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The challenge of valuing ecosystem services that have no material benefits

N. Small[a], M. Munday[b], I. Durance[c,*]

[a] Cardiff University Sustainable Places Research Institute, 33 Park Place, CF10 3BA, Cardiff, UK
[b] Cardiff University School of Business, Colum Drive, CF10 3 EU, Cardiff, UK
[c] Cardiff University Water Research Institute and School of Biosciences, Museum Avenue, CF10 3AX, Cardiff, UK

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ABSTRACT

Since the Millennium Ecosystem Assessment, ecosystem service science has made much progress in framing core concepts and approaches, but there is still debate around the notion of cultural services, and a growing consensus that ecosystem use and ecosystem service use should be clearly differentiated. Part of the debate resides in the fact that the most significant sources of conflict around natural resource management arise from the multiple managements (uses) of ecosystems, rather than from the multiple uses of ecosystem services.

If the ecosystem approach or the ecosystem service paradigm are to be implemented at national levels, there is an urgent need to disentangle what are often semantic issues, revise the notion of cultural services, and more broadly, practically define the less tangible ecosystem services on which we depend. This is a critical step to identifying suitable ways to manage trade-offs and promote adaptive management.

Here we briefly review the problems associated with defining and quantifying cultural ecosystem services and suggest there could be merit in discarding this term for the simpler *non-material ecosystem services*. We also discuss the challenges in valuing the invaluable, and suggest that if we are to keep ecosystem service definition focused on the beneficiary, we need to further classify these challenging services, for example by differentiating services to individuals from services to communities. Also, we suggest that focussing on ecosystem service change rather than simply service delivery, and identifying common boundaries relevant for both people and ecosystems, would help meet some of these challenges.

1. Introduction

1. a Rationale and scope

Since the Millennium Ecosystem Assessment, ecosystem service science has made considerable progress in framing core concepts and approaches that are relevant to both academics and practitioners (see es-partnership.org for a broad overview). As a consequence, our understanding of the ways in which ES support human wellbeing has improved dramatically. Lately much research and debate has gone into defining exactly what constitutes an ecosystem service. This is a bid to better quantify the extent to which ecosystems and 'natural capital' contributes to human wellbeing (Hails and Ormerod, 2013). One persistent issue in this debate is the idea of cultural ecosystem services, and those services with no obvious material benefits. Closely linked with our emotional perceptions of the world, valuing these services remains a real challenge.

Yet, if the ecosystem approach or the ecosystem service paradigm are to be implemented at national levels it is necessary to disentangle what are often semantic issues, and practically revisit the notion of cultural services. This is a critical step to identifying suitable ways to manage trade-offs and promote adaptive management. It is thus timely to synthesise what we know about ecosystem services including those that have no material benefits, assess remaining challenges in the implementation of this paradigm, and propose novel perspectives to ensure wider benefits from the knowledge acquired.

This paper starts by providing an introduction to the notion of ecosystems and ecosystem services. It presents current

* Corresponding author.
E-mail address: durance@cardiff.ac.uk (I. Durance).

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representations of the links between ecosystems and their beneficiaries. Section 2 underlines the semantic challenges in valuing ecosystem services, and particularly those with non-material benefits. Section 3 investigates how valuation frameworks have tackled the case of non-material services, and what challenges have been overcome so far. Key lessons are identified here. Section 4 builds on these lessons to propose a framework that is adaptive to the scale of analysis, and takes into account the plurality of ways that ecosystem services are valued. The conclusions discuss why such a framework is critical to identifying suitable ways to manage trade-offs and promote adaptive management.

1. b Ecosystems and ecosystem services

Functioning ecosystems provide a range of services that are essential to support economic performance and human welfare (Costanza et al., 2014; EFTEC, 2006; Pascual and Muradian, 2010). 'Ecosystem services', are generated when ecosystems directly or indirectly contribute towards meeting human needs. This means the services that an ecosystem delivers is defined by society. In consequence, they are particular to a given human requirement or activity (Banzhaf and Boyd, 2005; Haines-Young and Potschin, 2010). Some are essential for human survival (for example food), while others are more desirable services for human enjoyment (for example recreation). The Millennium Ecosystem Assessment (MEA, 2005) was pivotal in promoting the ecosystem service concept. Not only did it reveal how ecosystem degradation jeopardised human wellbeing, but it also provided the basis on which to describe the diverse services that ecosystems provide to people. This paved the way for further assessments including the UK's National Ecosystem Assessment (UKNEA, 2011), and led to ecosystem service thinking being integrated into decision making, planning and evaluation processes (Satz et al., 2013).

Over the past two decades, the concept of ecosystem services has been continually refined, moving from a descriptive concept focused on status and trends (Balvanera et al., 2014), to a more analytical science focused on understanding the processes by which ecosystems provide services. Interest in the complexity of the causal links has also led to models that describe the sequence of processes that connect the biophysical world with human wellbeing. These are typically described with cascading models (see Haines-Young and Potschin (2010) and Potschin and Haines-Young (2011)), which show the interdependence between an ecosystems' functions and processes (for example Bastian et al., 2013; Bateman et al., 2011; De Groot et al., 2010, 2002; Müller et al., 2010; Spangenberg et al., 2014b). These models have played a key role in formalising ecosystem service science (Balvanera et al., 2014).

The underlying principle of these cascading models (Fig. 1) is that functioning ecosystems provide a range of services that have many potential uses with different values attached. For example, in the case of fish production (an ecosystem service identified in the MEA, 2005), the ecosystem service cascade would investigate how primary production (which depends on the 'ecosystems organisation') supports the fish populations ('ecosystem functioning' or 'potential use') that are harvested to provide food ('ecosystem service' or 'actual use') with high nutritional content ('benefit') to the child that eats it. At this point the ecosystem service has a 'value' to society by contributing to the child's growth and survival. It is therefore only when people, individually or collectively (society), harvest an ecosystem service (in this example fish) that it becomes apparent what the contributions to human wellbeing (also called benefits) are; whether these be of financial nature, in

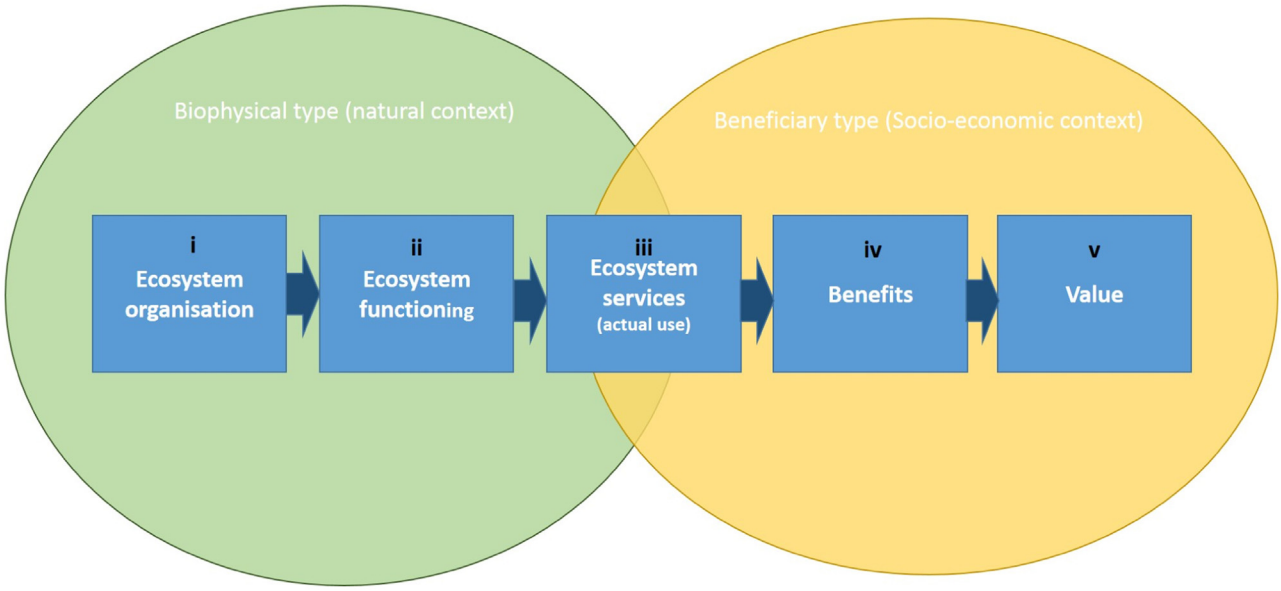

Fig. 1. Key aspects to understand when examining the links between the ecosystem and the benefits derived (cascade model adapted from Bastian et al. (2013), De Groot et al. (2010); Potschin and Haines-Young (2011), Haines-Young and Potschin (2010), Müller and Burkhard (2012), Müller et al. (2010), Spangenberg et al. (2014a)).This model highlights the elements necessary to understand and assess the links between the ecosystem and the benefits that we, as humans, derive from them. While many versions of this model have been proposed in both the social and natural sciences. In those reviewed there are slight differences in terminology. However, most concur that the main steps include assessing the links in the following ways. Firstly, the way the ecosystem is organised and works, referred to here as 'Ecosystem organisation', but referred to as 'biophysical structure or processes' by De Groot et al. (2010); Müller and Burkhard (2012); Müller et al. (2010); Potschin and Haines-Young (2011), or as 'ecosystem functions and elements' by Spangenberg et al. (2014a) and 'properties' by Bastian et al. (2013). Secondly, how the ecosystem functions i.e. its ecological integrity (De Groot et al., 2010; Müller et al., 2010); Potschin and Haines-Young (2011) or its potential to provide an ecosystem service, outlined in models by Bastian et al. (2013) as 'potentials' or 'ecosystem service potential' Spangenberg et al. (2014a). Thirdly, the way the ecosystem is actually used, all studies refer to 'ecosystem service' to describe the final services utilised. This is where the biophysical and socio-economic contexts overlap. Fourthly, the way an ecosystem benefits people and contributes to wellbeing (referred to as 'benefit(s) or human benefit) although in frameworks by Bastian et al. (2013) benefits have been grouped with values. Finally, the "value" placed on the ecosystems, which depends on the character of the beneficiary.