What is a 'Sandbank': A Commentary Based on a Maltese Case Study

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Abstract

Habitat Type 1110 ‘Sandbanks which are slightly covered by sea water all the time’, listed in Annex I of the EU’s Habitats Directive, is defined in the EU ‘Habitat Interpretation Manual’ as "elevated, elongated, rounded or irregular topographic features, permanently submerged and predominantly surrounded by deeper water", which "consist mainly of sandy sediments", and where the water depth above the sandbank "is seldom more than 20 m below chart datum". It is specified that Mediterranean sandbanks may be characterised by the marine angiosperm Cymodocea nodosa, but also that "on many sandbanks macrophytes do not occur".

The main objective of the present work was to characterise ‘geomorphological’ sandbanks around the Maltese Islands. Information on the physical characteristics of
sandy elevations in Ghajn Tuffieha, Mellieha Bay, and the Comino Blue Lagoon was collected during the LIFE BaĦAR for N2K project surveys in 2016, while biotic data from the Ghajn Tuffieha and Mellieha Bay banks was collected in 2013 as part of an ecological survey commissioned by the then Malta Environment and Planning Authority.

The results of these studies indicate that sandbanks in the Maltese Islands tend to be present in very shallow waters, at depths ranging from ca. 0.02 m to 2.00 m. The surveyed sandbanks had variable dimensions, with lengths ranging from ca. 11 m to 180 m, and widths ranging from ca. 1.5 m to 17 m. Samples of infauna collected using core samples in 2013 did not reveal any significant differences in the total number of species or in the total abundance of organisms between the sandbanks and nearby reference sites. No macroflora, and thus no *C. nodosa*, were recorded on any of the surveyed sandbanks. In the Maltese Islands, associations with *C. nodosa* are in fact found throughout the infralittoral, down to ca. 45 m. *Cymodocea nodosa* may occur as a dense meadow or very sparsely, either as almost monospecific stands or in association with other seagrasses (*Posidonia oceanica* or *Halophila stipulacea*) and/or macroalgae (e.g. *Caulerpa cylindracea* or *Caulerpa prolifera*). *Cymodocea nodosa* is thus clearly not limited to the environmental conditions created by sandbanks in the Maltese Islands, is not generally present where such conditions occur, and is therefore not a useful indicator species for this habitat type.

Detailed seasonal studies of physical characteristics are required to confirm with certainty that the habitats identified in Malta are indeed true sandbanks in the geomorphological sense. Monitoring of benthic assemblages is also required to ascertain whether there are any biotic assemblages which could serve as biological indicators for this habitat type, and to demonstrate the ecological importance of this habitat.

**Introduction**

Sandbanks are found in coastal and shelf areas, where currents act in conjunction with coastal or seabed topography to move and accumulate mobile sediments in a wide variety of forms (Dyer and Huntley, 1999; Kaiser et al, 2004). Dyer and Huntley (1999) developed a descriptive classification scheme to harmonise the definitions used by marine geologists and physical oceanographers, and considered formation processes as well as the hydrodynamic setting to be key factors influencing the long-term development of sandbanks. As a result of their unique physical characteristics, sandbanks may hold their own distinct assemblage of flora and fauna adapted to the conditions of this habitat (Withers and Thorp, 1978; Kaiser et al., 2004; Ellis et al., 2011; Atalah et al., 2013; Markert et al., 2015). Sandbanks are of considerable importance in stabilising coastlines and preventing erosion, and may act as nursery grounds for a number of commercially exploited species of fish in Northern Europe (Dyer and Huntley, 1999; Atalah et al., 2013).

In recognition of the known importance of sandbank habitats in Northern Europe, the European Union’s (EU) Habitats Directive (HD; Council Directive 92/43/EEC) lists ‘Habitat Type 1110 - Sandbanks which are slightly covered by seawater all the time’ in Annex I, as a ‘natural habitat type of community interest whose conservation requires the designation of special areas of conservation’. The EU ‘Habitat Interpretation Manual’
defines sandbank habitats as "elevated, elongated, rounded or irregular topographic features, permanently submerged and predominantly surrounded by deeper water", which "consist mainly of sandy sediments", although "larger grain sizes, including boulders and cobbles, or smaller grain sizes including mud may also be present". It is specified that 'slightly covered by sea water all the time' refers to sandbanks in which the water depth is seldom more than 20 m below chart datum. In a separate section on 'plants' associated with this habitat, the Interpretation Manual specifies that in the Mediterranean "the marine angiosperm Cymodocea nodosa, together with photophilic species of epiphytes (more than 15 species, mainly small red algae of the Ceramiaceae family), associated with Posidonia beds" may be found on sandbanks, but that "on many sandbanks macrophytes do not occur".

With regards to the different classification schemes currently in use for the description, designation and mapping of habitats in Europe, the EU Habitat Interpretation Manual considers that categories corresponding to sandbanks can be the relevant types within the EUNIS categories 'A5.1 Sublittoral coarse sediment'; 'A5.2 Sublittoral sand'; 'A5.4 Sublittoral mixed sediments'; and 'A5.5 Sublittoral macrophyte-dominated sediment'; the manual also lists the habitat classes relevant to sandbanks included in the RAC-SPA system. The EUNIS and the RAC-SPA systems include habitat categories which refer to ‘associations with Cymodocea nodosa on well-sorted fine sands’ and ‘associations with Cymodocea nodosa on superficially muddy sands in sheltered waters’, These, and other habitat categories, would however only be applicable to sandbanks in the presence of elevated, elongated, rounded or irregular topographic features surrounded by deeper waters, i.e. where sandbanks in the geomorphological sense are present.

Despite the above considerations several Mediterranean Member States consider C. nodosa beds on sand as equivalent to the HD Annex I sandbank habitats, since the EU Interpretation Manual (EC, 2013) lists C. nodosa as a characteristic plant species of sandbanks. Member States adopted this interpretation since they consider that the current definition of sandbanks given in the EU Habitat Interpretation Manual is based on sandbanks from Northern Europe (Evans et al., 2014).

In the Maltese Islands several areas with C. nodosa on sand are present in the marine Sites of Community Importance (SCIs) declared under the Habitats Directive. Very limited information is however available on sandbank habitats in the Maltese Islands; while sandy bedforms with a raised topography exist in shallow waters around the Maltese Islands, it is not known if these are ‘sandbanks’ in the geomorphological sense since there is no information on the processes that form and maintain them. In this context, the main objectives of the present work were to investigate the physical characteristics of ‘geomorphological’ sandbanks in the Maltese Islands, and to interpret the results in light of the biotic assemblages found on such sandy elevations.

**Material and Methods**

In order to locate sandy elevations SCUBA dives were carried out in areas where sandbanks in the geomorphological sense were considered likely to be present, as part of the LIFE BaĦAR for N2K project surveys in 2016. Concurrently, snorkelers surveyed shallow areas (Fig. 1). Sandy elevations that might be described as ‘sandbanks’ were
located at Ghajn Tuffieha, Mellieha Bay, and the Comino Blue Lagoon (Fig. 1). The approximate physical dimensions of the sandbanks, the bathymetry of the surrounding seabed, as well as their precise locations were subsequently recorded using measuring tapes and a handheld GPS. In addition the presence or absence of submerged vegetation on the sandy elevations was noted.

Fig. 1: Location of areas surveyed for sandbanks and sandbanks for which physical characteristics were measured during the 2016 LIFE BaĦAR for N2K project surveys.

Information on the biotic assemblages present on the Ghajn Tuffieha and Mellieha Bay sandbanks was available from a survey commissioned by the then Malta Environment Planning Authority (MEPA) in 2013. This survey entailed the collection of sediment cores in order to characterise the infauna present. Three replicate sediment core samples (using 10 cm diameter X 12 cm height corers) were collected from each of two stations on each sandbank, and from two nearby reference stations in waters that did not have largely different water depths to avoid any potential influence of this factor. Samples were fixed and preserved in 10% formaldehyde upon arrival at the laboratory.

In the laboratory, the samples were washed to remove the fine sediment (<0.5 mm fraction) and the preservative and were then sorted to separate out all macrofauna (animals larger than 0.5 mm). The motile macrofauna were then identified to the lowest possible taxon and counted. Where identification to species level was not possible, the different species present were labelled using an alphabetical code (e.g. *Paraonidae* sp. A, *Paraonidae* sp. B, etc.). Estimates of the total number of species and the total abundance were then made for each replicate core sample.

Three-factor Analysis of Variance (ANOVA), with \( \alpha \) set at 0.05 was used to test for significant differences in the total abundance and species richness of biota recorded from the samples. The factors used were ‘Locality’ (2 levels) ‘Habitat Type’ (2 levels) and ‘Station’ (nested within ‘Habitat Type’ and ‘Locality’). Prior to analyses, the data
were checked for normality and homogeneity of variances by using Cochran’s test and, where necessary, an appropriate transformation was carried out. All statistical tests were implemented using the ANOVA computer programme GMAV5 developed at the University of Sydney.

**Results and Discussion**

The information collected during the present study indicates that raised sandy elevations tend to be present in very shallow waters in the Maltese Islands, with the highest part of the surveyed sandbanks at depths ranging from 0.02 m to 2 m, and the depth of the surrounding seabed from 0.2 - 2.6 m. The physical dimensions of the three sandbanks surveyed in 2016 were variable, with the lengths of sandy elevations ranging from 11 m to 180 m, and widths ranging from 1.5 m to 17 m. In all cases the surveyed sandbanks were more or less consistent with part of the description of Habitat 1110 in the Interpretation Manual of European Union habitats in that the banks consisted of submerged sandy sediments that are elevated and elongated, and surrounded by deeper water. However, the habitat description in the Interpretation Manual is very broad and lacks any quantitative measure of precisely how 'elevated' a feature surrounded by deeper water should be in order to be classed as a sandbank; the crests of the sandy elevations measured during the present study were a mere 18 cm higher than the surrounding deeper waters. Moreover, detailed geomorphological, and ideally hydrological, studies which span different seasons over several years would be required in order to understand the processes which maintain these sandbank-like features, and to see whether the surveyed sandy elevations indeed persistently have structures in line with the descriptions of sandbanks in the geomorphological literature.

No macroflora or megafauna were recorded at any of the surveyed sandbanks. Infauna present on sandbanks was dominated by polychaetes. Table 1 gives a species-sample matrix showing the total number of macrobenthic invertebrates recorded in the sediment cores collected from the two sandbanks and nearby reference sampling stations during the 2013 survey.

**Table 1:** Species-sample matrix showing the total number of macrobenthic invertebrates recorded in sediment cores taken at sampling stations located on (stations 1, 2) and off (stations 3, 4) the sandbanks at Għajn Tuffiehaft Bay and Mellieha Bay.
The overall mean total number of species per core was 2.5 on the sandbank and 3.3 off the sandbank at Ghajn Tuffieha Bay, and 0.3 on the sandbank and 0.3 off the sandbank at Mellieha Bay. The overall mean total abundance per core was 17.2 on the sandbank and 6.3 off the sandbank at Ghajn Tuffieha Bay, and 0.3 on the sandbank and 0.3 off the sandbank at Mellieha Bay (Fig. 2 and 3). The results of the three-factor ANOVA indicated that the difference in the total number of species between the two localities was significant (ANOVA; p<0.01). Similarly, the difference in the total abundance of individuals recorded from the two localities was significant (ANOVA; p<0.001). No significant differences were indicated by the ANOVA between the sandbank habitat and the reference stations, although the mean total abundance of individuals found on sandbanks and at nearby reference stations varied at Ghajn Tuffieha Bay (Fig. 3).

**Fig. 2:** Mean species richness ± 1 standard deviation per core recorded from stations located on (stations 1 and 2, marked in light grey) and off (stations 3 and 4, marked in dark grey) the sandbanks at Ghajn Tuffieha Bay and Mellieha Bay during the 2013 survey.

**Fig. 3:** Mean total abundance ± 1 standard deviation per core recorded from stations located on (stations 1 and 2, marked in light grey) and off (stations 3 and 4, marked in dark grey) the sandbanks located at Ghajn Tuffieha Bay and Mellieha Bay during the 2013 survey.
A possible reason for the low number of species and low number of individuals recorded at Mellieha Bay compared to Għajn Tuffieha Bay is the higher anthropogenic impact at the former site, further exacerbated by the fact that the sandbank at Mellieha Bay was located in shallower waters more likely to be impacted by trampling. However, if the two sandbanks are maintained by hydrodynamism coupled with coastal morphology and sand supply, any or all of these factors, as well as the relative contribution of each may be different for the two bays.

No macroflora, and thus no *C. nodosa*, was recorded at the sampling stations on the sandbanks surveyed in 2013, and no submerged vegetation was present on the sandbanks surveyed in 2016. This confirms that ‘on many sandbanks macrophytes do not occur’ as stated in the EU Habitat Interpretation Manual (EC, 2013). Whilst macroflora such as *C. nodosa* may occur on other sandbanks in the Maltese Islands, it is not correct to base a definition of sandbanks solely on the associated vegetation, at least in the case of the Maltese Islands. *Cymodocea nodosa* is a fast growing and tolerant, species which can withstand a variety of environmental conditions and as a consequence is widely distributed in Mediterranean coastal waters, including in high-energy and degraded environments where *P. oceanica* meadows are not able to thrive (Marba and Duarte, 1995; Delgado et al., 1997; Lardi et al., 2015). It can co-occur with other seagrasses in mixed meadows, and has been observed to grow in association with opportunistic macroalgae (Olesen et al., 2002; Orfanidis et al., 2009; Sghaier et al., 2011; Pérez-Ruzafa et al., 2012; Lardi et al., 2015). Indeed, in the Maltese Islands, associations with the seagrass *C. nodosa* are found throughout the infralittoral, from very shallow depths down to about 45 m (GAS and MEPA, 2003). Locally *C. nodosa* has been observed to occur as dense meadows or very sparsely, and the plant may occur both as monospecific stands or in association with the seagrasses *P. oceanica* and *Halophila stipulacea*, and/or macroalgae such as *Caulerpa cylindracea* or *Caulerpa prolifera* (Borg and Schembi, 1995; Pirotta and Schembri, 1997; GAS and MEPA, 2003; Borg et al., 2013). *Cymodocea nodosa* is thus clearly not limited to the environmental conditions created by sandbanks, and is thus not a useful indicator species for this habitat type.

**Conclusion**

In the Maltese Islands, sandbanks generally consistent with the physical description of Habitat 1110 given in the EU Habitat Interpretation Manual (EC, 2013) were recorded in very shallow waters at several locations during two surveys carried out in 2013 and 2016. The banks consisted of sandy sediments, were elevated and elongated, permanently submerged, and surrounded by deeper water.

The results of a preliminary assessment of infauna present on sandbanks and at nearby reference stations did not find any significant differences with regards to the total number of species or the total abundance of polychaetes, bivalves and amphipods present. Moreover, no macroflora, and thus no *C. nodosa*, was recorded on any of the surveyed sandbanks. The results of the infauna assemblages need to be interpreted with caution due to the low number of samples and replicates collected. On the other hand, the authors are of the opinion that it can be concluded with certainty that *C. nodosa* is not a useful indicator species for sandbank habitats in the Maltese Islands. This species is in fact widely distributed and able to grow under a variety of environmental conditions in Malta.
and throughout the Mediterranean (Borg and Schembri, 1995; GAS and MEPA, 2003; Borg et al., 2013; Lardi et al., 2015), and is thus not limited to the environmental conditions created by sandbanks. The results of the present study consequently show that considering C. nodosa beds to be equivalent to the HD Annex I sandbank habitats, as is currently the interpretation of several Mediterranean Member States (Evans et al., 2014), is not appropriate.

Detailed seasonal studies of physical characteristics are required to confirm that the features identified in the present study are indeed true sandbanks in the geomorphological sense. Monitoring of benthic assemblages is also required to ascertain whether there are any biotic assemblages which could serve as biological indicators for this habitat type and to characterise seasonal changes. Moreover, the actual ecological importance of this habitat, and thus the relevance of protecting such habitats in the Maltese Islands, and indeed in the Mediterranean Sea more generally, has yet to be ascertained.

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