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Commentary

Monetary valuation of ecosystem services: It matters to get the timeline right

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ABSTRACT

In the abundant literature dealing with the monetary valuation, or monetization, of ecosystem services (MES), with very few exceptions, the concept is presented as having emerged in 1997. In fact, there is a long history, starting in the late fifties but largely ignored, of sustained attempts to assign monetary values to nature's services. These early efforts encountered many conceptual and methodological roadblocks, which could not be resolved and led a number of researchers to argue that monetary valuation was not a fruitful approach. It is in that context that MES was hailed by some in 1997 as a promising way to integrate environmental goods and services into the logic of economic markets. Knowledge of the full timeline casts a very different light, in particular on the difficulties currently encountered in the practice of MES; far from being the expected growing pains of a young discipline, these difficulties turn out to be long-standing problems that have eluded solution over the last half-century and appear intrinsically unresolvable. This perspective suggests that, at this point, it is advisable to look at alternatives to MES for the integration of nature into economic decisions.

1. Background: Standard Timeline

In the last few years, a significant amount of work has been devoted to the monetary valuation or "monetization" of the multitude of services that nature renders to human societies. This monetization of ecosystem services (MES) has been advocated by many as an optimal strategy to make nature visible to decision makers and financial markets, with the hope that this would lead eventually to the sustainable use of natural resources and their preservation. Thousands of articles have been devoted so far to MES, addressing a wide range of aspects of the topic, from its theoretical foundations to practical attempts at assigning monetary values to specific ecosystem services. In parallel to these academic pursuits, many international organizations, and more and more governmental agencies in numerous countries, are elaborating policies based on MES or on the occasionally-related "Payments for Ecosystem Services" (PES).

In a significant portion of the huge (and exponentially expanding) literature devoted to ecosystem services, MES is presented as a novel concept that emerged sort of out of the blue in 1997, and no historical information is provided on the process that led to its elaboration (e.g., Fisher et al., 2008; Juniper, 2013; Keddy, 2010; Pittock, 2013). Whenever scholarly articles or "grey literature" reports dealing with MES provide slightly more background on the genesis of the concept itself, the account that is given then in almost all cases is a variant of the self-described "fragmentary" history presented by Mooney and Ehrlich (1997, p. 11). Their chronology leapfrogs through time and involves only a few key dates, which are considered to be of particular significance. The timeline starts with various writers in antiquity who noticed disruptions caused by human actions in the provision of nature's benefits. Plato [c. 400 BC] acknowledged that deforestation could lead to soil erosion and the drying of springs. Pliny the Elder, in the first century AD, reported links between deforestation, rainfall, and the occurrence of torrents. The next landmark in the standard timeline occurs in 1864 when George Perkins Marsh, pointing out changes in soil fertility in the Mediterranean region, challenged the idea that the Earth's natural resources are unbounded. He alluded to the waste-disposal and pest-control services of nature, as well as to the multiple functions of "minute organisms" inhabiting the earth and water. Almost a century later, a number of authors, in particular Osborn (1948), Vogt (1948), and Leopold (1949), attempted to promote the recognition of human dependence on the environment. Vogt (1948, p. 67) also described in detail the notion of "resource capital". Closer to us, in 1970, the expression of "environmental services" was allegedly first introduced in the Study of Critical Environmental Problems (SCEP, 1970, p. 122), which listed a number of ecosystem services like insect pollination, fisheries, climate regulation, and flood control. The next significant date in the standard timeline is when the term of "ecosystem services" is considered to have been coined, by Ehrlich and Ehrlich (1981, p. 86). Then, finally, sixteen years later, a number of landmark articles (Costanza et al., 1997; Pimentel et al., 1997) and books (Daily, 1997) brought the concept of MES in the limelight. As a result, many authors appear to regard 1997 as the onset of the

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current MES movement. A slight variant of this timeline, adopted by some, acknowledges that mainstreaming of the ES really started with the publication of the influential Millennium Ecosystem Assessment (MEA, 2005), which was instrumental in making MES the de facto norm for the integration of nature into economic decisions.

2. Foundational Work Not Mentioned in the Standard Timeline

A handful of articles (e.g., Gómez-Baggethun et al., 2010; Liu et al., 2010; Wilson and Carpenter, 1999) provide additional historical background on the process that led to the monetization of ecosystem services. Gómez-Baggethun et al. (2010), for example, show how intimately connected MES is to the neoclassical theory of economics that supplanted classical economics and has become dominant in the second part of the 20th century. Liu et al. (2010) argue that economists started decades ago to consider valuating the contribution of nature to human well-being, and developed several of the methods now routinely used in attempts to assign monetary values to the many ecosystem services that are not traded in actual markets. In particular, Hotelling's (1949) discussion of the value of parks implied by travel costs stimulated the development of several *revealed preference* valuation approaches, like the travel cost valuation method, formally proposed by Clawson (1959) a decade later, and hedonic pricing methods (Ridker and Henning, 1967). Similarly, suggestions by Ciriacy-Wantrup (1947) eventually led to the use of *stated preference* techniques, like contingent valuation (Davis, 1963). Other types of values considered early on by economists include the so-called *option value*, i.e., the value of avoiding commitments that are costly to reverse (Weisbrod, 1964), and values associated with cultural services of nature (Krutilla, 1967).

There is an apparent contradiction between the fact that many current methods to evaluate nature's services were developed in the 50s and 60s, and the general understanding that their use started in earnest in the late 90s. In fact, nothing is farther from the truth, as it becomes immediately clear to anyone who does not focus exclusively on the expression "ecosystem services" in literature searches. A very large body of work was carried out in the 60s and 70s on what was at the time referred to as ecosystem functions (Odum, 1959), "environmental goods and services" (Vatn and Bromley, 1994, p. 130), "environmental amenities" (Adamowicz, 1991, p. 609) or, simply, "nature's services" (Westman, 1977, p. 960). In a comprehensive review of the state of the art of evaluating intangible benefits and costs associated with the use of the environment, Coomber and Biswas (1973) list around 300 articles, books and reports. A few years later, an extensive annotated bibliography assembled by Leitch and Scott (1977) comprises no less than 691 articles, reports, theses, and other publications, dealing solely with the economic values of fish and wildlife and their habitats. Most importantly, these early attempts to value nature were quickly followed by detailed analyses of the shortcomings of MES. These are highly relevant to current efforts to monetize nature.

3. Early Examples of Market Failures

One of the early sources mentioned by Leitch and Scott (1977), and one of the most enlightening, is a 426-page technical report by a committee headed by Wollman (1962), concerning an extensive research project carried out in New Mexico in the late fifties. A group of investigators from different disciplines (economics, sociology, engineering, biology) attempted over a number of years to determine how to most profitably allocate a portion, considered "unappropriated" (Wollman, 1962, p. xii), of the water resources in the San Juan and Rio Grande basins, in New Mexico. Through interviews, surveys, physical measurements, and in-depth analysis of extant population, economic, environmental and climatological data, the authors estimated, per unit volume of water, the value-added resulting from water use in agriculture, recreation, and industry, with a number of subcategories in each case. In their work, the authors encountered what they refer to as "methodological weaknesses" (Wollman, 1962, p. 71), in particular the fact that they could consider only the readily monetizable aspects of water use, and therefore had to implicitly ignore other (e.g., cultural, spiritual, and esthetic) components. Within these constraints, the authors came up with the conclusion that by far the least profitable use of the unappropriated water was in agriculture. Five to six times more profitable was water usage for recreation purposes (i.e., as fish and wildlife habitat), whereas industrial/municipal uses of water were between 60 to 85 times more profitable than in agriculture. On the basis of these estimates, the logical conclusion reached in the project was that, if the sole decision criterion were to maximize monetary profit in the region, all available water should go to industry. This perspective was not novel: Gertel and Wollman (1960) had described earlier a similar type of "market failure" and had come to the same conclusion when they calculated the economic yield per unit of water, finding that the monetary return on 1 gal of water is much higher when water is used in manufacturing and mining than when used in agriculture or for drinking by people. Nevertheless, the committee led by Wollman considered this outcome to be unrealistic, in line with the committee's view that "the 'free market' is a limited instrument for determining the relative desirability of water's alternative uses (Wollman, 1962, p. xii)."

4. Critical Appraisals

A decade later, after a number of researchers had made similar observations, Krutilla argued that "private market allocations are likely to preserve less than the socially optimal amount of natural environments" (Fisher et al., 1972, p. 605). Clark (1973) gave a particularly vivid endorsement of the same view, with his simple mathematical model of the commercial exploitation of a natural animal population. His key conclusion was that, depending on certain easily stated (and quantifiable) biological and economic conditions, in particular a preference of harvesters for present over future profit, extermination of the entire population may appear to be the most attractive policy, more profitable in the short run than conservation. Clark's (1973) and other similar calculations stimulated eloquent critiques of cost–benefit analyses and market-based principles for the management of ecological systems. In particular, Pearce (1976), in a critical analysis repeatedly echoed in the literature (e.g., Godard, 2009; Hanley, 1992; Heinzerling and Ackerman, 2002), argued that cost–benefit analysis has direct relevance only to pollutants that have "nuisance" features and do not have sustained ecological effects. He demonstrated further that in situations where the effective assimilative capacity of the environment is zero and the pollutants in question have biological effects, cost–benefit analysis has only limited relevance, whereas for conventional pollutants that have ecological effects, the ecologically-optimal solution diverges from that dictated by cost–benefit analysis.

A few other critical appraisals appeared in the 70s. Ghiselin (1977, p. 297) described cost–benefit analyses applied to environmental goods and services as the "commensuration of the incommensurable. […] The usual technique of cost–benefit analysis is based on an inherently delusive method. Instead of assessing costs and benefits on the same basis, it ignores costs and benefits that cannot be monetized at all." Georgescu-Roegen (1977, p. 125), in a discussion of the economics of food and energy, wrote: "We cannot possibly rely on a market mechanism to avoid ecological catastrophes because the market is the parameter of demand and supply only of current generations, whose horizon is just a brief spell in comparison with the life span of the whole species. Prices can never be ecologically right, simply because future generations are not present to bid on scarce resources side by side with current generations."

The many fundamental and methodological problems associated with the monetization of ecosystem services and identified in the 60s and 70s were summarized with remarkable clarity in an extensive