

ANALYSIS OF ECOLOGICAL SERVICES: CHALLENGES AND RESOLUTIONS

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Abstract. The consideration of ecosystem values is insufficient in decisions pertaining to natural resources. Within this particular context, the notion of ecosystem services presents a significant prospect for constructing a structure that supports the prudent utilization of biodiversity and other natural resources.

While it has been acknowledged that using ecosystem services to assess biodiversity has its benefits, the classification systems used often combine the methods used to achieve these services with the services themselves in the same category. This restricts their involvement in choices related to biodiversity. The lack of clarity in the definitions of important terminology, such as ecosystem processes, functions, and services, worsens this predicament. This paper establishes a classification of ecosystem services that serves as a framework for decision-making in natural resource management, following a thorough examination of definitions and the fundamental elements of an efficient typology. Nevertheless, additional effort is necessary to address specific challenges, such as the categorization of socio-cultural services.

Keywords: ecosystem, biodiversity, efficient typology, biodiversity protection, natural vegetation, Terrestrial features

АНАЛИЗ ЭКОЛОГИЧЕСКИХ УСЛУГ: ПРОБЛЕМЫ И РЕШЕНИЯ

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Аннотация. Учет ценностей экосистем недостаточен при принятии решений, касающихся природных ресурсов. В этом конкретном контексте понятие экосистемных услуг представляет собой значительную перспективу для создания структуры, которая поддерживает разумное использование биоразнообразия и других природных ресурсов.

Хотя было признано, что использование экосистемных услуг для оценки биоразнообразия имеет свои преимущества, используемые системы классификации часто сочетают методы, используемые для достижения этих услуг, с самими услугами той же категории. Это ограничивает их участие в принятии решений, связанных с биоразнообразием. Отсутствие ясности в определениях важной терминологии, такой как экосистемные процессы, функции и услуги, усугубляет это затруднительное положение. В этом документе после тщательного изучения определений и фундаментальных элементов эффективной типологии устанавливается классификация экосистемных услуг, которая служит основой для принятия решений в области управления природными ресурсами. Тем не менее, необходимы дополнительные усилия для решения конкретных проблем, таких как категоризация социокультурных услуг.

Ключевые слова: экосистема, биоразнообразие, эффективная типология, охрана биоразнообразия, естественная растительность, особенности суши.

Introduction. Ecosystem services are being increasingly advocated as a method for documenting the worth that humans assign to ecosystems. This trend is significant, especially in the context of biodiversity protection, where values are frequently challenging to articulate in economic terms and seldom adequately justified in decisions regarding natural resources. In order for ecosystem services to serve as a useful framework for making decisions about natural resources, they need to be categorized in a manner that enables comparisons and trade-offs among the various potential advantages. According to the Millennium Ecosystem Assessment (2005), an adequate classification of ecosystem services should include all the advantages that contribute to human well-being.

Nevertheless, the categorization of ecosystem services by prominent experts, such as Costanza et al. (1997), De Groot et al. (2002), Millennium Ecosystem Assessment (2005), and Farber et al. (2006), combines the methods (means) used to achieve services and the services themselves (ends) in the same classification category. While these articles hold significant value, their classifications provide intrinsic challenges for decision-makers, a matter that will be examined further. The issue also emerges in broader literature and practical applications of ecosystem services and comparable assessments (e.g., Abel et al., 2003; Groffman et al., 2004; Anielski and Wilson, 2005; Kremen, 2005; Naiman et al., 2005).

Limitations of existing classification schemes. To make successful decisions, it is necessary to classify services. The choices are designed in a way that they create a consistent set with the characteristics outlined for multi-criteria decision analysis by Burgman (2005). The classification of services provided by the Millennium Ecosystem Assessment is widely accepted in the current literature. A simplified version of this table, referred to as Table 2, is shown here. In order to evaluate the effectiveness of this classification system, let us

examine the scenario of a natural resource manager that oversees an area that consists of a combination of agricultural land and natural vegetation. The manager opts to utilize the list provided in Table 2 to guarantee a coherent arrangement of management outcomes. Consequently, the manager chooses the following as the primary services for initial planning:

The resources mentioned are food, fibre (used for construction lumber), and fresh water.

- Pollination
- Regulation of water
- Recreation and ecotourism
- Values pertaining to spirituality and religion

The two topics are photosynthesis and soil formation. In order to examine the planning consequences, the manager creates a basic schematic that illustrates some ecological connections that will require management. Based on the interactions depicted in Figure 2, it is clear that the manager does not prioritize pollination, water regulation, photosynthesis, and soil formation as individual objectives.

Biodiversity refers to the variety of life forms present in a particular ecosystem or on Earth as a whole. Biodiversity encompasses a wide range of life forms, such as plants, animals, fungi, microbes, and more. The word is limited to live organisms, thereby excluding the variety of habitats. The term "biodiversity" in this article primarily refers to natural biodiversity, unless specified differently. However, it should be noted that the term incorporates both natural and cultural biodiversity.

Biodiversity resource An organism, or collection of organisms, that serves a purpose for humans. An ecosystem is a complex network of living organisms, their physical environment, and the interactions between them. A "functional entity or unit formed locally through the interaction of all organisms and their

physical (abiotic) environment" (Tirri et al., 1998). All the ecosystems examined in this analysis consist of natural components to some extent. Ecosystem function refers to the processes and interactions that occur within an ecosystem, which contribute to its overall functioning and stability. If the ecosystem services, processes, structure, and composition are well-defined, then there is no need for this word. Considering the inconsistent and unclear usage of the phrase, "ecosystem function" is considered synonymous with "ecosystem processes" in this context, and is not utilized. Refer to the Appendix for a definition of structure and composition and for more explanation of 'ecosystem function'. Ecosystem processes refer to the various biological, chemical, and physical activities that occur within an ecosystem, influencing its functioning and dynamics. Ecosystem processes refer to the intricate interactions between living and non-living components of ecosystems that result in a specific outcome. Generally, these processes entail the movement of energy and substances (Lyons et al., 2005). A crucial differentiation exists between ecosystem components (including both living and non-living entities) and processes. The former are typically tangible entities quantified in terms of quantity, while the latter refer to operations and reactions described in terms of rates (such as production per unit time).

Ecosystem services Here, "used" refers to the definition given in the Millennium Ecosystem Assessment (2005, p. 1) as "the advantages that individuals derive from ecosystems." The benefits encompass resources such as food, water, timber, and cultural values. These advantages are the desired results of ecosystem management. The meaning of the term 'service' in this context is unclear and is explored in the Appendix.

Values held by humans The desired outcomes of existence, encompassing the conditions necessary for human survival and reproductive achievement,

which collectively define human well-being. Refer to the Appendix for additional clarification. Natural factors encompass various components, such as:

- Biotic diversity
- Terrestrial features, including:
 - Top layer of soil and loose material covering bedrock
 - Physical landscape The topic is minerals. The three main elements are water, air, and energy, which includes sources such as solar and coal. Socio-cultural factors encompass various aspects, such as cultural variety, which includes both domestic livestock and human populations.

- Infrastructure such as roads, buildings, cars, and homes, as well as household appliances.

- Energy generated through the process of nuclear fission.

Ecosystem processes facilitate the redistribution of matter and energy among resources, or generate new resources through evolution. The processes encompassed are as follows:

- Hydrological cycle
- Biogeochemical cycles
- Carbon cycle
- Energy flow
- Disease and pest regulation
- Photosynthesis
- Atmospheric regulation
- Flood control
- Social dynamics
- Economic activities

Revised framework and makeup of ecosystem (To simplify, we assume that natural assets include both living and non-living constituents of an ecosystem, rather than just a portion of them.)

Instead, they are all methods (procedures) used to accomplish goals (services) such as producing food and providing drinkable water. The manager will actively oversee these processes to ensure the production of sufficient quantities of food, fiber for construction, and spiritual experiences, among other things, in alignment with the overall management objectives. Therefore, the services provided in Table 2 do not form a cohesive set of services that can be examined and compared in a decision-making system. Processes such as pollination, soil formation, and water regulation are mechanisms via which several services are provided. Based on the definitions given, it is clear that these activities are undeniably part of the ecosystem. This suggests that they are methods or mechanisms to obtain services, rather than the services themselves.

Conclusion. Ultimately, the examination of ecological services poses a substantial difficulty in the current dynamic global environment. A thorough comprehension of ecosystem functioning and the vital services they give to civilization is necessary due to the intricate interplay between the environment and human activity. Although faced with difficulties, there exist numerous potential alternatives that can enhance our administration of ecological services. First and foremost, it is essential to enhance awareness and education regarding the significance of ecological services to cultivate a deeper understanding and recognition of nature, as well as to encourage the adoption of sustainable behaviors. This can be accomplished by actively involving the community, implementing educational programs focused on the environment, and enacting policies that promote conservation.

In summary, although the examination of ecological services may pose difficulties, by collaborative endeavors and inventive resolutions, we can strive towards a future that is more environmentally sound, allowing for the flourishing of both nature and society.

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