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## ***Porangatus ceteyus* n. gen., n. sp. (Digenea: Zoogonidae): A Parasite of *Hoplosternum littorale* (Pisces: Callichthyidae) from Amazonas State, Brazil**

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ABSTRACT: *Porangatus ceteyus* n. gen., n. sp. is erected to accommodate some specimens of Digenea recovered from the intestine of *Hoplosternum littorale*. Hosts were collected in lakes located near the junction of the Solimões and Negro rivers, Amazonas State, Brazil. The new genus differs from the others in the family mainly in the distribution of vitellarium, consisting of 2 lateral groups extending from the level of the anterior margin of the ventral sucker, where they may be confluent, to near the posterior end of body, occupying cecal, extracecal and intercecal areas.

KEY WORDS: *Porangatus ceteyus* n. gen., n. sp., Digenea, Zoogonidae, Neotropical fish, Brazil.

During studies on the helminthofauna of freshwater fish from Amazonas State, Brazil, carried out by 1 of the coauthors (A. M. Morais), specimens of a previously undescribed digenean were collected from the intestine of *Hoplosternum littorale* (Hancock, 1828) (Siluriformes: Callichthyidae) from Lake Catalão and waters of the floodplains of Marchantaria Island, in the north of Brazil. In the present paper, a new genus of the family Zoogonidae Odhner, 1902, is proposed to accommodate these specimens.

*Hoplosternum littorale* is a Neotropical catfish commonly called “tamboatá” or “tamoatá” and is found throughout South America. In the Amazon region, it is considered a benthic fish, inhabiting streams, lakes, and rivers of white, clear, and black waters (Saint-Paul et al., 2000; Siqueira-Souza and Freitas, 2004; Granado-Lorencio et al., 2005). It is an omnivorous species that feeds on detritus, insect larvae, macroinvertebrates, algae, fish scales, seeds, and small fragments of insects associated with sediment (Winemiller, 1987; Hahn et al., 1997; Mérona and Rankin-de-Mérona, 2004; Santos et al., 2006).

The Zoogonidae is a cosmopolitan family of digeneans with species reported from the alimentary tract, gall bladder, bile ducts, or urinary bladder of marine and freshwater fishes. In South America, Zoogonidae is represented by 6 genera: *Brachyenteron* Manter, 1934; *Diphtherostomum* Stossich, 1904; *Limnoderetrema* Bray, 1987; *Steganoderma* Stafford, 1904; *Steganodermatoides* Parukhin and Lyadov, 1979; and *Zoogonus* Looss, 1901. Twelve species are reported from the intestines of marine and

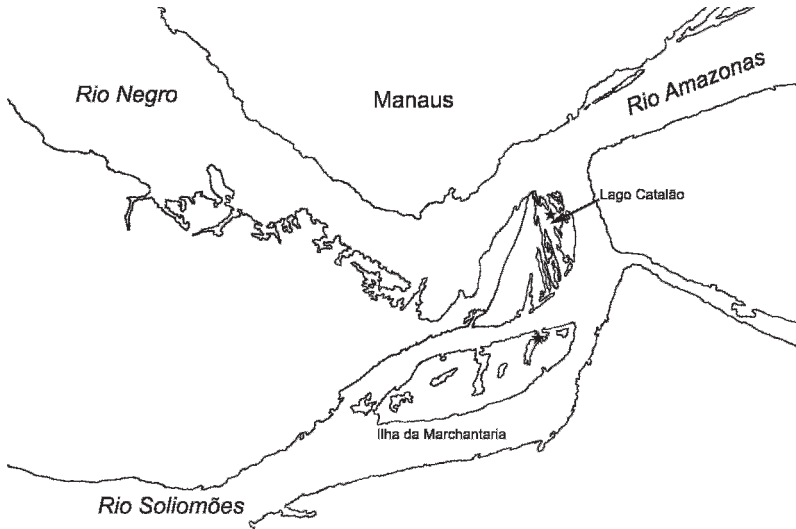
freshwater fish from Argentina, Brazil, Chile, Peru, and Venezuela (see Kohn et al., 2007). In Brazil, only the genus *Diphtherostomum* has been reported to parasitize marine fishes. The newly erected *Porangatus ceteyus* n. gen., n. sp. represents the first known zoogonid from a freshwater fish from Brazil.

### **MATERIALS AND METHODS**

During October and November 2010, 62 specimens of *H. littorale* from the floodplain region of Central Amazônia were examined for helminths. The fish were collected with gill nets from Lake Catalão and from the floodplain of Marchantaria Island, located near the junction of the Solimões and Negro rivers (Fig. 1). On average the specimens measured  $14.87 \pm 71$  cm in total length and weighed an average of  $97.49 \pm 24.01$  g. Forty digeneans were collected from both localities. Forty-two specimens of *H. littorale* were examined from Lake Catalão, and 2 were parasitized by a total of 11 digeneans, while 3 of 12 specimens examined from the Marchantaria Island were parasitized by a total of 29 digeneans.

Collected digeneans were cold-fixed in AFA (alcohol, formalin, and acetic acid) with compression under cover glass pressure. Specimens were stained with Langeron's alcoholic acid carmine, dehydrated in an ethyl-alcohol series, cleared in beechwood creosote, and mounted in Canada balsam as permanent slides. Measurements are presented in micrometers unless otherwise stated, with means in parentheses, followed by the number of specimens measured in brackets, where applicable. A specimen was illustrated with the aid of a camera lucida. Light micrographs were made using a Nikon Eclipse 800 camera. For scanning electron microscopy (SEM), the worms were fixed in a solution containing 2.5% glutaraldehyde, 2% paraformaldehyde in 0.1 M cacodylate buffer (pH 7.2) at room temperature, and then washed with cacodylate buffer, postfixed in 1% OsO<sub>4</sub> in 0.1 M cacodylate buffer, washed in the same buffer, dehydrated in an ethanol series, processed in a critical point dryer with CO<sub>2</sub>, sputter-coated with gold, and examined in a FEI Quanta 200 Electron Microscope. Parasitological indices (Table 1) were calcu-

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**Figure 1.** Study area in the Amazon River Basin south of Manaus, Amazonas State, Brazil. Stars mark study sites on Catalão Lake and Marchantaria Island located in the Solimões River.

lated and analyzed according to Bush et al. (1997). Specimens were deposited in the Helminthological Collection of the “Instituto Oswaldo Cruz” (CHIOC) in Brazil and as vouchers specimens (INPA 625a–d) in the Invertebrate Collection, Platyhelminthes, Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil.

**RESULTS**

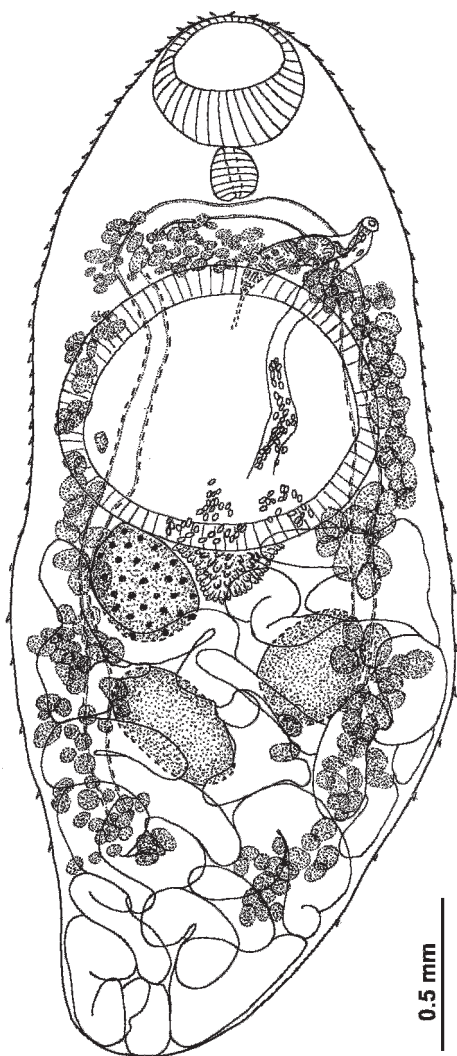
**Family Zoogonidae Odhner, 1902**  
***Porangatus* n. g.**

*Diagnosis:* Zoogonidae. Body large, oval, elongate. Tegument spinose. Oral sucker round, subterminal. Ventral sucker rounded, median, pre-equatorial. Prepharynx absent. Pharynx present. Esophagus absent. Intestinal bifurcation immediately posterior to pharynx. Ceca 2, extending to near posterior extremity of the body, ending blindly. Testes 2, round to oval, entire, oblique, located in the first region of

hindbody. Cirrus sac well developed, elongated, entirely anterior or slightly overlapping ventral sucker anteriorly. Internal seminal vesicle bipartite, followed by a short tubular pars prostatica and muscular cirrus. Genital pore submarginal, sinistral on mid-forebody. Ovary round, entire, submedian, pretesticular. Laurer’s canal present. Mehlis’ gland median, lateral to ovary. True seminal receptacle not observed. Vitellarium follicular, consisting of 2 lateral groups of large and small vitelline follicles, extending from the level of anterior margin of ventral sucker up to intestinal bifurcation to near posterior end of body, cecal, extracecal, and intercecal, confluent or not anteriorly and almost confluent in the post-testicular region. Uterus mostly post-testicular, occupying the entire space between testes and posterior end of body. Metraterm not differentiated. Eggs operculated. Excretory vesicle Y-shaped. Excretory pore at

**Table 1.** Quantitative descriptors of *Hoplosternum littorale*: hosts examined (HE), mean standard fish length (MSL, in cm ± SE), mean fish weight (MW), prevalence (P), mean intensity (MI), range of variation (RV), and mean abundance (MA).

Location	HE	MSL (cm ± SE)	MW (g ± SE)	Parasites	P (%)	MI (SE)	RV	MA
Lago Catalão	42	13.32 ± 1.11	89.03 ± 22.34	<i>Clinostomum marginatum</i>	4.76	3 (±1.41)	2–4	0.14
				<i>Porangatus ceteyus</i> n. gen., n. sp.	4.76	3 (±1.41)	2–4	0.14
Ilha da Marchantaria	12	12.17 ± 0.72	67.01 ± 6.48	<i>Clinostomum marginatum</i>	16.66	2 (±277.76)	2	0.16
				<i>Porangatus ceteyus</i> n. gen., n. sp.	16.66	4 (±4.35)	1–9	1



**Figure 2.** *Porangatus ceteusus* n. gen., n. sp. Holotype, total, ventral view.

posterior end of body. Intestinal parasite of freshwater fish.

Type and only known species: *P. ceteusus* n. sp.

***Porangatus ceteusus* n. sp.**  
(Figs. 2–12)

*Type host:* *Hoplosternum littorale* (Hancock, 1828) (Pisces: Callichthyidae).

*Type locality:* Lake Catalão (03°09'47"S; 059°54'29"W), Amazonas State, Brazil.

*Prevalence:* 2 out of 42 (4.7%).

*Intensity of infection:* 2–9.

*Other locality:* Marchantaria Island (03°15'35"S; 59°58'50"W), Amazonas State, Brazil.

*Prevalence:* 3 of 12 (42.5%).

*Intensity of infection:* 1–9.

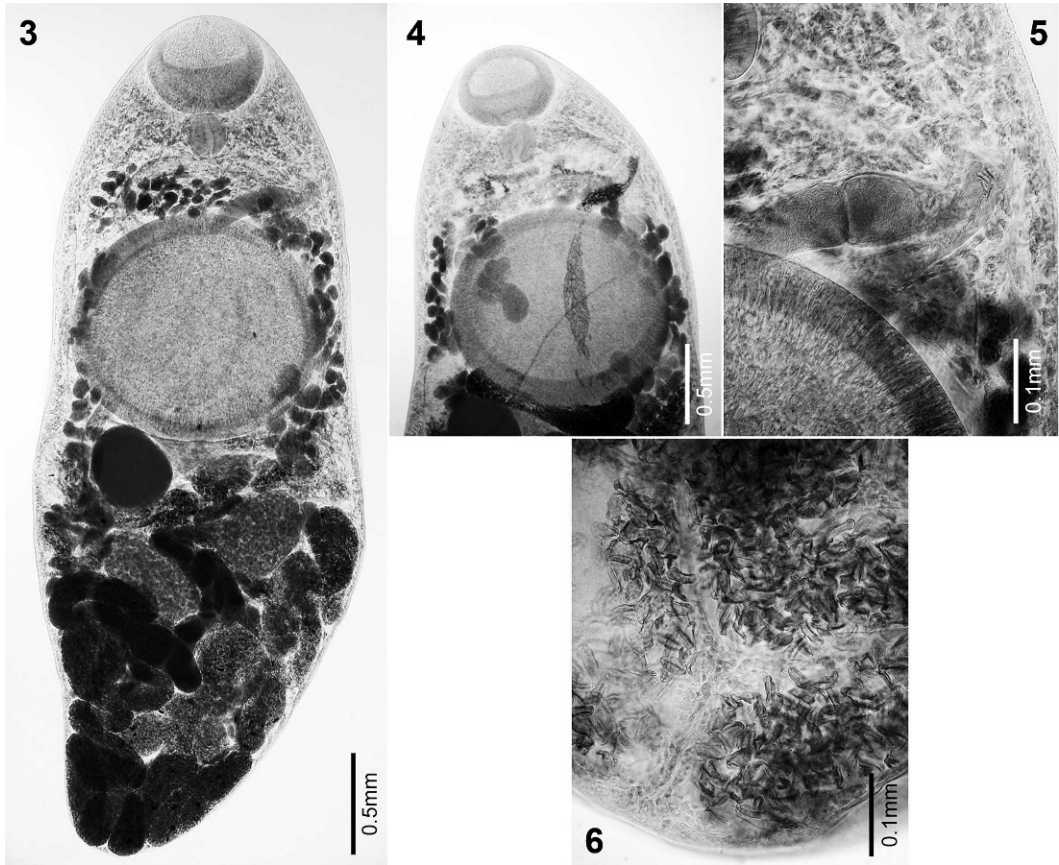
*Site of infection:* Intestine.

*Specimens deposited:* Holotype CHIOC No. 37543a; paratypes No. 37543b–v.

*Etymology:* The generic and specific names are based on "Tupi-guarani" (Indian language), *Porangatus* = very beautiful; *cete* = body, and *yus* = spinous.

**Description**

*General:* With characters of the genus. Based on observations and measurements of 22 compressed adult specimens: Body oval, elongate, 3.22–3.90 (3.62) long by 1.27–1.80 (1.43) wide. Tegument spinose (Fig. 7); spines decreasing in density in hindbody, posterior end without spines. Tegumental spines measuring 12–15 (Fig. 8). SEM shows the presence of tegumental papillae all over the whole body (Fig. 11). Oral sucker subterminal, round 310–420 (385) × 430–560 (491), with the edge covered by spines. Ventral sucker round, pre-equatorial, median, larger than oral sucker, 775–1,075 (971) × 1,000–1,225 (1,075). SEM shows spines different from those of the tegument on the inner surface of the ventral sucker, measuring 5 (Figs. 9–10). Oral:ventral sucker width ratio 1:2.0–2.4 (1:2.2). Prepharynx absent. Pharynx subglobular, 120–210 (190) × 120–170 (153). Esophagus absent. Intestinal bifurcation in anterior forebody immediately posterior to pharynx. Ceca ending blindly, extending to near posterior extremity of the body. Testes 2, round to oval, entire, oblique, in hindbody. Anterior testis 220–440 (351) × 330–500 (437), posterior testis 250–450 (378) × 350–550 (470). Cirrus sac well developed, anterior to ventral sucker, 350–550 (466) × 70–140 (95). Internal seminal vesicle bipartite, 190–500 (265) × 60–150 (85). Pars prostatica tubular, short, followed by a muscular cirrus. Genital pore submarginal, sinistral, opening on ventral surface on mid-forebody. Ovary round, entire, submedian, pretesticular, just below ventral sucker, 290–460 (369) × 270–390 (334). Seminal receptacle not seen. Laurer's canal present with pore visible. Mehlis' gland adjacent to ovary, median to submedian, measuring 110–300 (192) [*n* = 20] × 250–520 (388) [*n* = 20]. Vitellarium follicular, consisting of 2 lateral groups of large and small vitelline



**Figures 3–6.** Light micrographs of *Porangatus ceteyus* n. gen., n. sp. **3.** Holotype. **4.** Paratype with vitelline follicles not confluent anteriorly. **5.** Detail of the cirrus sac, showing bipartite seminal vesicle. **6.** Excretory vesicle.

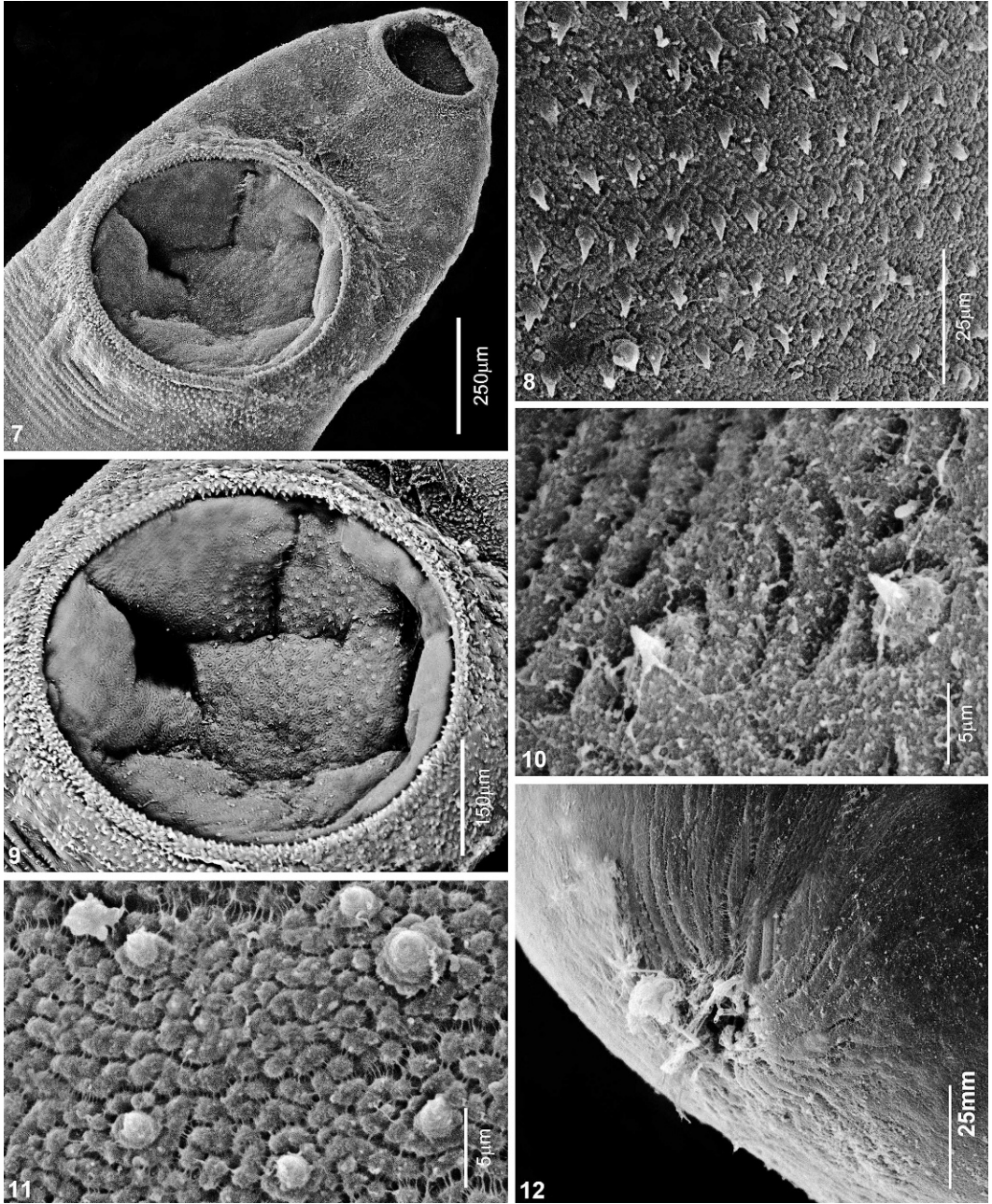
follicles, extending from the level of anterior margin of ventral sucker up to intestinal bifurcation and to near posterior end of body, cecal, extracecal, and intercecal, confluent or not anteriorly, and almost confluent in the post-testicular region. Uterus occupying entire hindbody. Eggs 22–30 (26) [ $n = 104$ ]  $\times$  10–12 (11) [ $n = 104$ ]. Excretory vesicle Y-shaped (Fig. 6). Excretory pore terminal (Fig. 12).

### DISCUSSION

The family Zoogonidae is cosmopolitan, and representatives have been reported from the alimentary tracts, gall bladders, bile ducts, or urinary bladders of both marine (mainly) and freshwater fishes. Zoogonidae is represented by 31 genera. Bray (2008) considered the family to be divided into 2 subfamilies: Zoogoninae Odhner, 1902, represented by 10 genera, which have vitellarium formed by 1 or

2 compact masses or of several follicles in an undivided median field; and Lepidophyllinae Stossich, 1903, which is represented by 19 genera, with members having vitellarium formed by paired fields of follicles. Subsequently, 2 additional genera belonging to the subfamily Lepidophyllinae were described from marine fishes: *Whitegonimus*, described by Jezewski et al. (2009) from *Patagonotothen tessellata* (Richardson, 1845) from Tierra del Fuego, Argentina, and *Oesophagotrema*, described from *Tylosurus acus imperialis* (Rafinesque, 1810) by Chaari et al. (2011) from Tunisia.

The characteristics of the vitellarium in *Porangatus* n. gen. place it in the Lepidophyllinae, making it the twenty-first genus in the subfamily. *Porangatus* n. gen. can be distinguished from all other genera in Lepidophyllinae by the extensive distribution of the vitellarium. Only 8 genera present vitellarium formed by many follicles arranged in lateral fields reaching



**Figures 7–12.** Scanning electron microscopy of *Porangatus ceteysus* n. gen., n. sp. **7.** Forebody showing oral and ventral suckers and the distribution of tegumental spines. **8.** Spines of the tegument level between oral and ventral sucker. **9.** Tegument of the inside of the ventral sucker with sinuous grooves and spines. **10.** Spines inside of the ventral sucker, arising from a rounded base. **11.** Tegumental papillae in the level of the oral sucker. **12.** Excretory pore.

the testes: *Steganoderma* Stafford, 1904; *Lecithostaphylus* Odhner, 1911; *Cephaloporus* Yamaguti, 1934; *Anarhichotrema* Shimazu, 1973; *Yamagutiplectognathotrema* Parukhin, 1977; *Overstreetia* Bray,

1985; *Sacculoacetabulum* Machida and Kuramochi, 1999; and *Whitegonimus* Jezewski, Zdzitowiecki, and Laskowski, 2009. The new genus differs from all these genera mainly by having the vitelline follicles

extending from the level of the anterior margin of the ventral sucker to near the posterior end of the body. It is also distinguished by the following combination of diagnostic characteristics: oblique testes, a ventral sucker larger than its oral sucker, and long ceca reaching the midlevel of the posterior portion of the body and surpassing the testes posteriorly. Further, this new species presents different kinds of spines on the tegument and inside the ventral sucker. According to Chai et al. (2000), differences in spine structures and distribution over the body may involve a significant difference in host–parasite relationships.

To date, the following digeneans have been reported parasitizing *H. littorale* in South America. In Brazil: metacercariae of *Clinostomum complanatum* Rudolphi, 1814 (Clinostomidae), have been reported from the Paraná River, Paraná State (Dias et al., 2003, 2006), while metacercariae of *C. complanatum*, progenetic metacercariae of *Herpetodiplostomum caimanicola* (Dollfus, 1935) (Proterodiplostomidae), and *Kalipharynx* sp. (*incertae sedis*) have been reported from hosts from the Guandu River, Rio de Janeiro State (Abdallah et al., 2006). Further, *Magnivitellinum corvittellinum* Lacerda, Takemoto, and Pavanelli, 2009 (Macroderoididae), has been reported from the Paraná River (Lacerda et al., 2009). Lastly, *Crassicutis intermedius* (Szidat, 1954) (Apocreadiidae) has been reported by Bray et al. (1996) from Paraguay.

In addition to the new genus and species, metacercariae of *Clinostomum marginatum* were also collected from *H. littorale*.

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