



## Refocusing ecosystem services towards sustainability



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### ABSTRACT

Ecosystem services and sustainability have become prominent concepts in international policy and research agendas. However, a common conceptual ground between these concepts is currently underdeveloped. In particular, a vision is missing on how to align ecosystem services with overarching sustainability goals. Originally, the ecosystem service concept focused on sustaining human well-being through biodiversity conservation. Nevertheless, studies within the field also consider appropriation beyond carrying capacities, and natural resource management that involves environmentally damaging inputs as ecosystem service provision. This brings the ecosystem service concept into conflict with the core goal of sustainability, i.e. achieving justice within ecological limits over the long term. Here, we link the ecosystem service concept to sustainability outcomes operationalized in terms of justice. Our framing positions sustainability as an overarching goal which can be achieved through seven key strategies: equitable (1) intergenerational and (2) intragenerational distribution, (3) interspecies distribution, (4) fair procedures, recognition and participation, (5) sufficiency, (6) efficiency, and (7) persistence. Applying these strategies has the potential to re-focus the ecosystem service concept towards the normative goal of sustainability. We identify research needs for each strategy and further discuss questions regarding operationalization of the strategies.

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### 1. Introduction

Ecosystem services and sustainability can both be defined as descriptive and normative scientific concepts. They are used to describe and analyse the relationship between humans and the environment (Abson et al., 2014; Gómez-Baggethun et al., 2010). The normative aspect of both concepts expresses how the relationship between human societies and their environment should be shaped. Next to their use in descriptive and analytical science, both concepts can also involve value judgements and norms.

Commonly, ecosystem services describe the ecological structures and functions appropriated as a means to increase human well-being (Haines-Young and Potschin, 2010a). The ecosystem service concept is a boundary object that illustrates the relationship between humans and their natural environment (Abson et al., 2014; Schröter et al., 2014b). The concept assigns instrumental value to ecological structures and functions, based on the extent to which they enhance human well-being. In other words, the ecosystem services notion contends that ecosystems should be conserved because to do so is also ‘good’ for humans. Currently, research on ecosystem services implements a rather descriptive understanding of ecosystems’ contributions to human well-being and often disregards normative questions, such as the well-being of future generations (van den Belt and Stevens, 2016) and how to achieve social and environmental justice (Jacobs et al., 2016). Here, we shed light on these questions by situating ecosystem

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services within the broader, normative concept of sustainability that focuses on human well-being (e.g. Kuhlman and Farrington, 2010). Sustainability has been defined in many different ways. A widely shared foundation, which we adopt for this paper, is that sustainability represents an ideal, non-fixed state that meets human needs of current and future generations within ecological limits (WCED, 1987).

Originally, the ecosystem service concept called attention to the consequences of biodiversity loss for future human well-being and was thus closely linked to sustainability (MA, 2005). Early notions of ecosystem services argued that fighting biodiversity loss should take place because biodiversity contributes to essential services that ecosystems provide (Ehrlich and Ehrlich, 1981; Ehrlich and Mooney, 1983). Links between ecosystem services and sustainability are also implied by their co-occurrence in research and policy agendas, such as the Aichi Targets of the Convention on Biological Diversity (UNEP, 2010), the Sustainable Development Goals (UN, 2012) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) (Díaz et al., 2015). This co-occurrence suggests that the ecosystem service concept can, or at least is intended to, contribute to sustainable ecosystem management (Bennett et al., 2015; Jacobs et al., 2013). However, various examples demonstrate that the application of the ecosystem service concept potentially conflicts with sustainability goals. We illustrate and elaborate some of these examples from recent literature on ecosystem services.

Despite some advancements to define and operationalize the ecosystem service concept (Boyd and Banzhaf, 2007; Haines-Young and Potschin, 2013; TEEB, 2010), definitions remain ambiguous and open to different interpretations (Danley and Widmark, 2016; Nahlik et al., 2012). This ambiguity allows different users to creatively apply the concept (Schröter et al., 2014b). However, some interpretations may place the ecosystem service concept at odds with its original discursive and normative framings. For instance, some studies have labelled intensive, non-renewable natural resource use as 'ecosystem services', such as lignite mining (Burkhard et al., 2012), peat extraction (UK NEA, 2011), and intensive animal husbandry and intensive crop production (Raudsepp-Hearne et al., 2010). Moreover, overuse of provisioning services can conflict with sustainability goals. As an example, large-scale intensive fishing above maximum sustainable yield is a global threat to marine ecosystems (Halpern et al., 2008; Pauly et al., 1998). Total landings are frequently used to quantify the ecosystem service provision 'food' (for a review cf. Liquete et al., 2013), regardless of how sustainable those landings may be. Overall, ecosystem service studies regularly consider food production within a set of assessed services (Lautenbach et al., 2015; Malinga et al., 2015). Intensive agricultural practices, however, can put regulating and cultural services at risk (Lee and Lautenbach, 2016; Power, 2010). In practice, value judgements based solely on an operationalization of the ecosystem service concept might conflict with value judgements based on the concept of sustainability. For instance, when ecosystem service assessments produce aggregated values, these tell little about inter- and intra-generational distribution of ecosystem services and the values attached to them. Intra- and intergenerational distributions are, however, important elements of sustainability (WCED, 1987), as we will explain in more detail below.

Despite calls for more consideration of sustainability in ecosystem service appropriation and management (Daly, 1992; Jacobs et al., 2013; Norgaard, 2010), an understanding of the common ground between ecosystem services and sustainability is currently underdeveloped. A common vision is lacking on how to (re)align the conceptualization and management of ecosystem services with sustainability as an overarching normative goal (Bennett et al., 2015; Loos et al., 2014).

In this paper, we embed the ecosystem service concept within a sustainability framework in order to operationalize normative judgements of ecosystems' contributions to human well-being. If the ecosystem service concept is to be understood as a means to analyse, deliberate and manage society-environment interactions, then the notion of sustainability would provide a well-established and flexible framework for normatively grounding that understanding. In order to develop a conceptual framework that refocuses the ecosystem service concept towards sustainability, we explore seven sustainability strategies that could be considered for the assessment, governance and management of ecosystem services. For each sustainability strategy, we suggest ways to advance future ecosystem service assessments and management.

## 2. A framework for conceptualizing ecosystem services for sustainability

We present a framework that connects five aspects of ecosystem service appropriation to four sustainability outcomes through seven key sustainability strategies (Fig. 1).

Five aspects of ecosystem service appropriation can be distinguished based on earlier conceptualisations of the ecosystem service framework, also described as the 'cascade model' (Haines-Young and Potschin, 2010b; TEEB, 2010). According to this model, which has been further developed by, among others, Villamagna et al. (2013), (i) Ecosystem properties are a "set of ecological conditions, processes and structures" (van Oudenhoven et al., 2012) from which ecosystem services are appropriated. (ii) Capacities are the potential of the social-ecological system's available ecosystem properties to sustainably provide ecosystem services (Villamagna et al., 2013). (iii) Flows are the actually appropriated ecosystem services (Schröter et al., 2014a). (iv) Benefits gained from that ecosystem service appropriation differ from the services as they refer to positive changes in different aspects of human well-being (Naeem et al., 2016), such as safety, leisure, happiness, health and welfare (Schmidt et al., 2016). (v) People can hold different values in relation to well-being, i.e. different measures of importance (Chan et al., 2012). Aspects (i) and (ii) relate to the *potential* to achieve human well-being through ecosystem service appropriation and (iii), (iv) and (v) relate to human well-being derived from *actual* appropriation of ecosystem services.

The right-hand side of our framework (Fig. 1) presents four aspects of justice as sustainability outcomes. Central to sustainability are equal rights of present and future generations to the prerequisites of a good human life (e.g. Ott, 2003). To achieve such distributive justice, ecosystem services would have to be used within ecological limits so that ecosystems can provide the conditions for human well-being over the long term. This differs from the conceptualization of natural capital and 'strong sustainability', which has been used earlier in the context of ecosystem services (Ekins et al., 2003). Strong sustainability assumes that non-declining natural capital is a necessary condition for achieving human well-being over time (Neumayer, 2010). Taking a more consequential position, we focus on the outcomes resulting from the interaction between natural capital, different other forms of capital (labour, knowledge, technology) and socio-political contexts (Palomo et al., 2016; Remme et al., 2014; van Oudenhoven et al., 2015). In parallel to distributive justice, sustainability also entails procedural justice, including fair treatment, recognition and participation in societal decisions (Agyeman and Evans, 2004; Schlosberg, 2004). While being a normative goal in itself, procedural justice may also help to ensure that rights and values of different interest groups are acknowledged and considered when it comes to fair distribution of benefits. Furthermore, as sustainability is a notion that is open to different interpretations, it

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