Ecological Indicators 52 (2015) 490–497

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Review

Ecosystem disservices research: A review of the state of the art with a focus on cities

Peer von Döhren[a,*], Dagmar Haase[a,b]

[a] Institute of Geography, Humboldt University Berlin, Unter den Linden 6, 10099 Berlin, Germany
[b] Department of Computational Landscape Ecology, Helmholtz Centre for Environmental Research – UFZ, 04318 Leipzig, Germany

ARTICLE INFO

Article history:
Received 24 September 2014
Received in revised form
27 November 2014
Accepted 20 December 2014

Keywords:
Ecosystem disservices
Human well-being
Literature review
Cities
Indicators

ABSTRACT

Ecosystem services, the benefits produced by ecosystem functions and structures for human well-being, have received continuous international attention since the publication of the Millennium Ecosystem Assessment (MA) and the TEEB study (The Economics of Ecosystem Services and Biodiversity). Ecosystem functions also have effects that are harmful to human well-being, and these effects are called ecosystem disservices (EDS). The aim of this paper is to explore how ecosystem disservices have been recognised in the scientific literature and how the concept has been used in the discussion of socio-ecological systems. The paper analyses 103 studies on EDS. We use a quantitative approach to assess geographical spread, focus and indicator choice. This quantitative picture is supplemented by a qualitative discussion of the effects of ecosystem disservices on urban systems and cities. The results of the review show that although the idea of detrimental ecosystem effects is not new, systematic research on EDS has only just begun. Most studies on EDS focus on Western Europe or the USA. EDS have been more frequently discussed in the most human-dominated ecosystem types: i.e., in agricultural and urban ecosystems. The latter in particular will be central for future research on EDS, considering that more than 75% of the world's population is expected to live in urban environments by 2050.

Contents

1. Introduction

Ecosystems are the basis for all life on Earth, particularly for human life and well-being. People receive many benefits from ecosystems, including clean air and water, food, and space for recreation (MA, 2005;

* Corresponding author. Tel.: +49 3020936905.
E-mail address: peervd@gmx.de (P. von Döhren).

http://dx.doi.org/10.1016/j.ecolind.2014.12.027
1470-160X/

TEEB, 2010). However, alongside these benefits, ecosystems also produce nuisances, such as pests, litter and deterioration of infrastructure; biological hazards such as diseases, animal attacks, allergenic and poisonous organisms and geophysical hazards such as floods heat waves and storms. These are called ecosystem disservices (EDS) (Lyytimäki and Sipilä, 2009).

The basic idea that natural or ecological processes or phenomena might cause nuisances or even harm people is not new; a substantial body of research has examined natural hazards (such as heat waves, floods, droughts, and storms) and assessed the negative impacts of water, soil or air pollution on human health and well-being (Fuchs et al., 2011; Handmer, 2004). These studies have been conducted across several scientific disciplines, including agriculture, natural disaster management, wildlife conservation, and public health (e.g., D'Amato, 2000; DeStefano et al., 2005; Treves et al., 2012). However, although these papers are about what we call EDS, they do not explicitly use this wording (Lyytimäki et al., 2008). In many articles, the negative ecological effects or impacts have been described as harmful consequences of ecological change or as deficient ecosystem services caused, for example, by the loss of biodiversity (Chapin et al., 2000; Folke et al., 2004; Balmford and Bond, 2005).

A framework that systematically contextualises negative ecological effects as part of ecosystem structure and function seems to be comparatively novel and more rarely discussed (O'Farrell et al., 2007; Zhang et al., 2007; Lyytimäki et al., 2008; Lyytimäki and Sipilä, 2009; Bennett et al., 2010; Dobbs et al., 2011; Limburg et al., 2009; Escobedo et al., 2011; Gómez-Baggethun and Barton, 2013 have come to the same conclusion). However, as ecosystem services (ES) have been increasingly discussed, negative ecological effects have also been introduced and described as ecosystem disservices. The wording of EDS is imprecise; in contrast to the positive effects provided by ecosystem services for human well-being, the prefix 'dis-' in 'disservices' points to negative effects, and it can be unclear whether the disservice is to the ecosystem or to organisms interacting with it. One of the first definitions of EDS was published by Lyytimäki and Sipilä (2009), where EDS were defined as "functions of ecosystems that are perceived as negative for human well-being" (p. 311). The authors emphasise that the idea of purely beneficial ecological effects is in contrast to older interpretations of nature as the wild and dangerous opposite of civilisation that had to be tamed to be exploited; however, with the growing awareness of environmental challenges, the focus in industrialised countries changed from taming nature to protecting nature (Lyytimäki and Sipilä, 2009, p. 309; Limburg et al., 2009).

This paper gives an overview of the state of the art EDS research across several disciplines.

2. Materials and methods

To assess the current state of the art in ecosystem disservices research, a review of the existing international journal literature was carried out. Thus, the core of this review describes the corpus of scientific papers that use the term 'ecosystem disservices'. The key questions guiding the review are: what is understood by the term 'ecosystem disservices'? Which phenomena are commonly associated with this term? Finally, how are ecosystem disservices identified or measured in these papers? Since the search strategy aimed at finding papers with a conceptual approach to EDS, contributions from research disciplines not using the term EDS, for example medical research, may be missing from the sample.

A keyword search in the Web of Science database (www.thomsonreuters.com/web-of-science) and a full-text search of the ScienceDirect (www.sciencedirect.com) database using the terms 'ecosystem' connected to 'disservice', beginning with the year 1993, was carried out. The search resulted in 166 scientific papers that use both terms. The outcome sample includes papers that appear in both databases. Papers in which both terms were not used in relation to each other were excluded from the review. The remaining 103 papers were examined in detail, using a set of criteria, derived from the guiding questions stated above. The choice of evaluation criteria for this review builds on the approach of ecosystem disservices as defined by Lyytimäki and Sipilä (2009; Table 1), and comprise the date of publication, the context of the papers, the type of data used/analysed (qualitative or quantitative), the spatial scale of the analysis (i.e., the scale on which ecosystem disservices were found), the process/function that describes the negative impact of the demonstrated EDS, the type of indicators used to demonstrate or measure the EDS, the affected groups mentioned, the geographical spread of case studies and whether a definition or at least an example was given in the paper.

Table 1
Review criteria and possible entries.

Criterion	Possible entries
Paper/source	Bibliographical reference of the paper
Ecosystem context	Ecosystem(s) studied in paper (examples: urban, forest, aquatic)
Type of paper	Research paper, review paper
Type of data used	Qualitative data, quantitative data
Spatial scale of measurement	Local, regional, national, global scale (if possible, dimensions were more precise)
Indicators	Number of scientific fields from which indicators are used, names of scientific fields
Types (clusters) of negative effects	Thematic field/context of impact: ecological, economic, health, psychological, general (not specified) effect
Who is negatively affected?	Societal groups that are affected, other elements (if not people), not specified
Spatial extent of field study	City or comparable unit where field study took place, general (in case no field study is reported)
Country	Country where field study took place, global (if done)
Definition provided	Yes (reference if possible), no, partially (if concept is explained)

A detailed results database can be found in the supplementary material (Table 3).

3. Results

3.1. Publication date of the case studies

Fig. 1 shows the change in the number of scientific research articles that used the term 'ecosystem disservices' over the past two decades. The term EDS, as understood in this paper, does not appear in scientific papers until 1998. We can see an increase in the number of published scientific papers from 2009 to the present. It becomes very clear that the majority of these papers were published after 2009, which proves that EDS is a new approach in research on socio-ecological systems.

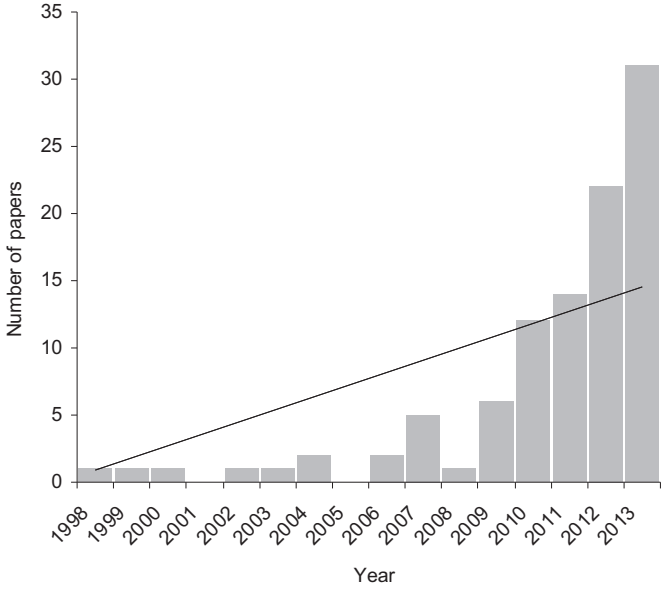

Fig. 1. Number of studies about urban ecosystem disservices since 1998.