FUNCTIONAL DIVERSITY OF FEEDING MECHANISMS IN INFRALITTORAL COBBLE BEDS IN MALTESE HARBOURS AND NON-HARBOURS

Juan J. Bonello [1]*, Joseph A. Borg [1], Julian Evans [2] and Patrick J. Schembri [1]
[1] Department of Biology, University of Malta, Msida MSD2080, Malta. - juan.bonello@um.edu.mt
[2] Marine Biology and Ecology Research Centre, University of Plymouth, Plymouth PL4 8AA, UK.

Abstract
Cobble beds from Maltese harbour and non-harbour sites were characterised in terms of the functional diversity of feeding mechanisms. Given the nature of these two environments, differences in the overall feeding modalities of the respective species assemblages were expected; however, Maltese harbour and non-harbour sites were not very different in the frequency of the different categories of feeding traits. ‘Suspension feeding’ occurred in high frequencies in both harbours and non-harbours but harbours were distinguished from non-harbours by a higher frequency of ‘deposit feeding’.

Keywords: Biodiversity, Coastal systems, Coastal waters, Infralittoral, Sicily Channel

Introduction
Functional characteristics are assumed to reflect adaptations to dominant environmental factors in a habitat. As a result, non-taxonomic aggregations of taxa into biological/ecological (i.e. behavioural, physiological and life history) categories might be an effective way of investigating mechanisms affecting species distributions and ecosystem function [1].

Cobble beds are intermediate between the epibiota of hard substrata and the infauna of soft sediments since they include elements from both habitats. Few studies have been made on Mediterranean cobble habitats and their ecology is practically unknown. In this study, the functional diversity of feeding mechanisms of cobble bed biotic assemblages from harbour and non-harbour sites was compared.

Material and Methods
Infralittoral cobble beds from four harbour sites (Tigné, Manoel Island A and B and Ta’ Xbiex) and five non-harbour sites (Mgarr ix-Xini, Ix-Xatt l-Ahmar, Hondoq Bay, Wied ix-Xoqqa and Fomm ir-Rih Bay) were sampled. Four replicate $0.1m^2$ core samples were collected from each bed. The cobble layer was removed from the corer and transported to the laboratory. The water depth and the thickness of each cobble bed were recorded.

In the laboratory, fauna retained by a 0.5-mm mesh were identified to the lowest possible taxon. Each species was assigned to one of six functional traits: ‘suspension feeding’ (using specialised entrapment mechanisms to capture suspended particles), ‘deposit feeding’ (feeding on particulate organic matter from the substratum), ‘grazing’ (feeding on sessile organisms attached to the substratum), ‘macropredation’ (capturing and killing non-microscopic organisms), ‘deposit feeding/grazing’, and ‘multifunctional feeding’ (having three or more different feeding mechanisms). This categorisation was used to generate a taxon X functional trait matrix. By multiplying trait category scores by species abundances and summing across all constituent species, a station X functional trait matrix was obtained. The matrix was normalised in terms of replicate percentage, where the total of each replicate was 100%. Statistical analyses were carried out using PRIMER v6 (Plymouth Routines In Multivariate Ecological Research, PRIMER-E Ltd.).

Results and Discussion
‘Suspension feeding’ was the dominant mechanism at all sites with three exceptions: Manoel Island B and Wied ix-Xoqqa where ‘multifunctional feeding’ was the dominant trait, and Manoel Island A, where ‘deposit feeding’ was dominant (Tab. 1). Harbours were distinguished from non-harbours by a higher frequency of ‘deposit feeding’, while non-harbours had a comparatively higher frequency of ‘macropredation’.

Generally, Maltese harbour and non-harbour sites were not very different in the frequency distribution of functional traits, and ‘suspension feeding’ had similar frequencies in the two environments, against expectations [2]. Maltese harbours are characterised by higher turbidity levels than non-harbour sites [3], but the present results suggest that the degree of anthropogenic activity may not be high enough to significantly affect the frequency of the dominant feeding mode. Non-harbour sites differed from harbour sites by having a higher frequency of ‘macropredation’, mainly due to predatory polychaetes, such as species of Aphroditidae and Nephtyidae.

Tab. 1. Percentage mean (±SD) frequency of feeding traits within the nine sites.

	Suspension feeding	Deposit feeding	Grazing	Deposit feeding / Grazing	Macropredation	Multifunctional feeding
Ta' Xbiex	44.7 (5.3)	20.1 (5.6)	3.82 (2.7)	17.7 (6.6)	0.7 (0.8)	13.1 (5.2)
Tigné	45.1 (19.6)	16.0 (12.0)	5.5 (1.5)	20.3 (8.9)	1.4 (0.1)	11.7 (4.9)
Manoel Island B	16.3 (3.9)	33.4 (8.9)	8.6 (1.8)	3.8 (1.2)	1.0 (0.5)	36.8 (10.4)
Manoel Island A	31.9 (12.8)	37.9 (13.8)	4.3 (0.9)	5.4 (1.5)	1.0 (0.6)	19.6 (6.6)
Mġarr ix-Xini	47.4 (11.7)	9.5 (4.2)	8.0 (1.2)	18.6 (5.8)	2.1 (1.0)	14.3 (4.6)
Fomm ir-Riħ	41.5 (21.9)	20.8 (16.2)	4.5 (5.1)	17.8 (10.9)	3.1 (0.8)	12.2 (6.6)
Ħondoq	50.8 (20.4)	14.2 (9.8)	5.2 (3.8)	1.4 (0.6)	3.0 (2.9)	25.4 (12.9)
Xatt l-Aħmar	47.7 (29.2)	16.9 (11.7)	2.1(0.4)	3.4 (1.8)	15.9 (21.9)	14.1 (8.0)
Wied ix-Xoqqa	32.2 (7.4)	20.3 (3.7)	6.2 (3.0)	7.3 (3.2)	1.6 (1.1)	32.4 (5.5)

The structure of the cobble bed itself will impose limitations on the representation of certain functional groups. For instance, cobbles cannot support a high frequency of grazers, compared with other habitats such as algal forests, since cobbles only support turf species, therefore limiting opportunities for grazing.

No significant correlation between the abiotic factors measured (water depth, thickness of cobble layer and cobble granulometry) and the frequency of the different feeding mechanisms observed within harbours and non-harbours was found (BIO-ENV procedure). This suggests that factors other than those considered in the present study influence the distribution of traits.

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