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Research article

Relating costs to the user value of farmland biodiversity measurements

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A B S T R A C T

The impact of agricultural management on global biodiversity highlights the need for farm-scale monitoring programmes capable of determining the performance of agriculture practices. Yet the identification of appropriate indicators is a challenging process and one that involves considering a number of different aspects and requirements. Besides the attention given to scientific effectiveness, relevant but less studied issues related to biodiversity measurements include the economic feasibility of monitoring programmes and the relevance of indicators for different end-users. In this paper, we combine an analytic assessment of costs and a stakeholder-based evaluation of the usefulness of a set of biodiversity-related parameters (habitat mapping, vegetation, bees, earthworms, spiders, and a farmer questionnaire) tested for scientific consistency in 12 European case studies and on more than 14,000 ha of farmland. The results point to the possibility of meeting the expectations of different end-users (administrators, farmers and consumers) with a common indicator set. Combining costs and usefulness also suggests the possibility of designing more efficient monitoring approaches involving private agencies and networks of volunteers and farmers for the field data collection at different stages of a monitoring programme. Although complex, such an approach would make it possible to enhance the effectiveness of available funds for farmland biodiversity monitoring.

1. Introduction

Biodiversity is rapidly decreasing and there is a general consensus that this process will raise severe concerns for future human well-being (Balvanera et al., 2006; Bommarco et al., 2013; Brooks et al., 2014). Despite global and national political initiatives and public spending on conservation (Hanley et al., 2012), data gaps hinder the consistent monitoring and interpretation of the trends in biodiversity change (Tittensor et al., 2014; Walpole et al., 2009). This has resulted in the creation of multiple initiatives aimed at developing frameworks for monitoring and analysis (e.g. the Essential Biodiversity Variables; cf. Pereira et al., 2013) and initiatives for the mobilisation of data (Hoffmann et al., 2014). These are robust data-driven scientific approaches; however, this does not necessarily mean that those who will use this information feel that these indicators convey the most important information in an understandable way (Bell and Morse, 2013).

The potential (positive/negative) impacts of agricultural systems on global biodiversity are widely acknowledged (Tilman et al., 2001; Kleijn et al., 2009). The political commitment towards farmland biodiversity and related ecosystems is also demonstrated in the EU Common Agricultural Policy (CAP, Reg. EU 1305, 1306 and 1307/2013). For instance, Pe'er et al. (2014) estimated that 30% of the CAP budget is devoted to environmental targets, including biodiversity (accounting for around €122 billion earmarked in the current programming period, 2014–2020). Despite various controversial outcomes arising from agro-environmental policies targeting farmland biodiversity (Kleijn et al., 2011; Pe'er et al., 2014) point to the need for improved monitoring programmes (EC, 2011), and the economic benefits that can be expected from biodiversity

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monitoring have been asserted by a number of authors (Balmford and Gaston, 1999; James et al., 1999; White and Sadler, 2012; Armsworth et al., 2012), no budget is currently earmarked for the direct monitoring of the CAP impact on biodiversity. The minor efforts included in the monitoring and evaluation systems of the Rural Development Programmes (RDP) in the context of High Nature Value (HNV) farmland constitute an exception, yet such efforts rely on land use information rather than direct biodiversity indicators (Beaufoy and Cooper, 2009).

Budget constraints are considered one of the major current limitations to biodiversity monitoring activities (Danielsen et al., 2005; McDonald-Madden et al., 2011; but see also Geijzendorffer et al., in press). In this context, raising the awareness of stakeholders can greatly support the implementation of monitoring schemes (Bell et al., 2012) while their direct involvement in monitoring implementation can allow for noteworthy budget savings (Levrel et al., 2010; Targetti et al., 2014; Theobald et al., 2015). Therefore, cost efficiency and stakeholder relevance should be considered in the development of a biodiversity indicator set (Noss, 1990; Rempel et al., 2004; Bockstaller et al., 2009). However, the identification of an indicator set able to strike a balance between the requirements and expectations of different stakeholder groups is a challenge that entails an assessment of what can be realistically measured to address different objectives in different contexts (Dudley et al., 2005).

The literature defines four key aspects for the selection of biodiversity indicators: scientific consistency, practicability, feasibility, and usefulness. Scientific consistency of indicators means that the indicators provide a reliable estimation of biodiversity, that they are independent from expert judgment, based on objective methods, and can be repeated independently of the observer (Favreau et al., 2006; Rodrigues and Brooks, 2007). Practicability and feasibility concern the operational requirements of indicator measurements in terms of effort and budget limitations (Caughlan and Oakley, 2001; Hagan and Whitman, 2006). Usefulness is related to the potential of the indicators to convey information to those actors who are expected to use it (Dudley et al., 2005; Turnhout et al., 2007; Bell and Morse, 2013). Usefulness of an indicator depends on the relevance of the information conveyed and therefore depends greatly on the type of audience that is targeted (Heink and Kowarik, 2010) and its communication potential to the different end-users that may be interested in the information.

Farmland biodiversity indicators are relevant for policy makers and administrators when the information supports the decision-making process e.g. for an efficient design of agro-environmental measures, and for the setting up of guidelines e.g. in the context of pesticide and GMO regulation (Firbank et al., 2003; White, 2005; Zabel and Roe, 2009; Hanley et al., 2012). Also, reporting the biodiversity status of farms to farmers could lead to the integration of environmental knowledge into farmers' decision making (Luescher et al., 2014). By becoming more aware of the functioning of the ecological sub-systems in which they operate, farmers can develop the capacity to manage their ecosystem services supply and motivate the participation in conservation programmes (Page and Bellotti, 2015). Indeed, improved awareness and understanding would help farmers in the management choices between efforts for direct producer benefits (e.g. production of marketable goods) and benefits to the society (e.g. recreation or biodiversity conservation), eventually rewarded by support policies (Vanclay, 2004; Dale and Polasky, 2007; Bommarco et al., 2013). This is particularly important in the case of complementary jointness between different bundles of ecosystem services supplied by agricultural lands (Wossink and Swinton, 2007; Firbank et al., 2012). Farmers are commonly more motivated to value the flow of ecosystem services that provide direct on-farm benefits (Zhang et al., 2007), whereas consumers have also interest in ecosystem services that are manifested substantially at scales above that of the plot, field or farm (Swift et al., 2004). Therefore, the attachment of environmental added-value to specific agricultural products could potentially reward environmentally friendly practices (e.g. organic farming; Sutherland, 2011), stimulate the development of “green farm” brands and generate cooperative behaviour at the landscape level (Goldman et al., 2007; Cong et al., 2014; Zavalloni et al., 2015).

Whilst there is a large body of literature focussing on the scientific quality of biodiversity indicators (e.g. Favreau et al., 2006 for a review), a limited number of studies address the relevance of indicators for different stakeholder groups (e.g. Turnhout et al., 2007; Bell and Morse, 2013). A recent paper addressing the costs of farmland biodiversity (Targetti et al., 2014) allows for an analysis combining the costs of data collection for biodiversity indicators and the usefulness of information as perceived by different stakeholders.

In this work, we relate the cost of the measurement of farmland biodiversity to a stakeholder-based assessment of the relevance of a set of indicators. The objective of this paper is to assess the potential of a set of biodiversity indicators to respond to monitoring needs based on: a) their ability to match the expectations of different end-users (administrators, farmers, consumers); and b) their cost. This study builds upon: a) a set of biodiversity indicators tested for scientific consistency in 12 European case studies (Herzog et al., 2013), b) an evaluation of costs for measuring that set of indicators (Targetti et al., 2014), and c) the evaluation of the usefulness of these indicators for different end-users based on a set of criteria elicited by a stakeholder panel and the concept of weights rooted in Multi-Criteria Evaluation (MCE) theory.

2. Materials and methods

2.1. Background: elicitation of stakeholders' values

Following Reed (2008), stakeholders can be defined as those affecting or that can be affected by a decision. In our context, these are exponents of interest groups, NGOs, land management agencies, landowners, consumers, etc.

Stakeholder involvement in environmental management is currently increasing and promoted by local and international agencies e.g. in the so-called citizen-science approach (e.g. European Environment Agency, 2013a, 2013b). One main reason for this trend is that environmental decisions typically encompass complex, urgent, and uncertain issues involving multiple divergent interests affecting different interest groups (Gregory and Keeney, 1994; Funtowicz and Ravetz, 1994; Rutgers et al., 2012). Stakeholder involvement in the decision making process is therefore considered an affordable and appropriate means for the evaluation of different alternatives when the collection of “hard” data is hampered by budgetary and time requirements (Kuhnert et al., 2010).

Indicators including values and conveying information relevant for stakeholders are acknowledged to be an effective tool capable of enhancing the quality, durability, and sustainability of decisions and are particularly important in the decision making process concerning agro-environmental issues (Dudley et al., 2005; Reed, 2008). Indeed, the aim of indicators to transfer scientific knowledge into usable knowledge underscores the need to include stakeholder perspectives from the early phases of the selection and development of indicators, as well as the importance of preliminary assessments of the usefulness of indicators against a range of stakeholder needs and expectations (Turnhout et al., 2007). The assessment of the usefulness of an indicator can follow two main approaches: An indirect approach e.g. tracing