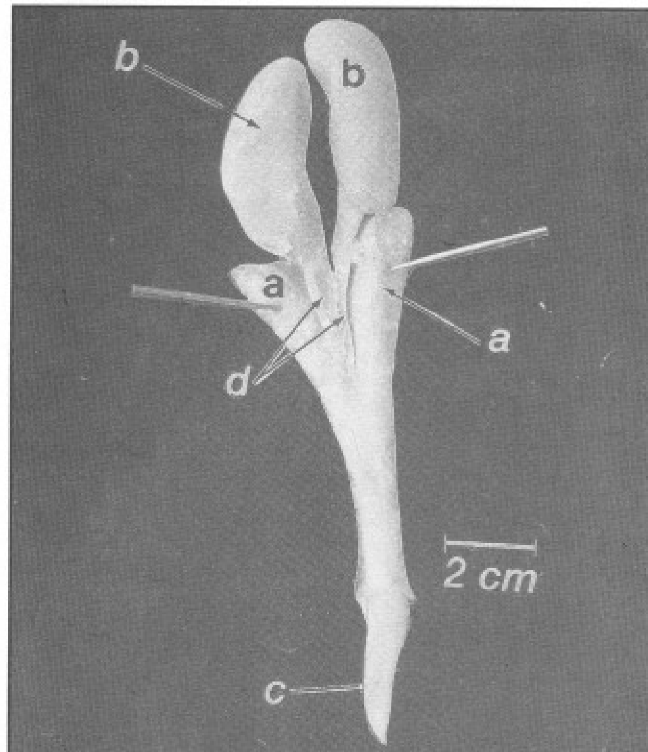

Figura 8. Ventral view of the reproductive anatomy in males. a: seminal vesicles. b: testes. c: copulating organ and d: ducts joining the testes and seminal vesicles.

tozoa surround every tube (fig. 9b); there are also other testicular elements such as cuboidal cells in an earlier stage of division (fig. 9c). Every testis has an epidermis externally as an envelope and in most of the males the left one is smaller than the right one (fig. 8b).

Seminal vesicles

A duct leaves the posterior region of every testis (fig. 8d) and goes to one seminal vesicle (8a). These glands are anteriorly extraperitoneal, and appear sponge-like. Microscopic histology observations demonstrate various crypt-like cavities, whose internal space contains motile spermatozoa (fig. 10a and 11b). A thin wall of connective tissue keeps the seminal vesicles apart (see fig. 11c and 12b). This wall is connected to the wide mesothelium of the urinary bladder. The crypts are bounded by a double glandular epithelium (fig. 10b and 11a). Apparently these epithelia perform a supplemental function as secretory gland of fluids and mucus. Additional studies are needed on this point, especially those to demonstrate the possible glandular secretions.

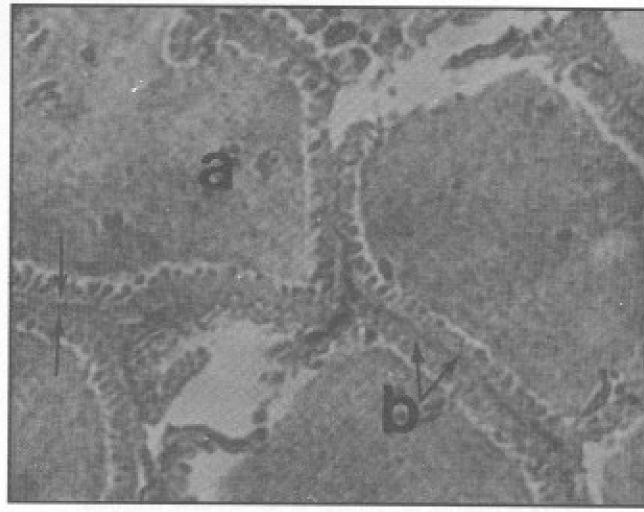

Figura 10. Cross section of the seminal vesicles. a: agglomeration of spermatozoa. b: double glandular epitelium walls indicated by the arrows.

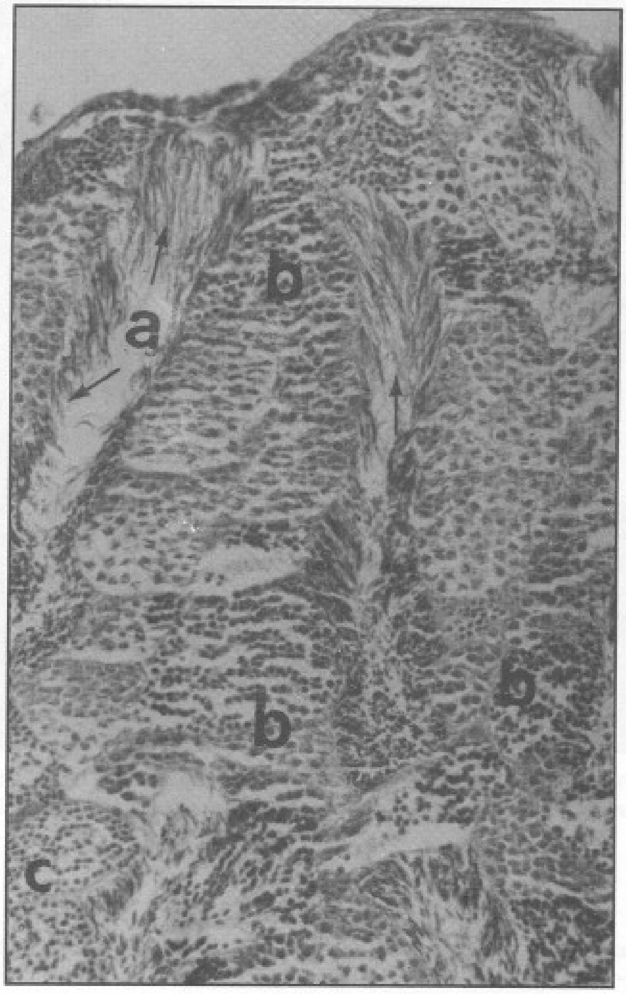

Figura 9. Cross section of the testes. a: spermatic tubes, the arrows indicate the tails of the spermatozoa. b: large nuclei. c: cells in early stage, these are identified here as cuboidal cells.

Figura 11. Cross section of both the two seminal vesicles and the urinary bladder. a: double glandular wall surrounding the agglomeration of spermatozoa (b). c: wall which separates the seminal vesicles. d: urinary bladder.

Urinary bladder

In a dorsal position to the seminal vesicle there is a translucent and distensible sac that is totally extraperitoneal. In most of the examined specimens of both sexes, this sac is large (fig. 11d, 12a and 13). According to the histology, the sac is a urinary bladder and the nephric ducs coming from the kidneys enter them anteriorly. In the cross sections, it appears as mucous folds (fig. 13b) with a superficial layer of epithelium (fig. 13a). It also is bound with conective tissue (fig. 13d) with a wide layer that appears to be a mesothelium (fig. 13c).

Discussion

According to the current literature, the presence of seminal vesicles is uncommon in fishes. In siluroideans, it is known that the genus ***Trachycorystes*** (Ihring 1937) has this structure. Althought we have not observed specimens of ***Trachycorystes***, the seminal vesicle is not independent of the testicles and makes its appearance in periods of reproduction (Burgess 1988). In contrast, once the species of ***Astroblepus*** develop the seminal vesicles, they remain functional for the rest of the life cycle and are independent of testes. Another group that has been the subject of studies in reproductive anatomy is the genus ***Gillichthys*** (Weisel 1949). The testes in this marine teleost have an accessory organ that Weisel referred to as a seminal vesicle. He did not consider it a part of the wolffian duct and therefore not homologous with seminal vesicles in mammals. It is not known if the seminal vesicles of ***Astroblepus*** species are part of wolffian duct. According to Sneed & Clements (1963), the testes in species of ***Ictaluridae*** are lobate and not compact. They also reported the presence of a sharply demarked portion in the posterior region of the testes. These lobules did not contain testicular elements (op.cit.).

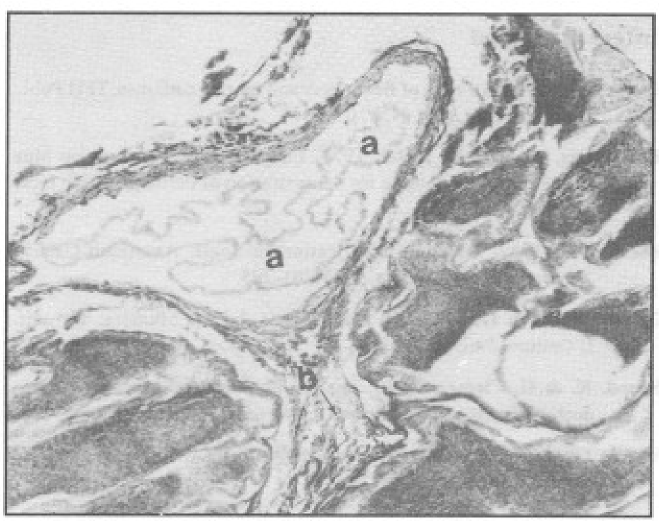

Figura 12. Cross section of a: urinary bladder and b: the wall between the seminal vesicles.

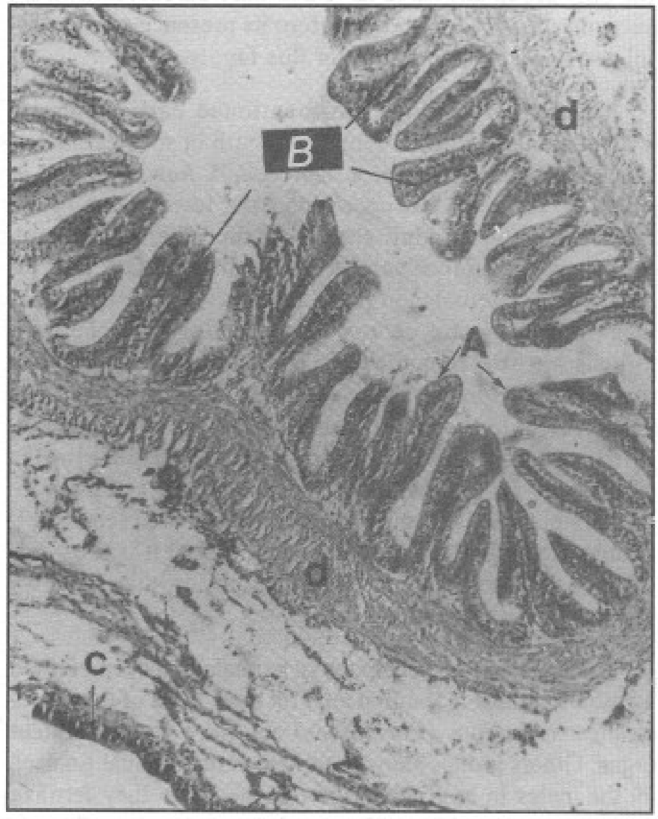

Figura 13. Cross section of the urinary bladder. a: epithelium, b: internal folds, c: mesothelium and d: connective tissue.

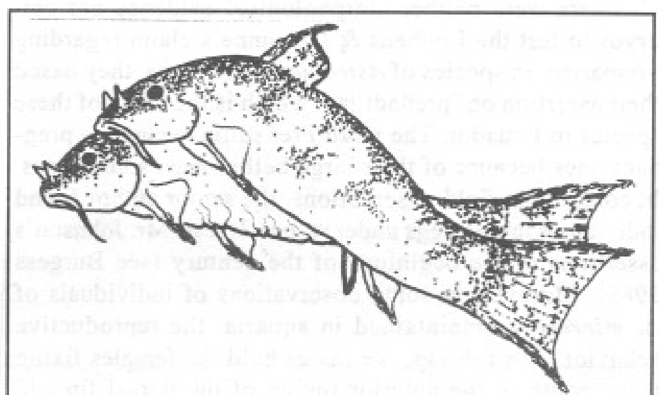

Figura 14. Diagrammatic representation of the reproductive behavior in ***Astroblepus micrescens***. This behavior could be common in all species of this genus.

A urinary bladder is uncommon as well; in ***Amia***, as in females of the ***Elasmobranchi***, each archinephric duct has its own urinary bladder. In species of ***Astroblepus***, the two nephric duct drain the kidneys into the same sac. The presence of this structure in separated evolutionary lines could be interpreted as a convergence. However, ***Astroblepus*** is the only group known to have a urinary bladder among the suborder ***Siluroidei***, and therefore its presence can be postulated as a synapomorphy for this family.

The sexual dimorphism mentioned earlier appears when the males reach 35 mm. of length in species such as ***Astroblepus micrescens, A. vanceae, A. homodon*** and ***A. guentheri.*** These species present the lowest size in the genus (50 mm. in adult stage). At this size, i.e. 35 mm, the immature individuals begin to differentiate into either males or females in those species. In the largest species (like ***A. chotae, A. rosei*** and ***A. longifilis)*** the individuals are still immature around 70 mm in length. The dimorphic features in males (i.e. the copulatory organ, the enlargement in the anal fin and the joining of the second, third and fourth anal fin rays) start to develop in synchrony. By the time the males mature, a third pore appears between the anus and urinary pores in females. It is not detected in immature specimens and it is the genital pore. In studies of internal anatomy in juveniles, we did not find differences between sexes.

Some teleosts present external genital organs represented by modifications in the first anal fin rays. Most of these species are viviparous ***(Poeciliidae)*** and have an intromittent organ. Others groups show modificated rays in anal fin used by the males to hold down the females when they fertilize the eggs. In ***Astroblepus*** the copulatory organ is well separated from the anal fin. It is unknown if this organ has the same embryological origin of the anal fin.

There were neither morphological evidence nor embryos to test the Loubens & Lauzanne's claim regarding viviparism in species of ***Astroblepus***. Perhaps, they based their assertion on "preñadillas" which is the name of these species in Ecuador. The word Preñadilla means the pregnant ones because of their large bellies seen some times. In contrast, in field observations, the senior author found individuals laying eggs under stones. It tests Mr. Johnson's assertions at the beginings of the century (see Burgess 1988). Morever, in some observations of individuals of ***A. micrescens*** maintained in aquaria, the reproductive behavior is as follows: the males hold the females fixing their mouth in the anterior region of the dorsal fin and then they (the males) curve their body forward and push the copulatory organ to make a fast contact with the genital region of the females. These observations are still not direct evidence of actual copulation (fig. 14). Since the species of this genus inhabit streams, it is certainly possible that a copulation is necessary and consequently an internal fecundation might occur.

Males collected in different periods through the year had the testes large. We observed neither seasonal changes in size nor changes in cross sections in testicular elements; they appear to be active or functional during the life cycle. However, these findings need to be tested by further studies in developmental behavior on individual and populational levels.

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