

## Life beneath the sand?



The Spiaggia dei Conigli in Lampedusa, one of the beaches sampled by the author in his Ph.D. thesis

Maltese beaches are known as 'pocket beaches' since they are flanked by headlands which restrict longshore exchange of material between the beaches. The Maltese archipelago is anomalous in that just 2.4% of our coastline is sandy, compared with Italy's 50% and 66% of the global coastline.

Couple this with the high tourism density in summer that our beaches are exposed to and you end up with this habitat facing intense human disturbance. Not that this raises too many qualms in most people due to the popular misconception that sand is a biological desert, largely devoid of life.

For my Ph.D. study, I sampled for eight consecutive seasons four beaches on our islands (Ramla and Xatt I-Ahmar in Gozo; White Tower Bay and Golden Bay in Malta) and during the spring seasons only, two beaches on Lampedusa (Spiaggia dei Conigli, Guitga), two on Favignana (Lido Burrone, Porto), one on Sicily (Pozzallo) and one in Calabria (Gioia Tauro).

The main aims of my study were to revisit the conclusions arrived at during a previous study conducted on local beaches over one season only, namely that local beach assemblages appear to be 'compartmentalised' and that our beaches appear to be poor in fauna when compared to others.

Since the previous study was a 'snapshot', conducted over just one sampling season (summer 2000), there was a need to confirm these conclusions through a multi-seasonal study. In addition, the multi-seasonal character of the current study makes it possible to document inter-seasonal and inter-annual variations in faunal assemblages, individual abundance and taxonomic composition and to relate these to the abiotic parameters monitored (such as median sand grain size, exposure to wave action, beach slope, sand organic content and particulate organic content of near-shore waters). Consequently, the validity of the snapshot studies carried earlier on local beaches will also be tested.

Finally, beaches with different lengths were sampled in this study to investigate the influence of beach length on beach macro-faunal assemblages and beaches located on islands at different distances from the mainland were also sampled to investigate the possible influence of barriers to recruitment on beach macro-faunal distributions.

Depending on its dimensions, two or three transects were laid out on every beach, extending over the 'bare sand' part of the beach (i.e. from a water depth of about a metre to the foot of any dune remnants backing the beach). Every transect was then divided into a wet and dry zone, with the strandline delineating the boundary between the two.

To achieve these aims, I used three different sampling techniques - coring/sieving at regular stations along the transects to collect infauna, pitfall trap constellations in the wet and dry zone of every transect to collect surface-active nocturnal macrofauna, and sweeps with a hand-towed net in shallow water to collect upper infralittoral, burrowing macro-fauna which emerge to swim at night.

The pitfall trap constellation consists of five plastic cups inserted into the sand so that their surface is flush with the sand surface and connected by means of wooden strips ('walkways') in the form of a cross. I learned the technique from Italian colleagues from Florence University during a study visit.

The efficacy of the pitfalling technique is evident from the fact that 78% and 77% of the total macro-faunal individuals collected during the first and second years of sampling respectively were collected by means of pitfall traps - this shows the predominantly nocturnal nature of psammophiles (beach-dwelling organisms), one of the key adaptations of such organisms to survive in such a harsh habitat. The taxonomic composition, feeding and habitat preferences of the macrofauna collected were subsequently determined.

Only 34 of the total species richness collected were strict psammophiles, the rest being either littoral (coastal) species (hence, found also on rocky shores, in sand dunes) or ubiquitous, like many species of ants. The relatively few psammophilic species, however, included the most numerically abundant species, like the isopod *Tylos europaeus*, restricted locally to Ramla l-Hamra, and *Phaleria* species.

Faunal assemblages recorded were almost entirely composed of arthropods, with insects being the most abundant taxon in terms of species richness and crustaceans (namely isopods and amphipods) being the most abundant in terms of individual abundance. Tenebrionids were the most abundant coleopterian family, followed by staphylinids.

In terms of individual abundance, detritivores and omnivores were the most abundant feeding type for pitfall trap and handnet collections respectively, while mysids were the most abundant taxon recorded by handnets.

The salient conclusions from this study are that the phenomenon of compartmentalisation (i.e. the isolation into distinct faunal assemblages) of local beach fauna was confirmed, it appears to be much weaker than originally thought - such a phenomenon is more significant for shallow-water assemblages than for supralittoral (dry-sand) assemblages and this could be attributed to the cell circulation patterns witnessed in our embayments which restrict dispersal of fauna from one bay to another.

The occurrence of such a phenomenon was also confirmed by the large number of species consistently collected over the eight sampling seasons from one beach only and this supports the concept that no local beach assemblage is expendable since it has a certain uniqueness resulting from the lack of exchange of sediment and fauna between adjacent beaches - genetic studies in the future should be conducted to test this.

The study also reports, rather surprisingly, a higher than expected degree of homogeneity between beach assemblages of different central Mediterranean islands, possibly due to the 'relict' hypothesis, which states that the different islands were once joined in one landmass and single species populations were later fragmented into smaller populations once the islands separated from each other.

Two final conclusions from the current study are that there was no statistically significant relation between beach length and the biotic composition on a beach and the dearth of infaunal individual abundance for local beaches recorded by previous studies was also confirmed, although higher macro-faunal species richness were recorded from the local beaches than that quoted in the literature for other Mediterranean beaches. The relatively low infaunal individual abundance densities of local beaches could not be explained solely in terms of the islands' isolation and relative lack of macro-faunal recruitment.

This article is a synopsis of the Ph.D. study just completed by the author at the Department of Biology of the University of Malta. Results from this study were presented at the Società Italiana di Biologia (SIBM) annual congress in Trieste in June 2005 and will be published this month in the latest issue of *Biologia Marina Mediterranea*; other results will be presented at the fourth Sandy Beaches International Symposium to be held in Vigo, Spain, late in October. The author teaches biology at St Aloysius College Sixth Form.

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