

Population dynamics and structure of talitrid amphipods from Bizerte sandy beach (North of Tunisia)

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Abstract. This study was focused on some aspects of population dynamics of the amphipods populating of Bizerte sandy beach (North of Tunisia). Five species, belonging to the Talitridae family, were sampled: *Talorchestia deshayesi*, *Talitrus saltator*, *Orchestia gammarellus*, *Orchestia montagui* and *Orchestia mediterranea*. During study period, 6480 specimens were sampled with a dominance of *T. deshayesi* individuals (50%). Within this species the sex ratio was female biased, with a yearly mean of 0.25. The population of *T. saltator* also showed a sex ratio biased in favour of females throughout the study period, except for October 2007 and May 2008. This result might be correlated with autumn and spring recruitment periods respectively. In contrary to *T. saltator*, which has a continuous reproductive period, *T. deshayesi* population showed a seasonal reproduction with a sexual rest period from December to March.

Key words: Sandy beach, Amphipods, Population dynamics, *Talitrus saltator*, *Talorchestia deshayesi*, Tunisia.

Résumé. *Structure et dynamique de populations d'amphipodes Talitridae de la plage sableuse de Bizerte (Nord Tunisie).* La présente étude s'est focalisée sur certains aspects de la dynamique de population des amphipodes de la plage sableuse de Bizerte sur le littoral nord tunisien. Cinq espèces appartenant à la famille des Talitridae ont été échantillonnées : *Talorchestia deshayesi*, *Talitrus saltator*, *Orchestia gammarellus*, *Orchestia montagui* et *Orchestia mediterranea*. L'échantillonnage a permis de récolter 6480 individus avec la dominance de *T. deshayesi* (50% de l'abondance totale). Pour cette espèce la sex-ratio est défavorable aux femelles avec une moyenne annuelle de 0,25. La population de *T. saltator* montre aussi une sex-ratio défavorable aux femelles pour toute la période de l'étude sauf pour octobre 2007 et mai 2008. Ce résultat semble correspondre aux périodes de recrutements respectivement de l'automne et du printemps. Contrairement à *T. saltator* dont la période de reproduction est continue, la population de *T. deshayesi* a montré une reproduction saisonnière et une période de repos sexuel de décembre à mars.

Mots clés : Plage sableuse, amphipodes, dynamique de populations, *Talitrus saltator*, *Talorchestia deshayesi*, Tunisie.

INTRODUCTION

Talitrid amphipods occur in sandy beaches on a wide geographical scale (Dahl 1946) and are in some beaches the most dominant species (McLachlan *et al.* 1981). They play an important ecological role as decomposers and are considered potential bioindicators of the quality of sandy beaches (Griffiths *et al.* 1983, Ketmaier *et al.* 2003). Talitrid amphipods are thus suitable for studying the relationships between biological features and environmental changes (Scapini *et al.* 2002).

In Tunisia, many studies were investigated on Amphipoda settlement. From one hand, the locomotor rhythm of some species was investigated in Bizerte, Barkoukech, Zouaraa, Kalaat Landalous, (Nasri-Ammar & Morgan 2006, Bohli *et al.* 2006, Ayari *et al.* 2008a, 2008b). On the other hand studies on the distribution, orientation, and biology have been carried out in Tunisia at Zouara and Korba (Charfi *et al.* 2000, Colombini *et al.* 2002, Scapini *et al.* 2002, Marques *et al.* 2003, Bouslama *et al.* 2007).

In the present study, we aimed at characterizing the diversity of amphipods populating in Bizerte sandy beach

and at studying the population dynamics of three species: *Talorchestia deshayesi*, *Talitrus saltator* and *Orchestia gammarellus*, despite the fact that the last species is represented with low number.

MATERIAL AND METHODS

Amphipods were sampled in Bizerte sandy beach (37°19'N-9°51'E), situated in the North of Tunisia and characterised by the presence of a banquette of *Posidonia oceanica* and other macrophytes. This beach measures 15 m approximately in width. Field work was conducted each month, from June 2007 to May 2008, in the supralittoral zone. Individuals were collected by hand, during the morning with sampling effort varied between 1 to 2 hours. In the laboratory, the specimens collected were identified, measured, counted and sexed for different categories: non sexually differentiated juveniles, adult males, young females, non reproductive females with empty oostegites, reproductive females (with setae or with eggs/embrios). During the sampling, sand temperature and relative humidity were also recorded.

Data were analysed using following indexes:

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Species richness: the species number during settlements

Frequency of occurrence: $F = (n/N) * 100$

Where n is the number of times the species appears in the sample; N is the total number of samples (N=12).

A species is called common if $75\% < F \leq 100\%$, constant if $50\% < F \leq 75\%$, accessories if $25\% \leq F \leq 50\%$ and rare if $F < 25\%$.

Simpson index: $I_s = 1 / \sum (p_i^2)$

Where p_i = number of individuals of the species (i) compared to the total number of individuals in the settlement.

Shannon-Weaver index: $H' = -\sum ((Ni/N) * \log_2(Ni/N))$

Where N_i is the individual number of species (i); N is the total individual number of settlement.

Pielou evenness index: $J' = H' / H_{max}$

Where $H_{max} = \log_2 S$

RESULTS

The highest relative humidity was recorded in January and February. Instead, two peaks of temperature were observed in June and July (Fig. 1).

During this study, 6480 specimens were collected. Five species of Talitridae were identified: *Talorchestia deshayesi*, *Talitrus saltator* and *Orchestia gammarellus*, *Orchestia montagui* and *Orchestia mediterranea*.

The frequency of occurrence showed that *Talorchestia deshayesi*, *Talitrus saltator*, *Orchestia gammarellus* were the most common species of the Bizerte sandy beach.

The species richness showed two peaks in November and June indicating the presence of all species (Fig. 2). Furthermore, the Simpson index does not exceeded the value of 2. In April these two indexes are close, indicating that the talitrid community is more equilibrated in this month (Fig. 2).

Shannon index, which takes into account rare species, varied between 0.1 and 1.1 (Fig. 3). Moreover, Pielou evenness index, which is insensitive to the richness, presented a minimum value in July (0.05), despite the presence of four species in this month.

We analysed also the population dynamics of the most abundant species: *Talorchestia deshayesi* and *Talitrus saltator*. The sex-ratios biased in favour of females for *T. deshayesi* (Table I). For *T. saltator*, sex ratios biased in favour of males were observed in October and May. Moreover, *O. gammarellus* presented a sex ratio oscillating between 0 and 1, attended in August when the number of males was equal to females.

During the period of study, 675 males of *T. deshayesi* were collected, with high values in October (90) and June (113) and a complete absence in July and August (Table I).

The monthly evolution of female categories for the main species showed that for *T. deshayesi*, the largest frequencies of females were observed in November, January and July, while for *T. saltator* the maximum of reproductive females was collected in January (Table I).

Apparently *T. deshayesi* showed a seasonal reproduction with a sexual rest period extending from December to March. In contrast, *T. saltator* showed a continuous reproductive period with two rest period. Because of the limited number of females collected for *O. gammarellus*, we can not infer any reproductive cycle for this species (Table I).

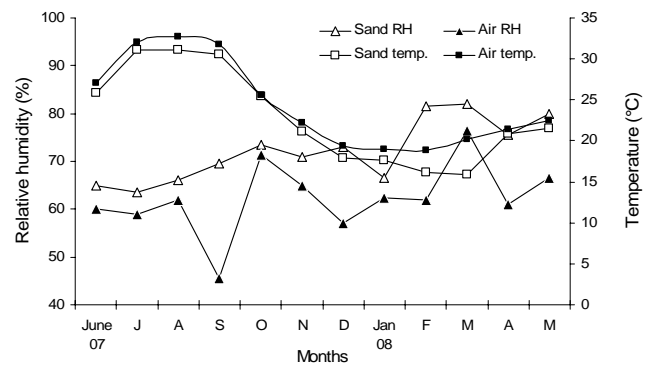


Figure 1: Variation of sand temperature (Sand temp.), air temperature (Air temp.), sand relative humidity (sand RH) and air relative humidity (air RH) at Bizerte sandy beach from June 2007 to May 2008.

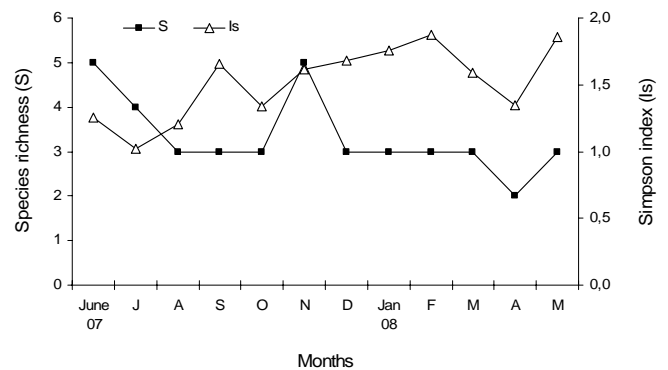


Figure 2: Variation of species richness (S) and Simpson index (Is) at Bizerte sandy beach from June 2007 to May 2008.

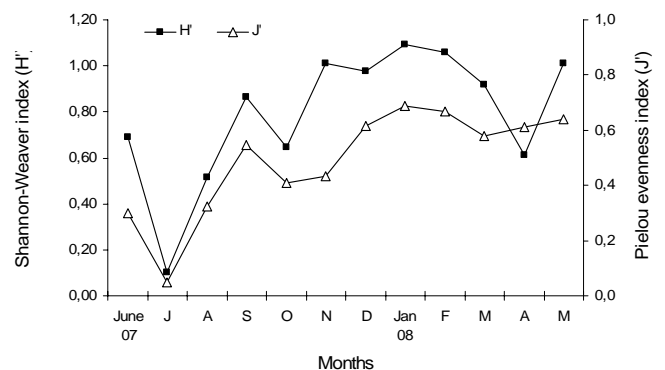


Figure 3: Variation of Shannon-Weaver index (H') and Pielou evenness index (J') at Bizerte sandy beach from June 2007 to May 2008.

Table I: Population structure of the three abundant species during the study period; NR: non reproductive females, R: reproductive females.

Months	Number of females	<i>T. deshayesi</i>			<i>T. saltator</i>			<i>O. gammarellus</i>					
		♂	♀		Sex ratio	♂	♀		Sex ratio	♂	♀		Sex ratio
			NR	R			NR	R			NR	R	
June 07	130	80	212	80	0.49	31	11	6	0.53	0	8	0	0.00
July 07	356	90	332	33	0.38	33	0	0	1.65	1	2	0	0.50
August 07	445	47	113	10	0.11	47	0	0	0.82	5	2	0	0.17
September 07	32	0	134	29	0.00	6	54	4	0.38	1	0	0	0.50
October 07	448	31	172	64	0.07	20	17	3	0.20	6	2	0	0.13
November 07	50	9	388	26	0.13	9	53	4	0.30	1	29	0	0.50
December 07	21	13	69	0	0.12	4	16	0	0.14	2	2	0	0.67
January 08	0	94	418	0	0.43	22	98	0	0.65	0	46	0	0.00
February 08	153	58	71	0	0.25	108	30	0	2.77	1	2	0	0.20
March 08	290	113	111	0	0.39	1	28	1	0.06	5	3	0	0.63
April 08	304	103	176	45	0.28	0	33	1	0.00	0	0	0	0.00
May 08	26	37	167	65	0.30	0	36	3	0.00	2	5	0	1.00

DISCUSSION

T. deshayesi, *T. saltator* and *O. gammarellus* were the most common species on the Bizerte sandy beach; instead, *O. montagui* and *O. mediterranea*, were present in the community with low frequencies; therefore, they may be considered as accessory species for the Bizerte sandy beach.

The results obtained from the study of populations of *T. deshayesi* and *T. saltator*, the two most abundant species in the talitrid community of the Bizerte sandy beach, showed that adults and juveniles were present throughout the whole sampling period for the first species, while, for *T. saltator*, males were not observed in July and August. The coincidence of this period with the swimming activity and the zonation of this species, which burrows close to the shoreline in summer, should explain this absence from the supralittoral zone. Bouslama *et al.* (2009) showed that talitrids, collected from the Tunisian beaches of Zouaraa and Korba, have a clear and dynamic zonation, with two distinct seasonal zones: animals were found near the water edge in summer, likely to escape desiccation risk in conditions of high temperatures and low humidity, while they take refuge in the dunes in winter, likely to avoid inundation risk, enhanced by the prevailing heavy waves and storms.

During the study period on the Bizerte sandy beach, the sex ratio was biased in favour of females for *T. deshayesi*. A similar result was obtained for *T. saltator* except in October and May, when, the sex ratio appeared biased in favour of males. On the Isle of Man, *T. saltator* presents a sex ratio slightly in favour of females (Williams 1978). Instead, for *T. saltator* found on the Lavos (Portugal) and Collelungo (Italy) beaches, the sex ratio was always in favour of males (Marques *et al.* 2003). Nevertheless, a sex ratio in favour of females appears to be common among other talitrid populations: in *Orchestia gammarellus* (Jones

& Wigham 1993; Persson 1999, Dias & Sprung 2004), in *Peudorchestoidea brasiliensis* (Cardoso & Veloso 1996) and in *Talorchestia capensis* (Van Sensus 1988).

During 12 months of this study, we observed that *T. deshayesi* has a seasonal reproduction cycle, with a sexual rest period extending from December to March. It must be noted that several populations of amphipods exhibit seasonal reproduction, e.g. this phenomenon was observed in *O. mediterranea* in the Medway estuary in Britain, with a rest period from October to mid-April (Wildish 1979). Concerning, the population of *T. saltator*, this species showed a continuous reproductive cycle. A similar reproduction cycle was also observed in *Platorchestia platensis* from Gouadaloupe (Civatti 1989) and *O. gammarellus* from Atlantic beaches (Amanieu 1969).

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