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Mapping beneficiaries of ecosystem services flows from Natura 2000 sites

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ABSTRACT

There is a growing need to integrate ecosystem services into management strategies of protected areas, and only a comprehensive ecosystem services assessment allows effective strategies for biodiversity conservation to be defined. Beneficiaries are largely disregarded or only mentioned in ecosystem services assessments related to protected areas. Thus, we propose indicators for identifying potential beneficiaries on the local and regional level, focusing on 16 relevant ecosystem services of Natura 2000 sites. For a case study in northern Italy, we used spatially-explicit modelling approaches to map and quantify the potential beneficiaries of multiple ecosystem services, including distance decay functions and basin catchment modelling. The resulting maps indicate that for provisioning and cultural services, the majority of the beneficiaries are located outside the protected area, whereas the beneficiaries of regulating services are mostly situated within or very close to it. The indicators and the beneficiary maps offer an important basis for an exhaustive assessment of ecosystem services flows from Natura 2000 sites and support the implementation of conservation policies by involving the local population and the community of users of protected areas.

1. Introduction

In recent decades, there has been an increasing interest in the concept of ecosystem services (ES) for decision-making and ecosystem management, to discuss the role of biodiversity on the global (Millennium Ecosystem Assessment (MEA), 2005; TEEB, 2010), the regional (Egoh et al., 2009; Eigenbrod et al., 2009), or the landscape scales (Bastian, 2013; Tscharntke et al., 2005). The ES valuation of protected areas, which aims to preserve natural environments and thus biodiversity, has mostly concentrated on national or natural parks (Martín-López et al., 2011; Martínez-Harms and Gajardo, 2008). In Europe, conservation objectives of biodiversity are pursued through the establishment of the Natura 2000 network under the European Habitats Directive 92/43/EEC and the Birds Directive 79/409/EEC. Whereas conservation efforts in the past principally concentrated on preserving and restoring biodiversity, there is a growing need to integrate ES into management strategies, considering interactions between demand and supply of multiple ES and accounting for spatial and temporal scales (Anton et al., 2010; Naidoo et al., 2008). Based on the toolkit to assess the socio-economic benefits of Natura 2000 (Kettunen et al., 2009), initial ES assessments were carried out in different European regions (Bugalho, 2009; Cruz and Benedicto, 2009; Kazakova, 2009; Pabian and Bogdan, 2009; Tinch, 2009). Together with conserving biodiversity, the Natura 2000 network provides a wide range of provisioning, regulating and cultural ES (Brink et al., 2011). The socio-economic benefits of the Natura 2000 network have mostly been related to tourism and recreation, and their economic benefits are estimated to be between three and seven times their annual costs (Gantioler et al., 2010).

Especially in Europe, protected areas are placed within social contexts, where the interaction between natural processes and human activities has established social–ecological systems (Figueroa and Aronson, 2006). The ecological functioning of protected areas is affected by the landscape dynamics in the surrounding area (DeFries et al., 2007; Hansen and DeFries, 2007; Mcdonald et al., 2009; Wade et al., 2011) and by the attitude of users, such as visitors and local communities, or landowners (Allendorf et al., 2012; Jones et al., 2012; Vodouhê et al., 2010). Only a comprehensive ES analysis, including stakeholders and

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beneficiaries in their cultural, economic and policy context, allows effective management strategies to be defined (Anton et al., 2010), and in particular, beneficiaries outside the protected area play a crucial role in integrating the ES approach into conservation policies (Tallis et al., 2008). Although great progress has been made on mapping and quantifying ES in the last decade (Egoh et al., 2008, 2012; Raymond et al., 2009; Schägner et al., 2013; Troy and Wilson, 2006), to date, ES of Natura 2000 sites have only been assessed in terms of the potential of ES provision (Bastian, 2013; Kettunen et al., 2009), and most ES valuations consider ES beneficiaries only in qualitative terms or disregard them (Burkhard et al., 2012). Spatially explicit tools and methods that take into account the location and number of beneficiaries and their demands for ES, which might support the ES governance for protected areas in terms of both planning and public support, are still missing (Anton et al., 2010).

Therefore, this study focuses on the assessment of the beneficiaries related to the Natura 2000 network by:

- providing definitions of beneficiaries related to the Natura 2000 network;
- defining indicators for multiple ES to identify potential beneficiaries of Natura 2000 sites;
- using spatially explicit modelling approaches to map such indicators on the landscape scale; and
- mapping and quantifying potential beneficiaries for multiple ES for a case study in Italy.

2. Definitions of beneficiaries related to the Natura 2000 network

Natura 2000 sites and their beneficiaries have rarely been the focus of ES assessments (Bastian, 2013; Kettunen et al., 2009). Our literature review (Annex A) revealed that beneficiaries of ES from protected areas were largely disregarded (e.g., Armsworth et al., 2011; Bastian, 2013; Wade et al., 2011) or merely mentioned (e.g., Barton et al., 2009; Eigenbrod et al., 2009; Petrosillo et al., 2010; Rodríguez-Rodríguez and Martínez-Vega, 2012). Where identified (e.g. Juutinen et al., 2011; Palomo et al., 2013; Pietrzyk-Kaszyńska et al., 2012; van Riper et al., 2012), they were generally reported as interested categories such as private landowners, municipalities, local communities or visitors. In a few studies, beneficiaries were identified and specifically described, or in some cases also spatially recognised in the region and involved in the analysis or assessment (e.g., Brandon et al., 2005; Bernard et al., 2009; DeFries et al., 2010; Martín-López et al., 2011; Kari and Korhonen-Kurki, 2013; Mackenzie, 2012).

An ES beneficiary is defined as any group or individual that benefits from ecosystem goods and services, either through active or passive consumption of both, or through simple appreciation resulting from the awareness of these services (Nahlik et al., 2012). If there are no beneficiaries, the same ecosystem elements or processes cease to be ES (Boyd and Banzhaf, 2007). The ES benefits vary, depending on the type of service with its individual characteristics, in terms of the spatial extent and quality of the relationships between source areas and benefit areas (Bagstad et al., 2013; Costanza, 2008; Fisher et al., 2009). Each ES has a distinctive spatial range, related to specific ecological and economic processes, which can be local, regional/national or global (Hein et al., 2006). In the specific context of Natura 2000 sites, governance levels also distinguish between public and private sectors (Kettunen et al., 2009). The relationships between ES and beneficiaries can be described in terms of the intensity of the relationship, along a gradient of dependency and location (Table 1).

Among the several definitions of stakeholders in the literature, the most accepted is that of Freeman (Fassin, 2009): a stakeholder is “any group or individual who can affect or is affected by the achievement of the organisation's objective” (Freeman, 1984). This definition was adapted for ecosystem valuation into “any group or individual who can affect or is affected by the ecosystem's services” (Hein et al., 2006).

We propose a distinction between stakeholder and beneficiary in terms of the ability to influence ES provision (e.g., deciding policies) and the conditions of benefiting. The beneficiaries of ES from Natura 2000 sites can correspond to the stakeholders, which are subjects involved or interested in the management of the site, at different levels and through different perspectives (Hein et al., 2006). In general, each beneficiary should be considered as a stakeholder and involved in decision-making processes (Hein et al., 2006; Rastogi et al., 2010), but not vice versa: not all stakeholders are necessarily beneficiaries. Moreover, we can distinguish different degrees of dependency among the beneficiaries (Table 1). Fig. 1 schematises the relationship intensity in the ES in the protected area by concentric circles. This relationship is not permanent, even for the same subject and can vary in time, with changing variables and perspectives. For example, farmers strictly depend upon soil productivity (or primary productivity), whilst they are also indirect beneficiaries from the mitigation of natural extreme events (drought, floods); furthermore, farmers can enjoy recreational opportunities provided by the cultivated ecosystems (Swinton et al., 2007). Thus, a farmer can be simultaneously a dependent beneficiary, a direct and indirect beneficiary and a stakeholder, able to influence decisions in the area (A in Fig. 1) for different interests. In contrast, a public authority at the regional level (e.g., environmental authority) might be in charge of site management, but might not obtain any significant

Table 1
Intensity of relationship between beneficiaries and ES.

Beneficiary type	Substitution costs	Substitution opportunities	At site	Dependency	Ecosystem services[a] (examples)	Benefit domain (examples)	Examples of beneficiaries
A	High	Low	Yes	**Strong**: totally depending on ES	Provisioning (cultivated crops)	Agriculture Forestry	Farmers
B	High	Low	No	**Medium**: depending on ES from outside	Regulation & maintenance (water regulation)	Water retention Flood mitigation	Residents local administration
C	Low	High	Yes	**Low**: depending on ES, but with substitution opportunities	Provisioning (fibres and timber) cultural (experiential use of land)	Forestry Recreation	Farmers Residents[b]
D	Low	High	No	**No dependency:** easily substitutable with other source areas	Cultural (physical use of land)	Recreation	Visitors, hikers

[a] ES definitions were derived from CICES V4.3.
[b] Including local tourism actors, e.g., hotel owners who offers bikes to recreants.

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