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Measuring stock and change in the GB countryside for policy – Key findings and developments from the Countryside Survey 2007 field survey

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ABSTRACT

Countryside Survey is a unique large scale long-term monitoring programme investigating stock and change of habitats, landscape features, vegetation, soil and freshwaters of Great Britain. Repeat field surveys combine policy and scientific objectives to provide evidence on how multiple aspects of the environment are changing over time, a key goal of international science in the face of profound human impacts on ecosystems. Countryside Survey 2007 (CS2007), the fifth survey since 1978, retained consistency with previous surveys, whilst evolving in line with technological and conceptual advances in the collection and integration of data to understand landscape change. This paper outlines approaches taken in the 2007 survey and its subsequent analysis and presents some of the headline results of the survey and their relevance for national and international policy objectives.

Key changes between 1998 and 2007 included: a) significant shifts in agricultural land cover from arable to grassland, accompanied by increases in the area of broadleaved woodland, b) decreases in the length of managed hedges associated with agricultural land, as a proportion deteriorated to lines of trees and c) increases in the areas and numbers of wet habitats (standing open water, ponds) and species preferring wetter conditions (1998–2007 and 1978–2007). Despite international policy directed at maintaining and enhancing biodiversity, there were widespread decreases in species richness in all linear and area habitats, except on arable land, consistent with an increase in competitive and late successional species between 1998 and 2007 and 1978 and 2007. Late successional and competitive species: Stinging nettle (*Urtica dioica*), Hawthorn (*Crataegous monogyna*) and Bramble (*Rubus fruticosus*), in the top ten recorded species recorded in 2007, all increased between 1998 and 2007. The most commonly recorded species in CS (1990, 1998 and 2007) was agricultural Ryegrass (*Lolium perenne*).

Increases in both water quality and soil pH were in line with policy aimed at addressing previous deterioration of both. Headwater streams broadly showed continued improvements in biological quality from 1998 to 2007, continuing trends seen since 1990. In soils, there were significant increases in soil pH between 1998 and 2007 consistent with recovery from acidification.

1. Introduction

Ecosystems within any one country tend to be complex and heterogeneous resulting from a combination of soils, geology, topography and climate interacting with vegetation, wildlife and, in most cases, human activities (MA, 2005). In highly managed landscapes, such as Great Britain (GB), understanding how ecosystems support human well-being is becoming increasingly important if we are to ensure their long term sustainability (MA, 2005; Hindmarch et al., 2006; UKNEA, 2011). In Great Britain, as elsewhere in Europe, land is primarily managed by private landowners, even within National Parks, where past human land

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management is often linked to landscape character (Marrs et al., 2007). The majority of the British landscape is farmed (~75%)[1] which results in agricultural, economic and policy drivers, alongside other drivers, significantly impacting on both productivity and all other ecosystem services delivered by land (Swinton et al., 2007). Worldwide, agricultural management has had profound impacts on the environment (Scherr and McNeely, 2008; Stoate et al., 2009) and specifically on biodiversity (Chamberlain et al., 2000; Krebs et al., 1999; Phalan et al., 2011). Policy responses to the often drastic and negative impacts of farming on ecosystems and biodiversity vary both nationally and internationally. In GB, post-war (1950's onward) policies (Stoate et al., 2009) include: the hedgerow regulations (DETR, 1997), the adoption of biodiversity targets relating to specific habitats and species resulting from the international Convention on Biological Diversity (CBD), the provision of broad-scale agri-environment schemes including woodland planting (Swash et al., 2000) and the EU Water Framework Directive (European Union, 2000).

Environmental monitoring is of fundamental importance for providing evidence and/or indicators of ecological change (Harrison, 2010; Sachs et al., 2010) which can help evaluate the success of such policy responses. It has been used to understand the processes by which drivers, including agricultural and land use change, impact on ecological change (Firbank et al., 2008; Pascher and Gollmann, 1999; Smart et al., 2006; Stahl et al., 2011; Thackeray et al., 2008). Increasingly, the requirement for policy and environmental management to focus on the provision of multiple ecosystem services (Carpenter et al., 2009; Foley et al., 2005) points to the need for integrated monitoring approaches which measure multiple environmental variables at the same locations. Hence, the spatial resolution and sampling approach of monitoring datasets are important factors influencing the extent to which they provide relevant data at appropriate/useful scales (Anderson et al., 2009). The recent National Ecosystem Assessment (UKNEA, 2011) was the first analysis of the UK's natural environment in terms of the benefits it provides to society and continuing economic prosperity. This analysis benefitted from a strong environmental research base and national scale environmental monitoring in the UK including Countryside Survey (CS) which contributed to many areas of the NEA.

Countryside Survey is a repeat national survey of the GB countryside (combined with the Northern Ireland CS (Cooper et al., 2009) to produce UK results) which includes integrated (soil, freshwater, vegetation and landscape) measures on a randomly stratified sample of 1 km squares (Bunce et al., 1996). The CS time series (5 surveys covering the period 1978–2007) provides a temporal scale which can be used to understand how processes impact on environmental change over time. The temporal and spatial scales of CS make it an ideal dataset to: investigate national trends in countryside characteristics, compare changes in different aspects of the environment (e.g. soil, land, water) at the same locations and to make broad-scale assessments of the potential impacts of national policy (Carey et al., 2002; Firbank et al., 2008; Rowe et al., 2011; Smart et al., 2003b). Whilst it is recognized that such broad-scale approaches offer incomplete evidence about the roles of specific drivers of environmental change (Smart et al., 2012) they provide valuable insight into the nature of countryside change in the context of relevant policy and help to direct more detailed analysis. Increasingly, with advances in computing power, tools available for analysis and modelling, and better datasets on potential driving variables, it is possible to carry out more complex analyses than were previously possible relating to the impacts of specific drivers on particular variables (Maskell et al., 2010; Smart et al., 2010b). In contrast, this paper takes an overview of the CS results (for GB) and discusses them in the context of some of the key drivers across the CS timescale and between the last two surveys.

The results presented constitute the main findings from CS2007 which have, to date, appeared across a number of web-based UK and country level reports for policy makers (countrysidesurvey.org.uk). Countryside Survey, in common with comparable national surveys (Pascher et al., 2011; Stahl et al., 2011), is funded for both science and policy objectives. In previous surveys, policy interest has been primarily focused on measurements of environmental performance including changes in the extent and condition of relevant habitats and in several of the UK Biodiversity Indicators (Defra, 2011). In the scoping phase of CS2007, the emerging convergence of scientific and policy objectives around the need to understand how ecosystems deliver ecosystem goods and services, as exemplified by the Millennium Ecosystem Assessment (MA, 2005), raised the potential for the use of CS data to provide measures of ecosystem services. The CS Integrated Assessment (IA) (Smart et al., 2010a) which fulfilled this potential is described briefly in the discussion here. The paper also highlights some of the methodological issues faced by long-term monitoring programmes in providing consistent measures of change over time in the face of political and technological change and the continuing demand for evidence to support policy. CS2007 was the first CS to use digital recording methodologies, rather than paper, partly driven by a requirement to report the survey results more rapidly and to reduce costs.

2. Survey design

The first CS, which was primarily science-led, was carried out in 1978 following years of development and testing on the underlying concept of definition of a limited number of land classes and their subsequent stratified random sampling (Firbank et al., 2003). The survey covered 256 one kilometre sample squares across GB. The sampling strategy was designed to enable national level reporting on the basis that sample squares were random representations of 32 land classes[2] classified from analysis of 40 square level physical variables (derived from Ordnance Survey maps) (Bunce et al., 1996). Due to changes in reporting requirements (see below) and closer engagement with policy from 1990 onwards there are now 45 land classes[3] as illustrated in Fig. 1. Subsequent surveys took place in 1984, 1990, 1998 and most recently 2007. All surveys have involved, where possible, revisiting the original sample locations, but have also expanded the survey in both the range of variables recorded and sample size. CS2007 was the largest survey to date including: habitats, landscape features, vegetation, soils, freshwater biota and hydromorphology (headwater streams and ponds) and remotely sensed imagery (not covered here) and covering 591 one kilometre squares.

For the first time, in 2007, CS provided data at the country level for England, Scotland and Wales requiring substantial increases in sample squares across Wales (Carey et al., 2008). Other changes reflecting political requirements included; plots sampling agri-environment scheme features, reporting on less common, higher quality Priority Habitats[4] alongside Broad Habitats (see 2.2) and the inclusion of detailed pond surveys.

[1] (http://www.ukagriculture.com/uk_farming.cfm).

[2] ITE Land Classification of Great Britain 1990 – http://data.ceh.ac.uk/metadata/ab320e08-faf5-48e1-9ec9-77a213d2907f.

[3] ITE Land Classification of Great Britain 2007 – http://data.ceh.ac.uk/metadata/5f0605e4-aa2a-48ab-b47c-bf5510823e8f.

[4] http://jncc.defra.gov.uk/default.aspx?page=5155.