Some laboratory evidences about the Mediterranean shrimp Atyaephyra desmarestii feeding on Alnus glutinosa (L.) Gaertn leaf detritus.

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ABSTRACT: Some laboratory evidences about the Mediterranean shrimp Athyaephyra desmarestii feeding on Alnus glutinosa (L.) Gaertn leaf detritus. The objective of this study was to evaluate the possibility of Atyaephyra desmarestii Millet (1831), a typical freshwater detritivorous shrimp living in Mediterranean region, feed on Alnus glutinosa leaves under laboratory conditions. The invertebrate species was selected because it was abundant during all year, easy to collect, manipulate and maintain under laboratory conditions. Visual observations suggested that, when in groups, A. desmarestii is able to feed on entire leaves. The consumption rate was 5.21 + 1.39 mg fresh weigh animal^{-1} day^{-1}, 1.24 $\pm$ 0.78 mg dry weight animal^{-1} day^{-1} and the shrimp median weight was 12.98 $\pm$ 53.16 mg DW. Fecal production estimation was 0.25 $\pm$ 0.16 mg DW. feces animal $^{-1}$ day $^{-1}$. Shrimp assimilation was calculated as the difference between the consumption and the feces production (0.99 $\pm$ 0.63 mg DW. feces animal^{-1} day^{-1}). Our findings indicate that functional feeding group classifications should not be used too rigorously, allowing inconclusive assumptions of invertebrates feeding habits.
Key-words: detritivorous, Alnus leaves, shrimp feeding, functional feeding groups.

RESUMO: Algumas evidências laboratoriais da alimentação do camarão mediterrâneo Atyaephyra desmarestii sobre o detrito foliar de Alnus glutinosa (L.) Gaertn. O objetivo deste estudo foi avaliar a possibilidade de Atyaephyra desmarestii Millet (1831), um típico camarão de água doce da região mediterrânea, alimentar-se de folhas de Alnus glutinosa em condições de laboratório. A escolha desta espécie de invertebrado deveu-se à sua abundância durante todo o ano, facilidade de coleta, manipulação e manutenção em condições de laboratório. Observações visuais sugeriram que, quando em grupos, A. desmarestii é capaz de consumir folhas inteiras. A taxa de consumo foi de 5,21 $\pm$ 1,39 mg peso fresco animal $^{-1}$ dia $^{-1}$, 1,24 $\pm$ 0,78 mg peso seco animal^{-1} dia^{-1} e o peso seco dos camarões foi de 12,98 $\pm$ 53,16 mg P.S. A estimativa de produção fecal foi de 0,25 $\pm$ 0,16 mg P.S. fezes animal^{-1} dia^{-1}. A assimilação dos camarões foi calculada como a diferença entre o consumo e a produção de fezes (0,99 $\pm$ 0,63 mg P.S. fezes animal^{-1} dia^{-1}). Nossos resultados indicam que as classificações em grupos tróficos funcionais não devem ser utilizadas de forma tão rigorosa, levando a inferências inconclusivas sobre os hábitos alimentares dos invertebrados.
Palavras-chave: detritivoros, folhas de Alnus, alimentação de camarões, grupos tróficos funcionais.

Introduction

Atyaephyra desmarestii Millet (1831) is widely distributed throughout Europe (as far north as Germany and the Netherlands, but absent from the British Isles), Middle-East, up to North Africa. The species exhibits some slight geographical variations and subspecies of questionable validity are recognized by some authors. Its original distribution in Europe was more limited, and it has slowly migrated northwards through canals connecting different river basins. Its distribution shows that density and biomass is specially high in August-September and reproductive period lasts about 5 months, incubation period and planktonic phase last about one month (Galhano, 1979). As synonyms species there are Atyaephyra desmarestii desmarestii (Millet, 1831), Atyaephyra desmarestii mesopotamica Al-Adhub, 1987, Atyaephyra desmarestii orientalis Bouvier, 1913.

The species is a typical detritivorous, leaving in slowly running waters associated with aquatic plants, feeding on fine particulate organic matter and aquatic macrophytes detritus and attached periphyton. A. desmarestii has been found in many Portuguese freshwaters, including reservoirs, rice fields, coastal lagoons and temporary streams, although the knowledge about its distribution is still uncertain (Fidalgo & Gerhardt, 2002). Its occurrence is related with degraded waters (Mayenco, 1993). The species size is about 25 mm total length. Mean calorific value of A. desmaresti is 5.094 cal/mg ash free dry weight (Machado & Galhano, 1980). Fluctuation of relative density is irregular all the year around and may be attributed to animal migration due temperature variations. Lower density is observed during winter and possibly wind and water movements may exercise influence too. Ovigerous females are observed since May up to September, thus reproductive period lasts about five months. Mean individual length do not increase during the period of reproduction (ovigerous females values are between 2.5 and 3.1mm). Number of eggs per female varies between 279 and 501, with an average of 374, but no correlation is found between the number of eggs and the female length. The incubation time and planktonic phases lasts about a month, each. Density values varies between 34 and 1,811 animals m^{-2} of micro-habitat, and biomass varies between 109 and 2,868 mg m^{-2} of micro-habitat. Coprophagy was previously observed and seems to be important for this species (Fidalgo, 1990; Meurisse-Génin et al., 1985).

The purpose of this study was to evaluate the possibility of Atyaephyra desmarestii Millet (1831), a typical freshwater detritivorous shrimp living in Mediterranean region, feed on Alnus glutinosa leaves under laboratory conditions in IMAR-Coimbra, Zoology Department, Universidade de Coimbra, Portugal. I evaluated the hypothesis that if A. desmarestii, as a generalist detritivorous, could feed on conditioned leaves of Alnus glutinosa, it should be important for the energy flux in freshwater ecosystems. Thus, the feeding habit of this shrimp may contribute to the knowledge of detritus chain and leaf breakdown in streams. The invertebrate species was selected because it was abundant during all year, easy to collect, manipulate and maintain under laboratory conditions. Previous experiments also showed that this invertebrate was sensitive to pollution (Rodrígues-Capítulo and Graça, unpublished data).

Some questions were addressed on this study: (i) A general detritivorous can feed on conditioned leaf detritus as coarse particulate organic matter?, (ii) If so, what is the feeding rate?, (iii) and what is the assimilation rate?, (iv) CPOM can represent an alternative food for this species?

Material and methods

Laboratory experiments were conducted in order to estimate the feeding rate and the assimilation efficiency of A. desmarestii. The field specimens used in feeding trials were collected in July 14th, 2004 in Ceira river (Portugal). The specimens were brought to the laboratory in ice chests and acclimated for 1-2 days prior to the experiments. A. desmarestii were maintained at 15ºC and fed Alnus glutinosa leaf detritus. Leaves were conditioned in São João river (Lousã locality) for 3 weeks, before laboratory experiments.

Groups of 5 shrimps were maintained in plastic boxes, and photoperiods of 12:12 h light-dark. Food was provided as leaf discs cut from contiguous areas of a same leaf of conditioned leaves. Three discs were exposed to shrimps, whereas other three discs were placed in a 0.200 mm mesh to avoid shrimp feed. Organisms were allowed to feed for a 7-10 days. Aeration was required during the feeding trials. One-third of water volume was changed every 2 days to avoid diminishing water quality and feces accumulation. The number of replicates was 20. Consumption was calculated as the difference between unexposed and exposed discs divided by the elapsed time in days and the number of shrimps in the box. Values were expressed as dry mass. Feeding was considered to have occurred when the mass of exposed discs was significantly lower (pair t-test, $p < 0.0001$) than the corresponding control disc (Friberg & Jacobsen, 1984).

Results

A preliminary experiment set using single invertebrates in 150 ml water and leaf discs as food, turned to the shrimps death due to the diminishing of water quality. No leaf consumption was observed.

A second experiment was realized using twenty-five boxes, each one with groups of five shrimps, 500 ml of river water in two treatments. In the first, two entirely conditioned leaves were offered in each box for 5 shrimps. After 3 days, visual observations suggested that, when in groups, A. desmarestii is able to feed on entire leaves. It seems that the organisms feed on leaf tissue, avoiding the principal and secondary nervules. Besides, shrimps use leaves as a refuge, being all grouped inside, protected in leaf shadow microhabitat. The feces production was high and some ecdises were present. It was not possible to estimate the dry weight due the risk of loose the microbial colonization during dry weight estimations. Thus, only fresh weigh was measured. The consumption rate was 5.21 + 1.39 mg fresh weigh animal^{-1} day^{-1}.

The second treatment consisted of 20 groups of 5 shrimps per box (500 ml) and 3 leaf discs as food (and other 3 discs as reference). The consumption rate was 1.24 $\pm$ 0.78 mg dry weight animal^{-1} day^{-1} and the shrimp median weight was 12.98 $\pm$ 53.16 mg DW. Fecal production estimation was 0.25 $\pm$ 0.16 mg DW. feces animal $^{-1}$ day $^{-1}$. Shrimp assimilation was calculated as the difference between the consumption and the feces production (0.99 $\pm$ 0.63 mg DW. feces animal^{-1} day^{-1}).

Discussion

The obtained results in laboratory experiments answered positively the first question we have proposed. A. desmarestii, as a general detritivorous, can feed on conditioned leaf detritus of Alnus glutinosa. This result is consistent with the observations of Friberg & Jacobsen (1994) that feeding plasticity of the detritivore-shredder group probably is less restrictive than traditionally supposed.

Mayenco (1993) found an association of A. desmarestii, Simulium intermedium and S. pseudequinum with phosphate and nitrite, suggesting a high resistance to polluted and degraded waters. A. desmarestii can be very useful in laboratory experiments due its pollution tolerance, especially when reference sites with no industrial or urban effluents are absent.

Furthermore, disturbance of the ecosystem (e.g. de- or afforestation of the riparian zone) can lead to a change in the type of food available (Stout et al., 1993). The ability of a stream to cope with such disturbances shoud be related to feeding plasticity of the organisms that inhabit it. Feeding plasticity experiments are essential to understand the trophic relationships and feeding plasticity (Friberg & Jacobsen, 1994). Consistent with several of other previous studies (Dangles, 2002; Tavares-Cromar & Williams, 1997; Friberg & Jacobsen, 1994), our findings indicate that functional feeding group classifications should not be used too rigorously, allowing inconclusive assumptions of invertebrates feeding habitats.

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