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Neotropical Monogenoidea. 40. *Protorhinoxenus prochilodi* gen. n., sp. n. (Monogenoidea: Ancyrocephalinae), parasite of *Prochilodus lineatus* (Characiformes: Prochilodontidae) from South Brazil

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Abstract. The monotypic *Protorhinoxenus* gen. n. is proposed to accommodate a species with the following characteristics: 1) tubular sclerotised vagina, 2) vaginal pore dextrolateral, 3) ventral and dorsal anchors with undifferentiated elongate shaft and base (representing approximately $^{2}/_{3}$ of the length of anchor), and 4) superficial and deep roots of ventral and dorsal anchors lacking. *Protorhinoxenus prochilodi* sp. n. is described from the gills of *Prochilodus lineatus* (Valenciennes) of the Represa Capivari-Cachoeira, Municipality of Campina Grande do Sul, metropolitan area of Curitiba, Paraná. Specimens of other probable new species of *Protorhinoxenus* are reported from *Prochilodus lineatus* of the Rio Paranapanema, Municipality of Salto Grande, São Paulo; *Hoplias* spp. of the Rio Dois de Fevereiro, Municipality of Antonina, Paraná, and the Rio Piraquara, metropolitan area of Curitiba, Paraná; *Leporinus elongatus* Valenciennes of the Rio Tibagi, Municipality of Jataizinho, Paraná; and *Schizodon fasciatum* Agassiz of the Rio Solimões, island of Marchantaria, near Manaus, Amazonas. *Protorhinoxenus* appears to be a sister group of *Rhinoxenus* Kritsky, Boeger et Thatcher, 1988 based on the following apparent synapomorphies: 1) ventral and dorsal anchors lacking superficial and deep roots, 2) ventral and dorsal anchors with elongate shaft, and 3) male copulatory organ with counterclockwise rings.

During a study of gill parasites of characiform fishes of the Neotropical Region, specimens of a new species of Monogenoidea were collected from *Prochilodus lineatus* (Valenciennes) (Prochilodontidae). This species is described here as the only member of a newly proposed genus of Ancyrocephalinae. Species of other families of Characiformes are also reported as hosts of other apparent new species of the new genus.

MATERIALS AND METHODS

Hosts were collected with cast or gill nets from several locations in Brazil (as indicated below). Gill arches and the contents of the nasal cavities were placed in vials containing formalin 1 : 4000. After 1 h, each vial was vigorously shaken and formalin was added to obtain a 5% solution. In the laboratory, the contents of each vial were examined under a dissecting microscope and the helminths were collected with the aid of probes. Some specimens were stained with Gomori's trichrome (Humason 1979) for study of internal morphology; others were mounted in Hoyer's medium (Humason 1979) for study of the sclerotised parts, as described by Kritsky et al. (1986). Measurements, in micrometres, were obtained with an ocular micrometer; the average is followed by the range and the number of measured structures (n) in parentheses. All measurements follow the procedure of Kritsky et al. (1986). Illustrations were prepared with the aid of a camera lucida attached to a phase-contrast microscope. Type specimens and vouchers are deposited in the parasite collections of Coleção Helmintológica do Instituto Oswaldo Cruz (CHIOC), Rio de Janeiro, RJ, Brazil; Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, AM, Brazil; U.S. National Parasite Collection (USNPC), Beltsville, Maryland, USA; Institute of Parasitology, Academy of Sciences of the Czech Republic, České, Budějovice, Czech Republic (IPCR), as indicated in the description section.

RESULTS

POLYONCHOINEA Bychowsky, 1937
Dactylogyridae Bychowsky, 1933
Ancyrocephalinae Bychowsky, 1937

Protorhinoxenus gen. n.

Diagnosis. Body divided into cephalic region, trunk and haptor; peduncle inconspicuous. Tegument lacking scales or spines. Eyes 4. Pharynx muscular, glandular; intestinal caeca 2, confluent in posterior trunk, lacking diverticula. Gonads overlapping; testis dorsal to germarium. Common genital pore near bifurcation of caeca. Vas deferens apparently looping left caecum; seminal vesicle a dilation of vas deferens. Copulatory complex comprising sclerotised male copulatory organ and accessory piece; male copulatory organ a coiled tube with counterclockwise rings (Kritsky et al. 1985), base inflated; accessory piece articulated with base of male copulatory organ by copulatory ligament. Seminal receptacle anterior to germarium. Vagina sclerotised; vaginal aperture simple,

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dextrolateral; vaginal vestibule present, with non-sclerotised wall. Vitellaria follicular. Haptor with 14 hooks with ancyrocephaline distribution (Mizelle 1936), comprising shank of two subunits; ventral and dorsal bar; pair of ventral and dorsal anchors; anchors with shaft and base undifferentiated, lacking superficial, deep roots. Parasites of gills of Neotropical characiform fishes.

E t y m o l o g y : The generic name is from the Greek (*proto* = first, original + *rhin/o* = nose + *xen/o* = guest) and refers to the proposed close phylogenetic relationship of the new genus to *Rhinoxenus* Kritsky, Boeger et Thatcher, 1988, a genus with species that parasitise the nasal cavities of characiform fishes, and the hypothesis that the gill filament is likely the site of parasitism of the ancestor for both genera (see below).

T y p e s p e c i e s : *Protorhinoxenus prochilodi* sp. n. from *Prochilodus lineatus* (Valenciennes, 1836) (Characiformes: Prochilodontidae).

O t h e r s p e c i e s : *Protorhinoxenus* spp. from *Prochilodus lineatus* (CHIOC 34544A-34544B), Rio Paranapanema, Municipality of Salto Grande, São Paulo (April 1993); *Hoplias* spp. (CHIOC 34546-34547-34548; INPA 415; IPCR M-366), Rio Dois de Fevereiro, Municipality of Antonina, Paraná (July 1994) and Rio Piraquara, metropolitan area of Curitiba, Paraná (July 1992 and May 1998); *Leporinus elongatus* Valenciennes (CHIOC 34545), Rio Tibagi, Municipality of Jataizinho, Paraná (June 1997); *Schizodon fasciatum* Agassiz (USNPC 79264), Rio Solimões, Ilha da Marchantaria, near Manaus, Amazonas (September 1983).

Protorhinoxenus prochilodi sp. n. Figs. 1-9

Description (based on 4 specimens): Body 459 (n = 1) long; greatest width 100 (n = 1) at midlength. Cephalic lobes poorly developed or absent; 3 pairs of head organs; unicellular, bilateral cephalic glands lateral, posterolateral to pharynx. Accessory eye granules oval, infrequently scattered in cephalic area. Pharynx oval, 23 (n = 1) in diameter. Haptor trapezoidal, 112 (n = 1) long, 186 (n = 1) wide. Ventral anchor 171 (145-186; n = 3) long, base 44 (40-49; n = 3) wide; base with sclerotised cap projection for articulation with ventral bar; shaft+base long, straight; point short. Dorsal anchor 114 (n = 2) long, base 8 (8-9; n = 2) wide, with shaft+base long, straight, point short. Ventral bar 73 (61-85; n = 2) long, flattened, with anterior margin bent backwards. Dorsal bar 37 (n = 1), with small anterolateral projections. Hooks similar, with erect thumb, shaft and evenly curved point; proximal half of shank dilated. Hook pair 2, 26 (24-28; n = 3) long; hook pair 3, 62 (60-63; n = 2) long; hook pairs 4, 5 and 6, 54 (47-57; n = 6) long; hook pairs 1 and 7, not measured. Male copulatory organ sclerotised, a coiled tube with approximately 5 rings, bulbous base; greatest ring diameter 24 (22-28; n = 3). Accessory piece with wide distal portion, serving as guide to male copulatory organ; copulatory ligament heavily coiled, passing within rings of male copulatory organ. Testis 35 (n = 1) long, 33 (n = 1) wide; seminal vesicle pyriform. Germarium 71 (n = 1) long, 35 (n = 1) wide. Ootype not observed. Vagina sclerotised, comprising proximal bulb and elongate coiled sclerotised tube. Seminal receptacle pyriform, 53 (n = 1) long. Vitellaria coextensive with caeca; vitelline commissure anterior to germarium. Eggs not observed.

T y p e h o s t : *Prochilodus lineatus* (Valenciennes, 1836) (Characiformes: Prochilodontidae).

S i t e o f i n f e s t a t i o n : Gill filaments.

T y p e l o c a l i t y : Represa Capivari-Cachoeira, Municipality of Campina Grande do Sul, metropolitan area of Curitiba, Paraná (May and June 1995).

S p e c i m e n s s t u d i e d : holotype, CHIOC 34542; 1 paratype, CHIOC 34543; 1 paratype, INPA 414; 1 paratype, IPCR M-366.

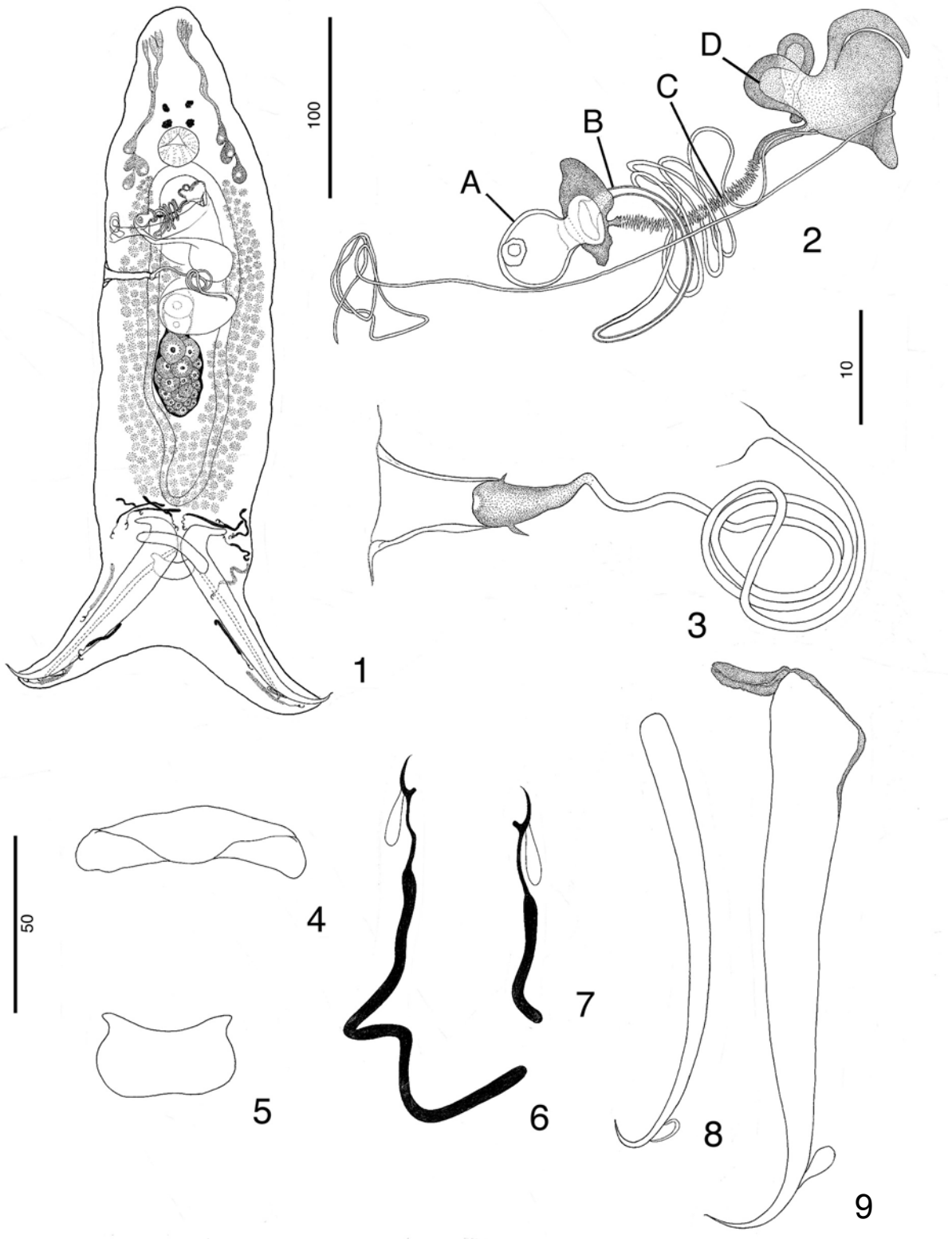
E t y m o l o g y : The specific epithet refers to the genus of the fish host.

DISCUSSION

Protorhinoxenus prochilodi is a member of Ancyrocephalinae (sensu Kritsky and Boeger 1989) based on the anatomy of internal organs, and morphology and number of haptoral sclerites. The new genus is characterised by and distinguished from other genera of the subfamily by the combination of the following features: 1) a tubular sclerotised vagina, 2) vaginal pore dextrolateral, 3) ventral and dorsal anchors with elongate shaft and base (representing approximately $^{2}/_{3}$ of the length of the anchor), and 4) superficial and deep roots of ventral and dorsal anchors lacking.

Although *Protorhinoxenus* is being proposed as monotypic, specimens of additional candidate species of this genus have been collected from two species of anostomid, one erythrinid and one prochilodontid hosts from distinct areas in Brazil. However, the small number of specimens available for each parasite form hinders the recognition of their taxonomic status and description. Some, however, are expected to represent new species of *Protorhinoxenus* based on the evolutionary distance of their hosts. Comparative measurements of sclerotised structures of all these specimens are presented in Table 1.

Kritsky et al. (1988) report one undescribed species of *Rhinoxenus* Kritsky, Boeger et Thatcher, 1988 from the nasal cavities of *Schizodon fasciatum* (Anostomidae) (USNPC 79264). However, the study of these specimens indicates that they also represent an additional candidate species of *Protorhinoxenus*. Kritsky et al. (1988) suggest that the nasal cavities of the hosts are the specific site of infestation for this parasite. However, since no specimen has been collected from the nasal cavities in the present study, we propose that the site of infestation of these parasites are the gill filaments and that their finding in the nasal cavities is accidental.



Figs. 1-9. *Protorhinoxenus prochilodi* sp. n. **Fig. 1.** Holotype (ventral). **Fig. 2.** Male copulatory organ. **Fig. 3.** Vagina. **Fig. 4.** Ventral bar. **Fig. 5.** Dorsal bar. **Fig. 6.** Hook pairs 1, 3-7. **Fig. 7.** Hook pair 2. **Fig. 8.** Dorsal anchor. **Fig. 9.** Ventral anchor. Scale bars: Fig. 1 = 100 μm; Figs. 2, 3, 6, 7 = 10 μm; Figs. 4, 5, 8, 9 = 50 μm. A – base of the male copulatory organ; B – male copulatory organ; C – copulatory filament; D – accessory piece.

Table 1. Comparative measurements (in micrometres) of sclerotised structures of specimens of *Protorhinoxenus* spp. from four characiform hosts (collected at distinct localities; see Diagnosis of the genus).

	Prochilodus lineatus *	n	*Hoplias* spp.	n	*Leporinus elongatus*	n	*Schizodon fasciatum* **	n
Copulatory organ								
Ring diameter	34	1	25 (25-26)	2	33	1	20	1
Ventral anchor								
Length	125	1	181 (169-190)	3	181	1	220	1
Base width	47	1	64 (58-73)	3	54	1	62	1
Dorsal anchor								
Length	108	1	165 (155-176)	2	167	1	-	-
Base width	10	1	11 (11-12)	3	11	1	8	1
Bar length								
Ventral	80	1	121 (115-130)	3	91	1	-	-
Dorsal	-	-	47 (38-55)	2	-	-	-	-
Hook length								
Pair 1	-	-	-	-	-	-	-	-
Pair 2	-	-	44	1	-	-	-	-
Pair 3	60	1	45	2	45	1	-	-
Pair 4	59	1	-	-	-	-	-	-
Pair 5	56	1	42 (40-43)	2	40	1	-	-
Pair 6	-	-	-	-	-	-	-	-
Pair 7	-	-	-	-	-	-	-	-

* Locality: Rio Paranapanema, Municipality of Salto Grande, São Paulo.
***Protorhinoxenus* sp. from *S. fasciatum* was reported as *Rhinoxenus* sp. by Kritsky et al. (1988).

Rhinoxenus and *Protorhinoxenus* are apparently sister genera, as suggested by the following synapomorphies: 1) ventral and dorsal anchors with superficial and deep roots lacking, 2) elongate shaft, and 3) male copulatory organ with counterclockwise rings. No other ancyrocephaline presents these characteristics concomitantly, supporting the proposed sister-group relationship. However, species of the new genus can be easily differentiated from *Rhinoxenus* spp. by having 1) dorsal bar (absent in *Rhinoxenus* spp.) and 2) vaginal aperture dextrolateral (sinistral in *Rhinoxenus* spp.).

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