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An economic assessment of the ecosystem service benefits derived from the SSSI biodiversity conservation policy in England and Wales

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ABSTRACT

Despite significant conservation efforts, global biodiversity continues to decline. A key contributing factor has been a failure to fully recognise the range of ecosystem service benefits provided by biodiversity. In this paper, we use a case study relating to Sites of Special Scientific Interest (SSSI) in England and Wales to demonstrate the potential ecosystem service benefits that can be derived from biodiversity conservation policies. Our approach involved three stages: (1) a choice experiment to assess the economic value of ecosystem services delivered by SSSI sites; (2) a 'weighting matrix' to (a) assign ecosystem services to the different SSSI habitats and (b) identify the contribution that conservation management on SSSIs has on the delivery of these services; (3) estimation of the aggregated economic value of ecosystem services directly attributable to conservation management on SSSI sites.

The public are willing to pay £956 m annually to secure the levels of services and benefits currently delivered by SSSI conservation activities, and a further £769 million to secure the benefits that would be delivered if SSSIs were all in favourable condition. These benefit estimates significantly exceed the annual £111 million costs of managing SSSIs, demonstrating that investing in biodiversity conservation can be cost effective.

1. Introduction

The Earth's biological resources are in decline: targets set by the Convention on Biological Diversity to '*significantly reduce the current rate of biodiversity loss*' by 2010 have not been achieved (Secretariat of the Convention on Biological Diversity, 2010). Further, human-induced drivers of changes (including land use change, climate change, invasive species and population/economic growth) are increasing the pressures on biological resources, which in turn are impacting the capacity of these resources to deliver ecosystem services that are important for people's welfare and livelihoods (Butchart et al., 2010; MA, 2005; Stern, 2006; TEEB, 2010a; Turner et al., 2009; United Nations, 2007; WWF, 2006). Effective conservation measures are thus urgently needed to protect the Earth's biodiversity, and thus maintain the stream of benefits derived from it.

Although biodiversity is (generally) declining, there are some success stories. For example, in England and Wales, conservation policies relating to 'Sites of Special Scientific Interest' (SSSI) have successfully improved the condition of key habitats over the past decade. SSSIs are a network of over 5000 sites designated to represent the best examples of biological and geological resources in England and Wales (Defra, 2003). Over the past decade, concerted conservation efforts have increased the proportion of SSSI area in England in a 'favourable' or 'unfavourable recovering' condition from 57% in 2003 to 95% in 2010 (Defra, 2012). As a result, England is now benefiting from enhanced delivery of a range of ecosystem services.

In this paper, we use the SSSI case study to demonstrate the potential economic benefits that can be derived from biodiversity conservation policies. Our approach involved three stages. Stage 1 involved the use of a choice experiment (CE) to assess the economic value of ecosystem services delivered by SSSI sites. Next, a 'weighting matrix' (WM) was used to (a) assign ecosystem services to the different SSSI habitats and (b) identify the contribution that conservation management on SSSIs has on the delivery of these services. Stage 3 draws on these two datasets to provide estimates of the economic value of ecosystem services directly attributable to conservation management on SSSI sites.

This paper is organised as follows. Following this introduction, we provide a discussion of the challenges of valuing ecosystem services associated with biodiversity (Section 2). Our SSSI case study is then introduced in Section 3. The aim, method and results

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are then reported in Sections 4–6 respectively. Finally we provide a discussion in Section 7.

2. Ecosystem assessments and valuation

Despite significant international, national and local conservation efforts, global biodiversity continues to decline (Butchart et al., 2010). Although there are many reasons why biodiversity conservation efforts have failed, a key contributing factor has been a failure to fully recognise the range of 'ecosystem service' benefits provided by biodiversity (Costanza et al., 1997; Daily, 1997; MA, 2005; Sachs et al., 2009; Secretariat of the Convention on Biological Diversity, 2000; TEEB, 2010a). The Millennium Ecosystem Assessment (2005) classifies ecosystem services into provisioning services (e.g., food, fibre, genetic resource, etc.), regulating services (climate regulation, water regulation, pollination etc.), cultural services (aesthetic values, recreation and ecotourism, spiritual and religious values, etc.) and supporting services (e.g., nutrient cycling, soil formation, etc.). Conserving the Earth's biodiversity is therefore important to protect and enhance the range of ecosystem services that are important to people's welfare and livelihoods. Recent discourse within the academic and policy making communities have argued that understanding the value of biodiversity and ecosystem services and embedding this value in decision-making is essential for ensuring more equitable, cost effective and sustainable biodiversity conservation policies (TEEB, 2011a,b).

Over the past decade, there has been a significant research effort to develop methodologies to assess the economic benefits of biodiversity and associated ecosystem services. Notable studies include the Millennium Ecosystem Assessment (2005), TEEB (2010a,b) and the UK National Ecosystem Assessment (2011). These studies have involved assessments at the international and national scales; however, there are many more studies that have focused on individual habitats or biomes at the sub-national level (Christie et al., 2006). There are significant challenges to ecosystem assessments. Specifically, the researcher will need to understand (i) the complex ecological linkages between biodiversity (the ecosystem) and ecosystem service provision, and (ii) how much people value the changes to ecosystem service provision. In both cases, there are many gaps in current knowledge and high degrees of uncertainty are involved in estimating those gaps. Haines-Young et al. (2007) provide a useful framework to consider these complex linkages between biodiversity, services and benefits. Key to this framework is the need to present ecosystem services in terms of 'final products', which can then be consumed/valued by people. Such an approach will help to avoid double counting of benefits.

The economic valuation of the benefits derived from ecosystem services may be undertaken using primary valuation research or value transfer (Defra, 2010); the former being the preferred option if funds allow. Methods currently available for primary valuation include: market prices, cost-based approaches (e.g., replacement costs, damage cost avoided and production functions), revealed preference (e.g., travel costs methods and hedonic pricing), stated preference methods (e.g., contingent valuation and choice experiments) and deliberative valuation methods—see Eftec (2006) and Christie et al. (2008) for a review of these methods. Often, ecosystem assessments draw on a range of valuation methods to evaluate the different services. Although this practice is useful as it allows the most appropriate method to be used to value each service, it does have draw backs in that valuations from different approaches often cannot be directly compared (Christie and Azevedo, 2009) and therefore it may not always be possible to gauge the relative benefits across services. To address this concern, our research evaluates the economic benefits across a range of services delivered by SSSIs using a single valuation protocol based on a choice experiment (CE). The CE approach also helps to avoid double counting from aggregating individual service values.

The choice experiment approach requires survey respondents to make informed value judgements on the environmental good under investigation. This requires information on these goods to be presented to respondents in a meaningful and understandable format (Arrow et al., 1993), which in turn will enable them to express their preferences consistently and rationally. Herein lies the problem: many studies have found that members of the public have a low awareness and poor understanding of biodiversity and related services (Defra, 2002; Spash and Hanley, 1995). To address this issue, some researchers have started to incorporate participatory and deliberative processes into stated preference studies (Christie et al., 2006; Macmillan et al., 2002; Spash, 2007). Such approaches allow more time for the provision of information on the environmental good and provide the respondent's with 'time to think' about and reflect on their preferences. There is evidence suggesting that deliberative approaches can improve the accuracy of valuation surveys (Kenter et al., 2011; Whittington et al., 1997; Whittington et al., 1992). For these reasons, we administer our choice experiment study through a series of deliberative valuation workshops.

3. Case study: English and Welsh Sites of Special Scientific Interest (SSSIs)

Our research uses the case study of the Sites of Special Scientific Interest (SSSI) in England and Wales to demonstrate the ecosystem service benefits that might be attained from biodiversity conservation policies. SSSIs conserve the England and Wales' most important sites for biodiversity and geodiversity. SSSI policy dates back to the 1949 National Parks and Access to the Countryside Act and has been developed through subsequent legislation. The purpose of SSSIs is '*to safeguard, for present and future generations, the diversity and geographic range of habitats, species, and geological and physiographical features, including the full range of natural and semi-natural ecosystems and of important geological and physiographical phenomena*.' (Defra, 2003).

In England, there are around 4000 SSSIs, covering 8% of the total land area (Natural England, 2008) and in Wales there are around 1000 SSSIs, covering 12% of the total area (Countryside Council for Wales, 2006). SSSIs cover a wide range of habitats (Table 1). Many of the largest sites are in upland and coastal areas, where semi-natural habitats survive as uninterrupted expanses. In contrast, many lowland habitats including meadows, heaths and woodlands, are often represented by small (often < 100 Ha), fragmented sites. Further, SSSIs protect a large proportion of the national area of some habitats, such as intertidal mudflats and saltmarsh; fen, marsh and swamp; sand dunes and shingle. Around three-quarters of the SSSI area in England and Wales are also subject to higher international designations such as Special Protection Areas and Special Areas of Conservation (together known as Natura 2000 sites) (Countryside Council for Wales, 2006; Natural England, 2007). Natura 2000 designation provides an extra layer of protection to these sites.

In the last 10 years there has been increased emphasis on improving and maintaining the condition of SSSIs in order to achieve their conservation objectives. Conservation management on SSSIs includes a range of actions to enhance the condition of the sites, as well as legislation to protect the site against damage. The condition of SSSIs in England and Wales is monitored under a Common Standards Monitoring (CSM) framework (Joint Nature Conservation Committee, 1998), which is based on the site-specific