Biodiversity, ecosystem services and conservation

Introduction

The focus of biodiversity conservation has shifted in recent years towards the protection not only of species and habitats, but also the ecosystem services that natural environments provide. This shift has led to substantial interest in the way in which biodiversity – the diversity of genes, species and habitats in our natural environment – actually underpins ecosystem service delivery.

Understanding this relationship is extremely challenging, not least because of the huge range of services that we derive from nature and the many different ways in which ecosystems and their component parts can interact to deliver these services. One way of addressing this complexity is to break down the overarching question into a set of component themes. Although we can recognise the inter-connected nature of the natural environment, it is reasonable to conclude that some ecosystem services are more relevant to particular sectors of society, business and government than are others.

A recent review has considered the role of biodiversity and biological and biophysical processes in underpinning ecosystem service delivery in Scotland. In particular it has focussed on "priority ecosystem services" which are considered particularly relevant to four broad policy goals: 1. Low carbon economy, 2. Sustaining food production, 3. Halting biodiversity loss, and 4. Sustainable water management. Here we summarise key information from this review that relates to the broad policy goal of **halting biodiversity loss.**

Key Concepts and Terms

Biodiversity - *'Biological diversity' means the variability among living organisms from all sources including,* inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems*. - Article 2 of the Convention on Biological Diversity

Biophysical processes - potential environmental regulators of ecosystem service delivery other than biodiversity, for example non-organismal soil processes.

Ecosystem services - an "activity or function of an ecosystem that provides benefit (or occasionally disbenefit) to humans" (Mace *et al.* 2012). Final ecosystem services directly underpin or give rise to a '**good**'. In general, **ecosystem functions** are considered to be the processes driven by organisms that support the delivery of services.

Key Points

The review considered the following ecosystem services to be particularly important for the broad policy goal of halting biodiversity loss: Wild species diversity (as both a cultural service and provisioning service); Disease and pest regulation; Crops. The information below summarises current understanding as to how they might in Scotland be underpinned by biodiversity and biological and biophysical processes.

• **Wild species diversity as a cultural service** (i.e. providing the non-material benefits that people gain from ecosystems) is more likely to be directly regulated by natural biophysical and biotic processes in upland than in lowland systems. Defining the 'goods' (the actual benefits delivered to people by this service) is complex but important: these may differ substantially between stakeholders, and so too might this service's relationship to biodiversity and biophysical processes. Understanding the basis for conservation targets – the "appropriate" level of biodiversity - is also important: this will differ, for example, between the lowlands and uplands.

• For **wild species diversity as a provisioning service** (i.e. providing products such as food or materials that people obtain from ecosystems) increased biodiversity is likely to be important for ecological restoration, but this positive relationship is probably weaker for other types of bioprospecting (e.g. the hunt for pharmaceutical products). Increased diversity overall can be beneficial for the provision of harvestable species, with the exception of increased biodiversity for some particular species groups (e.g. epidemic pests and diseases).

• The relationships between biodiversity and biotic/biophysical processes and **disease and pest regulation** are complex, not least because either side of the pathogen/pest–host relationship may be affected. We have some knowledge of these relationships from crop and livestock production systems, but our knowledge is poorer for more complex natural and semi-natural systems (although critical with respect to halting biodiversity loss). There is now considerable potential for extending techniques developed in crop and livestock production systems to explore these relationships in natural/semi-natural systems, and for enhancing positive interactions between cropped land and surrounding habitats (e.g. for biocontrol of pests).

• With respect to **crops**, intensification clearly leads to negative biodiversity impacts. Sustainable farming practices will be beneficial for biodiversity in crop production systems, but the extent to which biodiversity-supported functions can offset the loss for crop production that might result from less intensive farming practice is unclear. Other changes in crop production systems, beyond simply reducing the intensity of management, may have beneficial impacts for farmland biodiversity and can contribute to biodiversity conservation.

• **Overall**, in all systems it is important to understand which elements of biodiversity are critical for delivering the aims of the broad policy goal of halting biodiversity loss, and how these relate to the desires of and management by different stakeholder groups. This level of detail is necessary for developing integrated management practices that promote biodiversity conservation.

Research Undertaken

The review from which this information is derived has been undertaken as part of the Ecosystem Services Theme of the Scottish Government Strategic Research Programme: Environmental Change. Its aim is to help deliver the request from Scottish Government for:

> *Increased understanding of the linkages between the primary ecological and evolutionary processes, ecosystem function and ecosystem services, to inform assessment of the consequences of environmental change for the wide range of ecosystem services. (RD 1.1.2).*

The approach and terminology adopted throughout the review follows that used in the UK National Ecosystem Assessment. The overall scope, approach and conclusions of the review are described in the main report and accompanying Executive Summary.

Policy Implications

Different people and sectors want different components of biodiversity conserved; and different components of biodiversity are underpinned in different ways by natural systems and processes. **In**

general increasing biodiversity is beneficial for achieving the broad policy goal of halting biodiversity loss. This is for two reasons:

1. Biodiversity *in its totality* often supports those particular subsets of biodiversity which are prioritised by different stakeholder groups.

2. Enhancing biodiversity helps to deliver ecosystem services that in turn deliver 'goods' to a range of stakeholders; this in turn strengthens the argument for biodiversity conservation.

But it is important to remember that these relationships between ecosystem service delivery and underlying biodiversity and biophysical processes are variable. They depend on the service, how other management actions impact on the service, the location and the end user. We must understand this variability if we want to know how to manage biodiversity for conservation benefits and to promote biodiversity conservation.

In addition we must not overstate the case for ecosystem service delivery being a *raison d'être* for biodiversity conservation: **in some cases ecosystem services are not strongly dependent on biodiversity or biophysical processes**, or are dependent only on a small subset of the organisms that might occur. For this reason, the original imperatives for biodiversity conservation should not be forgotten.

Authors

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Topics

Biodiversity; Ecosystem services; Biodiversity conservation

Related websites

BaBU

http://www.hutton.ac.uk/babu

Scottish Government Strategic Research Programme: Environmental Change

http://www.scotland.gov.uk/Topics/Research/About/EBAR/StrategicResearch/future-research-strategy/Themes

UK National Ecosystem Assessment

http://uknea.unep-wcmc.org/Home/tabid/38/Default.aspx

2020 Challenge for Scotland's Biodiversity - A Strategy for the conservation and enhancement of biodiversity in Scotland

http://www.scotland.gov.uk/Publications/2013/06/5538