

Ecosystem assessment, climate change and the value of biodiversity

Tony Whitbread, November 2009

The value of biodiversity stems at least in part from the point that biodiversity is the main component of ecosystems and hence fundamental to the provision of ecosystem services. An ecosystem is defined as a system formed by the interaction of a community of organisms (biodiversity) with their physical environment, i.e. the interaction of biodiversity and its non-living environment. So, assess the value of ecosystems and this helps understand the value of biodiversity.

The UN Millennium Ecosystem Assessment,

This was published in 2005 and has been helpful in providing a structure for describing and valuing ecosystem services, and so in valuing biodiversity. It was a large and ambitious international project supported by over 1000 scientists' world wide.

Ecosystem services are defined as: The benefits that a healthy natural environment provides for people, either directly or indirectly. These range from the essentials for life, including clean air and water, food and fuel, to things that improve quality of life and wellbeing, such as recreation and beautiful landscapes. They also include natural processes, such as climate and flood regulation. Ecosystem services are divided into four categories:

- **provisioning services** – the products obtained from ecosystems, including fresh water, food, fibre (e.g. timber, cotton, wood fuel), genetic resources, biochemical products, natural medicines and pharmaceuticals
- **regulating services** – the benefits obtained from the regulation of natural processes, including air quality regulation, climate regulation, water/flood regulation, erosion regulation, water purification, disease and pest control, pollination, buffering pollution
- **cultural services** – the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic enjoyment
- **supporting services** – the services that are necessary for the production of all other ecosystem services, including soil formation, photosynthesis, primary production, nutrient cycling and water cycling.

It follows, therefore, that biodiversity provides the building blocks of ecosystems and ecosystems are fundamental in delivering the services on which we all depend.

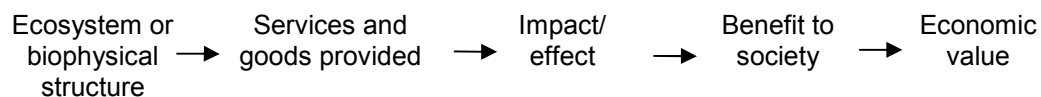
DEFRA's Ecosystem Approach.

DEFRA are in the forefront in developing a practical approach for ecosystem assessment which should help guide policy development. Their ecosystem approach is described as "integrating and managing the range of demands placed on the natural environment in such a way that it can indefinitely support essential services and provide benefits for all". More broadly, this seems to be a pretty good definition of environmental sustainability.

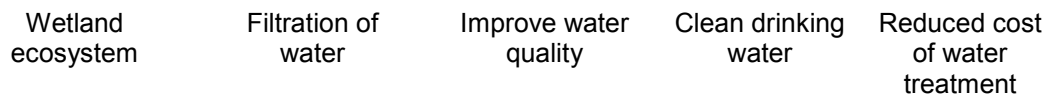
DEFRA has linked ecosystem services to human well-being in the following diagram:

| Ecosystem services | | Constituents of well-being | |
|---|---|--|---|
| <p>supporting services: soil formation, photosynthesis, primary production, nutrient cycling and water cycling</p> | <p>provisioning services: - fresh water, - food, fibre (e.g. timber, cotton, wood fuel), - genetic resources, biochemicals, - natural medicines pharmaceuticals</p> <p>regulating services: - Air quality regulation, climate regulation, water/flood regulation, - erosion regulation, - water purification, disease and pest control, - pollination, - buffering pollution</p> <p>cultural services: - spiritual enrichment, - cognitive development, - reflection, recreation - aesthetic enjoyment</p> | <p>Security: - personal safety - secure resource access - security from disasters</p> <p>Basic material for good life - adequate livelihoods - sufficient nutritious food - shelter - access to goods</p> <p>Health - strength - feeling well - access to clean air and water</p> <p>Good social relations - social cohesion - mutual respect - ability to help others</p> | <p>Freedom of choice and action: opportunity to be able to achieve what an individual values doing and being</p> |

DEFRA's pathway for valuing ecosystem services is along the following lines (summarised from various DEFRA sources):



An example might be:



Biodiversity and ecosystem functioning.

There is an assumption linking the richness of biodiversity to ecosystems, and this is that a healthy, well-functioning ecosystem is formed of and indicated by a rich biodiversity. In other words biodiverse ecosystems “work” better than poor ones. This is probably a reasonable assumption for various reasons. As Darwin noted, an ecosystem made up of a large number of characteristic, specialist organisms will utilise that ecosystem more efficiently than a poor mixture. As a result the presence of uncommon or special species will indicate that an ecosystem is functioning well. (For example if a wetland is good enough to have otters in it then it is probably

providing drinking water, flood amelioration and pollution buffering in the most effective way).

Ecosystem services and Living Landscape

In order to be of practical value in valuing ecosystem services, it will be necessary for ecosystem services to be analysed at various scales of organisation. Some ecosystem function might be delivered at the scale of a micro-habitat (for example a small river tributary), others may be at habitat level (such as a reedbed or fen), or delivered at an ecosystem level (a wetland system), some may be delivered at a landscape scale (such as a whole river catchment) and still others may provide a function at the level of a matrix or ecological network. However, whilst all scales should be considered, it is likely that practical assessment of ecosystem services will be most helpful at the scale of ecosystem or landscape units.

In The Wildlife Trusts we have now developed our own landscape scale approach to nature conservation, entitled Living Landscape. This is a major initiative supported by Wildlife Trusts throughout the country and with over 100 separate active projects. Each project is at the scale of a landscape unit and they provide valuable case studies where particular landscape units can be examined in order to assess the services that the constituent ecosystems provide. This is a strategic approach in which we wish to achieve the following:

- Protection, enhancement and enlargement of places that are already rich in biodiversity. These high-quality locations will include SACs, SSSIs and Wildlife Sites.
- Build connectivity between these high quality sites to allow species to move and natural processes to function at a landscape scale.
- The more general improvement of low quality areas (such as the urban environment and areas of intensive agriculture) so that species are able to move more generally throughout the environment.

Pitfalls with an economic valuing approach.

Ascribing an economic value to biodiversity does, however, have problems.

Placing a financial value on an ecosystem service may imply a “market” – the ability to trade or pay for the loss, or gain, of a service. In fact these services are essential, generally held in common and non-tradable. In some ways this will make them incompatible with normal approaches to economic valuation. Nevertheless, such services could be said to have a value in that if we had to deliver them artificially it would cost something. This clearly also has limits as it would be inconceivable to work out the cost of pollinating every plant or producing every oxygen molecule.

Valuation of services is also vulnerable to the idea of tipping points and lag times. A service may be assigned a low value, or even missed altogether, because it is considered ubiquitous. As that service becomes increasingly constrained its value may increase. By then, however, the service may have passed a tipping point and the cost (or even the possibility) of regaining that value could be disproportionately greater than the cost of retaining it in the first place. A good analogy for this is climate change and greenhouse gasses. Greenhouse gasses cause climate regulation to go beyond a tipping point. Originally climate regulation was considered an externality and not valued, as we reach a tipping point the cost of retaining it

hugely increases and as we go past it the cost of losing that function will be beyond value.

An understanding of the significance, and perhaps even the existence of a service, may be vulnerable to a non-linear reduction of the service as ecosystems become degraded. This may mean that a potential ecosystem service is not assessed because the degradation of an ecosystem has pushed it past the point where a service might be considered significant (for example a drained wetland system may have resulted in a river being so disconnected from its flood plain that any recharging of the aquifer has become insignificant). The logic works the other way around as ecosystems are restored. As the functioning of an ecosystem improves then unpredictable services might emerge – often called emergent properties by ecologists. Such services would almost inevitably be missed as most of the ecosystems today are already degraded.

Ecosystem services in relation to climate change.

Adaptation of biodiversity to climate change is often considered from the perspective of maintaining species and habitats in a changing environment. This is important in its own right but environmental adaptability should also be considered against the back-cloth of maintaining a healthy, functioning environment in order to continue to deliver vital ecosystem services. Thus ensuring adaptability for wildlife is central to ensuring environmental adaptability to underpin ecosystem services.

Summary:

- Ecosystems are the system of interaction between communities of plants and animals (biodiversity) and the non-living world. Ecosystems provide services on which we all depend.
- Ecosystem services have been well defined by the Millennium Ecosystem Assessment, an approach that is being taken forward in the UK by DEFRA.
- Biodiverse ecosystems probably function better and so provide ecosystem services better, than poor ones.
- The Wildlife Trusts Living Landscape projects could provide helpful case studies where ecosystem services can be examined at a practical level.
- Using the Millennium Ecosystem Assessment approach, it may be possible to assign an economic value to ecosystem services. This may involve approximations and assumptions, and will probably be a severe underestimate of their true economic value. It could, however, be good enough to guide policy.
- Encouraging adaptation of biodiversity to climate change is central to delivering continued ecosystem function and so the provision of future ecosystem services.

Useful web links:

<http://www.ecosystemservices.org.uk/index.htm>

<http://www.biodiversityeconomics.org/index.html> - This gives useful references on valuing biodiversity and ecosystem services listed under a section labelled “basics”

<http://ec.europa.eu/environment/nature/biodiversity/economics/> - This has a section on a major international project called “The Economics of Ecosystems and Biodiversity (TEEB)

<http://www.defra.gov.uk/wildlife-countryside/natural-environ/eco-actionplan.htm> - This is where DEFRA’s ecosystem documents can be found.

Useful references:

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