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Metazoários parasitos do Mandi-amarelo *Pimelodus maculatus* e do Jundiá *Rhamdia quelen* (Osteichthyes: Siluriformes) do Rio Paraíba do Sul, Volta Redonda, Rio de Janeiro

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Abstract

Forty-one specimens of mandi-amarelo *Pimelodus maculatus* Lacépède, 1803 (Siluriformes: Pimelodidae) and 54 specimens of jundiá *Rhamdia quelen* (Quoy & Gaimard, 1824) (Siluriformes: Heptapteridae) were collected from the Paraíba do Sul River, Volta Redonda, State of Rio de Janeiro, Brazil between November 2007 and October 2008. These fish underwent necropsy so their infracommunities of metazoan parasites could be studied. The same three species of parasites were collected in the two fish species studied. These were one monogenean, one nematode, and one hirudinean. *Cucullanus pinnai* (Travassos, Artiga, and Pereira, 1928) (Nematoda: Cucullanidae) and *Aphanoblastella* sp. (Monogenea: Dactylogyridae) were the dominant species with the highest prevalence in *P. maculatus* and *R. quelen*. The parasite species of *P. maculatus* and *R. quelen* showed an atypical over-dispersed pattern of distribution. No parasite species showed significant correlation between the body total length of the siluriform hosts and their prevalence and abundance. The parasite species richness showed a mean value of 0.87 ± 0.67 (0 - 2) and 0.57 ± 0.56 (0 - 2) in *P. maculatus* and *R. quelen*, respectively, and no correlation with the body total length.

Keywords: *Pimelodus maculatus*, *Rhamdia quelen*, metazoan parasites, Paraíba do Sul River, Volta Redonda.

Resumo

Quarenta e um espécimes do mandi-amarelo *Pimelodus maculatus* Lacépède, 1803 (Siluriformes: Pimelodidae) e 54 espécimes do jundiá *Rhamdia quelen* (Quoy & Gaimard, 1824)(Siluriformes: Heptapteridae) foram coletados no Rio Paraíba do Sul, Volta Redonda, Estado do Rio de Janeiro, entre novembro de 2007 e outubro de 2008. Os peixes foram necropsiados para o estudo das suas infracomunidade de metazoários parasitos. Foram coletadas as mesmas três espécies de metazoários parasitos nas duas espécies de peixes estudadas. Estes foram um monogenético, um nematóide e um hirudíneo. *Cucullanus pinnai* (Travassos, Artiga e Pereira, 1928) (Nematoda: Cucullanidae) e *Aphanoblastella* sp. (Monogenea: Dactylogyridae) foram as espécies dominantes com os maiores valores de prevalência em *P. maculatus* e *R. quelen*, respectivamente. As espécies de parasitos de *P. maculatus* e *R. quelen* apresentaram típico padrão de distribuição superdispersa. Nenhum parasito apresentou correlação significativa entre o comprimento total dos siluriformes estudados e a prevalência e abundância parasitária. A riqueza parasitária apresentou média de 0,87 ± 0,67 (0 - 2) e 0,57 ± 0,56 (0 - 2) em *P. maculatus* e *R. quelen*, respectivamente, e sem correlação com o comprimento total dos hospedeiros.

Palavras-chave: *Pimelodus maculatus*, *Rhamdia quelen*, metazoários parasitos, Rio Paraíba do Sul, Volta Redonda.

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Introduction

The Paraíba do Sul River is the main source of lotic waters in the State of Rio de Janeiro. It extends over 1,000 km and supplies approximately 80% of the water required by a population of around 12 million people, including millions of inhabitants living in the metropolitan area. The river is also responsible for 20% of the hydroelectric energy in the state. Its hydrographic basin has an area of approximately 57,000 km^2, being mostly flat with its lower-medium area surrounded by rounded hills and small intermediary valleys located at the valley bottoms between the Mar and Mantiqueira ranges (ARAÚJO, 1998; BIZERRIL; PRIMO, 2001; TEIXEIRA et al., 2005). Due to both consumptive and non-consumptive use, the Paraiba do Sul River has suffered a considerable anthropogenic impact (SEMADS, 2001; ARAÚJO et al., 2009). Despite four centuries of exploitation and the fact that the river is located between the two main urban-industrial centers in the country, the river still harbors great biodiversity (ARAÚJO, 1996; 1998; TEIXEIRA et al., 2004; 2005). A total of 81 species of fish, classified in 9 orders, 29 families, and 55 genera have been found in the river.

The mandi-amarelo *Pimelodus maculatus* Lacépède, 1803 (Siluriformes: Pimelodidae) is a benthopelagic omnivorous fish with a trend towards being piscivorous. The species is found throughout South America (BIZERRIL; PRIMO, 2001; TEIXEIRA et al., 2005).

The jundiá *Rhamdia quelen* (Quoy & Gaimard, 1824) (Siluriformes: Heptapteridae) is a benthonic omnivorous species found in the neotropical region, from Southern Mexico to Argentina. The species has been largely used in pisciculture (GOMES et al., 2000; BIZERRIL; PRIMO, 2001; CARNEIRO; MIKOS, 2005).

The siluriforms here studied are commercially important species that are abundant in the lower-medium region (Volta Redonda) of the Paraíba do Sul River (TEIXEIRA et al., 2005).

A vast literature on *P. maculatus* and *R. quelen* from different regions of Brazil exists. On the parasite fauna of these siluforms, a number of taxonomic studies as well as studies on the occurrence of these species are of great importance. These include the studies by Cellere et al. (2002), Martins et al. (2004), and Matos et al. (2005) on Myxozoa; Kohn (1990), Kritsky et al. (1995, 2000), Brasil-Sato and Pavanelli (2000), Boeger et al. (2001), Cohen and Kohn (2008), and Carvalho et al. (2009) on Monogenea; Kohn and Froes (1986), Kohn et al. (1997), Amato, S. and Amato, J. F. R. (1993), Bello et al. (2000), Brasil-Sato and Pavanelli (2004), Vianna et al. (2005), Kohn et al. (2007), and Silva et al. (2008) on Digenea; Pavanelli and Santos (1992), Rego et al. (1999), and Pertierra (2002) on Cestoda; Brasil-Sato and Pavanelli (1998) and Santos et al. (2008) on Acanthocephala; Travassos et al. (1928), Pinto et al. (1974), Kohn et al. (1985), Kohn and Fernandes (1987), Vicente et al. (1985), Moreira et al. (1991), Thatcher (1991), Moravec et al. (1993a, b), Moravec (1998), Vicente and Pinto (1999), Brasil-Sato (2003), and Madi and Silva (2005) on Nematoda; and Boxshall and Montú (1997), Brasil-Sato et al. (2000), Engers et al. (2000), and Thatcher and Brasil-Sato (2008) on Copepoda. Pereira Junior et al. (2006) have compiled a commented review of the literature on the parasites of *Rhamdia* in the neotropical region.

Ecological studies of the parasite fauna of *P. maculatus* were done by Brasil-Sato and Pavanelli (1999), and contain data on the acanthocephalus *Neoechinorhynchus pimelodi* Brasil-Sato and Pavanelli, 1998; by Pavanelli et al. (1997) on endoparasitic helminthes of species of the Paraná River; by Santos et al. (2007) and Albuquerque et al. (2008) on metazoan and endoparasites of the mandi-amarelo from Guandú River, respectively; and by Bachmann et al. (2007) on the parasitic fauna of the *P. maculatus* from Itajaí-Açu River in Blumenau, Santa Catarina, Brazil.

No studies on the parasite fauna of the fish of Paraíba do Sul River have been done before, although the number of studies on fish parasite biodiversity of the rivers of the State of Rio de Janeiro have increased. Among these are the studies done in the basin of the Guandu River on fish of the Callichthyidae (ABDALLAH et al., 2006, 2007), Characidae (ABDALLAH et al., 2004), Cichlidae (AZEVEDO et al., 2006, 2007; CARVALHO et al., 2008), Curimatidae (ABDALLAH et al., 2005), and Mugilidae (ABDALLAH et al., 2009) families.

Here we present a qualitative and quantitative analysis of the parasite fauna of *P. maculatus* and *R. quelen*, of the Paraíba do Sul River, Volta Redonda, Rio de Janeiro, Brazil.

Material and Methods

A total of 41 species of *P. maculatus* and *R. quelen* underwent necropsy. These fish were obtained by fishermen on the borders of the Paraíba do Sul River, lower-medium region (22° 30' S and 44° 05' W), in Volta Redonda, Rio de Janeiro, between November 2007 and October 2008. The fish were packed in Styrofoam boxes containing ice to ensure an efficient collection of parasites and protection during transportation to the Laboratory of Biology at Centro Universitário Geraldo Di Biase (UGB). Identification of hosts was done according to Bizerril and Primo (2001) and Reis et al. (2003). The parasites were collected, fixed, and processed according to Eiras et al. (2000).

The *P. maculatus* measured on average 24.6 ± 3.04 (18 - 31.5) cm of total body length and the *R. quelen* measured on average 23.8 ± 5.37 (16 - 36). The sex of the host was not considered when evaluating the parasitic abundance and prevalence.

Our analysis included only species with prevalence higher than 10% (BUSH et al., 1990). The frequencies of dominance and of relative dominance (number of individuals of one species/ total number of individuals of all species in each infracommunity) were calculated according to Rohde et al. (1995). The coefficient between variance and mean parasitic abundance (dispersion index, DI) was calculated for each infracommunity, aiming to determine distribution patterns. Its significance was tested using the *d* statistics (LUDWIG; REYNOLDS, 1988). The ecological terminology used is that indicated by Bush et al. (1997).

Values were considered significant when $p < 0.05$. Data on the length of the host, total number of parasites, and parasitic abundance were transformed into logarithms (log x + 1) for an approximation to the normal distribution (ZAR, 1996). Next, the data were analyzed using the Pearson (*r*) correlation to check

for potential correlations with the total length of the host. The Pearson coefficient was also used to investigate the existence of a correlation between the host length and the prevalence of infection/parasitic infestations, in which previous angle correction of the data on prevalence was done (ZAR, 1996). The host samples were grouped as follows: *P. maculatus* in four intervals with 3.5 cm of amplitude and *R. quelen* in five intervals of 4 cm of total body length.

Results

Of the individuals of *P. maculatus* and *R. quelen* analyzed, 70.8 and 53.0%, respectively, had parasites of at least one species of metazoan. A total of 179 and 292 parasites were collected from *P. maculatus* and *R. quelen,* with an average of 4.3 ± 5.5 and 5.4 ± 9.9 per host, respectively. Among all the parasite specimens found in both fish specimens, three were common to the two species of fish studied. These parasites were of three types: a monogenean, a nematode, and a hirudinean (Glossiphoniidae). *Cucullanus pinnai* (Travassos, Artiga and Pereira, 1928) (Nematoda: Cucullanidae) and *Aphanoblastella* sp. (Monogenea: Dactylogyridae) were the most prevalent and abundant species found in *P. maculatus* and *R. quelen*, respectively (Table 1). In *P. maculatus* we found 54.7% monogeneans, 44.8% nematodes, and 0.5% hirudineans whereas in *R. quelen* we found 96.3% monogeneans, 3.4% nematodes, and 0.3% hirudineans. The parasite community found in *P. maculatus* showed an atypical over-dispersed distribution pattern with *Cucullanus pinnai* showing the highest dominance frequency and relative average dominance (Table 2). In *R. quelen* the monogenean *Aphanoblastella* sp. had the highest dominance frequency and relative average dominance and the same over-dispersed pattern (Table 3). No significant correlation was found between the total body length of the host and parasitic abundance and prevalence. The parasite richness of *P. maculatus* and *R. quelen* had mean values of 0.87 ± 0.67 (0 - 2) and 0.57 ± 0.56 (0 - 2), respectively. In both cases the parasite richness did not correlate with parasitic abundance and the total length of *P. maculatus* and *R. quelen* (r_s = -0.020 and P= 0.897; r_s = 0.249 and P= 0.068).

Discussion

The two species of fish here studied presented the same parasite fauna. However, quantitative differences were observed, with some parasite species dominating more in one fish species than in the other. The fact that both fish species had the same parasites may be explained by the fact that they share biological features, besides the fact that they co-exist geographically. Additionally, both are omnivorous, opportunistic, and scavengers of lagoon and river bottoms (LOWE-McCONNELL, 1999; GOMES et al., 2000; BIZERRIL; PRIMO, 2001; CARNEIRO; MIKOS, 2005; TEIXEIRA; PINTO; ARAÚJO, 2005).

In *P. maculatus* we observed a dominance of the *Cucullanus pinnai* nematode. This finding agrees with that from studies by Santos et al. (2007) and Albuquerque et al. (2008) in fish from the Guandú River, Rio de Janeiro, Brazil. However, in these studies, the values for parasite prevalence and abundance were higher than the values found in our study. Also relevant is the fact that Albuquerque et al. (2008) found this nematode in the stomach, intestine, and celoma cavity of *P. maculatus*. These authors suggest that *C. pinnai* uses *P. maculatus* as an intermediary and definitive host, with histotrophy and evolutive phases in adults. This idea is supported by the low parasite richness endoparasites of this host in this environment, as compared to other limnic environments, which indicates a low availability of food (ALBUQUERQUE et al., 2008).

In our study we observed a low parasite richness of endoparasites, which were represented only by adult individuals of *C. pinnai*, both in *P. maculatus* and in *R. quelen*. These nematodes were not obtained from the celloma cavity, which indicates that *P. maculatus* from the Paraíba do Sul River act as definitive hosts only. As for *R. quelen* its piscivirous diet, besides feeding on aquatic invertebrates

Table 1. Metazoan parasites of *Pimelodus maculatus* and *Rhamdia quelen* of Paraíba do Sul River, Volta Redonda, Rio de Janeiro.

Parasite	Prevalence (%)		Mean Intensity		Mean Abundance		Intensity amplitude		Site of infection
	Pm	Rq	Pm	Rq	Pm	Rq	Pm	Rq	
Monogean *Aphanoblastella* sp.	26.8	45	8.90 ± 7.02	11.28 ± 12.26	2.39 ± 5.31	5.22 ± 10.02	1-12	1-41	Gills
Nematode *Cucullanus pinnai*	58.5	11	3.33 ± 2.98	1.8 ± 1.78	1.95 ± 2.81	0.16 ± 0.73	1-20	1-5	Intestine
Hirudinean Unidentified Glossiphonidae	2.4	2	1	1	0.024 ± 0.156	0.018 ± 0.13	1	1	Gills

(Pm)- *Pimelodus maculatus;* (Rq)- *Rhamdia quelen.*

Table 2. Dominance and mean relative dominance frequencies, dispersion index (DI), and *d* statistics of the parasites of *Pimelodus maculatus* of Paraíba do Sul River, Volta Redonda, Rio de Janeiro.

Parasite	Dominance frequency	Mean relative dominance	DI	*d*
Aphanoblastella sp.	34.5	0.22 ± 0.39	11.83	21.88*
Cucullanus pinnai	62	0.47 ± 0.48	4.04	9.09*
Total number of parasites	-	-	7.14	15.02*

*Significant values (*d* > 1.96).

Table 3. Dominance and mean relative dominance frequencies, dispersion index (DI), and *d* statistics of the parasites of *Rhamdia quelen* of Paraíba do Sul River, Volta Redonda, Rio de Janeiro.

Parasite	Dominance frequency (%)	Mean relative dominance	DI	*d*
Aphanoblastella sp.	82.7	0.44 ± 0.49	19.23	34.91*
Cucullanus pinnai	13.8	0.08 ± 0.26	3.12	7.94*
Total number of parasites	-----	-----	18.34	33.84*

*Significant values ($d > 1.96$).

(BIZERRIL; PRIMO, 2001), could explain the existence of phases of histotrophy of *C. pinnai*. However, this was not observed in the present study. Thus, long-term studies on the population dynamics of the nematode–fish interaction are necessary to provide insights on the infection mechanism of this helminth.

The monogenean *Aphanoblastella* sp. dominated the parasite fauna of *R. quelen*. Carvalho et al. (2009) found increased prevalence (100%) and mean abundance (71.4 ± 64.5) of the *Aphanoblastella juizforense* monogenean in *R. quelen* from Paraibuna River, Minas Gerais, which is considered an ancestor of the Paraíba do Sul River, also known as Alto Paraíba do Sul (SEMADS, 2001).

The over-dispersed distribution pattern has been observed in communities of metazoan parasites of freshwater fish from the southeast of Brazil (ABDALLAH et al., 2004, 2005, 2006; AZEVEDO et al., 2007). However, the dispersion index was not applied in studies with *P. maculatus* (BACHMANN et al., 2007; SANTOS et al., 2007; ALBUQUERQUE et al., 2008), and therefore a comparison with our findings is not possible.

The length of the hosts did not correlate with parasite abundance and prevalence, which agrees with studies done by Bachmann et al. (2007), Santos et al. (2007), and Albuquerque et al. (2008).

The parasite richness found in *P. maculatus*, in this case comprised by three species only, was lower than that found by Pavanelli et al. (1997). Those authors registered 29 species of parasites in individuals collected in the Rio Paraná. Our results also differ from those described by Bachmann et al. (2007), who found six species of metazoan parasites in individuals collected in the Rio Itajaí-Açu, Blumenau, Santa Catarina, and the results of Santos et al. (2007), who found 10 species of metazoan parasites in *P. maculatus* from Guandú River, Rio de Janeiro.

Another relevant fact on the composition of the parasite fauna described in our study is the lack of digenetic organisms, metacercaria and adults, which were described by other authors (KOHN et al., 1997; PAVANELLI et al., 1997; BRASIL-SATO; PAVANELLI, 2004; BACHMANN et al., 2007; SANTOS et al., 2007). According to Kennedy (1993), the number of parasite species of the infracommunities is considered to be a reflex of the number of host species in the same location and of the capacity of transmitting and infecting intermediary and definitive hosts. Chemical and physical characteristics of the water are limiting and essential factors for the stability of the community of invertebrate aquatic organisms, which may act as intermediary and/or paratenic hosts (SALGADO-MALDONADO; KENNEDY, 1997; MARCOGLIESE, 2001).

The place where *P. maculatus* and *R. quelen* were collected, the lower-medium Paraíba do Sul River in Volta Redonda, is totally urbanized and surrounded by many industries, with constant leakage of toxic products in the water and dumping of industrial and domestic sewers throughout its course (BIZERRIL, 1999; SEMADS, 2001; TEIXEIRA et al. 2004; ARAUJO et al., 2009). This may explain the low parasite richness found in *P. maculatus* and *R. quelen* in this study, as a number of pollutants may affect the fish parasite fauna. These pollutants may act directly on fish, causing immunodepression, which could lead to a higher level of parasites, as described by Madi and Ueta (2009). Or, pollutants may affect parasitism negatively by interfering directly in the larva stages of those with free life, or indirectly by reducing the population of intermediary hosts (POULIN, 1992; ALBUQUERQUE et al., 2008).

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