Assessing the capacity and flows of ecosystem services in multi-functional landscapes

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Introduction

Multi-functional landscapes, supporting cultural, ecological and economic functions, may serve as an adaptive strategy to address unknown future conditions and to increase resilience. Two distinctive hallmarks of multi-functionality are that landscapes are considered as (a) a matrix, with high spatial heterogeneity and (b) an integrative system defined in terms of ecosystem functions and services (Selman 2009). The Mediterranean mosaic landscapes were shaped through natural processes and a long history of human activities, which gave rise to mosaic landscapes characterised by a high diversity of ecosystems (Blondel et al. 2010). These multifunctional landscapes result from a co-evolution of social and ecological systems, and are associated with a high endemicity and species richness but are also of socio-cultural significance (Blondel et al. 2010; Martín-López et al. 2016). In contrast, the recent intensification of land-use management is associated with the loss of traditionally heterogeneous landscapes, which together with concurrent agricultural abandonment, may threaten the natural capital of the region, as multifunctional landscapes, which have traditionally hosted Mediterranean biodiversity and people, and their ecosystem services are lost (Plieninger et al. 2014)

Ecosystem services (ES) are defined as the contributions of ecosystems to the human well-being (Potschin & Haines-Young 2016). These contributions are those properties of ecosystems appreciated by humans for their benefits. Different conceptual frameworks have been identified for the assessment of ES (Schröter et al. 2014; Villamagna et al. 2013). These frameworks identify the different components, and interactions between these, which affect the final delivery of the ES and their associated benefits. In particular, the ES capacity is defined as the potential of ecosystems to provide services appreciated by humans, while ES flow refers to the actual use of the ES and occurs at the location where an ES enters within a utility or production function (Villamagna et al. 2013; Schröter et al. 2014). This study assesses the ES capacity and flow in the multifunctional landscapes of Malta (Central Mediterranean), shaped by the geo-climatic conditions and human exploitation over several millennia, to deliver key ES.

Materials and Methods

Selected indicators were used to assess the ES capacity and flow in the landscapes of the Maltese islands. Given the focus on the capacity and flow of ecosystem services in landscapes, ES delivered by terrestrial ecosystems were investigated in this study (Table 1). The assessment of ES in Malta, a small island state, presents a number of challenges, mostly associated with the availability of land use and other spatial data at relevant scales, and the scale of the existing spatial data. For the purpose of this study a tiered mapping approach, which makes use of different land-use dataset and ES assessment methods, was implemented.

Table 1 - Overview of selected ES categories and capacity and flow indicators.

Ecosystem Service (CICES 4.3)	Indicator	Capacity/Flow
Cultivated crops	Irrigated land	Capacity/Flow
Reared animals and their outputs	Honey Production	Capacity
Materials from plants, algae and animals for agricultural use	Rain-fed agricultural land	Capacity/Flow
Pollination and seed dispersal	Pollinator Diversity	Capacity
Pollination and seed dispersal	Value of crop pollination	Flow
Dilution by atmosphere, freshwater and marine ecosystems	Pollutant deposition velocity	Capacity
Dilution by atmosphere, freshwater and marine ecosystems	Dilution of atmospheric pollutants	Flow
Physical use of land- /seascapes in different environmental settings	Species and habitats of community importance	Capacity
Physical use of land- /seascapes in different environmental settings	Site visitation	Flow

Results and Discussion

Results obtained in this study provide a first assessment of the contribution of ecosystems to the delivery of key ES in the multi-functional landscapes of the Maltese Islands, and elicit the existing links between biodiversity and ES capacity and flows. In general, ES maps indicate that the conservation of ecosystem diversity in multifunctional landscapes is particularly important for the delivery of key ES. Results obtained here demonstrate how ecosystems contribute to the delivery of ES bundles. In addition, these can be used to assess how ES capacity and flows change between different multi-functional landscapes with different land cover and across land use gradients, example across a coastal – rural – urban gradient. In conclusion, the assessment of ES capacity and flows allows for monitoring sustainable ES use, and provide important information when assessing how land-use change may affect the delivery of ES, and associated benefits.

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