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Urban green space recreational service assessment and management: A conceptual model based on the service generation process

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ABSTRACT

The current understanding of urban green space (UGS) recreational service is limited due to the lack of being examined under the logic that underlies the ecosystem service paradigm, leading to limitations in the application of ecosystem based management in urban land use planning. This paper offers a conceptual model of UGS recreational service that follows the logical flow of ecosystem service generation, supplementing the knowledge gap and supporting the use of ecosystem base management in urban land use planning. The model includes four categories; UGS features, population characteristics, recreational use behavior, and recreational benefits while considering the use behavior as the service carrier. A process analysis shows the role of each model component in generating the services, and highlights the important role of regulating service potentials and their mobilization. Ways of informing interventions for improving efficiency or equity have been suggested. Efficiency can be assessed by applying the dose–response mechanism in the model. Equity on the other hand, can be measured by exploring which predictors of use are dominant, which advances UGS access assessment by shifting from the spatial-based to the use-based. Survey design techniques and indicators measuring various variables of the model have also been proposed.

1. Introduction

The ecosystem service paradigm has been evolving and shaping research and application for years. The current interest in ecosystem services was stimulated by the widely acknowledged Millennium Ecosystem Assessment (MA, 2005) as well as the study on the Economics of Ecosystem and Biodiversity (TEEB, 2010). This expansion of interest triggered the use of ecosystem services as a "common language" for ecosystem-based management (Granek et al., 2010). As an integrated approach that considers the interconnected nature of ecosystem, ecosystem based management aims at maintaining ecosystems in a healthy, productive and resilient condition so that they can provide the functions, goods and services that enrich and sustain human well-being (Kappel and Martone, 2011). Focusing on ecosystem services assessments can facilitate comparisons in management alternatives by linking these management actions to changes in ecosystem conditions and to an understanding of how those changes could affect the benefits that human derive from ecosystems (Granek et al., 2010).

Within the ecosystem service paradigm, the importance of socio-economic relevance has gradually been receiving attention (Spangenberg et al., 2014). This is important for cultural services because they have strong linkages to human perceptions, attitudes and beliefs (Chan et al., 2012; Wallace, 2007) and require further human activities for service provision and subsequent benefit generation. In the process of understanding provisions from cultural services, economics and social science are as important as ecology (Milcu et al., 2013).

As a cultural service, urban green space (UGS) recreational service has not been systematically examined under the ecosystem service paradigm (Fish, 2011), although many opinion pieces, reviews and conceptual models currently exist. The term "recreational service" is relatively new and has emerged in conjunction with the rising interests in ecosystem services. As a matter of fact, a range of publications have partially overlapped with the concept of UGS recreational service, yet they do not use the terminology related to ecosystem service, nor do they try to examine such service under the ecosystem service framework. Examples include studies on landscape preference (Hagerhall et al., 2004;

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Ode et al., 2009), environmental justice (Byrne et al., 2009; Matthew McConnachie and Shackleton, 2010), active living (Evenson et al., 2013; Giles-Corti et al., 2005) and environment–health relationships (Villeneuve et al., 2012; White et al., 2013). The ideas that these publications present are quite implicational and provide direction on how the service is essential in supporting human health and well-being.

Looking at the case of UGS recreational service under the ecosystem service paradigm would generate an integrated socioeconomic–ecological model, and such model can help support the assessment of the service via the use of indicators derived from multiple disciplines. To adopt ecosystem based management in urban land use planning is to show the linkages between land use changes and a variety of ecosystem services and benefits (of which UGS recreational service is included). Such information can provide valuable insight to decision makers. Without such a tool, the conduction of the service assessment would be constrained, leading to an insufficient understanding and thus impeding the integration of ecosystem based management into the process of urban land use planning.

Considering the various health and well-being benefits that UGS provides (Hartig et al., 2014), the setting of UGS is expected to lead to cost savings in health care (Carpenter, 2013; DTLR, 2002), and thus should be seen as a critical component in urban land use planning. For example, a pioneering study in the UK has shown that the potential economic implications of UGS from encouraging outdoor physical activity would be more than £1.8 million a year (Bird, 2004). However, the influencing factors of UGS recreation and its benefits vary from place to place. If we want to develop interventions that are successful in practice, it is crucial to know what factors underpin the UGS recreation, to what extent the benefits exist, and how efficiency in generating the benefits can be achieved. To answer these questions, assessment of the service would be needed.

Another key concern during the urban land use planning process is the issue of equity. How can equity in UGS access be assessed and improved? The current measure of equity in UGS access has been the mapping and analyzing the spatial distribution of UGS and then linking this with spatially referenced socioeconomic characteristics (Comber et al., 2008; Dai, 2011; Landry and Chakraborty, 2009; Matthew McConnachie and Shackleton, 2010; Wolch et al., 2005), which is believed to be quite limited and may leads to insufficient results of assessment. Firstly, access refers to the empowerment of an individual to use the service, and as a concept, it summarizes a set of dimensions describing the degrees of fit between service provider and individuals (McIntyre et al., 2009; Penchansky and Thomas, 1981). Spatial availability is only one sub-item of the complex concept of access, and thus can rarely represent it. Secondly, the spatial-based measure may not fully capture the information needed from either supply side (i.e. UGS) or demand side (i.e. potential visitors). UGS is not an "average" land use form (it differs in types, range of facilities or perception of safety) (Wheeler et al., 2015), and it may be of differing significance among population subgroups (e.g. gender difference (Thompson et al., 2014)) meaning that the potential visitors are not "average" people. More comprehensive way of measuring is needed.

The goal of this paper is to develop an evidence based conceptual model of UGS recreational service generation and delivery under the ecosystem service paradigm. It takes a closer look at the factors contributing to the use of UGS, allowing for biophysical and socio-economic relevance involved, and outlines the derived recreational benefits. The roles of each model component in generating UGS recreational service are elaborated and indicators that measure these components are recommended. Moreover, how the model can be used to serve management objectives such as efficiency and equity have also been suggested. In general, the paper has three contributions; first, it enriches the knowledge of UGS recreational service by adapting the case of UGS recreation to the ecosystem service cascade model; second, it supports the use of ecosystem based management in the process of urban land use planning by guiding the assessment of efficiency and equity in UGS recreation; and lastly, it proposes a way of assessing equity, which advances the current measure by shifting from the spatial-based measure to the use-based.

The remaining sections are organized as follows: Section 2 synthesizes the evidence supporting the relationships among components of the model. Section 3 outlines the structure and rationale of the model. Section 4 elaborates ways of the service assessment with aims of efficiency and equity. Section 5 discusses issues in relation to conduction of empirical studies. Finally, Section 6 concludes the paper.

2. The State of the Art Knowledge

2.1. The Ecosystem Service Cascade Model

The logic that underlies the ecosystem service paradigm represented by the cascade model offers a way of classifying different steps of generating ecosystem services from ecosystem to human well-being (Haines-Young and Potschin, 2010; Potschin and Haines-Young, 2011). The cascade model, since it was first introduced by Haines-Young and Potschin (2010), has been adapting and improving. In the most recent version of the model (Spangenberg et al., 2014), the roles of socio-economic processes have been reinforced. It recognizes the chain of "function–service potential–service–benefit" as the links of ecosystem service generation, and highlights the roles of socio-economic processes in leading from one level to the next on the cascade. Here the term "function" strictly refers to the biogeochemical characteristics of ecosystems, including the structures and processes. The model suggests that an ecosystem function can be turned into a service potential as long as the potential usability of certain biophysical structures are being recognized. The service potential can then be mobilized to provide service with additional inputs such as investment of labor, time, resources and possibly money. Once this flow has been understood, management interventions targeting the maintenance or increase in service benefits can be derived by enhancing service potentials and their mobilization.

2.2. Existing Conceptual Models

In the ecological health paradigm, the conceptualization of the natural environment has been steadily reflected in a number of conceptual models. A review of typical ecological health models (Coutts et al., 2014) has pointed out the relationship between natural environment and health "evolved from undynamic environment to a more sophisticated understanding of ecological interactions". For example, the roles of socioeconomic and natural environments are seen as equally significant in influencing health in the Butterfly Model of Health (VanLeeuwen et al., 1999). The Public Health Ecology Model (Coutts, 2010) advances the role of natural landscape as supporting health directly through environmental agents and indirectly through the behaviors that the environment facilitates or hinders. The Transformation via Balanced Exchange Model (Coutts et al., 2014) depicts the exchange of ecosystem services and human actions between natural and human systems, of which human health is among the outcomes of these interactions. With more relevance to the concept of ecosystem service, the conceptual framework integrating green infrastructure, ecosystem and human health (Tzoulas et al., 2007) highlights numerous dynamic factors and their complex interactions affecting ecosystem and human health in urban areas. It regards the green infrastructure and related improvements in ecosystem health as providing the environmental settings for public health, and at the same time, these environmental settings are affected by public health.

Efforts in understanding the environment–health relationship have also been made within the ecosystem service paradigm. Clark et al. (2014) have examined the indirect relationship between biodiversity and human health, through cultural pathways. It has been shown that biodiversity change will affect provision of cultural goods, the