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Parasitic copepods in the nasal fossae of five fish species (Characiformes) from the upper Paraná river floodplain, Paraná, Brazil

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ABSTRACT. The present work had the objective to study parasitic copepods in the nasal fossae of fish from the upper Paraná river floodplain. Fish were captured in different locations of the floodplain in March, June and September, 2004. A total of 73 specimens (Characiformes) were collected, belonging to 4 distinct families and 5 species: *Acestrorhynchus lacustris* (Acestrorhynchidae), *Schizodon borellii* (Anostomidae), *Prochilodus lineatus* (Prochilodontidae), *Serrasalmus marginatus* and *Serrasalmus maculatus* (Serrasalmidae). Among 73 fishes examined, 53 were parasitized by nasal fossae copepods, varying from 1 to 146 parasites per host. Parasites found belonged to 3 known species: *Gamidactylus jaraquensis* Thatcher & Boeger, 1984; *Gamispatulus schizodontis* Thatcher & Boeger, 1984; and *Rhinergasilus piranhus* Boeger & Thatcher, 1988. There were differences in parasite corporal measurements and in the quantity of parasites per host in relation to copepod parasites from the Amazon region. The present study constitutes one of the few studies of identification of copepod parasites in the nasal fossae of fish from the Southern region of Brazil.

Key words: copepods, Ergasilidae, Vaigamidae, ichthyoparasites, Characiformes, Paraná, Brazil.

RESUMO. Copépodes parasitos de fossas nasais de cinco espécies de peixes (Characiformes) da planície de inundação do alto rio Paraná, Paraná, Brasil.

O presente trabalho teve como objetivo o estudo de copépodes parasitos de fossas nasais de peixes da planície de inundação do alto Rio Paraná. As coletas foram realizadas em diversos pontos da planície nos meses de março, junho e setembro de 2004. Foram coletados 73 exemplares de peixes da ordem Characiformes, de quatro famílias distintas, pertencentes a cinco espécies: *Acestrorhynchus lacustris*, *Prochilodus lineatus*, *Schizodon borellii*, *Serrasalmus maculatus* e *Serrasalmus marginatus*. Dentre os 73 peixes examinados, 53 encontravam-se parasitados por copépodes de fossas nasais, variando de 1 a 146 parasitos por peixe. Os parasitos encontrados pertenciam a três espécies conhecidas: *Gamidactylus jaraquensis* Thatcher & Boeger, 1984; *Gamispatulus schizodontis* Thatcher & Boeger, 1984 e *Rhinergasilus piranhus* Boeger & Thatcher, 1988. Diferenças foram observadas nas medidas corporais dos parasitos e na quantidade de espécies de parasitos por espécie de peixe em relação aos copépodes encontrados em estudos anteriores na região amazônica. O presente estudo constitui um dos poucos trabalhos de identificação de copépodes parasitos de fossas nasais de peixes da região Sul do Brasil.

Palavras-chave: copépodes, Ergasilidae, Vaigamidae, ictioparasitos, Characiformes, Paraná, Brasil.

Introduction

Class Copepoda has over 1,900 species of fish parasites (Eiras, 1994). They can attach to gill filaments, nasal fossae and tegument. Consequently, some structures became specialized in fixation organs, and mouth parts were adapted for piercing and sucking. Most copepods parasites are free-living

larvae, and only adults are adapted to parasitism (Thatcher, 1991). Among the main copepods parasites of the nasal fossae of neotropical freshwater fish are the families Ergasilidae Thatcher & Robertson, 1984 and Vaigamidae Thatcher & Boeger, 1984. They can be recognized by a distinct blue or purple pigmentation that usually forms unique distribution patterns, something that free

living forms do not present. In these groups, only females are attached to the fish, while males are part of zooplankton (Thatcher, 1991). The observed effects of copepods parasitizing fishes are: serious damage to the nostril epithelium caused by their fixation organs, and interruption of normal water flow, interfering in the fish's sense of smell (Kabata, 1985).

Fishes studied in the present paper are Characiformes, an order that comprises the majority of freshwater fish species and is restricted to South America and Africa. This group contains species of great economic interest for aquariorily and feeding (Ferreira et al., 1998). Authors such as Boeger and Thatcher (1988), Thatcher (1991) and Varella and Malta (1995) studied parasitic copepods of Characiformes. However, considering that this group is very large and heterogeneous, there are still many fish species to be studied. Additionally, most studies have been restricted to the Amazon region.

Material and methods

Samples were part of the project PELD/CNPq – Site 6 developed by Nupélia (Nucleus for Research in Limnology, Ichthyology and Aquaculture – State University of Maringá) in the upper Paraná river floodplain. Fish were captured in March, June and September, 2004, using nets exposed for 24 hours at different locations in the floodplain. The nasal fossae of fish were washed with formalin 1:4000, and the liquid was analyzed under a stereomicroscope. Copepods were fixed and preserved in alcohol 70%GL, and clarified in lactic acid for temporary slides; for permanent slides, they were clarified using Amman's lactophenol and preserved in Hoyer's medium. The specimens were identified according to Thatcher and Boeger (1984a and b) and Boeger and Thatcher (1988). Measurements are expressed in millimeters; mean and range in parenthesis. The ecological terminology used throughout this study is from Bush et al. (1997). Fish species studied were: *Acestrorhynchus lacustris* (Acestrorhynchidae), *Prochilodus lineatus* (Prochilodontidae), *Serrasalmus marginatus* (Serrasalmidae), *S. maculatus* (Serrasalmidae) and *Schizodon borellii* (Anostomidae).

Results and discussion

Parasites found belonged to 3 known species: *Gamidactylus jaraquensis* Thatcher & Boeger, 1984 (Figure 1); *Gamispatulus schizodontis* Thatcher & Boeger, 1984 (Figure 2) and *Rhinergasilus piranhus* Boeger & Thatcher, 1988 (Figure 3).

Each fish species examined (Table 1) presented only one species of copepod parasitizing its nasal

fossae. Parasitism indexes are presented in Table 2. Body measurements of copepods studied in the Amazon region and in the upper Paraná river floodplain are presented in Table 3.

Table 1. Host species examined, prevalence, number of parasites observed, mean intensity, and species of copepods observed in the upper Paraná river floodplain in March, June and September 2004.

Host species	Prevalence %	Total N° of copepods	Mean intensity and range	Copepods
<i>S. marginatus</i>	68 (24/35)	181	7.5 (1-36)	<i>G. schizodontis</i>
<i>S. maculatus</i>	75 (3/4)	27	9 (4-19)	<i>G. schizodontis</i>
<i>A. lacustris</i>	83 (10/12)	23	2.3 (1-7)	<i>R. piranhus</i>
<i>S. borellii</i>	88 (15/17)	636	42.4 (2-146)	<i>G. schizodontis</i>
<i>P. lineatus</i>	20 (1/5)	2	2	<i>G. jaraquensis</i>
Total: 5 species	72 (53/73)	869	16.4 (1-146)	

Table 2. Parasitism indexes of copepods observed in 73 fishes from the upper Paraná river floodplain in March, June and September 2004.

Copepods	Prevalence %	Total number of copepods	Mean intensity and range	Abundance
<i>G. schizodontis</i>	57	844	20.2 (1-146)	11.6
<i>G. jaraquensis</i>	0.01	2	2	0.03
<i>R. piranhus</i>	13	23	2.3 (1-7)	0.31
Total	70.01	869	8.2 (1-146)	11.94

Table 3. Body measurements (µm) of adult females of *Gamidactylus jaraquensis*; *Gamispatulus schizodontis* and *Rhinergasilus piranhus*, from the Amazon region and from the upper Paraná river floodplain in March, June and September 2004.

Species	Amazon		Paraná	
	Length	Width	Length	Width
<i>G. jaraquensis</i>	435	147	620	240
Body*	(410-470)	(130-160)		
<i>G. schizodontis</i>	425	155	537	221
Body*	(380-470)	(140-170)	(450-620)	(123-260)
<i>R. piranhus</i>	263	98	380	187
Body*	(237-282)	(95-102)		(170-204)

Body (minus caudal setae).

Some studies were performed in the Amazon with ergasiloids, including the families Ergasilidae and Vaigamidae, who parasitize several groups of fish. In the upper Paraná river floodplain, identification studies are rare. Figure 4 shows genera observed in South America and their distribution.

Twelve genera of Ergasilidae and Vaigamidae are observed in Brazil: *Acusicola*, *Amplexibranchius*, *Brasergasilus*, *Ergasilus*, *Gamidactylus*, *Gamispatulus*, *Gamispinus*, *Prehendorastrus*, *Pseudovaigamus*, *Rhinergasilus*, *Therodamas* and *Vaigamus*. Except for *Ergasilus*, which is cosmopolitan, these copepods have only been observed in the Amazon, perhaps due to the lack of studies in other regions. According to Amado et al. (1995), this high diversity (50% of known genera are from the Amazon) suggests that ergasilids must have evolved in the Amazon basin, probably in association with a similar evolution of their host fish.

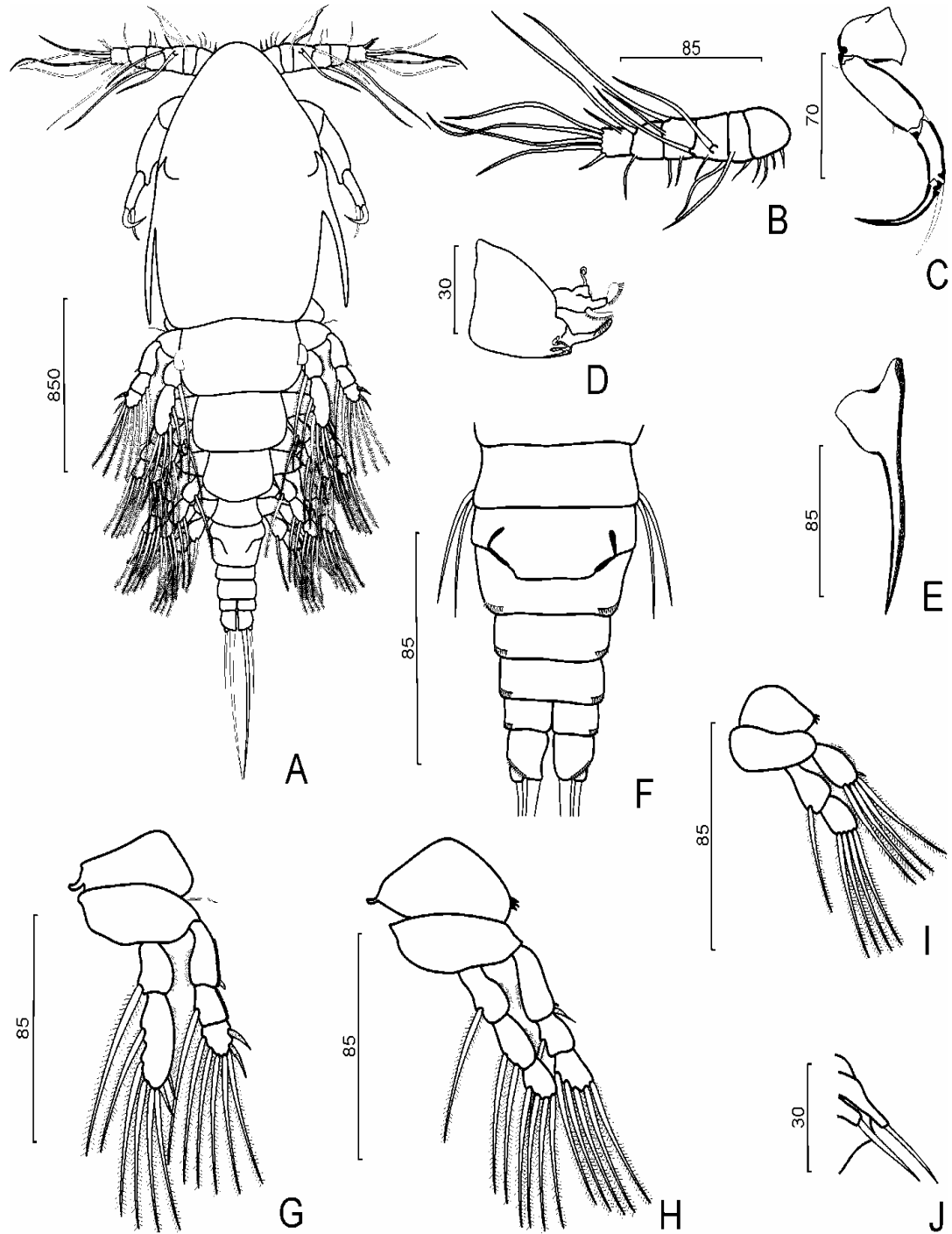


Figure 1. *Gamidactylus jaraquensis*. A- Dorsal view of entire specimen. B- Antennule. C- Antenna. D- Mouthparts. E- Retrostylet. F- Genital segment, abdomen and uropods. G- Leg 1. H- Leg 2. I- Leg 3. J- Legs 4 and 5.

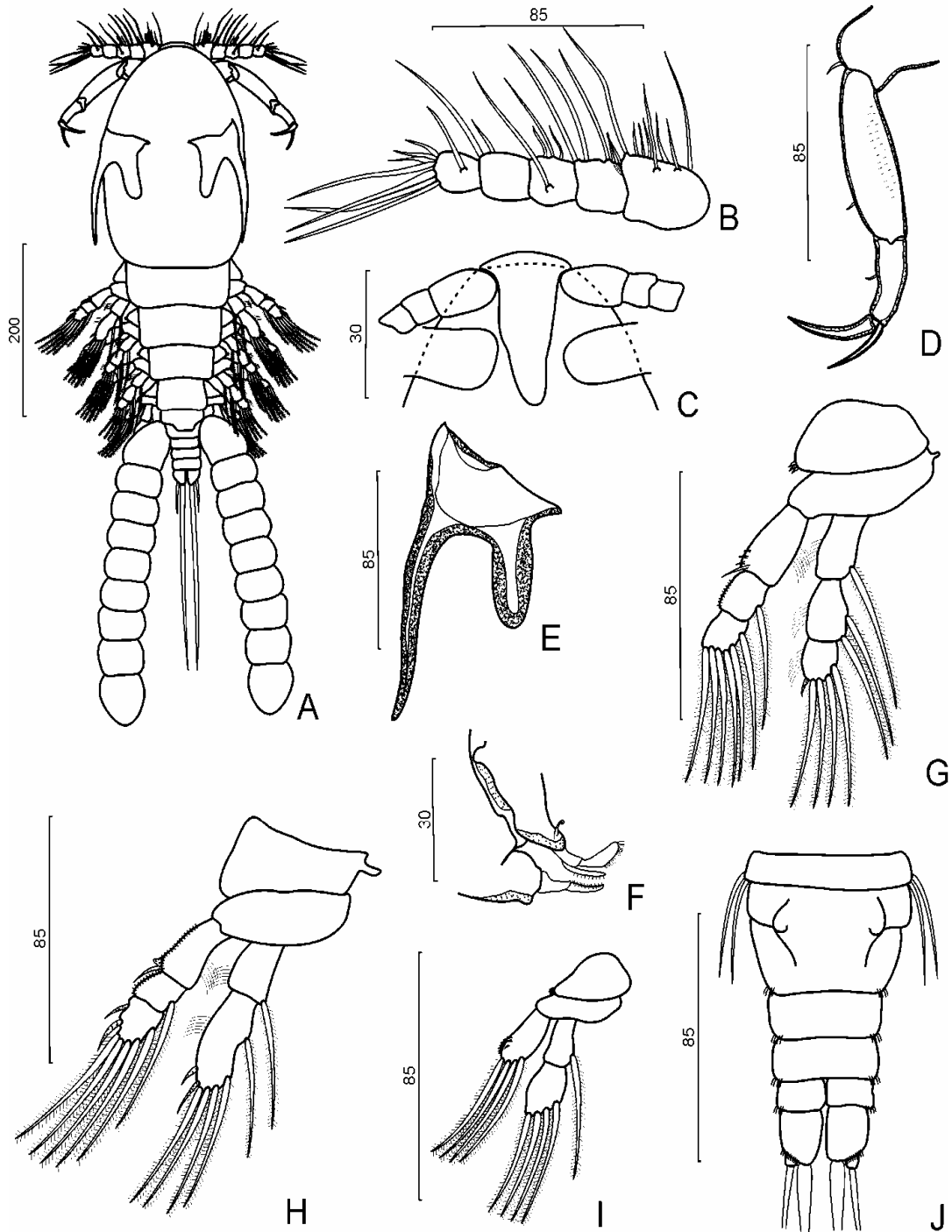


Figure 2. *Gamispatulus schizodontis*. **A-** Dorsal view of entire specimen. **B-** Antennule. **C-** Rostral projection in ventral view. **D-** Antenna. **E-** Retrostylet. **F-** Mouthparts. **G-** Leg 1. **H-** Leg 2 = 3. **I-** Leg 4. **J-** Genital segment, abdomen and uropods.

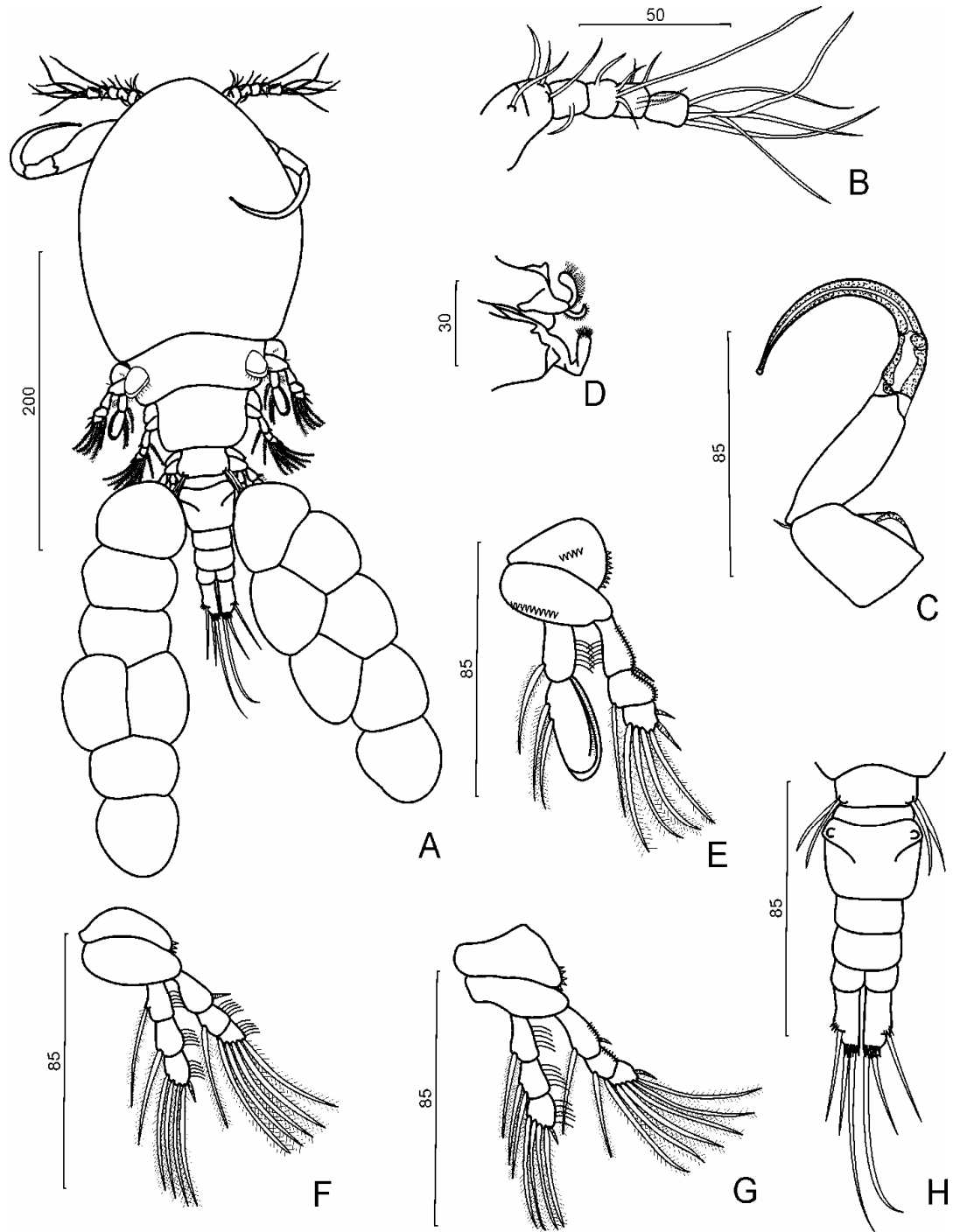


Figure 3. *Rhinergasilus piranhus*. **A-** Dorsal view of entire specimen. **B-** Antennule. **C-** Antenna. **D-** Mouthparts. **E-** Leg 1. **F-** Leg 2. **G-** Leg 3. **H-** Genital segment, abdomen and uropods.

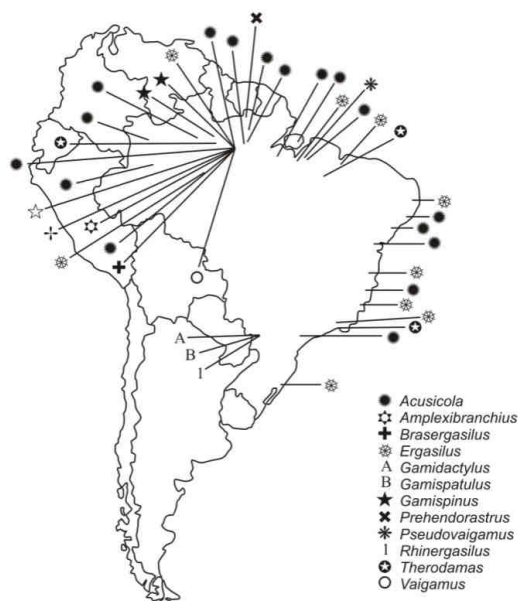


Figure 4. Distribution of genera of Ergasilidae and Vaigamidae in Brazil (adapted from Amado et al., 1995).

Letters A and B were added according to Lizama et al. (2003) and Tanaka (2000), respectively. Number 1 was added according to the present study. The genus *Rhinergasilus* Boeger & Thatcher, 1988 is characterized by having an antennule with six segments, antennae with four segments, and legs V and VI reduced to simple setae. The genus has only one species, *Rhinergasilus piranhus* Boeger & Thatcher, 1988, described as parasitizing *Serrasalmus nattereri* from the Amazon region. Later, it was observed in *Acestrorhynchus falcistrotris* by Varella (1992). *Rhinergasilus piranhus* is usually observed in its host together with other genera such as *Gamidactylus* and *Gamispatulus* (Varella and Malta, 1995). However, all fish examined presented only one parasite species per host and per fish species.

Gamidactylus jaraquensis was described by Thatcher and Boeger (1984a) parasitizing *Serrasalmus insignis*. The main characters of the genus are simple lateral retrostylets present on cephalothorax, antennal claw double and rostral spine absent. This species is characterized by two spines on the first exopods of legs 1 to 3, and basipods 1 and 3 without ornamentation. It was observed in *Serrasalmus nattereri* by Boeger and Thatcher (1988) and in *S. altuvi* by Leão et al. (1991). Varella (1992) recorded *G. jaraquensis* in *Prochilodus nigricans*, *Mylossoma duriventris* and *Hemiodus microlepis*, all from the Amazon region. In the upper Paraná river

floodplain, the only fish parasitized by *G. jaraquensis* was *Prochilodus lineatus*, presenting parasitism indexes similar to the ones observed by Varella (1992), but with greater body measurements. *G. jaraquensis* was observed parasitizing *P. lineatus* from the upper Paraná river floodplain by Lizama et al. (2003).

Gamispatulus schizodontis Thatcher & Boeger, 1984, is the only species of the genus, and was described parasitizing *Schizodon fasciatus* in the Amazon region. The main characteristics of the genus are retrostylets with medial spatulate processes. In the upper Paraná river floodplain, *G. schizodontis* was observed parasitizing *Schizodon borellii*, *Serrasalmus maculatus* and *Serrasalmus marginatus*. The genus *Gamispatulus* had already been observed in *S. marginatus* (Tanaka, 2000) and *P. lineatus* (Lizama et al., 2003). Prevalence of parasitism observed is similar to that observed by Varella (1992), but the mean intensity is higher (42.7) when compared to the Amazon region (2.4). Besides, parasites observed in the floodplain have greater measurements.

Copepods observed in the upper Paraná river floodplain present greater body measurements than copepods observed in the Amazon. Additionally, each host species presented only one parasite species. According to Krebs (1986), equatorial regions tend to present great variety and quantity of dominant species, permitting greater species richness and controlling the dynamic and growth of different populations. In the Amazon, it is possible to observe the presence of more than one parasite species per fish, showing a greater diversity in the microhabitat of parasites. On the other hand, regions far from the equatorial region, such as the upper Paraná river floodplain, tend to present a small number of dominant species that are able to develop more than others. This paradigm can explain greater body measurements (biomass) of copepod parasites in this region and the fact that only one species of parasite is present in a single species of fish.

Conclusion

In addition to their importance within biological diversity, copepod parasites of the nasal fossae of fish are important in acting directly upon the ichthyofauna. Thus, copepods with greater measurements and populations could possibly cause greater damage to the nasal fossae epithelium of their hosts. In addition, 146 parasites were observed in only one fish, which represents a high number of

parasites occupying such a small location as the nasal fossae. Therefore, the present paper can corroborate the identification of potential causes of problems in the sense of smell of fish.

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