



OCCURRENCE OF *Tuxophorus caligodes* WILSON, 1908 (COPEPODA: CALIGIDAE) A PARASITE OF *Echeneis naucrates* LINNAEUS, 1758 (ACTINOPTERYGII: ECHENEIDAE) OFF THE BRAZILIAN AMAZON COAST

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Submissão: 15/02/2023

Aceite: 19/07/2023

Publicação: 30/08/2023

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OCCURRENCE OF *Tuxophorus caligodes* WILSON, 1908 (COPEPODA: CALIGIDAE) A PARASITE OF *Echeneis naucrates* LINNAEUS, 1758 (ACTINOPTERYGII: ECHENEIDAE) OFF THE BRAZILIAN AMAZON COAST

ABSTRACT

In this paper, the first record of *Tuxophorus caligodes* Wilson, 1908 (Siphonostomatoida: Caligidae) off the North coast of Brazil is documented. This caligid copepod was found parasitizing the live sharksucker *Echeneis naucrates* Linnaeus, 1758 (Carangiformes: Echeneidae) a typical host of this parasitic copepod in the Atlantic waters.

Keywords: Caligid copepods; ectoparasites; sharksucker; Atlantic Ocean.

OCORRÊNCIA DE *Tuxophorus caligodes* WILSON, 1908 (COPEPODA: CALIGIDAE) PARASITO DE *Echeneis naucrates* LINNAEUS, 1758 (ACTINOPTERYGII: ECHENEIDAE) NA COSTA AMAZÔNICA BRASILEIRA

RESUMO

Neste trabalho, o primeiro registro de *Tuxophorus caligodes* Wilson, 1908 (Siphonostomatoida: Caligidae) na costa Norte do Brasil é documentado. Este copépode caligídeo foi encontrado parasitando uma rêmora *Echeneis naucrates* Linnaeus, 1758 (Carangiformes: Echeneidae) um típico hospedeiro deste copépode parasito em águas do Atlântico.

Palavras-chaves: Copépodes caligídeos; ectoparasito; rêmora; Oceano Atlântico.

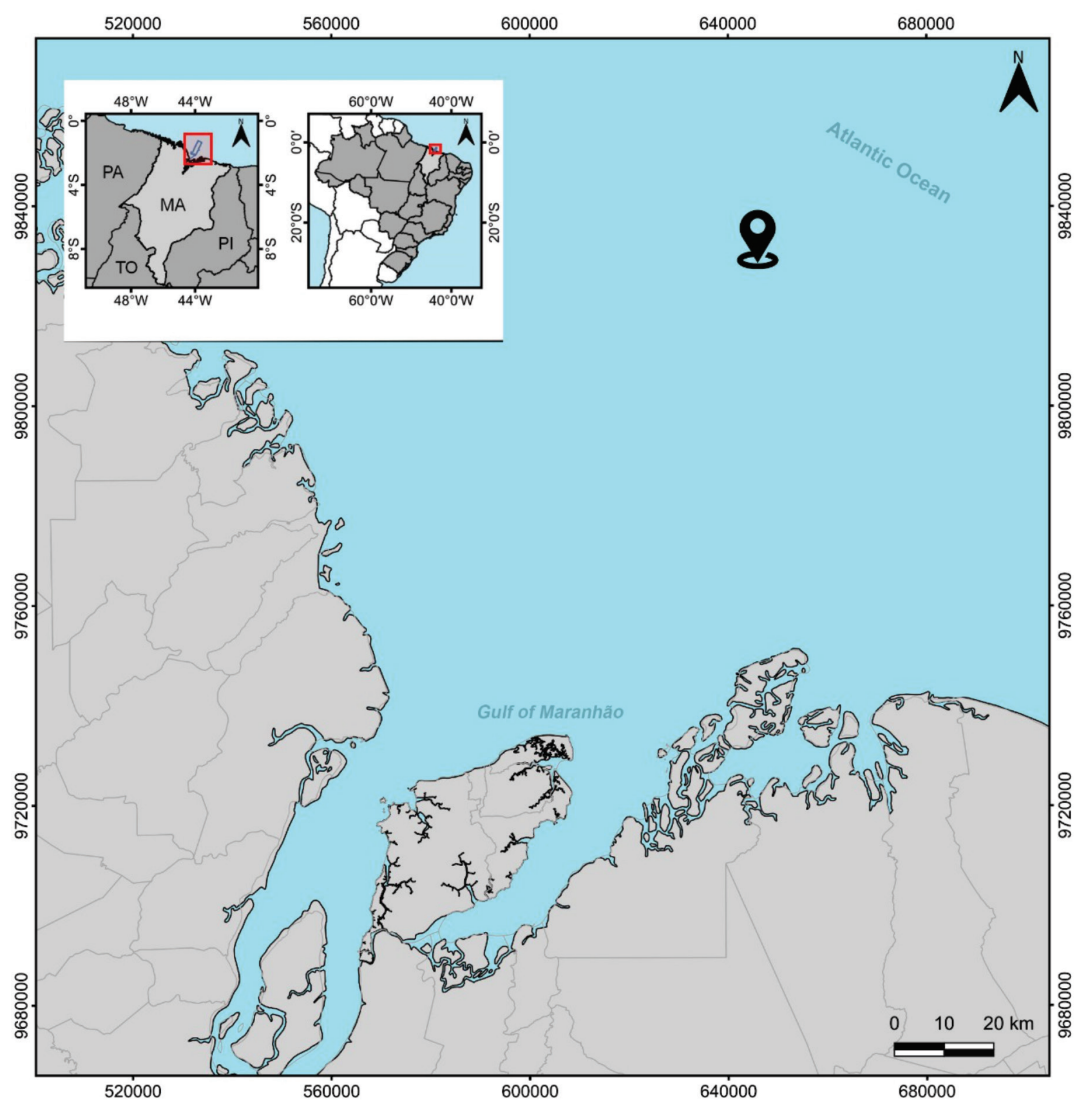
Caligid copepods represent one of the richest groups of crustacean parasites, currently including more than 400 species from 30 genera, distributed worldwide (Walter & Boxshall 2023). Most of these copepods are predominantly external parasites of fish, inhabiting the outer surface, the mouth, the gills and opercular cavity of their hosts (Boxshall & Halsey 2004; Ducatti et al. 2017). Representatives of the genus *Tuxophorus* Wilson, 1908 have a wide geographical distribution, found in the Indian, Atlantic and Pacific Oceans, parasitizing marine actinopterygian fish (Yamaguti 1963; Takemoto & Luque 2002; Dojiri & Ho 2013). In the seaboard of Brazil, only *T. caligodes* was recorded from the gills of *Mugil*

liza Valenciennes, 1836 (as *M. platanus*), *Oligoplites palometa* (Cuvier, 1832), *O. saliens* (Bloch, 1793), *O. saurus* (Bloch & Schneider, 1801), *Scomberomorus* sp., *Selene vomer* (Linnaeus, 1758) and *Trachinotus goodei* Jordan & Evermann, 1896, all records off the coast of Rio de Janeiro (Luque & Tavares 2007).

Representatives of the family Echeneidae (Carangiformes) comprise a singular group of fish, each characterized by the distinctly cephalic laminated adhesive disk which enables it to attach many different marine animals and objects (Cressey & Lachner 1970; Collete 2002). Echeneid fish are marine and can be found at the Atlantic, Pacific and Indian Oceans. In this fish family, about 8 species, included in 3 valid genera, are recognized from a wide geographic distribution and some species are host-specific (Nelson 2016; Fricke et al. 2022). *Echeneis naucrates* is the most common species of the Family Echeneidae, frequently found free-swimming in shallow inshore areas and around coral reefs. Nevertheless, displays the eclectic behavior and is known to attach to a wide variety of hosts including teleost fish, marine mammals, turtles and sharks, feeding mainly on pieces of its host's prey and parasites (Brunnschweiler & Sazima 2008; Froese & Pauly 2023).

A single specimen of *E. naucrates* (body length 56,8 cm, weight 465 g) was caught in September 2022 off the coastal zone of the State of Maranhão ($1^{\circ}32'47''\text{S}$; $43^{\circ}41'08''\text{W}$), Brazilian Amazon Coast (Figure 1).

Figure 1. Sampling area of the present study off the State of Maranhão, Brazil.

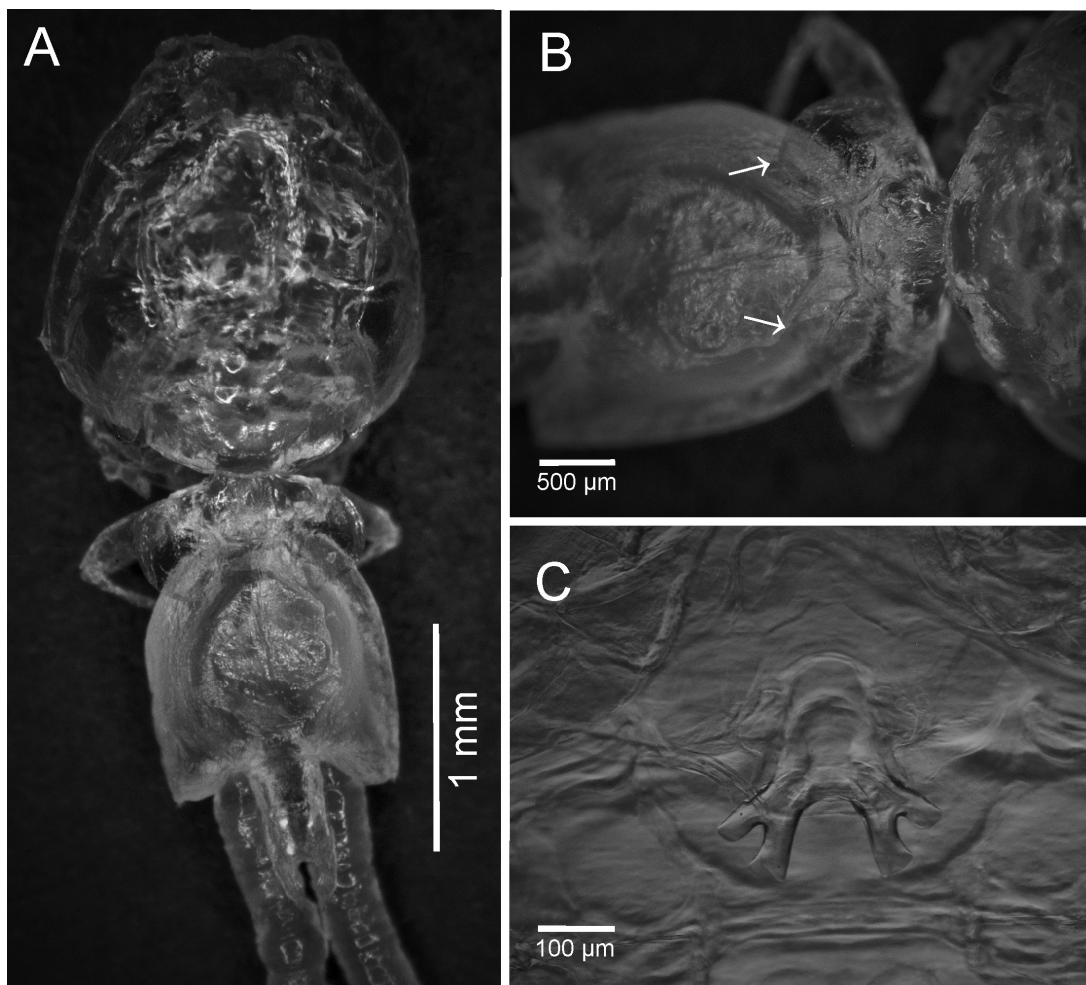


Copepods were removed from the fish surface, fixed in 70% alcohol, and subsequently cleared in a drop of 85% lactic acid before examination with a phase contrast microscope. Specimens were measured intact using an ocular micrometer, dissected and examined according to the wooden slide procedure of Humes & Gooding (1964). Measurements based on eight females are given in millimeters, with the mean followed by the range in parentheses. Host identification was based on the key of Marceniuk et al. (2021); the nomenclature and classification were updated according to Eschmeyer's Catalog of Fishes (Fricke et al. 2022). Voucher specimens of *T. caligodes* were deposited in the collection of the Museu de Zoologia da Universidade de São Paulo (MZUSP-43663), Brazil.

Based in the morphology of cephalothorax, genital process, abdomen, small appendages and body proportion, specimens of copepods collected in the coast of Maranhão corresponds to the description of *T. caligodes* given by Wilson (1908), Takemoto & Luque (2002) and Dojiri & Ho (2013). A total of eight females were collected from the host, all of them were attached to the external surface of the fish, near the operculum. No male individuals were found. Female specimens from the seaboard of Maranhão measured 4.88 (4.62 – 5.13) in total length; the present measure is very similar to the type specimens collected in Beaufort, North Carolina, USA 4.66 (4.55 – 4.78) and larger to the specimens collected in Rio de Janeiro, Brazil 4.38 (2.85 – 5.16) (Wilson 1908; Takemoto & Luque 2002; Dojiri & Ho 2013).

According to Dojiri & Ho (2013), the genus *Tuxophorus* is represented by six species, namely, *T. caligodes*, *T. cervicornis* Heegaard, 1962, *T. collettei* Cressey & Cressey, 1980, *T. cybii* Nuñez-Ruivo & Fourmanoir, 1956, *T. wilsoni* Kirtisinghe, 1937 and *T. zonichthi* Uma Devi & Shyamasundari, 1978. Members of *Tuxophorus* are morphologically similar to species of *Caligus* Müller, 1785, but the presence of dorsal aliform plates on the fourth pedigerous somite in their females (Figure 2) can easily distinguish them from *Caligus* (Boxshall & Halsey 2004; Dojiri & Ho 2013).

Figure 2. *Tuxophorus caligodes* Wilson, 1908 (adult female). A, habitus (dorsal); B, Detail of dorsal aliform plates on the fourth pedigerous somite, with arrow pointing its position (dorsal); C, Detail of sternal furca (ventral).



Tuxophorus caligodes was originally described by Wilson (1908) as predominantly parasitic on *E. naucrates* and a fish belong to the family Rachycentridae, i.e., *Rachycentron canadum* (Linnaeus, 1766). Since its description this species has been recorded parasitizing hosts of the families Belonidae, Carangidae, Mugilidae, Phycidae and Serranidae (Dojiri & Ho 2013). The probable dissemination of this caligid copepod on these bony fish may be based on the ability of this echeneid to be temporarily attached to its hosts, which may facilitate the transmission of some ectoparasites with a direct life cycle, such as copepods (Tavares & Luque 2004). According to Brunnschweiler & Sazima (2008), at least 30 different fish (e.g. batoids, jacks, parrotfishes, groupers) serve as host species for *E. naucrates* and it seems that no host is predominant. Therefore, it is reasonable to consider the possible flux of *T. caligodes* between *E. naucrates* and other fish.

Records of parasitic copepods off the coast of Maranhão are scarce and so far only two representatives of the Ergasilidae Burmeister, 1835 have been reported: *Ergasilus atafonensis* Amado & Rocha, 1996 and *E. caraguatatubensis* Amado & Rocha, 1996 both from *Mugil curema* Valenciennes, 1836 (Amado & Rocha 1996) off the São Luis City. Caligid copepods represent one of the most diverse families in number of species in Brazil, near 49 representatives are known (Luque & Tavares 2007; Luque et al. 2013). However, Brazil possesses the longest coastline in South America, extending for more than 7,000 km, harboring 1,238 fish species (Froese & Pauly 2023), but most of the records of Caligidae Burmeister, 1835 are concentrated off the State of Rio de Janeiro (Luque & Tavares 2006; Luque et al. 2013). Thus, the present study not only recorded *T. caligodes* for the first time in the Brazilian Amazon Coast, but also the first caligid copepod found in the coast of the State of Maranhão.

ACKNOWLEDGMENTS

Nivea Fernanda Ferreira was supported by Programa Institucional de Bolsas de Iniciação Científica (PIBIC), Brazil. Filipe Ribeiro Menks was supported by Programa Institucional de Bolsas de Iniciação Científica (PIBIC), Brazil. Fabiano Paschoal was supported by Fundação de Amparo à Pesquisa e ao Desenvolvimento Científico e Tecnológico do Maranhão (FAPEMA, Process no. 84516/2022), Brazil. Also thank to the crew members of the ship Ciências do Mar II of the Departamento de Oceanografia e Limnologia from the Universidade Federal do Maranhão, who helped us to catch the fish specimen.

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