Accounting for the capacity and flows of ecosystem services (ES) in a small islands state: the case of the Maltese Islands

A report presented to the Sub-Global Assessment Network for participation within the Mentoring Scheme (June – October 2014)

Dr Mario V Balzan, *Laboratory of Terrestrial Ecology, Institute of Applied Science, Malta College of Arts, Science and Technology, Malta. E-mail:* mario.balzan@mcast.edu.mt

Mentor: PD Dr Mario Potschin, *Centre for Environmental Management, School of Geography, University of Nottingham, UK.* http://www.nottingham.ac.uk/cem/

1 Mentoring scheme objectives and achievements

This ecosystem assessment study is intended to develop a framework for assessing ecosystem assets, capacity and flow, important for developing an adaptive and iterative ecosystem management approach for small island environments. Small islands supporting small communities have often been presented as a special case for sustainable development as, although they form a heterogeneous group of ecosystems with extremely variable characteristics (Hess 1990; Whittaker & Fernández-Palacios 2007; Nurse et al. 2001), they tend to be characterised amongst other by a small population and economy, restricted usable land area, isolation from and yet dependence on external market, high cost of transportation, susceptibility to natural disasters and climate change, and a constrained adaptation capacity (Briguglio 1995). Concurrently, islands often support numerous discrete ecosystems and, due to isolation from the mainland, high degree of endemism. These ecosystems provide key services and benefits necessary for the well-being of inhabiting island communities.
Malta is a small islands state situated in a biodiversity hotspot - the Mediterranean region, and occupying an area of just 316km^2 (Fig. 1). Although small the archipelago has a considerable diversity of organisms, ecosystems and landscapes, representative of those found in the Mediterranean region. The present landscape is the result of geology and climate coupled with intense human exploitation over several millennia. Given this context, an ecosystem assessment of ecosystem services in Malta is presented with a number of challenges and opportunities since this is to our knowledge the first attempt to assess and map multiple ES, the high reliance on ES given that the archipelago is one of the most population dense countries globally and has a thriving tourism industry, the multifunctional nature of Maltese Islands' landscapes, and the limited availability of spatially explicit data at smaller scales. Key objectives of this research project were:

1. to develop a methodology for mapping ecosystem services (ES) in a small islands state;
2. to develop and apply a framework for ecosystem accounting in a small islands state;
3. to apply biophysical and social assessment methods for mapping ES;
4. to distinguish between different valuation tools;
5. to implement of the developed ecosystem accounting framework for a broad range of ES

1.1 *Review of literature on small islands' ecosystem services*

To provide a context for the development of an ecosystem services assessment framework that may be used within a small islands state we have carried out a literature review of published literature that deals with (a) the economic and non-economic valuation of key islands' ecosystem services, (b) the management of ecosystem services, (c) pressures, and (d) the trade-offs between ecosystem services. We used ISI Web of Science to collect relevant published literature on the following ecosystem services: recreation and ecotourism (cultural ES); livestock and crops production, and freshwater availability (provisioning ES); erosion and pollination regulation (regulating ES). A total of 1552

articles were retrieved of which 421 were selected based on predetermined criteria. We are currently preparing a mansucript with the aim of publishing these results. Preliminary conclusions from this study highlight the importance of environmental management in small islands states that focuses on the maintenance of a broader set of ecosystem services rather than focusing on a single ecosystem service/benefit (e.g. fisheries/crop yield or the cultural values associated with island landscapes). Moreover, given the interlinkages between small islands ecosystems and the importance of these for maintaining multiple ecosystem services, our results emphasise the need for ecosystem assessments that investigate the capacity of small islands' ecosystems to provide bundles of ecosystem services and the flow of these to island communities, and any associated trade-offs.

Fig. 1: The Maltese archipelago is located within the central Mediterranean region. It has a land surface area of 316km^2, a fisheries management zone extending to 25 nautical miles around the archipelago. Malta has a high population density (1324 people/km^2 in 2014) and an important tourism industry with a total of 1.44 million tourists registered during 2012 (Source: Google Maps, 2014; NASA, 2010)

1.2 *Ecosystem accounting framework for the Maltese Islands*

The main aim of this ecosystem assessment is to monitor changes in ecosystem conditions and ES over time from a spatial perspective. Research during the mentoring scheme has entailed the identification, selection of indicators and the ongoing collection of data relating to a broad range of provisioning, regulating and cultural services, as described by the Common International Classification of Ecosystem Services (CICES, www.cices.eu). The concept of capacities and flows may be particularly important for the management of ES in a small islands state (Fig. 2). ES capacity has been defined as the long-term potential of ecosystems to provide services appreciated by humans in a sustainable way under concurrent management, while the ES flow is the actual use of ES and occurs at the location where an ES enters within a utility or production function (Schröter et al. 2012). During meetings with my mentor Dr. Marion Potschin and Prof. Roy Haines-Young, from the Centre of Environmental Management at the University of Nottingham, we identified key indicators that may be used for measuring the capacity and flow of ecosystems services in the Maltese Islands. The mapping of ES capacity and flows requires the use of methods to value their biophysical and social dimensions.

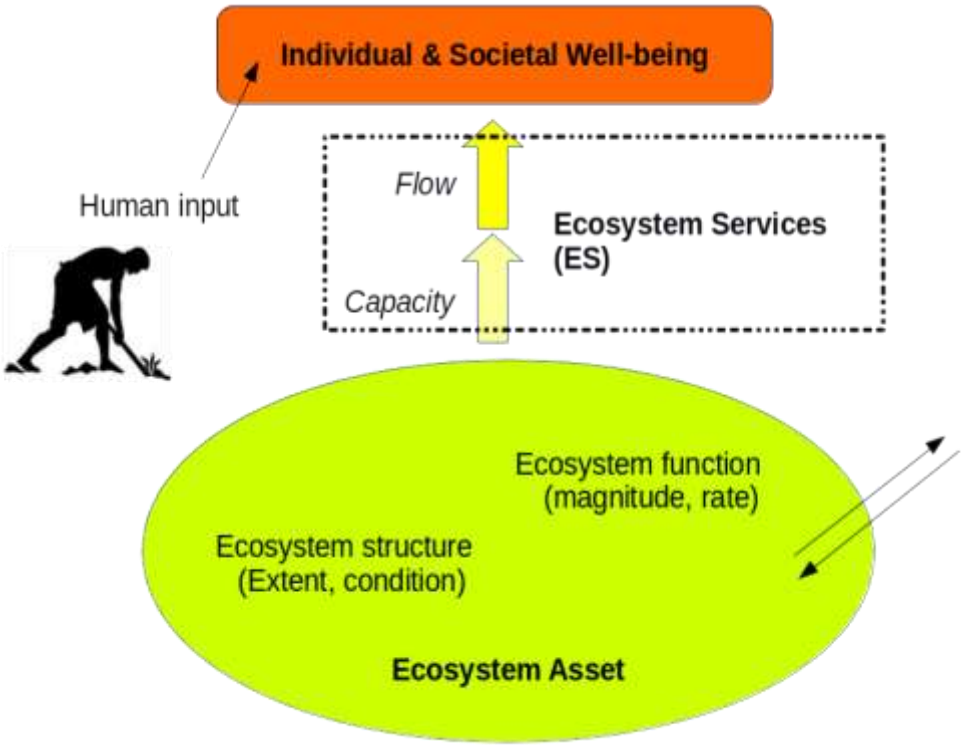

Fig. 2: A framework for the measurement of ecosystem services capacity and flow.

Following the identification of the ecosystem services to be included within the ecosystem accounting approach we identified relevant capacity and flow indicators. We are currently using these to map the capacity and flow of ecosystem services within one square kilometre cells of the Maltese Islands and have so far general maps for the following indicators: (a) species and habitats of community importance, (b) deposition velocity of NO_2 (capacity air quality regulation) and (c) flow of air quality regulation; (d) agricultural land cover and (e) modelled vegetable crop yield.

1.3 *Research Outcomes*

Balzan M.V. (2014) Assessing and mapping ecosystem services in a small islands state. Fifth SGA Network Annual Meeting. Dubai (UAE)

Balzan, M.V., Potschin, M. & Haines-Young, R. (submitted) Place-based Assessment of Small Islands' Ecosystem Services In: Haines-Young, R., Potschin, M., Fish, R., Turner, R.K. (eds). Handbook of Ecosystem Services. Routledge Handbook Series. Routledge.

Balzan, M.V., Potschin, M & Haines-Young, R. (in prep.) Valuing Small Islands' Ecosystem Services. CEM Working Paper no 14. Available at http://www.nottingham.ac.uk/cem/WorkingPapers.html

2 Plans to continue the mentoring relationship

We are currently following up on research activities carried out during the Mentoring scheme and we aim to publish a working paper of a review of published research on the assessment, management and valuation of ecosystem services in small islands states. This will eventually be developed into a full paper, with the aim of producing a publication in a selected journal. Research on the implementation of an ecosystem accounting approach for the Maltese Islands will be continued at the Laboratory of Terrestrial Ecology, Institute of Applied Science, MCAST in Malta. Continued collaboration will be ensured through participation in research projects investigating topics relating to ecosystem services.

References

Briguglio, L., 1995. Small island developing states and their economic vulnerabilities. *World Development*, 23(9), pp.1615–1632.

Haines-Young, R., & Potschin, M. 2013. Common International Classification of Ecosystem Services (CICES). Report to the European Environment Agency (www.cices.eu).

Hess, A., 1990. Overview: sustainable development and environmental management of small islands. In W. D'Ayala & P. Hein, eds. *Sustainable Development and Environmental Management of Small Islands*. Paris: UNESCO, pp. 3–14.

Maes, J., Paracchini, M.L. & Zulian, G., 2011. A European assessment of the provision of ecosystem services: towards an atlas of ecosystem services. JRC Scientific and Technical Reports (EUR collection) JRC63505. Publications Office of the European Union. 82pp.

Nurse, L. et al., 2001. Small Island States. In J. McCarthy et al., eds. *Climate Change 2001: Working Group II: Impacts, Adaptation and Vulnerability.* Cambridge, U.K.: Cambridge University Press, pp. 845–870.

Schröter, M., Remme, R.P. & Hein, L., 2012. How and where to map supply and demand of ecosystem services for policy-relevant outcomes? *Ecological Indicators*, 23, pp.220–221.

Whittaker, R. & Fernández-Palacios, J., 2007. *Island biogeography: ecology, evolution, and conservation* Second Edi., Oxford: Oxford University Press.