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Helminth parasites of *Ctenosciaena gracilicirrhus* (Perciformes: Sciaenidae) from the coast of Angra dos Reis, Rio de Janeiro State, Brazil

Helmintos parásitos de *Ctenosciaena gracilicirrhus* (Perciformes: Sciaenidae) de la costa de Angra dos Reis, del estado de Rio de Janeiro, Brasil

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Abstract. During a survey of the helminth parasites of *Ctenosciaena gracilicirrhus* from the Atlantic Ocean, off Angra dos Reis, Rio de Janeiro State, Brazil, 10 species of metazoan parasites were collected: 1 species of Monogenea (*Choricotyle rohdei*); 3 species of Nematoda (*Hysterothylacium* sp. third stage larvae, *Raphidascaris* sp. third stage larvae, and *Procamallanus* (*Spirocamallanus*) *pereirai* third and fourth stages larvae and adults); 6 species of Digenea (*Opecoeloides pedicathedrae*, *Opecoeloides melanopteri*, *Diplomonorchis leiostomi*, *Aponurus laguncula*, *Parahemiurus merus* and *Manteriella* sp.). *Choricotyle rohdei* and *Hysterothylacium* sp. had the highest prevalence, mean intensity and abundance and an aggregated pattern of distribution was observed in both species. A positive correlation between the standard length of hosts and the parasitic abundance of *Hysterothylacium* sp. and *C. rohdei* was observed. The prevalence of *C. rohdei* was positively correlated with standard length of the host, while in *Hysterothylacium* sp. there was no correlation. *Ctenosciaena gracilicirrhus* represents a new host record to all species of Nematoda and Digenea presented herein. The genus *Manteriella* is reported for the first time in South America.

Key words: Digenea, Monogenea, Nematoda, fishes, South America.

Resumen. Durante un estudio de los helmintos de *Ctenosciaena gracilicirrhus* de la zona costera de Angra dos Reis, Rio de Janeiro, Brasil, 10 especies de parásitos metazoos fueron recolectados: 1 especie de Monogenea (*Choricotyle rohdei*); 6 de Digenea (*Opecoeloides pedicathedrae*, *Opecoeloides melanopteri*, *Diplomonorchis leiostomi*, *Aponurus laguncula*, *Parahemiurus merus* y *Manteriella* sp.); 3 nemátodos (*Hysterothylacium* sp. y *Raphidascaris* sp., ambas larvas de tercer estadio y *Procamallanus* (*Spirocamallanus*) *pereira*, larvas de tercer y cuarto estadios y adultos). *Choricotyle rohdei* y *Hysterothylacium* sp. presentaron la mayor prevalencia, intensidad media y abundancia, así como un patrón agregado de distribución. Se observó una correlación positiva entre la longitud estándar de los hospederos y la abundancia parasitaria de *Hysterothylacium* sp. y *C. rohdei*. La prevalencia de *Choricotyle rohdei* se relaciona positivamente con la longitud estándar del huésped, mientras que en *Hysterothylacium* sp., no hubo correlación. *Ctenosciaena gracilicirrhus* representa un nuevo registro de huésped para todas las especies de Digenea y Nematoda registrados en este trabajo. El género *Manteriella* se registra por primera vez en América del Sur.

Palabras clave: Digenea, Monogenea, Nematoda, peces, América del Sur.

Introduction

The study of helminth fauna of marine fishes is very important to understand biological and ecological aspects and the host-parasite relationship. Besides this, the status of a marine environment can be studied directly by using water quality parameters, or indirectly by using bioindicators such as fish parasites (Palm and Rückert, 2009).

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Considering that most fish species are economically important, the presence of these helminths depreciates their commercial value, and some nematode, cestode and trematode larvae have a zoonotic potential.

Ctenosciaena gracilicirrhus (Metzelaar, 1919) inhabits coastal waters, usually over sandy mud bottoms, and is distributed in Nicaragua along the Caribbean coast and Atlantic coasts of South America to southern Brazil. It feeds mainly on shrimps (Froese and Pauly, 2011).

Recently, some studies have focused on characteristics of the community ecology of the metazoan parasites from the coastal zone of Angra dos Reis, State of Rio de Janeiro, Brazil (Tavares et al., 2004; Tavares and Luque, 2004a, b; Bicudo et al. 2005; Tavares and Luque, 2008). However, the helminth fauna of *C. gracilicirrhus* is being studied for the first time contributing to the knowledge of the biodiversity of the region.

Materials and Methods

From August 2007 to February 2009, 203 specimens of *Ctenosciaena gracilicirrhus* from the coast of Angra dos Reis, Rio de Janeiro State, Brazil (23°00'24'' S, 44°19'05'' W) were collected in order to determine the helminth fauna of this host. For taxonomic studies the nematodes were rinsed in 0.7% NaCl solution, fixed in hot AFA (2% glacial acetic acid, 3% formaldehyde, and 95% of 70% alcohol) and clarified in phenol 50%. The gill archs were separated and the monogeneans collected were cold fixed in 5% formaldehyde, with or without light cover glass pressure. The digeneans were cold fixed in AFA with slight compression under cover glass. Specimens of Monogenea and Digenea were stained with Langeron's alcoholic acid carmine, dehydrated in an ethyl-alcohol series, cleared in beechwood creosote and mounted in Canada balsam as permanent slides. Vouchers specimens were deposited in the "Coleção Helmintológica do Instituto Oswaldo Cruz" (CHIOC), Rio de Janeiro, Brazil. Calculations of the parameters of infection, related to prevalence, mean intensity, mean abundance were based on Bush et al. (1997). The quotient between variance and mean of parasite abundance (index of dispersion) was used to determine possible distribution patterns and was tested by the *d* statistical index (Ludwig and Reynolds, 1988). Spearman's rank correlation coefficient (*rs*) was used determine possible correlations between the standard length of hosts and parasites abundances of each species of parasite. To test correlations between the standard length and the prevalence of infection of each species of parasite, Pearsons's correlation coefficient (*r*) was used, with angular processing of prevalence data (arc sine $\sqrt{x}$) (Zar, 1996) and partition of host samples into twenty 0.7 cm length intervals. Statistical analyses were applied to parasite species with over 10% prevalence and the results considered significant when $p \geq 0.05$.

Results

Two hundred and three specimens of *Ctenosciaena gracilicirrhus* were analysed, with standard length that ranged from 3 to 17 cm (10 ± 2.1 cm). Ten species of helminth parasites were collected: 1 of Monogenea (*Choricotyle rohdei* Cohen, Cárdenas, Fernandes and Kohn, 2011); 6 of Digenea (*Opecoeloides pedicathedrae* Travassos, Freitas and Bührnheim, 1966, *Opecoeloides melanopteri* Amato, 1983, *Diplomonorchis leiostomi* Hopkins, 1941, *Aponurus laguncula* Looss, 1907, *Parahemiurus merus* (Linton, 1910) Manter, 1940 and *Manteriella* sp.), and 3 species of Nematoda (*Hysterothylacium* sp. third stage larvae, *Raphidascaris* sp. third stage larvae, and *Procamallanus* (*Spirocamallanus*) *pereirai* Annereaux, 1946 (third stage larvae, fourth stage larvae and adults).

Choricotyle rohdei and *Hysterothylacium* sp. had the highest prevalence, mean intensity and abundance (Table 1). Although Digenea was the group that showed a high diversity of species, they presented a low prevalence and mean intensity (Table 1).

C. rohdei and *Hysterothylacium* sp. showed a typical aggregated distribution pattern presenting an index of dispersion (DI= 12.6, *d*= 52.2 and DI= 30.8, *d*= 92.4), respectively.

Spearman's rank correlation coefficient indicated a positive correlation between the standard length of hosts and the parasitic abundance of *Hysterothylacium* sp. and *C. rohdei*. Pearsons's correlation coefficient showed that the prevalence of *C. rohdei* was positively correlated with standard length of the host, while in *Hysterothylacium* sp. there was no correlation (Table 2).

The host sex does not influence the prevalence and abundance of infection, (*Choricotyle* Z_c= -0.18, P= 0.78 and *Hysterothylacium* Z_c= -0.11, P= 0.99).

Discussion

Previous studies on helminth parasites from *C. gracilicirrhus* were published by Pereira and Boeger (2005) with a proposition of a new species of trypanorhynch, *Heteronybelinia annakohnae*, collected from Rio Grande and also reported *Progillotia dollfusi* Carvajal and Rego, 1983 from Rio de Janeiro, both in Brazil. Recently, a new monogenean species, *Choricotyle rohdei* was described from this host (Cohen et al., 2011). In the present paper, *C. gracilicirrhus* is referred to as a new host for all species of Nematoda and Digenea, and the detection of the genus *Manteriella* Yamaguti, 1958 represents the first report of the genus in South America.

The presence of distinct larval helminths suggests the possibility that *C. gracilicirrhus* occupies an intermediate level in the marine food web. Nematodes of the Ascaridoidea (families Anisakidae and Raphidascarididae) naturally parasitize fishes, cephalopods, marine mammals and piscivorous birds, and humans can also become accidental hosts by ingestion of infected fish. The presence of anisakid larvae on the viscera and flesh may have an impact upon visual aesthetics and the market value, and parasite removal only adds to the product cost whilst

Table 1. Prevalence (P), mean intensity (MI), mean abundance (MA) and site of infection of the parasites from *Ctenosciaena gracilicirrhus* from the coastal zone of Angra dos Reis, Rio de Janeiro State, Brazil

Parasites	*P %*	*IR*	*I/MI (SD)*	*MA (SD)*	*Site of Infection*
MONOGENEA					
Choricotyle rohdei (CHIOC 37.473-37.491)	25.1	1 - 19	1.96 ± 2.56	0.49 ± 1.55	Gills
DIGENEA					
Aponurus laguncula (CHIOC 37.535)	0.50	-	2*	-	Intestine
Diplomonorchis leiostomi (CHIOC 37.534)	0.50	-	1*	-	Intestine
Manteriella sp. (CHIOC 37.539)	0.50	-	1*	-	Intestine
Opecoeloides melanopteri (CHIOC 37.537)	2.50	-	1.00	0.02 ± 0.15	Stomach Intestine
Opecoeloides pedicathedrae (CHIOC 37.536)	7.40	1 - 2	1.13 ± 0.35	0.08 ± 0.31	Intestine
Parahemiurus merus Immature specimen (CHIOC 37.538)	0.50	-	1*	-	Intestine
NEMATODA					
Hysterothylacium sp. (larvae) (CHIOC 35.772)	10.30	1 - 12	1.81 ± 2.4	0.19 ± 0.9	Body Cavity Stomach
Procamallanus (*S.*) *pereirai* (adults and larvae) (CHIOC 35.773, 35.775, 35.776)	7.40	1 - 2	1.07 ± 0.22	0.08 ± 0.30	Intestine
Raphidascaris sp. (larva) (CHIOC 35.774)	0.50	-	1*	-	Intestine

(SD)= Standard deviation,* only one specimen parasitized.

Table 2. Values of Spearman's rank correlation coefficient (*rs*) and Pearson's correlation coefficient (*r*) obtained in relations between standard length of host, abundance and prevalence of *Choricotyle rohdei* and *Hysterothylacium* sp.

Parasite species	*rs*	*p*	*r*	*p*
Choricotyle rohdei	0.754*	<0.0001	0.599*	0.0052
Hysterothylacium sp.	0.535*	<0.0001	0.416	0.0679

p= level of significance, (*) significant values.

further reducing its attraction to consumers (Doupé et al. 2003).

The present work provides a new host record for third stage larvae of *Hysterothylacium* sp. and *Raphidascaris* sp. Only a single individual of *Raphidascaris* sp. was found in the intestine, which may indicate that *C. gracilicirrhus* is an accidental host for this species. However, *Hysterothylacium* sp. had a high prevalence indicating that *C. gracilicirrhus* is an important host for this alogenous endohelminth species.

Camallanids are considered a health problem for fishes when maintained in a closed ecosystem in the presence of suitable intermediate hosts (Rychlinski and Deardorff, 1982). Most species of *Procamallanus* (*Spirocamallanus*) are parasites of freshwater and marine hosts in South America. The larval stages of *P.* (*S.*) *pereirai* have been reported in 3 marine fish species of the family Sciaenidae: *Nebris microps* Cuvier, 1830, *Paralonchurus brasiliensis* (Steindachner, 1875), *Macrodon ancylodon* (Bloch and Schneider, 1801) and *Stellifer brasiliensis* (Schulz, 1945), and 1 more of the family Cyanoglossidae: *Symphurus tesselatus* (Quoy and Gaimard, 1824), from Rio de Janeiro State (Santos et al., 1999).

Choricotyle rohdei and *Hysterothylacium* sp. showed the typical aggregated pattern of distribution observed in many parasite systems. According to Holmes (1990), the aggregated distribution may increase the reproductive efficiency in some adult species, since it enhances mating opportunities. Besides, this distribution pattern improves the opportunity to infect the host (Dobson, 1990).

The high abundance of *C. rohdei* might be related to the population density increase of *C. gracilicirrhus* in offshore reproductive grounds, which might facilitate transmission of ectoparasites with a direct life cycle, similar to that suggested by Venerus et al. (2005) in *Pseudopercis semifasciata* off Patagonia.

A positive correlation between the standard length of hosts and the parasitic abundance of *C. rohdei* and *Hysterothylacium* sp. indicates that the number of specimens of parasites is greater as the standard length of fishes increases. The same occurs between the standard length of host and the prevalence of *C. rohdei*. In *Hysterothylacium* sp., however, no correlation was observed between the prevalence of parasites and the standard length of the host.

In our results we observed that host sex does not influence the prevalence and abundance of infection. According to Luque et al. (1996) and Alves et al. (2002) the absence of correlations in parasite prevalence and abundance with the sex of the host fish is a widely documented pattern, and interpreted as a consequence of absence of sexual differences in some biological aspects of the fish.

As mentioned by Polyanski (1961), quantitative and qualitative changes in parasitism are expected as the fish grows. Saad-Fares and Combes (1992) related that ontogenetical changes in the feeding behavior might have an influence on parasite prevalence and abundance in the host size classes. However, this pattern cannot be generalized because in many host-parasite species systems the correlation is positive but weak and non-significant (Saad-Fares and Combes, 1992; Poulin, 2000).

The present study increases the data on the biodiversity and enhances the knowledge of the helminthes with regard to public health importance, such as the nematodes of family Anisakidae. However, more information about host biology is needed to improve the interpretation of these parasitological patterns, in an ecological framework incorporating pertinent environmental and biological information, as recommended by Marcogliese (2001).

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