INFLUENCE OF THE TYPE OF ENVIRONMENT AND OF THE HYDROLOGICAL LEVEL VARIATION IN ENDOPARASITIC INFRAPOPULATIONS OF *PSEUDOPLATYSTOMA CORRUSCANS* (AGASSIZ) AND *SCHIZODON BORELLI* (BOULENGER) (OSTEICHTHYES) OF THE HIGH PARANÁ RIVER, BRAZIL

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ABSTRACT. One hundred and ten specimens of *Pseudoplatystoma corruscans* (Agassiz, 1829) (Pimelodidae), "pintado", and 582 specimens of *Schizodon borelli* (Boulenger, 1900) (Anostomidae), "piava", collected in the floodplain of the high Paraná River were analyzed. *P. corruscans* presented 74.54% of parasitism while *S. borelli* presented 19.42%. Results of the present research show that in the case of *P. corruscans*, two species of proteocephalideans presented a significant relationship with the type of environment with regard to prevalence. *Spasskyelina spinulifera* (Woodland, 1935) was the only species that presented a relationship between the intensity of infection and the environment. In *S. borelli* only *Cucullanus pinnai* Travassos, Artigas & Pereira, 1928 presented a relationship with the environment. In this case the mean intensity was greater in lentic environments. The high values of the similarity index in the three environments studied indicate a considerable homogeneity of the endohelminths' species with regard to *P. corruscans* and *S. borelli*. This is probably due to what occurs with environments during the high water period when they are interlinked. The hydrological level was a less influential variable in endoparasitic infrapopulations of the hosts studied. In *P. corruscans* only three species, *S. spinulifera*, *Nomimoscolex sudobim* Woodland, 1934 and *Megathylacus travassosi* Pavanelli & Rego, 1992 presented higher mean intensities in the high water period. This fact was also observed in the case of *C. pinnai* in *S. borelli*.
KEY WORDS. Ecology, endohelminths, freshwater fish, environment

The intensity of food taking by fish may vary according to the environment and to the characteristics of the species. Seasonal variations in this activity may be related to factors that modify habitats with an influence on the availability of alimentary resources and the success of capture or with aspects of the species life cycle (MARQUES 1993). Environment may also influence diversity in endohelminths (BELL & BURT 1991) since it makes changes in the composition of fauna of intermediate hosts.

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MACHADO *et al.* (1994, *in press*) described the structure and diversity and the influence of hosts sex and size on endoparasitic infrapopulation of *Pseudoplatystoma corruscans* (Agassiz, 1829) (Pimelodidae) and *Schizodon borelli* (Boulenger, 1900) (Anostomidae) of the high Paraná River. The present work gives continuity to studies conducted by MACHADO *et al.* (1994, *in press*) and analyses the possible influences of the type of environment and of the hydrological level fluctuations on the infrapopulations of endoparasites of two fish species with distinct trophic categories: *Pseudoplatystoma corruscans* (Siluriformes: Pimelodidae), "pintado", a carnivorous fish widely distributed throughout South America (FOWLER 1951) and *Schizodon borelli* (Characiformes: Anostomidae), "piava", a herbivorous species extremely common in the floodplain of the Paraná River (FUEM/NUPELIA 1993).

MATERIALS AND METHODS

The area under study lies in the floodplain of the Paraná River, municipality of Porto Rico, Paraná, Brazil (22°40'-22°50'S and 53°15'-53°40'W). Due to a great diversity of habitats, sampling was undertaken in three types of environments with distinct characteristics (Fig. 1): a) a lentic environment, represented by the Patos and Guaraná lakes; b) a semi-lotic environment represented by the Baía River and c) a lotic environment represented by the principal course of the Paraná River, by the Cortado channel and the Ivinheima River. The description of these collection sites are described in THOMAZ *et al.* (1991, 1992a,b).

Monthly collections were undertaken from March 1992 to February 1993. Fishing utensils consisted of simple nets, gill nets and boulters which were set during 24 h with hauling at every 4 hours. After capture and identification of fish total and standard lengths, weight and sex were determined to analyze the possible influences of the size and sex of host on the infrapopulations of endoparasites, that were commented in MACHADO *et al.* (1994). Fish were eviscerated and their visceral cavity examined. The organs examined by stereoscopic microscope on the site were: eyes, tube digestive and adjacent organs, kidneys, urinary bladder, gas bladder and gonads. The endoparasites collected were cleaned in a 0.65% physiological solution and prepared according to AMATO *et al.* (1991). Helminths were deposited in the Helminthological Collection of the Instituto Oswaldo Cruz (CHIOC) in Rio de Janeiro, Brazil (CHIOC no. 33.270 to no. 33.285).

With regard to the data analyses statistical tests ($P \leq 0.05$) and ecological indexes were used. Mann-Whitney's "U" test was used to verify the influence of the hydrological level on the intensity of infection of each parasite species (SIEGEL 1975) (applied only for infrapopulations with prevalence superior to 5%). The influence of the environment in the prevalence of each species of endoparasites (used only for infrapopulations with a prevalence superior to 10%) was determined by the Chi-square analysis. Variance analysis (ANOVA-one way) was used to verify the influence of environments on the intensity of parasitism. Later on Tukey test was applied (both tests were applied for the most influential infrapopulations).

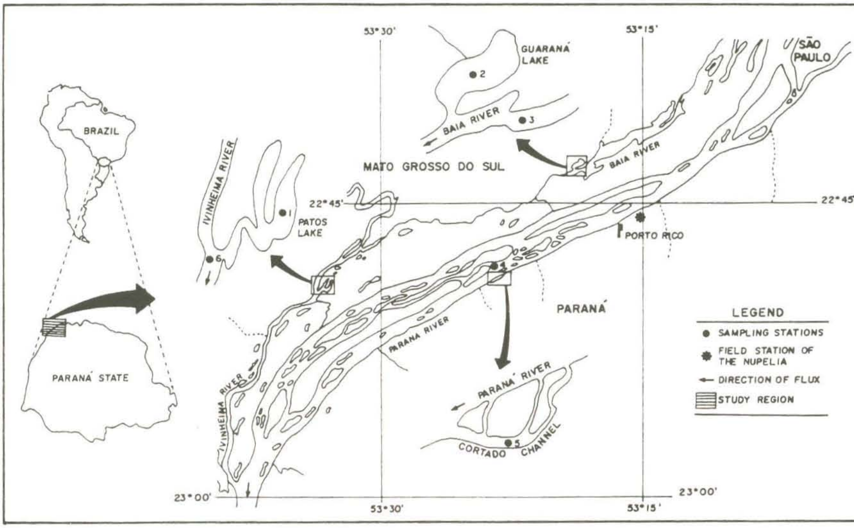

Fig. 1. Sites of the collecting points: (1) Patos lake, (2) Guaraná lake, (3) river Baía, (4) Paraná River, (5) channel Cortado and (6) river Ivinheima.

The similarity between species of endoparasites in the three type of environments under analysis was determined by Sorenson's Similarity Index (STONE & PENCE 1978). The Bush "I" value (according to THUL *et al.* 1985) was used to classify the species of endohelminths in accordance to their importance in the endoparasite community of each environment. Species in the larval state were not considered in this classification because they are cumulative and therefore they are not a good indicator to compare parasitic indexes. The computer programs used for the calculation of statistical tests and ecological indexes were Statistical Ecology (LUDWIG & REYNOLDS 1988) and Statistica for Windows. The terms related to parasitic ecology were those suggested by MARGOLIS *et al.* (1982) and HOLMES & PRICE (1986).

RESULTS

During the period under study high water occurred from March to May 1992 and from November 1992 to February 1993; the period of low water was from June to October 1992 (FUEM/NUPELIA 1993) (Fig. 2a).

Pseudoplatystoma corruscans (Agassiz, 1829)

Eighty-two out of 110 hosts examined (74.54%) were found to be parasitized by at least one species of endohelminths. Endoparasites collected included five species of cestodes [*Choanoscolex abscissus* (Riggenbach, 1895), *Spasskyelina spinulifera* (Woodland, 1935), *Nomimoscolex sudobim* Woodland, 1934, *Megathylacus travassosi* Pavanelli & Rego, 1992 and *Harriscolex kaparari*

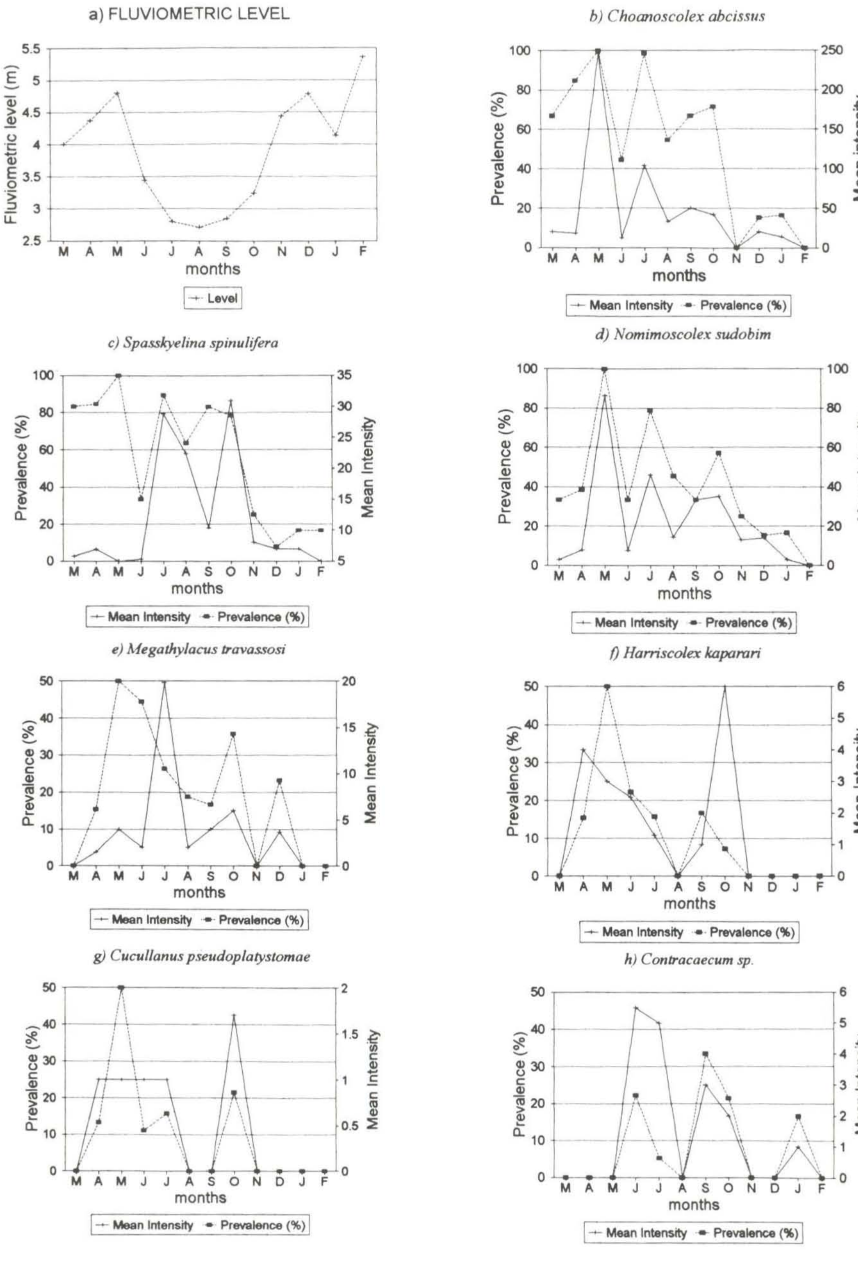

Fig. 2a-h. (a) Seasonal variation of the hidrological level and (b-h) seasonal variation of prevalence and mean intensity of parasitism of endohelminth species of 110 specimens of *Pseudoplatystoma corruscans* collected in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

(Woodland, 1935)] and five species of nematodes [*Cucullanus pseudoplatystomae* Moravec, Kohn & Fernandes 1993, *Eustrongylides* sp. (larvae), *Contracaecum* sp. 1 (larvae), *Contracaecum* sp. 2 (larva) and *Procamallanus (Spirocamallanus)* sp.] (Tab. I).

Table I. Prevalence (prev.%), mean intensity (mi), relative density (rd) and site of infection of endoparasites in 110 specimens of *Pseudoplatystoma corruscans* collected in the high Paraná River, Porto Rico, Paraná, Brazil, from March 1992 to February 1993 (ni = number of infected fish; a = amplitude of intensity variance).

Parasites *	ni	prev. (%)	mi	a	rd
CESTOIDEA					
Choanoscolex abscissus (1)	61	55.45	56.9	1 - 492	31.55
Spasskyelina spinulifera (1)	65	59.09	18.6	1 - 134	10.99
Nomimoscolex sudobim (1)	47	42.73	28.7	1 - 176	12.26
Megathylacus travassosi (1)	23	20.91	7.1	1 - 88	1.48
Harriscolex kaparari (1)	10	9.09	2.7	1 - 7	0.24
NEMATODA					
Cucullanus pseudoplatystomae (1)	9	8.18	1.2	1 - 3	0.10
Contracaecum sp. 1 (2)	9	8.18	3.2	1 - 10	0.26
Contracaecum sp. 2 (2)	1	0.91	1.0	-	0.01
Eustrongylides sp. (2)	2	1.82	10.0	1 - 19	0.18
Procamallanus (Spirocamallanus) sp. (1)	1	0.91	3.0	-	0.03

*. Numbers in parentheses indicate site of infection in host: (1) small intestine and (2) mesentery.

The analysis of environmental influence on the intensity of total parasitism revealed that the semi-lotic environment presented a significant difference (P=0.038052). It was here that the greatest mean intensity of total parasitism was recorded (Fig. 3). Among the analyzed infrapopulations, only *S. spinulifera* presented intensity of parasitism significantly influenced by environment (P=0.014632), presenting its greatest mean intensity of parasitism in a semi-lotic environment.

Distribution of the examined hosts and prevalence of parasitism for each environment are given in table II. With regard to prevalence, *C. abscissus* (X^2 = 7.51; $0.01 < P < 0.025$) and *S. spinulifera* (X^2=9.16; $0.01 < P < 0.025$) presented a significant environmental influence with greater prevalence in semi-lotic environments. Endoparasitic fauna of the three environments showed great similarities with regard to their composition (Tab. III): 3 out of 11 endoparasitic species collected (*C. abscissus*, *S. spinulifera* and *N. sudobim*) were dominant in three environments (Tabs IV-V).

The hydrological level was also an influential variable in the intensity of infection of three species of parasites: *S. spinulifera*, *N. sudobim* and *M. travassosi* (Tab. VI). The number of necropsies and the percentage of monthly parasitism are presented in table VII. In general, mean intensity and prevalence of parasitism were higher at the end of the first high water period (March 1992) and lower in the second high water period (November 1992 to February 1993) (Figs 2a-h).

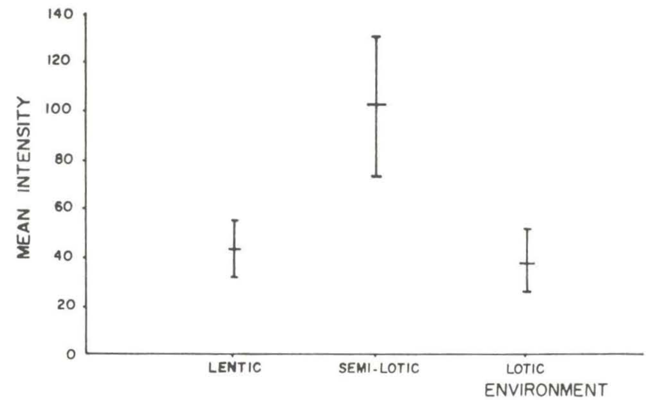

Fig. 3. Mean intensity of parasitism and standard deviation in each environment with regard to 110 specimens of *Pseudoplatystoma corruscans* collected in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Table II Distribution of number of examined fish, parasitized fish and prevalence of parasitism per environment in 110 specimens of *Pseudoplatystoma corruscans* collected in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Environment	Examined fish	Parasitized fish	Prevalence
Lotic	57	39	68.42
Semi-lotic	30	26	86.67
Lentic	23	17	73.91
Total	110	82	74.54

Table III. Values of Sorenson's Similarity Index "S" in lentic, semi-lotic and lotic environments in 110 specimens of *Pseudoplatystoma corruscans* collected in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Environments	Lentic	Semi-lotic	Lotic
Lentic	-	82.35%	82.35%
Semi-lotic		-	88.89%
Lotic			-

Schizodon borelli (Boulenger, 1900)

One hundred and thirteen (19.42%) out of 582 specimens were parasitized. The species of endoparasites collected include: five species of digeneans [*Ithyoclinostomum dimporphum* (Diesing, 1850) (metacercaria), *Diplostomum* sp. (metacercariae), *Clinostomum* sp. (metacercariae), *Saccocoelioides platensis* Lunaschi, 1984, *Paralecithobothrys brasiliensis* Freitas, 1947], four species of nematodes [*Procamallanus (Spirocamallanus) inopinatus* Travassos, Artigas & Pereira 1928, *Procamallanus (Spirocamallanus) iheringi* Travassos, 1929, *Piavussunema schubarti* Kohn, Gomes & Motta 1968 and *Cucullanus pinnai*

Travassos, Artigas & Pereira 1928] and two species of acanthocephalans [*Octospiniferoides incognita* Schmidt & Hugghins 1973 and *Echinorhynchus* sp.] (Tab. VIII).

Table IV. Distribution of endoparasite species of 110 specimens of *Pseudoplatystoma corruscans* in lentic, semi-lotic and lotic environments of the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Species of endoparasites	Lentic		Semi-lotic	Lotic		
	Patos	Guaraná	Baía	Paraná	Cortado	Ivinheima
Digenea	X	X	X			
C. abscissus	X	X	X	X	X	X
S. spinulifera	X	X	X	X	X	X
N. sudobim		X	X	X	X	X
M. travassosi			X	X	X	X
H. kaparari			X	X	X	X
C. pseudoplatystomae		X	X	X		X
Contracaecum sp. 1	X	X	X			X
Contracaecum sp. 2	X					
Eustrongylides sp.						X
Procamallanus (S.) sp.			X			

Table V. Classification and values of the importance of Bush (I) of parasite species of 110 specimens of *Pseudoplatystoma corruscans* per type of environment in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Lentic	I	Semi-lotic	I	Lotic	I
		DOMINANT SPECIES			
C. abscissus	55.227	*C. abscissus*	60.974	*C. abscissus*	58.230
S. spinulifera	30.615	*S. spinulifera*	22.273	*S. spinulifera*	18.612
N. sudobim	14.044	*N. sudobim*	15.866	*N. sudobim*	21.300
				M. travassosi	1.653
		CODOMINANT SPECIES			
M. travassosi	0.105	*M. travassosi*	0.775	*H. kaparari*	0.174
		H. kaparari	0.068	*C. pseudoplatystomae*	0.029
		C. pseudoplatystomae	0.037		
		SUBORDINATE SPECIES			
C. pseudoplatystomae	0.009	*Procamallanus (S.)* sp.	0.005	Digenea	0.002
		Digenea		0.002	
		UNSUCCESSFUL PIONEER SPECIES			
H. kaparari	0			*Procamallanus (S.)* sp.	0
Procamallanus (S.) sp.	0				

Analysis of environmental influence upon the mean intensity of total parasitism revealed that lentic environments presented a significant difference (P=0.035561) since the greatest mean intensity of parasitism has been recorded in this type of environment (Fig. 4). In the two most prevalent species of endoparasites (*Diplostomum* sp. and *C. pinnai*), only *C. pinnai* presented a mean intensity of parasitism significantly influenced by the environment (P=0.000001). Thus, the greatest mean intensity of parasitism with regard to this species has been registered in lentic environments. Distribution of the examined hosts and prevalence of parasitism for each environment are given in table IX.

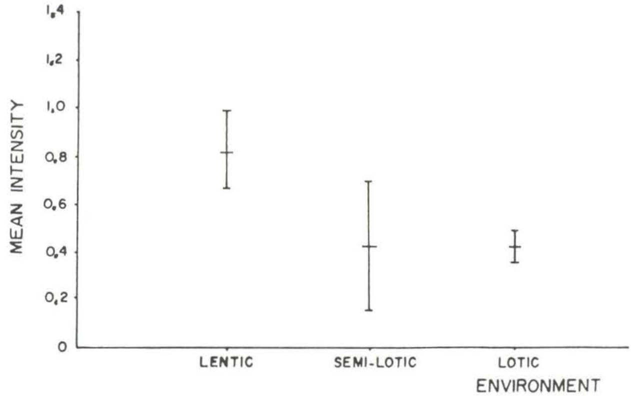

Fig. 4. Mean intensity of parasitism and standard deviation of each environment studied in 582 species of *Schizodon borelli* collected in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Table VI. Values of Mann-Whitney Test "U" to evaluate the relation between the hydrological level and the intensity of infection of each species of parasite in 110 specimens of *Pseudoplatystoma corruscans* collected in the high Paraná River from March 1992 to February 1993 ("U" = value obtained from test U, Z = value of normal approximation of test U).

Species of endoparasites	"U"	Z
Choanoscolex abscissus	2040.0	0.02
Spasskyelina spinulifera	2156.5	4.08***
Nomimoscolex sudobim	1987.0	3.24***
Megathylacus travassosi	1745.0	2.07*
Harriscolex kaparari	1581.5	0.98
Cucullanus pseudoplatystomae	1616.0	1.47
Contracaecum sp. 1	1672.5	1.09

*. $P<0.05$; ***.$P<0.001$

It was not possible to apply the Chi-square test to verify whether prevalence was influenced by environment since more than 20% of the expected frequency of the two species was less than 5%.

The endoparasitic faunas of lentic and lotic environments and of lentic and semi-lotic environments presented great similarity with regard to their composition, while between lotic and semi-lotic environments the similarity was lower than 50% (Tab. X). Among the 12 species of endoparasites collected in *S. borelli*, only two, *Diplostomum* sp. and *C. pinnai*, occurred in all environments. Lotic environments presented the greatest number of endoparasite species (Tab. XI).

In a lentic environment only one species was dominant, two were codominant; the others were classified as unsuccessful pioneers. In the semi-lotic environment three dominant species occurred, while the others were unsuccessful pioneers. In lotic environments four species were classified as dominant, four as codominant and one as unsuccessful pioneer (Tab. XII).

Table VII. Distribution of the number of necropsies, of parasitized fish and percentage of monthly parasitism in 110 specimens of *Pseudoplatystoma corruscans* collected in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Month/year	Examined fish	Parasitized fish	Prevalence
March/92	6	5	83.33
April/92	13	13	100.00
May/92	2	2	100.00
June/92	10	8	80.00
July/92	19	18	94.74
August/92	11	9	81.82
September/92	6	5	83.33
October/92	14	12	85.71
November/92	4	2	50.00
December/92	13	5	38.46
January/93	6	2	33.33
February/93	6	1	16.67
Total	110	82	74.55

Table VIII. Prevalence (prev. %), mean intensity (mi), relative density (rd) and infection site of endoparasites in 582 specimens of *Schizodon borelli* collected in the high Paraná River, Porto Rico, Paraná, Brazil, from March 1992 to February 1993 (ni = number of infected fish; a = amplitude of variation intensity).

Species of endoparasites *	ni	prev. (%)	mi	a	rd
DIGENEA					
Ithyoclinostomum dimorphum (1)	1	0.17	1.0	-	0.002
Diplostomum sp. (2)	31	5.33	2.0	1 - 10	0.106
Clinostomum sp. (3)	3	0.52	5.7	1 - 9	0.029
Saccocoelioides platensis (4)	1	0.17	1.0	-	0.002
Paralecithobothrys brasiliensis (4)	1	0.17	1.0	-	0.002
NEMATODA					
Procamallanus (Spirocamallanus) inopinatus (4)	8	1.37	1.1	1 - 2	0.015
Procamallanus (Spirocamallanus) iheringi (4)	1	0.17	1.0	-	0.002
Piavussunema schubarti (4)	1	0.17	15.0	-	0.026
Cucullanus pinnai (4)	54	9.28	2.7	1 - 10	0.250
ACANTHOCEPHALA					
Octospiniferoides incognita (4)	12	2.06	1.7	1 - 9	0.035
Echinorhynchus sp. (4)	1	0.17	4.0	-	0.007

*. Numbers in parentheses indicate site of infection in host: (1) external wall of stomach, (2) eye (aqueous humor), (3) branquial arches and (4) small intestine.

The hydrological level was an influential variable in the intensity of infection of *C. pinnai* (Tab. XIII). However, seasonal variation of the two most abundant and prevalent species (*Diplostomum* sp. and *C. pinnai*) did not present a definite pattern. With regard to prevalence, *Diplostomum* sp. was absent in the first high water period, reaching its peak in the period of low waters. Concerning the intensity of infection, its peak was verified at the beginning of the second high water period (Fig. 5a). *Cucullanus pinnai* presented the same tendency as the hydrological level not only with regard to prevalence but also with regard to mean intensity of parasitism. However, it presented an intensity peak in the low water period (Fig. 5b). The number of necropsies and the percentage of monthly parasitism are presented in table XIV.

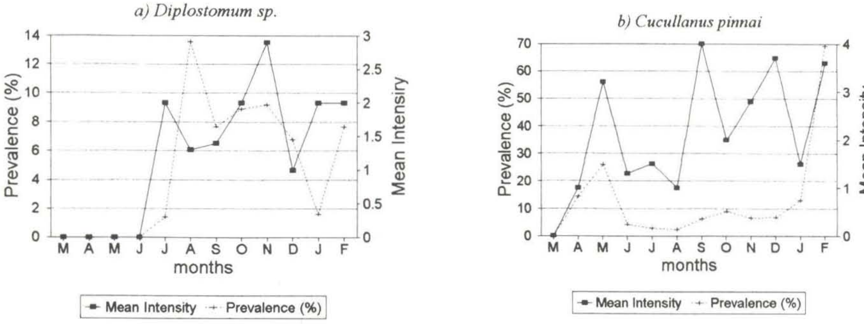

Fig. 5. (a-b) Seasonal variation of mean intensity of parasitism of endohelminth species of 582 specimens of *Schizodon borelli* collected in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Table IX. Distribution of the examined fish, parasitized fish and prevalence of parasitism per type of environment in 582 specimens of *Schizodon borelli* collected in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Environment	Examined fish	Parasitized fish	Prevalence
Lotic	434	72	16.59
Semi-lotic	336	6	18.18
Lentic	115	35	30.43
Total	582	113	19.42

DISCUSSION

Results of the present research show that in the case of *P. corruscans* two species of proteocephalideans (*Choanoscolex abscissus* and *Spasskyelina spinulifera*) presented a significant relationship with the environment in regard to prevalence. *Spasskyelina spinulifera* was the only species to show a relationship between the intensity of infection and the environment. The semi-lentic environment, represented by the Baía River, evidenced the greatest endoparasitic intensity. This is possible since it presents a very high density of copepods as registered by FUEM/NUPELIA (1994) and may also be supported by MARQUES (1993) who obtained higher values of alimentary activity for "pintados" in the Baía River. She credited this fact to a great availability of preys in lentic and semi-lentic environments where the presence of shelters is greater. The evidence that copepods are possible intermediate hosts is in agreement to SCHMIDT & ROBERTS (1989) and WILLIAMS & JONES (1994).

Table X. Values of Sorenson's Similarity Index "S" for lentic, semi-lotic and lotic environments in 582 specimens of *Schizodon borelli* collected in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Environments	Lentic	Semi-lotic	Lotic
Lentic	-	66.67%	53.33%
Semi-lotic		-	42.86%
Lotic			-

Table XI. Distribution of endoparasite species of 582 specimens of *Schizodon borelli* in lentic, semi-lotic and lotic environments of the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Species of endoparasites	Lentic		Semi-lotic	Lotic		
	Patos	Guaraná	Baía	Paraná	Cortado	Ivinheima
I. dimorphum		X				
Diplostomum sp.	X	X	X	X	X	X
Clinostomum sp.				X	X	X
S. platensis			X			
P. brasiliensis					X	
Digenea					X	
P. (S.) inopinatus		X		X	X	
P. (S.) iheringi					X	
P. schubarti						X
C. pinnai	X	X	X		X	X
O. incognita	X		X		X	X
Echinorhynchus sp.						X

Table XII. Classification and values of Importance of Bush (I) of parasite species of 582 specimens of *Schizodon borelli* per type of environment in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Lentic	I	Semi-lotic	I	Lotic	I
		DOMINANT SPECIES			
C. pinnai	99.740	*O. incognita*	94.286	*C. pinnai*	91.727
		C. pinnai	2.857	*P. (S.) inopinatus*	2.725
		S. platensis	2.857	*O. incognita*	2.384
		CODOMINANT SPECIES			
O. incognita	0.208			*P. schubarti*	0.730
P. (S.) inopinatus	0.052			*Echinorhynchus* sp.	0.195
				P. brasiliensis	0.049
				P. (S.) iheringi	0.049
		UNSUCCESSFUL PIONEER SPECIES			
S. platensis	0	*P. brasiliensis*	0	*S. platensis*	
P. brasiliensis	0	*P. (S.) inopinatus*	0		
P. (S.) iheringi	0	*P. (S.) iheringi*	0		
P. schubarti	0	*P. schubarti*	0		
Echinorhynchus sp.	0	*Echinorhynchus* sp.	0		

Table XIII. Values of Mann-Whitney Test "U" to evaluate the relation between the hydrological level and the intensity of infection of each species of parasite in 582 specimens of *Schizodon borelli* collected in the high Paraná River from March 1992 to February 1993 ("U" = value obtained from test U, Z = value of normal approximation of test U).

Species of Endoparasites	"U"	Z
Diplostomum sp.	42369.5	0.024
Cucullanus pinnai	38330.0	-3.910*

*. P<0.001

Table XIV. Distribution of examinde fish, parasitized fish and prevalence of monthly parasitism in 582 specimens of *Schizodon borelli* collected in the high Paraná River, region of Porto Rico, Paraná, Brazil, from March 1992 to February 1993.

Month/year	Examined fish	Parasitized fish	Prevalence
March/92	5	0	0.00
April/92	7	2	28.57
May/92	46	13	28.26
June/92	69	9	13.04
July/92	73	5	6.85
August/92	45	9	20.00
September/92	66	12	18.18
October/92	44	13	29.54
November/92	108	20	1.85
December/92	44	10	2.27
January/93	62	11	17.74
February/93	13	9	69.23
Total	582	113	19.42

In *S. borelli* only *Cucullanus pinnai* presented a relationship with the environment since the average intensity was greater in lentic environments. However, TORRENTE (1994) observed that spatial variations in the diet composition of *S. borelli* was not relevant, or rather, the same items participated in the species' diet in all environments. The greatest intensity of endoparasitic infection observed in lentic environments may possibly have occurred due to of a greater density of invertebrates in the fauna and associated to aquatic macrophytes (FUEM/NUPELIA 1994). The alimentary niche of fish species with herbivorous habits is restricted chiefly to marginal areas and to environments of riparian vegetation (TORRENTE 1994). Environments sampled in the floodplain of the high Paraná River favour this type of habit. Even if some areas have been affected by anthropic action, there is enough marginal vegetation that makes the presence of herbivorous species possible (FUEM/NUPELIA 1993).

The high values of similarity index for the three type of environments studied indicate a considerable homogeneity of species of endohelminths in these environments for both *P. corruscans* and *S. borelli*. This is probably a reflex of what occurs in environments during the high water period when they are interlinked. The absence of specific species of parasites in a place, when compared to others, may be related to seasonal differences in the host's diet, in the absence or non-availability of infecting larval stages and in the absence of adequate intermediate hosts (YANEZ & CANARIS 1988).

Three proteocephalidean species of *P. corruscans* were dominant in the three environments studied: *C. abscissus*, *S. spinulifera* and *N. sudobim*. In *S. borelli* only *C. pinnai* was the dominant species in the three environments. These species were also the most prevalent and the most abundant. Perhaps this may indicate a greater availability of intermediate hosts of endohelminth species in these environments. However, a study on the life cycle of the endoparasite species is necessary so that these suppositions may be verified.

The hydrological level was influential only for some endoparasitic infrapopulations. In *P. corruscans* three species of proteocephalideans (*S. spinulifera*, *N. sudobim* and *M. travassosi*) presented a greater mean intensity at the end of the high water period, while in *S. borelli*, *C. pinnai* and *Diplostomum* sp. presented a greater mean intensity at the beginning of this period. STROMBERG & CRITES (1974) suggested that the population of intermediate hosts (for example, copepods) was affected by the hydrological level in the tropics. Intermediary hosts present a tendency of aggregating at the low water period when the feeding rate of fish is higher. It is possible that the infection of fish occurs during this period and displaces itself only in the subsequent period (high water) when fish are stressed by the reproductive activity.

In places subject to floodings the water level variation seems to be an important factor in the feeding habit of the species (LOWE-MCCONNELL 1987; GOULDING *et al.* 1988). The species that depend upon an allochthonous supply of food (detritivorous, insectivorous, frugivorous and herbivorous species) are favored by a rise in the water level. On the contrary, piscivorous species and those that explore autochthonous alimentary resources may have difficulty in obtaining food because of the dispersion of preys due to a greater volume of water, to less transparent waters and to a great availability of shelters (AGOSTINHO & ZALEWSKI *in press*).

MARQUES (1993) showed that *P. corruscans* presents a greater quantity of food in its digestive tract during the cold months (low water period). She justify that this occurs because of a decrease in the rate of gastric evacuation due to low temperatures and not because of an increase in food taking. WELCOMME (1985) mentions that the alimentary cycle of fish in floodable rivers is clearly governed by the alimentary supply and populational density directly linked to the rain regimen. Some species of fish interrupt their feeding activity during the reproduction period (NIKOLSKY 1963; LOWE-MCCONNELL 1975). However, during reproductive migration, *P. corruscans* preys on the curimba, *Prochilodus scrofa* Steindacher 1882, which is also in its migratory activity of reproduction (RINGUELET *et al.* 1967). The pintado spawns in shallow water areas during the summer floods (MAGALHÃES 1931), from October to February, with a peak in November-December, coinciding with the end of the dry period and the beginning of the flooding period (MARQUES 1993). It is possible that the greatest prevalence of endoparasites of *P. corruscans* at the end of the first high water period is the result of its alimentary and reproductive activities of the previous year: a greater alimentary activity during the summer months, especially from November to February, with a possible increase in ingestion of intermediate hosts and the stress provoked by the reproductive effort collaborate towards an increase in prevalence of endoparasites in March. In the following months a decrease in prevalence and in intensity of infection is observed probably 1) because of the absence or decrease of recruitment of endoparasites due to a low alimentary consumption of the host during the winter months; and 2) because of the elimination of endoparasites by the host since a cumulative process does not occur.

ANDRIAN *et al.* (1994) found that during the period in which the research was conducted, *S. borelli* presented two peaks in food taking with regard to the season factor: first, when the hydrological levels were higher, or rather, when there was a greater availability of food; second, in October, related to the reproductive period of the species which extends from November to February. Due to low prevalences and intensities of infection of endoparasite species of *S. borelli*, the hydrological level does not seem to be related to the degree of parasitism, which is in contrast to what happens in the case of *P. corruscans*.

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