Dispelling the 'ecological desert' perception of sandy beaches

Current research highlights the conservation importance of macrofaunal assemblages on tideless beaches

Pocket beaches are flanked on both sides by headlands which restrict the longshore transport of sediment (and possibly even of water-borne biota), such that pocket beaches are essentially isolated from each other, resulting in a high degree of inter-beach distinctiveness of macrofaunal assemblages.

By Alan Deidun

Besides perennially submerged areas, the marine environment also encompasses coastal areas, of which sandy beaches form an inherent part, since, despite being located at the fringe of the marine environment, these areas are still under direct maritime influence. With specific reference to sandy beaches:

- The coastal fringe extends for roughly 8% of the world's surface area (Ray & Hayden, 1992), or *ca.*594,000km (Hammond 1990). Sandy beaches may constitute from 20% (Finkle, 2004) to 75% (Bascom, 1980) of this.
- Some authors (e.g. Brown & McLachlan, 1990) argue that many of the species on sandy beaches have a marine origin – this is especially true for oceanic tidal beaches. For example, the surf zone (defined as that part of the beach extending from the waterline to the most seaward point at which waves approaching the coastline commence breaking) is home to the larval stages of many commercially important fish species as well as a plethora of crustacean orders including mysids, cumaceans, tanaeids, amphipods, isopods and decapods.
- An exposed sandy shore consists of coupled surf zone, beach and dune systems (Short & Hesp, 1982) which together form a littoral active zone of sand transport. On open coasts subject to oceanic swell, the water depth of sediment transport may be 20m and may well extend beyond the surf zone.

Sandy beaches do not rank highly amongst conservation priorities, mainly as a result of the widespread misconception that these areas are essentially 'ecological deserts.' In fact, up to the early 1980s (the First International Symposium on Sandy Beaches was held in 1983 in Port Elizabeth, South Africa), sandy beaches were mainly studied from a geological perspective (e.g. Davis, 1985) and marine biologists tended to regard estuaries, coral reefs and rocky shores, obviously teeming with life, as more fruitful areas for study than apparently biotically impoverished sandy beaches (McLachlan & Erasmus, 1983). The 'desert' notion is further reinforced by the apparent lack of life in such coastal habitats – besides the lack of attached macrophytes, most macrofaunal species on sandy beaches burrow deep into the sand, emerging (if at all) at night, and have a cryptic coloration. As from the early 1990s, the situation began to improve, with hundreds of sandy beach studies being published.

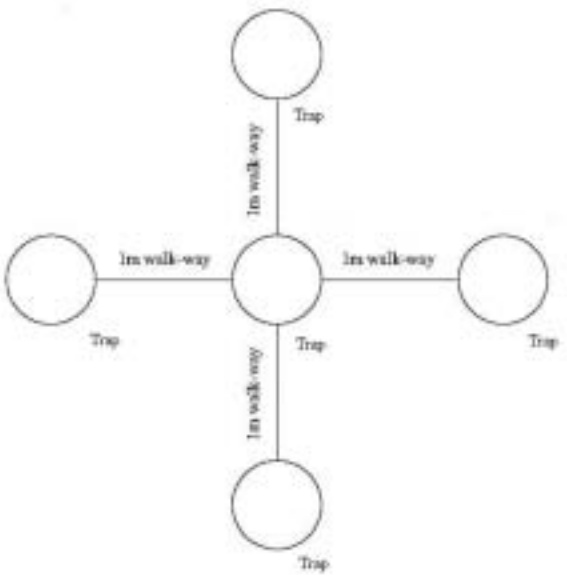
A debate which rages from time to time concerns the species to list under sandy beach assemblages – for example, Brown (1983) lists just 20 species of macrofauna which are resident on sandy beaches, whilst Weslawski *et al.* (2000) give a figure of 200. There is more consensus with respect to meiofaunal species counts, *ca.*600 meiofaunal species being described from sandy beaches worldwide (Brown, 2001). The manifest disparity in macrofaunal species counts is attributable to the type of species included in the censuses – Brown (1983), unlike Weslawksi *et al.* (2000), excludes insect species from his assessment, conducted on tidal, oceanic beaches. On tideless, microtidal beaches with wide supralittoral zones (supralittoral = that zone permanently exposed to the air except for the occasional wetting by seaspray and the highest waves), such as found in the Baltic and the Mediterranean, the insect component is significant, although largely overlooked in beach studies. For psammophilic (sand-specific, stenoecious) species, the order Coleoptera is by far the most represented, with many species belonging to the families Tenebrionidae, Staphylinidae and Anthicidae. Other common insect orders on beaches include Hymenoptera and Diptera. Since most insect species found on beaches are rarely submerged in seawater, despite being regularly exposed to sea spray, the term 'maritime' is proposed to describe these species.

Sandy beaches worldwide, but especially in touristic hotspots such as the Mediterranean, are bearing the brunt for the largely derisory conservation status afforded to them. In fact, Brown & McLachlan (2002), in their predictions for sandy beaches for 2025, list a welter of threats facing the integrity of sandy beach ecosystems, including enhanced beach erosion rates, the hardening of surfaces above and around dunes and the excessive discharge of nitrogen into coastal waters. Spearheading the conservation of the sandy beach macrofaunal communities as functional ecosystems is paramount in Mediterranean tourist islands, such as the Maltese Islands, where the dearth of sandy coastline (just 2.4% of the total coastline) further compounds the human impact on these coastal communities.

The conservation importance of Maltese pocket beaches is further underscored by the presence of a number of endemic species, mainly flightless species of Tenebrionidae *(Stenosis melitana, Erodius siculus melitensis* and *Pseudoseriscius cameroni;* the latter is listed within Annex II of the EU's Habitats Directive), and others with a very restricted distribution (for example, *Clithobius ovatus,* known only from the Maltese Islands and Tunisia). On undisturbed sandy beaches, the diversity of psammophilic life can be surprising; for example, on the largely inaccessible Xatt l-Ahmar, a beach on the island of Gozo that only covers an area of 500m^2, a total individual abundance of 114.3 inds/trap/hr and a total species richness of 36 were recorded during the spring season of 2003, through the use of pitfall traps. On the same undisturbed beach, a stunning 98% of all macrofaunal individuals collected, and 50% of all species collected, were psammophiles. Community taxonomic composition is a good non-quantitative indicator of the degree of human disturbance on a beach – in fact, Deidun & Schembri (2004) showed that an increase in human occupancy of sandy beaches results in an increase in the proportion of ubiquitous (euryoecious) species and a decrease in the proportion of psammophiles.

A pitfall trap constellation being deployed along a stretch of the Polish Baltic coast, in Slowinski National Park, in September 2007, in collaboration with the IOPAN institute in Sopot.

My research seeks to highlight the conservation importance of sandy beach macrofaunal assemblages, especially those on pocket beaches. Pocket beaches, such as those found in the Maltese Islands, are defined as sand and gravel beaches along which little or no lateral, longhsore drift of beach material takes place because they are contained between two headlands (Lambie, 2005). As a result, little (if any) exchange of suspended sediment and biota occurs between pocket beaches, despite the same beaches lying in close proximity to each other; the consequent 'isolation' of different beach assemblages is further accentuated by the long stretches of rocky coastline which might separate, as in the Maltese Islands, one pocket sandy beach from another. The resulting 'compartmentalisation' of macrofaunal assemblages from different beaches might be expressed in terms of species composition or, more subtly, as intraspecific genetic differences. Such inter-population genetic differences have already been demonstrated for some amphipod species, namely *Talitrus saltator* and *Talorchestia* spp., collected from different Mediterranean beaches (e.g. Ketmaier *et al.,* 2003). The implication of all this is that individual beaches are distinct and that no beach macrofaunal assemblage is expendable. Further research investigating macrofaunal recruitment on pocket sandy beaches located on different islands, especially in the wake of mass mortality events such as intense storm activity, is presently under way.



A schematic overview of the pitfall trap constellations used during sampling on sandy shores along the Mediterranean and Baltic Seas. Such constellations, consisting of traps connected via wooden 'walkways,' are very efficient in collecting surface-active macrofaunal species.

Whilst the conservation importance of sand dunes is acknowledged worldwide, culminating in their protection along various coastal stretches, 'bare sand' macrofaunal assemblages have a low conservation priority, mainly due to an 'apparent' lack of life within such systems but also because of their high amenity value, which makes them incompatible with conservation objectives – indeed Brown & McLachlan (1990) suggest reserving dunes for conservation and beaches for recreation. Perhaps it is time for a reappraisal of this maxim!

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Gnejna Beach, Malta. Conservation of sandy beach macrofaunal assemblages must take into consideration the huge popularity of beaches among tourists and locals, especially on islands reliant on tourism revenue.

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Alan Deidun
Department of Biology
University of Malta Junior College
Msida, Malta
Email: alan.deidun@um.edu.mt