



## A new species of the genus *Notozothecium* (Monogenea, Dactylogyridae) parasitizing the gills of *Rhaphiodon vulpinus* (Cynodontidae, Characiformes) from the Paraná River, State of Paraná, Brazil

Una especie nueva del género *Notozothecium* (Monogenea, Dactylogyridae), parásita de *Rhaphiodon vulpinus* (Cynodontidae, Characiformes) del río Paraná, estado de Paraná, Brasil

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**Abstract.** During parasitological studies on different localities along the Paraná River, State of Paraná, Brazil, a new species of *Notozothecium* (Dactylogyridae) was found parasitizing gills of the freshwater fish *Rhaphiodon vulpinus* (Cynodontidae). The new species is allocated to *Notozothecium* based on the presence of a ventral bar with anteromedial projection, a copulatory complex comprising a coiled male copulatory organ (MCO) with a counterclockwise incomplete ring and accessory piece with proximal articulation process and a dextrodorsal vagina, looping the right intestinal caecum. *Notozothecium lamotheargumedoi* n. sp. is similar to *Notozothecium janauachensis*, by the absence of terminal flabellate plate on the accessory piece, but differs from it in the shape of the bars, the copulatory complex and the difference of the size-ratio between ventral and dorsal anchors, which in *N. janauachensis* is larger.

**Key words:** Monogenea, *Notozothecium lamotheargumedoi* n. sp., *Rhaphiodon vulpinus*, freshwater fish, Brazil.

**Resumen.** Durante varios estudios en diversas localidades del río Paraná, estado de Paraná, Brasil, una especie nueva de *Notozothecium* fue encontrada en los filamentos branquiales de *Rhaphiodon vulpinus*, peces de agua dulce pertenecientes a Cynodontidae. La especie nueva se asigna a *Notozothecium* con base en la barra ventral, que está provista de una proyección anteromedial, un complejo copulador que abarca un órgano copulador en espiral a la izquierda, una pieza accesoria con proceso proximal y la vagina dextrodorsal, dando la vuelta en el ciego intestinal derecho. *Notozothecium lamotheargumedoi* n. sp. se asemeja a *Notozothecium janauachensis* por la ausencia de placa flabelada terminal en la pieza accesoria; no obstante, difieren por la forma de las barras, por el complejo copulador y por la relación entre las anclas ventrales y dorsales, que en *N. janauachensis* es mayor.

**Palabras clave:** Monogenea, *Notozothecium lamotheargumedoi* n. sp., *Rhaphiodon vulpinus*, peces de agua dulce, Brasil.

### Introduction

Fish species within Cynodontidae comprise a group of very distinctive Neotropical characiforms easily recognizable by their oblique mouth, well developed dentary canines, and relatively expanded pectoral fins. The group is not very diverse with 13 species currently recognized and grouped under 2 subfamilies: the Cynodontinae and the Roestinae (Toledo-Piza, 2000). The majority of cynodontid species occur in the Amazonas and Orinoco river basins, and the rivers of the Atlantic slopes of the Guianas. *Rhaphiodon vulpinus* is the only Cynodontidae that ranges southward to the Paraná-Paraguay and

Uruguay basins. They live in middle and surface waters of rivers, lakes, and flooded forests in all water types, are predatory, mainly piscivorous fishes, using their dentary canines to stab prey. Although not much valued as food, some species may have some importance in subsistence commercial fisheries (Toledo-Piza, 2000).

*Notozothecium* was proposed by Boeger and Kritsky (1988) for 2 new species parasitizing *Serrasalmus nattereri* (Characidae). Later, Kritsky et al. (1996) emended the generic diagnosis, describing 5 new species from other characid hosts. Currently, species of *Notozothecium* are distinguishable by having a vagina looping the right intestinal caecum and opening dextrodorsally, a ventral bar with an anteromedial projection and a copulatory complex comprising a counterclockwise coiled copulatory organ

and accessory piece with distal rod. Belmont-Jégu et al. (2004) described another species, *N. janauachensis*, from *Colossoma macropomum*.

Domingues and Boeger (2005) reported undetermined species of Monogenea from the cynodontid *Hydrolicus scomberoides*; to date, no other monogenean species have been described or reported from members of Cynodontidae.

During studies on different localities of the Paraná River, State of Paraná, Brazil, a new species of *Notozothecium* was found parasitizing the gills of the cynodontid freshwater fish *Rhaphiodon vulpinus*.

## Material and methods

Fishes were obtained from the Paraná River in the localities of Foz do Iguaçu, Santa Helena, Guaira, inside and outside of the reservoir of the Itaipu Hydroelectric Power Station, State of Paraná, Brazil. The gills were removed and placed in bowls containing 1:4000 formalin solution and shaken. In the laboratory, the parasites were collected with the aid of a dissecting microscope and stored in 4% formalin. Some specimens were mounted unstained in Hoyer's medium for study of the sclerotized parts and others were stained with Gomori's trichrome and Langeron's alcoholic acid carmine, cleared in beechwood creosote and mounted in Canada balsam as permanent slides. All measurements are in micrometres; the range is followed by the mean in parentheses and the number of specimens measured when more than 2. Numbering of hook pairs follows Mizelle (1936). Holotype and paratypes are deposited in the Helminthological Collection of Instituto Oswaldo Cruz (CHIOC), Rio de Janeiro, Brazil.

## Description

*Notozothecium lamotheargumedei* n. sp. (Figs. 1-6)

Body 615 (520-750; n=13) long by 181 (140-225; n=19) wide. Tegument smooth. Cephalic lobes well developed. Eyes 4: posterior pair developed slightly farther than anterior pair. Pharynx spherical 39 (32-50; n=23) long by 38 (30-47; n=23) wide. Haptor subhexagonal with anchors dissimilar in size and similar in shape: ventral anchor larger than dorsal, each with well developed superficial root, prominent deep root, elongate and curved shaft, elongate point. Ventral anchor 52 (43-61; n=63) long; dorsal anchor 47 (37-55; n=46) long. Ventral bar arcuate, 98 (74-122; n=49) long, with anteromedial projection and slightly enlarged terminations. Dorsal bar 82 (62-100; n=39) long, straight with recurved ends. Haptor with 7 pairs of

hooks with ancyrocephaline distribution. Hooks 2-4 and 6-7 similar in size, hooks 1 and 5 reduced, each with erect thumb, recurved shaft, short point, shank comprising 2 subunits, proximal subunit expanded. Filamentous Hooklet (FH) loop extending to union of shank subunits. Pair 1: 25 (20-30; n=55); pair 2: 45 (37-52; n=26); pair 3: 47 (42-55; n=17); pair 4: 50 (42-60; n=17); pair 5: 24 (21-26; n=33); pair 6: 47 (42-55; n=26); pair 7: 48 (40-55; n=27) long. Copulatory complex comprising a counterclockwise coiled copulatory organ with an incomplete ring. Accessory piece long, rod-like, with a prominent median thumb, distally hooked, articulated to cirrus base by a proximal process. Gonads clearly overlapping, testes dorsal to germarium, seminal vesicle elongate 49 (36-60; n=14) long, a dilation of vas deferens; 2 prostatic reservoirs lying beneath the copulatory organ; vas deferens looping left intestinal caecum. Germarium elongate. Seminal receptacle present; vagina looping right intestinal caecum, opening on dextrodorsal surface. Vitelline follicles in 2 bilateral fields of trunk, from pharynx to the level of haptor, coextensive with intestinal caeca. Single egg was observed in one specimen, measuring 75 long by 63 wide. Oviduct and ootype not observed.

## Taxonomic summary

*Type-host:* *Rhaphiodon vulpinus* Agassiz, 1829 (Cynodontidae).

*Site of infection:* gills.

*Type-locality:* Paraná River inside and outside of the reservoir of Itaipu Hydroelectric Power Station in the localities of Foz do Iguaçu (25°32'52''S, 54°35'17''W), Santa Helena (24°51'37''S, 54°19'58''W) and Guaira (24°04'48''S, 54°15'21''W), State of Paraná, Brazil.

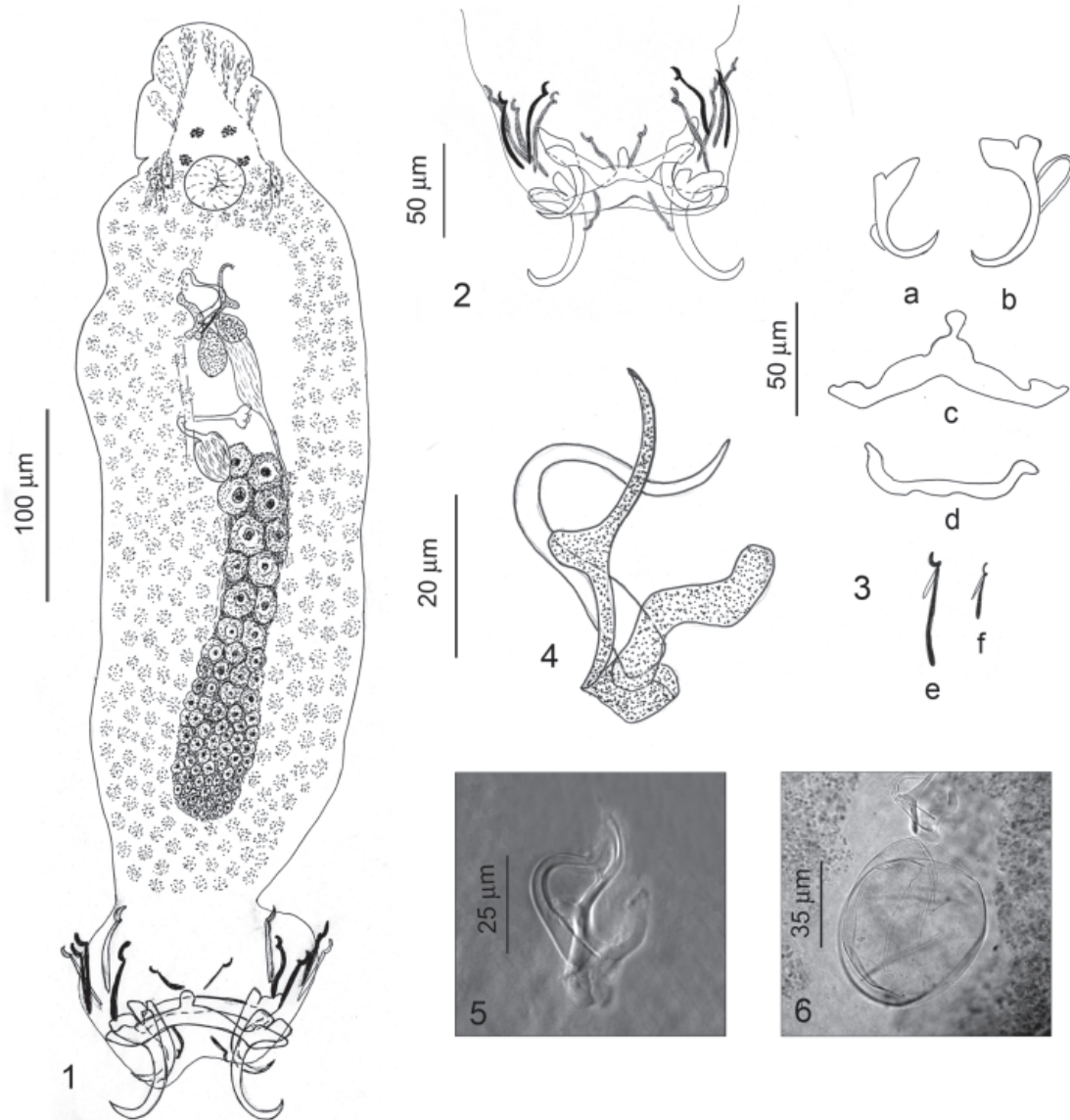
*Prevalence:* 34% (16 of 47 fishes examined).

*Type-specimens:* holotype and paratypes deposited in CHIOC (no. 36.895-36.901).

*Etymology:* the new species is in honour of Dr. Rafael Lamothe Argumedeo for the 50 years dedicated to description of helminth biodiversity from Mexico.

## Remarks

Regan (1911) included the fishes belonging to the Cynodontinae within Characidae, together with Characinae and Serrasalminae, among others. Greenwood et al. (1966) excluded Cynodontinae from the Characidae and placed it in its own family, the Cynodontidae. However, no further information was given concerning their relationships of this latter family with other Characiformes. Regarding helminth parasites, only species of Nematoda and Cestoda



**Figures 1-6.** *Notozothecium lamotheargumedei* n. sp. 1, total, ventral. 2, haptoral sclerites, dorsal. 3, a- dorsal anchor, b- ventral anchor, c- ventral bar, d- dorsal bar, e- hook pairs 2-4, 6, 7, f- hook pairs 1. 4, copulatory complex, dorsal. 5, photomicrography of copulatory complex. 6, photomicrography of an egg.

have been reported from *R. vulpinus*.

Boeger and Kritsky (1988) erected *Notozothecium* for their 2 new species, *N. penetratum* and *N. minor*, from the “piranha” *Serrasalmus nattereri* (Characidae), based on the presence of a coiled copulatory organ and a single vagina looping the right intestinal caeca. Subsequently, Kritsky et al. (1996) emended *Notozothecium*, including some characters (i.e., ventral bar with anteromedial projection and a copulatory complex comprising a counterclockwise coiled copulatory organ and accessory piece with proximal

articulation process, distal rod and terminal flabellate plate) in order to distinguish the species of this genus from species from other genera. These latter authors also described 5 new species of *Notozothecium* from Brazil parasitizing characid hosts. More recently, Bélmont-Jegu et al. (2004) described *N. janauachensis* from *Colossoma macropomum* and distinguished it from other congeneric species by the absence of a terminal flabellate plate on the distal rod of the accessory piece.

The new species presented here is allocated to

*Notozothecium* based on the main characters of the genus presented by Boeger and Kritsky (1988) and Kritsky et al. (1996), i.e., vagina dextrodorsal, looping the right intestinal caecum and anteromedial projection on ventral bar. *Notozothecium lamotheargumedei* n. sp. is similar to *N. janauachensis* by lacking a terminal flabellate plate on the accessory piece. It differs from the latter species in the shape of the bars (ventral bar robust with short digitiform anteromedial process, enlarged terminations, dorsal bar delicate, broadly u-shaped, with enlarged terminations vs ventral bar arcuate and dorsal bar straight, with recurved ends in *N. lamotheargumedei* n. sp.), copulatory complex (copulatory organ a coil of about one ring, base cone shaped with sclerotized margin, distal extremity with a long lateral extension pointed, feather-shaped. In the new species the accessory piece is short and wide, uniting with the proximal end of the distal rod, the distal rod is slightly sigmoid; the mail copulatory organ is a broadly hook-shaped subterminal flap vs. a coiled male copulatory organ counterclockwise incomplete ring. The accessory piece is long, rod-like, with a prominent median thumb, distally hooked, articulated to the cirrus base by a proximal process in *N. lamotheargumedei* n. sp.), and the size-ratio between ventral and dorsal anchors is different, in *N. janauachensis* it is greater than in the new species.

Species of *Notozothecium* have been reported from some Characiformes hosts (Characidae, Serrasalminidae), suggesting that the studies of the structure of parasite communities of these monogeneans may be a useful tool for phylogenetic studies among these teleostean fishes.

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