Community ecology of the metazoan parasites of Banded Croaker, *Paralonchurus brasiliensis* (Osteichthyes: Sciaenidae), from the coastal zone of the State of Rio de Janeiro, Brazil

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ABSTRACT. Ninety-three specimens of banded croaker, *Paralonchurus brasiliensis* (Steindachner, 1875), collected from *Pedra de Guaratiba* (23°01'S, 43°38'W), coastal zone, State of *Rio de Janeiro*, Brazil, between September 2001 and March 2002, were necropsied to study their infracommunities of metazoan parasites. Fifteen species of metazoan parasites were collected. *Paralonchurus brasiliensis* is a new host record for 13 parasite species. The majority of fishes were parasitized by one or more metazoan. Larvae of *Contracaecum* sp. proved to be the dominant species, with highest prevalence and abundance values. The parasite species of *P. brasiliensis* showed the typical aggregated distribution pattern. Prevalence and abundance of *Procamallanus* (*Spirocamallanus*) *pereirai* was positively correlated with the host total length. Abundance of *Contracaecum* sp. was positively correlated with the host total length. The abundances of a pair of adult endoparasites (*Aponurus laguncula* - *Procamallanus* (*S.*) *pereirai*) showed negative covariation and one pair of larvae stages of endoparasites (*Nybelinia* sp. - *Contracaecum* sp.) showed positive covariations between their abundances. *Paralonchurus brasiliensis* showed a metazoan parasite community composed by generalist species, little ordered and with scarce quantitative evidences of interspecific associations. These patterns agree with those detected in preceding studies about the parasite communities of Neotropical sciaenid fishes.

Key words: parasite ecology, marine fish, Sciaenidae, *Paralonchurus brasiliensis* – Brazil.

RESUMO. Ecologia da comunidade de metazoários parasitos da Maria-Luiza, *Paralonchurus brasiliensis* (Osteichthyes: Sciaenidae) do litoral do Estado do Rio de Janeiro, Brasil. Foram examinados 93 espécimes de *Paralonchurus brasiliensis* (Steindachner, 1875), provenientes da Pedra de Guaratiba (23°01'S, 43°38'W) litoral do Estado do *Rio de Janeiro*, Brasil. No período de setembro de 2001 até março de 2002, sendo necropsiados para estudo da sua comunidade de metazoários parasitos. Quinze espécies de parasitos foram coletadas. *Paralonchurus brasiliensis* é um novo registro de hospedeiro para 13 espécies de parasitos. *Contracaecum* sp. foi a espécie dominante, com os maiores índices de prevalência e abundância parasitária. Os componentes da comunidade parasitária de *P. brasiliensis* apresentaram o típico padrão de distribuição superdispersa. A abundância e a prevalência de *Procamallanus* (*Spirocamallus) pereirai* apresentaram correlação positiva com o comprimento total do hospedeiro. A abundância de *Contracaecum* sp. apresentou correlação positiva com o comprimento total do hospedeiro. Um par de endoparasitos adultos (*Aponurus laguncula* - *Procamallanus* (*S.*) *pereirai*) apresentou covariação negativa e um par de estágios larvais de endoparasitos apresentou covariação positiva entres as abundâncias. *Paralonchurus brasiliensis* apresentou uma comunidade de metazoários parasitos composta de espécies generalistas, pouco ordenadas e com poucas evidências de associações interespecíficas. Este padrão está em concordância com os estudos realizados com comunidades parasitárias de siaenídeos da região neotropical.

Palavras-chave: ecologia parasitária, peixes marinhos, Sciaenidae, *Paralonchurus brasiliensis*, Brasil.

Introduction

Sciaenids are the most important component of the demersal fish community in the coastal waters of Southeastern and Southern Brazil (Soares and Vazzoler, 2001). The banded croaker, *Paralonchurus brasiliensis* (Steindachner, 1875), whose known distribution ranges from Panama to Argentina, is a demersal and benthic sciaenid fish, found over muddy bottoms, often near estuarine areas and feeds mainly on polyquets and other benthic invertebrates (Menezes and Figueiredo, 1980; Cunningham and Diniz Filho, 1995).

Taxonomic papers about the parasites of *P. brasiliensis* from Brazil were published by Vicente *et al*. (1985), Pinto *et al*. (1984, 1992), Pereira Jr. and Costa (1996) and Santos *et al*. (1999) (Nematoda), Santos *et al*. (2001) and Kritsky and Boeger (2002) (Monogenea).

Neotropical sciaenid fishes have been studied in quantitative aspects of their parasite communities, mainly from South American Pacific Ocean (Oliva *et al*., 1990, Luque and Oliva, 1993; Luque, 1994, 1996; Oliva and Luque, 1998). Recently, some sciaenid fishes from the Southern Brazilian coastal zone have been studied for their parasite communities: Chaves and Luque (1999) and Alves and Luque (2001) described the parasite communities of *Menticirrhus americanus* (Linnaeus, 1758) and *Micropogonias furnieri* (Desmarest, 1823), respectively.

In this report, we studied the metazoan parasite community of *P. brasiliensis* from the coastal zone of the State of *Rio de Janeiro*, at component and infracommunity levels, and compared our results with those on the parasite communities of other marine sciaenid fishes.

Material and methods

From September 2001 to March 2002, 93 specimens of *P. brasiliensis* were examined. Local fishermen collected fish from *Pedra de Guaratiba* (23°01'S, 43°38'W), coastal zone of the State of *Rio de Janeiro*, Brazil. Fishes were identified according to Menezes and Figueiredo (1980) and showed from 15 to 25cm (mean = 21.1 ± 2cm) total length. The average total length of male (20.2 ± 2cm, n=28) and female (21.1 ± 1.9cm, n=65) fishes in the studied sample were not significantly different (t= - 0.443, P= 0.658). The analysis included only parasite species with prevalence higher than 10% (Bush *et al*., 1990). The quotient between variance and mean of parasite abundance (index of dispersion) was used to determine distribution patterns and was tested by the d statistical index (Ludwig and Reynolds, 1988). The dominance frequency and the relative dominance (number of specimens of one species/total number of specimens of all species in the infracommunity) of each parasite species were calculated according to Rohde *et al*. (1995). Spearman's rank correlation coefficient (r_s) was calculated to determine possible correlations between the total length of hosts and abundance of parasites. Pearson's correlation coefficient (r) was used as an indication of the possible relationship between the host's total length and the prevalence of parasites, with previous arcsine transformation of the prevalence data (Zar, 1996) and partition of host samples into four 2.5cm-length intervals. The possible influence of host gender on abundance and prevalence of parasites was tested using the Zc normal approximation to the Mann-Whitney test and the chi-square test, respectively. The possible interspecific association between concurrent species was determined using the chi-square test. Parasite infracommunities were separated into two groups – adult endoparasites (digeneans and nematodes) and larvae stages of endoparasites (cestodes and nematodes) – to determine possible interspecific associations. Ectoparasites were not included in this analysis because only one species (*Caligus haemulonis*) showed prevalence higher than 10%. Possible covariation among the abundance of concurrent species was analyzed using the Spearman rank correlation coefficient. Ecological terminology follows Bush *et al*. (1997). The statistical significance level was evaluated at $P \leq 0.05$. Voucher specimens of helminthes were deposited in the *Coleção Helmintológica do Instituto Oswaldo Cruz* (CHIOC), *Rio de Janeiro*, Brazil; copepods were deposited in the *Coleção de Crustacea do Museu Nacional* (MNRJ), *Quinta da Boa Vista, Rio de Janeiro*, state of *Rio de Janeiro*, Brazil.

Results and discussion

Component community - Fifteen species of metazoan parasites were collected (Table 1). *Paralonchurus brasiliensis* is a new host record for immature didymozoid, *Aponurus pyriformis, A. laguncula; Lecithochirium microstomum*, *Scolex pleuronectis, Nybelinia* sp., *Rhadinorhynchus* sp., *Serrasentis* sp., *Contracaecum* sp., *Philometra* sp., unidentified piscicolid, *Neobrachiella chevreuxii*, and *Caligus haemulonis*. The majority of the parasite specimens collected were nematodes (63%), followed by the digeneans (26.3%). *Contracaecum* sp. (larvae) was the predominant species, with 303 specimens collected

Table 1. Prevalence, intensity, mean intensity, mean abundance, and site of infection of the metazoan parasites of *Paralonchurus brasiliensis* from the coastal zone of the State of *Rio de Janeiro*, Brazil.

Parasites	Prevalence (%)	Intensity	Mean intensity	Mean Abundance	Site of infection
Digenea					
Aponurus laguncula (CHIOC 36205)	40	1 - 14	4.1 ± 3	1.6 ± 2.7	Stomach
Aponurus pyriformis (CHIOC 36206)	8.6	1 - 7	3.4 ± 1.7	0.2 ± 1	Stomach
Immature didymozoid (CHIOC 36207)	2.1	1 - 32	17 ± 21.2	0.3 ± 3.3	Intestine
Lecithochirium microstomum (CHIOC 36208)	1	---	1	<0.1	Stomach
Monogenea					
Pseudempleurosoma gibsoni (CHIOC 36209)	5.3	1 - 2	1.2 ± 0.4	<0.1	Gills and pharynx
Cestoda					
Nybelinia sp.(larvae) (CHIOC 36211)	13.9	1 - 4	1.7 ± 1	0.2 ± 0.7	Mesenteries
Scolex pleuronectis (CHIOC 36210)	1	1 - 23	23	0.2 ± 2.4	Mesenteries
Acanthocephala					
Rhadinorhynchus sp. (CHIOC 36212)	1	---	1	<0.1	Intestine
Serrasentis sp. (cystacanth) (CHIOC 35102)	1	1 - 2	2	<0.1	Intestine
Nematoda					
Contracaecum sp.(larvae) (CHIOC 35103)	63.5	1 - 25	5.1 ± 5.4	3.2 ± 5	Mesenteries
Philometra sp. (CHIOC 35104)	8.6	1 - 7	3.5 ± 2.3	0.3 ± 1.1	Gonads
Procamallanus (*Spirocamallanus*) *pereirai* (CHIOC 35105)	44	1 - 18	4.3 ± 3.7	1.9 ± 3.2	Intestine
Hirudinea					
Piscicolid not identified (CHIOC 35106)	3.2	---	1	<0.1	Gills
Copepoda					
Caligus haemulonis (MNRJ 18334)	10.7	1 - 6	2.2 ± 1.6	<0.1	Gills
Neobrachiella chevreuxii (MNRJ 18335)	2.1	1 - 2	1.5 ± 0.7	<0.1	Operculum

(37.5% of all parasites); and showed the highest values of mean relative dominance and frequency of dominance (Table 2). All parasites of *P. brasiliensis* had the typical aggregated pattern of distribution observed in many parasite systems. *Contracaecum* sp. showed the highest dispersion value indexes (Table 3). Abundance and prevalence of *Procamallanus* (*Spirocamallanus*) *pereirai* and abundance of *Contracaecum* sp. were positively correlated with the host total length (Table 4). The host's sex did not influence parasite prevalence or abundance of any species.

Infracommunities – Ninety-five percent of banded croaker were parasitized by at least one parasite species. A total of 807 individual parasites was collected, presenting a mean of 8.7 parasites/fish. Correlation between the total parasite abundance and the host's total body length (r_s = 0.288, P = 0.003) of fish were observed. The mean parasite species richness was 2.1 ± 0.9 (0-4). Parasite richness was not correlated with the host's total body length (r_s = 0.154, P = 0.123). Twenty hosts (21.5%) were infected by one parasite species, and 38 (40.9%), 25 (26.8%) and 6 (6.4%) had multiple infections with 2, 3 and 4 parasite species, respectively. One pair of adult endoparasites (*Aponurus laguncula* - *Procamallanus* (*S.*) *pereirai*) showed negative covariations (r_s = - 0.217; P = 0.036) and one pair of larvae stages of endoparasites (*Nybelinia* sp. - *Contracaecum* sp.) showed positive covariation (r_s = 0.270; P = 0.008) between their abundances.

Table 2. Frequency of dominance and mean relative dominance of the metazoan parasites of *Paralonchurus brasiliensis* from the coastal zone of the State of *Rio de Janeiro*, Brazil.

Parasites	Frequency of dominance	Frequency of dominance shared with one or more species	Mean relative dominance
Aponurus laguncula	15	7	0.166 ± 0.246
Nybelinia sp.	0	4	0.128 ± 0.091
Contracaecum sp.	31	8	0.361 ± 0.328
Procamallanus (*Spirocamallanus*) *pereirai*	27	1	0.254 ± 0.097
Caligus haemulonis	2	0	0.026 ± 0.097

Table 3. Dispersion index (DI) and the *d* statistical of the metazoan parasites of *Paralonchurus brasiliensis* from the coastal zone of the State of *Rio de Janeiro*, Brazil.

Parasites	DI	*d*
Aponurus laguncula	4.76	16.067[a]
Nybelinia sp.	2.04	5.847[a]
Contracaecum sp.	7.63	23.941[a]
Procamallanus (*Spirocamallanus*) *pereirai*	5.59	18.544[a]
Caligus haemulonis	3.04	10.123[a]

a: significant values

Table 4. Spearman's rank correlation coefficient (r_s) and Pearson's correlation coefficient (r) values used to evaluate possible relationships among the total length of *Paralonchurus brasiliensis*, abundance and prevalence of components from *Rio de Janeiro* coastal zone parasite community.

Parasites	r_s	*P*	*r*	*P*
Aponurus laguncula	0.027	0.792	-0.697	0.302
Nybelinia sp.	0.016	0.877	-0.246	0.754
Contracaecum sp.	0.251[a]	0.014	0.742	0.258
Procamallanus (*Spirocamallanus*) *pereirai*	0.426[a]	<0.001	0.984[a]	0.016
Caligus haemulonis	0.089	0.391	0.807	0.193

a: significant values, *P*: significance level

The parasite fauna of *P. brasiliensis* from *Rio de Janeiro* was composed by 15 species, all of them generalist. Also, the banded croaker is a new host record for 13 parasite species. The composition of the parasite fauna of *P. brasiliensis* showed similarity with other sciaenid fishes studied from *Rio de Janeiro*, *M. furnieri* and *M. americanus* (Chaves and Luque, 1999; Alves and Luque, 2001), mainly in relation to the infracommunities of digenean, and copepods. This similarity in the composition of the parasite fauna with the above mentioned sciaenid fishes was expected, because of their known similarity in some biological aspects. The similarity of the trophic relationships of *M. furnieri* and *P. brasiliensis* in the Southern Brazilian coastal zone has been widely documented. Vazzoler (1975) determined a higher value of interspecific association between the populations of *M. furnieri* and *P. brasiliensis,* with coexistence in the exploiting of available demersal and benthic resources in their diet. Both species showed great preference by polychaets and other benthic invertebrates (Amaral and Migotto, 1980; Soares and Vazzoler, 2001). At the same time, these sciaenids are prey of *Pontoporia blainvillei* and *Sotalia fluviatilis* (Cetacea) (Vazzoler *et al*., 1999). Also, some similarities are observed in relation to feeding behavior of *M. americanus*, although this species showed preference by inhabiting shallow and "surfing-zone" waters (Lunardon *et al*., 1991).

Nevertheless, some differences among the parasite communities of *P. brasiliensis*, *M. furnieri* and *M. americanus* were detected. At the component communities level, *M. furnieri* (N=28) showed a higher number of parasite species than *M. americanus* (N=15) and *P. brasiliensis* (N=15). At infracommunities level, prevalences were similar but both abundance and parasite species richness were also higher in *M. furnieri* and *M. americanus* than in *P. brasiliensis*. As many parasite species systems are based on trophic transmission, the differences above might be explained mainly by the feeding relationships of these sciaenids. According to Vazzoler (1975), *M. furnieri* and *P. brasiliensis* showed similarity in their dietary relationships (exception is made by the high frequency of small fishes in the diet of *P. brasiliensis*). These species are highly overlapped spatially but not alimentary, and did not show a clear diet feeding pattern (Soares and Vazzoler, 2001). As stated by Vazzoler (1975), frequency and diversity of *M. furnieri* diet items are higher than *P. brasiliensis*, possibly because of the larger size of *M. furnieri.* According to Platell *et al.* (1998), larger fishes consume more prey than smaller, because of the increased mouth size. This might explain partially the differences in the number of species of the parasite communities in these fishes. The data, made available by Vazzoler (1975), to compare the feeding biology of *M. furnieri* and *P. brasiliensis* are from localities more to the South than *Rio de Janeiro* and strongly influenced by the Subtropical Convergence (see Luque *et al*., 1996). Additionally, other factors must be evaluated, as the migrations to estuarine and coastal lagoons used as nurseries, and ontogenetic changes in the diet, adequately studied for *M. furnieri* but not studied in detail for *P. brasiliensis*.

Two different populations of *P. brasiliensis* with spatial overlap and some seasonal movements are known in the southern and south Brazilian coastal zone, respectively (Paiva Filho and Zani-Teixeira, 1980). *Euryhaliotrema atlantica* Kritsky & Boeger, 2002, a monogenean species recorded as parasitic on *P. brasiliensis* from *Guaratuba* Bay, State of *Paraná*, was not founded in the sample from *Rio de Janeiro*. Additional samples of *P. brasiliensis* from *Rio de*

Janeiro must be studied before the conclusion that this monogenean has a distribution restricted to southern Brazil. If it could be verified, this species would be useful as a biological tag for the different populations of *P. brasiliensis*.

Also, other patterns of distribution of the parasite infrapopulations are similar to those previously described for Sciaenid fishes (*M. americanus* and *M. furnieri*) from *Rio de Janeiro*. The size of the host is not always correlationed with prevalence and abundance of parasites, but it is positively correlationed at the infracommunity level. As pointed by Poulin (2000), this pattern cannot be generalized, because in many host-parasite species systems the correlation is positive, but weak and non-significant. Also, ontogenetical changes in the feeding behavior might have influence on parasite prevalence and abundance in the host size classes (Saad-Fares and Combes, 1992). The absence of correlations of parasite prevalence and abundance with the sex of the host fish is a pattern widely documented, and interpreted as a consequence of the absence of sexual differences in some biological aspects of the fish (Luque *et al*., 1996; Alves *et al.,* 2002).

According to Luque and Oliva (1999) and Alves and Luque (2001), the parasite communities from sciaenid fishes from South American Pacific and Atlantic Ocean showed significant differences based in the numerical dominance of ectoparasites (Pacific) and endoparasites (Atlantic). Luque and Oliva (1999) discussed these amphi-oceanic differences for *M. ophicephalus* (Pacific Ocean) and *M. americanus* (Atlantic Ocean) and suggested that these might be originated by the influence of regional ecological disturbances. The parasite community of *Paralonchurus* species can be included as another example of these differences. Luque and Oliva (1993), Luque (1996) and Oliva and Luque (1998) studied the characteristics of the parasite community in *P. peruanus* from Peru, in the South American Pacific Ocean. *Paralonchurus peruanus* showed dominance by ectoparasites, mainly diplectanid monogeneans and lerneopodid copepods, while *P. brasiliensis* had dominance by endoparasites, following the same pattern previously detected in *Menticirrhus* spp. by Luque and Oliva (1999).

Paralonchurus brasiliensis showed a parasite community little-ordered and with scarce quantitative evidences of interspecific association with this pattern. Preceding studies about Neotropical Sciaenid fishes also showed this type of parasite community, agreeing with the postulates of Rohde *et al*. (1995) and Morand *et al*. (2002).

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