



Science for Environment Policy

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SPECIAL ISSUE

Ecosystem Services

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Protecting natural capital for human wellbeing and sustainable development

The modern concept of 'ecosystem services' has progressed significantly in recent decades. Conceived of primarily as a communication tool in the late 1970s to explain societal dependence on nature, it now incorporates economic dimensions and provides help to decision makers for implementing effective conservation policies which support human wellbeing and sustainable development.

UNEP's Millennium Ecosystem Assessment (MA)¹, published in 2005, marked a major milestone in the historical development of the ecosystem services concept. It sought a strong scientific understanding for how ecosystems affect human welfare and how they can be sustainably managed.

Research into ecosystem services has flourished considerably since the publication of the MA, notably the ongoing Economics of Ecosystems and Biodiversity (TEEB) project² which is making a compelling case for promoting conservation, by estimating the economic benefits of ecosystems to human welfare and the economic cost to society of ecosystem decline.

This thematic issue provides a snapshot of the latest research in the most recent chapter of ecosystem services' story. It aims to help guide future conservation and sustainable development policies.

Placing an economic value on an ecosystem service is no simple task, and much can be learned by sharing experiences. The article '**Evaluating biodiversity and ecosystem services in France**' explains how values were calculated for French Government policy making, while casting a critical eye on valuation methods.

It is necessary to classify different types of services when incorporating ecosystem services into decision-making. However, UK researchers warn that a single classification scheme is inappropriate. For more details, see: '**The importance of social and political context for classifying ecosystem services**'.

Research shows that an ecosystem services approach integrates well with other types of conservation management. Studies described in '**Dispelling myths around ecosystem service projects**' and '**Improved biodiversity and ecosystem services go hand-in-hand**' indicate that biodiversity conservation projects and ecological restoration projects can provide win-win solutions for boosting biodiversity protection and ecosystem service provision.

Meanwhile, a case study from the Amazon demonstrates how REDD (Reducing Emissions from Deforestation and Forest Degradation) also enhances ecosystem services, such as maintaining water quality. See: '**REDD improves forest provision of ecosystem services**'.

Finally, we must manage our environment so that it continues providing essential ecosystem services. '**Mapping Europe's potential to provide ecosystem goods and services**' describes a new tool to help to achieve just this.

Damage to the natural environment is seriously threatening its ability to provide vital goods and services, with considerable economic and social repercussions. The concept of ecosystem services is a useful and important tool to enable a better understanding of these repercussions and preserving and enhancing natural capital, and can help support the implementation of key European nature protection legislation, such as Natura 2000.

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1. See: www.MAweb.org

2. See: www.teebweb.org TEEB's results will be presented at the Convention on Biodiversity Protection's tenth meeting of the Conference of the Parties (COP 10) in Nagoya, Japan, in October this year: www.cbd.int/cop10

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Evaluating biodiversity and ecosystem services in France

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Theme(s): Biodiversity, Environmental economics

“These reference values can be integrated into decision making processes, for example, into socio-economic impact assessments made prior to all large public infrastructure projects.”

A report commissioned by the French Government has calculated reference values for French ecosystems. These range from €600 per hectare/per year for pastureland to €2000 per hectare/per year for some types of forest. The methods used to calculate these values were carefully analysed.

Like many other countries, France has a clear commitment to account for biodiversity in public decision making, which means that the value of biodiversity and ecosystem services needs to be estimated in a clear and comprehensive way.

Based on an analysis of existing literature, the report calculated minimum estimates of the value of biodiversity, based on ecosystem services it provides to society. Reference values calculated by the study include those for temperate forestry (valued at a mean of €950 per hectare/per year) and pasture land (minimum valuation of €600 per hectare/per year). Forest valuations ranged from €500-2000 per hectare/per year; values varied primarily depending on whether the forest attracted tourism or used for recreation and on the forest management applied.

These reference values can be integrated into decision making processes, for example, into socio-economic impact assessments made prior to all large public infrastructure projects. Values quoted are the ‘absolute minimum’ values and can be used instead of ‘zero’ in public accounting of biodiversity. With further research, these values could significantly increase if more services were taken into account.

The report explains how it reached these results, and identified methodological weaknesses and questionable assumptions at each stage of the evaluation. Firstly, it prioritised ex-ante socio-economic calculations, i.e. it provided estimates of all the losses that may result from altering an ecosystem that would have to be endured or compensated for by society.

The reference values were drawn up using a cost/benefit approach. For example, it compared the cost of maintaining a specific Natura 2000 site on the Crau plain, with the financial benefits received by sheep and hay farmers on the land and the social benefits for local communities as a result of that investment. However, there are some questions surrounding the effectiveness of this approach, for example, its ability to consider changes in land use and the spatial impacts of these changes.

The report distinguishes ‘remarkable’ biodiversity from ‘general’ biodiversity, but it only provides reference values for general biodiversity. General biodiversity can be valued for the ecosystem services it contributes to society. In contrast, remarkable biodiversity also has an intrinsic value. For example, a very rare species, or biodiversity that also has strong cultural value. In these cases, valuation of opportunity costs for investment purposes was considered inappropriate.

Ecosystem services were classified according to the Millennium Ecosystem Assessment’s proposals: “provisioning services”, which provide goods that people can use, such as food, “regulating services”, for example, climate or disease regulation, such as water quality, and “cultural services”, such as recreational or aesthetic purposes. Services were also classified as either ‘dynamic services’, i.e. flowing services such as water production and tourist visits, or ‘static services’, for example, stability of soil or carbon storage.

Source: Chevassus-au-Louis, B., Salles, J-M., Pujol, J-L., *et al.* (2009). An economic approach to biodiversity and ecosystems services: Contribution to public decision-making. Centre d’analyses Strategiques report. Download from: www.strategie.gouv.fr/IMG/pdf/BIODIV_GB_19_02_2010pdf.pdf



The importance of social and political context for classifying ecosystem services

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Theme(s): Biodiversity, Environmental economics

“There are many contexts in which ecosystem services can be used and the context should help to determine which classification scheme is the most appropriate for decision making.”

It is important to have a single definition of ‘ecosystem services’, but a single classification scheme for services is not appropriate, according to researchers. There are many contexts in which ecosystem services can be used and the context should help to determine which classification scheme is the most appropriate for decision making.

Human wellbeing depends on the many services provided by ecosystems, such as clean water and food. In developing the concept of ecosystem services, a number of classification schemes have been proposed, such as those in the Millennium Ecosystem Assessment¹.

However, the researchers suggest that classification of ecosystem services should be based on: a clear definition of ecosystem services; understanding the characteristics of the ecosystem or ecosystem services being considered; and an understanding of the decision context in which the ecosystem services are being used.

As yet, there has not yet been a consistent definition of ecosystem services, which is needed to allow for meaningful comparisons across different policy contexts and projects. The researchers propose a definition of ecosystem services as “the aspects of ecosystems utilised (actively or passively) to produce human wellbeing”.

Ecosystem services therefore include the structure or organisation of ecosystems, in addition to their processes and/or functions, if they are used by people. The functions or processes only become services if people benefit from them, such as wetlands providing protection from floods.

Following this definition, key characteristics of the services and the ecosystems can be considered. For example, by understanding that there are seasonal fluctuations in water from streams used for irrigation, we can be better prepared by collecting water or improving irrigation management. However, decisions about using ecosystems services are made in specific social or political contexts. The researchers suggest this context as well as the characteristics of ecosystems should also be taken into account when deciding which classification system to use.

For example, one way to classify ecosystem services would be to use their ‘spatial’ characteristics. This classification system would be suitable when the decision is based on how to manage the provision of ecosystem services over different scales at a landscape level. One category in this classification system might be “in-situ”, representing the situation where the provision and benefit of the services are located in the same place.

Source: Fisher, B., Kerry Turner, R., Morling, P. (2009). Defining and classifying ecosystem services for decision making. *Ecological Economics*. 68: 643-653.

1. See www.millenniumassessment.org



Dispelling myths around ecosystem service projects

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Theme(s): Biodiversity, Environmental economics

“Ecosystem service projects use a wider range of financial tools [than biodiversity projects], such as carbon markets and ecotourism fees, which attract a wider range of funders, including private finance.”

A new study has compared conservation projects that focus on promoting only biodiversity with projects that focus on promoting both biodiversity and ecosystem services. The results dispel several myths surrounding ecosystem service projects and indicate they are as effective at addressing threats to biodiversity as their biodiversity counterparts.

Land alteration and degradation is increasing and biodiversity conservation often conflicts with human needs, especially in the face of growing populations and poverty. New projects must move beyond classic conservation approaches; one such approach is to focus on ecosystem services, which value the benefits provided by ecosystems to humans, such as water purification and nutrient cycling.

The research analysed projects from The Nature Conservancy (TNC)¹, the world's largest conservation organisation. It compared 34 conservation projects that focused on ecosystem services with 26 conservation projects that focused on biodiversity. The projects were from North, Central and South America. Data were collected through semi-structured interviews with project managers.

Results were reported around three major myths about the efficacy of projects focusing on ecosystem services:

- **Myth 1 – Ecosystem service projects direct resources towards a different set of threats than biodiversity projects.** The results indicated both types of projects addressed all the major threats to similar degrees. For example, 94 per cent of ecosystem service projects and 100 per cent of biodiversity projects focused on reducing habitat destruction.
- **Myth 2 – Ecosystem service projects veer away from investment in protected areas.** However, the results indicated that the two project types encouraged the same set of conservation activities and with similar frequencies.
- **Myth 3 – Ecosystem service projects are unstable and potentially short-term in nature.** There was no significant difference between project types in their investments in areas such as education, community forums and workshops which all support a long-term perspective.

The study also identified additional benefits of ecosystem service projects compared with biodiversity projects. For example, ecosystem service projects target more agricultural landscapes through measures similar to the EU's agro-environmental policies. Ecosystem service projects also use a wider range of financial tools, such as carbon markets and ecotourism fees, which attract a wider range of funders, including private finance.

Additionally, the study reported seven cases of ecosystem service projects that created a broker-type structure to distribute money for the provision of particular ecosystem services. This was governed independently and involved locally based leaders. In addition to providing the services themselves, the system proved extremely successful in satisfying a wide range of interests, such as supporting education, creating jobs and monitoring the outcome of the project.

Source: Goldman, R.L. & Tallis, H. (2009). A Critical Analysis of Ecosystem Services as a Tool in Conservation Projects: The Possible Perils, the Promises, and the Partnerships. *Annals of the New York Academy of Sciences*. 1162(The Year in Ecology and Conservation Biology, 2009): 63-78.

1. See www.nature.org



Improved biodiversity and ecosystem services go hand-in-hand

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Theme(s): Biodiversity, Environmental economics

“The largest effects of restoration on ecosystem services and biodiversity were in tropical ecosystems, whilst restored temperate aquatic ecosystems only experienced improvements in biodiversity.”

A new study has reinforced the view that biodiversity improvements and greater provision of ecosystem services are complementary. An analysis of projects that restored ecosystems indicated that restoration produced a 44 per cent increase in biodiversity and a 25 per cent increase in the provision of ecosystem services.

Ecological restoration involves helping an ecosystem recover from damage caused by human activity, such as logging or cropping. There is a widespread assumption that restoration increases the provision of ecosystem services although this has not yet been fully tested. As such, the relationship between biodiversity and ecosystem services remains uncertain. However, the EU's recent communication on biodiversity¹ pays attention to both biodiversity and ecosystem services and outlines four options for a target to halt their loss.

By examining the effects of restoration the study provided insights into the relationship between increased biodiversity and greater provision of ecosystem services. It analysed 89 published scientific assessments on the outcomes of restoration projects undertaken in a range of ecosystems worldwide. The effects of restoration were analysed on biodiversity (ie species abundance and diversity) and on three types of ecosystem services:

- ‘supporting ecosystem services’, such as nutrient cycling
- ‘provisioning ecosystem services’, such as food and timber
- ‘regulating ecosystem services’, such as water supply

The results indicated that, compared with degraded environments, restored environments had greater biodiversity and better ‘supporting ecosystem services’ and ‘regulating ecosystem services’, such as nutrient cycling and water supply. However, there was no effect on the ‘provisioning ecosystem services’, such as timber and crops.

Environments that had suffered no degradation had even greater biodiversity and ecosystem services, indicating that restoration cannot completely erase the effects of degradation. The largest effects of restoration on ecosystem services and biodiversity were in tropical ecosystems, whilst restored temperate aquatic ecosystems only experienced improvements in biodiversity.

The study also explored the relationship between ecosystem services and biodiversity and found a positive association between the two. The results suggested that the impacts of increasing biodiversity on the provision of ecosystem services are stronger when the levels of biodiversity are low. There is a plateau in this effect when biodiversity levels become high.

Ecological restoration is likely to lead to large increases in both biodiversity and ecosystem services, offering a potential win-win solution if the two goals are combined in future restoration projects. However, improved monitoring is needed for both biodiversity and ecosystem service outcomes of restoration projects.

Source: Rey Benayas, J.M., Newton, A.C., Diaz, A. & Bullock, J.M. (2009). Enhancement of Biodiversity and Ecosystem Services by Ecological Restoration: A Meta-Analysis. *Science*. 325(5999): 1121-1124.

1. See http://ec.europa.eu/environment/nature/biodiversity/policy/index_en.htm



REDD improves forest provision of ecosystem services

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Themes: Biodiversity, Environmental economics, Forests

“By providing ecosystem services both directly and indirectly, REDD could play an important role in maintaining quality of life for forest dependent communities.”

Actions to reduce emissions caused by deforestation and degradation (REDD) also enhance ecosystem services, according to a new report. Using a case study from the Amazon it indicated that REDD support schemes can also help maintain water levels and quality and protect soil from erosion.

The UN post-2012 climate agreement treaty is likely to include a mechanism for compensating nations that reduce emissions from deforestation and forest degradation (REDD). But some criticise this mechanism for its narrow focus on carbon and neglect of ecosystem services. Using a review of current research, the report investigated the possible ecological damages and co-benefits beyond the maintenance of carbon stocks from five REDD interventions: slowing deforestation, decreasing logging, reducing incidence of forest fires, regenerating native forest and expanding tree plantations.

The report identified only a few ecological costs of REDD interventions. The greatest possible threat would be the leakage of deforestation from high-biomass forests, such as rainforests, to low-biomass native ecosystems, such as savannas and grasslands. Another threat is the replacement of native ecosystems by tree plantations consisting of one or just a few species. In addition, reduced fire incidence could threaten wildlife that depend on periodic burning.

However, REDD interventions produce many more benefits by providing ecosystem services. Deforestation reduces evaporation and increases run-off, which means REDD interventions help maintain water levels and quality. Natural vegetation cover is one of the most secure ways of protecting soil from erosion and maintaining its nutrients. REDD interventions also slow local and regional climate change by reducing CO₂ release. Overall, less deforestation helps to maintain higher levels of biodiversity.

The study identified several methods of monitoring ecological benefits that are already used for monitoring and verifying carbon emissions. It recommended a combination of remote measurements (e.g. satellite maps of forest cover) and field-based measurements (e.g. surface run-off of water and soil erosion).

The report also evaluated three REDD plans for the Amazon basin using a model that simulated landscape changes. This indicated that a REDD plan that takes an integrated approach to protecting carbon stocks and ecosystem services would provide greater ecological benefits than one that prioritises protection of specific areas of land or indigenous territories. By providing ecosystem services both directly and indirectly, REDD could play an important role in maintaining quality of life for forest dependent communities.

Source: Stickler, C.M., Nepstad, D.C., Coe, M.T. *et al.* (2009). The potential ecological costs and cobenefits of REDD: a critical review and case study from the Amazon region. *Global Change Biology*. 15:2803-2824.



Mapping Europe's potential to provide ecosystem goods and services

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Themes: Biodiversity, Environmental economics, Land use

"The research evaluated the relationship between the ecological properties of larger areas of land and the capacity or potential of these areas to deliver goods and services."

New Europe-wide maps show the potential of landscapes to provide ecosystem goods and services over the next 20-30 years.

Ecosystem services, such as clean water, are essential for human wellbeing. These services need to be considered and valued to ensure multi-functional landscapes are sustainably managed to allow ecosystems to continue providing benefits and services to society.

Partly funded by the EU under the SENSOR project¹, the research evaluated the relationship between the ecological properties of larger areas of land and the capacity or potential of these areas to deliver goods and services. These capacities are also known as 'landscape functions'.

In this study landscape functions were classified into four groups: 1) production functions, supplying "natural products" to people; for example, commercial forest products; 2) regulation functions, maintaining the quality of the environment; for example, water regulation; 3) habitat functions, essential for maintaining nature and biodiversity; 4) information functions, providing people with cultural and recreational services. The study related 15 landscape functions to the capacity of the land to deliver ecosystem services.

In order to determine whether complex relationships between the functions of a landscape and different land characteristics, such as specific uses of land or particular environmental features, could be represented by a simple methodology, the researchers used a binary system to link land characteristics and landscape functions with either a "0" or a "1".

A "0" represents a landscape characteristic that does not support a particular landscape function; for example, "wetlands" (the landscape characteristic) do not support the provision of "cultivated products" (the landscape function). However, "wetlands" do support the provision of "wildlife products" and this link is therefore represented by a "1" (a supportive role).

This system was used to assess the importance of landscape functions at particular locations across 581 administrative units of Europe, representing a range of different land characteristics. The result was a set of Europe-wide maps depicting the relative importance of each of the landscape functions.

These maps were compared with existing European maps of ecosystem services or environmental indicators and the researchers suggest that, at a continental scale, the simple binary links were able to adequately represent the complex interrelations between ecosystem services and land characteristics for 9 of the 15 landscape functions.

In addition, the sensitivity of the landscape function maps to changing land use was analysed with land use change scenarios. The results suggest, under these scenarios, this approach is valid for assessing the mid-term (20-30 years) potential of landscapes to deliver goods and services.

Source: Kienast, F., Bolliger, J., Potschin, M. *et al.* (2009). Assessing Landscape Functions with Broad-Scale Environmental Data: Insights Gained from a Prototype Development for Europe. *Environmental Management*. 44:1099–1120

1. SENSOR (Sustainability Impact Assessment: Tools for Environmental, Social and Economic Effects of Multifunctional Land Use in European Regions) was supported by the European Commission under the 'Global Change and Ecosystems' priority of the Sixth Framework Programme. See: www.ip-sensor.org



A selection of articles on Ecosystem Services from the *Science for Environment Policy* news alert.

Natural capital underestimated by regional development plans (22/4/10)

Recent research has established how forest, wetland and agricultural ecosystems could affect economic growth in Sweden. The findings suggest that regions conventionally considered to be of low economic benefit, are in fact rich in valuable ecosystem resources.

Valuing nature protects biodiversity and reaps financial rewards (14/1/10)

A new global study on the economics of ecosystem services and biodiversity loss suggests that governments can achieve more resilient economies and receive higher rates of return on their public investment strategies when they recognise and target the value of ecosystem services.

Communal behaviour affects success of conservation programmes (22/10/09)

Social norms affecting an individual's behaviour in a community can have a substantial impact on the costs and sustainability of conservation programmes, according to recent research.

Measuring conservation: comparing valuation methods (20/5/09)

Measuring the nature conservation value of any given site is inherently difficult, but the most objective way to assess it to use independently defined criteria. Recent research in the UK found that common methods of valuing sites each emphasise a different aspect of conservation, resulting in slightly different outcomes but with potentially strong implications for policy.

Biodiversity conservation does not always protect ecosystem services (23/10/08)

Policymakers have prioritised habitat conservation to protect biodiversity; however, such programmes do not necessarily protect the function of ecosystem services. New research suggests that ecoregions selected to maximise biodiversity provide no more ecosystem services than regions chosen at random.

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