



Surveys

Evaluating conceptual definitions of ecosystem services and their implications



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ABSTRACT

“Ecosystem services” is a phrase with many meanings, yet very few studies have primarily focused on comparing different definitions of the term. Ecosystem services are now generally used in identifying an appropriately wide range of environmental variables for policy and management as well as better understanding the benefits provided by those aspects of the environment. A review of the dominant definitions of ecosystem services reveals the term is comprehensive in its scope and requires further specification for most purposes. Analysis further reveals that there are four main categories of conceptual definitions. The paper concludes that ecosystem services can be identified at various points along the spectrum of nature-human interaction depending on which specific definition is chosen and that the term was not created to identify a novel set of environmental objects or processes.

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1. Introduction

Culminating in the watershed UN Millennium Ecosystem Assessment (MA), ecosystem services (ES) has been embraced as a title for research in the academic community that can connect science with policy and practice in a way that makes a compelling case for urgent environmental action (MESAB, 2005). Having been identified for large-scale, nation-wide evaluation in a variety of countries (Brouwer et al., 2013), ES has become an important topic for policy as well as academic purposes. While the MA defines ES as “the benefits people obtain from ecosystems” (Millenium Ecosystem Assessment, 2005, p. V) the term ES scarcely provides specificity or clarity for how to approach environmental science or what aspects of the environment are important for study. Assuming agreement on what ES are from a definition as elegant as the MA definition obscures a wide variety of uses and meanings of the term. Using the term ES as a research title or identifying it as an urgent policy objective while simultaneously eschewing a serious definition of ES seems strange, but this contradictory practice is commonplace (e.g. Vincent, 2012, p. 2).

A number of studies discuss issues surrounding ecosystem services; such as histories of economic approaches to environmental study (e.g. Gómez-Baggethun et al., 2010), implications and critiques of the concept (summary in Schröter et al., 2014), and even how the complex relationship between human society and nature necessitates non-linear systems analysis for ES assessment and policy (Reyers et al., 2013). ES is often understood as an *approach* to analysis and policy that centers

around ES as an organizing framework for science (e.g. Haines-Young and Potschin, 2011; Wong et al., 2014). While important, the issues and critiques of ES as the practical framework of supporting, regulating, provisioning, and cultural services that is often used by private organizations and national or international governing and research bodies is not the central concern of this paper. The paper's focus is on identifying the various conceptual definitions of ES used to identify ES in various contexts.

Nahlik et al., 2012 present a review of different ES definitions, but the focus of their analysis is on which authors consider ES to be benefits of nature and those which consider ES to be processes and physical features that create benefits instead of an in-depth review of the definitions. Closer to a review of definitions is Lamarque et al.'s (2011) discussion of important points of contention in exactly where to separate ES from nature's structures, functions, direct and indirect provisioning, and resulting benefits; however, even this study does not compare the different definitions at a conceptual level. Saastamoinen et al. (2013) briefly quote from many of the prominent ES definitions studies and provide a practical guide for how different approaches are needed depending on the practical application of ES study in context. Absent from the review literature is a single analysis comparing and contrasting, at a conceptual level, the different definitions of ES. Currently, the different operational definitions of ES are either embedded in framework papers or descriptions of how to organize ES research for various purposes (e.g. Ash et al., 2010; Bastian et al., 2012; Carpenter et al., 2009; Fisher et al., 2008; Frank et al., 2012; Johnston and Russell, 2011; Nahlik et al., 2012; ten Brink, 2011). This paper lifts the different conceptual definitions in use out of the procedural frameworks and seeks to put them in terms that are more easily comparable with each other.

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ES terminology is frequently and widely used and it shows no sign of fading in popularity. For several decades, frameworks for how ES assessments should be conducted, how ES should be classified, and the best units of study or methodologies of study have been debated. Now that the term has been so widely adopted as a space for communication between academia and policymaking, the ambiguity surrounding its possible meanings should be re-evaluated.

2. Purpose

This paper approaches “ecosystem services” as a designation that can be assigned to the physical environment, natural processes, or nature’s benefits and seeks to find the dominant conceptual definitions that provide a criterion for determining if something should or should not be considered an ES. In other words, the aim of the paper is to identify and compare the different standards by which an aspect of the natural world, or the benefits arising from the natural world, can be called an ES. Tracing the conceptual definitions back to the creation and original definition of ES reveals it was not meant to help identify new parts of the environment, but was instead meant “as a way of combating a perceived blindness of policy-makers to the importance of biotic nature” (Lele et al., 2013, p. 354). The term’s ability to allow for a wide variety of different conceptions and definitions of itself helps make it a versatile policy advocacy tool, but that same diversity in meanings also hinders conceptual completeness and consistency needed to identify ES as subjects for research and policy (Lele et al., 2013).

As an evolving term, it is important to use ES terminology in an informed and qualified manner, rather than assumptively employing the multifaceted concept with little critical reflection on its variety of meanings. This selective review will therefore present the differing ways in which the central ES literature conceptualize ES as an ecosystem structure, process, or function and evaluate the extent to which those different definitions can change the way ES are discussed in literature and policy. Given the widespread use of ES for both scientific and policy purposes, this paper offers insights as to how ES language and terminology can possibly facilitate or hinder the sharing of knowledge. A theme that runs throughout the following analysis is how ES is commonly used as a label to discuss various environmental issues, a designation that can be given to various components and processes of ecosystems, and an organizing framework for science.

To clarify the different ways ES are understood in common usage, this paper is organized in the following manner: first, a general context is set by tracing ES’s original meaning-in-use as a label for policy-relevant conservation research to its current usage as a way to identify aspects missing from existing environmental goals and management practices. Then, a representative spectrum of definitions of the term itself is explained to reveal how ES are often defined in research and policy. Finally, reflections on how one should interpret the meaning of ecosystem services are offered.

3. The Origin and History of “Ecosystem Services”

Ecosystem services as a unit of study is arguably not a new concept, but an ancient one. As numerous scholars have noted, the idea of the natural environment providing services to humans stretches at least as far back as Plato discussing how deforestation on the hilly terrain of Greece caused the land around Athens to lose many of its desirable qualities (Mooney and Ehrlich, 1997). Various ancient societies recognized the contribution of the environment to human welfare throughout history (Folke et al., 1998) and it was not uncommon for the environment to even hold a religious significance for many civilizations (Diamond, 2005). Indeed, framing environmental issues in this manner is almost an anthropological way of examining how humans think of the natural world and how they make decisions about using it.

Publications credited as the forerunners to ES were largely focused around the issue of species extinction and its consequences. In fact,

the title of the book in which the term ecosystem services was first used is “Extinction: The Causes and Consequences of the Disappearance of Species” (Ehrlich and Ehrlich, 1981). In a seminal paper published in 1977, Westman discusses what was, at the time, the body of evidence on human intervention to stabilize and rehabilitate degraded functions of ecosystems in which various species had gone extinct. Case studies at the time led him to conclude, “we do not have the technology to replace the [lost] function[s] of degraded ecosystems (Westman, 1977, p. 961). Coupled with the assertion that “*humanity is forcing species and populations to extinction at what may well be an unprecedented rate,*” (Ehrlich and Mooney, 1983, p. 248 emphasis added) the appearance of the words ES began in an effort to assess what predictions could be made about the impact of species extinction in terms of its effects on humanity, and to assess the possibility of substituting for those losses (Daily and Dasgupta, 2001; Ehrlich and Mooney, 1983). The first policy agenda that used the phrase “ecosystem services” is therefore best characterized as an agenda focused on making the case for “a conservative approach [to policy], emphasizing the careful preservation of ecosystems and thus of the populations and species that function within them” (Ehrlich and Mooney, 1983, p. 252).

Throughout the following decades, the central message of conservation to avoid possibly catastrophic environmental change remained a prominent premise in much ES research. The landmark UN Millennium Ecosystem Assessment was the culmination of almost two decades of scientific work, and a summarized list of its key findings include the assertion that “human activities have taken the planet to the edge of a massive wave of species extinctions, further threatening our own wellbeing” (MESAB, 2005, p. 3) and goes on to say “the pressures on ecosystems will increase globally in coming decades unless human attitudes and actions change” (MESAB, 2005, p. 3). As a synthesis of the body of knowledge on ecosystems and ES, the MA conveys the general message of impending environmental catastrophe as a result of human activity and that solutions “involve significant changes in policies, institutions, and practices that are not currently underway” (MESA, 2005, p. 1). Not all ES research up to the MA had the explicit goal of making the case for nature conservation (e.g. Blanche et al., 2002; Bolund and Hunhammar, 1999) but the field certainly contained much research that can be characterized as such (e.g. Balmford et al., 2002; Balvanera et al., 2001; Daily et al., 2000; Horwitz and Finlayson, 2011; Hutton and Leader-Williams, 2003; Soule and Orians, 2001).

In the 15 years or so leading up to the MA, ES gradually began to be approached not just as a way to argue for the importance of ecological processes, but as a distinct set of variables for study in their own right (Norgaard, 2010). Along with the evolving use of the term, a distinctly different policy agenda developed within ES research. The newer, arguably more popular, agenda strives to consider as wide a range of environmental variables, and their benefits, as possible in public decision processes. A common aim of many studies and assessments in the contemporary agenda is to identify and include the variables missing in current environmental decision-making calculus, using the ES terminology to assist toward that end (e.g. Anton et al., 2010; Cowling et al., 2008; de Groot et al., 2010; Egoh et al., 2007; Fisher et al., 2008; Horwitz and Finlayson, 2011; MESA, 2005; Wegner and Pascal, 2011). One of the most prominent examples of this agenda is the UK National Ecosystem Assessment, approaching “decision making... to consider all contributions to welfare creation, extending from those derived from conventional human and manufactured capital to include natural, and through this determine optimal use of those necessarily limited resources” (Bateman et al., 2014, p. 274). The urgency of environmental conservation to avert disaster as a basic and underlying drive for research of the natural world is not necessarily present in this new approach to ES. Conservation is but one of several possible solutions to social issues involving the environment.

It is with both the popular, contemporary policy agenda as well as the original, and still enduring, conservation agenda (e.g. Chan et al.,

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