



A theoretical framework for researching cultural ecosystem service flows in urban agglomerations



Lan Xiao^{a,b}, Tang Haiping^{a,b,*}, Liang Haoguang^c

^a State Key Laboratory of Earth Surface Process and Resource Ecology, Beijing Normal University, Beijing 100875, China

^b College of Resources Science and Technology, Beijing Normal University, Beijing 100875, China

^c Beijing Key Laboratory of B&R's Data Analysis and Decision Support, Beijing International Studies University, Beijing 100024, China

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ABSTRACT

Urban agglomerations are both a new combination of regional units in economic and social development and regions with a series of highly concentrated ecological, economic, and social problems. Studies with a single urban ecosystem as the research object cannot fundamentally solve regional ecological problems. Therefore, urban agglomerations have provided a new perspective for studying regional ecosystems and their services. The importance and usage of cultural ecosystem services increase with their supply and demand, which is the key to linking the ecosystem with human well-being. The recognition and evaluation of cultural ecosystem services in urban agglomerations have become an important element that affects coordinated protection and decision making in regional ecosystem management. This paper proposes a theoretical framework for the study of the cultural ecosystem service flows and analyzes the impacts of the ecosystem structure, stakeholders, and management policies on the supply of and demand for cultural ecosystem services in urban agglomerations. Through a discussion of the framework, this paper proposes that using the urban agglomerations ecosystem as a research object is beneficial for multi-scale and cross-scale research on quantifying cultural ecosystem services. Service flows can better reveal the dynamic spatio-temporal characteristics of beneficiaries in urban agglomerations, and combined with the research concerning human well-being, the framework can enhance the application of research on cultural ecosystem services in decision making for regional coordinated development.

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1. Introduction

With the acceleration of urbanization, the development and utilization of high-intensity resources have caused a series of regional eco-environmental problems (Grossman and Krueger, 1995). However, the use of a single urban ecosystem as the object of research and management cannot fundamentally solve overall regional ecological problems (Gibbs et al., 2002; Marshall, 2008). Urban ecological management of cross-administrative regions represents a key challenge for research (Qureshi et al., 2014). Research in urban agglomerations can emphasize cooperation among different cities and decision-makers for regional coordinated development, thus providing a new perspective for the study of the regional ecosystem and its services (von Glasow et al., 2013; Jiang et al., 2016). The concept of urban agglomerations evolved from that of the

megalopolis (Gottmann, 1957). The concept primarily refers to a relatively complete city “complex” composed of a considerable number of cities (different in nature, type, and size) in a specific geographical area, showing the occurrence and development of internal relationships between individual cities relying on certain natural environmental conditions, with one or two large or mega-cities as the core of the regional economy, and taking advantage of accessibility through modern means of transportation and a comprehensive transportation network, in addition to a highly developed information network (Yao et al., 2006). The development of the urban agglomeration, which has gradually become the principal geographic unit for countries that participate in global competition, has profound effects on the sustainability of the ecosystem. The urban agglomeration ecosystem, as a populous social-economic-natural complex ecosystem, needs a more interdisciplinary collaborative management of the numerous factors and related complex interactions among urban ecosystems. To date, studies of urban agglomeration ecosystems have focused on maximizing the conservation of natural resources and monitoring and protecting of the environment (Tortajada, 2008; Gurjar et al.,

* Corresponding author at: State Key Laboratory of Earth Surface Process and Resource Ecology, Beijing Normal University, Beijing 100875, China.

E-mail addresses: 201431190027@mail.bnu.edu.cn (L. Xiao), tanghp@bnu.edu.cn (T. Haiping), lhg@bisu.edu.cn (L. Haoguang).

2008). The space of flow and city networks have provided new perspectives for analyzing the spatial structure and spatial organization of an urban agglomeration (Beaverstock et al., 2000; Liu Qing, 2012).

Ecosystem services (ES) are the basic condition for maintaining and improving the level of urban development and human well-being (Kroll et al., 2012). Natural urban ecosystems increase the quality-of-life of urban citizens through the ES generated by urban ecosystems. Services can be available on the local, regional or global scale according to the scope of the problem to which they are connected to and the possibility of transferring the service from where it is produced to the city in which humans benefit from it (Bolund and Hunhammar, 1999). Of the major ecosystem service categories defined by Millennium Ecosystem Assessment, cultural ecosystem services (CES) are the most closely related to the intangible properties of ecosystems (MA, 2005). Compared to other ES (provisioning, regulating, and supporting services), CES attach greater importance to the non-materiality of value, and the feasibility with which cultural services can be replaced is low (e.g., cultural heritage values and sense of place) (Oleson et al., 2015; Tengberg et al., 2012). Once degraded, it is difficult to restore them through technical means (Plieninger et al., 2013). The beneficiaries of all types of CES can be found on the regional scale (Palomo et al., 2013). Most cultural services are directly experienced and intuitively appreciated, often helping to raise public support for protecting ecosystems (Daniel et al., 2012). CES research has become an important tool for interdisciplinary research on ecosystems (Milcu et al., 2013).

CES has been defined as the non-material benefits that people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences (MA, 2005). Examples include an appreciation of natural scenery, opportunities for tourism and recreational activities, inspiration for culture, art and design, sense of place and belonging, spiritual and religious inspiration, and education and science (De Groot et al., 2010). In recent years, CES have received increasing scholarly attention (Hernández-Morcillo et al., 2013; Milcu et al., 2013). However, because of a lack of empirical data, the evaluation of CES is relatively insufficient compared to research on other categories of ES (Seppelt et al., 2011). Sociology-ecology interdisciplinary research, valuation, the characteristics of temporal and spatial distribution, and applications in decision making have also become focuses and challenges in the study of CES (Daniel et al., 2012; Milcu et al., 2013).

We performed a literature search for papers on CES.¹ From the studies found, we selected 70 papers in which either CES or the cultural property of ES were chosen as the main research object based on the titles, abstracts and key words of the papers. Based on our review of these selected papers, current research primarily focuses on single urban ecosystem and single-type ecosystems (e.g., forest ecosystems, watershed ecosystems, agriculture, etc.), and a total of 42 articles were included (e.g., Bieling and Plieninger, 2013; Allan et al., 2015; Bernués et al., 2014). In comparative studies of CES involving multiple cities or areas (7 papers), the geographical space of the research object was not continuous (e.g., Bertram and Rehdanz, 2015; Richards and Friess, 2015; Lindemann-Matthies et al., 2013; Pike et al., 2014). Although the number of CES research is rapidly increasing, to date only, few regional studies have been performed in urban agglomerations. Analysis of the benefits of CES in urban agglomerations aims to recognize the relationship between the individual and the environment on regional scale, including spa-

tial features of service flows and driving forces that influence the supply or demand side of CES (Serna-Chavez et al., 2014; Lankia et al., 2015).

The human species, while buffered against environmental changes by culture and technology, is fundamentally dependent on the flow of ES (MA, 2005). Ecosystem service flows have been used to understand the temporal and spatial distribution features of ES depending on the relationships between provisioning and benefiting areas (Serna-Chavez et al., 2014). For instance, Palomo et al. (2013) mapped ecosystem service flows in protected areas and their surroundings to explore the consequences of the demands originating from remote locations. Both Bagstad et al. (2013) and Serna-Chavez et al. (2014) presented frameworks to quantify the ES flows. Additionally, Schirpke et al. (2014) found through flows mapping that the majority of the beneficiaries of provisioning and cultural services are located outside the protected area. Lankia et al. (2015) valued recreational ecosystem service flow at a national scale. However, a systematic treatment of CES flows that can lead to generalizable results and guidelines for decision making has not yet been developed.

In this context, there is a need to develop a methodological framework to research the social importance of CES and the spatial associations between services' supply and demand in urban agglomerations. In this paper, we explore how the patterns of supply and demand for CES and their consequent flows can be used as a way to understand trans-boundary issues and implement cross-region environmental management. This paper is divided into five parts, including this introductory section. Next, the concept of the urban agglomerations ecosystem is proposed (Section 2). A theoretical framework for researching cultural ecosystem service flows in urban agglomerations is described in Section 3, and we conclude the application of the framework in Section 4. Section 5 presents our conclusion.

2. Urban agglomerations ecosystem

To better understand the overall ES in urban agglomerations based on the basis of urban ecology and according to the three distinguishing features of the system (i.e., boundaries, components, and uses) (Haskins et al., 2007), we define an urban agglomerations ecosystem (UAE), as an ecosystem composed of urban ecosystems (different from natural and human systems) in close spatial proximity and with close economic and ecological connections, relying on certain natural environmental conditions and having the objective of securing coordinated regional social economic and ecological environmental sustainable development. In the definition of UAE, natural environmental conditions refer to the natural geographical environment or natural resource and transportation conditions. For example, in Japan, all cities of the megalopolis are built on alluvial plains or are, in part, built upon hills or terraces bordering the alluvial plains (Karan and Stapleton, 2015). The natural condition provides location condition for urbanization development as the base of agricultural development. The population gravitating towards the more habitable areas (mostly in the plains) leads to urban concentration. The rich natural resources from the natural system and convenient transportation conditions create closer connection among cities, such as the Ruhr urban agglomeration, via resource development and cooperation. Meanwhile, the developments have also increased regional environmental issues.

Examples of UAE include Ruhr UAE, the Chicago-centered UAE, the central area of Kansai UAE and Jing-Jin-Ji UAE. The Ruhr UAE consists of several large, formerly industrial cities bordered by the rivers Ruhr to the south, Rhine to the west, and Lippe to the north, a previously agricultural region turned into a highly productive industrial landscape. A dense network of roads connects small-

¹ On March 12, 2016, we used "cultural ecosystem services" as the topic keyword to search for related journal articles from all previous years available in the Web of Science™ Core Collection database on the Web of Science web site. The search resulted in a total of 973 studies.

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