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A new species of *Tiddergasilus* Marques & Boeger, 2018 (Copepoda: Ergasilidae) from the gills of *Astyanax lacustris* (Lütken) (Osteichthyes: Characidae) in Brazil

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Abstract A new parasitic copepod, *Tiddergasilus bipartitus* **n. sp.** (Copepoda, Ergasilidae), is described herein based on three adult females found attached to the gills of the yellow-tail lambari *Astyanax lacustris* (Lütken), sampled in Pardo River, municipality of Botucatu, São Paulo State, Brazil. *Tiddergasilus bipartitus* **n. sp.** was recognized as a new member of the monotypic genus *Tiddergasilus* Marques & Boeger, 2018 by having: antennule 6-segmented; maxillary basis armed with 2 terminal teeth and ornamented with multiple spinules; second and third leg both with endopod 3-segmented. The new copepod can be distinguished from its congener, *Tiddergasilus iheringi* (Tidd, 1942), by the morphology of the antennal claw, number of somites/segments in abdomen and fourth leg, and by the ornamentation of the first leg. This report expands the geographic distribution and diversity of fish species parasitized with *Tiddergasilus* spp. in Brazil. Moreover, it also represents the first report of an ergasilid species in the Pardo River. A list of diagnostic features for the Brazilian species of *Ergasilus* von Nordmann, 1832 is provided herein, in order to aid comparisons with the species of this complex genus.

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Introduction

The copepod family Ergasilidae Burmeister is one of the most speciose parasitic families from the order Cyclopoida with over 260 species described worldwide, except in Antarctica (Amado et al., 1995; Boxshall & Defaye, 2008). Among the cyclopoids, ergasilids are unique due to their life cycle (i.e.: only post-mated adult females are parasitic while all developmental stages and adult males are free-living), by the shape of their prehensile antennae, which are modified in an attachment organ carrying 1 to 3 terminal claws, and by the loss of the maxilliped in adult females (El-Rashidy, 1999; Boxshall & Halsey, 2004). These small copepods (i.e. most species are smaller than 1 mm) inhabit a wide variety of salinity regimes from marine to freshwater and most adult females are parasites of fishes, mainly Osteichthyes, with few species found in bivalve mollusks (Tang & Kalman, 2008).

The Ergasilidae Burmeister, 1835 is a well-defined family distinguished by the shape of the prehensile antennae, mouthparts, and by the lack of the maxilliped in adult females (Boxshall & Halsey, 2004). Despite this stability, since the 1990’s this taxon has undergone profound taxonomic changes, such as: invalidation of family status of closely-related families and transfer of genera and species to Ergasilidae (e. g.: currently, the family status of Therodamasidae Tripathi, 1960 and Vaigamidae Thatcher & Robertson B.A., 1984 are not valid and the genera and species of both families are allocated in Ergasilidae) (El-Rashidy, 1999; Boxshall & Halsey, 2004). Nowadays, taxonomic changes still occur within Ergasilidae, but these changes are restricted to the genus and species level as occurred in *Ergasilus* von Nordmann, 1832. *Ergasilus* is the type-genus and also the most speciose genus of Ergasilidae with over 160 spp. worldwide (Waicheim et al., 2021). Despite being considered a valid genus, primary phylogenetic analysis of the entire family indicated that this genus is polyphyletic (El-Rashidy, 1999; Marques, 2018). Therefore, some *Ergasilus* species were re-evaluated and then transferred to newly proposed genera such as *Gauchergasilus* Montú & Boxshall, 2002 and, more recently, the same happened with *Tiddergasilus* Marques & Boeger, 2018 (Boxshall & Halsey, 2004; Marques & Boeger, 2018).

The ergasilid genus *Tiddergasilus* was proposed by Marques and Boeger (2018) to accommodate *Tiddergasilus iheringi* (Tidd, 1942) as a new combination for *Ergasilus iheringi* Tidd, 1942 (Marques & Boeger, 2018). When re-evaluating the type-material of *E. iheringi*, Marques and Boeger (2018) concluded that specimens differed from their congeners by the morphology of antennal segments and claw (i.e.: second endopodal segment short and unornamented; claw short, recurved with a sub-proximal indentation in the inner margin), and by having fourth swimming leg with 2-segmented endopod (Marques & Boeger, 2018). Currently, the monotypic *Tiddergasilus* is one of 29 valid genera of Ergasilidae and the records of *T. iheringi* (type-species) are restricted to a single region and host fish species in Brazil, e. g. Northeast region and *Hoplias malabaricus* (Bloch), respectively.

During the survey of the parasitic fauna of fishes from Pardo River, municipality of Botucatu, São Paulo State, Brazil, we found some ergasilids parasitizing the gills of the yellow-tail lambari, *Astyanax lacustris* (Lütken). Morphological analysis of these copepods indicated that they represent a new species of *Tiddergasilus*, which is described herein.

Materials and methods

Ten specimens of the yellow-tail lambari, *A. lacustris* were collected during a sampling survey in December/2020 in Pardo River (22°59’22.07“S 48°26’26.20”W), municipality of Botucatu, São Paulo State, Brazil. Fish collections were authorized by the Instituto Chico Mendes de Conservação da Biodiversidade – ICMBio and Sistema de Autorização e Informação em Biodiversidade - SISBIO # 60640-1 and all procedures followed the recommendations of the Ethical Commission for Animal Experimentation from the São Paulo State University (Unesp), Institute of Biosciences, Botucatu, Brazil (CEUA n° 9415260520). Fish were collected using seine nets, casting nets, and rod fishing. Each specimen was individually stored in plastic bags and placed in a freezer before necropsy. In the laboratory, the gill arches were removed, separated in Petri dishes, and then examined for parasitic copepods under a stereomicroscope. Each copepod was carefully removed using fine needles and then stored in vials with 70% ethanol. For morphological identification, some copepods were cleared in lactic acid and then mounted in Hoyer’s medium. Whenever necessary, some specimens were also dissected in glycerol medium and then each part was mounted on individual slides (e.g.: antennules, antennae, swimming legs, etc.). Coverslips were sealed with transparent nail varnish.

Morphological analysis and measurements of whole/dissected copepods were made using a microscope with differential interference contrast optics (Leica DMLB 5000, Leica Microsystems). Drawings were made with aid of a microscope (LeicaDMLS, Leica Microsystems, Wetzlar, Germany) equipped with a drawing tube. All measurements are in micrometers (µm) and presented as the range followed by the mean in parenthesis. Morphological nomenclature used for copepod description followed Boxshall and Montú (1997) and Boxshall and Halsey (2004). Abbreviations used throughout the text to refer to the name of the structures and segments present in Ergasilidae are shown in Table 1. Ecological descriptors such as prevalence and mean intensity were calculated following Bush et al. (1997).

The specimens of *Ergasilus* sp. used for morphological comparison of the antennae and L1 (see Fig. 4) was obtained from the Helminthological Collection of the Institute of Biosciences (CHIBB), Universidade Estadual Paulista “Júlio de Mesquita Filho” (UNESP), municipality of Botucatu, São Paulo State, Brazil (Num. CHIBB 677 to 679L). This copepod was originally sampled from gills of *Schizodon intermedius* Garavello & Britski 1990 (Characiformes, Anostomidae) from Paranapanema River, Jurumirim Reservoir, Upper Paranapanema River (23°29′16.54′’ S 48°37′12.88′’ W), municipality of Angatuba, São Paulo State, Brazil.

Table 1 Abbreviations of body parts and segments used throughout the text to describe copepods

Abbreviation	Meaning
PS-1 (2-5)	first (second to fifth) pedigerous somite
AS-1 (2, 3)	First (second, third) abdominal somite
L1 (2-5)	first (second to fifth) leg
enp	Endopod
exp	Exopod
enp-1 (2, 3)	first (second, third) endopodal segment
exp-1 (2, 3)	first (second, third) exopodal segment

Type specimens (holotype and paratypes) were deposited in the Zoological Collection of the Museu de Zoologia da Universidade de São Paulo (MZUSP), municipality of São Paulo, São Paulo State, Brazil.

Results

Ergasilidae Burmeister

Tiddergasilus Marques & Boeger, 2018

***Tiddergasilus bipartitus* n. sp.** (Figs. 1-3; Table 2)
Type host: *Astyanax lacustris* (Lütken) (Characiformes: Characidae), yellow-tail lambari.
Site of infection: Gill filaments.
Prevalence: One of 10 examined hosts (10,0%).
Intensity of infection: 3 copepods in one infected host.
Type locality: Pardo River (22°59'22.07"S 48°26'26.20"W), municipality of Botucatu, São Paulo State, Brazil.
Specimens deposited: Holotype MZUSP 42722 (adult female) and Paratypes MZUSP 42720 and 42721 (2 adult females) deposited deposited in the Zoological Collection of the Museu de Zoologia da Universidade de São Paulo (MZUSP), municipality of São Paulo, São Paulo State, Brazil.
Zoobank LSID: urn:lsid:zoobank.org:pub:4503775B-6609-4501-9177-46A0ACF6AFC6.
s*Etymology*: The specific name is derived from the Latin word, *bipartito* (= divided into two parts) in reference to the abdomen 2-segmented which is probably the result of the failure in the separation of AS-2 and AS-3 during development.

Description

Adult female (based on three specimens): Overall length, from anterior end of cephalothorax to posterior margin of caudal rami (less caudal setae), 889 – 926 long. Body cyclopiform, comprising prosome, urosome and caudal rami; prosome consisting of cephalosome and PS-1; PS-1 fused to cephalosome; and three free pedigerous somites (PS-2 to PS-4). Cephalothorax bullet-shaped, with maximum width at level of first intercoxal sclerite, 306 – 385 long, 312 – 320 wide; dorsal surface with elliptical integumental window and T-shaped mark (see black and white arrows in Fig. 1A). Rostrum with rounded posterior margin, ornamented with three pores arranged to form triangle (Fig. 1B). Free pedigerous somites decreasing gradually in width (on transverse axis) from anterior to posterior; PS-2 (Fig. 1C) narrower than PS-1, with paired integumental windows laterally on tergite, 69 – 90 long, 183 – 189 wide; PS-3 and PS-4, both lacking such integumental windows (Fig. 1A); PS-3, 65 long, 125 – 148 wide; PS-4, 37 – 50 long, 90 – 103 wide.

Urosome consisting of PS-5, genital double-somite, and 2 free abdominal somites (AS-1 and AS-2) (Fig. 2E); PS-5 (Fig. 2E) reduced, smaller and thinner than prosome somites, 11 – 14 long, 80 – 81 wide, unornamented; genital double-somite (Figs. 1F, 2B), about 1.5 times wider than long, 56 – 57 long, 86 wide, bearing paired slit-like genital apertures dorsally, dorsal surface with 2 rounded processes (= anterior and posterior process) on both lateral margins (Fig. 1F), ventral surface with paired pores near anterior margin; abdominal somites decrease gradually in width from anterior to posterior, each somite ornamented with transverse row of spinules ventrally (Fig. 2E); AS-1, 12 – 20 long, 45 – 54 wide; AS-2 (= anal somite) deeply incised posteriorly (= anus), 32 – 33 long, 44 – 53 wide.

Caudal rami (Fig. 2E), about 1.5 times longer than wide, 30 – 35 (33) long, 17 – 21 (20.5) wide; each ramus ornamented with 2 paired spinule rows on ventral surface and armed with 4 setae, all naked: seta 1 and 3 shortest, both inserted on ventral surface; seta 2 and 4, both inserted on posterior margin; seta 4 longest (Table 2); seta 1, 28 – 41 (35) long; seta 2, 54.5 – 101 (72) long; seta 3, 24 – 39 (29) long, seta 4, 226 – 239 (233) long.

Antennule 6-segmented (Fig. 1D), 116 – 127 (122) long, setal formula: 1, 8, 6, 4, 2, 5 + 2 ae (total 28).

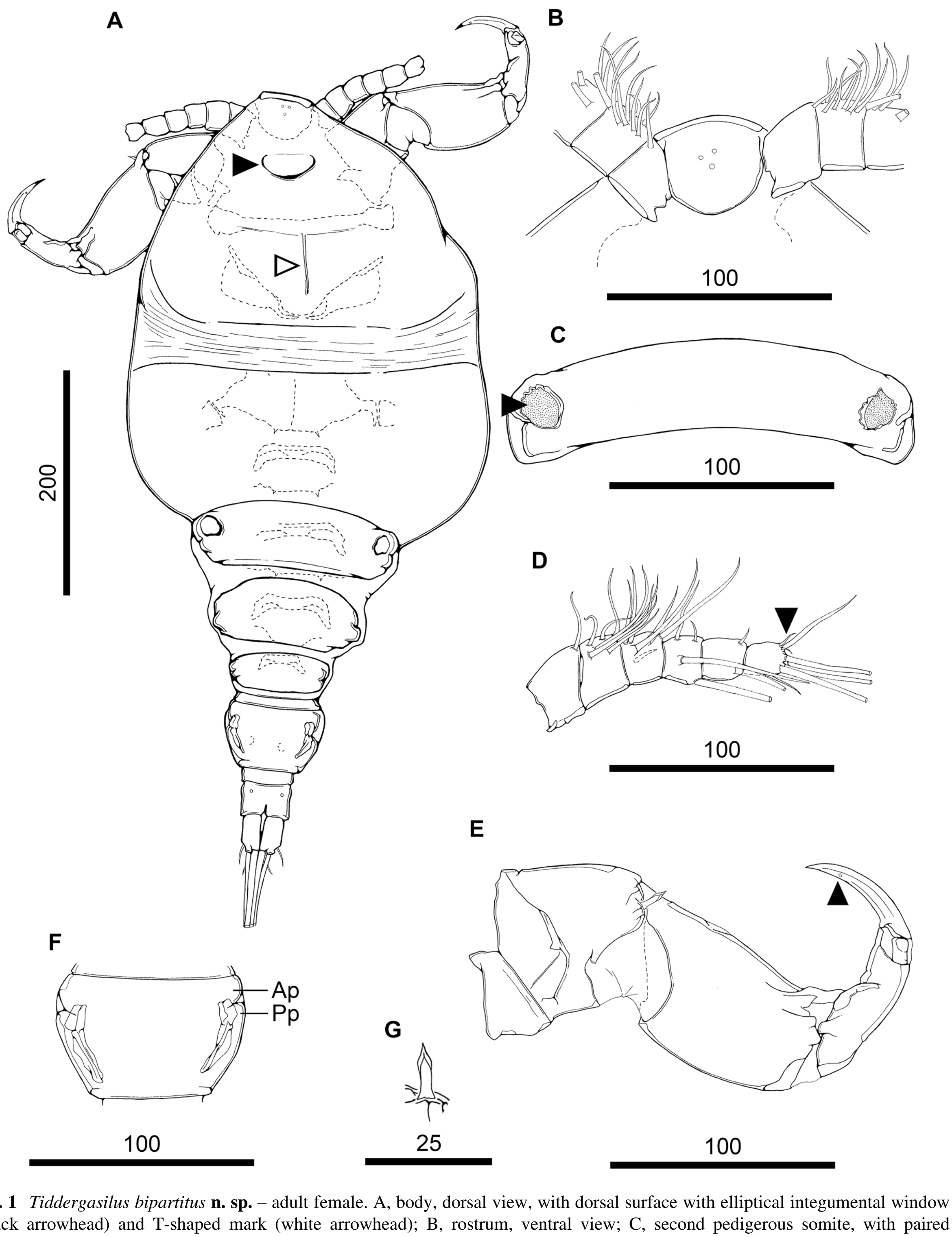

Fig. 1 *Tiddergasilus bipartitus* **n. sp.** – adult female. A, body, dorsal view, with dorsal surface with elliptical integumental window (black arrowhead) and T-shaped mark (white arrowhead); B, rostrum, ventral view; C, second pedigerous somite, with paired integumental windows laterally on tergite (arrowhead); D, antennule, ventral view, with 2 aesthestasc on sixth segment (arrowhead); E, antenna, with fossa on concave margin (arrowhead); F, genital double-somite, dorsal surface with 2 rounded processes (Ap = anterior process, and Pp = posterior process); G, morphology of distal seta present on coxobasis. Scale bars in micrometers (μm).

Table 2 Armature of swimming legs (L1 to L4) of *Tiddergasilus bipartitus* **n. sp.** – adult female. (Roman numeral = spines; Arabic numerals = setae).

Swimming leg	Coxa	Basis	Endopod	Exopod
L1	0-0	1-0	0-1; II-4	I-0; 0-1; II-5
L2	0-0	1-0	0-1; 0-1; I-4	I-0; 0-1; I-6
L3	0-0	1-0	0-1; 0-1; I-4	I-0; 0-1; I-6
L4	0-0	1-0	0-1; 0-4	I-4

Antenna (Fig. 1E) 4-segmented comprising coxobasis, and 3-segmented enp; coxobasis (= first segment) broad, 79 – 102 (91) long, armed with short naked seta; seta covered anteriorly with cuticular cap (Fig. 1G); enp-1 (= second segment) broad, 92 – 110 (103) long, unornamented; enp-2 (= third segment) straight, 70 – 77 (72) long, unornamented, narrower than previous segments; enp-3 (= fourth segment) reduced, 11 – 12.5 (12) long, unornamented; and single terminal claw; claw curved, 54 – 61 (58) long, with fossa on concave margin (arrowed in Fig. 1E).

Buccal apparatus comprising labrum, mandible, maxillule, and maxilla; labrum broad, truncated posteriorly, partially covering other buccal components (Fig. 2A); mandible (Fig. 2B) armed with three blades (anterior, mid, and posterior blade); anterior and mid blades fused at base; mid-blade short, ornamented with spinules on anterior margin; anterior and posterior blades both ornamented with spinules along posterior margin; maxillule (Fig. 2C) armed with 3 distal setae; maxilla (Fig. 2D) 2-segmented, comprising syncoxa (= first segment) and basis (= second segment); syncoxa broad, unornamented; basis armed with two terminal teeth and ornamented with multiple spinules.

L1 to L4 biramous (Figs. 3A-D), each leg comprising coxa, basis, enp (= inner ramus) and exp (= outer ramus). P1 (Fig. 3A); coxa unornamented; basis with bare outer seta; enp 2-segmented, both segments with long and sharp spinules along outer margin and lacking any ornament on inner margin; enp-1 (= proximal segment) armed with 1 plumose seta on inner margin; enp-2 (= distal segment) about 1.5 times longer than previous segment, armed with 2 semi-serrated spines and 5 plumose setae; exp 3-segmented; exp-1 (= proximal segment) armed with simple spine, ornamented with single spinule; spinule located immediately anterior to spine; exp-2 (= middle segment) ornamented with spinules on outer margin, armed with 1 plumose seta on inner margin; exp-3 (= distal segment) ornamented with 2 spinules on outer margin, armed with 1 simple spine, 1 semi-serrated spine, 1 semi plumose seta (= seta with outer margin serrated), and 4 plumose setae.

L2 (Fig. 3B); coxa ornamented with spinules (4 spinules); basis with bare outer seta; enp 3-segmented; enp-1 and -2 both ornamented with spinules and bristles along outer margin, armed with single plumose seta on inner margin; enp-3 ornamented with multiple spinules on outer margin, armed with 1 semi-serrated spine and 4 plumose setae; exp 3-segmented, all segments with spinules along outer margin; exp-1 ornamented with bristles on inner margin, armed with 1 simple spine; exp-2 with 1 plumose seta on inner margin; exp-3 armed with 1 simple spine, 1 semi-plumose seta, and 5 plumose setae. L3 (Fig. 3c) with same ornamentation and armament described for L2, except for simple spine on enp-3.

L4 (Fig. 3D); coxa unornamented; basis with bare outer seta; enp 2-segmented; enp-1 ornamented with bristles on outer margin, armed with 1 plumose seta; enp-2 ornamented with spinules on outer margin, armed 4 plumose seta; exp 1-segmented; segment ornamented with spinules on outer margin, armed with 1 simple spine, 1 semi plumose seta, and 3 plumose setae. L5 not observed. Spine and setal formula of biramous swimming legs presented in Table 2.

Intercoxal sclerites slender, unornamented, with both ends directed posteriorly (Fig. 2G). Interpodal plate of L1 and L2 both with lateral pores and ornamented with pair of spine-like processes on posterior margin; interpodal plate of L3 unornamented; interpodal plate of L4, absent. Egg sac (Fig. 2F) paired, multiseriate.

Remarks

The new copepod was identified as a member of the Ergasilidae by having all morphological features listed by Boxshall and Halsey (2004) as diagnostic for this family, such as: second pair of antennae strongly modified in an attachment organ with each antenna comprising four segments and carrying 1 or more sharp claws (maximum: 3 claws); mandible bearing 3 spinulate blades, rarely with 2; 2-segmented maxilla with the distal segment (= basis) ornamented with

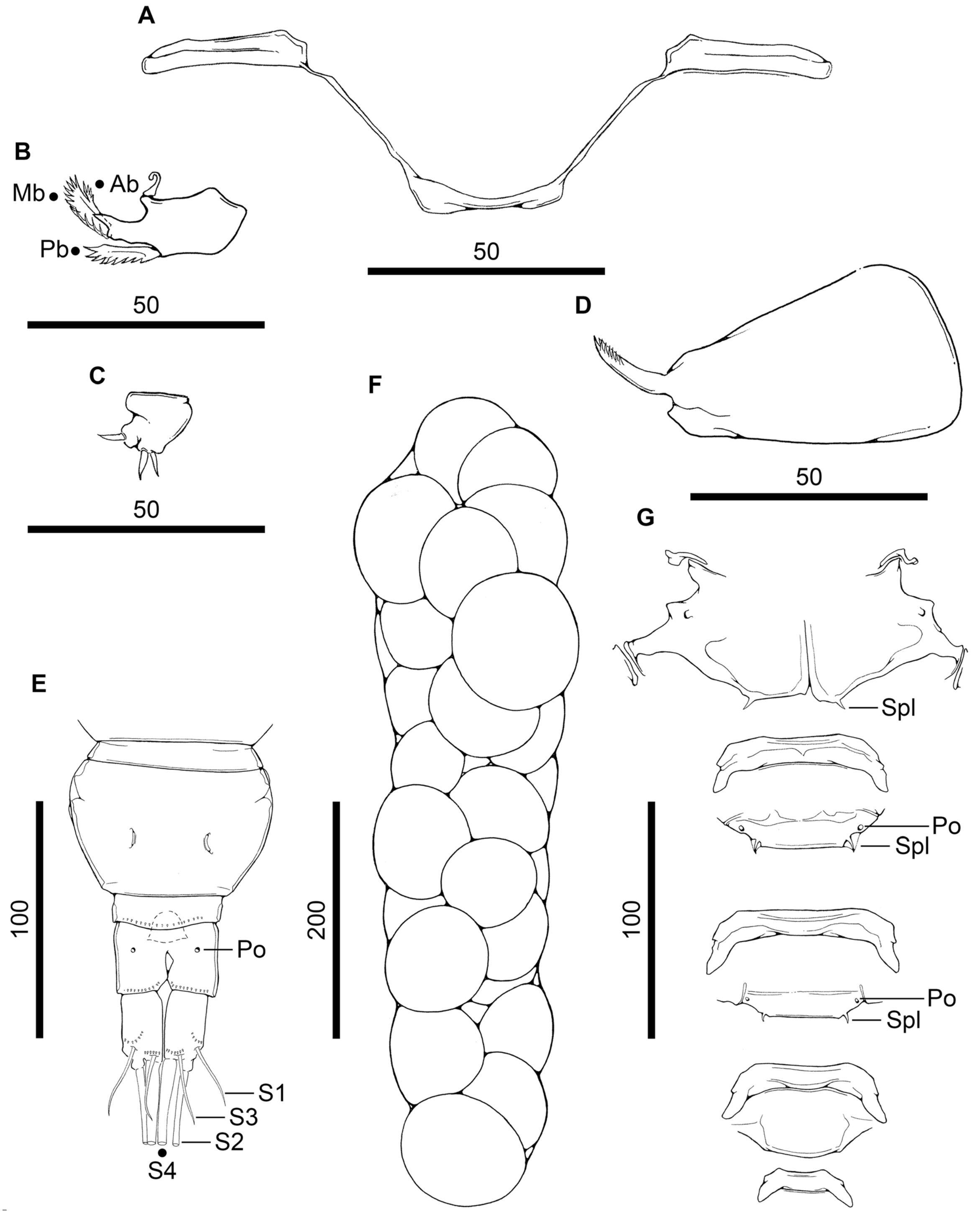

Fig. 2 *Tiddergasilus bipartitus* **n. sp.** – adult female. A, labium; B, mandible with three blades (Ab = anterior blade, Mb = mid-blade, and Pb = posterior blade); C, maxillule; D, maxilla; E, urosome and caudal rami, ventral view, with four setae (S1 to S4) and a pair of pores (Po) on ventral surface of the second abdominal somite; F, Egg sac; G, intercoxal sclerites and interpodal plates. Scale bars in micrometers (μm).

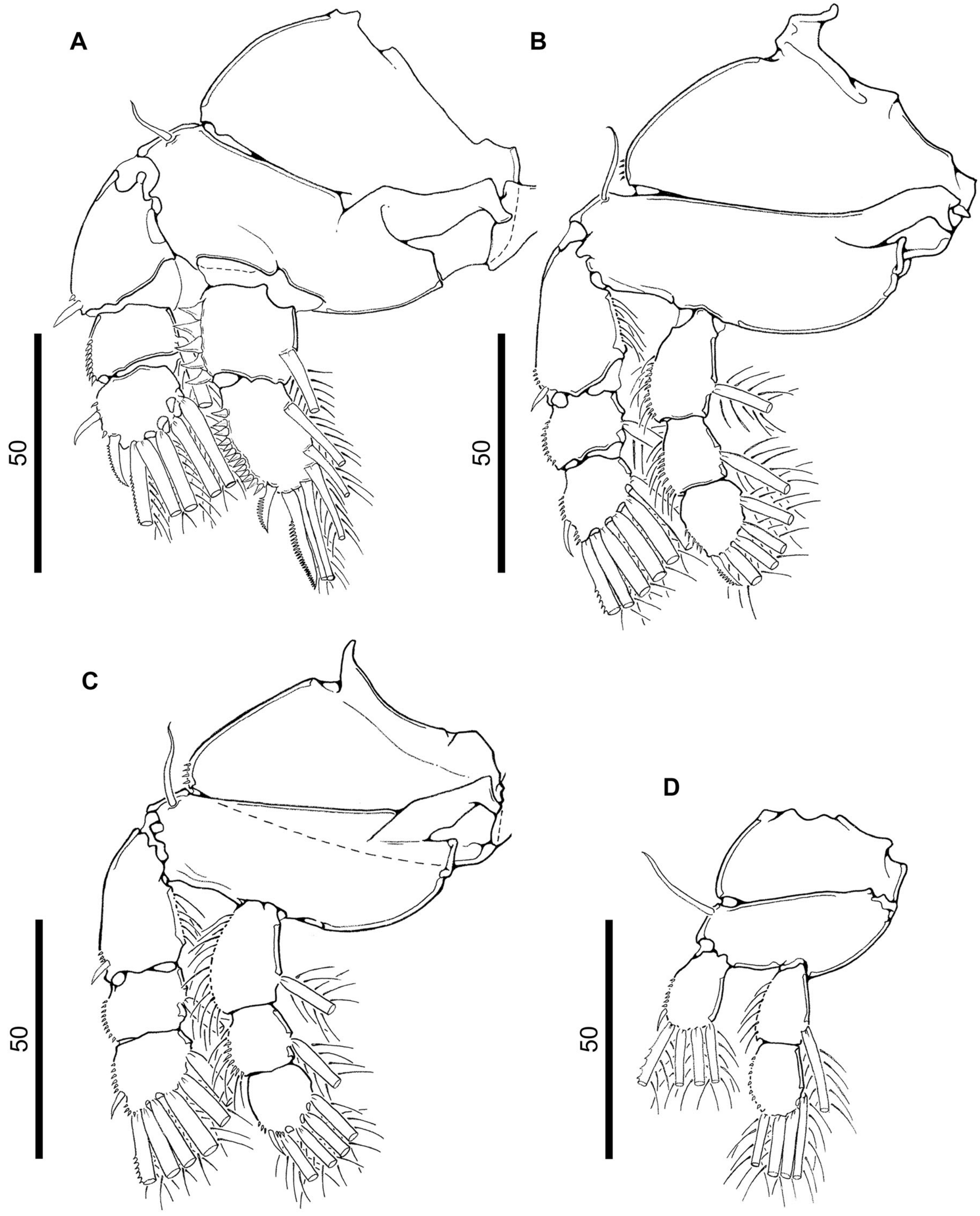

Fig. 3 *Tiddergasilus bipartitus* **n. sp.** – adult female. A, leg 1; B, leg 2; C, leg 3; D, leg 4. Scale bars in micrometers (μm)

multiple spinules; maxilliped absent in adult females; and fourth leg with exp 1- or 2-segmented. Among all 29 valid genera, the new copepod resembles species from two monotypic genera *Tiddergasilus* and *Duoergasilus* Narciso, Brandão, Perbiche-Neves & da Silva, 2019 due to the morphology of antennae (i.e.: antenna small and robust with second endopodal segment about 2 to 3 times shorter than the previous segment) and L4 with enp 2-segmented. When compared to the type-species of the two aforementioned genera (*T. iheringi* and *Duoergasilus basilongus* Narciso, Brandão, Perbiche-Neves & da Silva, 2019), the new copepod was identified as a member of *Tiddergasilus* rather than *Duoergasilus* because it is characterized by having: (1) antennule 6-segmented rather than 5-segmented; (2) maxillary basis ornamented with multiple spinules at the distal end instead of basis with posterior part reduced, ending as a thin extension; and (3) L2 and L3 both with 3-segmented enp rather 2-segmented as in *D. basilongus*.

The new copepod, *Tiddergasilus bipartitus* **n. sp.** differs from its congener, *T. iheringi* by the shape of antennal claw: in *T. bipartitus* **n. sp.** the claw has a uniform curvature and lacks any indentation on inner margin, whereas in *T. iheringi* the claw is strongly recurved and possesses a sub-proximal indentation. The number of abdominal somites is different: in *T. bipartitus* **n. sp.** abdomen comprises two segments, whereas in *T. iheringi* it is 3-segmented. Moreover, the number of segments in L4 exp is also different: in *Tiddergasilus bipartitus* **n. sp.** the exp comprises a single segment, while in *T. iheringi* it is 2-segmented. Finally, the ornamentation of L1 enp is distinct: in *T. bipartitus* **n. sp.** both endopodal segments (= proximal and distal) are ornamented with large spinules along the outer margin, whereas in *T. iheringi* such spinules are small or minute.

Discussion

The antennae are an important taxonomic feature for Ergasilidae since the morphology and the ornamentation of segments (i.e.: coxobasis and 3 free endopodal segments) and appendages (i.e.: claws) are widely used to distinguish species or even genera (Boxshall & Halsey, 2004). When comparing the antenna between the new copepod and the type-species, similarities in morphology, ornamentation, and in the size of the segments can be seen [see Fig. 6 in Marques and Boeger (2018)]. In contrast, the morphology of the claw is different between these two species: in *T. iheringi* the claw is short, strongly recurved, and possesses a sub-proximal indentation on the inner margin, whereas in *T. bipartitus* **n. sp.** it is relatively long, slightly curved, and lacks any indentation. The claw present in the new copepod resembles the most common type of claw found among ergasilids (i.e.: with uniform curvature and a sharp tip). It is the claw morphology most commonly found in the most specious genus *Ergasilus* (El-Rashidy, 1999). This type of claw probably represents the basic type in Ergasilidae and there is a possibility that it also represents the claw present in the common ancestor of this family.

Ergasilus is not only the type-genus, but is also the most widely distributed (i. e.: with representatives in almost all regions and continents) and specious genus (i. e.: over 160 described species) among the ergasilids (Virgilio et al., 2021). In Brazil, this taxon is also considered the most specious with over 30 species already reported throughout this country (~47% of known ergasilids from Brazil) (Marques, 2022). Despite being considered a valid genus, primary phylogenetic analysis of the entire family indicated that this genus is polyphyletic (El-Rashidy, 1999; Marques, 2018). The species within this taxon show a wide morphological variation among themselves (even among Brazilian species), which results in an exceptionally generic diagnosis for this genus (Marques, 2018). This variation hinders the identification of other ergasilids, as well as makes it difficult to propose new species or even genera for this family. Aiming to facilitate comparisons between putative new ergasilids and *Ergasilus* spp. in Brazil, we propose herein the following features as diagnostic for this genus: (1) L1 exp-3 with falciform seta (present in approximately 2/3 of the total species); (2) antennae with enp-1 and -2 narrow and long, both ornamented with 1 or 2 sensilla; (3) antennal enp-2 slightly or strongly curved; (4) enp-2 with proximal sensilla supported by cuticular elevation; and (4) claw single, uniformly curved, sharp tip, and with size equal to or smaller than enp-2.

Despite the similarities between the antennae, the new copepod was included as a new member of *Tiddergasilus* instead of *Ergasilus* as it lacks other features commonly found in the antennae of *Ergasilus*

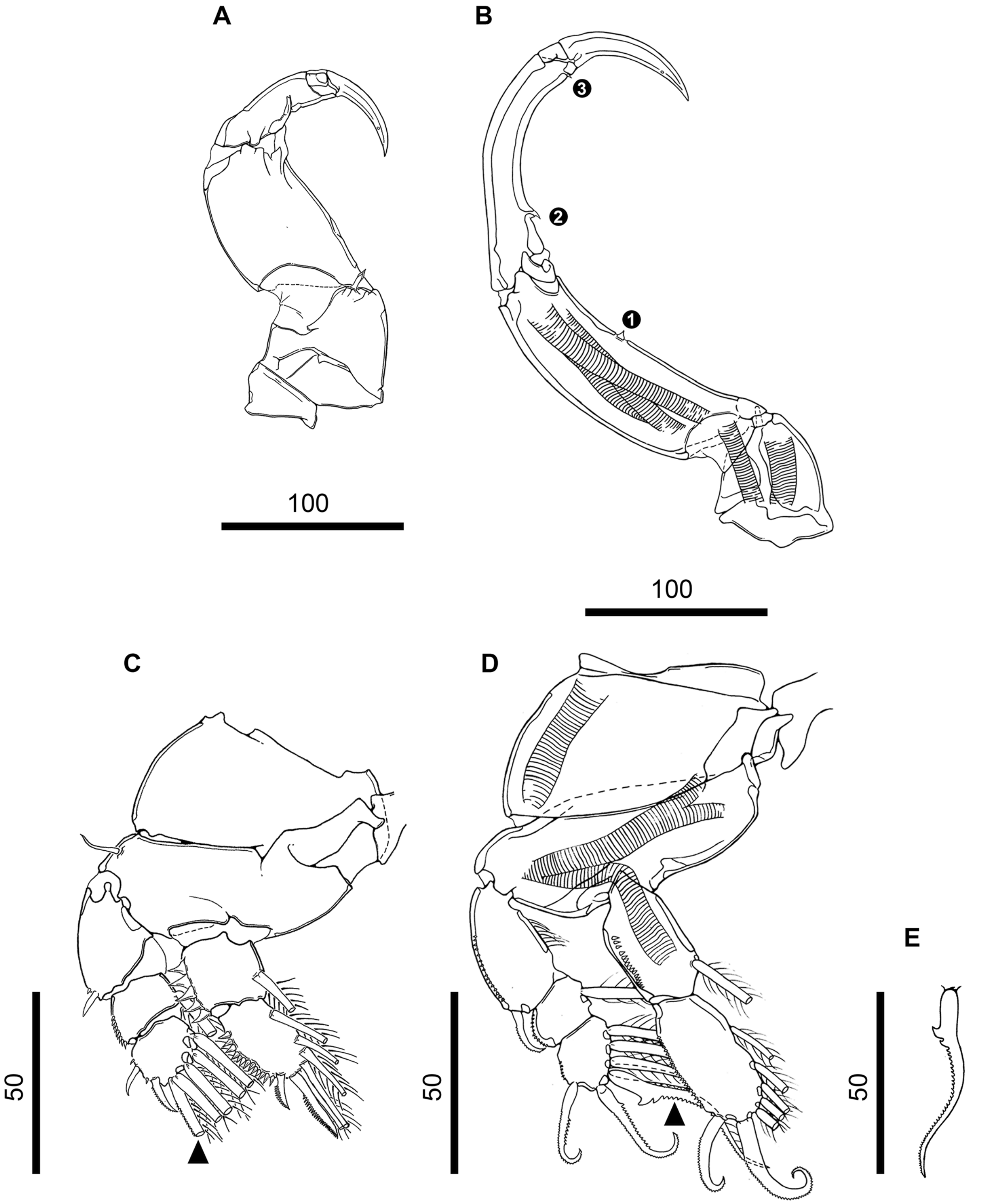

Fig. 4 Comparison between the morphology of the antenna and the first pair of legs of *Tiddergasilus bipartitus* **n. sp.** and *Ergasilus* sp. A, antenna of *Tiddergasilus bipartitus* **n. sp.**; B, antenna of *Ergasilus* sp., with first and second endopodal segments both ornamented with 1 or 2 sensilla (numbers inside black spheres); C, leg 1 of *Tiddergasilus bipartitus* **n. sp.**, with third endopodal segment armed with simple seta (black arrowhead); D, leg 1 of *Ergasilus* sp., with third endopodal segment armed with falciform seta (black arrowhead); E, morphology of falciform seta of *Ergasilus* sp. Scale bars in micrometers (µm)

species, such as: (1) enp-1 and -2 short and robust (rather than narrow and long, being in some species about 2 to 3 times longer than coxobasis as in *Ergasilus*); (2) enp-2 straight (rather than curved); and (3) endopodal segments lacking any sensilla or when present, as in the enp-1 of *T. iheringi*, lacking any cuticular elevation (rather than each segment ornamented with 1 or 2 sensilla, commonly supported by cuticular elevations) (see antennal comparison in Fig. 4). Furthermore, the new copepod also differs from *Ergasilus* species by lacking any falciform seta on L1 exp-3 (feature present in 2/3 of the species already reported in Brazil) (Fig. 4). Comparisons with other ergasilids were simpler than with *Ergasilus* species because the others commonly have better-defined diagnostic features, such as: trunk in *Urogasilus* Rosim, Boxshall & Ceccarelli, 2013; three pairs of claws in *Paraergasilus* Markevich, 1937; post-oral neck in *Therodamas* Krøyer, 1863; etc.

Similar to what was observed concerning antennae, the number of segments in P4 was also different from the type-species: in *T. bipartitus* **n. sp.** L4 exp 1-segmented and enp 2-segmented; whereas in *T. iheringi* both rami are 2-segmented (Fig. 4). Although the segmentation of the legs is a characteristic that serves to distinguish between genera (e. g.: L4 exp 2-segmented and enp 3-segmented in *Pseudovaigamus* Amado, Ho & Rocha, 1995 vs L4 exp 1-segmented and enp 2-segmented in *Vaigamus* Thatcher & Robertson B.A., 1984) and species (e. g.: L4 exp 2-segmented and enp 3-segmented in *Neoergasilus bullatus* Kim I.H. & Choi, 2003 vs L4 with both rami 2-segmented in *Neoergasilus angustus* Kim I.H. & Choi, 2003), reduction of segments (or oligomerization) occurs in many genera (El-Rashidy, 1999). Therefore, we consider that the difference in the segmentation of P4 between *T. bipartitus* **n. sp.** and *T. iheringi* does not justify the separation of these two species into distinct genera.

Finally, the new copepod exhibits a unique segmentation pattern of the urosome: the abdomen consists of 2 free abdominal somites instead of 3 as commonly found among ergasilids (Boxshall & Halsey, 2004). Comparisons between the abdomen of *T. bipartitus* **n. sp.** and other ergasilids (including its congener) indicate that in the new copepod the last abdominal somite (i. e.: second somite) could be the result of a non-separation between the "second" and "third" abdominal somites during development from copepodite V to adult (Abdelhalim et al., 1991; Kim, 2004). Although the 2-segmented abdomen can be seen as a juvenile feature, the present specimens were adults, since they possess well-formed egg sacs (Fig. 2F), as well as all other features found in adult females in Ergasilidae, such as the complete development of swimming legs, antennules, and antennae (Abdelhalim et al., 1991; Kim, 2004).

Thus, even with the aforementioned differences, we propose that the copepods found on the gills of *A. lacustris* represent a new species of *Tiddergasilus*. Furthermore, we emphasize that the three diagnostic features listed for Brazilian species of *Ergasilus* can be helpful for future species and genus descriptions of ergasilids in Brazil. Besides, it expands the geographic distribution and host diversity in *Tiddergasilus* through the report for the first time a *Tiddergasilus* species on a characid fish sampled in a river in southeastern Brazil. It also represents the first report of an ergasilid parasitizing a fish in the Pardo River.

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Authors' contributions All authors contributed to the study's conception and design. Material preparation, data collection, and analysis were performed by R.B.N, D.H.M.D.V, and R.J.S. The first version of the manuscript was written by R.B.N and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Availability of data and material All data will be available for consultation. Whenever necessary, they should be requested from the corresponding author. The specimens used for description will be available in specialized scientific collections.

Code availability Not applicable.

Declarations

Competing interests On behalf of all authors, the corresponding author states that there is no conflict of interest.

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

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