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THE MORPHOLOGY OF *TEREANCISTRUM PARANAENSIS* (DACTYLOGYRIDAE) INFECTING *SCHIZODON INTERMEDIUS*, WITH A KEY TO THE SPECIES

NUEVOS DATOS EN LA MORFOLOGÍA DE *TEREANCISTRUM PARANAENSIS* (DACTYLOGYRIDAE) INFECTANDO *SCHIZODON INTERMEDIUS* CON LA INCLUSIÓN DE UNA CLAVE PARA EL GÉNERO

NOVOS DADOS SOBRE A MORFOLOGIA DE *TEREANCISTRUM PARANAENSIS (DACTYLOGYRIDAE)* INFECTANDO *SCHIZODON INTERMEDIUS* COM A INCLUSÃO DE UMA CHAVE PARA O GÊNERO

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ABSTRACT

The occurrence and new morphological data of *Tereancistrum paranaensis* Karling, Lopes, Takemoto & Pavanelli, 2014 from the gills of *Schizodon intermedius* Garavello and Britski, 1990 in the Veados river, Municipality of Itatinga, São Paulo State, Brazil are reported. Our specimens vary from those previously described in the following structures: ventral and dorsal bars, prostatic reservoir and vagina. Moreover, the measurements of specimens collected in this study, show differences from specimens collected from Paraná river floodplain. This is the first record of *T. paranaensis* in São Paulo State, with *S. borellii* as new host. A key to species of this genus is included.

Keywords: Monogenea - morphologic analysis - Paraná river - piava - Trematoda - Veados river

RESUMO

Neste trabalho, registramos a ocorrência e novos dados morfológicos de *Tereancistrum paranaensis* Karling, Lopes, Takemoto & Pavanelli, 2014 coletados das brânquias de *Schizodon intermedius* Garavello and Britski, 1990 do rio dos Veados, município de Itatinga, Estado de São Paulo, Brasil. Nossos espécimes apresentam diferenças em relação aos espécimes previamente descritos nas seguintes estruturas: barras Ventral e Dorsal, reservatório prostático e vagina. Além disso, as medidas dos espécimes coletados neste estudo apresentam algumas diferenças em relação aos espécimes coletados na planície de inundação do rio Paraná. Este é o primeiro registro de *T. paranaensis* no Estado de São Paulo, com *S. borellii* como um novo hospedeiro. Uma chave para as espécies deste gênero foi incluída.

Palavras-chave: Análise morfológica – Monogenea – piava – rio Paraná – rio Veados – Trematoda.

INTRODUCTION

Despite the importance of Monogenea in pisciculture, this group of parasites is not well known in Brazil (Kohn & Santos, 1989). Currently in according to Cohen *et al.* (2013) the total number of monogenean species known in Brazil is 437. Based on the limited knowledge of the richness of the group, the studies of the taxonomy of Monogenea are still essential.

The Jurumirim dam is the first reservoir in cascade of Paranapanema River, and operates as a reservoir for regulating other downstream. The reservoir was built in the late 1950 and began in operation in 1962 (Henry & Nogueira, 1999). Its drainage area covers 17,800 km^2, having ten tributaries on its right margin and seven on the left margin (Carvalho, 2009). The Veados river is located in the following geographical coordinates (23º15'42.4"S; 48°37'27.6"W).

The genus *Tereancistrum* Kritsky, Thatcher & Kayton (1980) includes Neotropical fish parasites and is characterized mainly by presenting spatulate sclerites associated with the ventral anchors (Kristsky *et al.*, 1980). To date, eight species of this genus were recorded parasitizing the gills of Neotropical fishes: *Tereancistrum kerri* (Kritsky *et al.*, 1980), 1980 in *Brycon melanopterus* (Cope, 1872), *Tereancistrum ornatus* (Kritsky *et al*., 1980) in *Prochilodus reticulatus* (Valenciennes, 1850), *Tereancistrum parvus* (Kritsky *et al*., 1980), in *Leporinus fasciatus* (Bloch, 1794) *Tereancistrum toksonum* (Lizama *et al.*, 2004) and *Tereancistrum curimba* (Lizama *et al*., 2004) in *Prochilodus lineatus* (Valenciennes, 1837), *Tereancistrum arcuatus* (Cohen *et al.*, 2012) in *Salminus brasiliensis* (Cuvier, 1816), *Tereancistrum pirassununguensis* (Cepeda *et al*., 2012) in *Prochilodus lineatus* and *Tereancistrum paranaensis* (Karling *et al.*, 2014) in *Schizodon borellii* (Boulenger, 1900). *Schizodon intermedius* (Boulenger 1900), popularly known as "piava", is a fish of the order Characiformes. Its distribution area comprises the South America: Upper Paraná River basin (Froese & Pauly, 2010). This species is classified in red category of IUCN (International Union for Conservation of Nature) (IUCN, 2014).

In this paper, we provide new information on the geographical location, new host, and complementary morphological data on *T. paranaensis* on the basis of specimens collected in *S. borellii* and also a key for identification of the species in this genus.

MATERIAL AND METHODS

In 2012, 10 specimens of *Schizodon intermedius* (Garavello & Britski, 1990) were collected for the study of monogeneans from the Veados river (23º15'42.4"S; 48°37'27.6"W) in the municipality of Itatinga, São Paulo State, Brazil, under number collection license DEFOP 96/1988. Fish were collected using nylon monofilament gill nets with mesh sizes of 3 to 14 cm at 3 sites on the river. The nets were deployed at 1700 and removed at 0700 the following day for a total exposure time of 14 h. Each fish was placed in separate plastic bags and kept in coolers until necropsy. The gills were removed and the gill arches were separated, then placed in a vial and flooded with hot water (60° C to 70° C). The vial was vigorously shaken to detach parasites from the gills. After 1 h, absolute alcohol was added to the vials in order to fix the monogeneans.

Some specimens were stained with Gomori's trichrome and mounted with Canada balsam and others were mounted using Gray and Wess' medium (Humason, 1979) for the study of sclerotized structures. Differential interference contrast microscopy (Leica DMLB 5000, Leica Microsystems, Wetzlar,

Germany) was used for the morphologic examination. Measurements were obtained using a computerized image analysis system (LAS V3.8, Leica Microsystems). Measurements (in micrometers) were expressed as the mean followed by the range in parentheses. The illustrations were made with the aid of a camera lucida mounted on a Leica DMLS microscope. Voucher helminth specimens were deposited at Coleção Helmintológica do Instituto de Biociências de Botucatu (CHIBB), Botucatu, São Paulo, Brazil.

RESULTS

Dactylogyridae (Bychowsky, 1933)
Ancyrocephaline (Bychowsky, 1937)
Tereancistrum (Kritsky *et al*., 1980)
Tereancistrum paranaensis (Figures 1 and 2)

Morphological description (based on 8 whole-mounted worms, 2 stained with Gomori's trichrome and 6 mounted using Gray and Wess' medium)**.** Body 403 (303–587) long, elongate, fusiform; 100 (82–121) wide near gonad level. Tegument smooth. Cephalic lobes poorly developed; head organs well developed. Eyes two; component granules subspherical. Pharynx spherical**,** 28 (27–30) in diameter; esophagus short; intestinal ceca confluent posterior to testis. Peduncle short; haptor subhexagonal 71 (56–87) long, 94 (79–113) wide. Hooks 24 (22–27) long, with erect thumb, curved shaft, short point, dilated proximal portion of shank; FH loop 0.3 shank length. Ventral anchor robust 44 (37–53) long, with well-developed superficial root and incipient deep root, broadly curved shaft and point, base 15 (12–18) wide. Accessory anchor sclerite 24 (22-26) long, robust, with spatulate end, connected to well-developed musculature. Dorsal anchor 24 (21–31) long, with superficial root more developed than deep root, broadly curved shaft and point, base 7 (6–8) wide. Ventral bar 59 (55–62) long, straight with rounded ends directed posteriorly, with median groove. Dorsal bar 19 (16–21) long, straight with rounded ends directed anteriorly. Gonads intercecal, slightly overlapping. Testis elongate ovate; seminal vesicle a simple dilation of vas deferens; prostatic reservoir saccate. Male copulatory organ tapered, tubular, coiled, with 2½ clockwise rings; ring diameter 14 (13-16). Accessory piece 15 (13-17) long, variable, not articulated with base of MCO. Germarium elongate; vagina sinistral, forming simple sclerotised tube; seminal receptacle spherical. Vitellaria dense, random in trunk except in regions of reproductive organs.

Host: *Schizodon intermedius* (Garavello & Britski, 1990) (Characiformes: Anostomidae).
Site of infestation: Gills.
Locality: Veados river (23º15'42.4''S; 48°37'27.6"W), municipality of Itatinga, São Paulo State, Brazil.
Specimens deposited: CHIBB 136L and 137L.
Prevalence of infestation: 1 of 10 specimens analyzed (10%)

Key to known species of Tereancistrum

1. MCO non-coiled, unequal-sized hooks ……..…… 2
-. MCO coiled, equal-sized hooks….....3
2. Dorsal bar U-shaped.....*Tereancistrum kerri*
-. Dorsal bar straight..... .....*Tereancistrum arcuatus*
3. Accessory piece articulated with the MCO base..... *Tereancistrum ornatus*
-. Accessory piece non-articulated with the MCO base.....4
4. MCO with clockwise rings.....*Tereancistrum paranaensis*
-. MCO with counterclockwise rings.....5
5. Slightly undulated ventral bar..... *Tereancistrum parvus*
-. Otherwise ventral bar.....6
6. MCO with 2

rings..... .....*Tereancistrum pirassununguensis*
-. MCO with 1¼ rings.....…7
7. Presence of sclerotised intermuscular structure between the accessory sclerites of the ventral anchors .....….*Tereancistrum curimba*
-. Absence of a sclerotised intermuscular structure between the accessory sclerites of the ventral anchors ……. *Tereancistrum toksonum*

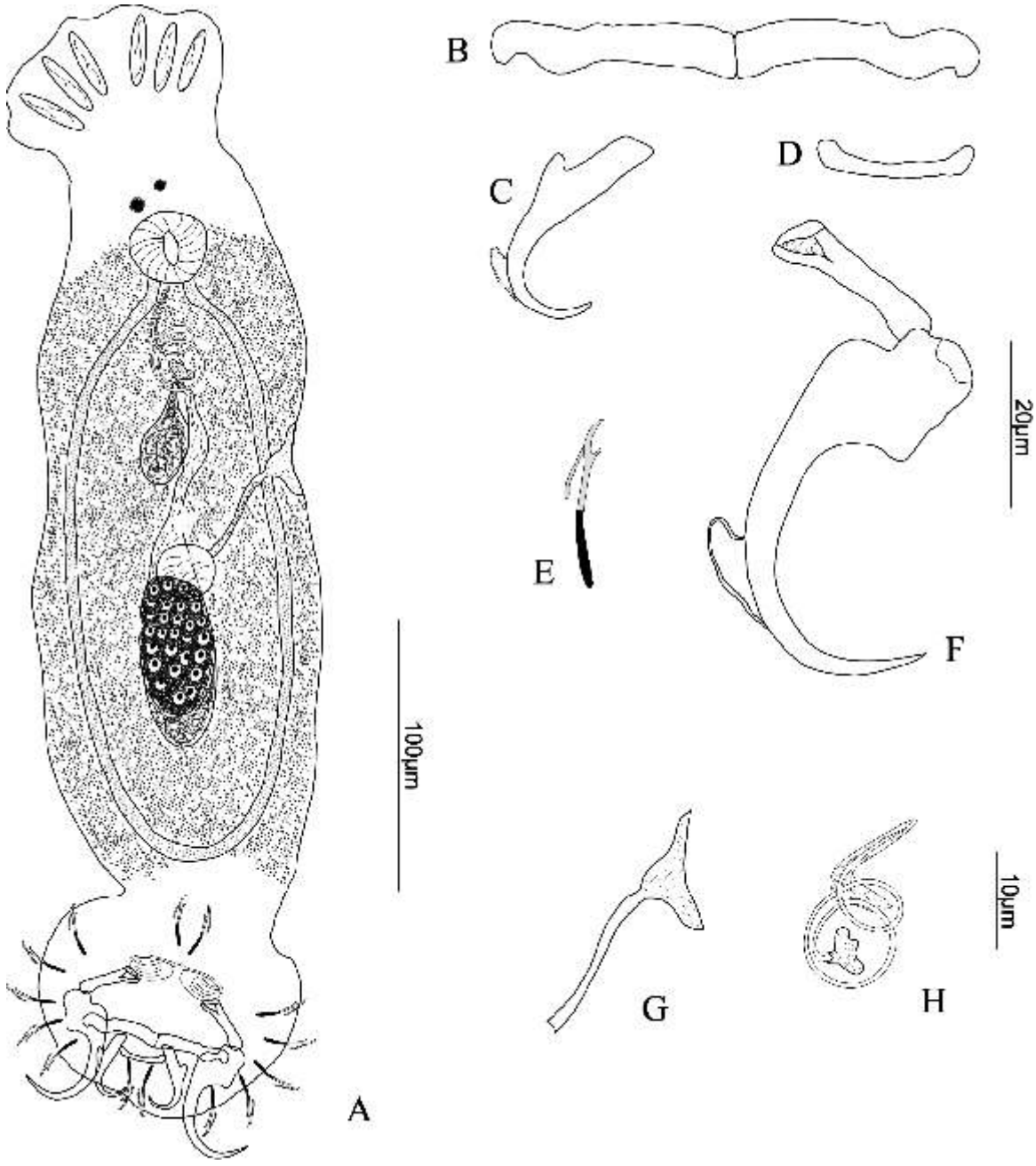

Figure 1. *Tereancistrum paranaensis* (A) Whole worm, ventral view. (B) Ventral bar. (C) Dorsal anchor. (D) Dorsal bar. (E) Hook. (F) Ventral anchor and accessory anchor sclerite. (G) Vagina. (H) Male copulatory complex: MCO and accessory piece. *Scale bars:* A, 100µm; B-F, 20 µm; G-H, 10 µm.

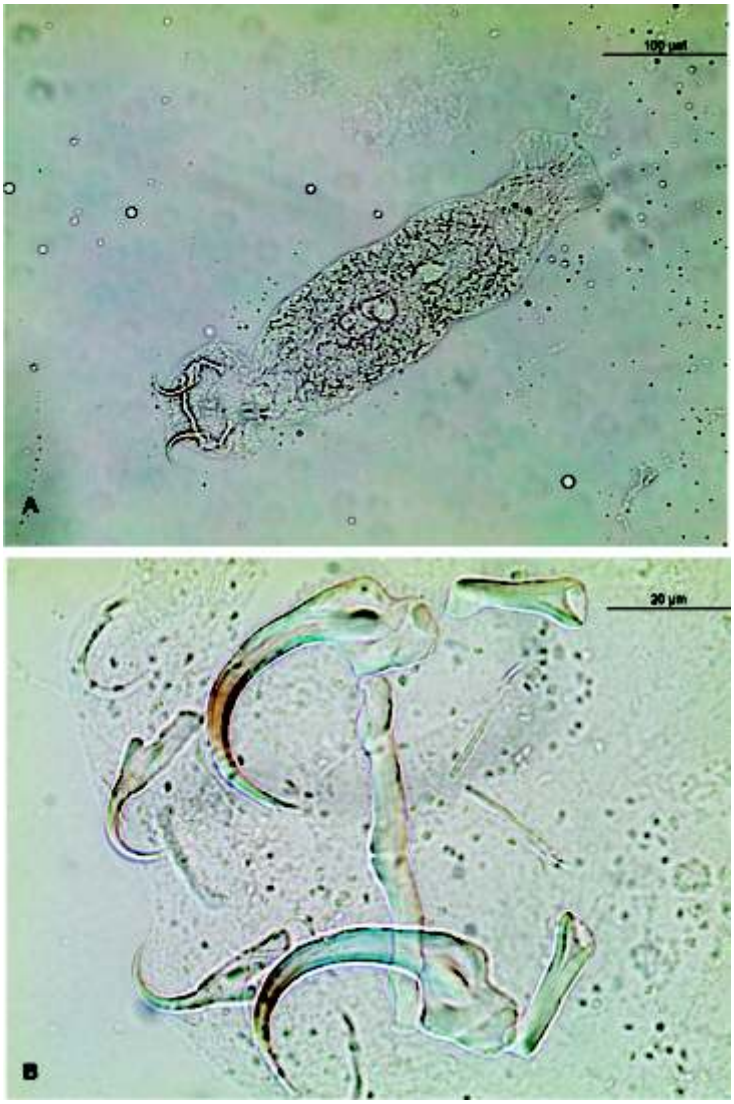

Figure 2. *Tereancistrum paranaensis* (A) Whole worm, ventral view. (B) Haptor showing ventral anchor, accessory anchor sclerite, dorsal anchor, ventral bar and dorsal bar.

DISCUSSION

Our results showed new host and new geographical location for *T. paranaensis* and also that the specimens found in *S. intermedius* from Veados river are slightly different in comparison with the specimens collected in the Paraná river floodplain by Karling *et al.* (2014).

Karling *et al.* (2014) reported in *T. paranaensis* an Ventral bar broadly M shaped and Dorsal bar arc-shaped, whereas in our specimens the Ventral bar is straight with rounded ends directed posteriorly and Dorsal bar is straight with rounded ends directed anteriorly. Karling *et al.* (2014) described the prostatic reservoir ovate; however, in our specimens this structure is saccate. Furthermore, the vagina described by Karling *et al.* (2014) is dextral but in

specimens collected in the present study the vagina is sinistral.

Finally, the measurements of the specimens collected in hosts from the Veados river present some differences in relation to the specimens described by Karling *et al.* (2014) (Table 1). This may be related to intraspecific variations that are common in Monogenea or to an adaptive process (Kritsky *et al.*, 1995). The intraspecific morphometric and morphologic changes are much common in parasites and some authors comment that these changes may be related to the different times of infection and/or intense competition for space and other host resources (Dobson, 1986; Shostak & Dick, 1987; Szalai & Dick, 1989); physiological differences found in different hosts may affect the establishment, grow and sexual maturity of the parasites (Watson & Pike, 1993); specific polymorphism of the parasites (Willis, 2002); different stages of parasites development (Francisco *et al.*, 2011) and environmental variability (Gonzáles *et al.*, 2013).

In description of Karling *et al.* (2014), the authors draw a well-developed muscle structure connecting the sclerites accessories of anchors but no mention is made in the description. The prevalence found in this study was much lower when compared to the prevalence found in the study of Karling *et al.* (2014), since only one analyzed fish was parasitized. This structure was also observed in our specimens. Finally we would like to mention that these authors exchanged the measurements of ventral and dorsal anchors in the diagnosis, but in figure the identification was correct. This is the first record of *T. paranaensis* in southeastern Brazil, with *S. intermedius* as new host, and also with presentation of complementary data to the morphology of this monogenean species.

Table 1. Comparative measurements of *Tereancistrum paranaensis* Karling *et al.*, 2014 from *Schizodon borellii* (Boulenger, 1900) and for specimens collected in this study (measurements in micrometers; mean followed by range in parentheses; -, indicates no measurement available).

Measurements	Karling *et al.* (2014) n=10	Present study n=8	Total variation for the species
Body length	322.4 (247–360)	403 (303–587)	247-587
Body width	140.6 (76.8–216)	100 (82–121)	76.8–216
Pharynx diameter	20.9 (20.6–32.3)	28 (27–30)	20.6–32.3
Haptor length	—	71 (56–87)	56–87
Haptor width	—	94 (79–113)	79–113
Hook length	11.1	24 (22–27)	11.1–27
Ventral anchor length	44.6 (42–49.1)	44 (37–53)	37–53
Ventral anchor base	16.7 (14.7–18.6)	15 (12–18)	12–18.6
Accessory anchor sclerite	—	24 (22–26)	22–26
Dorsal anchor length	24.9 (20.8–28.4)	24 (21–31)	20.8–31
Dorsal anchor base	7.1 (5.9–7.8)	7 (6–8)	5.9–8
Ventral bar	54 (44.1–68.6)	59 (55–62)	44.1–68.6
Dorsal bar	18.3 (14.7–20.6)	19 (16–21)	14.7–21
Accessory piece length	—	15 (13–17)	13–17
MCO ring diameter	18.3 (15.7–20.6)	14 (13–16)	13–20.6

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