Short Note

Phytophilous caridean shrimps (Atyidae and Palaemonidae) in Salsa river (Canavieiras, Bahia, Brazil)

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Abstract - This paper evaluates the role of three species of macrophytes in the population of caridean shrimps in the Salsa river (Northeastern of Brazil). Results revealed that macrophytes have important functions and directly responsible for modulating the spatial distribution of these shrimp species.

Key words: Caridea, ecological aspects, habitat preferences, phytophilous shrimps, Salsa river.

Aquatic macrophytes carry significant ecological importance due to their use as areas of protection, reproduction and nursery for a wide range of organisms, especially invertebrates. Moreover, their submersed stem and roots retain considerable amounts of particulate matter and debris, which can be used as components in the diet of aggregate species. Organisms that are associated with these macrophytes are known as phytophilous (for review see Thomaz and Bini, 2003, Thomaz and Cunha, 2010).

A large part of phytophilous invertebrates live in or above emergent and floating macrophytes, forming a very diverse community that can be obligatory or facultative (Thomaz and Bini, 2003). According to Thomaz & Cunha (2010), the architecture of each species of macrophytes creates different levels of heterogeneity resulting in different habitats for aquatic organisms. Several groups of invertebrates are associated with macrophytes, from protozoans to large crustaceans – including shrimp of the Infraorder Caridea Dana, 1852 (Montoya, 2003; Williner and Collins, 2007; Marçal and Callil, 2008), which is represented by 389 genera and 3,438 species (De Grave and Fransen, 2011).

Freshwater shrimps pertaining to this infraorder were recorded and studied recently in the northeast of Brazil, especially in the state of Bahia, by Almeida *et al.* (2006, 2008, 2012 for details). According to Almeida (unpubl. data) in this state, Caridea is represented by approximately 100 species, of which 30 live in freshwater and estuary systems – environments in which macrophytes can be found. However, there is still no information on the association and/or use of specific macrophytes by some species of Caridea in the northeastern region of Brazil. The aim of this study was to analyse this association and describe some of the ecological aspects of these phytophilous shrimp.

Salsa river (15º 42'S/38º59'W) is located in the south of the state of Bahia, northeast of Brazil. It is considered one of the main tributaries of Pardo river, with a basin that covers an area of 30,360 km². This region is subject to dumping of domestic untreated effluents, artisanal and commercial fishing, ecological tourism and water sports (Paschoal *et al.*, 2013).

Samples were collected during the day on a monthly basis from September 2009 to August 2010, at nine collection sites along a stretch of Salsa river. The sampling stations were selected according to the macrophyte patches, keeping approximately 300 meters of distance between them. Shrimps were captured using a hand net (0.5 mm mesh) dragged for 20 minutes with a collector along macrophyte banks, three of which consisted of species *Brachiaria* sp. (Trin.) Griseb., 1853 – BraI, II and III , another three *Juncus* sp. (L.) – JuncI, II and III and the last three *Eichhornia crassipes* (Mart.) Solms – EicI, II and III. With the exception of banks BraI and II, which are surrounded by pasture areas for livestock, human activities were not observed in the collection area.

Macrophytes were identified following the proposals of Cook *et al.* (1974). Decapod samples were identified according to Melo (2003). Voucher specimens collected were deposited in the crustacean collection of Museu de Zoologia da Universidade de São Paulo (MZUSP) and Universidade Estadual de Santa Cruz (MZUESC). The occurrence of shrimps was calculated for grouped sexes. The ovigerous females were counted separately. This differentiation allowed the establishment of specific habitat preferences between the groups. Data were submitted to Correspondence Analysis (CA) to verify and graphically summarize relationship patterns between the identified caridean species and the nine macrophyte banks along Salsa river.

A total of 9,972 individuals were collected belonging to four species in two families: *Potimirim potimirim* (Müller, 1881) (MZUESC 1560) (Atyidae) and *Macrobrachium acanthurus* (Wiegmann, 1836) (MZUESC 1561), *M. olfersii* (Wiegmann, 1836) (MZUESC 1562) and *Palaemon pandaliformis* (Stimpson, 1871) (MZUSP 28313) (Palaemonidae). Most individuals were recorded on *Brachiaria* sp. (41.79%), followed by *Juncus* sp. (29.96%), and *E. crassipes* (28.25%). These results are believed to be associated with the degree of retention of bovine faecal matter among the roots near the BraI and BraII bank. The high density and the complex spatial structure of the root system were capable of retaining a considerable amount of faecal matter, which served as food for the shrimps, and attracted larger numbers of microfauna that were also consumed by the shrimps. In spite of the recorded occurrences of these species at the nine macrophyte banks, they all presented different habitat preferences (Fig. 1).

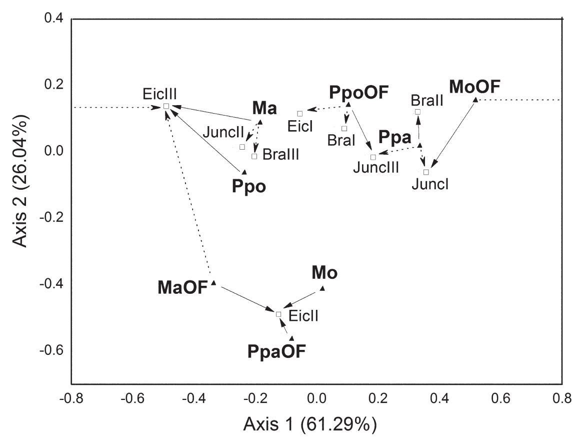

Figure 1. Correspondence Analysis of the total and ovigerous females occurrence for each species in each collection sites at Salsa river (Canavieiras, Bahia). Solid arrows indicate greater association of each species to a given macrophyte bank, dotted arrows indicate secondary associations. Ma, *Macrobrachium acanthurus*; Mo, *Macrobrachium olfersii*; Ppa, *Palaemon pandaliformis;* Ppo, *Potimirim potimirim;* OF: ovigerous females; Bra: *Brachiaria* sp.*;* Junc: *Juncus* sp.; Eic: *Eichhornia crassipes.*

Of the 271 samples collected of *P. potimirim* (3.2% of the total), 159 were ovigerous females, mostly associated with bank JuncIII (N = 35) and, on some occasions, banks BraI (N = 23) and EicI (N = 22). The remaining representatives of this species were evenly distributed along all macrophyte banks. Greater proportions of ovigerous females collected near macrophytes confirm the findings of Montoya (2003) in relation to the use of parts of these reproduction and nursery sites due to their richness in algae and particulate matter, increasing nutritional quality of this source. Melo (2003) and Almeida *et al.* (2008) state that representatives of this species prefer calm stretches of river and can be found in sandy and gravel river bottoms or associated with marginal and/or leafy vegetation accumulated in the river bed. This study, however, clearly showed the use of stems and roots of emergent and free-floating macrophytes as the habitat and shelter of a wide range of individuals, contrary to the findings of the abovementioned authors and increasing the variety of habitat spectrum of this species, and considering that Montoya (2003) and Thomaz & Bini (2003) suggested that macrophyte banks can be shifted and transported, significantly contributing to the distribution of invertebrates along water bodies.

For genus *Macrobrachium* Spence Bate, 1868, two representative species, with commercial importance for the region, were recorded: *M. acanthurus* – most abundant species, with 5,229 collected individuals (52% of total) and *M. olfersii* with 316 collected individuals (2.8% of total). These species show a significant association with areas of *E. crassipes*, as observed in EicII (N = 706 and 18, respectively) and EicIII (N = 411 and 60, respectively), corroborating results obtained by Montoya (2003). This author observed the presence of three species of *Macrobrachium* associated with *E. crassipes*, in Venezuela, and stated that this macrophyte plays an important role in the population dynamics of individuals of this genus given its use as a nutritional source, habitat, shelter and nursery, and can play an important role in the distribution and dispersion of this species in rivers. Melo (2003) and Almeida *et al*. (2006, 2008) highlight the occurrence of *M. acanthurus* in dark, stagnant waters with emergent vegetation and muddy substrate, and the rare occurrence in brackish waters. Furthermore, Almeida *et al*. (2006) state that the occurrence of species in *E. crassipes* is accidental. This study shows an increased habitat spectrum of *M. acanthurus* due to the use of several portions of *E. crassipes* by this species, added to the fact that this macrophyte is free-floating, which increases the scope of occurrence of this caridean given the high shifting and transport capacity of individuals in the flowing-water environment (i.e. lotic waters) (for details see Thomaz and Bini, 2003). It should be noted that the information of accidental presence of *M. acanthurus* in *E. crassipes* was refuted because a large number of individuals was recorded with the macrophytes.

On several occasions, males of *M. acanthurus* with hypertrophied chelae and considerably larger bodies (i.e. dominant males) were captured together with the female groups at the macrophyte banks, which was also observed for *M. olfersii* (Paschoal, pers. obs.). This suggests sexual dimorphism in relation to the sex and led us to speculate about the possibility of protection of females by males in the habitat. Bauer (2004) states that for certain species of the genus *Macrobrachium,* this behavioural pattern is common, as dominant males protect and guard females when they establish territories for mating and protect their harems with several reproductive females.

Palaemon pandaliformis was the second most abundant species with 4,151 collected individuals (42% of total), and the only species with a significant difference of habitat preferences between ovigerous females (452 ind.) and other representatives (3,699 ind.). These females were predominant in EicII (N = 105), showing a greater association with this bank, while the other individuals were associated with areas in which *Brachiaria* sp. (N = 1,630) and *Juncus* sp. (N = 1,253) were predominant. The difference in habitats is linked to greater sizes recorded for ovigerous females in relation to other representatives of the species (Paschoal *et al*., 2013), making them more vulnerable to inanition and predation. As the males of this species do not protect or defend reproductive females, these females are more susceptible to predators. Mattos & Oshiro (2009) suggest that ovigerous females of Palaemonidae seek shelter in specific habitats to become less susceptible to predators. Consequently, areas with high density of macrophytes and greater densification of roots – as found in EicII – served as a habitat and shelter against predators, favouring the occurrence of ovigerous females in these locations. Caridean shrimps also execute circadian migrations to specific sites and/or macrophytes banks in search of food, mating and realize physiological processes; thus different niches are used by females and males, reducing the intraspecific competition (Williner and Collins, 2002; Paschoal, unpubl. data).

Results and new information on association and ecological aspects of phytophilous carideans obtained in this study, serve as a basis for future studies related to management and preservation of these species, and partially fill the gap created by the lack of knowledge on freshwater caridean shrimps. Further and more complex studies on the interactions between caridean shrimps and aquatic macrophytes would be most rewarding. Moreover, they show the extent to which interactions between Caridae and plants should be studied and approached, as once discriminated they can cause serious environmental and financial problems, such as the accidental dissemination of these beings in aquatic environments of other hydrographical basins.

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