

Supplementary taxonomic description of *Demidospermus pinirampi* (Monogenoidea, Dactylogyridae), with a new host record and an expansion of its distribution range

Julio Cesar Cenci de AGUIAR^{1*}, Glauco Baptista Franco BUENO², Sonia Maria Cursino dos SANTOS³, Edson Aparecido ADRIANO^{1,4}

¹ Universidade Estadual de Campinas, Programa de Pós-Graduação em Biologia Animal. Prédio da PG-IB, Bloco O, CP. 6109, Avenida Bertrand Russel, s/n, 13083-865, Campinas, São Paulo, Brasil

² Universidade Federal do Tocantins, Programa de Pós-Graduação em Ecologia de Ecótonos. Rua 03, Quadra 17, Lote 11, s/n, Setor Jardim dos Ipês, 77500-000, Porto Nacional, Tocantins, Brasil

³ Universidade de Taubaté, Departamento de Biologia. Av. Tiradentes, 500, Bom Conselho, 12030-180, Taubaté, São Paulo, Brasil

⁴ Universidade Federal de São Paulo, Departamento de Ecologia e Biologia Evolutiva. Rua Prof. Artur Riedel, 275, Jd. Eldorado, 09972-270, Diadema, São Paulo, Brasil

* Corresponding author: julio_aguiar@msn.com

ABSTRACT

During a survey conducted in the Lajeado Reservoir of the Tocantins River, in the state of Tocantins, Brazil, dactylogyrids were recovered from the gills of *Pimelodina flavipinnis*. Initial morphological analysis showed these dactylogyrids shared aspects of character with species of *Demidospermus*, with affinity to *Demidospermus pinirampi*, despite exhibiting differences with the original description by Kritsky *et al.* (1987) regarding the vagina, the base of the male copulatory organ and the shape and length of the bars. The analysis of the holotypes of *D. pinirampi* and its most morphologically close species, *Demidospermus luckyi*, revealed that these dactylogyrids were indeed *D. pinirampi*. This study therefore reports a new host and locality of occurrence, and reviews some measurements of the original description, supplementing and enhancing the morphological diagnosis of *D. pinirampi*.

KEYWORDS: South America, Tocantins, morphology, parasite, Pimelodidae

Descrição taxonômica complementar de *Demidospermus pinirampi* (Monogenoidea, Dactylogyridae), com registro de um novo hospedeiro e ampliação de sua área de distribuição

RESUMO

Durante um levantamento realizado no Reservatório de Lajeado, no Rio Tocantins, no estado de Tocantins, Brasil, dactilogirídeos foram recuperados das brânquias de *Pimelodina flavipinnis*. A análise morfológica inicial mostrou que esses dactilogirídeos compartilham aspectos de caráter com espécies de *Demidospermus*, com afinidade com *Demidospermus pinirampi*, apesar de apresentarem diferenças em relação à descrição original fornecida por Kritsky *et al.* (1987) com respeito à vagina, à base do órgão copulatório masculino e à forma e comprimento das barras. A análise dos holótipos de *D. pinirampi* e de sua espécie morfológicamente mais próxima, *Demidospermus luckyi*, revelou que estes dactilogirídeos eram realmente *D. pinirampi*. Este estudo, portanto, relata um novo hospedeiro e localidade de ocorrência e revisa algumas medidas da descrição original, complementando a diagnose morfológica de *D. pinirampi*.

PALAVRAS-CHAVE: América do Sul, Tocantins, morfologia, parasita, Pimelodidae

Demidospermus pinirampi (Kritsky, Thatcher and Boeger, 1987) was described parasitizing gills of the pimelodid *Pinirampus pinirampu* (Spix and Agassiz, 1829) from the Janauacá Lake, near Manaus, state of Amazonas, Brazil (Kritsky *et al.* 1987). This parasite was originally classified within *Omothecium* Kritsky, Thatcher and Boeger, 1987, which was later synonymized to *Demidospermus* Suriano, 1983 (Kritsky and Gutiérrez 1998), and which today harbors 29 valid species (Cohen *et al.* 2013; Franceschini *et al.* 2017).

In a survey conducted between July and November of 2011, 71 specimens of *Pimelodina flavipinnis* Steindachner, 1876, a pimelodid found in the Orinoco, Amazon and Araguaia/Tocantins basins (Lundberg and Littmann 2003; Froese and Pauly 2016), were examined for the presence of monogenoids. The fish were caught in the mid-Tocantins River, in the state of Tocantins, Brazil. The helminths recovered were fixed in 4% formalin, posteriorly stained with Gomoris's trichrome and mounted in Canada balsam for visualization of the soft tissues, or in Gray and Wess medium for the study of the sclerotized structures (Kritsky *et al.* 1986). Observations were carried out through differential interference contrast (DIC) and phase contrast using an Axioplan 2 Zeiss microscope. Illustrations were made with an optical microscope Olympus CBA with a drawing tube attached. The measurements were taken according to Mizelle and Klucka (1953), except the male copulatory organ, which was thoroughly measured, using ImageJ software (Rasband 2015). Holotypes of *D. pinirampi* (INPA 059 – in the original description reported as INPA PA 282-1) and of *D. luckyi* (Kritsky, Thatcher and Boeger, 1987) (INPA 058 - in the original description reported as INPA PA 283-1), borrowed from the non-Insecta invertebrate collection of the Instituto Nacional de Pesquisas da Amazônia - INPA (National Institute of Amazonian Research), were examined. Quantitative population descriptors were carried out as proposed by Bush *et al.* (1997). The specimens studied were deposited in the Platyhelminthes collection of the *Museu de Zoologia da Universidade Estadual de Campinas* “Adão José Cardoso” (Adão José Cardoso Zoology Museum of the State University of Campinas), in the state of São Paulo, Brazil, and in the non-Insecta invertebrate collection of INPA.

Initial taxonomic analysis revealed that the dactylogyrids recovered from *P. flavipinnis* in the Tocantins River shared aspects of character with species of *Demidospermus*, with close affinity to *D. pinirampi*. Notwithstanding this finding, some important differences with the original description by Kritsky *et al.* (1987) were observed in the morphology of the base of the male copulatory organ (MCO), the vagina and the haptor bars, as well as some morphometric differences in the dimensions of the ventral and dorsal bars and the testis (Table 1). However, when confronted with the holotypes of *D. pinirampi* (INPA 059) and with its morphologically

closest species, *D. luckyi* (INPA 058), it was observed that these dactylogyrids indeed corresponded to *D. pinirampi*. Following this finding, a comparative analysis between the samples and the holotype of *D. pinirampi* (INPA 059) (Table 1) was carried out to supplement and enhance the diagnosis of *D. pinirampi*.

Table 1. Morphometric data, in micrometers (μm), of *Demidospermus pinirampi* from this study (specimens recovered from *Pimelodina flavipinnis* from the Tocantins River, Brazil), and from the original description in Kritsky *et al.* (1987), presenting separately the measurements of the holotype deposited in the collection of the National Institute of Amazonian Research - INPA. N is the number of specimens measured in this study. Values are means followed by the range in parentheses. The original description was based on five specimens, without specifying how many of those were measured.

	N	Present study	Original description	Holotype INPA-059
body length	11	895 (637.5-1320)	952 (924-1004)	970
greatest width	13	136 (97.5-247.5)	155 (129-189)	127
pharynx diameter	13	68 (36-112.5)	74 (68-78)	65
haptor long	13	69.5 (41-101)	90 (73-112)	64
haptor wide	13	134 (94-191)	154 (122-185)	133
ventral anchor long	13	42 (30-48.5)	44 (41-47)	44
ventral anchor wide	13	22 (17-26.25)	24 (20-27)	23
dorsal anchor long	13	39 (21-45)	41 (37-45)	45
dorsal anchor wide	12	21 (13-28)	26 (22-30)	20
ventral bar long	13	104 (90-122)	44 (41-47)	107
dorsal bar long	13	77 (47-99)	36-37	81
hook 1	12	14 (9-17)	-	16
hook 2	11	10 (6-11)	-	9
hook 3	13	17 (12-20)	-	-
hook 4	12	16 (13-18)	-	-
hook 5	12	18 (13-20)	-	18
hook 6	13	17 (12-20)	-	17
hook 7	11	18 (14-20)	-	18
accessory piece long	10	37 (23-49)	36 (30-44)	-
MCO long	13	121 (67-156)	155-156	-
testis long	12	128 (53-204)	191 (143-240)	130
testis wide	12	39 (25-50)	54 (41-67)	40
germarium long	10	65 (42-95)	68 (53-82)	82
germarium wide	10	30 (19-42)	37 (31-43)	31
egg size	2	44 x 28	-	-

Taxonomic summary

Class: Monogeneoidea Bychowsky, 1937.

Family: Dactylogyridae Bychowsky, 1933.

Genus: *Demidospermus* Suriano, 1983.

Species: *Demidospermus pinirampi* (Kritsky, Thatcher and Boeger, 1987) (Figure 1).

Type host: *Pinirampus pirinampu* (Spix and Agassiz, 1829) (Siluriformes, Pimelodidae) (Kritsky *et al.* 1987).

Additional host: *Pimelodina flavipinnis* Steindachner, 1876 (Siluriformes, Pimelodidae) (this study).

Site: Gills.

Type locality: Janauacá Lake, near Manaus, Amazonas, Brazil (3°23'27.98"S, 60°18'34.39"W) (Kritsky *et al.* 1987).

Additional locality: Reservoir of Lajeado, middle Tocantins River, municipality of Porto Nacional, Tocantins, Brazil (10°43'26.1"S, 48°24'57.6"W) (this study).

Prevalence of infection: 29.6%.

Mean abundance of infection: 0.72.

Mean intensity of infection: 2.43.

Specimens studied: Holotype of *D. pinirampi* INPA 059; holotype of *D. luckyi* INPA 058 and; vouchers ZUEC PLA 69, 71, in Gomori's trichrome; vouchers ZUEC PLA 70, 72, in Gray and Wess medium; vouchers INPA 729-730, in Gomori's trichrome; vouchers INPA 728, 731-736 in Grey and Wess medium.

The vagina observed in the specimens of the present study is conspicuous, with a wrinkled atrium resembling a trumpet flower (Figures 1A, 1C). This characteristic was also observed in the holotype examined (INPA 059), although it was not clear in the drawing from the original description (Kritsky *et al.* 1987). Although the morphology of the vaginal atrium contributes little to the phylogenetic proposal for some dactylogyrids (Wu *et al.* 2007), its proper characterization is useful for the discrimination of species, especially for closely related taxa (Wu *et al.* 2007; Wu *et al.* 2008; Aguiar *et al.* 2011).

With respect to the MCO, two conspicuous sclerotized flaps were observed in the base of the organ in the specimens of the present study (Figure 1). The number of flaps was not specified in the original description, which states only that the base of the MCO (cirrus) had a proximal "flare" (Kritsky *et al.* 1987). Examination of the INPA-059 holotype confirmed the presence of conspicuous flaps.

In terms of the bars, there appears to be a misunderstanding in the original description (Kritsky *et al.* 1987). In one part of the text, the authors report that the ventral bar is V-shaped and the dorsal bar is usually W-shaped, but frequently flattened, and this information coincides with the drawing provided. However, in another part of the manuscript, the authors state that the ventral bar is 44 µm in length, being longer than the dorsal bar, which is 36-37 µm. Examining the drawings

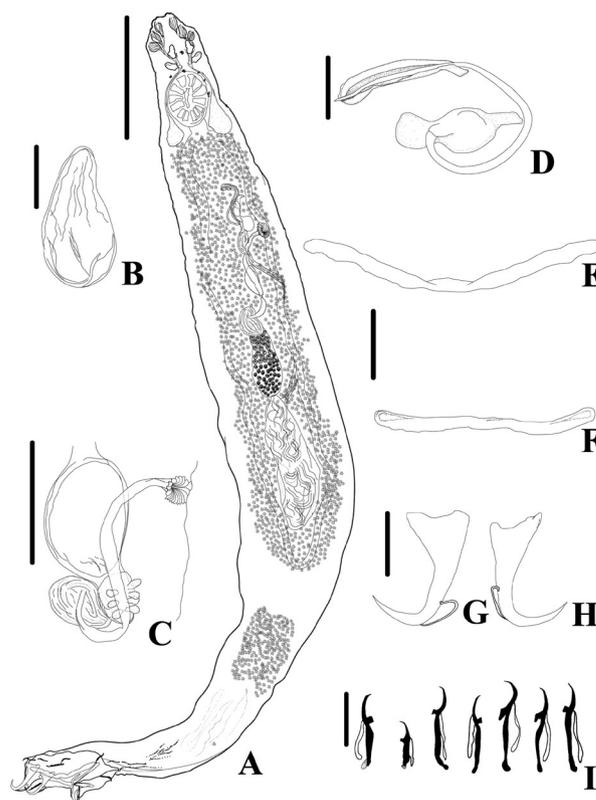


Figure 1. *Demidospermus pinirampi*, parasite of gills of *Pimelodina flavipinnis* from the Tocantins River, Brazil. A - composite drawing, ventral view; B - egg; C - female reproductive system; D - male copulatory organ, dorsal view; E - ventral bar; F - dorsal bar; G - ventral anchor; H - dorsal anchor; I - hook pairs 1 to 7. Scale bars: 200µm (A), 40 µm (Figs. E - F), 30 µm (C), 25µm (B, D), 20 µm (G - H), 10 µm (I).

of bars in the original description, it can clearly be seen that the longer bar was that which the authors described as the dorsal bar, contradicting the latter information from Kritsky *et al.* (1987) about the length of the ventral and dorsal bars. In the present study the ventral bar was indeed longer and W or U-shaped, while the dorsal bar, shown as V-shaped in the INPA-059 holotype, was almost straight.

We also observed a major inconsistency regarding the bar dimensions in the original description (Kritsky *et al.* 1987). While those authors reported a length of 44 µm for the ventral bar and 36-37 µm for the dorsal bar, measures of these structures in the present study were 104 and 77 µm, respectively, and 107 and 81 µm, respectively, for the INPA-059 holotype (Table 1). The scale of the drawing provided in the original description revealed that the dimensions of the bars were compatible with those obtained here, suggesting a misreading of the measurements presented by Kritsky *et al.* (1987).

The present study, as well as providing supplementary morphological data of *D. pinirampi*, which enables a more suitable diagnosis, reports the occurrence of this species in a

different host and geographic region to the originally reported type host and locality, extending the distribution of the parasite to a different river basin. Despite the fact that 14 monogenoid species have so far been reported from the Tocantins Basin (Fehlauer and Boeger 2005; Boeger *et al.* 2006; Domingues and Marques 2007; Domingues *et al.* 2007; Domingues and Marques 2010; Kritsky *et al.* 2013), *D. pinirampi* is only the second dactylogyrid species registered in this watershed.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Dr. Célio Magalhães, curator of the Non-Insecta Invertebrate Collection of Instituto Nacional de Pesquisas da Amazônia - INPA for kindly sending specimens for comparison in this study. We also acknowledge Dr. Elineide Eugênio Marques, from the Universidade Federal do Tocantins for providing support for the field work. Funding for the present study was provided by the Fundação de Amparo à Pesquisa do Estado de São Paulo – FAPESP (Proc. No. 2013/21374-6 – E.A. Adriano). J.C. Aguiar was funded by a postgraduate scholarship provided by the FAPESP 2013/20770-5. G.B.F. Bueno was funded by a postgraduate scholarship provided by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES. E.A. Adriano was supported by a research fellowship from Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq (Proc. No.305630/2013-0).

REFERENCES

- Aguiar, J.C.; Ceccarelli, P.S.; Luque, J.L. 2011. Two new species of *Pavanelliella* (Monogenea, Dactylogyridae) parasitic on pimedolid fishes from Mogi Guaçu river, Southeastern Brazil, and notes on the morphology of *P. pavanellii*. *Neotropical Helminthology*, 5: 213-224.
- Boeger, W.A.; Fehlauer, K.H.; Marques, E.E. 2006. Neotropical Monogeneoidea. 49. Four new species of the Diplectanidae (Dactylogyridae) from the gills of some pachyurines (Teleostei: Sciaenidae) from the Rio Tocantins and Rio Doce Basins, with the proposal of *Anoplectanum* n. g. and *Spinomatrix* n. g. *Systematic Parasitology*, 64: 57-68.
- Bush, A.O.; Lafferty, K.D.; Lotz, J.M.; Shostak, A.W. 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. *Journal of Parasitology*, 83: 575-583.
- Cohen, S.C.; Justo, M.C.N.; Kohn, A. 2013. *South American Monogeneoidea Parasites of Fishes, Amphibians and Reptiles*. Oficina de Livros, Rio de Janeiro, 663p.
- Domingues, M.V.; Marques, F.P.L. 2007. Revision of *Potamotrygonocotyle* Mayes, Brooks & Thorson, 1981 (Platyhelminthes: Monogeneoidea: Monocotylidae), with descriptions of four new species from the gills of the freshwater stingrays *Potamotrygon* spp. (Rajiformes: Potamotrygonidae) from the La Plata river basin. *Systematic Parasitology*, 67: 157-174.
- Domingues, M.V.; Marques, F.P.L. 2010. Phylogeny and taxonomy of *Potamotrygonocotyle* Mayes, Brooks & Thorson, 1981 (Monogeneoidea: Monocotylidae) with a description of four new species. *Journal of Helminthology*, 85: 353-380.
- Domingues, M.V.; Pancera, N.C.M.; Marques, F.P.L. 2007. Monogeneoidean parasites of freshwater stingrays (Rajiformes: Potamotrygonidae) from the Negro River, Amazon, Brazil: species of *Potamotrygonocotyle* (Monocotylidae) and *Paraheteronchocotyle* (Hexabothriidae). *Folia Parasitologica*, 54: 177.
- Fehlauer, K.H.; Boeger, W.A. 2005. Neotropical Monogeneoidea: *Euryhaliotrema dontykoleos* n. sp. (Dactylogyridae) from the gills of the freshwater sciaenid, *Pachyurus junki* (Perciformes). *Journal of Parasitology*, 91: 1025-1027.
- Franceschini, L.; Zago, A.; Müller, M.; Francisco, C.; Takemoto, R.; da Silva, R. 2017. Morphology and molecular characterization of *Demidospermus spirophallus* n. sp., *D. prolixus* n. sp. (Monogenea: Dactylogyridae) and a redescription of *D. anus* in siluriform catfish from Brazil. *Journal of Helminthology*, 6: 1-16.
- Froese, R.; Pauly, D. 2016. FishBase. World Wide Web electronic publication, (www.fishbase.org/search.php). Accessed on 10/2016.
- Kritsky, D.; Thatcher, V.; Boeger, W. 1987. Neotropical Monogenea. 10: *Omothecium*, new genus (Dactylogyridae: Ancyrocephalinae) and two new species from the Piranambu, *Pinirampus pirinampu* (Spix), (Siluriformes), in Brazil. *Proceedings of the Biological Society of Washington*, 100: 8-12.
- Kritsky, D.C.; Boeger, W.A.; Mendoza-Franco, E.F.; Vianna, R.T. 2013. Neotropical Monogeneoidea. 57. Revision and phylogenetic position of *Scleroductus* Jara & Cone, 1989 (Gyrodactylidae), with descriptions of new species from the Guatemalan chulin *Rhambdia guatemalensis* (Gunther) (Siluriformes: Heptapteridae) in Mexico and the barred sorubim *Pseudoplatystoma fasciatum* (Linnaeus) (Siluriformes: Pimelodidae) in Brazil. *Systematic Parasitology*, 84: 1-15.
- Kritsky, D.C.; Gutiérrez, P.A. 1998. Neotropical Monogeneoidea. 34. Species of *Demidospermus* (Dactylogyridae, Ancyrocephalinae) from the gills of Pimelodids (Teleostei, Siluriformes) in Argentina. *Journal of the Helminthological Society of Washington*, 65: 147-159.
- Kritsky, D.C.; Thatcher, V.; Boeger, W. 1986. Neotropical Monogenea. 8. Revision of *Urocleidoides* (Dactylogyridae, Ancyrocephalinae). *Proceedings of the Helminthological Society of Washington*, 53: 1-37.
- Lundberg, J.G.; Littmann, M.W. 2003. Family Pimelodidae (Long-winkered catfish). In: Reis, R. E.; Kullander, S. O.; Ferraris Jr, C. J. (Ed.). *Check List of the Freshwater Fishes of South and Central America*. Edipucrs, Porto Alegre, 729p.
- Mizelle, J.D.; Klucka, A.R. 1953. Studies on monogenetic trematodes. XIV. Dactylogyridae from Wisconsin fishes. *American Midland Naturalist*, 49: 720-733.
- Rasband, W.S. 2015. ImageJ, U. S. National Institutes of Health, (<http://imagej.nih.gov/ij/>). Accessed on 10/2016.
- Wu, X.Y.; Zhu, X.Q.; Xie, M.Q.; Li, A.X. 2007. The evaluation for generic-level monophyly of Ancyrocephalinae (Monogenea, Dactylogyridae) using ribosomal DNA sequence data. *Molecular Phylogenetics and Evolution*, 44: 530-544.
- Wu, X.Y.; Zhu, X.Q.; Xie, M.Q.; Wang, J.Q.; Li, A.X. 2008. The radiation of *Thaparocleidus* (Monogeneoidea: Dactylogyridae: Ancylodiscoinae): phylogenetic analyses and taxonomic implications inferred from ribosomal DNA sequences. *Parasitology Research*, 102: 283-288.

Received: 27/02/2017

Accepted: 05/07/2017