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A preliminary comparative assessment of the meiofaunal communities of Maltese pocket sandy beaches

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ABSTRACT

Whilst the macrofaunal communities of Maltese pocket sandy beaches have been extensively studied, the meiofaunal communities of the same beaches are virtually unknown. The main aims of the current study include the acquisition of preliminary data on the occurrence of meiofaunal higher taxa on Maltese pocket sandy beaches, the comparison between the Maltese beach meiofaunal communities with those on other Mediterranean sandy beaches and the assessment of the influence of a selected number of beach physical parameters on the same communities. Seven sandy beaches in the Maltese Islands were sampled during spring 2012, with sediment samples being collected at the Mean Sea Level (mediolittoral zone). Median grain size and sediment organic and water content were measured for each beach. A total of 13 higher meiofaunal taxa were recorded from the Maltese sandy beaches. The meiofaunal abundance ranged between 50 and 1392 individuals/10 cm^2, whilst the number of meiofaunal higher taxa recorded at a single sampling station ranged between 5 and 10. Mean grain size and sorting coefficient appeared to have the highest influence on variations in Maltese meiofaunal communities. Based on conducted analysis it is suggested that inter-beach dispersal of meiofaunal propagules for Maltese beaches is restricted to short distances and does not operate over distances exceeding 5–10 km. This in turn results in some degree of compartmentalisation of the same assemblages. The meiofaunal assemblages recorded from the Maltese beaches exhibited comparable densities to those recorded on other Central Mediterranean sandy beaches and no significant differences in community structure at higher taxa level were observed.

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1. Introduction

Whilst the macrofaunal community of Maltese pocket beaches has been extensively studied (e.g. Gauci et al., 2005; Deidun and Schembri, 2008a, b; Deidun et al., 2011), the meiofaunal component of the same beaches is virtually unknown. In fact, no study on the composition and abundance of meiobenthos, as well as on the spatial variability within their communities, for Maltese sandy beaches has been conducted to date.

The relative paucity in scientific works on meiofauna is not restricted to the Maltese Islands but is a characteristic of the entire Mediterranean Basin. In fact, most studies on sandy beaches meiofaunal assemblages in the Basin are restricted to the northwestern reaches (e.g. Albertelli et al., 1999; Moreno et al., 2006; Covazzi-Harriague et al., 2007) and to the Adriatic Sea (e.g. Danovaro et al., 1999; Semprucci et al., 2013), with the latter work investigating the response of higher meiofaunal assemblages to a dynamic river (Po) front plume. Despite the first international conference on meiofauna being held in Tunisia in 1962, meiofaunal assemblages in the central and southern Mediterranean have received little scientific attention to date. Whilst the use of meiofaunal taxa in ecotoxicological studies in Tunisian waters is relatively common (e.g. Beyrem et al., 2009), meiofaunal communities as a whole and their distribution at such latitudes have been poorly studied to date. However, Kotwicki et al. (2005b) incorporated meiofaunal community results from Tunisia within a broader study investigating latitudinal gradients pattern.

Although considered to be very diverse, and despite being highly accessible for sampling purposes, the census of sandy shore and shallow water meiobenthic taxonomic composition, and hence biodiversity, is still far from complete. Meiofauna is defined here as organisms passing undamaged through 0.5 mm sieves and retained on 0.032 mm ones. By virtue of their size, the meiobenthos are capable of living in the sand's interstitial system which, in contrast

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to the wave-swept sandy surface, is three-dimensional. The porous, water-filled system averages about 30–40% of the total sediment volume. Interstitial animals are adapted to living in this system by attaining small size, by having evolved elongated and flexible bodies and means or organs to adhere to sand grains, and by developing a variety of reproductive, life cycle and trophic adaptations (Giere, 2009).

The interstitial meiofauna on most sandy shores is numerically rich, occurring at abundances in the order of magnitude of up to 10^3 individuals under 10 cm^2 of seafloor surface (e.g., Kotwicki et al., 2005a, b). The abundances vary along a beach profile, with the highest densities being encountered at, or near to, the water line (e.g., Jonczyk and Radziejewska, 1984; Rokicka-Praxmajer et al., 1998). Generally, the abundance of the interstitial meiofauna is correlated with sand grain size and the sediment organic matter content (Ellison, 1984; Coull, 1988).

In addition to being very abundant, the meiobenthos is also very diverse, although, on sandy beaches, it is usually strongly dominated by one or two major taxa (Hulings and Gray, 1976). Meiofauna plays diverse roles in the sandy shore and shallow sandy sublittoral: it is regarded as a trophic link between microorganisms (including microphytobenthos) and larger fauna (including fish) and enhances the rate of carbon mineralisation and nutrient regeneration by stimulating microbial activity through grazing and assimilation of detritus, whereas predatory meiobenthic taxa exert control on a part of the assemblage (Giere, 2009). In addition, the meiobenthic organisms are highly sensitive to anthropogenic inputs, which make them excellent indicators of pollution or environmental disturbances (Schratzberger et al., 2002; Szymelfenig et al., 2006; Grzelak et al., 2009; Grzelak and Kotwicki, 2012).

Previous studies on the macrofaunal community of Maltese pocket beaches have hinted at the relative isolation of pocket beach assemblages by virtue of the deflection of longshore currents by flanking headlands, the so-called compartmentalisation theory. Deidun et al. (2003), Deidun and Schembri (2008b) and Marrone et al. (2013) failed, however, to identify considerable differences in the composition of macrofaunal assemblages on headland-separated adjacent beaches.

The current study aims to compile a preliminary list of higher meiofaunal taxa from the sampled Maltese sandy beaches, to assess the influence of crucial environmental parameters on the composition of such a meiofaunal assemblage, to investigate whether such assemblages differ between adjacent but headland-separated pocket beaches and to compare the meiobenthic assemblages of Maltese sandy beaches with those from other central Mediterranean beaches. The main hypotheses to be tested in the current study include: 1. Sediment grain size and organic content predict the structure of meiofaunal assemblages; 2. Geographical location does not shape the spatial meiofaunal distribution on Mediterranean sandy beaches; 3. Adjacent sandy beaches separated by longshore current-deflecting headlands support distinct meiofaunal assemblages, with such assemblages being 'compartmentalised'.

2. Materials and methods

2.1. Study area

The following seven pocket sandy beaches on the island of Malta within the Maltese archipelago were sampled in May 2012: Gnejna (GN), Ghajn Tuffieha (GT), Ramla tal-Mixquqa – Golden Bay (GB), Mellieha Bay (MB), Armier (A), Little Armier (LA) and White Tower Bay (WT). Meiofaunal communities of Maltese sandy beaches were compared with those from other Central Mediterranean sandy beaches. Fig. 1 gives the study area. Sampled Maltese beaches are separated from each other by headlands, peninsulas and short stretches of rocky coastline. Such a geomorphological setting

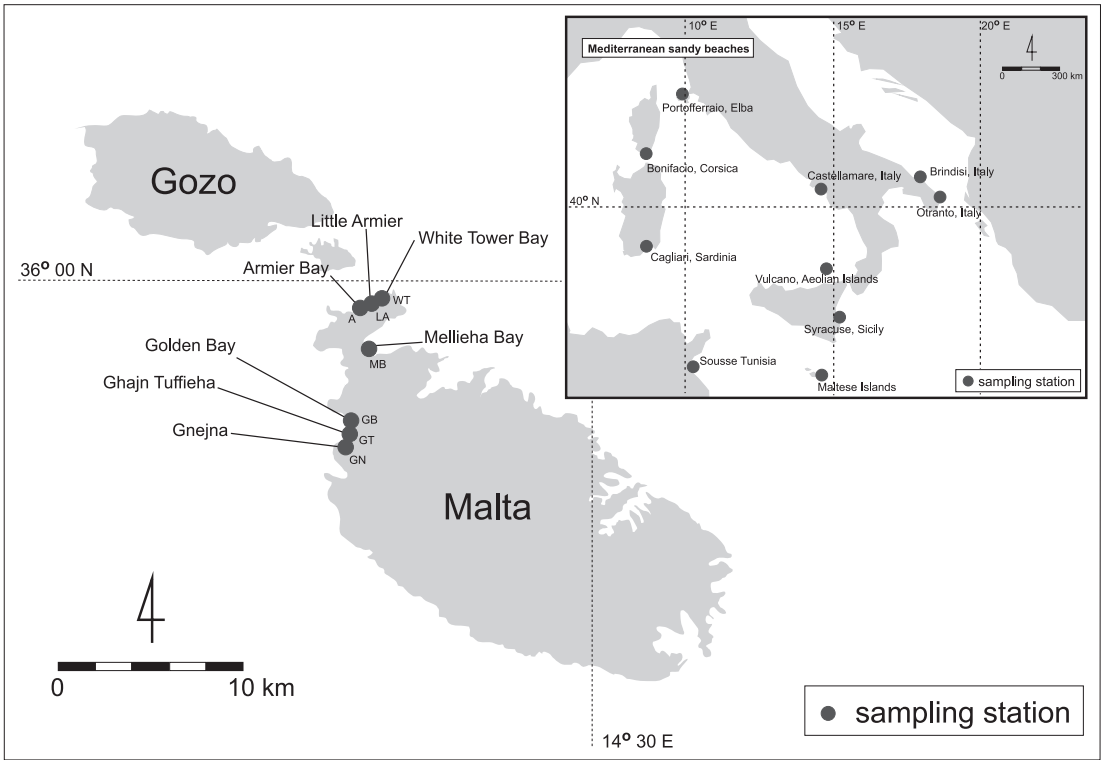

Fig. 1. Geographical position of investigated sandy beaches on the Maltese Islands and other Mediterranean beaches localisation. Legend: GN = Gnejna; GT = Ghajn Tuffieha; GB = Golden Bay; MB = Mellieha Bay; A = Armier Bay; LA = Little Armier; WT = White Tower Bay.

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