Biota Neotropica 22(3): e20211259, 2022
www.scielo.br/bn

biotaneotropica
ISSN 1676-0611 (online edition)
Article

A new species of *Phanerothecium* (Monogenea, Oogyrodactylidae), in *Hypostomus regani* (Loricariidae) from southeast Brazil

***Rogério Tubino Vianna*[1], *Larissa Sbeghen Pelegrini*[2,3*], *Diego Henrique Mirandola Dias Vieira*[2], *Rodney Kozlowiski de Azevedo*[4] & *Vanessa Doro Abdallah*[4]**

[1]*Universidade Federal do Rio Grande, Instituto de Ciências Biológicas, Laboratório de Biologia de Parasitos de Organismos Aquáticos, Av. Itália, km 8, Rio Grande, RS, Brasil*
[2]*Universidade Estadual Paulista, Instituto de Biociências de Botucatu, Rua Prof. Dr. Antônio Celso Wagner Zanin, Distrito de Rubião Júnior, Botucatu, SP, Brasil*
[3]*Universidade Federal do Amazonas, Instituto de Educação, Agricultura e Ambiente, Laboratório de Ictiologia e Ordenamento Pesqueiro do Vale do Rio Madeira, Rua 29 de agosto, 786, Centro, Humaitá, AM, Brasil*
[4]*Centro Universitário CESMAC, Programa de Pós-Graduação em Análise de Sistemas Ambientais, Rua Cônego Machado, 918, Farol, Maceió, AL, Brasil*
**Corresponding author: biolarapelegrini@gmail.com*

VIANNA, R.T., PELEGRINI, L.S., VIEIRA, D.H.M.D., AZEVEDO, R.K., ABDALLAH, V.D. **A new species of *Phanerothecium* (Monogenea, Oogyrodactylidae), in *Hypostomus* regani (Loricariidae) from southeast Brazil**. Biota Neotropica 22(3): e20211259. https://doi.org/10.1590/1676-0611-BN-2021-1259

Abstract: A new species of *Phanerothecium* Kritsky & Thatcher, 1977 (Oogyrodactylidae Harris, 1983) is described from locariid fish from southeast Brazil. *Phanerothecium macrosomum* n. sp. (Oogyrodactylidae) is described from the body surface of *Hypostomus regani* (Ihering, 1905) (Loricariidae). It is characterized by an armed male copulatory organ containing spines of different size from proximal to distal extremity, short peduncle and robust haptor.
Keywords: *Brazilian siluriforms; freshwater fish; Oogyrodactylidae; Batalha River; Neotropical region.*

Uma nova espécie de *Phanerothecium* (Monogenea, Oogyrodactylidae), de *Hypostomus regani* (Loricariidae) do sudeste do Brasil

Resumo: Uma nova espécie de *Phanerothecium* Kritsky & Thatcher, 1977 (Oogyrodactylidae Harris, 1983) é descrita em peixes locariídeos do sudeste do Brasil. *Phanerothecium macrosomum* sp. n. (Oogyrodactylidae) é descrito da superfície corporal de *Hypostomus regani* (Ihering, 1905) (Loricariidae) e é caracterizado pela presença de órgão copulador masculino armado contendo espinhos de diferentes tamanhos da extremidade proximal à distal, pedúnculo curto e haptor robusto.
Palavras-chave: *Siluriformes brasileiros; peixe de água doce; Oogyrodactylidae; rio Batalha; Região Neotropical.*

Introduction

Siluriformes Cuvier, 1816 is the most diverse group of fishes in South America and mainly in Brazil. Loricariidae Rafinesque, 1815 is one of the families included in this order and the second richest with 1192 valid species (Fricke et al. 2021). Loricariids usually harbor oogyrodactylids (Harris 1983, Boeger et al. 2021), although they can also concomitantly harbor species of gyrodactylids (Vianna & Boeger 2019).

There are 23 known species of oogyrodactylids all restricted to the Neotropical region and parasitizing loricariid and pimelodid fishes (Siluriformes). Oogyrodactylids were reported parasitizing pimelodid fishes, considered an accidental infestation, as *Phanerothecioides agostinhoi* Kritsky, Vianna & Boeger, 2007 found in *Pseudoplatystoma fasciatum* (Linnaeus) (Kritsky et al. 2007), and *Phanerothecium caballeroi* Kritsky & Thatcher, 1977 on *Zungaro zungaro* (Humboldt, 1821) (Kritsky & Thatcher 1977).

Eight genera of oogyrodactylids are known: *Aglaiogyrodactylus* Kritsky, Vianna & Boeger, 2007 (8 species); *Atopogyrodactylus* Kritsky, Boeger & Patella, 2020 (1); *Hyperopletes* Boeger, Kritsky & Belmont-Jégu, 1994 (1); *Nothogyrodactylus* Kritsky & Boeger, 1991 (3); *Onychogyrodactylus* Kritsky, Vianna & Boeger, 2007 (2); *Oogyrodactylus* Harris, 1983 (1); *Phanerothecioides* Kritsky, Vianna & Boeger, 2007 (1); and *Phanerothecium* Kritsky & Thatcher, 1977 (6) (Kritsky & Thatcher 1977, Harris 1983, Kritsky & Boeger 1991, Boeger et al. 1994, Kritsky et al. 2007, 2020).

Phanerothecium is characterized mainly for possessing vitelline follicles and ducts in reversed h-shaped, both absent in dextral pregermarial field; coiled, twisted copulatory organ spined (or not) inside of copulatory sac, eversible or with distal non-eversible sclerotized tube; uterus with heavy wall, containing from one-to-many eggs (sometimes empty) (Kritsky et al. 2007). *Phanerothecium caballeroi* Kritsky & Thatcher, 1977 was described in *Z. zungaro* (Pimelodidae) from Colombia, while the remaining species are from Brazil: *Phanerothecium deiropedeum* Kritsky, Vianna & Boeger, 2007 in *Hypostomus* sp.; *Phanerothecium harrisi* Kritsky & Boeger, 1991 in *Hypostomus plecostomus* (Linnaeus, 1758) (= *Plecostomus plecostomus* Linnaeus, 1758); *Phanerothecium spinatus* Boeger, Kritsky & Belmont-Jégu, 1994 (= *P. spinatum*, see Kritsky et al., 2007) in *Hypostomus punctatus* Valenciennes, 1840; *Phanerothecium spinatoides* Kritsky, Vianna & Boeger, 2007 in *Hypostomus* sp. 7 and sp. 9.; and *Phanerothecium spinulatum* Kritsky, Vianna & Boeger, 2007 in *Hypostomus* sp. (Kritsky & Boeger 1991, Boeger et al. 1994, Kritsky et al. 2007).

In this study a new species of *Phanerothecium* is described from the body surface of *Hypostomus regani* (Ihering, 1905) (Loricariidae) from southern Brazil.

Materials and Methods

Sixty specimens of the armored-catfish, *Hypostomus regani* (Loricariidae) (mean weight = 165.45 ± 77.75g and mean standard length = 17.72 ± 2.85cm), were collected from February 2014 to February 2016 in the Batalha River, Reginópolis municipality, State of São Paulo.

Fish were captured using nylon monofilament gillnets with different mesh sizes (sizes ranging from 20 to 100 mm internodes). The gillnets were placed on the slopes or near the river bottom at night and removed before dawn (10 hours exposure). Fish were removed from nets, anesthetized with eugenol solution (clove oil), and submitted to euthanasia through the physical method of medullary section, being immediately individualized in plastic bags and frozen for laboratory analysis. We observed that storing fish in plastic bags might have damaged the shape of some adults' parasites, flattening the bodies of the specimens. Even so, it was possible to observe the anatomy and represent it.

Sampling was carried out according to guidelines of the scientific fishing license under the authorization of the Chico Mendes Institute of Biodiversity through the System of Authorization and Information on Biodiversity (authorization nº 40998-2). The research project was submitted to the Ethical Committee on Animal Use of the Centro Universitário Sagrado Coração (UNISAGRADO) (authorization nº 3353050417).

Specimens of oogyrodactylids were collected under a dissecting microscope, preserved individually in 70% ethanol, and mounted on a slide prepared with Gray & Wess mounting medium; others were stained with Gomori's trichrome and mounted in Canada balsam (Humason 1979). Drawings were prepared with the aid of camera lucida on an Olympus BX51 microscope, equipped with phase contrast. Adult specimens were drawn from the side, as due to the size of the parasites and the form of conservation they were damaged. However, it is possible to identify and interpret the parasite anatomy. Measurements were made with ImageJ (NIH, Inc.) and are reported in micrometers (µm); the mean is followed by the range and sample size in parentheses (n). Measurements were taken by straight-line distances.

Type specimens were deposited in the helminthological collection of Museu de Zoologia da Universidade de São Paulo, São Paulo (MZUSP), Brazil, as presented in the respective descriptions.

Results

Phanerothecium Kritsky & Thatcher, 1977

Phanerothecium macrosomum n. sp.

(Figures 1, 2)

Type host: *Hypostomus regani* (Ihering, 1905) (Loricariidae).

Site of infection: Body surface.

Type locality: Batalha River (22° 06′ 35.2″S, 47° 49′ 12. 5″W), Reginópolis, São Paulo, Brazil, February 2014.

Prevalence and intensity: 11.7% and 3.3 ± 2.2 (7 parasitized hosts out of 60 analyzed).

Specimens deposited: MZUSP 8042-e (holotype), MZUSP 8042-a, MZUSP 8042-b, MZUSP 8042-c, MZUSP 8042-d, MZUSP 8042-f, MZUSP 8042-g, MZUSP 8042-h, MZUSP 8042-i, MZUSP 8042-j (paratypes).

Etymology**:** The specific name originates from Greek and refers to the strong and big body (*macro* = big; *soma* = body).

Description**:** Body 1509 (796–2098, n = 7) long, greatest body width at level of Mehlis' gland 309 (125–422, n = 7) (Figure 1a); peduncle short in pre-adult and matures adult specimens (Figure 1a, 2h). Unicellular cephalic glands, head organ conspicuous. Anterior pharyngeal bulb 96 (92–100, n = 2) diameter, from ovate to circular; posterior pharyngeal bulb 129 (120–137, n = 2) diameter, from ovate to circular. Testis observed only in immature specimens

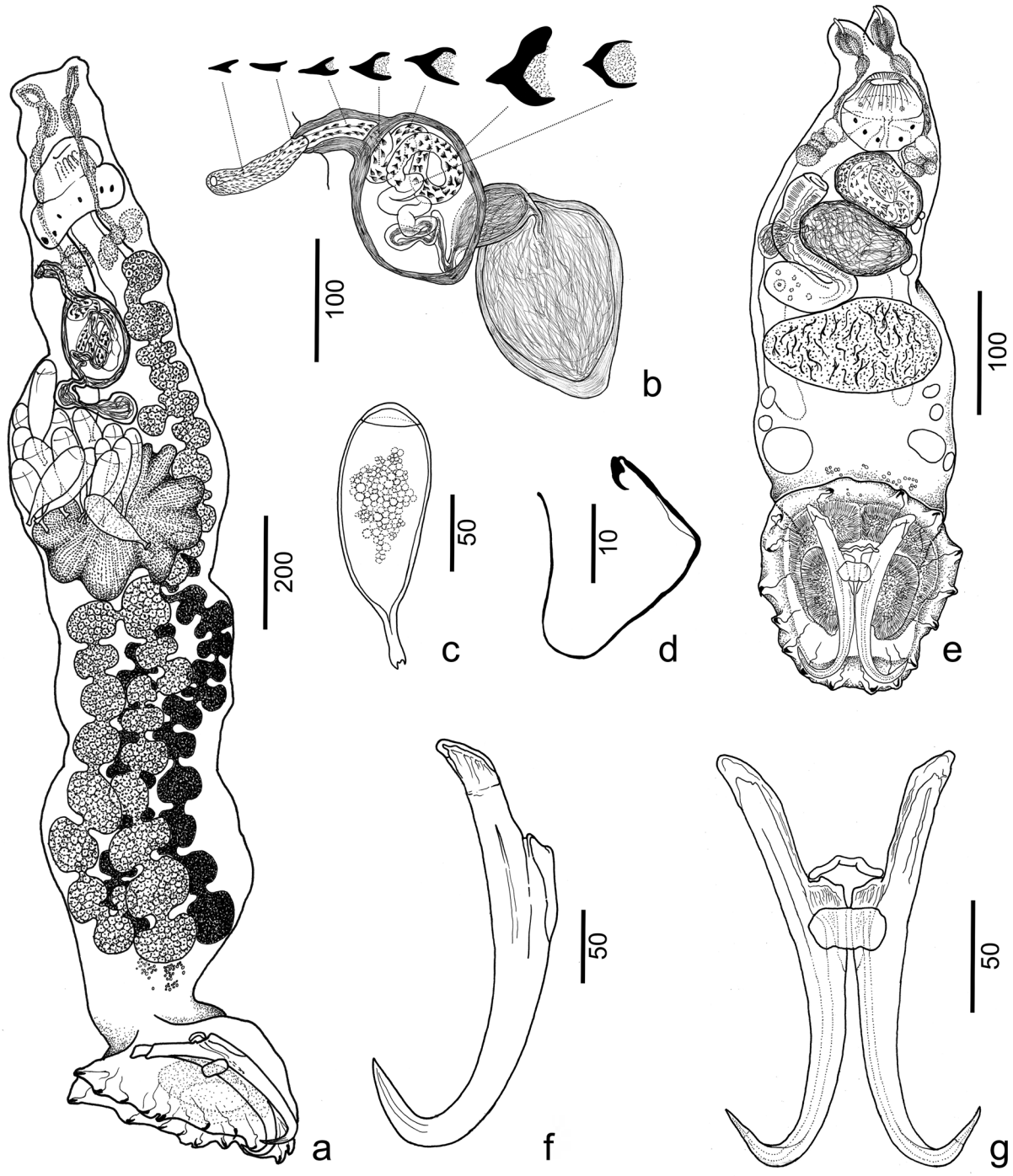

Figure 1. *Phanerothecium macrosomum* n. sp. (Oogyrodactylidae) on the body surface of *Hypostomus regani* (Loricariidae), holotype. a. Wholemount mature adult, lateral view. b. MCO (male copulatory organ). showing larger spines in the proximal portion and smaller spines in the distal portion. c. Egg. d. Hook. e. Wholemount immature specimen, ventral view, flattened. f. Anchor. g. Complex of anchors, superficial bar.

(Figure 1e, 2h), ovate, variable in size according to maturation; anterior seminal vesicle, elliptical, with thin wall; posterior seminal vesicle subspherical, bigger than anterior in pre-adults, with thick wall, reduced in adults (Figure 1b, 2l). Copulatory sac (Figure 2l) ovate, thick wall; male copulatory organ (MCO) tubular, muscular, inverted or everted (Figure 1b, 2l). MCO with spines of different sizes from proximal to distal portion (Figure 1b). Germarium not observed. Mehlis' gland well developed; uterus containing up to 19–40 eggs; uterine pore dextroventral, a transverse or diagonal slit with thickened rim. Egg 183 (170–213, n = 4) long, egg filament about 1/6 total egg length, with slight proximal bilobate flare (Figure 1c, 2i); egg droplets not observed. Haptor 368 (249–439, n = 7) long, 370 (276–447, n = 4) wide, subrectangular (young specimens) (Figure 1e, 2j) to circular (pre-adults and adults) (Figure 1a, 2k), with a thick edge formed by dorsal layer and hooklets (Figure 1d, 2j, 2k). Ventral portion containing two very conspicuous muscular

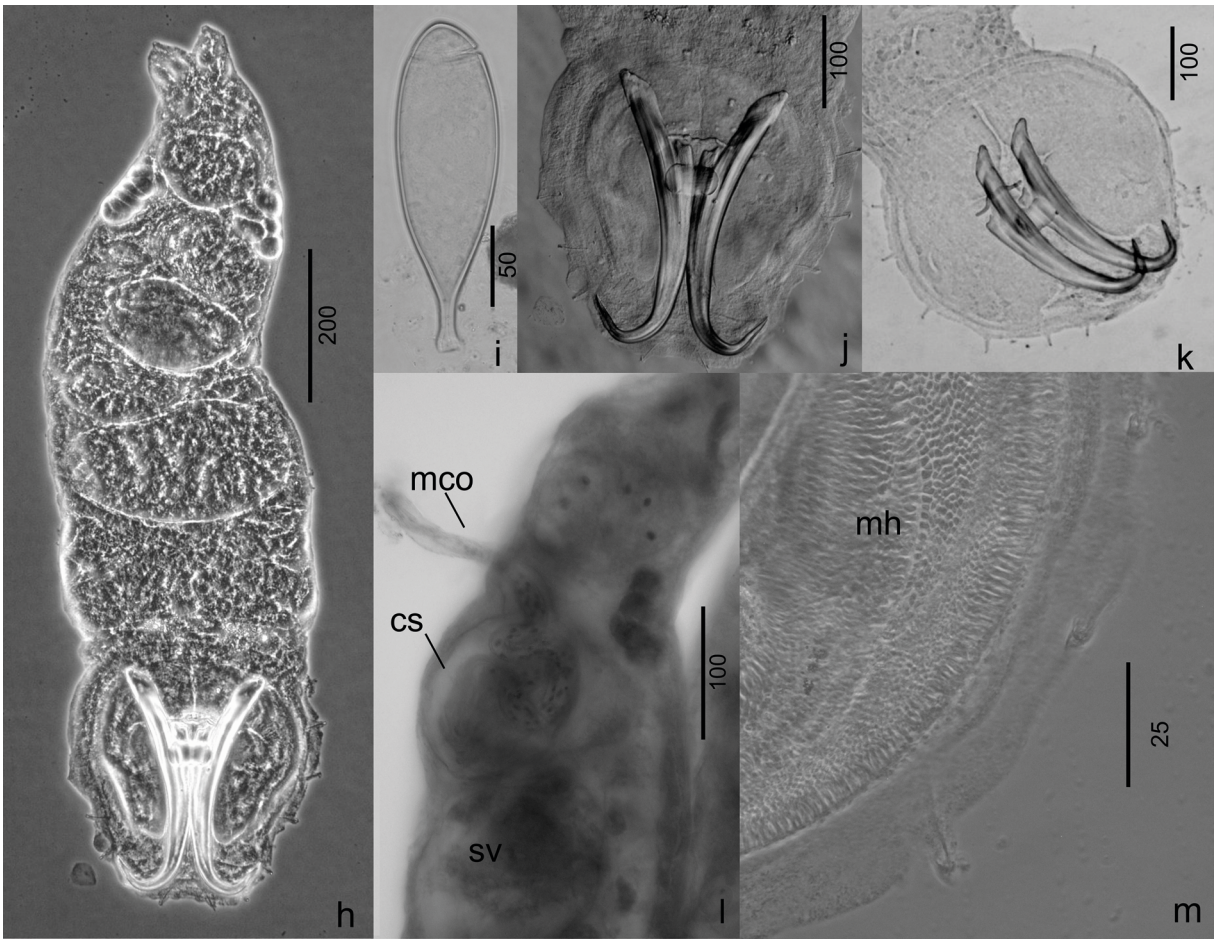

Figure 2. *Phanerothecium macrosomum* n. sp. (Oogyrodactylidae) on the body surface of *Hypostomus regani* (Loricariidae). h. Wholemount immature specimen, ventral view. i. Egg. j-k. Haptor. l. Male copulatory organ complex. mco – male copulatory organ, cs – copulatory sac, sv – seminal vesicle. m. Partial view of haptor. mh - musculature of haptor.

regions, lateral to anchor/bar complex, and due to striation appear to contain multiple papillae (Figure 2m). Anchor 385 (358–433, n = 3) long, with elongate superficial root, triangular and elongate deep root, slightly curved shaft and recurved point (Figure 1f, 1g, 2j, 2k). Superficial bar subrectangular 59 (51–66, n = 3) long; deep bar rod-shaped (Figure 1g, 2j). Hooks similar in shape and size, holocentric 34 (23–45, n = 2) long; hooklet 4 (n = 2) long, usually flexed ventrally, with short slightly recurved point, ventrally leaning shaft, globose heel and upright toe; shank tapers proximally to fine filament, with ventral keel near mid-length; FH (filament of hook) loop about 1/3 of shank length (Figure 1d).

Remarks**.** A comparison with other species of genus allows indicate *P. macrosomum* n. sp. as a new and the biggest species among all *Phanerothecium* species (Table 1). The new species is differentiated from the other congeneric species by presence of short peduncle; haptor subrectangular, containing strongly muscularized regions, antero-lateral to anchors; MCO armed with spines of different sizes from proximal to distal portion. Others three species of *Phanerothecium* presents armed MCO, *P. spinatus*, *P. spinatoides* and *P. spinulatum* and differ from *P. macrosomum* n. sp. by presence of spines of similar sizes and shapes.

Discussion

Oogyrodactylidae was proposed by Harris (1983) to accommodate *Oogyrodacytlus farlowellae* Harris, 1983 parasitic of *Farlowella amazonum* (Günther, 1864) (Loricariidae) and *Phanerothecium caballeroi* Kritsky & Thatcher, 1977, in *Zungaro zungaro* (Pimelodidae). Subsequently, Boeger & Kritsky (1993) consider Oogyrodactylidae synonymy of Gyrodactylidae due to the absence of synapomorphic features, thus uniting oviparous and viviparous species. Recently, through the use molecular data of 18S rDNA and COII (cytochrome oxidase II - mtDNA) Oogyrodactylidae (oviparous species) was reconsidered valid, separating this from species of Gyrodactylidae (viviparous species), thus both families were considered monophyletic and sister-groups (Boeger et al. 2021).

Phanerothecium Kritsky & Thatcher, 1977 was considered monophyletic (Boeger et al. 2021) and contains six species. In Brazil species of *Phanerothecium* were described only in *Hypostomus* Lacépède, 1803 hosts (Kritsky & Boeger 1991, Boeger, Kritsky & Belmont-Jégu 1994, Kritsky, Vianna & Boeger 2007).

Neither species of them *Phanerothecium* presents spines with different sizes on MCO as *P. macrosomum* n. sp. and the tubular MCO, muscular or sclerotized and unarmed was observed in *P. caballeroi*,

Table 1. Comparison of the measurements of *Phanerothecium* species. Values to *P. caballeroi* (forma minor/ forma major); values to *P. harrisi* (Kritsky et al. (2007)/ Kritsky & Boeger (1991)); values to *P. spinatoides* (from *Hypostomus* sp. 7/ from Hypostomus sp. 9). The values presented to measeruments gived are average.

	***P. caballeroi* forma minor**	***Phanerothecium* sp. (= *P. caballeroi* forma major)**	***P. deiropedeum***	***P. harrisi***	***P. macrosomum* n. sp.**	***P. spinatus***	***P. spinatoides***	***P. spinulatum***
Body								
Length	913	1094	1405	1107/ 1203	1509	1124	1376/ 1326	1362
Width	140	202	257	170/ 189	309	175	218/ 212	180
Wide (or diameter) pharyngeal bulb								
Proximal/ posterior	76	87	120	70/ 66	128	69	89/ 89	70
Distal/ anterior	48	46	85	50/ 83	96	69	63/ 64	51
Germarium		63						
Length/ Diameter	61/62	-	75/-	83/ 87	-	70/-	85/ 86	76/-
Width	-	-	-	-	-	75	89/ 88	78
Egg								
Length	-	-	224	-	183	162	155/ 158	161
Maximum number of eggs	-	-	12	22	40	10	>20	>7
Rate egg filament/ egg length	-	-	-	-	~1/6	-	~ 1/4	~ 1/4
Haptor								
Length	112	178	68	88/ 108	368	87	94/ 94	106
Width	115	184	102	113/ 104	370	95	111/ 117	143
Length of anchor	95	159	40	61/ 70	385	59	66/ 65	78
Superficial bar								
Length	29	46	17	23/ 25	59	48	25/ 24	25
Hook and hooklet								
Total length	47	48	46	37/ 33	34	35	40/ 40	44
Length of hooklet	6-7	6-7	8-9	5/ 5-6	4	6	5-6/ 5-6	6
Rate FH loop/ shank length	-	-	~1/3	-		~1/4	~1/5	~ 1/4
Keel of shank	Yes	Yes	No	No	Yes	Yes	Yes	Yes
MCO								
Eversible	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Spines present/ shape	No/-	No/-	No/-	No/ -	Yes/ different	Yes/ similar	Yes/ similar	Yes/ similar

P. harrisi and *P. deiropedeum*, while the muscular MCO, armed with diminutes spines and of the same size, were founded in *P. spinatoides*, *P. spinulatum* and *P. spinatus*.

The morphological features of *P. macrosomum* n. sp. as short peduncle, haptor and spines of MCO support the new species.

Acknowledgments

We would like to thank the São Paulo Research Foundation (FAPESP) for the research project grant of Vanessa D. Abdallah (2012/23655-0) and Rodney K. de Azevedo (2014/12862-0).

Associate Editor

Juan Schmitter-Soto

Author Contributions

Rogério Tubino Vianna: substantial contribution in the concept and design of the study; contribution to data analysis and interpretation; contribution to manuscript preparation; contribution to critical revision, adding intelectual content.

Larissa Sbeghen Pelegrini: substantial contribution in the concept and design of the study; contribution to data collection; contribution to manuscript preparation; contribution to critical revision, adding intelectual content.

Diego Henrique Mirandola Dias Vieira: contribution to data analysis and interpretation; contribution to manuscript preparation; contribution to critical revision, adding intelectual content.

Rodney Kozlowiski de Azevedo: substantial contribution in the concept and design of the study; contribution to critical revision, adding intelectual content.

Vanessa Doro Abdallah: substantial contribution in the concept and design of the study; contribution to data analysis and interpretation; contribution to critical revision, adding intelectual content.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethics

All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

Data Availability

The work qualifies as an exception according to the instructions for "Data Availability" (https://www.scielo.br/journal/bn/about/#instructions).

References

BOEGER, W.A. & KRITSKY, D.C. 1993. Phylogeny and a revised classification of the Monogenoidea Bychowsky, 1937 (Platyhelminthes). Syst. Parasitol. 26: 1–32.

BOEGER, W.A., KRITSKY, D.C. & BELMONT-JÉGU, E. 1994. Neotropical Monogenoidea. 20. Two species of oviparous Gyrodactylidea (Polynchoinea) from Loricariid catfishes (Siluriformes) in Brazil and the phylogenetic status of Oogyrodactylidae Harris, 1983. J. Helminthol. Soc. Wash. 61(1): 34–44.

BOEGER, A.B., KRITSKY, D.C., PATELLA, L. & BUENO-SILVA, M. 2021. Phylogenetic status and historical origins of the oviparous and viviparous gyrodactylids (Monogenoidea, Gyrodactylidea). Zool. Scr. 50:112–124.

FRICKE, R., ESCHMEYER, W.N. & VAN DER LAAN, R. 2021. Catalog of fishes: genera, species, references. <http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp> (accessed 11 Jun 2021).

HARRIS, P.D. 1983. The morphology and life-cycle of the oviparous *Oogyrodactylus farlowellae* gen. et sp.nov. (Monogenea, Gyrodactylidea). Parasitol. 87:405–420.

HUMASON, G.L. 1979. Animal Tissue Techniques. Freeman and Company, San Francisco.

KRITSKY, D.C. & BOEGER, W.A. 1991. Noetropical Monogenoidea. 16. New species of oviparous Gyrodactylidea with proposal of *Nothogyrodactylus* gen. n. (Oogyrodactylidae). J. Helminthol. Soc. Wash. 58(1): 7–15.

KRITSKY, D.C., BOEGER, W.A. & PATELLA, L. 2020. Neotropical Monogenoidea. 63. *Atopogyrodactylus praecipuus* gen. et sp. n. (Gyrodactylidae), an oviparous gyrodactylid from the external surface of a bristlenose catfish *Ancistrus* sp. (Siluriformes: Loricariidae) from the Ronônian Amazon, Brazil. Zootaxa. 4732(1):169–176.

KRITSKY, D.C. & THATCHER, V.E. 1977. *Phanerothecium* gen. nov. and *Fundulotrema* gen. nov. Two new genera of viviparous Monogenoidea (Gyrodactylidae), with a description of *P. caballeroi* sp. nov. and a key to the subfamilies and genera of the family. *Excerta Parasitológica en memoria del doctor Eduardo Caballero y Caballero, Instituto de Biologie (Mexico), Publicaciones Especiales*. 4: 53−60.

KRITSKY, D.C., VIANNA, R.T. & BOEGER, W.A. 2007. Neotropical Monogenoidea. 50. Oviparous gyrodactylids from loricariid and pimelodid catfishes in Brazil, with the proposal of *Phanerothecioides* n. g., *Onychogyrodactylus* n. g. and *Aglaiogyrodactylus* n. g. (Polyonchoinea: Gyrodactylidea). Syst. Parasitol. 66:1–34.

VIANNA, R.T. & BOEGER, W.A. 2019. Neotropical Monogenoidea. 60. Two new species of *Gyrodactylus* (Monogenoidea: Gyrodactylidae) from the armored-catfish, *Pareiorhaphis parmula* Pereira (Loricariidae) and from the cascarudo, *Callichthys callichthys* (Linnaeus) (Callichthyidae) from Brazil. Zootaxa. 4551:87–93.

Received: 21/06/2021

Accepted: 16/06/2022

Published online: 01/08/2022