Brazilian Journal of Biology
ISSN 1519-6984 (Print)
ISSN 1678-4375 (Online)

https://doi.org/10.1590/1519-6984.183672
Notes and Comments

First record of the non-native copepod *Pseudodiaptomus trihamatus* Wright, 1937 (Copepoda, Calanoida) in Rio de Janeiro state, Brazil.

G. M. Rocha[a], J. C. Féres[a], B. S. Esteves[b] and J. M. Sterza[a]*

[a]Ethica Ambiental Serviços e Consultoria Ltda., Rua Anésio Alvarenga, 276, Praia da Costa, CEP 29101-230, Vila Velha, ES, Brasil

[b]Porto do Açu Operações S.A., Fazenda Saco Dantas, s/n, São João da Barra, CEP 28200-000, Rio de Janeiro, RJ, Brasil

*e-mail: gusmrocha@uol.com.br

Received: August 10, 2017 – Accepted: October 27, 2017 – Distributed: May 31, 2019
(With 2 figures)

Pseudodiaptomus trihamatus Wright, 1937 is originally from Indo-pacific coast (Walter, 1984) and was introduced in Brazil in 1977. Its distribution in northeastern Brazilian territory is documented on different papers (Medeiros et al., 1991, 2006; Ferreira et al., 2009; Santos et al., 2009; Almeida et al., 2012). These studies point out the importance of monitoring the expansion scenario of this species.

This note presents the first record of *P. trihamatus* in southeastern Brazilian coast (Rio de Janeiro state), handing an updated scenario of its distribution and helping understand its environmental requirements for dispersion and establishment in new environments.

The occurrence of *P. trihamatus* was observed in October 2015 in a plankton sample from Açu lagoon, located between Campos dos Goytacazes and São João da Barra Municipalities, Rio de Janeiro state, during biological surveys carried out for two years. We filtered 200 L using 50 μm plankton net and fixed with 4% formalin solutions. Salinity was measured by a portable Hanna Multiparameter.

Açu lagoon has a 10 kilometer extension parallel to shoreline and it is strongly influenced by coastal waters due to artificial connections to ocean, marine water percolation and marine spray (Chagas and Suzuki, 2005). As a consequence, water salinity reaches 43.2 (Sterza et al., 2002).

General view and taxonomic features of the collected *P. trihamatus* specimens are shown in Figures 1A-E (female) and Figures 2A, B (male). Both specimens presents all taxonomic characteristics that describes this species, however, the number of spinules on the female left posterodorsal margin of the Urosome differs. The female collected in this study presents three spinules (see Figure 1C) and not two, as registered by the taxonomic description of this species (Walter, 1984; Walter et al., 2006).

Pseudodiaptomus trihamatus is the only species among *Pseudodiaptomus* that presents registered occurrence and even indications of reproduction activity in salinity over 42, (even up to 70) in Brazilian waters (see Medeiros et al., 2006; Matsumura-Tundisi and Tundisi, 2007 for the Genus salinity range of occurrence in Brazil). This species can also occur in freshwaters (Oka et al., 1991). Therefore, its tolerance to a wide salinity range makes it extremely competitive in comparison to native species, increasing dispersal and adaptation potential. It is well known that non-native *Pseudodiaptomus* may cause changes in native plankton communities, replacing species of the same Genus (Cordell et al., 2008).

During our surveys at Açu lagoon, salinity was 24.81 on average, with a peak of 74 in September 2015, one month earlier than *P. trihamatus* registration. Density was 10 ind./m^3 on October 2015 (see Table 1), similar to previously found in other study in Brazil (Almeida et al., 2012).

Pseudodiaptomus copepodits presented 120 ind./m^3 in the same month as *P. trihamatus* adults. Thus, despite the absence of female carrying eggs in the samples, *P. trihamatus* could present reproductive potential at Açu lagoon. Those copepodits could also be from the native *P. acutus*. It was registered in August 2015, but not found anymore on Açu lagoon (see Table 1).

Medeiros et al. (2006) suggests that *P. trihamatus* most likely would be driven to Amazon River, on Brazilian north region, regarding to local marine currents. However, we registered this species on the southeastern region, which do not excludes dispersion route suggested by that author, but reveals new alternatives for natural dispersion (Havel and Shurin, 2004) and/or introduction (Dibacco et al., 2012) from north to south of Brazilian territory. It is also possible an unregistered occurrence of this species between Rio de Janeiro and Pernambuco, southernmost region of its occurrence until now (Santos et al., 2009), considering that plankton diversity is not well studied along Bahia and Espírito Santo states. In addition, some studies discuss the possible independent introductions from Asia to different parts of Brazil of this non-native species (Medeiros et al., 2006; Santos et al., 2009). Table 2 shows an updated scenario of *P. trihamatus* distribution along Brazilian coast.

Açu lagoon is under influence of fishing and livestock activities, is located on a Harbor Industrial District and has history of shrimp farming on a nearby lagoon (Salgada) during the 60's (unpublished data). Therefore, the complexity of this environment makes it difficult to identify the exact route of *P. trihamatus* introduction. The presence of this species is diagnostic of the vulnerability of this environment. Therefore continued monitoring of its presence and possible establishment in Açu lagoon

and also in Brazilian southeastern region is required for a better understanding of its ecological relation with native species and implications for the local biological community.

As far as we know, morphological difference observed on *P. trihamatus* female sampled was not described in any other paper. This difference may be a punctual individual anomaly or a taxonomic feature from an isolated

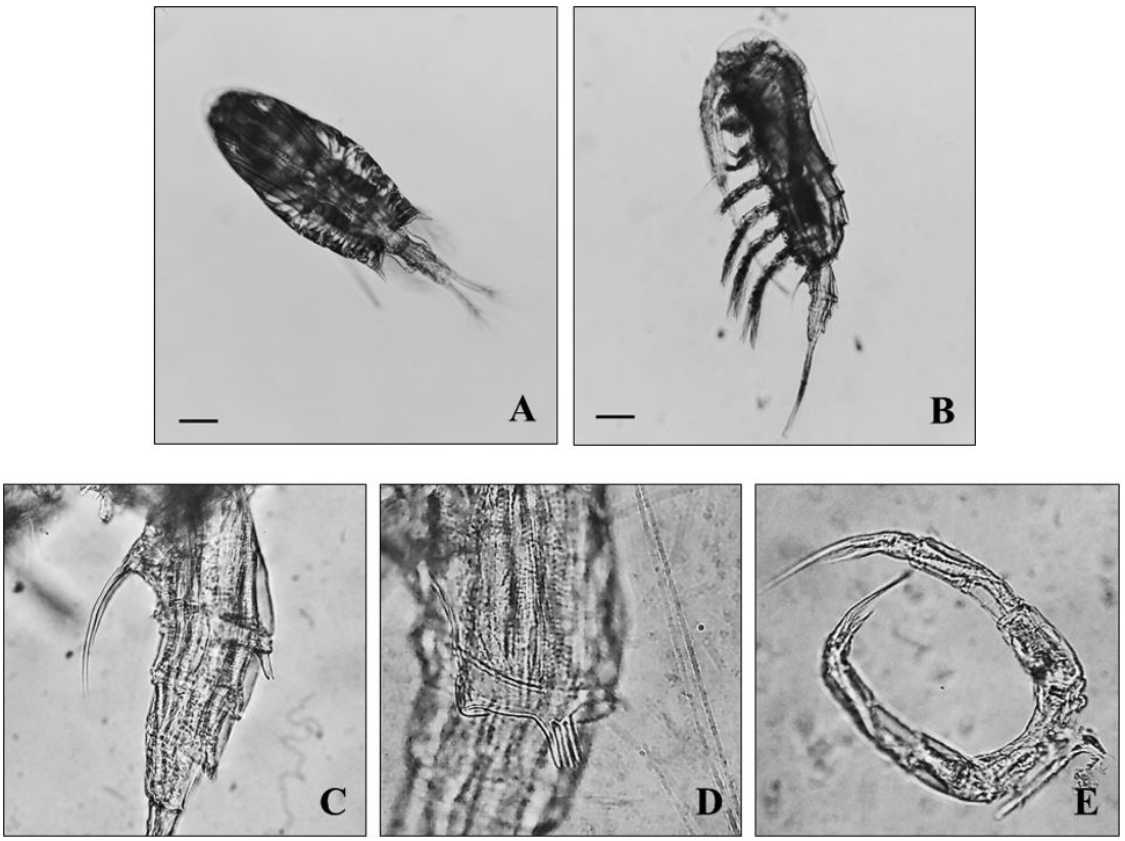

Figure 1. *Pseudodiaptomus trihamatus* female general view and taxonomic features. (A) dorsal view; (B) lateral view; (C) two long spines on the genital somite ventral portion; (D) three spines on the genital somite left posterodorsal portion; and (E) fifth leg.

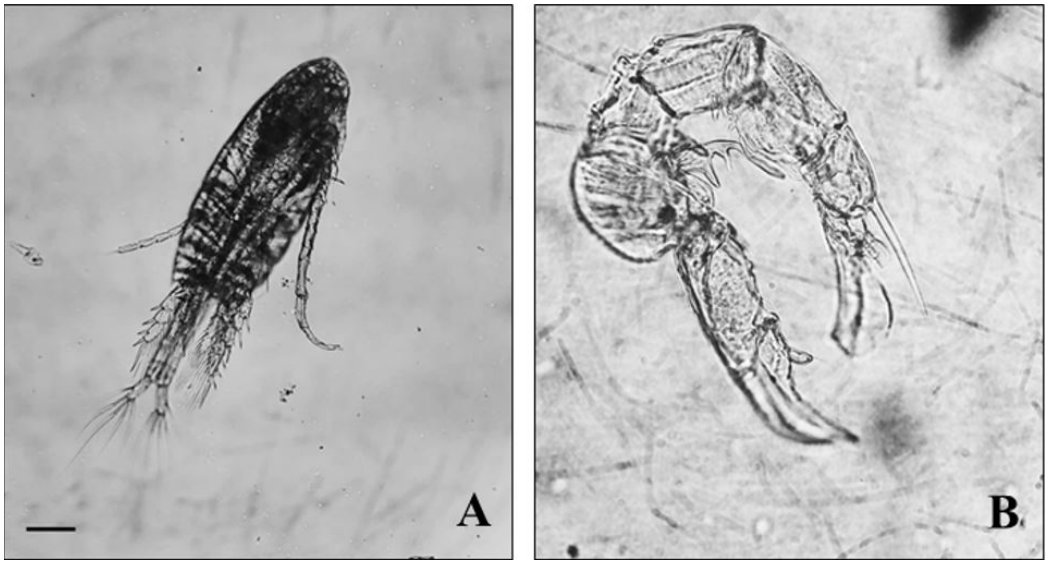

Figure 2. *Pseudodiaptomus trihamatus* male general view and taxonomic features. (A) dorsal view; and (B) fifth leg.

Table 1. Density (ind./m^3) of *Pseudodiaptomus* species at Açu Lagoon (coordinates: 21°55' and 22°00'S; 40°57'and 41°00'W) with its respective salinity.

Period	*Pseudodiaptomus* spp (copepodito)	*P. acutus*	*P. trihamatus*	Salinity (‰)
May/14	0	0	0	13.59
July/14	0	0	0	13.57
January/15	0	0	0	14.14
March/15	0	0	0	16.83
April/15	0	0	0	27.03
July /15	0	0	0	19.33
August/15	0	700	0	25.49
September/15	200	0	0	74.00
October/15	120	0	10	28.49
November/15	0	0	0	32.07
December/15	0	0	0	30.81
January /16	0	0	0	31.39
February/16	0	0	0	31.82
March /16	0	0	0	38.00

Table 2. Information from environments where *Pseudodisptomus trihamatus* was registered in Brazil.

Reference	Collected year	State	Salinity (‰)	Environment	Density (Ind./m^3)
Medeiros et al. (1991)	1977	Rio Grande do Norte	----	Potengí River estuary	----
Medeiros et al. (2006)	2001- 2005	Rio Grande do Norte and Ceará	18-70	Estuarine and coastal waters	----
Santos et al. (2009)	2006	Pernambuco	6.5-9.9	Pina Basin (estuarine area)	0.14-1.29
Almeida et al. (2012)	2005	Rio Grande do Norte	36-38	Guaraíras Lagoon (Costal lagoon)	10
This papper	2015	Rio de Janeiro	13.6-74	Açu Lagoon (Costal lagoon)	10

population in southeastern Brazil. Continuous surveys on Açu lagoon gathering adequate number of specimens and also molecular studies involving different populations could help with further conclusions (Achinelly et al., 2016). Genetic distance could also elucidate the closest related populations helping understand the source of this introduction (Miglietta et al., 2015).

References

ACHINELLY, M.F., ELICECHE, D.P., BELAICH, M.N. and GHIRINGHELLI, P.D., 2016. Variability study of entomopathogenic nematode populations (Heterorhabditidae) from Argentina. *Brazilian Journal of Biology = Revista Brasileira de Biologia*, vol. 77, no. 3, pp. 569-579. http://dx.doi.org/10.1590/1519-6984.20015. PMid:27783765.

ALMEIDA, L.R.D., COSTA, I.S. and ESKINAZI-SANT'ANNA, E.M., 2012. Composition and abundance of zooplankton community of an impacted estuarine lagoon in Northeast Brazil. *Brazilian Journal of Biology = Revista Brasileira de Biologia*, vol. 72, no. 1, pp. 12-24. http://dx.doi.org/10.1590/S1519-69842012000100002. PMid:22437380.

CHAGAS, G.G. and SUZUKI, M.S., 2005. Seasonal hydrochemical variation in a tropical coastal lagoon (Açu Lagoon, Brazil). *Brazilian Journal of Biology = Revista Brasileira de Biologia*, vol. 65, no. 4, pp. 597-607. http://dx.doi.org/10.1590/S1519-69842005000400006. PMid:16532183.

CORDELL, J.R., BOLLENS, S.M., DRAHEIM, R. and SYTSMA, M., 2008. Asian copepods on the move: recent invasions in the Columbia-Snake River system, USA. *Journal du Conseil*, vol. 65, no. 5, pp. 753-758. http://dx.doi.org/10.1093/icesjms/fsm195.

DIBACCO, C., HUMPHREY, D.B., NASMITH, L.E. and LEVINGS, C.D., 2012. Ballast water transport of non-indigenous zooplankton to Canadian ports. *Journal du Conseil*, vol. 69, no. 3, pp. 483-491. http://dx.doi.org/10.1093/icesjms/fsr133.

FERREIRA, C.E.L., JUNQUEIRA, A.D.O.R., VILLAC, M.C. and LOPES, R.M., 2009. Marine bioinvasions in the Brazilian coast: brief report on history of events, vectors, ecology, impacts and management of non-indigenous species. In: G. RILOV and J.A. CROOKS, eds. *Biological invasions in marine ecosystems*. Berlin: Springer, pp. 459-477. http://dx.doi.org/10.1007/978-3-540-79236-9_27.

HAVEL, J.E. and SHURIN, J.B., 2004. Mechanisms, effects, and scales of dispersal in freshwater zooplankton. *Limnology and Oceanography*, vol. 49, no. 4, pp. 1229-1238. http://dx.doi.org/10.4319/lo.2004.49.4_part_2.1229.

MATSUMURA-TUNDISI, T. and TUNDISI, J.G., 2007. Occurrence of *Pseudodiaptomus gracilis* (F. Dahl, 1894), Copepoda, Calanoida in amazonian fresh waters. *Brazilian Journal of Biology = Revista Brasileira de Biologia*, vol. 67, no. 3, pp.

585-586. http://dx.doi.org/10.1590/S1519-69842007000300029. PMid:18094847.

MEDEIROS, G.F., MEDEIROS, L.S., HENRIQUES, D.M., CARLOS, M.T., FAUSTINO, G.V.B.D.S. and LOPES, R.M., 2006. Current distribution of the exotic copepod *Pseudodiaptomus trihamatus* Wright, 1937 along the northeastern coast of Brazil. *Brazilian Journal of Oceanography*, vol. 54, no. 4, pp. 241-245. http://dx.doi.org/10.1590/S1679-87592006000300008.

MEDEIROS, G.F., ROCHA, C.E.F. and SILVA, M.L., 1991. A note on the occurrence of *Pseudodiaptomus trihamatus* Wright, 1937 (Crustacea: Copepoda) in Natal, Brazil. *Boletim of the Department of Oceanography and Limnology*, vol. 8, pp. 113.

MIGLIETTA, M.P., ODEGARD, D., FAURE, B. and FAUCCI, A., 2015. Barcoding Techniques Help Tracking the Evolutionary History of the Introduced Species *Pennaria disticha* (Hydrozoa, Cnidaria). *PLoS One*, vol. 10, no. 12, pp. e0144762. http://dx.doi.org/10.1371/journal.pone.0144762. PMid:26657561.

OKA, S., SAISHO, T. and HIROTA, R., 1991. *Pseudodiaptomus* (Crustacea, Copepoda) in the brackish waters of mangrove regions in the Nansei Islands, southwestern Japan. *Nihon Seibutsu Chiri Gakkai Kaiho*, vol. 46, pp. 83-88.

SANTOS, D.A., GARCIA-DIAZ, X.F., GUSMÃO, L.M.O. and SCHWAMBORN, R., 2009. Registro do Copepoda exótico *Pseudodiaptomus trihamatus* Wright, 1937 no estado de Pernambuco (Brasil). *Revista Brasileira de Engenharia de Pesca*, vol. 4, no. 1, pp. 124-133.

STERZA, J.M., SUZUKI, M.S. and TAOUIL, A., 2002. Resposta do zooplâncton a adição de nutrients inorgânicos (N e P) em mesocosmos na lagoa do Açu, Campos dos Goytacazes/São João da Barra, RJ. *Acta Limnologica Brasiliensia*, vol. 14, no. 2, pp. 87-94.

WALTER, T.C., 1984. New species of *Pseudodiaptomus* from the Indo-Pacific, with a clarification of *P. aurivilli* and *P. mertoni* (Crustacea: Copepoda: Calanoida). *Proceedings of the Biological Society of Washington*, vol. 97, no. 2, pp. 369-391.

WALTER, T.C., OHTSUKA, S. and CASTILLO, L.V., 2006. A new species of *Pseudodiaptomus* (Crustacea: Copepoda: Calanoida) from the Philippines, with a key to pseudodiaptomids from the Philippines and comments on the status of the genus *Schmackeria*. *Proceedings of the Biological Society of Washington*, vol. 119, no. 2, pp. 202-221. http://dx.doi.org/10.2988/0006-324X(2006)119[202:ANSOPC]2.0.CO;2.