



Introduction to the Special Issue: Ecosystem Services

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Although geographers have always been eclectic in their approach, the need for broad perspectives and partnerships with other disciplines has never been as important as it is in confronting contemporary environmental problems. This special issue explores a particularly active area of debate concerning the notion of ecosystem services. It looks at new dialogues that are now developing with economists and political scientists, and considers how an understanding of the biophysical characteristics of ecosystems is essential as we seek to bridge the science-policy divide.

It has been suggested that we have now entered the *Anthropocene*, an epoch in which we have seen a ‘quantitative shift in the relationship between humans and the global environment’ (Steffen et al., 2011: 843). Part of this shift involves recognition that while we continue to depend on the integrity of ecosystems for our well-being, we have to confront the fact that people are now one of the dominant drivers of environmental change. As a consequence our thinking about nature, and the way societies interact with it, must be transformed. If we are to solve the problems posed by global environmental change it has been argued that we need better coordinated international research that places equal emphasis on the social and natural sciences (Perrings et al., 2011). A focus on ecosystem services is potentially one way in which a balanced perspective might be achieved. Given

the interest that the idea of ecosystem services has attracted in the policy arena (ten Brink, 2011) it may also provide a focus for integrated, cross-sectoral forms of decision-making.

The rapid expansion of the literature dealing with ecosystem services is traced in the first paper in this special issue (Potschin and Haines-Young), which suggests that the idea has taken on many of the characteristics of a classic ‘Kuhnian’ paradigm. The relatively limited contribution that geographers have made to current debates is noted, and it is argued that this is unfortunate, in the light of our traditional disciplinary concerns. Although much of the current work surrounding ecosystem services is being driven by the possibility of making estimates of the economic value of the benefits ecosystems generate, such assessments depend on a good understanding of the sensitivity of ecosystem outputs to the different drivers of change in biophysical terms; and it is here where physical geographers can make a particular contribution. These sensitivities need to be understood if we are to estimate the marginal changes in value between different policy options or management strategies. More especially, they also need to be

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identified to be sure of the situations in which these types of analysis are appropriate, given that the drivers may trigger sudden collapse or non-linear irreversible regime shifts. In such circumstances political and ethical considerations may assume greater importance than economic ones in assessing the consequences of change. The analysis of the sensitivities of ecosystem outputs to the various drivers of change will require a deeper and broader understanding of the spatial structure and dynamics of ecosystems if we are to make progress applying the idea of ecosystem services in policy and management. Geographers have much to contribute by bringing a place-based perspective to such work.

The importance of mapping ecosystem services as a framework for analysis is emphasized by Fisher et al., who look at the links between the functioning of the ecosystems of Tanzania's Eastern Arc Mountains and their impact on human welfare at local, regional and global scales. They describe how spatially explicit, policy relevant information can be produced by using GIS to integrate inventory data, derived from remote sensing and field-based methods, with data-driven and rule-based models to estimate service flows. By combining these data with an understanding of the location to those who potentially benefit from these services, the value of the benefit and the opportunity costs for conservation and management, Fisher and his collaborators are able to examine the marginal changes in values of the service flows for a set of spatially explicit future scenarios. Using carbon sequestration as a case study, they show how their approach can be used to identify the potential winners and losers in relation to the different policy options designed to alleviate poverty.

The analysis of ecosystem services is not just about economic valuation, however. Indeed Potschin and Haines-Young, along with Gómez-Baggethun and Ruiz-Pérez in this volume, argue that an exclusive focus on the economic valuation of ecosystem outputs may

run the danger of narrowing the debates around ecosystem services and hindering the development and application of the idea. Potschin and Haines-Young suggest that equal attention needs to be paid to characterizing and sustaining the underlying stocks that make up our natural capital base, and this is often best done by drawing on biophysical data as much as economic information. The limitation of analyses of sustainability issues based on marginal changes in economic value is explored by Ekins, who argues that a new approach to environmental policy is needed that goes beyond the traditional cost-benefit analysis. He suggests that the concept of Safe Minimum Standards can be extended and refined by the analysis of ecosystem functions and associated service outputs to estimate, what he calls, the 'sustainability gap'. Knowledge about ecosystem functioning and the output of ecosystem services are used to define a set of standards (expressed as state or pressure indicators) against which present performance, current trends or specific policy proposals can be judged. According to this framework, the specific sustainability standards define the minimum conditions to sustain 'critical' natural capital in terms of its source, sink, life support and welfare functions.

Spatially explicit, physical accounting techniques have much to offer in terms of representing and understanding the structure and dynamics of social-ecological systems in ways that can be useful for decision-makers (Potschin and Haines-Young). At broad national and regional scales they provide an avenue for potentially going 'beyond GDP' (<http://www.beyond-gdp.eu>) and developing high-level indicators that better reflect the environmental and social dimensions of development. At more local scales, they provide a framework in which we can better design or evaluate policy or management interventions – even in the most artificial of ecosystems, our cities.

The paper by Lundy and Wade, for example, considers the issue of Sustainable Urban

Drainage (SUDS) from a multifunctional landscape perspective. They note that although the management of water in urban areas has long been a major concern it has frequently been done in isolation from the management of other urban issues. Instead, they suggest that integrated management approaches are possible if we understand how different components of the urban water system can deliver different kinds of ecosystem service. The approach is illustrated using a study of a restored section of an urban river in the UK. It involved identifying the functional relationships in the system using field survey data and information derived from a literature review. In undertaking the work they pointed to the range of scientific, policy and practitioner sources that needed to be considered in making the assessment, and concluded that the multifunctional, ecosystem service approach is inherently transdisciplinary and, as such, presents major challenges in terms of linking different types of knowledge and in publishing the outcomes of research.

The challenge of transdisciplinarity is also taken up by Fish in this volume. He argues that although there are grounds to claim that such approaches to natural resource management is now emerging around the idea of 'ecosystem services', we are still a long way from fully appreciating the practical aspects of 'thinking about the natural world in this way'. If we are to make progress, then a number of issues need to be addressed. His paper suggests that we need to move away from simplistic representations of the relationships between ecosystem services and human well-being and the way we frame cultural services, and learn to use the ecosystem concept in more creative ways. Perhaps the most difficult challenge he identified is finding ways to combine analytical rigour with interpretive complexity, so that natural and social scientists can work together to develop 'well-reasoned analytical constructions of a decision issue'. On the one hand the natural science community must be able to describe and predict how services react

and interact to different drivers and pressures. On the other, social scientists need to help find ways of identifying in different 'decision-making situations' the factors that need to be taken into account and how they are to be balanced against each other.

The goal of combining analytical rigour with interpretive complexity is one that all research communities would share. The problem is, of course, to develop methodologies that are appropriate given the sorts of problems that we face in particular knowledge domains. In relation to ecosystem services, we need to find ways of combining different sorts of expertise with both quantitative and qualitative data in order to unpack the 'production chains' that link ecological structures and processes with aspects of human well-being (Potschin and Haines-Young). The 'production function' approach, which is illustrated by Fisher et al. for the Eastern Arc Mountains, and is being actively discussed in the wider ecosystem services literature (cf. Daily and Matson, 2008; Kienast et al., 2009; Tallis and Polasky, 2009; Tallis et al., 2008). It is, we suggest, an approach with which physical geographers could fruitfully engage. Elsewhere in this issue, Haines-Young explores the use of Bayesian Belief Networks as one way in which different sorts of data can be brought together to represent and model service-benefit relationships, in the kind of analytic-deliberative framework described by Fish. But this is one approach among many. We need to be more creative in finding ways of combining deliberative practice with scientific and technical forms of analysis in order to make ecosystem service assessments in the face of uncertainty (cf. Polasky et al., 2011).

The ecosystem service paradigm carries with it both opportunities and dangers. The papers in this volume map out many of the analytical opportunities open to the research community to demonstrate the relevance of their work to decision-makers and the public. The aim of collecting them together in this journal is to

encourage physical geography to be more actively engaged in such an enterprise. There are also many dangers. As Gómez-Baggethun and Ruiz-Pérez argue in this special issue, the tendency of the ecosystem services concept to 'commodify' nature might ultimately be counter-productive for biodiversity and equity of access to ecosystem services benefits. It cannot be assumed that economic valuation will necessarily solve the problems and shortcomings of traditional conservation. Thus we must be critical of the ecosystem services paradigm as well as encouraged to develop novel, transdisciplinary partnerships. Whatever the prospect, an exploration of the links between ecosystem services and human well-being goes beyond the confines of environmental or ecological economics: it is one that the eclectic traditions of Geography can well serve and take forward.

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