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Ecosystem services: Where on earth?

Luisa E. Delgado^{a,b}, Víctor H. Marín^{b,*}^a Fundación CTF, Padre Mariano 391, Oficina 704, Providencia, Santiago, Chile^b Laboratorio de Modelación Ecológica, Departamento de Ciencias Ecológicas, Facultad de Ciencias Universidad de Chile, PO Box 653, Santiago, Chile

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ABSTRACT

The analysis of temporal changes in the number of scientific articles written on ecosystem services shows an exponential growth from 1991 to 2013. However, it also shows a lack of information regarding the location of the studies and the type of ecosystem analyzed. A literature search showed that some regions (Antarctica) and ecosystems (urban) have been less studied. However, given the structure of the knowledge databases it is impossible to know if there are no studies or it is difficult to reach them.

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1. Introduction

Four years ago, Gómez-Baggethun et al. (2010) stated: “The concept of ecosystem services is attracting increased attention...” However, that seems to be an understatement for the exponential growth of the literature on this subject matter (Fig. 1). We could illustrate the meaning of this growth with an example: if we request to one of our graduate students reading all the literature on ecosystem services published only during the year 2013, and in the process he/she takes one hour per article, reading 8 h a day, the process would take 6 months. If we push it to the extreme and ask him/her to read everything since the publication by Gómez-Baggethun et al. (2010) then it would take almost 2 years. Thus, it is impossible to keep track of all the literature being published on ecosystem services and this is where we raised our question: is the ecosystem service concept contingent to each ecosystem (in the sense of Schmitz, 2010)? In other words, do we need to address the study of ecosystem services in a system-by-system basis because each social-ecological system has evolved in a particular way that cannot be fully understood from global estimations? Costanza et al. (2014) have recently discussed this issue. They propose that global estimates on the value of ecosystem services are useful to increase awareness about them in a way that the general public may understand, but more spatially explicit approaches are necessary for other uses. Delgado (2010) and Delgado et al. (2013) have indeed show that the use of ecosystem services is contingent to the ecosystem condition (e.g. semi-pristine; under anthropogenic stress). Thus, ecologists or economists searching the literature about ecosystem services should know where they have been studied and

what ecosystems have been analyzed. Is it possible to do it using current knowledge information systems? We contend that the answer is no and show it in this brief note with an example, ending with a discussion about changes we should implement in order to make the growing literature on this issue easily available not only to scientists but also to decision makers.

2. Materials and methods

We conducted our analysis using the Thomson Reuters Web of Science (2014) database, available over the Internet. We searched the 1980–2014 database using several alternatives: (1) “Ecosystem services” as the only topic; (2) using the previous topic plus the word *Direct* as a second topic; and (3) using “Ecosystem services” as first topic and country names making up to 95% of the human population for each continent as a second topic (see Table 1 for continental names). Number of articles for the first alternative, including methodology, model or concept papers, was used as the universe against which we compared our results. The second alternative was used to analyze the availability of data related to the direct use, estimates, effects and valuations of ecosystem services. For example, data obtained from southern Chile (Delgado et al., 2013) and other regions of the world (e.g. Kabala et al., 2013) show that the direct use of provisioning services are important for the well-being of poor rural populations in developing nations. We subsequently analyzed the abstracts and keywords of all articles for this alternative in search of: (1) geographic location and (2) type of ecosystem analyzed. Finally, the third alternative was used as a secondary way to obtain geographic data on ecosystem services without the restriction of the term *Direct*.

* Corresponding author.

E-mail address: vmarin@antar.uchile.cl (V.H. Marín).

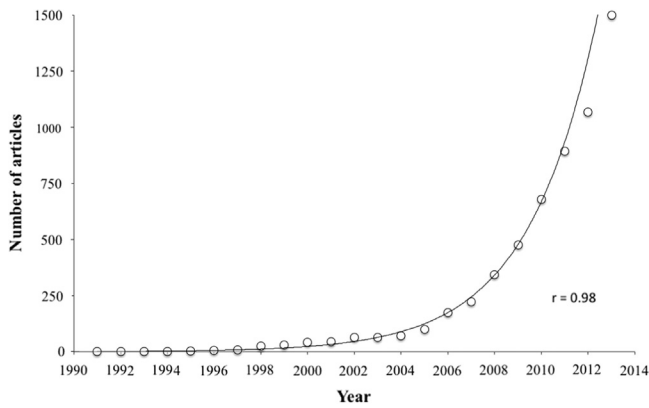


Fig. 1. Temporal changes in the number of articles written on ecosystem services. The line is the result of fitting an exponential curve (SYSTAT 12) to the data represented by the circles. (Topic: “Ecosystem services”).
Source: Web of Science (2014).

Table 1

Number of articles found in the Web of Science (2014) database using: (1) “Ecosystem services” and “Direct” as search topics (NA) and (2) “Ecosystem services” and name of countries adding to 95% of the human population for each continent as search topics (NA2).

Continent	NA	%	NA2	%
Africa	30	13	440	13
North America	59	25	659	19
South America	27	11	380	11
Asia	47	20	772	23
Antarctica	1	< 1	8	< 1
Europe	57	24	775	23
Oceania	14	6	379	11
Total	235	100	3413	100

Table 2

Distribution of articles, in percentages, in relation to the studied ecosystem. The total number of articles (235) corresponded to those obtained using “ecosystem services” and “direct” as search topics that included information on geographic area.

Ecosystem type	Percentage
Farms and rural areas	18
Forests	18
Other land systems	17
Ocean	13
Inland water	21
Urban	6
More than one type	7

3. Results

The universe of articles published under the topic ecosystem services, as recorded by the Web of Science (2014), was 7277 for the period 1991–2014 (Fig. 1), and when the term *Direct* was added to the search, the number decreased to 477 (7%). Furthermore, the analysis of abstracts and keywords of the latter set showed that only 49% (235 articles) had information on the geographic area (Table 1) and the analyzed ecosystem (Table 2). Still, when we added country names to the original search we found 3413 articles, representing 47% of all articles published so far on ecosystem services. Interestingly, although both ways to reach information on locations generated very different number of articles, the geographic distribution in terms of continents was the same (*K-S* test; $p > 0.9$). The largest number of studies came from Asia, North America and Europe and the smallest from Oceania, South America and Africa.

The analysis of the type of ecosystem showed that 80% of the studies have been conducted in relation to land ecosystems (e.g. farms, forests, inland water), 13% regarding ocean ecosystems (from near shore to deep ocean) and 6% on urban systems (Table 2). The largest percentage (21%) corresponded to inland water systems such as rivers, lakes and wetlands.

4. Discussion

The scientific literature on ecosystem services, as analyzed using the Web of Science (2014) database, has grown exponentially from one article in 1991 (Ehrlich and Wilson, 1991) to 1500 articles in 2013 (Fig. 1). Although this impressive attention can be interpreted as a very good sign for those working on this issue, it also generates a problem. Ehrlich and Wilson (1991), Gómez-Baggethun et al. (2010) and Costanza et al. (2014) to name only a few references, agree that the concept is of interest not only within the academy but also to generate governmental policies. However, policies such as payment for ecosystem services (Sepúlveda, 2010) and local environmental governance (Delgado et al., 2007) require data from specific ecosystems, given the contingent characteristic of the relationships between societal groups and the environment. This is where we suggest we have the problem since, using current knowledge databases, it is possible to reach only 47% of all articles if one is interested in specific geographic areas and as low as 3% if we look for direct studies on specific ecosystem types.

Capra and Luisi (2014) in the preface of their book “The systems view of life” propose that modern society lives “a perception of reality inadequate for dealing with our overpopulated, globally interconnected world”. Those of us working in issues related to ecosystem services have to accept the responsibility that our work, now and in the future, may play an important role in the generation of new policies impinging on the relationships between societies and ecosystems. However, in order to facilitate the process we have to start seriously thinking about where have studies been conducted and what type of ecosystem have they involved. For example, based on our results, there seems to be fewer studies on ecosystem services provided by the oceans and by the Antarctic continent. We should also increase studies on South America and Oceania. Or, is it that (1) the current structure of the available knowledge databases, and (2) the way we write article titles, abstracts and keywords is inadequate for our globally interconnected world? It is unlikely that we may change the first from night to morning, but we can certainly do something about the second. We humbly suggest that articles written on ecosystem services should include either in the title and/or abstract and the keywords: (1) the geographic area, region or country where the study was developed and (2) the type of ecosystem or ecosystems analyzed. Manuscripts dealing with very large-scale issues or reviews (e.g. planetary studies) should state it explicitly. Otherwise we will keep re-inventing the wheel because we simply will not know where it has been invented.

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