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Quantifying the Contribution of Organisms to the Provision of Ecosystem Services

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Quantifying the Contribution of Organisms to the Provision of Ecosystem Services

GARY W. LUCK, RICHARD HARRINGTON, PAULA A. HARRISON, CLAIRE KREMEN, PAM M. BERRY, ROB BUGTER, TERENCE P. DAWSON, FRANCESCO DE BELLO, SANDRA DÍAZ, CHRISTIAN K. FELD, JOHN R. HASLETT, DANIEL HERING, ARETI KONTOGIANNI, SANDRA LAVOREL, MARK ROUNSEVELL, MICHAEL J. SAMWAYS, LEONARD SANDIN, JOSEF SETTELE, MARTIN T. SYKES, SYBILLE VAN DEN HOVE, MARIE VANDEWALLE, AND MARTIN ZOBEL

Research on ecosystem services has grown rapidly over the last decade. Two conceptual frameworks have been published to guide ecological assessments of organisms that deliver services—the concepts of service-providing units (SPUs) and ecosystem service providers (ESPs). Here, we unite these frameworks and present an SPU-ESP continuum that offers a coherent conceptual approach for synthesizing the latest developments in ecosystem service research, and can direct future studies at all levels of organization. In particular, we show how the service-provider concept can be applied at the population, functional group, and community levels. We strongly emphasize the need to identify and quantify the organisms and their characteristics (e.g., functional traits) that provide services, and to assess service provision relative to the demands of human beneficiaries. We use key examples from the literature to illustrate the new approach and to highlight gaps in knowledge, particularly in relation to the impact of species interactions and ecosystem dynamics on service provision.

Keywords: ecosystem services, service-providing units, ecosystem service providers, biodiversity, functional diversity

Ecosystem services, the benefits humans derive from ecosystems (table 1), are a subset of ecosystem processes that directly or indirectly support and improve human well-being (Daily 1997). Ehrlich and Ehrlich (1981) are usually credited with introducing the term “ecosystem services,” but recognition of the contribution of nature to human well-being has a much longer history (Mooney and Ehrlich 1997). Nature contributes substantially to human well-being through a raft of services the Millennium Ecosystem Assessment (MEA 2003) classifies as provisioning services (e.g., food, water, fiber), regulatory services (e.g., flood mitigation, water purification), cultural services (e.g., recreation, aesthetic experiences), and supporting services needed for the production of all other ecosystem services (e.g., soil formation, nutrient cycling). Appropriate valuation of nature’s contribution to humanity was central to early work in environmental economics (e.g., Krutilla 1967) and continues to be prominent in the current literature. For example, Boyd and Banzhaf (2007) argued for standardized units of account to measure the value of ecosystem services

to society. We echo this call, but from the perspective of delineating the ecological units needed to generate a given service. Ecologists have been slow in addressing this issue, which has stalled progress in the development of a truly integrated approach to measuring the contribution of nature to human well-being.

In this article, we present an approach to delineating and quantifying the contribution of organisms and ecological systems to service provision that unites and extends previous conceptual frameworks. We focus primarily on the generation of services and the key measures that deserve ecologists’ attention, illustrating these through selected empirical examples. It is not possible to deal with every potential service, so we focus on those for which detailed empirical examples exist. We recognize the importance of social context to discussions of ecosystem services, but it is beyond the scope of this article to address this issue in detail. Nevertheless, by providing an explicit approach to measuring the ecological underpinnings of service provision, we hope to contribute to future advances in integrated, interdisciplinary assessments.

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Abstract:

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