Ecological aspects of the parasites of *Iheringichthys labrosus* (Lütken, 1874) (Siluriformes: Pimelodidae) in reservoirs of Paraná basin and upper Paraná floodplain, Brazil

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ABSTRACT. Sixty-two specimens of *Iheringichthys labrosus,* captured in Rosana, Taquaruçú, Salto Grande and Canoas I reservoirs, located in the Paraná River basin, were necropsied. Fifty specimens were parasited by at least one species (80.65%). Six parasite species were recorded: one species of Dactylogyridae; one species of Apocreadiidae; one species of Proteocephalidea; *Procamallanus* (*Spirocamallanus*) *pimelodus* Pinto, Fábio, Noronha e Rolas, 1974; *Quadrigyrus* sp.; and *Ergasilus* sp. Thirty-five specimens of *Iheringichthys labrosus* were captured in Upper Paraná River floodplain. Thirteen specimens were parasited by at least one species (37.14%). Five parasites species were found: *Herpetodiplostomum gymnoti* larvae; one species of Proteocephalidea; *Procamallanus* (*Spirocamallanus*) *pimelodus*; *Contracaecum* sp. Type 1 larvae of Moravec, Kohn and Fernandes, 1993; and *Quadrigyrus* sp. In both study sites, the prevalence and parasitism abundance were not correlated with hosts standard length. There were significant differences between prevalence and parasites species abundance according to fishes' sex only in upper Paraná floodplain. Moreover, the parasitism abundance did not influence the host condition factor in both sites. Parasites infra communities from the fishes of both sites comparison presented a similarity of 54.54%.

Key words: *Iheringichthys labrosus,* parasites, reservoirs, floodplain, Paraná.

RESUMO. Aspectos Ecológicos dos Parasitos de *Iheringichthys labrosus* (Lütken, 1874) (Siluriformes: Pimelodidae) em Reservatórios da Bacia do Rio Paraná e na Planície de Inundação do Alto Rio Paraná, Brasil. Foram examinados 62 espécimes de *Iheringichthys labrosus* capturados nos reservatórios de Rosana, Taquaruçú, Salto Grande e Canoas I, localizados na bacia do Rio Paraná. Cinqüenta peixes (80,65%) estavam parasitados por pelo menos uma espécie. Foram encontrados os seguintes parasitos: uma espécie de Dactylogyridae; uma espécie de Apocreadiidae; uma espécie de Proteocephalidea; *Procamallanus* (*Spirocamallanus*) *pimelodus* Pinto, Fábio, Noronha e Rolas, 1974; *Quadrigyrus* sp.; e *Ergasilus* sp. Na planície de inundação do Alto rio Paraná, foram capturados 35 espécimes deste mesmo hospedeiro, sendo que 13 estavam parasitados por pelo menos uma espécie (37,14%). As espécies de parasitos encontradas foram: *Herpetodiplostomum gymnoti* larva; uma espécie de Proteocephalidea; *Procamallanus* (*Spirocamallanus*) *pimelodus*; *Contracaecum* sp. Tipo 1 larva de Moravec, Kohn e Fernandes, 1993; e *Quadrigyrus* sp. Em ambos os locais de estudo, a prevalência e a abundância de parasitismo não estavam correlacionadas com o comprimento padrão dos hospedeiros. Houve diferenças significativas entre prevalência e abundância das espécies de parasitos de acordo com o sexo dos peixes somente na planície de inundação do Alto rio Paraná. Além disso, observou-se em ambas as localidades que a abundância de parasitismo não exerce influência sobre o fator de condição dos hospedeiros. A comparação das infracomunidades de parasitos presentes nos peixes de ambas as localidades apresentou uma similaridade de 54,54%.

Palavras-chave: *Iheringichthys labrosus,* ictioparasitos, reservatórios, planície, Paraná.

Introduction

The energy consumption increase in Brazil resulted in installation of many hydroelectric power stations. Consequently, a great number of reservoirs was constructed, with consequent changes in the hydrological regime of many water courses, as occurred in Paraná basin. These abrupt changes are

environmental impacts, which have directly or indirectly affected the physical, chemical and biological attributes of the impact occurrence area: the reservoirs of Paraná basin, and they have reflected in the immediacy: the upper Paraná River floodplain (Agostinho *et al.*, 1997). These biological attribute modifications, consequently, include changes in local organisms' physiological and biological conditions, and in the parasite-host relation (Pavanelli *et al.*, 2004).

As in this work the *Iheringichthys labrosus* parasitic fauna is studied, it is presupposed that these cited alterations reach the host, carrying direct consequences on parasites infracommunities structure and composition, especially in prevalences and infrapopulations size (Pavanelli *et al. op cit.*).

Iheringichthys labrosus, popularly called 'mandí-beiçudo', belongs to Pimelodidae family. Studies on feeding of this species were carried by Fugi (1993) and Fugi *et al.* (1996) in the Upper Paraná River floodplain and characterized this species as benthophagous. The morphology of its digestive system allows to characterize the species as a meso and macro benthos organism selector. *Iheringichthys labrosus* is a small size fish, which has a narrow and small mouth, with labial adaptations and located ventral. Its eyes are relatively big. It occurs in small rivers and streams (Agostinho *et al. op cit.*), as well as in the reservoirs of Paraná River Basin and in the Upper Paraná River floodplain.

Due to the benthophagous alimentary habit and the intermediate position in the trophic chain, it is presupposed that *I. labrosus* presents a very rich parasitic fauna, constituted by adult and larval parasites. For this reason, *I. labrosus* presents as a good object to carry out a study of parasites communities ecology. Moreover, it is expected that there are differences in *I. labrosus* parasitic community from both sites. Thus, it seems necessary to study, evaluate and compare the modifications caused in the parasite-host relation in both sites.

Material and methods

Sixty-two specimens of *Iheringichthys labrosus* were captured in four reservoirs of the Paraná basin (13 in Rosana, 4 in Taquaruçú, 23 in Salto Grande and 22 in Canoas I), in March, July, and November of 2001. Thirty-five specimens of the same fish was captured in Paraná River (7), Baía River (6), Patos Lagoon (16), Garças Lagoon (4) and Pau Véio Bayou (2), located in the Paraná River floodplain, in August and November of 2002, September of 2003, and March of 2004.

For the fishes capture, different size nets were utilized, exposed for a period of 24 hours in different points. The fishes' weight, standard length and sex were registered. The captured specimens were eviscerated and the organs were analyzed separately using a stereomicroscope. The parasites were collected, prepared and mounted according to Eiras *et al.* (2000). The parasites were identified by using an optic microscope and according to Szidat (1969); Thatcher (1991, 1993) and Moravec (1998).

For data analyses, the following statistical tests and ecological index were used: Student "t" test (Siegel, 1975) to verify the existence of significant differences among standard length of males and females. Pearson's correlation coefficient "r" (Zar, 1996) to determine possible correlation between host standard length and the prevalence of each parasite species, with previous angular transformation of prevalence (arc sen $\sqrt{x}$). Spearman's rank correlation coefficient "rs" (Zar, *op cit.*), to determine possible correlation between host standard length and each parasite species abundance and to verify the correlation between parasite abundance with the host relative condition factor (Kn) (Le Cren, 1951). Mann-Whitney "U" test (Siegel, *op cit.*) to verify the host sex influence in the parasites infection abundance. The log-likelihood "G" test, using the 2x2 contingency table (Zar, *op cit.*) to determine the effect of the host sex in each parasite species prevalence. Sorenson Similarity index, to verify the similarity among the parasitic fauna components of the reservoirs of Paraná basin and of upper Paraná floodplain samples (Stone and Pence, 1978).

The statistical analyses were applied to parasite species with prevalence higher than 10% and the results were significant when $p < 0.05$. The ecological terms used were based on Bush *et al.* (1997).

Results

Ecological analysis of the Paraná basin reservoirs

From 62 *I. labrosus* specimens examined (38 females and 24 males), 50 were parasited by at least one species, representing a prevalence of 80.65% and a mean intensity of 19.21. Six parasite species were recorded: one species of Dactylogyridae (Monogenea); one species of Apocreadiidae (Digenea); one species of Proteocephalidea (Cestoda); *Procamallanus* (*Spirocamallanus*) *pimelodus* Pinto, Fábio, Noronha e Rolas, 1974 (Nematoda); *Quadrigyrus* sp. (Acanthocephala); and *Ergasilus* sp. (Copepoda) (Table 1). Figure 1 shows that most of the infracommunities species was constituted by one species, when its richness is observed.

Table 1. Values of prevalence (P), mean intensity (MI), mean abundance (MA), range of variation (RV) and parasites site of infection/infestation of *I. labrosus*, of reservoirs of Paraná River basin, in March, July and November of 2001.

Parasites	P	MI	MA	RV	Site of Infection/ Infestation
Dactylogyridae	1.6	1	0.016	1	Nasal cavity
Ergasilus sp.	1.6	2	0.032	2	Nasal cavity
Apocreadiidae	9.7	1.67	0.16	1-4	Intestine
Proteocephalidea	17.74	1.54	0.27	1-4	Intestine
Procamallanus (*Spirocamallanus*) *pimelodus* (Adult)	75.80	19.30	14.63	1-104	Intestine
Procamallanus (*Spirocamallanus*) *pimelodus* (Larvae)	6.45	5.5	0.35	1-18	Intestine
Quadrigyrus sp.	3.22	1	0.03	1	Intestine

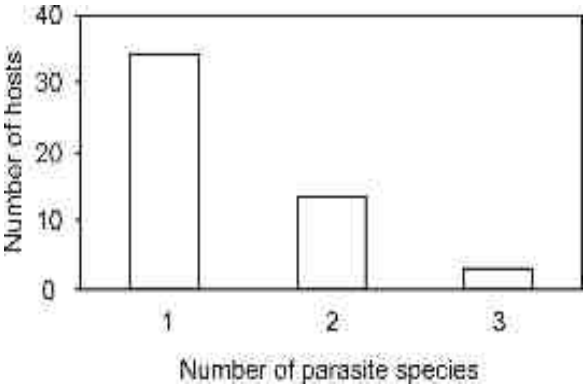

Figure 1. Parasite infracommunities richness of *I. labrosus* captured on reservoirs of Paraná River basin, in March, July and November of 2001.

The ecological analysis applied to the cestode of the Proteocephalidea Order, the adult nematode *P.* (*S.*) *pimelodus,* and the digenean of the Apocreadiidae family, showed significant differences between the standard length of *I. labrosus* male and female of the reservoirs of Paraná basin ($t = 2.85$; $P = 0.007$). It was verified for all parasites species that the prevalence and the parasitism abundance did not correlate with the hosts' standard length (Table 2). There were no significant differences in the prevalence and parasitism abundance according to the fishes' sex (Table 3). The parasitism abundance did not influence the host condition factor (Table 4).

Table 2. Values of Spearman's rank correlation coefficient "rs" and Pearson's correlation coefficient "r" to evaluate the relationship between abundance and prevalence of infection, respectively, of the parasite fauna with the standard length of *I. labrosus*, collected in reservoirs of Paraná basin, in March, July, and November of 2001 (P = significance level).

Parasites	rs	P	r	P
Proteocephalidea	0.01592	0.9023	0.2926	0.4819
Procamallanus (*Spirocamallanus*) *pimelodus* (Adult)	-0.08152	0.5288	-0.1323	0.7549
Apocreadiidae	0.1536	0.2334	-0.3922	0.3365

Table 3. Results of the log-likelihood "G" test and Mann-Whitney "U" test, with "Z" normal approach, to verify differences in the prevalence and abundance according to the *I. labrosus* sex, collected in reservoirs of Paraná basin, in March, July, and November of 2001 (P = significance level).

Parasites	Z	P	G	P
Proteocephalidea	0.1650	0.8689	0.0879	0.7668
Procamallanus (*Spirocamallanus*) *pimelodus* (Adult)	11.6718	0.0946	3.6367	0.0565
Apocreadiidae	0.2152	0.8296	0.1376	0.7107

Table 4. Values of the Spearman's rank correlation coefficient "rs" to evaluate the relationship between the host relative condition factor (Kn) and the parasitism abundance in *I. labrosus*, collected in reservoirs of Paraná basin, in March, July, and November of 2001 (P = significance level).

Parasites	rs	P
Proteocephalidea	0.0220	0.8652
Procamallanus (*Spirocamallanus*) *pimelodus* (Adult)	-0.0275	0.8425
Apocreadiidae	0.2162	0.0914

Ecological analysis of the upper Paraná floodplain

The analysis of 35 hosts (23 females, 10 males and 2 unidentified as to sex) showed that 13 specimens were parasited by at least one species of parasite, corresponding to a prevalence of 37.14% and a mean intensity of 3.5 parasites per fish. Five parasites species were found: *Herpetodiplostomum gymnoti* larvae (Digenea); one species of Proteocephalidea (Cestoda); *Procamallanus* (*Spirocamallanus*) *pimelodus* (Nematoda); *Contracaecum* sp. Type 1 larvae of Moravec, Kohn and Fernandes, 1993 (Nematoda); and *Quadrigyrus* sp. (Acanthocephala) (Table 5). Figure 2 shows that most of the infracommunities species were constituted by one species, when its richness is observed.

Table 5. Values of prevalence (P), mean intensity (MI), mean abundance (MA), range of variation (RV) and parasites site of infection/infestation of *I. labrosus*, of the upper Paraná floodplain, in August and November of 2002, September of 2003, and March of 2004.

Parasites	P	MI	MA	RV	Site of Infection/ Infestation
Herpetodiplostomum gymnoti larvae	5.71	9.5	0.54	1-18	Gonads
Proteocephalidea	5.71	1	0.06	1	Intestine
Procamallanus (*Spirocamallanus*) *pimelodus*	17.14	2.33	0.40	1-4	Intestine
Contracaecum sp. Type 1	2.86	2	0.06	2	Intestine
Quadrigyrus sp.	2.86	1	0.03	1	Intestine

The ecological analysis was applied to *Procamallanus* (*Spirocamallanus*) *pimelodus*, that presented prevalence higher than 10%.

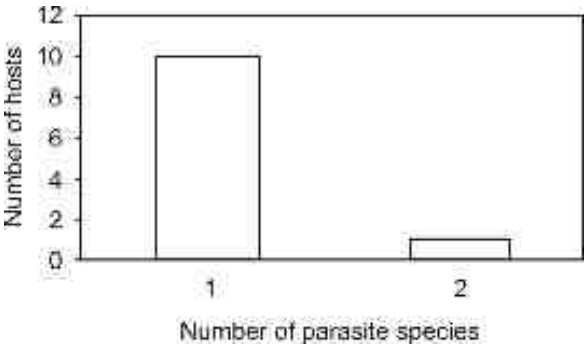

Figure 2. Parasite infracommunities richness of *I. labrosus* captured in the upper Paraná River floodplain, in August and November of 2002, September of 2003, and March of 2004.

There were no significant differences among the standard length of *I. labrosus* male and female of the upper Paraná floodplain (t = 0.286; P = 0.777). The prevalence (r = -0.208; P = 0.655) and the parasitism abundance (rs = -0.201; P = 0.256) did not correlate with the hosts standard length. Only the females were parasited. However, these data indicate that *I. labrosus* sex can influence the nematode species abundance and prevalence. The parasitism abundance did not influence the host condition factor (rs= -0.138; p= 0.4341).

The Sorenson Similarity index showed similarity of 54.54% between hosts' parasite infracommunities of the reservoirs of Paraná basin and of upper Paraná floodplain.

Discussion

According to the development stage of the different zoological parasite groups and the site where they were collected, results show that *I. labrosus* acts as intermediate and/or definitive host of these organisms.

The presence of great amount of chironomides in *I. labrosus* food resources, observed during the necropsies, can disclose the reason of the high prevalence and intensity of *Procamallanus* (*Spirocamallanus*) *pimelodus* in the parasitic fauna. It is known that chironomids can act as nematode intermediate hosts and when *I. labrosus* feed them, they can acquire *P.* (*S.*) *pimelodus* larval forms, which become adults in their new habitat.

The others *I. labrosus* food resources, as aquatic clams, crustaceans, microcrustaceans, and other invertebrates, can act as intermediate hosts for proteocefalidean cestodes, acanthocephalans, and digeneans, all finding in their adult form in that fish (Eiras, 1994).

For the other larval forms found, such as: *Contracaecum* sp. Type 1 and *Herpetodiplostomum gymnoti*, *I. labrosus* act as intermediate host, because the adult forms of those parasites do not compose that fish parasitic fauna. According to Thatcher (1993), the metacercariaes of the Proterodiplostomidae family reach their adult state in reptiles, when they ingest the intermediate hosts that shelter them.

According to Shotter (1976), the fish length is directly related with its age and this length is also related with its parasitic populations size (Dogiel, 1961). Therefore, it seems that the host's parasitic population increase according to its size and age. Moreover, this parasitic population size can also suffer influence from other factors, as to the fish exposition period to the parasite, the increase of its faying surface (due its growth), habitat changes, volume, and type of ingested food.

Nikolski (1963) said that the fish diet can suffer alterations in function of its age. These alterations can be a result of modifications that occur on fish behavior and biology during its development and influence its alimentary habit. As consequence, the parasitic fauna is affected, mainly the endoparasites, that are acquired through the intermediate hosts ingestion (Takemoto *et al.*, 1996).

The absence of correlation among the prevalence and parasitism abundance with the analyzed hosts' standard length can show that during fish development there is no parasites cumulative effect, in contrast with the expectations. However, it can be explained by the fact that the parasites can have short life cycles, being constantly infected and eliminated by the host organism. As the host life period is longer than parasite life period, it is observed that the fish growth does not influence significantly the parasitism levels. It is important to point out that there are a few studies about parasites longevity, making further considerations more difficult.

Studies of *Paralonchurus peruanus* parasitic fauna, developed by Luque and Oliva (1993), in Peru coast, disclosed the correlation absence between host length and parasitic community, indicating that during its development, the fish keeps a homogeneous behavior, that allows it to get the same parasite species. Perhaps this also occurs with *I. labrosus* and explains the parasitism levels maintenance during the fish development.

According to Esch *et al.* (1988), behavioral and physiological differences among the hosts sexes can influence the parasitism levels. However, for *I. labrosus* specimens captured in the reservoirs of Paraná basin, it was verified that the host sex did not influence prevalence and parasite abundance, suggesting that both sexes must present similar

behaviors and alimentary habits. Moreover, the fact of the host sex does not influence the parasite abundance probably occurs due to similarity in the hosts' size, thus the parasites physical survival space is similar in both sex.

However, the data from the upper Paraná floodplain disclosed that host sex influenced prevalence and parasite abundance. This result, opposite of the reservoirs, can be justified by the sampling, because the number of collected male hosts in the floodplain was small. But the existence of physiological or behavoring differences between male and female is not discarded.

According to Le Cren (1951), the host condition factor is a quantitative indicator of the fishes' fitness reflecting recent alimentary conditions. As the expected and the observed weight are used, the reproductive events of gonadal formation are minimized, since the relation between these weights is equal to one in normal conditions, any alteration that occurs in this relation will carry variations in the calculation. These variations can be carried by environment influences, food lack, or parasitism.

As the parasitism abundance did not influence significantly the host condition factor in the reservoirs of Paraná River basin and in the upper Paraná River floodplain, it can be inferred that the parasites do not carry significant damages in the host organism and that both already present a high degree of adaptation.

The lowest similarity verified among the samples from the reservoirs of Paraná River basin and from the upper Paraná River floodplain (54.54%) discloses a significant difference among their species wealth, because it deals with the same host's species and that these hosts are deriving from the same hydrographic basin. This can be explained by a probable difference in the hosts' diet in the different sites. Abes *et al.* (2001), studying *I. labrosus* diet at Itaipu Reservoir, concluded that this host ingests a wide variety of bentonic aquatic invertebrates, as a result of a food resource abundance or because of the buccal and digestive apparatuses morphology. According to the present study, results show that the different sites present different bentonic aquatic invertebrates abundances. Thus, the most abundant ones become the main *I. labrosus* food resource, infecting the fish with different parasite species.

Pavanelli *et al.* (1997) registered only Nematoda and Proteocephalidea in *I. labrosus* from the Upper Paraná River floodplain, therefore, the present study registered five species, contributing for the knowledge of the diversity of *I. labrosus* parasite species.

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