Zootaxa 736: 1–8 (2004)
www.mapress.com/zootaxa/

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

736

Notozothecium janauachensis n. sp. (Monogenoidea: Dactylogyridae) from wild and cultured tambaqui, *Colossoma macropomum* (Teleostei: Characidae: Serrasalminae) in Brazil

ELIZABETH BELMONT-JÉGU[1], MARCUS VINICIUS DOMINGUES[2] & MAURICIO LATERÇA MARTINS[3]

[1]*Laboratoire d'Ichtyologie, MNHN, 43 rue Cuvier 75231, Paris, FRANCE; elizabeth-belmont@wanadoo.fr*

[2]*Departamento de Zoologia, Curso de Pós Graduação em Zoologia, UFPR, caixa postal:19020, Curitiba, PR 81531-990, BRAZIL; mvdomingues@hotmail.com*

[3]*Universidade Federal de Santa Catarina, Centro de Ciências Agrárias, Departamento de Aquicultura UFSC, Rod. SC 404, Km 3, Itacorubi – Florianópolis, SC 88040900, Brazil; mlaterca@cca.ufsc.br*

Abstract

Notozothecium janauachensis n. sp. is described from the gills of naturally-infected tambaqui, C*olossoma macropomum*, from the Brazilian Amazon. This new species is characterized by possessing a ventral anchor that has an evenly curved, elongate shaft and a short point; a ventral anchor that is larger than dorsal anchor; a dorsal anchor with a shaft that is strongly bent proximally but distally straight; a copulatory organ that forms nearly a complete ring, the distal extremity of which has a feather-shaped extension and the accessory piece has a hook-shaped subterminal flap originating from the distal rod. *Notozothecium janauachensis* n. sp. was also found parasitizing *C. macropomum* from fishculture ponds in Southeast of Brazil.

Key words: Amazon Basin, Brazil, *Colossoma macropomum*, Dactylogyridae, fishculture, Monogenoidea, *Notozothecium janauachensis* n. sp., Serrasalminae

Introduction

The serrasalmine characid, *Colossoma macropomum* Cuvier (1818), is a common species endemic to the Orinoco and the Amazon Basins. Over the past three decades, this species has become increasingly prevalent in Latin American fishculture and because of its success there, it is also currently being considered for use by several Asian countries, such as the People's Republic of China and Thailand (Hernández et al., 1992, Araújo-Lima & Goulding, 1997).

Accepted by N. Dronen: 3 Nov. 2004; published: 22 Nov. 2004

Three monogenoidean species have been described and/or reported from the gills of *C. macropomum*: *Anacanthorus spathulatus* Kritsky, Thatcher & Kayton, 1979 (Anacanthorinae) from Lago Janauacá, Amazon, Brazil, and also from *Piaractus brachypomus* (Cuvier,1818) (= C*olossoma bidens* in Kritsky *et al.*, 1979); *Anacanthorus penilabiatus*, Boeger, Husak & Martins, 1995 (Anacanthorinae) from *Piaractus mesopotamicus* Holmberg, 1887, and reported on tambaqui from cultured ponds in the State of Ceará by Pamplona-Basilio *et al*. (2001); and *Linguadactyloides brinkmanni* Thatcher & Kritsky 1983 (Linguadactyloidinae) collected from hosts from Lago Janauacá (Thatcher & Kritsky, 1983).

Prieto (1989) illustrated a species of Ancyrocephalinae from *C. macropomum* cultured in Cuba and provided a brief description of its anchors and bars. Martins & Romero (1996) reported an undescribed ancyrocephaline from *C. macropomum* from fish farms in Brazil and noticed that their specimens were very similar to those reported by Prieto (1989) based on haptoral morphology. Belmonth-Jegú (1996) reported and presented a short description of *Notozothecium* sp. from *C. macropomum* in Lago Janauacá, Rio Solimões, AM, Brazil; Lago Camaçari, Rio Solimões, near Itacoatiara, AM, Brazil; and Lago Grande, Ilha da Marchantaria, Rio Solimões, Manaus, AM, Brazil. Fischer *et al*. (2003) reported *Notozothecium* sp. from the gills of *C. macropomum*, but these authors did not provide any formal description or illustrations of their material. In the present paper we report a new species of Dactylogyridae from the gills of native and cultured *C. macropomum*.

Materials and methods

Hosts were collected by seine from Lago Janauacá, Rio Solimões, Manaus, State of Amazonas, Brazil (1994–1995) and from experimental ponds of the Centro de Aqüicultura, Universidade Estadual Paulista, Jaboticabal, State of São Paulo, Brazil (1992). Methods of host collection and parasite study are as described by Kritsky *et al.*, 1986, 1996) and Thatcher (1992). In most cases, the measurements represent straight-line distances between extreme points of each structure and are expressed as the mean followed in parentheses by the range and number of specimens measured. The length of the copulatory organ was obtained using a Minerva curvimeter from camera lucida drawings. The measurements of the accessory piece are those of the length of the distal rod. Numbering (distribution) and nomenclature of haptoral hook pairs follows that recommended by Mizelle (1936). Type and *vouchers* specimens were deposited in the helminthological collections of the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil; Museu de Zoologia Universidade de São Paulo (MZUSP), São Paulo, Brazil; and Coleção Helmintológica do Instituto Oswaldo Cruz (CHIOC), Rio de Janeiro, Brazil, as indicated in the respective description.

Results

Dactylogyridae Bychowsky, 1933
***Notozothecium janauachensis* n. sp.**
(Figs. 1–15)

Synonym: *Notozothecium* sp. (of Belmont-Jégu, 1996).

Type-host: *Colossoma macropomum* (Cuvier, 1818), Characidae, Serrasalminae.

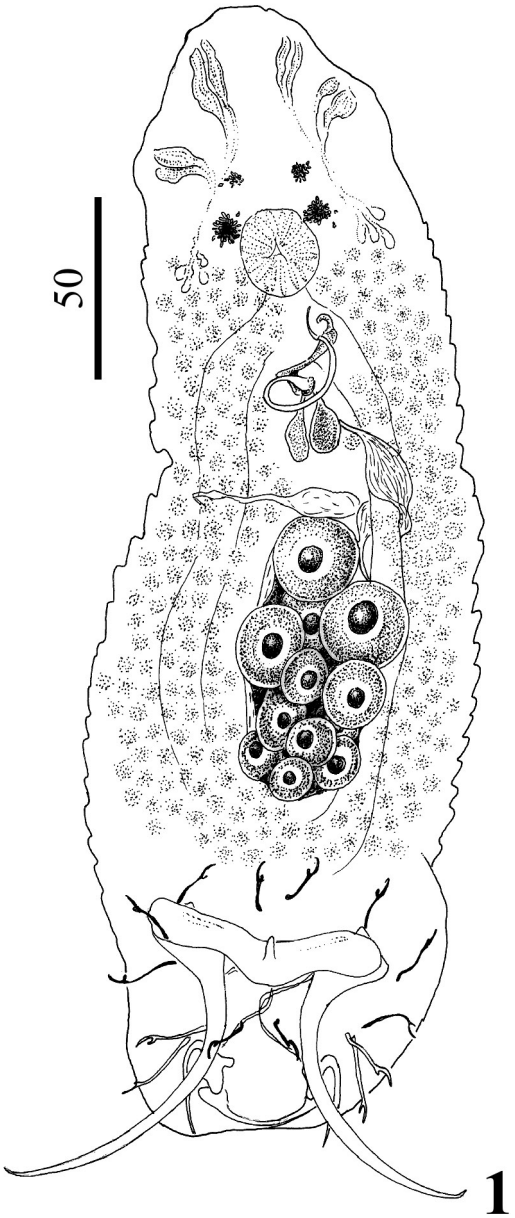
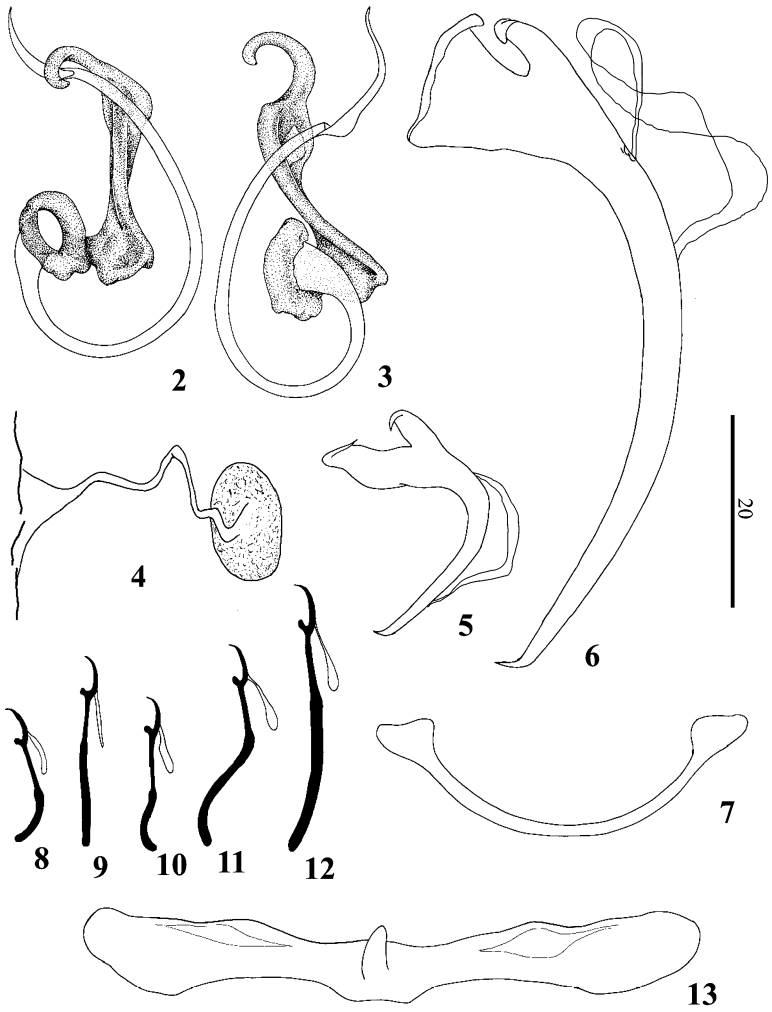


FIGURE 1. *Notozothecium janauachensis* n. sp. 1. Composite illustration of adult, ventral view of specimen from the natural habitat. Scale bar 50µm.



FIGURES 2–13. *Notozothecium janauachensis* n. sp. 2. Copulatory complex, ventral view. 3. Copulatory complex, dorsal view. 4. Vagina and seminal receptacle, lateral view, right side. 5. Dorsal anchor. 6. Ventral anchor. 7. Dorsal bar. 8. Hook pair 1. 9. Hook pair 4. 10. Hook pair 5. 11. Hook pair 6. 12. Hook pair 7. 13. Ventral bar. Scale bar 20μm.

Site: Gills.

Type-locality: Lago Janauacá — Rio Solimões, Amazonas, Brazil, 3°25'S, 60°17'W, 1994–1995.

Other records: Centro de Aqüicultura, Universidade Estadual Paulista, Jaboticabal, State of São Paulo, Brazil, 21°16'S, 48°19'W (1992).

Specimens deposited: Holotype, INPA 208; 5 paratypes, INPA 209a–e; 4 vouchers MZUSP 5934 a–d; 6 vouchers INPA 447 a–f; 7 vouchers CHIOC 36393 a–g.

Etymology: The specific name is derived from the type locality, Lago Janauacá.

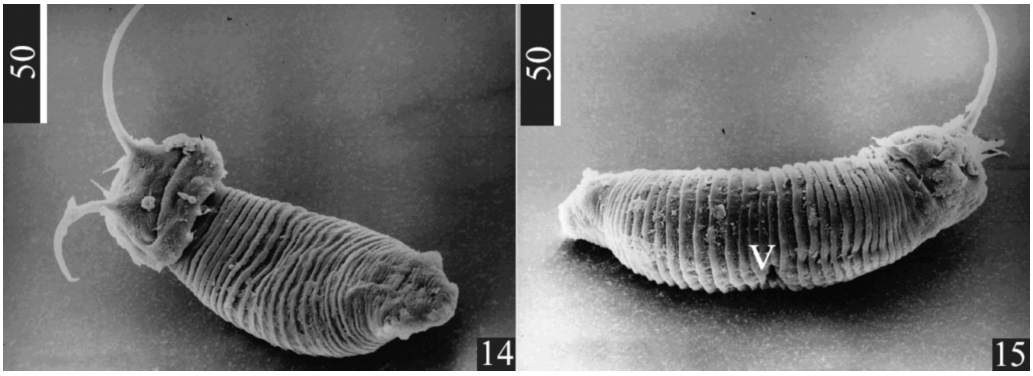
Comparative measurements: Table 1.

TABLE 1. Comparative measurements (in micrometers) of *Notozothecium janauachensis* n. sp. from *C. macropomum* from natural habitats (Amazon basin) and experimental ponds.

	Natural habitats	N	Experimental ponds	N
Body				
Length	330 (241–443)	25	185 (150–235)	17
Width	111 (99–142)	18	73 (55–100)	17
Haptor				
Length	60 (52–68)	11	46 (43–59)	16
Width	92 (72–104)	10	71 (62–85)	16
Pharynx				
Diameter	26 (22–31)	20	16 (12–18)	17
Copulatory organ				
Length	74 (62–84)	32	_	_
Ring diameter	18 (16–22)	9	20 (15–23)	17
Accessory piece				
Length	22–23	9	_	_
Dorsal anchor				
Length	25 (24–28)	18	28 (24–31)	10
Base width	11 (10–13)	12	8 (7–10)	5
Ventral anchor				
Length	54 (50–58)	21	68 (63–74)	16
Base width	19 (16–22)	26	20 (18–21)	18
Bar length				
Ventral	54 (48–64)	24	64 (55–73)	18
Dorsal	34 (30–38)	15	35 (27–39)	10
Hook lengths				
Pairs 1, 2	17 (16–20)	24	17 (16–18)	22
Pairs 3, 4	22 (21–24)	23	21(20–23)	12
Pair 5	20 (18–20)	19	20(18–21)	7
Pair 6	21 (20–23)	12	22(21–25)	11
Pair 7	26 (22–28)	20	27 (25–32)	4

Description: (based on 6 adult specimens). Body fusiform, greatest width near midlength. Tegument with annulations throughout trunk and peduncle. Cephalic lobes moderately developed. Posterior eyes larger than anterior eyes, slightly farther apart than anterior pair; eyes granules elongate; accessory granules absent or few in cephalic and anterior trunk regions. Pharynx spherical to subovate. Peduncle broad. Haptor subhexagonal. Ventral anchor larger than dorsal anchor, robust, roots well developed, heavily truncate superficial root, elongate and evenly curved shaft, short point. Dorsal anchor with elongated superficial root, slightly depressed deep root, slender shaft, short point. Ventral bar robust, with short digitiform anteromedial process, enlarged terminations. Dorsal bar delicate, broadly U-shaped, with enlarged terminations. Hook with truncate erect thumb, delicate point, expanded shank; proximal subunit of shank variable in length; FH loop extending to union of shank subunits Copulatory organ comprising a coil of about one ring; base cone-shaped with sclerotized margin; distal extremity with a long lateral exten-

sion pointed, feather-shaped. Articulation process of accessory piece short, wide, uniting with proximal end of distal rod; distal rod slightly sigmoid; broadly hook-shaped subterminal flap, serving as guide for male copulatory organ. Testis subovate; seminal vesicle sigmoid; prostatic reservoirs large, pyriform. Germarium subovate; vagina lightly sclerotized, a delicate tube opening on the dextrodorsal surface of the trunk; seminal receptacle pyriform; vitellaria limited to trunk, absent in regions of reproductive organs. Oviduct, ootype and uterus not observed.



FIGURES 14–15. Scanning electron micrographs of *Notozothecium janauachensis* n. sp. 14. Specimen showing the tegument with scaled annulations. 15. Specimen showing the dorsal vaginal aperture (V). Scale bars 50µm.

Discussion

We include this new species in *Notozothecium* Boeger & Kritsky, 1988 based on the position of the vaginal aperture. *Notozothecium janauachensis* n. sp. is distinguished from other congeneric species by lack of the terminal flabellate plate in the distal rod of the accessory piece (consistent with the amended diagnosis of Kritsky *et al*., 1996). Seven *Notozothecium* spp. are described by Boeger & Kritsky (1988) and Kritsky *et al*. (1996) all as parasites of serrasalmine fishes. The new species resembles *Notozothecium robustum* Kritsky, Boeger & Jégu, 1996, by having a ventral anchor with an elongated shaft and a short point. It differs from *N. robustum* by possessing a dorsal anchor with the shaft strongly bent proximally and distally straight (curved shaft, moderately long point in *N. robustum*), and the male copulatory organ forms a coil of about one ring (a coil of less than one ring, appearing J-shaped in *N. robustum*).

Species of *Notozothecium* are widespread within the serrasalmine hosts (Kritsky *et al*., 1996). They occur on *Acnodon normani* Gosline, 1951, *Myleus setiger* Müller & Troschel, 1844 (=*M. pacu* in Kritsky *et al.*, 1996), *Myleus rhomboidalis* (Cuvier, 1818), *Mylesinus paraschomburgkii* Jégu, Santos & Ferreira, 1989, *Pristobrycon sp.*, *Pristobrycon striolatus* (Steindachner, 1908), *Pristobrycon eigenmanni* (Norman, 1929), *Pygocentrus nattereri* Kner, 1858, *Serrasalmus elongatus* Kner, 1858, *Serrasalmus gouldingi* Fink & Machado-

Allison, 1991, *Serrasalmus manueli* Fernandez-Yépez & Ramírez, 1967, *Serrasalmus rhombeus* (Linnaeus, 1766), *Serrasalmus maculatus* Kner, 1858 (=*S. spilopleura* in Kritsky *et al.*, 1996), *Serrasalmus altispinis* Merck, Jégu & Santos, 2001 (=*Serrasalmus* sp.2 in Kritsky *et al.*, 1996) and *Serrasalmus* sp. (2n=58). The occurrence of *N. janauachensis* n. sp. in *C. macropomum* reinforces the Kritsky *et al*. (1996) hypothesis whereby *Notozothecium* is a relatively old genus, with its origin dating back to very early serrasalmine lineages, following the recent hypothesis on serrasalmine phylogeny (Porto *et al.*, 1991; Orti *et al.*, 1996, 2000; Jégu, 2004).

There are morphometric differences between specimens of *N. janauachensis* n. sp. from natural-infected fish and specimens from captive fish in the size of the worms and in the size of their anchors. *Notozothecium janauachensis* n. sp. from natural environments are relatively larger, but have smaller ventral anchors than worms from cultivated hosts (Table 1). Such differences may be consequences of the influence of the different physico-chemical conditions between the biotopes of the hosts. Mo (1991) suggested that the variations of haptoral hard parts of *Gyrodactylus salaris* Malmberg, 1957 on rainbow trout in a fish farm seems to be subject to morphological adaptation.

The species illustrated by Prieto (1989) morphologically resembles *N. janauachensis* n. sp. However, the specimens collected by Prieto (1989) and Martins & Romero (1996) were not available for comparative analysis with *N. janauachensis*. Illustrations and description of *Notozothecium* sp. presented by Belmont-Jegú (1996) correspond to *Notozothecium janauachensis* n. sp. described in this paper.

Acknowledgments

The authors wish to thank the following individuals and agencies for supporting this study: R. Leite (Instituto Nacional de Pesquisas da Amazônia-INPA, Manaus, Brazil) for help during collections of hosts in the natural habit; Centro de Microscopia Eletrônica and LACTEC (Universidade Federal do Paraná-UFPR, Paraná, Brazil) for assistance in scanning electron microscopy; M. Jégu (IRD, Paris) for identification the fish hosts; W. A. Boeger and M. R. Pie (Universidade Federal do Paraná) for providing presubmission reviews of this manuscript. This study was partially supported by the Programa de Recursos Humanos para o Desenvolvimento Tecnológico — RHAE (SCT/PR-CNPq), Fundação Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and the Instituto Nacional de Pesquisas da Amazônia (INPA).

References

Araujo-Lima, C. & Goulding, M. (1997) *So fruitful a fish: ecology, conservation, and aquaculture of the Amazon's tambaqui*. Columbia University Press, New York, 30 pp.

Belmont-Jégu, E. (1996) *Estudo da dinâmica das infestações de Monogenoidea (Platyhelminthes) de Colossoma macropomum (Teleostei: Characoidea)*. Relatório, INPA/RHAE-DTI, Manaus, Brasil, 59 pp.

Boeger, W.A. & Kritsky, D.C (1988) Neotropical Monogenea. 12. Dactylogyridae from *Serrasalmus nattereri* (Cypriniformes, Serrasalmidae) and aspects of their morphologic variation and distribution in the Brazilian Amazon. *Proceedings of the Helminthological Society of Washington*, 55, 188–213.

Fischer, C., Malta, J.C.O. & Varella, A.M.B. (2003) A fauna de parasites do tambaqui, *Colossoma macropomum* (Cuvier, 1818) (Characiformes: Characidae) do médio rio Solimões, Estado do Amazonas (AM) e do baixo rio Amazonas, Estado do Pará (PA), e seu potencial como indicadores biológicos. *Acta Amazonica, 33*, 651–662.

Hernández, R., Muñoz, D., Ferraz de Lima, J.A., Fex, R., Vasquez, W., Gonzales, R., Morales R., Alcántara, F., Luna, T.M., Kossowki, C., Pérez, J., Mora, J.A., Contreras, P.J., Diáz, F., Fadul, E.M. & Montoya, P (1992) Estado atual del cultivo de Colossoma y Piaractus en Brasil, Colombia, Panamá, Peru, y Venezuela. *Red Acuicultura Boletin*, 6, 3–28.

Jégu, M. (2004) *Taxonomie des Serrasalminae phytophages et phylogénie des Serrasalminae (Teleostei: Characiformes: Characidae)*. Thèse de Doctorat du Muséum d'Histoire Naturelle, Paris, 421 pp.

Kritsky, D.C., Thatcher, V.E. & Boeger, W.A. (1986) Neotropical Monogenea. 8. Revision of *Urocleidoides* (Dactylogyridae, Ancyrocephalinae). *Proceedings of the Helminthological Society of Washington*, 53, 1–37.

Kritsky, D.C., Boeger, W.A. & Jégu, M. (1996) Neotropical Monogenoidea. 28. Ancyrocephalinae (Dactylogyridae) of piranha and their relatives (Teleostei, Serrasalmidae) from Brazil and French Guiana: species of *Notozothecium* Boeger and Kritsky, 1988, and *Mymarothecium* gen. n. *Journal of Helminthological Society of Washington*, 63, 153–175.

Kritsky, D.C., Thatcher, V.E. & Kayton, R.J. (1979) Neotropical Monogenoidea. 2. The Anacanthorinae Price, 1967, with the proposal of four new species of *Anacanthorus* Mizelle and Price, 1965, from Amazonian fishes. *Acta Amazonica*, 9, 355–361.

Martins, M.L. & Romero, N.G. (1996) Efectos del parasitismo sobre el tejido branquial en peces cultivados: estudio parasitologico e histopatologico. *Revista Brasileira de Zoologia*, 13, 489–500.

Mizelle, J.D. (1936) New species of trematodes from the gills of Illinois fishes. *American Midland Naturalist*, 17, 785–806.

Mo, T.A. (1991) Variations of opisthohaptoral hard parts of *Gyrodactylus salaries* Malmberg, 1957 (Monogenea: Gyrodactylidae) on rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792) in a fish farm, with comments on the spreading of the parasite in South-eastern Norway. *Systematic Parasitology*, 20, 1–9.

Orti, G., Petry, P., Porto, J.I.R., Jégu, M. & Meyer, A. (1996) Patterns of nucleotide change in mitochondrial ribosomal RNA genes and the phylogeny of piranhas. *Journal of Molecular Evolution*, 42, 169–182.

Orti, G., Porto, J.I.R. & Sivasundar, A. (2000) *Phylogeny of the Serrasalminae (Characiformes) based on mitochondrial DNA sequences* Annual Meeting of the American Society of Ichthyologists and Herpetologists, June 2000, La Paz, Mexico, 30. (Abstract)

Pamplona-Basilio, M.C., Kohn, A. & Feitosa, V.A. (2001) New host records and description of the Egg of *Anacanthorus penilabiatus* (Monogenea, Dactylogyridae). *Memórias do Instituto Oswaldo Cruz*, 96, 667–668.

Porto, J.I.R., Feldberg, E., Nakayama, C.M., Maia, R.O. & Jégu, M. (1991) *Cytotaxonomic analysis in the Serrasalmidae (Ostaryophisi, Characiformes). VII European Congress of Ichtyology.* Bulletin Zoologish Museum, Universiteit van Amsterdam, The Hague, 66. (abstract)

Prieto, A. (1989) Hallazgos de monogeneas parásitos de *Colossoma macropomum*. Efecto sobre el huésped. Comunicación Corta. *Revista de Salud Animal* 11, 78–81.

Thatcher, V.E. (1992) Two new genera of Paramphistomidae (Trematoda, Digenea) from freshwater fish of Rondônia State, Brazil. *Memórias do Instituto Oswaldo Cruz (Suplemento em homenagem ao centenário de nascimento do Prof. Lauro Travassos)*, 87 (Supl. 1), 287–291.

Thatcher, V.E. & Kritsky, D.C. (1983) Neotropical Monogenoidea. 4. *Linguadactyloides brinkmanni* gen. et sp. n. (Dactylogyridae: Linguadactyloidinae subfam. nov.) with observations on the pathology in a brazilian freshwater fish, *Colossoma macropomum* (Cuvier). *Proceedings of the Helminthological Society of Washington*, 50, 305–311.