The Provision of Ecosystem Services in Response to Global Change: Evidence and Application

A proposal for a Special Issue on "*Environmental Research"*

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Justifications

The increasing global pressure on natural capital has become a major focus of applied interdisciplinary research, particularly for environmental studies (de Groot et al., 2010). The most important aspect is that environmental management and the decision making behind it have critical impacts on the delivery of ecosystem services (Andam et al., 2010; Girvetz et al., 2008). The use of natural capital in an unsustainable way can erode cultural, ecological, and economic benefit assets at the expense of human well-being (MEA, 2005). Global change issues, including climate change, natural disasters, air and water pollution, urban expansion, and water resource shortages, are placing increasing pressures on a range of ecosystem services such as biodiversity, carbon storage, nutrient and water recycling, flood protection, soil quality, and other services. For example, mounting changes in urbanization increase the risk of degrading ecosystem services provision through ecological consequences that can undermine efforts to promote a more sustainable and healthier society (Naidoo et al., 2008). Recent studies recognize and focus on the particular challenges faced by resource managers in human-dominated landscapes (Alig and Bair, 2006; de Groot et al., 2002; Krishnaswamy et al., 2009). Yet, it has proved difficult to move from the scientific **evidence** about the ecosystem services approach to its practical **application** (Tallis et al., 2009; Rounsevell et al., 2010). For example, there is increasing consensus on the importance of incorporating ecosystem services into management plans; however, quantifying the levels and values of these services is challenging. Without quantitative assessments, these services tend to be ignored by those making land use and management decisions.

Currently, there are two paradigms for generating ecosystem service assessments that are intended to assist in management decisions. Under the first paradigm, researchers model the production of a single service in a small area with an "ecological production function" and obtain knowledge on how the provision of that service depends on "local" ecological variables (Barlow et al., 2007; Chazdon, 2008; Harrington et al., 2010). Despite the high level of detail, this approach lacks both the scope (number of services) and scale (geographic and temporal) to be relevant for most management questions and decisions. In contrast, under the second paradigm, scientists use broad-scale assessments of multiple services to extrapolate a suite of estimates of ecosystem services, based on habitat types, to entire landscapes or regions (Naidoo et al., 2008; Nelson et al., 2009; Strassburg et al., 2010). However, this approach assumes that every habitat type is of equal importance regardless of its quality, rarity, spatial configuration, size, proximity to population centers,

or the prevailing social practices and values. Furthermore, this approach does not allow analyses of service provisions and changes under new management practices (Tallis et al., 2009). For example, if a forest area is converted into agricultural land, how could this affect the provisions of biodiversity, downstream flooding, climate regulation, and/or carbon storage?

Without information on the impact of land use management on ecosystem service provisions, it is impossible to design strategies that will provide and support such services (Benayas et al., 2009; Ewers et al., 2009; Goldman and Tallis, 2009; Lafortezza et al., 2010; Nelson et al., 2009). Multiple ecosystem service approaches are needed that (1) combine the rigor of small-scale studies with the breadth of broad-scale assessments, (2) reveal the likely relationship among services, and (3) identify management options that minimize trade-offs (Díaz et al., 2009; Nelson et al., 2008; Raudsepp-Hearne et al., 2010; Schroter et al., 2005).

A recent study by Raudsepp-Hearne et al. (2010) illustrates a methodological framework for analyzing interactions among multiple ecosystem services across different landscapes in Quebec, Canada. The authors provide empirical evidence on landscape-scale trade-offs among ecosystem services and suggest that, in the study areas, a greater biodiversity is positively correlated with the provision of regulating services. Schroter et al. (2005) used a range of ecosystem models and scenarios of climate and land use change to investigate ecosystem service supplies in Europe. Their results suggest that large-scale changes in climate and land use may affect the provisions of ecosystem services. There are several reasons as to why the current management decisions lead to trade-offs among sectors or ecosystem services. One reason is that not all services are positively correlated. For example, Nelson et al. (2008) found that targeting policies to provide carbon sequestration was effective at increasing the carbon storage in biomass, but not effective for forest species conservation. Alternatively, policies to meet species-conservation objectives were effective in increasing species conservation but not effective for carbon storage. What is clear is that ecosystem service modeling approaches should be spatially-explicit to account for the role of spatial patterns and heterogeneity in landscapes (Zhang et al., 2007). For example, a modeling framework that allows for assessments of biodiversity and carbon storage services should identify spatial locations that would lead to "win-win" outcomes, where all services could be increased relative to the current conditions, and those situations where outcomes would necessarily lead to trade-offs, i.e., "win-lose" outcomes (Naidoo et al., 2008; Nelson et al., 2008; Tallis et al., 2008; Williams et al., 2008).

Here, we propose a special issue on the ecosystem services provision under global change for *Environmental Research*, with a focus on ecological and human landscape processes. The issues to be covered include:

(1) Processes and disturbances under environmental and anthropogenic forcing in ecosystem landscapes.
(2) Productivity changes due to climate and human factors in various landscapes.
(3) Resources and future change in water-limited landscapes.

(4) Landscape change and carbon sequestration.
(5) Changes, environmental consequences, and management options for urban landscapes.

In preparing this proposal, we will be sending out a general call for papers to several listservs, including IUFRO, NASA's LCLUC, FLUXNET, etc. Our aim is to involve authors of original research, reviews, and synthesis studies. These potential authors will contribute to the special issue by illustrating general theories and methods, generating and analyzing natural and social datasets, developing integrated modeling techniques, and presenting state-of-the-art research results. We believe that this focus issue will play a critical role in improving our understanding of the current knowledge, research gaps, and future research needs for **ecosystem services provision in response to global change**.

The *Environmental Research* journal draws expertise together from biophysical, environmental, and socioeconomic sciences in order to explore basic and applied research questions concerning the effects of global warming/climate change on the environment and for human benefit. This mission is consistent with our goal of promoting integrated research and education on global change ecology and the environment. We will follow the journal's high-standard reviewing process and place quality as our first criteria. A guest editorial committee will be formed to work with and assist the ER editorial board and the handling editor during manuscript review and evaluation. For those authors whose native language is not English, we have a professional English editor to help improve language usage and writing before the manuscripts are submitted. This could be in addition to a similar service that the publisher may provide.

Proposed Plans

Guest Editors

Dr. Raffaele Lafortezza, University of Bari, Italy
Dr. Jiquan Chen, Michigan State University & IceMe/NUIST, USA

Number of submissions

~20 manuscripts

Proposed timetable

2/28/2015	Deadline for submissions
5/31/2015	Reviews completed
7/31/2015	Revisions submitted
8/15/2015	Recommendations for accepted manuscripts

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