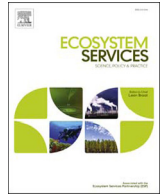


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Editorial: Operationalisation of natural capital and ecosystem services – Special issue

The concept of ecosystem services provides a powerful way of examining not only the interaction between ecosystems and human well-being, it also enables us to understand better how, when and where humans may benefit from ecosystems, influence ecosystems and lose crucial ecosystem functions when overexploiting them. Since the seminal works of [de Groot \(1992\)](#), [Daily \(1997\)](#) and [Costanza et al. \(1997\)](#), research on ecosystem services and natural capital has expanded significantly (see for example [Costanza et al. \(2017\)](#)). The *Millennium Ecosystem Assessment (2005)*, *The Economics of Ecosystems and Biodiversity (2010)* and the Intergovernmental Panel on Biodiversity and Ecosystem Services ([Díaz et al., 2015](#)) have brought these concepts into environmental planning and policy arenas (see for example [EC \(2006, 2011\)](#)). The ideas are now seen as relevant in European regulatory frameworks and policies for biodiversity, resource efficiency, sustainable land and water use, climate change mitigation, ecosystem restoration and the design of green infrastructure, human health, and sustainable economic development ([Priess et al., 2018](#), this issue).

Despite the progress in understanding the links between natural capital and aspects of human well-being that depend on the flow of ecosystem services up to 2012, many aspects of ecosystem services and natural capital were recognised as deserving further research and the application of the concepts was in many places still experimental ([Primmer and Furman, 2012](#)). Thus in 2012, the European Commission deemed it necessary to fund research to translate the concepts into operational frameworks that provide tested, practical and tailored approaches for integrating the ecosystem services and natural capital concepts into management and decision-making. This new research funding aimed to improve understanding of how the concepts can be embedded in ecosystem management practice, or can be used to transform current management and policy approaches. These challenges were the starting point of the OpenNESS project, funded by the European Commission 7th Framework programme (www.openness-project.eu). This Special Issue of *Ecosystem Services* synthesises key findings of the project which ran between 2012 and 2017.

The opening paper by [Jax et al. \(2018, this issue; see Fig. 1\)](#) describes the transdisciplinary approach adopted in OpenNESS to evaluate the ecosystem services concept when applied to real world problems at different scales and in different policy sectors. The power of this approach is summarised in the form of guiding principles towards operationalisation. The approach was built on 27 case studies and the development of the guiding principles

reflected the general requirements for operationalising the ecosystem services concept and the relevance of ecosystem services conceptual frameworks as tested in the cases. The paper emphasises that there is not one simple and straightforward way to approach real world complexity. The principles and tools developed in the OpenNESS project are presented for guidance to tackle the complexity and facilitate operationalisation of the ecosystem services concept.

To make the concept of ecosystem services “practical”, the Special Issue first presents two conceptual papers by [Potschin-Young et al. \(2018, this issue\)](#) and [Carmen et al. \(2018, this issue\)](#) (see [Fig. 1](#)). While [Carmen et al. \(2018, this issue\)](#) identify different but interrelated areas of knowledge needs which need to be considered for improving operationalisation, [Potschin-Young et al. \(2018, this issue\)](#) elaborate on the role of conceptual frameworks in operationalising and mainstreaming the ecosystem services approach. The authors demonstrate how the cascade model ([Potschin and Haines-Young, 2016](#)) was applied within some of the OpenNESS case studies to provide a common reference for understanding different components of the ecosystem services approach and how they link to each other in place-based studies. Findings show that the cascade model has an important ‘awareness raising’ role. However, such conceptual frameworks were less successful in linking case study work to broader societal issues such as human well-being, sustainable ecosystem management, governance, and competitiveness. Therefore further development on conceptual frameworks is needed when linking ecosystem services to these societal issues is the objective. The paper by [Carmen et al. \(2018, this issue\)](#) highlights the need to view knowledge building as a process orientated action if operationalisation is to be achieved. The paper discusses the potential to develop transdisciplinary research approaches and the development of tools and methods explicit as boundary objects in the ecosystem service science community. This to develop more collaborative practices with other stakeholders and facilitate the operationalisation of the concept of ecosystem services across contexts. Transdisciplinary research is therefore also of utmost importance when for instance the 2030 Agenda for Sustainable Development is further being planned and carried out to make it operational.

Numerous studies have been carried out to map, quantify and value ecosystem services at different scales ([Costanza et al., 2017](#)). This Special Issue highlights two specific modelling approaches (see [Fig. 1](#)), i.e. Bayesian Belief Networks ([Smith et al., 2018](#)) and the Ecosystem Service Mapping Tool (ESTIMAP)

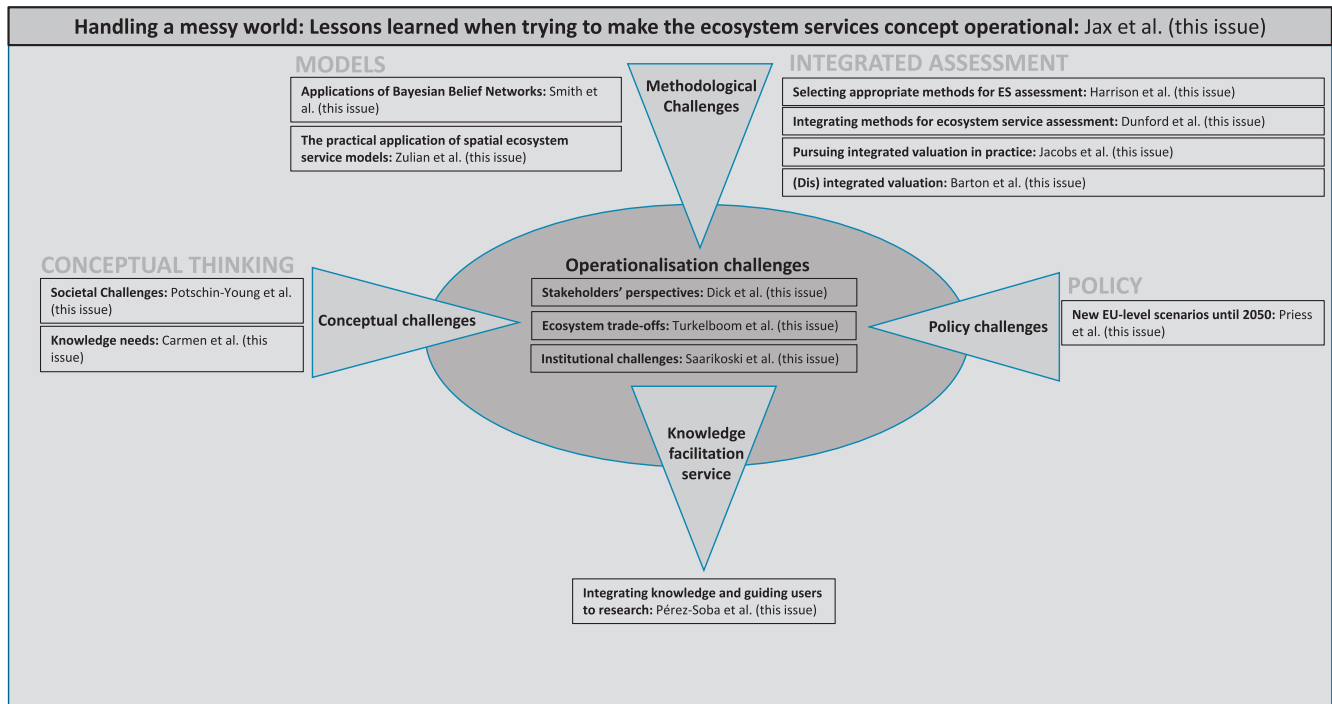


Fig. 1.

(Zulian et al., 2018). The paper on Bayesian Belief Networks is based on nine OpenNESS case studies and shows the method to be very flexible for exploring and awareness raising in relation to the ecosystem services concept. Although the approach has not yet been applied for decision-making *per se*, it proved to be very helpful with stakeholder engagement for facilitating exploration of alternative outcomes, knowledge elicitation and social learning. Zulian et al. (2018) present ESTIMAP, a spatial modelling tool for integrated assessments designed to support policies and environmental sustainable management practices. The paper proposes a protocol for adapting ESTIMAP to the local conditions. According to the opinion of stakeholders from the ten OpenNESS case studies that applied and tested downscaled versions of the model, the approach was useful for stimulating discussion and supporting communication. However, lack of spatial data and the level of expertise needed to set up and run the models, were identified as constraints.

Although relevant literature on modelling and tool development for ecosystem services assessment and valuation exists (Bagstad et al., 2013; Peh et al., 2013), there is still a lack of guidance for selecting methods which are suitable for different decision-making contexts. In order to fill this gap a comprehensive guidance tool in the form of a set of linked decision trees was developed using the experience from 27 case studies (Harrison et al., 2018). The authors describe how the different decision trees for biophysical, socio-cultural and monetary methods were developed and used to operationalise the ecosystem services concept towards sustainable land, water and urban management. The most important considerations were stakeholder-oriented reasons, decision-oriented reasons and pragmatic reasons such as available data, resources and expertise. The paper by Dunford et al. (2018) addresses the aspect of integrated assessment (see Fig. 1) to provide insight as to where, and in what contexts, different methods can be combined and how this can add value to case study applications of the ecosystem services concept. The last two papers about integrated assessment (Fig. 1) elaborate on challenges in ecosystem services valuation. While much has been done in the

direction of integrating valuation to include both monetary and non-monetary valuation methods (IPBES, 2015; Jacobs et al., 2016), the paper by Jacobs et al. (2018, this issue) addresses how existing valuation methods actually elicit different values. While different valuation methods each have a different suitability to elicit diverse value-types, some are more specialised than others, but all of them have blind spots implying a certain risk of biased decision-making. While no single valuation method is able to capture the complex spectrum of ecosystem values, guidance is given for selecting a complementary set of valuation methods to develop “integrated valuation” in practice that includes the values of all stakeholders (Jacobs et al., 2018 this issue). Barton et al. (2018, this issue) complete this part of the Special Issue addressing the challenges of integrated ecosystem appraisals in practice. They formulate and test an information-gap hypothesis to explain the relative frequency of different study purposes and found that the majority of ecosystem services appraisals conducted in the 26 OpenNESS case studies they examined, were for informative purposes, while significantly fewer had a decisive or technical policy design focus. The authors recommend that future research on integrating plural values in ecosystem services appraisal place more emphasis on information needs and associated costs, balanced against the governance support needs for accuracy and reliability.

The policy challenges are further elaborated in the paper by Priess et al. (2018, this issue). They analyse how natural capital and ecosystem services may evolve in Europe under different future socio-environmental conditions. Four scenarios were developed for the period until 2050 using a participatory iterative approach involving regional and EU-level stakeholders. Subsequently, the scenarios were further contextualised and applied in some of the case studies of the OpenNESS project.

The actual challenge of operationalisation of the ecosystem services concept (Fig. 1) and bridging the gap between scientific knowledge and policy-making, is elaborated in the paper by Dick et al. (2018, this issue). It focuses on the practitioners’ perspective on the implementation of the ecosystem services concept in the 27 OpenNESS case studies and the process of their implementation.

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