PREVALENCE, INTENSITY AND SEASONALITY OF *Ichthyouris voltagrandensis* (NEMATODA: PHARYNGODONIDAE) IN *Myleus tiete* (OSTEICHTHYES: CHARACIDAE) FROM VOLTA GRANDE RESERVOIR, MINAS GERAIS STATE, BRAZIL

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ABSTRACT

The prevalence, intensity and seasonality of *Ichthyouris voltagrandensis* (Nematoda), as a parasite of *Myleus tiete* (Osteichthyes) from Volta Grande Reservoir, Minas Gerais, Brazil, were studied. A total of 91 fishes were captured between April 2000 and April 2001. The highest parasite prevalence (100%) was observed in fish captured in April and August 2000. A prevalence of 86.7%; 86.7% and 93.3% and a mean intensity of 317.4; 112.6 and 123.7 parasites were recorded respectively in December 2000 and February and April 2001. Parasite prevalence was not related to host sex. However, infection was noted in 100% of the female specimens in August and December 2000 and April 2001. The highest mean parasite intensity was found in April and December 2000 and February 2001, pertaining, these last two months, to the rainy season. Moreover, a great number of larvae of the nematode were collected in December 2000. The relation between parasite/host/environment is also discussed.

Key words: *Myleus tiete;* Nematoda; *Ichthyouris voltagrandensis;* prevalence; seasonality; Brazil

PREVALÊNCIA, INTENSIDADE E SAZONALIDADE DE *Ichthyouris voltagrandensis* (NEMATODA: PHARYNGODONIDAE) em *Myleus tiete* (OSTEICHTHYES: CHARACIDAE) NO RESERVATÓRIO DE VOLTA GRANDE, ESTADO DE MINAS GERAIS, BRASIL

RESUMO

Estudaram-se a prevalência, intensidade e sazonalidade de *Ichthyouris voltagrandensis* (Nematoda), como parasito de *Myleus tiete* (Osteichthyes) do Reservatório de Volta Grande, Minas Gerais, Brasil. Um total de 91 peixes foram capturados entre abril de 2000 e abril de 2001. A mais alta prevalência do parasito (100%) foi observada em abril e agosto de 2000. Prevalências de 86,7%; 86,7; 93,3% e intensidades médias de 317,4; 112,6; 123,7 parasitos foram observadas, respectivamente, em dezembro de 2000 e fevereiro e abril de 2001. Não houve relação da prevalência do nematóide com o sexo do hospedeiro, embora tenha sido observada prevalência de 100% em fêmeas capturadas em agosto e dezembro de 2000 e abril de 2001. As maiores intensidades médias foram observadas em abril e dezembro de 2000 e fevereiro de 2001. Estes dois últimos meses, em particular, pertencem à época chuvosa. Além disso, um grande número de larvas do nematóide foi observado em dezembro de 2000. Discute-se, também, a relação parasito/hospedeiro/ambiente.

Palavras-chave: *Myleus tiete;* Nematoda; *Ichthyouris voltagrandensis;* prevalência; sazonalidade; Brazil

Artigo: Recebido em 15/10/2002 - Aprovado em 05/09/2003

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INTRODUCTION

This work is one of a series of papers that evaluate the parasitic fauna of fishes with importance in fisheries from Volta Grande Reservoir, Minas Gerais, Brazil. Already published or in press are the following studies: larvae of *Thynnascaris sp.* (Nematoda: Anisakidae) in the intestinal mesentery of *Plagioscion squamosissimus* (MARTINS *et al.*, 2000a), *Neoechinorhynchus curemai* (Acanthocephala: Neoechinorhynchidae) in the intestine of "curimbatá" *Prochilodus lineatus* (MARTINS *et al.*, 2000b) and recently metacercariae of *Diplostomum* sp. in the eyes of the "tucunaré" *Cichla ocellaris* (MARTINS *et al.*, 2002a).

Among the first studies on the helminthological fauna of freshwater fish in Brazil are those of TRAVASSOS *et al.* (1928), that later were complemented by SANTOS *et al.* (1979) and VICENTE and PINTO (1999). There are described six species of *Ichthyouris* Inglis, 1962, an oxyuroid nematode parasite of fish. INGLIS (1962) described *I. ro* collected in the intestine of *Cichlasoma festivum* at Sofia, Georgetown, British Guiana. MORAVEC and PROUZA (1995) related the occurrence of *I. bursata* from *Symphysodon discus*, an aquarium fish, in South Bohemia, Czech Republic. In Brazil, MORAVEC *et al.* (1992a) reported the presence of *I. brasiliensis* in armoured catfish, *Pterigoplichthys aculeatus,* in the Paraná River, Guaíra, Paraná State. Additionally, MORAVEC *et al.* (1992b) described *I. laterifilamenta,* found the doradid fish *Trachydoras paraguayensis* from the hydroelectric power station of Itaipu, Foz do Iguaçu, Paraná State. Also, *I. voltagrandensis,* in the intestine of *Myleus tiete* from Volta Grande Reservoir, Minas Gerais (MARTINS *et al.*, 2001), and *I. ovifilamentosa,* in the intestine of *Cichlasoma sp.* from Negro River, Amazonas (MORAVEC and THATCHER, 2001), were recently observed.

To date, no reports exist on the prevalence intensity and seasonality of *Ichthyouris*. The present work evaluated, during a period of one year, the influence of aquatic parameters and pluviometric values on the prevalence and intensity of *I. voltagrandensis* in naturally infected *M. tiete* from Volta Grande Reservoir, Minas Gerais State, Brazil.

MATERIAL AND METHODS

During the period of April 2000 through April 2001, a total of 91 specimens of *Myleus tiete* Eigenmann and Norris, 1900 (Osteichthyes: Characidae) were bimonthly captured with the aid of net and hook, in the Volta Grande Reservoir, which has an inundated area of 195 km^2. Immediately after collection, the fishes were measured, weighed, and evaluated in relation to the occurrence of parasites. During each sample period, the values of hydrological parameters, such as pH, electric conductivity, dissolved oxygen, chlorophyll, transparency and temperature, were also registered. The pluviometric data were analyzed, during all period of collection, by the Hydrology Department at CEMIG. The nematodes were remouved from the fish intestine, fixed in AFA (alcohol 70% - 930 ml; formaldehyde - 50 ml; acetic acid - 20 ml) at 65 ^{o}C, and later preserved in a solution of 70% alcohol and 5% glycerin. The parasites were counted and the male/female specimen ratio evaluated. The prevalence of infection, mean intensity and mean abundance were calculated, according to BUSH *et al.* (1997). The results were analyzed by Spearman's (rs) test with a 0.05 significance rate (SIEGEL, 1975), and the ANOVA F statistic was used for analysis of variance. The average comparison of parasite number and prevalence by sex was performed by Tukey test (MENDES, 1999).

RESULTS

No alterations in water electric conductivity and pH were observed, in spite of the low transparency recorded in April 2000. Months with highest temperatures were December 2000 and February and April 2001. On the other hand, the lowest values of dissolved oxygen were observed in December 2000 (7.47 mg/L) and February 2001 (6.73 mg/L). The algae biomass measured by chlorophyll analysis showed its highest value (11.30 mg/L) in April 2000, and in the other months it varied from 1.70 to 5.30 mg/L. A significant decrease in pluviometric data was recorded in April 2000 (53 mm), being the highest ones, 1,617 and 1,582 mm, observed in December 2000 and February 2001, respectively (Table 1). The parasite infection in *M. tiete* was found to be related to rainfall during the period of April 2000 to April 2001. The estimated value of the class correlation coefficient of Spearman (rs) was 0.82 of significance ($P < 0.05$), with $T_{rs} = 3.21$. A correlation between the mean intensity of nematodes and rainfall during the studied period was observed (Figure 1).

The nematodes found in the intestine of *M. tiete* were identified as *Ichthyouris voltagrandensis* (Nematoda: Pharyngodonidae) (MARTINS *et al.*, 2001). Mean values and variation of fish weight and

length, and prevalence, mean intensity, and mean abundance of nematodes in each month are shown in table 2. During the collection period, the highest prevalence values were 100% in April and August 2000 and 93.3% in April 2001. On the other hand, the highest mean intensity values were found in April 2000 (213.5), December 2000 (317.4), February 2001 (112.6) and April 2001 (123.7), as well as the highest mean abundance (274.4), in December 2000. When analyzing the data for sex of the fish, a slight tendency towards increased infection in females (Tables 3 and 5), but without significant difference ($P > 0.05$), was observed.

The highest mean intensities of males of *I. voltagrandensis* occurred in April 2000 (44.2), October 2000 (23.8) and December 2000 (32.1), and those of female parasites were observed in April 2000 (169.2), December 2000 (95.8) and February 2001 (108.0). A great number of nematode larvae were registered in December 2000 (1 to 928) and April 2001 (4 to 451), but no larvae were observed in April, August, and October 2000 (Table 4). The mean abundance of *I. voltagrandensis* showed its highest value (274.4) in December 2000 (Table 2). The statistical analysis do not show significant difference between parasite prevalence and sex (Table 5).

Table 1. Values of rainfall (RF) and water parameters measured in the Volta Grande Reservoir, Minas Gerais State, Brazil, between April 2000 and April 2001, during the collection of fish

	RF (mm)	Transparency (m)	Chlorophyll (µg/L)	pH	Conductivity (µS/cm)	Temperature (°C)	Oxygen (mg/L)
Apr. 2000	53	2.15	11.30	6.41	35.00	26.87	8.17
Jun. 2000	0	3.85	1.70	6.23	35.00	21.83	8.90
Aug. 2000	249	5.35	5.30	7.08	29.00	22.93	8.50
Oct. 2000	669	3.25	3.00	6.87	35.00	26.93	7.80
Dec. 2000	1,617	3.90	3.00	7.52	35.33	27.83	7.47
Feb. 2001	1,582	7.30	2.60	7.90	34.33	28.40	6.73
Apr. 2001	747	5.30	4.50	6.92	29.00	28.00	8.43

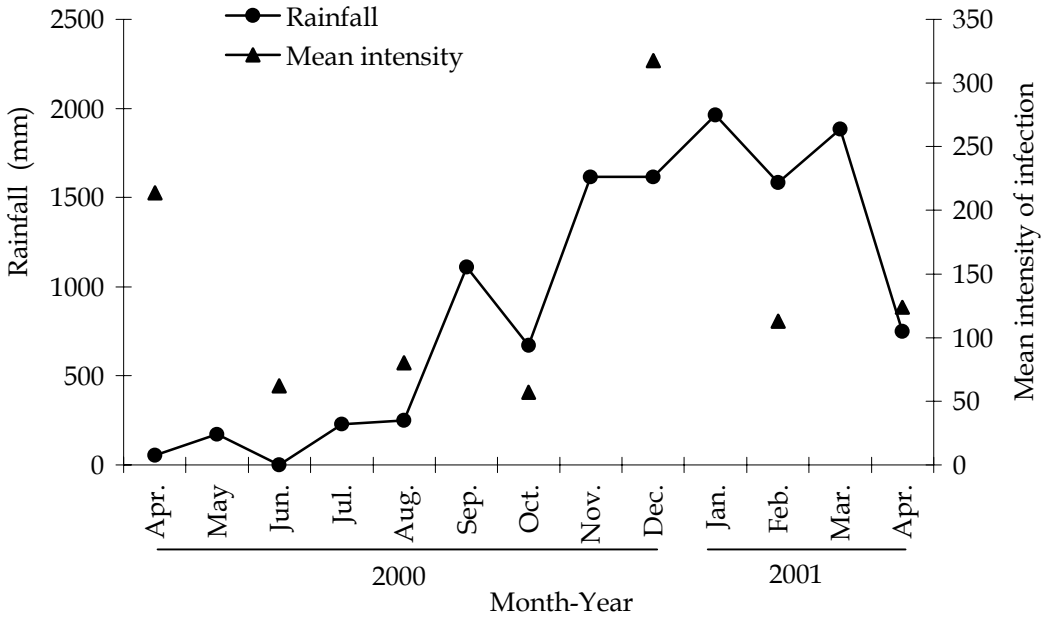

Figure 1. Relation between values of rainfall and mean intensity of infection of *Myleus tiete* from Volta Grande Reservoir, Minas Gerais State, Brazil, with *Ichthyouris voltagrandensis* during the period from April 2000 to April 2001

Table 2. Mean values and variation of weight and length of *Myleus tiete* infected with *Ichthyouris voltagrandensis* from Volta Grande Reservoir, Minas Gerais State, Brazil: Infected/collected fish, prevalence, mean intensity and mean abundance, in each sampling month

Month	Weight (g)	Total length (cm)	Infected fish/ Collected fish	Prevalence (%)	Mean intensity (Variation)	Mean abundance
Apr. 2000	134.25 (123.0 to 163.0)	17.9 (16.4 to 19.0)	4/4	100.0	213.5 (18.0 to 449.0)	147.0
Jun. 2000	41.7 (40.0 to 52.0)	12.0 (11.0 to 12.5)	8/12	66.7	62.2 (1.0 to 129.0)	41.5
Aug. 2000	108.4 (51.0 to 210.5)	16.4 (12.2 to 20.5)	15/15	100.0	80.4 (1.0 to 375.0)	83.2
Oct. 2000	86.5 (54.0 to 121.0)	15.1 (12.8 to 17.0)	11/15	73.3	57.0 (1.0 to 67.0)	173.7
Dec. 2000	61.9 (32.0 to 84.5)	13.0 (10.8 to 14.5)	13/15	86.7	317.4 (3.0 to 928.0)	274.4
Feb. 2001	44.0 (19.0 to 96.0)	11.4 (9.5 to 15.3)	13/15	86.7	112.6 (1.0 to 378.0)	96.9
Apr. 2001	50.6 (30.0 to 80.0)	11.9 (10.3 to 15.0)	14/15	93.3	123.7 (1.0 to 195.0)	118.0

Table 3. Males and females of *Myleus tiete* infected with *Ichthyouris voltagrandensis* from Volta Grande Reservoir, Minas Gerais State, Brazil, and their respective prevalence in each sampling month

Month	Infected fish/ Collected fish	Infected male/ Collected male	Prevalence (%)	Infected female/ Collected female	Prevalence (%)
Apr. 2000[a]	4/4	-	-	-	-
Jun. 2000[a]	8/12	-	-	-	-
Aug. 2000	15/15	6/6	100.0	9/9	100.0
Oct. 2000	11/15	3/4	75.0	8/11	72.7
Dec. 2000	13/15	5/8	62.0	6/7	86.0
Feb. 2001	13/15	10/11	90.9	3/4	75.0
Apr. 2001	14/15	7/8	87.5	7/7	100.0

[a] sex unidentified

Table 4. Mean intensity and variation of *Ichthyouris voltagrandensis* males, females and larvae in the intestine of *Myleus tiete* from Volta Grande Reservoir, Minas Gerais State, Brazil, in each sampling month

Month	Infected fish/ Collected fish	Male	Female	Larvae
Apr. 2000	4/4	44.2 (18 to 73)	169.2 (3 to 449)	0
Jun. 2000	8/12	9.6 (1 to 32)	46.6 (1 to 129)	16.0 (9 to 28)
Aug. 2000	15/15	12.6 (1 to 73)	67.8 (1 to 375)	0
Oct. 2000	11/15	23.8 (8 to 143)	33.2 (1 to 67)	0
Dec. 2000	13/15	32.1 (1 to 68)	95.8 (7 to 336)	189.5 (1 to 928)
Feb. 2001	13/15	3.9 (1 to 17)	108.0 (2 to 363)	0.7 (0 to 8)
Apr. 2001	14/15	5.3 (1 to 36)	44.7 (4 to 195)	73.7 (4 to 451)

Table 5. Statistical analysis of *Ichthyouris voltagrandensis* infection in *Myleus tiete* from Volta Grande Reservoir, Minas Gerais State, Brazil, in each sampling month

F for parasite number	1.22	
F for month	1.86	
F for sex	0.76	
C.V.	51.13	
Month	Average	F
August 2000	34.97 A	0.76 ns
October 2000	27.28 A	0.04 ns
December 2000	46.04 A	10.13 ns
February 2001	32.67 A	13.10 ns
April 2001	40.80 A	0.41 ns

Same letters indicate difference not significant by Tukey test (P > 0.05).

DISCUSSION

In Brazil, endoparasites in cultivated fish have been shown to be less pathogenic than the ectoparasites (MARTINS *et al.*, 2002b). Following this view, the influence of environmental quality (contamination), the natural host susceptibility to pathogens (caused by lower water quality, nutritional deficiency or intrinsic genetic factors) and the parasite infective capacity can also be added. A new reservoir causes significant changes in the environment and in fish and parasite population. The occurrence of disease in fish population depends on abiotic, biotic and/or genetic factors.

In the studied reservoir, HENRY (1999) has observed essentially oligotrophic characteristics, with low productivity. The lowest water transparency and the highest algae biomass were registered in April 2000, when, however, a parasite prevalence of 100% was observed. In relation to type of environment, VALTONEN *et al.* (1994) verified a high prevalence (63%) of the anisakid nematode *Raphidascaris acus* in roach (*Rutilus rutilus*) tissues from an eutrophic lake, when compared to a 23% prevalence in fish from an oligotrophic one. As expected, pluviometric data and water temperature values were higher in December 2000 and February and April 2001, in accordance to the season. In the present study, in the months with the highest pluviometric data and water temperature values, nematodes showed prevalences that varied from 86.7 to 93.3% and mean intensity ranging from 112.6 to 317.4 parasites per host, in the fish intestine. These observations are explained when analysing figure 1, which shows the highest pluviometric data occurring from November 2000 through March 2001. The highest pluviometric data registered in November and December 2000 can be favoured the increase of the parasite abundance (274.4), as comproved by the massive presence of larvae in December 2000. This was previously reported by MARTINS *et al.* (2000a), which studied *Thynnascaris* sp. infections in *Plagioscion squamosissimus* from the same reservoir.

Some authors have studied ecological aspects of host-parasite relationship in different Brazilian regions. In the State of Rio de Janeiro, BARROS (1994) registered the occurrence of *Contracaecum* larvae in 78% of the specimens of *Pagrus pagrus* studied. With the development and growth of the host, some alterations in the parasitic fauna may occur. KNOFF *et al.* (1997) observed in *Mugil platanus* positive correlation between length and infection intensity. In the State of Paraná, MACHADO *et al.* (1996) reported 74% of *Pseudoplatystoma corruscans* and 19% of *Schizodon borelli* parasitized with digenetic trematode, cestode, and nematode (adult and larvae), and, according to LUQUE *et al.* (1996), TAKEMOTO *et al.* (1996), and LUQUE and ALVES (2001), this fauna depends on habitat and fish species involved. LUQUE and CHAVES (1999) and LUQUE and ALVES (2001) observed prevalences of *Contracaecum* larvae, such as 21% and 18.2%, respectively in *Pomatomus saltator* and *Caranx latus,* and hence, lower than those registered in *M. tiete* at the present work. Similar results were observed by MACHADO *et al.* (2000), regarding high prevalence values of *Contracaecum* larvae - from 33.3 to 100%, in *Cichla monoculus* collected near Porto Rico, Paraná.

Finally, in the State of Rio Grande do Sul, the presence of Philometridae nematodes, *Porrocaecum jardimfreirei* and *Cucullanus* spp., *C. cassinensis* and *Dichelyne micropogonii,* in *Micropogonias furnieri,* and nematodes, such as *Anisakis tipica,* were also reported (FORTES and HOFFMANN, 1995; PEREIRA Jr and COSTA, 1996; ANDRADE *et al.*, 1997). However, FORTES *et al.* (1999) observed a 99% prevalence of the anisakid parasite *Raphidascaris (Sprentascaris) mahnerti* in the intestine of *Loricariichthys platymetopon* from Barbará dam, Uruguaiana, Rio Grande do Sul State. Similar results were verified in *M. tiete* in April and August 2000, when 100% of the collected fish were parasitized. Sometimes, fish from reservoirs may present values of parasite prevalence and mean intensity higher than those observed in fish from

rivers, as it was registered in this work. Mean abundance of *I. voltagrandensis* in fish from Volta Grande reservoir was so high as that observed by ANDRADE *et al*. (2001) in *Brycon cephalus* from Amazonia, parasitized by *Spirocamallanus inopinatus* (0.3). On the other hand, these authors reported elevated mean abundance (65) of monogenean parasites in the gills of that fish. Similar values of mean abundance (271) were recorded by MACHADO *et al*. (2000) in *Cichla monoculus* parasitized by the cestode *Proteocephalus microscopicus*. An interesting observation was the register, in December 2000, of a high mean abundance (274). This fact coincides with rainfall and reproductive activity of *M. tiete*, that occurs in the period between June and February.

Although the life cycle of *I. voltagrandensis*, so as that of other oxyuroid, are not documented, MORAVEC and PROUZA (1995), based on observation of parasitism in aquaria fish, believe that these parasites may have a direct life cycle. The same was not observed in the present work, in spite of the presence of male and female adult parasites and of a great number of larvae in the fish intestine. ANDERSON and GORDON (1982) observed the relationship between parasite occurrence and host susceptibility, parasite reproduction, and natural immunity, that may avoid parasite attachment and proliferation. So, the present work contributes to the knowledge of parasitic fauna of *M. tiete*, a common fish found in the region of Volta Grande Reservoir, in Minas Gerais State, Brazil.

ACKNOWLEDGEMENTS

We thank the Hydroelectric Power Station of Minas Gerais, Brazil, for its field support; Gastão Reis, Heloisa Laterça and Paula Rezende for their correction of the manuscript translation.

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