Ecosystem Services 17 (2016) 152–162

Contents lists available at ScienceDirect

Ecosystem Services

journal homepage: www.elsevier.com/locate/ecoser

# Does nature conservation enhance ecosystem services delivery?

A. Eastwood [a,*], R. Brooker [a], R.J. Irvine [a], R.R.E. Artz [a], L.R. Norton [b], J.M. Bullock [c], L. Ross [a], D. Fielding [a], S. Ramsay [a], J. Roberts [d], W. Anderson [e], D. Dugan [d], S. Cooksley [a], R.J. Pakeman [a]

[a] The James Hutton Institute, Craigiebuckler, Aberdeen, UK
[b] NERC Centre for Ecology & Hydrology, Lancaster Environment Centre, Lancaster, UK
[c] NERC Centre for Ecology & Hydrology, Benson Lane, Wallingford, UK
[d] RSPB Scotland, Abernethy National Nature Reserve, UK
[e] Seafield Estate, Grantown-on-Spey, UK

ARTICLE INFO

*Article history:*
Received 31 March 2015
Received in revised form
18 November 2015
Accepted 12 December 2015

*Keywords:*
Biodiversity conservation
Conservation designation
Ecosystem services
Expert opinion
Protected Areas

ABSTRACT

Whilst a number of studies have examined the effects of biodiversity conservation on the delivery of ecosystem services, they are often limited in the scope of the ecosystem services (ES) assessed and can suffer from confounding spatial issues. This paper examines the impacts of nature conservation on the delivery of a full suite of ES across nine case studies in the UK, using expert opinion. The case studies covered a range of habitats and explore the delivery of ES from a 'protected site' and a comparable 'non-protected' site. By conducting pair-wise comparisons of ES delivery between comparable sites our study attempts to mitigate confounding cause and effect factors in relation to spatial context in correlative studies. The analysis showed that protected sites deliver higher levels of ecosystem services than non-protected sites, with the main differences being in the cultural and regulating ecosystem services. Against expectations, there was no consistent negative impact of protection on provisioning services across these case studies. Whilst the analysis demonstrated general patterns in ES delivery between protected and non-protected sites, the individual responses in each case study highlights the importance of the local social, biophysical, economic and temporal context of individual protected areas and the associated management.



## 1. Introduction

Recognition in the late 1980s and early 1990s of the limitations of traditional approaches to biodiversity conservation created the impetus for the uptake of new approaches to natural resource management (Haines-Young and Potschin, 2010), including the development of an Ecosystem Approach under the auspices of the Convention of Biological Diversity (CBD). The importance and value of ecosystems to society, and the consequences of their degradation for human health and well-being, however, were not really brought to the fore of international policy until the publication of the Millennium Ecosystem Assessment (MEA, 2005), which characterised and linked ecosystems to the services and benefits they provide to humans. A more recent major shift in international conservation policy came with the tenth meeting of the Conference of the Parties to the CBD, (18–29 October 2010, Nagoya, Aichi Prefecture, Japan) which adopted a revised and updated Strategic Plan for Biodiversity for 2011–2020, including the Aichi Targets. These 'targets' focus on the conservation of ecosystem goods and services, as well as biodiversity. This overarching international strategy has more recently been translated into regional and national biodiversity strategies and action plans; for example, see the 2020 Challenge for Scotland's Biodiversity (Scottish Government, 2013) and the EU Biodiversity Strategy to 2020 (European Commission, 2011). This significant re-focusing of biodiversity conservation legislation and policy on ecosystem services (ES) appears to provide a mechanism by which the integration of biodiversity conservation into other policy sectors might be achieved. If biodiversity underpins the services which are the focus of multiple policy sectors (for example, food production, climate regulation and health), then for these sectors to deliver their own goals, biodiversity needs to be conserved. In this way the perception of biodiversity conservation changes from being an impediment to being essential for delivering many policies.

The corollary to this argument is that biodiversity conservation should be supported because it helps to deliver ecosystem services. However, the evidence base for this argument is weaker

* Corresponding author.
*E-mail address:* Antonia.Eastwood@hutton.ac.uk (A. Eastwood).

http://dx.doi.org/10.1016/j.ecoser.2015.12.001
2212-0416/

than might be expected, and sometimes equivocal. For example, carbon storage, agricultural value and recreation have been assessed as respectively negatively, positively and not associated with the richness of high conservation-value species in the UK, but these relationships change across regions (Anderson et al. 2009). Eigenbrod et al. (2009) found that protected areas appeared to have high levels of biodiversity and C storage, but low levels of recreation and agriculture in England. At the European scale, Burkhard et al. (2012) looked at the association of ES demand with different CORINE land classes, finding that important habitat classes for conservation, such as peat bogs and natural grassland, ranked highly for supply of, relative to demand for, regulating services, but low in terms of provisioning services. Castro et al. (2015) found that protected area networks in eastern Andalusia supplied only slightly higher levels of regulating services (climate regulation, erosion control and water flow maintenance) than non-protected areas and that the supply of these services varied spatially across the study area according to habitat/typographic features.

Unfortunately there are consistent problems with these types of large-scale correlative analyses. First, they are constrained in the number and range of ES analysed due to a lack of available datasets at relevant scales. Focusing on just two or three indicators of ES delivery (effectively a sub-sample) runs the risk of giving an incomplete or distorted picture of the full range of services (and disservices) that different ecosystems or land use types provide. Second, the lack of suitable metrics also means that there is often a reliance on 'imperfect' proxies to estimate and quantify ecosystem services, e.g. soil carbon stocks for climate regulation, which imposes limitations or caveats on findings, as acknowledged by Castro et al. (2015). Finally, they risk confounding spatial location with habitat type. For example, UK uplands are often under conservation designation and contain much of the UK's stored carbon (Reed et al. 2009), but are also often distant from areas of high population density. Consequently, we see a positive correlation of conservation with C storage and a negative correlation with recreation, but not because of any causal relationship between current conservation and service delivery. Likewise, the poor representation of ecosystem services (carbon storage, plant productivity and agricultural production) from Chile's protected area network was due to spatial bias, i.e. the PAs are concentrated in the south where there are large extents of rock and ice (Duran et al., 2013). One of the greatest challenges in retrospective studies is the lack of base-line data on ES prior to protection (Ferraro et al., 2015). Whilst data on carbon is now relatively abundant and widespread to allow for global and regional modelling, data on the full suite of ES that protected areas provide is not, and there are still uncertainties in metrics and values used, even in well studied protected areas (e.g. Peh et al. 2014). In addition, ES, such as cultural services, show great spatial and temporal heterogeneity (Martín-López et al., 2009) and are much more challenging to assess and value in a meaningful way for decision-making.

In order to control against confounding factors (co-variates), Ferraro et al. (2015) used matching analyses (using nearest neighbour analysis of co-variates between protected and unprotected forest parcels) to estimate the impact of protected areas on forest carbon storage in Brazil, Costa Rica, Indonesia and Thailand. Using this approach they estimated that an additional 1000 Mt of carbon had been stored in these four countries due to protection.

Insights on the potential impacts of nature conservation on ecosystem services can also be found from recent restoration projects or studies looking at the impacts of different management regimes on protected land. We again, see a range of ES responses. For example, changes in ES delivery depend on the land management option applied in agri-environment schemes (Bradbury et al. 2010). The delivery of supporting and regulating ecosystem services and biodiversity was found to be higher in restored than in degraded systems, but lower than in undamaged reference systems (Rey Benayas et al. 2009). A study of Natura 2000 sites, found that although some regulating (pollination) and cultural services (aesthetics, tourism/recreation, education) were highly influenced by within-habitat changes in condition, other service types (provisioning and regulating) were less affected (Bastian, 2013). This is because for these latter services, 'rough' vegetation structure and land cover type are more important than species diversity or specific habitat type. An increasing number of studies, however, have shown significant improvements in regulating services, for example, water quality and storage, carbon sequestration, and pest and disease regulation following restoration (Economics for the Environment Consultancy, 2009; Grand-Clement et al. 2013; Marton et al., 2014; Gilbert, 2013; Morandin et al. 2014; Meli et al. 2014; Barral et al. 2015). The meta-analysis by Meli et al. (2014), which looked at the effects of wetland restoration on biodiversity and ecosystem services, showed that biodiversity was 19% higher and ES supply 43% higher in restored wetlands than in degraded ones.

The conclusions of De Groot et al. (2010) are still relevant; overall, and despite the importance of understanding the relationship between land use and management – including that targeted at biodiversity conservation – and ES delivery, we are short of information. Furthermore, from a conservation perspective it is clear that we need to gain a more comprehensive understanding of the relationships between biodiversity conservation actions and ecosystem service delivery. This is in order to avoid the risk of policy bias by focusing on a subset of ES which are easier to quantify such as food, water and climate regulation at the expense of those ES that are more difficult to quantify Maes et al. (2012).

In this study we carry out a rapid assessment to look at the effect of nature conservation on all ES categories, using expert opinion. Specifically, we use a standardised approach to examine nine paired case studies covering a range of environments and habitats in the United Kingdom for 24 different ecosystem services. We assess current existing differences between ES delivery on sites managed for nature conservation versus sites in the same or comparable locality but with alternative land-use or management. This contrasts with other approaches that have explored projected changes in ES following a policy change to landscape conservation using counterfactual scenario planning (Hodder et al. 2014). We use the analysis to further explore whether the effects are the same across different habitats and different localities.

## 2. Methodology

### 2.1. The case studies

In order to explore how nature conservation affects the delivery of ecosystem services, nine different case studies across the UK were selected. The case studies represent a wide range of different types of habitats/ecosystems (and their associated ecosystem services) and included rivers, coastal and chalk grasslands, montane heaths, raised bogs and Scots pine woodlands. A summary of each case study can be found in Table 1. Seven of the case studies comprised pair-wise comparisons between a protected area, or site, and a non-protected area. One case study explored the difference between land managed under agri-environmental schemes and land outside the scheme (Loweswater).The Abernethy case study assessed the effects of protection over-time (temporal), before and after 1988 when the RSPB purchased Abernethy forest from a previous shooting/forestry estate. See