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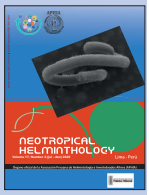

ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

GENARCHELLA PARVA TRAVASSOS, ARTIGAS & PEREIRA, 1928 (DIGENEA: DEROGENIDAE) IN FISH FROM TWO ENVIRONMENTS IN SOUTHERN BRAZIL: MORPHOLOGY AND COMMENTS ON HOST'S CHECKLIST

GENARCHELLA PARVA TRAVASSOS, ARTIGAS & PEREIRA, 1928 (DIGENEA: DEROGENIDAE) EM PEIXES EM DOIS AMBIENTES NO SUL DO BRASIL: MORFOLOGIA E COMENTÁRIOS SOBRE A LISTA DE HOSPEDEIROS

GENARCHELLA PARVA TRAVASSOS, ARTIGAS & PEREIRA, 1928 (DIGENEA: DEROGENIDAE) EN PECES EN DOS AMBIENTES DEL SUR DE BRASIL: MORFOLOGÍA Y COMENTARIOS SOBRE LA LISTA DE HOSPEDADORES

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ABSTRACT

Genarchella parva Travassos, Artigas & Pereira, 1928 has been reported mainly in Characidae hosts. The morphology of this species has been known based on specimens collected mainly by Travassos and researchers (20s and 60s decades) and also from specimens in Argentina. The goal of this study was to describe the morphology of *G. parva*, provide the parameters of the infections from different fish species, and discuss the host's checklist from Brazil. Specimens of *G. parva* were collected from species of *Astyanax* Baird & Girard, 1854 and *Psalidodon* Eigenmann, 1911 in Jacuí Delta (north of Lake Guaíba, in the municipality of Porto Alegre) and Lagoon Itapeva (municipality of Terra de Areia), extreme south of Brazil. The localization of the genital pore of *G. parva* and *Genarchella fragilis* Lunaschi, 1990 was compared and discussed. The prevalence of *G. parva* was higher in *Psalidodon* aff. *fasciatus* (Cuvier, 1819) (12.9%) from Itapeva Lagoon and *Astyanax henseli* Melo & Buckup, 2006 (11.43%) from Jacuí Delta than other species examined. A host's checklist of *G. parva* in Brazil is provided and two previous reports are discussed. This study is the first report of *G. parva* in *A. henseli* and *A. lacustris* from southern Brazil, while Itapeva Lagoon is considered a new locality record for *G. parva*.

Keywords: Biodiversity – characids – digenetic trematode – Halipeginae – helminths – Icthyoparasitology

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RESUMO

Genarchella parva Travassos, Artigas & Pereira, 1928 foi registrada principalmente em hospedeiros da família Characidae. A morfologia desta espécie é conhecida a partir de espécimes coletados principalmente por Travassos e outros pesquisadores (nas décadas de 20 e 60) e também por espécimes da Argentina. O objetivo do presente estudo foi descrever a morfologia de *G. parva*, fornecer os parâmetros das infecções em diferentes espécies de peixes e discutir a lista de hospedeiros do Brasil. Espécimes de *G. parva* foram coletados em espécies de *Astyanax* Baird & Girard, 1854 e *Psalidodon* Eigenmann, 1911 do Delta do Jacuí (limite norte do Lago Guaíba, no município de Porto Alegre) e Lagoa Itapeva (município de Terra de Areia), no extremo sul do Brasil. A localização do poro genital de *G. parva* e *Genarchella fragilis* Lunaschi, 1990 foi comparada e discutida. A prevalência de *G. parva* foi elevada em *Psalidodon* aff. *fasciatus* (Cuvier, 1819) (12,9%) da Lagoa Itapeva e *Astyanax henseli* Melo & Buckup, 2006 (11,43%) do Delta do Jacuí em relação as outras espécies examinadas. Uma lista de hospedeiros de *G. parva* no Brasil é fornecida e dois registros foram discutidos. Este estudo é o primeiro registro de *G. parva* em *A. henseli* e *A. lacustris* para o sul do Brasil, enquanto que a Lagoa Itapeva é considerada como novo registro de localidade para *G. parva*.

Palavras-chave: Biodiversidade – caracídeos – Halipeginae – helmintos – Ictioparasitologia – trematódeo digenético

RESUMEN

Genarchella parva Travassos, Artigas & Pereira, 1928 ha sido mayormente registrada en hospedadores pertenecientes a la familia Characidae. La morfología de esta especie se conoce a partir de especímenes recolectados principalmente por Travassos y otros investigadores (en las décadas de 1920 y 1960), así como de especímenes procedentes de Argentina. El propósito de este estudio es describir la morfología de *G. parva*, proporcionar los parámetros de infecciones en diferentes especies de peces y discutir la lista de hospedadores en Brasil. Se recolectaron especímenes de *G. parva* de las especies de *Astyanax* Baird & Girard, 1854, y *Psalidodon* Eigenmann, 1911, en el Delta do Jacuí (límite norte del Lago Guaíba, en el municipio de Porto Alegre) y en la Lagoa Itapeva (municipio de Terra de Areia), ubicados en el sur de Brasil. Además, se comparó y discutió la ubicación del poro genital de *G. parva* en relación con *Genarchella fragilis* Lunaschi, 1990. La prevalencia de *G. parva* fue notablemente alta en *Psalidodon* aff. *fasciatus* (Cuvier, 1819) (12,9%) de Lagoa Itapeva y *Astyanax henseli* Melo & Buckup, 2006 (11,43%) del Delta del Jacuí en comparación con otras especies examinadas. Se presenta una lista detallada de hospedadores de *G. parva* en Brasil, y se analizan dos registros en particular. Este estudio constituye el primer registro de *G. parva* en *A. henseli* y *A. lacustris* para el sur de Brasil, mientras que la Lagoa Itapeva se considera un nuevo registro de localidad para *G. parva*.

Palabras clave: Biodiversidad – carácidos – Halipeginae – helmintos – Ictioparasitología – tremátodos digéneos

INTRODUCTION

Genarchella Travassos, Artigas & Pereira, 1928 was proposed to accommodate *Genarchella genarchella* Travassos, Artigas & Pereira, 1928 (type species) and *Genarchella parva* Travassos, Artigas & Pereira, 1928 (Travassos *et al*., 1928). In South America, seven species of *Genarchella* have been reported: *Genarchella astyanacis* (Watson, 1976) Scholz, Vargas-Vazquez & Salgado-Maldonado, 1995, *Genarchella fragilis* Lunaschi, 1990, *G. genarchella*, *Genarchella isabellae* (Lamothe-Argumedo, 1977) Kohn, Fernandes, Gibson & Fróes, 1990, *G. parva*, *Genarchella porzanae* (Nasir & Gómez, 1977) Gibson, 2002, and *Genarchella tropica* (Manter, 1936) Szidat, 1954 (Kohn *et al*., 2007, 2011; Virgilio *et al*., 2022), although only *G. fragilis* and *G. porzanae* have not been reported in hosts from Brazil.

Until now, the morphology of *G. parva* has been known based on specimens mainly collected in the past by Travassos and other researchers (Travassos *et al*., 1928; Kloss, 1966; Kohn & Fernandes, 1988; Kohn *et al*., 1990) and from specimens collected in Argentina (Lunaschi, 1990). In Brazil, *G. parva* has been reported in different hosts (Kohn *et al*., 2007) such as *Astyanax bimaculatus* (Linnaeus, 1758) and *Psalidodon* aff. *fasciatus* (Cuvier, 1819) from specimens collected in the state of São Paulo and Espírito Santo (Travassos *et al*., 1928; Kloss, 1966; Kohn *et al*., 1990), and *P.* aff. *fasciatus* from Lake Guaíba, state of Rio Grande do Sul, southern Brazil (Fortes & Hoffmann, 1999). Some of characid fishes previously classified in *Astyanax* Baird & Girard, 1854, were currently transferred to *Psalidodon* Eigenmann, 1911 (*Psalidodon eigenmanniorum* (Cope, 1894) and *P.* aff. *fasciatus*) (Terán *et al*., 2020).

The present study is a part of the studies carried out on the helminth fauna of the species of *Astyanax* (*Astyanax henseli* Melo & Buckup, 2006 and *Astyanax lacustris* (Lütken, 1875)) and *Psalidodon* species (*P. eigenmanniorum* and *P.* aff. *fasciatus*) from southern Brazil (Gallas & Utz, 2019abc). In this paper, we describe the morphology of *G. parva*, present the parameters of infections in three fish species, and provide new hosts reports, including a discussion concerning the host's checklist of previous reports in Brazil.

MATERIAL AND METHODS

Specimens of fish were acquired from fishermen in two localities between 2017 and 2020: *A. henseli* (n = 35), *A. lacustris* (n = 42), *P. eigenmanniorum* (n = 29), and *P.* aff. *fasciatus* (n = 54) were collected in Jacuí Delta, in the locality of Pintada Island (30°17'11"S, 51°18'01"W), which represents the limit north of the Lake Guaíba in the municipality of Porto Alegre. Additionally, specimens of *A. lacustris* and *P.* aff. *fasciatus* (n = 31 each) were collected in Lagoon Itapeva (29°36'16"S, 49°59'28"W), municipality of Terra de Areia, in the state of Rio Grande do Sul, extreme south of Brazil. Fish were collected with seine nets or with the aid of hooks, packed in plastic bags, and transported in ice coolers to the laboratory for posterior necropsy. Host specimens were identified following Bertaco & Lucena (2010), Lucena *et al*. (2013) and Lucena & Soares (2016).

Procedures of helminth collection and staining were made according to Gallas & Utz (2019abc). Measurements represent the range followed by mean ± standard deviation, shown in micrometers (µm) unless otherwise stated. Figures were made using a Olympus BX50 microscope, scanned and prepared using CorelDraw X4® and Adobe's Photoshop® CS2. Prevalence, mean intensity and abundance of infections follow Bush *et al*. (1997). Helminth specimens were deposited in the Helminthological Collection of the Natural Sciences Museum (Coleção Helmintológica do Museu de Ciências Naturais, CHMU) at the Lutheran University of Brazil in Canoas, Rio Grande do Sul, Brazil, and in the Protist Collection of the Museum of Science and Technology (Coleção de Protistas do Museu de Ciências e Tecnologia, MCTP) at the Pontifical Catholic University of Rio Grande do Sul in Porto Alegre, Rio Grande do Sul, Brazil.

Ethic aspects: The study was approved by the Institutional Committee (Project # 7398). All fish were purchased dead.

RESULTS

Genarchella parva Travassos, Artigas & Pereira, 1928 (Figs 1 and 2).

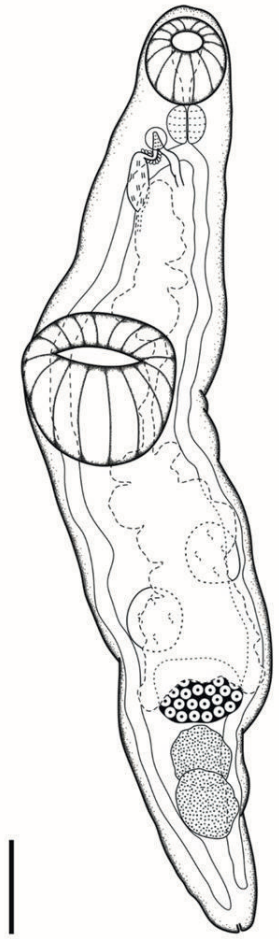

Figure 1. Diagram of specimen *in toto* of *Genarchella parva* Travassos, Artigas & Pereira, 1928, ventral view, scale bar = 200 µm.

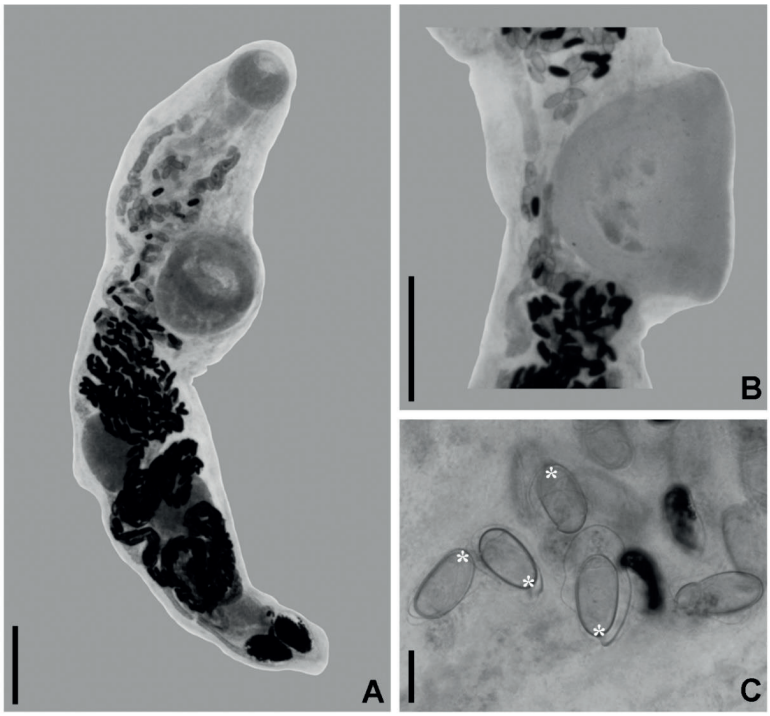

Figure 2. Photomicrographs of *Genarchella parva* Travassos, Artigas & Pereira, 1928. **A.** Specimen *in toto*; ventrolateral view, scale bar = 250 µm. **B.** Region of ventral sucker, lateral view, scale bar = 200 µm. **C.** Eggs, showing the single filament (asterisks), ventral view, scale bar = 25 µm.

Description based on nine specimens. Derogenidae, Halipeginae. Tegument without spines. Body elongated, 1.42–3.6 mm (2.5 ± 0.7 mm; n = 9) long, 0.25–0.47 mm (0.38 ± 0.08 mm; n = 9) wide. Oral sucker 150–220 (184 ± 26; n = 9) long, 150–260 (193 ± 34; n = 9) wide. Ventral sucker campaniform, 260–480 (367 ± 72; n = 9) long, 230–400 (332 ± 54; n = 9) wide, and 0.53–1.22 mm (0.83 ± 0.22 mm) from anterior end. Ratio of total body length/oral sucker 1:13.9; ratio of total body length/ventral sucker 1:6.7; ratio of oral sucker/ventral sucker 1:0.5. Pharynx 60–100 (83 ± 13; n = 9) long, 60–110 (80 ± 16; n = 9) wide. Esophagus indistinct, bifurcation of the intestinal caeca 230–330 (283 ± 44; n = 7) from anterior end; intestinal caeca ending next to the vitellarium.

Testes oval, oblique, intercaecal, of similar size, 80–250 (178 ± 50; n = 9) long, 70–220 (150 ± 49; n = 9) wide. External seminal vesicle sacculiform, 70–110 (86 ± 15; n = 5) long, 30–45 (37 ± 7; n = 5) wide. Sinus-sac 30–60 (47 ± 11; n = 6) long, 30–55 (44 ± 9; n = 6) wide. Sinus-organ not observed. Genital pore ventral, in the field of the pharynx. Ovary oval, elongated, intercaecal, post-testicular, anterior to vitellarium, 90–350 (209 ±98; n = 7) long, 90–160 (136 ± 22; n = 7) wide. Mehlis' gland and Laurer's canal not observed. Uterus mainly in the hindbody, occupying the middle and superior area of the ovary, inter and extracaecal. Vitellarium formed by two relatively symmetrical and oval masses, 100–230 (164 ± 40; n = 9) long, 80–130 (104 ± 21; n = 9) wide. Eggs with long, single filament at anopercular pole, 22–47 (38 ± 8; n = 9) long, 13–25 (21 ± 4; n = 9) wide. Excretory vesicle not observed, excretory pore terminal.

Taxonomic summary:

Synonyms (according Kohn *et al.*, 2007): *Genarchella tropica* Manter, 1936 by Szidat (1954), *Genarchella genarchella* Travassos, Artigas & Pereira, 1928 by Travassos *et al.* (1964), *Halipegus tropicus* (Manter, 1936) by Kloss (1966), *Halipegus cryptorchis* by Mañé-Garzon & Gascón (1973), *Halipegus parva* and *Halipegus* sp. by Kohn & Fernandes (1987, 1988), and *Genarchella szidati* by Hamann (1989).

Hosts: *Astyanax henseli* Melo & Buckup, 2006 (new host record), *Astyanax lacustris* (Lütken, 1875) (new host record), and *Psalidodon* aff. *fasciatus* (Cuvier, 1819).

Localities: Pintada Island, municipality of Porto Alegre, and Lagoon Itapeva, municipality of Terra de Areia (new locality record).

Site of infection: stomach.

Helminth specimens deposited: CHMU 319, MCTP 09.

DISCUSSION

Species of *Genarchella* present differences concerning the general morphology of the body, shape of the ventral sucker and the degree of development of the sinus-organ (Kohn & Fernandes, 1988; Kohn *et al.*, 1990). The species reported in South America with ventral sucker campaniform are *G. parva* and *G. fragilis* (Kohn *et al.*, 1990; Lunaschi, 1990; Scholz *et al.*, 1995), and they are considered morphologically similar. Lunaschi (1990) described *G. fragilis* and distinguished it from *G. parva* by body delicate and fragile and by the position of the genital pore. However, body delicate and fragile is not very informative to determine a species, and the procedures of host collection and helminth preparation could influence the conservation and quality of the specimens, mainly in the body shape.

The position of genital pore in *G. fragilis* was described as in the below limit of the pharynx or more posterior (Lunaschi, 1990). When comparing the descriptions and illustrations of *G. parva* in different studies, the location of the genital pore and consequently the sinus-sac appear to vary: they could be found in the field of the pharynx (Kohn & Fernandes, 1988; Kohn *et al.*, 1990; Lunaschi, 1990), as well as above (Kohn & Fernandes, 1988; Kohn *et al.*, 1990; Scholz *et al.*, 1995) or below (Travassos *et al.*, 1928; Kohn *et al.*, 1990; Lunaschi, 1990) the limit of the pharynx. The specimens found in the present study presented those traits mostly in the field of the pharynx or below the limit of the pharynx. Therefore, due the variation in *G. parva*, the specimens of *G. fragilis* should be reexamined to confirm the position of this trait in order to recognize or not both species.

In general, the measurements of *G. parva* found in the present study are similar to those found in the literature (Kohn & Fernandes, 1988; Kohn *et al.*, 1990; Lunaschi, 1990). The parameters of the infections showed a higher prevalence (12.9%) in *P.* aff. *fasciatus* from Itapeva Lagoon than other fish species examined (Table 1). Although with some differences in the life cycle of the species of *Genarchella* (Yamaguti, 1975; Ditrich *et al.*, 1997), possibly the infections in the examined fish in the present study occurred through random ingestion of the cercariae due the opportunistic food habit of the hosts (Vilella *et al.*, 2002), and may explain the differences in the parameters of the infections.

Table 1. Parameters of the infections of *Genarchella parva* Travassos, Artigas & Pereira, 1928 in different fish.

Host species and localities	Prevalence (%)	Mean intensity (helminth/host)	Mean abundance (helminth/host)
A. henseli (from Jacuí Delta)	11.43	2.25	0.26
A. lacustris (from Jacuí Delta)	2.38	2	0.04
A. lacustris (from Itapeva Lagoon)	6.45	1	0.06
P. aff. *fasciatus* (from Itapeva Lagoon)	12.9	1.5	0.19

In Brazil, *G. parva* have been reported from different hosts, but mainly in Characidae (Table 2). However, two host species deserve attention: *Acestrorhynchus falcatus* (Bloch, 1794) and *Oligosarcus hepsetus* (Cuvier, 1829). Travassos *et al.* (1928) found *G. parva* in *Acestrorhamphus* sp. (type host) in the state of São Paulo (type locality), a host posteriorly reported as *A. falcatus* by Kohn & Fernandes (1988), Kohn *et al.* (1990) and Kohn *et al.* (2007). However, *A. falcatus* occurs in the Amazon and Orinoco River basins and rivers of Guyana (Buckup *et al.*, 2007). Fortes & Hoffmann (1985) reported *G. parva* in *O. hepsetus* from Lake Guaíba, but the host species only occurs in southeastern Brazil rivers (Buckup *et al.*, 2007). In both cases, these records must be attributed to another host species. For future studies, and to avoid loss of information, researchers must follow a key to the host species or deposit voucher specimens of hosts.

Table 2. Previous records of *Genarchella parva* Travassos, Artigas & Pereira, 1928 from hosts in Brazil.

Host families	Host species	Localities	References
Acestrorhynchidae	*Acestrorhynchus falcatus* (Bloch, 1794)*	Rio Moji-Guaçu, Pirassununga, state of São Paulo	Travassos *et al.* (1928); Kohn & Fernandes (1988); Kohn *et al.* (1990)
Characidae	*Astyanax bimaculatus* (Linnaeus, 1758)	state of Espírito Santo	Kohn *et al.* (1990)
	Psalidodon aff. *fasciatus* (Cuvier, 1819)	Rio Moji-Guaçu, Pirassununga, state of São Paulo	Kloss (1966); Kohn *et al.* (1990)
		Lake Guaíba, Porto Alegre, state of Rio Grande do Sul	Fortes & Hoffmann (1999)
	Moenkhausia doceana (Steindachner, 1877)	state of Espírito Santo	Kohn *et al.* (1990)
	Oligosarcus hepsetus (Cuvier, 1829)*	Lake Guaíba, Porto Alegre, state of Rio Grande do Sul	Fortes & Hoffmann (1995)
	Oligosarcus robustus Menezes, 1969	Lake Guaíba, Porto Alegre, state of Rio Grande do Sul	Kohn *et al.* (1990); Fortes & Hoffmann (1995)
Bryconidae	*Salminus brasiliensis* (Cuvier, 1816)	Rio Moji-Guaçu, Pirassununga, state of São Paulo	Kohn *et al.* (1990)

* see remarks in the text.

Fortes & Hoffmann (1999) reported *G. parva* in *P.* aff. *fasciatus* from Lake Guaíba, but the authors did not provide the number of fish specimens examined, the morphometry of the helminths, and the parameters of the infections. As for the genus *Astyanax*, this is the first report of *G. parva* in *A. henseli* and *A. lacustris* from southern Brazil, including data on morphometry and parameters of the infections in different host species. Also, we report a new locality (Itapeva Lagoon) for *G. parva*, contributing to the knowledge and distribution of the biodiversity of parasites in freshwater fishes.

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Author contributions: **CRediT (Contributor Roles Taxonomy)**

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Conceptualization: MG
Data curation: MG
Formal Analysis: MG
Funding acquisition: MG, LRPU
Investigation: MG
Methodology: MG
Project administration: MG, LRPU
Resources: MG, LRPU
Software: MG, LRPU
Supervision: MG, LRPU
Validation: MG, LRPU
Visualization: MG, LRPU
Writing – original draft: MG, LRPU
Writing – review & editing: MG, LRPU

BIBLIOGRAPHIC REFERENCES

Bertaco, V.A., & Lucena, C.A.S. (2010). Redescription of *Astyanax obscurus* (Hensel, 1870) and *A. laticeps* (Cope, 1894) (Teleostei: Characidae): two valid freshwater species originally described from rivers of Southern Brazil. *Neotropical Ichthyology*, *8*, 7-20.

Buckup, P.A., Menezes, N.A., & Ghazzi, M.S. (eds). (2007). *Catálogo das espécies de peixes de água doce do Brasil*. Museu Nacional.

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.

Ditrich, O., Scholz, T., Aguirre-Macedo, L., & Vargas-Vázquez, J. (1997). Larval stages of trematodes from freshwater molluscs of the Yucatán Peninsula, Mexico. *Folia parasitologica*, *44*, 109-127.

Fortes, E., & Hoffmann, R.P. (1985). Contribuição ao conhecimento dos parasitos de peixes do estuário do Guaiba, no Estado do Rio Grande do Sul. IV – Trematódeos digenéticos. *Revista Brasileira de Medicina Veterinária, 7*, 209-210.

Fortes, E., & Hoffmann, R.P. (1995). Trematódeos gastrintestinais de *Astyanax fasciatus* (Cuvier, 1819), lambaris do lago Guaíba, Porto Alegre, Rio Grande do Sul, Brasil. *A Hora Veterinária*, *18*, 55-56.

Gallas, M., & Utz, L.R.P. (2019a). First report of *Dendrorchis retrobiloba* Volonterio & Ponce de León, 2005 (Digenea, Gorgoderidae) in *Astyanax* aff. *fasciatus* (Cuvier, 1819) (Characiformes, Characidae) from southern Brazil. *Check List*, *15*, 357-361.

Gallas, M., & Utz, L.R.P. (2019b). *Quadrigyrus torquatus* cystacants Van Cleave, 1920 (Acanthocephala: Quadrigyridae) parasitizing species of *Astyanax* (Characiformes: Characidae) from southern Brazil. *Biota Neotropica*, *19*, e20180693.

Gallas, M., & Utz, L.R.P. (2019c). Revalidation of *Saccocoelioides bacilliformis* (Digenea, Haploporidae) parasitizing species of *Astyanax* (Characiformes, Characidae) from southern Brazil. *Iheringia. Serie Zoologia*, *109*, e2019039.

Kloss, G.R. (1966). Helmintos parasitas de espécies simpátricas de *Astyanax* (Pisces, Characidae). *Papéis Avulsos de Zoologia*, *18*, 189-219.

Kohn, A., & Fernandes, B.M.M. (1988). Revision of the Brazilian species of the genus *Halipegus* Looss, 1899 (Trematoda: Derogenidae). *Systematic Parasitology*, *11*, 129-137.

Kohn, A., Fernandes, B.M.M., Gibson, D.I., & Fróes, O.M. (1990). On the Brazilian species of halipegine genera (Trematoda: Derogenidae) from fishes, with new morphological data, hosts and synonyms. *Systematic Parasitology*, *16*, 201-211.

Kohn, A., Fernandes, B.M.M., & Cohen, S.C. (2007). *South American Trematodes Parasites of Fishes*. Imprinta Express.

Kohn, A., Moravec, F., Cohen, S.C., Canzi, C., Takemoto, R.M., & Fernandes, B.M.M. (2011). Helminths of freshwater fishes in the reservoir of the Hydroelectric Power Station of Itaipu, Paraná, Brazil. *Check List*, *7*, 681-690.

Lucena, C.A.S., & Soares, H.G. (2016). Review of species of the *Astyanax bimaculatus* "caudal peduncle spot" subgroup *sensu* Garutti & Langeani (Characiformes, Characidae) from the rio La Plata and rio São Francisco drainages and coastal systems of southern Brazil and Uruguay. *Zootaxa*, *4072*, 101-125.

Lucena, C.A.S., Castro, J.B., & Bertaco, V.A. (2013). Three new species of *Astyanax* from drainagens of southern Brazil (Characiformes: Characidae). *Neotropical Ichthyology*, *11*, 537-552.

Lunaschi, L.I. (1990). Helmintos parasitos de peces de agua dulce de la Argentina IX. El género *Genarchella* Travassos, Artigas y Pereira, 1928, y descripción de *G. parva* Travassos, Artigas y Pereira, 1928, y *G. fragilis* sp. nov. (Trematoda, Derogenidae). *Studies on Neotropical Fauna and Environment*, *25*, 125-132.

Scholz, T., Vargas-Vazquez, J., & Salgado-Maldonado, G. (1995). Revision of *Genarchella* species (Digenea: Derogenidae) parasitizing freshwater fishes in Mexico and Central America. *Journal of Natural History*, *29*, 1403-1417.

Terán, G.E., Benitez, M.F., & Mirande, J.M. (2020). Opening the Trojan horse: phylogeny of *Astyanax*, two new genera and resurrection of *Psalidodon* (Teleostei: Characidae). *Zoological Journal of the Linnean Society*, *190*, 1217-1234.

Travassos, L., Artigas, P., & Pereira, C. (1928). Fauna helminthologica dos peixes de água doce do Brasil. *Archivos do Instituto Biológico*, *1*, 5-68.

Vilella, F.S., Becker, F.G., & Hartz, S.M. (2002). Diet of *Astyanax* species (Teleostei, Characidae) in an Atlantic Forest River in Southern Brazil. *Brazilian Archives of Biology and Technology*, *45*, 223-232.

Virgilio, L.R., Martins, W.M.O., Lima, F.S., Takemoto, R.M., Camargo, L.M.A., & Meneguetti, D.U.O. (2022). Endoparasite fauna of freshwater fish from the upper Juruá River in the Western Amazon, Brazil. *Journal of Helminthology*, *96*, e55.

Yamaguti, S. (1975). *A synoptical review of life histories of digenetic trematodes of vertebrates with special reference to the morphology of their life cycles*. Keigaku Publishing Co.

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