COMMUNITY ECOLOGY OF THE METAZOAN PARASITES OF ARGENTINE GOATFISH, *Mullus argentinae* (OSTEICHTHYES: MULLIDAE), FROM THE COASTAL ZONE OF THE STATE OF RIO DE JANEIRO, BRAZIL

Ecologia da comunidade de metazoários parasitos da Trilha, *Mullus argentinae* (Osteichthyes: Mullidae), do litoral do do Estado do Rio de Janeiro, Brasil

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SUMMARY: One hundred specimens of Argentine goatfishes, *Mullus argentinae* Hubbs & Marini, 1935 (Osteichthyes: Mullidae) collected from the coastal zone of the State of Rio de Janeiro, Brazil (21-23°S, 41-45°W), from March to July 2001, were necropsied to study their parasites. The majority of the fishes (97%) were parasitized by one or more metazoan species. Fifteen species of parasites were collected. *Mullus argentinae* is a new host record for ten parasite species. The digeneans and the nematodes were the majority of the parasite specimens collected. *Anisakis* sp. was the dominant species with highest prevalence and abundance. The parasites of *M. argentinae* showed the typical overdispersed pattern of distribution. *Anisakis* sp., *Contracaecum* sp. and the Piscicolid not identified showed correlation between the host's total body length and abundance. Host sex did not influence prevalence and parasite abundance of any parasite species. The mean diversity in the infracommunities of *M. argentinae* was H=2.069 ± 0.969, with no correlation with the host's total length and without differences in relation to sex of the host. Three pairs of larval stage of endoparasites shared positive covariations and/or association between their abundances and prevalences. Negative association or covariation was not found. The parasite community of *M. argentinae* from Rio de Janeiro showed endoparasite dominance, correlation of parasite abundance at the infracommunity level with the size of the host, and a low number of parasite species associated pairs.

KEY WORDS: Parasite ecology, community structure, Mullidae, *Mullus argentinae*, Brazil.

INTRODUCTION

Mullus argentinae Hubbs & Marini, 1935 is a benthic perciform fish, found on soft mud bottoms (depth range 10-190 m), with a known distribution from Rio de Janeiro, Brazil to Mar del Plata, Argentina (MENEZES & FIGUEIREDO, 1985). The Argentine goatfish is very common in the southern Brazilian coastal zone and is a commercially important species. Parasites of mullids from Brazil are scarce known. FABIO (1981) recorded *Opecoeloides adsphaericus* (Manter & Van Cleave, 1951) parasitic in *M. argentinae* from the State of Rio de Janeiro, and PALM (1997) recorded five species of trypanorhynch metacestodes from the mullid *Pseudopeneus maculatus* from the coastal zone of the State of Pernambuco. In this report, we analyze the metazoan parasite community of *M. argentinae* from the coastal zone of the State of Rio de Janeiro, at the component and infracommunity levels.

MATERIALS AND METHODS

We examined 100 specimens of *M. argentinae* from March to July 2001. Local fishermen collected fish from coastal zone of the state of Rio de Janeiro (21-23ºS, 41-45ºW), Brazil. These fish were identified according to MENEZES & FIGUEIREDO (1985) and measured 15 – 23 cm (mean = 17.8 ± 1.4 cm) in total length. The average total length of male (17.8 ± 1.3 cm, n = 54) and female (17.7 ± 1.4 cm, n =

46) fishes in the study sample were not significantly different (t = 0.258, P = 0.796). The analysis included only parasite species with prevalence greater than 10% (BUSH et al., 1990). The variance to mean ratio of parasite abundance (index of dispersion) was used to determine distribution patterns and tested by the *d* statistical index (LUDWIG & 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 host's total body length and abundance of parasites. Pearson's correlation coefficient r was used as an indication of the relationship between the host's total body length and the prevalence of parasites, with previous arcsine transformation of the prevalence data (ZAR, 1996) and partition of host samples into four length 2cm intervals. The possible influence of host sex on abundance and prevalence of parasites was tested using the Z normal approximation to the Mann-Whitney test and the chi-square test, respectively. Parasite species diversity was calculated using the Brillouin index (H), because

Table 1: Prevalence, intensity, mean intensity, mean abundance, and site of infection of the metazoan parasites of *Mullus argentinae* 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 34948)	10	1-14	1.4±0.9	0.1 ± 0.5	Stomach
Prosorhynchus ozakii (preadults) (CHIOC 34950)	47	1-173	3.7±8.5	1.7 ± 6.0	Intestine
Immature didymozoid (CHIOC 34951)	33	1-188	5.5 ± 6.4	1.9 ± 4.5	Mesenteries
Opecoeloides adsphaericus (CHIOC 34949)	55	1-254	4.6 ± 4.0	2.5 ± 3.8	Intestine
Monogenea					
Encotyllabe sp.	1	_	1	<0.1	Gills
Pseudempleurosoma sp. (CHIOC 34952)	33	1-47	1.4 ± 0.7	0.5 ± 0.8	Gills and pharynx
Cestoda					
Nybelinia sp. (larval) (CHIOC 34953)	27	1-67	2.5 ± 2.7	0.7 ± 1.8	Coelomic cavity
Heteronybelinia rougetcampanae (larval) (CHIOC 34954)	2	_	1	<0.1	Coelomic cavity
Acanthocephala					
Corynosoma australe (cystacanth) (CHIOC 34955)	1	_	1	<0.1	Mesenteries
Nematoda					
Anisakis sp. (larval) (CHIOC 34800)	66	1-378	5.7 ± 7.4	3.8 ± 6.6	Mesenteries
Contracaecum sp. (larval) (CHIOC 34801)	20	1-59	3.0 ± 5.2	0.6 ± 2.6	Mesenteries
Procamallanus cruzi (CHIOC 34803)	11	1-18	1.6 ± 0.7	0.2 ± 0.5	Intestine
Raphidascaris sp. (larval) (CHIOC 34802)	52	1-180	3.5 ± 3.4	1.8 ± 3.0	Mesenteries
Hirudinea					
Piscicolid not identified (CHIOC 34804)	18	1-22	1.2 ± 0.6	0.2 ± 0.5	Gills
Isopoda					
Rocinela signata (MNRJ 16752)	3	1-3	1	<0.1	Gills

each fish analyzed corresponded to a fully censused community (ZAR, 1996). The probable variation of diversity in relation to host sex (Mann-Whitney test) and to host total length (Spearman's rank correlation coefficient) was tested. For each infracommunity, the evenness (Brillouin-based evenness index) was calculated. The possible interspecific association between concurrent species was determined using the chi-square test. Possible covariation among the abundance of concurrent species was analyzed using the Spearman rank correlation coefficient. Ecological terminology follows BUSH et al. (1997). Statistical significance level was evaluated at $P \leq 0.05$. Voucher specimens of helminths and hirudineans were deposited in the Coleção Helmintológica do Instituto Oswaldo Cruz (CHIOC), Rio de Janeiro, Brazil; isopods were deposited in the Coleção de Crustacea do Museu Nacional (MNRJ), Quinta da Boa Vista, Rio de Janeiro, RJ, Brazil. Five voucher specimens of *M. argentinae* were deposited in the Coleção Ictiológica do Museu Nacional Quinta da Boa Vista Rio de Janeiro, RJ, Brazil (MNRJ 23326).

RESULTS

Component community: Fifteen species of metazoan parasites were collected (Table 1). *Mullus argentinae* is a new host record for *Aponurus laguncula*, *Prosorhynchus ozakii*, Immature didymozoid, *Encotyllabe* sp., *Pseudemplerosoma* sp., *Corynosoma australe*, *Anisakis* sp., *Contracaecum* sp., *Procamallanus cruzi* and *Raphidascaris* sp. The majority, 90%, of the parasites specimens collected were digeneans and the nematodes. *Anisakis* sp. and *O. adsphaericus* were the most dominant species, with 632 specimens collected (44.3% of all parasites), and showed the highest values of mean relative dominance and frequency of dominance (Table 2). All parasites of *M. argentinae* had the typical overdispersed pattern of distribution observed in many parasite systems. *Prosorhynchus ozakii* showed the highest values of dispersion indices (Table 3). *Anisakis* sp., *Contracaecum* sp. and Piscicolid not identified showed correlation between the host's total body length and abundance (Table 4). Host sex did not influence parasite prevalence or mean abundance of any species.

Table 2: Frequency of dominance and mean relative dominance of the metazoan parasites of *Mullus argentinae* 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	1	1	0.018 ± 0.081
Prosorhynchus ozakii	11	3	0.118 ± 0.196
Immature didymozoid	8	4	0.179 ± 0.908
Opecoeloides adsphaericus	23	4	0.195 ± 0.247
Pseudempleurosoma sp.	3	5	0.060 ± 0.147
Nybelinia sp.	2	1	0.045 ± 0.099
Anisakis sp.	21	5	0.224 ± 0.262
Contracaecum sp.	2	1	0.032 ± 0.106
Procamallanus cruzi	2	2	0.019 ± 0.076
Raphidascaris sp.	10	3	0.125 ± 0.188
Piscicolid not identified	1	1	0.027 ± 0.111

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

Parasites	DI	*d*
Aponurus laguncula	1.878	5.248
Prosorhynchus ozakii	20.947	50.366
Immature didymozoid	10.909	32.441
Opecoeloides adsphaericus	5.570	19.174
Pseudempleurosoma sp.	1.351	2.320
Nybelinia sp.	4.704	16.483
Anisakis sp.	11.573	33.834
Contracaecum sp.	11.371	33.414
Procamallanus cruzi	1.722	4.429
Raphidascaris sp.	4.949	17.268
Piscicolid not identified	1.336	2.229

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 *Mullus argentinae*, abundance and prevalence of the components of its parasite community from the coastal zone of the State of Rio de Janeiro, Brazil.

Parasites	r_s	*P*	*r*	*P*
Aponurus laguncula	-0.126	0.211	-0.939	0.222
Prosorhynchus ozakii	-0.025	0.800	0.107	0.932
Immature didymozoid	0.113	0.262	0.429	0.717
Opecoeloides adsphaericus	0.185	0.065	-0.938	0.225
Pseudempleurosoma sp.	0.051	0.610	0.693	0.512
Nybelinia sp.	-0.053	0.599	-0.680	0.524
Anisakis sp.	0.259*	0.009	0.708	0.499
Contracaecum sp.	0.211*	0.034	0.818	0.389
Procamallanus cruzi	-0.024	0.809	-0.116	0.926
Raphidascaris sp.	0.084	0.402	0.568	0.615
Piscicolid not identified	0.215*	0.031	0.996	0.055

*: significant values, *P*: significance level

Infracommunities: Ninety-seven percent of red goatfish were parasitized by at least one parasite species. A total of 1,405 individual parasites was collected, with mean of 14 parasites/fish. The values of the dispersion and *d* statistical index for the total individual parasites were 11.435 and 33.546, respectively. Relationships 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 3.8 ± 1.7

(1-9) and did not showed correlated with the host's total body length. Six hosts (6%) were infected by one parasite species and 14, 20, 25, 19, 7, 5 and 1 had multiple infections with 2, 3, 4, 5, 6, 7 and 9 parasite species, respectively. The mean diversity in the infracommunities of *M. argentinae* was H=2.069 ± 0.969, with no correlation with the host's total length and without differences in relation to sex of the host.

Parasite infracommunities were separated into three groups: adult endoparasites (digeneans and nematodes), larval stages of endoparasites (cestodes and nematodes) and ectoparasites (monogenean and hirudinea) to determine possible interspecific associations. Among all the parasite species, one species pair of larval stages of endoparasites, *Prosorhynchus ozakii* - *Nybelinia* sp., shared significant positive covariation and association (r_s = 0.268, P = 0.006; c^2= 7.02, P= 0.008); two pairs of larval stages of endoparasites, Immature didymozoid - *Anisakis* sp. and *Anisakis* sp. – *Raphidascaris* sp. (r_s = 0.275, P = 0.005; r_s =0.246, P= 0.013) shared significant positive covariation. Negative association and covariation were not found.

DISCUSSION

The parasite community of *M. argentinae* from Rio de Janeiro showed endoparasite dominance, correlation of parasite abundance at the infracommunity level with the size of the host; and a low number of associated parasite species. The literature with regard to the feeding habits of *M. argentinae* from Brazil is scarce. ZANETI-PRADO (1978) classified the Argentine goatfish as a benthic, with schooling behavior and with high ability to feeding on the second (invertebrates) trophic level. The predominant item of the diet of mullid fishes are crustaceans and polychaets, potential intermediate host of digeneans (ZANETI-PRADO, 1978; GOLANI & GALIL, 1991). For instance, JOUSSON & BARTOLI (2000) recorded decapod crustaceans as second intermediate host of two species of *Opecoeloides* parasitic on goatfishes from the Mediterranean sea. This condition might explain the quantitative dominance of digeneans. The high diversity of digenean species in goatfishes is widely document by LE POMMELET *et al*. (1997), who listed 18 digenean species parasitic in goatfishes, however, many of these species have a distribution restricted to the western Mediterranean sea and to the Adriatic sea.

Another characteristic of the parasite community of *M. argentineus* was the presence of helminth larval stages which are generally common in marine teleost fishes (GEORGE-NASCIMENTO, 1987). This could suggest that the diet of *M. argentineus* does favor its participation as intermediate or transport host in the life cycle of these parasites. This situation was also recorded in the parasite infracommunities of some benthic marine fishes from Rio de Janeiro (SILVA et al., 2000; ALVES & LUQUE, 2001). As mentioned by CEZAR & LUQUE (1999), the presence or absence of these parasite larval stages will be fully explained only by additional information on the population features of the potential intermediate and definitive hosts. Some benthic fishes of the coastal zone of Rio de Janeiro, examined to study of their parasite communities, showed heterogeneous patterns in relation to possible positive correlation, at the infracommunity level, between the parasite abundance and the total body length of the host (LUQUE et al., 1996; KNOFF *et al*., 1997; CEZAR & LUQUE, 1999; SILVA et al., 2000; ALVES & LUQUE, 2001;). In the Argentine goatfish, positive correlation of parasite abundance and the host size was detected at the infracommunity level.

As pointed out in the classic study by POLYANSKI (1961), quantitative and qualitative changes in parasitism are expected with the fish growth. According to SAAD-FARES & COMBES (1992), POULIN (2000), and OLIVA & LUQUE (2002), in the case of the endoparasites this correlation might be influenced by changes in the diet of the fish, because the availability of infective stages for trophically transmitted parasites, such as digeneans, depends mainly on the presence of a suitable intermediate hosts for these parasites.

LE POMMELET & SILAN (1998) demonstrated that the surface area of the infection site in the intestine of goatfishes increases with growth and provides more available space (biotopes) to infections. This situation is similar in the ectoparasites, as mentioned by CEZAR & LUQUE (1999) changes in levels of the parasitism with ranging host size are expected because the increase of the gill surface area (FERNANDO & HANEK, 1976). Better explanation of these patterns will only be possible when the life cycles of the parasites and their relationship with Argentine goatfish feeding patterns and population dynamics become known. Absence of correlation between the sex of the host and the prevalence and abundance of components of the parasite community of marine fishes is common. In *M. argentinae*, the lack of such correlation might be attributed to similarity in ecological relationships (behavior, habitat, and diet) of males and females as stated by LUQUE et al. (1996). According to POULIN (1996) the influence of host sex on parasite prevalence and abundance is a topic hardly touched upon in discussions of community analysis, and it is necessary to conduct experiments which show the influence of other factors, mainly on physiology and behavior of the fish.

According to ALVES et al. (2002) the scarcity of interspecific associations in the parasite infracommunities is a pattern characteristic of the majority of marine fishes studied. POULIN (2001) stated that experimental evidence from concomitant infections of captive hosts under laboratory

conditions, and field evidence on patterns of richness and co-occurrence of parasite species from wild-caught hosts are necessary for determine the real role of interspecific interactions in the structure of parasite communities.

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SUMÁRIO

Entre março e julho de 2001 foram necropsiados 100 espécimes de *Mullus argentinae* (Osteichthyes: Mullidae) provenientes do litoral do Estado do Rio de Janeiro, Brasil (aprox. 21-23°S, 41-45°W). A maioria dos peixes (97%) estavam parasitados por pelo menos uma espécie de metazoário parasito. Foram coletadas quinze espécies de parasitos. *Mullus argentinae* é um novo registro de hospedeiro para onze espécies. Os digenéticos e nematóides constituíram a maioria dos espécimes coletados. *Anisakis* sp. foi a espécie dominante, com maiores valores de abundância e prevalência. Os parasitos de *M. argentinae* apresentaram um típico padrão de distribuição superdispersa. *Anisakis* sp., *Contracaecum* sp. e o Piscicolídeo não identificado apresentaram correlação entre o comprimento total do hospedeiro e a abundância. O sexo do hospedeiro não influenciou nos índices parasitários. A diversidade média das infracomunidades de *M. argentinae* foi H=2,069 ± 0,969, e não apresentou correlação com o comprimento e o sexo do hospedeiro. Três pares de endoparasitos apresentaram covariação e/ou associação positiva entre suas abundâncias e prevalências, respectivamente. Não foram observadas associações ou covariações negativas. A comunidade parasitária de *M. argentinae* do Rio de Janeiro apresentou dominância de endoparasitos, correlação das abundâncias parasitárias, ao nível de infracomunidade, com o comprimento do hospedeiro e baixo número de pares de espécies associados.

PALAVRAS-CHAVE: ecologia parasitária, estrutura da comunidade, Mullidae, *Mullus argentinae*, Brasil.

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