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Ectoparasitic crustaceans on mullet, *Mugil curema* (Osteichthyes: Mugilidae) in the coastal waters of Rio Grande do Norte State, Brazil

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ABSTRACT. White mullet is a commercial fish species abundant in the coastal waters of Brazil. This study investigated the occurrence of crustacean ectoparasites on white mullet, *Mugil curema* captured from the littoral waters of Rio Grande do Norte State, Brazil. From 2006 to 2007, 31 individuals of *M. curema* were captured and encountered ectoparasites were observed, identified and counted. *M. curema* was parasitized by ectoparasitic crustaceans, caligid copepods, *Caligus bonito* and *Caligus* sp.; ergasilid copepods, *Ergasilus versicolor* and *E. lizae*; and isopod *Cymothoa spinipalpa*. Of the caligids detected, 66.66% were *C. bonito* and 33.33% *Caligus* sp. *C. bonito* occurred on males of *M. curema* during the drought season and *Caligus* sp. occurred on females during the rainy season. The prevalence of both caligid species was 3.23%. Of the ergasilids detected, *E. versicolor* (91.67%) occurred during the drought and rainy seasons, whereas *E. lizae* (8.33%) occurred during the rainy season. Prevalence of *E. versicolor* was 35.48% and *E. lizae* was 3.23%. *C. spinipalpa* was detected during the drought and rainy seasons with a prevalence of 16.13%. The preferred site of fixation by the parasites was the branchial chambers.

Keywords: marine fish, caligids, isopod, ecological indices of parasites.

RESUMO. Crustáceos ectoparasitos em tainha, *Mugil curema* (Osteichthyes: Mugilidae) nas águas costeiras do Estado do Rio Grande do Norte, Brasil. As tainhas são peixes marinhos de valor comercial, abundantes em águas costeiras brasileiras. O presente estudo investigou a ocorrência de crustáceos ectoparasitos na tainha, *Mugil curema* no litoral do Rio Grande do Norte. Foram capturados 31 exemplares de *M. curema* no período de março de 2006 a março de 2007 e os ectoparasitos encontrados foram coletados, observados, identificados e quantificados. *M. curema* foi parasitado por vários crustáceos ectoparasitos: caligídeos: *Caligus bonito* e *Caligus* sp.; ergasilídeos: *Ergasilus versicolor* e *E. lizae*; e isópode *Cymothoa spinipalpa*. Dos caligídeos detectados 66,66% foi de *C. bonito* e 33,33% de *Caligus* sp. *Caligus bonito* ocorreu somente nos machos de *M. curema* durante a estação seca e *Caligus* sp. ocorreu somente nas fêmeas durante a estação de chuva. A prevalência de caligídeos foi 3,23%. Dos ergasilídeos detectados, *E. versicolor* (91,67%) ocorreu durante ambas as estações de chuva e seca, enquanto que *E. lizae* (8,33%) ocorreu somente durante a estação de chuva. A prevalência de *E. versicolor* foi 35,48% e de *E. lizae* foi 3,23%. Isópode *C. spinipalpa* foi encontrado no período seco e de chuva com uma prevalência de 16,13%. O local de fixação preferido pelos parasitos copépodos e isópodos foi a câmara branquial do *M. curema*.

Palavras-chave: peixe marinho, caligídeos, isópode, índices ecológicos parasitários.

Introduction

The great diversity of species of the fish fauna is a striking feature of the Brazilian coast, though few are really abundant. Around 440 fish species were recorded in the coastal waters of Rio Grande do Norte State, Brazil (SOARES, 1988; CAVALCANTI et al., 2004). Studies on parasitic copepods of marine fishes are still scarce in Brazil

because of the great diversity of ichthyofauna in its coastal waters. Many crustacean copepods and isopods are ectoparasites of fish and their infestation may affect the development, health and appearance of economically important fish species, thus rendering their marketing difficult (BOXSHALL; MONTÚ, 1997; FONSÊCA et al., 2000).

There are about 35 known species of copepod parasites on marine teleost fishes along the Brazilian coast, and their hosts mostly belong to the families Belontiidae, Scombridae, Mugilidae and Haemulidae (LUQUE; TAKEMOTO, 1996; TAKEMOTO; LUQUE, 2002; CAVALCANTI et al., 2004). The records of copepod parasites of marine fishes in Brazil were made by Schubert (1936), and Rocha et al. (1982). Amado and Rocha (1995) reported on three new species of copepod parasites of the genus *Ergasilus* (Poecilostomatoidea, Ergasilidae) collected from gill filaments of mugilid fish species from Brazil. Boxshall and Montú (1997) published a manual with all the records of copepod parasites of marine fishes in Brazil. Cavalcanti et al. (2005, 2006a, 2006b) reported on the occurrence of copepod parasites on marine fish from the coast of Natal, Rio Grande do Norte. Luque and Tavares (2007) established a record of copepods associated with fish from Brazil.

The parasitic isopod crustaceans inhabit the gill chamber, mouth and skin of the fish, which are easily identified with the naked eye (EIRAS et al., 2006; THATCHER, 2000; LIMA et al., 2005; THATCHER et al., 2007). Among the isopod crustaceans, species belonging to the family Cymothoidae are of special interest, because their hosts are fishes of commercial importance. Lima et al. (2005) observed the occurrence of isopod parasites in the fish serra, *Scomberomorus brasiliensis* (Collette, Russo & Zavala-Camin, 1978) in the coastal waters of Rio Grande do Norte State, Brazil. Thatcher et al. (2007) published the first record of *Cymothoa spinipalpa* (Isopoda: Cymothoidae) in the oral cavity of the marine fish, *Oligoplites saurus* in Rio Grande do Norte State.

Fish species of the family Mugilidae have wide geographic distribution and are represented by species found in tropical and subtropical waters around the world, especially in coastal waters and estuaries. Mulletts are abundant in the Brazilian aquatic ecosystems and they belonging to a single genus *Mugil*. The commercially exploited species of this genus in the coastal waters of Brazil are *M. liza* and *M. curema* (MENEZES; FIGUEIREDO, 1985). Mulletts have a greasy meat of good quality and are of commercial importance. They are sold fresh or salted and their eggs are much appreciated. This study investigated the occurrence of ectoparasitic crustaceans in mullet, *M. curema* (Osteichthyes: Mugilidae) from the coastal waters of Rio Grande do Norte State, Brazil.

Material and methods

Specimens of *Mugil curema* Valenciennes, 1836 were captured from the coastal waters located in the geographic coordinates 05° 47'42 "S and 35° 12'24" W of Rio Grande do Norte State. Fish samples were captured by local fishermen using beach-seines from the coastal waters of approximately 10 m depth, during the period from March 2006 to March 2007. The beach-seines were 110 m in length, 3 m in height, with a mesh size of 1 cm in the central part and 7 cm in the extremities. Fish collected from the beach-seine were numbered and samples of whole fish were used for morphometric and meristic analysis to confirm the taxonomical identification of the species (MENEZES, 1983; SOARES, 1988). The total length (cm) and body mass (g) of each fish was recorded. Rainfall data of the region was obtained from the Meteorological Department (EMPARN) of Natal, Brazil.

The body surface of each fish was checked for the presence of ectoparasites, and when detected they were carefully removed and observed under a stereoscope (Model TE TAIMIN 1L, coupled with a Kodo Digital video camera), processed and quantified using appropriate techniques (EIRAS et al., 2006; PAVANELLI et al., 2002). The taxonomic identification of parasites was performed in the Ichthyoparasitological Laboratory of the State University of Maringá, UEM, Paraná State.

All fishes were dissected and their gonads were examined to identify the sexes. The sex ratio of the host fish was verified by analyzing the monthly relative frequency distribution of males and females during the study period. To check the difference in the proportion of males and females fishes and to verify whether the difference was statistically significant, the χ^2 test (chi-square) at 5% level of significance was performed, using the software Statistica 7.0. Parasitic ecological indices were calculated and expressed according to Bush et al. (1997).

Results

Rainfall: The period from March to August, with a mean monthly rainfall of 222.8 mm, was considered the rainy season. Conversely, the period from September to February with a mean monthly rainfall of 57.4 mm was considered as the drought period.

Size of hosts: A total of 31 specimens of *M. curema* were necropsied, with total length ranging from 10.1 to 37.3 cm (21.04 ± 5.64) and total weight

varying from 11.5 to 696.6 g (127.97 ± 126.35). Among the specimens of *M. curema* captured, 22 were males and 9 were females, with significant difference in the sex ratio of males and females ($\chi^2 = 20.96$; $df = 1$; $p > 0.05$). Of the 31 specimens of *M. curema* collected, 16 were parasitized, being 10 males and 6 females. Considering the sex ratio of males and females – 71% and 29% respectively – there was no significant difference in the proportion of infected males and females ($\chi^2 = 0.45$; $df = 1$; $p < 0.05$).

Parasites found on *M. curema*: The copepods species encountered were: *Caligus bonito* (Wilson, 1905) (Figure 1a) and *Caligus* sp. (Müller, 1785); *Ergasilus versicolor* (Wilson, 1911) (Figure 1b) and *E. lizae* (Kroyer, 1863); and isopod *Cymothoa spinipalpa* (Thatcher et al., 2007) (Cymothoidae) (Figure 1c).

Parasitic ecological indices

The ergasilid species found on *M. curema* were *Ergasilus versicolor* (Wilson, 1911) and *E. lizae* (Kroyer, 1863). The species which showed the highest intensity was *E. versicolor*, with a representation of 406 individuals. During the rainy season an occurrence of 380 individuals was recorded and in the drought season 26 individuals were recorded.

Ergasilus versicolor was found during both seasons, being more frequent during the rainy season, while *E. lizae* was recorded only during the rainy season. *E. versicolor* showed high values of prevalence, mean abundance and mean intensity compared to *E. lizae* during the rainy season. However, during the drought season, *E. versicolor* showed low values of prevalence, mean abundance and mean intensity, and *E. lizae* was not registered during this season. The site of fixation preferred by the ergasilids was the gill chamber of the hosts (Table 1).

Caligus bonito was found only during the drought season, while *Caligus* sp. was found only during the

rainy season. On the other hand, *C. spinipalpa* was more prevalent during the drought period (Table 1).

Table 1. Parasitic ecological indices and standard deviation of *M. curema* (when $n > 1$) examined during the rainy and drought seasons during March 2006 to March 2007.

Parasites	Mean Intensity		Mean Abundance		Prevalence (%)	
	Drought	Rain	Drought	Rain	Drought	Rain
Copepoda						
<i>E. versicolor</i>	13 ± 12.73	42.22 ± 5.10	0.84 ± 0.41	12.26 ± 1.48	6.45	29.00
<i>E. lizae</i>	-	3.00	-	0.10	-	3.23
<i>C. bonito</i>	4.00	-	0.13	-	3.23	-
<i>Caligus</i> sp.	-	2.00	-	0.06	-	3.23
Isopoda						
<i>C. spinipalpa</i>	2.5 ± 1.73	1.00	0.32 ± 0.05	0.03	12.90	3.23

Parasitism in relation to sex of the host

During rainy season, all the parasites showed clear host specificity with respect to sex of the host *M. curema*, being more frequent in males (79.9%), specifically in immature males (47.93%) than in females (20.10%) ($\chi^2 = 35.76$; $df = 1$; $p > 0.05$). During the drought season, the parasites occurred only in males (100%) and the number of parasites ($n = 214$) was higher in immature males of *M. curema*.

Ergasilus versicolor showed clear host specificity as to the sex of the host, being more frequent in males (66.66%) than in females (33.33%) of *M. curema* during the rainy season, and only occurred in males during the drought season. On the other hand, *E. lizae* occurred only in females during the rainy season.

Parasitism and pluviometry

Caligus bonito occurred only during the drought period, while *E. lizae* and *Caligus* sp. occurred only during the rainy season. *E. versicolor* and the isopod *C. spinipalpa* occurred during both rainy and drought seasons (Figure 2).

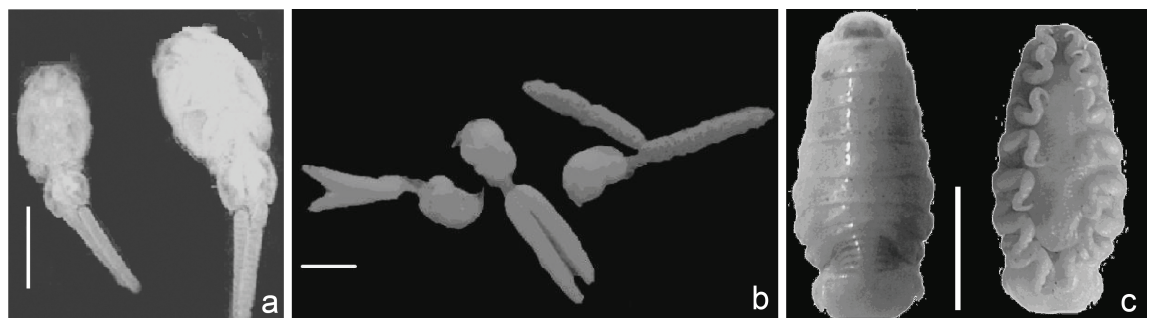


Figure 1. (a). Females of *Caligus bonito* with ovigerous sacs (scale = 1.5 mm); (b). Females of *Ergasilus versicolor* (scale = 1.5 mm); (c). Dorsal and ventral view of female isopod *Cymothoa spinipalpa* (scale = 8.5 mm) found in the gill chamber of *M. curema*

Caligus bonito occurred on males of *M. curema* during the drought season and *Caligus* sp. occurred in females during the rainy season. *E. versicolor* occurred during both the rainy and drought seasons and *E. lizae* occurred only during the rainy season. *C. spinipalpa* occurred during both the rainy and drought seasons. The preferred site of fixation of the parasitic copepods and isopod was the gill chamber of hosts.

Discussion

Fonsêca et al. (2000) investigated the copepod parasites found on mugilid fishes cultivated in estuarine fish ponds in Itamaracá, Pernambuco State. They identified the following ectoparasites on mullet, *M. liza*: *Ergasilus atafonensis*, *E. caraguatatubensis*, *E. lizae*; *Acanthocolax* sp.; *Caligus minimus* and *C. praetextus*, parasitizing the gills and skin of the host fish. The intensity of infestation was 0 to 12 copepods per fish.

Copepods *E. versicolor* and *E. lizae* were found in the gills of *M. platanus* (Günther), in the coastal waters of Rio de Janeiro (KNOFF et al., 1994), where prevalence values of 20.66% for *E. versicolor* and of 21.33% for *E. lizae* were verified. Comparing these data with the results obtained in this study, a low prevalence of *E. lizae* in *M. curema* was observed. This is possibly due to the high stocking density of cultivated fishes in ponds, which facilitates parasitic infestations.

The gills of the hosts were the preferred site of attachment by *C. bonito*. A similar occurrence was observed in the gills of *M. platanus* in the coast of Rio de Janeiro State, with a prevalence of 13.33% (KNOFF et al., 1994). This paper reports a low prevalence of caligids in *M. curema* in relation to the results obtained by Knoff et al. (1994) for *M. platanus*.

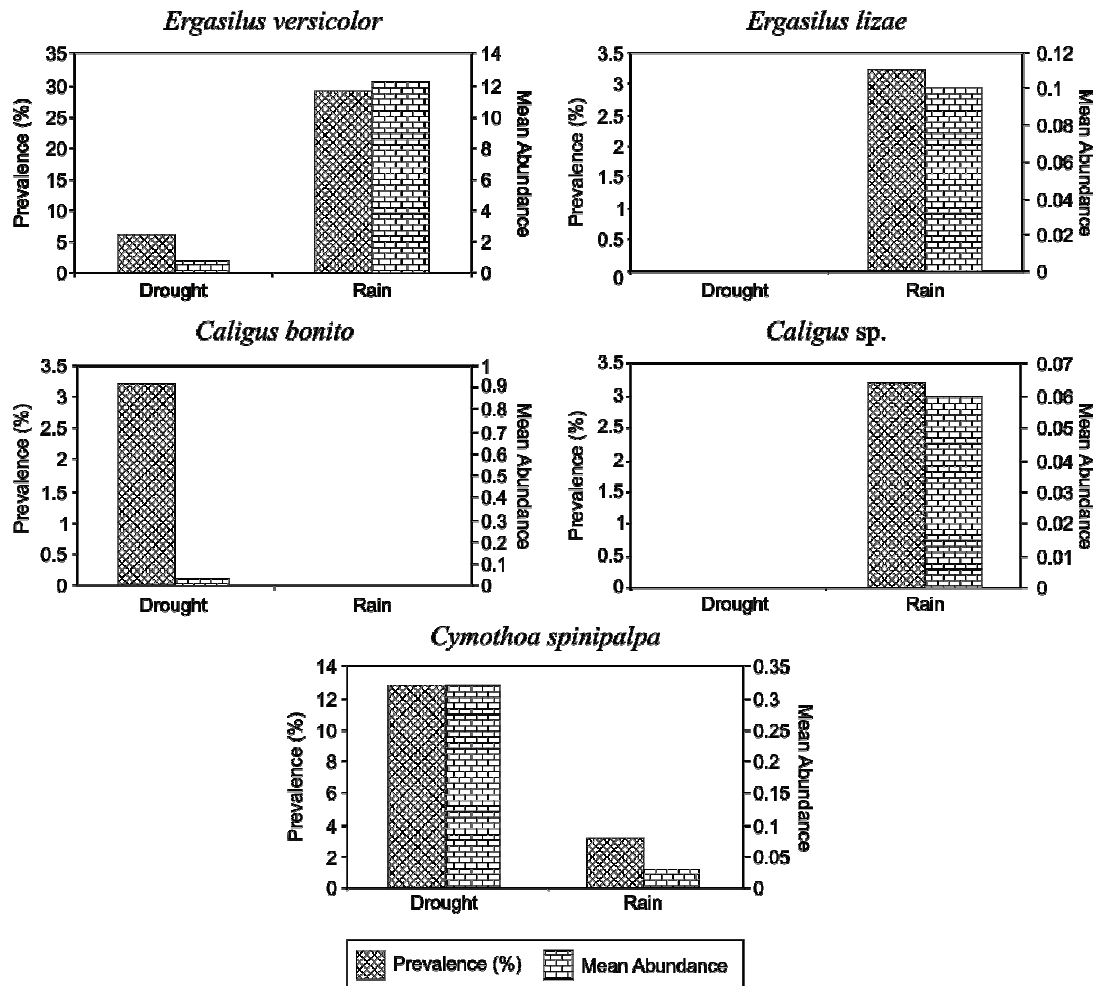


Figure 2. Values of Prevalence and Mean Abundance of crustacean ectoparasites on mullet, *M. curema* from the coastal waters of RN during periods of drought and rain.

Caligus bonito was found in carangid fish of the genus *Oligoplites* Gill (TAKEMOTO et al., 1993). Takemoto et al. (1996), conducted studies on comparative analysis of metazoan parasitic communities of *Oligoplites palometa*, *O. saurus* and *O. saliens* in Sepetiba Bay, Rio de Janeiro State, and they found *C. bonito* with a prevalence of 3.6%. The present study also reports a low prevalence of *C. bonito* on *M. curema*.

Lima et al. (2005) observed the occurrence of parasitic isopods in the fish serra, *Scomberomorus brasiliensis* (Collette, Russo & Cavala-Camin, 1978) in coastal waters of Rio Grande do Norte State, Brazil. Of the total fish captured, 31% was parasitized, where 86% was *Livoneca redmani* (Leach, 1818) (Cymothoidea) and 14% was *Rocinela signata* (Schioedt & Meinert, 1879).

Ergasilus versicolor and the isopod *C. spinipalpa* occurred during both seasons; as such, their presence was not influenced by the rainy and drought seasons. However, rain and drought influenced the occurrence of the parasites, *C. bonito*, *E. lizae* and *Caligus* sp. Rainfall is one of the environmental factors that may influence the parasitic infestation and the degree of temporal or permanent aggregation of host communities, which facilitates the contact with the larval stages of parasites (ROHDE et al., 1995; LUQUE; TAKEMOTO, 1996).

Conclusion

Present work confirms that *M. curema* was parasitized by ectoparasitic crustaceans, caligid copepods, *Caligus bonito* and *Caligus* sp.; ergasilid copepods, *Ergasilus versicolor* and *E. lizae*; and isopod *Cymothoa spinipalpa*. *C. bonito* occurred on males of *M. curema* during the drought season and *Caligus* sp. occurred on females during the rainy season. *E. versicolor* occurred during the drought and rainy seasons, whereas *E. lizae* occurred during the rainy season. The preferred site of fixation by the parasites was the branchial chambers.

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