INFLUENCE OF HOST'S SEX AND SIZE ON ENDOPARASITIC INFRAPOPULATIONS OF *PSEUDOPLATYSTOMA CORRUSCANS* AND *SCHIZODON BORELLI* (OSTEICHTHYES) OF THE HIGH PARANÁ RIVER, BRAZIL.

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SUMMARY: One hundred and ten specimens of *Pseudoplatystoma corruscans* (Pimelodidae), "pintado", and 582 specimens of *Schizodon borelli* (Anostomidae), "piava", collected in the floodplain of the high River Paraná were studied. *Pseudoplatystoma corruscans* and *S. borelli* presented 74.54% and 19.42% of parasitism, respectively. Results obtained, indicate that in *P. corruscans* two species of proteocephalideans, *Nomimoscolex sudobim* and *Harriscolex kaparari*, presented a positive correlation between their prevalences and length of the host; three species of proteocephalideans, *Choanoscolex abscissus, Megathylacus travassosi,* and *H. kaparari*, and two species of nematodes (*Cucullanus pseudoplatystomae* and *Contracaecum* sp.1). presented positive correlation between the intensity and the standard length of the hosts. In *S. borelli*, the length of host did not present any correlation with the intensity and prevalence of endohelminths. This fact indicated that the increase of infection levels did not influence the increase in length. With regard to the host's sex, results indicated that this was not an influential factor in endoparasitic levels of *P. corruscans* and *S. borelli*.

KEY WORDS: Ecology, Endohelminths, Freshwater Fishes, High Paraná River, *Pseudoplatystoma Corruscans*, *Schizodon Borelli*, Host's Sex and Size.

INTRODUCTION

The length of the host, considered as an expression of its age, is one of the most important factors in the variation of parasitic infrapopulations (DOGIEL, 1970). Age causes a series of changes in fish biology, chiefly with regard to the feeding habit (increase in quantity of food consumed by an older fish and an increase in the size of a prey which may be an intermediary host) and to reproductive migration (decrease of quantity of food consumed with regard to some fish species). DOGIEL (1970) defined the following as principal results of these variations: a) an increase in the prevalence and intensity of infection in proportion to the host's age; b) qualitative variation in fauna composition directly proportional to the increase of changes in the host's ecology through age; and c) the infestation of small fish, initially with parasites of monoxenic life cycle or with those that actively penetrate into their hosts.

The parasitic indexes may be influenced by the sex of host since males and females can evidence different ecological relationships as ocupation of habitat and feeding itens.

This research work analyses possible influence of sex and size of hosts on endoparasitic infrapopulations of two species of fish of distinct trophic categories: *Pseudoplatystoma corruscans* (Agassiz, 1829) (Siluriformes: Pimelodidae), the "pintado", a carnivorous fish widely distributed throughout South America (FOWLER, 1951) and *Schizodon borelli* (Boulenger, 1900) (Characiformes: Anostomidae), the "piava", a herbivorous fish extremely common in the high Paraná river floodplain UEM/NUPELIA (unpublished data).

MATERIALS AND METHODS

The area under analysis lies in the floodplain of the Paraná river, municipality of Porto Rico, Paraná, Brazil

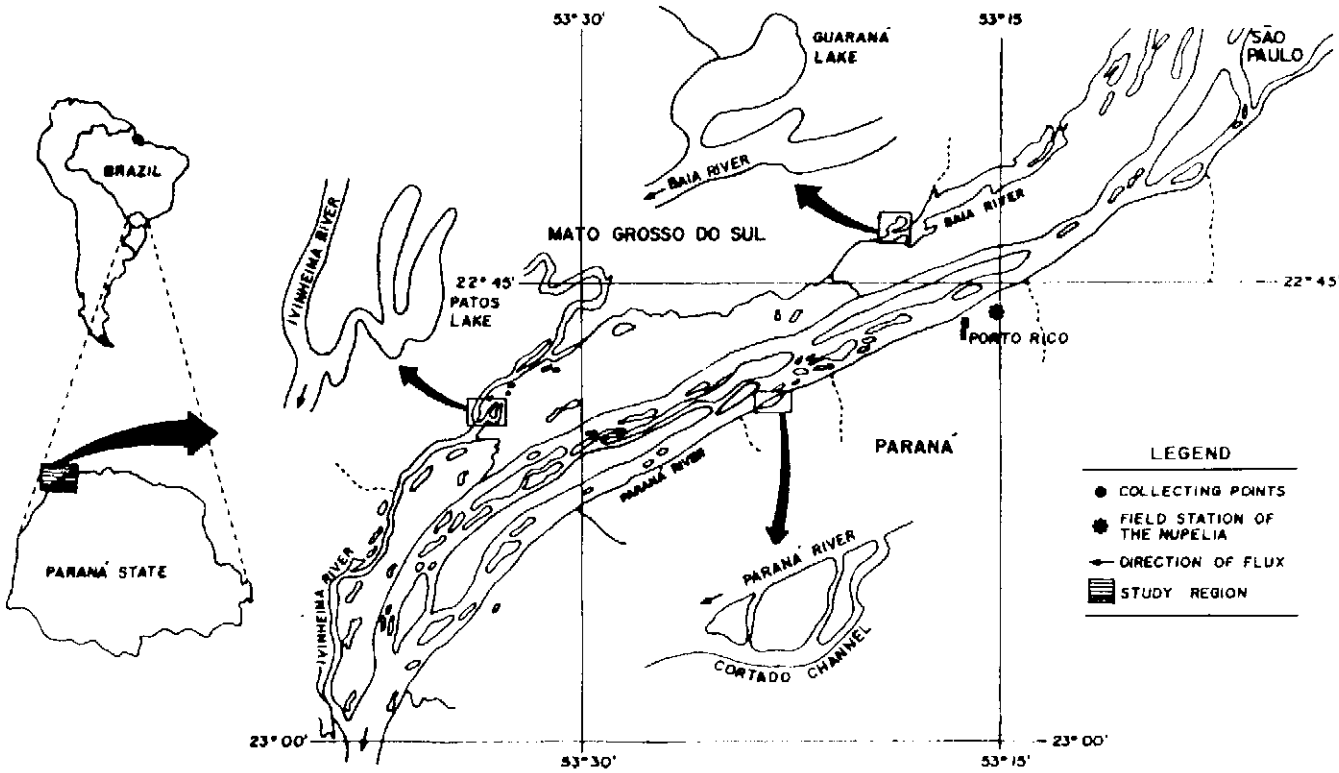

Figure 1 - Collection sites.

(22°40'-22°50'S and 53°15'-53°40'W) (Fig. 1). Due to a great diversity of habitats, sampling was undertaken in three types of environments with distinct characteristics: a) a lentic environment represented by the lakes Patos and Guaraná; 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 channel Cortado and the Ivinheima river.

Monthly collections were undertaken from March 1992 to February 1993. Fishing gear consisted of simple nets, gill nets and boulters which were set during 24 hours with hauling at every 4 hours. After capture and identification of fish, total and standard length, weight and sex were determined. Fish were eviscerated and their visceral cavity was examined. The organs examined with a stereoscopic microscope on the site were: eyes, digestive tube and adjacent organs, kidneys, urinary bladder, gas bladder, and gonads. Endoparasites were cleaned in a 0.65% saline physiological solution and prepared according to AMATO et alii (1991). Helminths were deposited in the Helminthological Collection of the Instituto Oswaldo Cruz (CHIOC) in Rio de Janeiro, Brazil (CHIOC n° 33.270 to n° 33.285).

For the analysis of data, statistical tests were used with $P \leq 0.05$. Student's "t" test was applied to determine whether the standard length of male and female hosts was similar. This test determined the possible influence of size and sex of hosts with regard to the size of endoparasitic infrapopulations. Mann-Whitney's-U test was used to determine the effect of host's sex on infection intensity of each parasite species (SIEGEL, 1975). The effect of the host's sex in the prevalence of each parasite species was verified by the "G" Log-Likelihood test with the use of the 2x2 contingency table (ZAR, 1984). Correlation coefficient "r" was used to determine the correlation between the host's standard length and the prevalence of infection in each endoparasite species with previous angular transformation of data and separation of host's samples in six class intervals (*P. corruscans* - amplitude = 14 cm, *S. borelli* - amplitude = 4 cm) according to their standard length (ZAR, 1984). Spearman rank correlation coefficient "rs" was used to determine possible correlations between the host's standard length and the intensity of infection (ZAR, 1984). Above mentioned tests were applied to those endoparasite species which presented prevalence superior to 5%. STATISTICAL ECOLOGY (LUDWIG & REYNOLDS, 1988) was the computer program used for statistical tests and for calculation of ecological indexes. Terms related to parasite ecology were those suggested by MARGOLIS *et alii* (1982) and HOLMES & PRICE (1986). Measurements of hosts' standard length are given in centimeters.

Table 1 - Prevalence, intensity, relative density and site of infection of endoparasites in 110 specimens of *Pseudoplatystoma corruscans* collected in the high River Paraná, Porto Rico, Paraná, Brazil, from March 1992 to February 1993 (ni = number of infected fish; prev = prevalence; mi = mean intensity of infection; a = amplitude of intensity variance; rd = relative density).

Species of endoparasites*	ni	prev. (%)	mi	a	rd
CESTODA					
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	287	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

Table 2 - Values of Spearman rank correlation coefficient (rs) and of the correlation coefficient (r) to evaluate the relationship between the intensity and prevalence of parasitic fauna respectively, with the standard length of 110 specimens of *Pseudoplatystoma corruscans* collected in the high River Paraná, Porto Rico region, Paraná, Brazil, during March 1992 and February 1993.

Species of endoparasites	"rs"	"r"
Choanoscolex abscissus	0.292**	0.0676
Spasskyelina spinulifera	0.120	- 0.2538
Nomimoscolex sudobim	0.107	0.8463**
Megathylacus travassosi	0.221*	0.1263
Harriscolex kaparari	0.252**	0.9787***
Cucullanus pseudoplatystomae	0.229*	0.3811
Contracaecum sp. 1	0.217*	- 0.0554

* P < 0.05; ** P < 0.01; *** P < 0.001

RESULTS

Pseudoplatystoma corruscans

Eighty-two out of 110 hosts examined (74.54%) were found to be parasitized by at least one species of endohelminth. 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* (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.] (Table 1).

The pintados examined consisted of 42 males (38.18%), 63 females (57.27%), and 5 (4.54%) of indefinite sex since they were juveniles. Standard length of hosts varied between 17.6 and 87.5 (mean length 44.58). Length of males varied from 17.6 to 68.5 (mean 42.15) and length of females from 27.4 to 87.5 (mean 46.68). Comparison between standard lengths of males and females did not show any significant difference ($t = -1.66$; $0.05 < P < 0.10$) and no species of parasite presented influence of sex on its prevalence and intensity of infection.

Two species (*N. sudobim* and *H. kaparari*) presented positive correlation between standard length of host and parasitic prevalence. Five species presented positive correlation between host's length and intensity of infection (*C. abscissus*, *M. travassosi*, *H. kaparari*, *C. pseudoplatystomae*, and *Contracaecum* sp. 1) (Table 2).

Table 3 - Prevalence, intensity, relative density and site of infection of endoparasites in 582 specimens of *Schizodon borelli* collected in the high River Paraná, Porto Rico, Paraná, Brazil, from March 1992 to February 1993 (ni= number of infected fish; prev. = prevalence; mi = mean infection intensity; a = amplitude of variation intensity; rd = relative density).

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

Schizodon borelli

Among the 582 specimens of *S. borelli* examined 113 (19.42%) were parasitized. Species of endohelminths collected included: five species of digenetics [*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.] (Table 3).

The "piavas" examined consisted of 284 males (48.80%), 286 females (49.14%), and 12 juveniles of indefinite sex (2.06%). Standard length of hosts oscillated between 7.4 and 28.7 (mean 18.7). In males length varied from 7.4 to 24.7 (mean 17.74) and in females it varied from 8.3 to 28.7 (mean length 19.71). Comparison of standard lengths of males and females showed a significant difference ($t = -6.93$; $P = 0.001$).

Host's sex and length were not relevant variables to explain variations of parasitic indexes since they were not correlated with prevalence and intensity of infection of endoparasitic infracommunities.

DISCUSSION

Existing correlation between prevalence and intensity of infection and the host's length observed in some endoparasitic infrapopulations of *P. corruscans* and the absence of a correlation for endoparasitic infracommunities of *S. borelli* indicate that the influence of length does not always determine an increase of infection levels as some authors state (ZDZITOWIECKI, 1988; OLIVA *et alii*, 1990; SAAD-FARES & COMBES, 1992).

MARQUES (1993) evaluated the variation of the feeding itens of pintado from the high Paraná river according to their size and stated that piscivorousness was common in all length classes. In medium-sized groups, however, other items such as molluscs and crustaceans occurred with a certain frequency. This fact may contribute to the relationship of some species of endohelminths with the host's length. AGOSTINHO *et alii* (*in press*) estimated that individuals of *P. corruscans* with standard lengths higher than 67.5 for males and 72.5 for females are all adults. Specimens with standard lengths lower than 40.0, of both sexes, were considered juveniles. Among the 110 pintados analysed in the present work, 63 (57.27%) presented standard length superior to 40.0 or in reproduction conditions. "Pintados" have a higher feeding consumption during the summer months which coincide with their migratory activity of reproduction. This may explain the higher prevalence of infection in larger hosts.

The fact that some species of endoparasites are related to the host's length, as occurred in some species of *P. corruscans*, may be associated to the influence of some factors related to the age of the fish, as: a) the migration of the host for reproduction which causes variations in its feeding spectrum (MUZALL, 1980; SKORPING, 1981; BOURGEOIS & NI, 1984; MOSER & HSIEH, 1992); b) the variation of different alimentary items of the hosts in each age group, considering that the biological cycle of endoparasites includes different species of intermediary hosts (BURN, 1980; SCOTT, 1982; GEORGE-NASCIMENTO & IRIARTE, 1989; MOSER & HSIEH, 1992) and c) the seasonal characteristic of the endoparasites' cycles. Since the area under analysis lies in a floodplain, these factors are heavily dependent on the hydrological level.

With regard to anostomids, great alimentary activity was registered in period previous to reproduction (BARBIERI & GARAVELLO, 1981; BENNEMAN, 1985; YABE & BENNEMAN, 1994). This behaviour reflects the preparation of the physiological state for the reproductive period in which energy loss is greatest (BENNEMAN, 1985; TORRENTE, 1994). Analyses of ontogenetic variations in the diet of *S. borelli* indicate small differences between juveniles (less than 13.0) and adults, resulting from the exploitation of different environments and morphological changes (as, for example, variations in size of the mouth) (TORRENTE, 1994). However, these variations were not relevant with regard to the intensity and prevalence of their endoparasitic infrapopulations.

Since the host's sex did not influence the prevalence and intensity of the endoparasites' infections, it may be supposed that males and females have similar ecological relationships (occupation of habitat and diet). This occurs in *P. corruscans* and in *S. borelli*, corroborating results obtained by MACHADO *et alii* (unpublished data). The absence of the relationship of the host's sex with parasitic level has already been shown in the research works of SHOTTER (1973), MUZALL (1980), VALTONEN (1980), ZDZITOWIECKI (1986), GEORGE-NASCIMENTO & IRIARTE (1989), OLIVA *et alii* (1990), MOSER & HSIEH (1992), and LUQUE *et alii* (unpublished data). However, some authors (ESCH *et alii*, 1988) have assumed that the host's sex would be a determining and influential factor on the parasitology of fish. This occurs because of the existing differences in the diet composition of males and females, in behavioural and in physiologycal resistance. (KENNEDY, 1970, cited by FERNANDES, 1985).

SUMÁRIO

Foram analisados 110 espécimes de *Pseudoplatystoma corruscans*, pintado, e 582 de *Schizodon borelli*, piava, coletados na planície de inundação do alto rio Paraná.

Pseudoplatystoma corruscans apresentou um parasitismo de 74,54%, enquanto que *S. borelli* acusou 19,42%. Os resultados obtidos indicam que: em *P. corruscans*, duas espécies de proteocefalídeos, *Nominoscolex sudobim* e *Harriscolex kaparari*, apresentaram correlação positiva entre suas prevalências e o comprimento do hospedeiro; três espécies de proteocefalídeos, *Choanoscolex abscissus*, *Megathylacus travassosi* e *H. kaparari*, e duas de nematóides, *Cucullanus pseudoplatystomae* e *Contracaecum* sp. 1, apresentaram correlação positiva entre a intensidade de infecção e o comprimento padrão do hospedeiro. Em *S. borelli*, o comprimento do hospedeiro não apresentou correlação com intensidade e prevalência parasitária dos endohelmintos, indicando que o aumento do comprimento não foi influenciado pelo aumento dos níveis de infecções. Em relação aos sexos dos hospedeiros, os resultados indicam não ser este um fator influente nos níveis de endoparasitismo de *P. corruscans* e *S. borelli*.

PALAVRAS-CHAVE: ecologia, endohelmintos, peixes de água doce, alto rio Paraná, *Pseudoplatystoma corruscans*, *Schizodon borelli*, sexo e tamanho dos hospedeiros.

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