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## First zoeal stage of the partner shrimp *Periclimenes paivai* Chace, with remarks on the genus *Periclimenes* O.G. Costa (Caridea, Palaemonidae)

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### Abstract

The morphology of the first zoeal stage of *Periclimenes paivai* Chace is described and illustrated for the first time. Larvae were obtained from three females with embryos, caught in the type locality (Cananéia, São Paulo state, Brazil). The morphological characters are detailed and compared with all previous descriptions of larvae in the genus (*P. amethysteus*, *P. brevicarpalis*, *P. diversipes*, *P. pandionis*, *P. sagittifer* and *P. soror*). The zoeae I of *Periclimenes* species are very similar, but *P. paivai* can be separated from the other six species by means of five characteristics: 8 plumose setae on the inner margin of the antennal scale, one spine on the endopod of the maxillule, one cuspidate seta on the basal endite of the maxillule, one plumose seta on the single coxal endite of the maxilla, and one plumose seta on the endopod of the maxilla. Remarks from a comparative analysis of available descriptions of the genus are furnished.

**Key words:** Crustacea, Decapoda, larval development, Pontoniinae, zoea

### Introduction

The palaemonid genus *Periclimenes* O.G. Costa is composed by over 152 species occurring in tropical and subtropical seas of the world. This is the fifth most speciose genus of caridean shrimps, after *Caridina* H. Milne Edwards (Atyidae, 290 species), *Alpheus* Fabricius (Alpheidae, 286), *Macrobrachium* Spence Bate (Palaemonidae, 243) and *Synalpheus* Spence Bate (Alpheidae, 159) (see Chace & Bruce 1993; De Grave & Fransen 2011 for revision).

The monophyletic status of these mega-genera has been discussed in recent years, and this ranking may substantially alter with phylogenetic studies (De Grave & Fransen 2011; Kou *et al.* 2013). In some cases the analysis of the larval morphology is key information, and can help to solve unclear classification and specific problems (Pohle & Marques 2000).

For the speciose genus *Periclimenes*, until now the first larval stage has been described for only six species: *Periclimenes amethysteus* (Risso), *P. brevicarpalis* (Schenkel), *P. diversipes* Kemp, *P. pandionis* Holthuis, *P. sagittifer* (Norman), and *P. soror* Nobili. The existing descriptions of the first larvae of five species [*P. agag* Kemp by Gurney (1938), *P. americanus* Kingsley by Kurata (1970), *P. calmani* Tattersall by Gurney (1927), *P. grandis* Stimpson by Gurney (1938) and *P. indicus* Kemp by Menon (1948)] were not included in our tables because they were moved to different genera and/or were synonymized, and are not now considered members of the genus *Periclimenes* (see De Grave and Fransen 2011). However, a brief comparison of the larval morphology of these species with our results is performed.

On the Brazilian coast, *Periclimenes* is represented by four species: *P. guarapari* De Grave, *P. magnus* Holthuis, *P. paivai* Chace and *P. yucatanicus* (Ives) (Vieira *et al.* 2012). *Periclimenes paivai* is endemic to the western Atlantic coast, and is restricted to shallow waters of Brazil from Rio de Janeiro to Santa Catarina (Pantaleão *et al.* in preparation). In general, shrimps of the subfamily Pontoniinae are commonly found associated

distinct rostrum; a smooth abdomen; and a telson posterior margin nearly straight or with a small median notch; the first two pereopods present as biramous buds; and the maxillipeds all developed, with four plumose setae on the posterior end of the exopod. However, it is important to remember that there are only seven zoea I known of a total of 152 species, and generalizations should be made cautiously.

For the species in which the first zoea is known, and which have been recently relocated from the genus *Periclimenes* (*P. agag*, *P. americanus*, *P. calmani*, *P. grandis* and *P. indicus*), we found some differences in the patterns of the morphological characteristics, from those in species of *Periclimenes*: the exopod of the first maxilliped of *P. calmani* may have only three setae, and this species have a pair of lateral spines on the fifth segment of abdomen (Gurney 1927); two species (*P. calmani* and *P. indicus*) have three pereopod buds (Gurney 1927; Menon 1948), while all *Periclimenes* species have a maximum of two (Table 2); *P. americanus* shows six segments on the antennal scale (Kurata 1970), while the others show a maximum of five (Table 2).

Apart from these differences, is possible to find some similarities between these two groups of species. *Periclimenes calmani* shares a 4-segmented endopod of the second maxilliped and a bilobed endopod of the maxilla with *P. soror* (Gurney 1927; Wear 1976); and all species which have been relocated of the genus have some characteristics (the number of setae on the antennal scale, the number of setae at the posterior end of the exopod of the maxillipeds, and one plumose setae plus one spine on the endopod of antenna) (Gurney 1927, 1938; Menon 1948; Kurata 1970) in common with the majority of *Periclimenes* species (Table 2). One possible explanation is that differences probably appear in subsequent stages of development.

As illustrated by this review, there is a clear need for further studies on the larval morphology of the genus *Periclimenes* and related genera, which would enable a clearer understanding of the phylogenetic relationships of the group in the future. Furthermore, the combination of a morphological analysis, including all zoeal stages if possible, with a molecular analysis could expand our understanding of the evolution of the genus.

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