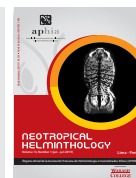




Neotropical Helminthology



ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

OCCURRENCE OF *BRAGA NASUTA* SCHIOEDTE & MEINERT (1881) (ISOPODA, CYMOTHOIDAE) PARASITIZING THE ORNAMENTAL FISH *HYPHESSOBRYCON EQUES* (STEINDACHNER, 1882) (CHARACIDAE) FROM A BRAZILIAN RIVER

OCURRENCIA DE *BRAGA NASUTA* SCHIOEDTE & MEINERT (1881) (ISOPODA, CYMOTHOIDAE) PARASITANDO EL PECE ORNAMENTAL *HYPHESSOBRYCON EQUES* (STEINDACHNER, 1882) (CHARACIDAE) DE UN RIO BRASILEÑO

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ABSTRACT

Cymothoidae is the most common family of parasitic isopods found in fishes from Brazil. Among freshwater cymothoids, the genus *Braga* has seven species already recorded for this country. *Braga nasuta* Schioedte & Meinert (1881) was originally described from the coast of Brazil, however, it has already been recorded parasitizing freshwater fishes from Amazonas, Bahia, São Paulo, and Pará States. An adult male of *B. nasuta* was recorded for the first time parasitizing the ornamental fish, *Hyphessobrycon eques* (Steindachner, 1882) sampled in the “Reserva Particular do Patrimônio Natural” Cisalpina, Mato Grosso do Sul State, Brazil. This study also represents the first record of this parasitic isopod in the Central-West region of Brazil. The occurrence of parasitic isopods on a highly appreciated and exported fish like *H. eques* increases the concern about the potential introduction of these parasites to importing countries.

Keywords: Crustacea – Freshwater – Malacostraca – Mato Grosso do Sul State

RESUMEN

Cymothoidae es la familia más común de isópodos parásitos encontrados en peces de Brasil. Entre los cimotoideos de agua dulce, el género *Braga* con siete especies ya registradas en el país. *Braga nasuta* Schioedte & Meinert (1881) fue originalmente registrada por la primera vez en la Costa de Brasil, pero ya se ha registrado en peces de agua dulce en los estados brasileños de Amazonas, Bahia, São Paulo y Pará. Un macho adulto de *B. nasuta* fue registrado por primera vez parasitando el pez ornamental, *Hyphessobrycon eques* (Steindachner, 1882) muestreado en la Reserva Particular de Patrimonio Natural Cisalpina, Mato Grosso do Sul, Brasil. Este estudio también representa el primer registro de ese isópodo parásito en la región Centro-Oeste del Brasil. El registro de isópodos parásitos en una especie de pez muy apreciada y exportada como *H. eques* aumenta la preocupación del potencial de introducción de estos parásitos a los países importadores.

Palabras clave: Crustacea - Agua dulce - Malacostraca - Mato Grosso do Sul

INTRODUCTION

Teleosts harbor a great quantity and variety of invertebrate parasites, being recorded host-parasite associations with parasites from different taxa, as: Protozoa, Ciliophora, Cnidaria (Myxozoa), Platyhelminthes (Trematoda, Cestoda, and Monogenea), Nematoda, Acanthocephala, Arthropoda (Copepoda, Branchiura, Isopoda, Pentastomida, and Acari), Annelida (Hirudinea) and Mollusca (Bivalvia) (Thatcher, 2006; Pavanelli *et al.*, 2013). Parasitic crustaceans, represented mainly by the subclasses Copepoda and Branchiura, and the order Isopoda are among the most relevant parasites of Brazilian freshwater fishes (Eiras *et al.*, 2010).

Isopods are dorso-ventrally flattened crustaceans found in marine, freshwater, and terrestrial habitats. They are characterized by having a free thorax (= pereon) with seven free segments (= pereonites) each bearing a pair of similar legs (= pereopods) (Thatcher, 2006). Parasitic isopods have from four to seven pairs of walking legs modified for grasping and each of these is provided with a stout claw-like dactyl (Thatcher, 2006). Currently, 53 species and 21 genera of parasitic isopods are known from Brazilian fishes and most of them belong to the family Cymothoidae Leach, 1818 (Luque *et al.*, 2013).

The knowledge about the impacts of isopods on the health of fishes is still scarce (Tavares-Dias *et al.*, 2014). Nevertheless, the presence of these

parasites can cause expressive damages to their hosts. Especially on the gills, these parasites can cause compression and destruction of tissues, blood loss, and decreasing of breathing capacity, which may affect hosts' metabolism and lead to a decrease in their growth rate (Carvalho *et al.*, 2004; Eiras *et al.*, 2010). Furthermore, these parasites can increase the mortality rate or even act as vectors for other fish diseases, particularly those caused by virus and bacteria (Tavares-Dias *et al.*, 2014).

The genus *Braga* Schioedte & Meinert, 1881 includes freshwater cymothoids, with seven species described: *Braga amapaensis* Thatcher, 1996, *Braga bachmanni* Stadler, 1972, *Braga brasiliensis* Schioedte & Meinert, 1881, *Braga cichlae* Schioedte & Meinert, 1881, *Braga fluviatilis* Richardson, 1911, *Braga nasuta* Schioedte & Meinert, 1881, and *Braga patagonica* Schioedte & Meinert, 1884 (Schioedte & Meinert, 1881). Except for *B. bachmanni* that was described from *Ancistrus cirrhosus* (Valenciennes, 1836) in Argentina (Stadler, 1972), all other species have already been recorded parasitizing fishes in Brazil (Luque *et al.*, 2013). Species from this genus are usually found associated with the tongue or the opercular cavity of their hosts (Thatcher, 2006).

Hyphessobrycon eques (Steindachner, 1882) is a small neotropical characid, which has diurnal activity anolis widely distributed in Amazon and Paraguay-Paraná River basins (Carvalho & Del-Claro, 2004). Popularly known as “serpa tetra”, “jewel tetra” or “matogrossinho”, this species is highly appreciated in aquariorifilism due to its

exuberant red color (Fujimoto *et al.*, 2013). Despite being an important species for the aquarium fishery industry, there is little information about the parasite fauna of *H. eques* (Acosta & Silva, 2015). Fujimoto *et al.* (2013) and Acosta & Silva (2015) are the only two assessment of its parasitic fauna reporting the occurrence of cysthacanth (Acanthocephala) of *Quadrigrurus nickoli* Schmidt & Huggins, 1973 and *Hysterothylacium* sp. larvae (Nematoda), respectively.

We present herein the first report of *B. nasuta* (Isopoda: Cymothoidae) parasitizing the ornamental fish, *H. eques* sampled in the “Reserva Particular do Patrimônio Natural (RPPN)” Cisalpina, Mato Grosso do Sul State, Brazil.

MATERIAL AND METHODS

Specimens of *H. eques* (n = 30) were collected under the Permanent License for the Collection of Zoological Material (SISBio 60640-1) in January 2018 in a stream (21°19'53.70"S; 51°56'39.91"W) in the RPPN Cisalpina, Mato Grosso do Sul State, Brazil. Fish were collected using sieve nets. Hosts were individually stored in plastic bags and transported to the laboratory for parasitological analyses. Oral cavity, gill chamber, and body surface of fish were examined for isopods using a stereo microscope. The Isopod was stored in vials with 70% ethanol. Morphological analysis and photomicrographs of the parasite were obtained using Leica Application Suite 3.7.0 software in Leica M125 stereomicroscope.

The identification of the isopod was based on descriptions and identification keys proposed by Lemos de Castro (1959), Lemos de Castro & Silva (1985), and Thatcher (2006). The parasite voucher was deposited in the “Coleção Helminológica do Instituto de Biociências de Botucatu (CHIBB)” at São Paulo State University (UNESP), Botucatu, São Paulo State, Brazil (CHIBB 8521).

This study was approved by the Ethics Committee in Animal Experimentation of the Institute of Biosciences of the São Paulo State University (Unesp) under the protocol number 942/2017.

RESULTS

Thirty specimens of *H. eques* were examined for crustacean parasites. Only one isopod adult male was found parasitizing one fish specimen (prevalence = 1/30 or 3.3%). The ectoparasite was identified as belonging to *Braga* based on the presence of the following: (i) body symmetrical longer than wide (5.6 mm long, and 2.6 mm wide) (Fig. 1A); (ii) cephalon not immersed in pereonite 1; (iii) all seven pairs of pereopods prehensile and provided with stout claw-like dactyls (Fig. 1B); (iv) pleopods multilaminar; and (v) pleon slightly immersed in pereonite 7 (Figs. 1-2).

The male was identified as belonging to the species *B. nasuta* by the presence of following features: (i) cephalon truncated anteriorly; (ii) pereopod 7 with a dactyl shorter and weaker than others; (iii) merus of pereopod 7 with a distal tooth near the articulation with carpus; (iv) pleotelson triangular, ending in a small and sharp tip (Fig. 2C); and (v) uropod extending beyond the apex of pleotelson and with exopod slightly longer than endopod.

DISCUSSION

The present study report for the first time the occurrence of *B. nasuta* infesting *H. eques*. The ectoparasite identification was confirmed based on the main morphological characteristics presented by Lemos de Castro (1959), Lemos de Castro & Silva (1985), Thatcher (2006), and Thatcher *et al.* (2009).

Hyphessobrycon eques is a Neotropical fish widely distributed along the Amazon and Paraná-Paraguay River basins (Carvalho & Del-Claro, 2004). In Brazil, its occurrence in other rivers, such as the Upper Paraná River may be related to the introduction of this species through aquarists (Pavanelli & Graça, 2007). This small characid presents a diurnal activity and an opportunistic foraging tactic, which consist in following substrate grubbers (Carvalho & Del-Claro, 2004). A despite this species is highly appreciated as an aquarium fish, given its peculiar red color (Fujimoto *et al.*, 2013), there is relatively little

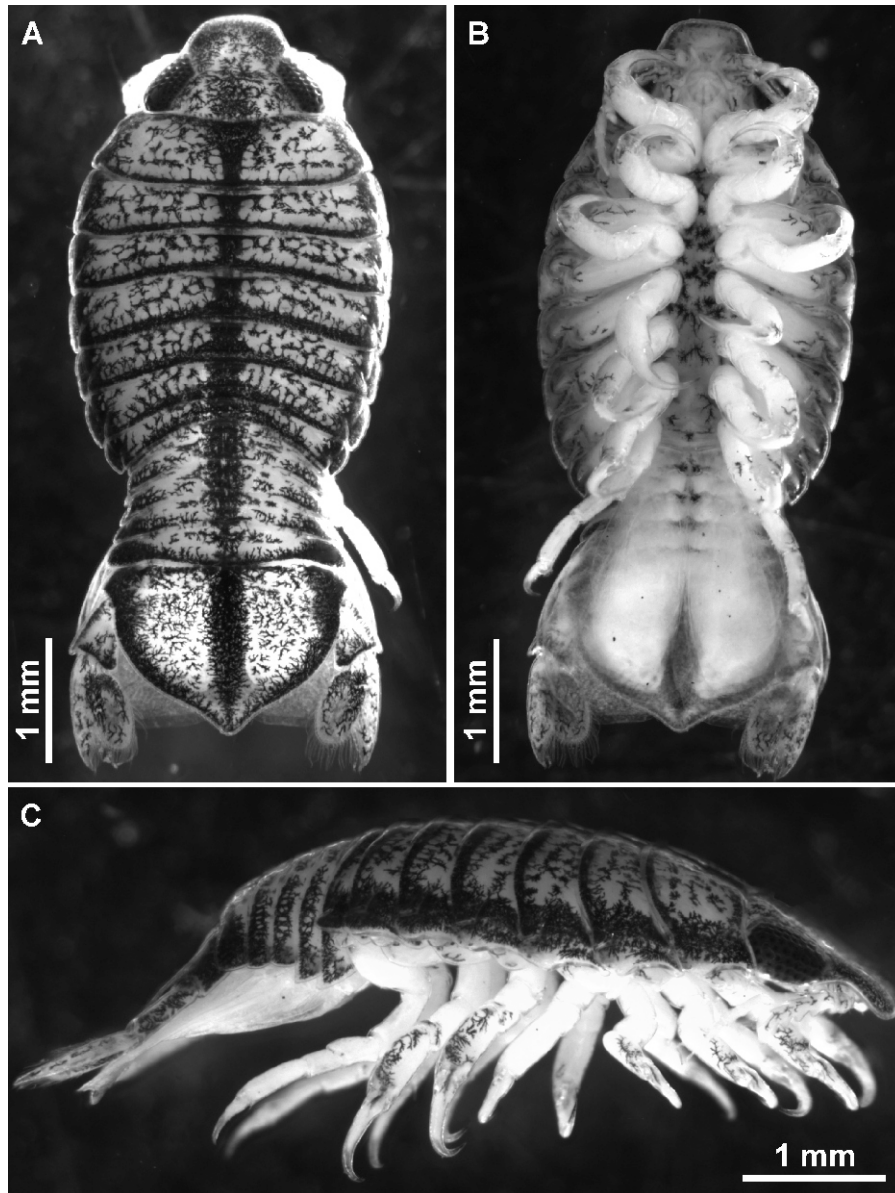


Figure 1. *Braga nasuta* Schioedte & Meinert (1881), adult male. (A) Dorsal view; (B) Ventral view; (C) Lateral view.

information about its biology and behavior in the wild (Carvalho & Del-Claro, 2004).

Likewise, the literature about its parasitic fauna is still scarce. Up to date, there are only two reports about metazoan parasites associated with this species. Fujimoto *et al.* (2013) recorded for the first time the occurrence of *Quadrigyrus nickoli* cystacanths (Acanthocephala, Quadrigyridae) in the stomach and intestine of *H. eques* sampled in

Chumucuí River, Pará State, Brazil. Acosta & Silva (2015) recorded *Hysterothylacium* sp. larvae (Nematoda, Anisakidae) in the intestine and coelomic cavity of *H. eques* sampled in the Paranapanema River, São Paulo State, Brazil. Hence, the present study is the first report of an ectoparasitic isopod on *H. eques*, and the first report of *B. nasuta* from Mato Grosso do Sul State, Brazil.

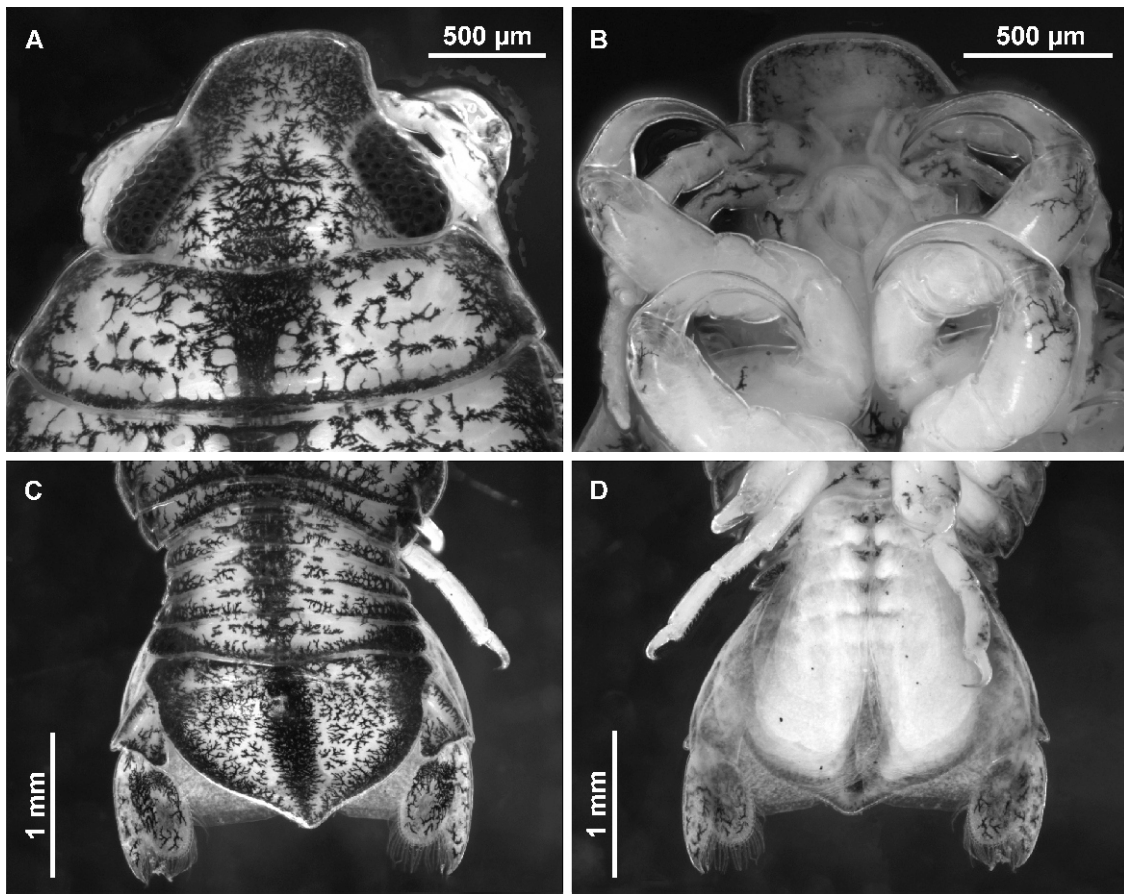


Figure 2. *Braga nasuta* Schioedte & Meinert (1881), adult male. (A) Cephalon, dorsal view; (B) Cephalon, ventral view; (C) Pleon, dorsal view; (D) Pleon, ventral view.

Studies regarding the parasitic fauna of ornamental fishes have gained importance over the last few years, not only because these parasites have the potential to affect their hosts' biology, and as a consequence resulting in economic losses for both breeders and hobbyists (e. g.: increased fish mortality, decreased fish grow rate, treatment costs, etc.) (Piazza *et al.*, 2006; Tavares-Dias *et al.*, 2009), but also due to increased concern with the potential for the introduction of diseases and parasites through the importation and exportation of these fishes (Tavares-Dias *et al.*, 2009). The introduction of a new parasite may lead to deep changes in the native fauna due to decreasing of native species recruitment, alterations in the trophic structure, species extinction, or even by modifications upon evolutionary pressures, resulting in decreased quality of fishery resources (Lacerda *et al.*, 2013).

Many crustaceans, mainly copepods, have been considered as invasive species worldwide (Johnson *et al.*, 2004; Piasecki *et al.*, 2004). The lernaeid copepod *Lernaea cyprinacea* (Linnaeus, 1758) is considered one of the most important invasive parasites on fishes. This species has been reported infesting numerous fishes, including both native and exotic species throughout the world (Piasecki *et al.*, 2004). In Brazil, *L. cyprinacea* was introduced at the beginning of 20th century via the importation of the common carp, *Cyprinus carpio* Linnaeus, 1758 with several reports in both farmed and wild fish throughout the country (Piasecki *et al.*, 2004). The presence of the cymothoids *B. nasuta*, which exhibits a monoxenous life-cycle and protandrous hermaphroditism (Thatcher, 2006), in a very largely exported and appreciated ornamental species like *H. eques*, increases the concern about the potential for the introduction of

these parasites to importing countries. Therefore, it is recommended to intensify measures when exporting *H. eques* and other ornamental fishes in order to avoid the spread of parasitic isopods as *B. nasuta* to other locations.

The parasitic cymothoid *B. nasuta* was originally proposed from a single specimen (female) by Schioedte & Meinert (1881) for the Brazilian coast. Later, Lemos de Castro (1959) considered the statement of Schioedte & Meinert (1881) that *B. nasuta* is a marine species, as vague and probably wrong, since two other specimens (males) were found in freshwater. *Braga nasuta* shows distribution restricted to the Brazilian territory with reports for Amazonas, Bahia, São Paulo and Pará States (Thatcher, 2006; Jesus *et al.*, 2017). In relation to hosts, *B. nasuta* was reported originally for *Hypostomus* sp. (Siluriformes, Loricariidae) (Thatcher, 2006) and, more recently, parasitizing fingerlings of *Arapaima gigas* (Schinz, 1822) (Osteoglossiformes, Arapaimidae) (Jesus *et al.*, 2017).

The main features used to identify the male cymothoid (reported herein) to species level were the morphology of cephalon, pleotelson, uropod, and pereopods, and the color pattern of the dorsal segments. This specimen exhibits the same morphology and body color proposed and illustrated by Lemos de Castro (1959). However, it differs from the male specimens reported by Jesus *et al.* (2017) for fingerlings of *A. gigas* (see Fig. 3 in Jesus *et al.*, 2017). Our specimen differs from those of *A. gigas* by presenting: (i) large cephalon in relation to the total body length (vs relative size of cephalon to the total body length smaller); (ii) cephalon truncated anteriorly (vs rounded anteriorly); (iii) uropod extending beyond the apex of pleotelson (vs smaller than the pleotelson); (iv) exopod longer than endopod (vs similar in size); (v) pleotelson triangular and wider than long (vs rounded and as long as wide). Our specimen also differs by presenting median pereon stripe and the posterior stripe of each pereonite thinner (vs thicker stripes). Because of these differences, we believe that the specimens found on *A. gigas* belong to another species of the genus *Braga*.

This study reported for the first the time infestation of *H. eques* from Mato Grosso do Sul State, Brazil, with *B. nasuta* and contributes to expanding the

knowledge about the geographical distribution and the list of fishes parasitized by this isopod in this country.

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BIBLIOGRAPHIC REFERENCES

- Acosta, AA & Silva, RJ. 2015. First record of *Hysterothylacium* sp. *Moravec, Kohn et Fernandes, 1993* larvae (Nematoda: Anisakidae) infecting the ornamental fish *Hypessobrycon eques* Steindachner, 1882 (Characiformes, Characidae). Brazilian Journal of Biology, vol. 75, pp. 638-642.
- Carvalho, LN, Arruda, R & Del-Claro, K. 2004. Host-parasite interactions between the piranha *Pygocentrus nattereri* (Characiformes: Characidae) and isopods and branchiurans (Crustacea) in the Araguaia River basin, Brazil. Neotropical Ichthyology, vol. 2, pp. 93-98.
- Carvalho, LN & Del-Claro, K. 2004. Effects of predation pressure on the feeding behaviour of the serpa tetra *Hypessobrycon eques* (Ostariophysi, Characidae). Acta ethologica, vol. 7, pp. 89-93.
- Eiras, JC, Takemoto, RM & Pavanelli, GC. 2010. Diversidade dos parasitas de peixes de água doce do Brasil. Clichetec. Maringá, Brazil, 333 pp.
- Fujimoto, RY, Almeida, ES, Diniz, DG, Eiras, JC & Martins, ML. 2013. First occurrence of *Quadrigyus nickoli* (Acanthocephala) in the ornamental fish *Hypessobrycon eques*. Revista Brasileira de Parasitologia Veterinária, vol. 22, pp. 110-113.
- Jesus, EC, Cardoso, L, Ferreira, TH, Martins, ML & Rodrigues, MDN. 2017. *Braga nasuta*

- (Cymothoidae): an ectoparasite of the Giant Amazonian fish *Arapaima gigas* (Osteoglossidae) fingerlings cultured in the Amazon region in Northern Brazil. *Acta Scientiarum*, vol. 39, pp. 507-511.
- Johnson, SC, Bravo, S, Nagasawa, K, Kabata, Z, Hwang, JS, Ho, JS & Shih, CT. 2004. A review of the impact of parasitic copepods on marine aquaculture. *Zoological Studies*, vol. 43, pp. 229-243.
- Lacerda, ACF, Yamada, FH, Antonucci, AM & Tavares-Dias, M. 2013. Peixes introduzidos e seus parasitos. In GC Pavanelli, RM Takemoto & JC Eiras (org.). *Parasitologia de peixes de água doce do Brasil*. Eduem. Maringá, Brazil, 25 pp.
- Lemos de Castro, A. 1959. Sobre as espécies sulamericanas do gênero *Braga* Schiödte & Meinert (Isopoda Cymothoidae). *Arquivos do Museu Nacional*, vol. 44, pp. 69-95.
- Lemos de Castro, A & Silva, JL. 1985. *Isopoda*. In R Schaden (eds.). *Manual de identificação de invertebrados límnicos do Brasil*. CNPq. Brasília, Brazil, 20 pp.
- Luque, JL, Vieira, FM, Takemoto, RM, Pavanelli, GC & Eiras, JC. 2013. Checklist of Crustacea parasitizing fishes from Brazil. *Check List*, vol. 9, pp. 1449-1470.
- Pavanelli, CS & Graça, WJ. 2007. *Peixes da Planície de Idunção do Alto Paraná e áreas adjacentes*. Eduem. Maringá, Brazil, 241 pp.
- Pavanelli, GC, Takemoto, RM & Eiras, JC. 2013. *Parasitologia de peixes de água doce do Brasil*. Eduem. Maringá, Brazil, 458 pp.
- Piasecki, W, Goodwin, AE, Eiras, JC & Nowak, BF. 2004. Importance of Copepoda in freshwater aquaculture. *Zoological Studies*, vol. 43, pp. 193-205.
- Piazza, RS, Martins, ML, Guiraldelli, L & Yamashita, MM. 2006. Parasitic diseases of freshwater ornamental fishes commercialized in Florianópolis, Santa Catarina, Brazil. *Boletim do Instituto de Pesca*, vol. 32, pp. 51-57.
- Schiödte, JC & Meinert, F. 1881. *Symbolae ad Monographiam Cymothoarum Crustaceorum Isopodum, Familie II. Anilocridae*. *Naturhist Tidsskrift*, Ser. III, vol. 13, pp. 1-166.
- Stadler, T. 1972. *Braga bachmanni* nuevo ectoparasito de *Ancistrus cirrosus* (Crustacea, Cymothoidae en Pisces, Loricariidae). *Neotropica*, vol. 18, pp. 141-145.
- Tavares-Dias, M, Araújo, CSO, Barros, MS & Viana, GM. 2014. New hosts and distribution records of *Braga patagonica*, a parasite cymothoidae of fishes from the Amazon. *Brazilian Journal of Aquatic Science and Technology*, vol. 18, pp. 91-97.
- Tavares-Dias, M, Lemos, JRG, Martins, ML & Jerônimo, GT. 2009. Metazoan and protozoan parasites of freshwater ornamental fish from Brazil. In Tavares-Dias M. (org.). *Manejo e sanidade de peixes em cultivo*. Embrapa. Amapá, Brazil, 25 pp.
- Thatcher, VE. 2006. *Amazon fish parasites*. Pensoft Publishers, 2nd ed. Sofia-Moscow, Bulgaria, 508 pp.
- Thatcher, VE, Oliveira, AAN & Garcia, AM. 2009. *Braga cigarra* comb. nov. for *Philostomella cigarra* (Crustacea: Isopoda: Cymothoidae) with a redescription of the species based on specimens from *Galeocharax kneri*, a freshwater fish of Minas Gerais State, Brazil. *Zoologia*, vol. 26, pp. 155-160.

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