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VERSITA

Brasergasilus bifurcatus sp. nov. (Copepoda, Ergasilidae, Abergasilinae) from the gills and nasal fossae of serrasalmid fishes from the Três Marias Reservoir, Upper São Francisco River, Minas Gerais State, Brazil

Michelle D. Santos[1*], Vernon E. Thatcher[2] and Marilia C. Brasil-Sato[3]

[1]Curso de Pós-graduação em Ciências Veterinárias, Universidade Federal Rural do Rio de Janeiro, Km 7 da BR 465, CP 74539, Seropédica, RJ, 23851-970; [2]Depto. de Zoologia, Universidade Federal do Paraná, CP 19020, Curitiba, PR, 81531-980; [3]Depto. de Biologia Animal, UFRRJ, CP 74539, Seropédica, RJ, 23851-970; Brazil

Abstract

Brasergasilus bifurcatus sp. nov. (Copepoda, Ergasilidae, Abergasilinae) is described. Specimens of the new species were collected from the gills and nasal fossae of the serrasalmid fishes, known as "piranhas", *Pygocentrus piraya* (Cuvier, 1819) and "pirambebas", *Serrasalmus brandtii* (Lütken, 1875). The fishes were netted in the Três Marias Reservoir (18°12′59″S, 45°17′34″W) of the upper São Francisco River, Minas Gerais State, Brazil. The new species differs from its congeners by the following characters: the specific setation on the antennule; the terminal barb of the antenna; the deeply bifurcate distal segment of the mandible; the chalice-shaped genital complex; a conspicuous external indentation of the second segment of the first endopod and a very short terminal segment of the first exopod.

Key words

Copepoda, Ergasilidae, *Brasergasilus bifurcatus* sp. nov., fish, *Pygocentrus piraya*, *Serrasalmus brandti*, Três Marias Reservoir, São Francisco River, Brazil

Introduction

The subfamily Abergasilinae was proposed by Thatcher and Boeger (1983) to include genera *Brasergasilus* Thatcher *et* Boeger, 1983 and *Abergasilus* Hewitt, 1978. Representatives of this subfamily have in common three-segmented antennae and three pairs of legs. The species named by Hewitt was called *A. amplexus* and was found on the gills of two species of fishes, *Retropinna retropinna* (Richardson, 1848) and *Anguilla australis schmidti* Philipps, 1925, from Ellesmere Lake, New Zealand.

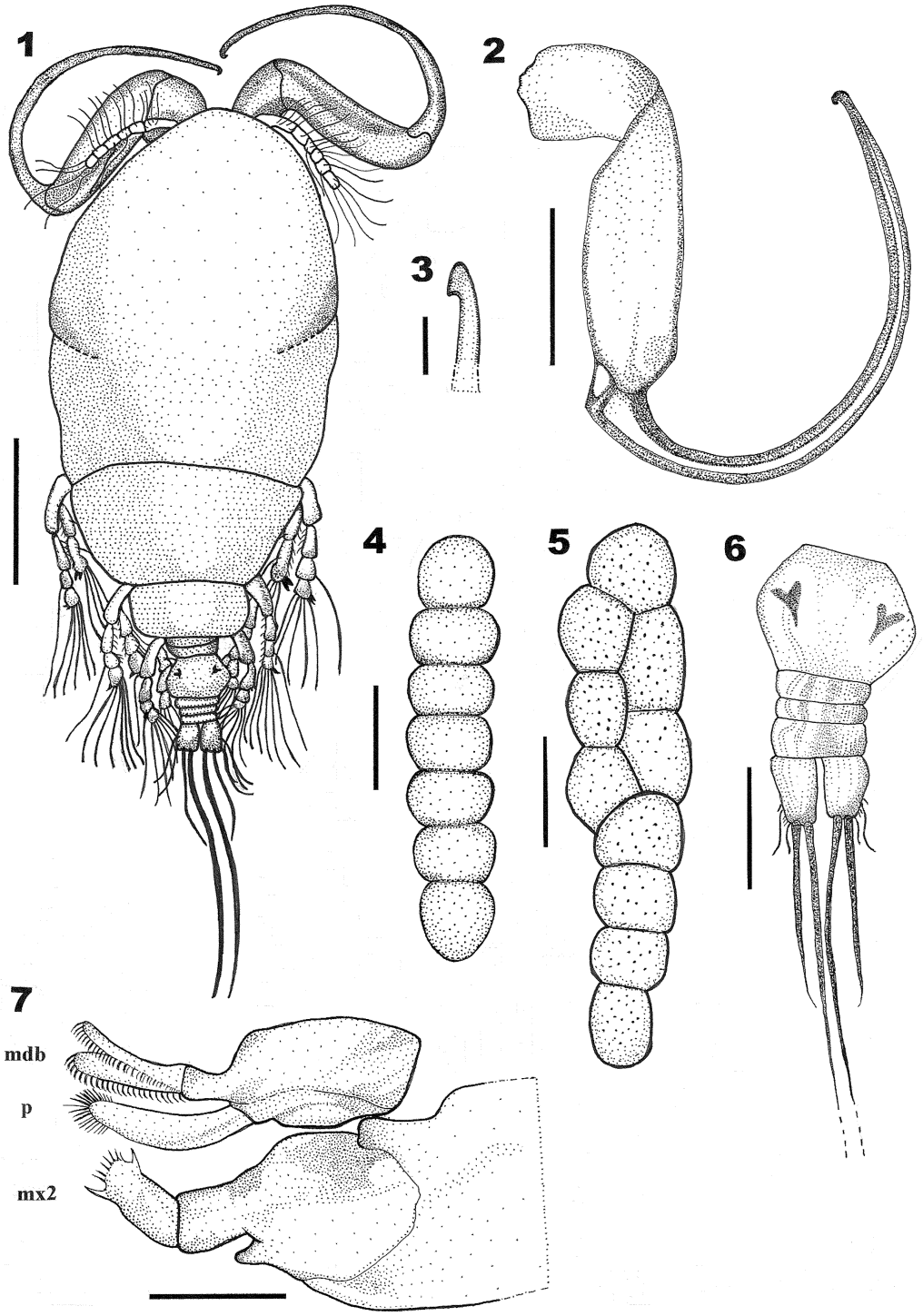
The genus *Brasergasilus* is known only from Brazil and presently comprises five nominal species: *B. jaraquensis* Thatcher et Boeger, 1983 (gills of *Semaprochilodus insignis* Jardine et Schomburgk, 1841, Solimões River, Amazonas State); *B. anodus* Thatcher et Boeger, 1983 (gills of *Anodus elongatus* Agassiz, 1829, Tocantins River, Pará State); *B. oranus* Thatcher et Boeger, 1984 (gills of *A. elongatus*, Amazon River, Amazonas State); *B. guaporensis* Malta, 1995 [gills of *Leporinus fasciatus* (Bloch, 1794), Guaporé River, Rondônia State]; and *B. mamorensis* Varella et Malta, 2001 [nasal fossae of *Hydrolycus pectoralis* (Guenter, 1866), syn. of *H. scomberoides* (Cuvier, 1819), Mamoré River, Rondônia State]. *Brasergasilus bifurcatus* sp. nov. would therefore constitute the sixth species of the genus.

Materials and methods

The fish were captured in the Três Marias Reservoir (18°12′59″S, 45°17′34″W), Upper São Francisco River, municipality of Três Marias, Minas Gerais State, between January 2004 and July 2005. The gills of *Pygocentrus piraya* and *Serrasalmus brandtii* were excised and shaken vigorously to free the parasites from the gill filaments and preserved in bottles containing 1:4000 formalin or in bottles containing distilled water at 60°C. Afterwards formalin was added to bring the concentration up to 5%. The copepods from the nasal fos-

*Corresponding author: michelledaniele@yahoo.com.br

sae were removed using jets of distilled water, examined with a dissecting microscope, and stored in 70% alcohol. The specimens were stained in 95% alcohol with small amounts of eosin and orange-G, dehydrated in pure phenol, cleared in methyl salicylate (Thatcher 2006), and mounted on microscope slides in Canada balsam. Measurements (in µm) (range and mean) were made with a measuring eye-piece. The parasitological terminology used follows Bush *et al.* (1997). Type specimens were deposited in the Coleção Helmintológica do Instituto Oswaldo Cruz (CHIOC), Rio de Janeiro, Brazil.



Figs 1–7. *Brasergasilus bifurcatus* sp. nov., female: **1** – entire, dorsal view; **2** – antenna; **3** – distal part of antenna; **4** and **5** – egg sacs; **6** – posterior extremity showing genital complex, abdominal somites, caudal rami; **7** – mouthparts; mdb – mandible, p – palp, mx2 – maxilla. Scale bars = 100 µm (1), 50 µm (2, 4, 5 and 6), 5 µm (3), 15 µm (7)

Results

***Brasergasilus bifurcatus* sp. nov.** (Figs 1–11)

Description (based on 40 specimens studied, 10 measured, measurements in Tables I and II). Cephalothorax longer than wide (Fig. 1). Head fused with first two thoracic somites. Body pale yellow. Thorax of five free somites including genital complex. Genital complex chalice-shaped, subcircular in diameter, wider than long (Figs 1 and 6). Thoracic somites V and VI reduced. Abdomen of three somites. Each caudal ramus with three terminal setae, one long, one medium and one short; also provided with small lateral seta and few spines laterally and ventrally (Fig. 6). Antennule (Fig. 8) six-segmented with simple setae; setal formula: 4–1–3–3–2–4. Antenna prehensile, three-segmented (Fig. 2); terminal segment (claw) very slim, regularly curved, with terminal barb (Fig. 3). Mouthparts consisting of mandibles and maxillae (Fig. 7). Mandible two-segmented, terminal segment distinctly bifurcate; mandibular palp with bristled tip; maxillules absent; maxilla two-segmented; first segment bearing posterior digitiform process; terminal segment surmounted with two spines and several spinules. Legs (Figs 9–11): Leg 1 (Fig. 9): endopod two-segmented, setose laterally; first segment with one medial pinnate seta, second segment with prominent medial indentation on the external face, medial seta on the anterior one third of the segment, four terminal pinnate setae and two postero-lateral spines. Exopod three-segmented and lateral setose; first segment unarmed and without pinnate setae; second segment with one medial pinnate seta; third segment with five terminal pinnate setae and two postero-lateral spines. Leg 2 (Fig. 10): both rami three-segmented; first endopodal segment laterally setose, with one medial pinnate seta; second segment laterally setose and with two medial pinnate setae; distal segment with four terminal pinnate setae and one lateral spine; first exopodal segment laterally setose and unarmed; second segment laterally setose, with one lateral pinnate seta; distal segment with six terminal pinnate setae and one postero-lateral spine. Leg 3 (Fig. 11): both rami three-segmented; all segments laterally setose; first endopodal segment with one medial pinnate seta; second segment with two medial pinnate setae, and distal segment with four terminal pinnate setae; first exopodal segment with one or two postero-lateral setules; second segment with one lateral pinnate seta and distal segment with six terminal setae. Egg sac (Figs 4 and 5): elongate with 7–21 eggs of variable size distributed in one or two rows.

Table I. Measurements (μm) of ten adult females of *Brasergasilus bifurcatus* sp. nov., minimum-maximum (mean) of serrasalmid fishes from Três Marias Reservoir, Upper São Francisco River, MG, Brazil

	Length	Width
Body (fewer caudal setae)	451–578 (524)	170–284 (236)
Cephalothorax	225–372 (283)	147–284 (236)
Free thoracic somites		
III	37–62 (50)	62–75 (71)
IV	20–50 (41)	52–62 (59)
VII (genital)	20–45 (33)	50–70 (55)
Abdominal somites		
I	10–15 (12)	32–50 (43)
II	7–10 (9)	37–50 (42)
III	12–17 (15)	40–47 (44)
Caudal rami	25–32 (29)	12–22 (18)
Caudal setae	175–232 (204)	–
Egg sac	176–294 (231)	39–59 (47)

Table II. Antennal measurements (μm) of ten adult females of *Brasergasilus bifurcatus* sp. nov., minimum-maximum (mean) of serrasalmid fishes of the Três Marias Reservoir, Upper São Francisco River, MG, Brazil

	Length	Width
Antennule	100–125 (110)	15–25 (19)
Antenna		
Segment 1	47–75 (62)	32–50 (39)
Segment 2	85–112 (100)	35–47 (39)
Segment 3	150–237 (212)	10–25 (19)

Table III. Relationships of spines to setae on the legs of *Brasergasilus bifurcatus* sp. nov.: Roman algarism refer to spines and Arabic algarism to setae of serrasalmid fishes of the Três Marias Reservoir, Upper São Francisco River, MG, Brazil

	Exopod	Endopod
Leg 1	0–0, 0–1, II–5	0–1, II–5
Leg 2	0–0, 0–1, I–6	0–1, 0–2, I–4
Leg 3	0–0, 0–1, 0–6	0–1, 0–2, 0–4

Type host: *Pygocentrus piraya* (Cuvier, 1819), "piranha" (Characiformes, Characidae).

Other host: *Serrasalmus brandtii* (Lütken, 1875), "pirambeba" (Characiformes, Characidae).

Site: Gill filaments and nasal fossae for both hosts.

Prevalence (P): 92.1% (*P. piraya*) and 56% (*S. brandtii*).

Intensity (I): 1–154 (*P. piraya*) and 1–43 (*S. brandtii*).

Mean intensity (MI): 23.4 ± 27.5 (*P. piraya*) and 4.4 ± 5.9 (*S. brandtii*).

Mean abundance (MA): 21.6 ± 27.1 (*P. piraya*) and 2.5 ± 4.9 (*S. brandtii*).

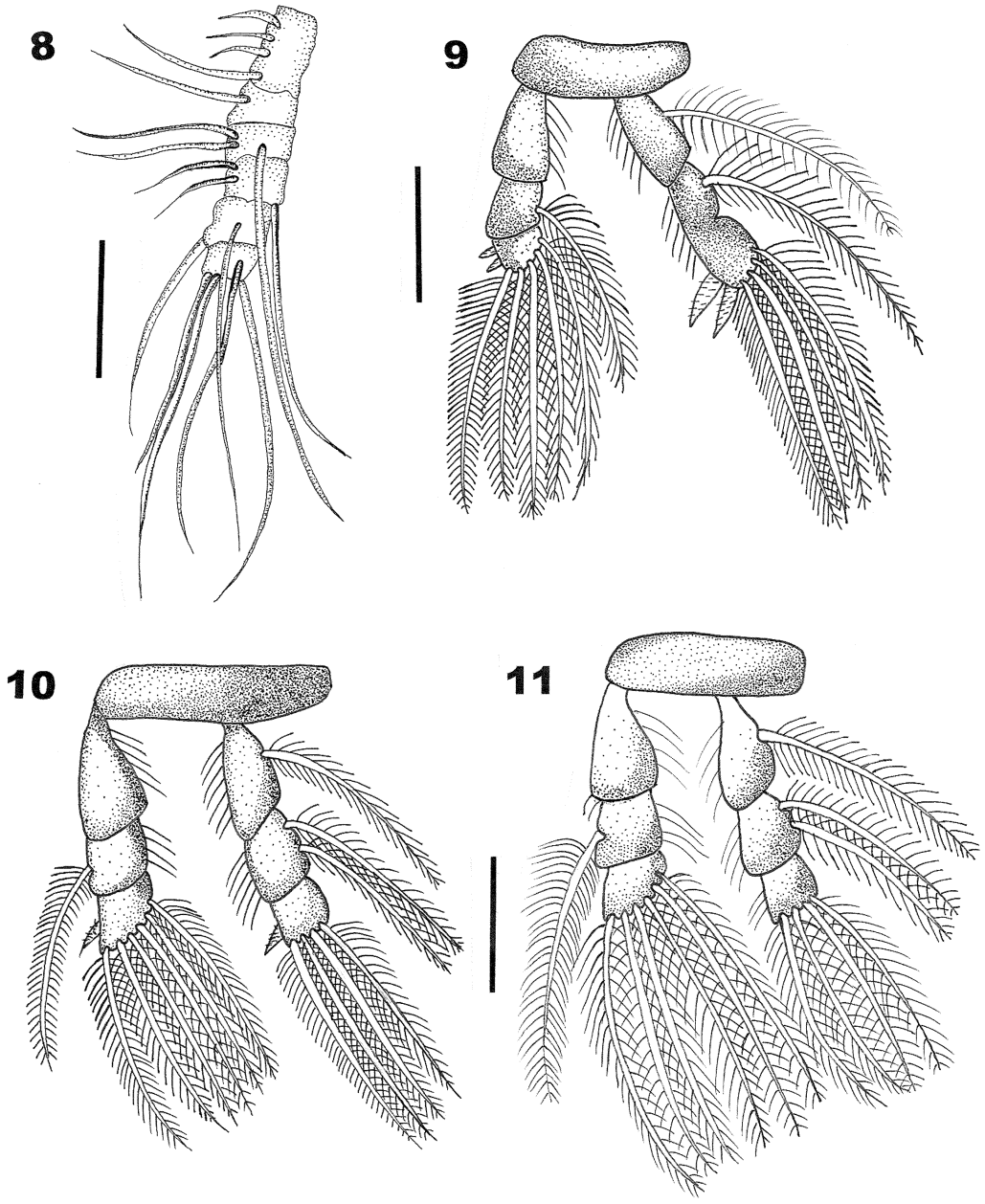
Type locality: Três Marias Reservoir (18°12′59″S, 45°17′34″W), Upper São Francisco River, Três Marias, MG, Brazil.

Male: Unknown.

Holotype: female, CHIOC-36841, gills of *P. piraya* (slide).

Paratypes: three females, CHIOC-36842-36844 (slides, gills of *P. piraya* and *S. brandtii*); 55 females, CHIOC-35502-35504 (ethanol 70%, gills and nasal fossae of *P. piraya* and gills of *S. brandtii*); 22 November 2006. All collected by M.D. Santos in the Três Marias Reservoir.

Etymology: The specific name is in reference to the profound bifurcation of the distal segment of the mandible (fork-shaped = *furcatus* in Latin).



Figs 8–11. *Brasergasilus bifurcatus* sp. nov., female: **8** – antennule, **9** – first leg; **10** – second leg, **11** – third leg. Scale bars = 50 μm

Discussion

Brasergasilus bifurcatus sp. nov. is the sixth known species of its genus. It shows the principal generic features, such as: a three-segmented antenna, three pairs of legs, and the lack of a maxillule. The new species differs from its congeners in a number of important characters. The antennule presents a specific setation; the terminal antennal segment (claw) bears a terminal barb; the distal segment of the mandible is bifurcate with both sides being similar in form and shape; the genital complex is chalice-shaped; the second segment of the first endopod has on the external face a prominent indentation and the third segment of the first exopod is very short.

In terms of the size, the new species is longer and wider than the others of the genus. *Brasergasilus jaraquensis* is 340–410 μm (370) in length and 120–170 μm (139) in width; *B. anodus* is 320–370 μm (354) by 118–163 μm (143); *B. oranus* is 420–510 μm (464) by 130–220 μm (184); *B. guaporensis* measured 301–382 μm (335) by 112–150 μm (125) and *B. mamorensis* was reported to be 432–512 μm (468) by 144–224 μm (195). The latter species is the nearest in size to *B. bifurcatus* sp. nov. The cephalothorax of the new species represents 54% of the total body length. The respective figures for the other species are: *B. jaraquensis* 53%, *B. anodus* 52%, *B. oranus* 62%, *B. guaporensis* 55% and *B. mamorensis* 56%. In addition to the similarities in size between *B. mamorensis*

and the new species, the two have other characters in common such as a projection on the external extremity of the maxilla and a cleft in the distal segment of the mandible. *B. mamorensis* can be distinguished from the new species by having a spine on the first antennal segment, different setation on the antennule and the caudal rami and in the termination of the third antennal segment.

Brasergasilus bifurcatus sp. nov. is the only species of its genus to have been found both on the gill filaments and within the nasal fossae of serrasalmid fishes. *B. jaraquensis* was found on the gills of a prochilodontid *S. insignis*, from the Solimões River, Amazonas State (Thatcher and Boeger 1983); *B. anodus* and *B. oranus* were found on the branchial filaments of the hemiodontid *A. elongatus*, from the Tocantins River, Pará State and the Amazon River, Amazonas State, respectively (Thatcher and Boeger 1983, 1984); *B. guaporensis* was from the gills of an anostomid *L. fasciatus,* of the Guaporé River of Rondônia State (Malta 1995) and *B. mamorensis* was from the nasal fossae of a cynodontid *H. pectoralis*, of the Mamoré River, Rondônia State (Varella and Malta 2001).

Although the new species was found on the gills and in the nasal fossae there was a definite preference indicated for the branchial filaments in both host species. In *P. piraya*, the relative figures were: gills, P = 91.9%, MA = 20.7; nasal fossae, P = 17.8%, MA = 0.9 while in *S. brandtii* they were: gills, P = 49.4%, MA = 2.1; nasal fossae, P = 16.1%, MA = 0.3.

Brasil-Sato (2003) found an unidentified species of *Brasergasilus* in *P. piraya*. The present paper describes this species and reports an additional host, *S. brandtii*. This paper also extends the geographic range of Abergasilinae to the São Francisco River.

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References

Brasil-Sato M.C. 2003. Parasitos de Peixes da Bacia do São Francisco. In: (Eds. H.P. Godinho and A.L. Godinho) *Águas*, *Peixes e Pescadores do São Francisco das Minas Gerais*. Editora PUCMINAS, Belo Horizonte, 149–165.

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.

Hewitt G.C. 1978. *Abergasilus amplexus* gen. et sp. nov. (Ergasilidae: parasitic Copepoda) from fishes in Lake Ellesmere, New Zealand. *New Zealand Journal of Marine Freshwater Research*, 12, 173–177.

Malta J.C.O. 1995. *Brasergasilus guaporensis* sp. n. (Copepoda: Ergasilidae) das brânquias de *Leporinus fasciatus* (Bloch, 1890) (Characiformes: Anostomidae) da Amazônia Brasileira. *Acta Amazonica*, 23, 441–447.

Thatcher V.E. 2006. Amazon fish parasites. 2nd ed. Pensoft Publications, Sofia, 508 pp.

Thatcher V.E., Boeger W.A. 1983. The parasitic crustaceans of fishes from the Brazilian Amazon. 5. *Brasergasilus* gen. nov. (Copepoda: Cyclopoidea), a "three-legged" ergasilid, with two new species and the proposal of Abergasilinae subfam. nov. *Acta Amazonica,* 13, 195–214.

Thatcher V.E., Boeger W.A. 1984. The parasitic crustaceans of fishes from the Brazilian Amazon. 6. *Brasergasilus oranus* n. sp. (Copepoda: Cyclopoidea) from *Anodus elongatus* Spix. *Revista Brasileira de Biologia*, 44, 395–401.

Varella A.M.B., Malta J.C.O. 2001. *Brasergasilus mamorensis* sp. n. (Copepoda: Ergasilidae) from the nasal cavities of *Hydrolycus pectoralis* (Guenter, 1866) (Characiformes: Cynodontidae) from the Brazilian Amazon, and considerations about Abergasilinae. *Acta Amazonica*, 31, 323–330.

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