Nauplius
THE JOURNAL OF THE BRAZILIAN CRUSTACEAN SOCIETY

e-ISSN 2358-2936
www.scielo.br/nau
www.crustacea.org.br

SHORT COMMUNICATION

First record of *Oithona attenuata* Farran, 1913 (Crustacea: Copepoda) from Brazil

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ZOOBANK: http://zoobank.org/urn:lsid:zoobank.org:pub:5761ED4C-A9E3-4A61-AB50-6537E7F192C1

ABSTRACT

Here, we report the first record of the marine copepod *Oithona attenuata* Farran, 1913, in Brazil, from a costal station near Cabo Frio Island, Arraial do Cabo Municipality, Rio de Janeiro State. Specimens were found during March and May 2011 in zooplankton samples obtained from horizontal hauls using a plankton-net with a 100μm mesh size, and mouth opening of 40 cm diameter.

KEYWORDS

Arraial do Cabo, Cyclopoida, geographic distribution, microcrustaceans, zooplankton

The order Cyclopoida consists of 44 families of mostly holoplanktonic species (Boxshall and Halsey, 2004), of which numerous members have been shown to be good indicators of the physical-chemical characteristics of water (Boltovskoy, 1981; Nishida, 1985; Dias and Araujo, 2006). Of these families, the Oithonidae Dana, 1853 stand out in terms of their occurrence frequency and abundance in the South Atlantic, particularly species of the genus *Oithona* Baird, 1843. The following species are known to occur along the Brazilian coast (Razouls *et al.*, 2018): *Oithona amazonica* Burckhardt, 1913, *Oithona atlantica* Farran, 1908, *Oithona bjornbergae* Ferrari and Bowman, 1980, *Oithona bowmani* Rocha, 1986, *Oithona fallax* Farran, 1913, *Oithona frigida* Giesbrecht, 1902, *Oithona gessneri* Kiefer, 1954, *Oithona oligohalina*

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SUBMITTED 26 February 2018
ACCEPTED 26 December 2018
PUBLISHED 28 March 2019

DOI 10.1590/2358-2936e2019001

Fonseca and Björnberg, 1976, *Oithona linearis* Giesbrecht, 1891, *Oithona nana* Giesbrecht, 1893, *Oithona plumifera* Baird, 1843, *Oithona pseudofrigida* Rosendorn, 1917, *Oithona robusta* Giesbrecht, 1891, *Oithona sapucaiae* Oliveira, 1945, *Oithona setigera* (Dana, 1849), *Oithona similis* Claus, 1866, *Oithona simplex* Farran, 1913, and *Oithona tenuis* Rosendorn, 1917. Different species of *Oithona* show different levels of adaptability to physical and hydrological parameters (Nishida, 1985) and include cosmopolitan species as well as those with narrower distribution ranges. They comprise both neritic and oceanic species that feed on smaller-sized organisms, such as heterotrophic and autotrophic protists and copepod nauplii (Yahia *et al.*, 2004). In turn, they are the more important food for fish larvae and other zooplanktivorous. Oithonids, therefore, may play a more important role in the transfer of both bacterial and algal carbon to higher trophic levels than previously thought (Hwang *et al.*, 2010). The species *Oithona attenuata* Farran, 1913 occurs only in the Southern Hemisphere, but has not yet been recorded on the Brazilian coast. However, this species has already been recorded in places of resurgence such as South Africa (Razouls *et al.*, 2018). In this present work we report the first record of *O. attenuata* in regions of upwelling currents in Brazil.

Weekly zooplankton samples were obtained for over three years (2010–2012) in Arraial do Cabo Municipality, Rio de Janeiro State, Brazil in a horizontal haul (3 min, ~1 m depth) using a 100 µm mesh 40 cm diameter WP2 plankton net in water of about 10 m deep (Fig. 1). Immediately after collection, samples were fixed in a 4% formalin solution diluted with seawater and previously buffered with sodium tetraborate. Copepod abundance (ind.m^{-3}) was estimated from three sub-samples taken with a modified Stempel pipette (2.68 ml) to a lower limit of 100 individuals (Frontier, 1981). Immediately after the hauls, water temperature (SST) was measured using a reverse thermometer mounted on the Nansen bottle and salinity using a Guildline salinometer. Copepods sorted from samples were identified and measured under a Zeiss Stemi SV6 stereo microscope. Measurements were taken with Zeiss Zen® software from pictures taken in petri dishes. The World Register of Marine Species - WoRMS website (http://www.marinespecies.org) was used to confirm the current species names. The entire field and laboratory procedure was performed with the assistance of the Instituto de Estudos do Mar Almirante Moreira (IEAPM). More details of the copepod assemblage can be found in the work by Rosa *et al.* (2016).

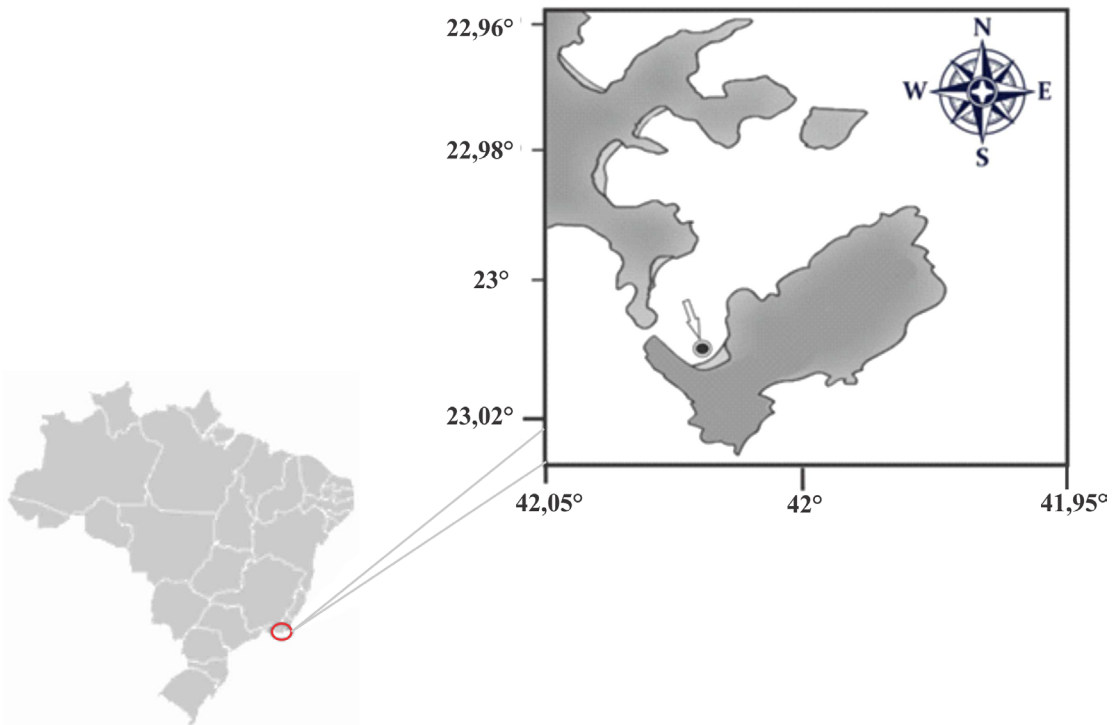

Figure 1. Map of the geographic location of Arraial do Cabo, state of Rio de Janeiro, Brazil.

The temperature and salinity at the sampling site off Cabo Frio Island (22°59'86"S, 42°00'28"W) were approximately 24.4°C and 35.9 psu, respectively, at the end of the austral summer (March) and approximately 24.5°C and 34.5 psu in autumn (May). The mean copepod abundance ranged between 92 and 125 ind.m^{-3} with higher densities found in more saline waters. In contrast, lower densities of copepods were found in less saline waters and constituted 17% of the Oithonidae collected over the two days of sampling. Over three years of monitoring, 6 individuals of *O. attenuata* were found in only two months: March and May 2011 (Fig. 2). Oithonidae species registered over the years include *O. simplex*, *O. oligohalina*, *O. plumifera*, and *O. setigera*. The size of *O. attenuata* females varied between 0.63 and 0.62 mm (prosoma 0.28 and 0.29 mm; depth the prosoma 0.12–0.14; urosoma 0.32–0.34 mm).

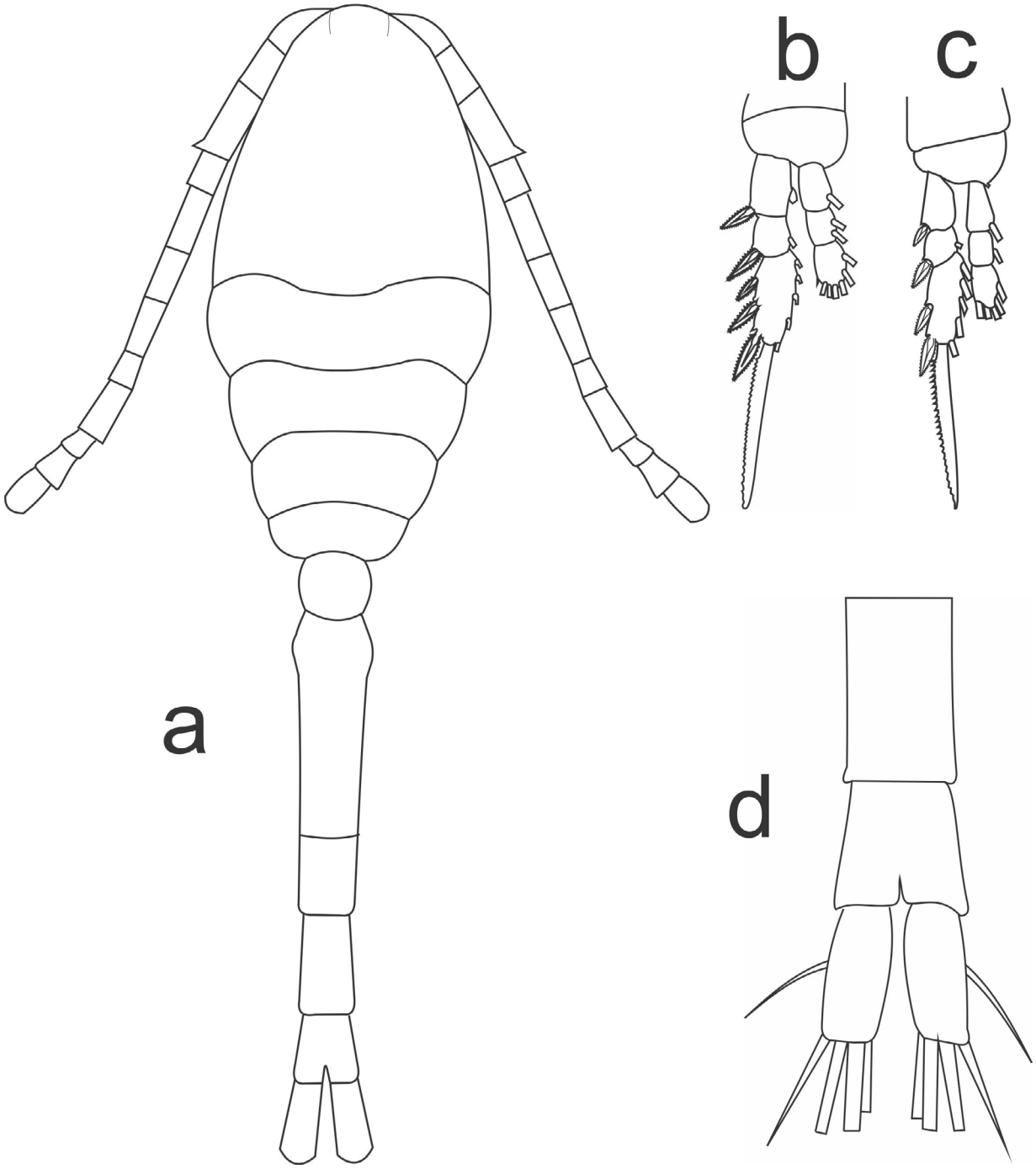

Figure 2. *Oithona attenuata* Farran, 1913. a, Whole body, dorsal view; b, leg 3; c, leg 4; d, furca.

Oithona attenuata is an epipelagic species most commonly found in the Mediterranean Sea (Lebanon Basin), Red Sea, Gulf of Oman, Arabian Sea and Arabian Gulf. It is also found throughout the Indian and tropical Pacific (W & central) oceans. More specifically, this includes: out off South Africa (Cape of Good Hope, Eastern side), the Maldives, Madagascar (Nosy Bé), Seychelles, Nicobar Is., Christmas Is., Straits of Malacca, Indonesia-Malaysia, Samoa (Pago Pago Harbour), China (Yellow Sea, East China Sea, South China Sea), Pa-Li, Taiwan (E, S, SW, W, NE, Tapong Bay, Danshuei Estuary), South Korea, Japan, Palau, W Baja California (Bahia Magdalena), Australia (Melbourne, Great Barrier, Exmouth Gulf, North West Cape, G. of Carpentaria) and Chile (Razouls *et al.*, 2018).

Diagnosis of *O. attenuata*: Swimming legs (P1) exopodite and endopodite 3-segmentend; caudal rami (CR) with 6 plumose setae; swimming legs (P1–P4) exopodite outer spine formula otherwise arranged (*Oithona*). Forehead not produced into pointed rostrum (R). Swimming legs (P4) exopodite 3 with 2 outer spines. Free segment of swimming legs (P5) with only 1 terminal seta or 1 terminal seta and 1 marginal spinule. Mandible B with 1 strong spinulose spine and 1 fine seta on distal end. Maxillule 1 endopod with 4 setae; maxillule (Mx) 1 lobe 1 distal marginal setae about twice longer than other setae. Caudal rami (CR) about 4 times longer than wide. The sister species *O. nana* has the following characteristics: Caudal rami (CR) 20–27 times longer than wide; maxillule 1, maxilla 2, endites (Li1) with marginal distal seta similar in length to other setae.

Oithona attenuata is recorded here for the first time off Brazil, even though several studies had previously been conducted in the same place (Valentin, 1984; Dias and Araujo, 2006; Dias *et al.*, 2010; Rosa and Monteiro-Ribas, 2012; Rosa *et al.*, 2016). Its absence in plankton samples over the last 30 years leads us to suggest that this species was brought to Brazilian waters as an exotic species. The study site is close (less than two miles) to the Arraial do Cabo harbor, where foreign ships rarely discharge ballast water. The potential of *O. attenuata* to become an introduced species depends upon its resilience and ability to adapt to the new environment (Villac *et al.*, 2009). In other words, it'd have to be some advantage in feeding or reproduction over native species that have similar environmental requirements, namely *Dioithona oculata* (Farran, 1913), *O. nana*, *O. oligohalina* and *Oithona simplex quinquesetosa* Früchtl, 1923 among others (Razouls *et al.*, 2018), to be successfully introduced. Exotic copepods that have been successfully introduced off the Brazilian coast include: *Temora turbinata* (Dana, 1849), *Pseudodiaptomus trihamatus* Wright, 1937, *Apocyclops borneoensis* Lindberg, 1954, *Paracyclopina longifurca* (Sewell, 1924), *Phyllopodopsyllus setouchiensis* Kitazima, 1981. Furthermore, another exotic species, *Pontella marplatensis* Ramirez, 1966 (Pontellidae), was also recorded for the first time in the same region off Arraial do Cabo in September 2010 (Rosa and Monteiro-Ribas, 2012). It was described from the Argentine Sea (Mar del Plata) by Ramirez (1966) and had since also been found off Texas (Gulf of Mexico) (Waggett and Buskey, 2008). There is a hypothesis that *O. attenuata* may have come from the Indian Ocean from a whirlwind and arriving in Brazil, because according to Villar *et al.* (2015) plankton can be transported in this way. The absence of more individuals in samples collected during ongoing monitoring in the following months lead us to conclude that *O. attenuata* did not successfully reach the status of an introduced species. Since little is known about the rate of introduction, as more exotic species are recorded in the literature, the more confident our results in addressing the risk of unintended introductions off the Brazilian Coast will be.

Acknowledgements

We thank FAPERJ – Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro for their financial support (E26/110.220/2011), training scholarship and technical training (enrollment - 2011.3807.5).

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