

PARASITISM INFLUENCE ON THE HEPATO, SPLENOSOMATIC AND WEIGHT/LENGTH RELATION AND RELATIVE CONDITION FACTOR OF *Prochilodus lineatus* (VALENCIENNES, 1836) (PROCHILODONTIDAE) OF THE UPPER PARANÁ RIVER FLOODPLAIN, BRAZIL

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ABSTRACT:-LIZAMA, M. DE LOS A.P.; TAKEMOTO, R.M.; PAVANELLI, G.C. **Parasitism influence on the hepato, splenosomatic and weight/length relation and relative condition factor of *Prochilodus lineatus* (Valenciennes, 1836) (Prochilodontidae) of the Upper Paraná River floodplain, Brazil.** [Influência do parasitismo na relação hepato, esplenossomática e relação peso/comprimento e fator de condição relativo de *Prochilodus lineatus* (Valenciennes, 1836) (Prochilodontidae) da planície de inundação do Alto rio Paraná, Brasil]. *Revista Brasileira de Parasitologia Veterinária*, v. 15, n. 3, p. 116-122, 2006. Nupélia, Universidade Estadual de Maringá (UEM), Bloco G-90, Av. Colombo, 5790, Maringá, PR 87020-900, Brasil. E-mail: takemotorm@nupelia.uem.br

One hundred and forty-nine specimens of *Prochilodus lineatus* (Valenciennes, 1836) were collected on the Upper Paraná River floodplain (Brazil) from February 2000 to June 2001. Both parasitized and unparasitized fish showed allometric growth. The parasitized fish presented relative condition factor (Kn) values that were significantly higher than those of the unparasitized fish. In the age classes with unparasitized fish, the mean relative condition factor was always lower. Starting from two years of age, the Kn values were higher in the parasitized hosts. The monogenean *Rhinonastes pseudocapsaloideum*, the copepod *Gamispatulus* sp. and the digenean *Saccocoelioides magnorchis* presented significant positive correlation between their abundance and the relative condition factor of the host. No species presented correlation between abundance and the hepatosomatic relation. The acanthocephalan *Neoechinorhynchus curemai* presented positive correlation and the metacercariae *Tylodelphys* sp. presented negative correlation between the splenosomatic relation and abundance of parasitism.

KEY WORDS: *Prochilodus lineatus*, hepato/splenosomatic relation, relative condition factor, Paraná River, Brazil.

RESUMO

Cento e quarenta e nove espécimes de *Prochilodus lineatus* (Valenciennes, 1836) foram coletados na planície de inundação do alto rio Paraná (Brasil) de fevereiro de 2000 a junho de 2001. Ambos peixes parasitados e não parasitados mostraram incremento alométrico. Os peixes parasitados apresentaram valores de fator de condição relativo (Kn) significativamente maiores que os peixes não parasitados. Nas classes etárias onde ocorreram peixes não parasitados, o fator de condição relativo médio foi sempre menor. A partir dos dois

anos de idade. Os valores de Kn foram mais elevados nos peixes parasitados. O monogenético, *Rhinonastes pseudocapsa-loideum*, o copépode *Gamispatulus* sp. e o digenético *Sacco-coelioides magnorchis* apresentaram correlação significativa positiva entre a abundância e o Kn do hospedeiro. Nenhuma espécie apresentou correlação entre a abundância e a relação hepatossomática. O acantocéfalo *Neoechinorhynchus curemai* apresentou correlação positiva e a metacercária *Tylodelphys* sp. apresentou correlação negativa entre a relação esplenossomática e a abundância de parasitismo.

PALAVRAS-CHAVE: *Prochilodus lineatus*, relação hepato/esplenossomática, fator de condição relativo, rio Paraná, Brasil.

INTRODUCTION

Application of indicators that use relationship between

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organs like the liver, kidney, spleen and gonads, measures of length and weight and the study of the relative condition factor of fish, in relation to parasitism levels, have been seen in recent decades as important tools in the study of ecological relationships between parasites and their hosts.

According to Tavares-Dias et al. (2000a), studies about various relationships in fish from natural environments and their parasites are important tools that further the understanding of diverse pathologies that occur in these hosts when they are confined. In this way, this study intended to learn more about the ecological relationships between metazoan parasites and their host *Prochilodus lineatus* (Valenciennes, 1836), “curimba”. Commercially important, is one of the most abundant species on the upper Paraná River floodplain. “Curimba” are large-sized fish that carry out

extensive migrations to feed and reproduce. Iliophagous, its diet is composed basically of detritus and sediment (FUGI et al., 1996; AGOSTINHO et al., 1997).

The object of this study was to evaluate the relationships between the host *Prochilodus lineatus* and the metazoan parasite fauna, including the hepato, splenosomatic and weight-length relation and relative condition factor of the host on parasite infrapopulations.

MATERIALS AND METHODS

One hundred and forty-nine specimens of *Prochilodus lineatus* were collected from February 2000 to June 2001 on the Upper Paraná River floodplain in the “Ilhas e Várzea do rio Paraná” Protected Area, Brazil (22°50' - 22°70'S and 53°15' - 53°40'W). The catches were carried out using gangs of gill

Table 1. Prevalence Values (P%), Mean Abundance (MA), Amplitude of Intensity (AI), and the site of infection/infestation of the parasite fauna of *Prochilodus lineatus*, captured on the upper Paraná River floodplain from February 2000 to June 2001.

| Parasite | P | MA ± SD | AI | Site of infection/infestation |
|--|-------|--------------|-------|------------------------------------|
| Monogenea | | | | |
| <i>Rhinonastes pseudocapsaloideum</i> | 43.62 | 1.31 ± 2.35 | 1-15 | Nasal cavity |
| <i>Kritskyia boegeri</i> | 28.85 | 1.55 ± 3.53 | 1-17 | Urinary bladder |
| <i>Tereancistrum curimba</i> | 22.80 | 0.75 ± 2.45 | 1-20 | Gills |
| <i>T. toksonum</i> | 5.30 | 0.23 1.29 | 1-13 | Gills |
| <i>Tereancistrum</i> sp. | 0.67 | 0.01 ± 0.08 | 1 | Gills |
| <i>Gyrodactylus</i> sp. 1 | 3.35 | 0.05 ± 0.29 | 1-3 | Nasal cavity |
| <i>Gyrodactylus</i> sp. 2 | 3.35 | 0.05 ± 0.32 | 1-3 | Gills |
| <i>Anacanthoroides</i> sp. | 2.01 | 0.05 ± 0.41 | 1-4 | Gills |
| Ancyrocephalinae | 6.04 | 0.23 ± 1.16 | 1-9 | Gills |
| Digenea | | | | |
| <i>Saccocoelioides magnorchis</i> | 26.84 | 3.63 ± 11.45 | 1-114 | Intestine, stomach, pyloric caecae |
| <i>S. nanii</i> | 26.84 | 8.97 ± 30.35 | 1-200 | Intestine, stomach, pyloric caecae |
| <i>S. leporinodus</i> | 2.68 | 0.07 0.47 | 1-5 | Intestine |
| <i>S. saccodontis</i> | 0.67 | 0.01 0.16 | 2 | Intestine |
| <i>Saccocoelioides</i> sp. | 0.67 | 0.04 ± 0.49 | 6 | Intestine |
| <i>Unicoelium prochilodorum</i> | 5.37 | 0.20 ± 1.66 | 1-2 | Intestine |
| <i>Megacoelium</i> sp. | 5.37 | 0.12 ± 0.64 | 1-6 | Intestine, stomach |
| <i>Tylodelphis</i> sp. (metacercariae) | 10.74 | 0.17 ± 0.80 | 1-9 | Gills |
| <i>Colocladorchis</i> sp. | 8.05 | 0.29 ± 2.39 | 1-29 | Intestine |
| <i>Sphincterodiplostomum</i> sp. | 0.67 | 0.01 ± 0.08 | 1 | Gills |
| <i>Lecitobothrioides</i> sp. | 0.67 | 0.01 ± 0.16 | 2 | Intestine |
| Digenea 1 (metacercariae) | 2.01 | 0,05 0.43 | 1-6 | Mesentery |
| Digenea 2 (metacercariae) | 0.67 | 0.02 ± 0.25 | 3 | Heart |
| Cestoda | | | | |
| Proteocephalidea (plerocercoid) | 5.36 | 0.25 1.28 | 1-10 | Mesentery |
| <i>Valipora campylancristrota</i> | 5.37 | 0.09 ± 0.53 | 1-6 | Gall bladder |
| Nematoda | | | | |
| <i>Raphidascaris</i> sp. | 2.01 | 0.02 ± 0.14 | 1 | Intestine, stomach |
| Acanthocephala | | | | |
| <i>Neoechinorhynchus curemai</i> | 20.13 | 0.72 ± 2.27 | 1-15 | Intestine, pyloric caecae |
| <i>Quadrigyrus</i> sp. | 3.35 | 0.05 ± 0.29 | 1-3 | Intestine, stomach, pyloric caecae |
| Copepoda | | | | |
| <i>Gamidactylus jaraquensis</i> | 15.43 | 0.58 ± 1.92 | 1-12 | Nasal cavity |
| <i>Gamispatulus</i> sp. | 15.43 | 0.37 ± 1.14 | 1-9 | Nasal cavity |
| <i>Amplexibranchius</i> sp. | 16.10 | 0.78 ± 4.38 | 1-48 | Gills |
| <i>Ergasilus</i> sp. | 15.43 | 0.41 ± 1.52 | 1-14 | Gills |
| Branchiura | | | | |
| <i>Dolops</i> sp. | 2.68 | 0.03 ± 0.20 | 1-2 | Skin, Gills |
| Hirudinea | 2.01 | 0.02 ± 0.14 | 1 | Skin |

* Significant Values.

nets with different mesh sizes. The total weight, standard length, age and sex of each fish were recorded. All of the experiments comply with the current laws of the country in which the experiments were performed. The parasites were collected with the aid of a stereoscopic microscopic. For the collects of endoparasites, the internal organs and the visceral cavity were individualized (EIRAS et al., 2000). The age of each specimen established by the growth parameters estimated in Lizama (2000), were applied here to obtain mean of length by each age class.

Metazoan parasites were identified according to Thatcher (1978, 1979, 1991, 1993), Thatcher and Boeger (1984a, 1984b), Thatcher and Varella (1981), Moravec (1998) and Takemoto et al. (2002).

Were estimated the parameters of the weight-length relation, for parasitized and unparasitized host, after visual inspection of the clouds of points resulting from the graphic position of the individual weight-length values, the expression $Wt = a.Ls^b$ was adjusted to these values (LE CREN, 1951). To establish if the weight increases of each group were isometric or allometric, the angular constant **b** from the weight-length relation was tested using the expression $t = (b-3)/S_b$ (5% of probability). The constants of this relation were employed in calculating the relative condition factor, Kn (LE CREN, 1951). The Mann-Whitney “U” test, with normal “Z” approximation,

was used to verify the existence of differences in the Kn values between parasitized and unparasitized hosts.

The hepatosomatic and splenosomatic relation were calculated using the following expressions: hepatosomatic relation (HSR) = liver weight (g)/ body weight (g) x 100; splenosomatic relation (SSR) = spleen weight (g)/ body weight (g) x 100. The Spearman rank “rs” coefficient of correlation between abundance and HSR, SSR and the Kn was calculated for each species of parasite (ZAR, 1996). The tests were applied to the species that presented prevalence higher than 10% (BUSH et al., 1990). The level of statistical significance was $p < 0.05$.

The terminology related to parasite ecology was based on Bush et al. (1997).

RESULTS

Of the 149 analyzed fish, 121 (82.1%) were parasitized by 1 or more species of metazoan parasite. Thirty-three metazoan parasite species were recorded (Table I).

The weight-length relation in *Prochilodus lineatus* showed that both groups (parasitized and unparasitized) presented allometric growth ($b > 3$ and $t > 1.96$). However, differences between the two groups were verified. The unparasitized fish presented more accelerated growth than the parasitized hosts, weighing more even with the same length standard (Figure 1).

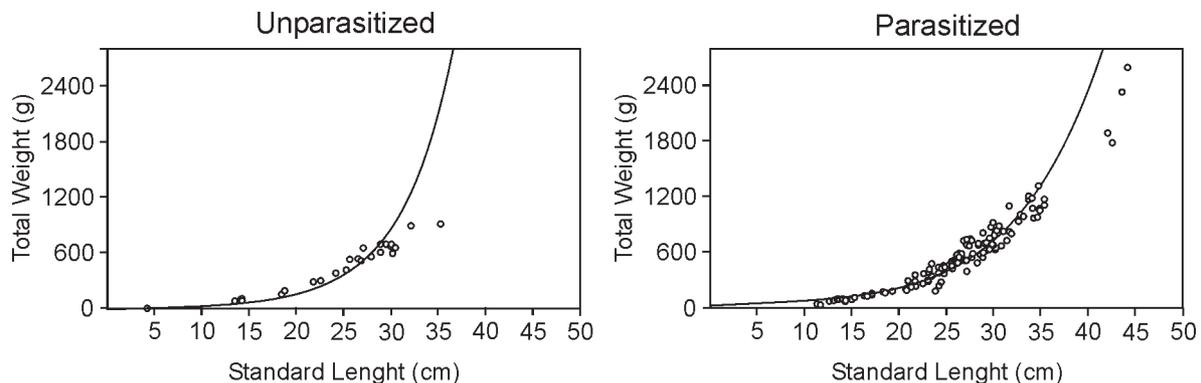


Figure 1. Weight-length relation between the parasitized and unparasitized group in *Prochilodus lineatus* captured of the Upper Paraná river floodplain, Brazil, during period from February 2000 to June 2001.

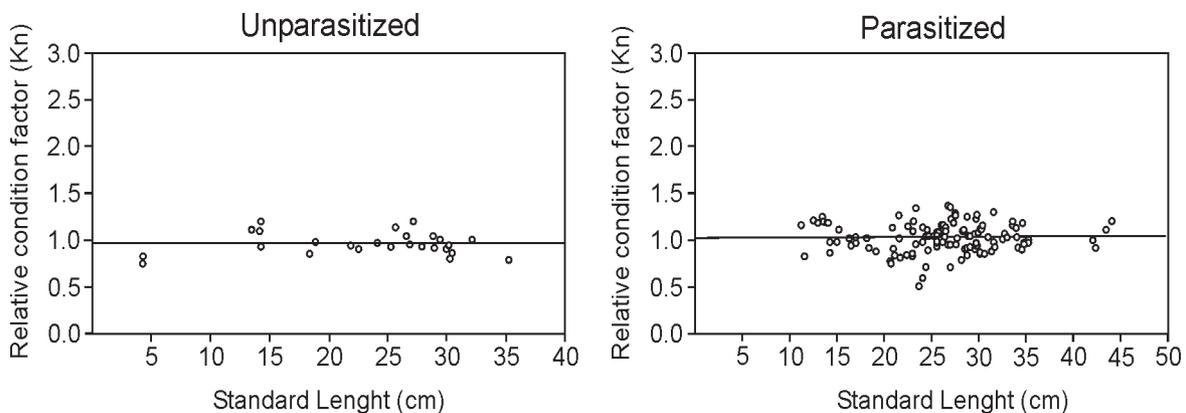


Figure 2. Relative condition factor (Kn) between the parasitized and unparasitized groups in *Prochilodus lineatus* captured of the Upper Paraná river floodplain, Brazil, during period from February 2000 to June 2001.

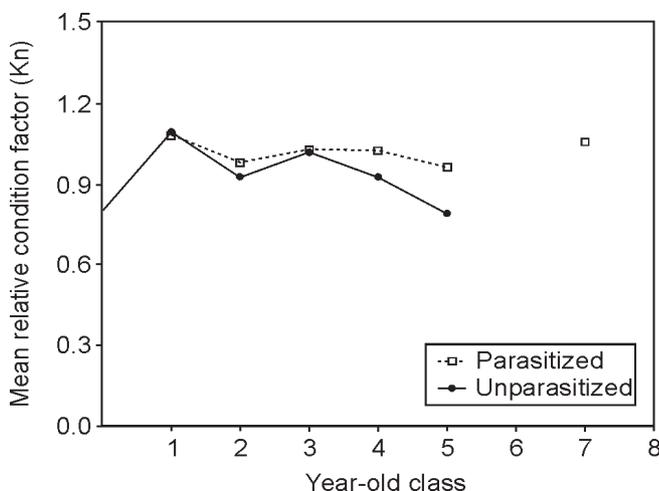


Figure 3. Relative condition factor (Kn) by age classes, between the parasitized and unparasitized groups in *Prochilodus lineatus* of the Upper Paraná river floodplain, Brazil, during period from February 2000 to June 2001.

Regarding the relative condition factor, it was observed that there were differences between the host groups. The parasitized fish presented a significantly higher relative condition factor than the unparasitized fish ($Z = 2.045$; $p = 0.0408$) (Figure 2).

In age classes of unparasitized fish (0 to 5 years old), the mean relative condition factor was always lower. In the two-year-old class, Kn values were higher in parasitized hosts. In the 7-year-old class, only parasitized fish were found (Figure 3).

The monogenean *Rhinonastes pseudocapsaloideum* Kritsky, Thatcher and Boeger, 1988 ($r_s = 0.20$; $p = 0.01$), the copepod *Gamispatulus* sp. ($r_s = 0.20$; $p = 0.01$) and the digenean *Saccocoelioides magnorchis* Thatcher, 1978 ($r_s = 0.22$; $p = 0.01$) presented positive correlation between their abundance and the relative condition factor of the host.

Among the more prevalent parasites in *P. lineatus* (above 10%), no species was correlated with the hepatosomatic relation (HSR).

The acantocephalan *Neoechinorhynchus curemai* Noronha, 1973 presented positive correlation and the metacercaria *Tylodelphis* sp. presented negative correlation between the SSR and abundance of parasitism ($r_s = 0.23$; 0.02 and $r_s = -0.23$ e $p = 0.03$, respectively).

DISCUSSION

Parasites are considered individuals that share physiological mechanisms with other species in a dynamic continuum of interactions with the host, which goes from harmful to beneficial (AEBY, 1992) and is difficult to quantify.

There is controversy over the host-parasite relationship. According to Bauer (1970), the pathogenic activity of parasites necessarily affects host condition in a negative way. According to Moore (1987), even more pathogenic parasites can benefit their hosts. Aebly (1992) showed that parasitism by the

digenean *Plagioporus* increased the regeneration capacity of a colony of healthy polypi due to the predation of parasitized polypi by its definitive host (Butterfly fish).

The analyzed weight-length datas showed interesting relationships between parasitized and unparasitized hosts, since both groups presented allometric growth, manifesting behavioral differences between them.

According to Le Cren (1951), the condition factor is a quantitative indicator of fish fitness, reflecting recent feeding conditions and is obtained using the weight-length relation of the individual. As the relative condition factor considers expected weight and observed weight, events involving reproduction or construction of the gonads are minimized if the relation is equal to one (1) in normal conditions. Any alteration (influenced by environmental change, lack of food or even parasitism) to this relation causes variations in this calculation.

Lemly (1980), studying the bluegill, established negative correlation between parasitism intensity and the condition factor in juveniles of this host. Data using the same age and length classes indicated that the condition factor and weight can be used to quantify the effects of parasites in small fish.

The results showed that the parasitized fish presented a relative condition factor significantly higher than the unparasitized fish. This was confirmed when the species were analyzed separately, where *R. pseudocapsaloideum*, *S. magnorchis* and *Gamispatulus* sp. presented significant positive correlation between Kn and abundance of parasitism. Considering that parasites are pathogenic, a negative correlation was expected. However, parasitism abundance is relatively low in *P. lineatus* in relation to other species. Thus, the largest individuals with the highest Kn tolerate higher levels of parasitism. This result is in accordance with the proposals of Moore (1987) and Cone (1995). However, in previous studies on the Upper Paraná River floodplain, Ranzani-Paiva et al. (2000) did not find significant differences in the relative condition factor between parasitized and unparasitized *P. lineatus* hosts. This may be due to the fact that sampling (February 1994 and March 1995) had been carried out before the closure of the Sergio Motta Hydroelectric Power Plant in 1998, which resulted in changes in the fluvimetric level fluctuation, affecting mainly migratory species like *P. lineatus* (JÚLIO Jr. et al., 2000).

Takemoto et al. (1998), in studies about *Prochilodus scrofa* (= *P. lineatus*) endoparasites on the Upper Paraná river floodplain, showed no significant difference between parasitized and unparasitized fish. Both groups presented isometric growth. The different results in this work can be explained by the difference in sample time, occurring before the closure of the Sergio Motta Hydroelectric Power Plant.

Paperna (1963) observed that cultivated fish that developed quickly tolerated intense infestations of *Dactylogyrus vastator*, through the quick regeneration of

epithelial tissues. In young fish that grew more slowly, epithelial regeneration was slower and death frequent. Cone (1995) affirmed that larger fish with a higher condition factor tolerate higher infestation intensities by monogeneans. For *P. lineatus*, it was observed that the older fish presented a higher relative condition factor than the younger ones, as described above by Cone (1995).

The fish spleen filters the blood (ELLIS et al., 1976) and is also an important erythropoietic and leucopoietic organ (QUENTEL; OBACH, 1992). The liver is formed by hematopoietic tissues (MATUSHIMA, 1995) that store large quantities of fat and glycogen (LAGLER et al., 1977). In some parasitic infections, an increase in liver volume can occur, with low levels of glycogen (QUENTEL; OBACH, 1992) and possible alterations to erythropoietic and leucopoietic tissues.

The hepatosomatic relation for Brazilian species has been discussed in various studies, which have related it to life cycle: Vieira (1984); Saint-Paul (1984); Agostinho et al. (1990) and Barbieri and Afonso-Marins (1995). One of the first works dealing with hepatosomatic relation was Kuperman (1973), studying young perch (*Perca fluviatilis*) parasitized by cestodes. Significant differences were observed only between the dimensions and host weight in massive infections, where parasite weight was between 20 and 60% of liver weight.

Studies carried out by Kurovskaya and Osadchaya (1993) confirmed the reduction in liver weight and the relative condition factor in fish infected by *Icthyophthirius multifiliis*. Alterations to the hepatosomatic and splenosomatic relations were also recorded in infestations by *Cryptobia salmositica* (LOWE-JINDE, 1980).

Tavares-Dias et al. (2000a) analyzed the hepatosomatic and splenosomatic relations in intensely cultivated fish, showing that correlation existed between liver and spleen weight and body weight, and liver weight and healthy host length. Tavares-Dias et al. (2000b) did not observe significant differences in the HSR for *Oreochromis niloticus*, *Leporinus macrocephalus* and the hybrid "tambacu" in parasitized and unparasitized hosts. Only *Piaractus mesopotamicus* presented lower HSR values in parasitized hosts. For *P. lineatus*, significant correlations between the HSR and parasitism abundance were not observed either.

In this study, was observed that infestations by metacercariae *Tylodelphis* sp. resulted in SSR decrease, while the acantocephalan *Neoechinorhynchus curemai* increased it. According Lowe-Jinde (1980), splenomegaly occurs due to the development of leucocytaric reactions caused by parasitism and the increase in erithrocite production in cases of anemia. Environmental alterations, as well as parasitic infections, can lead to an increase in spleen volume, permitting the organism to maintain its organic functions in balance, which may explain the increase in the SSR in *P. lineatus* parasitized by *N. curemai*. The negative correlation between the SSR and *Tylodelphis* sp. abundance, which was not expected, can be explained by the lower intensity of

infection (IM = 1.56) with an amplitude of 1-9 specimens per host, which could be masking the results, despite this parasite presenting prevalence greater than 10%.

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