

Changes in marine benthic community types in a Maltese Bay following beach rehabilitation works

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ABSTRACT

In the Autumn of 1990 large amounts of marine sediment collected during dredging works carried out in relation to the construction of the Malta Freeport, were dumped onto the shore at Pretty Bay, Birzebbuga, Malta. During the following months, movement of this sediment inside the bay resulted in the accumulation of sand on the seabed. As a consequence, many of the original benthic communities: the mediolittoral communities on hard substrata, the communities of photophilic algae on hard substrata and the communities of *Posidonia oceanica*, were almost completely buried by the sediment and replaced by a species assemblage characteristic of unstable sandy bottoms with a much lower species diversity than the original communities. Remnants of the original community types were only found in a few small areas of the bay, away from the central part where sediment deposition appeared to have been most intense. The authors have mapped the benthic communities present in the bay in order to provide a baseline against which future surveys can be compared as part of a monitoring programme to assess whether the original communities present are able to re-establish themselves.

INTRODUCTION

The coastal zone is a site of great resource conflicts in many parts of the world. This is aggravated in places such as Malta which has one of the highest population densities in the world. Malta's coastal development has overall been haphazard and lacking in effective management and planning (Anderson *et al.*, 1992). Physical human interference with the marine environment varies in form and magnitude. One interesting and poorly documented form of anthropogenic interference is the exploitation of marine sands and gravels for use in constructing and rehabilitating beaches. Commonly, exploitation of such sediments is small and of a limited duration. However, there are several instances where the rebuilding of beaches on a large scale has been carried out using sand extracted from other areas (Jeftic *et al.*, 1990). Some beach rehabilitation works have also been carried out in Malta. In October 1990, dredging works which were being carried out in relation to construction of the Malta Freeport at Kalafrana (SE Malta), resulted in the accumulation of large amounts of marine sediment which needed to be disposed of. A large proportion of this sediment was pumped directly onto the shore and shallow waters of Pretty Bay, the innermost part of Birzebbuga Bay. Shortly after, however, movement of the sediment was evident in different parts of the bay. This study considers the resultant impact of this sediment transport on the marine benthic communities of the area.

MATERIAL AND METHODS

Due to the large area affected and the short time available, it was decided to carry out a qualitative survey based on direct observation and random point sampling in order to map and characterise the main benthic assemblages present following works in the area. This method has been frequently employed to provide basic information on the species composition and spatial distribution of the dominant communities; Earl (1976) refers to such surveys as "primary surveys". The species composition and spatial extent of supralittoral communities of Pretty Bay and Birzebbuga Bay were recorded by direct observation whilst walking along the shore. The infralittoral benthic communities were mapped by laying transects perpendicular to the shore at approximately ten equidistant points spread along the shore of Birzebbuga Bay. The transect line used was graduated in 5m intervals to enable estimates of the distance from the starting point to at any point along its length to be made. Two divers using SCUBA equipment swam along the transects and recorded the distance from the shore and the seaward limit of the different communities occurring in the area. These data together with the identity of species characterising each community were recorded underwater on slates. Peres's (1967; 1982) nomenclature scheme for Mediterranean benthic communities was used to record communities on the basis of the presence of indicator species. Species which were not readily identifiable in situ were taken to the laboratory for identification. Only the benthic macroflora and macrofauna were systematically considered. Photographic records were made using an underwater camera. Observations on depth and sediment grain size were also made at different points in the study area.

RESULTS

The main output of this survey is a scale map of the benthic communities present in the area (Fig. 1). This map is meant to provide a baseline against which future surveys can be compared in order to monitor changes in benthic community structure with time. A brief description of the different communities present follows:

SUPRALITTORAL AND MEDIOLITTORAL COMMUNITIES

The rocky shore supralittoral appeared to be very impoverished and lacked the fauna and flora typical of this zone on Maltese shores (Attard & Giglio, 1990; Mallia, 1991). For example, the gastropod *Littorina neritoides* and the isopod *Ligia italica* were not seen. This low species richness was also observed on the sandy supralittoral zone. The mediolittoral zone was covered with a thick carpet of *Enteromorpha linza* and lacked the characteristic species typical of the Maltese mediolittoral such as the gastropod *Monodonta turbinata*, and the crab *Pachygrapsus marmoratus* (Attard & Giglio, 1990; Mallia, 1991).

INFRALITTORAL COMMUNITIES

In the infralittoral, most of the rocky substrata which originally supported a community of photophilic algae were found to be covered with medium to coarse bare sand. Those which remained uncovered were mainly colonised by the alga *E. linza* which is an opportunistic, pioneer, species with very few other plants and animals present. Most of the

remaining infralittoral bottom surveyed consisted of muddy sand. This bottom type supported an impoverished epifauna dominated by the hermit crab *Diogenes pugilator*, the crab *Parthenope massena* and a species of *Gobius*. Several infaunal species, mostly polychaetes were also present. Exposed *Posidonia oceanica* "matte", without live shoots were found at several places in the study area and only a few small isolated patches of the live seagrass were present. These patches of *Posidonia* appeared to be in an unhealthy state, with the leaves bearing heavy crusts of epiphytic algae and they lacked the rich faunal assemblage characteristic of this community type in the Mediterranean (Peres, 1967; 1982; Ros et al., 1984; Mazella et al., 1989; Scipione et al., 1983; Harmelin-Vivien, 1983) and in the Maltese infralittoral (Borg, 1991). The bedrock was exposed along the shore but only from sea-level to a depth of about one metre. This rocky fringe supported a few algae, mainly *Dictyoptera membranacea*, *Padina pavonica*, *Halopteris scoparia* and *Acerabularia* sp. The fauna associated with this algal assemblage was also very impoverished, quite unlike the highly diverse communities normally found inhabiting the "forests" of algae on the upper infralittoral rock (Peres, 1967; 1982, Ros et al., 1984).

DISCUSSION

Species richness was low throughout the study area. This contrasts with the high species richness of the well established communities of mediolittoral hard substrata, of *Posidonia oceanica* meadows and of photophilic algae on hard substrata which were present before the beach rehabilitation works were carried out (Borg & Schembri, 1991). Further changes in the ecology of Birzebbuga Bay are expected. This situation provides an ideal case-study of the effects of beach rehabilitation works on the ecology of the benthic communities characteristic of Maltese Bays. In particular, considering the mainly negative effects suffered by the benthic communities in the study area, caution should be taken against proceeding with further beach rehabilitation without carrying out a thorough study beforehand and an in-depth evaluation of the costs and benefits of the operation, environmental as well as economic. We intend to carry out periodical surveys similar to the one reported here to enable a monitoring of the changes taking place.

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FIGURE CAPTIONS

Figure 1

Map of the benthic communities in Birzebbuga Bay following the beach rehabilitation works. The dotted line extending from the fuel pipeline to the Freeport terminal represents the boundary of the area studied. Pretty Bay is the name given to the inlet lying to the northwest.

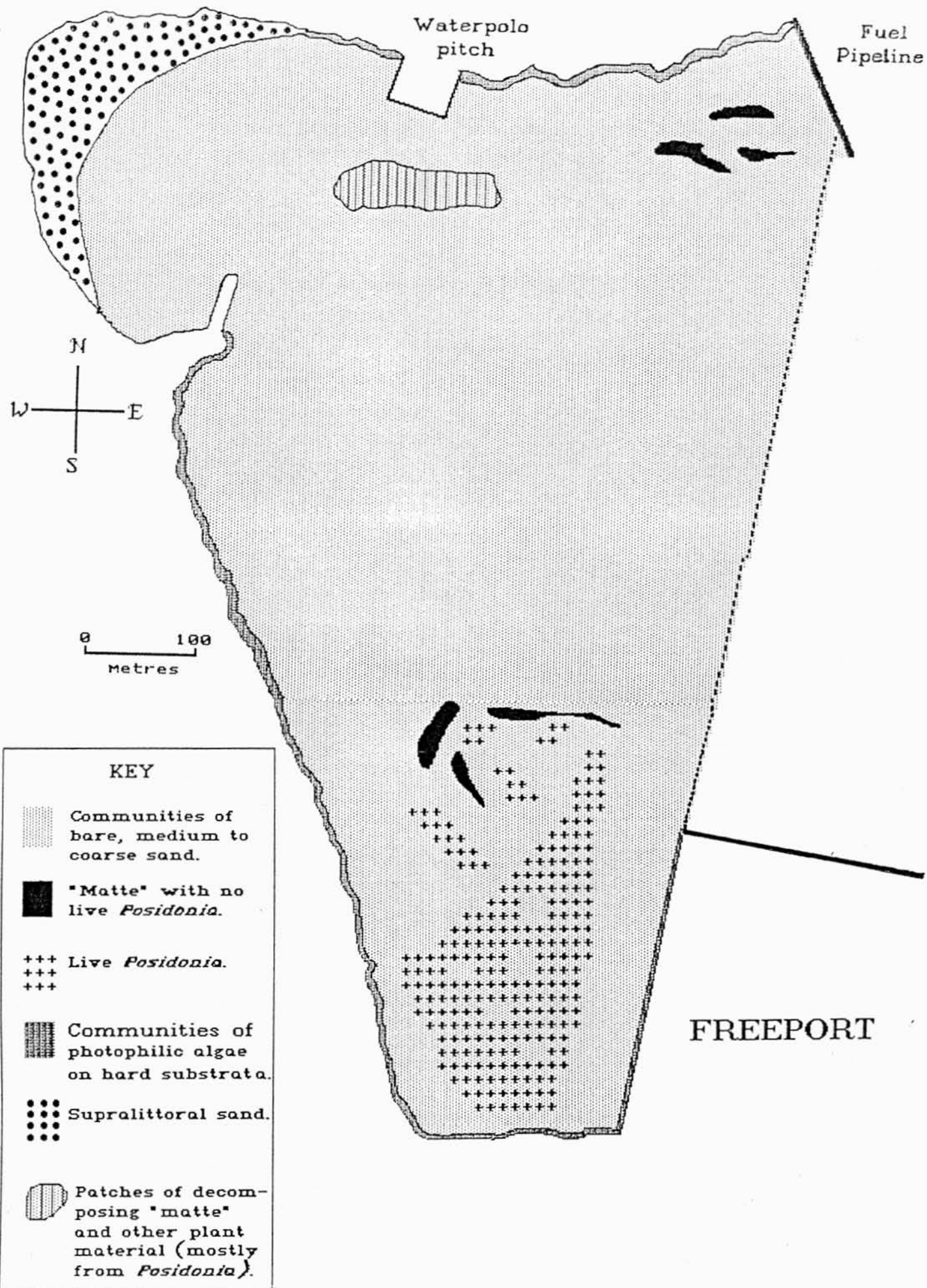


Figure 1