Distribution and behaviour of the amphipod, *Talorchestia capensis* (Crustacea; Talitridae)

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Distribution of the amphipod, *Talorchestia capensis* (Crustacea; Talitridae) has been studied in a dune-beach system. The majority of amphipods occurred in dune slacks with fewer on the beach. No zonation of size classes existed, both juveniles and adults occurring throughout the slack. Amphipods were concentrated in the top soil layers, where temperature fluctuations were highest and per cent moisture lowest. However, gravid females preferred slightly deeper soil layers. Studies during a spring and a neap tide indicated that the animals have a circadian rhythm with a nocturnal activity phase, and a weak tidal rhythm, but no lunar orientation mechanism.
S. Afr. J. Zool. 1985, 20: 253 – 257

Verspreiding van die amfipode, *Talorchestia capensis* (Crustacea; Talitridae) is bestudeer in 'n kussandduin-ekosisteem, en toon dat meeste van die amfipode in die duintrog en slegs 'n klein persentasie op die strand voorkom. Volwassenes en onvolwassenes kom nie in verskillende sones voor nie, en is versprei deur die hele duintrog. Meeste van die amfipode kom in die bogrondlae voor, waar temperatuurfluktuasies die hoogste en voggehalte die laagste is, maar eierdraende wyfies verkies die dieper grondlae. Migrasiestudies gedurende 'n spring- en dooiegety toon dat die spesies 'n daaglikse ritme, met 'n nagtelike aktiwiteitsfase het asook 'n swak getyritme, maar geen oriënteringsmeganisme relatief tot die maan nie.
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Talitrid amphipods are characteristic of the supralittoral of most temperate coasts (Dahl 1952). Their distribution and abundance is related to favourable microclimatic conditions, such as a low rate of evaporation and the presence of organic wrack, which serves both as a food source and protection against dehydration (Chelazzi & Ferrara 1978). Nocturnal behaviour has been observed in many talitrid species (Enright 1963; Bregazzi & Naylor 1972; Benson & Lewis 1975; Muir 1977), suggesting they have an endogenous circadian rhythm. Moving around during the night the animal must have an orientating mechanism to move back to suitable areas before sunrise. Williamson (1951) suggested animals utilize visual stimuli from silhouettes or sand dunes, while Papi (1960) suggested a lunar orientation mechanism.

This paper reports on a talitrid population inhabiting a large coastal dunefield. The vegetation cover of the dune system is restricted to damp hollows or slacks and *Talorchestia capensis* is associated with vegetation hummocks in these slacks. The aims of the present study were to investigate horizontal and vertical distribution, association with vegetation hummocks and migratory and activity patterns in *T. capensis*.

Study area

The study area was the Alexandria coastal dunefield in Algoa Bay, which lies between the Sundays River mouth and Cape Padrone. Several habitat types have been described in the dunefield, of which slacks make up 0,1% of the total area (McLachlan, Ascaray & Du Toit 1985). Slacks can be defined as low-lying ground between dunes, where the ground water is close to the surface (Tansley 1949) and contain vegetation hummocks formed by various plant species. They commence 50 m landward from the normal driftline and are separated from the beach by a ridge of sand and pebbles about 2 m above mean sea level. From this ridge a corridor leads into each slack, the slack lying between transverse dune ridges which average 5 – 7 m in height.

Materials and Methods

Spatial and temporal distribution

The temporal and horizontal distribution of *T. capensis* was determined by sampling a grid (Figure 1) every four weeks between February and December 1983. Pit traps, consisting of 5-ℓ buckets with ethylene glycol in the bottom, were used. Twenty such traps were placed in two separate slacks, and the animals caught were counted and divided into size classes.

To determine vertical distribution a 10 cm internal diameter corer was forced more than 25 cm into selected vegetation hummocks. Cores were divided into 5 cm vertical sections,

which were placed in 1-mm mesh bags. Temperature and moisture were recorded from sand in the walls of the holes with a mercury thermometer and Speedy Moisture Tester (Thomas Ashworth, England) respectively. The bags were washed and the animals in each depth layer counted, measured and sexed. This was done every hour for 12 h.

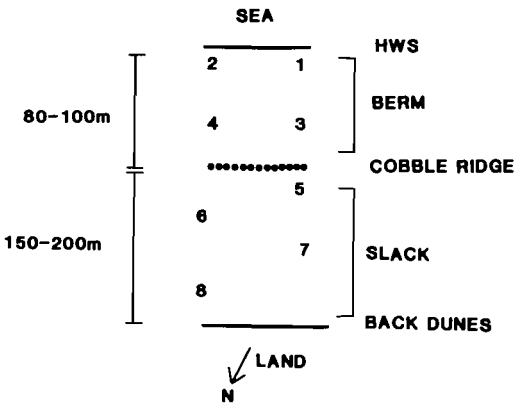

Figure 1 Diagram of trap grid.

Hummock preferences

During each of the four seasons of 1983: autumn, winter, spring and summer, each vegetation hummock within one slack, was checked for amphipods by looking for burrow holes or by turning over the sand. After all the hummocks had been checked, 40 random samples were taken in those hummocks containing amphipods. A corer with a 10 cm internal diameter and a length of 30 cm was used. The sand was wet sieved and the animals counted.

Migratory patterns

To monitor migratory patterns, two 12-h surveys were conducted, one over a nocturnal spring-tide (full moon), and the other during a nocturnal neap-tide (first quarter) cycle. Eight traps consisting of 5-ℓ buckets, sunk level with the sand were set up in a rough grid (Figure 1). A cross-shaped device was fitted inside each bucket subdividing it into four equal (east, west, north and south) sections. These traps were based on the directional traps used by Chelazzi & Ferrara (1978). A small volume of sea water was placed in the buckets to prevent sandhoppers from jumping out. The traps were checked every 2 h for 12 h and the tidal level and moon

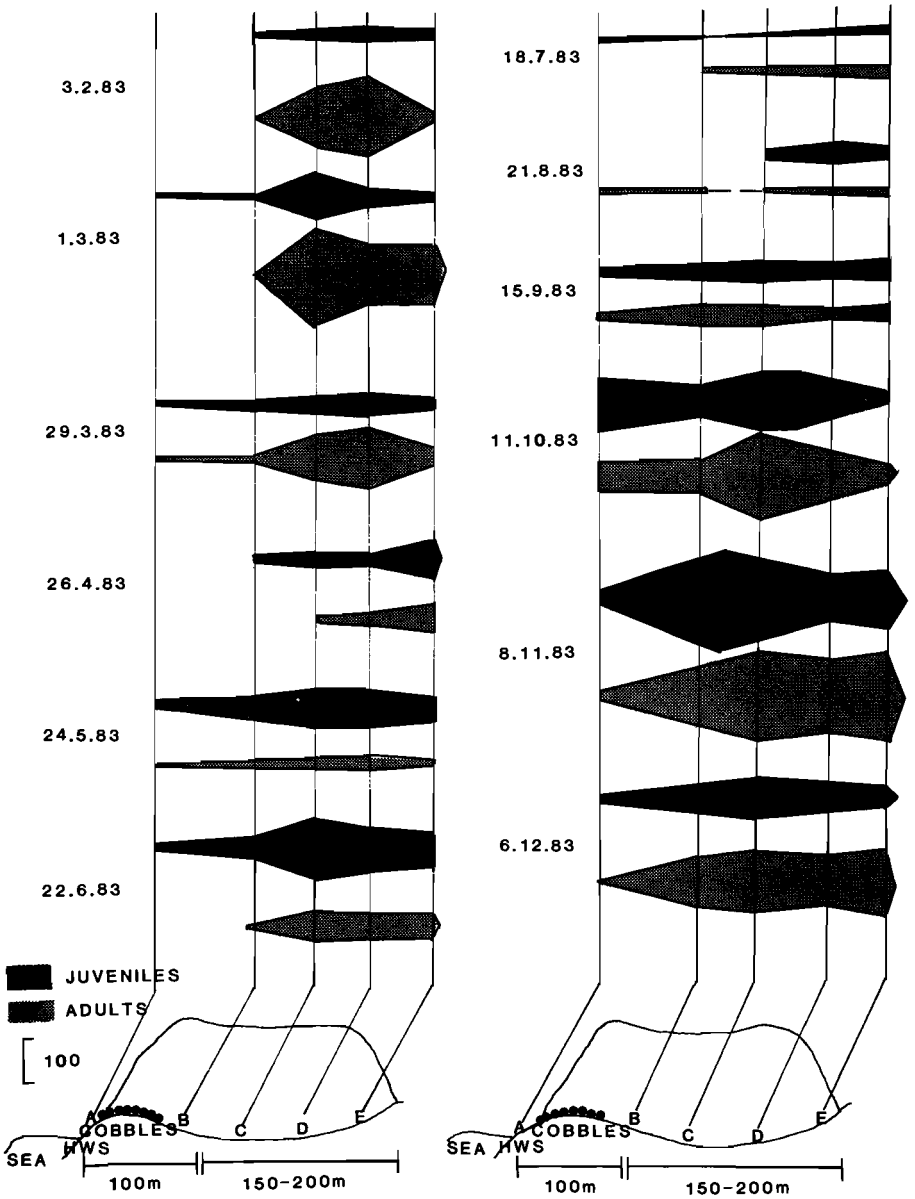

Figure 2 Kite diagrams to show the horizontal and temporal distribution patterns for *T. capensis* at Sundays River beach during 1983, where A = high-water mark; B = boundary of cobbles and slack; C = front of slack; D = middle of slack and E = end of slack.

position recorded. Animals were counted each time and left inside the traps.

Results

Spatial and temporal distribution

From Figure 2 it can be seen that the majority of animals occurred in the slack itself (Stations B – E), and very few on the beach (Station A). During early summer (October – November), however, a large amount of driftwood was deposited on the beach, and large numbers of *T. capensis* were associated with this. No zonation of size classes existed.

The majority of *T. capensis* occurred in the top 5 cm of soil (Figure 3) and none were found below 20 cm. At dawn, when temperature in the top soil layers dropped, the proportion of amphipods in this layer increased. Contrary to expectation, most amphipods occurred near the surface of the soil, although this is where the moisture content was always lowest and temperature highest. Moisture contents ranged 0 – 12% and temperature 23 – 33°C during the day with surface layers always drier and hotter. This suggests that moisture and temperature do not play a major role in the vertical distribution in the sediment. Juveniles showed a significant preference for the top soil layers (χ^2 test; $p < 0{,}01$), while gravid females showed a significant preference for soil layers deeper than 15 cm depth (χ^2 test; $p < 0{,}01$).

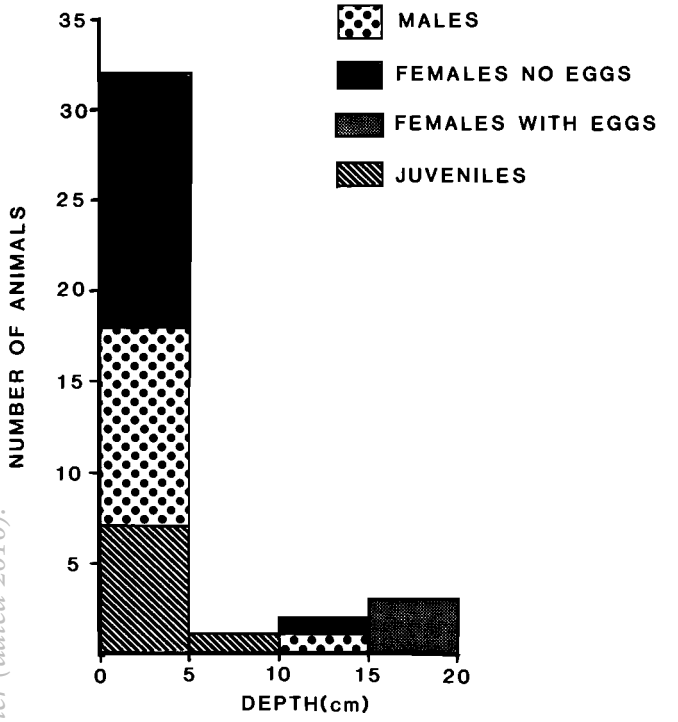

Figure 3 Numbers of male, female and juvenile *T. capensis* in relation to soil depth at Sundays River beach.

Hummock preferences

Throughout the year *Gazania rigens* hummocks, which are the commonest hummocks in the slack, housed most animals (Figure 4) while *Arctothecea populifolia* hummocks and driftwood also contained large populations.

Migratory patterns

Migration diagrams for spring and neap-tides are presented in Figures 5 and 6. During both periods few animals were caught in pit traps 1 – 4 on the beach, the majority being caught in the slack. Immediately after sunset some animals started to emerge from the sand, although most sandhoppers appeared later. These animals moved randomly about till sunrise, when they burrowed vertically in vegetation hummocks.

During the spring-tide sampling period the moon was visible the whole night, while during the neap-tide sample the moon appeared about midnight. No distinct orientation pattern was found in relation to the moon. Animals were active throughout the night, but most especially around the high-tide period on both occasions.

Discussion

Spatial and temporal distribution

Craig (1973) found that there was a size gradation in the distribution pattern of *Orchestoidea corniculata*, the larger amphipods occurring landward and the smaller ones throughout the habitat. A similar pattern exists in *Talorchestia*

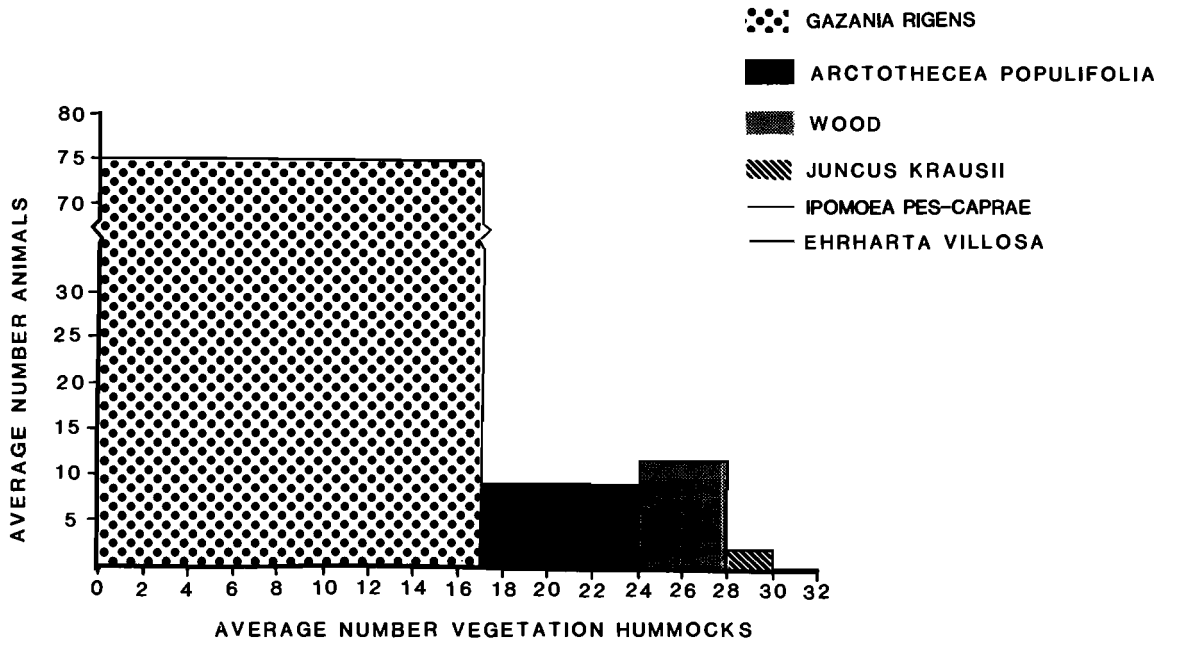

Figure 4 Hummock preferences during the four seasons of 1983 at Sundays River beach.

capensis (south-western Cape), the adults being higher up the beach and juveniles, which are more prone to dessication because of their thinner exoskeleton, occurring just above the high-water mark (Muir 1977). No such horizontal distribution pattern was found for *T. capensis* at Sundays River beach.

Although no horizontal segregation of size classes exists, there is a clear vertical distribution pattern, juveniles occurring near the surface and gravid females deeper down. Similar results were found for *T. capensis* in the south-western Cape (Muir 1977), *Orchestoidea corniculata* (Bowers 1964; Craig 1973) and *Neohaustorius schmitzi* (Croker 1967; Dexter 1971). Both *T. capensis* and *O. corniculata* are talitrid amphipods living in terrestrial environments. The majority of these amphipods occur in the top few centimetres of soil, where temperature fluctuations are highest and moisture content lowest, and only a small number (mostly gravid females) are found in the deeper, more stable soil layers. It would thus seem that temperature does not play a rôle in vertical distribution of these amphipod species. During nightfall a movement of amphipods to the surface layers is found, and this seems to be under the influence of a circadian rhythm.

Hummock preferences

Epifaunal amphipods select certain species of seaweeds washed up on the beach and associate with them. This leads to the clumped distribution pattern (Muir 1977; Venables 1981).

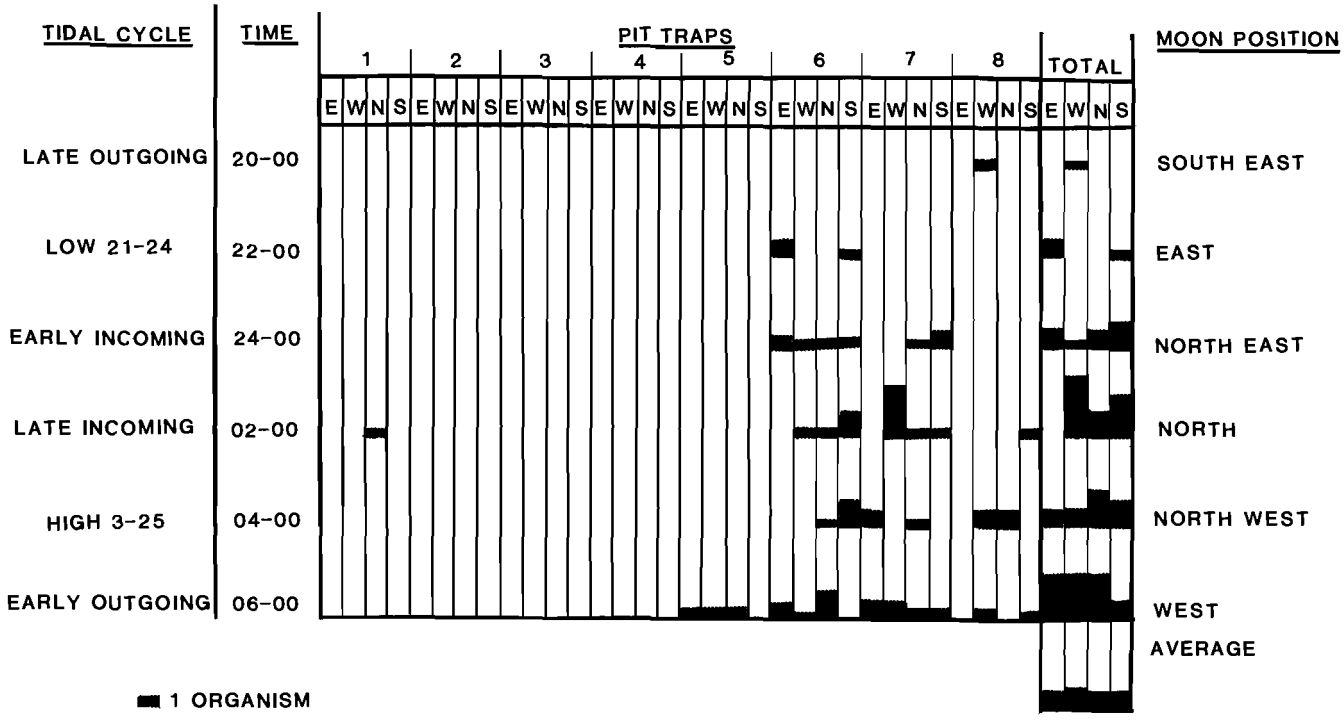

Figure 5 Migration diagram during a spring-tide (full moon) night cycle.

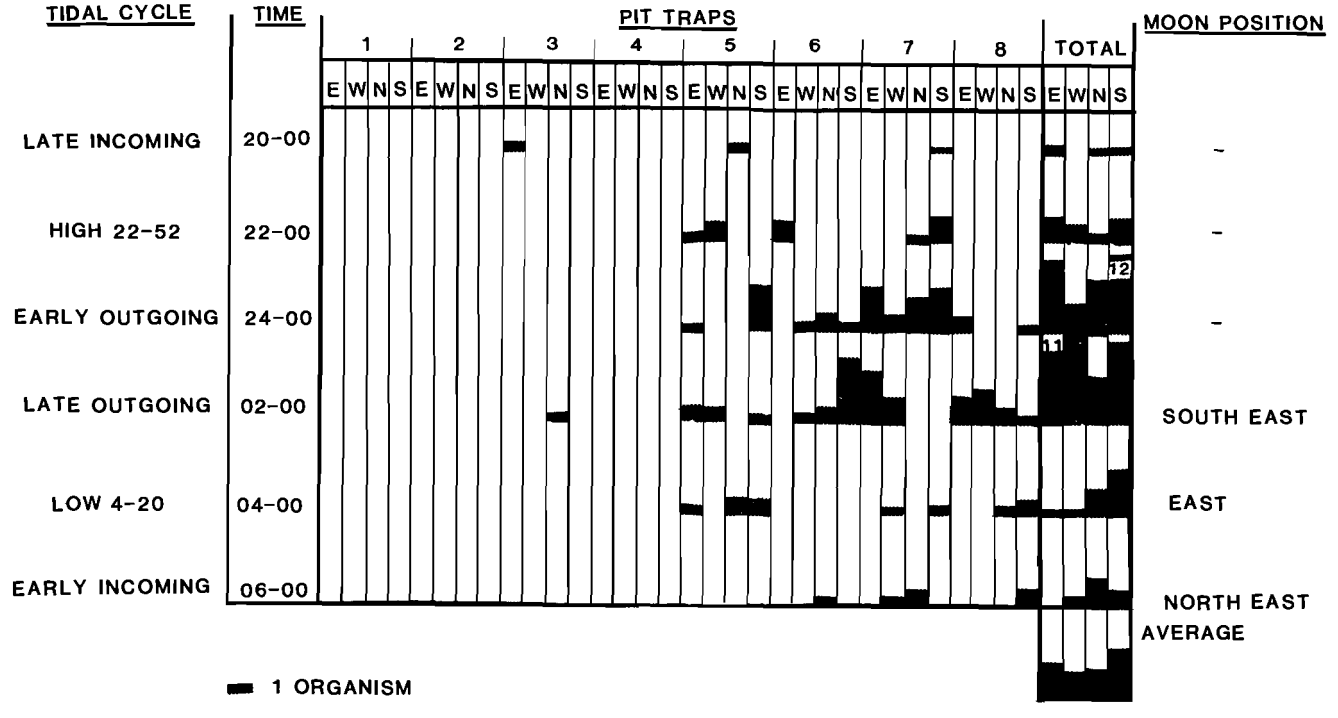

Figure 6 Migration diagram during a neap-tide (last quarter) night cycle.

At Sundays River beach there is no driftline and *T. capensis* has migrated further into the dune slacks where it is associated with moist vegetation patches, especially *G. rigens* and *A. populifolia*. *T. capensis* feeds on detritus, and the bulk of detritus is associated with the *G. rigens* hummocks (McLachlan *et al.* 1985), thus explaining why *T. capensis* is clumped, associating with these hummocks. Occasionally, owing to a storm, seaweed and driftwood gets deposited on the beach and then large numbers of *T. capensis* may migrate to the upper shore to make use of these deposits.

Migratory patterns

A day – night rhythm seems to control the emerging of the amphipods. Many high-shore species exhibit a pure circadian rhythm (Enright 1963; Wildish 1970; Williams 1982). Van Senus (1985), has shown a 24-h peak in respiration in a *T. capensis* indicating an endogenous locomotor rhythm of circadian frequency.

Wildish (1970) found that *Orchestia gammarella*, which occurs beneath wrack and stones around the high-water mark, posesses a similar circadian rhythm, while *Orchestia mediterranea* which lives lower down the shore, has both a circadian and a tidal rhythm. Williams (1982) found that *Talorchestia deshayesei*, which burrows above the high-water mark, had no tidal rhythm. *T. capensis*, which occurs well above the high-water mark in the dune slacks, has a weak tidal rhythm, with maximum activity around high tide at night (Van Senus 1985), while those amphipods which burrow along the high-water mark possess a tidal rhythm with maximum activity during the low-tide period since at high tide they become inactive and burrow to prevent inundation.

The question of how amphipods orientate themselves on the beach during the night has been investigated by various scientists. Papi (1960) and Papi & Pardi (1963) suggested that *Talitrus saltator* was capable of orientating by the position of the moon (endogenous rhythm). *T. capensis* lives in vegetated dune slacks, where they move around, probably randomly, from one vegetation hummock to another. They do not migrate significant distances from these slacks, and do not need a lunar orientation mechanism to lead them back to their burrow sites at sunrise. They simply move to the nearest hummock and burrow. The use of hummocks in orientation is an aspect that should be studied further.

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References

BENSON, J.A. & LEWIS, R.D. 1975. An analysis of the activity rhythm of the sand beach amphipod, *Talorchestia quoyana J. comp. Physiol.* 105: 339 – 352.

BOWERS, D.E. 1964. Natural history of two beach hoppers of the genus *Orchestoidea* (Crustacea : Amphipoda) with reference to their complemental distribution. *Ecology* 45: 677 – 696.

BREGAZZI, P.K. & NAYLOR, E. 1972. The locomotor activity rhythm of *Talitrus saltator* (Montagu) (Crustacea, Amphipoda). *J. Exp. Biol.* 57: 375 – 391.

CHELAZZI, G. & FERRARA, F. 1978. Researches on the coast of Somalia, the shore and the dune of Sar Uanle. *Monitore Zool. Ital.* 8: 189 – 219.

CRAIG, P.C. 1973. Behaviour and distribution of the sand beach amphipod, *Orchestoidea corniculata*. *Mar. Biol.* 23: 101 – 109.

CROKER, R.A. 1967. Niche diversity in five sympatic species of intertidal amphipods (Crustacea: Haustoriidae). *Ecol. Monogr.* 37: 173 – 200.

DAHL, E. 1952. Some aspects of the ecology and zonation of the fauna of sandy beaches. *Oikos* 4: 1 – 27.

DEXTER, D.M. 1971. Life history of the sand beach amphipod *Neohaustorius schmitzi* (Crustacea: Haustoriidae). *Mar. Biol.* 8: 232 – 237.

ENRIGHT, J.T. 1963. The tidal rhythm of activity of a sand beach amphipod. *Z. Vgl. Physiol.* 46: 276 – 313.

McLACHLAN, A., ASCARAY, C. & DU TOIT, P. 1985. Sand movements, vegetation succession and biomass spectrum in a dune slack. *J. Arid Environ.* (in press).

MUIR, D.G. 1977. The biology of *Talorchestia capensis* (Amphipoda; Talitridae) including a population energy budget. M.Sc. thesis, University of Cape Town.

PAPI, F. 1960. Orientation by night: The moon. *Cold. Spring. Harb. Symp. Quant. Biol.* 25: 475 – 480.

PAPI, F. & PARDI, L. 1963. On the lunar orientation of sandhoppers (Amphipoda: Talitridae). *Biol. Bull.* 124: 97 – 105.

TANSLEY, A.G. 1949. Introduction to plant ecology, a guide for beginners in the study of plant communities. Allen and Unwin, London.

VAN SENUS, P. 1985. The effects of temperature, size, season and activity on the metabolic rate of the amphipod, *Talorchestia capensis* (Crustacea: Talitridae). *Comp. Biochem. Physiol.* 81A: 263 – 269.

VENABLES, B.J. 1981. Energy allocation for growth and metabolism in *Talorchestia margaritae* (Amphipoda, Talitridae). *Crustaceana* 41: 182 – 190.

WILDISH, D.J. 1970. Locomotory activity rhythms in some littoral *Orchestia* (Crustacea, Amphipoda). *J. mar. biol. Ass. U.K.* 50: 241 – 252.

WILLIAMS, J.A. 1982. Environmental influence on the locomotor activity rhythm of the sand shore amphipod, *Talorchestia deshayesei*. *Mar. Biol.* 69: 65 – 71.

WILLIAMSON, D.I. 1951. Studies in the biology of Talitridae (Crustacea: Amphipoda). Visual orientation in *Talitrus saltator*. *J. mar. biol. Ass. U.K.* 30: 91 – 99.